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Impact of organic and bio-fertilizers on growth and yield of Chickpea (*Cicer arietinum* L.)

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Abstract

The present investigation entitled “Impact of organic and bio-fertilizers on growth and yield of Chickpea (*Cicer arietinum* L.)” was carried out on the well-protected field of the Research farm of the Department of Agronomy, School of Agriculture Science, Technology & Research, Sardar Patel University, Balaghat (M.P.). The field experiment was conducted during the Rabi (winter) season of 2023-24. The experimental observation data was recorded periodically on the plant growth parameters, yield attributes, productivity and quality parameters of chickpeas under Nine organic and bio-fertilizer treatments. The treatments comprised nine organic and bio-fertiliser treatments. Thus these nine treatments were laid out in the field in a randomized block design keeping three replications. chickpea var. JG - 63 was sown in rows 30 cm apart on 7th November, 2023. Nitrogen levels were applied through urea as basal in the respective treatments in 30 cm apart open furrows just before sowing of seed on the same furrow. Phosphorus levels were applied as basal through DAP as per treatments. Before sowing the seeds were treated with thorium fungicide @ 3 g/kg seed. The chickpea was grown as per the recommended package of practices. The above findings conclude that the joint application of Vermicompost 5MT/ ha+ Rhizobium @ 2.5gm/Kg is joint application. of seed proved to be beneficial and the maximum yield ie 20.45 q/ha protein 24.62% and economic gain Rs. 56196/ha was obtained.

Keywords: Bio-fertilize, branches, grains, pod, seed index, straw yield

Introduction

Chickpea (*Cicer arietinum* L.) is the foremost pulse crop in India occupies a unique position due to its high amount of protein content, and wide adaptability as a food grain in the semi-arid tropics in India. It is grown in an area of 7.1 million ha with a production of 5.75 million tonnes ha. The State of Madhya Pradesh ranks first in chickpea cultivation in the country covering an area of 28.62 lakh ha with annual production of 26.6 lakh tonnes and productivity of 931 kg/ha. Pulses are important source of dietary protein and have unique property of maintaining and restoring soil fertility through biological nitrogen fixation by virtue of their deep root system and leaf fall. India grows nearly 23 million hectares, of pulse crops and produces nearly 14.4 million tonnes of pulse grain.

The utilization of chemical fertilizers and crop varieties with high yields has led to a sharp rise in agricultural output. According to FAO research, the use of fertilizers increased crop production in developing nations by more than 50% between 1965 and 1976. Prasad (1983)^[6]. Numerous elements influence the profitable production of chickpeas, and one of the most crucial ones is the fertility of the soil for the generation of high-quality seed. The main causes of this crop's low yield in our nation are cultural practices, inadequate manuring, and insufficient soil fertility. Major and minor components that are limiting crop yield have run out in our soils. For the crop's new varieties to reach their full output potential, greater nutritional requirements are necessary. In addition to raising output, optimal fertilizer application also has an impact on crop quality. Adopting the idea of organic and bio-fertilizers is necessary to stop the trend of diminishing production. organic and bio-fertilizers include the intelligent use of organic, inorganic, and on-line biological resources to sustain optimum yields, improve or maintain the soil physical and chemical properties and provide crop nutrition packages which are technically sound, economically attractive, practically feasible and environmentally safe.

Organic manure is an important component of organic and bio-fertilizers and may help to recover soil health. Besides, organic manures also supply traces of micronutrients. Which are not supplied by chemical fertilizers. Therefore, it is needed to compare various organic manures with chemical fertilizers to find out the effective combination. Organic and bio-fertilizers system approach is not only a reliable way of obtaining high productivity with substantial fertilizer economy, but also a concept of ecological soundness leading to sustainable agriculture. The basic concept of an integrated plant nutrient system is the maintenance and improvement of soil fertility for sustaining crop productivity on long-term basis. Application of different organic-cum-inorganic sources was found very effective in realizing high yield. Better economy (Singh *et al.*, 2013 (a))^[10] and improved residual fertility of the soil.

Under the current farming system, chemical fertilizers are insufficient to maintain the productivity of the soil. Similarly, a crop's needs for nutrients cannot really be met by organic manures or biofertilizers. application of both inorganic and organic manures. Using fertilizers in concert with one another turned out to be the greatest option. It has been discovered that combining chemical fertilizer with organic manures holds significant promise for both preserving higher productivity and enhancing crop production stability. When used with lower dosages of inorganic fertilizers, farmyard manure or vermicompost enhanced soil fertility, crop growth, and yield. On the other hand, chemical fertilizers have a deleterious effect on soil fertility leading to unsustainable yields; while integration of chemical fertilizers with organic manures and bio-fertilizers would be able to maintain soil fertility and sustain crop productivity. Nutrient supply plays an important role in crop production but under intensive cultivation, the use of chemical fertilizers alone for a longer period would result in deterioration of soil fertility and quality of produce.

Materials and Methods

The experiment was carried out at the Research farm of the Department of Agronomy, School of Agriculture Science, Technology & Research, Sardar Patel University, Balaghat (M.P.). The present experiment was conducted to study the "Impact of organic and bio-fertilizers on growth and yield of Chickpea (*Cicer arietinum* L.)". The experimental observation data recorded periodically on the plant growth parameters, yield attributes, productivity and quality parameters of chickpeas under Nine organic and bio-fertilizer treatments were subjected to statistical analysis. The soil of the experimental field was silty clay-loam having pH 7.5 electrical conductivity 0.26 dS/m, organic carbon 0.48% available N 186.6 kg/ha, available P₂O₅ 12.5 kg/ha, available K₂O 200 kg/ha and available S 7.75 ppm. The total rainfall received during the cropping season (January to October 2023) was 773.0 mm. The treatments comprised nine organic and bio-fertilizer treatments. Thus these nine treatments were laid out in the field in a randomized block design keeping three replications. chickpea var. JG - 63 was sown in rows 30 cm apart on 7th November, 2023. Nitrogen levels were applied through urea as basal in the respective treatments in 30 cm apart open furrows just before sowing of seed on the same furrow. Phosphorus levels were applied as basal through DAP as per treatments. Before sowing the seeds were first treated with thorium fungicide @ 3 g/kg seed. The chickpea was grown as per recommended package of practices. The crop was harvested on 11th March in 2024. Soil samples were drawn earlier through soil auger before layout of the experiment for the determination of physico-chemical properties of the soil. The periodical field

and laboratory observations on growth, yield-attributes, grain yield and protein content of chickpea made as per approved technical programmes. Statistical computation of the data was done for each observation replication-wise. Economics per hectare was also worked out in case of each treatment as per existing market rates.

Table 1: Details of the treatments

Tr. No.	Treatment
T1	Control
T2	FYM 7.5 MT/ha+ Rhizobium @ 2.5gm/Kg. of seed
T3	FYM 10MT/ha+ Rhizobium @ 2.5gm/Kg. of seed
T4	FYM 12.5MT / ha + Rhizobium @ 2.5gm/Kg. of seed.
T5	FYM15MT / ha
T6	Vermicompost 1.5MT/ ha+ Rhizobium @ 2.5gm/Kg. of seed
T7	Vermicompost 2.5MT/ ha+ Rhizobium @ 2.5gm/Kg. of seed
T8	Vermicompost 3.75MT/ ha+ Rhizobium @ 2.5gm/Kg. of seed
T9	Vermicompost 5MT/ ha+ Rhizobium @ 2.5gm/Kg. of seed

Results and Discussion

Data regarding plant height and number of branches per plant are reported in Table 2. Amongst the organic and bio-fertilizer treatments, T9 has Vermicompost 5MT/ ha+ Rhizobium @ 2.5gm/Kg. of seed resulted in significantly higher plant height, branches and leaves/plant at 30,45 60 DAS and harvest stages the maximum height was 66.42 (cm), at 60 DAS branches were 15.26/plant and trifoliolate leaves 21.15/plant. This was followed by T7 and T8 treatments having Vermicompost 3.75MT/ ha+ Rhizobium @ 2.5gm/Kg. of seed. The fourth best organic and bio-fertilizers treatment was T6 having the highest Vermicompost 1.5MT/ ha+ Rhizobium @ 2.5gm/Kg. of seed. The Vermicompost 5MT/ ha+ Rhizobium @ 2.5gm/Kg. of seed brought about a significant reduction in these growth parameters of chickpeas. However, all the organic and bio-fertilizers treatments (T2 to T9) proved significantly superior to control (T1) with respect to all the growth parameters.

The boosted vegetative growth (plant height and number of leaves and branches per plant) as well as root length due to increased organic-cum-inorganic sources of nutrients may be because of the fact that these applied nutrients promoted plant growth by ensuring higher number of greener leaves with increased Photosynthesis as a result of (i) increased metabolism of the absorbed plant nutrient i.e. nitrogen, phosphorus, sulphur and zinc (ii) influencing cell membranes of leaves (iii) forming longer and stronger roots to absorb sufficient water and nutrients and (iv) as a result of acting on dividing cells in roots and shoots.

In the present investigation, the formation of leaves/plants was increased up to a significant extent under T9. This means the increase in leaf surface area/plant (photosynthetic surface) which is an important determinant in the production of photosynthetic. It is known that photosynthetic efficiency depends on leaf area, chlorophyll content and the gas exchange. The leaf area of a crop stand and its increase has a direct bearing on the amount of solar energy intercepted by canopy and represents the productive capacity of a crop.

In the present research, it is apparent that the combined impact of Vermicompost 5MT/ ha+ Rhizobium @ 2.5gm/Kg. of seed proved most beneficial as compared to their separate applications. The beneficial effect of the combined influence of FYM vermicompost and biofertilizer may be because there was great variation in their nutrient contents, decomposition of organic residue, C: N ratio, nutrient release pattern, climate and soil characteristics (Dharma, 2003 and Sanwal *et al.*, 2007)^[1, 8]

The beneficial effect of organic and bio-fertilizers on the vegetative growth of lentils and chickpeas has been reported by many workers Singh *et al.*, 2001^[9]. Patil *et al.* 2022^[5].

The factors which are directly responsible for the ultimate grain production of chickpeas viz. number of pods, length of pod, number of seeds/pod, test weight and grain yield/plant were augmented up to significant extent due to organic and bio-fertilizers treatment T9 having the highest dose of Vermicompost 5MT/ ha+ Rhizobium @ 2.5gm/Kg. of seed. Accordingly the maximum pods were 80.48/plant, number of seeds 1.38/pod, 1000 seeds test weight 166.0 g. and seed yield 14.56 g/plant. The maximum yield-attributes from the highest FYM, VC and Biofertilizer may be owing to maximum increase in dry matter production and its effective partitioning to the economic sink. The increased supply of multi-nutrients might have increased multi-role activities in plant and soil which, in turn, resulted in greater accumulation of carbohydrates, protein and their translocation to the reproductive organs i.e. yield-attributes. The results corroborate the findings of Patil *et al.* (2021)^[4], Elamin and Madhavi (2023)^[2] Singh *et al.* (2013)^[10]. Application of T9 (Vermicompost 5MT/ ha+ Rhizobium @ 2.5gm/Kg. of seed) recorded significantly higher grain yield (20.45q/ha) and Stover yield (28.45 q/ha) over the remaining organic-cum-inorganic sources of nutrients. Whereas in the control treatment the yield was reduced to half only 10.85q/ha. This might be owing to maximum growth parameters and a higher rate of photosynthesis which is always associated with higher productivity (Sanwal *et al.*, 2007)^[8]. It is apparent from the result that combined and individual FYM, VC and Biofertilizer. The higher yield response due to different organics was ascribed to improvement in physico-chemical and biological properties of the soil and nutrient use efficiency resulting in a better supply of multi plant-nutrients led to good crop growth and yields (Singh *et al.*, 2001)^[9]. The significant variation in grain yield response to different applied organic sources of nutrients (FYM, VC and Biofertilizer) might be due to variations in their nutrient composition, decomposition of organic residues,

carbon: nitrogen ratio, nutrient release pattern climate and soil characteristics. The results are per the findings of many research workers (Pathak *et al.*, 2003^[3]; Patil *et al.* (2022)^[5], Elamin and Madhavi (2023)^[2].

The ultimate aim of any chickpea grower is to secure maximum income out of the applied resources and production technology. It is a general understanding that the application of various organic manures not only produces the highest and most sustainable yields but also maintains the soil fertility as well as productivity and improve the quality of produce in comparison to inorganic chemical fertilizers.

Amongst the organic and bio-fertilizers treatments, T9 (Vermicompost 5MT/ ha+ Rhizobium @ 2.5gm/Kg. of seed) gave the maximum net income up to Rs. 56196/ha with 2.97 B:C ratio. This income was higher by Rs. 25907/ha over the highest FYM, VC and Biofertilizer levels. This was followed by T8, T6 and T7 treatments having the highest dose of Vermicompost 5MT/ ha+ Rhizobium @ 2.5gm/Kg. of seed (Rs. 51348, Rs. 46085 and Rs. 46059/ha, respectively). The net income under different organic and bio-fertilizer treatments was exactly by the increased grain yield which fetched higher market values.

Evaluation of nutritional modification in chickpea grain, in addition to quantitative parameters (grain yield and yield components), is necessary in relevance to the present investigation. Chickpea is known to contain seed protein in the range of about 22 to 25 per cent.

The protein content in chickpea grain was found to increase almost significantly with the increasing levels of multi-nutrients as in T9 thus the highest value being 24.62% as against 22.42% under control (Summary Table 6.2). The response of multi-nutrients in improving seed quality may be attributed to its significant role in regulating photosynthesis, root enlargement and better microbial activities more synthesis of protein through amino acids as a result of N=metabolism (Dwivedi and Bapat, 1998). The present findings are also in cognizance with those of Saket *et al.* (2014)^[7], and Elamin and Madhavi (2023)^[2].

Table 2: Impact of organic and bio-fertilizers on yield potential of Chickpea (*Cicer arietinum* L.)

Treatments	Plant height (cm)	Numbers of branches/plants	Trifoliolate Leaves/plant	Number of Pods/plant	Number of grains per pod	Test weight (g)	Grain yield (q/ha)	Straw yield (q/ha)	Harvest index (%)	Protein content (%)	B: C ratio
Control	55.65	7.67	18.09	30.84	0.78	122.5	10.85	14.56	45.31	22.42	2.12
FYM 7.5 MT/ha+ Rhizobium @ 2.5gm/Kg. of seed	59.86	10.64	19.30	53.15	1.17	144.8	15.08	23.46	42.83	23.42	2.69
FYM 10MT/ha+ Rhizobium @ 2.5gm/Kg. of seed	60.82	11.69	19.48	59.35	1.19	148.8	15.49	23.85	42.95	23.48	2.49
FYM 12.5MT / ha + Rhizobium @ 2.5gm/Kg. of seed.	61.79	11.87	19.79	61.43	1.22	151.8	16.25	24.45	43.30	23.54	2.67
FYM15MT / ha	62.15	12.06	20.09	63.38	1.28	153.5	16.72	25.18	43.16	23.59	2.50
Vermicompost 1.5MT/ ha+ Rhizobium @ 2.5gm/Kg. of seed	63.05	12.45	20.39	65.48	1.30	156.8	16.86	25.68	42.94	23.78	2.92
Vermicompost 2.5MT/ ha+ Rhizobium @ 2.5gm/Kg. of seed	64.48	12.78	20.59	67.08	1.34	160.5	17.48	26.15	43.18	24.13	2.74
Vermicompost 3.75MT/ ha+ Rhizobium @ 2.5gm/Kg. of seed	65.82	13.69	20.78	69.86	1.36	164.6	18.65	26.98	44.10	24.38	2.97
Vermicompost 5MT/ ha+ Rhizobium @ 2.5gm/Kg. of seed	66.42	15.26	21.15	80.48	1.38	166.0	20.45	28.45	44.19	24.62	2.97
S.Em. +	0.29	0.17	0.04	4.74	.005	0.45	0.13	0.32	0.41	0.05	
C.D. 5%	0.85	0.50	0.13	13.70	0.01	1.30	0.38	0.93	1.19	0.15	

Conclusion

From the above findings, it is concluded that joint application of Vermicompost 5MT/ ha+ Rhizobium @ 2.5gm/Kg. of seed proved to be beneficial and maximum yield ie 20.45 q/ha protein 24.62% and economic gain Rs. 56196/ha was obtained.

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