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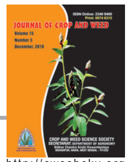

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Effect of integrated nutrient management through phosphorus and vermicompost on growth, phenology and yield of chickpea (*Cicer arietinum* L.)

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ABSTRACT

Chickpea (Cicer arientinum L.) is the 3rd most valuable food of legume crop belonging to the family Fabaceae. An experiment was carried out to find out the effect of different levels of phosphorus and vermicompost on growth and yield of chickpea at the research farm of Sant Baba Bhag Singh University, Jalandhar, India. The experiments were carried out in randomized block design with three replicates and seven treatments. Three factors of phosphorus (15, 20 and 25 kg ha^{-1}) and two factor of vermicompost (1 and 2 t ha^{-1}). The results suggested that application of phosphorus (25 kg ha^{-1}) and vermicompost (2 t ha^{-1}) significantly increased various growth parameters (plant height, number of branches, leaves, nodules and pods) and yield parameters (number of seeds pod^{-1}, 1000 seed weight and grain yield) in chickpea. It may be concluded that the application of phosphorus (25 kg ha^{-1}) along with the vermicompost (2 t ha^{-1}) is the most important nutrient managment practice for the effective growth, development and productivity in chickpea.

Keywords: Chickpea, growth, phosphorus, vermicompost, yield

Chickpea is the 3rd most valuable food legume crop belonging to family Fabaceae. In India, chickpea is the major *rabi* pulse crop, with high acceptability and wider use which occupies maximum acreage, production and contributes about 70% of the total world's production. Chickpea was grown on an area of 13.98 million ha, with production of 13.73 million tonnes and 982 Kg ha^{-1} average productivity during 2014 (FAO, 2017). In India, it is cultivated as a winter crop that require cool and dry weather for its optimum growth. It can tolerate high drought conditions because of its deep root system and susceptible to frost. Two types of chickpeas are cultivated in India i.e., Desi (Small seeded) and Kabuli (Large seeded) in Madhya Pradesh, Uttar Pradesh and Rajasthan. The crop requires less amount of N fertilizer as it fixes atmospheric N through symbiotic fixation, thus the chickpea crop has the great economic advantage for the farmers. The legume crops are large feeder of P and less responsive to Nitrogen.

In India pulse crop plays an important role in agriculture. Chickpea crop is cultivated mostly for human consumption, chiefly for closely vegetarian people, as they are free from any anti-nutritional factors. Around the world chickpea is the 3rd most crucial legume food after peas and dry beans over 10 million ha under cultivation (FAOSTAT, 2009). Chickpea is cultivated in Asia, Europe and known to be cultivated in the ancient Egyptians and Greeks and one of the oldest pulse crops with 3rd most cultivated area in the world and over 23% of total global production. In India, desi types are grown traditionally and account for more than 80% of the world production of chickpea. The dry seeds are puffed and known as 'Channa'. It is a source of dietary protein and grown as grain legume. The kabuli type chickpeas are cream coloured large seeded with a whitish flower, a smooth seed surface and a stem devoid of anthocyanin pigmentation (Jukanti *et al.,* 2012). It is largely cultivated in North America, Europe, West Asia and North Africa. The market price of desi types is less than kabuli type (Gaur *et al.,* 2010).

Chickpea seed contains fiber (64%), carbohydrates (40%), protein (23%), ash (3%) and sugar (6%). In addition, they are having important mineral sources like, Mg, Iron, Zinc, Phosphorus and Calcium. Presently, Uttar Pradesh, Madhya Pradesh, Rajasthan, Haryana and Karnataka are amongst the largest chickpea growing regions within India with 5.8 million tonnes production and 6.7 million ha area under the cultivation. Chickpea is also used as medicinal purpose for constipation, cholera, diarrhoea and snake bite. Seeds are also used for the treatment of scurvy. Its flour is known as 'Besan' and used for cooking chapattis. Its flour is used to prepare various snacks, soups and making bread. It is used for various medicinal purposes to treat the burning sensation. Seeds are also used for the treatment of liver diseases, ear infections and blood disorders. Also, for the purpose of fodder chickpea seed coats and pod cover are used (Tahir and Karim, 2011).

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Phosphorus fertilizer plays an important role in pulses for acquiring better crop growth and essential for high and sustained productivity of chickpea crop. Phosphorus is important for improving quality of crop, root development, increasing stalk, more stem strength, improving flower formation and resistance to plant disease. Higher phosphorus application improves number of pods and seed index. The production of legumes is negatively impacted by phosphorus nutrient deficiency in soil as it is necessary for energy transformation in nodule and also enhances N-fixation (Yadav *et al.,* 2017). Different doses of phosphorus *viz.,* 15, 20 and 25 kg ha^{-1} increase number of nodules $plant^{-1}$ over control (Basir *et al.,* 2008). The application of phosphorus significantly enhanced number of seeds pod^{-1}, 100 grains weight, yield and also recorded maximum yield of grain by 16 and 12%, respectively, with phosphorus @ 15 kg ha^{-1} over control in chickpea (Khourgamy and Farnia, 2009). Application of phosphorus @ 20 kg ha^{-1} increased pods number and grain yield as compare to control (Badini *et al.,* 2015).

Vermicompost enhances the physical, chemical and biological characteristics of the soil and ensures that effective use of fertilisers resulted in increased seed yield and crop quality (Patil *et al.,* 2012;Kaundal *et al.,* 2018). The application of vermicompost and phosphorus fertilizer significantly improved seed yield in chickpea (Patel *et al.,* 2014). Vermicompost increased organic matter and nutrient content in the soil (Jindo *et al.,* 2016). Application of vermicompost significantly increased plant height, shoot biomass and seed pod in chickpea (Yadav and Garg, 2015). The main objective of the experiment was to assess the effect of phosphorus and vermicompost on growth, biomass, yield and phenological characters of chickpea.

MATERIALS AND METHODS

Experiment details

The experiment was conducted at Sant Baba Bhag Singh University Khiala, Jalandhar over the *rabi* season of 2019-2020. The experiment consists of three levels of phosphorus (P_1 with 15 kg ha^{-1}), (P_2 with 20 kg ha^{-1}) and (P_3 with 25 kg ha^{-1}) and arranged in a randomised block design along with 2 levels of vermicompost (V_1 with 1 t ha^{-1}) and (V_2 with 2 t ha^{-1}) with seven different treatments and three replicates. The details of the treatments were ($T_1 = P_1V_1$), ($T_2 = P_1V_2$), ($T_3 = P_2V_1$), ($T_4 = P_2V_2$), ($T_5 = P_3V_1$), ($T_6 = P_3V_2$) and (T_7 = Control).

Agronomic practices

Field preparation was done with disc harrow by ploughing twice and with tractor drawn cultivator followed by planking. To break clods as well as removal of weeds, field was prepared. The seed was sown on ridges. The sowing depth of seed was 10-12 cm deep. The net plot size was 3.0 ×2.5 m with seed rate of 37.05 kg ha^{-1}. The variety of chickpea PBG-7 was used for sowing. The recommended dose of N was 15 kg ha^{-1} and applied through urea as a basal dose and phosphorus and vermicompost were applied as per the treatment before the sowing of crop. Weeding was done after 30 DAS to keep the field free from weeds. The sowing was done during November and harvested in April 2020.

Observations recorded

The various observations were recorded from the randomly chosen five plants during the crop period on growth attributes (plant height, number of branches $plant^{-1}$, leaf number $plant^{-1}$ and nodules $plant^{-1}$), phenological studies (Days taken to flower bud initiation, number of days taken to 50% flowering, number of days taken to 100% flowering, number of days taken to 50% grain filling, number of days taken to 100% seed maturity) and yield parameters (number of seeds $pods^{-1}$, number of pods $plant^{-1}$, 1000 grain weight (g), biological yield (kg ha^{-1}) and grain yield.

Statistical analysis

Statistical tests were conducted by OPSTAT software developed CCS HAU, Hisar, India.

RESULTS AND DISCUSSION

Growth analysis

Growth attributes such as plant height, number of branch $plant^{-1}$, number of leaves $plant^{-1}$, number of nodules $plant^{-1}$, pods number $plant^{-1}$ and number of seeds pod^{-1} had significant effect in various treatments (Table 1). The findings revealed that plant height was influenced under different treatments of phosphorus and vermicompost at 30, 60 and 90 DAS. The data revealed that combined application of phosphorus and vermicompost increased plant height as compared to control treatment. The higher plant height (16.47 cm) was observed in treatment T_6 (25 kg ha^{-1} P+2 t ha^{-1} V) while, lower plant height (9.47 cm) was recorded under control plots at 30 DAS. At 60 DAS, plant height (33.30 cm) was higher in treatment T_1 (15 kg ha^{-1} P+1 t ha^{-1} V) over control. At 90 DAS, plant height (60.40 cm) was higher in treatment T_3 (20 kg ha^{-1} P+1 t ha^{-1} V) as compared to control (55.30 cm). Application of phosphorus and vermicompost increased plant height in chickpea (Singh *et al.,* 2012).

Significantly higher branches $plant^{-1}$ were observed with phosphorus and vermicompost application at 60, 90 and 120 DAS. Higher branches $plant^{-1}$ were observed in treatment T_6 (25 kg ha^{-1} P+2 kg ha^{-1} V) at 60 DAS (3.70) and 90 DAS (5.20) as compare to control. At 120 DAS, number of branches (7.40) were higher in

Table 1: Effect of various treatments on growth attributes of chickpea

Treatments	Plant height (cm)			Branches plant^{-1}			Leaves plant^{-1}			Nodules plant^{-1}		
	Days after sowing (DAS)											
	30	60	90	60	90	120	30	60	90	60	75	90
T_1	14.27	33.30	56.40	3.50	4.40	6.50	445.6	742.4	997.61	30.32	25.35	24.39
T_2	12.69	32.20	58.40	3.30	4.50	6.40	565.8	845.6	1023.42	30.25	26.72	25.56
T_3	14.25	33.00	60.40	3.40	4.30	6.80	412.8	645.7	996.89	35.17	29.93	27.41
T_4	16.37	30.60	59.90	3.60	4.20	6.70	592.7	876.5	1063.58	38.12	30.72	30.49
T_5	15.03	28.20	60.10	3.20	4.60	7.40	487.6	654.6	1096.85	39.11	32.73	31.62
T_6	16.47	32.23	56.70	3.70	5.20	6.80	587.6	765.7	993.52	25.16	32.56	32.28
T_7	9.47	29.80	55.30	3.10	4.10	6.30	439.5	638.5	987.47	21.42	24.42	22.71
LSD (0.05)	3.20	1.78	1.10	1.14	0.41	0.47	1.40	32.10	10.96	2.74	0.85	1.76

LSD: Least significant difference, NS: Non significant

Table 2: Effect of various treatments on yield attributes of chickpea

Treatments	Pods plant^{-1}	Seeds pods^{-1}	100 grain weight (g)	1000 grain weight (g)	Grain yield (kg ha^{-1})	Biological yield (kg ha^{-1})
T_1	62.40	1.22	12.70	175.63	18.42	5464.00
T_2	58.30	1.26	12.83	178.26	20.56	5499.00
T_3	58.80	1.32	13.93	181.86	23.66	5556.00
T_4	56.60	1.34	12.43	182.53	24.55	5761.00
T_5	57.50	1.29	13.76	186.46	25.13	5331.00
T_6	63.90	1.34	12.93	188.70	25.46	5447.00
T_7	56.70	1.26	11.90	174.70	12.54	5293.00
LSD (0.05)	1.31	NS	0.78	3.16	2.21	116.41

LSD: Least significant difference, NS: Non significant

treatment T_5 (25 kg ha^{-1} P+1 t ha^{-1} V) as compare to control and other treatments. Application of vermicompost and phosphorus increased branches in chickpea (Singh *et al.,* 2012 ; Sinha *et al.,* 2010).

Number of leaves plant^{-1} was influenced under different treatments of phosphorus and vermicompost at 30, 60 and 90 DAS. Higher number of leaves plant^{-1} was observed in treatment T_4 (20 kg ha^{-1} P+2 t ha^{-1} V) at 30 DAS (592.73) and 60 DAS (876.57) as compare to control. At 90 DAS, higher number of leaves (1096.85) were observed in treatment T_5 (25 kg ha^{-1} P+1 t ha^{-1} V) whereas, minimum number of leaves plant^{-1} were seen in control plot. Number of leaves plant^{-1} increased with the application of vermicompost in chickpea (Sinha *et al.,* 2010). The data revealed that the different treatments had significant effect on number of nodules plant^{-1}. Higher number of nodules was recorded in treatment T_5 (25 kg ha^{-1} P+1 t ha^{-1} V) at 60 (39.11) and 75 DAS (32.73) as compare to control. At 90 DAS, the maximum number of nodules plant^{-1} (32.28) was recorded in treatment T_6 (25 kg ha^{-1} P+2 t ha^{-1} V), whereas, lesser number of nodules plant^{-1} (22.71) were seen in control plot. Higher number of nodules plant^{-1} in chickpea was also reported (Basir *et al.,* 2008).

Different phenological stages during our experiment have been recorded and described below (Fig. 1). It was observed that different treatments show significant effect on number of days taken to bud initiation. Least number of days was taken in treatment T_3 for bud initiation (20 kg ha^{-1} P+1 t ha^{-1} V) as compare to control. These results corroborate with the findings of Griffth (2010). Lesser number of days was taken to 50% flowering (74.87) in treatment T_1 (15 kg ha^{-1} P+1 t ha^{-1} V) as compare to control (84.51). Similar results were earlier reported in chickpea crop (Neenu *et al.,* 2014). Minimum number of days was taken to 100% flowering (117.79) in treatment T_4 (20 kg ha^{-1} P+2 t ha^{-1} V) over control. Similar results have been observed in soybean crop, where phenological stages were earlier as compared to control treatment (Moghadam *et al.,* 2014, Kochouie *et al.,* 2014).

Yield parameter

The data related to yield parameters were influenced by application of vermicompost and phosphorus (Table 2). The different treatments had significant influence on number of pods plant^{-1} as compare to control. Higher pods plant^{-1} (63.90) were recorded in treatment T_6 (25 kg ha^{-1} P+2 t ha^{-1} V) and lesser pods plant^{-1} (56.70) were

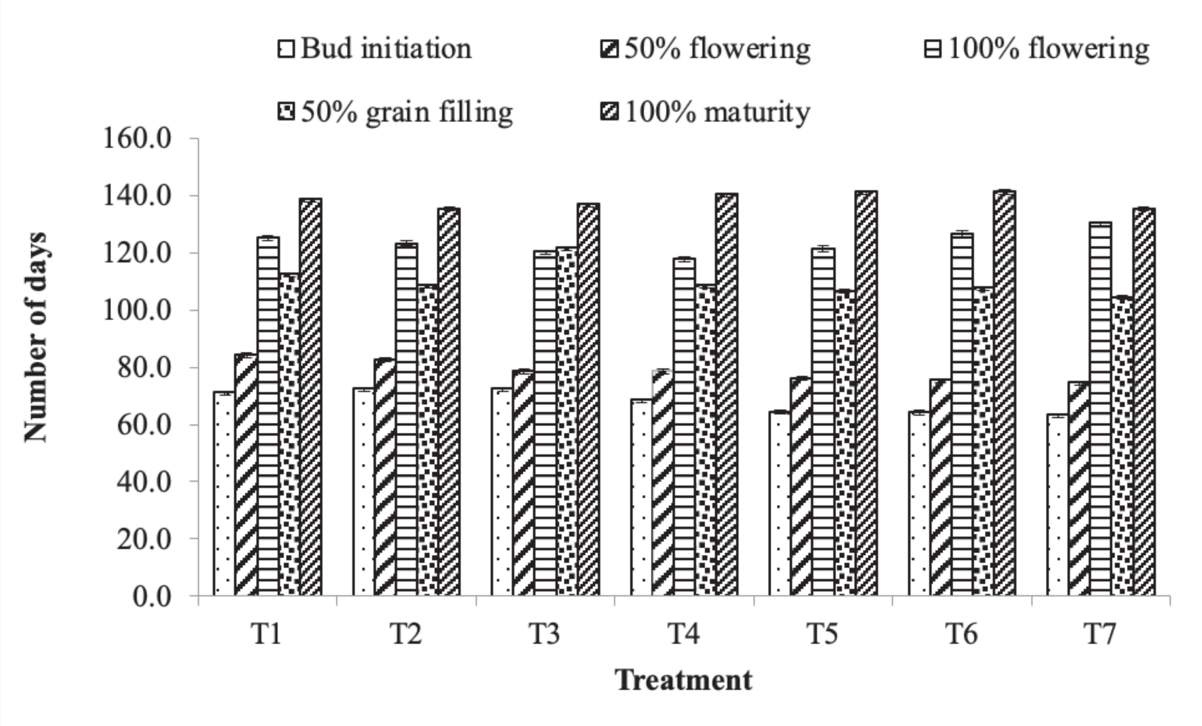

Fig. 1 : Effect of different treatments on phenology of chickpea

observed in control plot. Application of vermicompost and phosphorus increased number of pods plant^{-1} in chickpea crop (Singh *et al.,* 2012). Maximum seeds pod^{-1} (1.34) weres obtained in treatment T_4 (20 kg ha^{-1} P+2 t ha^{-1} V) and in T_6 (25 kg ha^{-1} P+2 t ha^{-1} V) as compared to control (1.26). Similarly, vermicompost and phosphorus treatment increased number of seed pod^{-1} in chickpea (Khourgamy and Farnia, 2009).

The various treatments had significant influence on 100 grain weight (g) as compare to control. Maximum 100 grain weight (13.93 g) was recorded in treatment T_3 (20 kg ha^{-1} P+1 t ha V), whereas, minimum grain weight (11.90 g) was recorded in control plot. These results are in close conformity to the findings in chickpea crop (Khourgamy and Farnia, 2009). Maximum 1000 grain weight (188.70 g) was observed in treatment T_6 (25 kg ha^{-1} P+2 t ha^{-1} V), compared to control (174.70 g). Increased test weight in chickpea crop with the application of vermicompost and phosphorus was also reported (Kumar *et al.,* 2009). The different treatments showed significant effect on the grain yield. Higher grain yield (25.46 kg ha^{-1}) was observed in treatment T_6 (25 kg ha^{-1} P+2 t ha^{-1} V) as compare to control (12.54 kg ha^{-1}). Likewise, application of phosphorus increased chickpea yield (Singh *et al.,* 2012). Biological yield (5761.00 kg ha^{-1}) was maximum in treatment T_4 (20 kg ha^{-1} P+2 t ha^{-1} V) and lower biological yield (5293.00 kg ha^{-1}) was observed in control plot.

CONCLUSION

In the present study application of vermicompost and phosphorus on chickpea crop was evaluated. The chickpea crop was improved in terms of growth parameters, yield attributes and biological yield with the application of vermicompost and phosphorus. It may be concluded that chickpea crop responded positively to phosphorus dose (25 kg ha^{-1}) and vermicompost (2 t ha^{-1}) which significantly improve plant height, leaf number, nodules, branches and pods plant^{-1} and yield parameters (Seeds number pod^{-1}, 1000 seed weight and grain yield). These findings made it clear that the phosphorus application along with the vermicompost is the most important nutrient management practice for the effective growth, development and productivity of the chickpea.

REFERENCES

Badini, S.A., Khan, M., Baloch, S.U., Baloch, S.K., Baloch, H.N., Bashir, W., Badini, A.R. and Badini, M.A. 2015. Effect of phosphorus levels on growth and yield of chickpea (*Cicer arietinum* L.) varieties. *J. Nat. Sci. Res.,* **5**(3): 169-176.

Basir, A., Shah, Z., Naeem, M., Bakht, J. and Khan, Z.H. 2008. Effect of phosphorus and farmyard manure on agronomic traits of chickpea (*Cicer arietinum* L.). *Sarhad J. Agric.,* **24**(4): 567-572.

Food and Agriculture Organization Corporate Statistical Database 2017. http://www.fao.org/faostat/en/#data/QC.

Food and Agriculture Organization of United Nations 2009. FAOSTAT. Retrieved on 10 December 2020. http://faostat.fao.org/site/567/desktop.

Gaur, P.M., Tripathi, S., Gowda, C.L.L., Ranga Rao, G.V., Sharma, H.C., Pandey, S. and Sharma, M. 2010. Chickpea seeds production manual. Patancheru (India): *International Crops Research Institute for the Semi-Arid Tropics*. Available at https//www.icrisat.org/tropicallegumesII/pdfs/Chickpea Manual _full.pdf.28.

Griffth, B. 2010. Efficient fertilizer use-Phosphorus (2nd ed.). McMillan Co. Amsterdam 1-7.

Jindo, K., Chocano, C., Melgares de Aguilar, J., Gonzalez, D., Hernandez, T. and Garcia, C. 2016. Impact of compost application during 5 years on crop production, soil microbial activity, carbon fraction, and humification process. *Commun. Soil Sci. Plant Anal.,* **47**:1907-1919.

Jukanti, A.K., Gaur, P.M., Gowda, C.L.L. and Chibbar, R.N. 2012. Chickpea: Nutritional quality and health benefits of chickpea (*Cicer arietinum* L.): A review. *Br. J. Nutr.,* **108**: 11-26.

Kachouie, M.A., Mohammadalizade, F. and Seyed, M.H.J. 2017. Effects of vemicompost and chemical fertilizers on phenological and phytochemical traits of soybean (*Glycine max* L.) *Res. Crop Ecophysiol.,* **12**(1): 53-62.

Kaundal, M., Bhatt, V. and Kumar, R. 2018. Elevated CO_2 and temperature effect on essential oil content and composition of *Valeriana jatamansi* Jones. with organic manure application in a Western Himalayan region. *J. Essent. Oil-Bear. Plants,* **21**(4): 1041-1050.

Khourgamy, A. and Farnia, A. 2009. Effect of phosphorus and zinc fertilization on field components of chickpea cultivars. *Proceed. African Crop Sci. Conference,* **9**: 205-208.

Kumar, V., Dwivedi, V.N. and Tiwari, D.D. 2009. Effect of phosphorus and iron on yield and mineral nutrition in chickpea. *Ann. Plant Soil Res.,* **11**: 16-18.

Moghadam, M.K., Darvishi, H.H. and Javaheri, M. 2014. Effect of bacteria and vermicompost on phenology and growth of soybean (*Glycine max* L.) in sustainable agricultural systems. *Int. J. Adv. Biol. Biomed. Res.,* **2**(9): 2534-2539.

Patel, H.K., Patel, P.M., Suthar, J.V. and Patel, M.R. 2014. Yield, quality and post-harvest nutrient status of chickpea as influence by application of sulphur and phosphorus fertilizer management. *Int. J. Sci. Res. Pub.,* **4**(7): 1-4

Patil, S.V., Halikatti, S.I., Hiremath, S.M., Babalad, H.B., Sreenivasa, M.N., Hebsur, N.S. and Somanagouda, G. 2012. Effect of organics on growth and yield of chickpea (*Cicer arietinum* L.) in vertisols. *Kar. J. Agric. Sci.,* **25**(3): 326-331.

.

Singh, G., Sekhon, H.S. and Kaur, H. 2012. Effect of farmyard manure, vermicompost and chemical nutrients on growth and yield of chickpea (*Cicer arietinum* L.). *Int. J. Agric. Res.,* **7**(2): 93-99.

Sinha, J., Biswas, C.K., Ghosh, A. and Saha, A. 2010. Efficacy of vermicompost against fertilizers on *Cicer* and *Pisum* and on population diversity of N2 fixing bacteria. *J. Environ. Biol.,* **31**(3): 287-292.

Tahir, N.A. and Karim, H.F.H. 2011. Determination of genetic relationships among some varieties of Chickpea (*Cicer arietinum* L.) in Sulaimani by RAPD and ISSR Markers. *Jordan J. Biol. Sci.,* **4**(2): 77-86.

Yadav, A. and Garg, V.K. 2015. Influence of vermi-fortification on chickpea (*Cicer arietinum* L.) growth and photosynthetic pigments. *Int. J. Recycl. Org. Waste Agric.,* **4**: 299-305.

Yadav, G.S., Babu, S., Meena, R.S., Debnath, C., Saha, P., Debbarma, C. and Datta, M. 2017. Effects of godawariphosgold and single super phosphate on groundnut (*Arachis hypogaea* L.) productivity, phosphorus uptake, phosphorus use efficiency and economics. *Ind. J. Agric. Sci.,* **87**(9): 1165-1169.