Annals of Plant and Soil Research 23(1): 112-115 (2021)
https://doi.org/10.47815/apsr.2021.10040

Influence of plant densities and fertility levels on growth and yield of chickpea (*Cicerarietinum*L.) genotypes

GURINDER SINGH, MOHINDER LAL AND PRADEEP KUMAR

Department of Agriculture, G.S.S.D.G.S. Khalsa College, Patiala, Punjab, India-147001

Received: November, 2020; Revised accepted: December, 2020

ABSTRACT

A field experiment was conducted at Research and Advanced Studies, Dhablan, Department of Agriculture, Khalsa College, Patiala during rabiseason 2019-20 to find out the influence of plant densities and fertility levels on growth and yield of chickpea (Cicer arietinum L.) genotypes. The experiment was conducted in factorial randomized block design and replicated thrice. The experiment consisted of two genotypes (PBG 7 and GPF 2), two planting densities and two fertility levels. The results revealed that the genotype PBG 7 recorded significantly highestgrain yield (18.01 q ha^{-1}) as compared to genotype GPF2 (16.62 q ha^{-1}). The growth parameters were also higher with genotype PBG 7 followed by GPF 2. The density of 30 × 10 cm recorded. The highest grain and straw yield (17.47 and 22.51 q ha^{-1})as compared to 45× 10 cm spacing (16.74 and 18.53 q ha^{-1}). However, yield attributes like pods plant^{-1}, grain yield plant^{-1} and harvest index were higher with wider planting density (45 × 10 cm). Higher fertility level ($N_{30}P_{60}K_{30}S_{20}$ kg ha^{-1}) produced highest grain yield (17.88 q ha^{-1}) as compared to low fertility levels(16.75 q ha^{-1}). The growth and yield parameters followed the similar trend. The chickpea genotype PBG 7 showed better response to closer planting density and higher fertility level.

Keywords: Chickpea, genotype, plant density, fertility level

INTRODUCTION

Chickpea (*Cicer arietinum* L.) is the second most important pulse crop after pigeon pea in the world of human diet and other use. It is an important winter season pulse crop in India grown as a dry pulse crop. Chickpea contributes 47% of the total pulse production and about 40% of total pulse growing area in the country. In India, Madhya Pradesh ranks first in area and production of chickpea followed by Rajasthan.It contains all the essential amino acids except S – containing amino acids.Being a leguminous crop, chickpea improves soil fertility by fixing atmospheric nitrogen in the roots through the phenomena of symbiosis. Application of nitrogen fertilization improves the seed yield, seed protein and amino acids. Among all the factors of productivity, application of phosphorus contributes directly to yield of the chickpea and also plays an important role in physiological functions of the plant. However, potassium acts as a catalyst in activating several enzymes as incorporation of amino acids in protein, synthesis of peptide bonds etc. Potassium enhance the resistance in plants against different abiotic factors like drought, heat, frost and various abiotic factors like disease caused by fungi, nematode and other microorganism (Ahmed *et al.* 2015). Also sulphur is an essential element in forming proteins, enzymes, vitamins and chlorophyll in plants. It is crucial in nodule development and efficient nitrogen fixation in legumes. It is an important factor in determining the nutritional quality of foods.The optimum density with proper plant geometry is one of the important characters which can be manipulated to attain the maximum production from per unit land area (Prasad *et al.* 2012). Proper geometry is dependent on variety of chickpea, its growth habit and agro climatic condition. Plant population also depends upon the environmental conditions under which the chickpea is grown (Kumar *et al.* 2018). Selection of cultivar andits adaptation on a particular environment is also an important factor. Old and degenerated cultivars due to poor yield potential and other drawbacks like shattering habits, late maturity, poor response to fertilizer, susceptible to diseases and insect pest results lower yield productivity as compared to the improved cultivars. Keeping these facts in view, the present study was initiated using chickpea as test crop.

MATERIALS AND METHODS

The field experiment was conducted at Research and Advanced Studies, Dhablan, Department of Agriculture, G.S.S.D.G.S. Khalsa College, Patiala during *rabi*season of 2019-20. The experiment was conducted in factorial randomized block design. The soil of experimental field contained 262 kg ha^{-1}available N, 22 kg ha^{-1} available P and 129 kg ha^{-1} available K. Soil of experimental field was clayey in texture having soil pH 7.3 and 5.2g kg^{-1} organic carbon. The experimental site is situated at $30^0$19′ North latitude and $76^0$24′ East longitude at an altitude of 250 metre above the mean sea level. The experiment consisted of two genotypes (PBG 7 and GPF 2), two planting densities (30× 10 and 45 × 10 cm) and two fertility levels (20 kg N + 40 kg P_2O_5+ 20 kg K_2O + 20 kg S and 30 kg N + 60 kg P_2O_5+ 30 kg K_2O + 20 kg Sha^{-1}) were replicated three times. The different doses of fertilizer as per treatment were applied in the form of urea, single superphosphate and murateof potash, respectively at the time of sowing. The crop was sown on 23 October 2019. Cultural operations carried out in the experimental field were done bymanually. Thinning and gap filling was done on 4 December 2019, hand weedings were done on 26 December 2019, 26 January 2020, 5 March 2020. Harvesting of crop was done on 2 April, 2020 and threshing was done on 8 April, 2020. The observations recorded were growth parameters like plant height, dry weight,branches $plant^{-1}$ at maturity; development parameters like days to flowering initiation, days to 50% flowering and days to maturity; yield attributes and yield parameters like pods $plant^{-1}$, grains pod^{-1}, grain yield, straw yield, biological yield, test weight and harvest index. The data were statistically analysed as per procedure given by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Genotypes

Genotype PBG 7 differed significantly in dry weight and branches $plant^{-1}$at maturity as compared to genotype GPF 2 (Table1).PBG 7 produced significantlyhighest dry weight (378.7) gand more branches $plant^{-1}$ at maturity (6.43) as compared to GPF 2.This might be due to superior varietal characters and genetic potential of variety PBG 7.Plant height and developmental parameters did not differ significantlybetween both genotypes of chickpea(Table 1).Similar results were observed by Goyal *et al.* (2010). Grain yield and harvest indexwere observed significantly higher with genotype PBG 7due to efficient utilization of resources by variety PBG 7 (Table 2). PBG 7 produced significantly highest grain yield (18.01 q ha^{-1}) as compared to GPF 2. Lower grain yield (16.60 q ha^{-1})was produced by GPF 2.Similar results were reported by Nawange*et al.* (2018). Test weight, straw yield and biological yield did not produce significant results with both genotypes of chickpea.

Table1: Influence of genotype, Plant density and Fertility levels on growth and development parameters of chickpea

Treatments	Plant height (cm)	Dry weight (g) m^{-1} row length	Branches $plant^{-1}$ at maturity	Days to flowering initiation	Days to 50% flowering	Days to maturity
Genotype						
PBG 7	63.3	378.7	6.43	105.5	112.8	155.2
GPF 2	63.6	334.0	5.62	105.7	112.6	155.6
SE(m)	0.34	11.6	0.22	0.31	0.32	0.36
C.D.	NS	35.2	0.66	NS	NS	NS
Plant density						
30 x 10 cm	63.3	333.0	5.22	105.1	112.4	154.9
45 x 10 cm	63.7	380.8	6.03	106.1	112.7	155.8
SE(m)	0.34	11.6	0.22	0.31	0.32	0.36
C.D.	NS	35.2	0.66	0.96	NS	NS
Fertility levels (kg ha^{-1})						
$N_{30}P_{60}K_{30}S_{20}$ kg ha^{-1}	62.5	330.4	4.85	106.0	112.5	155.5
$N_{20}P_{40}K_{20}S_{20}$ kg ha^{-1}	64.5	382.4	6.72	105.2	112.9	154.8
SE(m)	0.34	11.6	0.22	0.31	0.32	0.36
C.D.	1.03	35.2	0.66	NS	NS	NS

Plant density

Dry weight, branches plant^{-1} at maturity and days to flowering initiation increased with decrease of plant density (Table 1). A plant density of 45 × 10 cm resulted significant higher dry weight, branches plant^{-1} at maturity and days to flowering initiation as compared to plant density of 30 × 10 cm. The number of pods plant^{-1}, grain yield plant^{-1} and harvest index were observed more with plant density of 45 × 10 cm (Table 2). The number of pods plant^{-1} decreased with increase in plant density while total number of pods per unit land area increased with increase in plant density. Contrary to this, grain yield, straw yield and biological yield weresignificantly higher with plant density of 30 × 10 cm. This might be due to grain yield increases with increasing the total number of pods per unit land area at closer planting in chickpea. Hence, straw and biological yield were significantly higher with plant density of 30 × 10 cm. Similar results was also reported by Girma (2013) and Nawange*et al* (2018). The results clearly suggest that individual plant under lower plant population density performed better than plant under higher plant population density. The improvement in yield attributing characters under lower plant population was not sufficient enough to compensate the loss of density for higher seed yield.

Table 2: Influence of genotype, Plant density and Fertility levels on yield and yield attributeng characters of chickpea

Treatments	Pods plant^{-1}	Grains pod^{-1}	Test weight (g)	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Biological yield (q ha^{-1})	Harvest index (%)
Genotype							
PBG 7	42.4	2.04	136.7	18.01	19.98	37.99	47.4
GPF 2	44.6	2.32	137.4	16.62	21.06	37.68	44.4
SE(m)	0.64	0.08	0.49	0.14	0.43	0.48	0.53
C.D.	1.94	0.25	NS	0.42	NS	NS	1.60
Plant density							
30 x 10 cm	42.0	2.15	136.9	17.47	22.51	39.98	43.6
45 x 10 cm	44.9	2.26	138.0	16.74	18.53	35.27	47.4
SE(m)	0.64	0.08	0.49	0.14	0.43	0.48	0.53
C.D.	1.94	NS	NS	0.42	1.31	1.46	1.60
Fertility levels (kg ha^{-1})							
$N_{30}P_{60}K_{30}S_{20}$ kg ha^{-1}	42.1	2.06	138.0	16.75	20.85	37.60	44.7
$N_{20}P_{40}K_{20}S_{20}$ kg ha^{-1}	45.9	2.35	136.9	17.88	20.19	38.07	47.1
SE(m)	0.64	0.08	0.49	0.14	0.43	0.48	0.53
C.D.	1.94	0.25	NS	0.42	NS	NS	1.60

Soil fertility

Application of 30 kg N + 60 kg P_2O_5+ 30 kg K_2O + 20 kg S ha^{-1}recorded significantly higher growth as compared to lower fertility level (20 kg N + 40 kg P_2O_5+ 20 kg K_2O + 20 kg S ha^{-1}). The higher fertility level significantly produced more plant height, dry weight and number ofbranches plant^{-1} at maturity. The growth parameters were significantly improved due to morechlorophyll formation by additional amount of nutrients, which ultimately increased the food material for the plant to stimulate growth of plant. Similar results were also reported by Goyal *et al* (2010) and Kumar *et al.* (2018).The higher fertility level recorded significantly more number of pods plant^{-1}, number of grains pod^{-1}, grain yield and harvest index (Table2). The possible reason for increase in yield parameters could be that higher fertilization dose improving dry matter production in turn might have resulted in greater synthesis of photosynthesis contributing to increase in number of pods plant^{-1}. The more number of pods plant^{-1} finally led to higher grain yield. Similar data was observed by Goyal *et al* (2010) and Odyuo and Sharma (2020).

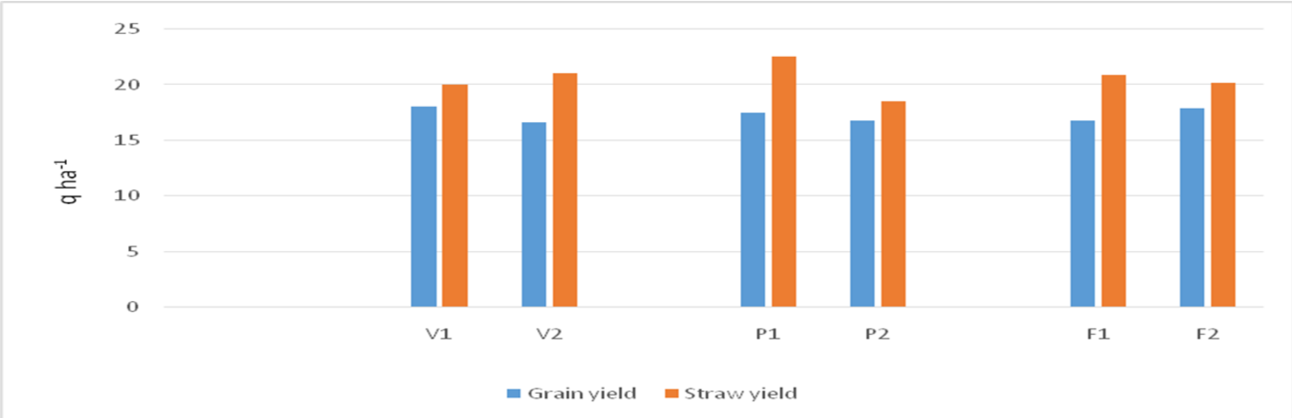

Fig 1: Effect of genotyps, plant density and fertility levels on yield of chickpea

It may be concluded from the results that the genotype PBG 7 gave higher growth, development and grain yield as compared to genotype GPF 2.Planting density of 30 × 10 cm proved more beneficial for maximum production of genotypes of chickpea.Higher fertility level was found suitable for highest yield of chickpea.Thus, chickpea crop fertilized with 30 kg N + 60 kg P_2O_5 + 30 kg K_2O + 20 kg S ha^{-1} and gram at spacing of 30 x 10 cm produced higher yield of grain and straw.

REFERENCES

Ahmed, A.G., Mohamed, M.H, Hassanein, M.S, Zaki, N.M, Habbasha, S.F.E, Tawifk, M.M. and Mohamed, M.F.(2015) Effect of water regime and potassium fertilization on productivity of two chickpea (*Cicer arietinum* L.) cultivars. *International Journal of Chemtech Research* **8**(4):1509-19.

Dhima, K,,Vasilakoglou, I,, Stefanou, S. and Eleftherohorinos, I. (2015) Effect of cultivar, irrigation and nitrogen fertilization on chickpea (*Cicerarietinum* L.) productivity. *Agricultural Sciences* **6**:1187-94.

Girma, A. (2013) Response of chickpea to different planting methods and planting densities under dryland condition. *Basic Research Journal of Agricultural Science* **2**(9):186-90.

G omez, K.A. and Gomez, A.A. (1984) Statistical procedures for Agricultural Research.Second Edition.John Willy & Sons, New York.

Goyal, S., Verma, H.D, and Nawange, D.D. (2010) Studies on growth and yield of kabuli chickpea (*Cicerarietinum* L.) genotypes under different plant densities and fertility levels. *Legume Research* **33**(3):221-23.

Kumar, H, Yadav, B.S., Singh, R, Yadav, D.D,, Chahal, V.P,, Yadav, R. and Yadav, O.S. (2018) Effect of potassium levels on performance of chickpea (*Cicerarietinum* L.) under different genotypes. *International Journal of Chemical Studies* **6**(6):1675-77.

Kumar, S., Khande, R.S,, Sonboir, H.L, Pande, N. and Bhambri, M.C. (2018) Effect of sowing time, spacing and nipping on growth and yield of chickpea (*Cicerarietinum* L.) under irrigated conditions. *International Journal of Chemical Studies* **6**(1):1218-22.

Nawange, D.D., Verma, H.D. and Verma, H. (2018) Growth and yield performance of kabuli chickpea (*Cicerarietinum* L.) genotype under different planting geometry and fertility levels in Vindhya Plateau Region. *International Journal of Agriculture Sciences* **10**(5):5291-93.

Prasad, D., Bangarwa, A.S,, Kumar, S. and Ram A. (2012) Effect of sowing dates and plant population on chickpea (*Cicerarietinum* L.) genotypes. *Indian Journal of Agronomy* **57**(2):206-08.

Odyuo, Z. R. and Sharma, Y.K., (2020) Response of green gram (*Vignaradiata*) to fertility levels in acid soil of Nagaland. *Annals of Plant and Soil Research* **22**(3): 296-300.