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(Arvind Kumar Shukla)

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NEW DISTRIBUTIONAL RECORDS OF ANTS OF GENUS *CREMATOGASTER* LUND (HYMENOPTERA: FORMICIDAE) FROM INDIA

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ABSTRACT

New locality records and illustrations for five known species viz., *Crematogaster biroi* Mayr, 1897, *C. contemta* Mayr, 1879, *C. dohrni artifex* Mayr, 1879, *C. rothneyi* Mayr, 1879, and *C. subnuda* Mayr, 1879 are provided from India. These records expand the area of occurrence and distribution of these species in India. In addition, *Crematogaster travancorensis* Forel (1902) is redescribed based on the worker caste collected from Pachmarhi, Madhya Pradesh and Ri Bhoi, Meghalaya, India.

Key words: Acrobat ants, Central India, taxonomy, *Crematogaster*, Crematogastrini, Formicidae, Hymenoptera, Madhya Pradesh, Delhi, new records, redescription, geographical distribution.

Crematogaster Lund, 1831 is a hyperdiverse myrmicine ant genus that is presently represented by 782 extant species/subspecies worldwide (Bolton, 2024) and 34 species/ subspecies in India (Bharti et al., 2016; Akbar et al., 2023). These ants are morphologically unique among due to the attachment of postpetiole to the dorsum of first gastral segment and its spatulate sting which is used to apply venom by contact rather than by injection (Buren, 1959; Marlier, 2004; Blaimer, 2012). Taxonomically, these ants have been classified into the two subgenera *Crematogaster* sensu stricto Lund, 1831 and *Orthocrema* Santschi, 1918 based on molecular and morphological observations (Blaimer, 2012). Subgenus *Crematogaster* comprises of a large group with more than 350 species/subspecies (Hosoishi, 2020) and many species groups (Blaimer, 2012). The present study redescribes, *Crematogaster travancorensis* collected from Pachmarhi, Madhya Pradesh and Ri Bhoi, Meghalaya (India). Moreover, new distributional records for five known species viz., *C. biroi* Mayr, 1897, *C. contemta* Mayr, 1879, *C. dohrni artifex* Mayr, 1879, *C. rothneyi* Mayr, 1879, and *C. subnuda* Mayr, 1879 are also provided.

MATERIALS AND METHODS

The workers of *Crematogaster* spp. were collected from different parts of India by direct hand collection method and preserved in 70-90% alcohol. Later, specimens were mounted on card points, morphologically studied, and photographed. *Crematogaster* specimens in the National Pusa Collection (NPC), New Delhi were also examined. The morphological study was done under the Leica S8AP0 stereo microscope and photography was done by using LEICA MC190 HD digital camera attached to the LEICA M205 C stereozoom automountage microscope. The measurements were recorded by using LEICA software LAS V4.13.0 in millimeters (mm) up to two decimals. All the studied specimens and type specimens have been deposited in the NPC, Division of Entomology, Indian Agricultural Research Institute (IARI), New Delhi, India. All new locality records for the species have been asterisked. The measurements and indices are as follows:

Eye length (EL): Maximum diameter of the compound eye measured in oblique lateral view; HL Head length (HL): Maximum distance from the midpoint of anterior clypeal margin to the midpoint of posterior margin of head, measured in full-face view; Head width (HW): Maximum width of the head in full-face view by excluding the eyes; Pronotal width (PRW): Maximum pronotal width in dorsal view; Petiole width (PTW): Maximum petiole width in dorsal view; Postpetiole width (PPW): Maximum postpetiole width in dorsal view; Scape length (SL): Maximum scape length excluding basal condyle and neck; Propodeal spine length (SPL): Measured from tip of propodeal spine to closest point on outer rim of propodeal spiracle, maximizing spine length in lateral view; Total length (TL): Roughly measured from

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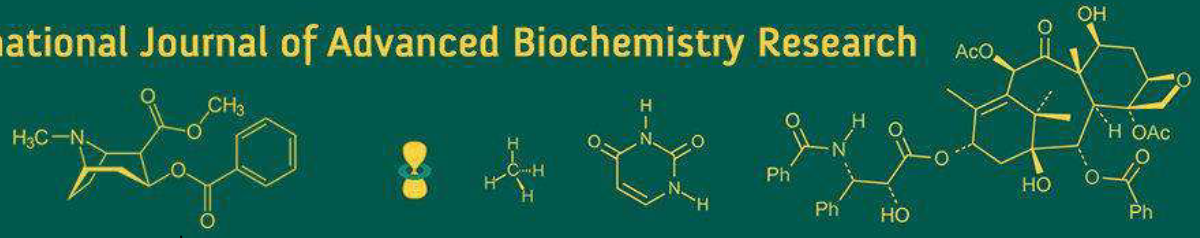

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Energy and monetary analysis of soybean cultivation under climate smart sowing techniques in Malwa region of Madhya Pradesh, India

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Abstract
Energy is the most valuable input in agricultural production. Energy and monetary analysis is used to find the energy and economic indices for better management. This study was conducted during 2020-21 and 2021-22 in *kharif* season in Malwa region to analysis the energy and monetary indices for the soybean cultivation under climate smart sowing techniques. Three sowing techniques were adopted for the trial *i.e*. T_1- Sweep Blade type, T_2- Broad Bed furrow (BBF) and T_3- Furrow Irrigated Raised Bed System (FIRBS). Randomized Block Design statistical design with eight replications were applied for analysis. The energy equivalent of different inputs and output were used to determine the energy indices. FIRBS resulted highest seed yield (1403 kg ha^{-1}), net return (₹32729/-) and B:C (2.14) and followed by BBF. Despite erratic climate, yield under climate smart sowing techniques (FIRBS and BBF) were better than Farmer's practice. The lowest total input energy requirement 11141MJha^{-1} was noticed in T_1 and highest was 11847 MJha^{-1} in T_3. Difference in total input energy requirement occurred because of time taken for sowing and seed rate was differ in all sowing techniques. The maximum soybean output (seed and straw) energy obtained under FIRBS (54429 MJha^{-1}) and lowest was recorded in farmer's practice (43976 MJha^{-1}). The maximum energy ratio (4.59) obtained in FIRBS, followed by BBF (4.36) and lowest was recorded in farmer's practice (3.95). Among all the treatments, highest net energy return (42582 MJha^{-1}) was recorded with FIRBS sowing technique, followed by BBF (39042 MJha^{-1}). Energy profitability was highest (3.59) with FIRB system and closely followed by BBF system (3.36). Specific energy was minimum in FIRBS (8.44), while maximum observed in sweep blade system (10.00). Higher productivity with maximum net energy return of soybean cultivation can be achieved by adopting climate smart sowing techniques (FIRBS and BBF) as compared to other methods.

Keywords: BBF, climate change, FIRBS, energy analysis, Malwa, soybean

Introduction
Energy is the most valuable input in agricultural production, which is used in various forms such as mechanical, chemical and electrical (Singh and Ahlawat 2015) [34]. The productivity and profitability of agriculture depend upon energy use (Jat *et al.* 2015) [15]. The amount of energy used depends on the mechanization level, quantity of active agricultural work and cultivable land (Ozkan *et al*. 2004; Alam *et al*. 2005) [27, 1]. Increase in agricultural productivity with minimal energy utilization without any adverse impact on the environment is a pre-requisite of present agricultural practices (Prajapat *et al*. 2018) [29]. Energy input-output analysis is widely used to find the energy and economic indices for several crops. Within this context, several researchers have focused on determining efficiency in agricultural units, in different countries.

Soybean [*Glycine max* (L.) Merril] is one of the economical and valuable seed legume which has 25% contribution in global edible oil. India contributes 10% in total soybean area at global level. Soybean is known as "Golden bean", "Miracle crop" *etc*., because of its several uses. Soybean, a high-value nutritive crop, plays a significant role in overcoming problems of food and nutritional insecurity. Soybean crop played a pivotal role in solving the problem of malnutrition as it contains about 20% oil and 40% high quality protein (Rahangdale *et al*. 2022) [30].

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Effect of Land Configuration on Different Crop Based Chickpea Sequences in Dryland Area of Central India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Original Research Article

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ABSTRACT

The present investigation makes an attempt to study the effect of land configuration on yield, water use efficiency and economics for cropping sequences in dryland area of Central India. Different cropping sequences soybean-chickpea, maize-chickpea and greengram-chickpea were adopted under different sets of land configurations such as Furrow Irrigated Raised Bed (FIRB), Broad Bed Furrow (BBF) and Flat System as Farmer's Practices (FP). Various yield attributes such as plant height, dry matter per plant, branches/plant, pods/cob per plant, seeds/cob per plant, 100 seed weight, seed and stover yield along with Seed Equivalent Yield (SEY), gross and net return, Benefit Cost ratio, Rain Water Use Efficiency (RWUE) were evaluated in this study. In case of SEY, for soybean-chickpea, maximum SEY was observed in FIRB (3197 kg ha^{-1}), followed by BBF (3131 kg ha^{-1}) and FP (2870 kg ha^{-1}). Similarly for maize-chickpea, highest SEY was detected in FIRB (3601 kg ha^{-1}), followed by BBF (3485 kg ha^{-1}) and FP (3241 kg ha^{-1}). A similar trend was obtained for

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Effect of Phosphorus Levels on Early Seedlings of Rice (*Oryza sativa*) under Varying Moisture Stress Conditions

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Original Research Article

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ABSTRACT

This study investigated the impact of moisture levels and phosphorus applications on different rice varieties. It aimed to: 1. Identify optimal rice varieties for specific moisture and phosphorus combinations. 2. Understand how moisture stress affects seed germination speed and root and shoot development. 3. Analyze the influence of increased phosphorus on root growth, especially under moisture stress. 4. Evaluate if additional NPK application enhances the positive effects of phosphorus.

The meticulously controlled experiment, conducted within the International Rice Research Institute (IRRI)'s RGA facility from October to November 2023, utilized five rice varieties, three moisture levels (flooded, ideal, and Drought-like), and varying phosphorus levels.

The findings revealed a positive correlation between phosphorus levels and root length across all rice varieties. This emphasizes the crucial role of phosphorus in promoting root development under challenging conditions. Notably, while increased phosphorus significantly enhanced root adhesion under flooding and aided seedling recovery, drought remained a significant barrier to root growth, regardless of phosphorus application. Interestingly, despite general genetic uniformity in germination and root-shoot parameters among the varieties, a clear positive correlation between phosphorus levels and root length was still observed.

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Effect of Different Spacing and Corm Size on Growth and Corm Production of Gladiolus (*Gladiolus grandiflorus* L.) cv Punjab Dawn under Malwa Plateau of Madhya Pradesh

Rajesh Yadav, Anuj Kumar, Jyoti Kanwar, Rajiv Dubey

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ABSTRACT

The present experiment was carried out at Bahadari research farm of College of Horticulture, Mandsaur (Madhya Pradesh) during *rabi* season of 2020-21 with an aim to find out the effect of different spacing and corm size on growth and corm production of gladiolus, using the three spacing's (S_1 30 × 30 cm, S_2 30 × 20 cm and S_3 20 × 20 cm) and three corm sizes (C_1 <3.0 cm, C_2 3.0-4.0 cm and C_3 >4.0 cm). The experiment was laid out in Factorial Randomized Block Design (FRBD) with three replications. The result revealed that, the plant produced from wider spacing with larger corm size (30 × 30 cm + >4.0 cm) was superior in days taken to sprouting (9.07 days), number of sprouts per hill (3.07), plant height at 60 DAP (62 cm), number of leaves per hill at 60 DAP (20.73), length of longest leaf at 60 DAP (46.47 cm), width of longest leaf at 60 DAP (2.85 cm), number of corms per hill (3.47) and weight of corms per hill (71.20 g) at maturity stage.

Keywords Gladiolus, Corm sizes, Corms weight.

INTRODUCTION

Floriculture has become one of the most important commercial trades in agriculture sector. Because of the steady increase in flower demand, the Indian government has designated floriculture as a sunrise industry with a 100% export orientation. As a result, industrial floriculture has evolved into a high-tech industry, with processing taking place in a greenhouse under properly controlled climatic conditions (APEDA 2020). Gladiolus (*Gladiolus grandiflorus* L.) is a famous flowering plant with chromosome number (2n) lies between 30 to 120 and belongs to the Iridaceae family. Pliny the Elder (A.D. 23-79) invented the term gladiolus to define the form of the leaf, which resembles as a sword. Latin word gladiolus means sword originated from South Africa (Singh *et al.* 2018). Gladiolus was introduced to India by British colonists in the 16th to 19th centuries. Gladiolus is ranked 4th in global trade, 3rd in cut flower production in India, and 6th in loose flower production (Nath *et al.* 2016). Gladiolus is known as the "Queen of Bulbous Ornaments" due to its widespread popularity among bulbous ornamentals grown around the world. Gladiolus is appreciated for its beautiful spikes, lovely

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Impact of different organic manures and plant geometry on growth and yield of Kalmegh

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ABSTRACT

The experiment was conducted at Horticulture Research Farm, College of Horticulture, R.V.S.K.V.V., Mandsuar (M.P.) during *Rabi* season of 2019-20 to study the effect of different organic manures (No fertilizer, Vermicompost @ 3 t ha^{-1} and Neemcake @ 5 t ha^{-1}) and spacing (30 × 15, 30 × 30 and 30 ×45 cm) and their interactions on growth, yield and quality characters under field condition. The research experiment was laid out in a Factorial Randomized Block Design with three replications. All the parameters were recorded at 30, 60, 90, 120 days after transplanting and at harvest. On the basis of one year research, the results revealed that the days taken to 50% flowering and days taken to maturity were significantly influenced with the application of different organic manures and spacing and their interaction. The M_1 (Vermicompost @ 3 t ha^{-1}) (43.12 and 152.89) and in the sub treatment S_2 (30×30 cm) (43.31 and 154.00) and their interaction M_1S_2 (Vermicompost @ 3 t ha^{-1} along with 30×30 cm spacing) (42.13 and 150.67) were found early as phenology of kalmegh. The crop growth rate (g g^{-1} day^{-1}) was recorded maximum (1.27, 11.45, 23.16, 30.80 and 30.90) in M_1 (Vermicompost @ 3 t ha^{-1}) and in the sub treatment S_2 (30×30 cm) was recorded maximum (1.26, 11.25, 21.46, 29.98 and 30.11). Under the interaction of different treatment, crop growth rate was recorded maximum (1.32, 12.79, 26.08, 33.60 and 33.75) in the treatment combination M_1S_2 (Vermicompost @ 3 t ha^{-1} along with 30×30 cm spacing). The dry herbage yield (kg ha^{-1}) was recorded maximum (2250.67) in M_1 (Vermicompost @ 3 t ha^{-1}) and in the sub treatment S_2 (30×30 cm) was recorded maximum (2146.67). Under the interaction of different treatment, maximum (2494.00) dry herbage yield (kg ha^{-1}) was recorded in the treatment combination M_1S_2 (Vermicompost @ 3 t ha^{-1} along with 30×30 cm spacing).

Key words: *Plant geometry, Dry herbage yield, Andrographis paniculata*

Introduction

Kalmegh (*Andrographis paniculata*) is an important medicinal plant of family Acanthaceae being used in Indian system of medicines since time immemorial. *Kalmegh* is a plant which is also known as "Green Chiretta" and the "King of Bitters". It is used for various medicinal purposes and is bitter in taste. It is mainly used for liver problems as it protects the liver against damage caused by free radicals due to its antioxidant and anti-inflammatory activity. It also helps to boost immunity and is used to manage the symptoms of the common cold, sinusitis and allergies due to its antimicrobial and Immunomodulatory properties. It is good for diabetics as it is effective in lowering blood sugar levels

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Effect of NPK on qualitative traits of Kalaunji

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Abstract
The judicial use of NPK performs more affluent plant growth, which led to maximum number of pods, resulting in higher yields. Keeping view, the present study is to be conducted on the effect of N, P and K on growth, yield and optimum dose of N, P & K for maximizing yield of Kalonji. In this experiment different combinations of NPK were tried to assess for growth and yield characters under the field condition. The research experiment was conducted in a RBD with three replications and nine treatments. All the parameters were recorded at 45, 90 DAS and at harvest. It is concluded that the different levels of NPK significantly influenced the growth and yield attributes of Kalonji. Hence, out of nine treatments NPK 70:70:55 kg ha-[1] was best for enhanced growth and yield of Kalonji.

Keywords: Nigella, benefit cost ratio, growth and yield, NP&K

Introduction
Black cumin (Kalaunji) is an annual herbaceous plant belonging to the Ranunculaceae family. One of the most important constituents of volatile oil of the Kalaunji seeds are thymoquinone (2-isopropyl-5-methyl-1, 4-benzoquinone), which is widely used in traditional medicine. The main alkaloids found in Kalaunji seeds contains a bitter principal (Nigellin), tannins, resins, proteins, reducing sugars (Mostly glucose), saponins and Arabic acids. The seeds of black cumin have exerted important health-beneficial effects including carminative, stimulant, diuretic antioxidant, anti-inflammatory, and anti-cancer effects. (Dhakad *et al*., 2021) [3].
Major and micro nutrients are one of the most important factors in enhancing crop profitability. The presence of nitrogen in the protein structure is well-known; Nitrogen plays a model role in the synthesis of plant components by various enzymes (Khalid and Shedeed, 2015) [5]. Judicious use of nitrogen promotes vegetative growth which ultimately increases the crop productivity. The mature seeds of plant rich in phosphorus concentration and are required in large quantities in shoots and root tips, where metabolism is high and cell division is rapid. The role of Phosphorus in root, fruit and seed development and flower initiation is described by Khalid and Shedeed, 2015 [5]. Phosphorus play a prominent role in increasing plant height, no. of branches, fresh and dry weight and oil yielding capacity in plants (Sushama and Jose, 1994) [10]. Potassium involved in movement of H_2O, nutrients and enzyme activation in plant tissue, which affects protein, starch and adenosine triphosphate (ATP) production. The production of ATP can regulate the rate of photosynthesis.

Materials and Methods
The investigation entitled “Effect of NPK on qualitative traits of Kalonji” was conducted at the “Horticulture Research Farm”, Department of PSMA, R.V.S.K.V.V. Campus-College of Horticulture, Mandsaur, (M.P.) during *Rabi* season of 2020-2021. The variety used in this experiment is AN-1 was obtained from NRCSS, Tabiji Farm, Ajmer, Rajasthan. The seeds were sown at a depth of 2.5 cm in row spaced at 30 cm using 8 kg seeds/ha and 2-3 seeds were sown at a spacing of 30 x 15 cm. The Observation recorded during course of investigation are morphological parameters at 45, 90 DAS and at harvest i.e. plant height (cm), number of branches per plant, fresh weight of plants (g), dry weight of plants (g), days to 50% germination, days to 50% flowering, days to maturity. The yield parameters recorded during course of investigation are number of capsules per plant, number of seeds per capsules, seed yield

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Research Article

Responses of INM on growth and yield of *Kalmegh*

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ABSTRACT

The discovery of the present study was carried out with eight treatments in simple randomized blocks design with three replications at department of Plantation, Spices, Medicinal and Aromatic crops, College of Horticulture, Mandsaur, Madhya Pradesh during the year 2021-22. The treatments accompanied with different doses of FYM, vermicompost and three bio-fertilizers (Phosphate solubilizing bacteria, *Azotobactor* and *Azospirillum*) along with a constant dose of nitrogen. All the growth and yield parameters were noted at 30, 60, 90, 120 days after transplanting and at harvest. Result revealed that the maximum plant height, leaf number, branch number, leaf area, leaf area index, leaf area duration, relative growth rate, crop growth rate, fresh weight, dry weight, number of pods, number of seeds, pod length, pod dry weight, harvest index by herbage and seed, dry herbage yield, seed yield, gross return, net return and benefit: cost ratio were recored in treatment T_7- N @ 40 kg ha^{-1}+50% vermicompost + biofertilizers @ 5 kg ha^{-1} while, cost of cultivation in T_2- N @ 40 kg ha^{-1} +50% FYM @ 7.5 t ha^{-1}.

Keywords: INM, morphology, yield, *Kalmegh,* bio-fertilizers

INTRODUCTION

Andrographis paniculata is known as *kalmegh* in Hindi. It is known to be an important native crop of India and Srilanka belongs to the family Acanthaceae, is a medicinal herb, generally known as *Bhui Neem*. It is a usually recognized as diversified plant used in Homeopathy as well as in Ayurveda. *A. paniculata* is having a preventive result from various diseases, because of its powerful immune strengthening benefits. The whole plant is used to cure snake bite, dried leaf against high blood pressure, gastric and liver tonic. It's have good "blood purifying" activity so, it is recommended for protecting the liver, improving digestion, treatment of ulcers, filaria, malaria, thrombolytic and cardioprotective, brain-related disorders and seasonal fevers (Shwetha *et al*., 2021). It is take the height of 30-90 cm under suitable environments, leaves are 2.5 cm wide and 7.5 cm long, and flower is zygomorphic, complete and bisexual. The stem is quadrangular with more branches (Srivastava, 2017). Its fruit is linear, oblong and acute at both the ends and called as capsule with slight, yellowish brown colour seed. Plants shows non synchronous maturity and diffused seeds frequently through capsule dehiscence (Shakywa *et al.,* 2022). The key active ingredients of *Kalmegh* are di-terepene lactones, andrographolide, andrographiside, neoandrographo-lideand flavones (Minz *et al*., 2013). In India, it is cultivated in the state of Madhya Pradesh, Odisha, Chhattishgarh, Assam, Maharashtra, Uttar Pradesh, Bihar, West Bengal, Tamil Nadu and Kerala.The integrated nutrient management in *Kalmegh* gained higher

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AESSRA

Research Paper

Growth and Variability in Selected Cereal Crops in Madhya Pradesh

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ABSTRACT

[illegible] over 30 years' time period from 1991-92 to 2020-21. Further these periods are divided into four sub-periods. The study is entirely based on secondary data obtained from the Directorate of Economics and statistics, ministry of Agriculture, Government of India, New Delhi. To obtained this, exponential growth model and Cuddy-Della Valle index (CDVI) were used. The study concluded that, the area, production and productivity of wheat reported positive compound annual growth rate. However, a positive and significant growth rate were seen across the sub-period II and III. In terms of variability, it was found that in both the crops wheat and rice reported highest variation in production when compared to area and productivity.

HIGHLIGHTS

- Growth rates was observed highest in production for wheat while for rice in productivity.
- Wheat and rice showed greater variation in production in comparison to area and productivity.

Keywords: Variability, compound growth rate, Cuddy-Della Valle index, rice, wheat

Wheat and rice are the leading cereal crops in the world. Together, they supply more than 30% intake to human population (DES). In India rice cultivation is very popular in agriculture. It is core crop in India and millions of people love to eat it every day. "Rice is life" for more than half of the community. 2004 was designated as the 'International Year of rice' by the United Nations (FAO). Rice is fully loaded with protein, carbohydrates, vitamins like thiamine, niacin and minerals like zinc, phosphorus. India is the second-largest producer and exporter of rice in the world. Rice is grown almost in Madhya Pradesh, Tamil Nadu Chhattisgarh, Andhra Pradesh, Assam, etc., states in India.

Wheat is one of the most popular staple foods in India. It compares well with other cereal in nutritive value. It has good nutrition profile with 12.1 per cent protein, 1.8 per cent lipids, 1.8 per cent ash, 2.0 per cent educing sugar, 6.7 per cent pentose, 59.2 per cent starch with good source of mineral of vitamin and nicotinic acid (Agam *et al.* 2017). It is processed in different forms like flour, suzi, maida and being eaten by number of consumers in different ways as porridge (Halwa), chapati, bread

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Response of *Bacillus megaterium* and *Bacillus mucilaginosus* Strains on Yield and Quality of Soybean

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Original Research Article

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ABSTRACT

At present due to continuous use of phosphatic and potassic fertilizers, a deposits of these nutrients have increased in the soil of studied area, and *Bacillus megaterium* and *Bacillus mucilaginosus* solubilize/mobilize P and K in the soil, thus, for increasing yield and quality of soybean, an experiment was planned with the aim to investigate the response of *Bacillus megaterium* and *Bacillus mucilaginosus* strains on yield and quality of soybean [*Glycine max* (L.) Merrill.] at All India Coordinated Research Project (AICRP) on Integrated Farming System Research at College of Agriculture, Indore, Madhya Pradesh, India during *kharif*, 2019 & 20. The research was conducted in randomized block design (RBD) with 8 treatments, viz. Control with 75% RDF (T_1), Control with 100% RDF (T_2), 75% RDF with *Bacillus megaterium* and *Bacillus mucilaginosus* strains as seed

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Response of *Bacillus megaterium* and *Bacillus mucilaginosus* Strains on Growth and Nutrient Uptake of Soybean

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Original Research Article

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ABSTRACT

The current study aimed to investigate the Response of *Bacillus megaterium* and *Bacillus mucilaginosus* strains on growth attributes and uptake of soybean (*Glycine max* (L.) Merrill.) at All India Coordinated Research Project (AICRP) on Integrated Farming System Research at College of Agriculture, Indore, Madhya Pradesh, India during *kharif*, 2019 & 20. The study was carried out in randomized block design (RBD) with 8 treatments, viz. Control with 75% RDF (T_1), Control with

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Enhancement of Growth and Productivity of Cucumber (*Cucumis sativus* L.) through Calcium Based Fertilizer

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ABSTRACT

The present study was carried out at Research Farm, Krishi Vigyan Kendra (RVSKVV), Manawar (Dhar), during *kharif* season 2020. Total 7 treatments were used in Randomized Block Design (RBD) with three replications to study the effect of calcium based fertilizer on yield attributes and yield of cucumber. All the treatments significantly improved growth, attributed and yield of cucumber as compared RDF alone treatments. Among the various treatments the maximum plan height and flower setting was recorded with the application of RDF + Turbocalcio Plus @ 2 kg at 25 DAT and 40 DAT (T_5) in comparison to other treatments. However, the less number of days (31.50) to flower appearance was recorded with the application of RDF + Turbocalcio Plus @ 2 kg at 25 DAT and 40 DAT. Significantly higher yield parameters *viz*., length of fruit (15.85 cm), girth of fruits (12.06 cm), weight of fruits (146.83 g/fruit) and number of fruit/plant (16.50) and fruit yield (324.67 q/ha) were RDF + Turbocalcio Plus @ 2 kg at 25 DAT and 40 DAT (T_5) which was statistically similar with RDF + Turbocalcio Plus @ 2 kg at 25 DAT and 60 DAT (T_6) and RDF + Turbocalcio Plus @ 1 kg at 25 DAT 2 kg at 40 DAT and 2 kg at 60 DAT (T_7).

Key Words: Calcium, Cucumber, Flower appearance, flower setting, Fruit yield

INTRODUCTION

Cucumber (*Cucumis sativus* L.) is extensively grown vegetable crop of *Cucurbitaceae* family. Due to its economic importance as a high value vegetable crop both in domestic and overseas markets due to more consumer preferences quality production of cucumber is the need of the day (Jakhar *et al*, 2016). Calcium is macronutrient which plays a very important role in plant growth and nutrition, as well as in cell wall deposition. Lower levels of calcium in plants affect growth and development of plant. As a soil amendment, calcium helps to maintain chemical balance in the soil, reduces soil salinity, and improves water penetration leads to improve crop growth, development and yield (Shafeek *et al*, 2013 and Siddique *et al*, 2017).

Calcium (Ca) is a major component of cell walls having 60-70% of its total tissue. It helps in maintaining cell wall integrity and membrane permeability. Calcium is the basic component of many enzymes (Akinki and Simsek, 2004). Application of supplemental Ca decreased the Na content in plant parts and increased the K content (Dabuxilatu, 2005). It is considered as important mineral elements that regulates fruit quality and enhances its post-harvest life through decrease the physiological disorders like water core, bitter pit and internal breakdown. As a versatile signaling ion of calcium (Ca^{2+}) act at multiple sites in diverse networks of signaling cascades. It serves as a major regulatory ion in Horticultural crops. These pathways receive signals from a wide array of biotic and abiotic sources, and cause changes

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AESSRA

Research Paper

Kharif Oilseed Crops Cultivation in Madhya Pradesh (India): Growth and Decomposition Analysis

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ABSTRACT

The study examined the growth in area, production, and productivity of major *kharif* oilseed crops and decompose the production growth into area and yield effect using secondary data collected for 30 years period from different government departments and other agencies. The compound growth rate was calculated by using an exponential trend model and decomposition analysis using a semi-log growth model. It is observed that compound annual growth rate (CAGR) in area, production, and productivity of soybean and sesamum were observed positive but non- significant. While, the positive and non-significant growth rate of groundnut was observed in production and productivity, a negative but significant growth rate was observed in the area. Decomposition analysis indicated that the yield effect of soybean and groundnut was more instrumental in increasing the production than the area and interaction effects. However, the area effect was observed more dominant in sesamum than the yield and interaction effects in the state.

HIGHLIGHTS

- Area, production and productivity of soybean and sesamum in Madhya Pradesh showed positive and non-significant annual growth pattern, whereas, a negative and significant growth was observed in area.
- Yield effect of soybean and groundnut were found to be more instrumental to increase the production, while, the area effect was observed more dominant in sesamum.

Keywords: Annual Growth rate, decomposition, *kharif* oilseed crops, Madhya Pradesh

Oilseed crop holds second most important determinant of agricultural economy next to cereal crops in the field crops category. The self-sufficiency in oilseed crops attained through "Yellow Revolution" during early 1990's, but it could not be sustained beyond a short period. India plays an important role in vegetable oil consumption in recent years in both edible as well as industrial usages. India stands as the largest importer of [illegible] was met through imports. India imported palm oil from Indonesia and Malaysia while, soybean oil and sunflower oil were imported from Argentina, Brazil, Ukraine and Russia (Roy *et al.* 2022). India produces a variety of crops like cereals, pulses, oilseeds, fruits, vegetables, medicinal, aromatics, spices, sugar, fiber crops etc. Among which oilseed crops were the most important commercial crops in our country. They contain useful carbohydrates, vitamins, lipids, fatty acids and the rich source of proteins (40-60%) which contains 18 essential amino acids and trace elements. India accounts the fourth position in leading oilseed producing countries in the world after USE, China and Brazil (Reddy *et*

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Rabi Pulse Crops Cultivation in Madhya Pradesh (India): Growth and Decomposition Analysis

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ABSTRACT

This study analyses growth performance and relative contribution of area, production and productivity of major *rabi* pulse crops i.e. chickpea and lentil crops in Madhya Pradesh. The secondary time series data used for the study were collected from various publications of Government departments for thirty years period from 1991-92 to 2020-21, which was further segregated decade wise into three periods namely Period-I (1991-92 to 1999-2000), Period-II (2001-02 to 2009-10) and Period-III (2011-12 to 2020-21). The exponential trend model was used to measure growth rates of area, production and productivity of *rabi* pulse crop and the relative contributions of factors of production were measured by principle decomposition model. The study indicated growth rates of area, production and productivity of chickpea at the rate of 1.62, 5.68 and 3.99 per cent, respectively, whereas, for lentil the magnitude of growth were 1.86, 7.40 and 5.44 per cent, respectively. However, growth of area only observed to be significant in both the crops (chickpea and lentil). During entire study period, it was seen that yield effect was found to be more instrumental than the area and their interaction effects to increase the total production of both the crops.

HIGHLIGHTS

- As shown in entire study period, the area of both the pulse crops i.e. chickpea and lentil was reported positive and significant growth pattern.
- Yield effect was more dominant than the area and their interaction effects to uplift the total output of both the *rabi* pulse crops i.e., chickpea and lentil.

Keywords: Compound Annual Growth Rate, Decomposition Analysis, *Rabi* Pulse Crops

A variety of crops like cereals, pulses, oilseeds, fruits, vegetables, medicinal, aromatic, spices, fiber and sugar crops etc. are produced in India out of which the most important commercial crops are the pulse crops. Main pulse crops grown in our country are chickpea, pigeon pea, green gram, black gram, lentil, horse gram, garden and field pea. Pulse crops contain useful proteins, carbohydrates, essential vitamins like A, D, E, K minerals and fatty acids that's why these are commonly known as "poor man's meat" or "rich man's vegetable" (Balai *et al.* 2021). These are having high nutritional values and traditionally integrate in the farming occupation as sustainable agriculture. Although, due to leguminous nature, it improves soil fertility by fixing atmospheric nitrogen into the soil, increases the porosity because of having tap root system, low water requirement and capacity to withstand in adverse weather conditions. (Anonymous, 2022). It is worth to note that it is of great significance for human health, the UN announces 2016 as an "International year of Pulses" and 10th of February

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rch Paper

Growth and Decomposition Analysis: Major Cereal Crops in Uttar Pradesh

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ABSTRACT

Cereal grains viz., Wheat, rice, and maize are stapled foods across the globe. Given this, the goal of the current study was to estimate the growth in acreage, output, yield, and decomposition analysis of the state's principal cereal crops. For the period of 30 years, from 1991-1992 to 2020-2021, the secondary data were gathered from the DES, New Delhi, Agricultural statistics yearly data book, etc. These decades were broken further into four sections: Decade I (1991-2000), Decade II (2001-2010), Decade III (2011-2020), and overall (1991-2020). The annual growth rates and proportional contributions of components in the grain harvest output were quantified using exponential trend and decomposition model. The study examined that the growth rate for wheat reported positive, whereas rice and maize show mixed patterns. Rice was one of the crops which reported affirmative and significantly favorable growth at the value of 0.46 per cent throughout the entire study period. Decomposition analysis of wheat, rice, and maize revealed that the rise in output was caused by the yield effect, although the acreage effect for rice and maize was significant and positive for decade II.

HIGHLIGHTS

- The growth rates showed mixed patterns during the study period.
- Yield effects were superior for wheat, rice, and maize.

Keywords: Growth, decomposition, rice, harvest, Uttar Pradesh

The farming sector and its derivatives are the primary employers in India. The primary source of income for 70% of its rural residents is still farming, with 82% of farmers being small and marginal farmers (FAO, 2022). The high output of grain crops in India is due to favorable weather and well-designed irrigation facilities. Cereal was the foundation of human civilization. Cereal is taken from the Roman term *'Ceres,'* which signifies the goddess of grain. The most vital grains are wheat, maize, and rice. Wheat crop is the second most after rice therefore wheat is called as *'King of cereals.'* Maize has the highest yield potential among cereals hence it is known as the *'queen of cereals.* Cereals, which include a broad variety of cereal products, are cultivated in vast amounts because of their high nutrient and mineral content. However, many bowls of cereal contain fiber, proteins, and carbohydrates. Cereals are enriched with niacin, iron, riboflavin, and thiamine.

The majority of the world's populace now gets the bulk of their energy from wheat cereals. Cereals are the primary source of energy for the vast majority of the world's people, and they are especially essential in developing nations. As compared to industrialized nations, developing nations rely more heavily on cereal grains to meet their

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A Review of Millet Crops for Agricultural Sustainability in India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Review Article

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ABSTRACT

A major issue in India is the sustainability of agriculture due to population expansion, climate change, and mounting demands on natural resources. This review paper explores how millet crops might help India's agriculture become more sustainable. A family of small-seeded grains known as millets has been cultivated for millennia and has various distinctive qualities that make them appropriate for sustainable farming methods. The paper looks at the advantages of growing millet from an environmental, economic, and social standpoint, as well as the difficulties and potential solutions for their broad adoption. Additionally, millet contributes to improved soil health, water resource conservation, mitigation against climate change, and strengthening rural communities. The review's conclusions underscore the important part millet crops can play in achieving agricultural sustainability and offer suggestions for how politicians, academics, and farmers should encourage the development of millet crops.

Keywords: Millet; pearl; finger; Sorghum; Kodo; Proso, barnyard; pseudo; little.

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Effect of biodynamic package with biofertilizer and vermicompost on the growth parameters of Radish (*Raphanus sativus*) under Malwa region of Madhya Pradesh

Shikha Aarya, Anvita Sharma, Swati Barche, Pragya Uikey and Vindesh Arya

Abstract
A study was conducted in radish to estimate the Effect of biodynamic package with biofertilizer and vermicompost on the growth parameters of Radish (*Raphanus sativus*)" under Malwa region of Madhya Pradesh". Growth parameters of Radish were studied with respect to number of leaves per plant, leaf length (cm), leaf width (g) and fresh weight of leaf (g), root length (cm) and root width (cm) showed different effect of treatments. The treatment T_{14} (BD 501 @ 5.0 g + Vermicompost @ 2.5 t/ha) was found significantly superior as compare to other treatments character likes number of leaves per plant, leaf length (cm), leaf width (g) and fresh weight of leaf (g), root length (cm) and root width (cm). However, the T_0 (Control) observed minimum as compare to other treatments.

Keywords: Biodynamic, biofertilizer, vermicompost, radish, growth characters

Introduction
Radish (*Raphanus sativus* L.) is an edible root cum leafy vegetable, belongs to family Brassicaceae (Cruciferеae) having chromosome number 2n=18. It is a popular vegetable in India suitable for tropical and temperate climate. In India area and production of Radish is 207 thousand hectare and 3,184 thousand MT with productivity of 15.569 t/ha (NHB 2019-20) [8], while in Madhya-Pradesh, area and production is 10.07 thousand hectare with a production of 152.56 thousand MT respectively, with 14.25 t/ ha productivity Biodynamic (BD) agriculture is the oldest form of ecological agriculture with a history of more than 95 years that is based on the anthroposophical concepts of Rudolf Steiner (Koepf *et al.* 1990) [6]. The biodynamic farming aims to restore humus status of the soil ecosystem to hold its fertility and productivity. Also it helps to restore the soil for a balanced functioning of flora and fauna because soil is a living system where in the microbes can be fully established and maintained.
Vermicompost being rich in organic matter is the commonly used manure to supplement the crops for nutrition. Vermicompost has all characteristic to use it as the most valuable organic manure. Vermicompost is slow releasing organic manure which has most of the macro as well as micronutrients in chelated form and fulfills the nutrients requirement of plant for longer period (Mali *et al.* 2018) [7]. Vermicomposting influences the physio chemical and biological properties of the soil, which, in turn improves the fertility. It is cost effective and renewable source of plant nutrients to supplement the chemical fertilizer
Biofertilizers in combination with organic manures found as effective component in organic farming for reliable and cheap supply of nutrients. These combinations were ecologically safe and improve soil fertility by improving the soil physical, chemical and biological condition. Microbial consortium is a carrier based microbial product that contains N fixing, P & Zn solubilizing and plant growth promoting microbes in single carrier. The Azotobacter and PSB are the main bio-fertilizers which are biologically active products containing bacteria and they improve soil health and fertility. They liberate growth promoting substances and vitamins which may increase crop yield (Sharma *et al.* 2013) [13].

Materials and Methods
The present experiment was laid out in the field of the research farm of Rajmata Vijayarraje Scindia Krishi Vishwa Vidyalaya, Department of Horticulture, College of Agricultur, Indore (M.P.) during 2021-22. The experiment was laid out in the Randomized Block Design with three replications comprised of fourteen treatment combinations.

Plant-Physiology

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Statistical Model for Annual Trends and Magnitude of Climatic Variability across Locations from the Malwa Plateau Agroclimatic Zone of Madhya Pradesh, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Global climate change has affected the local weather patterns in different regions, especially in India. To manage the water resources effectively, it is important to quantify the local changes in the climatic variables. One of the key variables is precipitation, which is often used as an indicator of

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Statistical Model for annual Trends and Magnitude of Climatic variability Across Locations from the Vindhya Plateau Agroclimatic Zone of Madhya Pradesh

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ABSTRACT: Climate change has disrupted the major climatic parameters at a global level. However, the changes having localized intensity area not equal for all especially in India. These changes must be quantified locally to manage the natural water resources more effectively. Precipitation is one of the most important climatic parameters. It has been widely measured as a starting point towards the apprehension of global climate change. The purpose of this study is to observe the temporal variability of rainfall for the period of 1991-2020 (30 year), to improve the Agriculture status of different districts of Vindhya Pleatue Agroclimatic zone (District – Bhopal, Damoha, Sagar, Sehore and Vidisha). The aim of the study is to determine the trend in annual precipitation time series using the Mann-Kendall and Sen's T test. The magnitudes of trend in precipitation have been estimated by Sen's estimator method. Auto correlation effects were reduced before applying the Mann-Kendall test for the trend in precipitation. On the annual basis, analysis of Mann-Kendall test shows decreasing and non-significance trend in rainfall times series of all the districts except Bhopal Bhopal, Damoha, Sagar, Sehore and Vidisha which showed significant changes.

Keywords: Mann Kendall & Sen slope estimator, Trend Analysis, Climatic variability, Rainfall analysis.

INTRODUCTION

The state of Madhya Pradesh occupies a total geographical area of 44.348 m ha out of which 55.9 % (24.804 m ha) is under major Kharif and Rabi crops. The state is predominantly rain fed farming state, as only 29.5% of the net cultivated area (6.07 m ha) is irrigated. The state of Madhya Pradesh is blessed with varied agro-climatic conditions which permits the farmers' of the state to cultivate a number of crops like cereals, pulses, oilseeds, commercial crops and horticulture crops across different seasons of the year.

Trend analysis in the Sabarmati basin showed statistically significant decreasing trends for annual, winter, pre-monsoon, and monsoon rainfall (Kale *et al.*, 2022). The trend analyses were done by a) using the Mann-Kendall test for trend significance (Kale, 2020) using Sen's slope estimator for trend magnitude estimation (Sen, 1968) using innovative trend analysis for aiding the results of trend analyses (Kale, 2020) using the Sequential Mann-Kendall test for start and end of trend detection (Kale, 2018) and e) also using linear regression method to identify the trend in rainfall data (Kaur and Kaur 2019). A rainy day receiving more than 2.5 mm of rainfall in a day is used for calculation.

Gajbhiye *et al.* (2016) have analyzed rainfall trends and variability over the basin of the Sindh River located in Madhya Pradesh, India. The daily rainfall data were collected from 'www.indiawaterportal.org/met_data/' to inspect the temporal and spatial variability in the series of precipitation. SS estimator was used for determining the trend magnitude, whereas the statistical significance was analyzed by using the MK test. Primary statistical characteristics of the seasonal (June to September) and annual rainfall events that occurred over one hundred and two years (1901-2002) were analyzed and significant rising trends in both seasonal and annual rainfall were detected.

Pandey and Khare (2017) have assessed the trends in evapotranspiration and precipitation over the Narmada RB (NRB), which is one of the most holy and crucial rivers of Central India. Monthly precipitation and reference evapotranspiration data corresponding to the period of 1901-2002 were analyzed in the study. Various tests were carried out over the data obtained from twelve precipitation stations and twenty-eight reference evapotranspiration stations of the NRB. Trend analysis in the annual precipitation series was executed by employing the MK test and SR test at 5% and 10% significance levels respectively. The results of the study

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Constraints, Suggestions and Feedback Behaviour of the Farmers in using different Mass Media in Nimar Agro Climatic Region of Madhya Pradesh

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ABSTRACT

Mass media have a tremendous effect in the field of agriculture. It is believed that mass media demand more active and creative participation in the part of villagers. The use of mass media is more advantageous because the reliable and scientific information on a specific topic well illustrated with pictures can reach many users, quickly and simultaneously in a simple language. In this view, a study was conducted to assess the Mass Media Utilization Behaviour as perceived by the Farmers. The study was conducted in Nimar Agro Climatic Region of Madhya Pradesh by selecting a sample of 240 farmers of mass media as respondents. The data collection was done with the help of structured interview schedule and analyzed using multistage sampling methods. Results of the study revealed that heavy load of work during farm broadcast hours, use of technical words, very fast speed of programme presentation, lack of a field-based programme, useful information is not timely, lack of real problem-oriented programmes and programmes have broadcasted only once and so farmers could not follow much in respect of radio. The farmers suggested that use simple language, provide useful information timely, change broadcasting time and increase the broadcasting duration. As constraints by the farmers non-participation of farmers in problem discussion, subject matter of the program does not conform to the needs of the farmers, non-availability of recommended inputs in the market, lack of programmes relating to agriculture in the local language, electricity problem, Illiteracy creates problems in understanding the new information, High cost of devices, Use of difficult technical terms and Timing of T.V. programmes is not suitable for farmers in respect of television. The study revealed that among the various parameters on feedback behaviour of mass media, the farmers preferred the satisfied with additional information, got additional information from Scientist/ KVK/ Agriculture Department, communicated problem discussed regarding agricultural and animal husbandry to veterinary doctors, written to AIR/ DDK M.P. to get additional information again on the topic broadcasted/telecasted and given suggestions for improvement of farm radio/ television and newspapers programme. Hence, this is concluded from the findings that majority of the radio listeners, television viewers as well as newspapers reading farmers had medium level of feedback behaviour.

Keywords: Mass media, Radio, Television, Newspaper, Nimar agro climatic region

INTRODUCTION

The mass media channels are catering to this important need i.e. craving for information. Communication in agriculture is not only to inform and generate awareness among the farmers additionally to execute new ideas that change the method and patterns of farming. Communication media play a very important role in the transfer of agricultural technologies to the farmers by minimizing the gap between technology and its uses. There are numerous mass media like television, films, slides, radio, literature, documentaries, dramas, exhibitions and tours etc. Mass media are essential ingredients needed for effective transfer of technologies

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Viewing Behaviour of the Farmers in Nimar Agro Climatic Region of Madhya Pradesh towards Mass Media of Television

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ABSTRACT

The present study was conducted in Nimar Agro Climatic Region of Madhya Pradesh on Viewing Behaviour of the Farmers towards Mass Media. The aim of this study is to know the viewing behaviour of the farmers of television programme. The study was carried out on a sample of 240 mass media user farmers. The data were collected through personal interviews of farmers with the help of a structured interview schedule. Data were analyzed with help of appropriate statistical tools. Majority of the farmers had self purchased their television sets. Maximum of the farmers had self motivation to purchase their television sets. Majority of the farmers had purchased television for entertainment purpose. Majority of the farmers had accompanied with their family television viewing. Majority of the farmers had watched television programmes at evening. Maximum of the farmers had viewed television up to 30 minutes. Majority of the farmers had viewed television for preserving the information simply by memorizing in their mind. Majority of the farmers had discussed television contents for getting technical package of practices information. As far as level of mass media viewing behaviour of the television viewing farmers were having high level of mass media viewing behaviour, respectively.

Keywords: Viewing behaviour, Mass media, Television

INTRODUCTION

Television is the most powerful medium at present. Television can bring the world to our door steps within seconds. This mass medium has made dissemination of news, information and entertainment possible on a scale extraordinary in human society. It is undoubtedly one of the most flexible audio visual aids ever developed. Admittedly, this is still a new field. There is a much to be completed before television achieves its full usefulness in teaching. Television is providing instruction and entrainment to far flung areas. It has unique advantages over other mass media. While it provides sound, vision and movement, it can accomplish the largest number of people in the shortest possible time. Several studies conducted in India have conclusively brought to light that it is very effective in transferring farm technology to the farmers irrespective of their socio-economic status and level of formal education. It has been realized that lack of education which is so predominant among Indian farmers, has not been found to be a limiting factor for the utilization and consumption of farm telecasts. Use of television as a powerful communication medium has no doubt to captivate the agriculture educators to connect its potential for reaching far across the nation. While it provides words with pictures and sound effects like movie, T.V. has the capacity to reach the largest number of people in the shortest possible time. People through the eyes and ears both thus, gain greater knowledge and understanding of the subject. Although T.V. is a new medium, it is developing very rapidly. With the development and acceptance of colour in television one can expect a greater reality in this medium for

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Reading Behaviour of the Farmers in Nimar Agro Climatic Region of Madhya Pradesh Towards Mass Media of Newspapers

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ABSTRACT

The present study was conducted in Nimar Agro Climatic Region of Madhya Pradesh on Reading Behaviour of the Farmers towards Mass Media. The aim of this study is to know the reading behaviour of the farmers of newspapers. The study was carried out on a sample of 240 mass media user farmers. The data were collected through personal interviews of farmers with the help of a structured interview schedule. Data were analyzed with assist of suitable statistical tools. Vast majority of the farmers had purchased their own newspapers. Maximum of the farmers had motivation for purchasing own newspapers. Vast majority of the farmers had purchased newspapers for news and other information. Majority of the farmers read newspapers alone. Vast majority of the farmers had read newspapers in the morning time. Maximum of the farmers read the newspapers for 30 minutes. Maximum of the farmers' reader to newspapers preserves the information simply by memorizing in their mind. Vast majority of the farmers had discussed newspapers contents for getting news and current affairs. As far as level of mass media reading behaviour of the newspapers reading farmers were having high level of mass media reading behaviour, respectively.

Keywords: Reading behaviour, Mass media, Newspaper

INTRODUCTION

Print media, among the various mass media, play a very significant role in communication of farm information. Annual farm publications are the very important tools used in communicating farm information regularly to the readers. The main function of print media is to inform, educate and motivate the farmers. It helps the farmers to accept new ideas and agricultural practices in order to increase production per unit of land. The print media have lasting power over spoken words. The written word has power when written well it convinces, motivate people. Its power can be used in leading them to action. These also contain specific information in simple language. These are comparatively low cost communication media. Newspapers, books, bulletins, leaflets, folders, farm diaries, farm magazines etc. are increasingly being purchased by the farming community. The print media have several advantages over other media like audio, audio visual aids and even spoken words. The printed words can be used for reading number of times and also can be referred any time to refresh one's memory. Those given more time to the communicator to think, to organize ideas, understand easily the ideas and finally adopt them even in computer era, the printed word have proved its unique features. The computer aids could not replace printed word but it entered in printed technology and enhanced the power of printed word. Farmers attribute special significance to the written information. They perceive it as reliable and trustworthy and feel that the written words are more authentic. Print media are thus, the permanent and trusted source of information which can effectively and efficiently be used for disseminating farm technology.

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Bio-efficacy of Newer Acaricides and Botanical against Red Spider Mite, *Tetranychus urticae* Koch. in Brinjal

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ABSTRACT: Field studies were undertaken at K.V.K Research Farm, Mandsaur, M.P. to study the Bio-efficacy of newer Acaricides and Botanical against red spider mite during 2020-2021. During the course of investigation Spiromesifen 22.90 % SC @ 400 ml/ha found most effective treatment and it recorded the lowest (2.74) adults followed by Fenazaquin 10 % SC @ 400 ml/ha (3.16) and Fenpropathrin 30 % EC @ 250 ml/ha (3.56) but superior to control (12.25) during both years. The data of percentage increase in yield over untreated control obtained with application of Spiromesifen 22.90 % SC @ 400 ml/ha recorded the highest 34.42 % increase over untreated control. Selection of specific acaricides for the control of red spider mites is difficulties, so that these studies are helpful for the selection of acaricides in Malwa region for the control of red spider mites.

Keywords: Red Spider Mite, Brinjal, Bio-efficacy and Acaricides.

INTRODUCTION

Brinjal, scientifically known as *Solanum melongena* (L.), holds immense importance as a vegetable in South-East Asia, where hot and humid climates are prevalent. It falls under the Solanaceae family and is highly valued for its rich nutritional content, including vitamins, proteins, minerals, and carbohydrates. Eggplant is the fifth most economically important solanaceous crop after potato, tomato, pepper, and tobacco (Taheri *et. al*. 2017). Brinjal is renowned in Ayurveda for its medicinal properties, making it beneficial for diabetic patients and those suffering from liver complaints. India, being the world's second-largest vegetable producer after China, cultivates brinjal across 7,27,000 hectares, yielding a production of 12,680 MT and a productivity rate of 17.5 tons per hectare. In Madhya Pradesh alone, brinjal cultivation spans 51,350 hectares, resulting in a production of 1,073.63 MT and a productivity rate of 20.91 tons per hectare (as per Horticulture statistics at a glance 2019).

However, the successful cultivation of brinjal faces significant threats from various pests and diseases. One of the primary arthropod pests affecting brinjal is the red spider mite, scientifically known as *Tetranychus urticae* Koch, (Ghosh and Hasan 2021) posing a major threat alongside the fruit and shoot borer. These mites, belonging to the sub-class Acari and the class Arachnida, are minute organisms found in diverse biotic and abiotic habitats. They are associated with field crops, vegetables, fruits, ornamental and forest plants, as well as different stored grain products (Pritchard and Baker 1955). In terms of their feeding behaviour, mites are categorized into phytophagous, parasitic, and predatory types. Phytophagous mites, especially *T. urticae*, can destroy 18-22 cells per minute during the feeding process. Continuous feeding results in a stippled, bleached effect on leaves, which later turn yellow, grey, or bronze. In the case of sever infestation the death of plants occurs (Jeppson *et. al.* 1975). If left uncontrolled, these mites can cause complete defoliation. When their population densities are high, they are found on both sides of leaves, producing abundant webbing where eggs, larvae, nymphs, and adults are attached. Given their significance as a major threat to agri-horticulture, understanding their bio-ecology and exploring host plant resistance in available brinjal germplasms is crucial.

Spider mites reproduce rapidly and can quickly become harmful in favorable conditions. Many experiments have aimed to control them, but they've developed resistance to pesticides, making control challenging. Chemical methods leave residues, pollute the environment, and harm humans and non-target organisms. Research now focuses on finding non-chemical alternatives (Kirisik *et. al.* 2020).

MATERIALS AND METHODS

A field experiment was conducted in the research farm of Krishi Vigyan Kendra, Mandsur M.P under the aegis

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Efficacy of insecticides against fruit borer, *Helicoverpa armigera* on *Lycopersicon esculentum* Mill

Rahul Patidar, Neelesh Raipuriya, Sanju Singh and Sumit Kakade

Abstract
Tomato fruit borer controls with six more recent pesticides were used. viz., Quinalphos 25% EC, Novaluron 10% EC, Chlorantraniliprole 18.5% SC, Flubendamide 39.35% SC, Emamectin benzoate 5% SG & Indoxacarb 14.5% SC. The total two of sprays were done. The treatment Quinalphos 25% EC, Novaluron 10% EC, Chlorantraniliprole 18.5% SC, Emamectin benzoate 5% SG & Indoxacarb 14.5% SC was on par with each other in terms of quality. Among them Flubendamide 39.35% SC was determined to be the most effective treatment of all. In both sprays, the descending order of efficacy was noted as chlorantraniliprole 18.5% SC>Emamectin benzoate 5% SG>Indoxacarb 14.5% SC>Quinalphos 25% EC>Novaluron 10% EC.

Keywords: Tomato, fruit borer, pesticides, efficacy, spray

Introduction
Tomatoes, *Lycopersicon esculentum* (Mill), are one of the most popular and widely farmed vegetables in the world, second only to potatoes in India in terms of importance. Tomato fruits can be eaten fresh, cooked, or utilized in soups, juices, ketchup, purees, pastes, & powders, among other things. Tomato is also rich in medicinal value. Tomatoes contribute a healthy and good balanced diet. It is rich in minerals, vitamins, essential amino acids, dietary fibers and sugar. Tomato contains of vitamin A, B and C, phosphorus and iron. In India total cultivated area under tomato is8, 13,000 hectares with the production of 21,195,000 MT during. Whereas, in Madhya Pradesh, the annual production of tomato is 2419.56 thousand MT from 84.53 thousand hectares area with the average productivity of 28.62 MT ha-1(Agri. Coop 2019) [1]. This crop is attacked by a number of insects which became a major constraint in optimum production of tomato (Wajombe *et al.* 2006) [4]. Tomato fruit borer, *Helicoverpa armigera* (Hubner) and leaf miners, *Liriomyza trifolii* (Burgess) and tobacco caterpillar, *Spodoptera litura* are important pest. Tomato fruit borer, which causes 40-50 percent damage in tomato crop (Pareek and Bhargava, 2003) [8]. *H. armigera* is a charismatic insect in agriculture accounting for the consumption of over 55 percent of total insecticides used in India. Almost all the stages of tomato crops, from nursery to maturity are attacked by many insect pests. Therefore, application of no. bio-pesticides including ready mix insecticides is felt one of the safe, economic and effective management options that can substantially reduce yield losses caused by fruit borer.

Materials and Methods
Studies on the "Efficacy of different insecticides against fruit borer *Helicoverpa armigera* on tomato (*Lycopersicon esculentum* Mill)" were carried out with a view to manage the fruit borer, *H. armigera* with the help of some chemical insecticides. The present investigation was carried out during *Kharif* season 2020 at college farm, JNKVV, Jabalpur. There were seven treatments including an untreated check and each treatment was replicated in the three randomized block design. In each treatment two sprays was given i.e. first spray at the time of flowering and second spray at 15 days after first spray. The observation on number of *Helicoverpa larvae* per plant was recorded from 10 randomly selected plants from each treatment. At each picking, the number of healthy and damaged fruits, as well as the count of *Helicoverpa per* 10 plants per treatment, were recorded. All the observations were recorded before the spraying and at 1, 3, 5 and 10 days after each spraying. The yield/plot was recorded and converted in kg/ha for each treatment separately.

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Effect of Abiotic Factors on the Population Dynamics of Red Spider Mite, *Tetranychus urticae* Koch. of Brinjal in Malwa Region, Madhya Pradesh, India

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Authors' contributions

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Influence of *Pseudomonas* and Biofertisol as Foliar Spray on Nodulation Attributes and Yield of Vegetable Pea under STCR Approach

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ABSTRACT

A field experiment was carried out during the *rabi* season in the Experimental Field, Department of Soil Science and Agricultural Chemistry, JNKVV, Jabalpur (M.P.) under RBD design with four replications consisting of five treatments of two types of biofertilizers: *Pseudomonas* and Biofertisol, and scheduled combinations of inorganic fertilizers based on STCR (Soil Test Crop Response) to achieve the desired yield using the vegetable pea variety PSM-3. The response due to treatment of T_4 (TY 100 q (58:110:47) + 5 t FYM+1 spray of Pseudomonas+1 spray of Biofertisol) was significantly effective in increasing nodulation attributes (nodulation enumeration, biomass and

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Effect of Foliar Application of Boron, Zinc and Manganese on Dry Matter Accumulation, Total Tuber Yield and Economic Feasibility of Potato (*Solanum tuberosum*) cv. Kufri Chipsona – 1 under Gwalior Climatic Conditions

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Effect of Micronutrients and Biofertilizer Treatments on Yield and it`s Attributes of Coriander (*Coriandrum sativum* L.) cv. RCR-41

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Original Research Article

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ABSTRACT

The current study, named "effect of micronutrients and biofertilizer on yield parameters of coriander *Coriandrum sativum* (L.) cv. RCR-41," is planned to be carried out in the Research Field, Department of Horticulture, College of Agriculture, Gwalior, M.P., during Rabi 2020-21 and 2021-

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Stability and Molecular Characterization of Heat Tolerant Genotypes of Chickpea (*Cicer arietinum* L.)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Original Research Article

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DOWNLOAD [**This article belongs to Volume - 54, Issue - 10**]

Title : "Screening of Garlic [Allium sativum (L.)] genotypes Growth, Yield and Quality Attributes in Malwa Region"

Abstract :

The mentioned experiment was conducted in rabi season of 2021-22 and 2022-23. The experiment was laid out in Randomized Block Design (RBD) with three replications. All the genotypes were randomized separately in each replication. The experiment comprised of fifteen genotypes consisting Sehore selection-1, Sehore selection-3, Amletha, Ashta-2, G-282, Malkapuri, G-189, G-384, G-323, G-2, Ichawar-5, Ashta-3, Ujjain-4, Ujjain-7, Raipura-8. During screening of different genotypes for growth parameters of the garlic genotypes, the genotype T3 (Amletha) performed very well under Malwa climate and the same trends were also reported for yield parameters at different growth stages. During the evaluation of the quality parameter like colour the various colour were recorded in different genotypes. The colour of the superior genotype Amltha is perfect white with have good market compatible.

FULL ARTICLE

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Productivity, Profitability and Water Use Efficiency of Sweet corn (*Zea mays* L. *saccharata*) as Influenced by Irrigation Scheduling

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Keywords:
B:C ratio, Irrigation scheduling, Net returns, Sweet corn, Water use efficiency, Economic water productivity, Yields

ABSTRACT

This field study was conducted at Research Farm of AICRP for Dryland Agriculture at College of Agriculture (RVSKVV), Indore (MP) during the *rabi* 2019-20 and 2020-21. Irrigation scheduling (IW: CPE) consisted three different level *viz.*, 0.6 IW: CPE, 0.8 IW: CPE and 1.0 IW: CPE with 6 replications in Randomized Block Design (RBD). Irrigation was applied through drip system having inline emitter of 4 lph (Litre per hour). Results revealed that among the irrigation scheduling, 1.0 IW: CPE recorded the taller plants (188.70 cm), maximum dry matter/plant (179.50 g) and number of leaves/plant (12.70) which was followed by 0.8 IW: CPE. Similarly, irrigation at 1.0 IW: CPE recorded the highest values of number of cobs/plant (2.67), cob length (29.5 cm) and weight of cob without husk (311.90 g) followed by 0.8 IW:CPE and 0.6 IW:CPE. 1.0 and 0.8 IW: CPE scheduling increased green cob yield by 10.9 and 9.3 per cent over 0.6 IW: CPE scheduling. Among the irrigation scheduling, 0.8 IW: CPE gave maximum net returns of ₹255796/ha and B:C ratio of 5.73. The maximum WUE (38.41 kg/ha-mm) followed by 47.32kg/ha-mm and 57.70 kg/ha-mm were observed in 1.0 IW:CPE, 0.8 IW:CPE and 0.6 IW:CPE, respectively. Harvested rainwater in the farm pond can be used for high remunerative crops i.e. sweet corn for obtained the better profit. Hence, it is concluded that for getting higher production and net returns from *rabi* sweet corn can be achieved by adopting proper irrigation scheduling from harvested rainwater.

1. INTRODUCTION

Maize (*Zea mays* L.) is one of the most versatile crops referred as a 'Miracle cereal' and 'Queen of the Cereals' due to its high productivity potential compared to other crops [1], [2]. It is an important food, feed, fodder and industrial raw material provided throughout the world [3], [4]. Worldwide, it is considered as the

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Impact of using Bio-NPK and Bio-Zn together with Chemical Fertilizers on uptake of Nutrients by Soybean (*Glycine max* L. *Merrill*) in Black Soil

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ABSTRACT: Soybeans are a large oil seed crop and legume that may be produced in a variety of soils and climates. A crucial micronutrient needed by humans, animals, and plants is zinc. As there is a greater concern to sustain the deteriorating soil health due to indiscriminate use of chemical fertilizers and hence exerting the lack of beneficial microbes in the soil. Therefore, lack of essential nutrients in the soil is a global concern for the growth of food crops. The present investigation was carried out during *kharif* 2021 on Research farm of R.A.K. College of Agriculture, Sehore (M.P.) to evaluate the effect of conjoint use of Bio-NPK and Bio-Zn with chemical fertilizers on nutrient uptake of soybean. The studies have been found beneficial to fetch the more production of the crop along with improving the soil health. The experiment was laid out in Randomized Block Design with seven treatments in combinations in three replications consisting of treatments T_1: Control; T_2: 100% Recommended dose of fertilizers (RDF); T_3: 75% RDF; T_4: 75% RDF + Bio-Zn; T_5: 75% RDF + Bio-NPK; T_6: 75% RDF + Bio-Zn + Bio-NPK; T_7: 75% RDF + *Rhizobium japonicum.* Revealed that nutrient content and uptake was also increased with the inoculation of microbial cultures as compared to uninoculated control and highest N uptake was found in treatment 100% RDF (74.95 Kg ha^{-1}) and it was at par with 75% RDF + Bio-NPK, 75% RDF + Bio-Zn + Bio-NPK and 75%RDF + *Rhizobium japonicum* which uptake 69.92, 70.16 & 66.13 Kg ha^{-1}. Highest P uptake found in 100% RDF (5.61 kg ha^{-1}) however it was at par with 75% RDF + Bio-Zn + Bio-NPK which uptake 5.05 Kg ha^{-1}. Highest k uptake found in 100% RDF (57.96 kg ha^{-1}) however it was at par with 75% RDF + Bio-NPK and 75% RDF + Bio-Zn + Bio-NPK which uptake 52.62 & 50.72 Kg ha^{-1} by soybean crop at harvest and highest Zn and Fe uptake was found in 75% RDF + Bio-Zn + Bio-NPK (0.0408 & 0.0470 kg ha^{-1}) however these were at par with75% RDF + Bio-Zn which uptake 0.0371 & 0.0430Kg ha^{-1}.

Keywords: Bio-Zn, Bio-NPK, Chemical Fertilizers, Black Soil, Soybean.

INTRODUCTION

Soybean (*Glycine max* L. Merrill) is also known as Golden Bean or Miracle Crop, as they contain a complete source of protein and oil. Soybean is mainly grown for their seeds and it is the second largest oil seed after groundnut in India. Soybean seeds contain 43.2% protein, 19.5% fat, 20.9% carbohydrate and a good amount of other nutrients like calcium, phosphorus, iron and vitamins (Gupta *et al*., 2003).

The state of Madhya Pradesh is known as the "soybean state". During kharif 2018, the total area under soybean crop in India was 11.13 million hectares, with a production of 13.26 million tonnes and a productivity of 1192 kg/ha, while the total area under soybean crop in Madhya Pradesh was 5.41 million hectares, with a production of 6.67 million tonnes and a productivity of 1231 kg/ha (Anonymous, 2021).

Microbial inoculants, also known as bio-fertilizers, are able to mobilise significant nutritional elements in the soil and change their state from unusable to useful by crop plants through biological processes. Unlike chemical fertilizers, which have an adverse effect on the soil, bio-fertilizers boost soil fertility naturally. Therefore, using bio-fertilizer is essential to boosting soil productivity (Nalawde *et al*. 2015). Legumes fix atmospheric nitrogen due to the relationship that exists between legume plants and a group of soil bacteria commonly known as rhizo-bacterium. This symbiotic relationship allows the bacteria to live on the roots of the legume plant, consuming carbohydrates from the plant and providing the plant with nitrogen that the bacteria

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Title : Evaluation of Different Dual Purpose Fenugreek Genotypes for Growth, Yield and quality attributes

Abstract :

The experiment was carried out at the Horticulture Research Farm, R.A.K College of Agriculture, Sehore (M.P.) during Rabi season 2019-2020 and 2020-2021. The experiment was laid out in randomized block design with eight treatments and three replications during the month of November for both years. Various Growth and yields parameters were evaluated in this experiment. In the evaluation of different genotypes of fenugreek for growth parameters. Growth parameters such as germination percentage, plant height, number of leaves per plant, number of branches per plant, leaf area and leaf area index were also found significant compared to check. Different genotypes of fenugreek for yield and yield parameters, the genotype Lajabab found significantly superior in earliest first pod initiation, 50% pod set and earliest seed maturation yield per plot and yield per hectare, fresh weight of leaves followed by Saryu Plume-55.

FULL ARTICLE

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Effect of Plant Growth Regulator and Vermicompost on Growth and Yield Parameters of Bottle Gourd [*Lagenaria siceraria* (mol.) standl.]

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Keywords:
Regulator, vermicompost, length, *Langenaria siceraria*

ABSTRACT

The present investigation in titled "Effect of growth regulators and vermicompost on female flower in bottle gourd [*Langeraria sicenaria* (mol.) standl.]'' by Growth Regulators" at the Horticulture Research Farm, R.A.K college of Agriculture, Sehore (M.P.) during 2019-20 and 2020-21. This experiment was laid down in Randomized block design with three replications. The thirteen treatments viz., T_1 (GA3 0 ppm + Vermicompost @ 0), T_2 (GA3 25 ppm + Vermicompost. @ 2 t/ha), T_3 (GA3 50 ppm + Vermicompost @ 4 t/ha), T_4 (GA3 75 ppm + Vermicompost @ 6 t/ha) T_5 (Etherel 100 ppm + Vermicompost @ 2 t/ha.), T_6 (Etherel 200 ppm + Vermicompost @ 4 t/ha.), T_7 (Etherel 300 ppm + Vermicompost @ 6 t/ha.) T_8 (NAA 100 ppm + Vermicompost@ 2 t/ha.), T_9 (NAA 150 ppm + Vermicompost @ 4 t/ha.), T_{10} (NAA 200 ppm + Vermicompost @ 6 t/ha.), T_{11} (CCC 200 ppm+ Vermicompost @ 2 t/ha.), T_{12} (CCC 400 ppm + Vermicompost @ 4 t/ha.) and T_{13} (CCC 600 ppm + Vermicompost @ 6 t/ha.) were evaluated during the experiment. The maximum days taken to first female flower were recorded under the treatment T_1 (61.33 in 2019-20) and (62.00 in 2020-21). While the minimum days taken to first fruit picking significantly recorded under the treatment T_6. In relation to sex ratio, the maximum sex ratio of flowers

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Effect of different Surface Coating Treatments on Physical Parameters of Guava (*Psidium guajava* L.) cv. Allahabad Safeda Fruits

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ABSTRACT: The experiment was conducted during 2019-2020 at the Instructional cum Research Department of Fruit Science, RVSKVV- K.N.K. College of Horticulture, Mandsaur (M.P.). Guava freshly harvested fruits were coated with different coatings Guar gum (0.5%, 1.0%, 1.5% and 2.0%), Shellac (0.5%, 1.0%, 1.5% and 2.0%), Aloe veragel (25%, 50%, 75% and 100%) and Carboxyl Methyl Cellulose (0.5%, 1.0%, 1.5% and 2.0%), comprising of seventeen treatments with three replications in Completely Randomized Design. Periodically effects of different surface coating materials were observed for Physical parameters for fruits like- fruit length (cm), Fruit width (cm), Fruit volume (ml), specific gravity, physiological loss in weight (PLW %), Decay loss (%), Shelf-life of fruit (days). Out of four types of edible coating (*i.e.* Guar gum, Aloe vera, Carboxyl Methylcellulose, Shellac), Guar gum was found to be more beneficial as compared to other edible coatings throughout storage period. The application of edible coating (Guar gum) has proved to be best post-harvest application storage of guava cv. Allahabad Safeda from the point of fruit size (length & diameter), fruit volume (ml), specific gravity, PLW (%), decay loss (%) and shelf-life of fruit. The effect of surface coatings revealed that the post-harvest application of guar gum (2%) were found to be superior over other treatments with respect to physical, shelf life and quality parameters at ambient conditions resulting in prolonging the shelf-life of guava fruit cv. Allahabad Safeda. The Post-harvest quality conservation of guava is still a challenge in the production chain due to reduced post-harvest life attributed to its high respiratory rate, ethylene peak, fast loss of firmness and incidence off-decay during storage.

Keywords: Fruit volume, specific gravity, Aloe vera coating, Carboxyl methylcellulose, Shellac, Guar gum, shelf life.

INTRODUCTION

Guava (*Psidium guajava* L.) is one of the predominant fruit crop in tropical and subtropical tracts of the world and claims superiority over different fruits by virtue of its commercial and nutritional values. It is also known as "The Apple of Tropics". Botanically, it belongs to the family Myrtaceae which comprises at least 150 genera and more than 5,650 species. It occupies fourth position in terms of area 2.65 lakh ha and production 40.54 lakh MT after mango, banana and citrus. The guava fruit is an excellent source of ascorbic acid but with poor calorific value (66 cal/100 g), protein content (1%), dry matter (17%) and moisture (83%). The fruit is also rich in minerals like phosphorus (2337 mg/100 g), calcium (14-30 mg/100 g), iron (0.6-1.4 mg/100 g) as well as vitamins like niacin, pantothenic acid, thiamine, riboflavin and vitamin A. Edible coatings have high potential to carry active ingredients such as anti-browning agents, colorants, flavours, nutrients, spices and antimicrobial compounds that can extend product shelf-life and reduces the risk of pathogen growth on fruit surfaces (Pranoto *et al*., 2015). There has been increasing interest for the use of Aloe vera gel as an edible coating material for fruits and vegetables driven by its antifungal activity (Jasso Rodriguez de *et al*., 2005). The positive effect of this edible coatings is based on their hygroscopic properties, which enables formation of O_2 and CO_2 by creating modified atmosphere (MA) and acting as moisture barrier between the fruit and the environment and thus reduced weight loss, browning, softening and growth of yeast and molds (Morillon *et al*., 2002). Shellac resin is secreted by the insect *Laccifer lacca* found in India. Shellac is composed of aleuritic and shelloic acids is

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Effect of Different Levels of Residue Retention on Soil Physico-Chemical and Biological Properties at different Stages of Soybean Crop after Harvest under Conservation Agriculture

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ABSTRACT: Adopting conservation agriculture with crop residue retention can enhance crop productivity, soil health and overall sustainability of soybean-wheat cropping system. Benefits of CA with crop residue application vary from location to location depending on management practices, agro-climatic condition and type of soil. However the effect of different levels of residue retention on soil properties and crop productivity in black soil of M.P. in soybean cropping system under conservation agriculture practices need to be studied. Keeping the above facts in view, a study was conducted during 2018-19 at ICAR- IISS, Bhopal and under this a experiment was carried out in randomized block design with four residue levels as treatments and six replications under soybean cropping system. So, the finding of the study indicate that Retention of 90% residue level in treatment T4 recorded significantly higher soil moisture content on dry weight and volume at 0-5 cm and 5-10 cm. With increase in levels of residues in soil after harvest of soybean crops OC of the soils under different treatments increased significantly. The highest SOC was recorded under treatment T4 (1.13%). Retention of different levels of residue significantly increased the soil available N, P & K status after harvest of soybean crops. Different residues level had significant effect on DHA. DHA, which indicates the microbial activity, was found to be increased with increasing levels of crop residues retention after harvest soybean crop.

Keywords: Soil, Residue, Retention, Under, Level, Soybean, Crop.

INTRODUCTION

Conservation Agriculture (CA) is a modern crop management technology being practiced over 155 m ha globally (FAO, 2015) and Vertisols in India occupy a total area of 70.3 m ha, constituting 22% of the total geographical area of the country of which 30.2% are in Madhya Pradesh (central India) (Kushwah *et al*., 2016). Improving soil health and conserving resources along with sustaining and improving crop yield is a challenging task in black soil. In this regard, conservation agriculture could be one of the potential practices for conserving soil and water, apart from other soil health benefits in black soil (Salem *et al*., 2015).

Conservation agriculture can be an important component for the overall strategy towards enhancing productivity, improving environmental quality and preserving natural resources for food security and poverty alleviation. Tillage is one of the fundamental operations in agriculture because of its significant influence on soil properties, clearing weeds, environment and crop growth. Since continuous tillage strongly influence the soil properties which results in degradation of soil and loss of soil OC, it is important to adopt appropriate tillage practices to avoid degradation of soil structure, maintain crop yield as well as ecosystem stability (Karunakaran and Behera 2015). For instance, soil organic carbon (SOC) generally seems to slightly increase if residues are returned to the soil, particularly in the long term (Chenu *et al*., 2014; Autret *et al*., 2016; Merante *et al*., 2017). However, the actual quantification of straw

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Dissection of genetic variability, correlation of seed yield and yield contributing traits in chickpea (*Cicer arietinum* L.) in different temperature conditions

Shivangi Tare, Mohammad Yasin, RS Sikarwar, Pooja Puri and Vaqar Malik

Abstract
The present experiment was conducted at research farm of All India Coordinated Research Project on Chickpea, R.A.K., College of Agriculture, Sehore (M.P.). The experimental material consisted of 28 diverse genotypes including 19 desi and 9 kabuli genotypes of chickpea laid out in Randomized Complete Block Design with two replications, were tested in consecutively two year under different sowing condition to provide optimum, normal and high stress conditions to the genotypes and genetic parameters, correlations observed. The analysis of variance is clearly indicating the impact of environment, G×E interactions observed significant for all traits. All the traits affected severely under stressful condition, because of high temperature. The days to flower initiation reduced by 5 days, days to 50% flowering reduced by 3 days, Days to pod initiation reduced by 17 days, plant height reduced by 17(cm), Days to maturity reduced by 23 days, number of pods per plant reduced by 33, number of empty pods per plant reduced by 1.15, number of seeds per plant reduced by 20.68, biological yield per plant reduced by 9.91(g), harvest index reduced by 6.91, hundred seed weight reduced by 4.78 (g), and seed yield per plant reduced by 5.06 (g) in normal to stress condition. PCV and GCV and heritability was almost high everywhere. The seed yield per plant was noticed significant and positively associated with number of pods per plant, number of seeds per plant, biological yield per plant, harvest index, hundred seed weight and pollen fertility while its significant and negatively correlated with days to flower initiation, days to 50% flowering, days to pod initiation in all the environmental conditions. For increasing seed yield due importance should be put on number of pods per plant, number of seeds per plant, biological yield per plant, harvest index, hundred seed weight and pollen fertility.

Keywords: Chickpea, correlation, heritability, genetic advance, seed yield

Introduction
Chickpea (*Cicer arietinum* L.) is one of the earliest cultivated legumes, also known as Gram or Bengal gram or garbanzo bean. These are originally found in Mediterranean and Middle East region about 7500 years ago and now it is one of the most important legume crops widely growing all over the world ranking third in production among the pulses. The name chickpea is derived from the French word "chiche" and the genus "cicer" which is Latin of chickpea. Chickpea is well adapted within temperature range of 30- 15 °C (day maximum and night minimum) for growth and pod filling, (Basu *et al*. 2011) [1]. A temperature of 35°C was found to be critical in differentiating heat tolerant and sensitive genotypes in chickpea under field conditions (Gaur *et al*. 2013) [4]. Hence, the present study was attempted to explicate the genetic variation, association studies between yield and yield contributing traits chickpea over three different sowing conditions (optimum, medium, vary late) with two seasonal conditions.

Materials and Methods
The present experiment was conducted in the experimental site of All India Coordinated Research Project on Chickpea at R.A.K., College of Agriculture, Sehore (M.P.) during Rabi 2020-21 and 2021-2022. The experimental material consisted of 28 genotypes including 19 desi and 9 kabuli genotypes of chickpea laid out in Randomized Complete Block Design with two replications. All recommended package of practices was followed during the cropping period to raise a good crop.

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Assessment of Genetic Variability in Physiological Traits on Chickpea in Three Sown Environments

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Original Research Article

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ABSTRACT

The present studies were conducted to the estimation of genetic variability and heritability for physiological traits in chickpea (*Cicer arietinum* L.) under Randomized Completely Block design with two replications in the field of the department of Plant Breeding and Genetics, of RAK College of Agriculture, Sehore (MP), during the crop season 2019- 2020. The high heritability were observed

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Article

Comparison between DTPA Extracting Methods for Available Zinc with Multinutrient Extractants in Vertisols and Inceptisols

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Abstract

Aims: To evaluate relationships between some universal soil extractants and legacy methods. Place and Duration of Study: The study was carried out at IISS, Bhopal. Methodology: Samples were analyzed by different methods being related; e.g. GLOSOLAN/international method or rapid methods/universal extractant and legacy methods. Measured data was obtained under the best achievable laboratory quality control conditions, for maximal transfer function reliability with the lowest RMSE (Root Mean Square Error). Out of the 60 samples in each category, a representative set (80% of the samples) was used (e.g. by linear regression analysis) for the development of the transfer function and the rest 20% of the samples were retained for validation of transfer functions. Residuals (differences) between measured and estimated soil property values were calculated. The correlation and RMSE (Root Mean Square Error) were calculated for the validation data set. Results: The Zinc extractable DTPA and Mehlich-3 had a regression coefficient of R2= 0.92. while the extracted with AB DTPA had the regression coefficient of R2= 0.72 with DTPA, with extraction in the order of Mehlich3> AB DTPA> DTPA. Hence, Mehlich-3 and AB-DTPA both extractants can replace DTPA extractants for the determination of available micronutrients in soils in Vertisols. Conclusion: In conclusion, different regression equations are developed between the various methods of analysis that must be used to compare the results obtained from different extraction methods.

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Effect of gamma irradiation on growth and corm yield of gladiolus (*Gladiolus grandiflorus*) varieties

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Keywords: Corm yield, Gamma irradiation, Gladiolus varieties

The interaction between humans and flowers has unique features. India's flower scene has changed significantly, with a substantial portion of agricultural output dedicated to floriculture. This significantly contributes to India's GDP. Gladiolus (*Gladiolus grandiflorus* Andrews), a notable member of the Iridaceae plant family, is nicknamed the Queen of Bulb Flowers. It's immensely popular as an ornamental plant in India and globally, thanks to its captivating flowers. With rising demand, there's a push to improve Gladiolus genetics. Successful cultivation relies on wisely choosing suitable varieties. Incorporating new genetic material requires evaluation to match specific regions. Mutations are a potent method for creating new Gladiolus types. Techniques involving chemicals and radiation have produced innovative varieties. Despite research, only a few types have emerged through radiation-induced mutations. Considering this, a year-long study evaluated Gladiolus growth and corm-related traits.

An empirical study was carried out during November 2022 to April 2023 at the K.N.K. College of Horticulture, Mandsaur (23.45° to 24.13° North and 74.44° to 75.18° East with elevation of 435.02 m above the mean sea level). This region falls under Agro climatic zone number 11 of the state. Soil in the field experimentation had a texture of clay loam (47.0% sand, 24.0 silt and 29.0% clay. The soil of experimental trail was low in available nitrogen (154 kg/ha), medium in phosphorus (18.5 kg/ha) and (293 kg/ha). Reaction of soil is slightly alkaline (*p*H 7.24). The experiment was carried out in Factorial Randomized Block Design with three replications. In this experiment 4 varieties [Arka Aayush (V_1); Arka Pratham (V_2); Arka Kesar (V_3); Arka Tilak (V_4)] were taken to expose the 5 doses of gamma radiation [0.0 kr (G_1); 1.25 kr (G_2); 2.25 kr (G_3); 3.25 kr (G_4); 4.25 kr (G_5)]. Different gamma doses were administered to corms of each variety. Gladiolus corms left untreated served as the control. Treated and untreated corms of each variety were planted in the beds for comparison.

Growth parameters: The results of our study revealed significant variation among the four gladiolus varieties concerning all the growth parameters assessed (Table 1). Notably, Arka Kesar stood out by displaying the highest values for plant height, length of longest leaf, and the width of longest leaf at both the 30 and 60 days after planting (DAP), surpassing the other varieties (Arka Aayush, Arka Pratham and Arka Tilak). These variations in plant height among the varieties could potentially be attributed to a combination of factors, including substantial genetic diversity within the gladiolus species and the influence of environmental conditions on their growth. Similarly, the discrepancies in the length of the longest leaf may result from both phenotypic differences and underlying genetic variances, which could interact with environmental factors. Our findings are consistent with previous research by Chourasia *et al.* (2015), Kaur and Bajpay (2019), Safeena and Thangam (2019), Chandramouli (2020), and Shyla and Kumar (2021) in the field of gladiolus cultivation, providing further support for the validity of our results. Arka Tilak variety displayed the highest number of leaves per plant at both 30 and 60 days after planting (DAP) (Table 1). This variation in leaf count might be attributed to the accumulation of distinct nutritional reserves in the mother corms of specific gladiolus varieties. This observation aligns with the findings of Pandey *et al.* (2012) and Chourasia *et al*. (2015) in the context of gladiolus cultivation, further underscoring the importance of genetic factors and environmental influences in shaping these growth characteristics. The differences in leaf count among the varieties may be linked to their unique genetic compositions, as well as the specific environmental conditions in which they were cultivated. Importantly, our results are in line with similar studies conducted by Mahawer *et al*. (2013), Naresh *et al*. (2015), Mushtaq *et al*. (2018), Safeena and Thangam (2019) and Sathyanarayana *et al.*

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EFFECTS OF PRUNING INTENSITY AND PLANT GROWTH REGULATORS ON GROWTH, YIELD AND QUALITY OF GUAVA (*PSIDIUM GUAJAVA* L.) CV. SARDAR

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Keywords: Guava, Pruning intensity, Plant growth regulators, Growth, Yield

Abstract

Effects of pruning intensity and spray of plant growth regulators (PGR) on dfferent parameters of Guava (*Psidium Guajava* L.) Sardar were investigated. Growth, quality and yield attributing characters were improved at 30 cm pruning intensity. With respect to effect of plant growth regulators, application of 600 ppm NAA improved all the characters except minimum number of days taken to flower initiation (39.47), acidity (0.33 %), TSS (12.11 ^{o}Brix) and total sugars (6.79 %) which were recorded in 600 ppm ethephon. The interaction studied showed that P_3G_2 (30 cm pruning + 600 ppm NAA) had recorded the highest value with growth, yield and quality, while the combination of P_3G_3 (30 cm pruning + 600 ppm ethephon) was good for qualitative parameters.

Introduction

Guava (*Psidium guajava* L.) is one of the most popular fruit grown in tropical and subtropical regions of India. It is the fourth most important fruit crop in area and production after mango, banana and citrus. Guava bears on current season's growth and flowers appear in the axils of new leaves and so it responds well to pruning. Pruning is usually practiced in the summer (April – May) before flower initiation. Whenever pruning has been attempted in guava, there has been a vast improvement in yield and fruit quality, especially with light pruning (Bajpai *et al*. 1973). Use of plant growth regulators has assumed an integral part of modern crop husbandry for increasing production of quality fruits. They are readily absorbed and move rapidly through the tissues, when applied to different plant parts. Thus, the plant growth regulators like NAA, NAD, 2,4-D carbaryl and ethrel were found successful in reducing the rainy season and increasing the winter season crop under different agro-climatic conditions (Chundawat *et al*. 1975). Whereas, ethephon acts as a ripening hormone and enhances the ripening process and thus helps in improving the fruit quality. In view of the above facts, it becomes quite clear that shoot pruning and applications of plant growth regulators are very useful not only for increasing the yield, but also to improve the quality of fruits. Hence in the present study attempts were taken to study the effects of pruning intensity and plant growth regulators on growth, yield and quality of guava (*Psidium Guajava* L.) Cv. Sardar

Materials and Methods

The present investigations were carried out on ten years old tree of uniform size at the *Instructional Cum Fruit Research Orchard*, Department of Fruit Science, RVSKVV, College of Horticulture, Mandsaur Madhya Pradesh India during the year 2016-2017. There were four levels of pruning intensity, namely P_0 (control unpruned plants), P_1 (10 cm pruning), P_2 (20 cm pruning) and P_3 (30 cm pruning). Regarding plant growth regulator treatments different concentrations, i.e.

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Effect of Indole-3-Butyric Acid (IBA) on Hardwood Cutting of Grapes (*Vitis vinifera* L.) cv. Pusa Navrang

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Original Research Article

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ABSTRACT

Aims: The study aims to investigate the influence of different IBA concentration on the rooting and subsequent growth of hardwood cuttings of "Pusa Navrang" grapevine.
Study Design: The study was performed in RBD design with replicate 5 times.
Place and Duration of Study: The study was conducted at Research Farm, College of Horticulture, Mandsaur, during the period November 2020- March 21.
Methodology: Polybags size of 5 X 7 inch was used for experiment. After the filling of growing media in poly bags, the hard wood cuttings of Pusa Navrang with uniform size having 4-5 functional bud was taken from one year matured canes from research farm, College of Horticulture,

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Effect of Different Growing Media on Hardwood Cutting of Grapes (*Vitis vinifera* L.) cv. Pusa Navrang

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Aims: The study the influence of different growing media on the rooting and subsequent growth of hardwood cuttings of the "Pusa Navrang" grapevine**.**
Study Design: Randomized block design were used.
Place and Duration of Study: Conducted at Research Farm, College of Horticulture, Mandsaur, during the period November 2020- March 21.
Methodology: Filling of Poly Bags: Before the cutting planting the 5 X 7-inch poly bags will be filled with different growing media. Three hundred sixty (360) poly bags of each growing media should be filled i.e., 360 bags of Soil, 360 bags of Soil + Sand (1:1 ratio), 360 bags of soil + sand +

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Response of Varieties and Role of Bio-fertilizer on Morphology and Growth of Isabgol (*Plantago ovate* Forsk.)

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Abstract

An experiment was carried out at College of Horticulture, RVSKVV, Mandsaur (M.P.) during the rabi season 2020-21 in factorial randomized block design with three replications with four varieties viz; Gujarat Isabgol-1, Gujarat Isabgol-2, Vallabh Isabgol-1 and Jawahar Isabgol-4 as main plot with two biofertilizer (B_1 - *Azotobacter* @5 kg ha^{-1} and B_2 - PSB @3 kg ha^{-1}) as sub plot and one untreated control (B_0 - control) on isabgol. Results revealed that the maximum plant height (7.91, 22.04, 36.48 and 36.72), number of leaves (11.53, 35.42, 100.57 and 102.11), number of tillers (5.22, 14.00 and 14.24), number of spike (13.27, 22.08 and 22.66), length of spike (3.02, 5.01 and 5.10), fresh weight (2.58, 26.67, 60.36 and 60.76), dry weight (0.85, 7.61, 17.09 and 17.19) and seed yield (412.26) were found in V_4 - JI-4. However, the maximum plant height (7.78, 21.78, 31.48 and 31.68 cm), number of leaves (10.67, 33.08, 87.66 and 88.40), number of tillers (4.70, 13.12 and 13.46), number of spike (10.98, 19.19 and 19.58), length of spike (2.40, 4.28 and 4.35 cm), fresh weight (2.38, 22.00, 53.76 and 54.01), dry weight (0.78, 6.25, 15.13 and 15.19) and seed yield (342.69) were recorded in B_1 - *Azotobacter*. Moreover, the highest plant height (8.29, 22.78, 39.37 and 39.62 cm), number of leaves (12.13, 37.40, 108.91 and 110.29), number of tillers (5.67, 14.91 and 15.25), number of spike (15.13, 23.81 and 24.50), length of spike (3.55, 5.30 and 5.38 cm), fresh weight of plant (2.71, 31.07, 65.55 and 65.82), dry weight of plant (0.90, 8.35, 18.39 and 18.46 g) and seed yield (459.00) in JI 4 x *Azotobecter* at different plant growth stages.

Key words : Varieties, Biofertilizers, Dry matter, Yield and Isabgol.

Isabgol (*Plantago ovate* Forsk.) word is derived from Isap and ghol, which mean horse ear, due to the shape of the seeds and is a plant of the Plantaginaceae family. It is a sub-caulescent softy hairy or woolly annual herb with short stems and take a height of 28-40 cm. It has a diversity of leaves, flowers are small and white, and the seeds are ovate and small with brown grey in color, and protected by a translucent membrane called husk (Tyagi *et al*., 2016). Constipation and gastrointestinal are treated with the swelling property of the husk (Salimath *et al*., 2019). India is the world's largest producer and exporter of seeds and husk. It is grown commercially in Madhya Pradesh, Gujarat, and Rajasthan states of county. It is primarily grown in the districts of Neemuch and Mandsaur in State. In Madhya Pradesh 15.209 T. ha, 16.663 TMT and 10.9 q. ha^{-1}, besides in India 351.536 T. ha, 333.681 TMT, and 9.50 q. ha^{-1} area, production and productivity respectively (Hapis, 2019).

There are a range of microbial inoculants that are used as bio-fertilizers nowadays, which have received much attention and they are favourable to plant development and yield. Through biological processes, bio-fertilizers can move nutritive ingredients from an unusable state to a usable state. The dose of chemical fertilizers is minimized by using vermicompost and biofertilizers, which may reduce the cost of cultivation along with the increased yield (Upadhyay *et al*. 2018).

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Response of recommended dose of fertilizers with organic manures on growth, yield and economics of kalmegh (*Andrographis paniculata* Nees.): A way to reduced use of chemical Fertilizers

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Abstract
Background: Integrated application of nutrients is an important issue among the formers for obtaining higher growth and yield of kalmegh. Nutrients must be accessible at right time, proportion and quantity.
Aim and Objective: To fulfill these necessities, chemical fertilizers and organic manures are required in integrated manner. Chemical fertilizers have ensured readily availability of particular nutrient for initial but organic sources release slow and long term availability of many nutrients and they improved the efficacy and reduced the quantity of chemical fertilizers.
Materials and Methods: Therefore, fields study was taken up to bridge the gap at department of Plantation, Spices, Medicinal and Aromatic Crops, College of Horticulture, RVSKVV, Mandsaur, (M.P.) during the *Kharif* season 2021-22 in RBD Design with three replications. The treatments accompanied with RDF NPK @ 50:30:30 kg ha^{-1}, FYM @ 7.5 & 15 T ha^{-1} and vermicompost @ 0.5 & 1.0 T ha^{-1} along with a control plot without any supplements.
Results: The result indicated that, the significant maximum plant height, number of branches, number of leaves, leaf area, leaf area index, relative growth rate, crop growth rate, biomass production at different growth stages and number of seeds per pod, pod length, pod dry weight, harvest index, dry herbage yield, seed yield, cost of cultivation, gross return, net return and benefit: cost ratio were observed in treatment T_8-100% RDF+100% FYM+100% vermicompost.
Conclusion: The treatment T_8-100% RDF @ 50:30:30 kg ha^{-1}+100% FYM @ 15 t ha^{-1}+100% vermicompost @ 1 t ha^{-1} is found to be the best for achieving the highest growth and yield of kalmegh.

Keywords: *Andrographis paniculata*, dry matter yield, growth, organic manures and RDF

1. Introduction
Kalmegh is a member of family Acanthaceae and a powerful medicinal herb used in Ayurveda, Siddha and Unani (Sharma *et al*., 2013) [1], generally known as "King of Bitter" (Naleena *et al*., 2019) [2]. It is having a preventive result from various diseases, because of its powerful immune strengthening benefits. The whole plant is used to cure snake bite, dried leaf against high blood pressure, gastric and liver tonic. It's have good "blood purifying" activity so, it is recommended for gonorrhea, leprosy, boils, skin eruptions, scabies, and chronic and seasonal fevers (Shwetha *et al*., 2021) [3]. It is take the height of 30-80 cm under suitable environments, leaves are 2.5 cm wide and 7.5 cm long, and flower is zygomorphic, complete and bisexual. The stem is quadrangular with more branches (Srivastava, 2017) [4]. Its fruit is linear, oblong and acute at both the ends and called as capsule with slight, yellowish brown colour seed. Plants are shows non synchronous maturity and diffused seeds frequently through capsule dehiscence (Shakywa *et al*., 2022) [5]. The key active ingredients of kalmegh are di-terepene lactones, andrographolide, andrographiside, neo andrographo-lide and flavones (Sharma *et al*., 2013) [1]. Kalmegh is natural grown in India and Sri Lanka and it is spread all over Thailand, Peninsular Malaysia to Indonesia. In India it is cultivated in the state of Madhya Pradesh, Odisha, Chhattisgarh, Assam, Maharashtra, Uttar Pradesh, Bihar, West Bengal, Tamil Nadu and Kerala. All the fertilizers in the forms of chemical source of nutrients have ensured readily availability of particular nutrient for initial requirement of plants but through organic sources they release slow and long term availability of many nutrients Naleena *et al*. (2019) [2]. For vigorous growth and higher yield, nutrients must be accessible to plants at right time, proportion and quantity.

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Performance of Cowpea *(Vigna unguiculata* L.) Varieties for Flowering and Seed Quality Under Integrated Nutrient Management Practices

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ABSTRACT

A field experiment was conducted during *rabi* season, 2015-16 at Department of Vegetable Science, College of Horticulture, Mandsaur (Madhya Pradesh) to evaluate the cowpea varieties to integrated nutrient management practices. The experiment was arranged in factorial Randomized Block Design with twenty treatment combinations comprising four cowpea varieties, viz. V_1-Pusa Sukomal, V_2-Kashi Unnati, V_3-Kashi Kanchan and V_4-Kashi Shyamal and five integrated nutrient management (INM) practices, viz. N_1-Vermicompost 2.5 t + *Rhizobium* (10 g/kg of seeds) + PSB (10 g/kg of seeds) + N (0 kg) + P_2O_5 (90 kg) + K_2O (70 kg)/ha, N_2-Vermicompost 2.5 t + *Rhizobium* (10 g/kg of seeds) + PSB (10 g/kg of seeds) + N (15 kg) + P_2O_5 (90 kg) + K_2O (70 kg)/ha; N_3-Vermicompost 2.5 t + *Rhizobium* (10 g/kg of seeds) + PSB (10 g/kg of seeds) + N (20 kg) + P_2O_5 (90 kg) + K_2O (70 kg)/ha, N_4-Vermicompost 2.5 t + *Rhizobium* (10 g/kg of seeds) + PSB (10 g/kg of seeds) + N (25 kg) + P_2O_5 (90 kg) + K_2O (70 kg)/ha and N_5-Vermicompost 2.5 t + *Rhizobium* (10 g/kg of seeds) + PSB (10 g/kg of seeds) + N (30 kg) + P_2O_5 (90 kg) + K_2O (70 kg)/ha. In present experiment the cowpea variety Pusa Sukomal recorded superior performance for flowering and quality attributes. This variety had taken minimum days to first flowering, days to 50% flowering and days to harvesting. The study revealed that the application of Vermicompost 2.5 t + *Rhizobium* (10 g/kg of seeds) + PSB (10 g/kg of seeds) + N (30 kg) + P_2O_5 (90 kg) + K_2O (70 kg)/haproved significantly superior over rest of treatment combinations and provided significantly higher test weight (16.44 g), germination percentage (95.83) and crude protein content (25.76%) in cowpea seed.

Keywords Cowpea, Vermicompost, Seed quality, Biofertilizer, Quality attributes.

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INTRODUCTION

Cowpea (*Vigna unguiculata* L.) belongs to the family Leguminoceae and having chromosome number 2n=22 with genus *Vigna*. It is originated from Central Africa and mainly cultivated in Asia, Africa, Central and South America. Leguminous crops play an im-

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Influence of varieties and fertilizer doses on growth, yield, quality and profitability of carrot (*Daucus carota* L.)

Pushpa Choudhary, RK Sharma, SS Kushwah, R Gallani, GPS Rathore and KK Tarak

Abstract
A field experiment was conducted during *Rabi* season, 2021-22 Experimental Farm of the Department of Vegetable Science, College of Horticulture, Mandsaur (M.P.) The experiment comprised of two carrot varieties (V_1- Pusa Rudhira and V_2 - Pusa Kesar) and five fertility levels (F_0 – 0 kg/ha, F_1 – NPK 40:30:30 kg/ha, F_2 – NPK 60:40:40 kg/ha, F_3 -NPK 80:50:50 kg/ha, F_4 – NPK 100:60:60 kg/ha). All together 10 treatment combinations were laid out in Factorial Randomized Block Design with three replications. Variety V_1- (Pusa Rudhira) exhibited maximum plant height (37.35 cm), number of leaves per plant (13.99), fresh weight of plant (257.31 g) and dry weight of plant (21.54 g). Earliest days to harvest (96.13), root length (27.88 cm), root diameter (3.94 cm), fresh weight of root (94.12 g), and root yield per hactare (313.74 q/ha), were observed with variety V_1 (Pusa Rudhira). Under quality parameters highest fiber content (964.41 mg/100 g), specific gravity (1.04 g/cc) and T.S.S. (8.74 ^{0}Brix) in root were also found in case of variety V_1 (Pusa Rudhira). Among fertility levels, application of F_3 (NPK 80:50:50 kg/ha) showed maximum growth, yield and quality parameters with all the two varieties of carrot. The net income and B:C ratio i. e. 105886.85 and 2.07 was found to be superior with variety V_1 (Pusa Rudhira) and fertility level F_3 (NPK 80:50:50 kg/ha).

Keywords: Carrot, fertility levels, NPK, yield, fiber content, TSS, B:C ratio

Introduction
The carrot (*Daucus carota* L.) is originated in Asia. Carrot belongs to the family Umbelliferae, genus Daucus and species carota with chromosome no 2 n = 18. The carrot is an annual for root production and biennial for seed production. The inflorescence of carrot is 'Compound Umbel' and the edible part of carrot is modified root (Conical form) which develops in soil (Pal *et al*., 2019) [19].

Nutrient composition of carrot root is moisture 86 %, protein 0.9 g, carbohydrate 10.6 g, fat 0.2 g, fiber 1.2 g, energy 48 kilo calorie, mineral 1.1 g, iron 2.2 mg, carotene 1890 mg, thiamine 0.04 mg, riboflavin 0.02 mg, niacin 0.5 mg, vitamin-C 3 mg, folic acid 15 mg, calcium 80 mg and phosphorus 30 mg per 100 g of edible portion (Bose *et al*., 2003) [3]. Carrot is one of the important and major root vegetable used as salad and cooked vegetable, canned pickles, preserves, sweets (especially Gajar halwa), carrot powders, kanji an appetizing drink *etc*. Besides being food, carrot has therapeutic importance as it enhances resistance against blood and eye diseases (Kumawat *et al*., 2018) [13].

A number of factors are responsible for successful cultivation of high quality roots, among these the judicious application of fertilizers is one of the important factors. Fertilization plays an important role in crop production because it affects crop quantity and quality, as well as physical, biological, and physiochemical properties of soil, and the quality of ground and surface water, as well as the air. From the producer's point of view, fertilization is an important factor impacting production costs (Sikora *et al*., 2020) [25].

Nitrogen is one of the most important yield-limiting nutrients for plants. Nitrate accumulation is affected not only by the type of nitrate fertilizer used, but also by nitrogen rates, variety, environment, harvesting date and other agronomical factors (Boskovic-Rakocevic *et al*., 2012) [4]. Phosphorus helps in nutrients uptake by promoting root growth and thereby increases in total dry matter. The phosphorus requirements vary depending upon the nutrient content of the soil. Phosphorus deficiency results in poor root development and subsequently reduces yield (Nahar *et al*., 2014) [16].

Potassium is necessary for the translocation of sugars and formation of carbohydrates. Potassium also provides resistance against pest and diseases and drought as well as frost stresses.

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Effect of varieties and nutrient levels on growth, quality and nutrient uptake of palak (*Beta vulgaris* var. Bengalensis)

Ilal Khedkar, RK Sharma, SS Kushwah and Roshan Gallani

Abstract
The present investigation entitled "Effect of varieties and nutrient levels on growth, quality and nutrient uptake of palak (*Beta vulgaris* var. bengalensis)" was conducted at Vegetable Research Field, College of Horticulture, Mandsaur (M.P.) during *Rabi* season, 2019-20 with two varieties V_1 (Pusa Bharati), V_2 (All Green) and 6 different nutrient levels (N_1- 00:00:00 NPK kg/ha, N_2- 40:30:20 NPK kg/ha, N_3- 60:40:30 NPK kg/ha, N_4- 80:50:40 NPK kg/ha, N_5- 100:60:50 NPK kg/ha and N_6 - 120:70:60 NPK kg/ha) with three replications. The experiment was laid out in a factorial randomized block design. Data from experiment revealed that among varieties V_1 (Pusa Bharati) found better for growth, quality and nutrient uptake of palak and recorded maximum fresh weight of plant (21.96 g, 22.80 g and 24.11 g) and maximum dry weight of plant (3.68 g, 3.89 g and 3.99 g) at 1st, 2nd and 3rd cuttings, respectively, maximum TSS content (7.70 °Brix), maximum iron content of leaf (13.36 mg/100 g) and maximum N (2.919%), P (0.703%) and K (3.208%) content in plant at harvest. While, maximum leaf moisture content i.e. 84.48%, 84.78% and 84.90%, was recorded at 1st, 2nd and 3rd cuttings, respectively, maximum nitrogen (209.40 kg/ha), phosphorus content in soil (16.34 kg/ha) and potassium (412.36 kg/ha) content in soil after harvest recorded in variety V_2 (All Green). Among nutrient levels, N_6 (120:70:60 NPK kg/ha) was recorded maximum fresh weight of plant (24.67 g, 24.68 g and 27.06 g), maximum dry weight of plant (4.70 g, 5.11 g and 5.20 g) at 1st, 2nd and 3rd cuttings, respectively, maximum TSS content (8.16 °Brix), maximum iron content of leaf (14.90 mg/100 g) and maximum N (3.122%), P (0.862%) and K (3.743%) content in plant at harvest. The maximum nitrogen (216.05 kg/ha), phosphorus content in soil (20.23 kg/ha) and potassium (418.42 kg/ha) content in soil after harvest was found with N_6 (120:70:60 NPK kg/ha).

Keywords: All green, growth, NPK, TSS, nutrient uptake, palak, Pusa Bharati, iron content

Introduction
Palak, scientifically known as *Beta Vulgaris*, is a leafy green vegetable renowned for its nutritional value and culinary versatility. This versatile leafy vegetable is rich in vitamins, minerals, antioxidants, and dietary fiber, making it a vital component of a balanced diet. The demand for palak has been steadily rising due to its perceived health benefits and its incorporation into various cuisines worldwide. However, to meet this escalating demand and ensure a consistent supply of high-quality palak, it is imperative to optimize the cultivation practices, particularly in terms of nutrient management (Bose *et al*., 2003) [5].

On an average it's leaves contain moisture 86.49%, fiber 0.7 g, protein 3.4 g, minerals 2.2 g, carbohydrates 6.5 g, riboflavin 0.5 g, calcium 380 mg, iron 16.2 mg, thiamin 0.26 g, Vitamin-A 9770 IU, Vitamin-C 70 mg/100 g of edible portion (Vishnu Swarup, 2014) [19].

Fertilizer management has considerable practical importance for obtaining high yield with good quality. Nitrogen (N), Phosphorous (P) and Potassium (K) are essential major elements for all life processes in plants. They are important components (N and P) for different essential organic compounds such as nucleic acids, amino acids, proteins, enzymes, vitamins and biochemical process that comprise the several stages of the plant growth and development (El-Saady, 2016) [6]. Potassium also plays a vital role in plant-water relations regulating many plant metabolic processes through its important role in the activation of necessary enzyme reactions and amelioration of quality parameters through speeding of the translocation assimilates and other solutes from plant leaves to edible plant parts (El-Saady, 2016) [6]. Keeping the above facts in view, the present investigation was undertaken to ascertain the optimum nutrient level for production of palak.

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Influence of Varieties and Nutrient Levels on Growth, Yield and Profitability of Palak (*Beta vulgaris* var. Bengalensis)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

A field experiment was conducted at the Department of Vegetable Science, College of Horticulture, Mandsaur (M.P.) during Rabi season of year 2019-20 to study the "Influence of varieties and nutrient levels on growth, yield and profitability of palak (*Beta vulgaris* var. bengalensis)". The experiment comprised of two varieties V_1 (Pusa Bharati), V_2 (All Green) and 6 different nutrient levels (N_1- 00:00:00 NPK kg/ha, N_2- 40:30:20 NPK kg/ha, N_3- 60:40:30 NPK kg/ha, N_4- 80:50:40 NPK kg/ha, N_5- 100:60:50 NPK kg/ha and N_6- 120:70:60 NPK kg/ha). The experiment was laid out in a factorial randomized block design with three replications. The variety Pusa Bharati was found significantly better plant height (26.87 cm, 31.88 cm and 32.12 cm), maximum number of leaves per plant (8.18, 13.70 and 14.02), maximum leaf area (31.28 cm^2, 76.53 cm^2 and 79.88 cm^2), maximum fresh green yield per plant (19.12 g, 20.64 g and 21.79 g), maximum fresh green yield per hectare

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ABSTRACT

A field experiment was conducted at the Department of Vegetable Science, College of Horticulture, Mandsaur (M.P.) during Rabi season of year 2019-20 to study the "Influence of varieties and nutrient levels on growth, yield and profitability of palak (*Beta vulgaris* var. bengalensis)". The experiment comprised of two varieties V_1 (Pusa Bharati), V_2 (All Green) and 6 different nutrient levels (N_1- 00:00:00 NPK kg/ha, N_2- 40:30:20 NPK kg/ha, N_3- 60:40:30 NPK kg/ha, N_4- 80:50:40 NPK kg/ha, N_5- 100:60:50 NPK kg/ha and N_6- 120:70:60 NPK kg/ha). The experiment was laid out in a factorial randomized block design with three replications. The variety Pusa Bharati was found significantly better plant height (26.87 cm, 31.88 cm and 32.12 cm), maximum number of leaves per plant (8.18, 13.70 and 14.02), maximum leaf area (31.28 cm^2, 76.53 cm^2 and 79.88 cm^2), maximum fresh green yield per plant (19.12 g, 20.64 g and 21.79 g), maximum fresh green yield per hectare

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Effect of Soil Propagation Media and Bio-fertilizers on Seedling Germination and Seedling Vigour in Aonla (*Emblica officinalis* Gaertn.)

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ABSTRACT

Aims/ Objectives: Effect of soil propagation media and bio-fertilizers on seedling germination and seedling vigour in Aonla.
Study Design: Completely Randomized Block Design.

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Performance of standard chrysanthemum cultivars (*Dendranthema grandiflora* Tzvelev.) for flowering parameters under Malwa region of Madhya Pradesh

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ABSTRACT

The present investigation was conducted during August to December 2019 in the shade net house of Department of Floriculture and Landscape Architecture, K.N.K. College of Horticulture, Mandsaur, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior (M.P.). The experiment was laid out in a Completely Randomized Design (CRD) with three replications and eight cultivars namely 'Coffee' (C_1), 'Hybrid-1' (C_2), 'Hybrid-2' (C_3), 'Mountaineer' (C_4), 'Star Whiter' (C_5), 'Star Yellow' (C_6), 'Tata Century' (C_7) and 'Thai Chen Queen' (C_8). The pots were filled with the medium (Soil: Sand: FYM-1:1:1) @ 5 kg/pot and uniform sized thirty days healthy rooted cuttings with 3-4 fresh leaves were planted in pots and were kept under shade net house. Study revealed that the various cultivars showed significant difference with respect of flowering and flower quality parameters. Among the standard chrysanthemum cultivars studied, the cultivar 'Thai Chen Queen' showed best performance with respect of flower diameter (11.58 cm), longest duration of flowering (36.40 days), earliest 50% flowering (82.00 days) while, 'Hybrid-2' shows the best results with respect of earliest flower bud appearance (52.93 days) and the maximum chlorophyll content in leaves (71.24) was recorded with 'Tata Century'. While, the minimum chlorophyll content in leaves (43.35), delayed flower bud appearance (70.47 days) and 50% flowering (102.33 days) was recorded with cultivar 'Coffee'.

Key words: Chrysanthemum cultivar, CRD, flowering and flower quality parameter, rooted cutting.

INTRODUCTION

Chrysanthemum belongs to family Asteraceae botanically known as *Dendranthema grandiflora*. The chromosome number of genus is n=9 and 2n=36, 45, 47, 51, and 75. It is a native to China and one of the most beautiful flowering plant referred as "Queen of the East" and "Autumn flower", while, in India it is called Guldaudi. Chrysanthemum is the national flower of Japan. The species of chrysanthemum have fibrous root system (shallow rooted plant), herbaceous perennial plant growing to 50-150 cm tall, with deeply lobed leaves and large flower heads like white, yellow or pink colour (Singh, 2006).

It is one of the leading commercial flowers, important as a cut flower, loose flower as well

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Effect of planting time on performance of Bermuda grass cv. Selection-I under Malwa plateau conditions of Madhya Pradesh

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ABSTRACT

Common Bermuda grass, *Cynodon dactylon*, is naturalized throughout the warmer regions of India. It is a tetraploid species with broad genetic variability. Bermuda grass has significant ecological, environmental and economic importance. Temperature is the main environmental factor that limits its adaptability to tropical and subtropical areas of the world. The impact of planting time on lawn grass fluctuates throughout the year. The present study was carried out to evaluate the effect of planting time on qualitative and quantitative parameters of Bermuda grass cv. Selection-1 at Experimental Farm, Department of Floriculture and Landscape Architecture, K.N.K. College of Horticulture, Mandsaur in the Malwa plateau region of Madhya Pradesh during 2022-23. The experimental material was consisting of 3 replications with 9 treatments of planting time *i.e.*, T_1 (September 20th), T_2 (October 10th), T_3 (October 30th), T_4 (November 20th), T_5 (December 10th), T_6 (December 30th), T_7 (January 20th), T_8 (February 10th) and T_9 (February 28th). The planting date, T_9 (28th February) gives the best results with respect of most of the quantitative and qualitative parameters *i.e.* the highest survival percentage, number of stolons per plant, stolon internodal length, canopy height, fresh and dry clipping yield, maximum leaf chlorophyll content and turf quality.

Key words: Bermuda grass, performance, planting time, quantitative and qualitative parameters.

INTRODUCTION

Lawn is an integral part of any landscape whose quality is determined by the management of the turf (Janakiram *et al.,* 2015). Lawn grasses belongs to the Poaceae family and comprises 9000 species (Rademacher, 2003) and 600 genera, of which 20-25 species are employed to produce turf which enhances the aesthetic appeal and recreational value of a property (Vengris, 1973). Establishing a healthy lawn requires careful planning and consideration of various factors, including soil conditions, grass species, watering and planting time. Among these factors, planting time plays a crucial role in determining the success of lawn grass establishment. The invention, production and maintenance of specialized grasses for functional, aesthetic and recreational facilities are all included in the turf grass sector today. The lawn care sector is growing with yearly revenue exceeding $1.5 billion (Bertin and Weston, 2002). There is widespread agreement that certain lawn characteristics are the primary drivers of quality. Many people agree that sod's

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Interactive effect of gamma irradiation and varieties on growth and corm parameters of gladiolus under Malwa region of Madhya Pradesh, India

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Abstract

A field experiment was carried out during November, 2022 to April, 2023 to study the response of gladiolus varieties to gamma irradiation at the K.N.K. College of Horticulture, Mandsaur (RVSKVV, Gwalior), M.P. The experiment was taken in Factorial Randomized Block Design(FRBD) with four varieties (Arka Aayush, Arka Pratham, Arka Kesar and Arka Tilak) and five gamma doses G_1 (0.0 kr),G_2 (1.25 kr), G_3 (2.25 kr), G_4 (3.25kr) and G_5 (4.25kr). Results from data revealed that Arka Kesar, a gladiolus variety, performed the best in terms of days taken to sprouting, corm diameter & weight of corms/plant. While, Arka Tilak performed better with respect to weight of cormels per plant. Arka Ayush variety was also having significantly higher number of sprouts/hill. Gamma irradiation at a level of 1.25 kr was found to be advantageous for days taking to sprouting, number of sprout/hill and weight of cormels/plant. Nevertheless, 2.25 kr was found positive for corm diameter and weight of corms per plant. Interactive effect of gamma irradiation and varieties showed that variety Arka Kesar irradiated with 1.25 kr (V_3G_2) required shortest time to sprout and Arka Pratham without irradiation (V_2G_1) displayed the maximal width for the longest leaf however, number of leaves at 60 DAP & number of corms per plant were significantly higher in Arka Tilak exposed to 1.25 skr ($V_4G_{2)}$. In terms of corm diameter and corm weight per plant, the most substantial results documented in V_3G_3(Arka Kesar irradiation with 2.25kr) treatment combination.

Key words: Gladiolus, varieties, gamma irradiation, growth parameters, corm parameter, interactive effects

Introduction

The interaction between flowers and humans exhibits distinct characteristics. Throughout history, humans have exhibited a peculiar attraction to flowers, even during periods of scarcity when flowers do not offer direct nutritional sustenance. Flowers have been cultivated by humans for their aesthetic appeal as well as their symbolic and tangible significance. While, flowers can yield basic therapeutic benefits and symbolize land fertility, their primary role is predominantly aesthetic.The floral landscape in India has undergone significant transformations. A notable portion of India's overall agricultural production is dedicated to floriculture, which contributes substantially to the country's Gross Domestic Product (GDP) growth. Within the realm of floriculture in India, the cut flower industry holds prominence. Gladiolus (*Gladiolus grandiflorus* L.), a member of the

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Effect of planting time on growth of gladiolus (*Gladiolus grandiflorus* L.) cv. Punjab Dawn under Malwa plateau conditions of Madhya Pradesh

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ABSTRACT

The present study was carried out to evaluate the effect of planting time on growth parameters of Gladiolus at Experimental Farm, Department of Floriculture and Landscape Architecture, K.N.K. College of Horticulture, Mandsaur (M.P.) in the Malwa plateau region of Madhya Pradesh during 2021-22. The experimental material was consisting of 3 replications with 7 treatments of planting time *i.e.*, T_1 (October 15th), T_2 (October 25th), T_3 (November 5th), T_4 (November 15th), T_5 (November 25th), T_6 (December 5th), T_7 (December 15th). The planting dates, T_3 (November 5th) and T_5 (November 25th) performed best results with respect of most of the growth parameters. The highest plant height (cm), number of leaves per hill, length of longest leaf (cm), width of longest leaf (cm), chlorophyll content of leaves was noticed in T_3 (November 5th)and days taken to sprouting was noticed in T_5 (November25th)

Key words: Gladiolus, planting time, growth parameters.

INTRODUCTION

Gladiolus (*Gladiolus grandiflorus* L.) is bulbous ornamental plant native to South Africa. It belongs to family Iridaceae, having approximately one hundred and fifty known species. This plant is commercially used for cut flowers and occasionally used for landscape purpose. Gladiolus is one of the few cut flower plants which produce beautiful flowers on long spikes (Adil *et al.*, 2013). Gladiolus also known as the queen of bulbous flowers due to its flower spikes with florets of massive form, brilliant colors, attractive shapes, varying size and excellent shelf life. The allmodern hybrids of gladiolus belonging to the family Iridaceae. Gladiolus is grown as flower bed in gardens used in floral arrangements, interior decoration as well as for making high quality bouquets (Kumar *et al.*, 2017). Gladiolus is one of the most popular cut flowers in international and domestic markets and is grown commercially in India. It has magnificent spike normally having 10-18 florets, which are open gradually. The cultivation of gladiolus on commercial basis is being done around big cities in India. In the plains of North India, good quality gladiolus spikes can be produced by planting suitable varieties from September to December (Singh

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Effect of Different Growing Media on Growth and Flowering of Petunia (*Petunia hybrida* L.)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The Department of Floriculture and Landscape Architecture, COH, Mandsaur, RVSKVV, Gwalior undertook the current study to assess the effectiveness of various growing media on the growth and flowering of petunia (*Petunia hybrida* L.) (M.P.). The experiment had fourteen treatments, three replications, and was set up using a Completely Randomized Design (CRD). Different combinations of cocopeat, FYM, sand, soil and vermicompost were used to create the growth media. In terms of number of branches, flowers per plant, days to blooming, length of flowering, fresh weight of root mass, and dried weight of root mass, data showed that T_{14} [Cocopeat + Sand +

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Evaluation of Tuberose Cultivars for Growth and Post-Harvest Attributes under Malwa Plateau of Madhya Pradesh

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ABSTRACT

The present investigation entitled "Evaluation of tuberose cultivars for growth and post-harvest attributes under Malwa Plateau of Madhya Pradesh" was conducted during 2019 to 2020 at Department of Floriculture and Landscape Architecture, K.N.K. College of Horticulture, Mandsaur (MP). The experiment was laid out in a Randomized Block Design (RBD) with three replications and ten treatments. The results of the experiment were revealed that maximum plant height at 30 and 60 DAP were recorded in cv Prajwal, whereas the maximum number of leaves at 30 and 60 DAP and maximum vase life were recorded in cv Mexican Single. The minimum water uptake at 3rd day of vase was observed in cv GK TC-4 and minimum water uptake at senescence stage was observed in cv Phule Rajani.

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Keywords Tuberose, Cultivars, RBD, Growth.

INTRODUCTION

Tuberose (*Polianthes tuberosa* L.) commonly known as Rajnigandha in hindi, is an important commercial ornamental bulbous plant flower crop in India and is popular due to its fragrance and long keeping quality of flower spikes. The spikes are useful as cut flowers for vase decoration and bouquets while individual flowers are used for making veni, garland and buttonholes. It is believed to have originated in Mexico. Where, it spread different parts of the world during 16th century. It belongs to the family Amaryllidaceae (Prakash *et al.* 2015) having haploid chromosome number 30. The generic name *Polianthes* is derived from Greek word "polios" meaning shiny or white and "anthos" meaning flower (Naik *et al.* 2018).

Tuberose is hardy, perennial plant. This is having fibrous root and perpetuating itself through bulblets. The leaves are long, narrow and grass like foliage with mild green color. The inflorescence is known as spike. This is can be 25±10 pairs of florets which is commonly open from base to top of the spike (i.e. acropetally). Flowers are waxy, white colored and funnel shaped (Singh *et al.* 2018). The flowers are also used for the extraction of valuable essential oil, which is having a greater demand for concrete and absolute in world wide market and fetches a very good price. It is appreciably cultivated as supply of raw material

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Response of bio fertilizers on growth and corm production of gladiolus (*Gladiolus grandiflorus* L.) cv. Punjab Dawn

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Abstract
The study was meant to assess the response of bio fertilizers on growth and corm production of gladiolus (*Gladiolus grandiflorus* L.) cv. Punjab Dawn. The experiment was laid out in RBD in ten treatments with three replications. Data revealed that effect of bio fertilizers on performance of gladiolus was statistically significant and among the treatments, T_4 (RDF + Azotobacter + PSB) showed the most excellent results with respect of plant sprouts/hill, plant height, number of foliage/hill, width of longest leaf, number of corm/hill, weight of corm/hill, number of cormels/hill and weight of cormels/hill.

Keywords: Bio fertilizer, azotobacter, PSB, gladiolus

Introduction
Gladiolus (*Gladiolus grandiflorus* L.) is a fashionable bulbous high profit flowering plant with its wonderful inflorescence. It is universally known as 'Queen of the bulbous flowers' with majestic flower spikes having florets of enormous form, bright color, beautiful shapes, changing size and outstanding keeping quality. Its generic name 'Gladius' is derived from the Latin word meaning 'Sword' and hence it is also known as 'Sword Lily'. It belongs to family Iridaceae and comprises about 260 species. Most Gladiolus species are native to the Mediterranean region and South Africa (Buch, 1972) [5]. Gladiolus is commercially propagated by corms. Gladiolus can be grown for good output in any sort of soil and it prefers a sandy loam for good performance. An ideal soil pH of 6-7 is optimum for cultivation of gladiolus. There are so many factors of lower yield, out of which, barren soil fertility is one of the main factors which adversely affects the flowering and corm production. The vital aspects in increase the flower yield and superiority of gladiolus spikes is nutrition (Bhalla *et al.*, 2006) [4]. N, P and K are the three most important nutrients that play an important role in influencing the growth and flowering parameter (Kumari *et al*., 2014) [14]. Bio-fertilizers and organic supplements can play a very important role, therefore they are being used to improve crop growth and flower quality and enhance the production of phytohormones as well as the absorption of plant nutrients. There by helping in sustainable crop production through maintenance of soil fertility and productivity. In horticulture crops, biofertilizers being used commercially on a large scale are Azotobacter, PSB and VAM. Azotobacter and Azospirillum are nitrogen fixing bacteria that help plants to indirectly improve nitrogen fixation and nutrient accessibility in soils. Phosphorus solubilizing bacteria (PSB) are used to increase the availability of phosphorus in the soil.

Materials and Methods
The research was conducted at Baradari experimental Farm, RVSKVV College of Horticulture Mandsaur (M.P) in 2019-20. The trial was laid out in RBD with 10 treatments replicated thrice. The treatment were T_1 RDF (N: P: K:-120:100:150), T_2 RDF + Azotobacter, T_3 RDF + PSB, T_4 RDF + Azotobacter + PSB, T_5 85% RDF + Azotobacter, T_6 85% RDF + PSB, T_7 85% RDF + Azotobacter + PSB, T_8 75% RDF + Azotobacter, T_9 75% RDF + PSB, T_{10} 75% RDF + Azotobacter + PSB. Preplanning treatment of application of biofertilizers to corms was given 15 minutes before planting and kept in shade. Corm planted in flat bed giving spacing 30×30 cm in plot size 1.2×0.8=0.96m^2 consisted number of plant per treatment is 16. 1/3 dose of N as per treatment and full dose of P and K was given at the time of planting. Remaining 2/3 dose

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Responses of different levels of potassium and zinc on growth and yield of isabgol (*Plantago ovate* Forsk.) under malwa plateau of Madhya Pradesh

RS Chundawat, KC Meena, DK Patidar, BK Patidar and BK Kachouli

Abstract

The experiments were carried out under AICRP on Medicinal and Aromatic Plant at College of Horticulture, Mandsaur under Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior (M.P.) during the *rabi* season of 2019-20, 2020-21 and 2021-22. The treatments consisting four levels of potassium (0, 10, 20 and 30 kg K_2O ha^{-1}) in main plot and three levels of zinc (0, 10 and 20 kg Zn ha^{-1}) in sub-plot were laid out in split plot design replicated thrice with cv. Jawahar Isabgol 4. Results revealed that, the maximum plant height was recorded in K_4-30 kg K_2O ha^{-1} (32.30, 33.00, 31.00 & mean 32.10 cm) while, number of tillers (4.10, 4.13, 4.00 & mean 4.08), spike length (3.80, 3.70, 3.50 & mean 3.67 cm) and seed yield (13.67, 13.67, 12.50 & mean yield 13.28 q ha^{-1}) were found in K_3-20 kg K_2O ha^{-1} during 2019-20, 2020-21, 2021-22 and mean, respectively. Similarly, Zn_3-20 kg Zn ha^{-1} had maximum plant height (30.70, 30.75, 29.50 & mean 30.32 cm) but number of tillers (4.00, 3.90, 3.80 & mean 3.90), length of spikes (3.55, 3.45, 3.36 7 & mean 3.45 cm) and seed yield (12.60, 12.25, 11.15 & mean yield 12.00 q ha^{-1}) were found with the application of Zn_2-10 kg Zn ha^{-1} during 2019-20, 2020-21, 2021-22 and mean, respectively. Thus, it is concluded that 20 kg K_2O ha^{-1} and 10 kg Zn ha^{-1} performed best under the experiment.

Keywords: Potassium, Zinc, growth, yield and *Plantago ovate*

1. Introduction

Isabgol (*Plantago ovate* Forsk.) word is derived from Isap and ghol, which mean horse ear, due to the shape of the seeds and is a plant of the Plantaginaceae family. It is a sub-caulescent softy hairy or woolly annual herb with short stems and take a height of 28-40 cm (Kumar *et al.*, 2023) [1]. It has a diversity of leaves, flowers are small and white, and the seeds are ovate and small with brown grey in color, and protected by a translucent membrane called husk (Tyagi *et al.*, 2016) [2]. Constipation and gastrointestinal are treated with the swelling property of the husk (Salimath *et al.*, 2019) [3]. India is the world's largest producer and exporter of seeds and husk. It is grown commercially in Madhya Pradesh, Gujarat, and Rajasthan states of country. It is primarily grown in the districts of Neemuch and Mandsaur in State. In Madhya Pradesh 15.209 T. ha, 16.663 TMT and 10.9 q. ha^{-1}, besides in India 351.536 T. ha, 333.681 TMT, and 9.50 q. ha^{-1} area, production and productivity respectively (Hapis, 2019) [4]. Most of the Indian soils are deficient in zinc causing yield losses in crops (Singh et al., 2011) [5] and crop like isabgol has been found to respond to zinc application. The lack of zinc is major cause of lower yield or even crop failure (Salimath *et al.*, 2019) [3]. It is also playing a significant effect in various physiological and enzymatic activity of the plant growth and also catalysis the process of oxidation in cells of plant and vital for transformation of carbohydrate. Soil application of potassium increases the growth and yield of plants because it play a role in the photosynthesis, mechanism of stomatal movement and helps in osmo-regulatory adaption of plant cause of water stress (Patel *et al.*, 2012) [6]. Adequate application of potassium has been exposed to enhance disease resistance in plants. It has triggers numerous enzymes activities and plays an important role in sustains of potential gradients around the cell membranes and maintained of turgor pressure in plants as well as regulate protein & starch synthesis and photosynthesis (Narolia *et al.*, 2013) [7]. Therefore, a study on effect of different levels of potassium and zinc on growth and yield of Isabgol (*Plantago ovata* Forsk) was carried out.

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Optimization of Sowing Date and Crop Geometry Management for Herbage Production of Fenugreek cv Kasuri (*Trigonella corniculata*) in a Subtropical Region

Deepanshi Deora, K. C. Meena, Akansha Deora, A.S. Shekhawat

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ABSTRACT

Sowing date and crop geometry are critical factors in the production of Kasuri methi as development, yield and quality of crop may be hampered by crop spacing and early or late sowing. So, to achieve the goal of doubling farmers' income, a study was conducted at Horticulture Research Farm, College of Horticulture Mandsaur, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior (MP), India during the year 2021-2022 to evaluate the effect of sowing dates and spacing on (*Trigonella corniculata*) fenugreek cv Kasuri with three dates of sowing viz. D_1 - 15th October, D_2 - 30th October and D_3 - 15th November as main plot and four different spacings S_1 (15 × 10 cm), S_2 (20 × 10 cm), S_3 (25 × 10 cm) and S_4 (30 × 10 cm) as sub-plot in Factorial Randomized Block Design with three replications. The result obtained during experiment showed significant effect to growth and herbage yield and most of the parameters were found maximum in main treatment D_2 – 30th October and sub treatment S_4 – 30 × 10 cm. The interaction of 30th October + S_3 – 25 × 10 cm observed maximum values in growth parameters while herbage yield was found maximum in 30th October + S_1 –15 × 10 cm.

Keywords Kasuri methi, Date of sowing, Spacing, *Trigonella corniculata*.

INTRODUCTION

Trigonella corniculata L., sometimes referred to as Kasuri, *Pan methi*, *Champa methi*, *Marwari methi* or sickle fruited fenugreek is an annual herbaceous, bushy, slow-growing legume seed spice crop that is native to the Mediterranean region and belongs to the family Fabaceae, subfamily Papilionaceae. It is farmed mostly for green herbage as well as dry herb. The chromosomal number for this species is 2n=16. It is a self-pollinating crop. During most of the vegetative growth period, it stays in rosette form (Anupama *et al.* 2017). It is a semi-arid crop that grows to a height of 30 cm, has pinnate leaves with leaflet sizes ranging from 1.25 to 2.0 cm and has bright orange-yellow flowers (Chandan *et al.* 2021). In the Nagaur District of Rajasthan (India), it is cultivated under the name of *Pan methi* because only the

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Effect of NPK and Bio-fertilizers on Growth and Yield of Chandrasur (*Lapidium sativum* L.)

Sanjay Vaktariya, K.C. Meena, R. Gallani, I. S. Naruka, B.K. Patidar, Nitin Soni

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ABSTRACT

The present field experiment was conducted at Department of Plantation, Spices, Medicinal and Aromatic Crops, College of Horticulture, RVSKVV, Mandsaur (MP) during the year 2020-2021 using Randomized Block Design in three replications. The experiment was carried out with various bio-fertilizers (PSB and *Azotobacter* @ each 5 kg/ha) and different doses of chemical fertilizers (NPK) along with one control. Result revealed that treatment T_{11} -NPK (40:50:40 kg/ha) + FYM (20 t/ha) + PSB+ *Azotobacter* (each 5 kg/ha) was recorded highest values of plant height (20.97, 101.20 and 114.40 cm plant^{-1}), number of branches at harvest (26.29 plant^{-1}), fresh weight (8.34, 95.57 and 84.17 g plant^{-1}) and dry weight (1.19, 19.11 and 40.40 g plant^{-1}) at 40, 80 and 120 days after sowing respectively. However, days to 50% emergence (6.28), days to 50% flowering (61.32) and days to maturity (114.38) were took lowest days with the same treatment. The maximum seed yield (22.06 q ha^{-1}), biological yield (83.59 q ha^{-1}), test weight (1.89 g) and highest harvest index (26.40) in the same treatment as compared to control. Under the economics of the treatment, the highest net return (Rs 70300) and benefit: Cost ratio (1.75) also found with same treatment.

Keywords Bio-fertilizer, Chemical fertilizer, Nitrogen, Phosphorus, Potassium, Yield.

INTRODUCTION

Chandrasur (*Lapidium sativum* L.) is commonly known as garden cress of Brassicaceae family. It is a fast-growing, erect annual edible herb grows up to a height of 50 to 90 centimeter, basal leaves have long petioles and culinary leaves are pinnate while, the upper leaves are entire in shape. The inflorescence is a dense raceme. The flowers have white or slightly pink petals, measuring two millimeter in length. The fruit, a siliqua measures five to six millimeter long and four millimeter wide, elliptical, is elate form at upper half and is glabrous (Chundawat *et al.* 2017). Seeds, leaves and roots are the economic parts of this crop (Vaishnavi *et al.* 2020). It is hottest drug of Unani medicine and useful in asthma, cough, diarrhea, dysentery, skin disease, blood disorder (Raval 2016). Chandrasur is widely cultivated in temperate

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Effect of storage age and containers on the physicochemical degradation of guggul oleo-resin

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Guggul is a gum oleo-resin, tapped from a data deficient plant- *Commiphora wightii* (Arnott.) Bhandari in India. It is extensively used in ayurvedic drugs and formulations since ages. Natural plant-based products; especially aromatic ones like guggul gum oleo-resin deteriorates, qualitatively during its storage and transits before reaching the industry for its value addition. This economical and ecological loss can be avoided if it is stored in proper containers. Physico-chemical degradation of guggul samples stored were analysed by scanned electron microscopy, fourier transformed infra red, thermogravimatric, Powdered X-ray diffraction and elemental analysis for carbon, hydrogen, nitrogen and sulphur. Physico-chemical degradation of guggul oleo-resin occurs with the age of storage and the type of storage containers used. Among the four storage containers (earthen pot, plastic jar, polythene bag, jute bag) evaluated, earthen pot was found to be the best in checking the qualitative loss of guggul even upto 24 months. The qualitative information generated in the study on guggul storage may be useful to the drug industry and guggul traders. It may encourage them practice storing guggul in earthen pots against current practice of using jute bags and polythene bags, to store it.

Across the continents, natural products are collected, traded, stored and transported before their processing[1]. Unlike synthetic products, natural products are less stable (physically or chemically), depending on its post harvest handling[2]. Degradation or deterioration of natural products[3] is not only an economical loss[4] but also a biological as well as ecological loss[5,6], in a broader term. Conditions and containers used[7] are crucial for storage of natural resin and gums (NRG). In the process of crushing, sieving and heating of natural products, decomposition takes place[8]. Temperature for initiation of decomposition (TID) or complete decomposition (TCD) of NRG depends on its storage containers and conditions[9].

Guggul gum is an important gum oleo-resin tapped from data deficient *Commiphora wightii*. The domestic supply is just 10 metric tonnes against the annual industrial demand of 10,000 metric tonnes in India[10,11]. This high value aromatic product tapped and collected from the field reaches industry not earlier than 24 months, through a complex labyrinth trade network. During this transit period, qualitative deterioration[7,12] cannot be ruled out. Good practices followed for production and collection are important in the primary stages of NRG, but the secondary stage (transport and storage) is of utmost industrial importance for maintaining its bioactive compounds[7]. Guggul gum oleo-resin is used in drug, cosmetic formulations as well as other products[11]. Product development involves processing[13], mixing of various ingredients[14] and even heating. Combination index[15] in drug formulation is vital for effectiveness and stability[16,17]. Quality deterioration of any natural product, including guggul during storage and transit is an important point for consideration[18], on account of the loss of aromatic oils and bio-active compounds[7]. A qualitatively degraded raw material will differ chemically and physically from its parent material. These physico-chemical changes may also influence its interaction with other materials viz. additive[19,20], antagonism[21], potentiation[22] and synergism[23] of the drug prepared.

Raw natural products intended for pharmaceutical applications are expected to be qualitatively superior. To maintain the superiority of raw materials it is important to store them in a suitable container. Earthen pot is made up of small soil particles and before its use it is baked. Earthen pots are preferred because of their low cost and easy construction followed by low-temperature variation that keeps the stored material cool[24]. Quality of

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Response of major nutrients and organic manure on growth, yield and economics of ajwain (*Trachyspermum ammi* L.)

Shubham Yadav, KC Meena, MK Tripathi, BK Kachouli, BK Patidar, Nitin Soni and DK Patida

Abstract
The primary goal of integrated nutrient management strategies is to substitute a portion of chemical fertilizers with a more sustainable and environmentally safe organic manure in order to mitigate soil degradation, improve crop production, and protect the environment. Nutrient management is closely associated with fertilizer type, application rate, application time, and application placement. Applying organic manure in combination with chemical fertilizers has become an effective approach towards nutrient management, this will maximize the agronomic value of organic manure and encourage recycling agricultural wastes into new valuable products for agricultural enhancement. Therefore, the present study was conducted to assess the impacts of different INM practices namely absolute control (T_1), 25 t/ha FYM (T_2), NPK – 40:20:20 Kg/ha + 5 t/ha FYM (T_3), NPK – 40:25:20 Kg/ha + 10 t/ha FYM (T_4), NPK – 40:30:20 Kg/ha + 15 t/ha FYM (T_5), NPK – 45:20:20 Kg/ha + 5 t/ha FYM (T_6), NPK – 45:25:20 Kg/ha + 10 t/ha FYM (T_7), NPK – 45:30:20 Kg/ha + 15 t/ha FYM (T_8), NPK – 50:20:20 Kg/ha + 5 t/ha FYM (T_9), NPK – 50:25:20 Kg/ha + 10 t/ha FYM (T_{10}) and NPK – 50:30:20 Kg/ha + 15 t/ha FYM (T_{11}) in RBD Design with three replications at Department of Plantation, Spices, Medicinal and Aromatic Crops, College of Horticulture, RVSKVV, Mandsaur, (M.P.) during the Rabi season of 2021-2022. The result indicated that treatment T_{11} showed early germination, flowering and maturity. The treatment T_{11} was recorded with superior values of plant height, number of branches plant^{-1}, fresh weight plant^{-1} and dry weight plant^{-1} at 45, 90 days after sowing and at harvest respectively. The treatment T_{11} was registered with highest value of number of umbels plant-^{1}, number of fruit umbel^{-1}, number of umbellates umbel^{-1}, number of fruit umbellate^{-1}, test weight, seed yield and highest net return while T_9 recorded best B: C ratio.

Keywords: Growth, nutrients, organic manures, phenology, *Trachyspermum ammi* and yield

1. Introduction
Ajwain (*Trachyspermum ammi* L.) is a plant of the Apiaceae family also known as Bishop's weed or Carom seed. It is grown in the Mediterranean region and South West Asian countries such as Iran, Iraq, Afghanistan, Egypt, and India. In India, it is primarily grown in the states of Rajasthan and Gujarat, with other growing states including Uttar Pradesh, Bihar, Madhya Pradesh, Punjab, Tamil Nadu, West Bengal, and Andhra Pradesh. The seeds of ajwain are the most lucrative and economical part of the plant and oil extracted from seeds used in the perfumery, essences, pharmaceutical and cosmetics. Ajwain seed gets its distinct odour and flavor from the presence of an essential oil (2-4%) that includes around 50% thymol, a powerful germicide, antispasmodic, and fungicidal agent and it is used as preservatives and flavorings in food (Thomas *et al*., 2020) [1]. Because of their aromatic scent and spicy flavour, their seeds (volatile oil) are extensively used as a spice in curry powder (Fathi *et al*., 2020) [2]. Plant nutrition is an important aspect in enhancing plant productivity (Chandravanshi *et al*., 2021 and Chundawat *et al*., 2023) [3, 4]. The integrated use of organic composts along with chemical fertilizer has been well-recognized as a vital agricultural practice to gain more benefits or at least comparable results with that of solely applying chemical fertilizers (Chouhan *et al*., 2023) [5]. The partial replacement of chemical fertilizer by manure has a significant positive impact on nutrient supply and crop yield (Lazcano *et al*, 2013) [6]. Importantly, the integrated use of organic compost and chemical fertilizers not only improves different soil properties and crop productivity, but also significantly minimizes the use of chemical fertilizer, which subsequently conserves energy, minimizing the risk of pollution, improving fertilizer use efficiency, reducing the cost for farmers especially in low-income

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RESPONSES OF ORGANIC MANURES AND BIO-FERTILIZERS ON GROWTH AND YIELD OF ASHWAGANDHA (*WITHANIA SOMNIFERA* L. DUNAL)

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ABSTRACT: The present field investigationwas carried out at Department of Plantation, Spices, Medicinal and Aromatic Crops, College of Horticulture, Mandsaur, under RVKSVV, Gwalior (M.P.) during the year 2021-2022 in RBD Design with three replications. In this experiment the plots of individual treatments were applied in different levels of FYM, vermicompost, neem cake, castor cake and in combination with bio-fertilizers (PSB*, Azotobactor* and *Azospirillum)* with a control plot in Ashwagandha (JA 134). Results revealed that treatment T_3 - VC at 6t ha^{-1} + BF at 2 kg ha^{-1} had highest plant height (44.64 cm), number of leaves (153.64 $plant^{-1}$), number of branches (9.52 $plant^{-1}$), fresh weight (107.73 g $plant^{-1}$) and dry weight (33.33 g $plant^{-1}$). Among the growth observations, leaf area index (0.93, 3.14, 5.28, 6.54 and 6.73), leaf area duration (83.53, 282.53, 474.86, 588.86 and 606.06 cm^2 day^{-1}), crop growth rate (0.046, 0.249, 0.076, 0.026 and 0.024 g cm^{-2} day^{-1}) and relative growth rate (0.047, 0.115, 0.063, 0.029 and 0.025 g g^{-1} day^{-1}) at 30-60, 60-90, 90-120, 120-150 DAS and 150 DAS-harvest respectively in T_3 - VC at 6t ha^{-1} + BFat 2 kg ha^{-1}. Moreover, the maximum number of berries (120.43), root girth (13.45), shoot girth (15.70), root length (21.32), root shoot ratio by weight (0.529), seed yield (8.15) and fresh root yield (21.09) found in treatment T_3-VC at 6t ha^{-1}+ BF at 2 kg ha^{-1} alsogross return (Rs. 201600), net return (Rs. 147000) and benefit: cost ratio (2.5) wile cost of cultivation (Rs. 56600) in T_9-CC at 2t ha^{-1} + BF at 2 kg ha^{-1}.

Keywords: *Bio-Fertilizers, growth, organic manures, Withania somnifera, yield*

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INTRODUCTION

Ashwagandha is a major dry land medicinal plant of Solanaceae family and used in the traditional Indian medicine since long times. The plant grows erect to height of 35-75 cm having small green-coloured flowers and orange-red ripe fruit. It is

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Consequence of organic manure and biofertilizers on growth, yield and economics of dill (*Anethum graveolens* L.)

Riya Vaishnav, KC Meena, IS Naruka, OP Singh, R Gallani, Ankit Pandey, SK Dviwedi and MK Tripathi

Abstract
A field experiment of winter season was conducted during the year of 2020-21 to study the result of organic manure and biofertilizers on growth and yield of dill (*Anethum graveolens* L.). The eight treatment combinations of FYM, vermicompost and biofertilizers were tested in randomized block design and replicated three times. Organic manure and Biofertilizers significantly influenced growth and yield of dill. Significantly biological yield and grain yield with harvest index were observed under treatment FYM (5 ton/ha) + Vermicompost (2 ton/ha) + *Azotobacter* (3 kg /ha) + PSB (5 kg/ha). Findings suggested that application of biological fertilizers significantly increased grains performance, biological yield per plant, plant height, fresh weight, dry weight, umbels number per plant, number of grains per umbel. Result revealed that, significant maximum plant height (9.08, 70.49, and 150 cm), fresh weight (2.74, 147.13, 469.40 g plant^{-1}) and dry weight (0.41, 7.54, 85.87 g plant^{-1}) were verified with treatment T_7 on forty, eighty and one twenty days after sowing, correspondingly. Though, sooner germination (7.8 days), flowering (82.67 days), maturity (154.40 days), and higher umbels number (121.07 plant^{-1}), umbellets number (35.47), number of grains per umbel (642.10), grain yield (19.69 q ha^{-1}), biological yield (42.67 q ha^{-1}), harvest index (46.14%) and benefit cost ratio (2.34) were recorded with treatment T_7 while, they were lowest with untreated control.

Keywords: *Anethum graveolens*, organic manure, biofertilizers, growth and yield

1. Introduction
Dill (*Anethum graveolens* L.), readily acknowledged as sowa, is one of the oldest cultivated grain spices of India. It is a biennial or annual herb of the Apiaceae or Umbelliferae family. It grows up to 90-120 cm tall and has slender branched stems, finely divided leaves, and small umbels of yellow flowers. Younger tender leaves are most important part for culinary use and grains as spice. The leaves could be used as food, salads, sea foods, and soups. The grains could be used in soups, bread and flavoring pickles. Dill grain have pleasant aroma with warming flavors is excellent for flavoring and seasoning. The grain used as an anti-spasmodic, anti-flatulent, carminative, anti-inflammatory, anti-rheumatic and diuretic in pharmacological industry and reduce the level of cholesterolemia (Lanky *et al*. 1993) [1]. Dill leaves have excellent antioxidant activities (Singh *et al*. 2005) [2].

Solicitation of organic manure with biofertilizers such as vermicompost and nitrogen preservative bacteria has led to diminish in the use of chemical fertilizers and has provided good value products free of injurious agrochemicals (Moradi *et al*., 2010; Thomash *et al*., 2020a) [3, 4]. Biological Fertilizers application has controlled to a decrease in the use of mineral fertilizers and has provided top quality products free of harmful agrochemicals for safety of social and have useful impact on soil physical and chemical assets and provide plants with a good and save source of nutrients (Darzi, 2012; Chundawat *et al*., 2023) [5, 6]. Use of organic and chemical fertilizers could improve soil physical properties by changing the organic carbon content of the soil and the chemical composition of the soil solution, which rises the plant's ability to increase the plant's access to high-consumption elements (Chundawat *et al*., 2017; Patidar *et al*., 2019) [7, 8].

Bid of biofertilizers provides effective application of biological appliance of plant nutrition and growth promotion. The biofertilizers rally the sustainability of the soil and make it extra productive. Biofertilizer boosts the efficiency of the soil either by fixing atmospheric nitrogen or exciting plant growth through synthesis of growth helping substances (Kumar *et al*., 2023)

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ASSOCIATION FOR AGRICULTURE ENVIRONMENT AND BIOTECHNOLOGY

RESEARCH PAPER

Effect of Major Fertilizers and Organic Manure Levels on Growth, Yield and Economic of Nigella (*Nigella sativa* L.)

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ABSTRACT

The main objective of the integrated nutrient management is to maintain economic yield for a long period with little effect on native soil fertility and environmental pollution, making some changes in farmer's awareness toward the eco-friendly technique for producing healthy food free from contaminants and insuring satisfactory economic returns. Integrated nutrient management (INM) can offer good options and economic choices to supply plants with sufficient amounts of nutrients and also can reduce the dose of chemical fertilizers, create favorable soil physiochemical conditions and healthy environment, eliminate the constraints, safeguard the soil nutrient balance in the long run to an optimum level for sustaining the desired crop productivity, and find safety methods to get rid of agriculture wastes. Therefore, the present study was conducted to assess the impacts of different INM practices namely absolute control (T_1), 25 t/ha FYM (T_2), NPK – 40:20:20 Kg/ha + 5 t/ha FYM (T_3), NPK – 40:25:20 Kg/ha + 10 t/ha FYM (T_4), NPK – 40:30:20 Kg/ha + 15 t/ha FYM (T_5), NPK – 45:20:20 Kg/ha + 5 t/ha FYM (T_6), NPK – 45:25:20 Kg/ha + 10 t/ha FYM (T_7), NPK – 45:30:20 Kg/ha + 15 t/ha FYM (T_8), NPK – 50:20:20 Kg/ha + 5 t/ha FYM (T_9), NPK – 50:25:20 Kg/ha + 10 t/ha FYM (T_{10}) and NPK – 50:30:20 Kg/ha + 15 t/ha FYM (T_{11}) in RBD Design with three replications at Department of Plantation, Spices, Medicinal and Aromatic Crops, College of Horticulture, RVSKVV, Mandsaur, (M.P.) during the Rabi season of 2020-2021. The result indicated that treatment T_8 observed early germination, number of days taken to 50% flowering and minimum days to maturity. Treatment T_8 was recorded highest values of plant height, number of branches plant^{-1}, fresh weight, and dry weight at 45, 90, days after sowing and at harvest. Treatment T_8 was recorded the highest value of number of capsule plant^{-1}, number of seeds capsule^{-1}, seed yield, 1000 seeds weight and harvest index.

HIGHLIGHTS

- INM can offer good options and economic choices to supply plants with sufficient amounts of nutrients.

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ANALYSIS OF EXTREME WEATHER EVENTS AT MORENA DISTRICT OF MADHYA PRADESH, INDIA

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ABSTRACT

Climate change is likely to intensify the variability of weather patterns, leading to a rise in extreme seasonal aberrations. The extreme weather events like heat waves, cold waves and frost have great influence on agriculture productivity. These events have negatively impact on crop production and farmers' livelihood. The prediction of magnitude, frequency, timing and duration of extreme weather events in the changing scenario of climate can be supportive towards adaptation of suitable strategies to mitigate its adverse effects on agriculture and socio-economic aspects. The study of occurrence of significant climatic events and their trend analysis were done by utilizing daily maximum temperature, minimum temperature for Morena district which lies in Gird Agroclimatic zone of Madhya Pradesh for the period of 30 years (1984-2013) with the IMD criteria. The study revealed that heat waves varied with annual time scale. The maximum number of heat waves was observed in the year 2010 (57). The 12.4 average annual heat waves were observed during the period 1984-2013. About 4 heat waves could be expected in the month of June. An increasing trend of heat waves was noticed and pointed towards rising of maximum temperature over the region. The cold waves were also exhibited variability. The maximum number of cold waves was observed in the year 2007-08 (20). On an average 5.8 cold waves were observed per year during the period 1984- 85 to 2012-13.The trend analysis revealed that cold waves were becoming less frequent. On an average, 9 frost events per year could be expected. The decreasing trend of frost events was noticed at annual time scale. There is a need for combining disaster reduction, natural resource management and climate change adaptation to reduce vulnerability and enhancement of resilience. Changes in technology and agricultural practices will help to create a society better able to survive the impacts of climatic extremes.

Keywords: Agricultural planning, cold wave, frost, heat wave, risk.

Introduction

Indian agriculture is particularly vulnerable to climate change. The key characteristics of agriculture that could influence its vulnerability to climate change are the high level of subsistence agriculture with small land holdings, majority of rain-fed agriculture, frequent occurrence of extreme weather events and the wide variation in agricultural productivity across the country. Climate change will affect food security through its impacts on components of global, national and local food production systems, which is projected to affect food availability, stability of food supplies, access to food and food utilization. India being mainly an agricultural country, the economy purely depends on the vagaries of the weather and in particular the extreme weather events. Extreme weather events such as heat and cold waves, frost, heavy rainfall and flood etc. are in fact hazardous weather. In past 50 years, India had lost assets of more than Rs 65000 crore and loss of more than 75000 human lives due to floods alone (Attri and Tyagi, 2010 a). The heat wave in 1995 and 1998 and cold wave in 2003 is matter of concern for scientists and planners resulted into partial loss in yield and sometimes complete crop failure and hence reduced income to farmers (De *et al.*, 2005). The yield reduction in winter crops like wheat, mustard and vegetables due to abnormally high temperatures in the month of March 2004 has been reported by Samara and Singh (2004). Episodic heat waves can reduce yields, particularly when they occur during sensitive developing stages of the crops, such as the reproductive phase which increases sterility (Moriondo *et al.*, 2011). The higher temperature caused forced maturity which brought down seed productivity of broccoli, carrot, radish and turnip by 10–15% in Himachal Pradesh. Coconut, banana, cardamom, black pepper and cashew crops were affected due to heat wave-induced lower humidity and soil moisture in Kerala (Singh, 2016). During December 2002 to January, 2003 daily maximum and minimum temperatures at several places in north India remained un-usually below the normal continuously for 3-4 weeks. As a consequence of such phenomena, about 600 ha of orchards of mango and litchi were severely damaged in the Shiwalik belt of Punjab. The extent of damage varied from 40-100 per cent in mango to 50-80 per cent in litchi with reduced fruit size and poor quality in guava, ber and kinnow (Samra *et al.*, 2003). Crop yields in the cold wave year of 2002–2003 were reported to be lowered by 10–42% in wheat, 25–30% in gram and 50–70% in mustard compared to the

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Climate Change Mitigation Potential of Forestry Sector for Sustainability of Agro-Ecosystem: A Review

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Abstract

Ecosystems that are currently struggling are likely faring and pathetic conditions because of climate change. The most pressing problems facing people in the world's developing parts of the world are water scarcity, dwindling biodiversity, and stagnant agricultural output. According to the majority of scientists, global warming can be stopped before it becomes irreversible if temperatures are kept within a range of 1.5 to 2 degrees Celsius. Green house gases, sometimes known as GHGs, are the burning causes of climate change impacts. Accelerated emissions of GHGs could be dependent on the rate of social, economic, and technological development. Forest systems have a crucial impact in mitigating global warming. Clearing forests, setting them on fire, or otherwise destroying those releases massive amounts of other greenhouse gases (GHGs), even if the forests are the planet's greatest terrestrial carbon sink. Forests' source-sink dynamics and the total quantity of carbon they store are profoundly impacted by regional differences in human land use, anthropogenic climate change, and disturbance. Constantly expanding conservation, restoration, reforestation, and afforestation operations will be necessary to keep global warming under control and stop it from exceeding the crucial threshold. Forests are currently being employed as a potential tool for combating climate change, which has been demonstrated to be an effective and long-term strategy. However, the impact of climate change on forests is largely negative. The negative effects of climate change on forests are becoming more pronounced, as evidenced by an increase in the forest fire events and results in a shift in species distribution at higher altitudes, an increase in dieback, an increase in the number of insect and pathogen infestations, drought and flood conditions, and a decrease in the ecosystem services

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REVIEW ARTICLE

Abatement of environmental degradation through agroforestry intervention: A review

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ABSTRACT

Agroforestry is an ecologically based approach for managing natural resources that sustains productivity and provides advantages to all land users. It conserves soil and improves soil fertility in addition to providing timber, feed, fuel wood, medicines, etc. By reducing soil erosion and runoff, preserving soil organic matter, enhancing soil physical, chemical, and biological properties, increasing nitrogen input from N-fixing trees and shrubs, mining minerals from lower horizons by roots, and recycling them through litter falling to the ground, soil fertility can be improved. The issue of environmental instability, which is brought on by increasing strain on the land resources as a result of population growth that won't stop, has caused significant disruption to the natural ecosystems that are already in place. It is necessary to address these human disturbances and unsustainable use of the natural ecosystem, which posed a serious threat to the local biodiversity and resulted in environmental deterioration. Therefore, it is important to embrace agroforestry, a potential strategy of land use that combines various tree species with herbaceous crops. These systems have the capacity to boost household productivity generally and biodiversity in particular. Additionally, it aids in reducing climate change to ensure environmental sustainability. A proper model must be adapted towards the sustainability of the environment in order to fully utilize agroforestry practices and systems.

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Key words: Agroforestry, Biodiversity, Ecosystem, Environment, Sustainability

INTRODUCTION

It is now necessary to engage in more intensive agricultural activities to fulfil the rising demand for both food and biofuel production, which the United Nations (2015) projects will top 9.7 billion by 2050 (Delgado and Berry 2008). Due to the use of agrochemicals (nutrients and pesticides), motorised agricultural equipment, and genetically modified crop species, modern production-oriented agriculture is characterized by high yields but also has a large environmental impact (Gold and Hanover 1987). Inadequate agrochemical management frequently leads to soil degradation, an increase in greenhouse gas (GHG) emissions, and contamination of groundwater and surface water recipients, all of which have a direct negative impact on the health of ecosystems and people (Reichenberger *et al.*, 2007; DeLonge *et al.*, 2016). The most prevalent and dangerous agricultural pollutants for the environment and human health are nitrates, phosphoric compounds, and organic pesticides. To prevent these pollutants from entering aquatic systems, a number of mitigating strategies have been suggested. A prominent method of mitigating climate change is agroforestry, which involves cultivating both crops and trees. Agroforestry is essential for lowering greenhouse gas emissions, preserving livelihoods, and providing some answers for biodiversity preservation. Enhancing farm productivity overall, enriching soil through above- and below-ground carbon sequestration, and sustaining environmental services are all goals of an agroforestry system. The function of tree roots to absorb nutrients that leach below the rooting zone of alley crops is the

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Effect of Indole-3-Butyric Acid (IBA) on Hardwood Cutting of Grapes (*Vitis vinifera* L.) cv. Pusa Navrang

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Original Research Article

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ABSTRACT

Aims: The study aims to investigate the influence of different IBA concentration on the rooting and subsequent growth of hardwood cuttings of "Pusa Navrang" grapevine.
Study Design: The study was performed in RBD design with replicate 5 times.
Place and Duration of Study: The study was conducted at Research Farm, College of Horticulture, Mandsaur, during the period November 2020- March 21.
Methodology: Polybags size of 5 X 7 inch was used for experiment. After the filling of growing media in poly bags, the hard wood cuttings of Pusa Navrang with uniform size having 4-5 functional bud was taken from one year matured canes from research farm, College of Horticulture,

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Novel approach of validation of online interactive weather information-based disease risk assessment in grapes in India

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Novel approach of validation of online interactive weather information-based disease risk assessment in grapes in India

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Grapevine (*Vitis vinifera)* is a globally important horticultural crop cultivated all over the world for its myriad uses. It is subjected to the infection of several diseases which attack susceptible grapevine varieties and cause severe loss in yield as well as to the economy. Application of fungicides is the major weapon against plant diseases, however, continuous application of fungicides leads to environmental pollution, emergence of fungicide resistance and pesticide residue in grapes. A weather-based disease forecasting model would enable the growers to take decisions at the right time for fungicide spray which will help in better disease management with reduced fungicide use. A reasonable level of prediction of downy mildew was obtained by using the disease forecasting model of MatWin II and iMETOS automatic weather data recorded. A multi-location trial was initiated to validate the prediction system to check the prediction of downy and powdery mildew and total reduction in the number of fungicide sprays for three consecutive years. Sprays were suggested when risk of disease was indicated by the model. Total five major parameters were observed *i.e.,* terminal PDI of powdery and downy mildew, reduction in the number of sprays, yield and number of pesticide detection in both the plots. Results showed the significant reduction in terminal PDI of downy and powdery mildew along with increased yield and reduction in number of sprays and pesticide detections.

Keywords: Disease forecasting model, Downy mildew, Grapes, Powdery mildew, Prediction system,

INTRODUCTION

Grapevine (*Vitis vinifera)* is a globally important horticultural crop cultivated all over the world. It is the fifth most widely cultivated fruit after banana, watermelon, apples and citrus in the world (Anonymous 2021). The grape itself is used for a myriad of products, ranging from fresh fruit, preserves, juice, wine and raisins. It is a rich source of nutrients like minerals, vitamins, antioxidants like resveratrol, etc. The major medicinal properties of grape and its constituents include antioxidant, anticarcinogenic, immunomodulatory, antidiabetic, anti-atherogenic, neuroprotective, anti-obesity, anti-aging and anti-infection attributes (Yadav *et al*. 2009). In India a production of 3213 Thousand MT from an average area of 152 Thousand ha in the year 2020-21 was recorded (Anonymous, 2022). However, grapevine is subjected to the infection of several diseases which attack susceptible grapevine varieties and cause severe loss in yield as well as to the economy (Mannini

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[Research Article]

Response of different varieties of gladiolus (*Gladiolus grandiflorus* L.) for post-harvest parameters

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ABSTRACT

The present investigation entitled "Response of Different Varieties of Gladiolus (*Gladiolus grandiflorus* L.) for Post-Harvest Parameters" was conducted during February 2021-March 2021 at the Department of Floriculture and Landscape Architecture, K.N.K. College of Horticulture, Mandsaur (M.P.). The experiment was laid out in a completely randomized design with three replications and used nine varieties of gladiolus viz. V_1 (Arka Darshan), V_2 (Arka Gold), V_3 (Arka Nazrana), V_4 (Green Star), V_5 (Jyotsana), V_6 (Psittacinus), V_7 (Punjab Dawn), V_8 (Pusa Kiran) and V_9(Yellow Stone). The result revealed that Yellow Stone recorded the best performance with respect of most of the post-harvest parameters i.e. fresh weight of spike (47.00 g), floret length (8.91 cm), rachis length at harvest (48.90 cm), rachis length at senescence (51.50 cm), longevity of 3rd floret (4.42 days), longevity of 5th floret (4.47 days) and percentage of open floret (88.30 %). The maximum floret diameter (10.21 cm), solution uptake at 5th days (73.75 ml), days taken to opening of 5th floret (5.42 days) and dry weight of spike (6.11 g) was recorded with cv. Arka Gold. The maximum solution uptake at senescence (111.67 ml) & number of open floret (11.92 florets) was recorded with cv. Jyotsana while shortest duration required to days taken to opening of last floret (8.67 days) was recorded with cv. Psittacinus. Punjab Dawn shower the best performance with vase life (13.33 days) of gladiolus spike.

KEY WORDS: Gladiolus, cultivar, spike, vase life and post-harvest

Gladiolus (*Gladiolus grandiflorus* L.) is one of the most popular commercially grown ornamental bulbous plants in many areas of the globe for its interesting blooms and belongs to the family Iridaceae and subfamily Ixoidae. It is often known to as the Sword Lily (Safeena and Thangam, 2019). At the end of the 16th century, gladiolus was introduced all over the world (Azimi, 2020). The gladiolus has around 200 species. Gladiolus has the n=15 of the basic chromosome. Heteroploids with relatively small chromosomes from 2n=30 to 120 (Mahawer *et al.*, 2013) comprise the majority of the genus (Diploid, triploid, tetraploid, pentaploid, hexaploid, octaploid and hyperaneauploid). Gladiolus is a herbaceous plant that sprout from the bud of an underground-modified stem known as corm. It is propagated through seeds, corms and cormels. However, for normal propagation purposes seeds are not used in modern practices.

Gladiolus is a glamorous and beautiful flower that is regarded as the queen of bulbous flowers because of its flower spikes with massive florets, bright colours, appealing forms, varied sizes and long shelf life. Gladiolus is a flowering plant that is cultivated as a flower bed in gardens and used in floral arrangements for gardens, interior decorating and bouquets. On the occasions of Diwali, Holi, New Year, Christmas and marriage ceremonies, there has been high market demand (Kumar *et al.*, 2020).

In India, commercial cultivation of gladiolus is mainly confined to Karnataka, Maharashtra, Punjab, West Bengal, Uttar Pradesh, Haryana, Tamil Nadu, Uttarakhand, Jammu and Kashmir, Himachal Pradesh and Odisha (Singh and Sisodia, 2017). Gladiolus production is becoming more popular among farmers because of its adaptability to various agro-climatic conditions, increased awareness, simple cultural technique and good return on investment. The difficulty is that gladiolus cut

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Effect of planting time on performance of Bermuda grass cv. Selection-I under Malwa plateau conditions of Madhya Pradesh

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ABSTRACT

Common Bermuda grass, *Cynodon dactylon*, is naturalized throughout the warmer regions of India. It is a tetraploid species with broad genetic variability. Bermuda grass has significant ecological, environmental and economic importance. Temperature is the main environmental factor that limits its adaptability to tropical and subtropical areas of the world. The impact of planting time on lawn grass fluctuates throughout the year. The present study was carried out to evaluate the effect of planting time on qualitative and quantitative parameters of Bermuda grass cv. Selection-1 at Experimental Farm, Department of Floriculture and Landscape Architecture, K.N.K. College of Horticulture, Mandsaur in the Malwa plateau region of Madhya Pradesh during 2022-23. The experimental material was consisting of 3 replications with 9 treatments of planting time *i.e.*, T_1 (September 20th), T_2 (October 10th), T_3 (October 30th), T_4 (November 20th), T_5 (December 10th), T_6 (December 30th), T_7 (January 20th), T_8 (February 10th) and T_9 (February 28th). The planting date, T_9 (28th February) gives the best results with respect of most of the quantitative and qualitative parameters *i.e.* the highest survival percentage, number of stolons per plant, stolon internodal length, canopy height, fresh and dry clipping yield, maximum leaf chlorophyll content and turf quality.

Key words: Bermuda grass, performance, planting time, quantitative and qualitative parameters.

INTRODUCTION

Lawn is an integral part of any landscape whose quality is determined by the management of the turf (Janakiram *et al.*, 2015). Lawn grasses belongs to the Poaceae family and comprises 9000 species (Rademacher, 2003) and 600 genera, of which 20-25 species are employed to produce turf which enhances the aesthetic appeal and recreational value of a property (Vengris, 1973). Establishing a healthy lawn requires careful planning and consideration of various factors, including soil conditions, grass species, watering and planting time. Among these factors, planting time plays a crucial role in determining the success of lawn grass establishment. The invention, production and maintenance of specialized grasses for functional, aesthetic and recreational facilities are all included in the turf grass sector today. The lawn care sector is growing with yearly revenue exceeding $1.5 billion (Bertin and Weston, 2002). There is widespread agreement that certain lawn characteristics are the primary drivers of quality. Many people agree that sod's

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Attitude of Farmers Towards Mass Media : A Study in Nimar Agro Climatic Region of Madhya Pradesh

Lalita Nargawe[1] and Shobhana Gupta[2]

ABSTRACT

Radio is one of the most important components of mass media, which became an integral part of the human life and society since ages. Because of its quick coverage, wide reach and popularly, radio is considered as an efficient and ideal tool for talking a wide variety of subjects to the public. The study was carried out on a sample of 240 farmers of mass media. Data were collected through personal interviews of respondents with the help of a structured interview schedule. The majority of the radio listening farmers had a strongly favourable to favourable attitude towards mass media. The study also indicated that majority of the radio listening farmers strongly agreed with the statements like "Radio programme tell us latest technical known-how about improved farm technologies" whereas, majority of them were strongly disagreed with the statements like "Those who follow the recommendations made in farm radio programmes obtain heavy losses".

Keywords: Attitude, farmers, mass media .

INTRODUCTION

Radio is considered as an effective tool to disseminate agricultural information among the farmers and it is the most powerful mass media for broadcasting information quickly. It is a powerful communication medium, particularly in India where, in the absence of regular and stable electric supply in rural areas. People have to depend on radio to meet their needs of information. Radio can reach large audience at the same time. In terms of cost, it is an extremely economical medium as compared to other extension media and methods involving individual and group contacts. Radio is considered as a credible source of information and is taken as authentic, trustworthy and prestigious medium of communication. Credibility refers to the trustworthiness of information perceived by farmers as important and gave weightage in adoption of information. This influenced the adoption of agricultural technology as farmers think them as praiseworthy. A credible source of information stimulates farmers to adopt the recommended package which is suitable to local farm condition. Radio is one of the most important components of mass media, which became an integral part of the human life and society since ages. Because of its quick coverage, wide reach and popularly, radio is considered as an efficient and ideal tool for talking a wide variety of subjects to the public. Even in agriculture sector, the role of radio is instrumental especially in disseminating the agricultural information to the farmers quickly and timely. Attitude of individual plays an important role in determining ones behaviour and adoption of technologies. The favourable attitude would help to adopt new innovation and increase farm production. As a corollary of this, one can say that listening or non-listening of farm radio programme by

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Symbiotic Efficiency, Productivity and Profitability of Soybean as Influenced by Liquid Bio-inoculants and Straw Mulch

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ABSTRACT

A field experiment was conducted at College of Agriculture (RVSKVV), Indore during *kharif* (July–October) 2019 to study on physiological parameter, symbiotic efficiency, productivity and profitability of soybean as influenced by liquid bio-inoculants and mulch under Vertisols in relation to ten treatments. Results revealed that the higher growth attributes, physiological parameters and symbiotic parameters were recorded under *Rhizobium*+phosphours solubilizing bacteria (PSB)+mulch+foliar spray of Plant Growth Promoting Rhizobacteria (PGPR) @ 20 ml l^{-1} water in comparison to other treatments. The highest seed yield (1232 kg ha^{-1}), straw yield (1537 kg ha^{-1}), protein content (41.72%) and protein yield (51628 kg ha^{-1}) were obtained under *Rhizobium*+PSB (seed inoculation)+mulch (wheat straw @ 5.0 t ha^{-1})+foliar spray of PGPR @ 20 ml lml l^{-1} water (at 35 days and flowering stage), which was at par with *Rhizobium*+mulch+foliar spray of PGPR @ 10 ml l^{-1} water, PSB +mulch+foliar spray of PGPR @ 15 ml l^{-1} water and *Rhizobium*+PSB +mulch. The maximum gross returns (₹ 48768 ha^{-1}), net returns (₹ 20762 ha^{-1}), B:C ratio (1.74), production efficiency (14.0 kg ha^{-1} day^{-1}) and economic efficiency (₹ 235.93 ha^{-1}) were also recorded under above treatment. Significantly higher nutrient uptake (82.61 and 35.31 kg N, 4.72 and 8.49 kg P, 24.17 and 41.27 kg K by seed and straw, respectively) were obtained under *Rhizobium*+PSB+mulch +foliar spray of PGPR @ 20 ml l^{-1} water.

KEYWORDS: Bio-inoculants, nutrient uptake, physiological parameters, symbiotic efficiency, yield

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Data Availability Statement: Legal restrictions are imposed on the public sharing of raw data. However, authors have full right to transfer or share the data in raw form upon request subject to either meeting the conditions of the original consents and the original research study. Further, access of data needs to meet whether the user complies with the ethical and legal obligations as data controllers to allow for secondary use of the data outside of the original study.

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Evaluation of Fungicides for Suppression of Bended Leaf and Sheath Blight, Maydis and Turcicum Leaf Blight of Maize

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ABSTRACT

The diseases of maize viz. banded leaf and sheath, maydis leaf blight and *Turcicum* leaf blight occurs persistently to cause severe yield loss. New fungicide combination Hexaconazole 4% + Zineb 68% WP with different concentrations was evaluated as spray application to control the diseases. Among the different doses tested application of Hexaconazole 4% + Zineb 68% WP (60 + 1020g/ml a.i./ha) resulted minimum banded leaf and sheath blight disease severity of 6.45 per cent at 7th day and 7.50 percent at 15th days after second spray during *kharif* season while it was 6.87 at 7th and 7.70 per cent at 15th days after second spray during *rabi* season. Similarly minimum disease severity of maydis leaf blight was 6.87 per cent at 7th and 7.70 per cent was reported at 15th days after second spray during *kharif* season and disease severity of maydis leaf blight was 5.84 at 7th and 6.36 at 15th days after second spray during *rabi* season. The disease severity of *Turcicum* leaf blight was 8.10 at 7th and 8.26 at 15th days after second spray during *kharif* season and in *rabi* season disease severity was 5.84 at 7th and 6.38 at 15th days after second spray. Higher growth attributes (plant height and dry matter/plant) and yield attributes (cob weight and grain weight/cob) were recorded with the application of Hexaconazole 4% + Zineb 68% WP (60+1020 g/ml a.i./ha). Maximum gross return of Rs. 45,887, net returns of Rs. 31,437 and B:C ratio of 2.18 were also noted under Hexaconazole 4% + Zineb 68% WP (60+1020 g/ml a.i./ha).

Keywords: Banded leaf and sheath blight, maydis leaf blight, *Turcicum* leaf blight, Maize, Hexaconazole

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INTRODUCTION

Maize (*Zea mays* L.) is the most versatile crop, adapted to different agro-ecological and climatic condition. In India, maize is 3rd most important cereal crop next to rice and wheat. It is mainly grown in Karnataka, Madhya Pradesh, Bihar, Tamil Nadu, Andhra Pradesh, Maharashtra, Uttar Pradesh and Rajasthan. It has great worldwide significance as human food, poultry feed, piggery feed and as source of large number of industrial products (Khedeka 2009). Maize is grown under diversified environments unmatched by any other crop as the expansion of maize to new areas and environments still continues. In India, it is grown over an area of 8.69 million hectare with total production of about 21.81 metric tonne. The average maize yield in India is 2509 kg/ha. Madhya Pradesh accounts for 1.10 million hectare area with the production of 12.63 metric tonne and 2350 kg/ha productivity (Anonymous 2016).

About 112 diseases of maize have been reported from different parts of the world. Of these, 65 are known to occur in India. The major diseases in different agro climatic regions are: banded leaf and sheath blight, maydis leaf and turcicum blight, seed rots, seedling blight, downy mildews, stalk rots, and smuts and rusts, leading to about 15-20 percent yield losses annually (Saxena 2002). Among them banded leaf and sheath blight (BLSB) of maize caused by *Rhizoctonia solani* f.sp. *sasakii* Exner (teleomorph) is known to be as a serious constraint to maize production in China, South Asia and Southeast Asia. The disease develops on leaves and sheaths and can spread to the ears. Concentric bands and rings appear on infected leaves and sheaths. Maydis leaf blight (MLB), a fungal disease caused by *Drechslera maydis* (Nisikado) Subram, is an important foliar disease in almost all the maize growing regions of India. Losses up to 40 per cent or more have been demonstrated in inoculated yield trails (Byrnes et al 1989). In India, it was reported for the first by Munjal and Kapoor (1960) from the Maldah, West Bengal. The maydis leaf blight injures or kills the leaf tissues and thereby reduces the area of chlorophyll which involved in photosynthesis. If considerable leaf area is killed, then vigour and yields are reduced drastically. Turcicum leaf blight (TLB) of maize caused by *Exserohilum turcicum* (Pass.) Leonard and Suggs is also an important foliar disease in almost all maize growing regions of India and identified as endemic areas for the disease, where reduction in yield has been to an extent of 98%. Bunker and Mathur (2006) reported 20-30 % reduction in grain yield due to TLB. Payak and Renfro (1968) reported disease epidemics at an early stage causing

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sustainability

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Article

Sustainability in Rainfed Maize (*Zea mays* L.) Production Using Choice of Corn Variety and Nitrogen Scheduling

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Abstract: Interestingly more than 50% of the world's area is rainfed and approximately 80% of maize is cultivated under rainfed condition where selection of cultivar and management of nitrogen have major impact on production. The aim of this study was to evaluate the growth, phenology, yield and quality parameters of maize as influenced by variety and nitrogen scheduling under rainfed condition. For this, a field experiment having two factors was laid out in a factorial randomised block design and replicated three times. The first factor was variety, i.e., V_1 (JM 216) and V_2 (JM 218), and the second was six nitrogen scheduling, i.e., N_1 to N_6, in which nitrogen splitting was done based on 30-years of average rainfall data. Variety JM 218 and N_5 [40 kg N as basal followed by (*fb*) 2 splits of 40 kg N and 38.8 kg N at 30 and 52 days after sowing (DAS) and 1% N foliar spray at 40 DAS] nitrogen scheduling were found promising under rainfed situation because it recorded maximum value of growth parameters, yield attributes, grain yield and quality parameters (protein, mineral and dickson quality index). Thus, it can be inferred that JM 218 and N_5 nitrogen schedule would be a better choice than alternative options.

Keywords: corn variety; rainfed; N scheduling; N foliar spray; dickson quality index

1. Introduction

The "Queen of Cereals", maize (*Zea mays* L.), is the world's third-largest cereal crop. The multiple uses of maize as a food, fodder, feed and more recently fuel has further made it a more demand friendly and a high-value crop. Maize is the basis for food security in some of the world's poverty aligned regions of Africa, Asia and Latin America [1]. Globally, 1148.48 million metric tonnes of maize was harvested in 2019 from 197.20 million hectares of land [2]. About 73 percent of this area is located in the developing world. Maize contributes a significant portion of the food consumed by poor communities in developing countries, yet its production is insufficient to meet the requirement of poor people in these areas.

The demand of maize will be doubled by 2050 in the developing world as per Consultative Group on International Agricultural Research (CGIAR) [3]. According to the FICCI-PwC [4] report, India would require 45 million tonnes of maize output by 2022, with 30 million tonnes necessary for feed and 15 million tonnes required for food, seed, and

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RESEARCH ARTICLE

Effect of tillage and weed management on weed dynamics and yield of rice in rice-wheat-greengram cropping system in vertisols of central India

Nisha Sapre*, M.L. Kewat, A.R. Sharma and Priya Singh

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ABSTRACT

A field experiment on effect of tillage and weed management on weed dynamics and yield of rice in rice-wheat-greengram cropping system in vertisols of central India was conducted during *Kharif* 2014 to 2015 at ICAR-DWR, Jabalpur. The experiment consisted of total 15 treatments. A split plot design having three replications was used with five tillage practices in main plots and three weed control treatments in subplots. The maximum weed density and biomass were found when zero tillage was done in rice in presence of *Sesbania* (S) and greengram residues (ZT+S+GG), under zero tillage in rice in presence of *Sesbania* and green gram residues-zero tillage in wheat in presence of rice residues- zero tillage in greengram in presence of wheat residues system [ZT+S+GG(R)-ZT+RR(W)-ZT+WR(GG)] followed by zero tillage done in rice in the presence of only *Sesbania* residues (ZT+S) under ZT+S(R)-ZT(W)-ZT(GG) system. Whereas the minimum was recorded when conventional tillage was done in transplanted rice under CT(TPR)-CT(W)-fallow system which also recorded higher grain and straw yields as well as gross monetary returns but had higher cost of cultivation followed by (ZT+S) under ZT+S(R)-ZT(W)-ZT(GG) system. This system also has the maximum net monetary returns and B:C along with the reduced cost of cultivation. Rotational application of chlorimuron + metsulfuron-methyl 4 g /ha during previous year and post-emergence application (PoE) of bispyribac-sodium 25 g/ha during next year in rice as well as regular application of bispyribac-sodium 25 g/ha PoE in rice during both the years gave similar weed control and recorded the higher crop yield, net monetary returns and B:C. Among different treatment combinations, rotational application of chlorimuron + metsulfuron-methyl 4 g/ha PoE during previous year and bispyribac-sodium 25 g/ha PoE during next year after conventional tillage in transplanted rice under CT(TPR)-CT(W)-fallow system and ZT+S in rice under ZT+S(R)-ZT(W)-ZT(GG) system has resulted lower weed density and biomass along with higher weed control efficiency, higher grain and straw yields and economic returns than other combinations.

Keywords: Bispyribac-sodium, Chlorimuron + metsulfuron-methyl, Conventional tillage, Economics, Productivity, Weed management, Rice, Zero tillage

INTRODUCTION

Rice is a major food crop in India and rice-wheat is one of the valuable and popular cropping system in India as well as most of the regions in the world. It occupies about 13.5 million ha (Mha) of cultivable land in South Asia (Nawaz *et al.* 2019), particularly in India, Bangladesh, Pakistan and Nepal. In most of the part of central India, rice is grown by transplanting method in puddled conditions. This type of cultivation requires a large quantity of water, huge labour and energy; declines crop productivity; causes ill effects on soil health as well as increases cost of cultivation and ultimately lowers the net income. Sowing direct-seeded rice (DSR) is a better choice to overcome the problem of water scarcity and labour shortage (Weerakoon *et al.* 2011). Similarly, sowing of DSR with zero or minimum tillage conserves the soil and water and ensures sustainable crop production. It also abridges the cost of cultivation as well as energy consumption to sustain productivity and secure good earnings for the farmers (Singh *et al.* 2006). Hence, conservation agriculture (CA) become popular among so many countries and they are shifting from conventional agriculture to CA. About 157 Mha area has come under CA in which 15 Mha occupied in India during, 2013 (FAO 2014). Sowing of DSR gives almost equal yield to transplanted rice and it has higher net monetary returns due to lower cost of cultivation (Singh *et al.* 2005). Weeds are the major constraint in DSR it causes yield reduction. Uncontrolled weeds in DSR cause 85 to 98% yield loss especially in zero tillage system (Chauhan and Johnsos 2011). It was assessed that 10 to 32 days after sowing (DAS) in wet-seeding and up to 83 DAS in dry-seeding were more critical for weed control (Sharma *et al.* 2006). In DSR, weed management is a very difficult task as weeds and crop plants emerge at the same time (Khaliq and

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Sources of growth and instability of cotton and castor crops in Madhya Pradesh (India)

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Abstract
The study investigates that the growth, its contribution and variation in area, production and productivity of cotton and castor crops in Madhya Pradesh. The study confined to secondary time series data from 1991-92 to 2020-21 was divided into four periods *viz*., period- I (1991-2001), period-II (2001-2011), period-III (2011-2021) and over all period (1991-2021). The data was collected from various sources *viz*., Directorate of Economics and Statistics, New Delhi, Gol., Directorate of oilseed crops, Bhopal, Agriculture Statistical yearly data books and Directorate of Agriculture, cooperation and farmer's welfare, M.P. etc. The compound growth rate and instability in area, production and productivity of cotton and castor crops were calculated by using exponential growth function and Cuddy Della Index (Cuddy and Della, 1965). It was revealed that throughout the study period, the growth performance of cotton was reported significant increase in area with the magnitude of 1.86 per cent however production and productivity seen increasing growth rate of 18.85 and 16.68 per cent per annum whereas in castor the compound growth rate in area, production and productivity were found to be negative and non-significant at the rate of -1.37, -2.73 and -1.37 per cent per annum respectively in Madhya Pradesh state. It was revealed that during entire study period, yield effect in cotton crop was found to be more dominant at the rate of 558.39 per cent than the area effect (74.53%). Per cent contribution in castor was on served that the interaction effect (321.19%) was reported primary contributor than the area effect (145.83%). The results of instability analysis revealed that the highest variation was observed in production of both the crops the crops (Cotton and Castor) whereas, lowest degree of instability was found in productivity.

Keywords: Exponential function, compound growth and cuddy Della Valle index

Introduction
Cotton and castorwere the most popular textile raw materials and also the cash crops. Cotton referred to as the 'King of Fibre' or 'White Gold'. In worldwide scenario, cotton is grown in over 120 countries among which India holds the largest area (34%) and attained the status of world's largest cotton producer. Cotton plays a dominant role in the industrial and agricultural economy of the country. Globally, the area under cotton was 32.10 million hectares, production accounts for 257.71 million bales and productivity of 1370 kg/ha during 2021-22. India is also largest producer of cotton in the world and producing countries in term of both total area and production. Among the major cotton producing countries in the world, India occupied 1st position with 68.71 million bales. (Estimate report-2021). About 60 million peoples including 15 million cultivators get employment directly or indirectly in the agricultural and industrial sector related to cotton production, processing and textile. By way of cotton exports, the foreign exchanges in 2015-16 alone with amount of Rs. 12.821 crores. Madhya Pradesh tops the organic cotton producer's chart with 38% of the total production during the last 5 years followed by Odissa (20%), Maharashtra (19%), Gujarat (15%) and Rajasthan (8%) are the major organic cotton producer's (Pavithra, *et al*., 2022) [8]. In Madhya Pradesh cotton is grown more than 404.08 thousand hectares with an annual production of 312.03 lakh tonnes 180 Kg/bales. (Anonymous, 2021-22) [1, 2]
Castor bean is one of the prominent industrial oilseed crop grown in India. It is confined to mostly Gujarat, Rajasthan and Andhra Pradesh. Cotton is also grown on a limited scale in the states of Karnataka, Tamil Nadu, Maharashtra, Orissa and Madhya Pradesh. (Padmaiah, M 2014) Castor is a non-edible vegetable oilseed crop cultivated overall the world. Indian is the largest producer and exporter of the castor oil. Castor is an important feed stock for th chemical industry which is utilized for biodiesels. It is used for the production of lubricant hydraulic, brake fluid, coating fertilizer, soaps, waxes and grasses. Castor oil is mostly utiliz as economically important seed oil in the world. Castor seed comprises about 40-55% oil, a kernel contains 64-71% oil which is the highest among cultivated oil crops.

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Growth and Instability of Major *Kharif* Pulse crops in Madhya Pradesh State of India

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ABSTRACT

The study was conducted to evaluate the growth rate and instability in area, production and productivity of major *Kharif* pulse crops *viz.*, pigeon pea, green gram and black gram in Madhya Pradesh. The study was solely based on secondary time series data, collected from various sources: e-pulses data book (ICAR), State Pulses Board (M.P.), Directorate of Economics and statistics (DES), GoI. The compound growth rate and variation in area, production and productivity of major *Kharif* pulse crops in Madhya Pradesh were calculated by using exponential trend function and Cuddy-Della Valle Index for the last thirty years had been segmented into four periods namely period-I (1991-92 to 2000-01), period-II (2001-02 to 2010-11), period-III (2011-12 to 2020-21) and overall period (1991-92 to 2020-21). The results of growth performance had been shown that the area of pulse crops was continuously increased over the years. In overall study period, the growth rate in area, production and productivity of pigeon pea were seen significantly increasing pattern accounts for 0.69, 2.33 and 1.62 per cent, respectively. However, area of green gram seen declined non-significant growth at the rate of -0.69 per cent while, production and productivity were increased significantly at the rate of 2.09 and 3.04 per cent, respectively. And in Black gram, the area, production and productivity were increased significantly at the rate of 9.14, 13.76 and 4.23 per cent per annum, respectively. The study revealed that the instability analysis showed almost all pulse crops as well as total pulse crops grown in Madhya Pradesh were observed more variation in terms of production and least variation in productivity as compared to area. Crop wise analysis during entire study periods showed that in case of production, the highest instability was observed in green gram (63.94%), followed by black gram (62.00%) and pigeon pea (43.32%), respectively. And similar instability pattern was observed in case of area of pulse crops. However, least variation was observed in productivity of pigeon pea (17.35%), followed by black gram (26.17%) and green gram (19.18%) during overall period.

Keywords: Exponential trend function, Compound growth rate, Cuddy-Della Valle Index and Instability.

Production of pulse crops plays an important role in Indian agriculture after cereals and oilseed crops. Pulse crops comprises of pigeon pea, green gram, black gram, cowpea, horse gram, moth bean in *Kharif* and chickpea, lentil, pea, lathyrus in *Rabi* seasons with high nutritive value in quality protein complementing with cereals in the country. Pulses are generally known as "Poor man's meat" and "rich man's vegetable" because pulse crops provide proteins, vitamins and minerals especially for vegetarian diets in India. Pulse crops enrich the

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Overview of Dryland Agriculture Research and Achievements in Malwa Plateau Zone of Madhya Pradesh

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Brief history of the centre

The All India Coordinated Research Project for Dryland Agriculture (AICRPDA) centre at Indore was started in 1971 while the Operational Research Project (ORP) at the centre started in 1986. Indore centre since its inception has been carrying out location-specific research on various themes of dryland agriculture, *viz.* rainwater and soil management, cropping systems, integrated nutrient management, participatory approach for crops/varietal selection, energy management, alternate land use system.

Agro-climatic zone characteristics

The centre is located in central highlands (Malwa) Gujarat plain Kathiawar peninsula semi – arid eco-region (AESR 5.1). It represents Malwa region situated at 76° 54' E longitude and 22°43' N latitude at an altitude of 618 m above MSL. The agro-climatic zone IX *i.e.*, Malwa plateau comprises of districts Ujjain, Shajapur, Indore, Rajgarh, Dewas, Dhar, Neemuch, Mandsaur, Ratlam, Jhabua (only Petlawad tehsil) covering an area of 5.18 million hectares. The climate in this zone is semi-arid. Out of the total annual average rainfall of 941 mm, about 90 to 94% is received during south-west monsoon while 3 to 6% and 3 to 4% is received during northeast monsoon and summer, respectively. The normal onset of monsoon is during third week of June and normal withdrawal is during third week of September. The dry spells during crop season are experienced during September coinciding with seed formation stage of the soybean and maize.

Mean season-wise and annual rainfall and rainy days at AICRPDA centre, Indore

Rainfall	Normal rainfall (mm)	Normal rainy days (No.)
South west monsoon (June-September)	855.91	-
North east monsoon (October-December)	48.50	-
Winter (January-February)	13.40	-
Summer (March-May)	21.36	-
Annual	939.17	-

Major soil types

The major soil types in the zone are clayey and clay loam and shallow to medium deep, deep black soils.

Major rainfed crops

The major rainfed crops cultivated in the zone during *kharif* are soybean, maize and sorghum and during *rabi*, chickpea, mustard and wheat.

Dryland agriculture problems

Soils and land problems

- High intensity of rains
- Poor infiltration rate of water
- Lack of adoption of suitable conservation measures
- The soils are low in nitrogen, medium in phosphorus and high in potassium

Crop production

- Low seed replacement rate
- Residue management
- Lack of locally growing green manure
- Poor mechanization

Socio economic conditions

- Small land holdings
- Low risk bearing capacity of farmers
- Poor adoption of technologies
- Market risks
- Short supply of inputs

Significant achievements

Rainwater management

- Maize (grain)-sweet corn cropping system with supplemental irrigation from harvested rainwater in farm pond was found more remunerative with total net returns of Rs.159844 ha^{-1} followed by maize (grain) – chickpea (Rs. 120433 ha^{-1}) and soybean- onion (Rs. 108394 ha^{-1}). Seven irrigations (317 m^3) were given in sweet corn and onion (344.25 m^3) at critical growth stages and one irrigation (39.25 m^3) was given to chickpea crop before flowering stage.

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Effect of biodynamic package with vermicompost on growth, yield, quality and economics of potato under Malwa conditions of Madhya Pradesh

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ABSTRACT

A field experiment was conducted to assess the impact on growth, yield, quality and economics of potato at Research farm, College of Agriculture, Indore (M.P.) during *Rabi* season 2021-2022 in RBD with 3 replications. For meet up the demand, 9 treatments *viz.* T_1 [Biodynamic preparation 500 (BD-500) @ 2.5 g/l], T_2 [Biodynamic preparation 500 (BD-500) @ 5.0 g/l], T_3 [Biodynamic preparation 501 (BD-501) @ 2.5 g/l], T_4 [Biodynamic preparation 501 (BD-501) @ 5.0 g/l], T_5 (Vermicompost @ 2.5 tons/ha), T_6 (BD-500 @ 2.5 g + vermicompost @ 2.5 tons/ha), T_7 (BD-500 @ 5.0 g + vermicompost @ 2.5 tons/ha), T_8 (BD-501 @ 2.5 g + vermicompost @ 2.5 tons/ha), T_9 (BD-501 @ 5.0 g + vermicompost @ 2.5 tons/ha) and T_0 (Control) were used. The treatments T_9 (BD-501 @ 5.0 g + vermicompost @ 2.5 tons/ha) (53.83 g) and T_8 (BD-501 @ 2.5 g + vermicompost @ 2.5 tons/ha) (53.67) recorded higher fresh weight of leaves per plant. Diameter of tubers was highest in T_9 (8.42 cm) followed by T_8 (8.23 cm). T_9 recorded highest net income and B-C ratio (Rs 5,75,070.67 and 1:3.72 respectively) followed by T_8 (Rs 5,06,428.33 and 1:3.71 respectively). Thus, it can be concluded that the vermicompost and biodynamic approach are an advantageous source for sustainable agriculture specially for heavy feeder crops like potato.

Keyword: Biodynamic approach; biofertilizer; potato; yield; quality

INTRODUCTION

Potato (*Solanum tuberosum* L.) is one of the most important food crops after wheat, maize and rice. It belongs to the family Solanaceae and is originated from South America having chromosomes number 2n (4x) = 48 and is a self-pollinated crop. In India, area and production of potato is 2.20 Mha and 56.17 MT while in Madhya Pradesh area and production is 0.15 Mha and 3.67 MT respectively (Anon 2021). Major potato growing districts are Indore, Chhindwara, Dewas, Dhar, shajapur, Ujjain, Sidhi, Satna, Sagar district in Madhya Pradesh has maximum total area and production of potato (NHB, 2020-2021).

The biodynamic method is a new approach to agriculture, based on advanced knowledge of the working with soil, plants and animals which are considered to be the components of the environment. The biodynamic methods aims to produce well balanced plant growth and sustainable soil fertility by improving the soil structure and nutrient availability. A good range of preparations are available in biodynamic package, which increase production and at the same time eliminate the use of agricultural chemicals. The biodynamic preparations include various type preparation 500 and preparation 501.

Vermicompost enhances physical and chemical characteristics of soil in potato cultivation, provides excellent effect on overall plant growth and encourages the growth of new shoot/leaves and improves the quality and shelf life of produce. Organic matter through the application of vermicompost increases the bioavailability of phosphorus in the soil effecting plant growth in potato cropping. Compost application also effects nitrogen mineralization in soil (Ansari et al, 2008). Positive effect of vermicompost on photosynthetic pigments of vegetable crops is recommended and the increase in growth, yield and

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Effect of Biodynamic Package with Biofertilizer on Growth, Yield, Quality and Economics of Potato under Malwa condition of Madhya Pradesh

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ABSTRACT: A field experiment was conducted to assess the impact on growth, yield, quality and economics of potato at Research farm, College of Agriculture, Indore (M.P.) during *Rabi* season 2021-2022 in RBD with 3 replications. The yield, productivity and quality parameters are limiting in the potato crop, particularly in the black cotton soil. Hence, the biodynamic package with biofertilizers are attemped to enhance the production, productivity and quality parameters in potato crop. For meet up the demand, 9 treatments *viz.* T_1: Biodynamic preparation 500 (BD-500) @ 2.5 g/litre, T_2: Biodynamic preparation 500 (BD-500) @ 5.0 g/litre, T_3: Biodynamic preparation 501 (BD-501) @ 2.5 g/litre, T_4: Biodynamic preparation 501 (BD-501) @ 5.0 g/litre, T_5: Azotobactor @ 5 ml/litre, T_6: BD 500@ 2.5 g + Azotobactor @ 5 ml/litre, T_7: BD 500@ 5.0 g + Azotobactor @ 5 ml/litre, T_8: BD 501@ 2.5 g + Azotobactor @ 5 ml/litre, T_9: BD 501 @ 5.0 g + Azotobactor @ 5 ml/litre, and T_0: Control were used The results revealed that combination of azotobacter + biodynamic approach (BD-501) was the best among all the treatments for most of the growth and yield parameters under study and gave highest net return and B: C ratio. Thus, it can be concluded that the biofertlizer (Azotobacter) and biodynamic approach are an advantageous source for sustainable agriculture specially for heavy feeder crops like potato.

Keywords: Biodynamic approach, Biofertilizer, Potato and Sustainable agriculture.

INTRODUCTION

Potato (*Solanum tuberosum* L.) is a versatile, carbohydrate-rich food and highly nutritious, easily digestible, wholesome food containing carbohydrates, protein, minerals, vitamins and high quality dietary fiber. In India area and production of potato is 2.15 Mha and 51.30 Mt with productivity of 23.86 t/ha. While in Madhya Pradesh area and production is 0.18 Mha and 2.69 Mt respectively, with 14.95 t/ha productivity (NHB, 2020-2021).

Being a high yielding and nutrient exhaustive and short duration crop needs higher quantities of fertilizers and pesticides. The low productivity of potato in India as well as in Madhya Pradesh is mainly due to imbalanced utilization or non- utilization of fertilizers/organic manures which does emphasizes the need for judicious and combined application of biofertilizers and organic manures. The biodynamic methods aims to produce well balanced plant growth and sustainble soil fertility by improving the soil structure and nutrient availability. Biofertilizers can play an important role in potato crop which has higher nutrients need because of its sparse root system, it becomes imperative to adopt environment friendly approaches through integrated use of biofertilizer and organic manure in right proportion for ensuring optimum potato yield.

The application of Azotobacter and PSB might have significantly enhanced the availability of native and applied macro and micro nutrients, vitamins, enzymes, antibiotics, growth hormones and insoluble nutrients to the plants, as consequence of which increase the yield of potato tubers and plant. The biofertlizers (azotobacter & phosphobacteria) and biodyanamic inputs area beneficial sources of nutrients for sustainable organic agriculture in potato (Verma *et al.*, 2011). However, the available information on the role of these biofertilizers together with a biodynamic approach in potato is meager. Therefore, an experiment was carried out to examine the effect of biodynamic package with biofertilizer on growth and yield characteristics in potato.

MATERIALS AND METHODS

A field experiment on potato (cv. Kufri Jyoti) was conducted at Research Farm of Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Department of Horticulture, College of Agriculture Indore, during (*Rabi*) 2021-2022 at spacing of 45cm × 30cm in net plot size of 2.25 × 1.8 sq.m. The experimental was conducted in Randomization Block Design with three replications and nine treatments with control, *viz.*, T_1: Biodynamic preparation 500 (BD-500) @ 2.5 g/litre, T_2: Biodynamic preparation 500 (BD-500) @ 5.0

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Impact of organic mulches on growth, yield and quality of potato (*Solanum tuberosum* L) in Malwa region of Madhya Pradesh

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ABSTRACT

A field experiment was conducted to assess the impact of organic mulches on growth, yield and quality of potato at the research farm of College of Agriculture, Indore, Madhya Pradesh during rabi season of 2020-2021. The experiment was conducted in RBD with 3 replications. Nine treatments viz T_0 [Control (non-mulch)], T_1 (Paddy straw 2.5 cm), T_2 (Paddy straw 5.0 cm), T_3 (Wheat straw 2.5 cm), T_4 (Wheat straw 5.0 cm), T_5 (Soybean straw 2.5 cm), T_6 (Soybean straw 5.0 cm), T_7 (Vermicompost 2.5 cm) and T_8 (Sawdust 2.5 cm) were used to find out the best materials that could help the farmers to improve their crop production. The results revealed that growth parameters like plant height (30.58 and 29.71 cm), number of branches/plant (15.77 and 14.66), number of leaves/plant (51.66 and 50.21), fresh weight of leaves/plant (57.41 and 56.61 g), dry weight of leaves/plant (5.50 and 5.17 g) and diameter of tubers (5.27 and 5.00 cm) were maximum in T_1 (Paddy straw 2.5 cm) and T_2 (Paddy straw 5.0 cm) respectively, whereas, leaf area (305.04 cm^2), leaf area index (3.05), weight of tubers/plant (747.00 g), yield of tubers/ha (373.52 q) and TSS (7.50°Brix) were maximum in T_1. The same treatment, T_1 also resulted in maximum net profit/ha (Rs 4,06,474) and B-C ratio (1:2.64). Among the treatments, T_8 (Sawdust 2.5 cm) was the poorest performer.

Keyword: Potato; mulching; straw; compost; growth; yield; economics

INTRODUCTION

Agriculture today has become a highly knowledge intensive enterprise. Moreover, in the modern day paradigm of sustainable development goals, it is expected of the farmers to produce more from less input and with minimum detrimental effect on the environment. The farmers on the other hand, desire to get the maximum profit using the resources available at their command without deteriorating their non-renewable resources. This calls for expertise for determining the quantity of various inputs to be used as well as scheduling of various cultural operations. Thus agriculture calls for great deal of managerial and technical skills for successful crop production and its marketing.

Potato, an important food and vegetable crop of the world, produces more weight and calories per unit area as compared to all other field crops. It provides a source of low cost energy for human diet. Potato tubers are also a rich source of starch, vitamins (specially B and C) and minerals (Arora et al 2009). During 2020-21 in India, potato occupied about 22.50 lakh hectare area and production was about 542.30 lakh MT (http://www.aau.in/sites/default/files/23_potato_pre_sowing_pf_2021_22_ eng.pdf). In India, the major rabi potato producing states are Uttar Pradesh, West Bengal, Bihar, Gujarat, Madhya Pradesh, Punjab, Assam, Chhattisgarh, Jharkhand and Haryana.

The application of organic mulches increases the crop growth such as earliness and harvesting period. It has a great role in soil moisture conservation through modification of microclimatic soil conditions. It helps to prevent weed growth and increases infiltration of rain water during growing season and also reduces

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Standardization of growing media on growth and yield of cucumber (*Cucumis sativus* L.) in containers

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Abstract
The entitled research work "Standardization of growing media for organic cucumber (*Cucumis sativus* L.) Production in containers" was conducted during the *rabi* season of the year 2020-21 in the Department of Horticulture, College of Agriculture, Indore (M.P.). The research material under research comprised of 8 treatment 8G1-soil + sawdust + FYM (2:1:1), G2-soil + cocopeat + FYM (2:1:1), G3-soil + sawdust + vermicompost (2:1:1), G4-soil + cocopeat + vermicompost (2:1:1), G5-soil + cocopeat + vermiculite + perlite (2:1:1:1), G6-soil + cocopeat + vermiculite + FYM (2:1:1:2), G7-sawdust + vermiculite + FYM + perlite + coco coir (1:1:2:1:1), and G8-soil alone (Control) which were tested in RBD with three replications with the objectives *viz.*

1. To find out the effect of different growing media on growth and yield of cucumber in containers.
2. To find out the suitable growing media for rooftop and terrace gardening of cucumber.
3. To know the economics of different growing media in containers.

It can be concluded that the applied of different treatment combinations, treatment G5-soil + cocopeat + vermiculite + perlite (2:1:1:1), was best at all the stages of growth, quality and yield parameters like vine length (cm), number of primary branches per vine, number of leaves per vine, number of nodes per vine, days to first flower initiation, fruit length (cm), fruit girth (cm), total number of picking, no. of fruit per vine, average fruit weight per vine, fruits yield per vine, total fruit yield per container and fruit TSS parameters showed better performance from other treatment levels. B:C ratio was obtained under different treatments ranged from -0.07 to 1.50. It was found to be highest (1.50) under the G1-Soil +sawdust +FYM and the lowest (-0.07) under the G7-sawdust +vermiculite +FYM +perlite +Cococoir, no doubt this is due to more input cost of media in the treatment.

Keywords: Sawdust, cocopeat, perlite, vermicompost, FYM, cucumber in containers gardening

Introduction
Cucumber (*Cucumis sativus* L.) is commonly known by its vernacular name as "Khira" is an important vegetable crops belongs to the Cucurbitaceous family having chromosome number 2n = 14. It is originated in Southern Asia probably in India (Gangadhara *et al.* 2019) [5]. From India, it seems to have spread to other parts of Asia, Africa and then to Europe. It is almost grown throughout India in open as well as in protected conditions. It is a short duration crop and most important in kitchen gardens, therefore, cultivated broadly throughout the world round the year The leading states in India growing cucumber are Punjab, Uttar Pradesh, Bihar, Rajasthan, Madhya Pradesh, West Bengal, Assam, Meghalaya, Andhra Pradesh, Tamil Nadu and Gujarat. The major growing districts in Madhya Pradesh are Barwani, Indore, Shahdol, Satna, Jabalpur, Khargone, Sagar, Rewa, Dhar and Ujjain. The China is the world leader in cucumber area and production, However, India ranks 25th with area under cultivation 82,000 ha. And annual production 12,60,000 MT. In Madhya Pradesh and district Indore the area under cultivation and av annual production of cucumber is 9,460 ha. And 154,520 MT. and 1,000 ha. And 20,000 MT. respectively.

Materials and Methods
A field experiment was conducted during 'Kharif' season of the year 2016a. A field experiment was conducted during 'Kharif' season of the year 2016a. A field experiment was conducted during the rabi season of 2021-22. Department of Horticulture, College of Agriculture, Indore (MP). At a latitude of 22o 43 "N and a longitude of 75o 66 "E with an altitude of 555.5 meters above mean sea level. The experiments was laid out in randomized block design (RBD) with three replication. The experiment comparised 24 treatment combinations 8G1-soil + sawdust + FYM (2:1:1), G2-soil + cocopeat + FYM (2:1:1), G3-soil

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Combined Impact of Major and Micronutrients on Vegetative Growth and Incidence of Pests and Diseases of Garlic (*Allium sativum* L.)

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ABSTRACT: Incidence of pest and diseases is a common problem in garlic production. Micronutrients application may redress this problem to some extent. Therefore a field experiment was carried out at Research Farm, College of Agriculture, Indore (M.P.) during season 2020-21 to study the combined impact of major and micronutrients on vegetative growth and incidence of pests and diseases of garlic. The experiment comprising ten major-cum-micronutrients was laid out in a randomized block design with three replications. The Results revealed that the application of 100:50:50 NPK + boron 1 kg ha^{-1} (soil application) + boron 0.5% (foliar) T_7 recorded maximum plant height (54.31 cm), leaf width (1.94 cm) and length of pseudostem (4.95 cm). The yield was 143.44 q ha^{-1}. This was equally followed by T_2 and T_1 having foliar and soil applied boron respectively along with 100:50:50 NPK kg ha^{-1}. On the other hand, application of only 100:50:50 NPK recorded significantly lowest vegetative growth parameters and thereby yield (109.60 q ha^{-1}). The thrips and purple blotch incidence was found minimum under T_8 having 100:50:50 NPK + sulphur 30 kg ha^{-1} applied through soil + sulphur 0.6% applied through foliar which recorded maximum garlic yield up to 158.44 q ha^{-1}. This was followed by T_4 (156.44 q ha^{-1}) and T_3 (150.89 q ha^{-1}) having foliar and soil applied sulphur along with 100:50:50 NPK.

Keywords: Major, micronutrients, yield, disease pest, garlic.

INTRODUCTION

Garlic (*Allium sativum* L.) is one of the most important spices and condiments used in daily cooking in India. It is an important crop among all the spice crops due to its medicinal as well as flavour and taste imparting characters. Garlic belongs to the family Alliaceae with genus *Allium* and species *Sativum* having 2n=16 chromosome numbers. In Madhya Pradesh, garlic has the highest area of 178 thousand hectares and production 1808 thousand tonnes with the productivity up to 10.15 t ha^{-1} (National Horticulture Board, 2020). The Mandsaur and Indore districts are the main producer of garlic in Madhya Pradesh. Continuous low yield in garlic attributed due to many factors like lack of proper planting material, inappropriate agronomic practices, inadequate pest and disease management, marketing facilities etc. (Nasreen *et al.*, 2009). The use of major and micronutrients application is also very limited in this crop, resulting poor growth, yield and quality of garlic. Micronutrients are deficient in Indian soils because their removal by vegetable crops are never replenished (Rattan and Sharma 2014).

The micronutrients like sulphur, zinc, boron play an important role in photosynthesis, N-fixation, respiration and the metabolic processes of plant. Foliar application of micronutrients during crop growth correct the deficits and improving the mineral status of plants as well as increasing the crop yield and quality of garlic (Kolota and Osinska 2001). Garlic requires different micronutrients which are essential for health, growth and development. These are usually required in smaller amount than nitrogen, phosphorus and potassium. These are very important for growth and general health. (Singh *et al.*, 1995).

Due to non-addition of zinc and boron, crops suffer in many ways. In deficient condition of boron, growing plant become dead and ultimately the lateral shoots, buds and flowers dies. Chlorosis, thickening and curling of leaves were also observed (Francois, 1991). Limited work has been done on sulphur, zinc and boron towards the control of pests and diseases in garlic. Looking to all these facts the present research was taken up.

MATERIALS AND METHODS

The field experiment was conducted during *rabi* season of 2020-21 at the Research Farm, College of Agriculture, Indore (M.P.). The soil of the experimental field was silty clay-loam having pH 7.2, organic carbon 7.6 g kg^{-1}, available N, P and K 226, 10 and 448 kg ha^{-1}, respectively. The experiment was laid out in randomized block design keeping three replications. The 10 treatments having different combinations of major and micronutrients fertilizers were T_0=100:50:50 NPK (control), T_1=100:50:50 NPK + boron 1 kg ha^{-1}(soil application), T_2=100:50:50 NPK + boron 0.5% (foliar), T_3= 100:50:50 NPK + sulphur 30 kg ha^{-1} (soil application), T_4= 100:50:50 NPK + sulphur 0.6% (foliar), T_5= 100:50:50 NPK + zinc 7.5 kg ha^{-1} (soil application), T_6= 100:50:50 NPK + zinc 3% (foliar), T_7

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Effect of integrated nutrient management strategies on growth and yield of Amaranthus (*Amaranthus tricolor* L.)

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Abstract
An experiment was conducted during the Kharif season to investigate the effect of integrated nutrient management on growth and yield of amaranthus. It was laid out in Randomized Block Design with three replications. Results revealed that application of different levels of manures, fertilizer and biofertilizers application, either alone or in combination significantly affected the growth and yield of Amranthus at first, second and third cutting at 20 cm height. Application of T_{12} half dose of NPK (60:40:20 kg ha^{-1}) + half dose of vermicompost (2.5 t ha^{-1}) + *Azotobacter* and PSB (200g/10 kg seed each) observed significantly higher number of leaves $plant^{-1}$ (11.81, 29.16 and 20.58), fresh weight of leaves (227.34g, 591.95g and 406.97g), dry weight of leaves (43.97 g, 111.69 g and 77.74 g), leaf area (18.67 cm^2, 20.77 cm^2 and 20.18 cm^2), leaf area index (0.0277, 0.0308 and 0.0299) and yield per hectare (21.31 q^{-1}, 48.68 q^{-1} and 35.98 q^{-1}) at first and subsequent second and third cutting at 20 cm height.

Keywords: Integrated, nutrient, management, Amaranthus, *Amaranthus tricolor* L.

Introduction
Vegetables form a vital part of our daily diet. The general recommendation for intake of vegetables is at least 300 grams per person per day which includes 125 gm leafy vegetables. Leafy vegetables which are also called as "mines of minerals" (Van Soest *et al*, 1991) [22]. because they supply a noteworthy amount of vitamins and minerals plus protein, carotene (vitamin A), iron, and ascorbic acid (vitamin C) to our diet. Out of common leafy vegetables, Amaranthus is the most popular vegetable consumed by people all over India (Akubugwo *et al*, 2007) [1]. The word amaranthus is basically derived from the Greek word "Anthos" (flower) which means everlasting or unwilting. It is popularly known as "Chaulai" and "poor man's vegetable" belongs to the genus Amaranthus, family Amaranthaceae. The family comprises 65 genera and 850 species throughout the world. *Amaranrthus tricolor* L. is one of them. It was extensively cultivated in Bengal by the natives (Watts, 1889) [24] and an important amaranth cultivated in South India (Sankaran, 1943) [18]. It is said to be the native of India (Nath, 1976) [13]. The centers of diversity for amaranthus are Central and South America, India, South East Asia and the secondary diversity is the West Africa and East Africa (Grubben, 1977) [6]. It is a C4 plant and fits well in crop rotation because of its very short duration nature and large yield of edible matter per unit area. The fresh leaves and stem of amaranthus are delicious when cooked. Its wider environmental adaptability, higher nutritive value, good taste, less risk of crop failure and various biotic and abiotic factors indicated that there is enough scope for its promotional cultivation. It is a highly nutritive crop as it contains 371 kcal energy, 65.5 g carbohydrates, 7.02 g fat, 13.56 g protein, vitamins and trace elements (Kumar *et al*, 2015) [9]. The overall performance of amaranth directly relies on nutrient status of soil, which is managed by the application of organic and inorganic fertilizers in an appropriate ways. Nutrients may be applied through two sources *viz*. Organic and inorganic sources. Increased use of chemical fertilizers in crop production deteriorates soil health, kills useful microbes and creates an imbalance in the environment by polluting nature. Besides, nowadays gradual deficiencies in soil organic matter and reduced yield of the crop are alarming problems in India. Apart from this, the cost of chemical fertilizers is very high and sometimes it is not available in the market for which the farmers fail to apply the inorganic fertilizers to the crop field in optimum time. The harmful impacts of chemical fertilizers on soil and human health and their increasing prices forced us to adopt alternative source of nutrients for vegetable production.

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Estimation of Genetic Parameters in Okra [*Abelmoschus esculentus* (L.) Moench] under Malwa region of Madhya Pradesh

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ABSTRACT: Sixteen okra genotypes were evaluated to estimate the genetic parameters of yield and its attributing traits. The genotypes were sown in randomized complete block design (RCBD) with 3 replications at the Research area, Department of Horticulture, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, College of Agriculture, Indore, Madhya Pradesh. The differences were statistically significant among the genotypes for all the traits studied. Fruit and shoot borers and yellow vein mosaic virus (BYVMV) are major challenges in okra production. In the present study, High magnitude of the phenotypic coefficient of variance (PCV) than the genotypic coefficient of variance (GCV) was observed for all the traits. None of the characters reported higher PCV and GCV while, moderate PCV and GCV were observed for the number of branches per plant, number of nodes to 1st flowering, length of internodes and number of leaves per plant, fruit yield per plant, fruit yield per plot and fruit yield per hectare. High heritability coupled with high genetic advance as a percentage of mean (GAM) was observed for fruit yield per plant, fruit yield per plot, fruit yield per hectare, number of branches per plant at 60 DAS and 90 DAS, plant height at 60 DAS, number of leaves per plant at 30 DAS, number of nodes to 1st flowering and length of internodes, suggesting that direct selection of these traits for crop improvement will be rewarding due to predominance of additive variation.

Keywords: Variability, heritability, genetic advance, PCV and GCV, yield, Okra.

INTRODUCTION

Okra [*Abelmoschus esculentus* (L.) Moench] belongs to the Malvaceae family and has chromosome 2n = 130. It is one of the most well-known vegetables. The world's most favoured fruit and vegetable is widely cultivated in tropical, subtropical, and warm regions like India, Africa, Turkey, and its neighbouring nations. In India, it occupies the fifth position, next to tomato in the area under vegetables in the country. It is grown throughout the country except in mountainous regions. India ranks 1st in the world with an area of 5.07 Million ha and production of 58.5 Million tonnes and productivity 11.5 tonnes per hectare. In Madhya Pradesh, okra is grown in a 2.8 Million ha area with a production of 32.8 Million tonnes and productivity of 11.7 tonnes (Anonymous, 2021).

It is an important fruit vegetable of high commercial and food value. Although its curry, soups, and young leaves are particularly popular, its tender immature green in fresh form is its main selling point. Characterization and quantification of genetic diversity and information on the genetic, for the effective use of plant genetic resources, variation within and among closely related crop varieties is crucial. When evaluating attributes, it is necessary to grow the plants to full maturity before identification because phenotypic and morphological diversity typically vary with environments. The amount of genetic parameters, heritable and non-heritable factors, and other factors have all been attempted to quantify such as genotypic and phenotypic coefficient of variation (GCV & PCV), heritability (bs) and genetic advance as a percentage of mean (GAM) in some of the quantitative traits of okra.

MATERIALS AND METHODS

Sixteen germplasm lines of Okra [*Abelmoschus esculentus* (L.) Moench] were evaluated for yield and its contributing traits. List of genotypes used in the study is depicted in (Table 1). All the 16 genotypes of

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Role of growth stimulators, retardants and inhibitors in combination with micronutrients on growth and development of okra [*Abelmoschus esculentus* (L.) Moench] Variety Arka Anamika

Priyanka Jain, Diksha Tembare, Ajay Kumawat and NK Gupta

Abstract
The experiment detail for the present investigation was comprised of 13 treatments in Randomized Block Design with three replication, to record morphological, phonological, Growth analysis, yield its attributes and economics. The growth stimulators, Retardant and micronutrient significantly improved the plant height and highest branches of okra. The maximum plant height and highest branches per plant was recorded when sprayed NAA @ 100 ppm followed by $Feso_4$ (0.5%). The higher number of leaves and leaf area (cm^2) were recorded at NAA @ 100 ppm followed by $Feso_4$ (0.5%). Higher numbers of internodes, higher length of internodes and plant stem diameter were recorded in foliar spray of NAA @ 100 ppm followed by $Feso_4$ (0.5%). The foliar spray of growth regulators, retardants and micronutrient was recorded in significant improvement in dry weight okra. The days taken to first flowering differed significantly the different treatment. The number of flower bud, the fruit length, fruit width, fruit per plant, fruit yield per plot, and fruit weight and crop growth character are differed significantly in different treatment combination.

Keywords: Randomized block design, growth regulators, micronutrients, retardant etc.

Introduction

Okra [*Abelmoschus esculentus* (L.) Moench] popularly known as 'Bhindi' (ladies' finger) is an economically important vegetable crop grown in tropical and sub-tropical parts of the world (Tindall, 1986) [1]. Okra having chromosome number = 130, belongs to the family Malvaceae. Several species of the genus Abelmoschus are grown in many parts of the world among them *Abelmoschus esculentus* (L.) Moench is most commonly cultivated in Asia and has a great commercial demand due to its nutritional values. Okra is a multipurpose crop due to its various uses of the fresh leaves, buds, flowers, pods, stems and seeds. Okra immature fruits (green seed pods), which are consumed as vegetables, can be used in salads, soups and stews, fresh or dried, fried or boiled. Okra fruits are cooked and consumed in a variety of ways. It has been reported to have an average nutritive value (ANV) of 3.21 which is higher than tomato, eggplant and most of cucurbits except bitter gourd (Grubben, 1977) [2]. Okra [*Abelmoschus esculentus* (L.) Moench] popularly known as 'Bhindi' (ladies' finger) is an economically important vegetable crop grown in tropical and sub-tropical parts of the world (Tindall, 1986) [1]. Okra having chromosome number = 130, belongs to the family Malvaceae. Several species of the genus Abelmoschus are grown in many parts of the world among them *Abelmoschus esculentus* (L.) Moench is most commonly cultivated in Asia and has a great commercial demand due to its nutritional values. Okra is a multipurpose crop due to its various uses of the fresh leaves, buds, flowers, pods, stems and seeds. Okra immature fruits (green seed pods), which are consumed as vegetables, can be used in salads, soups and stews, fresh or dried, fried or boiled. Okra fruits are cooked and consumed in a variety of ways. It has been reported to have an average nutritive value (ANV) of 3.21 which is higher than tomato, eggplant and most of cucurbits except bitter gourd (Grubben, 1977) [2]. The Plant growth regulators available are often inadequate in the plants. The specific quantities in the plants are directly responsible for the promotion, inhibition or otherwise modification in the physiological processes. (Kumar *et al.*, 2018) [12]. The role of plant growth regulators is enhancing the production and quality of crops. They can be divided into five classes i.e., Auxin, Gibberellins, Cytokinins, Abcissic acid and Ethylene. It is known to influence growth and development at very low concentration but inhibit plant growth and development at high concentration (Patel *et al.*, 2018) [11].

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Evaluation of yield and economics of soybean cultivation under different land configuration in Malwa region of Madhya Pradesh

ML Jadav, Narendra Kumawat, KS Bhargav, Rajesh Gupta, DV Bhagat and SK Choudhary

Abstract
The field experiment was carried out during two consecutive (*kharif* 2019 and 2020) at farmers field in the Dewas district of Madhya Pradesh. The experiment was laid out by the using of randomized block design (RBD) with eight replications. The treatments were consisting of three sowing methods as land configuration i.e. T_1- Sweep Blade type, T_2- Broad bed and furrow (BBF) and T_3- Furrow Irrigated Raised Bed System (FIRBS). Results reveled that among the different land configuration treatment, significantly higher plant height (50.8 cm) and number of branches/plant (4.29) was recorded under FIRBS method which was at par with BBF method (49.6 cm and 4.22, respectively). Similarly, the maximum pods/plant (29.21), seed yield/plant (11.33 g), 100-seed weight (11.0 g) and seed yield (1184 kg/ha) were recorded under FIRBS method it was found statistically similar with BBF method. The FIRBS and BBF method give 23.3 and 15.2 per cent higher yield over sweep blade type seed drill. The highest gross returns (Rs. 47365 /ha), net returns (Rs. 22974 /ha) and B: C ratio (1.94) was also noted with FIRBS method followed by BBF.

Keywords: BBF, FIRBS, land configuration, Malwa, soybean, yield

Introduction

Rainfed agriculture occupies 60% net sown area of the country, contributing 44% of total agriculture production with an average productivity of one tonne/ha and supporting 40% of the total production. Over 87% of coarse cereals and pulses, 55% of upland rice, 70% of oilseeds and 65% of cotton are cultivated under rainfed agriculture (Dhale *et al.*, 2021) [3]. Among the rainfed crops, soybean (*Glycine max* L. Merrill) is one of the economical and valuable seed legumes which have 25% contribution in global edible oil. The spread of the soybean in different regions of the country resulted into parallel growth of the oilseed industries and also earning foreign exchange through export of soy-meal (Khandkar *et al.*, 2019 and Rahangdale *et al.*, 2021) [10, 15]. Currently Madhya Pradesh accounts for nearly 87% of the area under the crop in the country and contributes about 83% of the total national production. Madhya Pradesh is known as 'soy-state' (Morya *et al.*, 2018 and Tomar *et al.*, 2018) [13, 19]. Soybean mainly grown in the rainfed condition and it is important for the livelihood of small and marginal farmers. Soybean contributes 43 per cent to the total oilseeds and 25 per cent to the total oil production in India and ranks fourth in respect to production of soybean in the world (Tomar *et al.*, 2018 and Kumawat *et al.*, 2021) [19, 11]. The soybean crop presently covers an area of about 12 million hectares with a total production of about 14 million tones (Rahangdale *et al.*, 2022) [14].

Vagaries of monsoon and prolonged dry spells affect crop growth and yield and significantly in Malwa region of Madhya Pradesh. Even under normal rainfall situation crop failures are occurring due to moisture stress due to occurrence of dry spells occurred particularly during critical crop growth stages (Verma *et al.*, 2018) [20]. For sustainable production, suitable in-situ conservation practices may ensure higher productivity by saving the crops during limiting and non-limiting moisture condition through safe disposal of runoff or its retention for profile moisture as and when required. Hence, it is necessary to exploit the technologies for in-situ moisture conservation like tillage, land configurations, mulching etc. (Rajput *et al.*, 2009 and Mohanty *et al.*, 2017) [16, 12].

Among the in-situ moisture conservation methods, BBF (Broad bed furrow) approach is known for its water conservation, automated weeding, fertilizers placement, available moisture

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Productivity, Profitability and Water Use Efficiency of Sweet corn (*Zea mays* L. *saccharata*) as Influenced by Irrigation Scheduling

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Keywords:
B:C ratio, Irrigation scheduling, Net returns, Sweet corn, Water use efficiency, Economic water productivity, Yields

ABSTRACT

This field study was conducted at Research Farm of AICRP for Dryland Agriculture at College of Agriculture (RVSKVV), Indore (MP) during the *rabi* 2019-20 and 2020-21. Irrigation scheduling (IW: CPE) consisted three different level *viz.*, 0.6 IW: CPE, 0.8 IW: CPE and 1.0 IW: CPE with 6 replications in Randomized Block Design (RBD). Irrigation was applied through drip system having inline emitter of 4 lph (Litre per hour). Results revealed that among the irrigation scheduling, 1.0 IW: CPE recorded the taller plants (188.70 cm), maximum dry matter/plant (179.50 g) and number of leaves/plant (12.70) which was followed by 0.8 IW: CPE. Similarly, irrigation at 1.0 IW: CPE recorded the highest values of number of cobs/plant (2.67), cob length (29.5 cm) and weight of cob without husk (311.90 g) followed by 0.8 IW:CPE and 0.6 IW:CPE. 1.0 and 0.8 IW: CPE scheduling increased green cob yield by 10.9 and 9.3 per cent over 0.6 IW: CPE scheduling. Among the irrigation scheduling, 0.8 IW: CPE gave maximum net returns of ₹255796/ha and B:C ratio of 5.73. The maximum WUE (38.41 kg/ha-mm) followed by 47.32kg/ha-mm and 57.70 kg/ha-mm were observed in 1.0 IW:CPE, 0.8 IW:CPE and 0.6 IW:CPE, respectively. Harvested rainwater in the farm pond can be used for high remunerative crops i.e. sweet corn for obtained the better profit. Hence, it is concluded that for getting higher production and net returns from *rabi* sweet corn can be achieved by adopting proper irrigation scheduling from harvested rainwater.

1. INTRODUCTION

Maize (*Zea mays* L.) is one of the most versatile crops referred as a 'Miracle cereal' and 'Queen of the Cereals' due to its high productivity potential compared to other crops [1], [2]. It is an important food, feed, fodder and industrial raw material provided throughout the world [3], [4]. Worldwide, it is considered as the

(19)

Evaluation of Different Soybean Based Rainfed Cropping Sequences in Vertisols of Madhya Pradesh

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ABSTRACT: A field experiment was conducted at AICRP for Dryland Agriculture, College of Agriculture (RVSKVV), Indore (MP) during 2018-19 to 2020-21, to find out the suitable cropping sequences for *Malwa* and *Nimar* valley region. Nine cropping sequences including soybean/maize/blackgram-based cropping systems, *viz.*, soybean-chickpea, soybean-safflower, soybean-mustard, maize-chickpea, maize-safflower, maize-mustard, blackgram-chickpea, blackgram-safflower and blackgram-mustard were tested in randomized block design with 5 replications. Among the sequences, soybean equivalent yield of maize–chickpea cropping sequence was the highest (4153 ~~qha^{-1}~~), followed by maize-mustard (3293 ~~qha^{-1}~~) and maize–safflower sequence (3222 ~~qha^{-1}~~). Existing soybean-chickpea sequence recorded soybean equivalent yield of 2586 ~~t ha^{-1}~~, which was 60.60% lesser than maize-chickpea cropping sequence. The maize-chickpea cropping sequence recorded the highest gross returns (Rs. 1,86,890 ha^{-1}), net returns (Rs. 1,46,890 ha^{-1}) and B:C ratio (4.67) followed by maize-mustard (Rs.1,48,200 ha^{-1} Rs.1,08,200 ha^{-1} and 3.71, respectively) and maize–safflower sequence (Rs.1,44,990 ha^{-1} Rs.1,04,990 ha^{-1} and 3.62, respectively). Similarly, the maximum production efficiency (18.06 ~~kg ha^{-1}day^{-1}~~), economics efficiency (638.65 ~~Rs ha^{-1}day^{-1}~~) and relative production efficiency (60.60%) were recorded under maize-chickpea cropping sequence. Highest land use efficiency (98.63%) was noticed with maize-mustard followed by blackgram-mustard sequence.

Key word: Chickpea, crop sequences, economics, LUE, rainfed, SEY, soybean, Vertisols

Introduction

Rainfed cropping is practiced on 1.13 billion ha globally (Biradar *et al.*, 2009), and meets about 60 per cent of the food and nutritional needs of the world's population. Rainfed cropping in India is practiced on 72 m ha, mostly in arid, semi-arid and sub-humid climatic zones and constitutes about 51 per cent of the net cultivated area. Low and erratic rainfall, degraded soils, and poor infrastructure are among the principal constraints in the rainfed areas of India. Thus, intensive cropping of Vertisols requires a careful management of soil temperature and moisture regimes (Srinivasarao *et al.*, 2012).

Soybean [*Glycine max* (L.) Merill] based cropping systems are important for sustaining agricultural production and also maintain soil fertility with an ecological balance (Khandkar *et al.*, 2019). Sustainability aims at balanced use of all available resources to achieve maximum production with minimum exploitation of natural resources (Morya *et al.*, 2018 and Tomar *et al.*, 2018). Soybean is grown both as an oilseed and grain legume, fixes atmospheric nitrogen in soil and makes it available to partially fulfill the nitrogen requirement of succeeding crop (Kumawat *et al.*, 2021 and Rahangdale *et al.*, 2022). The traditional cropping systems in *kharif* are soybean, cotton, maize, etc. and intercropping systems are soybean + maize/pigeonpea, etc. Length of growing period is 90-120 days. Generally, soybean is grown as a monsoon season crop under rainfed situation mainly under Vertisols and associated soils. It has resulted increased cropping intensity and profitability (Rahangdale *et al.*, 2021). In Malwa and Nimar valley region, its cultivation is largely practiced in rainy season followed by gram/wheat on conserved soil moisture. Under irrigated conditions, soybean is largely grown in soybean-wheat cropping system, while soybean-chickpea cropping system is prevalent under rainfed conditions. The major cropping system in the Vertisol and associated soils of Central India under the regime is soybean-wheat in which soybean is a rainfed crop. Both soybean and wheat are most productive crops and predominantly grown in a sequential cropping, particularly under irrigated production system in Vertisol of Madhya Pradesh (Vyas *et al.*, 2008).

Soybean-chickpea system is also prevalent as a next important cropping sequence mainly in those areas, where rainfall is not adequate or irrigation water is scarce. Long-term regular practice of soybean-chickpea and soybean-wheat system in the growing region is posing severe problems to the growers such as difficulty in weed management, deterioration of soil-properties, delayed sowing of wheat and low market value of produce owing low productivity as well as poor economic viability of this cropping system. Under such circumstances, the diversification of crops under soybean based cropping system assumes significance for improving the productivity and profitability per unit area per year without jeopardizing the soil health. The resource use efficiency *viz.*, land use efficiency and water productivity and employment opportunities can be increased with diversification of soybean based cropping system with minimization of agricultural risks

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Improved Fertigation Doses of Nitrogen, Phosphorus, Potassium and Sulphur in Garlic (*Allium sativum* L.) to Enhance Postharvest Soil Nutrient Status

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Keywords:
B:C ratio, BBF, Fertigation, FUE, Fertility status, Garlic, Irrigation, *Malwa*

ABSTRACT

The field experiments were conducted during the two consecutive *rabi* seasons 2018-19 and 2019-20 at farmer's field in Dhariyakhedi village of Mandsaur district of Madhya Pradesh to assess the post-harvest status of soil nitrogen, phosphorous and potassium as influenced by different irrigation and fertilizer levels in drip fertigated garlic. The experiment consists of three levels of irrigation water i.e., IW/CPE ratio 0.60 (I1), 0.80 (I2), 1.00 (I3) and three levels of recommended doses of fertilizer i.e., 60% (F1), 80% (F2), and 100% (F3) for garlic crop. The initial fertility status of soil at experimental site with regard to nitrogen, phosphorus (P_2O_5), potassium (K_2O) and sulphur were recorded as 260 kg/ha, 21.5 kg/ha, 380 kg/ha and 19.2 kg/ha respectively. Most of the crop growth and quality parameters viz., plant height, polar diameter, equatorial diameter, fresh weight and dry weight of garlic bulb were significantly influenced by different irrigation and fertigation treatments. Among different irrigation and fertigation levels, the treatment I3F3 recorded highest FUE (64.47 kg/kg), marketable bulb yield (147.43 q/ha) and B:C ratio (5.63). The drip fertigation treatment with IW/CPE ratio 1.0 and fertigation at a rate of 100:50:50:50 kg/ha (N:P:K:S) resulted in higher post-harvest status of soil with regard to nitrogen (275.29 kg/ha), phosphorus (24.52 kg/ha), potassium (402.54 kg/ha) and sulphur (21.37 kg/ha) content.

1. INTRODUCTION

Drip fertigation is the most advanced and efficient practice of fertilization, combining the two main factors for plant growth and development, i.e. water and nutrients. Fertigation ensures the application of fertilizers directly to the plant roots and is gaining popularity in all the horticultural crops [1]. In drip irrigation, the adoption of advanced and competent methods of fertilizer application will resulted in economizing the

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Effect of residual soil moisture on yields and monetary return of rain fed cropping sequences under *vertisols* in *Malwa* region of Madhya Pradesh

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Abstract
Field experiments were conducted during 2019-20 and 2020-21 at the AICRP for Dryland Agriculture, College of Agriculture (RVSKVV), Indore, Madhya Pradesh, India to find out the effect of residual soil moisture on rain fed cropping sequences in *vertisols*. Nine cropping sequences including soybean/maize/ black gram-based cropping systems, *viz.*, soybean-chickpea, soybean-chickpea (*kabuli*) soybean-safflower, maize-chickpea, maize-chickpea (*kabuli*), maize-safflower, black gram-chickpea, black gram-chickpea (*kabuli*) and black gram-safflower were tested in randomized block design with 5 replications. The soil moisture content (%) were determined by gravimetric method from two depths *viz.*, topsoil (0-15 cm) and subsoil (15-30 cm) at 20, 40, 60, 80 DAS and at harvest. Results revealed that significantly highest SEY (3504 kg/ha), total net returns (Rs. 104142/ha) and B:C ratio (3.89) were recorded by the sequence of soybean - chickpea followed by black gram-chickpea (SEY 2945 kg/ha, total net return Rs. 81815/ha and B:C ratio of 3.27). Whereas, the lowest SEY (1138 kg/ha), total net return of Rs. 9510/ha and B: C ratio of 1.26 were noticed under the sequence of maize-safflower. During initial period of crop growth, soil moisture content was higher in the upper depth but at later stages soil moisture content was found higher in lower depth of the soil. It can be concluded that residual soil moisture availability can affects the yield and economics of *Rabi* crops after *kharif* season under rain fed conditions.

Keywords: Crop sequences, rain fed, SEY, soil moisture, yield, vertisols

Introduction

In agriculture, availability soil moisture determines the success of crop production because the growth and productivity of crops highly depends on the sufficient moisture (Awulachew *et al.*, 2007) [2]. Residual soil moisture can play important role in *Rabi* crops. Kar and Kumar (2009) [9] reported that after rainy season (*kharif*) where irrigation water is not available, residual moisture become imperative for second crop (*Rabi*). In rain fed areas rainfall is the gamble for crop production. The aberrant nature of rainfall is often faced may be due to delay or untimely onset and or withdrawal or associated drought spell at any stage in the crop season. The medium to deep *vertisols* in *Malwa* region are capable of sustaining sequential cropping with the short duration crops for a period about 220 days under the normal monsoon season. If heavy rainfall occurred, *kharif* crops badly affected but *Rabi* crop production can compensate it, because of residual moisture content in rain fed condition. Lack of adequate seed-zone moisture is a major problem in the timely sowing of *Rabi* crop after *kharif* in rain fed areas (Sharma and Acharya, 2000) [16].

In India, rain fed farming accounts for 52 per cent in terms of net cultivated area, about half the total population of the country and two-thirds of livestock strength (Anonymous, 2020) [1]. Low and erratic rainfall, degraded soils, and poor infrastructure are among the principal constraints in the rain fed areas of India. Thus, intensive cropping of *vertisols* requires a careful management of soil temperature and moisture regimes (Srinivasarao *et al.*, 2012) [20]. Soybean [*Glycine max* (L.) Merill] based cropping systems are important for sustaining agricultural production and also maintain soil fertility with an ecological balance (Khandkar *et al.*, 2019) [8]. Rain fed cropping is practiced on 1.13 billion ha globally (Biradar *et al.*, 2009) [3], and meets about 60 per cent of the food and nutritional needs of the world's population. Soybean grown both as an oil seeds and grain legume, fixes atmospheric nitrogen in soil and makes it available to partially fulfill the nitrogen requirement of succeeding crop (Kumawat *et al.*, 2021 and Rahangdale *et al.*, 2022) [21].

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DAMAGE POTENTIAL AND MANAGEMENT OF SORGHUM SHOOT FLY *ATHERIGONA SOCCATA* ON SORGHUM WITH SEED TREATMENT

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ABSTRACT

A field experiment conducted at the sorghum research field, College of Agriculture, Indore Madhya Pradesh during kharif 2019-20 evaluated six seed dressing chemicals along with soil application of carbofuran against shoot fly *Atherigona soccata* (Rondani). Significantly least deadheart (1.36 to 15.95%) was observed with thiamethoxam+ cyantraniliprole followed by thiamethoxam 30FS (1.61 to 21.76%). Soil application of carbofuran resulted in less efficacy (2.96 to 38.21%). The mean yield obtained was 29.13 q/ha in protected plots as against 16.20 q/ha in unprotected plots. Mean deadheart incidence was 11.59% in protected plots and 58.23% in unprotected plots. The avoidable loss in term of deadheart was recorded to be 80.10%.

Key words: Sorghum, *Atherigona soccata*, chlorantraniliprole, cyantraniliprole, imidacloprid, thiamethoxam, seed dressing, deadheart, grain yield, avoidable loss

In India, sorghum ranks fourth in area with a productivity of 780 kg/ ha (Anonymous, 2018). This low productivity is due to insect pests. At least 150 insect species damage sorghum in different agroecosystems (Jotwani et al., 1980), of which the shoot fly (*Atherigona soccata* Rondani) and stem borer (*Chilo partellus* Swinhoe) cause enormous losses. Of these the former is the most destructive at the seedling stage. Padmaja et al., (2010) observed that shoot fly ambush sorghum at 7-30 days after seedling emergence which can destruct crop > 50%. Raise in shoot fly deadhearts by 1% results in a reduction of 143 kg grain yield/ ha and an overall loss of 90-100% under delayed sowing in kharif (Dhaliwal et al., 2004). Kumar and Prabhuraj (2007) observed that seed treatment with thiamethoxam 70 WS@ 2 g/ kg led to the least amount of deadhearts (7.9%) and maximum grain yield (31.93 q/ha) besides, higher fodder yield (58.92 q/ ha). Lower dose of thiamethoxam can be used effectively and economically for shoot fly management in late sown kharif sorghum (Daware et al., 2011). Seed dressers as systemic insecticides are considered to be more selective for targeted pests. Therefore, the present study to evaluate some newly launched systemic seed dressers and their combination.

MATERIALS AND METHODS

The field experiment was conducted at the College of Agriculture, Indore (22°70'N, 75°89'E, 555.7 masl), in randomized block design with three replications. The plot size was 4.00x 2.25 m and 2.70 x 1.50 m net, and the cultivar CSV-15 was used with a spacing of 45x 15 cm, and sown on 1st July 2019. The treatment details are: with trade name and their manufacturing companies- imidacloprid 70WS @ 3 ml/ kg of seed (Confidor, Chemet Wets and Flow Ltd.), fipronil 5SC @ 5 ml/ kg of seed (Regent, Bayer), chlorantraniliprole 18.5SC @ 1 ml/ kg of seed (Coragen, Dupont), thiamethoxam 30FS @ 10 ml/ kg of seed (Cruiser, Syngenta), thiamethoxam 19.8 w/w+ cyantraniliprole 19.8 w/w @ 6 ml/ kg of seed (Foretenza Duo, Syngenta), soil application of carbofuran 3G @ 20 kg/ ha (Furadon, FMC) and untreated plot. Deadheart count was taken at 7, 14, 21 30 and 45 days after germination of seedlings on whole plant basis to calculate % deadheart. The incidence data was subjected to arc sine transformation before ANOVA. The treatment was separated by LSD at (p= 0.05). For the estimation of yield loss caused a separate field trial was laid out with two strips. Sorghum variety RVJ-1862 was sown on 1 July, 2019 at 45 cm spacing (row to row) having plot size of 2.25x 2.0 m (6 rows of 2 m). For protected plots, the seed was treated with thiamethoxam 30FS @ 10 ml/ kg before sowing and was kept protected from shoot fly, stem borer and sorghum earhead bug infestation with insecticides (thiamethoxam+ lambda cyhalothrin @ 125 ml/ ha followed by whorl application of carbofuran 3G @

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POPULATION DYNAMICS OF SHOOT FLY *ATHERIGONA SOCCATA*

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ABSTRACT

Population dynamics of shoot fly *Atherigona soccata* Rondani was carried out at the Sorghum Research field, College of Agriculture, Indore, Madhya Pradesh during kharif, 2019-20. The incidence was assessed in terms of egg, deadheart, adult flies' activity. The results revealed that the peak incidence was observed during 29th and 30th standard meteorological week (SMW). The fish meal trap correlation studies showed that shoot fly eggs, showed a positive and significant correlation with maximum temperature (r = 0.73). Every unit increase in maximum temperature, results in increase of 0.81 eggs/ 5 plants, while deadheart (r = 0.68) and adult flies (r = 0.79) showed positive significant correlation with minimum temperature. The regression analysis revealed that for deadheart and adult flies, with every unit increase in minimum temperature there was a increase of 16.30% deadhearts and 7.79 adults.

Key words: *Atherigona soccata, Sorghum bicolor*, population dynamics, correlation, deadheart, oviposition, eggs, adults, fish meal trap, regression

Sorghum (*Sorghum bicolor* (L.) Moench) is one of the most important foods and fodder crop with a productivity of 1456 kg/ ha during 2017-18 (Anonymous, 2019), and in India, it is with a productivity of 780 kg/ ha (Anonymous, 2018). The insects pests are the reason behind this low productivity, and major ones are the shoot fly, grasshopper, grey weevil, stem borer, aphid and termite. Garg and Singh (2002) observed that among all these, the shoot fly *Atherigona soccata* Rondani (Diptera: Muscidae) is the most disastrous at the seedling stage (*Sharma et al.,* 2006a,b). Due to variation in the agroclimatic conditions, insects show varying trends in their incidence pattern and extent of damage. The weather factors play a key role in determining the incidence and dominance of a pest or pest complex (Meena *et al.,* 2013). Many researchers had assessed the correlation between shoot fly infestation and the ecological factors (Kandalkar *et al.,* 2001; Balikai and Venkatesh, 2001). The effect of sowing dates on the incidence and productivity of sorghum has also been evaluated (Ameta *et al.,* 2004). The present study is on the population dynamics of *A. soccata* on sorghum in relation to weather factors in the Malwa region of Madhya Pradesh.

MATERIALS AND METHODS

This study on the *A. soccata* in sorghum was carried out during kharif 2019- 20 at the All India Coordinated Sorghum Improvement Project (AICSIP), sorghum research farm, College of Agriculture, Indore. The sowing of sorghum variety RVJ-1862 was done on 1st July 2019 and the incidence was observed from germination till harvest at weekly interval, in terms of eggs, deadheart (%) and adults. Adults were monitored with plastic fishmeal traps, consisting of a plastic bottle with an entry hole on top for the flies and fish meal (20 g) placed inside and a small tube to hold dichlorvos soaked cotton to kill the trapped flies. Two fishmeal traps were set just after sowing the crop from July to October, 2019, with traps hung at 30 cm above the ground level. The population density was observed twice in a week. In the same way the number of eggs and deadhearts were also observed and counted from randomly selected five plants regularly. The meteorological data i.e. temperature (minimum and maximum in °C), relative humidity (morning, evening %) and rainfall (mm) were obtained from the Observatory, All India Co-ordinate Research Project for Dry land Agriculture, College of agriculture, Indore. the data obtained were correlated with weather factors and multiple linear regression analysis was done using WASP software.

RESULTS AND DISCUSSION

Atherigona soccata eggs were first observed at 27th standard meteorological week (SMW) when the crop was 7 days old (2.13 eggs/ 5 plants) (Fig. 1), with maximum being 7.32 egg/ 5 plants during 29 SMW. *The e*gg laying was observed up to 32nd SMW (0.76

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RESEARCH ARTICLE

Biochemical characterization of chickpea genotypes for Fusarium wilt resistance

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Abstract

Fusarium wilt caused by *Fusarium oxysporum* f. sp. *ciceri* is one of the major constraints in chickpea production. The present study was aimed at identifying resistant donors for this disease and to elucidate the role of bio chemicals in imparting resistance to the plants. Twenty-five chickpea lines were screened against Fusarium wilt, out of which ten were found resistant(R), nine as moderately resistant (MR) and six as highly susceptible (HS). Biochemical analysis of reducing sugars, total phenols, peroxidase and polyphenol enzyme activity was assessed under both wilt free and wilt sick conditions to study the dynamics of these biochemicals. There was a significant reduction in the overall mean of reducing sugar contents in wilt sick soil conditions (60.228) over wilt free conditions (76.267). Percent reduction of reducing sugars in wilt sick plot over wilt free plot was found to be highest in HS genotypes (39.91) followed by MR (15.19) and R genotypes (11.17). It indicated utilization of sugars by the pathogen is more in HS genotypes. Higher amounts of reducing sugars were found in HS genotypes followed by MR and R genotypes under wilt free conditions indicating genotypes having highest reducing sugars are more vulnerable to this wilt and vice-versa. Higher quantity of total phenols (40.19) PO (134.48) and PPO (8.92) enzyme activity was found in genotypes grown in wilt sick plot as compared to total phenols (36.76) PO (123.01) and PPO (7.72) under wilt free conditions indicating their inducible nature due to host pathogen interaction. Under wilt sick conditions higher quantity of phenols and enzyme activity were found in resistant genotypes as compared to susceptible genotypes indicating that they are highly induced in resistant genotypes against Fusarium wilt. Resistance towards Fusarium wilt is positively correlated with the amount of phenolic content and PO and PPO enzyme activity. Resistant sources identified in this study can aid in resistant breeding programs. Dynamics of different biochemicals in relation to disease reaction can also help in strategic disease management programs.

Keywords Biochemical analysis · Chickpea · Disease resistance · Fusarium wilt

Introduction

Chickpea is the most important food legume grown worldwide and is the major pulse crop in Indian subcontinent. (Saxena 1990). In India, it has been grown in an area of 10.94 M ha with a production of 11.08 M t and productivity of 1012 kg/ha (FAOSTAT 2021). Madhya Pradesh being highest both in area and production of chickpea, estimated to contribute about 36.37% (3.43 MH) to total area and 45.54% (4.61MT) to total production in the country (Anon 2019).

Chickpea production in India is being challenged by different biotic and abiotic stresses, major being wilt caused by *Fusarium oxysporum* f. sp. *ciceri* (Singh et al. 2019). Annual chickpea yield losses due to Fusarium wilt were estimated to be 10% in India (Dubey et al. 2017). According to Haware and Nene (1982) Fusarium wilt epidemics can be devastating to individual crops and can cause up to 100% loss under favorable conditions. Deployment of genetic resistance is the effective and economic means to manage this disease (Jalali and Chand 1992). Extensive screening and exploitation of resistant germplasm sources is the pre-requisite for chickpea improvement against Fusarium wilt (Reddy and Singh 1984). Accumulation of phenolic compounds in the host during host–pathogen interaction is a general phenomenon of disease resistance. (Goodman et al. 1967). Several studies on the biochemical basis of Fusarium wilt resistance

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Study on morpho-physiological, yield and quality characteristics of turmeric (*Curcuma longa* L.) as influenced by plant geometry and cultivars

Vaqar Malik, IS Naruka, DK Raidas, Sikandar Malik and Huda Khalil

Abstract
The present field experiment was conducted at investigation carried out during *Kharif* + Rabi season of 2019-20 at the Herbal Garden, College of Horticulture, Mandsaur (M.P.). The experimental material comprised of nine treatment combinations of three plant spacing and three cultivars of turmeric. These treatments were sown in Factorial Randomized Block Design with four replications. The individual effect of planting geometry 45 × 30 cm (S_3) was recorded the maximum plant height, number of leaves, leaf area, dry weight of plant at harvest and number of tillers at 90 DAP. Similarly the physiological characteristic *viz*. LAI (1.086), CGR (1.043), RGR (0.348), LAD (36657.47) at 90-120 of growth stage and chlorophyll content (28.46 SPAD) at 90 DAP as compared to other plant spacing 45×25 cm (S_2) and 45×20 cm (S_1) respectively. The maximum yield *viz*. fresh rhizomes yield plant^{-1} were observed maximum in 45 × 30 cm (S_3) and fresh rhizomes yield ha^{-1} ((239.86)) were found maximum in S_1 (45 × 20 cm)) with quality parameter *viz*., oil content (4.13%) and curcumin content (5.49%) were observed maximum in S_3 (45 × 30 cm)). In case of cultivars, the Sonali (V_2) was significantly superior and was recorded maximum plant height, number of leaves, leaf area, dry weight of plant at harvest and number of tillers at 90 DAP. The physiological characteristics *viz* LAD (1.047), CGR (0.848), RGR (0.341), LAD (35348.78) at 90-120 growth stages and chlorophyll content (28.00 SPAD) as compared to other cultivars Suroma (V_1) and Ranga-3 (V_3). The yield characteristic *viz*. fresh rhizomes yield (300.86g) plant^{-1} and fresh rhizomes yield (242.94 q ha^{-1}) was observed with cultivar Sonali (V_2) as compare to cultivars Suroma (V_1) and Ranga-3 (V_3) and quality characteristics *viz*. was exhibited oil content (4.18%) and curcumin content (5.47%) of rhizomes was significantly higher with cultivars Sonali (V_2) in comparison to other cultivars.

Keywords: Plant height, chlorophyll content, leaf area index, fresh rhizomes yield, oil content, Curcumin content

Introduction
Turmeric (*Curcuma longa* L.) belongs to family Zingiberaceae. It is known as Golden spice of life. Turmeric is a native of South East Asia. It is a rhizomatous perennial herb grown as an annual plant. Turmeric is grown in both tropical and subtropical regions, have a preference for a warm and humid climate with temperature ranges from 20 °C to 35 °C. It is a great healer of wounds owing anti-inflammatory, anti tumor and anti-fungal properties. it is an excellent for treating skin diseases like acne, eczema, skin cancers etc. The rhizomes contain curcuminoids, curcumin and dihydrocurcumin which are found to be natural anti-oxidants. India contributes the largest share in the production (80%) and export (60%) of turmeric all over the world. Telangana, Maharashtra, Tamil Nadu, Andhra Pradesh, Karnataka, Orissa, West Bengal and Kerala are the major turmeric growing states in India. The total area under turmeric cultivation in India is about 237.96 thousand hectare with the production of 1132.72 thousand metric tons. In Madhya Pradesh having a production of 39.05 thousand metric tons and a productivity of (3.56 MT/ha) with a total area of 10.95 thousand hectares (Anonymous, 2018) [3]. Among the different factors affecting growth, yield and quality of turmeric, spacing and selection of cultivars appear to be the most important factors. Optimum spacing between plants enables better utilization of soil moisture, nutrient, solar radiation and all the available growth factors which ultimately affect nutrients uptake, growth and yield of plants. With an increase in spacing, the total population of plant per hectare decreases but in this condition the nutrition uptake increases which makes the individual plant grow better and yield more and vice-versa. Therefore, the increase and decrease in plant population as a result of a change in plant spacing both ways has a definite pattern in relation to the yield.

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Study of physiological growth and drought tolerance in genotypes of Cotton (*Gossypium hirsutum* L.)

BR Baraiya, DK Shriwastava, Lekha Ram and Veena Satya

Abstract
The study was conducted during *Kharif* season of 2016-17 and 2017-18 at AICRP on Cotton, B. M. College of Agriculture, Khandwa in a randomized block design with three replications in rainfed condition. Twenty cotton genotypes were sown at 60 cm row and plant spacing. The presence of ample variation among cotton genotypes for major yield attributing and drought tolerance traits was reflected from high estimates of phenotypic and genotypic coefficient of variation. The low magnitude of difference between genotypic coefficient of variation and phenotypic coefficient of variation suggested that traits RGR, CGR, NAR, RWC, transpiration rate, proline content, seed index, boll per plant, harvest index, boll weight (g), seed cotton yield (kg/ha), uniformity ratio and ginning *per cent* were more stable traits for environmental changes. the high heritability estimates and high mean of yield attributing traits *viz.*, boll /plant, boll weight (g), harvest index and seed cotton yield (kg/ha) and physiological growth and drought tolerance traits *viz.*, LAI, RGR, CGR, NAR, RWC, photosynthetic rate, transpiration rate, stomatal conductance, LWP and Proline content suggested that selection of parents through these traits may yield better genotypes for drought tolerance. The cotton genotypes JK-4, TCH-1199, TSH-327, AR-9108 and RS-2835 with high RWC, LWP, highest photosynthetic rate and low transpiration rate were found most suitable genotypes for use in further breeding programme for draught tolerant cotton varieties.

Keywords: Plant height, sympodia, monopodia, Dry matter production and seed cotton yield
Abbreviation: Leaf area index (LAI), Specific Leaf Area (SLA), Relative Growth Rate (RGR), Crop Growth Rate (CGR), Net Assimilation Rate (NAR), Leaf Area Duration (LAD), Relative water Content (RWC), Leaf water potential (LWP), (60-90), (90-120), (120-150), (150-180) Days after sowing (DAS).

1. Introduction
Cotton is a prominent fibre crop of the world. It has a great economicimportance asa domestic and export commodity. It has, in fact, been a decisive factor in the economic modernization and industrialization of the country. Cotton belongs to genus *Gossypium* of family Malvaceae. The genus *Gossypium* consists of 50 species (Poehlman and Sleper, 1995) [17] out of which only four species are cultivated, *viz G. hirsutum*,*G. barbadense*, *G. arboreum* and *G. herbaceum*. The species *G. hirsutum* and *G. barbadense* are tetraploid (2n=4x=52) while species *G. arboretum* and *G. herbaceum are* diploid (2n=2x = 26). Though all the four species producing spinnable lint but according to their production potential G. hirsutum gained more acreage in irrigated cotton areas while *G.arboreum* is limited up to rainfed areas in India.
China, India, USA, Pakistan, Argentina, Australia, Brazil, Mexico and Turkey are the major cotton producing countries and contributed approximately 85% of the world total cotton production. Economically and socially, it is one of the most important fibre crops in the world with the production of 117.8 million bales. India ranks first in area, second in production and fourth in productivity of cotton crop in the world. In India this crop occupies an area of 118.81lakh ha with a production of 352.0 lakh bales (170kg lint per bales) and productivity of 503 kg lint /ha. In India cotton grows mainly in seven states *viz*., Maharashtra, Gujrat, Karnataka, Andhra Pradesh, Madhya Pradesh, Hariyana and Rajasthan. Madhya Pradesh ranks first in respect to area 5.47 lakh hectares with production 17.0 (Lakh bales) and productivity 559 (kg/ha) as compared to other states (Anon, 2016) [2].
In Madhya Pradesh, Cotton is grown in Malva- Nimar region. The major districts having commercial cultivation of cotton in Malwa-Nimar region are Khandwa, Khargone, Dhar, Jhabua and Barwani. The area of cotton in Khandwa district is 6.03 lakhs hectares with production of 20 lakh bales and productivity of 578 kg lint/ ha.

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In Madhya Pradesh, Cotton is grown in Malva- Nimar region. The major districts having commercial cultivation of cotton in Malwa-Nimar region are Khandwa, Khargone, Dhar, Jhabua and Barwani. The area of cotton in Khandwa district is 6.03 lakhs hectares with production of 20 lakh bales and productivity of 578 kg lint/ ha.

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Study of Morphological and Seed Yield Architecture in Genotypes of Fenugreek (*Trigonella foenum-graecum* L.)

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ABSTRACT: The productivity of fenugreek is very low as it is often cultivated on marginal lands with poor management of soil fertility, irrigation, fertilizer and with little insect pest management. Further the seeds of improved varieties have limited availability; hence farmers are forced to use local materials for sowing which are variable in productivity and susceptible to various diseases. Considering the above points, there is a great scope to improve the productivity of this crop by varietal improvement and adopting the improved production technology in our country. The real yield potential of the crop can be exploited through varietal improvement program. Considering same present investigation, was conducted during the *Rabi* 2020-21 at Research farm Department of Horticulture, RAK College of Agriculture, Sehore (M.P.). This investigation was carried out on sixteen genotypes collected from different part of the country. The research experiment was laid out in Randomized Block Design with three replications. The results revealed that, all the parameters were exhibited significantly differences among genotypes during investigation. The maximum plant height (cm) plant^{-1} (13.00, 34.20 and 60.13), number of branches plant^{-1} (7.13, 9.07 and 11.01), leaf area (cm^2) plant^{-1} (14.04, 37.00 and 65.00) and leaf area index (0.19, 0.44 and 0.82) at all stages of crop and the maximum germination (%) (93.28), number of pods plant^{-1} (38.07), number of seeds pod^{-1} (17.13) and seed yield (721.76 Kg ha^{-1}) were recorded in Sehore-7, which were found remarkably better than other genotypes. The leaf area was recorded by using laser area meter (LI-300) at different stages of the crop. The LAI calculated the assimilatory surface area over a certain ground area. The yield parameter was recorded on five randomly selected plants from every treatment at the time of harvest.

Keywords: plant height, number of leaves, leaf area, leaf area index, germination percentage, pods per plant, seed yield.

INTRODUCTION

Fenugreek (*Trigonella foenum-graceum* L.) belongs to the family Fabaceae. Fenugreek generally known as methi, occupies an important position amongst leafy vegetables and condiment crop largely grown in central northern India during *Rabi* season. Fenugreek is also grown for forage. It is regarded as traditional forage in Egypt, India, Turkey and the Mediterranean region (McCormick *et al.,* 2009). It is recommended as alternative leguminous forage in alfalfa based cattle farms since it can prevent bloating in cattle which is a disadvantage associated with use of alfalfa fodder (Acharya *et al*., 2007). Fenugreek seeds contain alkaloids including trigonelline, saponins, flavonoids, mucilage protein 4.4%, mineral matter, 1.1%, fat 0.9%, calcium 360.0 mg, and vitamin 'A' 6450 IU (Singh and Kaur, 2007). Seeds and leaves of fenugreek are well characterized with a distinctive pungent scent that has made it highly desirable in culinary applications (Max, 1992). The crop species has long been used as a galactogogue to promote lactation in weaning mothers and to promote weight-gain in women (Rguibi and Belahsen, 2006 and Tiran, 2003). Fenugreek is the third major seed spices in India after coriander and cumin. In India total annual production of about 220 thousand metric tons (NHB, 2017). The maximum area and production about 80% of fenugreek is in Rajasthan. Madhya Pradesh shared 10.12% of the total production of India. The major Fenugreek growing districts of M.P. are Jabalpur, Chhatarpur, Indore, Mandsaur, Neemuch, Sehore and Sagar. The importance of fenugreek cultivation has been increased due to presence of asteroid called "*Diosgenin"* and it is used in the synthesis of sex hormones and contraceptives (Meena *et al.,* 2017). Fenugreek leaves and seeds are generally consumed as a spice in food preparation because of its strong flavor and aroma and also used as an ingredient in traditional medicine. Seed yield is a major parameter, which is influenced by several yield and yield attributing characters controlled by polygenes and also influenced by environment (Hosamath *et al.,* 2017). Farmers of Madhya Pradesh are still growing local cultivars of fenugreek which are low yielding and poor

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Pigeonpea (*Cajanus cajan* L.) Growth, Yield and Monetary Influence by Drip Irrigation and Mulch in *Vertisols* of Madhya Pradesh

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Abstract

Background

Farmers are facing many constraints related with pigeonpea cultivation therefore proper resources management and scientific practices can increase the production and productivity of pigeonpea. Drip and mulching can be a way to achieve the goal of *more crop per drop.*

Methods

The field experiments were conducted during *kharif* season of year 2016–17 and 2017–18. The study area is located (23T 16′48" N-latitude, 77T 21′36" E-longitude) in Madhya Pradesh. The experiment was laid out in *vertisols* with twenty seven treatment combinations consisting of three mulching, three discharge rate (2 lph-D_1, 4 lph-D_2 and 8 lph-D_3) and three irrigation levels *viz.* 60% CPE (I_1), 80% CPE (I_2) and 100% CPE (I_3). Well treated bold seeds of pigeonpea (TJT-501) were dibbed in soil on ridge-furrow land configuration.

Result

The plant height was maximum in 2 lph (175.78 cm), I_2 (176.10 cm) and number of branches, number of pods per plant, seeds per pod also followed the same trend. Maximum yield was registered with D_1 (16.48 q/ha) followed by D_2 (14.91 q/ha) and D_3 (14.46q/ha). Irrigation level I_2 (16.01 q/ha) registered 13.77% higher seed yield than I_1 (14.07 q/ha). In case of discharge rate, B:C decreased as rate increased. Among irrigation level treatments, lowest value (1.26) of B:C recorded with 60% CPE whereas highest B:C (1.56) was registered with 80% CPE, which is at par with 100% CPE (1.52). It can be concluded that pigeonpea cultivation is not economical with mulch and 100% supply of irrigation during *kharif*. It is viable to supply irrigation as per CPE only at branching, flowering and pod development stages.

Top

Keywords

B:C ratio, CPE, Discharge rate, Drip, Mulch, Pigeonpea, *Vertisols*.

Top

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NUTRIENT UTILIZATION AND YIELD OF SOYBEAN APPLIED WITH JEEWAMRIT FORTIFIED WITH BANAN PEEL, SLACKED LIME AND BIOFERTILIZERS IN BLACK SOIL.

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RAK College of Agriculture, Sehore 466001 (M.P.)

ABSTRACT

A field experiment was conducted consecutively during *kharif* season of 2018 and 2019 at the Research Farm, RAK College of Agriculture, Sehore (M.P.), India to study on nutrient utilization Nutrient utilization and yield of soybean applied with Jeewamrit fortified with slacked lime and biofertilizers biofertilizers. The combined application of 50 % RDF + *Rhizobium* + PSB @ 4 kg ha^{-1} as soil application + Jeewamrit 500 lit ha^{-1} 30 DAS + Slacked lime @ 25 kg ha^{-1} (T_7), followed by T_6 significantly enhanced the N, P, K, S, Zn and Fe contents and their uptake in seed and straw of soybean over control T_1). The available nutrient balance of N, P, K, S, Zn and Fe in post-harvest soil was found significantly higher under T_7 treatment, followed by T_6 treatment. Thus the treatment T_7 producing maximum total biomass (grain + straw) up to 29.0 q/ha significantly increased the total uptake of nutrients (109, 11.7, 51.27 and 8.0 kg/ha N, P, K, and 3.89 and 165.63 q/ha Zn and Fe, respectively). All these nutrients were also found significantly higher in the post-harvest soil, the values being 241 kg N, 13 kg P, 419 kg K, 10.3 ppm S, 0.56 ppm Zn and Fe. The second best treatment was T_6 with respect to all these nutrients.

Key words: Jeewamrit, slacked lime, biofertilizers, soybean

Nickel-mediated lead dynamics and their interactive effect on lead partitioning and phytoremediation indices in spinach

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Mohan Lal Dotaniya ✉, Jaypal Singh Pipalde, Ramesh Chandra Jain, Rajendiran Selladurai, Subhash Chandra Gupta, Madhav Das Vyas, M Vassanda Coumar, Sonalika Sahoo, Jayanta Kumar Saha & Ajay Kumar

Abstract

A greenhouse research was conducted to monitor lead (Pb) translocation dynamics in spinach (*Spinacia oleracea* L.) mediated by nickel (Ni) application. Each of the four levels of Pb (0, 100, 150, and 300 mg/kg) and Ni (0, 100, 150, and 300 mg/kg) was applied in

https://link.springer.com/article/10.1007/s10661-022-09935-4#auth-Ramesh_Chandra-Jain-Aff2 ully matured spinach crop was harvested

Kumar

Abstract

A greenhouse research was conducted to monitor lead (Pb) translocation dynamics in spinach (*Spinacia oleracea* L.) mediated by nickel (Ni) application. Each of the four levels of Pb (0, 100, 150, and 300 mg/kg) and Ni (0, 100, 150, and 300 mg/kg) was applied in different combinations in the pot experiment. A fully matured spinach crop was harvested and divided into biomass samples from the roots and above ground. ICP-OES was used to determine the concentrations of Pb and Ni in the samples. The increase in Pb application rate in soil resulted in a decrease in dry matter yield of plant roots and above-ground biomass, according to the findings. Pb accumulation was also found in significant amounts in roots and above-ground biomass. Pb was accumulated in greater quantities in the spinach roots than in the above-ground biomass. Pb uptake in spinach roots and above-ground biomass decreased when high dose of Ni was applied. The Ni application in spinach crop had a negative impact on various parameters of Pb uptake, including translocation factor, bioconcentration factor, translocation efficiency, and crop removal of Pb. Pb toxicity was reduced when higher doses of Ni (100 to 300 mg/kg) were applied to Pb-contaminated soil. The findings of this study could help researchers better understand how Pb and Ni interact, as well as how to treat soil that has been contaminated by industrial wastewater containing nickel and lead.

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Impact of Tillage and Chemical Weed Management Practices on Wheat Yield and Nutrient Uptake (*Triticum aestivum* L).

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ABSTRACT: A field study titled "Impact of tillage and chemical weed management practices on wheat yield and nutrient uptake (*Triticum aestivum* L)." was conducted during the Rabi seasons of 2019-20 and 2020-21 at the Agronomy Research Farm, Department of Agronomy, R.V.S.K.V.V. Gwalior (M.P.). To determine the effect of various tillage and chemical weed control practices on growth, yield attribute, yield, nutrient content, and economics of various treatments after harvesting the wheat crop. The combination of three tillage systems (CT, ZT, MT) and seven weed management practices (Solfosulfuron, Metsulfuron-Methyl, Clodinafop, Solfosulfuron + Metsulfuron-Methyl, Clodinafop + Metsulfuron-Methyl, Two hand weeding, and weedy check) was laid out in Split Plot Design and replicated three times. The results showed that among various tillage and weed management practices, zero tillage was more significantly effective than conventional tillage in increasing growth parameters, yield attributes, and yield of wheat. Weed control practices were found more significantly effective in w_6 (two hands weeding 30and 60 DAS).in a present study nutrient uptake was influenced by various factors tillage and chemical weed management practices. In zero tillage T_1 was found to be most effective in significantly increasing nutrient uptake and weed control practices significantly influence w_6 (two hands weeding). Zero tillage + crop residue, on the other hand, should be used to improve soil health.

Keywords: Tillage, field experimentation, and chemical weed control practices.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is one of the world's most significant cereal crops and one of the most important staples for roughly 2.5 billion (36 percent) of the world's population, and advancements in its production have helped the country become self-sufficient in food grains. It contributes roughly 55% of all carbs and 20% of all dietary calories consumed globally (USDA, 2019). Wheat varieties have resulted in a problem with grassy weeds, particularly Phalaris minor Retz and wild oats, as a result of enhanced irrigation and fertilizer facilities (Avena ludoviciana Dur) Depending on the intensity of the infestation, A. ludoviciana has caused wheat losses ranging from 16 to 65 percent. In many sections of the country, grassy weeds in combination with broadleaf weeds are a typical occurrence, resulting in large crop losses and complicating weed management (Singh *et al.,* 2002). For effective weed control, new herbicide molecules such as clodinafop (60-80 g ha^{-1}), metribuzin (75-210 g ha^{-1}), and metsulfuron-methyl4 g ha^{-1} have been introduced (Tiwari and Vaishya, 2004).

MATERIALS AND METHODS

The experiment was conducted in the Department of Agronomy, College of Agriculture, and Gwalior's Research Farm (M.P.). The topography of the field was uniform, with adequate drainage. The experimental field's soil type was sandy clay loam. The experiment was conducted using a split-plot design (SPD), with each treatment being replicated three times. Tillage practices and chemical weed control strategies were both parts of the experiment. Three tillage systems (CT, ZT, MT) are combined with seven chemical weed control strategies (Solfosulfuron, Metsulfuron-Methyl, Clodinafop, Solfosulfuron+ Metsulfuron-Methyl, Clodinafop+ Metsulfuron-Methyl, Clodinafop+ Metsulfuron-Methyl, Clodinafop+ Herbicide was sprayed on weeds at the 4-5 foliage stage (30 DAS). Entirely other agronomic procedures were applied to each experimental unit in the same amount. The height of the plants and the number of Tillage were measured Plant height, spike/plant, ear length, grain weight, number of grain spikes, test weight, grain, straw, biological yield, harvest index, and other aspects must all be taken into account. Using the appropriate split-plot design approach, all of the acquired data was

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IMPACT OF CO-INOCULATION OF BIOFERTILIZERS ON GROWTH, YIELD AND YIELD-ATTRIBUTES OF SOYBEAN (*Glycine max* (L) Merrill) IN VERTISOL .

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ABSTRACT

A field experiment was conducted during *kharif* season of 2018 and 2019 at the Research Farm, RAK College of Agriculture, Sehore (M.P.), India to study the impact of co-inoculation of biofertilizers on growth, yield and yield-attributes of soybean. The combined application of 50% RDF + *Glomus geosporum* (AMF) + PGRS (*Paenibacillus polymyxa*) + *Rhizobium japonicum* (T_7) proved most beneficial for growth symbiotic traits, yield-attributes and productivity of soybean in vertisol. This was equally followed by 50% RDF + *Glomus geosporum* (AME) + PGPR (*Paenibacillus polymyxa*) (T_6) and then 50% RDF + *Rhizobium japonicum* (T_5). The grain yield in T_7, T_6 and T_5 treatments was 13.91, 13.44 and 12.94 q/ha, respectively.

Key words: Biofertilizers, inoculation, soybean

INTRODUCTION

Soybean (*Glycine max* L) is an important oilseed-cum-pulse crop. Soybean contains 40% protein and 20% oil. Soybean is capable of fixing atmospheric-N

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Article

Evaluation of Global Composite Collection Reveals Agronomically Superior Germplasm Accessions for Chickpea Improvement

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Abstract: The rich genetic diversity existing within exotic, indigenous, and diverse germplasm lays the foundation for the continuous improvement of crop cultivars. The composite collection has been suggested as a gateway to identifying superior germplasm for use in crop improvement programs. Here, a chickpea global composite collection was evaluated at five locations in India over two years for five agronomic traits to identify agronomically superior accessions. The desi, kabuli, and intermediate types of chickpea accessions differed significantly for plant height (PLHT) and 100-seed weight (100 SW). In contrast, the intermediate type differed substantially from kabuli for days to maturity (DM). Several highly significant trait correlations were detected across different locations. The most stable and promising accessions from each of the five locations were prioritised based on their superior performance over the best-performing check cultivar. Accordingly, the selected germplasm accessions of desi type showed up to 176% higher seed yield (SY), 29% lower flowering time, 21% fewer maturity days, 64% increase in PLHT, and 183% larger seeds than the check cultivar JG11 or Annigeri. The prioritised kabuli accessions displayed up to 270% more yield, 13% less flowering time, 8% fewer maturity days, 111% increase in PLHT, and 41% larger seeds over the check cultivar KAK2. While the intermediate type accessions had up to 169% better yield, 1% early flowering, 3% early maturity, 54% taller plants, and 25% bigger seeds over the check cultivar JG 11 or KAK2. These accessions can be utilised in chickpea improvement programs to develop high-yielding, early flowering, short duration, taller, and large-seeded varieties with a broad genetic base.

Keywords: germplasm; yield; flowering time; genetic diversity; seed size

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Estimation of genetic divergence for agro morphological characters in mungbean [*Vigna radiata* (L.) Wilczek]

Lekha Ram and Ashok Kumar Saxena

Abstract
The genetic diversity in germplasm provides a good opportunity for plant breeders to create new and better genotypes with beneficial traits, which include both farmer-preferred traits (yield potential etc.) and breeders preferred traits (stress resistance / tolerance etc.). The present investigation was conducted to ascertain the information about the magnitude and extent of genetic diversity of agro-morphological characters in mungbean. A total of sixty genotypes of mungbean were evaluated during Kharif season 2018 with three replications adopting randomized compete block design. The observations of each genotype under each replication for phenological and yield attributing traits were recorded on the basis of per plot and five randomly selected plants, respectively. Based on the D^2 values, the sixty genotypes were divided into ten clusters. A maximum of 18 genotypes belongs to cluster I which evolved as the largest cluster, followed by cluster III with 16 genotypes, while cluster VII and IX were solitary. The highest intra-cluster distance was observed for cluster IX (17.20) and the lowest was observed for cluster V, VIII, X (0.0), while the maximum inter-cluster distance was observed between cluster IX and X (35.6). Within the twelve characters studied, the seed yield per plant contributed most to the divergence followed by the 100-seed weight. On the basis the results of this study, it was suggested that a successful hybridization programme could be performed between the genotypes of clusters *viz.* IX and V, VIII, X that exhibit maximum inter-cluster distance to produce new recombinants with desired traits.

Keywords: Genetic divergence, inter-cluster distance, intra-cluster distance, mungbean

1. Introduction
Mungbean (*Vigna radiata* L. Wilczek, 2x=2n=22), also known as green gram, belongs to the Leguminosae family. In India, mungbean has been cultivated since prehistoric times and served as a major source of dietary protein for most people. Being a short duration legume crop and its adaptability to all zones, it is cultivated in three different seasons *viz.*, Kharif, Rabi and Summer. However the maximum coverage of the area under cultivation is in the Kharif season (Sharma *et al.*, 2011) [12]. Mungbean seeds contain approximately 25 *per cent* protein, 1.0-1.5 *per cent* oil, 3.5-4.5 *per cent* fiber, 4.5-5.5 *per cent* ash and 62-65 *per cent* carbohydrates on a dry weight basis. Its protein is comparatively rich in the lysine which is mainly lacking amino acids in cereals. It adds about 42 kilogram nitrogen (N) per hectare because of its ability to fix atmospheric nitrogen to the soil. Mungbean is also used as green manuring, hay and cover crop. Mungbean is cultivated in 4.74 million hectares with a total production and productivity of 2.62 million tonnes and 553 kg per hectare, respectively in India. While in Madhya Pradesh, the cultivated area is 12.76 lakh hectares, with an annual production of 5.74 Lakh tonnes and a productivity of 450 kg per hectare (Anonymous 2020-21) [2]. Mungbean has a noteworthy contribution in diversifying Indian agriculture and its ability to meet the protein deficit of the country's vegetarian population, but its productivity in the country is still low and needs for improvement. Yield components are the primary objective under study for crop improvement as Grafius (1978) [6] suggested that there may not be genes for yield *per se* but for the various components, the multiplicative interactions of which resulting in the artifact of yield. Genetic diversity is the basic requirement in any crop improvement program which aimed to improve the crops genetically. Hence, the success of breeding depends entirely on the genetic diversity of desired traits and the great emphasis has been placed on the usefulness of multivariate analysis (Gadakh *et al.*, 2013) [4]. Genetic diversity is defined as the extent to which heritable material differ within a group of plants as a result of evolutionary forces, including domestication and plant breeding (Hintum and Van, 1995) [7].

Article

Efficacy of Herbicides for Weed Control in Cauliflower (Brassica oleracea var. botrytis L.)

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Abstract

A field experiment was conducted during Rabi, 2018-19 at Horticulture farm, RAK College of Agriculture, Sehore (M.P.) to study the effect of different weed management practices on growth and yield of cauliflower. The treatments namely - T1- Weedy check (control), T2- Weed free (through hand weeding) at 30 & 60 DAT, T3 -Pendimethalin 30% EC (PE) + one hand weeding at 30 DAT, T4 Oxyfluorfen 23.5% EC (PE) + one hand weeding at 30 DAT, T5 - Propaquizafop 10% EC (POE) + one hand weeding at 60 DAT, T6 -Wheat straw mulch 5kg/plot, T7- Black plastic mulch (150 mm) were evaluated in randomized block design with three replications. Results indicated that the there was no weed under T7 -black plastic mulch (150 mm) at all the stages. The maximum weed control efficiency (98%) was found with the treatment T7 - black plastic mulch (150 mm) at all the stages i.e. at 30, 60 and 90 DAT. The minimum weed index (0.00, 0.00 and 0.00%) was found with the treatment T7 (Black plastic mulch (150 mm) at all the stages. The maximum curd length, curd width, total curd weight (g) and curd yield (q ha-1) was recorded T7- black plastic mulch

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EFFICACY OF CO-INOCULATION OF BIOFERTILIZERS ON YIELD, ECONOMICS AND MICROBIAL ACTIVITIES UNDER SOYBEAN (*Glycine max* (L) Merrill) CROPPING IN VERTISOL

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ABSTRACT

A field experiment was conducted during *kharif* season of 2018 and 2019 at the Research Farm, RAK College of Agriculture, Sehore (M.P.), India to study the efficacy of co-inoculation of biofertilizers on yield, economics and microbial activities under soybean cropping. The combined application of 50% RDF + *Glomus geosporum* (AMF) + PGRS (*Paenibacillus polymyxa*) + *Rhizobium japonicum* (T_7) proved most beneficial for growth symbiotic traits, yield-attributes and productivity of soybean in vertisol. This was equally followed by 50% RDF + *Glomus geosporum* (AME) + PGPR (*Paenibacillus polymyxa*) (T_6) and then 50% RDF + *Rhizobium japonicum* (T_5). The grain yield in T_7, T_6 and T_5 treatments was 13.91, 13.44 and 12.94 q/ha, respectively. The combined application of 50% RDF + *Glomus geosporum* (AMF) + PGPR (*Paenibacillus polymyxa*) + *Rhizobium japonicum* (T7) recorded the highest net returns (Rs 29988/ha), and 2.33 B:C ratio, followed by the treatment (50% RDF + *Glomus geosporum* (AMF) + PGPR

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Effect of tillage and chemical weed control practices on the growth and quality characteristics of a late-sown wheat cultivar in Madhya Pradesh's Gird region (*Triticum aestivum* L.)

PK Para, SS Kushwah, J Sharma, BK Sharma and G Malgaya

Abstract
A field experiment entitled "The effect of tillage and weed management practices on yield and nutrient uptake in wheat (*Triticum aestivum* L)" was carried out at Agronomy research form, Department of Agronomy, R.V.S.K.V.V. Gwalior (M.P.) during the Rabi season of 2019-20 and 2020-21.To find out the effect of various tillage and chemical weed control practices on growth, yield attribute, yield, nutrients content, after harvesting the wheat crop, and economics of various treatments. The combination of the five tillage systems (CT, ZT, MT) and seven weed management practices (Solfosulfuron, Metsulfuron-Methyl, Clodinafop, Solfosulfuron+ Metsulfuron-Methyl, Clodinafop+ Metsulfuron-Methyl, Two hand weeding, and weedy check) was laid out in Split Plot Design and replicated thrice. The results reported that the higher growth parameters *viz*., number of tillers, leaf area, dry weight per plant protein and starch content were recorded under during both the experimental years. Among the zero tillage conditions recorded higher growth parameters. In the case of chemical weed practices, weed-free up to 60 DAS exerted a significant effect on the growth of wheat. However, in herbicidal treatments, post emergence application of clodonafop + metsulfuron - methyl, (60+4) g/ha ready mixture noted higher values of the above parameters after weed-free treatment. Protein and starch content was to show significant effect due to the above treatments tillage and chemical weed practices.

Keywords: Effect of tillage, quality of wheat field experiment, and chemical weeds practices

Introduction
Wheat (*Triticum aestivum* L.) is the world's most important staple food crop and has emerged as the foundation of India's food security. It feeds approximately 36% of the world's population. It contains approximately 12% protein, 2% total fat, and 55% carbohydrates (Kumar *et al*., 2011). Food demand in India is expected to rise significantly in the coming decades; according to the study, India's total demand for food grains will rise from 236.2 million tonnes in 2010 to 272-277 million tonnes in 2020 and 303-318 million tonnes in 2030. (DACFW, 2017) [8]. As a result, in order to meet the demand for food grains, we must increase wheat production and productivity.

The possibility of expanding wheat production in the coming years is limited. As a result, any increase in wheat production must be accompanied by an increase in productivity. Wheat productivity in India is either stagnating or decreasing due to a variety of factors such as improper tillage practices, imbalanced fertilizer use, water scarcity, weed infestation, unpredictable monsoon seasons, poor quality seeds, over-irrigation and over-fertilization, and soil becoming less fertile, among others (Kantwa *et al.*, 2015) [11]. Formalized paraphrase late sowing reduces yield primarily due to delayed germination, insufficient seedling emergence, and insufficient stand establishment due to low temperatures at sowing time (Patra and Singh, 2018) [19]. Protein is the largest component of wheat grain. The storage protein (gliadin and glutenin) are the most important fractions determining the viscoelastic properties of dough for different foodstuff making (Leon *et al*. 2010) [16]. Wheat grain comprises three major tissues the embryo (germ), endosperm, and the outer layer which account for 3%, 80%, 85%, and 13%, 14% of the dry weight respectively (Barron *et al.*, 2007) [1].

Materials and Methods
The experiment was carried out at the Research Farm of the Department of Agronomy, College of Agriculture, and Gwalior (M.P.).

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Effect of Phosphorous Level and Phosphorous Solubilizing Bacteria (PSB) on Yield Attributes and Yield of Berseem (*Trifolium alexandrinum* L.)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The present study was conducted at Research farm of R.A.K., college of Agriculture, Sehore, Madhya Pradesh during 2020-21. The experiment was laid out using Randomized Block Design with different levels of Phosphorus with or without PSB application (T_1- 45 kg P_2O_5/ha, T_2- 60 kg P_2O_5/ha, T_3- 75 kg P_2O_5/ha,T_4 -90 kg P_2O_5/ha, T_5 - 45 kg P_2O_5/ha + PSB @ 5g/kg seed, T_6 - 60 kg P_2O_5/ha + PSB @ 5g/kg seed, T_7 - 75 kg P_2O_5/ha + PSB @ 5g/kg seed, T_8 - 90 kg P_2O_5/ha + PSB @ 5g/kg seed).Treatment T_7 found to be best for yield and yield attributes of berseem. Maximum no. of capsules/m^2 (466), no. of seeds/capsule (28.81), Test weight (2.01 g), Seed yield (0.46 g/plant, 0.478 kg/plot, 239 kg/ha), Green fodder yield (63.75 kg/plot, 31870 kg/ha) and HI (10.21).While minimum recorded with treatment T_1 (45kg P_2O_5/ha without PSB application).

Keywords: Phosphorous level; phosphorous solubilizing bacteria; yield attributes.

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Effect of growth regulators and vermicompost on No of nods per vine and vine length of bottle gourd [*Lagenaria siceraria* (Mol.) Standl.]

Varsha Uikey, Dr. RK Pathak and Dr. RK Jaiswal

Abstract
The present investigation in titled "Effect of Growth paramenters Bottle Gourd [*Langenaria siceraria* (mol.) stand L.] by Growth Regulators" at the Horticulture Research Farm, R.A.K college of Agriculture, Sehore (M.P.) during 2019-20 and 2020-21. The thirteen treatments *viz.*, T_1 (GA3 0 ppm + Vermicompost @ 0), T_2 (GA3 25 ppm + Vermicompost. @ 2 t/ha), T_3 (GA3 50 ppm + Vermicompost @ 4 t/ha), T_4 (GA3 75 ppm + Vermicompost @ 6 t/ha) T_5 (Etherel 100 ppm + Vermicompost @ 2 t/ha.), T_6 (Etherel 200 ppm + Vermicompost @ 4 t/ha.), T_7 (Etherel 300 ppm + Vermicompost @ 6 t/ha.) T_8 (NAA 100 ppm + Vermicompost@ 2 t/ha.), T_9 (NAA 150 ppm + Vermicompost @ 4 t/ha.), T_{10} (NAA 200 ppm + Vermicompost @ 6 t/ha.), T_{11} (CCC 200 ppm+ Vermicompost @ 2 t/ha.), T_{12} (CCC 400 ppm + Vermicompost @ 4 t/ha.) and T_{13} (CCC 600 ppm + Vermicompost @ 6 t/ha.) were evaluated during the experiment ranges from 130.50cm to 210.83cm. The maximum vine length were recorded under the treatment T_4 (210.83cm).While the minimum vine length was find out under control treatment T_1 (130.50cm). During the experiment the treatment T_4 over all performed superior in relation to pooled data. The vine length increase every stage might be GA_3 increase cell elongation and the closely finding are Komal Kumari *et al.,* (2019) he studied on different dosed of GA3 and reported that the 200 ppm GA3 give highest growth of vine.

Keywords: Regulators, vermicompost, length, *Langenaria siceraria*

Introduction
Bottle gourd [*Langenaria siceraria* (Mol.) stand L.] is a one of the most popular vegetable of cucurbits and it is also commonly grown in India. Bottle gourd is also popular vegetable in other tropical sub-tropical countries like Ethopia, Africa, and Central America. It is photo-insensitive crop but sensitive to thermo-periodism. Thus, most of the existing bottle gourd varieties are season specific. Its chromosome number is 2n=22 and belongs to family Cucurbitaceae. The tender fruits of the bottle gourd is used for cooking vegetable, making sweet and pickle. It is easily digest, even by patients. The fruit has a cooling effect, cardio tonic and diuretic. The pulp is good for overcoming constipation, cough, and night blindness. Per 100g of fresh fruit contain 0.2% of protein, 2.9% of carbohydrate, 0.5% of fat and, 0.5% mineral matter, 0.044 mg thiamine, 0.023mg riboflavin, 0.33mg niacin and 12 mg vitamin C and 0.6g fibre (Aykyoyd, 1968).

Material and Methods
The experiment was carried out at the Horticulture Research Farm, R.A.K college of Agriculture, Sehore (M.P.) during 2019-20 and 2020-21 i.e., from July 2019 to November 2020. The experimental site is situated in the western part of the Vindhya Plateau at 23.11º North latitude and 77.04º' East longitudes at an altitude of 502 meter above mean sea level in Madhya Pradesh. The topography of the experimental field is plain. The region lies under 5thagro-climatic zone of state. Sehore belongs to sub-tropical zone. The summers here have a good deal of rainfall, while the winters have very little. The average temperature is about 25.3o C. The rainfall here is around 1266 mm (49.8 inch per year). The highest temperature recorded in the month of May at around 33.8º C whereas January is the coldest month with temperature 18.6 ºC. Temperatures in the summer range from 25 to 45 ºC, while the temperature in winter is 10 to 25 ºC. The experiment was laid out in Randomized Completely Block Design (RCBD) with three replications. Each replication consists of 13 treatments. The above experiment was conducted in medium black soil having sand 25% sand, 38% silt and 37% of clay. The plant seedlings were prepared in polybags and transplanted at four true leaves.

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Title : Effect of drought on Cotton Genotypes under field condition

Abstract :

The cotton grow in drought condition is a matter of interest to research workers due to in short supply of water to cotton grow in area to area and a solemn problem in rainfed cotton growing area. The field experiment was laid down that the twenty genotypes grown in randomized block design with three replications during Kharif season of 2016-17 and 2017-18. The investigations gained on effect of drought on cotton genotypes parameters viz., plant height, monopodia, sympodia, dry matter production and seed cotton yield were recorded under field condition. In the investigations what could wondering possibility to maximum 137.33cm, 2.54 and 111.91g in TSH-324 and RHC-1217, plant height, monopodiaplant-1and dry matter production, while the minimum 79.66cm, 0.21 and 83.73g in JK-4, AR-9108 and L-799, noticed in the genotype. Apart from this, maximum number of sympodia plant-1(26.43) and seed cotton yield 1803.35 kg ha-1 recorded in the genotype JK-4 while the minimum number of sympodia per plant and seed cotton yield recorded in the genotype L-1384 that were 19.96 and 742.14 kg/ha respectively. The genotype JK-4 is statistically significant superior over rest genotypes. From this investigation, JK-4 genotype is suitable to cultivate in Malwa-Nimar region under drought condition in respect to seed cotton yield.

FULL ARTICLE

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ORIGINAL RESEARCH
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Development of High Yielding Fusarium Wilt Resistant Cultivar by Pyramiding of "Genes" Through Marker-Assisted Backcrossing in Chickpea (*Cicer arietinum* L.)

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Pusa 391, a mega *desi* chickpea variety with medium maturity duration is extensively cultivated in the Central Zone of India. Of late, this variety has become susceptible to Fusarium wilt (FW), which has drastic impact on its yield. Presence of variability in the wilt causing pathogen, *Fusarium oxysporum* f.sp. *ciceri* (*foc*) across geographical locations necessitates the role of pyramiding for FW resistance for different races (*foc* 1,2,3,4 and 5). Subsequently, the introgression lines developed in Pusa 391 genetic background were subjected to foreground selection using three SSR markers (GA16, TA 27 and TA 96) while 48 SSR markers uniformly distributed on all chromosomes, were used for background selection to observe the recovery of recurrent parent genome (RPG). BC_1F_1 lines with 75–85% RPG recovery were used to generate BC_2F_1. The plants that showed more than 90% RPG recovery in BC_2F_1 were used for generating BC_3F_1. The plants that showed more than 96% RPG recovery were selected and selfed to generate BC_3F_3. Multi-location evaluation of advanced introgression lines (BC_2F_3) in six locations for grain yield (kg/ha), days to fifty percent flowering, days to maturity, 100 seed weight and disease incidence was done. In case of disease incidence, the genotype IL1 (BGM 20211) was highly resistant to FW in Junagarh, Indore, New Delhi, Badnapur and moderately resistant at Sehore and Nandyal. GGE biplot analysis revealed that IL1(BGM20211) was the most stable genotype at Junagadh, Sehore and Nandyal. GGE biplot analysis revealed that IL1(BGM 20211) and IL4(BGM 20212) were the top performers in yield and highly stable across six environments and were nominated for Advanced Varietal Trials (AVT) of AICRP

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JOURNAL ARTICLE

Characterization of '*QTL-hotspot*' introgression lines reveals physiological mechanisms and candidate genes associated with drought adaptation in chickpea

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Abstract

'*QTL-hotspot*' is a genomic region on linkage group 04 (CaLG04) in chickpea (*Cicer arietinum*) that harbours major-effect quantitative trait loci (QTLs) for multiple drought-adaptive traits, and it therefore represents a promising target for improving drought adaptation. To investigate the mechanisms underpinning the positive effects of '*QTL-hotspot*' on seed yield under drought, we introgressed this region from the ICC 4958 genotype into five elite chickpea cultivars. The resulting introgression lines (ILs) and their parents were evaluated in multi-location field trials and semi-controlled conditions. The results showed that the '*QTL-hotspot*' region improved seed yield under rainfed conditions by increasing seed weight, reducing the time to flowering, regulating traits related to canopy growth and early vigour, and enhancing transpiration efficiency. Whole-genome sequencing data analysis of the ILs and parents revealed four genes underlying the '*QTL-hotspot*' region associated with drought adaptation. We validated diagnostic KASP markers closely linked to these genes using the ILs and their parents for future deployment in chickpea

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Evaluation of culture media to select the most suitable medium for the growth of leaf spot of pigeonpea [*Cajanus cajan* (L.) Millsp.] Caused by *Cercospora cajani*

Vijay Kumar Kashyap, Vivek Kumar Vishwakarma and AK Choudhary

Abstract
Cercospora leaf spot caused by *Cercospora cajani* Henningsis one of the most important fungal diseases of Pigeonpea [*Cajanus cajan* (L.) Millsp.]. Out of six culture media maximum fungal growth was recorded in Potato dextrose agar medium followed by V-8 agar juice, seed extract arhar agar, Carrot dextrose agar, Old leaves extract arhar agar and new leaf extract arhar agar at seven days. Out of six culture media maximum (83.00 mm) fungal growth was recorded in Potato dextrose agar medium.

Keywords: Media, suitable, pigeonpea, *Cercospora cajani*, *Cajanus cajan* L.

Introduction
Pigeonpea [*Cajanus cajan* (L.) Millsp.] is an important grain legume crop of rainfed agriculture in the semi-arid tropics. Besides Indian sub-continent, it is widely grown in Eastern Africa and Central America. It is not only an important source of protein, but also plays an important role in atmospheric nitrogen fixation into soil (Reddy *et al.*, 2012) [5]. Globally pigeonpea is cultivated in about on 4.7 million ha area with 3.69 million tonnes annual production. India accounts 78% of the global output with current production of 2.78 million tonnes from 3.5 million ha. In Madhya Pradesh Pigeonpea is grown in about 0.57 million ha with an annual production of 0.57 million tonnes. The average yield of Pigeonpea in M.P. is 848 kg/ha which is much larger than the potential yield of crop (1500-2000 kg/ha). Several biotic and abiotic factors are responsible for reducing the yield (Anno. 2018) [1]. Cercospora leaf spot inflicts heavy yield losses ranging from 23 to 96 per cent under natural epiphytotic conditions. (Kasno, 1990; Iqbal *et al.*, 1995; Kaur, 2007) [3, 2, 4]. The yield losses vary depending upon how early the crop is infected in the season, crop variety and prevailing weather. The leaf spot disease is caused by fungus *Cercospora cajani.* It is present in parts of Uttar Pradesh, Bihar and several places of south India (Reddy *et al.*, 2012) [5].

Materials and Methods
Evaluation of culture media to select the most suitable medium for the growth of *Cercospora cajani*
The different media were evaluated for obtaining maximum mycelial growth of the *Cercospora cajani***.** The experiment was laid out in complete randomized design with replicated in four times. Six solid culture media *viz.*, Seed extract arhar, Old leaves extract, New leaves extract arhar, V-8 agar juice Carrot agar and Potato Dextrose agarused to compare the growth rate of *Cercospora cajani* (Table-2). The Culture Medium were prepared by the standardized method and autoclaved at 121.6 °C, 15 psi pressure for twenty minutes. The quantities (20 ml) of each medium were poured in 90 mm Petri dish. Each Petri plate was inoculated separately with uniform mycelia culture bits (7 mm) cut with the help of cork borer from young (5 days) vigorously growing culture were placed on the middle of the each pre poured medium and incubated at 25±1 ^{0}C (Dela Paz *et al*., 2006). Each treatment was replicated three times. The diameter of the growth of the fungus was measured after inoculation 3, 5 and 7 days on radial growth of mycelium were recorded.

Experiment details
Design: CRD
Replication: 4
Treatments: 6

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Effect of polysaccharide based edible coating to improve shelf -life and quality of guava (*Psidium guajava*) in Malwa region of central India

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ABSTRACT

Guava fruit have a very short shelf life due to high rate of respiration. Storage of guava fruits at room temperature causes weight loss, microbial disease, physiological disorders and physical injuries and is moreover, highly susceptibility to chilling injury making low temperature storage less possible. Therefore, the present investigation was carried out at the Department of Fruit Science, College of Horticulture, Mandsaur, Madhya Pradesh, India during the year 2019- 2020 with an objective to extend shelf-life of guava fruits cv. Rewa-72. The treatments comprised of post-harvest treatments with Chitosan, Carboxymethyl cellulose, Aloe vera gel. The physico-chemical, functional and sensory quality of guava fruits were significantly influenced by application Chitosan @ 1.5% and Carboxymethyl cellulose @ 1.5%) coating up to 12 days of storage. It was found that the CMC or Chitosan bilayer coating was equally effective as the commercial polyethylene wax in enhancing glossy appearance of guava fruits because it is a good moisture barrier, thus preventing the water loss by transpiration. Chitosan @ 1.5% and CMC @1.5% treated fruits had more overall acceptability because this coating helped in improving the colour, aroma, taste, texture, appearance and quality of fruits. Hence, this technology could be more useful for increase shelf life of fruits, low cost and reduce the post-harvest loss of fruits it also helps to replace the use of harmful chemicals by growers and traders.

Key words : *Aloe vera* gel, carboxymethyl cellulose, chitosan, guava, post-harvest

INTRODUCTION

Guava (*Psidium guajava* L.), the apple of tropics, is a member of the family Myrtaceae with chromosome number 2n= 22. It is forth most important fruit in terms of area and production after mango, banana and citrus in India. Good amount of guava is produced in India after banana, mango and citrus. The major guava producing states of India are Uttar Pradesh, Bihar, Madhya Pradesh and Maharashtra. In India it occupies 2.87 lakh ha area with a total production of 43.04 lakh metric tons and productivity 15.3 metric tons/ ha in 2019-20. Madhya Pradesh secured IInd position in area (35.08 thousand ha) and production (686.7 thousand MT) whereas, IVth rank in productivity 19.58 metric tons/ha in 2017-18. However, around 18.01% of this production was lost due to a lack of effective post-harvest facilities during handling, transportation and storage. Guava is quite hardy, prolific bearer and highly remunerative even without much care (Mitra and Bose, 1990; Singh *et al.*, 2017; Singh and Kaur, 2019).

Guava fruits are the important part of our dietary, which are rich source of nutrients (carbohydrates, proteins and fat, vitamins, minerals and dietary fibre). Carbohydrates, proteins and fat are macronutrients, considered as energy sources. Vitamins and minerals are micronutrient, play important role in body building. Maximum dietary fibre found in fig (7%) followed by guava (6.9%) in fruit. A guava fruit tends to spoil very quickly and have the very short shelf life due to high rate of respiration. Storage of guava fruits at room temperature causes weight loss, microbial disease, physiological disorders and physical injuries (Kohli *et al.*, 2019). On other

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Effect Pre-Harvest Spray of Calcium and Potassium Nutrients Sources on Storage Behaviour of Aonla *(Emblica officinalis* Gaertn.) Fruits Cv. Hathijhool

Krishna Kumar, R.N. Kanpure, Jyoti Kanwar, B. Kachouli and R.P. Patel
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Abstract

Results revealed that minimum of physiological weight loss (5.37, 8.60 and 16.60%), minimum percentage of decay loss (9.08 [illegible]), maximum specific gravity (1.08, 1.07 and 1.05) maximum percentage of marketable fruit (100, 90.92 and [illegible] 10th and 15th days of storage period respectively was recorded in T_3 (calcium nitrate @ 2%). Maximum TSS ([illegible] and 13.27 °Brix) on 0th, 5th, 10th and 15th days of storage period was recorded with the application 1.5% @ potassium sulphate (T_8). The maximum acidity (1.92, 1.90, 1.88 and 1.87%) on 0th, 5th, 10th and 15th day was recorded with the application calcium nitrate @ 1.5% (T_2). Maximum total sugars (5.78, 6.12, 6.33 and 6.53%) and maximum reducing sugar ([illegible] 3.47, 3.58 and 3.72%) respectively on 0th, 5th, 10th and 15th days of storage period was recorded in T_3

Key words : *Preharvest, spray, calcium, potassium, storage behaviour, aonla*

Introduction

Aonla [*Emblica officinalis* Gaertn] syn. [*Phyllanthus emblica* Gaertn.] belongs to family *Euphorbiaceae*, and sub family *Phyllathoidae* is an important fruit crop of commercial significance. It is quite hardy, prolific bearer and remunerative even without much care. Indian gooseberry is an under utilized fruit tree with medicinal and herbal qualities. Its fruit is tonic for diuretic, laxative, antibiotic and act as cooling refrigerant. It is the richest source of vitamin "C" (500 mg/100 g) among all fruits except Barbados cherry and rich in pectin, iron, calcium and phosphorus. It is also known as *amritphal*. It is indigenous to tropical south-eastern Asia, particularly in central and southern India. Fruit pulp of Indian gooseberry is an important ingredient of *chavanprash* and *triphala* powder which is used for curing different abnormalities. The fruit contains a chemical substance gallic acid and leucoanthocyanin that has antioxidant property.

In India aonla is wildly distributed in Himalaya Region, U.P. Chhota Nagpur, Bihar, Orissa, West Bengal, Deccan and Karnataka. The total cultivated area under aonla in India is 92,000 hectares with annual production of 1063,000 MT (1). Madhya Pradesh forests have rich diversity of aonla. The pathological losses in fruits start soon after the harvesting which requires systematic study on shelf-life and storage stability of aonla fruits. Pre-harvest calcium application have been used to delay aging or ripening to reduce post-harvest decay and to control the development of physiological disorders in different fruits. Firming and resistance to softening resulting from addition of calcium have been attributed to the stabilization of membrane systems and formation of Ca-pectate, which increase rigidity of the middle portion & cell wall of the fruit. Chemicals like calcium compounds have been reported to prolong shelf- life by affecting the wide range of physiological processes in plants and also inhibit specific aspects of abnormal senescence in aonla fruit (2).

Among various nutrients, potassium is considered to be of high importance and is known to have profound influence on fruit quality through its influence on size, appearance, color, soluble solids, acidity and vitamin contents. It has also beneficial role in recovery of nutritional and physiological disorder in fruit trees.

Materials and Methods

The present investigation was carried out at Instructional cum research fruit orchard and laboratory of department of fruit science during the year 2017. Ten year old aonla trees were treated at three concentrations (1.0, 1.5 and 2.0%) of calcium and potassium nutrients sources from calcium nitrate, calcium chloride and potassium sulphate. The experiment was laid out in randomized block design (RBD) with three replications consisted ten treatments. Single spray of calcium nitrate, calcium chloride, and potassium sulphate was done on 26 December 2017 and fruits harvested after 20 days and stored for 15 days.

Rotting was expressed on percentage basis

$$\text{Per cent rotting} = \frac{\text{Rotten fruits}}{\text{Total fruits}} \times 100$$

Total soluble solid in fruits was recorded at room temperature using hand refractometer (Erma,Tokyo, Japan) and expressed in term of °Brix.

Acidity in fruit was estimated as method described by (3).

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Effect of different surface coating materials on chemical characteristics of guava (*Psidium guajava* L.) cv. Allahabad safeda fruits

Sikandar Malik, RN Kanpure, Vinay Prakash Bagde, Vaqar Malik and DK Raidas

Abstract
The lab experiment conducted in complete randomized design under three replications of seventeen treatment on variety Allahabad safeda of Guava. The experiment was conducted during 2019 - 2020 at the Instructional cum Research Department of Fruit Science, RVSKVV- K.N.K. College of Horticulture, Mandsaur 458001 (M.P.). Guava freshly harvested fruits were coated with different coatings Guar gum (0.5%, 1.0%, 1.5% and 2.0%), Shellac (0.5%, 1.0%, 1.5% and 2.0%), *Aloe vera* gel (25%, 50%, 75% and 100%) and CMC, Carboxyl Methyl Cellulose (0.5%, 1.0%, 1.5% and 2.0%). Periodically effects of different surface coating materials were observed for Chemical parameters of fruits like- total soluble solids (°Brix), titratable acidity (%), ascorbic acid (mg/100 g), total sugars (%), tannins (mg/100 g) and organoleptic evaluation like- fruit flavour. Guar gum was found to be more beneficial as compared to other edible coatings throughout storage period. The application of edible coating (Guar gum) has proved to be best post-harvest application storage of guava cv. Allahabad Safeda from the point of different chemical characteristics *viz*. total soluble solids (°Brix), titratable acidity (%), ascorbic acid, total sugars, tannins and organoleptic evaluation like- flavour during storage up to 12th day of storage.

Keywords: Guar gum, *Aloe vera* coating, Carboxyl methylcellulose, total soluble solids, total sugars, tannins, flavour

1. Introduction
Guava (*Psidium guajava* L.) is one of the predominant fruit crop in tropical and subtropical tracts of the world and claims superiority over different fruits by virtue of its commercial and nutritional values. It is also known as "The Apple of Tropics". Botanically, it belongs to the family Myrtaceae which comprises at least 150 genera and more than 5,650 species. It occupies fourth position in terms of area 2.65 lakh ha and production 40.54 lakh MT after mango, banana and citrus. The guava fruit is an excellent source of ascorbic acid but with poor calorific value (66 cal/100 g), protein content (1%), dry matter (17%) and moisture (83%). The fruit is also rich in minerals like phosphorus (2337 mg/100 g), calcium (14-30 mg/100 g), iron (0.6-1.4 mg/100 g) as well as vitamins like niacin, pantothenic acid, thiamine, riboflavin and vitamin A. Edible coatings have high potential to carry active ingredients such as anti-browning agents, colorants, flavours, nutrients, spices and antimicrobial compounds that can extend product shelf-life and reduces the risk of pathogen growth on fruit surfaces (Pranoto *et al*., 2015) [12]. There has been increasing interest for the use of *Aloe vera* gel as an edible coating material for fruits and vegetables driven by its antifungal activity (Jasso Rodriguez de *et al*., 2005) [7]. The positive effect of this edible coatings is based on their hygroscopic properties, which enables formation of O_2 and CO_2 by creating modified atmosphere (MA) and acting as moisture barrier between the fruit and the environment and thus reduced weight loss, browning, softening and growth of yeast and molds (Morillon *et al*., 2002) [11]. Shellac resin is secreted by the insect *Laccifer lacca* found in India. Shellac is composed of aleuritic and shelloic acids is compatible with waxes and gives coated products a high gloss appearance (Hagenmaier and Shaw, 1991) [6]. Guar gum is a galactomannan rich flour, water soluble polysaccharide obtained from the leguminous Indian cluster bean (*Cyamopsis tetragonoloba* L.). It is one of the most important thickener and versatile material for many food applications due to its different physico-chemical properties as well as its high availability, low cost and biodegradability. This galactomannan has similar properties as carrageenan, alginate, xanthan gumand gum Arabic as an edible coating but guar gum has the advantage of being cheaper than all the others (Rodge *et al*., 2012) [15].

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Effect of different Chemical and Physical Treatments on Germination and Seedling Vigour of Chironji (*Buchanania lanzan* Spreng.)

Homeshvari, RN Kanpure, Devid Kumar Sahu and Badri Lal Nagar

Abstract
An experiment was conducted to see the effect of different chemicals and physical treatments on germination and seedling vigour of chironji (*Buchanania lanzan* Spreng.). Result revealed that minimum number of days (29.18 days) for seed germination, number of days for 50 per cent seed germination(36.02 days), maximum germination percentage after 30 days(2%), and germination index (0.94%) were observed in treatment T_7 (mechanical scarification breaking of seed coat through hammering) and treatment T_5 (soaking in GA_3 250 ppm for 24 hrs.) was recorded the maximum value of survival percentage(62.92%), seedling height(6.38 and 9.79 cm), number of leaves per plant(4.11 and 6.16), leaf area(16.75 and 24.07 cm^2), collar diameter (0.18 and 0.29 cm), root length(9.63 and 12.73 cm) at 60 and 90 DAS, respectively. Similarly maximum fresh shoot weight (7.18 g), fresh root weight (3.8 g), shoot and root ratio (0.93), dry shoot weight (4.66 g), dry root weight (1.86 g) and seedling vigour index (682.07) was also notice in treatment T_5 (soaking in GA_3 250 ppm for 24 hrs.) at 90 DAS.

Keywords: Chironji, germination index, seed, vigour, GA_3, scarification

Introduction
Chironji (*Buchanania lanzan* Spreng) is a common agro-forestry and social forestry fruit tree. It has gained a lot of popularity due to its many uses and its ability to survive extreme weather conditions (Chauhan *et al*., 2020) [6]. It belongs to the Anacardiacae family and was first described by Francis Hamilton in 1798. Depending on the region, it is known by various common names, like charoli in Madhya Pradesh, chawar, achar, cuddapah almond in Bengali, piyal in Assam, charu in Oriya and char in Telugu. The species is a native of the Indian sub-continent (Chauhan *et al*., 2012) [7] and is north, western, and central India's tropical deciduous woods are home to this species (Prasad, 2020) [18]. Chironji is a small - to - medium almost evergreen tree with a tiny crown and a short stem that may reach up to 18 meters tall and 1.5 meters spread. Trees of chironji have the same alternate bearing nature as mango trees with flowering in January-February and maturing in April-May (Chauhan *et al*., 2020) [6]. This fruit is under cultivation/underutilized but it has lots of culinary and medicinal properties. Chironji is a good source of oil (52%) (Kumar *et al*., 2012) [14]. The seeds consists of moisture (3.0%), fat (59.0%), protein (19.0-21.6%), carbohydrate (12.1%), fiber (3.8%), calcium (279.0 mg), phosphorus (528.0 mg), iron (8.5 mg), thiamine (0.69 mg), ascorbic acid (5.0 mg), riboflavin (0.53 mg), niacin (1.50 mg) and also contain 34-47% fatty oil and 650 kcal/100g of kernel as caloric value (Siddiqui *et al*., 2014) [20] and may fetch Rs. 800-1000 per kg in market. The gum from the bark is used for treating diarrhea and intercostal pains and leaves are used for promoting wound healing.

Chironji is propagated through seed as well as vegetative method (soft wood grafting, chip budding, root cutting). Germination is one of the main constraints in the propagation and cultivation of chironji because of hard seed coat present on the kernels. Seeds of Anacardiaceae species usually possess physical dormancy type, which is promoted by an impermeable endocarp. Seed germination is broadly affected by two factors i.e. external factors (factors outside the embryo) and internal factors (embryo associated) (Hassani *et al*., 2009) [10].

Chironji seeds are recalcitrant in nature and it losses viability soon after 3 months of harvesting. Such seeds may require special treatments like stratification, scarification, soaking in water, growth regulators etc. for overcoming dormancy.

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Effect of Foliar Application of Salicylic Acid and Nutrients on Growth, Yield and Fruit Quality of Nagpur Mandarin (*Citrus reticulata* Blanco.)

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Abstract

An investigation was carried out at Instructional cum Research Fruit Orchard, Department of Fruit Science College of Horticulture, Mandsaur (M.P.) during 2019-20, to study the effect of foliar application of salicylic acid and nutrients on growth, yield and fruit quality of Nagpur mandarin (*Citrus reticulata* Blanco.). Results revealed that the maximum plant height (2.92 m), plant spread East-West direction (1.81 m), plant spread North-South direction (1.73 m), canopy volume (15.9 m^3), number of flowers $plant^{-1}$ (563.67), fruit setting (54.05 %), minimum fruit drop (28.33 %), fruit retention (71.67 %), fruit length (6.61 cm), fruit diameter (6.79 cm), fruit volume (145.33 ml), fruit juice (36.20 %), minimum number of seeds $fruit^{-1}$ (10.34), TSS (12.37 ^{0}Brix), minimum acidity (0.74 %), TSS: acid ratio (16.74), ascorbic acid content (26.65 mg/100 ml juice), SPAD value (68.72), total sugars (8.32 %), number of fruits per plant (201.33), fruit weight(138.33 g), fruit yield $plant^{-1}$ (27.85 kg) and fruit yield $hectare^{-1}$ (7.71 tonnes) were observed with foliar spray of SA @ 5mg/l + K_2SO_4 @0.4% + $ZnSO_4$ @ 0.4% + Ca $(NO_3)_2$ @ 0.4% (T_{10}) followed by treatment T_9 (SA @ 5mg/l + $ZnSO_4$ @ 0.4% + Ca $(NO_3)_2$ @0.4%). The minimum data were recorded with respect to all the parameters under control (T_{11}).

Key words : *Mandarin, salicylic acid, nutrients, quality and yield.*

Introduction

Nagpur Mandarin (*Citrus reticulate* Blanco.) occupies the first position among the citrus in India with respect to area and production. It is considered to be one of the most important loose skinned oranges. In India, citrus fruits occupy a prominent place and are extensively grown as tropical and subtropical fruits after mango and banana. Mandarin is considered to be one of the most important cultivated species among citrus and is being commercially grown in certain specific region of the country like Nagpur mandarin in central India, Nagpur santra is finest variety and very popular in India as well as in world for its good quality fruits and in Madhya Pradesh Sajapur, Agar Malwa, Mandsaur, Ratlam, Neemuch and Ujjain are major mandarin growing districts. Fruit size big, sub-globose, average weight 110-125 g, rind medium thick, fairly loosely adherent, surface is also relatively smooth but, segment found in 10-15 number and number of seeds 1-2 per segment, colour of peel pale orange yellow. Fruit have mild flavor, excellent quality, juicy, TSS 10- 12 ^{0}Brix, and acidity 0.50-0.70%. Citrus are relatively high nutrients-demanding crops (Wang *et al.*, 2006) and highly responsive to applied nutrients in the form of fertilizers. Enhanced growth with improved fruit yield can be obtained with the application of proper compound fertilizers because any nutrient either deficient or excess can lead to huge reduction in crop yield.

Salicylic acid (SA) classified as a plant hormone-like substances, has been reported to play an important role in the regulation of plant growth and development. It stimulates flowering and tuberization in a range of some angiosperm species, increases flower life, besides improving flowering number or density and fruit set percentages (Mohammadi *et al.*, 2015). Inadequacy of potassium is one of the most striking factor s that regulaethe fruit size. Foliar spray of potassium two months after flowering increases fruit size of Valencia oranges (Miller and Hafman, 1988). The role of Zn in plant is due to its requirement in the synthesis of tryptophan which is a precursor of IAA and the formation of this growth substance is directly influenced by Zn. Also it could stimulate vegetative growth (Shaaban *et al.*, 2005). Calcium like that of all minerals is still obscure, but it is important for cell division and cell wall development (Babu and Yadav, 2005).

Materials and Methods

The present investigation was carried out on four years old mandarin plants of uniform size at the Instructional Cum Fruit Research Orchard Department of Fruit Science RVSKVV KNK College of Horticulture, Mandsaur, (Madhya Pradesh) during the year 2019-2020. The experiment included eleven treatments viz. T_1- Salicylic acid (SA) @ 5mg/l, T_2- K_2SO_4 @ 0.4%, T_3- $ZnSO_4$ @ 0.4%, T_4- Ca $(NO_3)_2$ @ 0.4%, T_5- SA @ 5mg/l + K_2SO_4 @ 0.4%,

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Effect of Foliar Spray of Nutrients and Plant Growth Regulator on Quality and Yield of Acid Lime (*Citrus aurantifolia* Swingle)

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ABSTRACT

The present investigation was conducted to see the effect of foliar spray of nutrients and plant growth regulator on cropping and yield of Acid lime (*Citrus aurantifolia* Swingle). Result revealed that maximum total soluble solids (8.39° Brix), acidity (7.27 %), TSS / acid ratio (1.15), ascorbic acid (30.11 mg / 100 ml juice), total sugars (1.45%), reducing sugar (0.77%), non-reducing sugar (0.67%) were recorded in alone treatment T_4 (GA $@$ 75 ppm), while maximum number of fruits plant^{-1} (1037.60), fruit weight (40.40 g), fruit yield plant^{-1} (41.92 kg) and fruits yield ha^{-1} (11.61 tonnes) was obtained in alone treatment T_5 ($ZnSO_4$ $@$ 0.6%). In combined treatments T_{11} (KNO_3 $@$ 2% + GA $@$ 75 ppm + $ZnSO_4$ $@$ 0.6%) was recorded the maximum total soluble solids (8.89° Brix), acidity (7.42 %), TSS / acid ratio (1.20), ascorbic acid (32.45 mg / 100 ml juice), total sugars (1.67%), reducing sugar (0.88%), non-reducing sugar (0.79%), maximum number of fruits plant^{-1} (1098.00), fruit weight (48.67 g), fruit yield plant^{-1} (53.44 kg) and fruits yield (14.80 tonnes) ha^{-1}.

Keywords Acid lime, Nutrients, Yield, Quality, Vitamin C.

INTRODUCTION

Acid lime (*Citrus aurantifolia* Swingle) is mainly cultivated for its multi-fold nutritional and medicinal values which made acid lime more important among the fruit. It is good appetizer, anti-helmintic and it checks biliousness and stomach ache. 100 grams of fruit juice contains 80 % of water, carotene 26 IU, Vitamin A, Vitamin B$_1$ 20 mg, Riboflavin 0.1 mg, Vitamin C 63 mg, Iron (Fe) 1.83 mg, Copper (Cu) 0.16 mg, Oxalo-acetic acid 0.30%, Malic acid and alkaline salt 8.2% therefore, it is very essential for human health (Ranganna *et al* 2017).

It has also rich source of bioflavonoid, acid and volatile oils. Special interest in lime oils has been flavonoids called flavonol glycosides, including many kaempferol- related molecules. While these flavonoids have been shown to stop cell division in many cancer cell lines, they are perhaps most interesting for their antibiotic effects and also contain of coumarins such as bergapten which sensitive the skin to sunlight. Bergapten is sometimes added to tanning preparation

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ASSOCIATION FOR AGRICULTURE ENVIRONMENT AND BIOTECHNOLOGY

AGRONOMY

ffect of Sowing Methods and Seed Rates on Phenological, hysiological and Yield Parameters of Chandrasur (*Lepidium tivum* L.)

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ABSTRACT

The present experiment was conducted in the department of Plantation, Spice, Medicinal and Aromatic Crops, College of Horticulture, RVSKVV, Mandsaur (M.P.) during 2019-20 in factorial RBD design with replicated thrice with two sowing methods and five seed rates as treatments. All the parameters were recorded at a fixed interval of 30 days from 30 days after sowing to harvest. The results revealed that line sowing exhibited early germination, flowering, maturity, and higher leaf area, leaf area index, crop growth rate, relative growth rate, chlorophyll content, and seed yield compared to broadcast. Among the seed rates, medium seed rate @8 kg ha^{-1} is shown early in all the phenological and superior in physiological parameters. During interactions, line sowing with @ 8 kg seed ha^{-1} was also early in germination, flowering, maturity, leaf area, leaf area index, crop growth rate, relative growth rate, chlorophyll content, and seed yield. On the other hand, the maximum harvest index was noted in the broadcast with 12 kg seed rate.

HIGHLIGHTS

- Optimum spacing can ensure proper growth and development through efficient utilization of sources.
- Seed rate avoids wastage of valuable seeds.
- Line sowing with lower seed rate provides non-competitive space between the plants.
- Line sowing with @ 8 kg seed rate per hectare had the best performance for growth and yield.

Keywords: *Lepidium sativum*, Seed rates, Sowing methods, Phenology, and Physiology

Chandrasur (*Lepidium sativum* L.), coming to the family Cruciferae is an edible, annual, and erect herb called 'water cress' or 'common cress' or 'pepper cress. Its seeds, leaves, and roots are economic (Priya *et al.* 2018). If is beneficial in promoting digestion and growth in teenagers. The extracts of seed have a hypotensive effect with transient respiratory stimulation (Saraswathi *et al.* 2014). As a result of differentiated uses, Its demand, popularity, and cultivation is increasing en route for commercial production (Chundawat *et al.* 2017). It is grown mostly in India, North America, and some

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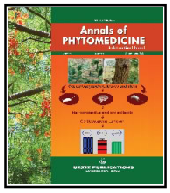

Original Article : Open Access

In vitro assessment of cytotoxic effects of guggul in L929 mouse skin fibroblast cells

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Abstract

Cancer is one of the major causes of death after cardiovascular diseases worldwide. Guggul is gum oleo-resin exudates from *Commiphora wightii* (Arnott.) Bhandari with immense medicinal properties. Guggulsterone (GS) is one of the main constituent of guggul. During the present study three samples of gum oleo-resin of *C. wightii* were evaluated for their cytotoxic activity against L929 mouse skin fibroblast cell lines. In our study, the cytotoxic responses of guggul was determined by the 3-(4,5-dimethylthiazol2yl)-2, 5-biphenyl tetrazolium bromide (MTT), neutral red uptake (NRU) assays and lactate dehydrogenase (LDH) release assay. The initial analysis indicated that guggul samples tested has exhibited cytotoxicity. The outcome has opened a new window of possibility for the potential use of guggul against L929 cells.

1. Introduction

After cardiovascular illnesses, cancer is a serious cause of death globally (GBD, 2015). Cancer in the human body can result from abnormal cell growth of any variety (Cooper, 2000). According to the World Cancer Research Fund, there were around 18 million new instances of cancer worldwide in 2018. Since the advent of precision medicine, the survival rate of cancer patients has increased in developed nations. In underdeveloped and developing nations, prolonged treatment and the cost of treatment are important socioeconomic obstacles (Bhatt *et al.*, 2019; Desai *et al.*, 2021). Numerous studies are being conducted to find ways to treat cancer more affordably and with fewer casualties using medicinal herbs (Purushothaman and Kuttan, 2019; Mathew *et al.*, 2019).

One of the most significant ways of treating illnesses in India is Ayurveda (Chanchal *et al.*, 2018). Numerous plants, including trees, shrubs and herbs, are recognised to have medicinal effects. Guggul is a therapeutically important oleo-resin obtained from a shrub, *C. wightii*. This important medicinal plant species generally grows in semi-arid and desert climates (Thomas *et al.*, 2011).

Guggulsterone (GS) is one of the significant ingredients of guggul gum oleo-resin and *C. wightii* is one of the significant pharmacological plants initially mentioned in the Atharva Veda (2000 B.C). According to the *Sushrut Samhita*, guggul purportedly treats abrupt paralytic seizures, edoema, leucoderma, internal tumours, malignant sores and ulcers, internal tumours, obesity and liver failure (Shishodia *et al.*, 2007).

An important sterol derived from guggul is GS (4, 17 [20]-pregnadie 3, 16-dione). The farnesoid X receptor, which is necessary for healthy lipid and glucose metabolism, is antagonistic to GS (Cui *et al.*, 2003). Additionally, *in vitro* studies using PC-3, DU145 and LNCaP human prostate cancer cells revealed that the trans-(z)-isomer of GS caused apoptosis and decreased cell proliferation (Singh *et al.*, 2005; Singh *et al.*, 2007). Other cell types, such as human lung, acute myeloid leukaemia and breast cancer, have also demonstrated GS's anticancer capabilities (Samudio *et al.*, 2005).

Poor handling and storage of guggul is known to cause degradation in GS content (Thomas *et al.*, 2020). Due to the severe shortage and increasing demand, adulteration is another issue to be concerned about. In light of this, the present investigation was created to assess the anticancerous activity of pure guggul gum with various storage times.

2. Materials and Methods

Three samples of gum oleo-resin of *C. wightii* were evaluated for their cytotoxic activity. Three age group of stored guggul gums were termed as sample I, II and III. Fresh guggul gum (Figure 1) were collected immediately after tapping and brought to the laboratory for its storage at room temperature. Guggul gum was stored (Figure 2) for different periods 4 months (fresh sample I), 12 months (sample II) and 24 months (sample III). Baked earthen clay pots of capacity 500 ml capacity with a wall thickness of 2.5 mm was used for storage. All the pots with guggul gum were covered with earthen lid.

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RESPONSE TO ORGANIC MANURES AND PLANT GEOMETRY IN KALMEGH (*ANDROGRAPHIS PANICULATA* NEES.) : WAY TO REDUCE EXPLOITATION OF FOREST

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Abstract

The experiment was taken at department of Plantation, Spice, Medicinal and Aromatic Crops, College of Horticulture, RVSKVV, Mandsaur (M.P.) during 2019-20 in factorial RBD design replicated thrice with two organic manures along with control and three plant spacing. Result revealed that vermicompost @ 3 t ha^{-1} had higher plant height (13.89, 31.16, 44.71, 55.37 and 55.58 cm), number of primary branches (6.85, 9.50, 13.41, 15.28 and 15.37), chlorophyll content (16.97, 31.51, 45.92 and 54.89), leaf area (8.42, 49.28, 107.75, 135.46 and 135.57), fresh weight (10.28, 20.05, 45.14, 83.91 and 83.95) and dry weight (0.63, 4.47, 9.52, 33.19 and 33.24) over other organic manures, similarly 30×30 cm had maximum plant height (13.75, 30.73, 43.84, 53.37 and 53.67), number of primary branches (6.19, 8.34, 12.26, 14.14 and 14.26) chlorophyll content (16.12, 30.09, 44.29 and 52.52), leaf area (7.99, 46.96, 106.88, 133.71 and 133.88), fresh weight (10.28, 19.58, 43.96, 83.21 and 83.25) and dry weight (0.62, 4.38, 9.43, 32.41 and 32.46) among the other spacing. In the interaction of vermicompost @ 3 t ha^{-1} along with 30×30 cm spacing shown similar finding at 30, 60, 90, 120 DAT and harvest, respectively.

Introduction

Kalmegh (*Andrographis paniculata*) is an important annual medicinal plant of family Acanthaceae being used in Indian system of medicines since time immemorial. The plant is also known as king of bitters. It is native to India, Sri Lanka and distributed throughout Thailand, Peninsular Malaysia to Indonesia also In India it is cultivated the state of Madhya Pradesh, Chhattisgarh, Odisha, Maharashtra, Assam, Bihar, West Bengal, Uttar Pradesh, Tamil Nadu and Kerala. The genus *Andrographis* consists of 28 species out of which few species are medicinally used and *A. paniculata* is most popular. The plant grows erect to a height of 30 to 110 cm with lance shaped leaves and small flowers. The herb is having a preventive effect from many diseases, due to its powerful immune strengthening benefits. The demand of kalmegh is increasing day by day (Chauhan *et al.* 2021). Organic farming provides several benefits to the growers. It reduces production cost and it is an environmentally friendly way of cultivation for improvement of soil fertility and biological properties particularly with vermicompost (Chandravanshi et al., 2021).

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Impact of Sowing Date and Crop Geometry on Growth and Seed Yield of Fenugreek cv Kasuri (*Trigonella corniculata*)

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ABSTRACT

The present field experiment was conducted at Research Farm, College of Horticulture Mandsaur, RVSKVV, Gwalior (MP) during the year 2021-2022 with three dates of sowing viz., D_1 - 15th October, D_2 - 30th October and D_3 - 15th November and four different plant spacings S_1 (15 × 10 cm), S_2 (20 × 10 cm), S_3 (25 × 10 cm) and S_4 (30 × 10 cm). The result obtained during present investigation to measure the morphology, seed yield and yield attributing parameters were studied. The plant height, number of branches, number of leaves, fresh weight of plant, dry weight of plant, seed yield and yield attributing parameters were found maximum when crop sown on 30th October. The plant height decreased gradually while other mentioned parameters except seed yield ha^{-1}, biological yield and harvest index increased with wider spacing from 15 cm to 30 cm.

Interaction effect of date of sowing and spacing showed that kasuri methi sown on 30th October with 15 × 10 cm spacing recorded maximum height while 30th October with 30 × 10 cm spacing recorded maximum branches, leaves, weight of plant and yield attributing parameters while 30th October with spacing 25 × 10 cm produced maximum seed yield (6.67 q ha^{-1}).

Keywords Kasuri methi, Date of sowing, Spacing, *Trigonella corniculata.*

INTRODUCTION

Trigonella corniculata L., or kasuri methi belongs to family Leguminaceae and used for its greens and seeds as a condiment, is one of the significant winter season legume crops and one of the primary seed spices farmed in India. It is indigenous to South-Eastern Europe and Western Asia. In general, seed production is taken after 3-4 cuttings, but seed yield obtained without cuttings is superior to seed yield obtained after 2-3 cuttings (Nandre *et al.* 2011). The seeds and tender pods of kasuri methi are used as a spice in pickle making. These are also used in traditional medicine as diuretics, tonics, carminatives, astringents and aphrodisinics (Sharma 2006). Regular consumption of kasuri methi seeds is thought to lower blood glucose levels, total cholesterol and helps in stimulating the secretion of insulin (Babale-

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[Research Article]

Growth and yield of fenugreek (*Trigonella foenum-graecum* L.) as influenced by bio-fertilizers and chemical fertilizers

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ABSTRACT

The field investigation was was conducted at Department of Plantation, Spices, Medicinal and Aromatic Crops of College of Horticulture, R.V.S.K.V.V. Mandsaur (M.P.) during the year 2020-2021. All the treatments accompanied such as bio-fertilizers (*Azospirillum* @ 5 kg ha^{-1}, *Rhizobium*@ 1.5 kgha^{-1} and PSB@ 5 kg ha^{-1}) and chemical fertilizers (Nitrogen, Phosphorus and Potassium @40:20:20 Kg ha^{-1}), while the plants in the control plots were shown without any application of supplements in Randomized Block Design in three replications. Result revealed that, T_9 - 50% RDF + 50% *Rhizobium* recorded maximum plant height (11.90, 40.84, 73.33 and 76.24 cm), number of leaves (20.90, 44.77, 90.89 and 69.44 plant^{-1}), dry weight (0.19, 3.65, 19.71 and 22.08 g plant^{-1}), leaf area (22.76, 128.22, 147.35 and 124.53 cm^2 plant^{-1}), leaf area index (0.248, 0.451 and 0.453), lead area duration (22.32, 40.57 and 40.79), crop growth rate (0.039, 0.178 and 0.0484), relative growth rate (0.0417, 0.0925 and 0.0450), number of pod (82.51 plant^{-1}), number of seeds (15.91 pod^{-1}), pod length (12.21 cm), seed yield (9.72 g plant^{-1} and 27.77 q ha^{-1}), biological yield (84.36 q ha^{-1}), test weight (12.80 g), harvest index (33.89 %) and B: C ration (3.44:1) while, they were lowest in T_1 – control at 30, 60, 90 days after sowing and at harvest, respectively.

KEYWORDS: Bio-fertilizers, chemical fertilizers, growth, yield and *Trigonella foenum-graecum*

Fenugreek (*Trigonella foenum-graecum* L.) is self-pollinated and species occupies the prime place among seed species, belongs of the family "Fabaceae". It is native to the Mediterranean Region, extending to Central Asia. Its seeds are used as a condiment for flavoring of foods regularly and leaves as vegetable (Bairva *et al*., 2012). India is one of the major producers and exporters of fenugreek (Kumar and Sharma, 2014) after coriander and cumin (Shakthi *et al*., 2020a). In India, fenugreek occupies an area of 122 thousand hectares with total annual production of about 189 thousand metric tonnes (NHB, 2018-19). In Madhya Pradesh, area of 53440 hectares with 104 thousand metric tonnes production (Spice Board, 2019). Bio-fertilizers have a very high potential for nitrogen fixation. It has been estimated that 40-250 kg N/ha/year is fixed by different legume crops by the microbial activity of *Rhizobium* (Nair *et al*., 2021). Apart from their role in nutrient transformation, they also secrete several growth hormones and vitamins, which enhance the seed germination and growth. Further, bio-fertilizers are cost effective and environmental friendly technique and serves as a good supplement to chemical fertilizers. Thus, bio-fertilizers are intended to improve the nutrient uptake and their use efficiency without application of extra doses of inorganic chemicals. Use of bio fertilizers cut down the quantity of chemical fertilizers (Meena *et al*., 2015) and improve soil health. But excessive applications of chemical fertilizers reduce plant performance due to soil acidification, reduced soil biological activities, degradation of soil physical features, and lack of micronutrients (Alaghimand *et al*., 2017).

MATERIALS AND METHODS

The present field experiment was conducted at Department of Plantation, Spices, Medicinal and Aromatic Crops, College of Horticulture, R.V.S.K.V.V. Mandsaur (M.P.) during the year 2020-2021. In this experiment application of bio-fertilizers (*Azospirillum* @ 5 kg ha^{-1}, *Rhizobium*@ 1.5 kgha^{-1} and PSB@ 5 kg ha^{-1}) and chemi-

RESEARCH ARTICLE Legume Research- An International Journal, Volume 45 Issue 2: 227-231 (February 2022)

Influence of Varieties and Integrated Nutrient Management Practices on Growth and Yield of Seed in Cowpea (*Vigna unguiculata* L.)

Seema Pardhi, R.K. Sharma, S.S. Kushwah, Roshan Gallani

10.18805/LR-4475

ABSTRACT

Background: Cowpea is one of the most important leguminous vegetable crops. It has a unique ability of biological nitrogen fixation and mobilization of insoluble soil nutrient and bringing qualitative changes in soil. The basic concept of integrated nutrient management system is to maintain of plant nutrients supply to achieve a good level of crop production by optimizing the benefits from all possible sources of plant nutrients in an integrated manner, appropriate to each farming system. Considering these aspects, a field experiment was conducted to boost up productivity of cowpea seed.

Methods: A field experiment was carried out during *Rabi* season, 2015-16 at Research Field of the Department of Vegetable Science, College of Horticulture, Mandsaur (Madhya Pradesh). The experiment was arranged in factorial randomized block design with twenty treatment combinations comprising four cowpea varieties, *viz*. V_1- Pusa Sukomal, V_2- Kashi Unnati, V_3- Kashi Kanchan and V_4- Kashi Shyamal and five integrated nutrient management (INM) practices, *viz*. N_1-Vermicompost 2.5t + *Rhizobium* (10 g/kg seeds) + PSB (10 g/kg seeds) + N (0 kg) + P_2O_5 (90 kg) + K_2O (70 kg)/ha; N_2 -Vermicompost 2.5 t + *Rhizobium* (10 g/kg seeds) + PSB (10 g/kg seeds) + N (15kg) + P_2O_5 (90kg) + K_2O (70 kg)/ha; N_3 -Vermicompost 2.5t + *Rhizobium* (10 g/kg seeds) + PSB (10 g/kg seeds) + N (20 kg) + P_2O_5 (90 kg) + K_2O (70 kg)/ha; N_4 -Vermicompost 2.5 t + *Rhizobium* (10 g/kg of seeds) +PSB (10 g/kg seeds) + N (25 kg) + P_2O_5 (90 kg) + K_2O (70 kg)/ha and N_5-Vermicompost 2.5 t + *Rhizobium* (10 g/kg seeds) + PSB (10 g/kg seeds) + N (30 kg) + P_2O_5 (90 kg) + K_2O (70 kg)/ha.

Result: In present experiment the cowpea variety V_1-Pusa Sukomal recorded superior performance for growth attributes, yield and yield attributes and quality attributes. This variety had taken minimum days to first flowering, days to 50% flowering and days to harvesting. Among the nutrient levels, application of Vermicompost 2.5 t + *Rhizobium* (10 g/kg seeds) + PSB (10 g/kg seeds) + N (30 kg) + P_2O_5 (90 kg) + K_2O (70 kg)/ha resulted in the highest growth parameters, yield and yield parameters of cowpea seed.

Key words: Biofertilizer, Cowpea, Nitrogen, Seed, Variety, Vermicompost, Yield attributes.

INTRODUCTION

Cowpea (*Vigna unguiculata* L.) is one of the most important leguminous vegetable crops. Leguminous crops play an important role in Indian Agriculture having unique ability of biological nitrogen fixation, deep root system, mobilization of insoluble soil nutrient and bringing qualitative changes in soil. It is originated from Central Africa and mainly cultivated in Asia, Africa, Central and South America. The countries like Bangladesh, China, India and Indonesia are the major cowpea growing countries in Asia. In India it is grown in the states like Rajasthan and adjoining part of Himachal Pradesh have a good acreage (Das *et al.,* 2011).

In India, cowpea is grown widely throughout the year for all forms- tender pods, dry seeds, fodder, green manure and cover crops both as sole and mixed crop. Cowpea fixes atmospheric N up to 240 kg/ha and leaves about 60-70 kg residual N for succeeding crops. Thus, cowpea is one of the most important vegetable crops in organic farming systems as it improves soil fertility even in marginal lands through provision of ground cover, plant residue, nitrogen fixation and suppressing weed and contributes to the sustainability of cropping systems. Besides plant nutrients, the presence of enzymes and hormones in manure make them essential for improvement of soil fertility and productivity. Cowpea requires good quantity of nutrients throughout the growth periods especially P for better development of roots, better nodulation and N-fixation. Moreover, in early stages, plant requires N for better germination, production of more branches and peduncles resulting in greater number of pods, seeds and significantly higher yields (Abayomi *et al.*, 2008).

Nitrogen is an essential constituent of protein and chlorophyll (Meena *et al.,* 2014) and metabolic process of

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Effect of growing media on growth and flowering of calendula (*Calendula officinalis* L.)

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ABSTRACT

An investigation entitled "Effect of growing media on growth and flowering of calendula (*Calendula officinalis* L.)" was conducted to find out suitable media for calendula. The experiment was laid out in completely randomized design (CRD) with seven treatment combinations replicated thrice. The observations on various growth and flowering parameters were recorded. Among the growing media, T_6 (Soil + Cocopeat + Vermicompost) showed the best results with respect of days taken to bud appearance, days taken to first flower appearance, number of flowers per plant, duration of flowering (days), fresh and dry weight of flower, flower size, individual flower life (days), the maximum postharvest soil organic carbon, maximum postharvest available nitrogen, postharvest available phosphorus, postharvest available potassium. However, the least performance of all of the above parameters were recorded with T_5 (Sand + Cocopeat).

Key words: Calendula, cocopeat, vermicompost, organic matter.

INTRODUCTION

Calendula is an herbaceous annual or short-lived perennial native to Egypt, but widely naturalized throughout temperate climate zones. Calendula has been cultivated since Roman times for its purported medicinal properties. Today calendula is grown for medicinal and ornamental uses. Calendula produced for ornamental use includes both cut flowers and potted flowering plants. Cut flowers and herbs may be grown either in the field and pots or in the greenhouse (Kareem *et al.,* 2014).

The pot marigold is formally known as *Calendula officinalis* L. of the Asteraceae family. It is widely cultivated and can be grown in most kinds of soil and sunny situation, it blooms rapidly from seed under a couple of months in bright and beautiful oranges, yellows and gold flowers (El-Sayed *et al.,* 2018).

Growing media are the substrates in which a plant will grow, they provide anchorage for the plant's roots, air spaces to allow respiration, and retain sufficient available water to enable plant growth. When selecting media, the grower needs to find the optimum balance between their requirements and those of the plants to be grown (Kaushal and Kumari, 2020).

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Effect of Meteorological Parameters on Population Fluctuation of Fruit Fly (*Bactrocera cucurbitae* Coq.) Infesting Cucumber (*Cucumis sativus* L.)

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ABSTRACT: Population dynamics of fruit flies *Bactrocera cucurbitae* (Coquillett) was studied on cucumber (*Cucumis sativus* L.) variety Cucumber Gautam-910, during *summer* season 2020-21 and 2021-22 at College of Horticulture, Mandsaur (M.P.). The studies revealed that, for seasonal incidence, the fruit fly was found damaging and remained active on cucumber attaining peak population in the 18th SMW (52.62%) in 2020-21 and 17th SMW (30.29%) during 2021-22. The correlation studies showed that the fruit fly population was significant and positively correlated with Maximum temperature (r= 0.7246, r= 0.7454) and minimum temperature (r= 0.5367, r= 0.7871), significant and negatively correlated with relative humidity (r= -0.5949, r= -0.5598) whereas, rainfall (r= -0.0870, r = 0.1846) and rainy days (r= -0.1158, r =1.000) exhibited non-significant positive correlation in both year respectively.

Keywords: Cucumber, correlation, fruit fly, meteorological parameters, incidence.

INTRODUCTION

Cucumber (*Cucumis sativus* L.) is a popular and widely grown vegetable all over the country, reported to have originated in India. Cucumber cultivation has been as old as three thousand years in India, (Rai and Yadav 2005). In Hindi, cucumber (*Cucumis sativus* L.) a member of Cucurbitaceae family, is referred to as "Kheera", considered one of the world's oldest cultivated vegetable crop. Cucumber is the quickest maturing vine vegetable crops and the second most widely cultivated crop after watermelon. It is grown in high-temperature, humidity and light-intensity environment, requires frequent irrigation along with constant nutrients supply.

In relation to nutritious value it contains Moisture (96.3%), Protein (0.4g), Fat (0.1g), Minerals (0.3g), Fiber (0.4g), Carbohydrate (2.5g), Calcium (10 mg), Phosphorus (25 mg), Iron (1.5 mg), Thiamine (0.03 mg), Niacin (0.2 mg), Vitamin-C (7 mg) and Energy (13 Kcal) in 100 g of its edible part (Rai and Yadav 2005).

In India, cucumber is cultivated in an area of 117.05 million ha. With a production of 1650 million tons. In Madhya Pradesh, In Madhya Pradesh total area under cucumber cultivation is 15.22 million ha with 252.26 million tones production (Horticultural Statistics at a glance, 2020-21).

Like other vegetables the major limiting factors in causing considerable damage to the crops at different stages from nursery rising to the harvest are insect pests. Among these, fruit fly, *Bactrocera cucurbitae* (Coq.), is one of the most serious and destructive pests of cucumber (Sapkota *et al.,* 2010). *Bactrocera cucurbitae* (Coq.) is the major species infesting cucurbits (Sunil *et al.,* 2016). This serious pest causes destructive damage to cucurbits including cucumber which leads to considerable reduction in the yield, quality and marketable value. As per a report, near about 50 per cent of cucurbits are partially or completely damaged by the pest every year in India (Agarwal *et. al*, 2020). The extent of losses inflicted by these dipteran flies is varying from 30 to 100 per cent depending upon cucurbit species and environmental conditions (Dhillon *et al.,* 2005). Their attack not only reduces the yield but also affect fruit quality and rendering them unfit for the consumption and unprofitable farming.

MATERIALS AND METHODS

The study on population dynamics of cucumber (*Cucumis sativus* L.) fruit flies *Bactrocera cucurbitae* (Coq.) on variety "cucumber Gautam-910", during *summer* season 2020-21 and 2021-22 at College of Horticulture, Mandsaur (M.P.). Seasonal incidence of *Bactrocera cucurbitae* was studied on crop sown in 6

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Effect of IAA and IBA on rooting of nerium cuttings

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Abstract

The present investigation entitled was conducted during November 2019 to January 2020 in the shade net house of Department of Fl and Landscape Architecture, K. N. K. College of Horticulture, Mandsaur, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior The experiment was laid out in a Completely Randomized Design (CRD) with eleven treatments and three replications. Five concentr each plant growth regulators namely IAA (1500, 2000, 2500, 3000 and 3500 ppm) and IBA (1500, 2000, 2500, 3000 and 3500 ppm) v considered as each treatment *viz.* IAA at 1500 ppm (T_1), IAA at 2000 ppm (T_2), IAA at 2500 ppm (T_3), IAA at 3000 ppm (T_4), IAA at 3 (T_5), IBA at 1500 ppm (T_6), IBA at 2000 ppm (T_7), IBA at 2500 ppm (T_8), IBA at 3000 ppm (T_9), IBA at 3500 ppm (T_{10}), Control (T_{11}). cuttings were treated according to the treatments and planted on polybags under shade net house. The results revealed that IBA @ 3 (T_9) had significant effect on shoot and root growth of nerium cutting and recorded the maximum value of various attributes of shoot a parameters like days taken to sprouting (11.33 days), number of shoots per cutting (4.60), shoot length (3.99 cm), fresh weight of sho cutting (2.573 g), dry weight of shoot per cutting (0.743 g), number of roots per cutting (34.53), root length (10.85 cm), fresh weight of cutting (0.452 g), dry weight of root per cutting (0.097 g) and survival percentage of rooting (78.88%) recorded the maximum values.

Keywords

IAA, IBA, Nerium, Cutting, Rooting, Shoot parameters and root parameters.

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Performance of different tuberose cultivars for flowering parameters under Malwa Plateau of Madhya Pradesh

Ekta Rajput, Anuj Kumar, RK Sharma, Roshan Gallani and Saransh Saxena

Abstract
An experiment entitled "Performance of different tuberose cultivars for flowering parameters under Malwa Plateau of Madhya Pradesh" was carried out during 2019-20 at RVSKVV – College of Horticulture, Mandsaur (MP). Experiment were consist 10 cultivars and these treatments were replicated three times in Randomized Block Design and analyzed. Data raveled that V_7 show the best performance with respect of most of the parameters i.e. spike length, spike girth, rachis length, number of florets per spike, number of spike per plant, length of florets, number of open florets per spike, percentage of open florets per spike, fresh weight of spike and dry weight of spike, while the minimum days taken to spike emergence, days taken to opening of first floret and maximum diameter of florets was observed under the cultivar V_1 Arka Nirantra.

Keywords: Tuberose, cultivars, flowering parameters

Introduction

Tuberose (*Polianthes tuberosa* L.) is one of the most important cut flower and loose flower crop of India. It comes under genus *Polianthes* and having 14 species out of which *P. tuberosa* is commercially cultivated and it belongs to the family Amaryllidaceae. It is native to Mexico from where it's spread to different parts of the planet during 16th century. The tuberose is derived from Greek word '*Polios*' that means Shiny or white and '*Anthos* 'meaning flower. Tuberose having haploid chromosome number 30. It is commonly known as Rajanigandha in Hindi and in Kannada it is known as Sugandharaja.

Tuberose is an important perennial bulbous crop. This is having shallow and adventitious root system. In tuberose the stem is modified into bulbs and bulblets which are used for the propagation purpose. The colour of the leaves is light green (Singh *et al.*, 2018) [13]. The inflorescence of tuberose is called spike. This will be of 25±10 pairs of florets which usually open from bottom to top i.e. acropetal. Flowers are usually inverted cone shape and are highly fragrant, the flowers are white in colour and having waxy appearance. They have about 25 mm long stamens, which are 6 in numbers and ovary posses 3 locules which contains numerous ovules. The fruit of tuberose is called capsule (Naik *et al.*, 2018)[7].

Tuberose crop is commercially grown for the ornamental, aesthetic and oil extraction purpose. It is having more demand in international market for its fragrance for making perfumes. In India it is having a major role in making flower arrangement, bouquets, indoor decoration, and garlands and also used as cut flower. Tuberose may be used in religious functions as well as auspicious occasions. It grows well in tropical and subtropical climatic condition. Well drained loamy and sandy loamy soils are best suitable for tuberose cultivation. The soil temperature around 20 ^{0}C suitable for maximum root growth (Singh and Sisodia, 2017)[12]. Optimum soil pH for flower is 5.5-6.0 (Ganesh *et al.*, 2013)[1]. Tuberose is propagated through bulbs. In our country mostly planted in the month of February–March in plain regions where as in hills it is planted in April-May. (Singh and Sisodia, 2017)[12].

There are mainly two type's varieties in tuberose, which includes single and double type the single type varieties bear pure white flowers with just one row of corolla segment, whereas double type flowers are white in colour with red ting at bud stage, the corolla segment of more than 3 rows (Kamei & Singh,2019)[5]. Flower of the 'Single' cultivars are extra aromatic than 'Double' kind and incorporate 0.08 to 0.14% concrete that is utilized in high-grade perfumes. (Safeena & Thangam,2019)[14].

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Evaluation of garden pea (*Pisum sativum* L.) varieties for yield and quality attributes under Malwa region of Madhya Pradesh

Badri Lal Nagar, Sharma RK, Kushwah SS, Kachouli BK and Homeshvari

Abstract

An experiment was conducted to see theevaluation of garden pea (*Pisum sativum* L.) varieties for yield and quality attributes under Malwa region of Madhya Pradesh. Result revealed that in the present investigation, the genotypes differed significantly with respect to different yield and quality parameters. A comparison of pea varieties indicated that they differed significantly for yield parameters *viz.*, number of pods per plant, pod length, number of seed per pod, pods weight, pod yield per plant as well as green pod yield per hectare (q/ha) and shelling percentage. Variety Kashi Shakti was recorded highest number of pods per plant (12.59), pod length (10.50 cm), highest number of seeds per pod (9.53), highest average pod weight (4.74 g), highest pod yield per plant (59.68 g/plant), maximum pod yield per hectare (198.92q/ha), highest proportion of shelling (58.80%). Quality parameters *viz.*, TSS and protein content of green pea.The variety Palam Priya has noticed the highest TSS (17.87 °Brix) and highest protein content (16.90g/100g) was observed in variety Kashi Shakti.

Keywords: Pea (*Pisum satioum* L.), varieties, yield parameters, quality parameters

Introduction

Garden pea (*Pisum satioum* L. var. *hortense*) belongs to the family Fabaceae (Leguminosae) is also called sweet pea is a choice vegetable grown for its fresh shelled green seeds rich in protein (7.2%), vitamins and minerals. Peas are grown for their soft immature and mature dry pods. Immature pods are used as fresh vegetables and mature dried pods are used as pulses. In both situations, the pea seeds are separated from the pod and used as a vegetable or pulses and as well as in making soup (Kumari and Deka, 2021) [15]. The pea cultivars, cultivated by the vegetable growers in Madhya Pradesh particularly are very low in yield and their quality. Indian pea varieties do not compete with the varieties grown in the many other countries. The productivity of pea in India is less than many other pea growing countries. This could be attributed to the lack of suitable cultivars for different pea growing regions in the country. Though, many new varieties have been developed in India through varietal development programme under different SAU's and ICAR institutes. Varieties either introduced or developed during very early continue to dominate its cultivation. Therefore, evaluation of varieties for higher yield, suitable for different agro-climatic conditions is necessary to enhance production and productivity of vegetable pea. India is the world's second-largest producer of garden pea, after China and tenth ranks among vegetable crops in terms of productivity. Pea is grown on around 568.00 thousand hectares in India, with a total yield of 5791 thousand MT (Anonymous, 2020) [2]. In India, Peas are grown in Uttar Pradesh, Madhya Pradesh, Assam, Jharkhand, Himachal Pradesh, West Bengal, Punjab, Rajasthan, Haryana, Uttarakhand and Bihar. In Madhya Pradesh, total production is 961.55 thousand MT with 94.99-thousand-hectare area and productivity 10.12 MT per hectare (Anonymous, 2018) [3]. Important pea growing districts of Madhya Pradesh are Jabalpur, Ratlam, Chhindwara, Ujjain, Narsinghpur, Dewas, Tikamgarh, Gwalior, Datia and Seoni etc.

To eradicate the malnutrition problem and improve the protein deficient diet and low yield of pea, it is necessary to increase pea production per unit area to meet out the requirement of increasing population of the nation. Besides, good agronomic practices like growing high yielding varieties, providing proper spacing, irrigation, use of fertilizers, optimum sowing time and appropriate plant protection measures to be essentially followed in order to increase the productivity. Among all these factors, identification of high yielding varieties for certain region is most important.

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Mass Media Utilization Behaviour of Farmers in Nimar Agro Climatic Region of Madhya Pradesh

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ABSTRACT

Mass media channels are catering to this important need i.e. craving for information. Communication in agriculture is not only to notify and generate awareness among the farmers additionally to execute new ideas that change the method and patterns of farming. Communication media play a vital role in the transfer of agricultural technologies to the farmers by minimizing the gap between technology and its uses. There are several mass media like television, films, slides, radio, literature, documentaries, dramas, exhibitions and tours etc. Keeping importance of these factors in view, a research study was conducted in Nimar Agro Climatic Region of Madhya Pradesh the relationship between personal, socio-psychological and communication characteristics of the farmers and their mass media utilization behaviour. The study was carried out on a sample of 240 farmers of mass media. Data were collected through personal interviews of respondents with the help of a structured interview schedule. The study concludes high mass media utilization behaviour of the farmers. It can be summarized that the characteristics viz., scientific orientation had significant relationship with mass media utilization behaviour at 0.05 level of probability. The result also represent that the characteristics viz., age, education, socio-economic status, extension participation, social participation, cosmopoliteness, innovativeness, mass media exposure and contacts with extension agency had non-significant relationship with mass media utilization behaviour.

Keywords: Mass media, Personal, Socio-psychological and Communication characteristics

INTRODUCTION

As regards Social Sciences, the process of transmitting meaningful symbols between individuals is designated a communication. It is only all the ways through the transmission of meaning from one person to another that information and ideas can be communicated. The information has become an important part of our daily life. At present, people want sufficient and genuine information as early as possible. The mass media channels are catering to this important need i.e. craving for information. Communication in agriculture is not only to notify and generate awareness among the farmers additionally to execute new ideas that change the method and patterns of farming. Communication media play a vital role in the transfer of agricultural technologies to the farmers by minimizing the gap between technology and its uses. There are several mass media like television, films, slides, radio, literature, documentaries, dramas, exhibitions and tours etc. Mass media are essential ingredients needed for effective transfer of technologies that are designed to boost agricultural production (Okwu and Daudu, 2011). Agriculture information delivery is precisely a process of communication of improved skills, practices, innovations, technologies and knowledge to the farmers. Hence, the agricultural extension provides a great pillar to the rural people, particularly farm families through educational procedures in promoting their farming practices techniques, increasing their production efficiency and enhancing economy raising their living standard and uplifting the social and educational level of rural life.

RESEARCH METHODOLOGY

Locale of the Study: The present study was conducted in Nimar Agro Climatic Region of Madhya Pradesh. Barwani district is one of the tribal dominated districts and Khargone district, with its headquarters at Khargone, lies in the south-west part of Madhya Pradesh, state of India.

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Mass Media Preferences of the Farmers: A Study in Nimar Agro Climatic Region of Madhya Pradesh

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ABSTRACT

Mass media are essential ingredients needed for effective transfer of technologies that are designed to boost agricultural production. Agriculture information delivery is precisely a process of communication of improved skills, practices, innovations, technologies and knowledge to the farmers. Hence, the agricultural extension provides a great pillar to the rural people, particularly farm families through educational procedures in promoting their farming practices techniques, increasing their production efficiency and enhancing economy rising their living standard and uplifting the social and educational level of rural life. Keeping importance of these factors in view, a research study was conducted in in Nimar Agro Climatic Region of Madhya Pradesh the preference on Listening/ Viewing/ Reading behaviour of mass media by the farmers, preference on utility perception behaviour of mass media by the farmers and preference on feedback behaviour of the farmers regarding mass media. The study was carried out on a sample of 240 farmers of Mass Media. Data were collected through personal interviews of respondents with the help of a structured interview schedule. It can be summarized that the preference on listening/ viewing/ reading behaviour of mass media availability of mass media, motivation for purchase, purpose of purchase, with whom, time slot, duration of programme, mode/ method of content retention and discussion about contents. Preference on utility perception behaviour of mass media comprehensibility, reliability, clarity, simplicity, timeliness, feasibility, subject matter covered, innovativeness, inspiration and Illustrativeness. Preference on feedback behaviour of radio, T.V. and newspaper of mass media, "Satisfied with additional information" followed by "Got additional information from Scientist/ KVK/ Agriculture Department, Communicated problem discussed regarding agricultural and animal husbandry to veterinary doctors", "Written to AIR/ DDK M.P. to get additional information again on the topic broadcasted" and "Given suggestions for improvement of farm radio/ TV programme & suggestion implemented" in respect of radio.

Key word: Mass Media, Performance, Farmers, Nimar Agro Climate

Introduction

Mass media are essential ingredients needed for effective transfer of technologies that are designed to boost agricultural production (Okwu and Daudu, 2011). Agriculture information delivery is precisely a process of communication of improved skills, practices, innovations, technologies and knowledge to the farmers. Hence, the agricultural extension provides a great pillar to the rural people, particularly farm families through educational procedures in promoting their farming practices techniques, increasing their production efficiency and enhancing economy rising their living standard and uplifting the social and educational level of rural life.

In a country like "India", it is difficult to contact every farmer in a controlled time in effective to transfer agricultural technology. The use of mass media is certainly the most effective possibility to convey information to people. Mass media play a significant role, in bringing awareness to people and motivating them to play an active role in the nation-building undertaking. Through, mass media one

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Response of Wheat to Different Irrigation Methods under Sodic Vertisols

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Abstract

The field experiment was carried out during the year of 2016-17 and 2017-18 in sodic black soils having ESP 35.2 with wheat crop (cultivar HI- 1077) to know the comparative performance of two irrigation systems, border strip irrigation (BSI) and sprinkler irrigation (SI) with respect to wheat yield and water productivity (WP). The BSI was adopted with 8 liters per second (LPS) stream size at 65, 75 and 85 per cent cut off distance (COD) in the plot size of 6 m × 50 m. The SI was also adopted by giving 2, 3 and 5 cm irrigation water with plot size of 24 m × 50 m. Irrigation was scheduled on the basis of IW/CPE ratio as 1.2. Results revealed that higher gram yield of 2869 and 2567 kg ha^{-1} was obtained in SI with irrigation depth as 3 cm during 2016-17 and 2017-18 respectively while the lowest yield of 1941 and 1673 kg ha^{-1} was noticed under BSI with COD 65 per cent. The highest values of water productivity (WP) as 0.71 and 0.64 kg/m^3 with the mean value of 0.68 kg m^{-3} were noticed in case of SI with depth of irrigation 3 cm during 2016-17 and 2017-18, respectively, followed by BSI with cut off distance of 85 per cent and stream size 8 LPS as 0.44 and 0.38 kg m^{-3} during 2016-17 and 2017-18 respectively, with mean as 0.41 kg per m^3. The minimum water use (40.13 cm) was recorded under SI with irrigation depth 3 cm followed by 41.06 cm with irrigation depth 2 cm. However, the maximum water use (52.87 cm) was recorded in case of BSI with COD 65 per cent followed by 50.28 cm in BSI with COD 85 per cent. Results implied that sprinkler irrigation with irrigation depth 3 cm scheduled on the basis of 1.2 IW/CPE ratio was most suitable irrigation compared to border strip irrigation as it gave additional yield of 650 kg ha^{-1} (31.35 %) over the best border strip irrigation. This additional yield and enhanced water productivity justified investment on sprinkler irrigation. In case of three sprinkler irrigation treatments, average uniformity coefficient was 85.9 %. It indicated that distribution of irrigation water by sprinkler was uniform and acceptable

Key words: Sodic vertisols, Sprinkler irrigation, Border strip irrigation, Water productivity

Introduction

The problem of sodic black soils persists in the areas of south west Madhya Pradesh having low rainfall and insufficient irrigation facilities. The affected area has been estimated as 22,000 ha. Presence of excessive exchangeable sodium in sodic soils tends to modify soil water plant relationship (Acharya and Abrol, 1991). These soils are generally deflocculated due to higher concentration of sodium (ESP>15). This sodium adversely affects the hydraulic conductivity and infiltration rate. The reduction in saturated hydraulic conductivity results in initial swelling followed by particles dispersion and translocation (Bangar *et al.*, 1984). Dispersion and swelling of clay particles disturb the geometry of pores affecting hydraulic conductivity and bulk density of the sodic soils. The deterioration in physical properties of sodic soil causes relatively low rate of wetting during irrigation and hence slow change in water content of soils profile (Gupta and Verma, 1983). Secondly, the crop roots in these soils remain restricted to 0-20 cm depth or lower due to high bulk density and presence of impervious layer at lower depth and more adverse effects are seen with increase in sodicity. The available moisture amount is estimated on basis of moisture contents at field capacity and wilting point. Due to adverse effects of soil sodicity on soil physical properties, available moisture content of sodic

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Research Paper

Growth and Decomposition analysis of *Rabi* Pulse Crops in Rajasthan

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ABSTRACT

The present study was conducted to analyze the growth rate and source of output growth in area, production and productivity of *rabi* pulse crops *viz.*, gram and lentil crops in Rajasthan. The study was solely based on secondary time series data. The study period (1988-89 to 2017-18) has been divided into four periods namely period-I (1988-89 to 1997-98), period-II (1998-99 to 2007-08), period- III (2008-09 to 2017-18) and overall period (1988-89 to 2017-18). Exponential growth and principal decomposition models were used to measure the growth rates and relative contribution of factors in production of gram and lentil crops. The area, production and productivity of gram showed mixed pattern of growth at the rate of -0.46, 1.86 and 2.33 per cent, respectively during overall period. However, the area, production and productivity of lentil were reported positive growth with the magnitude of 11.94, 12.72 and 0.93 per cent, respectively in the state. The study revealed that the mixed growth rate was observed in area, production and productivity of gram while increasing growth was observed in area, production and productivity of lentil. During all the study periods, the expansion in area was effective to increase the production of lentil in Rajasthan. During period-I and II, the production of gram was mainly contributed by expansion in area while in the case of period-III and overall, the interaction effect was more dominant.

Highlights

- More growth rate was observed in production of gram and lentil.
- Area effect was more dominant of gram and lentil.

Keywords: Growth rate, decomposition, production, pulse crops, Rajasthan

Production of pulses is one of the important segments of Indian agriculture after cereals and oilseeds. The pulses comprise of Chickpea, Pigeon pea, Lentil, Green gram, bean, Black gram bean and Field pea. These pulses are an important commodity group of crops that provide high quality protein with complementing cereal proteins for predominantly substantial population of the country. Pulses are popularly known as "*Poor man's meat*" and "*rich man's vegetable*" as a result of being a major source of proteins, vitamins and minerals especially for vegetarian diets in India (Singh *et al.* 2016). Pulses prove to be a boon for mankind as they are highly nutritive processing important gift of nature. They not only increase the fertility of the soil by nitrogen fixation but also increase the porosity of the soil due to their invasive tap root system. Although there is low requirement of water and ability to withstand draught, the production of pulses decreased leading to decline in protein intake and therefore malnutrition (Shalendra *et*

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AAEBM
ASSOCIATION OF AGRICULTURAL ECONOMICS & AGRI-BUSINESS MANAGEMENT

To Study the Instability and its Causes in Production of Major Pulse Crops in Rajasthan

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ABSTRACT

The study was conducted the growth of area, production and productivity of major pulse crops i.e. gram, lentil, black gram, green gram and pigeon pea crops in Rajasthan. The study was based on secondary data from 1988-89 to 2017-18. Instability in area, production and productivity of selected pulse were worked out for entire period of analysis by Cuddy- Della Valle index and to measure the cause of instability with respect of selected pulse crops i.e. gram, lentil, black gram, green gram and pigeon pea in Rajasthan, acreage response function (log linear function) and yield response function have been used. The study revealed that area and production of selected pulse crops were highly instable in Rajasthan except area under green gram. Subsequently, the productivity of green gram and pigeon pea were also more instable while gram and black gram were found medium instable. In the mean, time productivity of lentil was very less instable. Gram and green gram growers in Rajasthan showed contrary response to lagged area under its competing crop i.e. the decrease in area of competing crop in last year season, thereby that was tendency to increase the area under gram and green gram in Rajasthan. while quite responsive to lagged area under lentil, black gram and pigeon pea crop in Rajasthan. It means the increase in area of lentil, black gram and pigeon pea crops in last year season, there is tendency to increase the area under lentil, black gram and pigeon pea in Rajasthan. The time trend factor showed positive influence on productivity of all selected crops in Rajasthan. Further, seasonal rainfall recorded positive impact on black gram, green gram and pigeon pea crops while on lentil and gram it was negative in Rajasthan.

Keywords: Instability, acreage response function and yield response function

One of the most important segment of Indian agriculture after oilseeds and cereals is pulse production. The pulses comprise Chickpea, Pigeon pea, Lentil, Green gram, Black gram and Field pea. Being an important crop commodity they provide high quality protein. Moreover they complement other cereal crops thus helping the population of the country by providing nutritious diet. Pulses are popularly known as "Poor man's meat" and "rich man's vegetable" as a result of being a major source of proteins, vitamins and minerals especially for vegetarian diets in India (Singh *et al.* 2016).

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ASSOCIATION OF AGRICULTURAL ECONOMICS & AGRI-BUSINESS MANAGEMENT

To Study the Seasonal Price Behaviour of Major *Kharif* Pulse Crops in Rajasthan

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ABSTRACT

The study based on time series data on arrivals and prices of major *kharif* crops. The time series data of arrivals and wholesale prices of selected *kharif* pulse crops were collected for 10 years (January 2008 to December 2017) in selected Krishi Upaj Mandi Samiti of Rajasthan. The study based on secondary data collected from different sources i.e. viz., AGMARK and NAFED and Krishi Upaj Mandi Samities. Three districts of Rajasthan state i.e., Bundi, Ajmer and pratapgarh were selected purposively. One Krishi Upaj Mandi Samiti from each district were selected, based on maximum tri-annum average [2015- 16 to 2017-18] arrivals and prices of major *kharif* pulse crops in the market. Seasonal Index of arrivals and prices of selected pulse crops were worked out by ratio to moving average method. The study revealed that there was inverse relationship between price and arrivals of black gram, green gram and pigeon pea in the KUMS, Bundi, Kekari and Pratapgarh of Rajasthan. It might be due to distress sale, lack of storage facilities and overdue burden of the farmers.

Keywords: Price behaviour, Seasonal arrivals index, Prices analysis, Seasonal price index, Pulses

Production of pulses are one of the important segments of Indian agriculture after cereals and oilseeds. The pulses comprise Chickpea, Pigeon pea, Lentil, Green gram bean, Black gram bean and Field pea. These pulses are an important commodity group of crops that provide high quality protein with complementing cereal proteins for pre-dominantly substantial population of the country. Pulses are popularly known as "Poor man's meat" and "rich man's vegetable" as a result of being a major source of proteins, vitamins and minerals especially for vegetarian diets in India (Singh *et al.* 2016).

Among the pulses, chickpea and pigeon are the important crops accounting for 50 per cent of pulse area and 60 per cent of total production. Madhya Pradesh, Uttar Pradesh, Maharashtra, Rajasthan, Andhra Pradesh, Karnataka, Bihar, Chattisgarh, Gujarath and Tamil Nadu. Pulses are grown in *Kharif* and *Rabi* seasons. Chickpea, drypea, lentil and lathyrus are known as *Rabi* pulses. The *Kharif*

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Growth and Decomposition Analysis of Kharif Pulse Crops in Rajasthan

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Abstract

The present study was conducted to analyze the growth rate and source of output growth in area, production and productivity of kharif pulse crops viz., black gram, green gram and pigeon pea crops in Rajasthan. The study was solely based on secondary time series data. The study period (1988-89 to 2017-18) has been divided into four periods namely period-I (1988-89 to 1997-98), period-II (1998-99 to 2007-08), period- III (2008-09 to 2017-18) and overall period (1988-89 to 2017-18). Exponential growth and principal decomposition models were used to measure the growth rates and relative contribution of factors in production of selected kharif crops. The area, production and productivity of black gram were increased significantly at the rate of 5.20, 8.89 and 3.75 per cent per annum, respectively. The production of black gram may be increased due to positive and significant contribution made by area and productivity of black gram. However, area and production of green gram in Rajasthan were increased significantly at the rate of 13.24 and 19.12 per cent per annum, respectively in the entire study period whereas, the productivity of this crop was increased non significantly at the rate of 5.20 per cent per year. In this period, the production of green gram might be increased due to positive and significant augmentation in area of green gram. In the overall period, the area under pigeon pea was declined significantly with annual growth rate of -3.17 per cent in Rajasthan. During same period, the production of this crop was recorded positive and significant growth rate with the magnitude of 0.10 per cent per annum. Further, the productivity of pigeon pea was increase non-significantly at the rate of 3.04 per cent over the year. The tinny growth in production of pigeon peas was highly attributed by positive growth in productivity of pigeon pea throughout the study period. At the same time, the area under this crop was registered negative growth; it might be due to positive and significant growth in area of its competitive crop i.e. black gram and green gram. During overall period area expansion was comparatively more instrumental in increasing in production of black gram while yield effect and its interaction effect were next in order with 12.63 per cent and 9.36 per cent contribution to the output growth of black gram. During overall period, the growth in production of green gram was mainly achieved through interaction and area effect. The contribution of interaction and yield effect in the production growth in this period was about 70.26 per cent and 64.99 per cent respectively. During overall period, however interaction effect turned out to be the most powerful factor in growth of pigeon pea with 100.66 per cent. Area and yield effect were very small during this time with -0.77 and 0.11 per cent, respectively.

***Key words :** Compound growth rate, decomposition, area, production and productivity of pulses.*

Introduction

Production of pulses is one of the important segments of Indian agriculture after cereals and oilseeds. The pulses comprise of Chickpea, Pigeon pea, Lentil, Green gram, bean, Black gram bean and Field pea. These pulses are an important commodity group of crops that provide high quality protein with complementing cereal proteins for pre-dominantly substantial population of the country. Pulses are popularly known as "*Poor man's meat*" and "*rich man's vegetable*" as a result of being a major source of proteins, vitamins and minerals especially for vegetarian diets in India (Singh *et. al.*, 2016). Pulses prove to be a boon for mankind as they are highly nutritive processing important gift of nature. They not only increase the fertility of the soil by nitrogen fixation but also increase the porosity of the soil due to their invasive tap root system. Due to low requirement of water and ability to withstand serves revealed that decline in pulses consumption lead to increase in malnutrition due to decline in protein intake. (Shalendra *et al.*, 2013). India is presented about 24 percent of undernourished populace in the universe (Sharma *et al.*, 2016 and Ahlawat *et al.*, 2016). To make the public aware of the nutritional benefits of pulses as part of sustainable food production aimed at food security and nutrition, The United Nations declared 2016 as "International year of pulses (IYP). India is the largest producer, consumer and importer of the pulses in the world. India was the largest producer (25%), consumer (27%) and importer (14%) of pulses in the world. (Mohanty and Satyasai 2015).

Among the pulses, chickpea and pigeon are the important crops accounting for 50 per cent of pulse area and 60 per cent of total production. Madhya Pradesh,

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To Study the Instability and Causes of Instability of Major Pulse Crops in Karnataka

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Abstract

The study was conducted the growth of area, production and productivity of major pulse crops i.e. gram, black gram, green gram and pigeon pea crops in Karnataka. The study was based on secondary data from 1988-89 to 2017-18. Instability in area, production and productivity of selected pulse were worked out for entire period of analysis by Cuddy- Della Valle index and to measure the cause of instability with respect of selected pulse crops i.e. gram, black gram, green gram and pigeon pea in Karnataka, acreage response function (log linear function) and yield response function have been used. The study revealed that production of selected crops were highly instable in Karnataka. In case of area, gram was highly instable and black gram was less instable while green gram and pigeon pea were medium instable. In the mean time, productivity of gram and pigeon pea were medium instable while productivity of black gram and green gram were highly instable. Green gram growers in Karnataka showed contrary response to lagged area under its competing crop i.e. the decrease in area of competing crop in last year season, thereby that was tendency to increase the area under green gram in Karnataka. while quite responsive to lagged area under gram, black gram and pigeon pea crop in Karnataka. It means the increase in area of gram, black gram and pigeon pea crops in last year season, there is tendency to increase the area under gram, black gram and pigeon pea in Karnataka. The time trend factor showed positive influence on productivity of gram and pigeon pea crops while negative influence on productivity of black gram and green gram crops in Karnataka. Further, seasonal rainfall was recorded positive impact on gram crop while negative influence on productivity of black gram green gram and pigeon pea crops in Karnataka.

Key words : *Instability, acreage response function and yield response function.*

Introduction

One of the most important segment of Indian agriculture after oilseeds and cereals is pulse production. The pulses comprise Chickpea, Pigeon pea, Lentil, Green gram, Black gram and Field pea. Being an important crop commodity they provide high quality protein. Moreover they complement other cereal crops thus helping the population of the country by providing nutritious diet. Pulses are popularly known as "Poor man's meat" and "rich man's vegetable" as a result of being a major source of proteins, vitamins and minerals especially for vegetarian diets in India (Singh *et. al.*, 2016). Pulses are also capable of taking upcoming and changing environmental challenges. About 9-10 per cent share is of the pulses to the total food grain having important and valuable plant based proteins, vitamins and minerals. As they are inexpensive and protein rich they form an essential part of the meal about 20-25 per cent. Pulses are also useful from health point of view helping fight, malnutrition, diabetes etc. (Source: Ministry of Agriculture and Farmers Welfare, DAC and FW, 2018)

Pulses prove to be a boom for mankind as they are highly nutritive important gift of nature. They not only increase the fertility of the soil by nitrogen fixation but also increase the porosity of the soil due to their invasive top root system due to the low requirement of water and ability to withstand serves revealed that decline in pulses consumption lead to increase in malnutrition due to decline in protein intake. (Shalendra *et al.*, 2013). India is still a home for about 24 per cent of under nourished people in the world (Sharma *et al.*, 2016 and Ahlawat *et al.*, 2016).

Almost 50 per cent of world pulse output is concentrated in Asia (India, Myanmar, China and Turkey), followed by 22 per cent in Africa (Nigeria, Tanzania, Niger and Ethiopia), 19 per cent in the America (Canada, Brazil, USA and Mexico), 9 per cent in Europe and the remaining 4 per cent in Oceania. Low Income Food Deficit Countries (LIFDCs) account for 48 per cent of world production and Least Developed Countries (LDCs) about 23 per cent substantiating the importance of these crops in the most economically disadvantaged countries. As per the data for the past 30 years is concerned, India finds its place in doubly as the largest producer of pulses, consequently producing two-three times more than any other country. (Food outlook, biannual report 2016, Food and Agriculture Organization).

Labour Absorption in Livestock Activities in Transitional Plain Region of Rajasthan

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Abstract

In the Transitional plain regions of Rajasthan livestock activity is a complementary activity to farming and it provides much needed risk cover in case of crop failure. The present investigation was undertaken to study the labour absorption in different livestock activities in Transitional plain regions of Rajasthan. The study was conducted based on both primary and secondary data. The primary data were collected from the 200 households of 10 villages during year of the 2018-2019. The average utilization of human labour in livestock activities was found 63.27 man-days/ animal/ year in Transitional plain region. The participation of woman labour in all livestock activities was found more than man labour in all herd size group in Transitional plain region. The annual average human labour absorption was maximum in site preparation activity i.e., 48.02 hours/ animal/ year for male and 117.84 hours/ animal/ year for female, then other activities in all size of farms.

Key words: Labour absorption; livestock activity & production; health care; standard animal unit

The results presented are part of the PhD thesis submitted by first author to the MPUAT, Udaipur.

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To Study Growth and Decomposition of Major Pulse Crops in Karnataka

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Abstract

The study was conducted the growth of area, production and productivity of major pulse crops i.e. gram, black gram, green gram and pigeon pea crops in Karnataka. The study was based on secondary data from 1988-89 to 2017-18. The study period (1988-89 to 2017-18) has been divided into four periods i.e. period-I (1988-89 to 1997-98), period-II (1998-99 to 2007-08), period- III (2008-09 to 2017-18) and overall period (1988-89 to 2017-18). Compound annual growth rates (CAGR) of area, production and productivity of selected pulse were worked out for different periods as well as for entire period of analysis by fitting exponential function. To measure the relative contribution of area, yield and interaction towards the total output change with respect of selected major pulse crops i.e. gram, black gram, green gram and pigeon pea in Karnataka, Minhas and Vaidyanthan, (1965) model has been used. The study revealed that the positive and significant growth rate were observed in area, production and productivity of gram and pigeon pea while decreasing growth was observed in production and productivity of black gram and green gram in the Karnataka. The area effect was more dominant than yield and interaction effect in gram and black gram crops while interaction effect was most powerful to increase in the production of green gram and pigeon pea of Karnataka.

Key words : *Compound growth rate, decomposition.*

Introduction

Production of pulses is one of the important segments of Indian agriculture after cereals and oilseeds. The pulses comprise of Chickpea, Pigeon pea, Lentil, Green gram bean, Black gram bean and Field pea. These pulses are an important commodity group of crops that provide high quality protein with complementing cereal proteins for pre-dominantly substantial population of the country (Balai *et al.*, 2021). Pulses are popularly known as "*Poor man's meat*" and "*rich man's vegetable*" as a result of being a major source of proteins, vitamins and minerals especially for vegetarian diets in India (Singh *et. al.*, 2016). Pulses prove to be a boon for mankind as they are highly nutritive processing important gift of nature. They not only increase the fertility of the soil by nitrogen fixation but also increase the porosity of the soil due to their invasive tap root system. Due to low requirement of water and ability to withstand serves revealed that decline in pulses consumption lead to increase in malnutrition due to decline in protein intake. (Shalendra *et al.*, 2013). India is presented about 24 percent of undernourished populace in the universe (Sharma *et al.*, 2016 and Ahlawat *et al.*, 2016). To make the public aware of the nutritional benefits of pulses as part of sustainable food production aimed at food security and nutrition, The United Nations declared 2016 as "International year of pulses (IYP). India is the largest producer, consumer and importer of the pulses in the world. India was the largest producer (25%), consumer (27%) and importer (14%) of pulses in the world. (Mohanty and Satyasai 2015).

Among the pulses, chickpea and pigeon are the important crops accounting for 50 per cent of pulse area and 60 per cent of total production. Madhya Pradesh, Uttar Pradesh, Maharashtra, Rajasthan, Andhra Pradesh, Karnataka, Bihar, Chattisgarh, Gujarath and Tamil Nadu. Pulses are grown in Kharif and Rabi seasons. chickpea, drypea, lentil and lathyrus are known as Rabi pulses. (Anonymous, 2018)

The pulses crop was cultivated over 85.40 million hectares along with 87.40 million tones production and 1023 kg/ha productivity. Chickpea, pigeon pea and lentil are major contributing crops in total world pulses production with the share of 16.69, 10.40 and I 7.72 percent respectively (Anonymous 2019).

India secured the top position in area and production with 35 percent and 29 percent in the world respectively. India plays a significant role in the world pulse market. In India food grains occupy 65 per cent of total gross cropped area comprising cereals in 50 per cent and pulses in about 15 per cent. Pulses were cultivated over >27 million hectare area with production of 23.02 million tones and productivity of 823 kg/ha. (Anonymous, 2019).

In India, Madhya Pradesh secured first position in area with 6600 thousand hectare followed by Rajasthan,

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TO STUDY OF SEASONAL PRICE BEHAVIOUR OF MAJOR RABI PULSE CROPS IN RAJASTHAN

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ABSTRACT

The study based on time series data on arrivals and prices of major rabi crops. The time series data of arrivals and wholesale prices of selected rabi pulse crops were collected for 10 years (January 2008 to December 2017) in selected Krishi Upaj Mandi Samiti of Rajasthan. The study based on secondary data collected from different sources i.e. viz., AGMARK and NAFED and Krishi Upaj Mandi Samities. Two districts of Rajasthan state i.e., Bikaner and and Bundi were selected purposively. One Krishi Upaj Mandi Samiti from each district were selected, based on maximum tri-annum average [2015- 16 to 2017-18] arrivals and prices of major rabi pulse crops in the market. Seasonal Index of arrivals and prices of selected pulse crops were worked out by ratio to moving average method. The study revealed that there was inverse relationship between price and arrivals of gram and lentil in the KUMS, Bikaner and Bundi of Rajasthan. It might be due to distress sale, lack of storage facilities and overdue burden of the farmers.

Key words: Arrivals, Prices, Seasonal Index, Pulses.

Production of pulses are one of the important segments of Indian agriculture after cereals and oilseeds. The pulses comprise Chickpea, Pigeon pea, Lentil, Green gram bean, Black gram bean and Field pea. These pulses are an important commodity group of crops that provide high quality protein with complementing cereal proteins for pre-dominantly substantial population of the country. Pulses are popularly known as "Poor man's meat" and "rich man's vegetable" as a result of being a major source of proteins, vitamins and minerals especially for vegetarian diets in India (Singh *et. al.*, 2016).

Among the pulses, chickpea and pigeon are the important crops accounting for 50 per cent of pulse area and 60 per cent of total production. Madhya Pradesh, Uttar Pradesh, Maharashtra, Rajasthan, Andhra Pradesh, Karnataka, Bihar, Chattisgarh, Gujarath and Tamil Nadu. Pulses are grown in Kharif and Rabi seasons. chickpea, drypea, lentil and lathyrus are known as Rabi pulses. The Rabi pulses contribute about 60 per cent of the world pulse production. Rabi pulses contribute 55 per cent of the total area and about 65 per cent of production. (Anonymous, 2018-19)

The pulses crop was cultivated over 85.40 million hectares along with 87.40 million tones production and 1023 kg/ha productivity. Among all the major pulses cultivated globally, performance of lentil has been good at the productivity level (1152 kg/ha) but chickpea production has made it a leading crop amid other pulse crops in the world. Chickpea, pigeon pea and lentil are major contributing crops in total world pulses production with the share of 16.69, 10.40 and 1 7.72 percent respectively (Anonymous 2019-20).

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Characterization and Mapping of Groundwater Quality of *Gird* Region in Central India

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Abstract

The *Gird* is the region of Madhya Pradesh in part of central India and is situated in the northern part of the state. It includes the districts of Bhind, Gwalior, Morena, Sheopur and Shivpuri. This region is one of the 11 agro-climatic regions of the state and is known for sorghum-wheat cropping zone. Groundwater samples were collected through survey for above mentioned districts and characterized and classified into different quality classes. The mapping of groundwater quality at 1: 50000 scale was done for the region. Out of the 302 water samples from Bhind district, 158, 20, 7 and 5 belonged to category good (A), marginally saline (B_1), saline (B_2) and high SAR saline (B_3), respectively. Alkali water representation was 47, 47 and 18 in marginal alkali (C_1), alkali (C_2) and high alkali (C_3) category in same district. Groundwater samples of Morena district (90) was categorized as good (60) and marginally saline (6), marginally alkali (20), alkali (2) and highly alkali (2). In Gwalior, 126 samples belonged to good (A) category and 29 samples come under alkali (C_2) category. Most of the groundwater samples of Sheopur district come under good category 174 (86.6%) and only 9% samples belonged to alkali water. Out of total 754 samples of Gird region, 518 (68.7%) are good water category. 51 (6.8%) samples are saline in nature of saline (B) category, whereas, 185 (24.5%) come in alkali water category. The results of the study showed that water quality of the gird region followed the trend of good> alkali water> saline water. The use of such alkali water for irrigation may create hazard of soil sodicity in long run. Management options for use alkali and saline groundwater for irrigation are discussed.

Key words: *Gird* region, Groundwater quality, Mapping, Characterization of water, Electrolytes, Sodium adsorption ratio (SAR), Residual sodium carbonate (RSC)

Introduction

Groundwater is precious gift of nature and important source of irrigation water in arid and semi-arid agriculture. Groundwater interacts with rocks under geochemical processes possess with variable concentrations of certain electrolytes Ca^{2+}, Mg^{2+}, Na^{+} and K^{+}, Cl^{-}, SO_4^{2-}, CO_3^{2-} and HCO_3^{-} (Das *et al.*, 2010; Kumar *et al.*, 2015). The groundwater quality changes spatially due to the variations in types of groundwater recharge, seasonal changes, groundwater extraction and presence of stratified or pervious or impervious lithology *etc*. Therefore, a keen monitoring on underground water becomes imperative in order to lower down the spread of groundwater pollution and to ensure the best quality underground water for irrigation. The chemica quality of groundwater is a function o innumerable factors which vary spatially and i varies spatially. The geo-chemistry of rocks is th main influencing factor for groundwater qualit Sometimes, human activities in the region als influence it. The *Grid* region of Madhya Prade comprises of Bhind, Gwalior, Morena, Sheop and Shivpuri district with normal annual rainf as 668, 700, 754, 944 and 800 mm, respectiv There are reports about groundwater qual problems in the region except Shivpuri. T

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RESEARCH ARTICLE

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Crop Productivity Enhancement under Soybean Based Cropping System through Harvested Rain Water in Malwa Region

D.H. Ranade, M.L. Jadav, Indu Swarup, O.P. Girothia, D.V. Bhagat, Ashish Upadhyay

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ABSTRACT

Background: Rainwater harvesting is commonly practiced in areas, where the rainfall is insufficient for crop growing. Due to the intermittent nature of run-off events, it is necessary to store the maximum possible amount of rainwater during the rainy season so that it may be used as irrigation to enhance the crop productivity and farm income under soybean based cropping system.

Methods: A study was carried out during 2018-2019 in Indore district of Malwa region. Rainwater harvesting tanks at on station (42×21×2.4m) and on farm (15×11×4m) were constructed for irrigation water availability. Provision of water harvesting tank increased the irrigation water availability (1781m³ and 630m³ respectively) and stored water was managed through various irrigation systems *viz.* rain gun, drip and flood.

Result: It was resulted that the provision of water harvesting tanks enhanced the crop productivity and farm income under soybean based cropping system. Availability of irrigation encouraged the farmers to diversify the cropping pattern (soybean-chickpea, soybean -wheat). It is also clear from the study that even with smaller storage tank and through conjunctive use of ground (1164.2m³) and surface water (596m³), multiple crops (Soybean, potato, sweet corn, chickpea, onion, garlic *etc.*) can be grown. Soybean-Chickpea cropping system at station gave the net return of 70976 Rs/ha with B: C ratio of 3.15. Soybean-Wheat cropping system at farm gave the net return of 119000 Rs/ha with B:C ratio of 3.38.

Key words: Conjunctive use, Legume production, Rainfed area, Rainwater management, Water-harvesting tank.

INTRODUCTION

Rainwater harvesting, the small-scale collection and storage of runoff for irrigated agriculture, is recognized as a sustainable strategy for ensuring food security, especially in monsoonal landscapes in the developing world (Kimberly *et al.*, 2016). Within a context of scarce water resources for agriculture, rainwater harvesting constitutes a promising alternative (Juan *et al.*, 2019). Rainwater harvesting technologies are a critical factor for productivity of agricultural crops (Schlenker and Lobe, 2010). The hydrological and geological status of any watershed having Vertisol are the major factors for deciding the type and size of water harvesting tank. Rainwater harvesting is commonly practiced in areas, where the rainfall is insufficient for crop growing. Due to the intermittent nature of run-off events, it is necessary to store the maximum possible amount of rainwater during the rainy season so that it may be used at a later date (Qadir *et al.*, 2007 and Oweis *et al.* 2003). If the soil is underlained by fragmented basaltic murram with high percolation rate, the lining of such excavated farm pond is very essential. Presently, HDPE (High Density Polyethylene) films of 500 µm or cross layer-reinforced silpaulin with 300-350g/m² are commonly used (Rao *et al.*, 2017). On the other hand, if soil is very deep, excavated farm pond may store runoff water for longer time to be utilized during prolonged dry spell or providing lifesaving /supplemental/pre sowing irrigation to *kharif* and *rabi* crop. Rainwater harvesting implies harvesting, storing and conserving rainwater directly, in a farmed area that is generally smaller than the size of the catchment area (Kiggundu *et al.*, 2018 and Boers *et al.*, 1982). The location wise heterogeneity, therefore reflect on effectiveness of lined and unlined water harvesting tank. However, not much information is available on comparative performance of these two types of tanks on farm productivity. Further, due to limited storage capacity, long-term use of rainwater is only possible in conjunction with groundwater (Hubert and Agnes, 2017). In order to meet the increased irrigation water, augmentation of existing water sources by development of additional sources of water and conjunctive use of surface and ground water will be needed (Mall *et al.*, 2006). The objective of the study was to assess the impact of increased water availability on farm productivity and farm income through water harvesting tank only on station and through conjunctive use of ground water and surface water

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Effect of liquid bioinoculants and straw mulch on health of Vertisols and productivity of soybean (*Glycine max*)

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ABSTRACT

Now-a-days use of machinery for crop harvesting leave behind large quantities of crop residues, which is burnt by farmers as cheap and easiest method with misconception that, burning of crop residues enhances soil fertility and helps in control weeds, insects and pests. The burning of crop residues result in heavy loss of soil nutrients emits large amount of submicron aerosols and trace gases and smoke, thereby posing problem to environment and human health hazards. Therefore, a field experiment was carried out during *kharif* season of 2019 at Research Farm, College of Agriculture (RVSKVV), Indore, India to study the effects of liquid bio-inoculants and wheat straw mulch on yield attributes, productivity and nutrient content of soybean grown in Vertisols. The soil of experimental site was clay loam in texture and alkaline in reaction (pH 7.8). The treatments were laid out in RBD in three replications with ten treatments. Among the various treatments, significantly higher yield parameters were recorded in *Rhizobium* + PSB + wheat straw mulch @ 5.0 t/ha + foliar spray of PGPR @ 20 ml/L water at 35 DAS and flowering stage as compared to other treatments. Similarly, highest seed yield (12.32 q/ha) and biological yield (27.68 q/ha) was also recorded with the application of *Rhizobium* + PSB + wheat straw mulch @ 5.0 t/ha + foliar spray of PGPR @ 20 mL/L water at 35 DAS and flowering stage. The higher nutrients content (N, P, and K in seed and straw) and their uptake; and available N content (262.67 kg/ha) and P content (12.27 kg/ha) in soil were observed under *Rhizobium* + PSB + wheat straw mulch @ 5.0 t/ha + foliar spray of PGPR @ 20 mL/L water at 35 DAS and flowering stage in comparison to other treatments. Hence, dual seed inoculation, foliar spray of PGPR along with wheat straw mulch was found promising with higher productivity of soybean under Vertisols.

Key Words : Liquid bio-inoculants, nutrient content, productivity, soil health, soybean, yield attributes

INTRODUCTION

Soybean (*Glycine max* L. Merill) seeds are an important source of protein (35-45%) and edible oil (18-22%) in the world. It is a unique crop among all the legumes because it provides complete protein containing 8 amino acids essential for human health and is a concentrated source of isoflavones which have a potential role in preventing and treating cancer and osteoporosis. In India soybean is grown in 11.60 M ha with total production of 8.57 MT. In Madhya Pradesh it is grown in 5.40 m ha with total production of 5.51 MT (Morya *et al.*, 2018). Soybean occupies the highest area and production amongst the oilseeds in Madhya Pradesh (Khandkar *et al.*, 2019). The state has its major share in area and production of soybean in India (nearly 60%) and hence designated as *Soya State*. The productivity of soybean can be increased by inoculation with bio-agents such as *Rhizobium* and phosphate solubilizing microorganisms. Co-inoculation with these bio-cultures has shown encouraging results in sustaining the crop productivity and improving soil fertility

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Rainwater harvesting to mitigate climate change effects on the cropping sequences in *Malwa* region of Madhya Pradesh

ML Jadav, DV Bhagat, OP Girothia, SK Choudhary and Narendra Kumawat

Abstract
A study was carried out for two consecutive years (2018-19 and 2019-20) at All India Coordinated Research Project for Dryland Agriculture Indore of Madhya Pradesh. Four cropping systems *viz.* Soybean – Chickpea, Maize– Chickpea, Maize– Sweet corn (Green cob) and Soybean- Onion were sown for the trial. Rabi crops were irrigated through the water stored in farm pond (rainwater harvesting structure). The study reported that during 2018-19, Soybean and maize yield was 1630 kg/ha and 4333 kg/ha respectively whereas in 2019-20 it was 919 kg/ha and 652 kg/ha respectively. Productivity of *Kharif* crops in second year severely affected due to excess and continue rain fall during crop growth period. Annual rainfall for the years were 756.7mm and 1565.4mm respectively whereas normal annual rainfall is 984mm Water use efficiency of soybean and Maize were 2.62 kg/ha-mm and 7.87 kg/ha-mm respectively during *kharif* of year 2018-19, whereas next year, WUE of soybean and Maize were 0.64 kg/ha-mm and 0.45kg/ha-mm respectively. On the basis of pooled data of economics of different system, it is clear that Soybean – Onion found the more remunerative as it recorded total net returns Rs. 189161/- per hectare with B: C ratio 4.16 whereas, the lowest was recorded with Soybean – Chickpea (Rs. 64551/- with B: C ratio 2.8). Yield, WUE and economics of the crops clearly indicate that climate change severely affects the *kharif* crops but rainwater stored in farm pond can mitigate it in *rabi* crops.

Keywords: B:C ratio, climate change, farm pond, rainwater harvesting, yield, water use efficiency

Introduction
The Madhya Pradesh is predominantly rain fed farming state, as only 6.07 m ha area is irrigated. Malwa agro climatic zone comprises 8 entire districts and part of Dhar (Dhar, Badnawar, Sardarpur Tehsil) and Jhabua (Petlawad Tehsil) districts of Madhya Pradesh (Ranjeet *et al.*, 2018) [17]. Soybean had played a pivotal role in socio-economic transformation of majority of small and marginal farming community of central India (Dupare *et al.*, 2019). Dupare *et al.* (2020) [3, 4] studied among soybean farmers of *Malwa* and *Nimar* region and found that more than 40 per cent farmers also perceived that the yield losses due to climatic adversities were even up to 50 per cent during the last two decades in spite of following management practices. Due to climate change, water related problems are increasing throughout the world in both developing and developed countries (Duguna and Januszkiewicz, 2019) [2]. It is predicted that change in climate will affect soil moisture, ground water and frequency of flood or drought (Kisakye *et al.*, 2018) [11]. Constructions of rainwater harvesting structures have been the strategy to stop migration of the people (Pandey *et al.*, 2003) [13]. Maize is the third largest produced and consumed food crop, after rice and wheat in India. Sweet corn consume as green cobs and maize seed as staple food (Ranjit kumar *et al.*, 2014) [18]. Madhya Pradesh is the largest producer of chickpea followed by Maharashtra, Rajasthan, Uttar Pradesh, Andhra Pradesh and Karnataka (Singh and Singh, 2018) [22].
There is need to harvest each drop of water and use efficiently and effectively in climate change (Chouhan *et al.*, 2020) [1]. Scarce water resources is one of the crucial factors that contributes to the decline in agricultural productivity (Zhang *et al.*, 2012) [24]. Fereres and Soriano (2007) [5] emphasized on the current challenge in agriculture is to produce more yields by utilizing less water.

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Evaluation of percolation tank as soil and water conservation measure in Malwa-Nimar region

ML Jadav, DH Ranade, SK Choudhary, DV Bhagat, N Kumawat, Ashish Upadhyay and OP Girothia

Abstract
In a study conducted by AICRPDA Indore during 1991-2019 on the rainwater management aspects through percolation tanks constructed in on farm and on station trials at various locations in *Malwa* and *Nimar* region, it was observed that construction of percolation tanks and thus collection of runoff water is very beneficial in terms of enhancing water availability in nearby open wells and tube wells. Based on the experiences gathered from all these percolation tanks, it can be pointed out that these percolation tanks are instrumental in enhancing availability of irrigation water, modifying crop diversification, reducing offsite damage to environment and downstream fields due to uncontrolled runoff and through recharging the ground water and ultimately in increasing the farm productivity and income. Further, it is observed that in *Malwa* and *Nimar* region, various geological situations are such located that many percolation tanks can be constructed which can ultimately enhance the availability of ground water in the area and crop production through better rainwater management.

Keywords: ground water recharge, irrigation, percolation tank, rainwater management

1. Introduction
Availability of irrigation water is the most important factor for the production of *rabi* crops mostly in rainfed areas like *Malwa* region. It is also instrumental in achieving the potential yield of any *rabi* crop if it is available in sufficient amount. However, it is a fact that the availability of irrigation either on surface or in groundwater depends mainly on monsoonic rainfall pattern. Rainfall amount and distribution during *kharif* also decides the cropping pattern of *rabi* season. If sufficient rainfall is received during monsoon, the farmers opt for crops like potato, wheat, onion etc. during *rabi* otherwise they cultivate mostly gram during *rabi* season of scanty rainfall year (Ranade *et al* 2018) [4]. Even during good rainfall year, it is observed that most of tube wells started providing water at the reduced rate since December onwards and even then farmers fail to provide required water in last critical crop stage. Over exploitation of groundwater in the region mainly due to increasing demands for irrigated agriculture causing severe groundwater depletion when less amount of rainfall recharge (Surinaidu *et al.*, 2018) [10]. The runoff potential is very high in the region due to inherent soil properties (black *vertisol*), the harvesting of excess water at suitable locations in farm ponds has been found to be beneficial by providing supplemental irrigation water for the crops other than tube well water (Ranade *et al.*, 2021) [5]. However, efforts should also be made to enhance the ground water recharge through percolation tanks as in this region many such topographical and hydrological situations are existed. Many researchers advocated for the construction of percolation tanks for enhancing ground water recharge. Rangarajan *et al.* (2014) [7] conducted a case study in basalt watershed of Ujjain district of *Malwa* region in Madhya Pradesh and concluded that infiltration of monsoon precipitation through unsaturated zone is the principal source of natural recharge. Srivastava R. C. (2007) [9] and Bhagyawant *et al.* (2008) [2] reported that percolation tanks are constructed for increasing water table depth below the ground surface. Reena Kumari *et al.* (2014) [6] observed that rainfall is the principal means for replenishment of moisture in the soil water system and recharge to ground water. Farmers have increasingly recognized the enhanced reliability of supplementary wet season and dry season irrigation with groundwater that brings with it reduced risk of investment losses and higher levels of agricultural productivity (Bhaduri *et al.*, 2009) [1]. Small dams or groundwater supplies are used for supplementary watering to grow crops during the monsoon (*Kharif*) season and dry winter (*Rabi*) (Garg *et al.*, 2011) [3].

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To assess the accomplishment of new wheat varieties (*Triticum aestivum* L.) under various dates of sowing and agro-ecosystem of northern part of Madhya Pradesh

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ABSTRACT: The present experiment was conducted at Research Farm, All India Coordinated Wheat Improvement Project, RVSKVV, College of Agriculture, Gwalior (M.P.) during the year 2017- 2018, to evaluate the new varieties of wheat (*Triticum aestivum* L.) in various dates of sowing under irrigated condition. For this research in total six wheat varieties namely- HS 562, HD 2967, HD 3086, HI 1544, MACS 6222, WR 544 were taken and the same were evaluated under two dates of sowing dates viz 10 November and 15 December 2017. The pooled data professed that crop sown on 10 November showed promising results in terms of grain yield i.e. 5720 kg/ha while the crop sown on 15 December results in reduced grain yield (5292 kg/ha). Out of six wheat varieties, Variety HD 2967 resulted in significantly highest grain and straw yield per hectare.

Key words: *Triticum aestivum*, different sowing dates, grain yield, irrigated conditions

INTRODUCTION

Wheat [*Triticum aestivum*(L.)] is one of the major cereal crop of India and it has a leading position amongst the important cereals that substantially feed nearly one third of the entire world population by providing half of the dietary protein and calories, Dhanda *et al.* (2004). Wheat is considered as one of the major *Rabi* crop of Madhya Pradesh, under irrigated condition, and it holds second position both in terms of area and production in India. Wheat varieties suits a broad range of sowing condition under irrigated condition, even in late sown condition it withstand a good level of grain yield which is due to its photo–thermo–insensitive nature (Anonymous 2016-17). Modern varieties of wheat have possibilities to replace the former traditional varieties for northern region of Madhya Pradesh. Plant growth, yield attributes, grain and straw yields are significantly influenced by sowing time. Untimely planting of the crop is one of the major factor which influence yield and quality of crop, Saini *et al.* 1988, So another foremost aspect of low yield is shortage of advanced varieties, under late sown condition. Newly developed wheat varieties, along with the agronomical manipulation of sowing time will help to improve the yield of wheat in northern Madhya Pradesh. In account of the aforesaid facts the present research is conducted to assess the accomplishment of new varieties in various date of sowing, under agro-ecosystem of northern part of Madhya Pradesh.

MATERIALS AND METHODS

Experimental Site, climate and season: The current experimentation was carried out at the Research Farm, All India Coordinated Wheat Improvement Project, R.V.S.K.V.V, College of Agriculture, Gwalior (M. P.) and the meteorological data was registered during the period of observation from the meteorological observatory of College of Agriculture, Gwalior. The terrain of the field was almost steady with marginal slope from East to West direction with well drainage. The experiment comprised of six wheat varieties (HS 562, HD 2967, HD 3086, HI 1544, MACS 6222, WR 544) and two dates of sowing viz 10 November and 15 December with three replications and net plot size 1.40m × 7.0 m, plotted in split plot design. A regular dose of N, P and K fertilizer 120, 60 and 40 kg respectively applied in the experimental field during the research. At the time sowing all the treatment have been applied with full quantities of phosphorus and potash along with half quantity of nitrogen (basal dose), the leftover nitrogen was applied as two split top dressing at 30 DAS and 60 DAS. Small furrows in the field are opened at a row spacing of 20 cm with the help of wooden marker and 100 kg/ha seed were line sowed in that small furrows on 10th Nov and 15th Dec. In addition to pre sowing irrigation practice, six irrigations were given during the entire crop growing period. The irrigation practices is done timely, whereas all the agricultural practices were kept usual and consistent for all the treatments. The observations noted during pre-harvest covers plant population / m^2, plant height in cm, number of tillers/ m^2, number of leaves/ 25 cm row length, dry weight/ 25 cm row length (g), number of ear heads/ m^2 , number of days to ear head emergence, and number of days to maturity while post harvest observations include length of earhead in cm, number of grains/ earhead, weight of ear head (gm), test weight (g), grain yield q/ha and straw yield q/ha, biological yield(kg/ ha) and harvest index (%). The data which is recorded during the research work were statistically analyzed as per the method given by Panse and Sukhatme (1967).

RESULTS AND DISCUSSION

Sowing dates seriously influence the yield and yield components. Wheat varieties planted on 10 November showed promising

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Efficacy of Herbicides for Weed Control in Cauliflower (*Brassica oleracea* var. *botrytis* L.)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

A field experiment was conducted during *Rabi*, 2018-19 at Horticulture farm, RAK College of Agriculture, Sehore (M.P.) to study the effect of different weed management practices on growth and yield of cauliflower. The treatments namely - T_1- Weedy check (control), T_2- Weed free (through hand weeding) at 30 & 60 DAT, T_3-Pendimethalin 30% EC (PE) + one hand weeding at 30 DAT, T_4 Oxyfluorfen 23.5% EC (PE) + one hand weeding at 30 DAT, T_5- Propaquizafop 10% EC (POE) + one hand weeding at 60 DAT, T_6-Wheat straw mulch 5kg/plot, T_7- Black plastic mulch (150 mm) were evaluated in randomized block design with three replications. Results indicated that the there was no weed under T_7-black plastic mulch (150 mm) at all the stages. The maximum weed control efficiency (98%) was found with the treatment T_7- black plastic mulch (150 mm) at all the stages i.e. at 30, 60 and 90 DAT. The minimum weed index (0.00, 0.00 and 0.00%) was found with the treatment T_7 (Black plastic mulch (150 mm) at all the stages. The maximum curd length,

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Safflower in Madhya Pradesh - an overview of 25 years of research and development

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Abstract

Madhya Pradesh is a non-traditional region for safflower production, therefore it is significant that over a period of nearly three decades it has developed multiple varieties of Safflower, in three categories, namely Spiny, Spineless and Semi-Spiny. JSF-1 (Shweta) was the first Safflower variety released in 1984 even before the establishment of AICRP centre at Indore .Thereafter AICRP development work on safflower started in 1986 in Indore. This pushed the production area upward from small acreage to a splendid amount of 10,000 hectares (1988-89) in the Indore and Ujjain division. Fast forward to 2019, Nimar region farmers have now come forward for cultivation of Nonspiny Safflower varieties. After the establishment of AICRP centre , JSI-7 which is a high yielding spineless variety was released in 1990 for farmers. This was followed by the release of The JSI-73 (variety) in 1997, and quickly thereafter in 2004 came the bold seeded spineless variety JSI-97.

. The semi spiny variety JSI-99 (2004) is of extra early category with short stature and higher seed weight and a seed yield of about 1100 kg/ha under late planting condition in soybean-safflower sequence cropping. After mechanization in state the Spiny variety RVSAF 14-1 has been recently released in 2019.

Key words: spiny cultivars, adoption, yield, oil content, petals, medicinal use

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A study of technological gap in cultivation of Bt-cotton under FLD through KVK Khargone (M.P.)

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Abstract

Front Line Demonstrations (FLDs) have been proved the best means for creating awareness of new development in technology generation and to assess the various socio-economic variables for affecting the adoption level of farmers as the regular feedback is a necessary component of these demonstrations. KVK in Khargone district has been organizing FLDs on Bt-cotton, therefore keeping in view the researcher's interest a research entitled A Study of Technological Gap and Constraints in Cultivation of Bt-cotton under FLD through KVK Khargone (M.P.) was undertaken. Ex-Post facto design was used for this study. The study was conducted in KVK adopted villages in Khargone district. Khargone district comprises of nine blocks. One block from the district i.e. Gogawan will be purposively selected because this block has been selected for Bt-cotton demonstration. Out of this list 12 farmers will be selected randomly from each village. Therefore, 120 Bt-cotton growers from 10 villages will be selected for the present study. As observed the highest technological gap index in use of bio-fertilizer and FYM 44.44 percent followed by Seed treatment 43.33 percent, adopt of Bt cotton 28.61 percent, method of sowing 37.22 percent, weed management 26.11 percent, seed rate 25.56percent, Insect control 22.50 percent, Selection of variety 21.39 percent, disease management 20.56 percent and same technological gap in Sowingspacing20.56 percent, method of land preparation 20.28 percent, Irrigation 18.61 percent and selection of land 18.33 percent in technological gap about Bt cotton production technology.

Keywords: Technological, cultivation, Bt-cotton, FLD, KVK

Introduction

Cotton is soft, staple fiber that grows around the seeds the cotton plants (*Gossypium sp.*) a shrub native to tropical and subtropical regions around the world, including America, India and Africa. Only in India, all the four spinnable fibre yielding species of Gossypium *viz. Gossypium hirsutum, G. barbadense, G. arboreum* and *G. herbaceum* are cultivated commercially. All the commercial cotton is Native American species (*Gossypium hirsutum* and *Gossypium barbadense).* Bt-cotton, the first genetically modified (GM) crop in India was, initially approved in India on March 26th 2002 for commercial cultivation in six states belonging to southern and central cotton cultivation zones of the country. Cotton production in India during 2018-19 is Maharashtra, Gujarat and Telangana were the major cotton growing states covering around. In Madhya Pradesh, cotton is mainly grown in the districts of Khargone, Khandwa, Ghhindwada, Ratlam, Dewas, Burhanpur, Dhar and Barwani. A wide gap exists between the available techniques and its actual application by the farmers which is reflected through poor yield in the farmer's field. This gap is one of the major problems in increasing the productivity of the Bt cotton crop.

Keeping in view the low productivity, it was considered worthwhile to find out how much this program had helped the Bt cotton growers to bring about changes in terms of knowledge and adoption of improved Bt cotton production technology and thereby increasing farm productivity. Further since the inception of front line demonstration no systematic study in Madhya Pradesh has been made to measure its adoption behavior of farmers. It was felt relevant to take up a study entitled, A Study of Technological Gap and Constraints in Cultivation of Bt-cotton under FLD through KVK Khargone (M.P.) with following specific objective.

Objective

1-Technological gap in recommended Bt-cotton cultivation technologies under FLD through KVK.

Review literature

Tripp (2011) examined the performance of transgenic, insect-resistant cotton in four countries (China, India, Colombia and South Africa) are used to examine the adequacy of the institutions required to support the development and delivery of transgenic crops for resource-poor farmers. These institutions include the formal seed sector, the basic regulations that support it, conventional agricultural research and the provision of information to farmers. He argued that inadequacies in these institutions in many developing countries represent significant barriers to the hopes for a rapid uptake of transgenic crops.

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A Study on Identification of Indigenous Technology Knowledge (ITK) and its Utilization in Contemporary Modern Agriculture at Shajapur District of Madhya Pradesh

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Abstract

The ITK is an explicit or "codified" knowledge that is transmittable in formal, systematic language. On the other hand, ITK is a tacit knowledge of the local or indigenous people, which is personal, content-specific and therefore hard to formalize and communicate. Local or indigenous people acquire knowledge by actively creating and organizing their own experiences. Indigenous knowledge functions within the given socio-economic and spatial boundaries of the society and plays an active part in the culture of the population concerned, being preserved, communicated, and used by its members to serve some purpose in relation to productive activity within the society. Therefore, "A Study on Identification of Indigenous Technology Knowledge (ITK) and its Utilization in Contemporary Modern Agriculture at Shajapur District of Madhya Pradesh" with specific objective. The sample of the present study was selected by proportionate random sampling method 120 ITK users were selected randomly for this study through the KVK Shajapur, M.P. The finding regarding adoption behavior of ITK users in contemporary modern agriculture: the highest adoption observed in case of horticulture crop (mean score 2.20), followed by Sorghum (mean score 2.10), oil seed crops (mean score 2.06), soybean (mean score 1.99), maize (mean score 1.97), groundnut (mean score 1.95), wheat (mean score 1.92), weather forecasting (mean score 1.91), and pulses crops (mean score1.87).

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A Study on Impact of NICRA (National Innovation of Climate Resilient Agriculture) Project on Adoption of Recommended Production Technology of chickpea in Indore block, Indore district

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Abstract

National Innovations on Climate Resilient Agriculture (NICRA) is a network project of the Indian Council of Agricultural Research (ICAR) launched in February, 2011. The project aims to enhance resilience of Indian agriculture to climate change and climate vulnerability through strategic research and technology demonstration. The research on adaptation and mitigation covers crops, livestock, fisheries and natural resource management. The project consists of four components viz. Strategic Research, Technology Demonstration, Capacity Building and Sponsored/Competitive Grants. Aim of NICRA is to make Indian agriculture resilient to climate change through development and application of adaptation and mitigation technologies. National Innovations on Climate Resilient Agriculture (NICRA) is a network project of the Indian Council of Agricultural Research (ICAR) launched in February, 2011. The project aims to enhance resilience of Indian agriculture to climate change and climate vulnerability through strategic research and technology demonstration. The research on adaptation and mitigation covers crops, livestock, fisheries and natural resource management. The project consists of four components viz. Strategic Research, Technology Demonstration, Capacity Building and Sponsored/Competitive Grants. Aim of NICRA is to make Indian agriculture resilient to climate change through development and application of adaptation and mitigation technologies. 75 beneficiary farmers of NICRA Project were taken from DARP, for this study 75 non beneficiary farmers were taken for this study. Study revealed that according to adoption of recommended production technology of Chickpea regarding the beneficiaries of NICRA project 12.00% were having low adoption, 24.00% were having medium adoption, while 64.00% were having high adoption. In case of non-beneficiaries 48.00% were having low adoption, 36.00% were having medium adoption, while 16.00% were having high adoption. Therefore majority of NICRA beneficiaries had high adoption, while majority of non-beneficiaries had low adoption.

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I. Introduction

National Innovations on Climate Resilient Agriculture (NICRA) is a network project of the Indian Council of Agricultural Research (ICAR) launched in February, 2011. The project aims to enhance resilience of Indian agriculture to climate change and climate vulnerability through strategic research and technology demonstration. The research on adaptation and mitigation covers crops, livestock, fisheries and natural resource management. The project consists of four components viz. Strategic Research, Technology Demonstration, Capacity Building and Sponsored/Competitive Grants. Aim of NICRA is to make Indian agriculture resilient to climate change through development and application of adaptation and mitigation technologies.

Chickpea is commonly known as gram which is one of the important pulse crops of India. About 71% of global area with 71.95% of Global chickpea is contributed by India (Source-Annual Report of DPD 2016-17). It is important point to note that chickpea continues to be the largest consumed pulse in home as well as industrial purpose comprising of about 50% of total pulse production in India.

Objective

To determine knowledge and adoption of recommended production technology of chickpea

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Efficacy of advanced insecticides against sucking pests of okra

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Abstract
The present investigation was carried out in randomized block design (RBD) during *kharif* 2019 at experimental site of research field, College of Agriculture, Indore (M.P.). Efficacy present investigation was carried out in randomized block design (RBD) during *kharif* 2019 of different advanced insecticide against okra pests result revealed that afidopyropen 50 g/l DC @ 600 ml/ha was found to be most effective against jassid, aphid and whitefly. Next better treatment was afidopyropen 50 g/l DC @ 750 ml/ha followed by tolfenpyrad 15% EC @ 1000 ml/ha, afidopyropen 50 g/l DC @ 450 ml/ha, and spirotetramat 11.01% w/w + imidacloprid 11.01% w/w SC @ 500 ml/ha. Treatment afidopyropen 50 g/l DC @ 1000 ml/ha and abamectin 1.9% EC @ 987 ml/ha were the better group of best treatment and found to be least effective but significantly superior to control.

Keywords: *Abelmoschus esculentus*, abamectin, afidopyropen, *Amarasca biguttula biguttula*, *Aphis gossypii*, *Bemisia tabaci*

1. Introduction
Okra [*Abelmoschus esculentus* (L.) Moench] is the most important vegetable of family Malvaceae. The leaves of okra are utilized for planning of medications to reduce inflammation. Because of adequate level of iodine content, the utilization of products of okra can be considered as a solution for the goiter. India positions second regarding vegetable production in the world with the production of around 187474 thousand MT yet it possesses the first position in okra production. In India, area under okra is 528.4 thousand ha, alongside production of 6146 thousand MT, and productivity 11.6 MT/ha. In Madhya Pradesh, area, production and productivity of okra is 40.12 thousand ha, 536.73 thousand MT, 13.38 MT/ha, individually (Anonymous, 2017) [1].

Insect pests are the principle bottleneck in development of this yield. In general, the overall damage due to insect pests accounts to 48.97% loss in fruit yield (Subbireddy *et al.*, 2018) [8]. In case of sucking pests jassids, *Amarasca biguttula biguttula* (Hemiptera: Cicadellidae) attacked during both nymph and adult life stages on the undersurface of leaves by sucking the cell sap. During feeding they inject venomous saliva into plant tissues and attacked leaves turning yellow, twist downwards, desiccated and fall down. Aphids, *A. gossypii* (Hemiptera: Aphididae) are infrequently considered as a major pest of okra. The nymph and adult are found in enormous numbers and they suck the sap from different parts of the plants. Profoundly infested leaves become yellow, get twisted, distorted and dried up causing serious reduction in yield. It likewise help in developing sooty mould on the leaves by emitting honey dew which adversely influences the cycle of photosynthesis. Whiteflies, *Bemisia tabaci* (Hemiptera: Aleyrodidae) nymph and adult likewise suck the cell sap from the leaves. The affected leaves are curled and dried. The affected plants show an undersized growth.

The current investigation depends on the assessment of efficacy of some advanced insecticides for example Afidopyropen, Abamectin, Tolfenpyrad, Spirotetramat, and Imidacloprid. The method of activity of this various insecticides are unique. A major advantage of these new products is that they works as one shot solution for more than one target pests also reducing the cost of crop protection. The current examination will be undertaken with the accompanying objectives to evaluate the efficacy of advanced insecticides against jassid and aphid pests of okra.

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Bio-efficacy of Seed Priming with Fungicides against major Soil Borne Diseases of Maize

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ABSTRACT

Field experiments were conducted to evaluate the bio-efficacy of fungicides (Carbendazim 25% + Mancozeb 50% WS, Carbendazim 50 WP, Mancozeb 75 WP and Carboxin 37.5% + Thiram 37.5% WS) against the seed rot and seedling blight of maize at Research Farm, Zonal Agricultural Research Station, Jhabua (MP). All the fungicides were found significantly effective against the seed rot and seedling blight compared to control. The maximum seed germination (86.98 and 86.32% in kharif and rabi, respectively), shoot length (32.76 and 38.30 cm in kharif and rabi, respectively), root length (4.79 and 5.12 cm in kharif and rabi, respectively) and seedling vigour index (3254.8 in kharif and 3748.0 in rabi) were recorded on Carbendazim 25% + Mancozeb 50% WS @ 35 g/kg seeds (T_3) followed by Carbendazim 25% + Mancozeb 50% WS @ 3.0 g/kg seeds (T_2). While the lowest values of these parameters were in control. Similarly, lowest % disease incidences of seed rot (9.08 and 8.0% in respective seasons) and seedling blight (5.81 and 4.11%) was recorded with Carbendazim 25% + Mancozeb 50% WS @ 35 g/kg seeds followed by Carbendazim 25% + Mancozeb 50% WS @ 30 g/kg seeds. Yield attributes, yields and economics of maize also significantly influenced by various fungicides. Significantly higher grain yield of 2795 kg/ha and stover yield of 3860 kg/ha was recorded in Carbendazim 25% + Mancozeb 50% WS @ 35 g/kg seeds and which was on par with Carbendazim 25% + Mancozeb 50% WS @ 30 g/kg seeds. Maximum gross returns of Rs. 47914, net returns of Rs. 36615 and B:C ratio of 2.60 were also recorded with the seed priming with Carbendazim 25% + Mancozeb 50% WS @ 35 g/kg seeds.

KEYWORDS

Maize, Seed rot, Seedling blight, Yields, Carbendazim, Mancozeb

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INTRODUCTION

Maize (*Zea mays* L.) was introduced to India from America at the beginning of 17th century (Singh *et al*, 2018). Its ranks third as a food-grain crop after wheat and rice and it is not only as a cereal but also as vegetable, fodder crop and industrial crops (Singh *et al*, 2017) and (Kumawat *et al*, 2020) . It is called as queen of the cereals because highest productivity among the cereal crops (Kumar *et al*, 2017). Madhya Pradesh is the second major maize producing states among the country (Kumawat *et al*, 2019). In India, kharif maize is cultivated in 7.47 Mha with production of 17.85 Mt and productivity of 2391 kg/ha. While in rabi, it is cultivated in 1.75 Mha with production of 7.28 Mt and productivity of 4164 kg/ha. The Karnataka is the leading state which covered 3.73 Mt followed by Madhya Pradesh with production of 3.68 Mt (Anonymous, 2018). Wet and cool soil temperature (less than 50 to 55^0 F) can delay seed germination and emergence and predispose maize seedling to disease. Seedling become more vulnerable to infection the longer a seed is in the ground before emergence and the more stress germinating corn endures. When soil conditions are favourable for germination and used a broad-spectrum fungicides seed treatment can minimize the risk of seeding diseases of maize. In field conditions diagnosis of seedling diseases can be difficult because multiple pathogens are often involved and symptoms can appear similar. Several common soil borne fungi such as Fusarium, Penicillium, Pythium and Rhizoctonia are often isolated from infected seedings and roots of maize (Anonymous, 2015) . Seed treatment with fungicides protect the seed from infection by seed borne and soil borne pathogens, enables the seed to germinate and establish as a healthy seedling (Henis and Chet, 1975) and (Windels, 1981). Seed treatment is therefore a routine practice to ensure good emergence and better crop stand (Nene and Thapliyal, 1979) and (Ramos and Ribeiro, 1993).

MATERIALS AND METHODS

The field experiment as carried out during kharif 2017 and rabi 2017-18 at Research Farm, Zonal Agricultural Research Station, Jhabua to identify suitable fungicides for the control of soil borne diseases of maize under Jhabua Hill of Madhya Pradesh. The maize cultivar JVM-421 was sown in randomized block design with a spacing of 60 x 25 cm with three replications the details of the treatments given in Table 1.

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Genetic diversity and phylogeography of mungbean yellow mosaic India virus in Central India

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ABSTRACT

Mungbean yellow mosaic India virus (MYMIV) is widely prevalent in Central India and threatens many food legumes, including soybean, mungbean and blackgram. Three isolates of MYMIV from the state of Madhya Pradesh, India were fully anlayzed on the basis of their sequences; two genomic components of the virus, DNA-A and DNA-B, eoncoded seven and two genes, respectively, and showed general features in the intergenic region. Phylogenetic analyses of a number of MYMIV isolates classified them into three general groups and virus map location illustrated that MYMIV has been differentiated on the basis of geographical distribution in the Indian subcontinent.

Key words: Begomovirus, Central India, Geographical distribution, Legumes, MYMIV

INTRODUCTION

Food legumes such as soybean, mungbean and blackgram are important agricultural crops in India as well as in other countries of the world. Within India, the state of Madhya Pradesh (MP) produces 50 % of soybean grains in *Kharif* (rainy) season (June-September) (SOPA 2016). However, large quantity of economic losses are estimated for grain legumes by infection of viruses in India (Varma and Malathi 2003; Wrather *et al.* 1997). The most serious virus disease in soybean in MP is yellow mosaic disease (YMD), which is caused by begomoviruses belongs to the family *Geminiviridae*.

Geminiviruses possess circular single-stranded DNA genome packed in twinned particles, and are divided into nine genera, *Becurtovirus*, *Begomovirus*, *Capulavirus*, *Curtovirus*, *Eragrovirus*, *Grablovirus*, *Mastrevirus*, *Topocuvirus* and *Turncurtovirus*, collectively composed of more than 360 species (ICTV 2016; Zerbini *et al.* 2017). The genus *Begomovirus* currently includes more than 320 species (Zerbini *et al.* 2017) and is the largest genus among plant viruses with respect to the number of species included (Brown *et al.* 2015). Begomoviruses are transmitted by whitefly *Bemisia tabaci* (Ansari *et al.* 2017; Navas-Castillo *et al.* 2011; Varma *et al.* 2011). Most begomoviruses are monopartite, having DNA-A and often associated with beta satellite DNA (Zhou 2013). In contrast, some begomoviruses have bipartite genomes, which are referred to as DNA-A and DNA-B. Each of the twinned virus particles possesses one of the genome components. Therefore, two virus particles, each containing a different genome component (DNA-A or DNA-B), are usually required for successful infection (Brown *et al.* 2015).

Legume crops showing symptoms of YMD include soybean (*Glycine max*), mungbean (*Vigna radiata*), blackgram (*V. mungo*), pigeonpea (*Cajanus cajan*), mothbean (*V. aconitifolia*) and common bean (*Phaseolus vulgaris*) (John *et al.* 2008). Four species of begomoviruses have been reported to cause YMD in legume crops in India, i.e.,Mungbean yellow mosaic virus (MYMV), Mungbean yellow mosaic India virus (MYMIV), *Dolichos* yellow mosaic virus (DoYMV) and Horsegram yellow mosaic virus (HgYMV) (Haq *et al.* 2011; John *et al.* 2008; Qazi *et al.* 2007). These viruses have bipartite genomes and are refered as legume yellow mosaic viruses (LYMVs). The former two species, MYMV and MYMIV, are most prevalent (Borah and Dasgupta, 2012) and MYMIV is widely found in legume plants in India (Naimuddin *et al.* 2011a; Naimuddin *et al.* 2011 b; Reddy *et al.* 2015).

The present study was undertaken aiming at molecular characterization of MYMIV collected from legume plants in Madhya Pradesh and also to see the geographical differentiation of MYMIV in Indian subcontinent.

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Delineation of genotype-by-environment interactions for identification and validation of resistant genotypes in chickpea to *fusarium* wilt using GGE biplot

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ABSTRACT

Fusarium wilt, caused by *Fusarium oxysporum* f. sp. *ciceris*, is a major constraint to chickpea (*Cicer arietinum* L.) production and breeding for resistant cultivars is one of the most practical and economical strategies for managing this disease. The present study assesses elite chickpea breeding lines for *Fusarium* wilt resistance through multi-location evaluation in field sick plots over two years in India. The effects of genotype, environment and GE interaction for wilt incidence were highly significant with maximum variation caused by GE effect (82.09%) followed by genotype (11.16%) and environment effect (6.38%). GGE biplot analysis revealed that Rahuri and Indore locations were most discriminating locations and could differentiate the wilt resistant and susceptible chickpea genotypes while Dholi and Kanpur locations were least discriminating. Durgapura location was the most representative of average environment followed by Sehore while Rahuri and Indore locations were least representative. The genotypes GJG 0904, GJG 0906, GJG 1010, GJG 0814, GJG 0922, JAKI 9218 and GJG 1001 possessed high level of multiple race resistance against *Fusarium* wilt pathogen and can be exploited for disease resistance breeding in chickpea.

1. Introduction

Chickpea (*Cicer arietinum* L.) is the most important pulse crop in India accounting for 32.64% (11.90 million ha) of pulse acreage and 44.79% (11.38 million tonnes) of total pulse production in the country ( ). The average yield of chickpea in India is only 956 kg/ha which is much below its potential yield ( ). Many factors contribute towards reducing the productivity including rainfed cultivation on poor soil, inadequate application of nutrients, narrow genetic base (;) and various biotic and abiotic stresses affecting crop yield ( ). Among biotic stresses, Fusarium wilt caused by *Fusarium oxysporum* f. sp. *ciceris* is the most serious problem in almost all chickpea growing areas of India. The disease is prevalent in the Indian subcontinent, West Asia, Africa, Southern Europe and the North American countries (; ,). The average annual losses to Fusarium wilt have been estimated to be 10–30% which may escalate to 90–100% depending upon varietal susceptibility and high soil temperature (>25 °C) (; ; ,). The mode of action of the pathogen involves entering the host through roots and blocking the vascular vessel thereby resulting in progressive yellowing, wilting and

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Influence of Different Sources of Plant Nutrients on Soil Fertility, Nutrient Uptake and Productivity of Soybean under Vertisols

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ABSTRACT

A field experiment was conducted at College of Agriculture (RVSKVV), Indore during *kharif* 2013 to study the effect of different sources of plant nutrients on productivity, profitability nutrient uptake and soil fertility of soybean in relation to eight nutrient management treatments (T_1: RDF- recommended dose of fertilizer (N:P:K:S @ 30:60:30:30 kg/ha), T_2: RDF + *Rhizobium* + PSB (20 g/kg seed), T_3: RDF + 50 kg $ZnSO_4$/ha + *Rhizobium* + PSB, T_4: RDF + 1 g $(NH_4)_2MoO_4$/kg seed + *Rhizobium* + PSB, T_5: RDF + 5 kg Borax/ha + *Rhizobium* + PSB, T_6: RDF + 10 kg $FeSO_4$/ha + *Rhizobium* + PSB, T_7: RDF + 25 kg $MnSO_4$/ha + *Rhizobium* + PSB and T_8: RDF + FYM 5 t/ha + *Rhizobium* + PSB.). Highest seed yield (844 kg/ha) was obtained under T_4, which was at par with T_8. The maximum gross returns (` 36,376/ha), net returns (` 20,132/ha), B:C ratio (2.24), production efficiency (7.47 kg/ha/day) and economic efficiency (` 178.16/ha) was also recorded under T_4 treatment. Significantly higher nutrient uptake (52.50 and 22.79 kg N, 3.28 and 6.0 kg P, 17.84 and 24.79 kg K, 85.83 and 382.55 g Fe, 67.50 and 313.02 g Mn and 0.27 and 3.96 g Mo/ha by seed and stover, respectively) were obtained under T_4. However, the highest uptake of Zn (41.39 and 40.55 g/ha by seed and stover, respectively) was recorded in T_3 followed by T_8. While the significantly higher uptake of B by seed and stover (24.17 and 40.80 g/ha) was recorded with the application of RDF + 5 kg Borax/ha + *Rhizobium* + PSB. Application of RDF + FYM 5 t/ha + *Rhizobium* + PSB (T_8) significantly enhanced the available organic carbon (0.40%), N (174.0 kg/ha) and P_2O_5 (18.67 kg/ha) which was at par with T_4. Higher Fe content in soil (4.81 mg/kg soil) was noted with T_6, while maximum Mn (2.0 mg/kg soil) was found under T_7. Maximum Zn content (0.56 mg/kg soil) was found with the application of T_3, whereas, the maximum Mo content (0.048 mg/kg soil) was recorded in T_4.

Key words: Economics, FYM, Micronutrients, Nutrient uptake, RDF, Seed yield, Soil fertility.

INTRODUCTION

Soybean [*Glycine max* (L.) Merill] is also known as a 'Miracle crop'. It is the world's foremost provider of protein and oil. It also contains valuable oil, which is perhaps exceptional in pulse crops. Madhya Pradesh has its major share in area and production of soybean in India (>60%) and hence designated as Soya-state. In India soybean is grown in 11.60 Mha with total production of 8.57 million tonnes. In Madhya Pradesh it is grown in 5.40 m ha with annual production of 5.51 mt (Morya *et al.*, 2018 and Tomar *et al.*, 2018). One component of seed quality is chemical composition, such as concentration of mineral elements, including micronutrients such as Zn, Fe, Mo, B, Mn and Zn have several important role in plant nutrition *viz.*, enzyme activation, protection of bio-membranes, hormones metabolism and other functions. Boron plays an important role in development and growth of new cells in plant meristem. Mn is also an essential component of the major enzyme nitrate-reductase in plant. Iron plays an important role in nitrogen fixation and photosynthesis. Molybdenum plays an important role in nitrogen fixation. Bioinoculants have promising effect on nutrient availability and nitrogen fixation. Rosas *et al.* (2002) reported that combined inoculation of soybean by symbiotic bacteria of soybean and phosphate solubilizing bacteria improved dry weight of soybean. The use of FYM helps in maintaining soil productivity by improving the soil structure. It also keep control on soil pH, thus help in maintaining the availability of plant nutrients. Like other leguminous crops, requirement of nitrogen is substantially fulfilled from symbiotic nitrogen fixation through *Rhizobium i.e.* 125-150 kg N/ha is utilized and leaves about 30-40 kg N/ha for the succeeding crop (Saxena and Chandel, 1992). Crop fertilization can be achieved by using integration of chemical, organic and biofertilizers fertilizers. Most of the chemical fertilizers are composed of a combination of nitrogen, phosphorus and potassium. Organic fertilizers include compost, green manure, grass clippings or decaying leaves and biofertilizers. Hence, a balanced nutrients supply is must to harness the productivity of the crops. Intensively cultivated

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Article

Translational Chickpea Genomics Consortium to Accelerate Genetic Gains in Chickpea (*Cicer arietinum* L.)

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Abstract: The Translational Chickpea Genomics Consortium (TCGC) was set up to increase the production and productivity of chickpea (*Cicer arietinum* L.). It represents research institutes from six major chickpea growing states (Madhya Pradesh, Maharashtra, Andhra Pradesh, Telangana, Karnataka and Uttar Pradesh) of India. The TCGC team has been engaged in deploying modern genomics approaches in breeding and popularizing improved varieties in farmers' fields across the states. Using marker-assisted backcrossing, introgression lines with enhanced drought tolerance and fusarium wilt resistance have been developed in the genetic background of 10 elite varieties of chickpea. Multi-location evaluation of 100 improved lines (70 desi and 30 kabuli) during 2016–2017 and 2018–2019 enabled the identification of top performing desi and kabuli lines. In total, 909 Farmer Participatory Varietal Selection trials were conducted in 158 villages in 16 districts of the five states, during 2017–2018, 2018–2019, and 2019–2020, involving 16 improved varieties. New molecular breeding lines developed in different genetic backgrounds are potential candidates for national trials under the ICAR-All India Coordinated Research Project on Chickpea. The comprehensive efforts of TCGC resulted in the development and adoption of high-yielding varieties that will increase chickpea productivity and the profitability of chickpea growing farmers.

Keywords: chickpea; marker assisted backcross; farmer participatory varietal selection; multi-location trials; drought; Fusarium wilt

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Newly Developed Modified Banana Peel Jeewamrit based Vermicomposting Method.

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Vermicomposting Concept:

"Modified Banana Peel Jeewamrit based Vermicomposting is a method in which the earthworms and Banana Peel based Jeewamrit used to convert the raw organic waste/farm weeds biomass into vermicompost rich in high CEC , beneficial microfloral population and nutritional elements.

What is modified Banana Peel Jeewamrit based?

Modified Banana Peel Jeewamrit based vermicompost is the scientific method of preparation of vermi compost by using earthworms, Banana Peel based Jeewamrit. Earthworms are added together with Banana Peel based Jeewamrit rich in mineral nutrients and beneficial microfloral populations, earthworms feed biomass and excreting it in a digested form. Modified Banana Peel based Jeewamrit vermicomposting means "Quick worm farming". Earthworms depend feed on the raw un decomposed organic waste materials and give out excreta in the form of "vermicast" which are rich in nitrogen and other minerals such as phosphorus, Potassium, magnesium, Calcium & Sulfur. It also contains micronutrients, hormones, enzymes, and some beneficial bacteria, actinomycetes, fungi and protozoans etc.for boosting its chemical composition which increases the soil fertility when incorporated in the arable fields and thus enhhanced the soil health and it's quality.This is prepared from farm residues based vermicompost. Its chemical composition is variable depending upon the types of raw organic farm based vegetative biomass which are used.

Modified Vermicomposting comprises two methods:

- **Bed Method:** This is an easy method in which beds of using crop weeds,vegetable residues and ,animal wastes are put in a bed (Bed size 60 feet long × 08 feet wide × 03 feet high) to get good quality vermicompost. •
- **Pit Method:** In this method, the raw organic materials are• collected in cemented pits. However, this method is not prominent as it involves problems of poor aeration and waterlogging.

Process of Modified Vermicomposting:

The entire process of Modified Vermicomposting is given below:

Aim:

To prepare good quality vermicompost using modified Banana Peel based Jeewamrit together with raw organic farm based vegetative biomass.

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EFFECT OF JEEWAMRIT FORTIFIED WITH BANANA PEEL, SLACKED LIME AND BIOFERTILIZERS ON YIELD, ECONOMICS AND MICROBIAL ACTIVITIES UNDER SOYBEAN CROPPING IN VERTISOL.

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ABSTRACT

A field experiment was conducted during kharif season of 2018 and 2019 at the Research Farm, RAK College of Agriculture, Sehore (M.P.) India to study the effect of jeewamrit fortified with slacked lime and biofertilizers on yield, economics and microbial activities under soybean cropping. The treatment T_7 (50 % RDF + *Rhizobium* + PSB @ 4 kg ha^{-1} soil + application + Jeewamrit @ 500 liter ha 30 DAS + Slacked lime @ 25 kg ha^{-1} exerted the maximum seed yield (13.09 q/ha) of soybean which was found at par with the treatment T_6 (12.38) and then T_5 (11.98 q/ha). The application of 50 % RDF + Rhizobium + PSB @ 4 kg/ha + Jeewamrit @ 500 liter/ha + Slacked lime @ 25 kg/ha 26702/ha) with 2.14 B:C ratio. It was followed by the application of 50 % RDF + Jeewamrit @ 500 liter ha^{-1} + Slacked lime @ 25 kg ha^{-1} (T_6) Rs. (24393 /ha with 2.06 B:C ratio and then T_5 (50 % RDF + Rhizobium + PSB @ 4 kg ha^{-1} + Slacked lime @ 25 kg ha^{-1}) Rs. 32458 /ha with 2.05 BC ratio. The highest population of Bacteria (8.55 CFU x 10^6 gm^{-1} soil) and fungi (6.45 CFU x 10^4 gm^{-1} soil) were observed under treatment T_7, followed by T_6 and then T_5 treatments. The significant and highest f DH activity (78.0 TPE μg 24 hr^{-1} g^{-1}) was found under treatment T_7, followed by treatment T_6 (75.33 TPF μg 24 hr^{-1} g^{-1}) and then T_5 (71.60 TPF μg 24 hr^{-1} g^{-1}). The minimum DH activity was in T_1 (59.33 TPF μg 24 hr^{-1} g^{-1}).

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Influence of herbicides on weed control efficiency and economics of Garlic (*Allium sativum* L.) production

DK Ahirwar, DK Raidas, SR Ramgiry and N Dohare

Abstract
A field experiment was conducted during *Rabi* season of (2017-18) to study the impact of herbicides on weed control efficiency and yield attributes in Garlic (*Allium sativu*m L.) at Fruit Research Station Intkhedi Bhopal, RAK College of Agriculture, Sehore (M.P.) The investigation was carried out to study the relative impact of cultural practices and herbicides on weed control in garlic production. The result of the present investigation indicated that, the population of monocot and dicot weeds recorded the least weed density (2.0, 3.0) in treatment two hand weeding at 30 and 60 days after sowing followed by application of Quizalofop ethyl 5% EC 40 g a.i. /ha+ one hand weeding (15.20) after 30 DAS and Oxyfluorfen 23.5% EC 250 g a.i. /ha + one hand weeding (18.12, 8.00) after 30 DAS at 30, 60 and 90 days after sowing. While the highest weed population density found in control plot (132, 125). The treatment two hand weeding at 30 and 60 DAS found maximum bulb yield (86.45) and thereafter it were received from Oxyfluorfen 23.5% EC 250 g a.i. ha^{-1} + one hand weeding after 30 days after sowing (84.33) as compre to control (25.62). The B:C ratio in treatment Oxyfluorfen 23.5% EC 250 g a.i. ha^{-1} + one hand weeding after 30 days after sowing (1:60) was recorded the highest net return of 469385 ₹ ha^{-1} as compare to two hand weeding at 30 and 60 DAS which has net return of ₹ 447963 ha^{-1}. However, Control plot (without hand weeding and without use of herbicides) recorded significantly lesser B: C ratio (1.20).

Keywords: Treatments, weed density, weed control efficiency, bulb yield, DAS, B: C ratio

Introduction
Garlic (*Allium sativum* L.) an herbaceous annual vegetable crop of family Alliaceae, is the second most valuable bulb crop after Onion crop an important spice crop cultivated in India since ancient time. China is the leading garlic producing country accounting for over 75% of world output followed by India, Egypt, Russia, Myanmar, Ethiopia and USA (FAO, 2010) [2]. The bulb comprises many pungent cloves. In India, Madhya Pradesh is the leading producer of garlic followed by Gujarat (Area, production and productivity of garlic in Jammu and Kashmir, 2011) [1]. Madhya Pradesh ranks second in garlic production grown in an area of 92.50 thousand hectares with production of 405.00 thousand MT and productivity of 4.38 tones $hectare^{-1}$. Indore, Ratlam, Neemuch, Shajapur, Ujjain and Sehore are the major garlic producing districts of Madhya Pradesh. Garlic grows to a height of one foot, competition of weeds start at the early growth stage of seedlings. Garlic is highly vulnerable to weed infestation due to its slow initial growth and shallow root system (Rahman *et al.*, 2012) [8]. The garlic is closely planted crop with very small canopy. Weeds are mostly managed by human labour, which is tedious time taking and expensive operation and often damages the crop (Sampat *et al.*, 2014) [9]. The weeds compete for the nutrients, moisture, space and light and finally affect growth and development. Weed reduces the bulb yield to the extent of 40-80% (Verma and Singh, 1996) [11] therefore, it is essential to keep the field weed free during the critical period of crop growth. As garlic is commercial crop, farmers invest more money through costly inputs like seed material, fertilizers, plant protection schedule and irrigation for achieving higher yield. Hence, the present investigation was carried out to test the efficacy of herbicides either as pre-emergence spray and post emergence with one hand weeding at 30 days after planting or with one more additional spray at 30 days after planting of cloves for weed management for obtaining better garlic bulb yield.

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Impact of Pre and Post Herbicides Treatments on Growth and Bulb Yield Parameters of Garlic (*Allium sativum* L.)

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ABSTRACT: Weeds are the most important biotic constraints to garlic production. Weed in garlic field are worldwide problem and losses due to weed were as high as 72.5%. The main problem for farmers in garlic cultivation is weed control, which occurs mainly during the vegetative growth stage of the crop. Since, labour availability to manual weeding and higher wages, it is necessary to have the strategy of conventional hand weeding and chemical control of weeds in appropriate time to attain target yield and economic benefit. In this view, field experiments were conducted at Fruit Research Station Intkhedi Bhopal, RAK College of Agriculture, Sehore (M.P.) during the *Rabi* season, 2017-18. The experiments were laid out in RBD and replicated thrice. The weed management options *viz*., pre and post emergence herbicide applications in different doses and time with conventional hand weeding. The trials were also compared with control plot (without hand weeding and without use of herbicides). Results indicated that the T_2 - Two hand weeding at 30 and 60 DAS recorded maximum value of plant height (cm), number of leaves plant^{-1} at 90 DAS and yield parameters viz. neck thickness (cm), clove diameter (cm), polar diameter (cm), equatorial diameter (cm), number of cloves bulb^{-1}, weight of 20 cloves (g), bulb yield (g plant^{-1}), bulb yield (86.45q ha^{-1}) at harvest and benefit cost ratio over the remaining various weed management practices followed by T_{10} Oxyfluorfen 23.5% EC 250g a.i. /ha + one hand weeding after 30 DAS and T_8 Oxadiargyl 80% WP 100g a.i. /ha +one hand weeding after 30 DAS as compare to control.

Keywords: plant height, number of leaves, weeds, neck thickness, clove diameter, bulb yield

INTRODUCTION

Garlic (*Allium sativum* L.) a herbaceous annual vegetable crop of family Alliaceae, is the second most valuable bulb crop after Onion crop. Garlic usable since ancient times and is believed to be native to Central Asia and Northeastern Iran. India ranks second in the cultivation and production of garlic in the world. It is cultivated in an area of 301.700 thousand hectares and production of 1717.900 thousand million tons with productivity of 5.69 tons ha^{-1}. Madhya Pradesh ranks second in garlic production grown in an area of 92.50 thousand hectares with production of 405.00 thousand MT and productivity of 4.38 tones hectare^{-1}. Indore, Ratlam, Neemuch, Shajapur, Ujjain and Sehore are the major garlic producing districts of Madhya Pradesh. Garlic is the most important as a spice crop which contains vitamin C (31 mg), calcium (181 mg), phosphorus (153 mg), calories (149 Kcal), sulphur (70 mg), manganese (1672 mg) and lysine (0.273 g) of edible portion (Mardomi, 2017). Further it is used in the treatment of many diseases like hypertension, diabetes, cancer, scabies and itching (Kilgori *et al*., 2007). Weed infestation in garlic is one of the major factors for loss in yield and bulb loss to the tune of 30-60%. Weed reduces the bulb yield to the extent of 40 to 80% (Verma and Singh, 1996). In garlic shallow root system make mechanical method of weed control difficult and sometimes causes damage to developing bulbs (Lawande *et al*., 2009). The main problem for farmers in garlic cultivation is weed control, which occurs mainly during the vegetative growth stage of the crop (Mohite *et al.*, 2015). Hence, weed control at their

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Impact of Bio fertilizers on Growth and Yield Attributes of Onion (*Allium cepa* L.) var. AFLR

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The experiment was carried out at the Horticulture Research Farm, R.A.K college of Agriculture, Sehore (M.P.), India during rabi 2019-2020 and the experiment was laid out in the randomized block design with ten treatments. Among various treatments of onion, it was observed that the plant height was significantly increased in various growth stage (30, 45, 60 and 90 DAT). Plant height of treatment T_8 (Vc + *Azospirillum* (1/3 dose) + *VAM* (1/3dose) + PSB (1/3 dose) was found significantly superior at 30 DAT (29.27cm), 45 DAT (38.37cm), 60 DAT (45.63cm) and 90 DAT (66.80cm) while Treatment T_1 (control) performed poorly. Regarding the number of leaves per plant in various growth stages treatment T_8 again found significantly superior due to heavy vegetative growth as compared to T_9T_{10} and $T_{7.}$ However, lowest number of leaves per plant found were noticed in T_1 (control) and the minimum number of bolted plant per plot and bolting percentage was found in $T_8$and in relation to yield parameters satisfactory maximum bulb yield per plot and per hectare yield q/ha was recorded again in treatment T_8 (11.40) and (301.58) respectively in this experiment overall treatment t8 is found superior in all stages

Introduction

Onion (*Allium cepa* L.*)* is one of the most important and famous commercial vegetable crop grown all over the world also in India. It belongs to family Amaryllidaceae and commonly known as "*pyaj*" in Hindi. The crop is native of Asia (Jones and Mann, 1963). It is hardy bulbous and winter plant grown as annual for bulb production and biennial for seed production. Now a day's no one dish is completed without onion and it is widely used throughout the year as salad, culinary purpose for flavoring as spices in pickles, sauce and vegetable. It occupies an important position among all the vegetable crops in kitchen garden as well as commercial production and plays a vital role in Indian economy.

Onion is an immense potential crop being part of medicinal value and hence, useful in fever, dropsy and chronic bronchitis. it is consumed as a vegetable and condiment. The green leaves, immature and matured bulbs are eaten raw or used in vegetable preparations.

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Genetic Analysis for Agro-Physiological Characters of Pigeonpea [*Cajanus cajan* (L.) Millsp.] under Rainfed Condition

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Abstract

The present investigation was carried out during kharif 2017-2018 in randomized complete block design with three replications on sixteen genotypes to get the estimate of genetic variability, correlation coefficient and path analysis for sixteen characters including yield attributing and physiological traits, Analysis of variance exhibited significant differences among genotypes for all the characters. The elevated estimates of heritability coupled with elevated genetic advance as per cent of mean were recorded for seed yield per plant, number of seeds per pod, biological yield per plant, number of seeds per plant, number of secondary branches per plant, number of primary branches per plant, harvest index and number of pods per plant indicated that these characters were controlled by additive gene action and direct selection for these traits would be more effective for desired genetic improvement. Seed yield per plant showed positive association with number of seeds per plant, biological yield per plant, number of seeds per pod, days to 50 % podding, harvest index, number of pods per plant, 100-seed weight, number of primary branches per plant and plant height indicated that direct selection for these traits may lead to increase in genetic potential of seed yield. Path coefficient analysis revealed that traits viz., biological yield per plant, harvest index, number of seeds per plant and number of pods per plant exhibited highest positive direct effect and some traits have indirect positive effects on seed yield and these traits must be given preference while selecting the superior genotypes.

Key words : *Agro-physiological characters, correlation, genetic advance, heritability, direct and indirect effect, pigeonpea, rainfed condition.*

Introduction

Pigeonpea [*Cajanus cajan* (L.) Millsp.] is an often cross pollinated crop with 2n=2x=22 chromosomes belongs to the family Leguminosae. India is considered as the centre of origin of pigeonpea (Van der Maesen, 1990). Pigeonpea is a deep rooted and drought-tolerant leguminous food crop. It can grow in any warm climate; particularly throughout tropical and subtropical regions. It is highly proteinaceous and its seed contains 62.78 g. carbohydrates, 21.7 g. proteins and 1.49 g. fats per 100 grams (Techale et al. 2013). In India, pigeonpea has been grown on 4.2 million ha area with 3.68 million tons production and 832 kg per ha productivity, whereas in Madhya Pradesh it has been grown 6.47 lakh ha area with 8.07 lakh tons production and 1247 kg per ha productivity (Anonymous 2018-19).

The identification and development of drought tolerant genotypes due to extrinsic properties to withstand drought conditions has attracted the attention of scientists at globally to select appropriate genotypes that are insensitive to environmental fluctuations and can contribute sustainable yield. A clear understanding of variability in various quantitative characters existing in the breeding material helps plant breeder in selecting superior genotypes on the basis of different genetic parameters. Therefore, it is necessary to estimate the relative amount of genetic and non-genetic variability exhibited by the characters under study. Estimation of genetic variability including heritability estimates and expected genetic advance for the particular character and correlation between these characters with the aim that some components which are less susceptible to environmental vagaries may provide more efficient basis of selection. The seed yield is not an independent character; it is a complex in nature and depends on the number of component characters that are quantitatively inherited (Rao and Rao, 2020). Thus, the selection pressure given only on the yield is misguided many times. The knowledge on the nature of association of the yield and its attributes enable a plant breeder to plan an effective breeding programme (Rao and Rao, 2020). Keeping this in consideration, the present investigation was undertaken to elucidate the nature and extent of genetic variability including heritability, genetic advance and to identify the seed yield influencing characters of pigeonpea.

Materials and Methods

The experimental material for present investigation consisted of sixteen genotypes of pigeonpea which was laid out in a randomized complete block design (RCBD)

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Epidemiological Studies of Leaf Spot of Pigeonpea [*Cajanus cajan* (L.) Millsp.] Caused by *Cercospora cajani*

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Keywords

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A B S T R A C T

Cercospora leaf spot caused by *Cercospora cajani Henningsis* one of the most important fungal diseases of Pigeon pea [*Cajanus cajan (L.)* Millsp.]. Epidemiology of *Cercospora cajani* of pigeon pea. The correlation studies between individual parameters and CLS intensity was carried out and the data are summarized in which reveals that maximum temperature (-0.06089) showed correlation coefficient with the disease intensity. This non significant and negative correlation indicates that the disease incidence increased with decrease in maximum temperature. On the other hand minimum temperature (-0.86547*), average maximum relative humidity (-0.82866*), total rainfall (-0.75349*) and number of total rainy days (-0.79524*) showed negative correlation coefficient with the disease intensity which clearly indicates that the disease increased with the decrease in average relative humidity, average minimum relative humidity, total rainfall.

Introduction

Pigeonpea [*Cajanus cajan* (L.) Millsp.] is an important grain legume crop of rainfed agriculture in the semi-arid tropics. Besides Indian sub-continent, it is widely grown in Eastern Africa and Central America. It is not only an important source of protein, but also plays an important role in atmospheric nitrogen fixation into soil (Reddy *et al.*, 2012). Globally pigeon pea is cultivated in about on 4.7 million ha area with 3.69 million tonnes annual production. India accounts 78% of the global output with current production of 2.78 million tonnes from 3.5 million ha. In Madhya Pradesh Pigeon pea is grown in about 0.57 million ha with an annual production of 0.57 million tonnes. The average yield of Pigeon pea in M.P. is 848 kg/ha which is much larger than the potential yield of crop (1500-2000 kg/ha). Several biotic and abiotic factors are responsible for reducing the yield

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Effect of Waterlogging Condition on Growth, Physiology and Yield Characteristics of Soyb Genotypes (*Glycine max*(L.) Merrill)

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Abstract

Waterlogging is one of the environmental stresses that affect the growth, physiology and yield attributes injured due to the anaerobic environment. The objective o investigation was to study the variation in growth, physiological and yield characteristics in soybean genotypes/varieties. Atotal of 25 soybean genotypes/varieties complete randomized block design with three replications having 5 rows 40 cm apart with 3 meter row length of every genotype. Water logging was created at20 D 60 DAS in event of no rains after planting by applying water level about 5 cm above the soil surface. The mean data of the all characters viz. plant height, number number of nodules/plant, dry weight of nodules/plant, ascent of sap in (%), transpiration rate in (mmolH_2O m^{-2} s^{-1}), harvest index (%) and yield (q/ha.) were compu analysis. The results revealed that soybean could grow and produce grains even under water logging condition. The significantdifferences were observed among t major growth physiological and yield attributes except number of branches, number of nodules and ascent of sap. Further the result revealed that high magnitude plant height, dry weight of nodules, transpiration rate harvest index and yield per hectare were recorded in genotypes/varieties RVS2007-7, JS2069, RVS2007-1, 2059 as compared to control. Hence these genotypes/varieties were found suitable under waterlogged condition.

Keywords

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Effect of Different Plant Growth Hormones on Morpho-Physiological and Yield attributing Characteristics in Kalmegh (*Andrographis paniculata* Burn F. Ex)

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Andrographis paniculata, commonly known as Kalmegh, is used both in Ayurvedic and Unani system of medicines because of its immunological, antibacterial and hepatoprotective properties. It is an annual herb has high value compound used in the treatment of the various diseases. A field experiment was conducted at the research farm of RAK College of Agriculture, Sehore (Madhya Pradesh) during Kharif 2015 & 2016. Investigations undertaken aiming to increase the growth and yield parameters of Kalmegh. Using different Plant Growth Hormones Cycocel (100, 150 and 200 ppm), GA_3 (100, 150 and 200 ppm) and NAA (100 and 150 ppm) and water spray as control to study the effect of plant growth Hormones on Growth viz plant height (cm), leaf area (cm^2), chlorophyll content, photosynthesis rate (µmol CO_2 m^{-2} s^{-1}) at 90 DAS and yield viz test weight (g), seed yield (kg ha^{-1}), herbage yield(q ha^{-1}) and leaf alkaloid content (%) of kalmegh at harvesting. Foliar spray of GA_3 @ 150 ppm, GA_3 @ 100 ppm, cycocel@100ppm and GA_3 100ppm significantly maximum the plant height (47.33), leaf area (420.82), chlorophyll content (57.78) photosynthesis rate (24.78) during 2015-16 and spray with GA_3 @ 100 ppm, applies the maximum plant height (46.20) and leaf area (426.41) was significantly differed from other treatments during 2016-17. Significantly higher seed yield (521.03, 531.17), herbage yield (185.50 193.23) and leaf andrographolide alkaloid content (2.89, 3.02) was observed by treatment GA_3 @ 100 ppm during both the year respectively.

Introduction

Kalmegh (*Andrographis paniculata* Burn F. Ex) important medicinal plant belonging to the family Acanthaceae. Which is indigenous to India and has been used in Indian systems of medicines since time immemorial. The plant is also known as Rice bitters in West

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Chickpea (*Cicer arietinum* L.) as model legume for decoding the co-existence of *Pseudomonas fluorescens* and *Mesorhizobium* sp. as bio-fertilizer under diverse agro-climatic zones

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ABSTRACT

Microbial co-inoculation strategy utilizes a combination of microbes to stimulate plant growth concomitant with an increased phytopathogen tolerance. In the present study, 15 endophytic bacterial isolates from rhizosphere and roots of wild chickpea accessions (*Cicer pinnatifidum*, *C. judiacum*, *C. bijugum* and *C. reticulatum*) were characterized for morphological, biochemical and physiological traits. Two promising isolates were identified as *Pseudomonas fluorescens* strain LRE-2 (KR303708.1) and *Pseudomonas argentinensis* LPGPR-1 (JX239745.1) based on 16S rRNA gene sequencing. Biocompatibility of selected endophytes with *Mesorhizobium* sp. CH1233, a standard isolate used as a national check in All India Coordinated Research Project (AICRP) was assessed to develop functional combinations capable of producing Indole acetic acid, gibberellins, siderophores and improving seed vigour (*in vitro*). *In vivo* synergistic effect of promising combinations was further evaluated under national AICRP, (Chickpea) at two different agro-climatic zones [North-West plain (Ludhiana and Hisar) and Central zones (Sehore)] for three consecutive *Rabi* seasons (2015−18) to elucidate their effect on symbiotic, soil quality and yield parameters. On the pooled mean basis across locations over the years, combination of *Mrh*+LRE-2 significantly enhanced symbiotic, soil quality traits and grain yield over *Mrh* alone and highly positive correlation was obtained between the nodulation traits and grain yield. Superior B: C ratio (1.12) and additional income of Rs 6,505.18 ha^{-1} was obtained by application of *Mrh*+LRE-2 over *Mrh* alone and un-inoculated control. The results demonstrate that dual combination of *Mrh* and *Pseudomonas* sp. from wild *Cicer* relatives can be exploited as a potential bio-fertilizer for increasing soil fertility and improving chickpea productivity under sustainable agriculture.

1. Introduction

The agricultural system worldwide faces many constraints, including productivity losses and an inability to manage agro-economic sustainability. Extensive efforts of agriculturists across the globe are focused on providing sufficient food for the ever-growing world population of 9 billion, by 2050. Prasad et al. (2019) suggested that to feed the growing population, crop productivity needs to be uplifted by 70 %. However, the World Food Programme (WFP) has documented a statistically less boost in per hectare yield of crops as compared to the rising population. Food and Agriculture Organization (FAO) has assessed the present scenario of heavy greenhouse gas emissions and prevailing climate change as a factor leading to declined productivity of crops upto 50 % of the total produce (Šikanja, 2019). In the pursuit of improved crop yields, conventional agronomic practices, such as, inadvertent use of chemical inorganic fertilizers, have negatively impacted soil and human health, posing a serious threat to environment and agricultural sustainability. Hence, the focus has now shifted to investigating greener alternatives to conventional chemicals. Under present conditions, sustainability cannot be achieved without the intervention of the soil microbiome, which

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Assessment of Variability and Genetic Parameters in Agro-Physiological Traits of Chickpea (*Cicer arietinum* L.) under Rainfed Condition

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

An experiment was conducted during *rabi* season of 2017-18 to estimate the genetic parameters of variation including heritability and genetic advance for agro-physiological characters *viz.*, days to flower initiation, days to 50 *per cent* flowering, days to maturity, plant height, branches per plant, pods per plant, seeds per plant, biological yield per plant (g), seed yield per plant (g), 100-seed weight (g), root length (cm), relative water content and harvest index (%) in 20 genotypes of chickpea. High phenotypic coefficient of variance (PCV) and genotypic coefficient of variance (GCV) were observed for characters *viz*., number of branches per plant, seeds per plant and 100-seed weight. The magnitude of phenotypic coefficient of variance and their corresponding genotypic coefficient of variance for all the characters were observed in good agreement reflecting the narrow range of environmental influence in the manifestation of the characters. High heritability was

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A chickpea genetic variation map based on the sequencing of 3,366 genomes

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Zero hunger and good health could be realized by 2030 through effective conservation, characterization and utilization of germplasm resources[1]. So far, few chickpea (*Cicer arietinum*) germplasm accessions have been characterized at the genome sequence level[2]. Here we present a detailed map of variation in 3,171 cultivated and 195 wild accessions to provide publicly available resources for chickpea genomics research and breeding. We constructed a chickpea pan-genome to describe genomic diversity across cultivated chickpea and its wild progenitor accessions. A divergence tree using genes present in around 80% of individuals in one species allowed us to estimate the divergence of *Cicer* over the last 21 million years. Our analysis found chromosomal segments and genes that show signatures of selection during domestication, migration and improvement. The chromosomal locations of deleterious mutations responsible for limited genetic diversity and decreased fitness were identified in elite germplasm. We identified superior haplotypes for improvement-related traits in landraces that can be introgressed into elite breeding lines through haplotype-based breeding, and found targets for purging deleterious alleles through genomics-assisted breeding and/or gene editing. Finally, we propose three crop breeding strategies based on genomic prediction to enhance crop productivity for 16 traits while avoiding the erosion of genetic diversity through optimal contribution selection (OCS)-based pre-breeding. The predicted performance for 100-seed weight, an important yield-related trait, increased by up to 23% and 12% with OCS- and haplotype-based genomic approaches, respectively.

Pulses are an important crop commodity providing protein for human health. Worldwide pulse productivity has been stagnant for the last five decades, contributing to low per-capita availability of these foods and high levels of malnutrition in developing countries[3]. Chickpea (*Cicer arietinum* L.) production ranks third among pulses, and chickpea is cultivated in more than 50 countries, especially in South Asia and sub-Saharan Africa. As it is an important source of protein, dietary fibre and micronutrients, chickpea is key to nutritional security. More than 80,000 chickpea germplasm accessions are being conserved in 30 genebanks across the world[4], but only a few have been used for chickpea improvement[2].

Germplasm sequencing efforts in some crop plants have provided insights into the global distribution of genetic variation[5]; how this diversity has been shaped by the genetic bottlenecks associated with domestication[6] and by the effects of selective breeding[7]; and, finally, how we can link this genetic variation to phenotypic diversity[2] for breeding applications. Haplotype maps developed using whole-genome sequencing (WGS) data have helped to determine the percentage of the constrained genome and detect deleterious mutations that can be purged for accelerated breeding[8,9]. Furthermore, sequencing and genotyping of a germplasm collection allows better conservation and management in genebanks[5,10].

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RESEARCH ARTICLE

Assessment of molecular genetic diversity of 384 chickpea genotypes and development of core set of 192 genotypes for chickpea improvement programs

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Abstract *Cicer arietinum* L. (chickpea) is one of the most significant legume crops domesticated in the Fertile Crescent. This study was aimed to characterize a diverse composite set of 384 *Cicer* genotypes using unlinked simple sequence repeat (SSR) markers. The genotypes grown under the temperate conditions of Western-Himalayas included cultivated and wild relatives from primary (*Cicer reticulatum* Ladiz.), secondary (*Cicer echinospermum* P.H. Davis) and tertiary (*Cicer microphyllum* Benth.) gene pools. The analysis of genotypic data of eight SSR markers from eight linkage groups led to the identification of 63 alleles, ranging from 2 to 6 with an average value of 3.7 alleles per locus. The polymorphic information content of SSR markers ranged from 0.46 to 0.79 with an average value of 0.77 and the gene diversity ranged from 0.47 to 0.79 with an average of 0.64. The clustering of genotypes in the form of dendrogram discriminated all 384 genotypes into four major clusters. The wild genotypes belonging to different gene pools got clustered uniformly in different clusters along with cultivated chickpea genotypes. The analysis of data also led to the selection of core set of 192

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Effect of different post-harvest parameters on physiological and biochemical parameter of custard apple var. Arka Sahan

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Abstract
The custard apple (*Annona squamosa* L.) fruits were treated with different edible coating like chitosan (0.5%, 1.0% and 1.5%), benzyl adenine (50 ppm, 100 ppm and 150 ppm) and calcium chloride (2.0%, 4.0% and 6.0%) with or without combinations. After that fruits were stored at room temperature. The treated fruits were evaluated for physiological parameters (PLW and volume,) and biochemical parameters (Total Soluble Solids, total sugar, reducing and non reducing sugar and titrable acidity) during storage. The result concluded that the higher combination of treatments (Chitosan 1.5% + BA 150 ppm + $CaCl_2$ 6.0%) was found to be the best for enhanced the shelf life of fruit upto 12 days with good quality and appearance of fruits as compared to control.

Keywords: custard apple (*Annona squamosa* L.), chitosan, benzyl adenine, calcium chloride

Introduction
Custard apple (*Annona squamosa* L.) is one of the important tropical fruit crops belonging to the family Annonaceae which introduced in India from Tropical America. Fruit ripening nature of custard apple is climacteric i.e. sharp rise in respiration after harvest. Custard apple is very high perishable fruit crop with very short life of storage (Wills *et al*. 2001) [17]. The fruit is formed of loosely cohering carpels projecting to squamose or tuberculated surface. Seeds are black covered by white, creamy pulp which is sweet as well pleasant flavoured. (Mahadevbhai and Patel, 2018) [9]. The fruits contain vitamin C and minerals such as calcium, phosphorus and potassium. They are also an excellent source of carbohydrate base energy. Annonas are treated as table consumable fresh fruit because of high perishable in nature due to fruit could not be sent to distant market (Gutierrez *et al*. 1994) [4]. It is also necessary to develop a technology which enables to extend the sugar apple postharvest shelf life, reaching the consumer with good sensory qualities and available at compensatory prices. Among the different methods, fruit coatings are one such alternative as they do not only improve external appearance, but also modify the internal atmosphere of fruits (Trung *et al*. 2011) [16]. Among the different edible coating materials, Chitosan dissolved in diluted organic acids can be used as a casting fluid to form a preservative membranous coating on the fruits that have been successfully used to maintain the quality and shows antifungal activity against several fungi (Trung *et al*. 2011; Li and Yu, 2001) [16, 8], benzyl adenine (antioxidant) acts as antisenescent, stop the metabolic break down deterioration caused by various biochemical activities in the fruits (Bhardwaj *et al*. 2005) [2] and calcium chloride has found promising new technology in maintaining fruit quality during storage, which alternative to disinfestations of fruit and could modify its response to other stresses. (Netravati *et al*. 2018) [11]. An immediate consequence is a raise of the product's price. Hence, it is necessary to develop a technology which enables to extend the custard apple postharvest shelf life, reaching the consumer with good sensory qualities and available at compensatory prices by the application of edible coatings.

Materials and Methods
Custard apple fruits were obtained from a KVK of Chittorgarh, Rajasthan. The full matured fruits were subjected to manual sorting and used for experiment in the laboratory of department of fruit science, college of horticulture in Mandsaur, in plastic crates. The fruits were cleaned with running tap water to remove the adherent dirt material and then spread in room. The fruits were disinfected with 0.1% (w/v) bavistin solution for 2 minutes then fruits were dipped in the coating solutions of chitosan (0.5%, 1.0% and 1.5%), BA (50 ppm, 100 ppm and 150 ppm) and $CaCl_2$ (2.0%, 4.0% and 6.0%), singly or with combinations of treatments. After applications of treatments fruits were kept in the room temperature in plastic

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Responses of organic manures and inorganic fertilizers on growth, yield and economics of turmeric (*Curcuma longa* Linn.)

OK Chandravanshi, KC Meena, K Alam Khan, Nitin Soni and DK Patidar

Abstract
Experiment was carried out at the College of Horticulture, R.V.S.K.V.V., Mandsaur, M.P. during 2019-2020 in RBD design with three replications. All the parameters significantly influenced with the application of organic manures and inorganic fertilizers. However, the maximum leaf area (520.91, 790.35, 919.20, 1314.28 and 859.98 cm plant^{-1}), LAI (0.583, 0.733, 0.966 and 0.966), LAD (19668.90, 24743.20, 32602.15 and 32613.90 cm^2 day^{-1}) were registered under in RDF 50% + VC 100% at different growth stages, CRG in RDF 50% + VC 100% (0.00185) at 60-90 DAS, in RDF 75% + VC 75% (0.00204) at 90-120 DAS, in RDF 100% + FYM 50% (0.00238) at 120-150 DAS and in FYM 25% + VC 25% + NC 25% (0.00253) at 150 DAS - at harvest. Wherever, the maximum RGR in RDF 100% + NC 50% (0.0776) at 60-90 DAS, in RDF 75% + VC 75% (0.0187) (0.0279) at 90-120 DAS and at 120-150 DAS, FYM 25% + VC 25% + NC 25% (0.01804) at 150-at harvest. However, RDF 50% + VC 100% was registered the highest fresh rhizomes yield (332.237 g plant^{-1}) and chlorophyll content (72.83). The highest net return (Rs. 431546.00) and benefit: cost ratio (4.31:1) was obtained from RDF 50% + VC 100%. All the weather data were shown significant sign with most of the parameters, resulted in a better physiological functioning which contributed to higher growth and yield in turmeric.

Keywords: *Curcuma longa* L., organic manure, inorganic fertilizers, correlations, CGR and RGR

Introduction
Turmeric (*Curcuma longa* L.) belongs to the Zingiberaceae family and is an important spice. It is known as the "Indian saffron" and is generally referred to as the golden spice of life. The history of medicinal uses of this spice is very long. For so long, India has held the most important role in the global turmeric trade. It is used to cleanse blood, destroy germs, protect the liver and eliminate digestive disorders. It is being used for stomach diseases, blood purification, eliminate germs, liver protection and cholesterol level reduction [1]. An underground turmeric rhizome that results in primary and secondary rhizomes known as fingers and also known as daughter rhizomes. Turmeric is cultivated at temperatures ranging from 20 °C to 35 °C in both tropical and subtropical areas, but is susceptible to low atmospheric temperatures. Organic farming implies substantial ecological production and efficiency progression of turmeric worldwide. It has great role in soil structure refinement, fertility and better water holding ability for improved turmeric rhizomatous growth and production [2, 3]. Organic manures rapidly increase the activity of soil microbial biomass and play an important role in the transfer of plant nutrients from inaccessible to usable forms [4].

Materials and Methods
Site of the experiment
The field experiment was carried out at the Department of Plantation, Spices, Medicinal and Aromatic Crops, College of Horticulture, RVSKVV, Mandsaur Madhya Pradesh, India during the rainy season in the year 2019-2020. Mandsaur is located in the Malwa plateau in the western part of Madhya Pradesh and belongs to sub-tropical and semi-arid climatic conditions.

Applied design and treatments
The experiment was laid out in Randomized Block Design with three replications. The experimental material consisting of twelve configurations of organic manures (farm yard

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Genetic Variability, Heritability, Genetic Advance and Correlation Coefficient Study in Fenugreek Cultivars (*Trigonella foenum-graecum* L.)

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ABSTRACT: A field experiment was conducted with twenty cultivars at College of Horticulture, Mandsaur (Madhya Pradesh) in Randomized Block Design with three replications during the year 2018-19. This investigation revealed that phenotypic coefficient of variation was higher than the genotypic due to influence of environment on the expression of the characters. The highest GCV was observed for number of pods plant^{-1} (27.13). The highest PCV % observed for number of pods plant^{-1} (27.62) followed by seed yield (21.09).The highest heritability was recorded in number of pods plant^{-1} (96.55) followed by days to 50% flowering (96.00) and number of secondary branches plant^{-1} (90.60). The highest genetic advance was recorded in number of pods plant^{-1} (33.69) followed by plant height (15.42) and fresh weight g plant^{-1} (14.72). The highest genetic advance as percent of mean was observed in number of pods plant^{-1} (54.93) afterward seed yield g plant^{-1} (34.84) and seed yield q ha^{-1} (34.84). Correlation studies showed that, at both genotypic and phenotypic levels, seed yield gram plant^{-1} was significantly and positively correlated with seed yield q ha^{-1} (1.00 and 1.00), pod length (0.987 and 0.560), dry weight g plant^{-1} (0.876 and 0.724) and number of seeds pod^{-1} (0.850 and 0.614). The maximum nitrogen (3.70 %) and protein (23.15 %) content of the seed were recorded in V_{10} PEB. Efforts should be initiated to develop stratagems for improving fenugreek dry matter production and genetic diversity among different germplasm, which will be needful for breeding and crop improvement programme in fenugreek.

Key wards: Genetic Variability, Heritability, Genetic Advance, Correlation Coefficient and *Trigonella foenum-graecum* L.

INTRODUCTION

Fenugreek (*Trigonella foenum-graecum* L.) is self-pollinated and destogamous annual diploid species and is belongs to the family "Fabaceae". It is native of Mediterranean region, extending to Central Asia. It having a chromosome number 2n=16.Fenugreekis cultivated as a leafy vegetable, condiments and medicinal plant. Bitter taste of seeds is due to the presence of an alkaloid "Trigonelline". The importance of fenugreek has been increased due to presence of asteroid called "*Diosgenin"* and it is used in the synthesis of sex hormones and contraceptives (Meena *et al.,* 2017 and Prasad *et al*., 2020). Both leaves and seeds have medicinal uses and act as anti-diabetic, lowering blood sugar and cholesterol level (Chouhan *et al*., 2017). In India total annual production of about 220 thousand metric tons (NHB, 2017) and holding topmost position among the fenugreek growing countries in the world. It is mainly grown in Rajasthan, Madhya Pradesh, Andhra Pradesh, Uttar Pradesh, Gujarat and Punjab states (Kumar *et al.,* 2018 and Shakthi *et al*., 2020).Yield is a major parameter, which is influenced by several yield and yield attributing characters controlled by polygenes and also influenced by environment (Hosamath *et al.,* 2017). Phenotypic variability changes under different environmental conditions whereas genetic variability remains unchanged and more helpful to a plant breeder for exploitation in selection or hybridization. Studies on genetic variability with the help of proper biometrical tools such as variability, heritability, genetic advance gives an idea about the extent of genetic variability existing in the population (Kumar *et al.,* 2018).The correlation co-efficient help to judge existing relationship between the yield and yield attributing traitsand only discloses the direction and magnitude of association between any two characters (Verma *et al.,* 2018).

MATERIALS AND METHODS

The field experiment was carried out at the "Horticulture Research Farm" College of Horticulture, Mandsaur, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior (M.P.) during *rabi* season of 2018-19.Investigation was carried out in randomized block besign with twenty cultivars includes seven local collected genotypes from the Mandsaur, Jaora and Tikamgarh district of Madhya Pradesh and thirteen released varieties obtained from different research centres. Observations were taken from five randomly selected plants of each plot and later on their mean was calculated. The experimental data were subjected to statistical analysis using analysis of variance technique suggested by Panse and Sukhatme (1985). Where the "F" test was found significant at 5 % level of significance, the critical differences for the treatment's comparison were worked out. The phenotypic and genotypic coefficient of variation was worked out as per Burton (1952) and heritability (broad sense) and genetic advance were determined following the methodology of Johnson et al. (1955). The phenotypic and genotypic correlation coefficients were calculated as per the methods given by Al- Jibouri *et al.* (1958).

RESULTS AND DISCUSSION

Genetic variability, Heritability and Genetic advance as a percent mean: Analysis of variance revealed that, there was significant difference among the cultivars for all the traits under investigation, except days to 50 % germination which was non-significant. Range for all the character is broadly indicating the presence of wide range of variation.

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A Study of Growth Rate and Seed Yield in *Ocimum basilicum* Germplasms

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Abstract

The present field experiment was conducted at department of Plantation, Spices, Medicinal and Aromatic Crops, College of Horticulture, Mandsaur in simple Randomized Block Design during 2019-20. This investigation was carried out with twenty germplasms obtained from ICAR-AICRP on MAP, college of Horticulture, Mandsaur. The analysis of variance revealed significant difference in all the growth parameters among the germplasms. However, G_{19} IC-0622541 recorded maximum leaf area (244.50, 1297.09, 4977.09, 7492.67 and 11461.17 cm^2 $plant^{-1}$), leaf area index (0.321, 1.307, 3.425 and 3.949) and leaf area duration (25.69, 104.57, 273.97 and 315.90 cm^2 day^{-1}) during all the growth intervals. While, crop growth rate (0.060, 0.422 g cm^{-2} day^{-1}) and relative growth rate (0.052, 0.117 g g^{-1} day^{-1}) were higher till 120 days after transplanting in G_{19} IC-0622541 but in later stages to harvest G_{11} IC-0622533 was superior in crop growth rate (1.896, 0.340 g cm^{-2} day^{-1}) and relative growth rate (0.152, 0.108 g g^{-1} day^{-1}). G_{14} IC-0622536 had maximum seed yield (29.57 g $plant^{-1}$) among the germplasms.

Keywords: Biofuel, fuelwood, fuel, pigeon pea

1. Intoduction

The genus Ocimum collectively called "basil" belonging to the family Lamiaceae and also known as sweet basil, French basil or Common basil. It has around 50-150 species of shrubs and herbs from the tropical areas of Asia, Africa and Central and South America. It is usually referred as the "King of the herbs" being widely utilized due to its economic, culinary, industrial, cosmetic and medicinal importance (Erum et al., 2011) and also used for the pharmaceutical industry and in traditional medicines in many parts of the world (Ghoshi et al., 2020). Basil has several medicinal properties and rich source of vitamins, carbohydrates, fibre, protein, phosphorous, calcium, iron, beta-carotene and in essential oils. The major constituents in Ocimum oils include eugenol, linalool, geraniol, citral, camphor, menthol chavicol, safrol, thymol (Kumar et al., 2014). *Ocimum basilicum* Linn. occurs in nature as a tetraploid (2n=48). It grows to a height of 30-90 cm and is an enormous, erect, strongly, aromatic annual herbaceous plant with inverse, ovate-lanceolate, petioles very slender usually slightly hairy leaves, flora born on racemose inflorescences, corolla 0.72 - 1.25 cm long, white, pink or pale-purplish in coloured, bracts are petiolated, flowers are conspicuous, black seeds and ellipsoid which become mucilaginous on moistening (Gingade et al., 2014). In India, cultivation and average yield of basil is low. It may be due to lack of suitable cultivars, genotypes and varieties to a particular region. In basil, the selection is based on fresh herbage, essential oil yield and oil quality along with their constituent characters which would prove very useful. There is urgent need for the evaluation of the genotypes in different agro-climatic conditions to know their performance in terms of yield attributing and oil quality traits.

2. Materials and Methods

The field research was carried out with twenty obtained germplasms from ICAR-AICRP on MAPs, College of Horticulture Mandsaur in Randomized Block Design during kharif season of 2019–20 under department of Plantation, Spices, Medicinal and Aromatic Crops, College of Horticulture, RVSKVV, Mandsaur (M.P.). The experiment site is located at Malwa plateau in Western part of Madhya Pradesh at 23° 45' North to 24° 13' North and between the meridians of longitude 74° 44' East and 75° 18' East. In this study, five plants were collected from each plot at 30, 60, 90, 120 DAT and at harvest to record all the parameters and later on their mean was calculated. The experimental data were subjected to statistical analysis using analysis of variance technique suggested by Panse and Sukhatme (1985) where the "F" test was found significant at 5% level of significance, the critical differences for the treatment's comparison were worked out.

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[Research Article]

Growth and yield of Chandrasur (*Lepidium sativum* L.) in response to different sowing methods and seed rates

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ABSTRACT

The experiment was undertaken at the Experimental Farm of Department of Plantation, Spice, Medicinal and Aromatic Crops, College of Horticulture, RVSKVV, Mandsaur (M.P.) during 2019-20 in factorial RBD design, replicated thrice with two sowing methods and five seed rates as treatments. All the parameters were recorded at fixed interval of 30 days from 30 days after sowing to harvest. The result confirm that, the tallest plant height registered with broadcast (12.96, 68.00, 116.84 & 117.47 cm), 10 kg seed (13.34, 67.96, 118.30 & 118.93 cm) and in interaction broadcast x 10 kg seed (13.45, 68.60, 118.85 & 119.10 cm) but number of leaves in line sowing (12.41, 21.45, 24.77 & 62.02), seed rate (13.23, 22.23, 26.11 & 27.57) at 30, 60, 90 DAS and at harvest, respectively. The higher number of racemes (169.48, 192.16 & 204.92 plant^{-1}), number of racemes (6.80, 7.35 & 7.65 branch^{-1}), racemes length (23.93, 24.57 & 25.54 cm), single racemes weight (0.73, 0.80 & 0.82 g), weight of 1000 seed (1.85, 1.87 & 1.88 g), seed yield (23.46, 23.98 & 24.32 q ha^{-1}) and biological yield (54.26, 68.97 & 74.96 q ha^{-1}) were found in line sowing, 8 kg seed and line sowing with 8 kg seed, respectively.

KEY WORDS: *Lepidium sativum*, **seed rates, seed yield, sowing methods and growth**

Chandrasur (*Lepidium sativum* L.) is an annual erect edible herb belonging to the family Cruciferae. It is commonly known as 'Water cress' or 'Common cress' or 'Pepper cress'. Seeds, leaves and roots are economic parts of this crop (Priya *et al*., 2018). The seeds are used for enhancing milk yield in human beings and animals. It is beneficial in promoting digestion and growth in teenagers. The extracts of seed have hypotensive effect with transient respiratory stimulation (Saraswathi *et al*., 2014). Due to its diversified uses, demand, popularity and cultivation is increasing on a commercial scale (Chundawat *et al*., 2017). It is cultivated in India, North America and parts of Europe. In India, it is grown mainly in Uttar Pradesh, Madhya Pradesh, Rajasthan, Gujarat, Maharashtra and Tamil Nadu for seeds. Seed rate is one of the main factors that has an important role on growth, yield and quality of plant. Optimum spacing can ensure proper growth and development through efficient utilization of solar radiation, nutrients, water, land and air as well as intercultural operations. This avoids wastage of valuable seeds and unnecessary competition (Tiwari *et al*., 2002). But in India most of the farmers follow broadcast or line sowing method without maintaining proper spacing for growing Chandrasur (Meena *et al*., 2017). Most of the farmers of Madhya Pradesh sow Chandrasur through broadcasting method. So, there is an urgent need to develop agronomical practices such as optimum seed rate, sowing time, plant geometry and method of sowing etc. for obtaining good yield and to provide information to farmers for its production technology (Chundawat *et al*., 2017)

MATERIALS AND METHODS

The field experiment was conducted at the Experimental Form of Department of Plantation, Spice, Medicinal and Aromatic Crops, College of Horticulture Mandsaur, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior (M.P.) during 2019-20 in factorial RBD design and replicated thrice. Experimental site is situated in Malwa plateau in Western part of Madhya Pradesh at 23.450 to 24.130 North latitude, 74.440 to 75.180 East

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Influence of varieties, organic manures and inorganic fertilizers on growth, yield and quality of okra (*Abelmoschus esculentus* L.)

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Abstract

A field investigation was carried out during *Rabi* season, 2016-17 at Vegetable Research Field, College of Horticulture, Mandsaur, Madhya Pradesh. The experiment was comprised of two varieties (Kashi Pragati and Kashi Kranti) and seven nutrient levels with different sources of nutrients including organic fertilizers, inorganic fertilizers. Variety V_1 (Kashi Pragati) exhibited maximum plant height, number of leaves per plant, number of branches per plant, internodal length, SPAD value, fresh weight and dry weight of plant, earliest days to 50% flowering and days to first picking. Similarly, maximum number of fruits per plant, fruit length, fruit diameter, fruit weight, fruit yield per plant and fruit yield per hectare in variety Kashi Pragati. Quality parameters i. e. protein content (%) and fibre content (%) in fruit were also found maximum in case of variety Kashi Pragati. Among the nutrient levels, application of 50 % NPK + 50 % N through vermicompost (62.5:40:40 NPK + 4.1 t/ha) showed highest growth, yield, quality parameters and yield of okra. The gross income, net income and benefit: cost ratio was found to be superior with variety Kashi Pragati and nutrient level 50 % NPK + 50 % N through vermicompost(62.5:40:40 NPK + 4.1 t/ha).

Key words: Organic manures, Vermicompost, Okra, FYM, Quality, Yield

Introduction

Okra (*Abelmoschus esculentus* L.) commonly known as Bhindi or lady's finger belongs to family Malvaceae. It is an annual vegetable crop in tropical and subtropical parts of the world. It is one of the most important nutritious vegetable crops grown round the year in India. Okra is an important fruit vegetable of high commercial and food values. It is primarily valued for its tender, immature green pods in fresh form; however, its curry, soups and edible young leaves are also popular. To a limited extent, it finds use in canned, dehydrated or frozen forms for off-season consumption by the army at high altitudes and export (Sharma et al. 2015). India is a largest producer of okra in the world with an annual production of 6094.94 thousand MT from an area of 509.02 thousand hectare (5.7 % of total vegetable area). The major okra growing states of India are Uttar Pradesh, Bihar, Orissa, West Bengal, Andhra Pradesh, Karnataka and Assam. (Anonymous 2018). Among the various factors affecting successful cultivation of okra, the judicious use of nutrients is one of those. Nitrogen is an essential element and important determinant in growth and development of crop plants. It plays an important role in chlorophyll, protein, nucleic acid, hormone and vitamin synthesis and also helps in cell division, cell elongation. Phosphorus fertilization can influence fruiting and development of okra. Phosphorus is called the "key to life" because it is directly involved in most living processes (Firoz 2009). The requirements of fertilizers in okra are important for the early growth and total yield of fruit. Integrated use of organic and inorganic fertilizers can improve crop productivity. The soil enriched with vermicompost provides additional substances that are not found in chemical fertilizers (Mal et al. 2013).

Use of organic manures to meet the nutrient requirement of crop would be an inevitable practice in the years to come for sustainable agriculture since, organic manures generally improve the soil physical, chemical and biological properties along with conserving the moisture holding capacity of soil and thus resulting in enhanced crop productivity along with maintaining the quality of crop produce although the organic manures contain plant nutrients in small quantities as compared to the fertilizers, the presence of growth promoting principles like enzymes and hormones, besides plant nutrients make them essential for improvement of soil fertility and productivity (Premsekhar and Rajshree 2009). In organic agriculture, N is usually the limiting nutrient because its availability in the soil depends on organic matter

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Performance of standard chrysanthemum (*Dendranthema grandiflora* Tzvelev.) cultivars for growth and post-harvest life under Malwa region of M.P.

Damini Visen, Anuj Kumar, Priyamvada Sonkar and Roshan Gallani

Abstract
The present investigation was conducted during 2019-2020 under the shade net house, of Department of Floriculture and Landscape Architecture, College of Horticulture, Mandsaur, RVSKVV, Gwalior (M.P.). The experiment was comprised of eight cultivars (Coffee, Hybrid-1, Hybrid-2, Mountaineer, Star White, Star Yellow, Tata Century and Thai Chen Queen) laid out in a Completely Randomized Design (CRD) with three replication. Study revealed that the cultivars showed significant difference with respect to growth and post harvest life parameters. Among the standard cultivars studied the cultivar Star Yellow showed best performance with respect to plant height at 30 and 60 DAT and plant spread at 30 DAT, while maximum plant spread (at 60 DAT), number of leaves (at 60 DAT), number of leaves per plant at 60 DAT, vase life, maximum fresh weight of flowers at harvest, and fresh weight of flowers at senescence was recorded with Thai Chen Queen. On the other hand cultivar maximum number of leaves per plant at 30 DAT was noticed in the cultivar Star White. However, the minimum plant height (at 30and 60 DAT), plant spread (30 DAT and 60 DAT), number of leaves per plant (at 60 DAT), vase-life, fresh weight of flower at harvest and fresh weight of flower at senescence was found in cv. Hybrid-1.

Keywords: Chrysanthemum cultivar, CRD, growth and post harvest parameters

Introduction
Chrysanthemum is one of the most beautiful flowering plant referred as "Queen of the East" and "Autumn flower", while, in India it is called Guldaudi. It belongs to family Asteraceae, botanically known as *Dendranthema grandiflora* Tzelev and chromosome number is n = 9 and 2n = 36, 45, 47, 51, and 75, native of China. Chrysanthemum is the national flower of Japan. The species of chrysanthemum have fibrous root system (shallow rooted plant), herbaceous perennial plant growing to 50-150 cm tall, with deeply lobed leaves and large flower heads like white, yellow or pink (Singh, 2006) [10].

It is one of the leading commercial flowers, having important once as a cut flower and lose flower as well as pot plant. Spray type chrysanthemum ranks second after rose while, Standard type chrysanthemum stands seventh in term of consumption (NHB, 2019) [1]. In Madhya Pradesh, chrysanthemum is cultivated on an area of 1145.82 ha, with a production of 14316.85 metric tons and productivity of 12.49 metric tons of loose and cut flowers (Anonymous, 2020) [2]. Its commercial cultivation is being done in states like Maharashtra, Rajasthan, Madhya Pradesh, Bihar and Delhi. Chrysanthemums are mainly classified under two categories: Large flowered (standard type) and small flowered (spray type). Large flowered chrysanthemums which produce lengthy, strong stems and good vase-life quality while small flowered are frequently grown for loose flower and are categorized into 10 groups. The standard type flowers fetch higher prices though their share in export market but Spray types i.e. smaller flower size and are major share in the world market (Siddiqua *et al.* 2017) [9].

Materials and Methods
The present investigation was conducted during the year 2019-2020 in shade net house, Department of Floriculture and Landscape Architecture, College of Horticulture, Mandsaur, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior (M.P.). The experiment was laid out in a Completely Randomized Design (CRD) with three replications and eight cultivars namely Coffee, Hybrid-1, Hybrid-2, Mountaineer, Star White, Star Yellow, Tata Century, and Thai Chen Queen.

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Effect of phosphorus and bioinoculants and their residual effect on succeeding chickpea (*Cicer arietinum*)

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ABSTRACT

A field experiments were conducted during *kharif* and *rabi* 2016–17 and 2017–18 at ZARS, Jhabua to study the effect of phosphorus and bioinoculants on growth attributes, yields, nutrient uptake and economics in maize - chickpea cropping system. Among the treatments, significantly higher growth and yield parameters of maize were recorded with the application of 60 kg P_2O_5/ha + NPK consortia as compared to other treatments. The highest grain yield (54.62 q/ha), stover yield (52.63 q/ha), biological yield (106.58 q/ha) were obtained under 60 kg P_2O_5/ha + NPK consortia which was at par to each other and significantly superior to control. PSB I, PSB II and NPK consortia. This treatment also observed the highest total N, P and K, uptake by grain and stover. The residual study of phosphorus and bioinoculants on succeeding chickpea was found to have significant effect on growth and yield attributes. Among the various treatments, maximum seed yield (24.04 q/ha), and biological yield (60.69 q/ha) were observed under 60 kg P_2O_5/ha + NPK consortia. Similarly, the highest total uptake of N, P and K were recorded with the application of 60 kg P_2O_5/ha + NPK consortia. Treatment receiving 60 kg P_2O_5/ha + NPK consortia realized the maximum gross return (×10^3 204.34 ₹/ha), net return (×10^3 157.08 ₹/ha) and B:C ratio (3.32) as compared to other treatments.

Key words: Bioinoculants, Chickpea, Economics, Nutrient uptake, Phosphorus, Yields, Yield attributes

Maize (*Zea mays* L.) is one of the important cereal crops and is a very versatile grain that benefits mankind in many ways. It had 3rd position in production after wheat and rice in the world (Singh *et al.* 2018 and Yadav *et al.* 2018). Chickpea (*Cicer arietinum* L.) is one of the predominant *rabi* crops in pulse growing areas. Being a legume it responds well to phosphorus added through organic manure and chemical fertilizer. In India, the price of commonly used phosphatic fertilizer has increased considerably since the early seventies (Singh and Sharma 2011). The low productivity of maize and chickpea may be due to various reasons, viz. weeds, drought, environmental factors, improper nutrients management and biotic and abiotic factors etc. Among these, nutrient management plays a significant role in influencing the yields being an exhaustive crop requires a huge quantity of nutrients during growing periods (Kumar *et al.* 2015a).

Bioinoculants provide nutrients such as N, P and K through their activities in the soils or rhizosphere and makes them readily available to the plants. Now-a-days bioinoculants are becoming more important because improving of soil fertility and health and also reduce pollutions in the environment by cutting down the use of chemical fertilizers (Roy chowdhury *et al.* 2017). Seed inoculations with *Rhizobium*, phosphorus solubilizing bacteria (PSB) and organic amendments increased yield of cereal crops (Siyal 2017). Liquid bioinoculants (LBs) are the most promising and latest technology which has many advantages over the chemical fertilizers. Shelf-life is the first and foremost problem of the carrier based biofertilizers which is up to 3 months and it does not retain throughout the crop cycle. LB on the other hand facilitates the long survival of the organism by providing the suitable medium which is sufficient for the entire crop cycle (Pindi and Satyanarayana 2012). Therefore, LBs are believed to be the best alternative for the conventional carrier based biofertilizers in the modern agriculture research community. Considering the above facts, the present study was undertaken to assess the effect of phosphorus and bioinoculants on yields, nutrient uptake and profitability under rainfed conditions of Jhabua hills, Madhya Pradesh.

MATERIALS AND METHODS

A field experiment was conducted at Research Farm, Zonal Agricultural Research Station, Jhabua during *kharif* and *rabi* 2016–17 and 2017–18 to assess the different liquid bioinoculants and phosphorus levels on yields, nutrient

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Effect of integrated nutrition on productivity, profitability and quality of French bean (*Phaseolus vulgaris*)

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ABSTRACT

A field experiment was conducted to investigate the effect of integrated nutrition along with application of micronutrient and biofertilizers on productivity and profitability of french bean (*Phaseolus vulgaris* L.) at the ICAR-RC for NEH Region, Nagaland Centre, Jharnapani, during *rabi* 2013–15. Treatment consisted of four nutrition levels, viz. control, 100% RDF (80-60-30-20 kg NPKS/ha), 100% RDN (RDN:80 kg/ha through 16 t/ha of FYM), 75% RDF + 25% RDN and 100% RDF + 25% RDN in main-plot and five levels of biofertilizers + micronutrient, viz. control, PGPR (*Rhizobimum* + *Bacillus* + *Pseudomonas*), PGPR + 5 kg Zn/ha, PGPR + 1.5 kg Mo/ha and PGPR + 5 kg Zn + 1.5 kg Mo/ha in sub-plot. Experiment was laid out in split-plot design and replicated thrice. Significantly higher seed yield (1630 kg/ha) was recorded with application of 100% RDF + 25% RDN, which was 30% higher over 100% RDN. Maximum net returns (₹ 21399/ha), B:C ratio (1.31), production efficiency (15.8 kg/ha/day) and economic efficiency (₹ 305/ha/day) were noted with 100% RDF + 25% RDN. Maximum grain yield (1551 kg/ha) had recorded with PGPR +5 kg Zn ha+1.5 kg Mo/ha. Maximum net returns (₹ 29941/ha), B:C ratio (1.30), production efficiency (15.1 kg/ha/day) and economic efficiency (₹ 210/ha/day) were also noted with PGPR+5 kg Zn ha + 1.5 kg Mo/ha. Thus, to achieve the higher productivity and profitability, french bean could be grown with 100% RDF+25% RDN through organic manures (FYM) and seed inoculation with PGPRs + micronutrient in foot hill condition of Eastern Himalayas.

Key words: French bean, Micronutrient, PGPRs, Productivity, Profitability, Quality

French bean (*Phaseolus vulgaris* L.) commonly known as rajmash, common bean, dry bean, pinto bean, field bean, navy bean and kidney bean and grown as premier pulse crop in the worldwide. It is newly introduced as non-traditional winter pulse crop in India with high yield potential of 2.5–3.5 t/ha. This crop is gaining importance in country for its dual uses both for green pods and dried grain, and spreading to north eastern hilly (NEH) states of India like Nagaland. The lower productivity of french bean has been found mainly due to inadequate nutrition management in NEH region. Modern agriculture requires intensive use of chemical fertilizers, but price of inorganic fertilizers has gone up considerably, which in turn increased the production cost and decreased markedly fertility status of the soil (Kumawat *et al*. 2009a, b, c). In view to maintaining the agro-ecosystem, it has become necessary to minimize the uses of chemical fertilizers by adding organic sources more, mainly biofertilizers (PGPRs) and organic manures (Kumar 2015).Thus, optimum fertilization along with farm yard manures (FYM), biofertilizers and micronutrient to crop has to be standardized, which enables as to meet the entire nutrient requirement during cropping and to obtain a better crop yield (Kumar *et al*. 2014, Kumar *et al*. 2015a). Supplying of nutrition through, PGPRs (plant-growth rhizobacteria) and micronutrients sources has found the best option for increasing the crop productivity (Kumar *et al*. 2010). There is ample scope of increasing productivity through combined use of nutrition sources that reduce load of chemical fertilizers within reach of small and marginal farmers (Saikia *et al*. 2018). Combined nutrition of NPKS and micronutrient is always beneficial for enhancing the crop yield. Most of the micronutrients are highly essential for plant growth and development and increase bacterial activity of nodule in pulses (Kumar *et al*. 2010). Therefore, an optimum supply of nutrients in balanced modes is foremost important to achieve the higher productivity in foot hill condition of Eastern Himalayas. Keeping these things in view, the present study was undertaken.

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MATERIALS AND METHODS

The field experiment was conducted on french bean during two consecutive *rabi* season of 2013–14 and

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Yield and Water Productivity of Cabbage on Sodic Vertisols as Influenced by Drip Application Rate and Irrigation Schedule

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Abstract

Field study was carried out during 2016-17 and 2017-18 at Salinity Research Station, Barwaha, Khargone (Madhya Pradesh) to evaluate the performance of drip irrigation under different discharge rate and schedules for cabbage crop grown on black sodic soil of ESP 40±2. The treatment comprises of three discharge rates of dripper as Q_1- 1.3 litre per hour (LPH), Q_2- 2.5 LPH and Q_3 - 4.0 LPH along with three schedules of irrigation as S_1-daily, S_2-alternate and S_3-every 3rd day. Results revealed that the highest average curd yield of 18.57 Mg ha^{-1} was recorded with drip irrigation system scheduled daily with 1.3 LPH. The lowest cabbage yield (9.78 Mg ha^{-1}) was obtained under every third day with 4.0 LPH. Similarly, maximum water productivity (344 kg per ha-cm) was observed in case of drip irrigation system scheduled every day with 1.3 LPH dripper discharge rate followed by drip irrigation system scheduled every alternate day with 1.3 LPH dripper discharge rate (317 kg per ha-cm). Soil moisture contribution by soil profile estimated ranged in between 3.12 to 3.99 cm m^{-1} soil depth in different treatments. Cabbage can be grown successfully on sodic black soil (ESP 40±2) by adopting drip irrigation system scheduled every day with 1.3 LPH dripper discharge rate.

Key words: Cabbage yield, Drip irrigation, Discharge rate, Vertisols, Water productivity

Introduction

Vertisols and associated soils occupy nearly 76.4 million hectares of area in India. More than 1.0 million salt-affected black soils in India mainly occur in the states of Maharashtra, Gujarat, Madhya Pradesh, Karnataka, Andhra Pradesh and Tamil Nadu (Chinchmalatpure *et al.*, 2019; Kaledhonkar *et al.*, 2019). In state of Madhya Pradesh, salt-affected soils are found in around 0.034 million ha area and are present in Indore and adjoining areas and canal command areas (Dubey *et al.*, 1998). Sodic Vertisols are mostly found in arid and semi-arid regions of the country. Vaidya and Pal (2002) also observed that micro-topographic variations are also responsible for sub-soil sodicity in the calcareous Vertisols of Central India, albeit in a different manner. Soils are termed as sodic or alkali soils, if ESP is more than 15. In case of sodic Vertisols, adverse effects of sodicity are observed at ESP value lesser than 15 (Gupta and Verma, 1983). More specifically, in case of Vertisols, ESP at 6 is also classified as sodic (Nayak *et al.*, 2004). Vertisols have swelling and shrinking characteristics when wet and dry, respectively. Soil structure of Vertisols gets disturbed due to dispersion with increase in ESP. Basic infiltration of sodic Vertisols decreases with increase in ESP. Major constraints associated with sodicity in Vertisols are reduced permeability in swollen state (when wet) leading to low infiltration rates and internal drainage; poor aeration and reduced root development; narrow workable moisture range for tillage and seeding operations, and extremely hard consistency in both A and B horizons.

Cotton-wheat, soybean-wheat, soybean-chili, soybean-vegetables, soybean-gram are the major crop rotations in Indore region where sodic Vertisols are found. Water movement in these soils

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Secular Analysis of Domestic Animals Composition in Indian Context: Recent Evidence

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ABSTRACT

India is a developing country, where livestock sector is highly dynamic due to rapidly increasing demand for animal products in various sectors. Livestock sector contributes about 37 and 4.1 percent in agriculture and gross domestic product (GDP) respectively, of the country. It contributes in the socio-economic development of rural livelihoods. It is revealed from the investigation that in India, about 50 per cent of bovine (buffalo and cattle) population is maintained by the marginal farming households. We have argued that women have predominant responsibility for animal rearing. The productions of milk, meat and wool have increased tremendously with the increase in livestock composition. Despite the fact that exports of livestock sector have expanded in numerous times over the study period. India held strong position in exports of livestock products as poultry and dairy produce and buffalo's meat. Study purposes that the Central Government of India should recognize and agree to implement the new programmes to expand the production behaviour of livestock products particularly in drought areas.

HIGHLIGHTS

- India's exports of livestock products were moderately volatile.
- The total livestock population in India has positive expanding trend by 5.05 per cent.

Keywords: Livestock Composition, Forecasting, Trade, Instability, Growth

Livestock sector is major contributor in the social and economic development of rural households in India. This sector contributes approximately 36 percent to the total agricultural gross domestic product and 4 per cent to the complete gross domestic product. It is moreover indicated as one of the dominant sectors for foreign earning. This sector put forward its impending to emerge as an instrument for agricultural growth in the next decades. It supports to crop farming in the form of manure cake, organic manure and draught power, supplies hides, bones, blood, fibers and skin to the livestock industries and provides food, nutritional security and transportation facilities to rural livelihood. In Indian context, animal husbandry and crop cultivation are interlinked like a pair of wheels in bullock cart. Livestock production is thus likely to be undergoing significant change in the forms of efficient production, populace adjustment, production efficiency, industrialization, profit oriented and augmentation to respond to the expanding requirement for farm animal-based food products (Rae and Nayga, 2010). More than 70

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Evalution of different cultivars of Brinjal (*Solanum melongena* L.) for kharif season under Malwa condition

Ashok Gurjar, Ajay Kumawat, Deeksha Tembhre, Ritesh Jain and Shailendra Kumawat

Abstract
The present study was undertaken to investigate "Evalution of different cultivars of Brinjal *Solanum melongena* L." for kharif season under Malwa condition" was carried out at the research field, Department of Horticulture, College of Agriculture, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Indore, (M.P.) during Kharif season 2018. In this experiment Evaluated 10 different cultivars of Brinjal (Punjab sadabahar, Annamalai, Arka Abhilamb, Arka nidhi, Hisar shyamla, Green gold, Krishana, Brinjal nano-038, Brinjal No.-209 and Green long) were tested in randomized complete block design with three replications with 3.0 X 1.8 sqm plot size and 60 cm X 45 cm spacing. The result was found that At 20, 40, 60 and 80 days after transplanting, cultivar Hisar Shyamal was observed in significantly maximum plant height, number of branches per plant, leaf area, fruits per plant, fruit yield per plant and fruit yield per hectare followed by Krishna and Arka Nidhi as compared to other cultivars and the minimum time to first flower bud formations, first flowering and first harvesting after transplanting were recorded in Hisar Shyamal cultivar fallowed by Krishna and Arka Nidhi as compare other cultivar.

Keywords: Hisar Shyamal, Krishna, plant height, yield per hectare and brinjal

Introduction
Brinjal (*Solanum melongena* L.) is one of the most important indigenous vegetable crops grown in India and other parts of the world. Brinjal (*Solanum melongena* L.) belongs to the family Solanaceae. It is highly productive and poor man's crop, it is also known as egg plant. Brinjal is of much importance in the warm areas of far East, being grown extensively in India and other Asian countries like Bangladesh, Pakistan, and Philippines. Other major brinjal producing countries are China, Turkey, Japan, Egypt, Indonesia, Iraq, Italy, Syria and Spain. Brinjal is a herbaceous annual and erect or semi spreading habits. It is a perennial plant but cultivated as annual. It is grown mainly for its tender and immature fruits. They are primarily used as cooked vegetable for the preparation of various dishes in different parts of the world. Brinjal fruits are fairly good source of Ca, P, Fe, and vitamins particularly B group. Brinjal is also valued for its medicinal properties, and has got de-cholestrolizing property primarily due to presence of polyunsaturated fatty acids (linoleic and lenolenic) present in flesh and seeds of fruit in higher amount (65.1%). Presence of magnesium and potassium salt in fruits also impart de-cholestrolizing action.

Material and Methods
The experiments were carried out during Kharif season 2018, at the research field, Department of Horticulture, College of Agriculture, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Indore, (M.P.). Geographically Indore is situated in Malwa plateau region in the Western part of the state of Madhya Pradesh at an altitude of 555.5 meters above mean sea level (MSL). It is located at latitude 22.43^{0}N and longitude of 75.66 ^{0}E. It has subtropical climate having a temperature range of 21 ^{0}C to 45 ^{0}C in summer and 6 ^{0}C to 31 ^{0}C in winter seasons, respectively. The rainfall in the region has been mostly inadequate and erratic in most of the recent past seasons.
Late commencement, early withdrawal of monsoon and occurrence of two to three dry spells during the rainy season are the common features.

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RESEARCH PAPER

Impact of priming techniques on germination, vigour, growth and survivability of drumstick (*Moringa oleifera* L.) variety PKM-1 under open and protected condition

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Abstract : The present investigation was carried out in *Kharif* season 2017-18 at the Horticulture nursery and dry land research farm College of Agriculture, Indore (M.P.) to study the germination, physiological parameters, biotic stress susceptibility, survivability per cent, as influenced by different condition and priming. The experimental materials for the present investigation was practiced with factorial experiment in Completely Randomized Design replicated thrice with different combinations of condition and priming. Condition and priming (CxP), the treatment combination C_1P_6 (Open x Hormonal Priming Gibberellic acid @2000 ppm) maximum germination percentage, physiological parameters, survivability per cent, economics while treatment combination C_2P_1 (Protected x Unprimed) recorded with minimum results in terms of all the parameters except in incidence of pest per cent.

Key Words : Drumstick, Priming, Open, Protected condition, Germination, Vigour, Growth, Survivability

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INTRODUCTION

Drumstick (*Moringa oleifera* L.) is an important vegetable crop belonging to the family Moringaceae having chromosome no. 2n = 28. It has tremendous economic and dietic importance. It is called "Miracle tree" because it content all kinds of nutrient and amino acids needed for human body. The high proportion of minerals and vitamins suggest its value for both human beings and animals. It can be successfully grown in open and protected condition by direct sown or transplant method. Under both methods, slow and late emergence rate in the crop lead smaller and weak seedlings that affect the uniformity of the crop and ultimately affect the yield, quality and net return. Hence, for obtaining better seedlings along with strong establishment, priming techniques helps in reducing the time between seed sowing, seedling emergence and synchronize emergence (Parera and Cantliffe, 1994).

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RESEARCH PAPER

Efficacy of herbicides on weed growth and bulb yield in onion under kymour plateau region of Madhya Pradesh, India

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Abstract : Onion (*Allium cepa* L.) belonging to family Alliacea is one of the most important and export oriented crop grown all over the world including India. The production of onion in Madhya Pradesh is not as much as compared to Maharashtra. Application of herbicides offer a suitable method for weed control by producing maximum sized bulbs and higher yield. The present investigation was carried out during *Rabi* 2014-15 with the objective to study the effect of herbicides on growth, yield and its attributing traits of onion at Horticulture complex, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur with twelve treatments in Randomized Completely Block Design and three replications. Maximum weed control efficiency was recorded in the treatment Pendimethalin @ 2.5-3 l/ha for all type of weeds observed in the field while maximum growth and yield traits were recorded in weed free check (Hand weeding). On the basis of one year data it is concluded that the maximum reduction in weeds and increase in yield obtained in the onion by the application of herbicide of Pendimethalin 2.5-3 L/ha.

Key Words : Growth, Herbicide, Kymore plateau, Madhya Pradesh, Onion, WCE, Yield

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INTRODUCTION

Onion (*Allium cepa* L.) belonging to family Alliacea is one of the most important and export oriented crop grown all over the world including India. It is a condiment crop and consumed as fresh salad and added as a spice while cooking dishes. The production of onion in Madhya Pradesh is not as much as that compared to Maharashtra. It may be due to less area of cultivation as well as number of factors which can be related to production. Under cultivation a routine practice of providing frequent irrigation and fertilizer application for the crop growth and development but the slow growth rate at initial stage of crop due to its inherent characteristics such as short stature, non- branching habit, sparse foliage, shallow root system, favors the congenial environment for the weed growth and weed compete with crop plants for moisture, nutrients, light and space. Under such circumstances application of herbicides offer

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Original Research Article

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Effect on Yield, Water use Efficiency and Economics of Pigeonpea of Mulch and Irrigation under Vindhyan Plateue of Madhya Pradesh

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Keywords

Mulching, CPE, Growth, Yield. Water use efficiency, B: C Ratio

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ABSTRACT

The field trials were conducted during the two consecutive *kharif* seasons 2016-17 and 2017-18 with three mulching and three irrigation levels viz. 60%, 80%, 100% CPE (cumulative pan evaporation) to determine the growth and yield attributes of pigeonpea (*Cajanus cajan* L.) in Vindhyan plateau of Madhya Pradesh. The experiment was laid out in a split plot design with three replications. Mulching and irrigation levels significantly affected ($P<0.05$) the growth and yield attributes of pigeonpea. M_2 (17.51 q/ha) registered 47.98% higher seed yield than without mulch (11.83 q/ha). Irrigation treatments also affect the yield. I_2 (16.01 q/ha) registered 13.77% higher seed yield than I_1 (14.07 q/ha). Highest water use efficiency (q/ha-cm) registered with black plastic mulch (1.02) which is at par in wheat straw mulch (0.96) and lowest value recorded in without mulch (0.69). Wheat straw mulch recorded maximum B: C ratio of 1.52 which is at par with black plastic mulch (1.48). Lowest B: C ratio (1.33) recorded under without mulch treatment. Among irrigation treatments, lowest value (1.26) of it recorded with 0.6IW/CPE whereas highest B: C (1.56) registered with 0.8IW/CPE which is at par with 1.0IW/CPE (1.52).

Introduction

Pigeonpea (*Cajanus cajan* (L) MillSp.) is commonly known in India, as redgram or arhar or tur. Pigeonpea is a perennial member of the Fabaceae family and one of the major legume crop of the tropics and subtropics (Vanaja *et al.,* 2010). Pulses are known as unique jewels of Indian farming. Pulses are an integral part of diets across the globe and have great potential to improve human health, conserve soils, protect the environment and contribute to global food security. The United Nations, declared 2016 as *"International Year of Pulses"*. India is the largest producer, consumer and importer of the pulses in the world. Pigeonpea is particularly rich in lysine, riboflavin, thiamine, niacin and iron (Manikandan and Sivasubramaniam, 2015). Pigeonpea plays an important role in food security, balanced diet and the alleviation of poverty, since it is used in diverse ways as a source of food and fodder.

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Influence of mulch and drip irrigation on growth and yield of pigeonpea

ML Jadav, KP Mishra, Anjaney Pandey, US Mishra, A Duggal, SS Gautam and RK Khariya

Abstract
The field trials were conducted during the two consecutive *kharif* seasons 2016-17 and 2017-18 with three mulching and three irrigation levels viz. 60%, 80%, 100% CPE (cumulative pan evaporation) to determine the growth and yield attributes of pigeonpea (*Cajanus cajan* L.) in Vindhyan plateau of Madhya Pradesh. Mulching and irrigation levels significantly affected ($P<0.05$) the growth and yield attributes of pigeonpea. The maximum plant height was obtained in black plastic mulch (181.29 cm) and lowest in without mulch (161.99 cm) which has significantly difference of 11.91%. The maximum plant height was recorded in I_2 (176.10 cm) which is at par in I_3 (174.16 cm). The significantly lowest height was registered in I_1 (166.22 cm). Individual and interaction (MXI) effect was found significant at harvest in case of branching. Black plastic mulch registered maximum number of pods (119.34) which is 20.67% higher than without mulch (98.90 However, The number of pods per plant was significantly lowest with I_1 (106.45) and highest with I_2 (113.19) which is at par with I_3 (111.97). Growth and yield attributes of pigeonpea gave better performance under plastic mulch than without mulch. Drip irrigation at 0.8% CPE results satisfactory than at upper and lower side.

Keywords: Pigeonpea, mulching, irrigation, vertisols, CPE, growth and yield

Introduction
Pigeonpea (*Cajanus cajan* (L) MillSp.) is a perennial member of the Fabaceae family and one of the major legume crop of the tropics and subtropics (Vanaja *et al.* 2010) [22]. Pulses are known as unique jewels of Indian farming. Pulses are an integral part of diets across the globe and have great potential to improve human health, conserve soils, protect the environment and contribute to global food security. The United Nations, declared 2016 as "International Year of Pulses". India is the largest producer, consumer and importer of the pulses in the world. Pigeonpea is particularly rich in lysine, riboflavin, thiamine, niacin and iron (Manikandan and Sivasubramaniam, 2015) [8]. Pigeonpea plays an important role in food security, balanced diet and the alleviation of poverty, since it is used in diverse ways as a source of food and fodder.
Pigeonpea grown worldwide in an area of 4.23 m.ha., with a production and productivity of 4.68 MT and 751 kgha^{-1} respectively. More than 85% area of pigeon pea is under rain fed condition (Sanjay *et al.*, 2017) [15]. In India, it occupies an area of 3.71 m.ha. with a production and a productivity of 2.78 MT and 750 kg/ha respectively (GOI Report, 2015). Increasing population resulted in reducing per capita availability of pulses to the masses. (Annual Report 2017-18, IIPR, Kanpur).
Lack of adequate water on a continuous basis is a serious obstacle to stable pigeonpea yields (Reddy and Virmani, 1980) [13]. Water stress affects the final yield due to the reduction in growth attributes i.e. plant height, number of pods, reduction in pod weight. Many researchers have reported that more than 50% of yield loss in pigeon-pea is due to drought (Roder *et al.* 1998; Sharma *et al.* 2012) [14, 17]. The plant's physiological processes get affected because of moisture stress in plant (Patel *et al.* 2001) [11]. Proper use of existing water resources by using suitable irrigation technologies to increase pigeonpea production per unit area is the need of the hour (Jeyjothi *et al.*, 2017).
Mulching as a moisture conservation practice has been widely practiced as a mean of improving yields in water limited environment. It also favourably modifies the soil thermal regime, retards soil erosion and improves soil health. Apart from those the plastic mulching increases the soil temperature and moisture of upper layer of soil (Rao *et al.*, 2018) [12]. Swathi *et al.* (2018) [20] reported that the congenial environmental conditions determine the growth and flowering behaviour of pigeon pea.

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Study of Tomato Producer's Entrepreneurial Behaviour under National Horticulture Mission (NHM) in Dhar District of Madhya Pradesh

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Abstract: ***Entrepreneurship is a movement that goes for beginning, building up and expanding the span of an undertaking that produces and sells products or administrations in market. Doing new things and doing things that are as of now done recently is along these lines a basic meaning of entrepreneurship. Looking to the importance of tomato production in Dhar district, the personnel of NHM programme provided various extension programmes and facilities for its development. The programme has completed many years, hence; it was felt appropriate to know the entrepreneurial behaviour of tomato growers under NHM with 120 respondents of Dhar district. The study revealed that in entrepreneurial behavior of tomato growers, the farmers maximum level is agree for Feedback uses, Persistence, Self-confidence, Innovativeness and Knowledge ability etc.***
Keywords: Entrepreneurial Behaviour, Tomato Producers, National Horticulture Mission (NHM)

Introduction

Development of economy of any nation depends primarily on the important role played by entrepreneurs. The role played by such entrepreneurs is of vital importance in developing country like India, where there are ample opportunities for using innovations to exploit the available resources, particularly in the field of agriculture. Thus, in all economic development activities more and more focus is being centered on entrepreneurship of the people. Entrepreneurship has been now recognized as a concept, not only vital for starting industries but also in the development of agriculture.

Entrepreneurship is the central force of economic activity and prime mover of development and most needed component for the development. This finding of the study may help the administrators and policy makers to know the entrepreneurial behaviour of farmers, the relationship between socio-economic characteristic with entrepreneurial behaviour and reasons for practicing tomato cultivation and help in further investigations on entrepreneurial behaviour of tomato growers.

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Bionomics of whitefly on soybean cultivars under laboratory conditions

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Abstract
Biology of *Bemisia tabaci* was carried out on eight soybean cultivars, in controlled laboratory conditions (25± 2 ^{0}C, 70±10% RH, 13 photophase). Plants at the trifoliate stage were placed in plastic cages and a pair of whitefly/cage was released for 72 hrs. The development was observed until adult emergence. Adult emergence percentage was highest on cultivar JS 335 (96.30%) followed by RVS- 2001-4, JS 97-52, JS 20-69, JS 20-98, NRC 86, JS 20-29 and RVS- 24 (95.83%, 94.44%, 91.67%, 86.67%, 75.56%, 75.00% and 63.89%) while the total developmental period from egg to adult on the soybean cultivars varied and it was lowest (16.59 days) on JS-335, followed by JS-97-52 (17.94 days), RVS- 2001-4 (18.76 days), JS 20-69 (21.83 days), JS 20-98 (23.14 days), RVS- 24 (23.18 days), JS 20-29 (23.36 days) and highest (23.99 days) on NRC 86, respectively.

Keywords: *Bemisia tabaci,* soybean, bionomics, development

Introduction
Soybean (*Glycine max* L.) is considered as "Miracle Crop" or "Wonder Crop" owing to its good quality vegetable protein and edible oil. There is a gradual reduction in the soybean yield because of various problems in the field, such as interference from plant intruder organisms (pests and diseases). Whitefly, *Bemisia tabaci* (Gennadius) (Hemiptera: Aleyrodidae) is one of the most serious, cosmopolitan sucking pest that causes severe yield losses in soybean. This insect causes both direct and indirect damage to plants. Direct damage occurs due to the nymphs and adults feeding on the phloem sap, which compromises the plant's vegetative and reproductive development. While, the indirect damage is due to the insects' excretion of honeydew during the feeding process, which serves as a substrate for the growth of sooty mold. Sooty mold darkens foliage, affecting the plants' ability to photosynthesize [1, 2]. Furthermore, whiteflies are also considered one of the most important virus vectors for several economically important crops [3]. To improve the ecologically based management of the pest, the behaviour of the pest such as the host preference and oviposition should be known [4]. It prefers the leaves having thick trichomes for egg-laying and it lays stalked eggs [5]. In resistant cultivars very few number of eggs hatch into nymphs [6] and period of the developmental stages is also affected [7]. The number of adults developing from nymphs also decreases due to antibiosis [8]. Considering the damage caused by whiteflies and the fact that controlling them mainly involves massive spraying of synthetic insecticides, it is important to search for new tools that can be used to manage this pest. In this sense, the adoption of resistant genotypes may represent an important avenue of investigation. Therefore, the present studies were designed to evaluate some biological aspects of *B. tabaci* on eight cultivars of soybean.

Materials and Methods
Studies on the biology of *B. tabaci* were carried out on eight soybean cultivars (*viz.*, JS 335, JS 20-29, JS 20-69, JS 20-98, JS 97-52, RVS- 24, RVS- 2001-4 and NRC 86) in the Biocontrol Research and Production Centre, Department of Entomology, JNKVV, Jabalpur (M.P.) during the year 2017-2018. During the study period the average temperature and relative humidity were maintained at 25±2 °C and 70±10%, respectively with 13 hours of photophase period as suggested by (Oriani *et al.*, 2011) [9]. The culture of *B. tabaci* was multiplied and maintained on the potted plants of soybean variety JS 335. Initially whitefly adults were collected from the field using an aspirator and were released on the soybean plants which were kept inside the screen house. The second generation of the non-virulent *B. tabaci* adults were used for the study of their biology (Gopaldas *et al.*, 2018) [10].

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Validation of detection techniques and management of seed borne diseases of Chilli (*Capsicum annum*)

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Abstract
Diagnosis of seed borne pathogens is an important step for seed health and management of crop diseases. This study was carried out to assess seeds of two chilli varieties, namely, Garima-12 and HPH-12 for inoculum of seed borne pathogens. Agar plate method. Blotter paper method and Rolled paper towel method were used for germination percentage and presence of seed borne pathogens. Five seed borne pathogens *viz., Aspergillus flavus, A. niger, Colletotrichum capsici, Penicillium citrinum* and *Fusaium annum* were predominant. Efficacy of seed treatment with fungicides and bioagents in reducing the seed borne fungi was also studied using three methods. Carboxin, Metalaxyl and Carbendazim in combination with *Trichoderma* were effective in reducing the seed borne fungi.

Keywords: Seed health, seed borne pathogens, blotter paper method, agar plate method, rolled paper towel method

Introduction
Chilli (*Capsicum annum* L.) is an important vegetable cum spice crop grown in almost all tropical and subtropical countries of the world. The production of chilli was 1.30 mt. with an area of 0.806 mha. during 2013-14 in India. In Madhya Pradesh it occupied an area of 54410 ha. witha production of 93570 tons of chilli. The seeds of chilli hybrids and varieties are most priced input to the farmers and delayed and erratic germination of chilli seeds is one of the reasons for low yield and increasing the cost of cultivation of this commercial crop. The success of chilli crop dependent on raising of healthy seedling to transplanting in desirable land by following good agronomical practices and proper soil moisture maintenance. There are many biotic and abiotic constraints responsible for the delayed and erratic germination, among these, seed borne pathogens are predominant. Chilli suffers many of the fungi among them*Fusarium oxysporum, Colletorichum capsici, Aspergillus niger, A. flavus, A. fumigatus, Alternaria alternata and Penicillium citrinum*as leading seed borne fungal pathogens associated on seed either internally or externally, which reducing seed germination and seedling vigour, and result in poor yield. *Colletotrichum capsici, Aspergillus niger, A. flavus, fusarium* and *Penicillium* were the most frequency isolated fungi with 54.75%, 44.00%, 29.75%, 1.25%, and 0.25% (Ekhuemelo and Ebenezar, 2013) [3]. To validate the promising fungicides for raising of seedling are immensely required for successful cultivation and producing more vigour seedling, complete elimination of pre-existing inoculum of fungi is the key criteria for successfully harvesting of crop, because management of that type of pathogen at the time of growing phase of the crop is comparatively more difficult and some time due to delayed detection and diagnosis, it may incite tremendous irreparable losses to the crop. The present investigation was undertaken to study the validation of detection techniques from two varieties of chilli and assessment of different fungicides and their impact on seed germination and associated fungi with two types of seed.

Materials and Methods
Untreated seed of two varieties of chilli *viz.*, variety Garima-12 and hybrid HPH-12 were procured from Khargone, and Khandwa district of Madhya Pradesh, respectively. Identification of pathogens found to be associated with different types of seeds and varieties were made on the basis of their cultural and morphological character appears on petri plates and microscopic observation.

Detection of seed borne pathogens
Following three methods were evaluated *in vitro* condition to identify the pathogens onchilli varieties. The possible reduction in the associated seed borne pathogens assessed by dressing

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Original Research Article

Effect of organics and inorganics on soil properties - A step towards nutrient management in Vertisols of Malwa Region

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Keywords

Organics and inorganics on soil properties, Kharif season

A B S T R A C T

An experiment was conducted at AICRPDA farm Indore, in *kharif* season 2017-18, in which 3 replications and 9 treatments were taken with soybean crop. After experiment it was revealed that good soil physical properties maintained by the application of organics. Treatment 6 which is applied with 6 tonnes FYM + N20P13 gave the better soil physical and chemical properties. In T6 status of Available N, P, K and S after harvest found increased, pH found increased, BD found decreased, WHC and Porosity found increased. Result shows that applying organics alone and in combination with inorganics improves the nutrient status in soil also improves its physical condition.

Introduction

Soil fertility refers to the ability of a soil to sustain agricultural plant growth, i.e. to provide plant habitat and result in sustained and consistent yields of high quality. A fertile soil has the properties like ability to supply essential plant nutrients and water in adequate amounts and proportions for plant growth and reproduction and absence of toxic substances which may inhibit plant growth. Sufficient soil depth for adequate root growth and water retention, Good internal drainage, allowing sufficient aeration for optimal root growth (although some plants, such as rice, tolerate water logging). Topsoil with sufficient soil organic matter for healthy soil structure and soil moisture retention. Soil pH in the range 5.5 to 7.0 (suitable for most plants but some prefer or tolerate more acid or alkaline conditions). Adequate concentrations of essential plant nutrients in plant-available forms, Presence of a range of microorganisms that support plant growth. Inorganic fertilizers are generally less expensive and have higher concentrations of nutrients than organic fertilizers. Also, since nitrogen, phosphorus and potassium generally must be in the inorganic forms to be taken up by plants, inorganic fertilizers are generally immediately bio-available to plants without modification. However, some have criticized the use of inorganic fertilizers, claiming that the water-soluble nitrogen doesn't provide for the long-term needs of the plant and creates water pollution. Slow-release fertilizers may reduce leaching loss of nutrients and may make the nutrients that they provide available over a longer period of time.

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Original Research Article

Integrated Nutrient Management – A remedy for enhancing the lives of Microbes in soil

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A B S T R A C T

An experiment was conducted to examine the microbial populations at AICRPDA farm Indore, in kharif season 2017-18, in which 3 replications and 9 treatments were taken withorganic and inorganic farming practices in soybean crop. Soil samples collected from the surface (0-15 cm) soil depths of the treated plots by soil plate and dilution plate methods for fungi, bacteria and actinomycetes respectively. Results obtained showed that the organically treated plot recorded the maximum microbial population counts (fungal, bacterial and actinomycetes). A significant variation in microbial population was found between control and treated plots (organic and inorganic) at the surface soil depth. The application of organic fertilizers increased the nutrient content of the soil and thereby increasing the microbial counts.

Keywords

Nutrient management, microbial populations

Introduction

Soil is the habitat of a diverse array of organisms which include both micro flora and fauna. Soil micro organisms play a very important role in soil fertility not only because of their ability to carry out biochemical transformation but also due to their importance as a source and sink of mineral nutrients. Soil microbes, the living part of soil organic matter, function as a transient nutrient sink and are responsible for releasing nutrients from organic matter for use by plants (e.g., N, P and S). An understanding of microbial processes is important for the management of farming systems, particularly those that rely on organic inputs of nutrients. The soil microbial community is involved in numerous ecosystem functions, such as nutrient cycling and organic matter decomposition, and plays a crucial role in the terrestrial carbon cycle. Chemical fertilizer generally improves crop production but, due to long term use they decrease the soil quality. On the other hand, use of organic materials (e.g., animal manures, crop residues, green manures, etc.) as an alternative source holds promise, they improves the soil quality and yes, improves the microbial population soil.

Materials and Methods

A long term studies on the impact of organic, integrated and chemical nutrient management practices on soybean production at AICRPDA, Indore, during 2017-18. From sowing to harvesting 16 Standard Meteorological weeks were recorded. 34.70

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Original Research Article

Nutrient Management Practices for Enhancing Soybean Production in Rainfed condition

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A B S T R A C T

An experiment was conducted in Kharif, at AICRPDA in College of Agriculture Indore, during 2017-18, to study the effects of different Nutrient Management Practices for enhancing Soybean Production. Here 3 replications and 9 treatments were taken in RBD. Highest yield (908 kg ha^{-1})recorded from Treatment 6(FYM 6t ha^{-1} + N20 P13) followed by T7 and T9. Lowest yield was recorded from control. Similarly, best yield attributing characters - Plant height (51.98), number of branches $plant^{-1}$ (4.13 $plant^{-1}$), number of pods $plant^{-1}$ (42.07 $plant^{-1}$), plant population (19.33 $plot^{-1}$), were recorded from treatment 6 (FYM 6t ha^{-1} + N20 P13). In all the different treatments, T6 was found superier and control was found inferior. Result shows that treatments in combination of inorganic and organics were superior over control.

Keywords

Soybean Production, Nutrient Management

Introduction

Soybean is one of the most important legume crop in the world. Soybean is grown approximately 6% of world's arable land. The latest survey by the apex industry body, the Soybean Processors' Association (SOPA), estimates India's soybean output at 8.35 million tonnes for the harvesting season 2017-18.After an extensive survey in the major soybean growing districts in Madhya Pradesh, Maharashtra and Rajasthan.

Traditional non-fermented food uses of soybeans include soy milk from which tofu and tofu skin are made. Fermented soy foods include soy souce, fermented bean paste, natto and tempeh. Together protein and soybean oil content account for 56% of dry soybeans by weight (36% protein and 5% ash). The remainder consists of 30% carbohydrates, 9% cotyledons and 2% hypocotyl axis or germ. 100 grams of raw soybeans supply 446 calories and 9% water, 30% carbohydrates, 20% total fat and 36% protein.

Soybean sown with the onset of the monsoon, is a kharif crop that contributes to nearly a third of India's overall oilseeds' output and sets the trend for other seeds such as groundnut and sesame in the summer sowing season, and rapeseed and mustard in winter. Cultivation is successful in climates with hot summers, with optimum growing conditions in mean temperatures of 20° to 30° C (68° to 86°F), temperatures of below 20 °C and over 40 °C (68 °F, 104°F) stunt growth significantly. They can grow in a wide range of soils, with optimum growth in moist alluvial soils with a good organic content.

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Original Research Article

Reduced tillage and use of organics: A progressive manoeuvre towards conservation of resources and improvement in soil intrinsic properties

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Keywords

Reduced tillage, soil intrinsic properties

A B S T R A C T

More recently, conservational tillage practices are being contemplated as an effective management practice to restore intrinsic physical soil fertility and overall soil health. An experiment was conducted at AICRPDA farm Indore, in kharif season 2017-18, in this study we used a combination of reduced tillage and organic materials namely, compost, straw and Glyricidia green leaves to assess their effect on soil properties. The design used in the experiment was RBD with soybean crop with eight treatments and each of them was randomized and replicated four times. Application of the different organic materials and reduction in the tillage intensity in different treatment plots connoted exaltation in different soil physical properties. Treatment T3in which reduced tillage was adopted with 4t ha^{-1}straw+ Hand Weeding depicted the foremost soil physical and chemical properties. Augmentation in available N, P, K and S after harvest was found in treatment T3.Also, in treatment T3 pH, EC and BD was found decreased whereas WHC and Porosity of the soil was found increased. Result showed that adoption of reduced tillage and application of different organics improved the nutrient status and physicochemical properties of the soil.

Introduction

Escalating global demand for food led to intensification of agricultural practices Ineffectual management practices with intensive agricultural practices during the last few decades has resulted in degradation of arable soils worldwide including breakdown of soil structure, accelerated oxidation, consequent loss of soil organic carbon (SOC) content and release of carbon dioxide to the atmosphere. Excessive disturbance of the top soil through intensive tillage operations and removal of residues in conventional tillage systems result in loss of soil fertility and hampers soil health. Soil health (Döring *et al.*, 2015) loss as a result of agricultural intensification is a global concern (Tittonell, 2014). Soil fertility is an important form of renewable natural capital (Sanchez *et al.*, 1997). The loss in fertility of the soil of farming land has become a major cause of poor yield of the crops. A fertile soil which is productive results most often in yield increase giving profit to farmers (Fresco and Kroonenberg, 1992). Intensive and conventional tillage led to a loss of soil fertility and reduction of soil water holding capacity and soil structural stability, by facilitating erosion by water and wind, and is reflected in a constant increase in the rates of fertilizers used by farmers to maintain crop productivity (Du Preez *et al.*, 2001; Roldán *et al.*, 2003; D'Haene *et al.*, 2008). With the loss in productivity farmers tend to use chemical fertilizers indecorously which leads

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Original Research Article

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GIS Based Mapping of Soil Fertility Status of Tehsil Jobat, District Alirajpur, Madhya Pradesh, India

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Arc-GIS, Electrical conductivity, Organic carbon, Site-specific nutrient management, Soil reaction

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The investigation was conducted in 2018-19 at Jobat Tehsil, District Alirajpur, to know the soil reaction, electrical conductivity, organic carbon content and status of primary nutrients. Surface soil samples were collected grid wise by using cadastral map of the study area and were analyzed for their fertility status. The value of pH, electrical conductivity, and organic carbon was ranged 6.15 to 8.48, 0.08 to 0.74 dSm^{-1}, and 0.20 to 0.81% respectively. The available nitrogen, phosphorus, potassium ranged from 96 to 315 kg ha^{-1}, 0.60 to 25.20 kg ha^{-1} and 114.46 to 472.64 kg ha^{-1} respectively. The available nitrogen was in low, phosphorus content varied from low to medium and medium to high in potassium. Using the field survey and laboratory analysis results, the soil heterogeneity units were determined using Arc-GIS 10.5.1. Based on data obtained after analysis; the maps of all parameters were prepared which will be successfully used in the future for site-specific nutrient management.

Introduction

Soil is the basic requirement of all life on earth. The origin of life has been attributed is soil along with other basic elements. Soil the source of life is passionate. An excessive or imbalanced application of fertilizers not only wastes this limited costly resources, but also pollutes the environment. In the face of economic and environmental concerns, farmers face in increasing challenge of effective soil fertility management (Singh *et al.,* 2020). An approach towards justifying such concerns is site-specific nutrient management, which takes into account spatial variations in nutrients status, thus cutting down the possibility of over or under use of fertilizer.

Fertility assessment is the process of estimation soil susceptibility in processing plant nutrients required for optimal growth.

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Screening of Pigeonpea Genotypes against Leaf Spot Incited by *Cercospora cajani*

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Keywords

Cercospora, Fungal diseases, IVT, genotypes

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A B S T R A C T

Cercospora leaf spot caused by *Cercospora cajani* Henningsis one of the most important fungal diseases of Pigeon pea [Cajanus cajan (L.) Millsp.].Screening of IVT forty one, eleven IVT Early & Extra Early genotypes were undertaken in poly house conditions during 2017-18.A mong IVT forty one genotypes CRG-16-008 was found completely disease free genotype is statistically at par with RKPV-911significantly superior to other remaining genotypes and eleven IVT Early & Extra Early genotypes two AL 2211 and RKPV 705 genotype are immune or resistant against Cercospora *cajani*. AL211 and RKPV 705 were significantly superior over the PUSA 2018-5, AL 1992, PUSA-2018-3, AL 2207, RKPV 704, and PUSA 2018-4 and statistically at par with RVKT 314, PUSA 2018-2, and PUSA-2018-1.

Introduction

Pigeonpea [*Cajanus cajan* (L.)] is an important grain legume crop of rainfed agriculture in the semi-arid tropics. Besides Indian sub-continent, it is widely grown in Eastern Africa and Central America. It is not only an important source of protein, but also plays an important role in atmospheric nitrogen fixation into soil (Reddy *et al.*, 2012).Globally pigeonpea is cultivated in about on 4.7 million ha area with 3.69 million tonnes annual production. India accounts 78% of the global output with current production of 2.78 million tonnes from 3.5 million ha. In Madhya Pradesh Pigeonpea is grown in about 0.57 million ha with an annual production of 0.57 million tonnes.

The average yield of Pigeonpea in M.P. is 848 kg/ha which is much larger than the potential yield of crop (1500-2000 kg/ha). Several biotic and abiotic factors are responsible for reducing the yield (Anno. 2018).

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Potential impact of future climate change on maize (*Zea mays L.*) under rainfed condition in central India

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ABSTRACT

A simulation experiment was carried out using Agriculture Production Systems Simulator (APSIM) model to assess the impact of climate change (change in temperature and rainfall patterns) on productivity of maize in the state Madhya Pradesh. Thirty districts with 74 soil profiles from Madhya Pradesh state were considered for the study. However, we are presenting the average results over districts and soil profiles. A well-parameterised and validated APSIM model was used to simulate the effects of temperature and rainfall on maize grain and biomass yield. Increase in temperature having negative effects on both grain and biomass yield of maize. While increasing the temperature from base to 5 °C, the grain and biomass yield of maize decreased by 40% and 28%, respectively. Further, increasing the temperature by 1 °C could reduce the grain and biomass yield by 10% and 8 %, respectively. A small increase in maize yield was observed by 10% decrease of rainfall from the base. While rainfall increase by 10% or more and decrease by >20% would results in lower maize yield and biomass. The decrease in maize yield due to increase in temperature could be attributed to decrease in duration of the crop. One-degree increase in temperature may decrease the duration of crop by 4.3 days. This study also revealed that agronomic management practices such as delaying of sowing dates could reduce the impact of climate change on crop yield to a considerable extent. By adopting the sowing date between 7th and 14th July, it may be possible to reduce the impact of temperature change on maize grain and biomass yield in central Indian condition.

Key words: Maize, climate change, rainfed, central India

Maize (*Zea mays L.*) is one of the most versatile crops owing to wider adaptability under diverse agro-climatic conditions. Worldwide, it is cultivated on nearly 150 mha in about 160 countries, representing diverse soil, climate, biodiversity, and management practices, and contributes ~36% (782 million tonnes, mt) of global grain production (Singh *et al.,* 2017). In India, maize is the third largest staple food crops in terms of area and contributes nearly 9% in the national food basket. The predominant maize growing states that contributes more than 80% of the total maize production are Andhra Pradesh (20.9%), Karnataka (16.5%), Rajasthan (9.9%), Maharashtra (9.1%), Bihar (8.9%), Uttar Pradesh (6.1%), Madhya Pradesh (5.7%), and Himachal Pradesh (4.4%) (Murdia *et al.,* 2016). Maize is one of the promising options for diversifying agriculture in upland areas of India. The area under maize cultivation in India has gradually expanded over the past few years to about 9.19 million ha in 2014-2015 and produces 24.17 mt (Anonymous, 2016).

The change in climate in terms of rainfall variability and temperature fluctuation projected to have significant impacts on agricultural production (Battude *et al.,* 2016). Worldwide, researchers agree that anthropogenic emissions of greenhouse gases lead to accelerating climate change and their impact on agriculture sector at the local, regional and global scales (Li *et al.,* 2014). The impact of climate change on agriculture vary through the latitudes and from crop to crop (Msowoya *et al.,* 2016). Higher temperatures can reduce crop production in many parts of the world (Gohari *et al.,* 2013) although crop yield could increase in temperate region of the world (Chavas *et al.,* 2009).

Nevertheless, the majority of the past studies have generally reported that negative impact of climate change on crop production (McDermid *et al.,* 2016; Mohanty *et al.,*

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Physiological Modification of Patharchur *Coleus forskohlii* (Willd) Briq as Impact of Plant Growth Hormones

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Coleus, Cycocel, ppm, Patharchur, Hormones

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A B S T R A C T

A field experiment was carried out in the farmer field adjoining, RAK College of Agriculture, Sehore (Madhya Pradesh) during 2015 and 2016 to find out Physiological modification of Patharchur *Coleus forskohlii* (Willd) Briq as impact of Plant Growth Hormones. Field experiment consisting of Plant Growth Hormones MH @ (100 and 150 ppm), Cycocel @(500 and 1000 ppm), NAA @(50 and 100 ppm), GA_3 @ (150 and 200 ppm) and water spray as control. Bjective of the study is to study the impact of plant growth Hormones on physiology of *Coleus forskohlii* (Willd) Briq. Physiological parameters like, Photosynthesis rate (µmol CO_2 m^{-2} s^{-1}), Stomatal conductance ($mmol^{-1}m^2s^{-1}$), Transpiration rate (mmol H_2O m^{-2} s^{-1}), CO_2 utilization (µmol CO_2 mol^{-1}) and H_2O utilization (Kpa) by using IRGA and observations were recorded at 150 day after transplanting. Pooled data (2015 and 2016), 150 day after transplanting (DAT) revealed that application of Cycocel @1000 ppm resulted in increased Physiological parameters like, Photosynthesis rate (µmol CO_2 m^{-2} s^{-1}), Stomatal conductance ($mmol^{-1}m^2s^{-1}$), Transpiration rate(mmol H_2O m^{-2} s^{-1}), CO_2 utilization (µmol CO_2 mol^{-1}) and H_2O utilization (Kpa), respectively (13.14, 14.56, 3.64, 13.53 and 0.458) followed by Cycocel @ 500 ppm (12.68, 13.64, 3.19, 13.38 and 0.447) as compare to control (10.63, 9.90, 2.22, 9.99 and 0.349).

Introduction

Coleus forskohlii (Willd) Briq. [syn. *C. barbatus* (Andr.) Benth] is a plant in Indian origin (Valdes *et al.*, 1987) belonging to mint family and grows in the subtropical temperate climates of India, Nepal, Thailand and Sri Lanka. Coleus is an aromatic perennial, with an erect stem and tuberus roots, reaching 30 to 60cm tall having teardrop leaves (Prajapati *et al.*, 2003). The tuberous root of coleus is rapidly spreading and typically golden brown (Thorne Research, 2006). Coleus has been used since ancient times in Hindu and Ayurvedic medicine. *Coleus forskohlii* (Willd) Briq. [syn. *C. barbatus* (Andr.) Benth] (Patharchur) is an exclusive source of a labdane diterpene forskolin along with

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Molecular marker validation and identification of Fusarium wilt resistant chickpea genotypes

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Abstract

***Fusarium* wilt is one of the most destructive biotic stress reducing chickpea productivity worldwide. As a step towards understanding the basis of wilt resistance in chickpea, we investigated the morpho-physiological and biochemical traits of 29 desi and 15 kabuli chickpea genotypes and screened these genotypes for fusarium wilt disease using gene based molecular markers. The number of branches per plant were significant and positively correlated with number of pods per plant (r=0.635) and number of seed per plant (r=0.556) at 1% significance level. Biochemical parameters related to stresses were also analyzed for proline (1.19-3.92 µ mol/g), sugar (23.6-37.4 mg/g), malondialdehyde (MDA) (1.1 -3.67 nmol/g) and hydrogen peroxide (H_2O_2) (10.4-21.5 µ mol/g) in seeds of these genotypes grown under normal field conditions. Molecular screening was done by using15 gene-based markers. Polymorphic Information Content (PIC) value was in the range of 0.221 to 0.695, respectively. The genotypes JG-63 and Vijay identified during the investigation could be included in the hybridization programs during development of high yielding and wilt resistant varieties. The molecular markers TA194, TA-59, TA-96, TR-19, TR-29 and TR-31 can be used as marker assisted breeding tools for screening, validation and development of fusarium wilt resistant chickpea genotypes.**

Key words: Chickpea, Fusarium wilt, proline, sugar, MDA, Polymorphic Information Content (PIC)

Introduction

Chickpea, a self-pollinating diploid (2n=2x=16) species with a genome size of 740 Mbp, is the 2nd most important food legume in the world (FAO, 2018). It is rich in protein content as well as important for soil quality due to its ability of biological nitrogen fixation. It is widely grown in countries like India (67.4%), Australia (6.21%), Pakistan (5.73%), Turkey (3.86%) and Myanmar (3.74%) (Mannur et al. 2019). In India, major chickpea growing areas are covered by Madhya Pradesh (32.97%), Maharashtra (18.36%), Rajasthan (16.70%), Andhra Pradesh (8.55%), Karnataka (8.21%), Uttar Pradesh (6.85%) and Gujarat (2.92 %). The chickpea is divided into kabuli and desi types based on seed morphology. The white colour and relatively bigger in size with thin seed coat types are kabuli. The brown with thick seed coat and smaller in size are desi types. Productivity of chickpea is, restricted due to several abiotic and biotic stresses. Major biotic stresses of chickpea include the bacterial, viral and fungal diseases. Important fungal diseases are wilt and blight caused by *Fusarium oxysporum* and *Ascochyta rabei*, respectively. Wilt of chickpea is a major limiting factor of chickpea production in the Mediterranean Basin and the Indian Subcontinent. Annual yield losses due to *Fusarium oxysporum*. f. sp. *ciceri* range from 10 to 15% but it can be devastating to individual crops and cause 100% loss under favorable conditions (Sharma et al. 2004). Till today eight distinct physiological races *i.e*., 0, 1A, 1B/C, 2, 3, 4, 5 and 6 based on variation in virulence among isolates of foc races have been reported. The genetics of six resistance races has been studied extensively (Singh et al. 1987; Sharma et al. 2004). This disease is a soil borne and its causative agent has the potential to survive in soil even in absence of host for many years. Therefore, it becomes more

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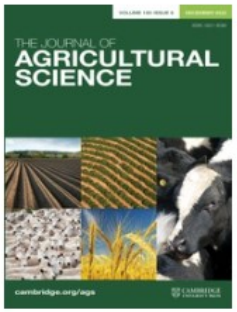

The Journal of Agricultural Science

Article contents

Abstract

References

Methane consumption potential of soybean-wheat, maize-wheat and maize-gram cropping systems under conventional and no-tillage agriculture in a tropical vertisol

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Bharati Kollah, Mahendra Bakoriya, Garima Dubey, Rakesh Parmar, J. Somasundaram, Abhay Shirale, S. C. Gupta, A. K. Patra and Santosh Ranjan Mohanty

Show author details

Abstract

Methane (CH_4) consumption in agricultural soil is imperative for the mitigation of climate change. However, the effect of tillage and cropping systems on CH_4 consumption is less studied. Experiments were carried out in Madhya Pradesh, India with soybean-wheat (SW), maize-wheat (MW) and maize-gram (MG) cropping systems under conventional tillage (CT) and no-tillage (NT). Soybean/maize was cultivated during the *kharif* season (July–October) and wheat/chickpea in the *rabi* season (October–March) for 9 years consecutively. Soil

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Manure addition influences the effect of tillage on soil aggregation and aggregate associated carbon in a Vertisol of Central India

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Abstract

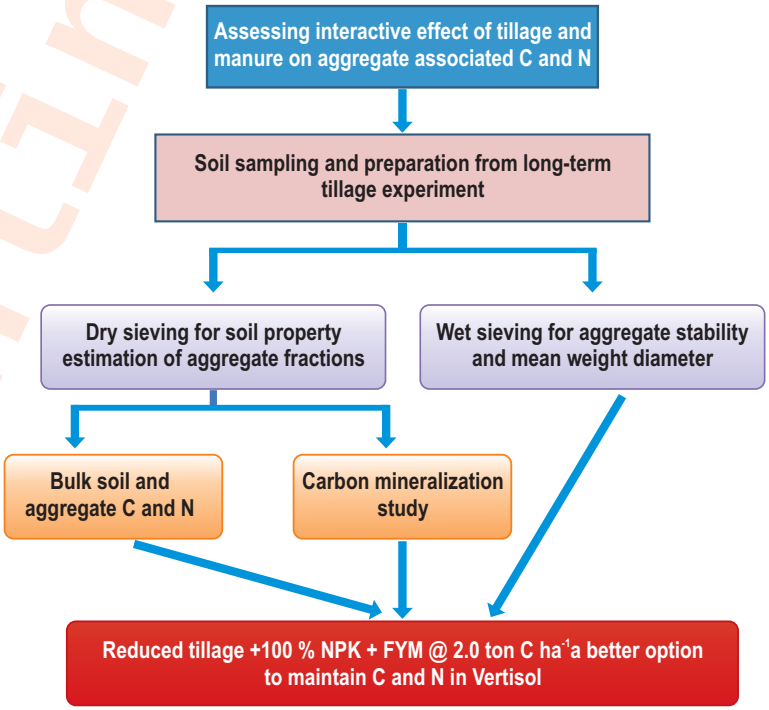
Aim: To study the combined effect of tillage and manure addition on bulk soil and aggregate associated carbon and nitrogen in Vertisol.

Methodology: The study was conducted in a long-term tillage experiment having two tillage treatments (reduced tillage and no-tillage) together with100% NPK fertilizer without (T_1) and with addition of farm yard manure (T_2) @ 2.0 ton C ha^{-1} to soybean in a soybean-wheat cropping system in a Vertisol of Central India, with three replicates in a split plot design. The parameters studied were aggregate size distribution, mean weight diameter, water stable aggregates, bulk soil and aggregate associated organic carbon, available nitrogen and rate of carbon mineralization.

Results: The results indicated significantly higher SOC in reduced tillage (0.87%) than no-tillage (0.71%) under100% NPK fertilization in the bulk soil for 0-15 cm depth. However, 100% NPK + FYM showed a significant increase in the bulk soil organic carbon in the no-tillage treatment only. Available nitrogen content in the bulk soil and aggregate fractions were significantly lower under no-tillage than the corresponding reduced tillage treatments. Manure addition led to significantly higher available N content and proportion of WSA in both the tillage practices. The carbon mineralization was significantly higher by 1.4 to 1.6 times under reduced tillage than no-tillage.

Interpretation: Long-term tillage study in Vertisol of Central India indicated reduced tillage to be a better option than no-tillage in maintaining organic carbon and nitrogen availability in soil.

Key words: Nitrogen, Soil aggregate carbon, Tillage, Vertisol, Water stable aggregates



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Influence of Plant Growth Hormones on Morphology and Yield of Patharchur (*Coleus forskohlii* (Willd) Briq)

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Keywords

Coleus, Cycocel, ppm, Patharchur, Hormones

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A B S T R A C T

This study was conducted at A field experiment was carried out in the farmer field adjoining, RAK College of Agriculture, Sehore (Madhya Pradesh) during 2015 and 2016. Field experiment consisting of Plant Growth Hormones MH @ (100 and 150 ppm), Cycocel @ (500 and 1000 ppm), NAA @(50 and 100 ppm), GA3 @(150 and 200 ppm) and water spray as control to study the influence of plant growth Hormones on morphology and yeild of *Coleus forskohlii* (Willd) Briq. The studies on morphological parameters, pooled data (2015 and 2016) at 150 day after transplanting (DAT) revealed that application of Cycocel @1000 ppm resulted in reduction of plant height (cm) plant^{-1} (51.11), increase fresh weight of plant (g) plant^{-1} (759.88) and dry weight of plant (g) plant^{-1} (104.33) followed by Cycocel @ 500 ppm respectively (54.30, 730.56, 89.49) as campier to control (63.35, 530.24, 63.78). The yield attributing parameters, at harvesting revealed that application of Cycocel @1000 ppm resulted in increased fresh weight of tuber (g) plant^{-1} (258.01), dry weight of tuber (g) plant^{-1} (42.93), and yield of tuber (t) ha^{-1} (2.60) followed by Cycocel @ 500 ppm respectively (240.27, 253.56 and 2.51) as compare to control (205.18, 229.47 and 2.01).

Introduction

India stands good position among mega-biodiverse countries in the world and known to be the storehouse of medicinal plants. Economic importance of medicinal plants is much more in India. Medicinal plants cultivated about 2,500 hectares in parts of Rajasthan, The importance of medicinal plant in health care results from the combination of secondary products present either in whole plant or in plant parts. These secondary products may be phytochemicals, steroids, biologically active compounds, alkaloids, antioxidants, flavonoids, pigments etc. and day by day the demand of these compounds is increasing. *Coleus forskohlii* (Willd) Briq. [syn. *C. barbatus* (Andr.) Benth] is a plant in Indian origin (Valdes *et al.,* 1987) belonging to mint family Lamiaceae and grow perennially over tropical and sub tropical region of India, Pakistan, Sri Lanka, East

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Research Article

Influence of P & K with and without *Rhizobium japonicum* and Phosphorous Solubilizing Bacteria on Growth and Yield Sustainability of Soybean in Black Soil

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ABSTRACT

An experiment was conducted to study during kharif season of 2016 and 2017 at Sehore (M.P). The experiment was laid out in Randomized block design with three replication having Ten treatments viz. Control (T1), Bradyrhizobium japonicum alone(T_2), Local check (KRIBHICO–rhizobium culture(T3), T_2+ P $_{60}$ kg/ha through SSP(T4), T_2 + K $_{30}$ kg through MOP(T5), T_2 + PSB 10 g/kg seed treatment(T6), T_2 + P $_{30}$ kg/ ha + PSB 10 g/kg seed treatment(T7), T_2 + K 15kg /ha + PSB 10 g/kg seed treatment(T8), T_2 + T_8 (T9) and P $_{60}$ kg/ ha+ K $_{30}$ kg/ha (T_{10}). On the basis of results obtained on various parameters as per approved synopsis following summary and conclusions have been drawnout: Growth characters such as no. of branches/plant, dry weight/plant, number and dry weight of root nodules attained significantly higher values with the application of P $_{60}$ kg/ ha+ K $_{30}$ kg/ha (T_{10}) as compared to other treatments followed by (T_5 and T_6).Yield and yield attributing characters such as no. of pods/plant, seed index and seed yield attained significantly higher values with the application of P $_{60}$ kg/ ha+ K $_{30}$ kg/ha (T_{10}) as compared to other treatments followed by (T_5 and T_6). Number of pods per plant was noted higher in the treatment P $_{60}$ kg/ ha+ K $_{30}$ kg/ha (T_{10}) as compared to other treatments followed by (T_5 and T_6). Appreciably higher seed index was noted under P $_{60}$ kg/ ha+ K $_{30}$ kg/ha (T_{10}) as compared to other treatments followed by (T_5 and T_6). Application of P $_{60}$ kg/ ha+ K $_{30}$ kg/ha (T_{10}) as compared to other treatments followed by (T_5 and T_6) gave significantly higher N, P, K, Zn, B & Mo in straw and seed as compared to other treatments and control. Application of P $_{60}$ kg/ ha+ K $_{30}$ kg/ha (T_{10}) as compared to other treatments followed by (T_5 and T_6).also improved the content of N, P, K , Zn, B and Mo in soil at harvest of soybean.

Key words: *Soybean, Rhizobium, Kharif, FYM*

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RESEARCH ARTICLE Legume Research- An International Journal, Volume 45 Issue 10: 1197-1208 (October 2022)

Evaluation of Physiological and Biochemical Contents in Desi and Kabuli Chickpea

Vinod Kumar Sahu, Sushma Tiwari, Neha Gupta, M.K. Tripathi, M. Yasin[1]

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ABSTRACT

Background: Chickpea (*Cicer arietinum* L.), a self-pollinating legume being cultivated globally as a rich source of vegetarian protein. It plays an important role in human feed and nutritional security, especially in agricultural-based communities. Chickpea has higher bioavailability of protein, good sources of polyphenols and flavonoids. Besides their nutritional value, chickpea seeds contain various phenolic compounds. Phenolic compounds are of particular interest due to their contribution to the seed colour, sensory characteristics and several biological properties. Flavonoids are one of the main groups of phenolic compounds found in grain legumes. Desi and Kabuli chickpeas are being used worldwide and there are few studies where both desi and kabuli chickpeas seed flour for above properties with respect to physiological traits has been reported.

Methods: The present investigation has been formulated to compare popular chickpea genotypes of desi and kabuli types for biochemical parameters *viz*., protein content, amino acid, total flavonoid content, total phenolic contents and RSA as well as two physiological traits *i.e*., chlorophyll content and leaf area index. The experiment consisted of 44 genotypes grown in randomized block design with row to row distance of 30 cm, in two replications during *Rabi* 2018-19.

Result: The average crude protein content in desi and kabuli chana varied from 18.2% (Dollar variety) to 26.7% (JG315) and total phenolic content (TPC) ranged 1.22 to 0.74 mg/g. Total flavonoid content (TFC) varied from 0.39 (ICCV-2) to 0.61 mg/g (JAKI-9218) with mean value of 0.47. Radical scavenging activity (RSA) in chickpea genotypes ranged from 36.2 to 49.5% with mean value of 40.86%. Total amino acid significantly correlated with TPC and TFC and TPC significantly correlated with TFC at 5% significant level.

Key words: Desi chana, DPPH, Kabuli chickpea, Leaf area index.

INTRODUCTION

Chickpea (*Cicer arietinum* L.), a self-pollinating diploid (2n=2x=16) species with a genome size of 740 Mbp, is the world's second largest grown pulse crop after beans. Chickpea is a valuable legume due to rich source of protein. India is the producer of 75% of world's chickpea production. Production of chickpea has increased worldwide by 56% and during in period 2004-2013 in India by 55%. Australia, Pakistan, Myanmar, Ethiopia, Mexico, Canada, USA, Tanzania and Malawi are other chickpea producing countries (Gaur *et al*. 2016). The United Nations General Assembly declared the year 2016 as International year of pulses with the record production of pulses in India of 17.56 Mt. Also, India emerged as the largest chickpea producer in the world with the production of 7.8 Mt (Kumar *et al*. 2018; Kaur *et al*. 2019). In India, the major chickpea producing states are Madhya Pradesh, Uttar Pradesh, Rajasthan and Maharashtra. Madhya Pradesh is the largest producer of chickpea in the country accounting for over 40 per cent of the total national production.

Pulses have both environmental and nutritional benefits, they are often recommended in sustainable diets (Chaudhary *et al*. 2018). Their environmental benefit is related to their ability to restore soil nitrogen by process of nitrogen fixation. The Food and Agriculture Organization (FAO) recommend pulses as staple food to fulfil the basic protein and energy requirements of the human diet (Mudrai *et al*. 2014). Due to the balanced nutrient composition, chickpea is a popular pulse in human diet. Chickpea is an outstanding source of nutritional constituents such as proteins and minerals (Gupta *et al*. 2017). Cereals are rich in thiol containing amino acids (methionine and cysteine) and deficient in lysine whereas pulses are rich in lysine and deficient in methionine and cysteine. In human diet proper intake of essential amino acids, pulses are taken with addition of cereals (Reinkensmeier *et al*. 2015). Indeed, pulse grains are a low-fat source of proteins and carbohydrates. Now a day's pulses have main interest as a gluten-free food category. They exhibit complementary amino acid profiles to those of cereals in well-balanced semi-

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RESEARCH ARTICLE

Evaluation and identification of wild lentil accessions for enhancing genetic gains of cultivated varieties

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Abstract

Domesticated lentil has a relatively narrow genetic base globally and most released varieties are susceptible to severe biotic and abiotic stresses. The crop wild relatives could provide new traits of interest for tailoring novel germplasm and cultivated lentil improvement. The primary objective of this study was to evaluate wild lentil accessions for identification of economically viable agro-morphological traits and resistance against major biotic stresses. The study has revealed substantial variations in seed yield and its important component characters. Further, the diversity analysis of wild accessions showed two major clusters which were bifurcated into sub-clusters, thereby suggesting their wider genetic divergence. However, principal component analysis exhibited that seed yield plant^{-1}, number of seeds plant^{-1}, number of pods plant^{-1}, harvest index and biological yield plant^{-1} contributed significantly to the total genetic variation assessed in wild lentil taxa. Moreover, some of the wild accessions collected from Syria and Turkey regions showed resistance against more than one disease indicating rich diversity of lentil genetic resources. The identification of most promising genotypes carrying resistance against major biotic stresses could be utilized in the cultivated or susceptible varieties of lentil for enhancing genetic gains. The study has also identified some trait specific accessions, which could also be taken into the consideration while planning distant hybridization in lentil.

Introduction

Lentil is a self-pollinating true diploid (2n = 2x = 14) grain legume crop having genome size of 4063 Mb [1]. The cultivated lentil species (*Lens culinaris*) encompasses two groups, established on the basis of distinct morphological characters, the small-seeded (*microsperma*) and large-seeded (*macrosperma*) [2]. The production and productivity of lentil has increased from an average yield of 565 kg ha^{-1} in 1961–63 to 1153 kg ha^{-1} during 2016–2017 [3]. Despite the

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Effect of sulphur and zinc on growth and yield of kharif onion (*Allium cepa* L.)

RK Jaiswal, SA Ali, Jayashri Niwariya and Nidhi Mewara

Abstract
A field experiment was laid down to evaluate effect of Sulphur and Zinc of growth and yield of onion. Experiment was carried out during *kharif* season of 2018-19 at Horticulture farm, College of Agriculture, Sehore RVSKVV, Gwalior in factorial randomized block design with three replications. The experiment was comprised of ten treatments *viz*., T_1: 0 Kg Sha-1, T2: 18.75 Kg Sha^{-1}, T_3: 37.50 Kg Sha^{-1}, T_4: 56.25 Kg Sha^{-1}, T_5: 75 Kg Sha^{-1}, T_6: 0 Kg (Zinc EDTA 12%) ha^{-1}, T_7: 2.5Kg (Zinc EDTA 12%) ha^{-1}, T8: 5 Kg (Zinc EDTA 12%) ha^{-1}, T_9: 7.5 Kg (Zinc EDTA 12%) ha^{-1}, T_{10}: 10 Kg (Zinc EDTA 12%) ha^{-1}.
Observation recorded on Growth attributing Characters *viz*., plant height, no. of leaves per plant, leaf length per plant, and leaf width per plant recorded at 30, 60 and 90 DAT; Yield attributing characters *viz*., no. of bolting per plant, neck thickness, equatorial diameter, polar diameter of bulb, No. of scales per bulb, Girth of bulb, Dry matter of tops per hectare fresh weight of bulb, bulb yield per plot, bulb yield per hectare. Present study revealed beneficial effect of sulphur and zinc on growth and yield of onion.

Keywords: Onion, sulphur, zinc, bulb yield

Introduction
Onion (*Allium cepa* L.) is a bulbous biennial herb of amaryllidaceae family. Onion is a vegetable and spice crop cultivated commercially almost all the countries of the world and consumed across the globe. The produce of *rabi* season is stored for consumption in summer and *kharif*, but due to lack of proper storage condition and losses due to spoilage in the *monsoon* season and the prices goes up. Hence, production of onion during *kharif* is required to fill up the gap of demand and supply.
In recent years, sulphur deficiency is becoming widespread due to continuous use of sulphur free fertilizers, high yielding varieties and intensive cropping of high sulphur requiring crops. Leaching and erosion losses also contribute to sulphur deficiency.
Sulphur is an essential constituent of certain amino acids namely cysteine, cystine and methionine and involved in synthesis of protein and sulphur bearing vitamins like biotine, thiamine and some coenzymes. It is also a constituent of allyl propyl disulphide, which imparts the specific pungency to onion. It is involved in the formation of chlorophyll that permits photosynthesis. On the other hand, sulphur deficiency may be responsible for cupping of leaves, reddening of stems and petiole and stunted growth. Therefore, adequate attention should be paid to sulphur fertilization.
Zinc is an essential micronutrient, which has become increasingly important in agricultural production during the past two decades. It plays an important role in various enzymatic and physiological activities of the plants.

Materials and Methods
The investigation was carried out at research field, department of Horticulture, College of Agriculture, Sehore campus of RVSKVV, Gwalior during *kharif* season 2016-17. The experiment was comprised of ten treatments *viz*., The experiment was comprised of ten treatments *viz*., T_1: 0$KgSha^{-1}$, T_2: 18.75 $KgSha^{-1}$, T_3: 37.50 $KgSha^{-1}$, T_4: 56.25 $KgSha^{-1}$, T_5: 75 $KgSha^{-1}$, T_6: 0 Kg (Zinc EDTA 12%)ha^{-1}, T_7: 2.5Kg (Zinc EDTA 12%) ha^{-1}, T_8: 5 Kg (Zinc EDTA 12%) ha^{-1}, T_9: 7.5 Kg (Zinc EDTA 12%)ha^{-1}, T_{10}: 10 Kg (Zinc EDTA 12%)ha^{-1}. Experiment was laid out in Factorial Randomized Completely Block Design with three replications. Full dose of phosphorus, potash and ½ dose of nitrogen were applied.
Full quantity of phosphorus and potash along with one third of nitrogen was applied as per treatment plot before transplanting the seedling. While, the rest of the nitrogen was applied in two equal splits doses at 25 and 50 days after transplanting.

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Effect of organic manures and biofertilizers on growth, yield and quality of cabbage (*Brassica oleracea* L. var. c*apitata*)

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ABSTRACT

An investigation was carried out during rabi season of 2017-18 at Horticulture farm, College of Agriculture, Sehore RVSKVV, Gwalior to study experiment "Effect of organic manures and bio fertilizers on growth and yield of cabbage (Brassica oleracea L. var. capitata)". Experiment was carried out in randomized block design with three replications The experiment was comprised of ten treatments viz., T_1:V_1 (Green galaxy) + FYM @20t/ha + Azotobacter@2.5kg/ha, T_2: V_1 (Green galaxy) + Vermicompost @5t/ha+Azotobacter @2.5kg/ha, T_3: V_1 (Green galaxy) - Poultry Manure @5t/ha + Azotobacter @2.5kg/ha, T_4: V_1 (Green galaxy) + Pig Manure@5t/ha + Azotobacter @ 2.5kg /ha, T_5: V_1 (Green galaxy) + Recommended doses of manure and fertilizer (NPK@ 100:60:80 kg/ha respectively), T_6: V_2 (Green ball) + FYM @20t/ha + Azotobacter@2.5kg/ha, T_7:V_2 (Green ball) + Vermicompost@5t/ha + Azotobacter @2.5kg/ha, T_8 : V_2 (Green ball) + Poultry Manure@5t/ha +Azotobacter@2.5kg/ha, T_9:V_2 (Green ball) + Pig manure@5t/ha + Azotobacter@2.5kg/ha, T_{10} : V_2 (Green ball) + Recommended doses of manure and fertilizer (NPK).The maximum plant height, stalk length, maximum number of non-wrapper leaf per plant, plant spread, maximum head size, head diameter, gross head weight, head compactness, head yield per plot, head yield per hectare, maximum self life (11.54 days), highest benefit cost ratio (1:1.41) and maximum net return (229244 Rs./ha) under the treatment T_8 (Green ball + Poultry Manure@5t/ha + Azotobacter@2.5kg/ha)closely followed by T_9 (10.22 days) for all the characters.Whereas minimum growth and yield parameters was recorded under the treatment T_5 (Green galaxy + Recommended doses of manure and fertilizer).

Key Words: Cabbage, organic manure, poultry manure (PM), vermicompost (VC), *Azotobacter*

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INTRODUCTION

Cabbage (*Brassica oleraceae* L. Var *capitata*) is a cole crop and belongs to the family Cruciferae or Brassicaceae having chromosome number 2n=2x=18. Cabbage is a cool season crop but adapted to a wide range of climates and soils but best results are obtained in a cool environment with a monthly temperature of 13°C to 16°C and where soil is well supplied with nutrients and irrigation water. In India the productivity is low as compared to other countries Therefore there is a need to increase productivity [3-5]. There are many factors involve in overall growth of cabbage viz., nutrient management, irrigation, plant protection measures, varieties etc [30, 20-22]. Among these factors nutrient management is an important factor to increase productivity of cabbage. Since long term use of inorganic fertilizer reduces soil fertility therefore there is a need to maintain soil fertility through

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Effect of gibberellic acid on growth, quality and yield of tomato varieties (*Lycopersicon esculentum* Mill.)

S Mukati, DK Raidas and B Choudhary

Abstract
An experiment was conducted to find out the effect of different concentration of Gibberellic acid on tomato varieties at Horticulture Farm, RAK College, of Agriculture Sehore, Madhya Pradesh during *Kharif* 2017. The experiment consisted of two tomato variety-Amrutha (V_1) and Abhilash (V_2) with six treatments and five levels of Gibberellic acid (12.5 ppm, 25 ppm, 37.5 ppm, 50 ppm and 62.5 ppm), arranged in randomized block design with three replications. The highest plant height, Number of leaves, Leaf area, No. of Branches, Shoot girth (cm), Number of fruits and Fresh fruit weight has been observed and total soluble solid (TSS) was estimated for GA_3 62.5 ppm.

Keywords: Tomato, *Lycopersicon esculentum Mill.*, GA3 spray, ppm, growth, yield

1. Introduction
Tomato (*Lycopersicon esculentum* Mill.) of the family Solanaceae is said to be native of Peru of South America but occupies an important position among the vegetable crops. Tomato is the most important warm season fruit vegetable grown throughout the world. Among vegetables, tomato occupies 4th position in area and 2nd position in production in India. In India tomato covers an area about 7.9 lac ha with 19.5 MT production and productivity was 23.2 tones/ha. (Anonymous 2016) [1]. In MP tomato covers an area of about 0.70 lac ha with 2.1 MT production and productivity was 30.8 tones/ha. (Anonymous, 2016) [1] Plant growth regulators (also called plant hormones) are numerous chemical substances that profoundly influence the growth and differentiation of plant cells, tissues and organs. Plant growth regulators function as chemical messengers for intercellular communication. In tomato, different growth regulators play a pivotal role in germination, root development, branching, flower initiation, fruiting, lycopene development, synchronization and early maturation, parthenocarpic fruit development, ripening, TSS, acidity, seed production etcetera. To boost the tomato production in India these versatile resources greatly help the professionals and researchers. (Pramanik *et al*., 2017) [9]. The influence in yield and quality may vary greatly depending upon the type of plant growth regulator and their concentration and its method of application. Presently a large number of plant growth regulators are available in the market but their method of application and concentrations may vary crop to crop, season to season and climate to climate. Hence, they are very meager available in this crop. So there is urgent need to identify the most suitable plant growth regulators and their appropriate concentrations to increase yield as well as quality parameters of tomato for higher production and for commercial applications to the farmers. Use of plant growth regulators (PGR's) might be a useful alternative to increase crop production. Recently, there has been global realization of the important role of PGR's in increasing crop yield. GAs constitute a group of plant hormones that control developmental processes such as germination, shoot elongation, tuber formation, flowering, and fruit set and growth in diverse species. The most widely available plant growth regulator is GA_3 or gibberellic acid, which induces stem and internode elongation, seed germination, enzyme production during germination and fruit setting and growth (Davies, 1995). gibberellic acid is an important growth regulator that may have many uses to modify the growth, yield and yield contributing characters of plant (Rafeekher *et al*., 2002).

2. Materials and Methods
This study was conducted at Horticulture Farm, RAK College, of Agriculture Sehore, (Madhya Pradesh) during *Kharif* 2017). The experiment consisted of two tomato variety-Amrutha (V_1) and Abhilash (V_2). The tomato verities seeds were sown in nursery on July 15, 2017. Healthy seedlings of about one-month old were used for transplanted in the

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Effect of different weed management practices on growth and yield of cauliflower (*Brassica oleracea* var. *botrytis* L.)

K Choube, DK Raidas, RK Jaiswal and S Chakraborty

Abstract
A field experiment was conducted during Rabi, 2018-19 at RAK College of Agriculture, Sehore (M.P.) to study the effect of different weed management practices on growth and yield of cauliflower. The treatments namely - T_1- Weedy check (control), T_2- Weed free (through hand weeding) at 30 & 60 DAT, T_3 -Pendimethalin 30% EC (PE) + 1 HW at 30 DAT, T_4 Oxyfluorfen 23.5% EC (PE) + 1 HW at 30 DAT, T_5 - Propaquizafop 10% EC (POE) + 1 HW at 60 DAT, T_6 -Wheat straw mulch 5kg/plot, T_7- Black plastic mulch (150 mm) were evaluated in randomized block design with three replications. Results indicated that the T_7 -Black plastic mulch (150 mm) recorded maximum value of plant height (cm), stalk length (cm), number of leaves/plant, Leaf area (cm^2), Chlorophyll content (SPAD value) and yield attributing characteristics curd length, curd width, average curd weight, curd yield and marketable curd yield (q/ha). It was followed by T_2 - weed free (through hand weeding) at 30 & 60 DAT. Maximum plant height, stalk length, number of leaves/plant, Leaf area (cm^2) and Chlorophyll content (SPAD), total curd yield (q/ha) and marketable curd yield (q/ha) was recorded with the treatment T_7- Black plastic mulch (150 mm).

Keywords: Growth, leaf area, plant height, SPAD, weed, yield

1. Introduction
Cauliflower (*Brassica oleracea* var. *botrytis* L.) is one of the most popular vegetable crop among the Cole crops and has originated from the mediterranean region. It was introduced in our country in 1822. Cauliflower belongs to family brassicaceae and is grown for its white tender curd which is used for vegetable, curry, soup and pickle preparations. Besides being good source of protein and carbohydrates, cauliflower is a rich source of vitamins and minerals (Bana *et al.*, 2012) [1]. India ranks second in area and production of cauliflower in the world after China. In India major cauliflower growing states are West Bengal, Bihar, Maharashtra, Madhya Pradesh, Orissa, Gujarat and Haryana etc. It is grown in an area of 435.9 thousand hectare with production of 8573.3 thousand metric tones and productivity of 19.8 metric tons per hectare in India. In Madhya Pradesh, it is grown in an area of 25.1 thousand hectare with a production of 70.38 metric tons and highest productivity of 28.1 metric tones per hectare (NHB, 2015) [5]. In India annually undergoes considerable loss due to various stresses of the agriculture and among these, weeds top the list by contributing 33% towards total loss. Weeds interfere with crop plants severely reduce crop growth and lower yield and quality (Mal *et al.*, 2005) [4]. Although considerable research work has been carried out in India on various aspects of cauliflower cultivation, but the problem of weeds in this crop need special attention, as weeds when present in the field reduce the yield and impair the quality of the produce for vegetable purposes, the crop remain in the field for about four months and during its growth period, the crop faces competition due to presence of monocot and dicot weed. Keeping in view the seriousness of weed problems, high cost of manual labor and availability of different herbicides, the present investigation was planned to assess the effect of weed management practices on growth and yield of cauliflower.

2. Materials and Methods
The field experiment was conducted during Rabi season, 2018-19 at Research Field of the Department of Vegetable Science, RAK College of Agriculture, Sehore (M.P). Seven treatment consisted T_1- Weedy check (control), T_2- Weed free (through hand weeding) at 30 & 60 DAT, T_3 -Pendimethalin 30% EC (PE) + 1 HW at 30 DAT, T_4 Oxyfluorfen 23.5% EC (PE) + 1 HW at 30 DAT, T_5 - Propaquizafop 10% EC (POE) + 1 HW at 60 DAT, T_6 -Wheat straw mulch 5kg/plot, T_7- Black plastic mulch (150 mm) were arranged in randomized block design with three replications.

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Role of plant growth hormones on economic yield, andrographolide and active ingredient content in Kalmegh (*Andrographis peniculata* Burn F. Ex)

Raidas DK, Upadhayaya SD, Sharma A and Choudhary AK

Abstract
Kalmegh is known as green Chiretta or King of bitters. Investigations undertaken aiming to increase the growth and yield traits and biochemical constitute of Kalmegh. The investigations were carried out at the Farmer field, Village Badiyakhedi, District Sehore, (Madhya Pradesh) during Kharif season 2015-16 to study the influence of plant growth hormones viz., Cycocel (100, 150 and 200ppm), GA_3 (100, 150 and 200ppm), NAA (100, 150ppm) and control (water sprayed) at different concentrations on morpho-physiological traits and economic yield of Kalmegh (*Andrographis peniculata* Burn F. Ex) exhibited maximum plant height, number of branches, fresh weight of leaves, dry weight of leaves, fresh weight of plant, dry weight of plant, chlorophyll content, photosynthesis rate, CO_2 and H_2O utilization, seed yield, dry herbage yield, andrographolide and active ingredient content. Significantly higher Seed yield (621.78 Kg/ha), dry herbage yield (46.61 q/ha), andrographolide (2.59%) and active ingredient content (105.66 Kg/ha) was obtained by treated with GA_3 @100ppm as compare to other treatments at harvest.

Keywords: Growth hormones, GA3, ppm, andrographolide, harbage yield, active ingredient

Introduction
Kalmegh (*Andrographis peniculata* Burn F. Ex) is a genus of herbs and shrubs, distributed mostly in the tropical and moist regions. It comprises of about 19 plant species found in India and Sri Lanka, certain parts of Thailand and Bangladesh. In India it is grown in Assam, Bihar, Karnataka, Karla, Madhya Pradesh, Andhra Pradesh and West Bengal. Kalmegh, also known as "King of bitter" is one among the prioritized medicinal plants in India, and this herb is being used mainly for treating fever, liver disease, diabetes, snake bite etc. The leaf and the whole herb contain the medicinal properties and is useful in treatment of diabetes, influenza, bronchitis, hepatomegaly, skin disorder and many such diseases (Patra *et al.* 2004) [8]. The plant contains Andrographolides, neo-Andrographolides, Deoxy-Andrographolides. The leaves of Kalmegh contain maximum active principle Andrographolides, Homo-Andrographolides, Andrographesterol and Andrographone. Andrographolides the major constituent in leaves which is bitter substance. The leaves contain much more of Andrographolides then seed The average Andrographolides content varied from 12.44 to 33.52 mg/g in dried leaves which is found maximum at 90-120 days. Andrographolides is colorless, bitter crystalline compound. The term plant growth regulators however applied in phyto hormone as well as synthetic compound (Nickell, 1978) [6]. Plant growth regulators are organic compound, other than nutrients, that modify plant physiology processes. Plant growth regulator called bio stimulants or bio inhibitors, act side plant cell to stimulate or inhibit specific enzyme or enzyme system and help regulate plant metabolism. They are normally active at very low concentration in plant. The specific plant growth hormones are used to modify crop growth rate and pattern during the various stages of development, from germination to harvest and post harvest preservation. Growth hormone chemicals that have positive influences on major medicinal plant can be of value for higher economic yield and quality of medicinal content.

Material and Methods
The experiment was conducted at Farmer field, Village Badiyakhedi, District Sehore, (Madhya Pradesh) during Kharif season 2015-16. Nine treatments (Cycocyl @100, 150 and 200ppm), (Gibberellic acid @100, 150 and 200ppm), (NAA @100 and 150ppm) and control (water spray). Treatments were evaluated in RBD with three replications. The seeds were sown on June 15th, 2015 and in nursery beds in lines of 10 cm apart and 1 cm deep and covered with fine sand. Seed germination was noticed after 7 days of sowing which continued till another week. A seed rate of 400 g per hectare was used. After sowing the seeds in the nursery, watering was applied daily by using rose can.

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Research Article

Response of Kalmegh (*Andrographis peniculata* Burn F. Ex) To Foliar Spray of Plant Growth Hormones on Morpho-Physiological Traits

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ABSTRACT

Andrographis paniculata, commonly known as Kalmegh or green chirata, is used both in Ayurvedic and Unani system of medicines because of its immunological, antibacterial and hepatoprotective properties. It is an annual herb has high value compound used in the treatment of the various diseases. A field experiment was conducted at Farmer field Village, Badiyakhedi, District Sehore (Madhya Pradesh) during Kharif 2015 & 2016. Investigations undertaken aiming to increase the growth and yield traits of Kalmegh. Application of different plant growth hormones viz., Cycocel @100ppmm, Cycocel@150ppm, Cycocel@200ppm, GA_3 @100, GA_3@150ppm, GA_3@200ppm, NAA@100ppm, NAA@150ppm and water spray as control to study the influence of plant growth hormones on growth viz., plant height (cm) plant^{-1}, number of branches plant^{-1}, fresh weight of plant (g) dry weight of plant (g), leaf area cm^{2}plant^{-1}, chlorophyll index (SPAD), photosynthesis rate (µmol CO_2 m^{-2} s^{-1}), CO_2 (ppm) utilization and H_2O (Kpa) utilization at 90 DAT and yield viz., 1000-seed weight (g), seed yield (kg ha^{-1}), dry herbage yield (q ha^{-1}) and active ingredient content (Kg ha^{-1}) in Kalmegh at maturity. Application of different plant growth hormones significantly increased the maximum number of branches plant^{-1} under foliar sprayed with Cycocel @100ppm, maximum plant height^{-1}, fresh weight of plant, dry of plant, photosynthesis rate, CO_2 utilization (ppm) and H_2O utilization (Kpa) recorded under foliar spray with GA_3@100ppm, respectively.

Keywords: *GA_3, Cycocel, NAA spray, Photosynthesis rate, H_2O utilization.*

INTRODUCTION

About 90% of medicinal plants used by the industries are collected from the wild source. While over 800 species are used by industries, not more than 20 species of plant are under the commercial cultivation.

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Effect of different weed management practices on growth and yield of cauliflower (*Brassica oleracea* var. *botrytis* L.)

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Abstract
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Keywords: Growth, leaf area, plant height, SPAD, weed, yield

1. Introduction
Cauliflower (*Brassica oleracea* var. *botrytis* L.) is one of the most popular vegetable crop among the Cole crops and has originated from the mediterranean region. It was introduced in our country in 1822. Cauliflower belongs to family brassicaceae and is grown for its white tender curd which is used for vegetable, curry, soup and pickle preparations. Besides being good source of protein and carbohydrates, cauliflower is a rich source of vitamins and minerals (Bana *et al.*, 2012) [1]. India ranks second in area and production of cauliflower in the world after China. In India major cauliflower growing states are West Bengal, Bihar, Maharashtra, Madhya Pradesh, Orissa, Gujarat and Haryana etc. It is grown in an area of 435.9 thousand hectare with production of 8573.3 thousand metric tones and productivity of 19.8 metric tons per hectare in India. In Madhya Pradesh, it is grown in an area of 25.1 thousand hectare with a production of 70.38 metric tons and highest productivity of 28.1 metric tones per hectare (NHB, 2015) [5]. In India annually undergoes considerable loss due to various stresses of the agriculture and among these, weeds top the list by contributing 33% towards total loss. Weeds interfere with crop plants severely reduce crop growth and lower yield and quality (Mal *et al.*, 2005) [4]. Although considerable research work has been carried out in India on various aspects of cauliflower cultivation, but the problem of weeds in this crop need special attention, as weeds when present in the field reduce the yield and impair the quality of the produce for vegetable purposes, the crop remain in the field for about four months and during its growth period, the crop faces competition due to presence of monocot and dicot weed. Keeping in view the seriousness of weed problems, high cost of manual labor and availability of different herbicides, the present investigation was planned to assess the effect of weed management practices on growth and yield of cauliflower.

2. Materials and Methods
The field experiment was conducted during Rabi season, 2018-19 at Research Field of the Department of Vegetable Science, RAK College of Agriculture, Sehore (M.P). Seven treatment consisted T_1- Weedy check (control), T_2- Weed free (through hand weeding) at 30 & 60 DAT, T_3 -Pendimethalin 30% EC (PE) + 1 HW at 30 DAT, T_4 Oxyfluorfen 23.5% EC (PE) + 1 HW at 30 DAT, T_5 - Propaquizafop 10% EC (POE) + 1 HW at 60 DAT, T_6 -Wheat straw mulch 5kg/plot, T_7- Black plastic mulch (150 mm) were arranged in randomized block design with three replications.

EFFECT OF PRUNING INTENSITY AND SPRAY OF PLANT GROWTH REGULATORS ON GROWTH, YIELD AND ECONOMICS OF GUAVA FRUIT (*PSIDIUM GUAJAVA* L.) CV. SARDAR

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Abstract

A field experiment was carried out at KNK college of Horticulture, Mandsaur (Madhya Pradesh) during 2016-17 to study the effect of pruning intensity and spraying of plant growth regulators in relation to growth parameters, physical characters of fruit, yield and cost economics of guava (Psidium guajava L.) cv. Sardar. Different Pruning Intensity like P_0 (control-unpruned), P_1 (10 cm pruning), P_2 (20 cm pruning) and P_3 (30 cm pruning) and three growth regulators namely G_0 (control-water spray), G_1 (30 ppm 2, 4-D), G_2 (600 ppm NAA) and G_3 (600 ppm Ethephon) were used contributed favorable effects on growth parameters, fruit characters, yield and B:C ratio. Result revealed that the maximum increment in plant height (0.46 m), canopy spread E-W (0.77 m), canopy spread N-S (0.65 m), fruit weight (175.97 g), fruit volume (220.20 ml), fruit length (7.13 cm), fruit diameter (8.04 cm), pulp thickness (1.64 cm) and minimum number of seeds per fruit (265.67), minimum seed weight (2.97 g), while highest yield (271.29 q/ha) and higher B:C ratio (5.5) were recorded in 30 cm pruned plants with 600 ppm NAA (P_3G_2) treatment over control (P_0T_0).

Keywords: guava, pruning, growth regulators, yield and cost economics

Introduction

Guava (*Psidium guajava* L.) is one of the most popular fruits grown in tropical and subtropical regions of India, it is usually known as the poor man's fruit or apple of the tropics, which belongs to the family Myrtaceae. It is classified under genus *Psidium*, which contains 150 species, but only *Psidium guajava* has been exploited commercially. In India, it is ranked as fifth major fruit after mango, banana, citrus and apple. Its cultivation in India started as early as in 17th century (Mitra and Bose, 1990). In northern India, winter season crop is preferred because of its superior quality as compared to monsoon crop (Pandey *et al.*, 1980). In Northern parts of India, guava flowers once in April-May for the rainy season crop and again in August-September for the winter season crop. It bears on current season's growth and flowers appear in the axils of new leaves therefore, it responds well to pruning. The rainy season crop is poor in quality and also attacked by many pests and diseases. On the other hand winter season crop is superior in quality, free from diseases and pests. Regulation of rainy season crop has been done by deblossoming, flower thinning, withholding irrigation and foliar application of NAA in the past. Recently, pruning has emerged as a commercial and alternative method for regulating the crop in guava (Lal *et al.*, 2000). Pruning is usually practiced in the summer (April-May) before flower initiation. The use of plant growth regulators has assumed an integral part of modern crop husbandry for increasing production of quality fruits. The plant hormones or regulators are the organic chemical compounds, which modify or regulate physiological processes in an appreciable measure in the plant when used in small concentration. They are readily absorbed and move rapidly through the tissues, when applied to different plant parts. The use of plant growth regulators has resulted in some outstanding achievements in several fruit crops with respect to growth, yield and quality. Thus, the pruning may be helpful in reducing the tree size and improving the fruit quality as well. Also, the growth regulators like NAA, NAD, 2,4-D carbaryl and ethrel were found successful in reducing the rainy season and increasing the winter crop under different agro climatic conditions (Chundawat *et al.*, 1975) Whereas, ethephon acts as a ripening hormone and enhances the ripening process and thus helps in improving the fruit quality. NAA or ethephon has been applied to guava trees in a vigorous vegetative state of growth to change yield patterns (Singh *et al.*, 1991).

Materials and Methods

The present investigation was conducted during the year 2016-2017 at the *Instructional Cum Fruit Research Orchard,* Department of Fruit Science, K.N.K College of Horticulture Mandsaur (M.P.). The experimental material consisted of ten- year-old uniform trees of guava variety Sardar. The treatment consisted of 4 levels of pruning intensity, *i.e.* P_0 (control unpruned plants), P_1 (10 cm pruning), P_2 (20 cm pruning) and P_3 (30 cm pruning) and 4 treatments of plant growth regulators, G_0 (control-water spray), G_1 (30 ppm 2,4-D), G_2 (600 ppm NAA) and G_3 (600 ppm Ethephon). There were sixteen treatment combinations each replicated three times in factorial randomized block design. Shoot pruning was performed in last week of May. In order to study the effects, observations were recorded on plant height and canopy spread in meter, average fruit weight and weight of seeds in grams, length of fruit, diameter of fruit and pulp thickness in centimeter. Fruit volume was determined by the conventional water displacement method on immersion of the fruit and expressed in milliliter and yield in quintal per hectare. Profitability of various treatments was also calculated.

Results and Discussion

The results obtained from the present investigation are summarized below:

Effect of pruning and growth regulator treatment on growth characters in guava

Data highlighted that pruning had significant effect on plant height, canopy spread E-W and canopy spread N-S (Table-1). Maximum increased plant height (0.39 m), canopy spread E-W (0.64 m) and canopy spread N-S (0.58 m) were recorded with P_3 (30 cm pruning). However, among different plant growth regulator treatments maximum increment in plant height (0.42 m), canopy spread E-W (0.70 m) and canopy spread N-S (0.62 m) were observed in treatment G_2 (600 ppm NAA). The interaction effect revealed significant differences for canopy spread E-W and canopy spread N-S. High values for plant height (0.46 m), canopy spread E-W (0.77 m) and canopy spread N-S (0.65) were recorded in P_3G_2 (30 cm pruning with NAA 600 ppm) treatment combination. It might be due to well response of vegetative growth to pruning and narrow C: N ratio of plant that induces vegetative flush in tree in vigorous growth (Jadhav *et al.*, 1998). Similar views were reported by Shabban and Haseeb (2009) who found an increase in shoot length by severe pruning in guava. Pruning caused better movement of air and light into the inner part and thereby resulted in greater photosynthesis. This increased photosynthesis activity of the plants leads to higher accumulation of the photosynthates, which were utilized by developing shoots, leading to increase in plant vigour. Pruning also encouraged dormant bud to put forth new shoots owing to absence of apical dominance. Whereas, Ravi (2011) reported that, 25 per cent pruning intensity produced maximum number of shoots as compared to control. This increase in shoot length may be attributed to the reserve food material in the main scaffolds or branches due to which new growth was put forth just after the pruning. Increase in shoot length with increase in pruning level was also reported by Mohamed *et al.* (2006) in guava. NAA stimulated cell division, cell enlargement and cell elongation in the apical region.

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Effects of containers and duration of storage on the guggulsterone and volatile oils content of guggul

Moni Thomas, Niraj Tripathi, Kailash C Meena, JLN Sastry, GP Kimothi, Sakshee Sharma, Jatin Katna, Dhirendra Khare and Niranjan Prasad

Abstract
Guggul - an oleo-resin gum of immense medicinal value is tapped from a bushy shrub *Commiphora wightii* (Arnott) Bhandari distributed in semi-arid and rocky regions in Indian sub continent. *C. wightii* is an IUCN data deficient plant. Increase in the annual demand of guggul gum to the tune of 1000 metric ton, there is an increase in destructive tapping of C. wightii, which is a serious concern. Generally guggul gum from the site of its tapping to the site of processing or value addition being distantly far off, improper post harvest handling, storage and transport results in qualitative loss of its crucial bio-active compounds. Among the four containers (earthen clay pot, plastic jar, polythene bag and jute bag) evaluated for long term storage of guggul the earthen clay pot was the best in terms of Total Guggulsterone (TG) content. In earthen clay pot the TG of guggul gum was maintained over 1% for four months while Total Volatile Oils (TVO) 1% for nine months. In jute bag TG rapidly deteriorated within one month.

Keywords: Data deficient, guggulsterone, containers, deterioration, quality, chromatography

1. Introduction
Guggul- an oleoresin gum, of *Commiphora wightii* (Arnott.) Bhandari, belongs to family Burseraceae is of immense medicinal importance. It is a slow-growing, highly branched shrub or small tree, found in the arid rocky tracts of Rajasthan, Gujarat, Madhya Pradesh and Karnataka States of India and in Sind and Baluchistan provinces of Pakistan (Siddiqui *et al*., 2013) [37]. According to Siddiqui (2011) [35] Guggul comprises resins (61%), gum (29.3%), volatile oils (0.6%), moisture (6.1%) and foreign matter (3.2%). Guggul was first introduced to the scientific world in 1966 as a lipid lowering drug (Satyawati, 1966). However, Guggul is reported to be used since Vedic period for treatment of atherosclerosis, hypercholesterolemia, rheumatism, obesity, respiratory diseases, liver disorders, digestive problems, menstrual irregularities (Siddiqui and Mazumdar, 2012) [36]. Fresh guggul proved to have better effect in lowering serum cholesterol (5.67%), triglyceride (17.7%) and very low-density lipoprotein (18.36%), while one-year old guggulu had mild effect in lowering Tryglyceride (13.64%), VLDL (11.07%) and non-significant increase in serum HDL- cholesterol (0.94%). It also provided significant decrease in body weight (7.69%) and BMI by 7.82% (Vyas *et al*., 2015).
For the past few decades, natural compounds have been gaining value due to their immense element variation, and many of them are being used as a medicine (Sairkar *et al*., 2017). The main bio-active compound of guggul is inter-convertible isomeric form E and Z of guggulsterone that are steroidal in nature (Agrawal *et al*., 2004) [1]. Two different arrangements of CH_3 at C_{20} in three-dimensional space and the hindered rotation about the carbon – carbon double bond at C_{17} and C_{20} classifies guggulsterone into Z-{4,17(20)-cis-pregnadiene-3,16-dione} and E- {4,17(20)- trans-pregnadiene-3,16-dione} isomers.
Volatile oils - the secondary metabolite of plants consisting of a complex mixture of aldehydes, ketones, epoxides, alcohols and esters. Many volatile oils constitute of monoterpenes, diterpenes, and even sesquiterpenes (Rehman *et al*., 2007). However the volatile oils from the resin of *Commiphora* are myrcene, dimyrcene and polymyrcene (Bhati, 1950) [5].
The tapping and collection period of oleo gum-resin from guggul plants varies in different locations. Ideally tapping starts from the last week of February and the yield is about 200-800 g per plant depending on the plant health and ecology.

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Study of growth, phenology and seed yield in fenugreek (*Trigonella foenum-graecum* L.) varieties

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Abstract
The present field experiment was conducted at Research Farm, K N K College of Horticulture, Mandsaur. This investigation was carried out with twenty varieties includes seven local collected genotypes and thirteen released varieties. The research experiment was laid out in simple Randomized Block Design in three replications during the year 2018- 19. The analysis of variance revealed significant difference in all the growth parameters among the varieties. However, the maximum leaf area index (0.31, 0.53 and 0.35) and leaf area duration (4.59, 8.00 and 6.85 cm^2 day^{-1}) recorded in V_{10} PEB at all the growth stages at 30 days fixed intervals. The variety V_5 AFg-2 was recorded maximum crop growth rate (0.59, 1.30 mg cm^2 day^{-1}) and relative growth rate (55.98 and 82.35 mg g^{-1} day^{-1}) at 30-60 and 60-90 DAS respectively, but 90-at harvest in V_{17} Jaora Local-2 crop growth rate (1.29 mg cm^2day^{-1}) and V_8 AFg-5 relative growth rate (79.50mg $g^{-1}day^{-1}$). The maximum leaf area (26.82, 156.66, 163.19, and 47.54 cm^2 $plant^{-1}$) in V_{10} PEB, fresh weight (2.30, 34.33, 100.30 and 72.62 g plant-1) in V5 AFg-2, SPAD value (57.29, 67.42, 78.56, and 52.94) in V_{10} PEB at all the growth stages at 30 days fixed intervals and seed yield (8.77g $plant^{-1}$) in V_5 AFg-2.The variety V_9 HM-57 was took minimum days to 50% germination (4.33), 50% flowering (43.67) and days to maturity (119.00) as compared to other varieties.

Keywords: Fenugreek, LAI, LAD, CGR, RGR

Introduction
Fenugreek (*Trigonella foenum-graecum* L.) is self-pollinated and destogamous annual diploid species, popularly grown by its vernacular name "*Methi*", belongs of the family "Fabaceae". It is native to the Mediterranean Region, extending to Central Asia. Fenugreek is used as whole seed and in powdered form and often roasted to reduce its bitterness and enhances the flavor. Bitter taste of seeds due to presence of an alkaloid "Trigonelline". The importance of fenugreek has been increased due to presence of asteroid called "*Diosgenin"* and it is used in the synthesis of sex hormones and contraceptives (Meena *et al.*, 2017) [10]. Fenugreek leaves and seeds are generally consumed as a spice in food preparation because of its strong flavor and aroma and also used as an ingredient in traditional medicine. It is rich source of calcium, iron, alpha-carotene and other vitamins (Chouhan *et al.*, 2017) [1]. Fenugreek is an annual herb, 30 to 90 cm tall having light green leaves which are pinnately trifoliate. The flowers are papilionaceous and white or yellow coloured. The plant produces slender curved pods, which contain 10 to 20 small, yellowish brown seeds, which are smooth and oblong, about 3 mm long, bitter in taste and having distinct flavor (Farooqui *et al*., 2004) [4].
Fenugreek is the third major seed spices in India after coriander and cumin. In India total annual production of about 220 thousand metric tons (NHB, 2017) [11]. Among different states of India, Rajasthan is leading state followed by Madhya Pradesh accounting for 25 thousand tons of production contributing 10.13% share (NHB, 2017) [11].
Yield is a major parameter, which is influenced by several yield and yield attributing characters controlled by polygenes and also influenced by environment (Hosamath *et al.*, 2017) [6]. Farmers of Madhya Pradesh are still growing local cultivars of fenugreek which are low yielding and poor marketable quality. Even though huge number of fenugreek varieties are released by various research institutes with high yield potential and marketable quality, these

Research Article

Changes in Gum Yield and Anatomy of *Commiphora wightii* (Arnott.) Bhandari in Response to Foliar Application of PGR and Nutrients

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Abstract

A two year field study with foliar application of plant growth regulator (PGRs) and nutrients on *Commiphora wightii* (Arnott.) Bhandari, was carried out to explore the relationship of leaf area, chlorophyll content, the density and circumference of gum ducts, gum ooze and yield. Increase in the leaf area of *C. wightii* treated with PGR and nutrients over the control though was non significant but the total affect due to cumulative increase in the total leaf area of a plant and photosynthesis cannot be ruled out. The leaf chlorophyll content (a, b and total) was significantly highest in Humic acid treated *C. wightii* over rest of the treatments. It was followed by that in micronutrient treated *C. wightii* plants. The mean gum ooze immediately after incision was highest in the micronutrient treated *C. wightii* but was at par with that of Humic acid and more than that in the control plants. The weight of gum w/v was significantly highest in micronutrient treated *C. wightii*, followed by Humic acid. *C. wightii* treated with micronutrients had the highest density of gum ducts in the month of December while it was highest in the March among the *C. wightii* plants treated with Humic acid. Thus, *C. wightii* treated with micronutrients can be tapped three months earlier i.e. December. It has another advantage as the atmospheric temperature remains low for rest two months which may prevent loss of aromatic content of guggul gum. Foliar applications of PGR and nutrients improved leaf area, chlorophyll content, gum duct density, duct circumference and guggul yield of *C. wightii* over the control treatment.

Keywords: Data deficient, Guggul, Gum duct, mirco-nutrients, Natural resins

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Introduction

Gum resin and oleo-resin producing plants are of economical [1, 2] and ecological [2, 3] interests. These products are non wood forest produce, serves as cash crop to millions of poor and tribal communities [1] living either in the forest [4] or in the arid regions [5] of the world. Natural resins and gum producing plants are usually slow growing and generally found in semi-arid [6] and arid regions [7] across the world. Destructive tapping of these plants [8] are threatening them in their natural stand [9] and degrading the ecology. Losses of these valuable plants are equally a threat to the socio-economy [10] of the people depending on it [11, 12] for their household income [13] and livelihoods [2]. In this context, the challenge before the scientific community is to develop technologies to conserve the present stock of natural resin and gums yielding plants [14, 15] as well as increase the productivity [16].

Resins and gums are the secondary metabolites [17, 18] of the plant. The production or yield of resin and gum depend on many factors like soil [19], its nutrient status [20], soil moisture [21, 22], location [23], nutrient applications or availability [22], growth period [24], leafy period [22] and genetic characters [25] of the plant. Unfortunately, resin and gum producing plants are never cared for its nutrient status [26] or nutrient replenishment [27], in its natural stand. It is widely acknowledged that the production of resin and gum depends on the allocation of primary metabolites to the sink or storage by the plants [28].

The present two year field study is an attempt to find a relationship with plant growth, physiology, anatomy and gum production *C. wightii* with foliar application of PGR and nutrients.

Materials and Methods

A two years field trial was carried out during 2014-15 and 2015-16 to study the response of foliar application of plant growth regulator (PGR) and nutrients on 40 *C. wightii* plants in its natural stand. The field experiment was conducted in the Chambal ravines of Morena district, Madhya Pradesh, India. Four spray schedules of the five treatments had

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Performance of Round Melon [*Praecitrullus fistulosus* (Stocks) Pangalo] Varieties under Different Nutrient Level during *Kharif* Season

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A B S T R A C T

Ten treatment combinations comprising of two varieties (V_1- Akra Tinda and V_2-Tinda Ludhiana) and five nutrient levels (N_1-0:0:0 NPK kg/ha+15t FYM q/ha, N_2- 30:20:15 NPK kg/ha+15t FYM q/ha, N_3-40:30:25 NPK kg/ha+15t FYM q/ha, N_4- 60:40:35 NPK kg/ha+15t FYM q/ha, N_5-80:50:45 NPK kg/ha+15t FYM q/ha) were evaluated in factorial randomized block design with three replications at vegetable research farm, College of Horticulture, Mandsaur during Kharif season 2018-19. The findings of the present study revealed that among the varieties of round melon, V_2 (Tinda Ludhiana) recorded superior performance for growth and yield attributes as well as yield and gross income, net income and B:C ratio. There was significant effect of nutrient levels on growth and yield parameters as well as NPK content in plant and fruit. Application of N_4 (60-40-35 NPK kg/ha +15t FYM q/ha) showed highest growth attributes, earliest female flower appearance and fruit picking as well as yield attributes and yield in round melon. Economic evaluation of different nutrient levels revealed highest gross income, net income and B:C ratio with application of N_4 (NPK-60-40-35 kg/ha+15t FYM q/ha). Besides, highest NPK content in plant and fruit was recorded with application of N_4 (60-40-35 NPK kg/ha +15t FYM q/ha). Post-harvest analysis of NPK in soil revealed significant effect of varieties and nutrient levels on available NPK content in soil. Highest available NPK in soil were determined with variety V_1 (Arka Tinda). Post-harvest available NPK in soil were estimated highest with N_5 (80:50:45 NPK kg/ha+15t FYM q/ha) which was significantly superior over all other nutrient levels.

Keywords

Round melon, Varieties, Nutrient levels, Yield, Economics

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Introduction

Round melon [*Praecitrullus fistulosus* (Stocks) Pangalo] is a warm season, monoecious, annual vine belongs to family cucurbitaceae. It is also known as tinda or Indian round gourd or apple gourd or Indian squash or Indian baby pumpkin or squash melon. It is a squash like cucurbit grown for its immature fruit. The fruit has light green skin with soft hair and spherical in shape (Nath and Swamy, 2016).

The immature tender fruits of tinda are used as a vegetable, canned, rayata or curry preparation and its seeds are roasted and

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Influence of organic manures and inorganic fertilizers on growth, yield and profitability of radish (*Raphanus sativus* L.)

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ABSTRACT

A field experiment was conducted during rabi season of 2015-16 at Vegetable Research Farm, College of Horticulture, Mandsaur (MP) to study the influence of organic manures, inorganic fertilizers and their combinations on growth and yield of radish.Ten treatments were evaluated under randomized block design with 3 replications. Application of recommended dose of fertilizers through combination of fertilizer and organic manures significantly increased the crop growth, yield attributes and root yield as compared to other treatments. Among these treatments application of 75 % NPK + 25 % nitrogen through vermicompost resulted in significantly higher values of plant height (35.2 cm), number of leaves per plant (13.5), length of leaves (29.9 cm), root length (19.9), diameter of root (3.84 cm), days to harvest (51.5), average root weight (117.8) and yield (392.8 q ha^{-1}) and harvest index (56.8 %). The cost benefit-ratio (4.1) was also recorded maximum in this treatment. Thus, the application of 75 % NPK + 25 % nitrogen through vermicompost showed highest growth, yield and better return as compared to other treatments.

Key words: Organic manure, vermicompost, radish, yield, poultry manure, net income, B: C ratio

INTRODUCTION

Radish (*Raphanus sativus L.*) is a popular root vegetable of brassicaceae family grown all over world. In India it is widely cultivated in northern and southern plains, as well as in hills. It can be cultivated under cover for early production but large scale production in field is more common in India. Radish is grown for its young tender tuberous root which is consumed either raw as salad or cooked as a vegetable. Radish has cooling effect, prevents constipation and increases appetite. It is recommended for patients suffering from piles, liver troubles and jaundice. The juice of fresh leaves is used as diuretic and laxative. Radish is a good source of vitamin- C (ascorbic acid), containing 15-40 mg per 100 g of edible portion and supplies a variety of minerals. Trace elements in radish include aluminum, barium, lithium, manganese, silicon, titanium, fluorine and iodine (up to 18 u g/10 g). Beside tender leaves which are used as greens are rich in vitamin-A and C. roots are also rich in carbohydrate and protein. Pink skinned radish is generally richer in ascorbic acid than the white skinned one. The characteristics pungent flavor of radish is due to the presence of volatile isothiocynates (Bose *et al.*, 2000).

Chemical fertilizers deteriorate the quality of produce and are expensive too, leading to reduction in net profit and returns to the farmers. The integrated nutrient management system approach utilizes a judicious combination of inorganic fertilizer and organic manure in building soil fertility and to the increase the production potential of crop (Kumar *et al.*, 2013). In recent years use of organic manures like FYM, vermicompost and neem cake for improving the productivity of crop and maintaining soil fertility and productivity of soil is gaining prominence (Mahokar *et al.*, 2007). Vermicompost is a rich source of micro and macro nutrients, vitamins, growth hormones and enzymes. FYM is not a rich source of nutrients, increase organic carbon content to the soil and improves soil physical properties. Being a short duration and quick growing crop, the root growth should be rapid and uninterrupted in radish. Hence, for the production of good quality radish, optimum nutrition through organic, inorganic and biofertilizers are essential for

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Correlation analysis on different characters in garden pea (*Pisum sativum* var *hortense* L.)

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Abstract
A field investigation was carried out at experimental farm of Department of Vegetable Science, College of Horticulture, Mandsaur (MP) to estimate the character association for 17 quantitative traits in 20 diverse genotypes of garden pea during the year 2018-19. The correlation studies revealed that pod yield per hectare exhibited highly significant and positive correlation with pod yield (g/plant), pod yield (q/ha), average pod weight (g), total sugar, T.S.S., number of seeds per pod, protein content, number of leaves per plant, number of pods per plant, pod length (cm), shelling percent, Plant height, number of primary branch per plant and negative association with days to first flower appearance, days to 50% flowering and days to first picking and phenotypic correlation coefficient revealed that the pod yield per hectare showed the maximum significant positive correlation with pod yield (g/plant), pod yield (q/ha), average pod weight (g), total sugar, T.S.S., number of seeds per pod, protein content, number of leaves per plant, number of pods per plant, pod length (cm), shelling percent, Plant height and number of primary branch per plant. Negative association showed with days to first flower appearance, days to 50% flowering and days to first picking.

Keywords: *Pisum sativum* var. hortense L., Character association, Quantitative traits, Phenotypic and genotypic correlation

Introduction
Garden pea (*Pisum sativum* var. Hortense), belong to family Leguminacea It is one of the most important vegetable crops grown all over the world. In India, it is grown mainly in winter season in plains of north and central parts and as a summer vegetable in the hilly regions of the country. Peas are highly nutritive and high content of digestible protein, carbohydrate, vitamin- C, phosphorus, and minerals. In India, pea is grown in an area of 554 thousand ha with annual production of 5524 million tones having productivity of 10.0 tones per hectare. The major pea growing states are Uttar Pradesh, Madhya Pradesh, Punjab, Himachal Pradesh, West Bengal and Chhattisgarh. In Madhya Pradesh, pea is covering an area of 106.51 thousand ha and 1113.47 thousand million tones production with 10.45 tones/hectare productivity (Anonymous, 2017) [1].

Estimates of parameters of variability importantly, heritability and genetic gain are reliable indicators for improvement of characters in a particular genetic material through selection. Since, the selection for highly heritable characters is more effective, therefore, heritability along with other parameters can be used in predicting the gain for a given selection intensity and expected genetic gain further gives the idea of the extent of improvement in a character through simple selection. Moreover, selection for yield and quality traits can be better achieved if the information with respect to correlation between such traits is also available with a better understanding of the association between the relevant characters with yield which is provided through path coefficient analysis (Kumar *et al*., 2015) [8]. The understanding of association of characters is of prime importance in developing an efficient breeding programme. The correlation studies provide information about association between any two characters. The path coefficient analysis provides the partitioning of correlation coefficients into direct and indirect effects giving the relative importance of each of the casual factors (Basaiwala *et al*., 2013) [2]. Therefore the present investigation was conducted to study the association among pod yield contributing traits towards green pod yield in garden pea.

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Genetic variability and correlation analysis for fruit yield and quality traits in bottle gourd

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ABSTRACT

Twenty-five bottle gourd genotypes were evaluated to know the heritable genetic variation and correlation coefficients among fruit yield, yield attributes and quality parameters. Mean sum of squares due to genotypes were highly significant for all the traits studied. Genotypes Narendra Shivani, MBL 3, Anand Bottle Gourd 1, MBL 2 and IC 085608 were high fruit yielding genotypes. The yield attributes among these genotypes varied from genotype to genotype being governed by different genetic mechanism. In general, the low to moderate estimate of GCV and PCV, ranging from 2.85 to 44.53 and 6.21 to 46.17 was observed in the present material, respectively. Fruit yield q/ha, fruit length, fruits/ vine and vine length showed the moderate estimates of both GCV and PCV, whereas, rest of the characters exhibited the low estimates. Fruit yield q/ha, fruit length, fruits/ vine, vine length, fruit diameter, nodes bearing first female flower, primary branches/ vine and nodes bearing first male flower exhibited high heritability coupled with high genetic advance as percentage of mean thus, direct selection based on phenotypic performance would be effective. Fruit yield q/ha showed significant positive correlation coefficient with fruits/vine, fruit length, harvest index, vine length, primary branches / vine, nodes bearing first female flower, fruit weight, nodes/vine, SPAD value, inter nodal length, fruit diameter, nodes bearing first male flower, inter nodal length and days to first male flower anthesis. Similarly, total soluble solids showed positive and significant correlation with fruit yield, harvest index and dry matter content of the fruits thus, these characters can be improved simultaneously in bottle gourd.

Key words: *Lagenaria siceraria*, interrelationship, diversity, genetic parameters, heritability.

INTRODUCTION

Bottle gourd (*Lagenaria siceraria* (Mol.) Standl.) also known as calabash gourd or white flowered gourd plant and locally known as *Lauki* is a member of the Cucurbitaceae family. It is an easily digestible and cooked vegetable recommended to patients suffering from stomach problems. In addition, white pulp of fruit is emetic, purgative, diuretic, antibilious and it's having a cooling effect. Oil from the seeds is used to relieve headache and also diuretic and nutritive (Rahman *et al*., 8). In India, this crop is successfully cultivated in states of Rajasthan, Punjab, Uttar Pradesh, Bihar, West Bengal, Madhya Pradesh, Maharashtra, Gujarat and Andhra Pradesh. The total area under its cultivation in India was around 149.00 thousand hectares with an annual production of 2458.00 thousand metric tonnes during 2015-16. The crop has a tremendous potential for export and created a huge demand in Gulf markets in recent years. However, its productivity is low which deserve improvement through genetic manipulations with systematic breeding programme.

Selection efficiency largely depends upon the magnitude of variability exists in population. Heritability and genetic advance as percentage of mean determine the extent of ability of a character to transmit in next generation and influence of environment determine their phenotypic expression. The heritability estimates accompanied with genetic advance as percentage of mean through light on nature of inheritance of the characters thus, add in selection. Correlation coefficients among yield and its attributing characters determine the nature of selection criteria to be practice in selection breeding programme. The information on these aspects is very scanty in bottle gourd. The present investigation was planned with this objectives and view.

MATERIALS AND METHODS

Twenty-five bottle gourd genotypes were evaluated in Randomized Complete Block Design with three replications during *kharif* season 2016-17 at Vegetable Research field, Department of Vegetable Science, College of Horticulture, Mandsaur, Madhya Pradesh. The healthy, disease and insect free good quality seeds were treated with mancozeb + carbendazim (2 + 1 g/kg seed) before sowing. The experiment was sown on 7th September in lines at a spacing of 1.5 × 0.9 m^2 and depth of 1.5 - 2.5 cm, which were covered with soil. A dose of fertilizers 60: 50: 50 kg NPK /ha was applied to the crop. The entire quantity of

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Performance of Strawberry (*Fragaria x ananassa* Duch.) Varieties for Growth and Fruit Physical Parameters under Western Malwa Plateau Conditions of Madhya Pradesh, India

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Keywords

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A B S T R A C T

A research trial was carried out in the experimental field of Department of fruit science, KNK College of Horticulture Mandsaur Madhya Pradesh during the year 2017-2018 to evaluate some strawberry varieties in sub-tropical region (Western Malwa Plateau condition) of Madhya Pradesh. The runners of 12 strawberry varieties i.e., *viz.* V_1 (Northwest), V_2 (Tioga), V_3 (Pajaro), V_4 (Seascape), V_5 (Fern), V_6 (Chandler), V_7 (Shimla Delicious), V_8 (No.5), V_9 (Dil Pasand), V_{10} (Larson), V_{11} (Torrey) and V_{12} (Sweet Charlie) were planted at 30x30 cm apart on the ridge beds at end of October. The design of experiment was Randomized block design (RBD). The results of the study indicated that out of the varieties tried, the strawberry variety V_6 (Chandler) proved to be the best in producing maximum plant height (14.27 cm), Number of leaves per plant (18.07) except the number of crown's per plant. The number of crown(s) per plant was recorded in variety V_{10} (Larson) 2.43. Maximum fruit diameter (2.47 cm), fruit weight (8.58 g), fruit volume (8.23 ml) were found in variety V_6 (Chandler) whereas fruit length (3.80 cm) observed in variety V_{10} (Larson). Best specific gravity was recorded in variety V_{11} (Torrey). Fruit full maturity after fruit set (31.11 days) were found in variety V_2 (Tioga).Based on the experimental findings it was concluded that variety V_6 (Chandler) be recommended as best variety under the Western Malwa Plateau condition of Madhya Pradesh.

Introduction

Strawberry (*Fragaria x ananassa* Duch.) is an important fruit of family Rosaceae and occupies an important place among the small fruits.It is an aggregate fruit and octapoloid in nature having basic chromosome number 2n = 8x = 56 (Singh *et al.*, 2016). Strawberry is one of the important fruit crops of temperate region. It is also grown to a limited extent in subtropical areas (Kumar and Kumar, 2011). There is a considerable variation among different strawberry varieties for their adaptability in a particular set of agro-climatic conditions (Sharma *et al.*, 2014). It is very much liked for its cool and refreshing nature. Fruits are of high demand for fresh market and for processing industries. The other important advantage of strawberry cultivation as gives early and high returns from a unit area. Yield and fruit quality of strawberry is influenced by a number of factors like

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Effect of pre-harvest application of plant growth regulators and calcium salts on biochemical and shelf life of acid lime (*Citrus aurantifolia* Swingle)

Angurbala Dhakad, Priyamvada Sonkar, Abdulrazaq Bepari and Umesh Kumar

Abstract
The present study was undertaken to investigate "Effect of pre- harvest application of plant growth regulators and calcium salts on fruit quality and shelf life of acid lime (*Citrus aurantifolia* Swingle)'' was conducted in the *Instructional cum Research Fruit Orchard*, Department of Fruit Science, College of Horticulture, Mandsaur, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior (M.P.) during 2017-2018. In this experiments the treatments consisting of plant growth regulators and calcium salts *i.e.* Gibberellic acid (20 ppm, 40 ppm and 60 ppm), Napthalene acetic acid (10 ppm, 15 ppm, 20 ppm), Calcium Nitrate (0.5%, 1% and 1.5%) and Calcium Chloride (1%, 1.5% and 2%). The significant results showed minimum mean Total Soluble Solids (6.82 ^{0}brix), rag percentage (45.46%), TSS: acid ratio (0.98), mean decay loss (10.48%) and maximum mean acidity (6.95%), ascorbic acid (30.49 mg/100g), percentage of marketable fruits (89.52 was recorded in treatment (T_9) (Calcium Nitrate 1.5%). compared to control after harvest during the storage period upto the 15 days.

Keywords: Acid lime, GA_3, NAA, $CaCl_2$, biochemical and quality

Introduction
Citrus are the most important fruits of the world. Citrus is cultivated widely in the tropical and sub-tropical regions. It ranks third among the sub-tropical fruits of the world (Jagtap *et al.*, 2013) [5]. Acid lime *(Citrus aurantifolia* Swingle*)* belongs to the acid group of genus citrus and its family is Rutaceae. It is also called as Kagzi lime in the northern India. The word Kagzi being derived from the world Kagaj meaning paper, as the rind of the fruit is very thin. Fruits of acid lime possess great medicinal and nutritional value. Lime is an appetizer, stomachic, antiscorbutic and anthelmintic (Shinde *et al.* 2008) [14]. It is a rich source of vitamin C and has good antioxidant properties. Fruits being acidic in nature, they are largely used for garnishing and flavouring several vegetarian and non- vegetarian dishes. Besides its value-added products like pickle, juice, squash etc., lime peel oil, peel powder are also in great demand in soap and cosmetic industry (Debaje *et al*., 2008) [3].

Citrus exceeds most other fruits in productivity and is highly remunerative. However, these acid lime orchards are declining in their fruit quality and self life. There is an urgent need for an alternative pre-harvest treatment to attain long term sustainability for fruit quality and shelf life. Under agro-climatic conditions of Madhya Pradesh, acid lime bears two crops in a year. Winter season crop, though good in quality and needs prolong storability. However, large quantity of fruit is lost after harvest due to inherent bio-chemical changes. In recent years, plant growth regulators (GA_3, NAA, 2,4-D) have been used for improving the quality, delaying deterioration in storage and thereby increasing shelf life of various fruit crops (Lal *et al*., 2015) [9].

GA_3 increases the fruit length, fruit diameter; fruit weight ultimately the yield was increased. NAA checking the fruit drops and increasing the fruit retention and also increasing the fruit weight and TSS of the fruits (Shinde *et al*., 2008) [14]. However, due to the high cost of plant growth regulators, it is imperative to find out some other {$Ca(NO_3)_2$, $CaCl_2$, $ZnSO_4$, KNO_3} chemicals which can be used with combination of PGR's to improve the shelf life and fruit quality. Some chemicals like calcium compounds with combination of PGR's reported to prolong shelf life by affecting the wide range of physiological processes in plants and also inhibit specific aspects of abnormal senescence in kinnow mandarin fruits (Chahal *et al*., 2012) [2].

The use of Ca compounds also enhance the shelf life of fresh fruits by reduction in respiration rate, delayed ripening, protein breakdown, reduced decay losses and disease incidence.

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Study on strawberry (*Fragaria x ananassa* Duch.) varieties for growth, fruit bio-chemical and yield parameters under western malwa plateau conditions of Madhya Pradesh

Umesh Kumar, Priyamvada Sonkar and Angurbala Dhakad

Abstract
A research trial was carried out in the experimental field of Department of fruit science, KNK College of Horticulture Mandsaur Madhya Pradesh during the year 2017-2018 to evaluate some strawberry varieties in sub-tropical region (Western Malwa Plateau condition) of Madhya Pradesh. The runners of 12 strawberry varieties i.e., *viz*. V_1 (Northwest), V_2 (Tioga), V_3 (Pajaro), V_4 (Seascape), V_5 (Fern), V_6 (Chandler), V_7 (Shimla Delicious), V_8 (No.5), V_9 (Dil Pasand), V_{10} (Larson), V_{11} (Torrey) and V_{12} (Sweet Charlie) were planted at 30x30cm apart on the ridge beds at end of October. The design of experiment was Randomized block design (RBD). The results of the study indicated that out of the varieties tried, the strawberry variety V_6 (Chandler) proved to be the best in producing maximum plant height (14.27cm), leaf length (7.70cm), leaf width (12.08cm) except the number of runner(s) per plant. The number of runner(s) per plant was recoded in variety V_8 (No.5) 5.53 runner(s) per plant. The best result in 12 strawberry varieties of biochemical characters was found in variety V_6 (Chandler) proved to be the best in producing lowest fruit acidity (0.98) and highest pectin (0.47%), higher ascorbic acid (56.67mg), however highest TSS (14.04^0B) were found in variety V_9 (Dil Pasand) and maximum reducing sugar (4.80) was recoded in variety V_{12} (Sweet Charlie). The maximum yield (17250.22kg) was recoded in variety V_6 (Chandler) which was statistically *at par* with variety V_{12} (Sweet Charlie) 15103.56kg. Based on the experimental findings it was concluded that variety V_6 (Chandler) and V_{12} (Sweet Charlie) be recommended as best variety under the Western Malwa Plateau condition of Madhya Pradesh.

Keywords: Strawberry, different varieties like chandler, sweet charlie, tioga and pajaro; fruit TSS, fruit acidity, ascorbic acid, pectin

1. Introduction
Strawberry (*Fragaria x ananassa* Duchesne) is one of the most delicious, refreshing and nutritious soft fruits of the world. It belongs to family Rosaceae and is native to America. Strawberry is an herbaceous perennial short day plant. It was first introduced by the NBPGR Regional Research Station, Shimla (Himachal Pradesh) in the early sixties (Gowda *et al.*, 2016) [8]. Strawberry is one of the most delicious fruits in the world. In India, it was introduced in the early sixties, but these efforts made to popularize it failed due to poor adaptation of the introduced varieties and lack on technical know-how. Later, many more varieties were introduced and production technology was standardized, which led to increase its area and production (Sharma and Sharma, 2004) [19]. In general, its cultivation had been confined only to temperate regions, but development of day-neutral cultivars had made its entry in tropical and subtropical areas as well (Sharma *et al.*, 2003) [18].
There is a considerable variation among different strawberry cultivars for their adaptability in a particular set of agro-climatic conditions. Besides quick returns, strawberry fruits are attractive with distinct and pleasant flavour/aroma, rich in vitamin-C and minerals. Strawberry fruits have a special demand by fruit processing industrial for preparing various products. The strawberry cultivation is associated with many problems. Among all characters fruit character have always remained of prime importance and are much influenced by environmental factors. Since strawberry is a crop of temperate regions of the world, its cultivation has been extended to subtropical regions like Maharashtra, Punjab, and Haryana. However, no information was available on the cropping behavior of strawberry cultivars in the semi temperate climate of mid hills (Sharma *et al.*, 2014) [20]. The research work for finding suitable varieties has however, been limited to sub-tropical regions (Western Malwa Plateau condition) of Madhya Pradesh. Therefore, the present investigation was planned with the objective to assess growth, yield and

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Evaluation of standard chrysanthemum (*Dendrathema grandiflora* Tzvelve.) cultivars in the Malwa region of Madhya Pradesh

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ABSTRACT

An experiment was conducted to evaluate the ten varieties of standard chrysanthemum, namely Star Yellow, Tata Century, Star White, Pusa Century, Pusa Arunodya, Thain Chen Queen, Pusa Kesri, Hybrid-1, Hybrid-2 and Jaya. The experiment was conducted during the year 2016-2017 at College of Horticulture Mandsaur, Madhya Pradesh. Study revealed that the various cultivars showed significant difference with respect of growth, flowering, vase-life and biochemical parameters. Among the standard cultivars studied the cv. Pusa Century showed the best performance with respect of plant height (95.60 cm), number of leaves per plant (52.87), stalk length (87.37 cm), stalk girth (5.07 mm) and flower diameter (13.70 cm) The maximum leaf length (9.97 cm) was recorded by the cv. Star White. The earliest flower bud appearance (25.67 days) and first flower opening (53.13 days) were recorded by cv. Tata Century. The maximum vase life of flower (26.00 days) was recorded in cv. Pusa Kesri. The maximum pigment content (0.67 mg/100g) was recorded in cv. Jaya and the maximum T.S.S. in petals 7.90° Brix was recorded in cv. Hybrid-1. The maximum soluble sugars content in petals (4.66 mg/g) was recorded with Thai Chen Queen and the maximum reducing sugars content in petals (3.87 mg/g) was recorded with Star Yellow.

Key words : *Biochemical parameters, Chrysanthemum, Flowering parameters, Vase-life, Vegetative growth.*

INTRODUCTION

Chrysanthemum (*Dendranthema grandiflora*) belong to family Asteraceae. The basic chromosome number of the genus is 9 and a wide range of ploidy levels is found in different cultivars of the species with 2n=36, 45, 47, 51 and 75. It is one of the leading commercial flower, important as a cut flower as well as pot plant. It is a native of China. There are about 160 species in the genus *Chrysanthemum* among which the modern autumn flowering perennial *Chrysanthemum morifolium* is most important (Singh, 2006). It is commercially propagated by terminal cuttings. It ranks second after rose in world cut flower trade and fifth as pot plant. In general, it requires high light intensity and plants grown under reduced light become taller, have strong stem and larger leaves. Standard chrysanthemum is mostly grown for cut flower production and as potted flowering plant for exhibition and decoration.

The successful cultivation of chrysanthemum depends on selection of suitable variety. In recent years, several new cultivars of chrysanthemum with wide range of colours have entered in the market, but all the cultivars cannot be grown everywhere especially under North Indian conditions (Reddy *et al.*, 2016).

Identification of suitable varieties of the particular locality/ region is considered important. Besides varietal evaluation, variability studies help in Chrysanthemum crop improvement programme. With the introduction of new germplasm from diverse sources, it becomes mandatory to carry out evaluation studies in order to identify suitable cultivars for utilization in breeding programme for developing improved cultivars. Keeping in view the above facts a study entitled evaluation of standard chrysanthemum (*Dendranthema grandiflora* Tzvelev.) cultivars in the Malwa region of Madhya Pradesh.

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Research Paper 73

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Effect of micronutrients (Zn, B and Fe) in flowering and post-harvest parameters of gladiolus (*Gladiolus grandiflorus* L.)

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ABSTRACT

An experiment was conducted to see the effect of micronutrients (Zn, B and Fe) in flowering and postharvest parameters of gladiolus (*Gladiolus grandiflorus* L.) at Department of Floriculture and Landscape Architecture, K.N.K. College of Horticulture, Mandsaur, M.P. during 2017-18. The experiment was laid out in Randomized block design (RBD) with three replications. Nine treatments (T_1 to T_9) were used in the experiment. Data raveled that treatment T_9 performed the best results with respect of most of the parameters such as days taken to opening of first floret (88.73 days), number of florets per spike (13.93), diameter of floret (10.13 cm), length of floret (10.63. cm), rachis length (46.27 cm), fresh weight of spike (49.90 g), dry weight of spike (4.07 g), vase life (11.67 days), water uptake (72.50 ml) and pigment content (1.57 mg/ 100g). On the basis of this research finding we can say that quality of flowers may be increased with applications of micronutrients.

Key words : *Boron, Ferrous sulphate, Gladiolus, Mayur, Micronutrient, Zinc sulphate.*

INTRODUCTION

Gladiolus (*Gladiolus spp.*), generally called "Glad", is the mostly used as cut flower plant belongs to the family Iridaceae and sub-family Ixiodeae and chromosome number 2n = 30. It is a prominent bulbous cut flower plant. It occupies eighth position in the world's cut flower trade and has a global history (Ahmad *et al.*, 2008). This flower bears an economic and aesthetic value for its beauty and elegance. The long flower spikes are excellent as cut flower for ornamentation when arranged in vases. Flower and corm of some gladiolus are used as food in many countries reported by Khan (2009). Gladiolus with its beautiful spikes, produces flowers from October to March in the plains and from June to September in the hills of India. Micronutrients play a crucial and vital role in gladiolus production as well as major nutrients in growth and development. The micronutrient contributes most important role on various metabolism and synthesis processes in plants. The deficiencies of micronutrients create different abnormalities like chlorosis, roselling and scorching etc. (Singh *et al.*, 2012). Its required in small amount Zn recorded with high values of plant development, leaf area, floret length and number of florets (Paradhan *et al.*, 2004). Boron plays a key role in a diverse range of plant functions including cell wall formation and stability, movement of sugar or energy into growing parts of plants, and pollination and seed set. Adequate B is also required for effective nitrogen fixation. Iron acts as catalyst in formation of chlorophyll and several enzymes. It is an important element in various reactions of respiration and photosynthesis.

MATERIALS AND METHODS

Considering the importance and demand of cut-flowers in India continuously increasing day by day gladiolus is the best material as a cut-flower for long time preservation for that it may transport easily than others flowers. Hence, a field experiment on gladiolus was conducted at the Experimental farm, Department of Floriculture and Landscape Architecture, KNK College of Horticulture Mandsaur Madhya Pradesh, during 2017-2018 to investigate the effect of micronutrients ($ZnSO_4$, $FeSO_4$ & B) on flowering and postharvest parameters of gladiolus cv. "Mayur". The experiment was laid out as a Randomized block design (RBD) and replicated thrice. Nine treatments were applied in present trail. Before planting all soil

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Effect of Sowing Dates on Growth, Flowering and Yield of Indian Bean Varieties under Agroclimatic Conditions of Malwa Plateau in Madhya Pradesh

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10.18805/LR-4212

ABSTRACT

A field experiment was carried out at research field, College of Horticulture, Mandsaur (M.P.) during *kharif* season, 2018-19. Twenty treatment combinations comprising of four dates of sowing (D_1 - 20th July, D_2 - 5th August, D_3 - 20th August and D_4 - 5th September) and five varieties (V_1 - Arka Vijay, V_2 - Konkan Bhushan, V_3 - Arka Visthar, V_4 - Arka Adarsh and V_5 - Arka Prasidhi) were evaluated in factorial randomized block design with three replications. The findings of the investigation revealed that among the dates of sowing, D_1 (20th July) recorded significantly higher growth parameters, yield parameters and yield. There was highest protein content, dry matter content and fibre content in edible pods under D_1 (20th July) and lowest with D_4 (5th September) date of sowing. Earliest first flowering, 50% flowering and first picking of pod was noted with D_4 (5th September) date of sowing. Among the varieties, variety V_3 (Arka Visthar) showed superiority for growth parameters and yield parameters *viz*., number of spikes plant^{-1}(116.21), pod width (23.04mm), weight of 10 pods (96.19g), pod yield plant^{-1} (2579.1g), pod yield ha^{-1} (339.6q) and harvest index (39.4%). Earliest first flowering (41.5 days) and first picking (63.7 days) was observed with V_2 (Konkan Bhushan). Highest spike length (31.49cm) was measured with variety V_2 (Konkan Bhushan). Highest pod length (14.05cm) and number of pods plant^{-1} (340.6) were recorded with variety V_5 (Arka Prasidhi). Highest protein content (2.80%), fibre content (1.94%) and dry matter content (16.20%) were obtained under the variety V_1 (Arka Vijay).

Key words: Flowering, Growth, Indian bean, Quality, Sowing, Varieties, Yield.

INTRODUCTION

Indian bean (*Lablab purpureus* L.) belongs to the family Fabaceae, is commonly known as Field bean, Hyacinth bean, Country bean, Dolichos bean, Egyptian bean, Sem, Wal, Avare, Avarai, etc. (Shivashankar and Kulkarni, 1989). It has been originated in India as wild forms of this bean are found in this country. From India, it was introduced to China, Western Asia, Egypt and other tropical countries of South and South-east Asia and Africa. In India, dolichos bean is primarily cultivated in Karnataka and adjoining districts of Tamil Nadu andhra Pradesh, Maharashtra and Madhya Pradesh. It is used as vegetable (immature green soft pods and immature grains) and forage.

The crop is grown for tender pods as vegetable and mature seeds as pulse and play an important role in the nutritional security of the region. The crop is also known for its richness in protein (3.6%) and fibre (1.8%). However, dry seed contain 23.0 - 28.0% protein. The pods are also rich in phenol (1.7- 9.67 mg/100 g) which is a potential antioxidant (Rai *et al*., 2014). It is very important for the fleshy and soft textured green pod, which supplies a good amount of protein, minerals and dietary fiber in vegetarian diet. Its seeds also contain water soluble polysaccharides comprised of rhamnose, xylose, arabinose, galactose, glucose, uronic acid, unidentified sugars and proteins (Basu *et al*., 2002).

Sowing at different dates or staggered sowing increases the availability of produce in the market thereby protects the consumers from paying higher prices. Sowing date is one of the most important factors which have tremendous effect on growth, development and biological yield of a crop species (Fagnano *et al*., 2009; Compant *et al*., 2010).

A great range of variation exists in the plant and pod characters of the Indian bean cultivars grown all over the country (Peter and Kumar, 2008). Both photo and thermo-sensitive types are dominant and insensitive type is rarely found in India. Photo-insensitive genotype, which does not require any specific short day conditions for flowering and pod set, can be grown as a remunerative off-season crop during summer and rainy season. Determinate type cultivars have relatively more synchronous flowering and hence have more uniform pod maturity facilitating cost-effective harvesting. Therefore, concerted efforts are required to

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Effect of pre harvest spray of GA_3, calcium nitrate and potassium sulphate on post harvest behaviour of guava (*Psidium guajava* L.) fruits

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Abstract
The present investigation was carried out in Instructional cum research fruit orchard and laboratory of Department of Fruit Science, College of Horticulture Mandsaur (M.P.) during 2015-16 and 2016-17. Results of two years pooled data revealed that minimum decay loss percentage (15.38% & 52.28%) on 6th and 9th days at storage condition respectively in fruits of Chittidar guava. Maximum TSS (10.97 ºB, 12.15 ºB, 11.93ºB & 10.38ºB) on 0, 3rd, 6th and 9th days at storage condition, minimum acidity (0.45%, 0.51% & 0.49%) on 0, 3rd & 6th, Chittidar was registered maximum value in respect to total sugars (7.82%, 8.94%, 8.49% &7.21%) on 0, 3rd, 6th and 9th days at ambient storage condition was recorded in Chittidar. Dharidar was registered maximum value in respect to pectin content (0.92%, 0.84%, 0.74% & 0.57%) on 0, 3rd, 6th and 9th days at storage condition respectively. As regards to plant growth regulator and nutrients (GA_3, Ca $(NO_3)_2$ and K_2SO_4), minimum decay loss percentage (27.88%) was recorded in T_{12} followed by T_7 (28.77%) and T_{10} (33.44%) on 9th day of storage respectively. The highest TSS (12.51 ºB & 11.22 ºB) was found in T_{12} which was followed by T_{10} (12.25 ºB) & (11.08 ºB) and T_8 (12.08 ºB) & (10.84 ºB) on 6th and 9th days at ambient storage condition respectively. Lowest acidity (0.46%) was found in T_8 and T_{12}, with which equal performance on 6th day of storage. At 9th day of storage the minimum acidity (0.34%) was recorded with T_{12} which was followed by T_{10} (0.35%) and T_8 (0.36%), maximum total sugars (10.15%, 11.11%, 10.68% & 9.57%) was recorded in T_{12} which was followed by T_{10} (9.64%, 10.81%, 10.31% & 9.16%), maximum pectin content (1.18%, 1.12%, 1.06% & 0.92%) was recorded with T_{12} which was followed by T_{10} (1.17%, 1.11%, 1.02% & 0.88%) and T_7 (1.14%, 1.09%, 0.99& 0.83%) on first 0, 3rd, 6th and 9th days at storage conditions respectively. Interaction study revealed that minimum decay loss percentage (26.81%) was recorded in V_2T_7 which was followed by (27.19%) in V_2T_{12} and V_1T_{12} (28.56%), highest TSS (11.83 ºB, 13.07 ºB ºB, 12.77 ºB & 11.35 ºB) was found in V_2T_{12} followed by V_2T_{10} (11.49 ºB, 12.79 ºB , 12.46 & (11.33 ºB) V_2T_8 (11.43 ºB, 12.68 ºB,12.38 ºB &11.17 ºB) on 0, 3rd 6th and 9th day at ambient storage condition respectively. Maximum total sugars (10.20%, 11.18%, 10.81 & 9.54%) were recorded in V_2T_{12} on 0, 3rd, 6th & 9th days at storage condition respectively.

Keywords: Pre harvest spray, GA_3, calcium nitrate, potassium sulphate, post harvest behaviour, guava (*Psidium guajava* L.) fruits

Introduction
Guava (*Psidium guajava* L.) is an important fruit crop of India. Due to hardy nature of plant it can withstand adverse climatic condition and grows under a wide range of soil types fro sandy to clay loam (Dhiliwal and Singla 2002) [12]. It is normally consumed fresh as a dessert fruit, of processed into, juice, concentrate, jam, jelly, nector or syrup (Jagtiani *et al.*, 1988) [21]. There is an increasing demand of fruits for fresh as well as processing purpose in domestic and international markets.

Physico-chemical and biochemical changes affect the final texture and quality of fruits during the storage. The effect of elucidating the maintenance of fruit quality has been based on the modifications taking place in the cell wall (Brummell *et al*., 2004) [8]. Calcium, as a constituent of the cell wall, plays an important role in forming cross-bridges, which influence cell wall strength and regarded as the last barrier before cell separation (Fry 2004) [14].

In recent years plant growth regulators have been used for improving the quality, delaying deterioration in storage and thereby increase the shelf life of various fruit crops including guava. Some chemicals like calcium, potassium and plant growth regulator have been reported to prolong shelf life and improve the quality by affecting the wide range of physiological processes in plants and also inhibit specific aspect of abnormal senescence in numerous fruits

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Studies on integrated weed management practices in maize- A review

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AICRP on Management of Salt Affected Soils and Use of Saline Water in Agriculture,
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ABSTRACT

Worldwide yield losses in maize due to weeds are estimated to be around 37%. Weeds reduce crop yield by competing for light, water, nutrients and CO_2, interfere with harvesting and increase the cost of cultivation. The predominant weed flora were *Echinochloa crusgalli* L. and *Cynodon dactylon* L. among monocots; *Cyperus rotundus* L. among sedges; and *Amaranthus viridis* L., *Digera arvensis* L., *Portulaca oleracea* L., *Alternanthera sessili* L. and *Trianthema spp.* among dicots in India. The infestation of these weeds is increasing day by day in the maize growing belt of the state especially where the farmers are using atrazine year after year. New herbicides with broad spectrum of weed control are highly essential for effective control of grasses, sedges and broad leaved weeds. So, in order to widen the weed control spectrum, it is desirable to use tank mix combinations of two herbicides having different mode of action and integrated weed management practices for better weed control.

Key words: Maize, Nutrient uptake, Weed flora, Weed management, WCI, Yields.

Cereals are dominate in world agricultural production because they are directly or indirectly provide the large portion of human subsistence. These crops are most important source of concentrated carbohydrate and happened to be a cheap source in terms of afford and costs of production. Among the cereals, Maize (*Zea mays* L.) is the world's widely grown cereal crop and primary staple food-crop in many developing countries (Kumar *et al.*, 2015a,b and Ram *et al.*, 2017). It is the 3rd major food-grain crop after rice and wheat in India. Maize is known as 'Queen of Cereals' because of its high production potential and wider adaptability (Kumar *et al.*, 2016 and Kumar *et al.*, 2017a). The cereals occupy about 54 per cent of the total cropped area of which maize occupies about 3.61 per cent of the total cropped area of India. In India, it is cultivated on an area of 8.69 million ha with a production of 21.81 million tonnes and the productivity of 2509 kg/ha contributing nearly 9.0 per cent of the total food-grains production in the country (Anonymous, 2016). The major maize producing states are Karnataka, Rajasthan, Andhra Pradesh, Bihar, Maharashtra and Uttar Pradesh, which shared 60 per cent of area and 70 per cent production in the country (Singh *et al.*, 2017a and Trivedi *et al.*, 2017).

Weed management in maize can be highly sophisticated due to wider row spacing. Mechanical control of weeds growing between the rows is labour intensive. Hence weed control in developed countries is done by using herbicides. Herbicides weed control is an important alternative to manual weeding because it is cheaper, faster and gives better weed control (Chikoye *et al.*, 2005 and Kumar *et al.*, 2017b). Management of weeds is considered to be an important factor for achieving higher productivity as weed problem is more severe during continuous rains in early stages of maize growth which cannot be controlled by traditional and cultural practices alone due to too much wetness. Weeds reduce maize yield from 33-50% depending upon weed species and density (Sharma *et al.*, 2000). Weeds compete with crops for light, moisture, space and plant nutrients and consequently interfere with the normal growth of crops. It is known that there is a critical crop-weed competition period with grain losses reaching between 28 and 100% if weeds are not controlled (Teasdale and Mohler, 2000 and Kumar *et al.*, 2017b). Control of weeds in maize is, therefore, very important for obtaining higher productivity. Weed control practices in maize resulted in 77 to 96.7% higher grain yield than the weedy check (Tesfay *et al.*, 2014 and Yadav *et al.*, 2018). Hence, systematic investigations on these aspects are important; therefore, this review chapter was prepared.

Major Weeds Flora Associated with Crop: Sanodiya *et al.* (2013) found that predominant weeds under monocot

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Effect of integrated nutrient management on growth development and yield traits of tomato (*Solanum lycopersicon* L.)

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Abstract
An experiment was conducted to find out the suitable organic, inorganic nutrients and biofertilizers or their combinations for integrated nutrient management in tomato at the Horticulture Research Farm, College of Agriculture, Indore (M.P). The experiment comprised of total eight treatments combinations of organic and inorganic nutrients and control. The experiment was laid out in randomized completely block design with three replications. Application of RDF treatment T7 (RDF 180:100:60 NPK) recorded significantly growth and recorded the best performance over Plant height (144.07cm), number of fruit cluster per plant (10.23), days to first flowering (45.73), days to 50% flowering (43.53), while in number of flowers/plant (53.77), minimum days to flowering (41.67) and highest fruit yield/ha (359.95q), treatment T5 [(75% RDF% + 25% of RDF T4 [(i.e. Neem cake (6.25%) + Vermicompost (6.25%) + FYM (6.25%) + Poultry manure (6.25%) + PSB + Azospirillum.)] recorded best result. Similarly, treatment-1 (Neem cake (50%) + Vermicompost (50%) + PSB + Azospirillum) recorded maximum weight of fruit(89.20g), fruit length(6.13cm) and fruit diameter(18.20cm), while treatment-6 [(50% RDF% + 50% of RDF T4 [(i.e. Neem cake (12.5%) + Vermicompost (12.5%) + FYM (12.5%) + Poultry manure (12.5%) + PSB + Azospirillum)] was recorded significantly the maximum leaf area per plant (343.24 cm^2).

Keywords: Tomato, INM, chemical fertilizers, organic manures, biofertilizers, growth, yield

Introduction

Tomato (*Solanum lycopersicon* L.) is one of the most popular fruit vegetables grown in the world. It is one of the most widely, grown vegetable in India and has become popular within the last six decades. It is grown in small home gardens and market gardens for fresh consumption as well as processing purposes. India ranks second in area and production of tomato in the world. The leading tomato growing states in India are Uttar Pradesh, Karnataka, Maharashtra, Haryana, Punjab and Bihar. It is a self-pollinated crop and Peru- Equador region is considered to be the centre of origin. It was introduced by the Portuguese. It is cultivated in tropics and subtropics of the world and it is being cultivated in kitchen gardens, commercial fields under green house and poly house conditions and soil less culture or hydroponic systems. It consist of vitamins, minerals and antioxidants which are essential for human health. It is one of the popular vegetable of great commercial value and used in various forms of salad or cooked and are used in the preparation of products like sauce, pickles, puree, paste, syrup, ketchup, soup and powder. Although, a ripe tomato has 94 per cent water, being a good source of vitamin A and B and excellent source of vitamin C and has good nutritive value. It is very appetizing, removes constipation and has a pleasing taste. Tomato is universally treated as a "Protective Food" and is also a very good source of income to small and marginal farmers. It is a rich source of minerals, vitamin and organic acid.

The growth, yield and fruit quality of tomato largely depend on number of various interacting factors. Among them, INM is the most crucial as well as basic factor. The continuous use of chemical fertilizer increases the concentration of heavy metals in the soil, disturbs soil health and quality which cannot support plant growth in long term basis. Integrated Nutrient Management comprises organic, inorganic component and microorganism that are highly beneficial for sustainable crop production as it ameliorates soil environment, maintains adequate level of nutrients and provides favourable conditions for high tomato yield with desired quality.

Use of organic with inorganic nutrient sources not only helps in increasing the yield of crop but acts as store house of nutrients for successive crops, besides improving the physical condition of soil. Bio organic nutrition also improves the quality of product. Organically produced vegetable fetches higher price as compared to product obtained from inorganic

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Effect of Organic Manures, Fertilizers and their Combinations on Growth, Yield and Quality of Radish (*Raphanus sativus* L.) cv. Japanese White

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A B S T R A C T

The present investigation entitled "Effect of Organic Manures, Fertilizers and their Combinations on Growth, Yield and Quality of Radish (*Raphanus sativus* L.) cv. Japanese White" was conducted at the Department of Horticulture, College of Agriculture, Indore (M.P.) during the year 2017-2018. The experimental materials for the present investigation were comprised of treatments *viz.*, Control- No organic manure /fertilizers, Recommended dose of fertilizer (100 Kg N, 80 Kg P_2O_5 and 50 Kg K_2O ha^{-1}), 50% RDF + 50% FYM of Recommended Dose, 50% RDF + 50% Vermicompost, 50% RDF + 50% Poultry manure, 50% RDF + 25% FYM + 25% Vermicompost, 50 % RDF + 25%FYM + 25% Poultry manure, 50% RDF + 25% Vermicompost + 25% Poultry Manure, 75% FYM + 25% RDF, 75% Vermicompost + 25% RDF, 75% Vermicompost + 25% RDF, 75% Poultry Manure + 25% RDF and 25% of each RDF + 25% FYM + 25% Vermicompost + 25% Poultry Manure, laid out in Randomized Block Design with three replications. The plant height (32.43 cm), Length of leaves (29.37), fresh weight of root (119.73 g) and Dry weight of root (20.36 g), root length (22.83 cm), diameter of root (3.87 cm), average weight of root (119.73 g) and yield of root (498.89 q ha^{-1}), total soluble solids (5.09^{0}Brix) and fiber content (749.87 mg) recorded maximum values with respectively in treatment T_8 (50% RDF + 25 % Vermicompost + 25% Poultry Manure). The number of leaves (13.23) recorded maximum values with respectively in treatment T_4 50% RDF + 50% Vermicompost.

Introduction

Radish (*Raphanus sativus* L.) belongs to the family Brassicaceae and it has 2n=18 chromosomes. It is a popular root vegetable in both tropical and temperate regions. It can be cultivated under cover for early production but large scale production in field is more common in Haryana, West Bengal, Punjab, Bihar, Assam, Madhya Pradesh and other some state of India. In Madhya Pradesh, radish is grown in 10440 ha with a production of 153270 tones (Anonymous, 2016-17).

Radish is grown for their young tender tuberous roots which are consumed either cooked or raw. The radish leaves are rich in minerals and vitamin A (5 IU) and vitamin C

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Study of different parameters of genetic variability and performance of various genotypes in Okra

Inderpreet Kaur Binepal, Swati Barche, Mandeep Kaur and KP Asati

Abstract
The present investigation was conducted at Nursery area, Department of Horticulture, College of Agriculture, Indore, M.P. during kharif season of 2016. The experiment was laid out in Randomized Completely Block Design (RCBD) with three replications and eighteen genotypes were collected namely Shakti, Jhilmil, No. 55, Sahiba, No. 64, Harita, Saarika, Ns-801, Arya Mohini, Shaan, Hissar Unnat, Panchwati, Panchali, Swati, Lakshmi, OH-102, Shankar Ganga and Parbhani Kranti. Analysis of variance revealed highly significant variation for all the characters indicating greater variability in the existing material. The genetic variation can only be useful for crop improvement with the help of partitioning variances. Phenotypic co-efficient of variation (PCV) agreed closely with the genotypic co-efficient of variation (GCV), but the magnitude of PCV was higher than GCV for almost all the characters. The phenotypic coefficient of variations (PCV) was highest for characters *viz*., length of internodes, fruit yield per plot, fruit yield per ha and fruit yield per plant, while highest genotypic coefficient of variation (GCV) was noted for fruit yield per plant, length of internodes, fruit yield per plot and fruit yield per ha indicating greater diversity for these traits and their further improvement through selection. High heritability coupled with high genetic advance for traits like fruit yield per plant, fruit yield per plot, fruit yield per ha, length of internodes, number of leaves per plant at 90 DAS, plant height at 90 DAS and fruit weight suggested that they could be improved through direct selection.

Keywords: Variability, PCV, GCV, DAT and diversity

Introduction
Okra [*Abelmoschus esculentus* (L.) Moench] belongs to the family Malvaceae having chromosome no. 2n=130 has captured a prominent position among vegetables. Genetic variability in a group of germplasm is a pre-requisite for a successful breeding programme. It is said that genetic variability is the "sine quanon" of any such programme. Selection is said to be effective in a population having large heritable variability. Since most of the characters influencing yield are polygenic, it is essential for plant breeders to estimate the type of variation available in the germplasms.

The genetic variability and its components are the genetic fractions of observed variability that provides measures of transmissibility of the variation and response to selection. The breeder's choice of the material for any improvement work consequently depends on the amount of genetic variability present. Therefore the present investigation was undertaken to estimate the magnitude and nature of variation in the collected germplasms of okra with respect to different morphological, phenological and quality parameters which can be used in the improvement programme.

Material and Methods
An experiment was conducted at Nursery area, Department of Horticulture, College of Agriculture, Indore, MP during Kharif season of 2016. The experiment was laid out in a Randomized Completely Block Design with three replications. The experiment material consisted of eighteen genotypes of okra. Seed of germplasm was collected from different location of India. The seeds were sown in July in field in fifty four separate plots. The plot size was kept 4.2 m x 2.5 m. Each plot consisted of thirty five plants. All the cultural practices were adopted uniformly for all the genotypes.

Observations were recorded on growth, flowering and yield characters *viz*. plant height, number of leaves plant^{-1}, number of branches plant^{-1}, length of internodes, number of nodes to first flowering, days taken to first flowering, days taken to 50% flowering, days taken to first picking, fruit length, fruit width, fruit colour, fruit weight, fruit surface, number of fruits plant^{-1}

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Adoption Behavior of Orange Producer under National Horticulture Mission (NHM) at Shajapur district of M.P.

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Abstract

In Madhya Pradesh, near about 25 percentage area is under orange crop in Shajapur district. In Shajapur block, the area under orange crop is 22052 ha with production of 28514 tonnes (CRIDA), under National Horticulture Mission (NHM).This area has been selected because of high demand of orange and its diversified nature. It is a cash crop and provides motivational features to the farmers to grow long term crop. Oranges are rich in potassium, an electrolyte mineral that controls the heart function, controls blood pressure, prevent cancer and anti-inflammatory properties. In light of the above facts, the present study entitled as " Adoption Behavior of Orange Producer under National Horticulture Mission (NHM) at Shajapur district of M.P" with 120 orange growers from Shajpur district. It was observed that the mean adoption behavior score was highest in practice of improved variety followed by planting material, chemical fertilizer, method of Irrigation, plant distance, selection of land; inter cropping, weed management, planting season, insect and pest management, disease management, market management.

Keywords — *Adoption Behavior, Orange Producer, National Horticulture Mission (NHM)*

I. INTRODUCTION

One of the most widely favoured of the world's fruits, the orange, sweet orange was for many years known as Citrus aurantium var. sinensis L. It was considered to be a form of the sour orange, assumed to have originated in southern China, North eastern India. The Mandarin orange belongs to Rutaceae family and it is very important fruit crop due to rich source of vitamin C. In the world it is cultivated over an area of 7.9 million ha with a production of about 3.84 million metric tonnes of fruit.

In India, orange producing states are Maharashtra, Madhya Pradesh, Assam, Odisha, W.B., and Nagaland. The total area under orange fruit is 324 thousand ha with the production of 3255 thousand million tonnes and productivity of 10mt/ha. Maharashtra is leading state in orange production, whereas M.P. being the second. These interesting facts came to fore in the recently released the report adds that State is at second position in orange production. Orange farming is done on maximum area 24.3 % in M.P. Madhya Pradesh is one of the leading states of orange growing after Maharashtra in our country which has shared 38 thousand ha with production of 684.9 thousand million tonnes and its productivity 18 mt/ha. Major varieties of orange cultivated in Madhya Pradesh are Nagpur Santra, Coorg Santra, Khasi Santra, Mudkhed, Seedless-182 and Kinnow Mandarin and Jaffa etc.

II. Objective

1. To study the adoption behaviour of improved orange production technology under NHM.

III. Review of Literature

Harish and Manjunatha (2011) revealed from their study that majority of crossandra farmers fall under the high adoption category

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Assessment of the Correlation and Path Analysis with Association of Growth and Yield Characteristics in Okra

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Correlation analysis, Path analysis, Growth and yields of okra

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A B S T R A C T

The present investigations were conducted at Nursery area, Department of Horticulture, College of Agriculture, Indore, M.P. during kharif season of 2016. The experiment was laid out in Randomized Completely Block Design (RCBD) with three replications and eighteen genotypes were collected i.e. Shakti, Jhilmil, No. 55, Sahiba, No. 64, Harita, Saarika, Ns-801, Arya Mohini, Shaan, Hissar Unnat, Panchwati, Panchali, Swati, Lakshmi, OH-102, Shankar Ganga and Parbhani Kranti. The genotype Panchwati was recorded maximum in growth and yield characters like number of branches plant^{-1}, number of leaves plant^{-1}, fruit length (16.23 cm), fruit width (2.14cm), fruit weight (17.15 gm), number of fruit plant^{-1}(14.53), fruit yield plant^{-1} (292.17gm), fruit yield plot^{-1} (11.62 kg), and fruit yield ha^{-1} (161.28 q). The highest positive and significant correlation coefficient of fruit yield plant^{-1} was observed with number of fruits plant^{-1} and fruit length. The highest positive and significant correlation coefficient of fruit yield plant^{-1} has been noted with number of fruits plant^{-1} indicating that these characters is the primary yield determinant in okra. The yield attributing characters exhibited varying trend amongst them. Path coefficient analysis revealed that number of fruits plant^{-1} had highest positive direct effect followed by fruit weight, number of nodes to first flowering, number of branches plant^{-1} at 90 DAS (days after sowing), length of internodes, number of leaves plant^{-1} at 90 DAS, plant height at 90 DAS and fruiting span are the most important character contributing towards fruit yield and hence purposeful and balance selection based on these character would be rewarding improvement in okra. Direct selection of fruit yield plant^{-1}, days to 50% flowering, days to first flowering, fruit length and days to first picking should be avoided instead of direct selection.

Introduction

Okra [*Abelmoschus esculentus* (L.) Moench] belongs to the family Malvaceae having chromosome no. 2n=130 has captured a prominent position among vegetables. These studies along with the association analysis will be more useful in the estimation of inter-relationship among the growth and yield contributing components. It is essential to have detail information on the association among different yield components and their

2014

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Research Article

ENHANCING CROP PRODUCTIVITY THROUGH WATER HARVESTING TANK UNDER CHANGING CLIMATIC CONDITIONS

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Abstract: The study, conducted during, 2011-2018 on the rainwater management aspect through water harvesting tank in a farmer's field, it was observed that collection and utilization of runoff water is very beneficial in terms of enhancing crop production and farm income, modifying adverse effect of prolonged dry spells, crop diversification, reducing offsite damage to downstream fields due to uncontrolled runoff and through recharging the ground water. The same water harvesting tank can also be used for storage of pumped water and its subsequent efficient use as irrigation to black soils during *rabi* season. On an average, the lifesaving irrigation to soybean enhanced the soybean production by 10 q/ha and on the other hand the supplemental water increases the chickpea yield from 6 q/ha to 18 q/ha.

Keywords: *Water harvesting tank, Crop diversification, Rainwater management*

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Introduction

Due to climate change, water shortage problems are increasing throughout the world in both developing and developed countries [1]. It is predicted that change in climate will affect soil moisture, ground water and frequency of flood or drought [2,3]. The changing climate is a global challenge to sustainable livelihoods and economic development [4]. Constructions of rainwater harvesting structures have been the strategy to stop migration of the people [5]. Water harvesting and enhancing productivity of available water is the key to provide food for increasing population [6]. Thus, in order to meet the increased irrigation water, augmentation of existing water sources by development of additional sources of water and conjunctive use of surface and ground water will be needed [7]. Rainwater harvesting technologies are among which has long been recognized as a critical factor for productivity of agricultural crops [8]. Rainwater harvesting represent fundamental tools for land and water development, because it use the scattered and intense precipitation for productive purposes [9]. Rainwater harvesting measures could play a key role in further mitigation strategies against the global warming instead of carbon dioxide avoidance policy [10]. Therefore, to evolve the mitigation strategy, a study was initiated during 2011 in Malwa region under NICRA (National innovations on climate resilient agriculture) Project. Rainwater management can minimize the risk due to changing climatic conditions associated with farming [11]. Water resource management acts as a catalyst for socioeconomic development for the country [12]. In Malwa region, water level is depleting, therefore need of rainwater harvesting is essential to enhance irrigation water availability [13]. As the runoff potential of black soils of Malwa region is very high due to its inherent properties, it is decided to harvest the runoff at suitable locations and its subsequent utilization with conjunctive use of ground water. The increased water availability will thus ensure the provision of life saving and supplemental irrigation under changing climatic conditions.

Material and Methods

The team of scientists of All India Coordinated Research Project for Dryland Agriculture, College of Agriculture, Indore have been visiting different villages of Malwa region from time to time to study about the adopted agricultural practices by the farmers. The main objective of this study is to evaluate these techniques scientifically for modifying it and to provide to the farmers for enhancing their crop production and farm income. This on-site and on-farm study also decides future research work. It has been observed by the team that for adopting scientific methods the farmers also consider various hypothesis. However, the team continuously motivating the framers to adopt these advanced practices. A similar attempt has been made by the team during 2010-11 in the village Ningnoti (22°47'23.9N,75°54'17.1.9E) of Sanwer block of Indore district under project NICRA financed by ICAR New Delhi. The main objective of this project is to reduce the adverse effect of changing climate on the crop production. For this, attempts have been made to reduce the cost of cultivation by contingent plan, enhancing irrigation water availability and use of improved farm implements.

In an initial study, it was observed in 2010 that farmers of the village use mostly tube well for irrigating the crops. Most of the farmers having more than one tube wells therefore due to deeper ground water level almost all the existing open wells are defunct. The soils of the village are deep soil, which is very fertile, but most of the farmers cultivate chickpea due to scarcity of the irrigation water despite good rainfall, the water availability from the tube well is gradually reduced after the month of December. Therefore, it was estimated that if the runoff from the cultivated field is collected at a suitable location it will not only increase the *rabi* crop productivity but also will provide lifesaving irrigation to kharif crops during prolonged dry spell. Thus, by storing the runoff water at suitable location in individual farmer's field can diversify the *rabi* crops by including potato, onion, garlic and wheat in place of chickpea, besides increasing productivity. Initially the farmers of the village were reluctant to construct water harvesting tank because it is hypnotized that due to tank construction a sizable part of land would be wasted and will not be in use for crop cultivation. The continuous persuasion and attempts by the team, ultimately was successful in convincing a farmer Shri Balu Singh s/o Shri Nathu Singh for the construction of water harvesting tank in his field.

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Research Article

INNOVATIVE AND MODIFIED RIDGE–FURROW IRRIGATION SYSTEM IN MALWA REGION

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Abstract: In a study conducted during 2017-18, a comparative evaluation between traditional ridge-furrow irrigation system and modified irrigation practices was made. It was observed that innovative practices like PVC pipe with taps & valves and flexible rubber pipe with holes not only match with the costly micro irrigation system (drip, trikle irrigation) but also helpful in controlling water movement in the furrow, increasing time of concentration, providing uniform soil moisture profile throughout the furrow and in avoiding the over irrigation with lesser time and labour requirement in comparison to traditional ridge-furrow irrigation system. At the same time, these practices are having higher distribution efficiency as water in the furrow covering higher number of furrows simultaneously.

Keywords: Ridge-furrow system, Innovative approach, Irrigation water management

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Introduction

As we are celebrating 'world water day' 2019 with the theme '*Leaving No One Behind*'. It motivates us to rethink about irrigation practices which are more water consuming. Now a days about 80% the farmers irrigate their soil by using flood irrigation system [1]. Water use efficiency indicates that India uses 2-3 times more water than major agricultural countries like China, Brazil and the US to produce one unit of food crop [2]. NITI Aayog's report (2018) on 'composite water management index' also underlined the depressing state of water stress, hence efficient and innovative irrigation system is needed. In Mulwa region of Madhya Pradesh, ridge-furrow irrigation system is the traditional irrigation system for vegetable crops. Ridge Furrow is the best planting method; however, this practice is time and labour consuming as physical presence in the field required throughout the irrigation process [3]. Irrigation variables (inflow discharge, furrow length and time of irrigation cutoff) affect the performance of furrow irrigation systems [4-6]. Holzapfel1 Eduardo, *et al.*, (2010) [4] Suggested the design criteria for furrow irrigation management, but practically movement of water in furrow are found to be non-uniform, resulting over irrigation of the furrow. In the study area, it is observed that water availability is increased due to Narmada-Kshipra Link Project [7]. Since there is hypothesis that the farmers over irrigate their field if sufficient water is available. Therefore, it is essential to introduce efficient, effective cheaper and labour-time saving techniques for irrigation. Similarly use of drip irrigation system have been advocated by different research workers from time to time [8,9]. However, this micro irrigation system is relatively costlier [10] and not user friendly and farmers opt for the traditional irrigation practices instead for irrigating different crops. Thus, a suitable and alternative irrigation practice is required to enhance the efficiency in comparison to traditional irrigation practices, to match the costly micro irrigation system. With this idea and objectives in view, the present study was carried out to compare the traditional ridge-furrow irrigation system with few innovative and cheaper ridge-furrow irrigation techniques adopted by few farmers in consultation with the team of All India Coordinated Research Project for Dry land Agriculture, College of Agriculture Indore.

Material and Methods:

The study was carried out in different villages of Malwa region namely Jalod keu and Jani of Indore district (N-220 47.717', E-760 03 .680'). In these villages it has been observed that due to an ambitious and important project of linking Narmada-Khsipra river (Feb 2014) water availability has been increased appreciably. Similarly, due to construction of stop dam near these villages in Kshipra river almost throughout the year water is stored in the nearby river portion. This not only increased the surface water but also ground water recharge insured the irrigation water throughout the year. Thus, many traditional irrigation systems have been widely practiced by the farmers (Prajapati, J.R. and Suryanarayana, T.M.V., 2014) However, few innovative and cost-effective irrigation systems by modifying existing traditional system have been adopted in consultation with the project team. A comparative study has been made on these practices and documented here.

Result and Discussion:

Efficient water management

There is a hypothesis that due to enhanced water availability the farmers do n use the irrigation water judiciously but over irrigate their fields and waste t precious water. On the other hand, however, in these two villages, it has be observed that the farmers not only converted their fields into terraced field but a made provision to save their fields from the losses due to runoff during monso season. The already eroded fields are now converted into levelled field a spreading excavated soil from other areas. Similarly, underground pipelines laid from water source to cultivated fields to reduce the water conveyance los This has to reduce appreciable amount of water losses and enhance the w availability in the field.

Innovative irrigation practices

Normally with the enhanced water availability, the farmers are advised to a micro irrigation system for irrigation for efficient and judicious use of the pre water.

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Assessment of genetic variation and divergence in black gram's genotypes on climatic condition of Madhya Pradesh

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Abstract
Total forty six genotypes of black gram were studied at College of Agriculture, Indore (M.P.). Wide differences found between PCV and GCV in respect of yield and yield attributing traits. Based on the estimates of genetic divergence through Mahalanobis' D^2 – statistic, total forty six genotypes of black gram were grown at College of Agriculture, Indore (M.P.) and grouped into 12 different clusters. Highest intra-cluster distance of 2.148 was observed for cluster I which comprises of five genotypes. Cluster II which contained one genotype, had lowest intra-cluster distance. The maximum inter-cluster distance of 9.900 was recorded between cluster V and cluster II. A cross between these two inter-cluster's genotypes is expected to give a heterotic hybrid and wide spectrum of variability. The lowest inter-cluster distance of 2.333 was recorded between cluster IX and VIII. Highest intra-cluster distance & lowest inter-cluster distance indicates that the genotypes of these clusters were genetically less diverse and were almost with same genetic makeup or follows more or less same evolutionary phases during development.
The cluster I (KU7-522, KU7-619, KU7-626, KU7-608 and IVU-486) had lowest mean value for earliness flower initiation, 50% flowering and maturity could be used to develop short duration black gram varieties; cluster III (KU7-632, KU8-611, KU8-612 and KU8-532) for dwarf plant type; cluster X (KU3-62, JU-840 and TPU-4) for tall plant type; cluster II (KU8-632) and cluster IV (KU7-320 and KU8-278) for more number of primary branches per plant, number of seeds per plant, number of pods per plant, biological yield per plant and seed yield per plant; cluster VI (RBU-466-D, KU8-476, JU-86, TYPE-9 and IVU-466-D) for seed weight that may be used as bold seeds. To improve any particular trait, donor may be selected from these clusters for hybridization program to evolve high yielding strains.

Keywords: black gram, variability, diversity, inter-cluster distance, intra-cluster distance

Introduction
Urdbean belongs to Phylum- Angiosperms, sub-phylum- Dicotyledones, division- Lignosae, Order- Leguminales, family- Leguminaceae, genus- Vigna and species- mungo, thus finally called Vigna mungo L. Hepper. It is vernacularly called in different names like Biri (odia), Urd, Urad, Urid, Mash and Mungo in different parts of India and abroad (Panda, 2016). The somatic chromosome number of this crop is 2n=22. It is grown mainly in rainy and/or summer seasons. The total availability of black gram in India per person is low as compared to other pulse crops.

Blackgram is extensively used as a nutritious pulse. Its seeds may be eaten raw, roasted, parched or boiled in split form. It is pached and ground to flour for making cakes, biscuits and confectionaries. It is used for making dosa and idli amalgamated with rice, popular breakfast dishes and also used in preparing papad and barian. Sprouting seeds are also eaten as such. It acts as a direct source of protein in vegetarian diet and indirect source of protein in non-vegetarian diet (Panda, 2016). The productivity of urd bean in the state as well as in India is very low due to various constraints like; non-availability of quality seed of high yielding variety, seeds germinate in mature pod itself if there is rains at maturity time of crop and the crop is highly sensitive to high intensity rains etc. Thus, the crop requires due attention to increase its production and productivity.

Yield is a complex quantitative trait which cannot be improved by selecting individuals on *per se* performance basis. The knowledge of nature and magnitude of genetic variability for characters of economic importance and cause and effects of relationship of yield and yield components for the available genotypes are utmost essential which helps in planning the future breeding programme for genetic improvement for yield potential of any crop species (Gour *et al.* 2018) [5].

Hybridization programme gives an opportunity to create wide spectrum of genetic variability. Black gram is a self-pollinated crop and lacked in genetic variability.

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Association biometrical analysis of yield and yield attributing determinants in *Vigna mungo* (L.) hepper

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Abstract
Black gram (*Vigna mungo* (L.) Hepper), popularly known as urd bean, urid or mash is widely grown in India. The experimental material used in the present study comprised of forty six genotypes including standard checks. A total of eleven traits have been studied for association analysis. The experiment was carried out at Research Farm, College of Agriculture, Indore (M.P.).
Correlation coefficient analysis at phenotypic and genotypic levels indicated that apart from number of seeds per plant and 100-seed weight other traits like number of pods per plant, number of primary branches per plant, number of seeds per pod, biological yield per plant, harvest index, days to 50% flowering, plant height and days to flower initiation were positive correlated with seed yield per plant. It is therefore suggested that preference should also be given to these traits in selection programme to isolate superior strains with genetic potentiality for higher seed yield. Path coefficient analysis revealed a higher and positive direct effect for number of seeds per plant and 100-seed weight on seed yield so weightage should be given to such traits in selection of parents for yield improvement.

Keywords: Black gram, correlation coefficient analysis, path coefficient analysis

Introduction
Black gram (*Vigna mungo* (L.) Hepper), popularly known as urd bean, urid or mash is an important self-pollinating diploid grain legume and belonging to the family Fabaceae. This pulse originated in south and south east Asia (Indian sub-continent) but widely grown in India, Pakistan, Bangladesh, Myanmar, Thailand, Philippines, China and Indonesia (Poehlman, 1991) [12].
It contains sulphur containing amino acids, methionine and cysteine and also contains lysine, which are excellent component of balanced human nutrition. The dried seeds are used to make dal, soups, and curries and added to various spiced or fried dishes. In spite of its various uses, its cultivation is decreasing day by day both in acreage and yield which badly effects on human health (Sohel *et al*., 2016) [13]. The productivity of urd bean in the state as well as in India is very low due to various constraints like; non-availability of quality seed of high yielding variety, seeds germinate in mature pod itself if there is rains at maturity time of crop and the crop is highly sensitive to high intensity rains etc., all such factors cause heavy losses in terms of yield. Thus, the crop requires due attention to increase its production and productivity in terms of its quantitative and qualitative values.
The yield is a complex character and governed by a large number of genes with negligible individual gene effects and largely influenced by environmental factors. Knowledge of inter-relationships existing among yield components is essential when selection for improvement is to be effective. Association studies give an idea about the contribution of different characters towards seed yield and it reveals the type, nature and magnitude of correlation between yield components with yield and among themselves. The knowledge of direct and indirect influence of yield contributing characters is of prime importance to select high yielding genotypes.
Correlation coefficient analysis measures the mutual relationship between various plan characters and determines the components characters on which selection can be based fo genetic improvement of yield. Path analysis splits the correlation coefficient into the measure of direct and indirect effects and determines the direct and indirect contribution of variou characters towards yield.

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Assessment of polygenic character's association with yield in chickpea genotypes

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Abstract
Chickpea is one of the important pulse crop in Asia with special concern to India. Productivity of chickpea is low as compared to wheat in India. For this concern, the analysis of the relationships among yield attributing characters and their associations with seed yield is essential to establish selection criteria. The experimental material used in the present study comprised of forty genotypes including standard checks.

The characters *viz*., 100-seed weight, biological yield per plant, harvest index, number of pods per plant and number of seeds per plant recorded positive correlation coefficient with seed yield both at genotypic and phenotypic level. Path coefficient analysis revealed a higher and positive direct effect *viz*., number of seeds per plant, lowest branch height, number of primary branches per plant, harvest index and number of seeds per pod on seed yield per plant.

The result obtained from genotypic correlation coefficients and path analysis indicated that the characters namely; number of seeds per plant and harvest index exhibited strong positive correlation coefficient and high magnitude of positive direct effects on seed yield. Hence, it is suggested that while exercising selection index due weightage should be given to number of seeds per plant and harvest index as these were important components influencing seed yield of chickpea.

Keywords: Chick pea, correlation coefficient, path analysis

Introduction

Chickpea is one of the important pulse crop grown during *rabi* season in Asia. It is a self-fertilizing annual diploid grain legume of the family *Fabaceae,* sub family Faboideae. The scientific name *Cicer arietinum* (2n=2x=16) has been derived from the roman word '*Cicer*' owing to the resemblance of the head and the word '*arietinum*' derives its name from aries meaning ram. Hence it has resemblance to the head of ram. It is also known as Gram, Indian pea, Cecibean or Bengal gram, Garbanzo bean, and Egyptian pea. The cultivated chickpea are mainly divided into two groups based on plant characteristics, seed size, shape and colouration as *'kabuli'* and *'desi'*. The *'kabuli'* chickpea has relatively large creamy coloured seeds, white flowers and do not contain anthocyanin. In contrast, the *'desi'* chickpea has comparatively small seeds of various colours, purplish flowers and do contain anthocyanin pigmentation. Chickpea seeds contain on an average 23% protein, 64% total carbohydrates (47% starch, 6% soluble sugar), 5% fat, 6% crude fiber and 2% ash. It is also reported to contain high mineral content: phosphorus (340 mg/100 g), calcium (190 mg/100 g), magnesium (140 mg/100 g), iron (7 mg/100 g), zinc (3 mg/100 g) (Jukanti *et al*., 2012) [10].

Madhya Pradesh is also known as "Fort of Pulses" and chickpea is grown largely in rainfed and partial irrigated condition. Madhya Pradesh is the single largest producer of chickpea in the country accounting for over 40 per cent of the total national production. *Malwa* plateau, Vindhyan plateau, Bundelkhand, Narmada valley and Chambal valley regions of the state are the major chickpea producers. Production and price risks are more in chickpea compared to wheat in the state. That's why breeder has to concern on yield enhancement of chick pea for increasing production and productivity.

Breeding chickpea for various desirable traits is limited by the lack of adequate selection criteria (Meena and Kumar, 2014) [12]. Remembering above condition, the analysis of the relationships among yield attributing characters and their associations with seed yield is essential to establish selection criteria. But only using simple correlation coefficients between yield and yield components may not give satisfactory results.

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Identification of sorghum parental lines with high phenotypic stability using GGE biplot analysis in Central India

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ABSTRACT

The experimental material was newly developed sorghum parental lines (25 B-lines and 38 R-lines) which were evaluated in RBD in two trials for two consecutive years (2016 & 2017) at research Farm, College of Agriculture, Indore in rainy season. The objective of the present study was to identify stable grain sorghum lines and also evaluate them for grain yield and other agronomic attributes (days to 50% flowering, plant height, leaf length, leaf width, leaf area, panicle length) and suitable for kharif season using GGE biplot analysis. Genetic variation was the major contribution for LL, LA and GY in B-lines and PL in R-lines. Variance due to genotype × year interaction effect was a major source of variance for only LL in B-lines. The GE influence was seen only for grain yield in both B- and R-lines. The GY per panicle was high in R-lines (52 to107g) as compared to B-lines (32 to 79g). Three B-lines (E Nos. 1, 5, 17) has GY greater than 63g panicle^{-1} while eight R-lines (I 28, I 32, I 40, I 45, I 47, I 50, I 51 and I 56) had GY greater than 90g panicle^{-1}. Based on mean performance and stability, 1, 14, 7 and 5 were desirable B-lines and 142, 134, 156, 155, RS673 and 126 were desirable R-lines for cultivation and use in further breeding programme over the years.

Keywords: Biplot, mega-environment, sorghum, stability, testers and yield

Sorghum bicolor (L.) Moench is a multipurpose cereal having genome size 730Mb, is a traditionally important cereal crop of India being cultivated in around 5.65 million ha with a production of 4.41 million tons and with a productivity of 740 kg ha^{-1}. The major sorghum growing states in India are Maharashtra, Madhya Pradesh, Karnataka, Andhra Pradesh, Tamil Nadu, Telangana, Gujarat and Rajasthan. In the state of Madhya Pradesh, sorghum is important as a food crop, feed crop and also as a fodder crop for rainfed farming. In view of the multiple usage of the crop, sorghum is presently grown in area of about 2.05 lakh hectare with a productivity 1951 kg ha^{-1} in Madhya Pradesh (Anonymous, 2018). Over the past few years, sorghum has taken a quantum leap in productivity in Madhya Pradesh on account of development of high yielding hybrids and varieties with photo insensitivity, short stature and high yield along with simultaneous improvement in production technology. The development sorghum hybrid has been possible primarily due to the availability of Cytoplasmic Male Sterile lines (CMS lines). Due to the availability of well established CMS system for sorghum, all the national and state released hybrids are based entirely on the three line system *viz*., the male sterile line *i.e.* A, maintainer line called B and fertility restorer line R. It is a need of time to ensure nutritional security for the large poor masses of the world *via* enhancing production potential of grain sorghum needs using breeding approaches (Shetty *et al*., 2013).

In the recent times, with uncertainty around the climate conditions and the constantly changing evolving climatic and or environmental factors, evaluation of genotypes (parental lines) for consistence of performance in different environment conditions is of utmost importance to enable development of stable high performing hybrids. Change in environmental conditions has major impact on performance of genotypes. The occurrence of large G×E interaction becomes a major hurdle in direct selection for relative phenotypic performance related to genetic constitution and selection of genotypes becomes extremely onerous. Therefore it is pertinentto to understand the type of interaction between genotype and the environment in order to make testing and the ultimately selection of more efficient genotypes. This increased efficiency in selection of genotype will lead to the identification of stable parental lines which are necessary to increase productivity levels.

The GGE biplot is one of the most reliable method for stability analysis over the mega-environments (ME) data analysis and it pin points that only GEI and G are the most relevant factors and must be considered simultaneously when evaluating genotypes over mega environments even though the measured yield is a result of combination effect by Genotype (G), Environment (E) and genotype x environment interaction (GEI). Yan *et al*., 2000 reported that GGE it very easy for one to see which genotype won in which environments because it is based on singular value decomposition of

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Effectiveness of WhatsApp Messages Regarding Improved Agricultural Production Technology Disseminated by KVK, Dewas(M.P.)

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Abstract: *New agricultural technologies are generated by research institutes, universities, private companies, and by the farmers themselves. The role of research and advisory services is to give highly accurate, specific and unbiased technical and management information and advice in direct response to the needs of their clients. Due to poor linkages between research and advisory services, the adoption of new agricultural technologies by farmers is often very slow and research is not focusing on the actual needs of farmers. As social networking (Whatsapp) continue to grow and attract more users, it is important to research the possible and perceived opportunities, benefits, and risks of using this technology. So keeping this in mind proposed the ongoing study with 120 farmers (whatsapp beneficiaries) of Dewas district. It is revealed from the study that the higher number of the whatsapp beneficiaries found sometime effective regarding overall whatsapp messages followed by never effective and always effective of overall whatsapp message in agricultural development.*

Keywords - WhatsApp Messages, Agricultural Production Technology, Disseminated

Introduction-

India is a land of diversity and thus package of practices for raising crops differ significantly from place to place, today most of the farmer do not have access to information at right time, so farmers' approach towards receiving agricultural information has been completely changed by getting ICT base-tool mobile learning in their hand. This innovative method utilize ICTs in delivering information to farmer by personal calls, voice and text SMS. The role of mobile learning (smart phone) in agriculture for management decision in modern farming require to be up to date and local

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Research Article

A STUDY ON SCIENTIFIC TEMPERAMENT OF DURUM WHEAT GROWERS UNDER FLD CONDUCTED BY IARI, REGIONAL STATION IN INDORE DISTRICT OF MDHYA PRADESH

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ABSTRACT

Durum Wheat (Triticum tergidum L.) is an economically important crop grown worldwide including India. It is being cultivated 10 to 11% of world area and accounts about 8% of the total Wheat production. Durum is 2nd most important species grown in the country. The aestivam wheat is invariably consumed as chapatti. Durum Wheat is consumed in the form of suji, macroni, noodles, sevai, pasta and some local product like "bati"and "baffle". In central india it is being cultivated in Malva region, Sourastra and Kathiaward in Gujarat and Kota, Bundi, Jhalawad and Udaipur regions of Rajasthan Bundelkhand region and west Maharashtra since long time and its traditional food product like Bati, Bafla, Dalia, Churma, LapsiUpmaetc are being consumed as staple food. The frontline demonstration is to demonstrate potential of new varieties, newly released crop production and protection technologies and its management practices in the farmers' field under different farming situations. The present study is an attempt to evaluate Scientific Temperament of Durum Wheat Growers under FLD in Indore district with 120 durum wheat beneficiaries. The major finding of the study was Majority of the respondents (beneficiaries of FLD programme and non-beneficiaries) possessed medium level of scientific temperament. The mean value of scientific temperament of beneficiary farmers of FLD was higher than the mean score of scientific temperament of non-beneficiaries. The't' test indicated that there is a significant difference between scores mean of both the group. Thus, it can be stated that, there is an impact of FLD programme on scientific temperament of the wheat growers.

INTRODUCTION

The population is increasing in a geometric progression leading to an increased demand of wheat but there is no possibility of further increase in area due to growing urbanization, diversification, dwindling water resources, micro-nutrient deficiencies and soil health deterioration. Therefore, the need to produce more wheat has to be met out with fewer resources in a sustainable and cost effective manner. The wheat production, currently, is hovering around 70 to 94 million metric tons (MMT) and produced around 157 MMT of wheat straw in the past few years. Recent estimates have shown that India will need nearly 100 million tons of wheat by the end of 2018-19 and more than 113 million tons by 2025.

The area under throughout the world as well as in India has become constant i.e., 215 million ha. and 26 million ha. Respectively. India can harvest over 95 million tons of wheat merely by bridging the present demonstrated through frontline trials. There lies tremendous scope of improving wheat production in UP, MP, and Bihar.

The frontline demonstration is to demonstrate newly released crop production and protection technologies and its management practices in the farmers' field under different agro-climatic regions and farming situation. The objective of Front Line Demonstration (FLD) is to demonstrate newly released crop production and protection technologies and its management practices on the farmers' field to study the constraints of production, factors contributing for higher production and thereby to generate production data and feedback information.

The IARI Regional station on wheat, Indore (M.P) was entrusted with the responsibility of conducting FLD in Sawer block of district Indore m.p. the main emphasis was to maximize production per unit area by using high yielding varieties of wheat in conjunction with the package and practices. While a large number of studies have been made to

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Impact on Sustainable Rural Livelihood of Integrated Watershed Management Program of Beneficiary Farmers in Khandwa District of Madhya Pradesh

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Abstract: ***This study concentrates on the Integrated Watershed Development program and impact of the program in terms of crop production, water consumption in farming system, as well as income and employment generation. Again it is found to use to the maximum extent water resources and provide betterment in farmer's livelihood. Evaluation studies on Integrated Watershed Development Programme have shown that the impact of the programme in terms of production, consumption, income and employment generation was found to be satisfactory to a minimum extent. Hence it is worthwhile to study the changes occurred in livelihood activities of beneficiaries farmer of Integrated Watershed Development Programme (IWMP) in Khandwa district of Madhya Pradesh with 80 beneficiaries farmers. The major finding of study was that the impact of agricultural activities on rural livelihoods of watershed project beneficiaries on different attributes like improvement of water resources, land use change, socio economic status, health services improvement, employment generation in family, capacity building, agriculture livelihood favourability, capital and food security.***

Keywords: sustainable rural livelihood, Integrated Watershed Management Program, beneficiary farmers, Impact

Introduction:

The twenty-first century is a time by which the world is seriously confronted by issues sustainable use of water and land resources to improve rural livelihoods for It is clearly argued that a stable livelihood contributes to the pleasant development of related polices, poverty eradication and sustainable use of resources. Conservation and management of land and water resources. for sustainable intensification of agriculture and poverty, decrease in developing regions has remained one of the most challenging policy issues for a long time, and most local, regional, and international policies, programs, initiatives, covenants, protocols, and conferences pay much attention on land resources such as soil, water, and vegetation in trying to improve human livelihoods as well as conserving these resources for future generation. It is clearly argued that a stable livelihood

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A potential menace: Stem rot in mustard

Omprakash Bharti, RK Pandey, Reeti Singh and RK Singh

Abstract
Stem rot is a most serious disease of rapeseed mustard. Earlier, it was considered as a minor disease and now, it has become a serious problem in recent years. Northern region of Madhya Pradesh jointly contributes >60% production of the rapeseed mustard. In search of the new botanicals, biological agents, animal byproducts and chemicals may lead to integrated management of the disease with no fluctuation of the environment. With view of resistance, there was no proven resistance in the brassica genotypes against the disease. Stem rot is a polyphagous and soil born nature, hence, the sclerotia can survival upto 5 years in the soil. The identified of the new genes in rapeseed mustard against this disease though advanced biotechnological approaches. With the view of the above points more need to do work in future on the mustard crop against Stem rot.

Keywords: Stem rot, mustard, chemical, survey, isolates, RAPD

Introduction
Stem rot is one of the most serious disease and causes damage to oilseed Brassica. Earlier, it was considered as minor disease and now, it has become a serious problem in recent years. Stem rot set as a key in foot of the most mustard growing area of northern region of Madhya Pradesh. Disease incidence was recorded upto 60 per cent and in fields where disease incidence was upto 70 per cent, 40-50 per cent seed yield loss was recorded Fig-1. With the view of the Resistance in mustard genotypes, none of the cultivars were found free from infection of the disease till now. The overview article or survey of article is prepared on available related aspects work done on the Stem rot (*Sclerotinia sclerotiorum*) in rapeseed mustard crop has been reviewed by earlier researcher and upto present status of work. The available literature on the concerned topic is briefly reviewed as under:

History and geographical distribution
Shaw and Ajrekar (1915) [71] first recorded that the occurrence of *Sclerotinia* blight on rapeseed and mustard has been made from India and later the disease has been observed in severe from in other countries like Australia (Holtzhausen and Knox Davies, 1974) [33] Brazil (Neto,1955) [52], Canada (Duczek and Morral, 1971; Plat ford and Bernier, 1975; Davidson, 1977) [26, 21], China (Yang, 1959) [88] Denmark (Buchwald 1947) [11] England (Sansford,1995) [69], Finland (Jamalainen 1954) [35], France (Brun *et al.* 1981; Hims,1979) [10, 32], Germany (Klemm,1938; Kirchner and Pluschkell,1979; Kruger1976) [42, 41, 45] India (Shaw and Ajrekar, 1915; Roy and Saikia, 1976) [71, 67], Israel (Palti,1959) [57], Italy (Zazzerini and Tosi, 1985) [89], Mexico (Ponce and Mendoza 1983) [59], New South Wales (Loof, 1959) [50], Nepal (Shreshtha, 1986), New Zealand (Wong and Willets,1975) [85], Peru (Bazan and Segura, 1952) [6], South Africa (Holtzhausen and Knox Davies, 1974) [33] Swedan (Djurle,1982) [25] and United Kingdom (Hims, 1979) [32]. Boland and Hall (1994) [9] reported that *Sclerotinia sclerotiorum* (Lib.) de Bary capable to infect over 408 plant species under 75 families. Purdy (1955) [62] concluded that the synonymy with *S. sclerotiorum* several species described from various hosts and locations since 1955 no new information has appeared that would justify alternate of my opinion. Sansford (1995) [69] reported that the stem rot is world-wide problem to mustard cultivation. Vasudeva (1958) [82] reported that the term white blight has been used as a common name of the disease incited by *S. sclerotiorum*. However the disease has also beer named as white rot (Rai and Dhawan, 1976; Rai *et al.*1974) [64, 65] White blight (Roy and Saikia, 1976) [67] and stem canker (Klemm, 1938; Kruger *et al.* 1981) [42], based on the specific symptoms produced. The different isolates of *Sclerotinia sclerotiorum* of infected *B. juncea* in

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Development of chickpea wilt (*Fusarium oxysporum* f. sp. *ciceri*) incidence in relation to soil edaphic and aerial environments

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ABSTRACT

Correlation between incidence of chickpea wilt [*Fusarium oxysporum* f. sp. *ciceri* (Padwick) Matuo & K. Sato (foc)] and soil edaphic factors on four lines, viz. JG 315, IGP 187, IGP 29 and JG 62 was studied. There was a significant correlation between disease incidence and soil temperature and moisture (%). The test entries showed positive correlation with soil temperature and negative correlation with soil moisture as well as contributed 54.7% (JG 315), 56.32% (IGP 187), 54.88% (IGP 29) and 39.42% (JG 62) in development of wilt. Three different levels of temperatures, viz. 20, 27 and 34, two different levels of relative humidity, viz. 60, 80% and two inoculum load (5 and 10%) exhibited positive correlation with wilt incidence. Statistically, aerial temperature (0.7226**) and inoculum load (0.6435**) showed significant positive correlation with wilt incidence, while relative humidity (0.1315) was found to be non-significant.

Key words: Aerial temperature, *Fusarium oxysporum* f. sp. *ciceri*, Inoculum load, Soil moisture, Soil temperature, Wilt incidence

Chickpea (*Cicer arietinum* L.) is the most important pulse crop of Indian sub-continent. India is the largest producer as well as consumer of chickpea in the world. It is an ancient conventional rainfed pulse crop widely adopted by the farmers especially in poor natural resource availability. Chickpea is a main crop of *rabi* widely cultivated in rainfed areas of Malwa Plateau, Jhabua hills and Nimar Valley region of western Madhya Pradesh. Soybean-chickpea and soybean - wheat is the predominant cropping pattern of black cotton soil in the region, as the depth of soil is mostly shallow to deep. Black cotton soil has the natural property of ploughing and in drought conditions large, sized, cracks appear in the field. The area is well known for production of export quality extra-large seeded *Kabuli* (JLSK) chickpea locally called as Dollar and the best quality desi varieties for dal and floor preparation. The changing scenario of climate not only affects normal physiological processes of chickpea but also the pathogenic behavior. The pathogens related to crops always take their nourishment from their host and in fact their, survival, multiplication, vigourness and comparative infectiveness to desirable host is determined by the congenial microclimatic conditions. Soil borne pathogens especially hemibiotroph growth rate and multiplication have to be determined by the microclimatic conditions of rhizosphere, rhizoplane and availability of nutrients in surrounding. The population dynamics of types and number of rhizospheric microbes in crops have the great variation in colonisation of microbes in rhizosphere, rhizoplane and even in non rhizospheric soils (Wieland *et al.* 2001). Chickpea wilt caused by *Fusarium oxysporum* f. sp. *ciceri* (Padwik) Matuo & K. Sato (foc) is responsible for wilting, flagging and consequently loss of the yield. The environmental conditions play a vital role in the incidence and development of chickpea wilt disease (Merkuz and Getachew 2012). Chickpea wilt disease is caused by a soil and seed borne pathogen. (Pande *et al.* 2007) and faster growth and multiplication of wilt pathogen is dependent on the soil temperature, soil moisture, pH, inoculum load and availability of organic substrate in the micro climate of rhizospheric soil (Chaudhary *et al.* 2001). Epidemiological studies are therefore essential to determine the effects of all environmental factors. The objective of this study was to identify the environmental/soil conditions favourable for chickpea wilt disease.

MATERIALS AND METHODS

For characterization of soil factors (Soil moisture and soil temperature) conducive to chickpea wilt disease development, four resistant to highly susceptible lines (JG -315, IGP187, IGP29 and JG62) were raised in experimental field (Continuously chickpea crop laid out from five years) with four replications at College of Agriculture, Indore (Madhya Pradesh), which was being used for germplasm

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Integrated Nutrient Management in Different Types of Maize *(Zea mays* L.) in the Malwa Plateau of Madhya Pradesh

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ABSTRACT

There is a wide gap in potentiality and productivity of different maize types in India. Indiscriminate use of fertilizers is one of the most important factors for it. A filed experiment on integrated nutrient management in different maize types was conducted during 2011 and 2012 in Indore for assessing different doses of inorganic fertilizers coupled with vermicompost. Plant population, plant height (cm), no. of cobs per plant were recorded significantly highest with maize type baby corn, while cob length (cm) was found highest with maize type flint corn and cob girth was recorded highest with maize type sweet corn. Highest cob yield was registered with maize type sweet corn. In case of fertility levels, the highest values of growth parameters viz. plant height, number of cobs per plant, cob length, cob girth were recorded with the fertility level 75% RDF +25% equivalent N through Vermicompost. The same treatment gave the highest cob yield but the highest stover yield recorded with the fertility level of 100 per cent RDF. The return per rupee investment was found highest with baby corn with nearly one rupee (Rs 0.94) and under fertility level, it was found highest of Rs 1.05 with treatment 75% RDF +25% equivalent N through Vermicompost.

Keywords *Maize type, baby corn, flint corn, sweet corn, INM, vermicompost, nitrogen.*

Maize *(Zea mays* L.) is one of the most versatile crops having wider adaptability under varied agro-climatic conditions. Globally, it is referred to as the miracle crop or "the Queen of Cereals" because it has the highest genetic yield potential among the cereals. It is cultivated on nearly 182 m. ha. in about 160 countries of the world having wider diversity of soil, climate, biodiversity and management practices and that produced 987 m.t. of grain with a productivity of 54.23 q/ha at global level (Mruthunjaya et al., 2016). On the other hand, the average productivity in India is only 2.56 t ha^{-1} (Mahajan, 2016). Different types prevailing in cultivation in India are flint maize that is grown primarily for consumption as human food. Another type "baby corn" also known as young corn, mini corn or candle corn, harvested very early while the cobs still small and immature especially when the silks have either emerged or just emerged and no pollination has taken place. It is typically eaten as whole cob. Near metros and big cities it has fetched big market. The other major type "sweet corn" (*Zea mays* saccharata Sturt) also called pole corn is a sub-species with high sugar content, naturally occurring recessive mutation in the gene which control conversion of sugar to starch. Unlike field corn varieties, which are harvested when the kernels are dry and mature (flint stage), sweet corn is picked when immature (milk stage) and prepared for eaten as roasted and vegetable rather than as a grain. Maize has immense potentiality of yield than the other cereals. There is a wide gap between its potentiality and the production realised in our country *i.e.*, only 26 q/ha, which is almost half its potential or global productivity. Continuous, inadequate and imbalance application of chemical fertilizers with restricted or no use of organics creates not only the deficiencies of some nutrients in the soil but also deterioration the natural resources viz. land, water and air and resulted in a poor agricultural production/ productivity. This indiscriminate and non judicious use of fertilizers cause imbalance in soil fertility and poor soil health. Further, rainfed conditions and poor organic status of soil, etc. in general and age-old varieties *in* particular, make the conditions worse to worst. A good quality and quantity of produce is harvested by the farmers under assured irrigation but the quantity is much lowering than that of realized under rainfed conditions. As many times, *kharif* crops suffer badly with moisture *stress* at their critical growing period owing to erratic behavior of rainfall *i.e.*, doughtiness during the intermittent rainy periods in the rainy season and rains at seedling and/ or harvesting of *crops* damage the population and produce considerably.

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EFFECT OF MICRONUTRIENTS, ORGANICS, AND BIOFERTILIZERS ON GROWTH AND YIELD OF SOYBEAN UNDER VERTISOLS

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ABSTRACT: With the view of investigation the effect of micronutrients, organics, and biofertilizers on growth and yield of soybean under vertisols, a field experiment was carried out at Research Farm, College of Agriculture (Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya), Indore, during *kharif* season 2013. Among the various nutrient management treatments, significantly higher growth characters, namely plant height (62.67 cm), nodules/plant (54.0), dry weight of nodules (242.27 mg), and dry matter accumulation/plant (21.88 g) were recorded in recommended dose of fertilizer (RDF) + 1 g ammonium molybdate/kg seed + *Rhizobium* + phosphate solubilizing bacteria (PSB) as compared to others nutrient management treatments. Similarly, highest yield attributes (pods/plant, seeds/pod, and 100-weight) and seed yield (844 kg/ha) were recorded also recorded with the application of RDF + 1 g ammonium molybdate/kg seed + *Rhizobium* + PSB during the investigation. Whereas the lowest values of growth, yield attributes and yield were recorded in RDF.

Key words: Biofertilizers, growth characters, micronutrients, soybean, yields.

INTRODUCTION

Soybean is known as "Golden Bean" of the 21st century. This legume crop is widely used as a source of vegetable. Since last few decades, intensive cropping systems with the use of high-yielding varieties of crops harnessed the native soil fertility, which is posing a threat to the sustainable crop production, besides rampant nutrient deficiencies (Singh *et al*, 2013 and Bhagwat *et al*, 2018). Soybean occupies the highest area and production among the oilseeds in Madhya Pradesh. The state has its major share in area and production of soybean in India (nearly 60%) and hence designated as Soya State. The main reason for its popularity in the world is its richest protein content as compared to other pulse crops. It also contains valuable oil, which is perhaps exceptional in pulse crops. In India, soybean is grown in 11.60 m ha with total production of 8.57 MT. In Madhya Pradesh, it is grown in 5.40 m ha with total production of 5.51 MT (Morya *et al*, 2018).

Micronutrients are needful elements for normal growth of plants that are needed at little amount. One component of seed quality is chemical composition, such as concentration of mineral elements, including micronutrients such as Zn, Fe, Mo, B, and Mn. Zn has several important role in plant nutrition, namely enzyme activation, protection of biomembranes, hormones metabolism, and other functions. Boron plays an important role in the development and growth of new cells in plant meristem. Mn is also an essential component of the major enzyme nitrate reductase in plant. Iron plays an important role in nitrogen fixation and photosynthesis. Molybdenum plays an important role in nitrogen fixation (Billore *et al*, 2005 and Tomar *et al*, 2018). Biofertilizers have promising effect on nutrient availability and nitrogen fixation (Roy *et al*, 2013 and Morya *et al*, 2018). The use of farmyard manure (FYM) helps in maintaining soil productivity by improving the soil structure. It also keep control on soil pH and thus help in maintaining the availability of plant nutrients (Yaduwanshi *et al*, 2018 and Singh *et al*, 2018a). Organic manure and biofertilizer play an important role as they have many desirable properties and exert beneficial effect on the soil physical, chemical, and biological characteristics.

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Nature of soil reaction and status of EC, OC and macro nutrients in Ujjain Tehsil of Madhya Pradesh

Yashwant Gehlot, Aakash, Roshan Gallani, KS Bangar and Sudheer Kumar Kirar

Abstract
A study was undertaken to evaluate the nature of soil reaction and status of EC, OC and macro nutrients in Ujjain tehsil of Madhya Pradesh. The GPS based 150 soil samples were collected from 0-15 cm depth by random sampling method. The soil analysis showed that the pH, electrical conductivity and organic carbon status ranged between 7.01-8.15, 0.10-0.79 dSm^{-1} and 0.30-0.60% with mean value of 7.61, 0.28 dSm^{-1}, and 0.48% respectively. These soils are characterized under neutral to alkaline in soil reaction and less than 1 dSm^{-1} soluble salt content (EC) which comes under safe limit for all soils. The available nitrogen, phosphorus, potassium and sulphur status ranges between 139-235, 8.00-25.60, 301-463 and 8.06-24.36 kg ha^{-1} respectively with mean value of 198.27, 15.8, 358.85 and 16.27 kg ha^{-1} respectively. It could be concluded that these soil data can be effectively utilize with proper nutrient management and regular monitoring to avoid any nutrients stress on crop.

Keywords: GPS, organic carbon, available nitrogen, available sulphur

Introduction
Soil characterization, particularly soil fertility assessment of an area or a region is an important aspect in view of sustainable agricultural production (Singh *et al*., 2017) [27]. As soil nutrients governs the fertility of soil and controls the productivity of crops grown on to soil (Bharti *et al*., 2017) [2]. Currently, crop productivity is declining or stagnating because of imbalanced and inadequate fertilizer application coupled with low efficiency of other inputs mostly in the tribal belt of the country. Also, efficiency of chemical fertilizer nutrients has declined tremendously under an intensive agricultural system in recent years (Meena *et al*., 2017) [19]. Nutrient supply in soil is a natural phenomenon and varies soil to soil, and some of the nutrients may sufficient where others deficient (Dotaniya and Meena, 2013) [7]. The stagnation in crop productivity cannot be boosted without judicious use of the essential plant nutrients to overcome the existing deficiencies or imbalances (Lenka *et al*., 2016) [18].

Soil is a vital and finite natural resource for agriculture. In this regard soil fertility plays a key role in increasing crop production. It comprises not only in supply of nutrients but also their efficient management. The most important constituents in soil is organic matter, an appreciable amount of organic matter in soil tremendously increase soil fertility. Decay of organic matter release nitrogen, phosphorus and mineral nutrients in a form available to plant. Availability of N, P, K, secondary and micronutrients induce better germination of seeds and hence subsequent better growth and stronger root development. Soil fertility is a dynamic natural property and it can change under the influence of natural and human induced factors. As human population continue to increase, human disturbance on the earth's ecosystem to produce food and fiber will place greater demand on soils to supply essential nutrients. Soil fertility fluctuates throughout the growing season each year due to alteration in the quantity and availability of mineral nutrients by the addition of fertilizers, manure, compost, mulch, and lime in addition to leaching. Hence, evaluation of fertility status of the soils of an area or a region is an important aspect in the context of sustainable agriculture (Kavita and Sujatha, 2015) [12].

The evaluation of soil fertility is perhaps the most basic decision making tool in order to impose appropriate nutrient management strategies (Brady and Weil, 2004) [3].

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TEMPORAL DYNAMICS OF NITROGEN ACQUISITION IN MAIZE CULTIVARS GROWN UNDER ORGANIC-N SUPPLY

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ABSTRACT

The field experiment was conducted at the Indian Institute of Soil Science, Bhopal during *kharif* 2014 to study the influence of organic N supply on nitrogen concentration, uptake and partitioning in different parts of twelve different maize cultivars at various growth stages. The twelve varieties of maize viz., Kanchan, Arawali, Sona-222, JM-8, JM-12, JM-216, Pratap-5, Pratap-6, Proagro-4412, CPBG-4202, Popcorn-1 and Sweetcorn were grown in a randomized block design (RBD) with three replications under 100 kg ha^{-1} N through cattle dung manure, vermicompost and poultry manure in equal proportion (1:1:1) on N-equivalent basis. The results revealed that, the N uptake was found lower in stalks than leaves at 45 and 75 DAS as well as at harvest. The N uptake in all the cultivars was highest in grain than in leaves and stalks. The Maize cultivar Kanchan removed maximum nitrogen from soil followed by Proagro-4412, Pratap-5 and JM-12 cultivars. The range of N uptake by cultivars was found relatively lower as it varied between 28.1 and 61.6 kg ha^{-1}. The partitioning indicated, 24 per cent, 12 per cent and 64 per cent of total N uptake was concentrated in leaves, stalk and grain, respectively. The temporal N-uptake revealed that, the maize required adequate supply of N during initial (up to 45 DAS) and final (after 75 DAS) growth stage as these stages contributed 23 per cent and 65 per cent of the total N uptake by maize cultivars. The temporal N-uptake pattern of maize followed the trend: [45-75 DAS] < [up to 45 DAS] < [75DAS-Harvest] in all the maize cultivars.

(Key words: Maize, nitrogen partitioning, nitrogen uptake, organic farming)

INTRODUCTION

Maize 'the queen of cereals' is one of the most potential cereals grown globally, and is the third after wheat and rice in total food grain production in the country (Kumar *et al.*, 2015). Maize is now widely cultivated around the world, and a greater weight of maize is produced each year than any other grain (Singh *et al.*, 2010). The maize crop is considered as a heavy feeder as it requires adequate and timely supply of nitrogen for optimum production (Skowronska and Filipek, 2010). On the other hand, the limited supply of fertilizers and related heavy expenses increasing the cost of cultivation. Similarly, the imbalanced use of chemical fertilizers threatens the sustainability of agricultural production as the long term field experiments have clearly visualized the negative impact of continuous use of chemical fertilizers on soil health (Yadav, 2003).

Researchers throughout the globe highlighted the importance of organic farming for soil health sustenance and production of healthy foods in sufficient quantities (Aher *et al.*, 2012; Aher *et al.*, 2015) through crop rotation, green manure, compost and biological pest control (Subba Rao *et al.*, 2013). However, it has not been practiced for the cultivation of high yielding varieties due to their high nutrient demand. But the recent findings emphasized that though nutrient release pattern especially of N from organic sources is slow, they still able to fulfill the nutrient demand of the plant and helps to uptake nutrient for longer time (Sharma and Mitra, 1991; Vanlauwe *et al.*, 2004; Abou el-Magd *et al.*, 2005). The nitrogen uptake, accumulation and partitioning under fertilizer N supply has widely studied (Abendroth *et al.*, 2011; Bender *et al.*, 2013; Havlin *et al.*, 2014; Ciampitti *et al.*, 2013; Tiwari *et al.*, 2018) but the scientific information with respect to the nitrogen acquisition under N supply through organic sources is lacking. The narrowing of research gap in this context has been tried by studying the nutrient acquisition pattern of twelve maize varieties under organic-N supply.

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Studies on seasonal incidence and nature of damage of girdle beetle and stem fly in soybean

RS Chouhan, B Sundar, V Rashmi, N Khandwe and M Surya Prakash Reddy

Abstract
Field experiment was conducted during Kharif season of 2015 at Zonal Agriculture Research Station, R.A.K. College of Agriculture, Sehore to study the seasonal incidence and nature of damage of girdle beetle and stem fly in soybean. Plant infestation with stem fly abruptly increased and reached up to 80 percent in the last week of September with highest stem tunneling (48.50 percent). The fly-infested almost every plant (90%) in the first week of October 2015. The Maximum infestation of girdle beetle in 2nd week of September it ranged from 11.6 to 15.00 percent. Negligible level of Plant infestation was also observed during the 1st fortnight of October.

Keywords: Plant infestation, girdle beetle, Stem fly, stem tunneling

Introduction
Soybean [*Glycine max* (L.) Merrill] is now a cash crop and has occupied an important place in agriculture and oil economy of the country. Soybean has occupied first rank among oilseed crops in India since 2005 onwards. There is a continuous increase in area and production. The area under soybean cultivation has increased from 8.12 million ha. To 8.87 million ha. And production from 7.96 million tones to 9.46 million tones, i.e, about 9.2% and 18.7% in 2006-2007 and 2007-2008, respectively which is a peculiar increase. In Indian scenario, Madhya Pradesh contributes about 67% and 56% in total area and production of soybean, respectively in the country and is called as "soya state" (Anonymous, 2005 and Anonymous, 2007) [1-2]. In India, soybean has acquired third position among the oilseeds after groundnut and mustard.
The grub of girdle beetle, *Obereopsis brevis* (Swed.) bores the main stem and branches, resulting in stunting plant growth and sometime whole plant succumb to injury. The early-stage infestation of the pest is even more disastrous (Ramesh Babu, 2010) [7]. The stem fly, *Melanagromyza sojae* attacks the soybean throughout the growing season, but the most vulnerable period is within three to four weeks after germination the maggot may tunnel up to 70% of the stem length (Singh and Singh, 1990) [9] and may reduce the grain yield up to 33 percent (Singh and Singh 1992) [8].
Chaudhary *et al*. (2014) [4] reported girdle beetle, (*Obereopsis brevis* Swed) as a predominant borer. Adult female makes girdles in the petiole and even some time on the main stem of plant. It has been observed that girdle beetle cause higher reduction in yield in early and most vulnerable crop stages identified in between 30 to 55 days when girdler confined to petiole.

Materials and Methods
The research work was carried out during *Kharif* season of 2015 at Zonal Agriculture Research Station, R.A.K. College of Agriculture, Sehore. Madhya Pradesh under "All India Coordinated Research Project on Soybean" financed by ICAR, New Delhi.

Observations recorded
Girdle beetle
To record the seasonal incidence of girdle beetle, observation on the number of girdled plants by girdle beetle was recorded at weekly intervals starting from the initiation of infestation till harvest of the crop. The pest incidence was recorded by counting healthy and damaged plant by girdle beetle and the data was calculated in percentage.

Stem fly
Observation on stem fly was recorded on 3 randomly selected plants at weekly interval starting from the initiation of infestation till harvest of the crop. To record the stem tunneling caused by the maggot of stem fly the plants were uprooted and open vertically. Plant height and tunnel

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MORPHO-PHYSIOLOGICAL EVALUATION OF SOYBEAN CULTIVARS AGAINST EXCESS MOISTURE STRESS IN WESTERN MADHYA PRADESH

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ABSTRACT

The field experiment was carried at research farm of RAK College, of Agriculture Sehore, Madhya Pradesh with financial and technical assistance by Japan International Cooperation Agency. Five cultivars were grown under two environments namely, normal and excess moisture stress during kharif 2015-16 all the treatment were replicated thrice in a randomized block design. Each cultivar was sown in four rows 45 cm apart with 2 m row length. Different morpho-physiological and yield traits were recorded on five randomly selected plant from each treatment. The morpho-physiological parameters namely mean plant height, No. of branches/plant, dry matter accumulation/plant. Similarly chlorophyll content photosynthesis rate, transpiration rate, stomata conductance at flowering stage and yield traits, over environments showed that varieties RVS 2007-4, JS 335, JS 20-69, JS 20-59 and RVS 2001-4 were found stable types considering major morpho-physiological and yield traits together.

Key words : *Excess moisture stress, chlorophyll content, soybean varieties, yield traits.*

Soybean (*Glycine max* L. Merrill.) with its 40-42 percentage protein and 20-22 percentage oil has emerged as one of the major oil seed crop in India it has now been established as one of the most important oil seed crop in the world. Accounting for more than 50 percent of oil seeds production and 30 percent of the total suplly of all vegetables oil. In spite of its high yield potential (4.5 t/ha) , soybean productivity is much less in india (1.07 t/ha) than the word average of 2.43 tones per ha. Among the various growth stages of soybean , flowering and seed filling period have been found to be most sensitive to drought. The *Kharif* season of soybean cropping in MP is characterized as a monsoon season with gradual increase of soil water content to an excess extent, after a long-term dry season known as Rabi. In the Kharif season, soybean seeds germinate in an optimum soil moisture condition, but suffer in later growth stages from excess moisture conditions due to continuous raining, consequently developing poor root systems by the time of flowering. The end of monsoon corresponds to flowering and maturity stages: thereafter soybean plants further suffer from water deficit due to the poor root system developed in the excess soil moisture. Thus, soybean plants during *Kharif* season in M.P. face excess moisture stress till flowering as well as water deficit during the maturity. Identification and use of soybean cultivars that develop good root systems in excess soil moisture conditions during the monsoon to tolerate water deficit during maturity is an important approach to increase or stabilize soybean yields in M.P. field conditions. Soybean is very sensitive to excess water compared to other crops. The response to excess water in soybeans is associated with a number of biochemical, morphological and anatomical changes in both the root and the shoot (1, 2) reported that morphological mechanisms of acclimation to flooding stress in soybean appear to involve an avoidance of water loss by transpiration and a facilitated transport of atmospheric O_2 to the submerged roots through the flood-induced formation of adventitious roots and aerenchyma. The effects of water logging on soya bean root development are substantial and generally negative (4). However, short-term acclimation to flooding through biochemical mechanisms may limit the impacts of injurious factors (5). Long-term flood tolerance may require morphological adaptations in the plant to sustain adequate aeration and functioning of the root system (3). Extensive adventitious root development has been reported to enhance oxygen transport from the stem to the roots (6) thereby reducing flooding injury in soya beans. Flooding increased adventitious root fresh weight as a percentage of total root weight (3). While yield and seed qualities are typically selection criteria (7). Therefore the present investigation was undertaken to physiological evaluation of soybean cultivars under excess moisture stress.

MATERIALS AND METHODS

A field experiment was carried out in the research farm of RAK College of Agriculture Sehore, Madhya Pradesh with financial and technical assistance by Japan International Cooperation Agency. Five genotypes/varieties were grown under two environments *viz.*, normal and excess moisture stress during *kharif* 2015-16. All the treatments were replicated thrice in a randomized complete block design. The

Recommended dose of fertilizer for soybean was 20, 60 and 20 kg N,P and Klha respectively. The seed were treated with thirum and bevistin, PSB and rhyzobium

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Influence of different plant growth hormones on morpho-physiological attributing characteristics in Kalmegh (Andrographis paniculata Burn F. Ex)

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ABSTRACT

Andrographis paniculata, commonly known as Kalmegh, is used both in Ayurvedic and Unani system of medicines because of its immunological, antibacterial and hepatoprotective properties. It is an annual herb has a high-value compound used in the treatment of various diseases. A field experiment was conducted at the research farm of RAK College of Agriculture, Sehore (Madhya Pradesh) during Kharif 2015-16 and 2016-17. Investigations were undertaken to aim to increase the growth and yield parameters of Kalmegh. Using different Plant Growth Hormones Cycocel (100, 150 and 200ppm), GA3 (100, 150 and 200ppm) and NAA (100 and 150ppm) and water spray as control to study the effect of plant growth hormones on Growth viz plant height (cm), leaf area (cm2), chlorophyll content (SPAD), photosynthesis rate (µmol CO2 m⁻ ² s-¬¹) at 90 DAS and yield viz test weight (g), seed yield (kg ha-1), herbage yield(q ha-1) and leaf alkaloid content (%) of kalmegh at harvesting. The foliar spray of GA3 @ 150ppm, GA3 @ 100ppm, Cycocel @100ppm and GA3 100ppm significantly maximum plant height (47.33), leaf area (420.82), chlorophyll content (57.78) photosynthesis rate (24.78) during 2015-16 and spray with GA3 @ 100 ppm, applies the maximum plant height (46.20), leaf area (426.41) and photosynthesis rate (22.88) significantly differed from other treatments during 2016-17 respectively. The average plant height, chlorophyll content and photosynthesis rate were higher during 2015-16 (39.57), (51.01) and (22.75) than 2016-17 (39.41), (46.71) and (21.07) except leaf area.

Keywords— *Cycocel, GA3, NAA spray, PPM, Photosynthesis rate, Chlorophyll content*

1. INTRODUCTION

Kalmegh (*Andrographis paniculata* Burn F. Ex) important medicinal plant belonging to the family Acanthaceae. Which is indigenous to India and has been used in Indian systems of medicines since time immemorial. The plant is also known as Rice bitters in West Indies and the king of bitters or Chiretta in England. It is an erect or recumbent, annual herbaceous plant. The branches are quadrangular, leaves simple petiolate, lanceolate with acute base and apex. Flowers are small, solitary and panicles with externally hairy rose or purple colored corolla, calyx-lobes glandular, pubescent, anther bearded at the base, fruits 20 mm long linear-oblong capsules acute at both ends. Seeds are numerous (i.e. containing 8-12 seeds per plant) yellowish-brown. The leaves of Kalmegh contain maximum active principle Andrographolides, Homo-Andrographolides, Andrographesterol and Andrographone. Andrographolides the major constituent in leaves which is bitter substance. The leaves contain much more of Andrographolides then seed. The average Andrographolides content varied from 12.44 to 33.52 mg/g in dried leaves which is found maximum at 90-120 days. The whole part of the plant like leaves, stem, and roots are used in different medicine. Four lactones, viz. deoxyandrographolide, andrographolide, neo andrographolide, and deoxy didehydro andrographolide were found in *Andrographis paniculata* (Sangalungkarn *et al.*, 1990). Kalmegh is used in 26 Ayurvedic formulations as evidenced from Indian Pharmacopoeia; while, in Chinese Medicine, it is an important “cold property” herb and is used to release body heat in fever and prevent the common cold. This also possesses anti diabetes, anti-jaundice, anti-inflammatory anti-ulcer genic, anti-typhoid, anti HIV, and antimalarial, antifertility, anticancer, and antiviral properties. (Joseph and Solomon, 2014). In kalmegh major economic

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Impact of plant growth hormones on growth, physiology and alkaloid content of kalmegh (*Andrographis peniculata* Burn F. Ex)

DK Raidas, SD Upadhayaya, A Sharma and AK Choudhary

Abstract
This study was conducted at A field experiment was carried out in the research farm of RAK College of Agriculture, Sehore (Madhya Pradesh) during *Kharif* (2015-16). A field experiment consisting of Plant Growth Hormones Cycocel (100, 150 and 200 ppm), GA3 (100, 150 and 200 ppm) and NAA (100 and 150 ppm) and water spray as control to study the impact of plant growth Hormones on plant height, No. of branches, Fresh weight of leaf/plant, Dry weight of leaf/plant. Chlorophyll content, Photosynthesis rate, and leaf andrographolide content of Kalmegh (*Andrographis peniculata* Burn F. Ex). Significantly higher Photosynthesis rate was observed by treatment GA_3 100 ppm (23.15) at 70 days of crop as compare to treatment GA_3 150 ppm (22.43) respectively and Cycocel 100 ppm (57.72) at 70 days maximum Chlorophyll content recorded. The applied with NAA at 100 ppm (3.05% w/w) and GA_3 150 ppm (2.93% w/w) was very effective and recorded maximum percentage of leaf andrographolide respectively. The foliar application of NAA 100 ppm at 90 days dry weight of leaf per plant maximum recorded (2.73 g/plant).

Keywords: Andrographolide, medicinal plant, cycocel, GA_3 spray, ppm, chlorophyll content, photosynthesis rate, HPLC

1. Introduction
Kalmegh (*Andrographis paniculata* Burn F. Ex) is a large genus of herbs and shrubs. In the family of Acanthaceae. Kalmegh is an annual erect or recumbent plant. Distribution mostly in the tropical and moist region. It comprises of 19 species the plant is found in India and Shrilanka. It is indigenous to India. In India it is grown in Assam, Bihar, Karnataka, Kerla Madhya Pradesh, Andhra Pradesh and West Bengal. Kalmegh also known as "King bitter" is one among the prioritized medicinal plant in India and this herbs is being used mainly useful in treating fever, treating liver related diseases, jaundice, diabetes. Snake bites. The leaf and the whole herb contain the medicinal important. The fresh and dried leaves of Kalmegh are used as drugs in India. Growth of a plant is greatly affected by much environmental condition which affected the physiology of plant. The leaves of Kalmegh contain maximum active principle like Andrographolide, homo-Andrographolide anndrographesterol and andrographone. Andrographolide the major constituent in leaves which is bitter sub-stance (Gorter, 1911) [1]. The average Andrographolide contain varied from 12.44 to 33.52 mg/g in dried leaves (Prathanturarug, 2007) [8] found maximum at 90-120 (Maheshwari *et al*., 2000) [4]. It has been already used for treating cancer as it promotes cell differentiation in tumour cell (Mutsuda *et al.* 1994) [3]. The recognition of such growth control mechanism has introduced the possibility of modifying growth and development of plant by manipulating hormone level in different organs and various stages in the life cycle. One of the way to achieve this is by exogenous application of chemical growth regulators (Thams, 1985). The term plant growth regulators however applied in phyto hormone as well as synthetic compound (Nickell, 1978). Plant growth regulators are organic compound, other than nutrients, that modify plant physiology processes. PGRs called bio stimulants act side plant cell to stimulate or inhibit specific enzyme or enzyme system and help regulate plant metabolism. To specific PGRs are used to modify crop growth rate and growth pattern during the various stages of development, from germination through harvest and post-harvest preservation. Growth hormone chemicals that have positive influences on major medicinal plant can be of value. The final test, however is that harvested yields must be increase or medicinal quality enhanced in order for growth hormones to be profitable. The synthetic growth regulators chemicals are being extremely important and valuable for manipulating the growth and yield of medicinal plants.

Global-level population genomics reveals differential effects of geography and phylogeny on horizontal gene transfer in soil bacteria

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Although microorganisms are known to dominate Earth's biospheres and drive biogeochemical cycling, little is known about the geographic distributions of microbial populations or the environmental factors that pattern those distributions. We used a global-level hierarchical sampling scheme to comprehensively characterize the evolutionary relationships and distributional limitations of the nitrogen-fixing bacterial symbionts of the crop chickpea, generating 1,027 draft whole-genome sequences at the level of bacterial populations, including 14 high-quality PacBio genomes from a phylogenetically representative subset. We find that diverse *Mesorhizobium* taxa perform symbiosis with chickpea and have largely overlapping global distributions. However, sampled locations cluster based on the phylogenetic diversity of *Mesorhizobium* populations, and diversity clusters correspond to edaphic and environmental factors, primarily soil type and latitude. Despite long-standing evolutionary divergence and geographic isolation, the diverse taxa observed to nodulate chickpea share a set of integrative conjugative elements (ICEs) that encode the major functions of the symbiosis. This symbiosis ICE takes 2 forms in the bacterial chromosome—tripartite and monopartite—with tripartite ICEs confined to a broadly distributed superspecies clade. The pairwise evolutionary relatedness of these elements is controlled as much by geographic distance as by the evolutionary relatedness of the background genome. In contrast, diversity in the broader gene content of *Mesorhizobium* genomes follows a tight linear relationship with core genome phylogenetic distance, with little detectable effect of geography. These results illustrate how geography and demography can operate differentially on the evolution of bacterial genomes and offer useful insights for the development of improved technologies for sustainable agriculture.

microbial ecology | population genomics | integrative conjugative element | symbiosis | nitrogen fixation

Biogeography studies the distribution of taxa and ecosystems in space and time and the factors that pattern those distributions. By observing global geographic patterns in plant and animal taxa and the ecosystems they comprise, 18th-century biologists contributed foundational insights to modern evolutionary biology and ecology. Biogeographic principles are less understood for microorganisms, despite the fact that they comprise the vast majority of life's diversity.

For most of microbiology's history, understanding the diversity and relatedness of microorganisms has come from studies of pure cultures, which produces a limited and biased view (1). Increasingly, studies examine diversity in microbial ecosystems interrogated through rRNA–gene surveys (2, 3), which allow high-throughput and relatively unbiased assessments of the composition of microbial ecosystems (4). These and related molecular genetic methodologies have begun to uncover biogeographic patterns. Multiple studies have shown that geographic distance between samples is less explanatory

Significance

Legume crops are significant agriculturally and environmentally for their ability to form a symbiosis with specific soil bacteria capable of nitrogen fixation. However, nitrogen fixation is limited by the availability of the legume host's bacterial partners in a given soil, and by strain variance in symbiotic effectiveness. In intensively managed agriculture systems, legume crops are provided specific inoculants; inoculation can fail if the added strains are unable to compete in soil with less symbiotically efficient endemic strains. Biogeographic insight is vital to understand what factors affect nitrogen fixation in legume crops and techniques to improve nitrogen fixation. Similarly, understanding the relationship between a legume crop's symbionts in a geographic context can elucidate broader principles of microbial biogeography.

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The authors declare no conflict of interest.

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Data deposition: All sequences reported in this paper have been deposited in the National Center for Biotechnology Information BioProject (accession no. PRJNA453501). A full list of biosample numbers is given in Datasets S1 and S7. Annotations are available at https://figshare.com/projects/Greenlon_Mesorhizobium_Biogeography/63542. Scripts and computational pipelines are available at https://github.com/alexgreenlon/meso_biogeo.

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Exploring the Genetic Cipher of Chickpea (*Cicer arietinum* L.) Through Identification and Multi-environment Validation of Resistant Sources Against *Fusarium* Wilt (*Fusarium oxysporum* f. sp. *ciceris*)

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Fusarium wilt (*Fusarium oxysporum* f. sp. *ciceris*) of chickpea is the major limitation to chickpea production worldwide. As the nature of the pathogen is soil borne, exploitation of host plant resistance is the most suitable and economical way to manage this disease. Present study was therefore conducted with an aim to find new, stable and durable sources of resistance of chickpea against *Fusarium* wilt through multi-environment and multi-year screening. During 2007/2008 crop season, 130 promising genotypes having <10% wilt incidence were selected from initial evaluation of 893 chickpea genotypes in wilt sick plot at ICRISAT, Patancheru. Of them 61 highly resistant lines were selected through further evaluation in 2008/2009 and 2009/2010 crop season. Finally, a set of 31 genotypes were selected to constitute a Chickpea Wilt Nursery (CWN) and tested at 10 locations in India for three cropping seasons (2010/2011, 2011/2012, and 2012/2013) coordinated through Indian Council of Agricultural Research (ICAR) and ICRISAT collaboration. The genotype and genotype × environment interaction (GGE) indicated significant variations ($p \leq 0.001$) due to genotype × environment (G × E) interaction. Most of genotypes were resistant at two locations, ICRISAT (Patancheru) and Badnapur. On the contrary most of them were susceptible at Dholi and Kanpur indicating the variability in pathogen. GGE biplot analyses allowed the selection six genotypes ICCVs 98505, 07105, 07111, 07305, 08113, and 93706 with high resistance and stability across most of the locations and eight moderately resistant (<20% mean incidence) genotypes *viz.*,

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Effect of plant growth hormones on growth, tuber character and forskolin content of patherchur (*Coleus forskohlii* (Willd) Briq).

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Abstract
This study was conducted at A field experiment was carried out in the research farm of RAK College of Agriculture, Sehore (Madhya Pradesh) during *Kharif* 2015-16). A field experiment consisting of Plant Growth Hormones MH (100 and 150 ppm), Cycocel (500 and 1000 ppm), NAA (50 and 100 ppm), GA3 (150 and 200 ppm) and and water spray as control to study the impact of plant growth Hormones on plant height, No. of branches, Number of tuber/plant, Lengh of tubers (cm) Diameter of tuber (cm). Fresh weight of tuber (g/plant) Dry weight of tuber (g/plant) and Forskolin Content (%)of *Coleus forskohlii* (Willd) Briq. 1000 ppm concentration of cycocel determined a decrease of the plant hight, incraes number of branches, number of tuber/plant, lengh of tubers (cm), Diameter of tuber (cm), fresh and dry weight of tuber (g/plant) and Forskolin Content (%).

Keywords: Forskolin, medicinal plant, Cycocel, GA_3 spray, ppm, HPLC

Introduction
Coleus forskohlii (Willd) Briq. [syn. *C. barbatus* (Andr.) Benth] is a plant in Indian origin (Valdes *et al.*, 1987) [5] belonging to mint family Lamiaceae and grow perennially over tropical and sub tropical region of India, Pakistan, Sri Lanka, East Africa and Brazil. In India the crop is being commercially grow in large area in Madhya Pradesh, Maharashtra, Kerala, Karnataka and Tamil Nadu (Lakshmanan *et al.*, 2013). The root portion of the plant has been traditionally used for medicinal purposed and contains an active constituent, forskolin. The crop has a great potential in future due to respected increase in demand for forskolin widely used in glaucoma, cardiac problem and also used in treatment of certain type of cancer (Shah *et al.*, 1980) [4]. To specific PGRs are used to modify crop growth rate and growth pattern during the various stages of development, from germination through harvest and post harvest preservation. Growth hormone chemicals that have positive influences on major medicinal plant can be of value. The final test, however is that harvested yields must be increase or medicinal quality enhanced in order for growth hormones to be profitable. The synthetic growth regulators chemicals are being extremely important and valuable for manipulating the growth and yield of medicinal plants. Their effect varies with plant species, variety concentration used, and frequency of application and various other factors which influence the uptake and translocation of chemicals (Singh *et al*., 1990). The present study was conducted with an objective of finding out the effect of growth hormones on the growth and yield of medicinal plant of Patherchur.

2. Materials and Methods
This study was conducted at A field experiment was carried out in the research farm of RAK College of Agriculture, Sehore (Madhya Pradesh) during *Kharif* 2016). There were eight treatments MH (100 and 150 ppm), Cycocel (500 and 1000 ppm), NAA (50 and 100 ppm), GA3 (150 and 200 ppm) and the water being the control. This study was done on the base of randomized complete block design. The treatment was replicated 3 times. The plant growth regulators were sprayed in three stages viz cutting stage, vegetative stages and reproductive stage. The local coleus variety cutting were transplanted in main field. The whole plot was divided into 3 block each representing the replication. Each block was then divided into unit plot of 3 x 3 m size. Seedlings were transplanted at 60 x 30 cm spacing. The experiment plot fertilized with urea, single super phosphate and murate of potash at the rate of NPK 40 kg, 60 kg and 50 kg ha^{-1} respectively. Nitrogen was applied at two equal splits, one at the time of transplanting and another as top dressing at 30 day after sowing. All the operations done regularly during growing season.

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Effect of organic manures and biofertilizers on growth, yield and quality of cabbage (*Brassica oleracea* L. var. c*apitata*)

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ABSTRACT

An investigation was carried out during rabi season of 2017-18 at Horticulture farm, College of Agriculture, Sehore RVSKVV, Gwalior to study experiment "Effect of organic manures and bio fertilizers on growth and yield of cabbage (Brassica oleracea L. var. capitata)". Experiment was carried out in randomized block design with three replications The experiment was comprised of ten treatments viz., T_1:V_1 (Green galaxy) + FYM @20t/ha + Azotobacter@2.5kg/ha, T_2: V_1 (Green galaxy) + Vermicompost @5t/ha+Azotobacter @2.5kg/ha, T_3: V_1 (Green galaxy) - Poultry Manure @5t/ha + Azotobacter @2.5kg/ha, T_4: V_1 (Green galaxy) + Pig Manure@5t/ha + Azotobacter @ 2.5kg /ha, T_5: V_1 (Green galaxy) + Recommended doses of manure and fertilizer (NPK@ 100:60:80 kg/ha respectively), T_6: V_2 (Green ball) + FYM @20t/ha + Azotobacter@2.5kg/ha, T_7:V_2 (Green ball) + Vermicompost@5t/ha + Azotobacter @2.5kg/ha, T_8 : V_2 (Green ball) + Poultry Manure@5t/ha +Azotobacter@2.5kg/ha, T_9:V_2 (Green ball) + Pig manure@5t/ha + Azotobacter@2.5kg/ha, T_{10} : V_2 (Green ball) + Recommended doses of manure and fertilizer (NPK).The maximum plant height, stalk length, maximum number of non-wrapper leaf per plant, plant spread, maximum head size, head diameter, gross head weight, head compactness, head yield per plot, head yield per hectare, maximum self life (11.54 days), highest benefit cost ratio (1:1.41) and maximum net return (229244 Rs./ha) under the treatment T_8 (Green ball + Poultry Manure@5t/ha + Azotobacter@2.5kg/ha)closely followed by T_9 (10.22 days) for all the characters.Whereas minimum growth and yield parameters was recorded under the treatment T_5 (Green galaxy + Recommended doses of manure and fertilizer).

Key Words: Cabbage, organic manure, poultry manure (PM), vermicompost (VC), *Azotobacter*

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INTRODUCTION

Cabbage (*Brassica oleraceae* L. Var *capitata*) is a cole crop and belongs to the family Cruciferae or Brassicaceae having chromosome number 2n=2x=18. Cabbage is a cool season crop but adapted to a wide range of climates and soils but best results are obtained in a cool environment with a monthly temperature of 13°C to 16°C and where soil is well supplied with nutrients and irrigation water. In India the productivity is low as compared to other countries Therefore there is a need to increase productivity [3-5]. There are many factors involve in overall growth of cabbage viz., nutrient management, irrigation, plant protection measures, varieties etc [30, 20-22]. Among these factors nutrient management is an important factor to increase productivity of cabbage. Since long term use of inorganic fertilizer reduces soil fertility therefore there is a need to maintain soil fertility through

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ORIGINAL ARTICLE

EFFECT OF GRADED DOSES OF N, P AND BIO-FERTILIZER ON NUTRIENT COMPOSITION (NPK & S) OF FENUGREEK IN VERTISOL OF CENTRAL INDIA

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Abstract : The field experiment was conducted with 'Plume 55' fenugreek during the winter season (*rabi*) of 2015-16 and 2016-17 at Farmer field Ikchhawar, District Sehore (M.P.), India. The soil had pH 7.7, electrical conductivity 0.30dS/m, organic carbon 0.48%, available N 210 Kg/ ha, available P 12 kg/ha and available K 485 kg/ha. The treatments consisted of 5 grated levels of N (0, 15, 30, 45 and 60 kg/ha) through urea and 4 graded levels of P (0, 20, 30 and 40 kg/ha) through single superphosphate along with basal application of Potassium @ 30 kg muriate of potash. Fenugreek seeds were treated with *rhizobium* species suitable for fenugreek. Each treatment was replicated 3 times in randomized block design. The crop was seeded during the second fortnight of October and harvested for seed during the first fortnight of March in each year. Irrigation was done at 25 day interval during the crop period. The first cutting was done 25-30 days after sowing and the second cutting 45 days after sowing. Total 2 cuttings were taken each year. Seed yield was recorded plot wise and relative yield was worked out. The plant samples were collected at time of crop harvest and analyzed as per standard methods to determine nutrient composition in the form of NPK & S. It was concluded that the application of 60 kg N/ha, 40 kg P/ha along with bio-fertilizer increased the nutrient composition (NPK & S) and seed yield of fenugreek.

Key words : Fenugreek, Nutrient composition, Vertisol, NPK & S, Bio-fertilizer.

1. Introduction

Fenugreek (*Trigonellafoenum-graecum*) is one of the most important leafy vegetables and medicinal spices of central India. It responds well to nitrogen, phosphorus and bio-fertilizer application [Pareek and Gupta (1981)]. However, information is scanty in medium to deep black soils of Central India. An effort was therefore made to find out the nutrient composition (NPK & S) and seed yield of fenugreek.

2. Materials and Methods

The field experiment was conducted with 'Plume 55' fenugreek during the winter season (*rabi*) of 2015-16 and 2016-17 at Farmer field Ikchhawar, District Sehore (M.P.), India. The soil had pH 7.7, electrical conductivity 0.30 dS/m, organic carbon 0.48%, available N 210 Kg/ha, available P 12 kg/ha and available K 485 kg/ha. The treatments consisted of 5 grated levels of N (0, 15, 30, 45 and 60 kg/ha) through urea and 4 graded levels of P (0, 20, 30 and 40 kg/ha) through single superphosphate along with basal application of Potassium @ 30 kg muriate of potash. Fenugreek seeds were treated with rhizobium species suitable for fenugreek. Each treatment was replicated 3 times in randomized block design. The crop was seeded during the second fortnight of October and harvested for seed during the first fortnight of March in each year. Irrigation was done at 25 day interval during the crop period. The first cutting was done 25-30 days after sowing and the second cutting 45 days after sowing. Total 2 cuttings were taken each year. Seed yield was recorded plot wise and relative yield was worked out:

After the crop harvest soil samples were collected and analyzed for organic carbon, available N and

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A Novel Seed-Dressing Formulation Based on an Improved Mutant Strain of *Trichoderma virens*, and Its Field Evaluation

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Using gamma-ray-induced mutagenesis, we have developed a mutant (named G2) of *Trichoderma virens* that produced two- to three-fold excesses of secondary metabolites, including viridin, viridiol, and some yet-to-be identified compounds. Consequently, this mutant had improved antibiosis against the oomycete test pathogen *Pythium aphanidermatum*. A transcriptome analysis of the mutant vis-à-vis the wild-type strain showed upregulation of several secondary-metabolism-related genes. In addition, many genes predicted to be involved in mycoparasitism and plant interactions were also upregulated. We used tamarind seeds as a mass multiplication medium in solid-state fermentation and, using talcum powder as a carrier, developed a novel seed dressing formulation. A comparative evaluation of the wild type and the mutant in greenhouse under high disease pressure (using the test pathogen *Sclerotium rolfsii*) revealed superiority of the mutant over wild type in protecting chickpea (*Cicer arietinum*) seeds and seedlings from infection. We then undertook extensive field evaluation (replicated micro-plot trials, on-farm demonstration trials, and large-scale trials in farmers' fields) of our mutant-based formulation (named TrichoBARC) for management of collar rot (*S. rolfsii*) in chickpea and lentil (*Lens culinaris*) over multiple locations in India. In certain experiments, other available formulations were included for comparison. This formulation consistently, over multiple locations and years, improved seed germination, reduced seedling mortality, and improved plant growth and yield. We also noticed growth promotion, improved pod bearing, and early flowering (7–10 days) in TrichoBARC-treated chickpea and lentil plants under field conditions. In toxicological studies in animal models, this formulation exhibited no toxicity to mammals, birds, or fish.

Keywords: *Trichoderma*, mutant, tamarind seeds, formulation, chickpea, lentil, farmers' fields

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In-vitro micrografting technique in sweet orange (*Citrus sinensis*) cv. Blood Red to produce virus free plants

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ABSTRACT

This study was carried out to assess the potential use and applicability of micrografting technique for the development of virus free nursery in sweet orange (*Citrus sinensis* Osbeck) cv. Blood Red Malta. The micro grafting was carried out using 11-20 days old etiolated seedlings of Rough Lemon, Sour orange, Carrizo and Karna Khatta rootstocks. An apical meristem (1-2 mm) having 3-leaf primordial (0.3-0.5 mm) were taken from the axillary proliferated nodal segments. Finely excised meristems were placed on aseptically grown rootstocks making an inverted 'T' incision *in vitro*. Micro grafts were inoculated on MS media added with different Plant Growth Regulators, *i.e.* IAA, NAA and 2,4-D each under varied concentrations (control, 0.1 ppm, 0.5 ppm, 1.0 ppm , 1.5 ppm, 2.0 and 3.0 ppm). Highest grafts success (60%) was recorded when 13 days old Carrizo seedlings were used as rootstock. Among all the treatments, scion treated with 2,4-D at 3.0 mg/l exerted maximum positive effect on the success of STG (70.00%). Overall, Sweet orange cv. Blood Red, micro grafted on Carrizo rootstock culturing on liquid MS media containing 2, 4-D at 3.0 mg/L resulted maximum success and growth of grafts. Successful micrografts were hardened under controlled conditions and further shifted in insect proof net house to develop disease free mother progeny.

Key words: Blood Red, *Citrus aurantium*, *C. carrizo*, *C. jambheri*, *C. karna*, Micrografting

Sweet orange (*Citrus sinensis* Osbeck) is one of the most important fruit crop known by the humans since antiquity and is a good source of vitamin "C" with high antioxidant potential. Sweet orange tree belongs to the family *Rutaceae*. In, Rajasthan, the interest of farmers in the adoption of sweet orange is increasing continuously due to suitable agro-climatic conditions, higher yield of crops and government policies. However, healthy planting material for fulfilling plantation demand is very limited. Citrus orchards and nurseries survey based on the characteristic symptoms expression and serological indexing reported that the major virus, viroid and prokaryotic diseases commonly observed were Citrus Tristeza, Citrus Variegation, Citrus Exocortis, Citrus Cachexia (Xyloporosis), Citrus Greening and Stubborn (Arif *et al.* 2005). Various methods, viz. Nucellar Line Breeding, Thermo-therapy, Meristem Culture and Shoot Tip Grafting (STG) have been employed for producing virus free citrus plants (Weathers and Calaven 1959, Roistacher 1977). The limitation of the former method is long juvenile period (7-8 years), and excessive vigour. Thermo-therapy technique is ineffective to eliminate heat resistant viruses like Exocortis and Xyloporosis and cannot be used with heat susceptible species (Roistacher 1977, Navarro 1988). To overcome these problems, some alternative techniques, viz. Meristem Culture and Shoot Tip Grafting are preferred for virus elimination in Sweet Orange. In this perspective present investigation will be taken to standardize the micropropagation technique for *in vitro* Shoot Tip Grafting for raising virus free bud woods in Sweet Orange cv Blood Red.

MATERIALS AND METHODS

The experimental work was carried out at the tissue culture laboratory, Department of Horticulture, Agricultural Research Station, Sriganganagar, SKRAU, Bikaner under the controlled conditions during the year 2012-13. Freshly harvested seeds of *Citrus* species, cleopatra (*Citrus reshnii*), sour orange (*Citrus aurantium*), karna khatta (*Citrus Karna*), carrizo (*Citrus carrizo*) and jhatti khatti (*Citrus jambheri*) were obtained from the Experimental Fruit Garden. Prior to use seeds were held in sterilised distilled water. To surface sterilize, seeds were washed under running tap water. The seeds were washed with detergent (Teepol), pretreated with 0.2% (w/v) Bavistin (a systematic fungicide) for 10 minutes followed by washing with double distilled water. The seeds were placed in the vertical position in test tubes one third filled with solidified (1% Agar) MS medium fortified

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Influence of foliar nutrition of urea, borax and zinc sulphate on growth, yield and quality of guava (*Psidium guajava* L.) cv. Rewa-72

Rakesh Kumar, RN Kanpure, J Bhandari, DK Patidar and DS Mandloi

Abstract
A field experiment entitled Influence of foliar nutrition on growth, yield and quality of guava (*Psidium guajava* L.) cv. Rewa-72 was conducted at the *Instructional cum research fruit orchard* Department of Fruit Science KNK College of Horticulture, Mandsaur (MP) during 2016-17. The experiment was consisted of 15 treatments having two doses of urea (1% and 1.5%) and three doses of each borax (0.2%, 0.4% and 0.6%) and zinc sulphate (0.2%, 0.4% and 0.6%). The experiment was laid out in randomized block design with three replications. Result revealed that urea (1.5%) + borax (0.6%) + zinc sulphate (0.6%) (T_{15}) was found significantly superior over control and rest of treatments with respect to growth, yield and quality attributes of guava.

Keywords: Foliar spray, urea, borax, zinc sulphate, growth, quality, yield

Introduction
Guava (*Psidium guajava* L.) is an important fruit crop of India. It is also known as “Apple of tropics”. It belongs to the natural order Myrtal and the botanical family Myrtaceae. The fruit type is berry is an excellent source of vitamin-“C” (210-305mg/ 100g fruit pulp) and pectin (0.5-1.8%). It is largely grown in warmer tropical countries of the world. The Portuguese introduced it in India in the 17th century. Guava is classified under genus *Psidium*, which consists of 150 species but only *Psidium guajava* L. has been exploited commercially. It is popular in India due to its delightful taste, pleasant flavor, high palatability and digestive value. It has paramount importance as a source of ascorbic acid in human diet, content of which is three to five times more than that in fresh orange juice. It is a very rich source of vitamin A and C along with minerals like iron, calcium and phosphorus. It is also contains substantial quantities of carbohydrates, sugars and pectin. Owing to excellent taste and flavor, high nutritional value and wide availability at moderate price the fruit is often called as "Poor man's apple".

It is one of the fourth most important fruit crop in India after mango, banana and citrus. In India, it occupies nearly 2.68 lakh hectares of area with production of 36.67 lakh metric tonnes and average productivity of 13.7 metric tonnes. In Madhya Pradesh, the area covered by guava is around 24.37 (000’ha) with a production of 912.00 (000’ MT) and productivity 37.43 MT/ha in guava crop (Anonymous, 2016) [3].

Nitrogen is one of the inevitable major nutrients and an adequate supply of nitrogen is very essential for growth and development. It is an indispensable constituent of protein and nucleic acid molecules. Troug (1973) [17] mentioned that N application increases the assimilating process through glycolsis and fatty acid synthesis. Every increment of nitrogen dose significantly increased the shoot yield. The increase nitrogen supply is known to accelerate the synthesis of chlorophyll and amino acid resulting in increased vegetative growth.

Borax acts as catalyst in the oxidation and reduction processes and also has great importance in the sugar metabolism; it might have improved the physical characters of guava fruit and thus increased the yield per tree assumed in our finding. Heavier fruits with more fruit weight under borax treatment might be due to the high level of auxin in the various parts of the fruit plant maintained by borax. Borax increases pollen grain germination, pollen tube elongation, consequently fruit set percentage and finally the yield (Abd-Allah, 2006) [2].

Zinc is an essential micro element for plants. It is involved in many enzymatic reactions. For growth and development of plant, zinc is necessary.

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Effect of plant growth hormones on growth and yield of ashwagandha (*Withania somnifera* L. Dunal.)

Patidar S, Meena KC, Naruka IS and Haldar A

Abstract
A field experiment was conducted during Late *Kharif* season 2017-18 at Research Farm, College of Horticulture, Mandsaur (MP) to study plant growth hormones on growth and yield of ashwagandha. The experiment was laid out ten treatments and three replications in randomized block design. The results found that spray of IBA 100 mg l^{-1} found maximum in plant height (39.17, 45.80, 46.97 and 47.27 cm $plant^{-1}$), no. of leaves (32.80, 83.00, 160.00, 182.33 and 117.80 $plant^{-1}$), no. of branches (2.67, 4.33, 4.83, 5.17 and 5.17 $plant^{-1}$), root girth (13.43 mm $plant^{-1}$), root shoot ratio by weight (125.40 g), root yield (461.33 kg ha^{-1}), root harvest index (31.00 %), fresh of weight root (19.83, 28.67, 29.90 and 33.33 g $plant^{-1}$) and dry of weight root (0.87, 6.50, 9.50, 11.83 and 13.67 g $plant^{-1}$) compared to other growth hormones *viz.* TIBA, CCC and control, while no. of berries (100.20 $plant^{-1}$), seed yield (5.50 q ha^{-1}), and seed Harvest index (38.83 %), was maximum with CCC 250 ppm mg l^{-1}, spray of 50 mg l^{-1} individually were very effective in increasing shoot girth (15.70 mm $plant^{-1}$) and spraying of TIBA suppressed the shoot girth.

Keywords: PGR, Withania, TIBA, CCC and Ashwagandha

Introduction
Ashwagandha (*Withania somnifera* L. Dunal) is an important medicinal crop belongs to family Solanceae. It is commercially cultivated in western MP especially in (Mandsaur and Neemuch) and southern Rajasthan. The plant is erect, herbaceous, evergreen shrub with ovate, hairy, thin leaves growing up to 60-75 cm height. It can be grown successfully in sandy loam or light-red soil with pH range of 7.5 to 8 and good organic matter and drainage (Kukreti *et al*., 2013) [3]. It is cultivated in 10000-15000 hectare area to produce 2500-3500 tonnes with average productivity 6-7q/ha, (Bhaure *et al*., 2014) [1]. Ashwagandha is late sown rainy season crop and is ready for harvest in 150-170 days after sowing. The root and leaves of this plant contain many alkaloids and with anolides are medicinally important which used to increase vigour; vitality and to cure many diseases (Bhaure *et al.*, 2014) [1] there is a good demand of roots of ashwgandha which is also called Indian ginseng owing to its use as sex tonic leaves and seeds are also valued owing to their medicinal property. Ashwagandha roots and occasionally its leaf and seeds are used in ayurvedic and unani medicine preparations. The important alkaloid present in the roots is with a nine constituting 38 per cent of the total alkaloids. Other alkaloids recorded are somniferine, somniferinine, somnine, with anine, pseudo with anine, with a naninine and with somine (Majumdar, 1955) [6]. The total alkaloid content of the roots under Indian conditions is reported to vary between 0.13 to 0.31 percent. Apart from roots, alkaloids have also been reported in leaves and berries (Sreerekha *et al*., 2004) [16].

Materials and methods
The experiment was laid out at the "Research Field of the Department of Plantation, Spices, Medicinal and Aromatic Crops", College of Horticulture, RVSKVV, Mandsaur (M.P.) during Late *Kharif* season of 2017-18. Mandsaur is situated in Malwa Plateau in western part of Madhya Pradesh at North latitude of 23.45º to 24.13º and 74.44º to 75.18º East longitudes and an altitude of 435.02 meters above mean sea level. The soil of the experimental field was light black loamy in texture with low nitrogen (192 kg/ha), low phosphorus (7.6kg/ha), medium potassium (145.0kg/ha) soil having (pH 8.36) and EC (0.18dS/m). The field experiment comprising 10 treatments with three replication was laid out in (RBD) randomized block

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Research Article

RESPONSE OF GARLIC (*Allium sativum* L.) TO ORGANIC AND INORGANIC FERTILIZERS

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Abstract: A field experiment was conducted during the *rabi* season of 2016-17 to study the effect of organic and inorganic fertilizer on growth, yield attributes, yield, quality and economics of garlic (*Allium sativum* L.). The eight treatment combinations of different fertilizers doses, FYM and biofertilizers (PSB and *Azotobacter*) were tested in randomized block design with three replications. Organic and inorganic fertilizer significantly influenced growth, yield attributes, yield, quality and economics of garlic. Application of 75% RDF + FYM (20 tones/ha) + PSB (5 kg /ha) + Azotobacter (3 kg/ha) treatment significantly increased the bulb yield by 90.37 and 24.47 percent over control (83.11 q/ha) and 100% RDF (100:60:60 kg/ha) (127.11 q/ha) treatments, respectively.

Keywords: *Garlic, FYM, NPK, PSB, Azotobacter*

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Introduction

Garlic (*Allium sativum* L.) belongs to the family Alliaceae. It is the second most important bulb crop after onion. The economic yield is obtained from its underground developed part known as bulb. Garlic is one of the important bulb crops for its nutritive value as a spice. It is widely used in flavoring of food, preparation of chutneys, pickles, curry powder, tomato ketchup etc. It is included in Indian system of medicines as a carminative and gastric stimulant to help in digestion and absorption of food [1]. India ranks second in area and production of garlic in the world. In India, garlic was cultivated in 261 thousand ha producing 1428 thousand tones with productivity 5.1 tones/ha. In Madhya Pradesh, it is grown in about 6,000 thousand hectares area and total production of 27 thousand tones giving an average production of 4.5 tones/ ha. Madhya Pradesh ranks first in area and second in production in India [2]. The productivity of garlic is very low due to imbalanced nutrient management. Among the bulky organic manures, the farm yard manure (FYM) is the extensively used organic source of plant nutrients. It is also helpful in maintaining the organic carbon content in soil. Majority of the nitrogen is lost in soil through leaching or to the atmosphere as a result of denitrification. Therefore, it becomes imperative to tap new methods of enriching soil with N and thus the possibility of using bio-fertilizers in crop production has attained a special significance. Bio-fertilizers also known as micro-bio-inoculants are the preparations containing live or latent cells of efficient strains of microorganisms, which may be the biological nitrogen fixers or p-mobilizers [1]. The interactive advantage of inorganic and organic sources of nutrients generally proved superior to the use of each component applied separately. The role of farm yard manure (FYM) in enhancing efficient use of chemical fertilizers is well documented [3]. Keeping the above facts in view, the present investigation was conducted entitled effect of organic and inorganic fertilizer on growth, yield and quality of Garlic (*Allium sativum* L.).

Materials and Methods

The field experiment was carried out at the Horticultural Research Farm, College of Horticulture, Mandsaur, MP, during 2016-17. The soil of the experimental field was light black loamy in texture with 243.2 kg/ha of available nitrogen, 19.75 kg/ha of available phosphorus and 448 kg/ha of available potassium and neutral in reaction (pH 6.5). There were 8 treatments in the experiment *viz*., T_1–Control,T_2 - 100% RDF (100:60:60 kg/ha), T_3 - 50% RDF + FYM (20 t/ha),T_4 - 50% RDF + PSB (5 kg/ha) + *Azotobacter* (3 kg/ha), T_5 - 50% RDF + PSB (5 kg/ha) + *Azotobacter* (3 kg/ha) + FYM (20 t/ha), T_6 - 75% RDF + FYM (20 t/ha),T_7 - 75% RDF + PSB (5 kg/ha) + *Azotobacter* (3 kg/ha), T_8 - 75% RDF + PSB (5 kg/ha) + *Azotobacter* (3 kg/ha) + FYM (20 t/ha). The garlic cv. G-282 was sown at the spacing 10 x 7.5 cm and at depth of 5 cm in open furrows. First weeding was done 30 days after germination and second weeding was done after 60 days of germination. All the other recommended package of practices was adopted for raising the crop.

Result and Discussion

Effect on growth attributes

The data showed that application of organic and inorganic fertilizer significantly affected different growth attributes of garlic *viz*., plant height at 120 DAS, number of leaves/plant at 120 DAS, length of leaves at 90 DAS, stem girth (mm), chlorophyll content of leaf (SPAD value). The significant maximum plant height (79.17cm), number of leaves /plant (14.97), length of leaves (64.23 cm), stem girth (10.97 mm) and chlorophyll content of leaf (78.86 SPAD value) was recording with treatment75% RDF + FYM (20 t/ha). + PSB (5 kg/ha) + *Azotobacter* (3 kg/ha). The difference in plant height of garlic may be due to the treatment combination of organic and inorganic fertilizers maintain long term soil fertility and sustain high level of productivity and also due to increased availability of nutrients to the plant initially through organic and inorganic fertilizers in the cropping season. Application of inorganic and organic sources might possibly have enhanced meristem activity leading to increased plant height and dry matter accumulation. The increase in growth attributes might be due to the production of more chlorophyll content with the application of balanced nutrition in the form of organic

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Effect of Sowing Time and Plant Geometry on Growth, Yield and Quality of Chandrasur (*Lepidium sativum* L.)

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A B S T R A C T

The present study was undertaken to investigate "Effect of sowing time and plant geometry on growth, yield and quality of Chandrasur (*Lepidium sativum* L.)" was carried out at the "Horticulture Research Farm" College of Horticulture Mandsaur, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior (M.P.) from 2017 to 2018. In this experiment 3 dates of sowing (15th October, 30th October and 15th November) and 3 plant geometry (20x10 cm, 30x10 cm and 40x10 cm) with 3 replication, the was analyzed by Factorial RBD. The result was found that maximum plant height (119.60 cm), number of branch per plant (22.30) fresh weight of plant (74.25 g), dry weight of plant (39.99 g), number of racemes per plant (130.13), number of racemes per branch (13.12), racemes length (31.25 cm), racemes weight (0.87 g), weight of 1000 seed (1.88 g), seed yield per plant (21.15 g), seed yield (23.97 q/ha) biological yield (89.14 q/ha), harvest index (26.89%) and oil content in seed (23.83%) was recorded under treatment D_2S_2 (30th October and 30 cm) respectively.

Introduction

Chandrasur (*Lepidium sativum* L.) it is also known as asalio and garden cress the plant belongs to family Brassicaceae. It is a fast growing crop that can be ready to eat within 7 days of sowing the seed. The plant has traditional medicinal uses also and it is the source of edible oil that can be used for lighting. In India, it is cultivated as winter crop in selected parts of Rajasthan, Gujarat and Madhya Pradesh for their seeds. The seeds are galactagogue, laxative and diuretic. Seeds contain phytochemicals that resemble estrogen action. Hence it is used in treating amenorrhoea and irregular menstrual cycles.

It is fed to lactating mothers for improving breast milk production. Seed paste is used as poultice to relieve pain, worm infestation in wounds and useful in skin disorders associated with itching. The mucilage obtained from the seeds is used against intestinal irritations. The leaves are used as diuretic and to treat liver diseases. It is also used as salad for treating Anemia.

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Assessment of economic sulphur doses of soybean (*Glycine max merill* L.) in *Malwa* region of western M.P.

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Abstract
On farm trials (OFTs) were conducted for consecutive two years during 2011-12 and 2012-13 to assess the optimum sulphur levels of soybean with respect to growth, yield attributing characters, productivity, protein content and economics involved under Malwa plateau conditions of Central India. Soybean variety, JS 95-60 was taken to assess three levels of sulphur (0, 20 and 40 Kg S/ha). Treatment RDF+ 40 Kg S/ha found to be optimum level of sulphur as this treatment recorded significantly higher soybean root nodulation, yield and yield attributing characters, oil and protein content over 0 and 20 Kg sulphur/ha. This treatment also expressed its superiority over rest of the treatments in case of B: C ratio and net return. Thus, it may be concluded that application of RDF +sulphur @ 40 kg per ha was found economic feasible and beneficial for enhancing soybean productivity in Vertisols under rainfed conditions of Madhya Pradesh.

Keywords: Soybean, sulphur doses, root nodulation, yield, oil, protein content and economics

Introduction
Soybean [*Glycine max* (L.) Merrill], being an oil yielding leguminous crop, richest source of high quality protein, oil, calcium, iron and in amino acid like glycine, has established its potential as an industrially and economically viable oilseed crop in the world by virtue of its high nutritional value and myriad uses. In India, soybean has emerged as an important oilseed crop. One of the major constraints for low soybean productivity is provision of imbalanced nutrition (Joshi and Bhatia, 2003) [4]. Unless soybean is provided with required nutrient input to produce sufficient biomass, it may not yield high (Singh *et al*., 2003) [9].
Sulphur is an essential plant nutrient for crop production. For oil crop producers, sulphur fertilization is especially important because oil crops require more sulphur than cereal crops. For example, the amount of S required to produce one ton of seed is about 3-4 kg sulphur for cereals (range 1-6); 8 kg sulphur for legumes (range 5-13); and 12 kg sulphur for oil crops (range 5-20) (Jamal *et al*., 2010) [3]. In general, oil crops require about the same amount of sulphur as, or more than, phosphorus for high yield and product quality. The role of sulphur in soybean production has been reported by Srivastava *et al*. (2000) [10].
Application of sulphur improved nitrogenase activity, nitrogen fixation, plant dry matter and quality of soybean grain in sulphur deficient soil (Kandpal and Chandel, 1993) [5]. Sulphur fertilization significantly improves various quality parameters within plant system. Sulphur application @ 20 to 40 kg per ha in soybean produced maximum yield in various soils (Billore and Vyas, 2012). The present investigation was undertaken to assess the optimum economic sulphur levels of soybean in Malwa region of western M.P.

Materials and Methods
On Farm Trials (OFTs) were conducted in kharif seasons of 2012 and 2013 in the adopted village Rakoda by Krishi Vigyan Kendra, Ratlam. The soil of the experimental area was light black, loamy in texture, with low available nitrogen, medium in phosphorus and high in potassium status. This OFT was conducted at 5 farmer's fields with JS 95-60 variety during both the years. The treatments were farmers' practice T_1 (RDF+ No sulphur), T_2 (RDF+ sulphur @ 20 Kg/ha) and T_3 (RDF+ sulphur @ 40 Kg/ha). The recommended doses of nitrogen (20 kg N /ha), phosphorus (60 kg P_2O_5/ha) and potassium (20 kg K_2O/ha) were applied as basal to all the treatments. The different sulphur doses were also applied as basal dose. The sowing of soybean was carried out in the month of June and harvested in the first week of October. The recommended packages of practices were followed to raise the crop. The root nodules were counted by deep uprooting and washing of the root system with water

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Effect of organic manures, inorganic fertilizers and varieties on growth, yield and quality of tropical carrot

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ABSTRACT

A field trial was conducted during *rabi* season 2014-15 to study the effect of organic manures, inorganic fertilizers and varieties on growth, yield and quality of carrot. Two varieties V_1 (Pusa Rudhira) and V_2 (Pusa Kesar) and nine nutrient levels *i.e.* N_1 (100 % NPK through inorganic fertilizer), N_2 (100 % N through FYM), N_3 (100 % N through vermicompost), N_4 (100 % N through poultry manure), N_5 (100 % N through neem cake), N_6 (50 % NPK + 50 % N through FYM), N_7 (50 % NPK + 50 % N through vermicompost), N_8 (50 % NPK + 50 % N through poultry manure) and N_9 (50 % NPK + 50 % N through neem cake) were evaluated in factorial randomized block design (FRBD) with three replications. Result indicated that variety V_1 (Pusa Rudhira) recorded maximum plant height, number of leaves per plant, length of leaves, fresh weight and dry weight of plant, length, diameter, root girth, fresh and dry weight of root, yield of root and TSS at harvesting stage as compare to Pusa Kesar. Application of N_7 recorded higher values of plant height, number of leaves per plant, length of leaves, fresh and dry weight of plant, length, diameter, root girth, fresh and dry weight of root, yield of root and TSS as compare to other nutrient levels. Economic evaluation of different combinations showed that V_1 (Pusa Rudhira) and nutrient level N_7 were promising with highest net income and B:C ratio(1:3.78).

Key words: *Daucus carota*, vermicompost, neem cake, quantitative traits.

INTRODUCTION

Carrot (*Daucus carota* L.) is a popular cool season root vegetable of umbelliferae family. It is a heavy feeder of nutrients, which removes 100 kg N, 50 kg P_2O_5 and 180 kg K_2O ha^{-1} and is very sensitive to nutrient and soil moisture (Sunanadarani and Mallareddy, 14).

Since root vegetables are an exhaustive crop therefore, use of organic manures alone may not be able to supply the desired amount of nutrients to the crop. However, it has been observed that use of organic manures with inorganic fertilizers play vital role and hold great promise in pushing up the production of root vegetables. Although inorganic fertilization is very important for the healthy plant growth and development, the organic source of nutrients have the advantage of consistent and slow release of nutrients, maintaining ideal C:N ratio, improvement in water holding capacity and microbial biomass of soil profile, without any adverse residual effects (Yadav *et al.,* 17). Furthermore, there have been positive responses of organic manures for quality attributes in different vegetables. Therefore, a balanced and integrated supply of various nutrient supplements is of great relevance for the quality and sustainable carrot production. Moreover, integrated use of inorganic and organic fertilizers reduces erosion, improves water infiltration, soil aeration and plant root growth, and also minimizes the risk of downstream flooding (Kumar *et al.*, 9). Keeping the above facts in view, an experiment was carried out to study the effect of different organic manure, inorganic fertilizer and varieties on growth, yield and quality of carrot.

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MATERIALS AND METHODS

A field experiment was conducted during *rabi* season, 2014-15 at Research Field, College of Horticulture, Mandsaur, Madhya Pradesh. The soil of the experimental field was light alluvial soil having sandy loam texture, having 8.22 pH, 0.27 dSm^{-1} EC, 327.5 kg ha^{-1} available N, 20.1 kg ha^{-1} available phosphorus and 728.0 kg ha^{-1} available potassium. The experiment was laid out in factorial randomized block design with three replications. The treatments were two varieties (V_1- Pusa Rudhira and V_2- Pusa Kesar) and nine nutrient levels namely N_1- Recommended dose of fertilizer (80:50:50 Kg NPK/ha), N_2-100 % N through FYM, N_3 - 100 % N through vermicompost, N_4- 100 % N through poultry manure, N_5- 100 % N through neem cake, N_6- 50 % NPK + 50 % N through FYM, N_7- 50 % NPK + 50 % N through vermicompost, N_8- 50 % NPK + 50 % N through Poultry manure and N_9- 50 % NPK + 50 % N through neem cake. Fertilizers were applied through urea (46% N), diamonium phosphate (46% P, 18% N) and muriate of potash (60% K) according to the treatment. Recommended

RESEARCH ARTICLE

MANAGEMENT OF CHILLI INSECT PESTS BY USING DIFFERENT DOSES OF EMAMECTIN BENZOATE 3.7%+ DIFENTHIURON 46.3% WP

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Abstrtact: The experiment was conducted in *Rabi* season of 2015-16 at College of Agriculturefarm, Indore (M.P.) in a Randomized Block Design (RBD) with seven treatments and three replications with variety Aakansha (hybrid), transplanted on 27th November 2015 with 60x45 cm spacing. Three doses of emamectin benzoate 3.7%+difenthiuron 46.3%WP @ 5.60+69.45gai/ha , 7.40+92.60 gai/ha and 9.25+115.75 gai/ha were marked as T1,T2 and T3, respectively.T4- Emamectin benzoate 5%SG @ 10gai/ha , T5- Difenthiuron 50%WP 300 gai/ha and T6- Lambda cyhalothrin 5%EC @ 15 gai/ha were alone insecticidal treatments including T7-Untreated check. Treatments were sprayed thrice at 15 days interval as foliar application with knapsack sprayer @ 500 liter water per hectare. Thrips and whitefly population were counted on five tagged plants from each plot and five leaves per plant i.e. Two leaves from top, two from middle and one leaf from lower portion of plant. Thrips were counted by jerking the twig on a white paper. Observations were recorded at one day before and 7 and 14 days after each spray. Leaf curling was recorded10 days after each spray visually on five plants selected randomly in each. The green chilli yield data (q/plot) was recorded for economic assessment of treatments.The highest reduction in thrips and whiteflypopulation was recorded with highest dose of emamectin benzoate 3.7%+ difenthiuron 46.3% WP @ 250 g.a.i / ha and found at par with the second highest dose of emamectin benzoate 3.7%+ difenthiuron 46.3% WP @ 200 g.a.i / ha in all the sprays.After first spraying minimum leaf curling was noted in highest dose of emamectin benzoate 3.7%+ diafenthiuron 46.3% WP @ 250 g.a.i./ha (21.69%) and found at par with second highest dose of emamectin benzoate 3.7%+ diafenthiuron 46.3% WP @ 200 g.a.i./ha (24.14%). Similar trend was recorded as 16.20% and 18.79% in second spraying and 9.61% and 11.86% in third spraying, respectively.The highest green chilli yieldwas obtained again with highest dose of emamectin benzoate 3.7%+ difenthiuron 46.3% WP @ 250 g.a.i./ha (171.11 q/ha and 44.40) and found at par with rest of its two doses as166.29 q/ha and 147.03 q/ha, respectively. Cost benefit ratio was calculated in same trend as 4.40, 4.30 and 3.82, respectively.

Keywords: Thrips, Whitefly, Emamectin benzoate, Difenthiuron, Management

INTRODUCTION

Chilli(*Capsicum annum* Linnaeus) is one of the important Solanaccouscommercial vegetable crop grown all over India. Out of total production of chilli 90-95 per cent consumed within the country and about 5-10 per cent in the form of dry chilli, chilli powder and oleoresins (Singhal, 2003). India is the world's largest producer of chilli occupies an area of 309 thousand ha with a production of 3592 thousand tonnes of green chilli. India contributes about 36% to the total world production. In India, Chilli is grown in almost all the state throughout the country. In Madhya Pradesh, chilli occupies an area of 41.29 thousand ha with a production of 669 thousand MT of green chilli (Anon., 2018).

A number of limiting factors have been attributed for low productivity and viral diseases as well as ravages caused by insect pests are significant ones. Thrips (*Scirtothrips dorsalis* Hood) and white fly (*BemisiatabaciGannadius*) are important insect pests besides others (Berke and Sheih, 2000). Economic yield loss due to all the sucking insect pests may be 11-75% quantitatively and 60-80% qualitatively in the event of serious infestation (*Ghos et al* .2009). The yield loss due to chilli thrips and mites is estimated to be to the tune of 50-90 per cent (*Kandasamy et al*.1990).

Now-a-days build-up of these sucking pests in chilli are so much and for that sprays have increased over the years, but on the contrary , cost of cultivation has increased enormously making cultivation of chilli highly risky. In addition to this, pesticides sprays became a threat to chilli ecosystem causing problems of resistance,resurgence of pests, pesticide residue and menace to natural enemies' fauna (David 1986). In present scenario, to increase the efficacy of insecticides, combination products are being used .Viewing the above facts the experiment was planned to test the efficacy of combination productsemamectin benzoate 3.7%+difenthiuron 46.3%WPcomparing with other insecticides.

MATERIALS AND METHODS

The experiment wasconducted in *Rabi* season of 2015-16 at experimental site of farm College of Agriculture, Indore (M.P.) on medium black cotton soil having a uniform topography in a Randomized Block Design (RBD) with seven treatments and three replications. Variety Aakansha (hybrid) was sown on26th October 2015 in nursery and transplanted on 27thNovember 2015 with 60x45 cm spacing. Three spraying of treatments was made at 15 days interval as foliar application with knapsack sprayer @ 500 liter water per hectare. The treatments were

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Original Research Article

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Efficacy Assessment of Insecticidal Alternation for the Management of Jassid (*Amrasca biguttula biguttula* Ishida) and Aphid (*Aphis gossypii* Glover) Pest of Bt Cotton

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ABSTRACT

The study was conducted during kharif 2014 at College of Agriculture, Indore under All India Coordinated Cotton Improvement Project in Randomized Block Design (RBD) with eight treatments and three replications on Bt cotton hybrid NCS 927, sown on 27th July with 0.6x0.6 m spacing. All the recommended agronomical practices were adopted. Treatments were planned for alternate use of two insecticides during six sprays. The spraying was done at 10 days interval with 500 litre water per hectare, using knapsack sprayer fitted with a duromist nozzle. These treatments were prepared as T_1- Imidacloprid (70%WG) @ 24.5 gai/ha & Oxydmeton methyl (25%EC) @ 250 gai/ha, T_2- Thiaclorprid (21.7%SC) @ 30 gai/ha & Dimethoate (30%EC) @ 250 gai/ha, T_3- Imidacloprid (17.8%SL) @ 25 gai/ha & Acephate (75%SP) @ 250 gai/ha, T_4- Imidacloprid (30.5%SC) @ 26.25 gai/ha & Thiamethoxam (25%WG) @ 37.5 gai/ha, T_5- Spiromesifen (22.9%SC) @ 144 gai/ha & Deltamethrin (2.8%EC) @ 15 gai/ha, T_6-Fipronil (5%SC) @ 100 gai/ha & Lambdacyhalothrin (4.9%EC) @ 15 gai/ha, T_7- Acetamiprid (20%SP) @ 30 gai/ha & Difenthiuran (50%WP) @ 300 gai/ha and T_8- Untreated check. All the treatments Exhibited a significant reduction in jassid population over untreated check. Treatment T_6- Fipronil (5%SC) @ 100 gai/ha & Lambdacyhalothrin (4.9%EC) @ 15 gai/ha showed least pest population in each spray and expressed no significant difference with T_5- Spiromesifen (22.9%SC) @ 144 gai/ha & Deltamethrin (2.8%EC) @ 15 gai/ha. Similarly the overall jassid population reduction was recorded highest in treatment T_6 (80.56%) followed by T_5 (74.88%) and other treatments in which T_1- Imidacloprid (70%WG) @ 24.5 gai/ha & Oxydmeton methyl (25%EC) @ 250 gai/ha (61.21%) showed least population reduction. Similar trend of efficacy was observed against aphid where treatment T_6 showed least pest population in each spray and expressed no significant difference with T_5. Again T6 showed highest aphid population reduction (80.56%) and followed with T_5 (74.88%).

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Effect of Pre harvest Spray of ZnSO4, KNO3 and NAA on Growth, Yield and Quality of Ber (*Zizyphus mauritiana* Lamk.) cv. Seb under Malwa Plateau Conditions

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A B S T R A C T

The experiment was conducted at the *Instructional cum Research Fruit Orchard*, College of Horticulture, Mandsaur (M.P.), Department of Fruit Science, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior (M.P.). The experiment comprised 13 treatments of foliar spray of $ZnSO_4$, KNO_3 and NAA and control, first foliar spray of growth regulator and micronutrient ($ZnSo_4$ and KNO_3) on crop was done on 15th October, 2014 and same spray was repeated after 30 days of the first spray with three replications and data analyzed in Randomized Block Design (RBD). The treatments which were compared among them and found best during the period of experiment are given below: Growth Parameters: Maximum Shoot diameter (9.32 mm), Shoot length (204 cm), Physical parameters: Maximum Fruit length (3.17 cm), Fruit diameter (3.00 cm), Fruit volume (23.50 ml), Stone weight (1.70 g), Pulp weight (20.67 g), Specific gravity (0.97), Bio - chemical parameters: Maximum TSS (15.93 ^{0}Brix), minimum Acidity (0.26 %), Ascorbic acid (49.47 mg/100g of pulp), Reducing sugar (6.11 %), Total sugars (11.87 %), Non-reducing sugar (5.76 %) and Yield parameters: Maximum Number (1608.33) of fruits / tree, Fruit weight (22.87 g), Yield / tree (36.79 kg) was found in treatment T_{12} (NAA 60 ppm + KNO_3 1.5% + $ZnSO_4$ 0.5%) and minimum was found in control respectively.

Introduction

Ber (*Zizyphus mauritiana* Lamk.) the member of family Rhamnaceae, is one of the ancient fruit. Ber is a very nutritious fruit and is rich in vitamin C, A & B complex. Fresh bqr fruit contains moisture (81.6-83.0 g), total sugars (5.4-10.5g), reducing sugar (1.4-6.2g), non - reducing sugar (3.2-8.0g), iron (0.76-1.8 mg), Morton 1987. NAA is an important growth regulator of auxin group, which helps to reduce fruit drop and to improve fruit set and quality specially TSS. NAA spray was useful in increasing fruit yield and quality (Singh and Randhawa, 2001). They act as a metabolic sink for the diversion of metabolic from one part to other of the plant specially towards developing fruits. The pre harvest sprays of PGR's are using to control fruit drop and to improve fruits retention percentage. Zinc also considered necessary for the growth and development of fruits. It is one of the essential

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Effect of biofertilizers on growth and flowering of tuberose (*Polianthes tub* L.) under Malwa Plateau of Madhya Pradesh

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Abstract

The present experiment on the effect of bio-fertilizers on growth and flowering of tuberose was carried out during 2016 with 8 treatme combinations replicated thrice in a Randomized Block Design. The different biofertilizers treatments had significant influence on the g flowering and vase life parameters of tuberose in the present study. Among the different biofertilizers treatments, the treatment T_7 (R Azotobacter @ 5.0 kg/ha + PSB @ 5.0 kg/ha) showed the best results in terms of all parameters like, maximum plant height, maximu number of leaves per plant, maximum leaf area, earliest spike emergence, minimum days taken to flowering, maximum number of sp plant, maximum length of spike, highest number of florets per spike, maximum length of floret, maximum diameter of floret, longest fl duration, longest vase life of cut spike, maximum fresh weight of cut spike at harvest, maximum fresh weight of cut spike on 3rd day i 6th day in vase and at senescence, while the minimum performance were recorded with respect of all parameters under control (T_8) c

Keywords

Bio-fertilizers, growth, flowering, vase-life, tuberose spikes.

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Combining ability analysis for yield and yield attributes characters in Brinjal (*Solanum melongena* L.)

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Abstract
Combining ability analysis was done in dialle analysis by using 8 parents and 28 F_1s in a randomized block design with two replications. Analysis of variance for combining ability revealed that variances due to gca and sca were significant for all the traits. GCA and SCA interacted significantly. The estimates of dominance variance were higher in magnitude than corresponding estimates of additive variance indicating the preponderance of non-additive gene action. None of the parents exhibited desirable gca effects for all the traits simultaneously. Parents DRNKVO-2-26 identified as good general combiners for fruit yield per plant and most of the attributes including seed weight per fruit, average fruit weight and fruit length. The cross, DRNKVO-2-26 x JB-15, Arbha Kranti X Rajendra brinjal, and Aruna X DRNKVO-2-26 were good specific combiner for grain yield and various yield components. These parents may be used for varietal improvement through the simple recurrent selection in segregating generations to increase in fruit yield potentiall of brinjal. This may lead in the fixation of both additive and non-additive components while making improvement in fruit yield and its attributes.

Keywords: Combining ability, GCA, SCA, Diallel

Introduction

Brinjal (*Solanum melongena* L) is the very important vegetable crop cultivating in India Sękara *et al.* (2007) [14]. Brinjal is often cross pollinated and possess considerable diversity for plant types, fruit yield and yield attributing characters and thus offers an opportunity to exploit the genetic diversity for development of hybrid varieties. In most of the countries, brinjal is the major component of the human diet. It is rich source of protein, P, Fe, Ca, K, Mg, Na and fibre Nyadanu and Lowor, (2015) [10]. It has medicinal value for asthma, allergic rhinitis, constipation, skin infections, joint pains, dyspepsia and rheumatic diseases Nwodo *et al.* (2011) [9].

The combining ability analysis is an important tool in preferring suitable parents for hybridization and superior cross combinations through general combining ability (GCA) and specific combining ability (SCA), respectively Sharma *et al.* (2016) [16]. In the present investigation, a study was conducted to study the combining ability analysis in various crosses.

Methods and Materials

The present experiment was conducted at Bahadari Farm, College of Horticulture Mandsaur Madhya Pradesh India. An experiment was sown in randomized complete block design with 2 replications. The experimental materials for the present study comprised of eight elite genotypes viz., Arka kranti, Kashi taru long, Aruna, HABR-4 (Swarna Shobha), JB-64, DRNKVO-2-26, Rajendra brinjal and JB-15, were crossed in half diallel technique, in all possible combinations excluding reciprocals and generated a set of 28 F_1 hybrids. Crosses were made Kharif 2015 for the evaluation of F_1s during two seasons's viz., 2016 and 2016-17. Three dates of sowing seedlings were transplanted at the spacing of 60 cm x 50 cm in rows of 5 meter length consisting of 10 plants each row. Recommended package of practices were followed for raising the normal seedlings and crop. Observations were recorded on five randomly selected plants from each hybrid in each replication. Observations were recorded on five randomly selected plants in each parents and cross for grain yield and its attributes (Table 1). The data were subjected to appropriate statistical analysis. The combining ability analysis was carried out according to Griffing's (1956) [5] Method 2 Models I (fixed effect). In this approach, using a suitable statistical model the component of variances due to general and specific combining ability was estimated.

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To study the Impact of adoption of soil testing techniques for providing balance dose of fertilizers Kharif and Rabi Crops grown in Gwalior district (M.P.)

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Abstract

A study was carried out in the Gwalior district of Madhya Pradesh to find out the knowledge and attitude of farmers toward soil testing practice. As the soil testing is an important measure of the soil's ability to sup-ply nutrient elements needed for better plant growth. A proper soil testing will help to ensure the application of enough fertilizer to meet the requirements of the crop and taking advantage of the nutrients already present in the soil. Soil testing is a comprehensive soil fertility evaluation programme, which helps the farmer's injudicious application of chemical fertilizers. The farmers will be able to know how much nutrients are already available in the soil and how much will have to be provided additionally for a particular crop. In present study, the majority of farmers had knowledge about soil testing practices. A Majority of 20.83% respondents gained the knowledge from trainings/ Kisan Gosthis/ Kisan Mela conducted by Krishi Vigyan Kendra in the operational area and the 15.83% respondents gain knowledge by personnel of State Department of Agriculture. Therefore, efforts should be made by KVK and Department of Agriculture for encouraging and to increasing the respondent or the farmers to adopt soil testing practices by organizing training programmes and campaigns especially on soil testing process.

Key words: Nutrient, knowledge, Kisan Gosthis, Kisan Mela, Krishi Vigyan Kendra, soil testing

Introduction

An efficient use of fertilizers is a major factor in any programme designed to bring about an economic increase in agricultural production. The farmers involved in such a programme will have to use balance quantities of fertilizers to achieve the desired yield levels. However, the amounts and kinds of fertilizers required for the same crop vary from soil to soil, even field to field on the same soil. The use of fertilizers without first testing the soil is like taking medicine without first consulting a physician to find out what is needed. It is no doubts that the fertilizers increase yield and the farmers are aware of this. However, are they applying right quantities of the right kind of fertilizers at the right time at the right place to ensure optimum profit? Without a proper fertilizer recommendation based upon a soil test, a farmer may be applying too much of a little needed plant food element and too little of another element, which is actually the principal factor limiting plant growth. This not only means an uneconomical use of fertilizers, but in some cases crop yields actually may be reduced because of use of the wrong kinds or amounts, or improper use of fertilizers. Soil testing is a chemical process by virtue of which requirement of nutrients for plant can be analyzed to sustain the soil fertility. The farmers find it extremely difficult to know the proper dose and type of fertilizer, which is suitable for his soil. While, using a fertilizer one must take into account the requirement of his crops and the characteristics of the soil (Biswas, 2002).

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Assessment of Premix Broad Spectrum Herbicides for Weed Management in Wheat (*Triticum aestivum* L.)

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ABSTRACT

The study was conducted at the farmer's field in village Fatehgarh adopted by KVK Mandsaur (Madhya Pradesh), during Rabi 2015-16, 2016-17 and 2017-18 to assess the effect of weed management treatments on weed infestation and wheat yield. The experiment consisted of three treatments namely T1: farmers' practice (hand weeding at 25 and 45 DAS), T2: sulfosulfuron 75% + metsulfuron methyl 5% @ 32 g a.i./ha at 25 DAS as post emergence and T3: clodinafop 15% + metsulfuron methyl 1% WP @ 64 g a.i./ ha at 25 DAS as post emergence. Application of clodinafop 15% + metsulfuron methyl 1% WP @ 64 g a.i./ha resulted in significant reduction in the weed count and weed dry matter as compared to rest of the treatments. Clodinafop 15% + metsulfuron methyl 1% WP @ 64 g a.i./ha registered 27.87 percent higher grain yield as compare to farmers' practice. Further, application of clodinafop 15% + metsulfuron methyl 1% WP @ 64 g a.i./ha as post emergence registered significantly higher net return and B:C as compared to all other treatments and in addition to increased grain yield of improved technology. The technological gap, extension gap and technology index existed which were 7.47 q/ha, 10.36 q/ha and 13.58 %, respectively.

Key Words: B:C, Grain yield, Net returns, Weed management

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the second most important cereal crop in India after paddy both in terms of area and production. It is cultivated in an area of 305.97m ha with an annual production of 98.38 MT and productivity of 3216 kg/ha; whereas in Madhya Pradesh, it is cultivated in 6421.1 thousand hectares of land with an annual production of 21918 thousand tonnes and productivity of 3413 kg/ha (Anon, 2016). Weeds emerge after germination of crop and if not controlled in the early stages of crop growth these may cause reduction in yield up to 10 to 40 per cent depending upon the intensity and kind of weeds present in the field. The wheat fields are mostly infected by monocot weeds like *Phalaris minor*, *Avena fatua*, *Polypogon monspliensis, Cyperus rotundus* and *Cynodon dactylon* and broad leaves weeds like *Rumex retroflexus, Chenopodium murale, Chenopodium album, Malwa parviflora* and *Convolvulus arvensis*. Due to continuous use of herbicides coupled with mono-cropping of wheat, resistance has been evolved against the particular herbicide. Further, due to effective control of any single predominating weed, a shift in weed flora in favour of broad-leaved weeds or narrow leaf weeds was observed. Hence, it is essential to identify alternative herbicide molecules with broad spectrum activity for sustainable weed management in wheat. Therefore, an on farm trial was conducted to check the effectiveness of post-emergence herbicides in weed control in wheat in Mandsaur district of Madhya Pradesh.

MATERIALS AND METHODS

An experiment was conducted in village Fatehgarh adopted by Krishi Vigyan Kendra,

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