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RESEARCH ARTICLE

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Nutrient Management Through Organic Sources in Chickpea

S.N. Shah[1], V.D. Chaudhari[1], J.C. Shroff[1], V.J. Patel[1], A.P. Patel[1]

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ABSTRACT

Background: Chickpea is the third most important food legume grown globally and provides nutritious food for an increasing world population. Considering the environmentally friendly and improves and maintains soil fertility force to use organic manures. The organic amendments like composts and vermicompost have a positive influence on the quality of soil. Further, combined application of *Rhizobium* and phosphate solubilizing bacteria along with organic manure has increased nodulation, growth and yield parameters in chickpea. In view of above consideration, the present investigation entitled "nutrient management through organic sources in chickpea (*Cicer arietinum* L.)" was carried out.

Methods: The field experiment was conducted at Agronomy Farm, B.A. College of Agriculture, AAU, Anand during three consecutive *rabi* seasons of 2018-19, 2019-20 and 2020-21. The experiment was laid out in randomized block design with four replications.

Result: Based on three years investigation data clearly brought out that significantly taller plants, higher number of branches, number of pods per plant, seed index and seed yield were recorded in application of 10 kg nitrogen through vermicompost and bio-NP 1.0 litre ha^{-1}, but it was at par with application of 10 kg nitrogen through NADEP along with Bio NP 1.0 litre ha^{-1} and 20 kg nitrogen through NADEP. Among all the treatment, higher value of BCR was observed under application of 10 kg nitrogen through vermicompost along with Bio NP 1 litre ha^{-1}.

Key words: Bio NP, Chickpea, NADEP, Seed yield.

INTRODUCTION

Chickpea (*Cicer arietinum*) is one of the most important grain legumes of the world, which is grown in 44 countries across five continents. Since legumes are vital sources of protein, calcium, iron, phosphorus and other minerals, they form a significant part of the diet of vegetarians since the other food items they consume do not contain much protein (Latham,1997). Production ranks third after beans with a mean annual production of over 11.5 million tons with most of the production centred in India. Land area devoted to chickpea has increased in recent years and now stands at an estimated 14.56 million hectares. Over 2.3 million tons of chickpea enter world markets annually to supplement the needs of countries unable to meet demand through domestic production (Bulti and Jema, 2019). Pulses are a source of supplementary protein to daily diets based on cereals and starchy food for a predominantly vegetarian population. They also provide energy, essential minerals, vitamins and several compounds considered beneficial for good health. They are a rich source of protein and by virtue of nitrogen fixing ability, plays vital role in sustaining the soil fertility.

However, the productivity of these crops is very low because of their cultivation on marginal and sub marginal lands having poor soil fertility, where the little attention is paid for adequate fertilization. Reliance on the increased use of chemical fertilizers and associated hazards put back attention on organic sources, which are effective in promoting health and productivity of the soil. In addition to supply of nutrients, organic sources improve the physical condition and biological health of the soil, which improves the availability of applied and native nutrients. As input requirements are seemingly much lower than that of any other cereal crops, chickpea is well suited in organic nutrient management.

Based on the available knowledge from the literature, the present investigation was carried out to study the nutrient management through organic sources involving Bio NP (liquid biofertilizer contain *Rhizobium* and PSB) to enhance the productivity of chickpea.

MATERIALS AND METHODS

An investigation was carried out from 2018-19 to 2020-21 at Agronomy Farm, B.A. College of Agriculture, Anand Agricultural University, Anand, Gujarat on loamy sand soil having organic carbon 0.36%, available $P_2O_5$28.45 kg ha^{-1} and K_2O, 240.80 kg ha^{-1}. The experiment was laid out in randomized block design with ten treatments and four replications. The treatments were T_1 - Bio NP (*Azospirillum* and PSB), T_2 - N equivalent of 20 kg ha^{-1} through FYM, T_3 - N equivalent of 20 kg ha^{-1} through Vermicompost, T_4- N equivalent of 20 kg ha^{-1} through NADEP compost, T_5- N equivalent of 20 kg ha^{-1} through Castor Cake, T_6- N

[1]Department of Agronomy, B.A. College of Agriculture, Anand Agricultural University, Anand-388 110, Gujarat, India.

Corresponding Author: J.C. Shroff, Department of Agronomy, B.A. College of Agriculture, Anand Agricultural University, Anand-388 110, Gujarat, India. Email: jagruti@aau.in

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equivalent of 15 kg ha^{-1} through FYM, T_7 - N equivalent of 10 kg ha^{-1} through FYM+ Bio NP (*Rhizobium* and PSB), T_8- N equivalent of 10 kg ha^{-1} through Vermicompost + Bio NP (*Rhizobium* and PSB), T_9- N equivalent of 10 kg ha^{-1} through NADEP compost + Bio NP (*Rhizobium* and PSB) and T_{10} - N equivalent of 10 kg ha^{-1} through Castor Cake + Bio NP (*Rhizobium* and PSB). The Bio NP (*Rhizobium* and PSB) will be applied @ 1.0 l ha^{-1} with organic sources and in treatment T_5 by drenching in furrow. The Bio NP (*Rhizobium* and PSB) were purchased from Department of Biofertilizer, Anand Agricultural University, Anand. Chickpea variety GJG 3 was sown during the first fortnight of November, 2018 and 2019 while during 2020 it was sown in first week of December in 30 cm apart rows using 60 kg seed ha^{-1}. Entire quantity of nitrogen equivalent to different organic manures was applied in respective treatments before sowing. All other cultural practices were kept normal and uniform for all the treatments. Observations were recorded on some important plant parameters like plant height, number of branches plant^{-1}, number of pods plant^{-1}, seed index, seed yield and protein content of seed. Nitrogen content of the seeds was estimated using Kjeldhal method, phosphorous by Olsen method and potassium by Flame Photometer method (Jackson, 1973). Whereas, protein content of seed was estimated from N content of the seeds. The data collected were statistically analysed using analysis of variance technique and Least Significant Difference (LSD) test at 5% probability to compare the difference among the treatments means.

RESULTS AND DISCUSSION

Effect on growth attributes

Results showed that plant population was not influenced significantly but plant height (cm) and number of branches per plant, were significantly influenced by different treatments (Table 1). Significantly taller plants (57.23 cm) and higher number of branches (10.50 plant^{-1}) were recorded in application of 10 kg nitrogen through vermicompost and Bio-NP 1.0 litre/ha, but was at par with application of 10 kg nitrogen through NADEP along with Bio NP 1.0 litre/ha and 20 kg nitrogen through NADEP. The higher plant height and number of branches per plant was due inoculation of seeds with *Rhizobium* is known to increase nodulation and N uptake thereby increased growth of the plant in terms of plant height (Namvar *et al*., 2011). Similarly, Srivastava *et al*. (2021) stated that PSB possess the ability to bring sparingly insoluble inorganic or organic phosphates into soluble form and thus, the PSB enhances the P availability in the soil and phosphorus is essential constituent of plant cell and is also helpful in increasing the different growth characters. Significantly lower number of branches and pods per plant was observed with application of Bio NP alone, but was at par with application of FYM alone. Seeds inoculated with Bio NP showed significant results and produced higher nodule number and nodule weight per plant as compared to uninoculated seed. Biofertilizer has significant effect on nodule number and nodule activity (Mohammadi *et al*., 2010). Bacteria had beneficial effect on plant growth due to the fixation of atmospheric nitrogen and release auxins to the root zone thereby enhance the growth of the plant. The positive effect of *Rhizobium* + PSB on increasing number of nodules per plant in comparison to other inoculants in chickpea was also observed by Singh *et al*. (2018).

Effect on yield attributes and yield

Number of pods per plant and seed index was recorded significantly higher under application of 10 kg nitrogen through NADEP along with Bio NP 1.0 litre ha^{-1} but it was at par with application of 20 kg nitrogen through vermicompost and 10 kg nitrogen through vermicompost along with Bio NP 1.0 litreha^{-1}. Nitrogen applications along with Bio NP simultaneously have positive effects on growth indices and yield attributes of chickpea. Plants with nitrogen application

Table 1: Growth and yield attributes of chickpea as influenced by different treatment (Pooled data 2018-19, 2019-20 and 2020-21).

Treatment	Plant population/ meter row length	Plant height (cm)	Number of branches plants^{-1}	No. of nodules plant^{-1}	Dry weight of nodules plant^{-1} (mg)	Pods plant^{-1}	Seed index (g)
T_1 : Bio NP	10.73	51.28	8.44	26.75	0.26	32.69	21.51
T_2 : N equi. 20 kg through FYM	11.08	52.43	9.18	37.33	0.77	35.11	22.37
T_3 : N equi. 20 kg through VC	10.92	54.56	10.17	34.17	0.84	37.86	24.41
T_4 : N equi. 20 kg through NADEP	11.18	55.22	9.89	35.00	0.77	37.32	23.99
T_5 : N equi. 20 kg through CC	11.00	54.03	9.37	45.08	0.91	35.60	22.81
T_6 : N equi. 15 kg through FYM	10.72	51.97	8.98	46.33	0.95	33.92	21.99
T_7 : N equi. 10 kg through FYM + Bio NP	10.83	53.64	9.37	45.00	0.95	36.04	22.85
T_8 : N equi. 10 kg through VC + Bio NP	11.32	57.23	10.50	45.17	0.96	38.82	25.62
T_9 : N equi. 10 kg through NADEP + Bio NP	11.08	56.33	10.31	37.25	0.80	39.20	24.45
T_{10} : N equi. 10 kg through CC + Bio NP	11.01	54.30	9.91	37.00	0.74	36.93	23.06
S.Em. ±	0.18	0.74	0.20	0.99	0.016	0.83	0.47
CD (5%)	NS	2.08	0.57	2.77	0.05	2.34	1.32

NS: Non-significant.

Table 2: Yield and economics of chickpea as influenced by different treatment (Pooled data 2018-19, 2019-20 and 2020-21).

Treatment	Seed yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Protein content of seed (%)	Gross return (` ha^{-1})	Common cost (` ha^{-1})	Input cost (` ha^{-1})	Total cost of cultivation (` ha^{-1})	Net returns (` ha^{-1})	BCR
T_1 : Bio NP	2080	2354	16.28	123131	20537	1164	23093	100038	5.33
T_2 : N equi. 20 kg through FYM	2214	2640	17.28	131265	20537	2730	24760	106505	5.30
T_3 : N equi. 20 kg through VC	2439	3017	16.97	144768	20537	9038	31473	113295	4.60
T_4 : N equi. 20 kg through NADEP	2417	2963	17.55	143422	20537	3089	25142	118280	5.70
T_5 : N equi. 20 kg through CC	2248	2717	17.33	133336	20537	5597	27811	105524	4.79
T_6 : N equi. 15 kg through FYM	2193	2542	17.47	129911	20537	1365	23307	106603	5.57
T_7 : N equi. 10 kg through FYM + Bio NP	2286	2700	17.09	135495	20537	1833	23805	111690	5.69
T_8 : N equi. 10 kg through VC + Bio NP	2539	3175	17.00	150755	20537	5054	27233	123522	5.54
T_9 : N equi. 10 kg through NADEP + Bio NP	2462	3087	17.31	146196	20537	2147	24139	122056	6.06
T_{10} : N equi. 10 kg through CC + Bio NP	2332	2751	16.97	138217	20537	3200	25260	112957	5.47
S.Em. ±	52	114	0.52	-	-	-	-	-	-
CD (5%)	150	330	NS	-	-	-	-	-	-

NS: Non-significant.

in lower amount and inoculated with Bio NP showed better yield attributes including number of pods and seed index. Yadav *et al*. (2021) also observed higher number of pods in chickpea when crop was supplemented with *Rhizobium* + PSB. Seed and stover yield were also recorded significantly higher under application of 10 kg nitrogen through vermicompost along with Bio NP 1.0 litre ha^{-1} but it was at par with application of 10 kg nitrogen through NADEP along with Bio NP 1.0 litre ha^{-1} and application of 20 kg nitrogen through either vermicompost or NADEP. The higher yield might be due to the more positive effect of biofertilizer in presence of application of organic manure in the form of vermicompost or NADEP. Application of *Rhizobium* and PSB as Bio NP enhance the phosphorus availability and this available phosphorus enhances the number pods and thereby of seed yield. Shwetha (2009) stated that 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. Srivastava *et al*. (2021) also observed higher chickpea seed yield with application of recommended dose of nitrogen through vermicompost with bio-fertilizers (*Rhizobium*+PSB). Ajaykumar *et al*. (2022) also observed positive effect of liquid biofertilizer on growth, yield attributes and yield of black gram. Further, results showed non-significant influenced on protein content of chickpea seed.

Economics

The data on economics presented in Table 2 revealed that application of 10 kg nitrogen through vermicompost along with Bio NP 1 litre/ha registered maximum net income of ` 123522 $ha^{-1}$ which was followed by application of 10 kg nitrogen through NADEP along with Bio NP 1 litre/ha treatment (` 122056 ha^{-1}). While, higher value of BCR (6.06) was observed under application of 10 kg nitrogen through vermicompost along with Bio NP 1 litre ha^{-1}.

CONCLUSION

From the results of three-year experimentations, it can be concluded that different treatments were significantly influence on seed yield of chickpea in individual years as well as in pooled results. Application of 10 kg nitrogen through NADEP mixed with Bio NP (*Rhizobium* and PSB) 1.0 l ha^{-1} as soil application or 10 kg nitrogen through vermicompost mixed with Bio NP (*Rhizobium* and PSB) 1.0 l ha^{-1} as soil application produced significantly higher seed yield and better economic return.

Conflict of interest

All authors declare that they have no conflicts of interest.

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