# 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 T1: Vermicompost 3 t/ha + Boron @ 1 kg/ha, T2: Vermicompost 3 t/ha + Boron @ 1.5 kg/ha, T3: Vermicompost 3 t/ha + Boron @ 2 kg/ha, T4: Poultry manure 4 t/ha + Boron @ 1 kg/ha, T5: Poultry manure 4 t/ha + Boron @ 1.5 kg/ha, T6: Poultry manure 4 t/ha + Boron @ 2 kg/ha, T7: Farmyard Manure 5 t/ha + Boron @ 1 kg/ha, T8: Farmyard Manure 5 t/ha + Boron @ 1.5 kg/ha, T9: 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, Boron, yield.*

## INTRODUCTION

Chickpea (Cicer arietinum L.) is an important grain legume crop in the world which was globally, total production is approximately 14.2 million tons from an area of 14.8 million ha and a productivity of 0.96 t ha-1 **FAOSTAT, (2014).** South East Asia, led by India is leading producers, while in East Africa, Ethiopia, Tanzania, Malawi, and Kenya are leading chickpea producers. 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 favoured crops. For obtaining high grain yields proper management of the crop is must and proper nutrient management is one of the important factors contributing towards high productivity.

Chickpea (Cicer arietinum L.) is the fourth largest grain legume crop in the world, with a total production of 13.1 M tonnes from an area of 13.5 M ha and productivity of 0.97 tonnes/ha **(FAO–STAT 2013).** India is one of the important chickpea growing countries in Asia with an area of 9.6 M. ha and production of 8.83 M tonnes with a productivity of 920 kg per ha **(FAO-STAT, 2013).** 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

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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 labour 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

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**(Adeleye, 2007).** For maintaining soil fertility poultry manure occupied a place as it is rich in nutrient then the other manures **(Mohamad 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.*, 2003; 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.

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## 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° 24' 42" N latitude, 81° 50' 56" E longitude and 98 m altitude above the mean sea level (MSL). To assess the effect of organic manure and boron on growth and yield of chickpea. 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, T1: Vermicompost 3 t/ha + Boron @ 1 kg/ha, T2: Vermicompost 3 t/ha + Boron @ 1.5 kg/ha, T3: Vermicompost 3 t/ha + Boron @ 2 kg/ha, T4: Poultry manure 4 t/ha + Boron @ 1 kg/ha, T5: Poultry manure 4 t/ha + Boron @ 1.5 kg/ha, T6: Poultry manure 4 t/ha + Boron @ 2 kg/ha, T7: Farmyard Manure 5 t/ha + Boron @ 1 kg/ha, T8: Farmyard Manure 5 t/ha + Boron @ 1.5 kg/ha, T9: 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 Gomez and Gomez (1984).

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## 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 might have increased plant height by formation of new plant cells, elevated level of IAA, development of meristematic tissues, cell elongation and tissue differentiation and sugar transportation. Similar results were reported by **Ceyhan and Onder (2007).** The application of Poultry manure might have favoured better root proliferation, more solubility of phosphorous which consequently favoured higher biological nitrogen fixation and uptake of nutrients and availability of all plant nutrients during the crop growth period. Which resulted in the higher plant height. These results are in close in close conformity with the findings of **Jat *et al.* (2012).**

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### 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 increase in number of nodules per plant might be due to direct addition and slow release of nutrients from poultry manure. The more content of phosphorous and its solubility in soil helped in better root proliferation and formation of nodules. The results were found to be in resonance with **Singh *et al.* (2017).**

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**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. Such enhancement effect of soil application might be attributed to the favourable influence of these nutrients on metabolism and biological activity and its stimulating effect on photosynthetic pigments and enzymes activity which in turn encourage vegetative growth of plants. These findings are in harmony with those obtained by **Tekale *et al.* (2009).** The increase in the total dry matter production may be due to better source and sink capacity developed due to better dry matter production and its accumulation in assimilatory surface area and increase in the photosynthetic efficiency and thus increased the production of photosynthates reflected in better growth and ultimately in higher dry accumulation. The results were found to be similar with **Nehra *et al.* (2001).**

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**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 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 (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 beneficial response of poultry manure to yield attributes might also be attributed to the availability of sufficient amounts of easily utilizable from of plant nutrients throughout the growth period and especially at critical growth periods of crop resulting in better uptake, plant vigour and superior yield attributes. The results were found to be similar with **Saravanan *et al.* (2013).**

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**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 could be 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).**

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**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, the treatments 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 higher increase in the yield has been reported to be associated with the release of macro and micro nutrients during the course of microbial decomposition. Organic matter also functions as source of energy for soil micro flora which brings about the transformation of other nutrients held in soil or

applied through other means, in a form that is readily utilized by growing plants which helped in increase of seed yield. The results were in accordance with **Kannan *et al.* (2014).**

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**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 application Farmyard Manure 5 t/ha + Boron @ 1 kg/ha.

The number of pods per plant is the most effective yield component that is most closely correlated with seed yield. Grain and stover yield of chickpea was significantly influenced with increasing levels of boron. 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. Similar results have been reported by the findings of **Choudhary *et al.* (2000).**

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**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 |

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| 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

Based on the findings of the investigation it may be concluded that treatment with Poultry manure 4 t/ha + Boron @ 2 kg/ha performed exceptionally in all growth and yield parameters and 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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