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Effect of Organic Nutrient Management Practices on Growth and Yield of Chickpea (*Cicer arietinum* L.)

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Abstract

A field experiment to know the effect of organic nutrient management practices on growth and yield of chickpea was conducted at Experimental block, College of Agriculture Bheemarayanagudi, UAS, Raichur on black soil during *rabi* 2022-23 The experiment was laid out in Randomized complete block design with seven treatments and three replications comprising of both soil and foliar application of different organic manures. The results revealed that application of FYM @ 2.5 t ha^{-1} + Vermicompost @ 1 t ha^{-1} + Jeevamrutha @ 250 l ha^{-1} + foliar spray of Panchagavya @ 3 % at 30 and 45 DAS recorded significantly higher plant height (40.07 cm), number of root nodules (18.33), total dry matter accmulation (17.71 g plant^{-1}), number pods plant^{-1} (39.25), seed yield (2284 kg ha^{-1}) and haulm yield (2499 kg ha^{-1}) compared to other treatments.

Key words : *Organic nutrient management practices, growth, yield, chickpea.*

Introduction

Pulse crops play an important role in Indian agriculture and India is the largest producer and consumer of pulses in the world. Chickpea (*Cicer arietinum* L.) is one of the most prominent pulse crops not only in India but also in the world next to beans and peas, it also bears synonyms such as gram or bengal gram and popularly referred as chana in several places of the country. Chickpea is a cool season quantitative long-day legume crop belongs to Family: fabaceae and Subfamily: faboideae. It is valued for its rich nutritive seed with enormous source of protein (21.1%), carbohydrate (61.5 %) and fat (4.5%), hence it is increasingly consumed as a substitute for animal protein. Chickpea is an ancient crop of modern times who occupied cultivable lands for nearly 50 countries around the world and accounts for more than 20 per cent of world pulse production, moreover much of the world's chickpea supply (80-90 %) comes from India. India ranks first in area (9.9 m ha) and production (11.9 m t) of chickpea in the world, with productivity of 1,192 kg ha^{-1} (1). In India, Karnataka ranks fourth in the cultivation of chickpea with an area of 0.713 m ha, with annual production of 0.4 m t and productivity was 733 kg ha^{-1} (11).

Pulses contain high percentage of quality protein nearly three times as much as cereals (2). Thus, they are cheaper source of protein to overcome malnutrition among human beings. There is a scope to improve the productivity of pulses by enhancing the soil fertility and its productivity through increasing soil organic carbon, soil moisture storage capacity and adopting integrated nutrient and pest management practices. The crop productivity under organic production system can be enhanced through optimizing the nutrient requirement of crop at different stages. Organic systems rely on management of organic matter to enhance the soil fertility and productivity (3). Availability of appropriate organic sources of nutrients for organic farming of crops is a challenge therefore, there should be promotion of organic input production at farm itself. It can be achieved through using different sources of nutrients which have different nutrient release pattern and efficiency. Combined application of organic manures mainly FYM, vermicompost and gliricidia green leaf manure produced higher yield apart from improving soil health (4). Further, the liquid organic manures meet the nutrient requirement of crops with greater nutrient use efficiency and also correct the deficiency as and when noticed under organic production system (5). Chickpea being legume derives its greater nitrogen requirement through biological nitrogen fixation, which can be harnessed by providing good soil physical and chemical condition. The edhaphic environment under organic production system will be more congenial for good crop growth and application of organics regularly maintains it at optimum level. Studies have shown that the legume crop productivity can be enhanced and sustained under organic production system. Indiscriminate and continuous use of chemical fertilizers also shown adverse effect on soil physical, chemical and biological properties there by affecting the sustainability of crop production, besides causing environmental pollution (6). Therefore, a study was envisaged to find out the effect of different organic manures on growth and yield of chickpea.

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Materials and Methods

A field experiment was conducted during *rabi*, 2022-23 at Experimental block, College of Agriculture, Bheemarayanagudi, UAS, Raichur, Karnataka on medium black soils having pH 8.32 and EC 0.34 dS m^{-1}. The soil was medium in organic carbon content (0.51 %) and available P_2O_5 (21.04 kg ha^{-1}), and low in available N (168 kg ha^{-1}) with high available K_2O content (369.71 kg ha^{-1}). The experimental site was located at a latitude of 16º15' North, longitude of 77º21' East and an altitude of 389 meters above mean sea level in North Eastern Dry Zone of Karnataka (Zone 2). During the year 2022-23, The highest rainfall of 246.1 mm was received in the month of August followed by July (200.1 mm).

The experiment was laid out in randomized complete block design along with three replications. There were seven treatment combinations, consisting FYM, Jeevamrutha, Vermicompost, Panchagavya, Vermiwash and Gokrupamrutha. The land was ploughed once after the harvest of the previous crop, followed by two harrowing. At the time of sowing, the land was prepared to a fine seedbed and the plots were laid out. The variety JG-11 was used and application of FYM was done 15 days before sowing of crop. The crop was sown on 20th October 2022 with a spacing of 30 × 10 cm. The crop grown with the residual moisture of monsoon rains with one protective irrigations. Harvesting was done at physiological maturity of the crop. The net plot area as per the treatments was harvested by cutting the plants to the ground level. After harvesting, the plants were bundled and allowed for sun drying. After complete sun drying, the crop was threshed by beating with wooden sticks. The separated seeds were winnowed, cleaned and grain and haulm yield were expressed in kilogram per hectare. The harvest index was calculated by using the formula suggested by (7).

The growth and yield attributes observations were recorded from the net plots and grain yield was converted to hectare basis in kilograms. The data collected from the experiment at different growth stages and at harvest were subjected to statistical analysis as described by (8). The level of significance used for 'F' and 't' tests was P=0.05. Critical Difference (CD) values were calculated at 5 per cent probability level if the F test will found to be significant.

Results and Discussion

Growth Attributes : Among different organic manures, application of FYM @ 2.5 t ha^{-1} + Vermicompost @ 1 t ha^{-1} + Jeevamrutha @ 250 l ha^{-1} + foliar spray of Panchagavya @ 3 % at 30 and 45 DAS recorded significantly higher plant height (40.07 cm), number of branches per plant (5.05), number of root nodules (18.33), total dry matter accumulation (17.71 g $plant^{-1}$) and SPAD value (38.45) over other treatment. It was found on par with application of FYM @ 2.5 t ha^{-1} + Vermicompost @ 1 t ha^{-1} + Jeevamrutha @ 250 l ha^{-1} + foliar spray of Vermiwash @ 5 % at 30 and 45 DAS higher plant height (39.55 cm), number of branches per plant (4.90), number of root nodules (17.93), total dry matter accumulation (17.32 g $plant^{-1}$) and SPAD value (38.02) and application of FYM @ 2.5 t ha^{-1} + Vermicompost @ 1 t ha^{-1} + Jeevamrutha @ 250 l ha^{-1} + foliar spray of Gokrupamrutha @ 15 % at 30 and 45 DAS higher plant height (39.01 cm), number of branches per plant (4.82), number of root nodules (17.77), dry matter accumulation (16.99 g $plant^{-1}$) and SPAD value (37.84). Significantly the lower plant height higher plant height (34.20 cm), number of branches per plant (4.17), number of root nodules (15.91), total dry matter accumulation (14.60 g $plant^{-1}$) and SPAD value (36.41) was recorded with the application of FYM @ 5 t ha^{-1}. Data presented in Table-1

Significantly higher plant height recorded may be due to application of FYM, Jeevamrutha and Vermicompost along with spraying of Panchagavya at 30 and 45 DAS responded better in terms of growth due to balanced and timely availability of nutrients and better moisture throughout growing period and also increased the activity of meristematic cells and cell elongation, thus indicating favourable effect on metabolic process. Addition of FYM, Vermicompost and Jeevamrutha might have helped in release of major, secondary and micronutrients required for favourable crop growth. The results are well supported with findings of Parmar *et al.* (2020) who noticed that the application of panchagavya @ 3 per cent as foliar spray increased the plant height in blackgram (27.24 %) over control. Increased plant height may be due to increase in protein synthesis and growth regulators such as foliar sprays expanded the plant level in blackgram (27.24 %) over control. Expanded plant level might be because of expansion in protein union and development controllers for example, IAA and GA_3 in panchagavya might have upgraded the cell division, cell duplication and cell growth which favours expanded bury nodal length (9,10) in vegetables and legumes. Chemotrophs and autotropic (ammonifiers and nitrifiers) present in panchagavya which colonize in the leaves increase the ammonia uptake and enhance total supply of nitrogen, thus increasing the height of the plant and vegetative growth (11).

Yield Attributes : Data presented in Table-2 clearly indicate that application of FYM @ 2.5 t ha^{-1} + Vermicompost @ 1 t ha^{-1} + Jeevamrutha @ 250 l ha^{-1} + foliar spray of Panchagavya @ 3 % at 30 and 45 DAS had

Table-1 : Growth attributes as influenced by nutrient management practices under organic cultivation.

Treatments	Growth attributes				
	Plant height (At harvest)	Number of branches plant^{-1} (At harvest)	Number of root nodules (60 DAS)	Total dry matter accumulation (g plant^{-1})	SPAD value (90 DAS)
T_1 : FYM @ 5 t ha^{-1}	34.20	4.17	15.91	14.06	36.41
T_2 : FYM @ 5 t ha^{-1} + Jeevamrutha @ 500 l ha^{-1}	35.54	4.36	16.42	14.80	36.98
T_3 : Vermicompost @ 2 t ha-1 + Jeevamrutha @ 500 l ha^{-1}	36.21	4.43	16.83	15.14	37.07
T_4 : FYM @ 2.5 t ha^{-1} + Vermicompost @ 1 t ha^{-1} + Jeevamrutha @ 250 l ha^{-1}	37.36	4.52	17.20	15.54	37.54
T_5 : FYM @ 2.5 t ha^{-1} + Vermicompost @ 1 t ha^{-1} + Jeevamrutha @ 250 l ha^{-1} + foliar spray of Panchagavya @ 3% at 30 and 45 DAS	40.07	5.05	18.33	17.71	38.45
T_6 : FYM @ 2.5 t ha^{-1} + Vermicompost @ 1 t ha^{-1} + Jeevamrutha @ 250 l ha^{-1} + foliar spray of Vermiwash @ 5 % at 30 and 45 DAS	39.55	4.90	17.93	17.32	38.02
T_7 : FYM @ 2.5 t ha^{-1} + Vermicompost @ 1 t ha^{-1} + Jeevamrutha @ 250 l ha^{-1} + foliar spray of Gokrupamrutha @ 15 % at 30 and 45 DAS	39.01	4.82	17.77	16.99	37.84
S.Em±	0.41	0.08	0.21	0.28	0.22
C.D. at 5%	1.26	0.25	0.64	0.87	0.67

Note : FYM-Farm Yard Manure, DAS-Days After Sowing.

Table-2 : Yield attributes as influenced by nutrient management practices under organic cultivation.

Treatments	Yield attributes			
	Number of pods plant^{-1}	seed yield (g plant^{-1})	seed yield (kg ha^{-1}	haulm yield (kg ha^{-1})
T_1: FYM @ 5 t ha^{-1}	34.93	7.46	1860	2104
T_2: FYM @ 5 t ha^{-1} + Jeevamrutha @ 500 l ha^{-1}	35.69	7.77	1934	2173
T_3: Vermicompost @ 2 t ha^{-1} + Jeevamrutha @ 500 l ha^{-1}	35.84	7.82	1950	2185
T_4: FYM @ 2.5 t ha^{-1} + Vermicompost @ 1 t ha^{-1} + Jeevamrutha @ 250 l ha^{-1}	36.78	8.10	2023	2249
T_5: FYM @ 2.5 t ha^{-1} + Vermicompost @ 1 t ha^{-1} + Jeevamrutha @ 250 l ha^{-1} + foliar spray of Panchagavya @ 3 % at 30 and 45 DAS	39.25	9.17	2284	2499
T_6: FYM @ 2.5 t ha^{-1} + Vermicompost @ 1 t ha^{-1} + Jeevamrutha @ 250 l ha^{-1} + foliar spray of Vermiwash @ 5 % at 30 and 45 DAS	38.47	8.70	2184	2393
T_7: FYM @ 2.5 t ha^{-1} + Vermicompost @ 1 t ha^{-1} + Jeevamrutha @ 250 l ha^{-1} + foliar spray of Gokrupamrutha @ 15 % at 30 and 45 DAS	37.93	8.65	2139	2368
S.Em±	0.35	0.08	17.98	32.80
C.D. at 5%	1.07	0.24	55.40	101.06

Note : FYM-Farm Yard Manure, DAS-Days After Sowing.

recorded significantly higher number of pods (39.25), seed yield (9.14 g plant^{-1}), seed yield (2284 kg ha^{-1}) and haulm yield (2499 kg ha^{-1}). It was found on par with application of FYM @ 2.5 t ha^{-1} + Vermicompost @ 1 t ha^{-1} + Jeevamrutha @ 250 l ha^{-1} + foliar spray of Vermiwash @ 5 % at 30 and 45 DAS higher number of pods (39.10), seed yield (8.66 g plant^{-1}), seed yield (2184 kg ha^{-1}) and haulm yield (2393 kg ha^{-1}) and application of FYM @ 2.5 t ha^{-1} + Vermicompost @ 1 t ha^{-1} + Jeevamrutha @ 250 l ha^{-1} + foliar spray of Gokrupamrutha @ 15 % at 30 and 45 DAS higher number of pods (37.93), seed yield (8.63 g plant^{-1}), seed yield (2138 kg ha^{-1}) and haulm yield (2368 kg ha^{-1}). Significantly the lower number of pods (34.93), seed yield (7.44 g plant^{-1}), seed yield (1860 kg ha^{-1}) and haulm yield (2104 kg ha^{-1}) was recorded with the application of FYM @ 5 t ha^{-1}.

The significant improvement in accumulation of dry matter, chlorophyll content and enhancement in the biological efficiency of crop plants results in improved yield and yield attributing characters (9). When liquid organic matter applied as foliar spray, increased number of pod per plant could be expected to the amounts of IAA and GA_3 present in panchagavya, Vermiwash and Gokrupamrutha which may have produced upgrades in the plant framework and increased growth regulator output in the cell system and the action of growth regulators in the plant system stimulated the required growth and development (12). Increased seed number and seed yield per plant might be expected to the nutrients present in the panchagavya, *i.e.* macronutrients such as nitrogen (N), phosphorus (P), potassium (K) and

micronutrients needed for plant growth and development. In addition, the existence of several amino acids, vitamins, growth regulators such as auxins, gibberellins, cytokinin and even beneficial microorganisms such as *pseudomonas, azotobacter* and *phosphobacteria* affected yield characteristics such as number of pods per plant and 100 seed weight (13). The increase in seed yield was attributed primarily to an increase in the number of seeds and the seed weight per plant. This finding are in line with the greengram results of (14,15).

Conclusions

Application of FYM @ 2.5 t ha^{-1} + Vermicompost @ 1 t ha^{-1} + Jeevamrutha @ 250 l ha^{-1} + foliar spray of Panchagavya @ 3 % at 30 and 45 DAS helped to increase growth and yield parameters in chickpea.

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