Effect of Organic Manures and Boron on growth and yield of Chickpea (*Cicer arietinum* L.)

ABSTRACT

A field experiment was conducted during *Rabi* 2021 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P). The soil of experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.1), low in organic carbon (0.36%), available N (171.48 kg/ha), available P (15.2 kg/ha) and available K (232.5 kg/ha). The experiment was laid out in Randomized Block Design with nine treatments each replicated thrice on the basis of one year experimentation. The treatments which are T_1: Vermicompost 3 t/ha + Boron @ 1 kg/ha, T_2: Vermicompost 3 t/ha + Boron @ 1.5 kg/ha, T_3: Vermicompost 3 t/ha + Boron @ 2 kg/ha, T_4: Poultry manure 4 t/ha + Boron @ 1 kg/ha, T_5: Poultry manure4 t/ha + Boron @ 1.5 kg/ha, T_6: Poultry manure 4 t/ha + Boron @ 2 kg/ha, T_7: Farmyard Manure 5 t/ha + Boron @ 1 kg/ha, T_8: Farmyard Manure 5 t/ha + Boron @ 1.5 kg/ha, T_9: Farmyard Manure 5 t/ha + Boron @ 2 kg/ha are used. The results showed that application of Poultry manure 4 t/ha + Boron @ 2 kg/ha was recorded significantly higher Plant height (42.45 cm), No. of Nodules/plant (19.74) and Plant dry weight (8.63 g/plant). Significantly highest Pods/plant (30.06), Seeds/Pod (1.80), Test weight (223.07 g), Seed yield (1811.28 kg/ha), Stover yield (3217.59 kg/ha) was obtained in the treatment of Poultry manure 4 t/ha +Boron @ 2 kg/ha as compared to other treatments.

Key words: *Vermicompost, Poultry manure, Farmyard Manure, Chickpea, Organic Manures, Boron, yield.*

INTRODUCTION

Chickpea (Cicer arietinum L.) is an important grain legume crop in the world which was globally, total production is approximately 142.4 lakh tons from an area of 137 lakh ha and a productivity of 1038 kg ha-1 **FAOSTAT, (2019).** Worldwide chickpea is largely grown as a rain fed crop (> 90%) in the arid and semiarid environments in Asia and Africa. Chickpea, almost in all regions, is grown on marginal soils and the good soils are used for growing other more favored crops. Proper crop management is essential for high grain yields, and proper nutrient management is one of the most critical aspects contributing to high productivity. "India is one of the important chickpea growing countries in Asia with an area of 112 lakh ha and production of 116.2 lakh tons with a productivity of 1036 kgper ha" **(FAO STAT, 2021). "**India ranked first in area and production in the world. Chickpea also plays an important role in sustaining soil productivity by improving its physical, chemical and biological properties and trapping atmospheric nitrogen in their root nodules" **(Ali and Kumar, 2005).**

"Boron (B) is very important in cell division and in pod and seed formation. Boron ranks third place among micronutrients in its concentration in seed and stem as well as its total amount after zinc" **(Shil et al. 2007). "**Boron is an important micronutrient, plays role in carbohydrate metabolism, translocation of sugars from source to sink, flower retention, pollen fertility and germination, pod setting, seed development, yield and its components. Thus, the requirement of boron appears more essential for reproductive development than vegetative" **(Nalini and Bhavana 2013).**

"Farmyard manure is constrained by access to sufficient organic inputs, low nutrient content of manures, high labor demand for preparation and transportation. These constraints can be solved by the substitution of organic sources containing higher amount of plant nutrients, which can improve and sustain crop yields while improving soil fertility status" **(Dhakal *et al.,* 2016).**

"Application of poultry manure increases soil organic matter content, total-N, available-P, exchangeable cations (Ca, Mg and K), CEC and percent base saturation"

(Adeleye, 2010). "For maintaining soil fertility poultry manure occupied a place as it is rich innutrient then the other manures" **(Ananullah et al., 2007).**

Vermicompost for enhancing crop productivity and improving soil health is gaining popularity among the farming community. The possibility of utilizing different plant biomass (weed biomass, crop residue etc.) into quality organic manure. Improvement in soil health and crop productivity, following vermicompost application, have been earlier reported by many workers **(Rajkhowa *et al.,* 2000)**. Vermicompost enhances soil biodiversity by promoting beneficial microbes, which in turn enhances plant growth directly by production of plant growth regulating substances (hormones and enzymes) and indirectly by controlling plant pathogens, nematodes and other pests.

Therefore, it is important to find the best manure and Boron to be used in proper proportions for the best growth and yield of crop. This research was done to find out the Effect of Organic Manures and Boron on growth and yield of
Chickpea (*Cicer arietinum* L.)

MATERIALS AND METHODS

A field experiment was conducted during kharif season of 2021, at Crop research farm of Department of Agronomy at Sam Higginbottom University of Agriculture, Technology, and Sciences, Prayagraj which is located at 25^{o} 24' 42" N latitude, 81^{o} 50' 56" E longitude and 98 m altitude above the mean sea level (MSL). The experiment was laid out in Randomized Block Design comprising of 9 treatments which are replicated thrice. Each treatment net plot size is 3m × 3m. The treatment are categorized as with recommended dose of nitrogen through urea, Phosphorous through DAP and potash through Muriate of Potash, in addition with bio fertilizers and Boron when applied in combinations as follows, T_1: Vermicompost 3t/ha + Boron @ 1 kg/ha, T_2: Vermicompost 3 t/ha + Boron @ 1.5 kg/ha, T_3: Vermicompost 3 t/ha + Boron @ 2 kg/ha, T_4: Poultry manure 4 t/ha + Boron @ 1 kg/ha, T_5: Poultry manure 4 t/ha + Boron @ 1.5 kg/ha, T_6: Poultry manure 4 t/ha + Boron @ 2 kg/ha, T_7: Farmyard Manure 5 t/ha + Boron @ 1 kg/ha, T_8: Farmyard Manure 5 t/ha + Boron @ 1.5 kg/ha, T_9: Farmyard Manure 5 t/ha + Boron @ 2 kg/ha. The chickpea crop was harvested treatment wise at harvesting maturity stage. Growth parameters viz. plant height (cm), no of nodules and dry matter accumulation g $plant^{-1}$ were recorded manually on five randomly selected representative plants from each plot of each replication separately and after harvesting, seeds were separated from each net plot and were dried under sun for three days. Later winnowed, cleaned and grain yield per ha was computed and expressed in tons per hectare. After complete drying under sun for 10 days stover yield from each net plot was recorded and expressed in kgs per hectare. The data was computed and analyzed by following statistical method of ANOVA.

RESULTS AND DISCUSSION

Plant height (cm)

It is evident from Table-1 that significantly highest plant height (42.45 cm) was recorded in the treatment with Poultry manure 4 t/ha + Boron @ 2 kg/ha over all the other treatments. However, the treatments with application of Vermicompost 3 t/ha + Boron @ 2 kg/ha (42.18 cm) and Poultry manure 4 t/ha + Boron @ 1.5 kg/ha (42.01 cm) which were found to be statistically at par with treatment Poultry manure 4 t/ha + Boron @ 2 kg/ha as compared to all the treatments. Factors such as boron have increased plant height by formation of new plant cells, elevated level of IAA, development of meristematic tissues, cellelongation and tissue differentiation and sugar transportation. Ceyhan and Onder (2007) also reported similar results. Poultry manure treatment encouraged improved root proliferation, increased phosphorus solubility, which favored stronger biological nitrogen fixation, nutrient uptake, and availability of all plant nutrients during the crop growth period. As a result, the plant height increased.

No. of Nodules/plant

Treatment with Poultry manure 4 t/ha + Boron @ 2 kg/ha was recorded with significantly highest No. of Nodules /plant (19.74) over all the treatments. However, the treatments with Vermicompost 3 t/ha + Boron @ 2 kg/ha (19.62) and Poultry manure 4 t/ha +Boron @ 1.5 kg/ha (19.22) which were found to be statistically at par with Poultry manure 4 t/ha + Boron @ 2 kg/ha. The direct input and slow release of nutrients from poultry manure has resulted in an increase in the number of nodules per plant. The higher the phosphorus content and solubility in the soil, the better the root proliferation and nodule development. The findings were found to be consistent with those of Singh et al (2017).

Dry matter accumulation

Treatment with Poultry manure 4 t/ha + Boron @ 2 kg/ha was recorded with significantly maximum dry weight (8.63 g/plant) over all the treatments. However, the treatments Vermicompost 3 t/ha + Boron @ 2 kg/ha (8.53 g/plant) and Poultry manure 4 t/ha
+ Boron @ 1.5 kg/ha (8.36 g/plant) which were found to be statistically at par with Poultry manure 4 t/ha + Boron @ 2 kg/ha. A significant effect of dry weight chickpea plants by soil

application of boron and molybdenum. This beneficial effect of soil application could be linked to these nutrients' favorable influence on metabolism and biological activity, as well as their stimulating effect on photosynthetic pigments and enzyme activity, which encourages plant vegetative development. These results are consistent with the findings of Tekale et al (2009). The rise in total dry matter production was attributable to improved source and sink capacity established as a result of improved dry matter production and accumulation in assimilatory surface area, as well as an improvement in photosynthetic efficiency, which resulted in enhanced production of photosynthates, which resulted in better growth and, ultimately, higher dry accumulation. The findings were found to be comparable to those of Nehra et al (2001).

Table 1. Effect of Organic manures and Boron on growth parameters of Chickpea.

S.No	Treatments	Plant height (cm)	Nodules/plant	Dry weight (g plant^{-1})
1.	Vermicompost 3 t/ha + Boron @ 1 kg/ha	40.87	17.90	7.72
2.	Vermicompost 3 t/ha + Boron @ 1.5 kg/ha	41.77	18.82	8.19
3.	Vermicompost 3 t/ha + Boron @ 2 kg/ha	42.18	19.62	8.53
4.	Poultry manure 4 t/ha + Boron @ 1 kg/ha	41.24	18.17	7.94
5.	Poultry manure 4 t/ha + Boron @ 1.5 kg/ha	42.01	19.22	8.36
6.	Poultry manure 4 t/ha + Boron @ 2 kg/ha	42.45	19.74	8.63
7.	Farmyard Manure 5 t/ha + Boron @ 1 kg/ha	40.36	17.39	7.35
8.	Farmyard Manure 5 t/ha + Boron @ 1.5 kg/ha	40.52	17.64	7.53
9.	Farmyard Manure 5 t/ha + Boron @ 2 kg/ha	41.57	18.48	8.07
	SEm (±)	0.21	0.18	0.11
	CD (P 0.05)	0.62	0.55	0.32

Yield and Yield Attributes:

Number of Pods/plant

Significantly Maximum Number of Pods/plant (30.06) was recorded with the treatment of application of Poultry manure 4 t/ha + Boron @ 2 kg/ha over all the treatments. However, the treatments Vermicompost 3 t/ha + Boron @ 2 kg/ha (29.78) and Poultry manure 4 t/ha + Boron @ 1.5 kg/ha (29.44) which were found to be statistically at par with Poultry manure 4 t/ha + Boron @ 2 kg/ha.

Number of Seeds/Pod

Significantly Maximum Number of Seeds/Pod (1.80) was recorded with the treatmentof application of Poultry manure 4 t/ha + Boron @ 2 kg/ha over all the treatments. However, the treatments Vermicompost 3 t/ha + Boron @ 2 kg/ha (1.73) and Poultry manure 4 t/ha + Boron @ 1.5 kg/ha (29.16) which were found to be statistically at par with Poultry manure 4 t/ha + Boron @ 2 kg/ha. The good reaction of poultry manure to yield characteristics can be related to the availability of appropriate amounts of easily utilizable plant nutrients throughout the growth period, particularly during critical growth periods of the crop, resulting in improved absorption, plant vigour, and superior yield attributes. Saravanan et al. observed comparable results (2013).

Test weight (g)

Significantly highest Test weight (223.07 g) was recorded with the treatment of application of Poultry manure 4 t/ha + Boron @ 2 kg/ha over all the treatments. However, the treatments Vermicompost 3 t/ha + Boron @ 2 kg/ha (221.94 g) and Poultry manure 4 t/ha + Boron @ 1.5 kg/ha (220.47 g) which were found to be statistically at par with Poultry manure 4 t/ha + Boron @ 2 kg/ha. The plant performance in terms of yield attributing characters such as number of pods per plant, seed yield per plant and seed index were significantly influenced. This attributed to increase the availability of boron with each successive level and its positive effect on growth attributes and subsequently on yield components. Combined application of B helped in translocation of photosynthates to pods and seeds. Working with different crops other researchers have also reported increased yield with application of B. All the growth parameter increases because of better balanced nutrient supply (B) that resulted in better crop growth. These results are in agreement with the findings of **Singh *et al.* (2002).**

Seed yield (kg/ha)

Significantly highest Seed yield (1811.28 kg/ha) was recorded with the treatment application of Poultry manure 4 t/ha + Boron @ 2 kg/ha over all the treatments. However, thetreatments with (1782.56 kg/ha) in Vermicompost 3 t/ha + Boron @ 2 kg/ha and with (1726.08 kg/ha) in Poultry manure 4 t/ha + Boron @ 1.5 kg/ha which were found to be statistically at par with Poultry manure 4 t/ha + Boron @ 2 kg/ha. The release of macro and micro nutrients during microbial decomposition has been linked to a larger rise in yield. Organic matter also serves as a source of energy for soil microflora, which helps to change other nutrients contained in the soil or applied in other ways into a form that is easily consumed by growing plants, resulting in an increase in seed output. Kannan et al. predicted the same outcomes (2014). **Stover yield (kg/ha)**

Significantly highest Stover yield (3217.59 kg/ha) was recorded with the treatment application of Poultry manure 4 t/ha + Boron @ 2 kg/ha over all the treatments. However, the treatments with (3159.05 kg/ha) in Vermicompost 3 t/ha + Boron @ 2 kg/ha and with (3093.32 kg/ha) in Poultry manure 4 t/ha + Boron @ 1.5 kg/ha which were found to be statistically at par with Poultry manure 4 t/ha + Boron @ 2 kg/ha.

Harvest Index (%)

There was no significant difference among the treatments. However, highest Harvest index (36.07 %) was recorded with the treatment application of Poultry manure 4 t/ha + Boron @ 2 kg/ha whereas, lowest Harvest index (33.96 %) was recorded with the applicationFarmyard Manure 5 t/ha + Boron @ 1 kg/ha.

The most effective yield component that is most closely connected with seed yield is the number of

pods per plant. Increased boron levels had a substantial impact on chickpea grain and stover yield. Which enhanced the survival and multiplication of microorganisms, improved nitrogen fixation, transport of sugars and better uptake and assimilation of available nutrients by the plants during the entire growth period. The studies of Choudhary et al. showed similar outcomes (2000).

Table 2. Effect of Organic manures and Boron on Yield attributes and Yield of Chickpea.

Treatments	Pods/plant	Seeds/Pod	Test Weight (g)	Seed yield (kg/ha)	Stover yield (kg/ha)	Harvest Index (%)
1. Vermicompost 3 t/ha + Boron @ 1 kg/ha	27.89	1.43	212.71	1554.35	2844.37	35.33
2. Vermicompost 3 t/ha + Boron @ 1.5 kg/ha	29.16	1.60	218.97	1686.98	3030.94	35.75
3. Vermicompost 3 t/ha + Boron @ 2 kg/ha	29.78	1.73	221.94	1782.56	3159.05	36.01
4. Poultry manure 4 t/ha + Boron @ 1 kg/ha	28.30	1.50	214.60	1590.82	2909.45	35.34
5. Poultry manure 4 t/ha + Boron @ 1.5 kg/ha	29.44	1.63	220.47	1726.08	3093.32	35.81
6. Poultry manure 4 t/ha + Boron @ 2 kg/ha	30.06	1.80	223.07	1811.28	3217.59	36.07
7. Farmyard Manure 5 t/ha + Boron @ 1 kg/ha	27.15	1.30	208.78	1395.81	2712.80	33.96
8. Farmyard Manure 5 t/ha + Boron @ 1.5 kg/ha	27.56	1.33	210.57	1486.56	2771.33	34.91
9. Farmyard Manure 5 t/ha + Boron @ 2 kg/ha	28.76	1.53	216.13	1626.92	2985.03	35.27
F test	**S**	**S**	**S**	**S**	**S**	**NS**
S. EM (±)	0.21	0.06	0.89	31.57	50.80	0.41
CD (P = 0.05)	0.63	0.19	2.66	94.66	152.29	-

CONCLUSION

It is concluded that treatment with Poultry manure 4 t/ha + Boron @ 2 kg/ha performed exceptionally in all growth and yield parametersand in obtaining maximum grain yield of chickpea. Hence, Poultry manure 4 t/ha + Boron @ 2 kg/ha may be more preferable and can be recommended to the farmers.

COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

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