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Effect of different planting densities and fertility levels on growth and yield of chickpea (*Cicer arietinum* L.)

Kaushik Mohanta and Shikha Singh

Abstract
A field experiment was conducted to study the "Effect of different planting densities and fertility levels on growth and yield of chickpea (*Cicer arietinum* L.)" It was laid out during Rabi season 2020 on sandy loam textured soil at Central Crop Research Farm, Department of Agronomy, SHUATS, Allahabad, (U.P.). The treatments comprised of different plant spacing e.g. (30cm x 15cm,40cm x 15cm, 50cm x 15cm) and also different fertility levels (e.g. 40 kg of phosphorous/ha,50kg of phosphorous/ha and 60kg of phosphorous/ha). There were 9 treatments each replicated thrice. The experiment was laid out in Randomized Block Design with three replications. Results showed that the growth parameters e.g. plant height (49.61cm), number of primary branches per plant (8.27), Dry weight (14.42gm), CGR (5.72 g m-2 day-1), RGR (0.124g/g/day), nodules per plant (40.66) and yield attributes e.g. pods per plant (45.20), seeds per pod (1.27), seed index (29.16gm), grain yield (18.65q/ha), Straw yield (20.45q/ha) and harvest index(47.69%) were recorded maximum by the application of 40cm x 15cm + 60kg of phosphorous/ha. However, the gross return (₹1,05,340 /ha), net return (₹67,402.3 /ha) and B:C ratio of (1.77) were recorded higher with the application of 40cm x 15cm + 60 kg of phosphorous/ha.

Keywords: chickpea, phosphorus, planting density, yield

Introduction
Chickpea (*Cicer arietinum* L.) belongs to family Fabaceae was first domesticated in the middle east.it is widely cultivated in India, Australia, Pakistan, turkey, Myanmar, and Ethiopia. Bengal gram (*Cicer arietinum* L.) commonly known as "gram" or "chickpea" is most important and popular winter season pulse crop of India. Pulse crops have remained as a mainstay of Indian agriculture for centuries. Pulses occupy an indispensable place in our daily diet as a source of protein. pulses contain 20 to 25 percent proteins as against 8 to 15 percent in cereals. pulses occupy an important position in the agriculture economy of our country. It is well known that pulses are the best and cheap source of protein in human diet and especially for vegetarians. In India chickpea is a premier pulse crop grown on an area of 8.25 million ha during 2014-15, contributing 7.33million tonnes to national pulse basket with productivity of 889 kg per ha. This accounts for about 70% of total global are with 67% of global production (Anonymous 2016) [1]. The main chickpea production states are Madhya Pradesh, Rajasthan, Maharashtra, Andhra Pradesh and Uttar Pradesh. In Punjab it was grown on an area of 1.8 thousand hectares with total production of 1.90 thousand tonnes and yield of 1056 kg per ha during 2014- 15(Anonymous 2016) [1]. There is a big gap between demand and supply of pulses and this can be overcome by increasing the productivity of pulses. Diversified domestic, industrial and other uses of chickpea and its ability to grow better with low inputs under abrasive edaphic factors and arid environments make it an important component of the cropping system of subsistence farmers in the Indian subcontinent (Verma *et al.* 2013) [16]. Under good management conditions, chickpea fixes up to 141 kg N per ha. Chickpea production under a particular set of environmental conditions is influenced by various agronomic factors. Among them, plant density and fertilizer management are most important. The optimum plant density with proper geometry of planting is dependent on variety, its growth habit and agro climatic condition. Seed yield increases with increased plant density up to an optimum limit which changes according to genotypes. The inter and intra plant competition in plant plays a vital role in ultimate yield. Too high population leads to more competition for nutrients, moisture, light etc. and too low population may not exploit the available resources efficiently resulting in poor yield.

So, optimum plant population plays a chief role in obtaining maximum yields, Grain, straw yield and better protein content. Fertilizers is single most important input in modern agriculture to raise the productivity specially in dry areas because these are not thirsty but are also hungry. Among the primary nutrient element's Phosphorus nutrition is considered very important for oilseed and pulses. Phosphorus (P) is known to be one of the most important elements in plant nutrition after nitrogen (Nosheen and Shafique 2006) [11]. It is a key nutrient element required for high and sustained productivity of grain legumes (Madzivhandila *et al.* 2012) [9]. The significant effect of phosphorus on nodule development, plant height, branches per plant, pods per plant, grain yield and harvest index (HI) is well documented in chickpea (Singh *et al* 2010b, Gulpadiya and Chhonkar 2014) [5]. The enhanced root development and nodulation through application of phosphorus helps in improving the supply of nutrients and water to the growing parts resulting in more dry matter production in chickpea (Das *et al.* 2008, Islam *et al*. 2013a) [4, 6].

Materials and Methods

A field experiment entitled Effect of different planting densities and fertility levels on growth and yield of Chick Pea (*Cicer arietinum* L.) was conducted at Crop Research Farm, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj in Rabi season 2020 which is located at geographical coordinates 25° 24' 42" N latitude, 81° 50' 56" E longitude and 98 m altitude above the mean sea level. The experimental soil contained 0.51% medium organic carbon, low nitrogen (78.9 kg/ha), high in available phosphorus and potassium levels (32.88 kg/ha and. 385.10 kg/ha respectively) with pH 7.4. Treatments comprised of T1-(30cm x 15cm + 40 kg of 'P'/ha), T2-(30cm x 15cm + 50 kg of 'P'/ha),T3- (30cm x 15cm + 60 kg of 'P'/ha),T4-(40cm x 15cm + 40 kg of 'P'/ha), T5-(40cm x 15cm + 50 kg of 'P'/ha),T6-(40cm x 15cm + 60 kg of 'P'/ha),T7-(50cm x 15cm + 40 kg of 'P'/ha),T8- (50cm x 15cm + 50 kg of 'P'/ha),T9-(50cm x 15cm + 60 kg of 'P'/ha). The experiment was laid out in Randomized Block Design. The parameters *viz.*, plant height(cm), no. of primary branches per plant, dry weight (g/plant), crop growth rate (g/m2/day), relative growth rate (g/g/day), and no. of nodules per plant also the yield parameters *viz*., pods per plant, seed per pod, seed index(g), grain yield (q/ha), straw yield (q/ha) and harvest index with standard process were recorded data and statistically analysed with, Analysis of Variance (ANOVA) as applicable to Randomized Block Design (Gomez and Gomez., 1984).The expenses incurred for all the cultivation operations from preparatory tillage to harvesting including the cost of inputs *viz*., seeds, fertilizers, irrigation, etc. applied to each treatment was calculated on the basis of prevailing local charges. The gross realization in terms of rupees per hectare was worked out taking into consideration the seed and straw yields from each treatment and local market prices. Net return of each treatment was calculated by deducting the total cost of cultivation from the gross returns. The benefit: cost ratio (B:C) was calculated by dividing net return with total cost of cultivation. Statistical analysis of the individual data of various characters studied in the experiment was carried out using standard statistical procedures as described by. Standard error of mean, critical difference (C.D.) at 5 percent level of probability and coefficient of variance were worked out for the interpretation of the results.

Result and Discussion

Growth attributes

Data pertaining to growth parameters were recorded and depicted in Table 1. Significantly higher plant height (49.61cm) was observed with the application treatment T6-(40cm x 15cm
+ 60 kg of 'P'/ha), whereas T9-(50cm x 15cm + 60 kg of 'P'/ha) was found to be statistically at par with highest. Maximum no. of primary branches per plant (8.27) was observed with the application of treatment T6-(40cm x 15cm + 60 kg of 'P'/ha) whereas T3- 30cm x 15cm + 60 kg P/ha, T4- 40cm x 15cm + 40 kg P/ha, T5- 40cm x 15cm + 50 kg P/ha and T7- 50cm x 15cm + 40 kg P/ha were found to be statistically at par with highest. Significantly highest dry weight (14.42g/plant) was observed with the application of treatment T6-(40cm x 15cm + 60 kg of 'P'/ha), which was closely followed by T9 (50cm x 15cm + 60kg 'p'/ha). Similarly maximum Crop Growth Rate(2.34 g/m2/day) was observed with the application of T6-(40cm x 15cm + 60 kg of 'P'/ha), whereas T2-(30cm x 15cm + 50 kg of 'P'/ha) and T3-(30cm x 15cm + 60 kg of 'P'/ha) were statistically at par with highest. Maximum Relative Growth Rate (0.0117 g/g/day)was observed with the application of treatment T8-(50cm x 15cm + 60 kg of 'P'/ha) which was significantly superior over other treatments. Maximum no. of nodules per plant (40.66) was observed with the application of T6-(40cm x 15cm + 60 kg of 'P'/ha), whereas T4-(40cm x 15cm + 40 kg of 'P'/ha), T5-(40cm x 15cm + 50 kg of 'P'/ha), T7-(50cm x 15cm + 40 kg of 'P'/ha) and T8-(50cm x 15cm + 50 kg of 'P'/ha) were statistically at par with highest.

Increase in plant height, no. of primary branches per plant, dry weight and no. of nodules per plant might be due to combined application of Phosphorous along with maintaining proper plant density where Phosphorous is an essential nutrient both as a part of several key plant structure compounds and also as a catalyst in conversion of numerous key biochemical reactions in plant like photosynthesis, respiration, cell elongation, cell division, activation of Amino acid for synthesis of protein and carbohydrate metabolism, also helps in formation of energy rich phosphate bonds, phospholipids and development of root system and nodulation which contributed to increase in general health and vigour of plant. Phosphorous also important for its role in capturing and converting sun's energy into useful plant compounds. Phosphorous also associated with different metabolic activities that leads to better translocation of nutrients that leads to better expression of characters like increased stem strength, increased stalk and stimulated root development. With wider row spacing helped in reducing inter and intra plant competition thus helped in efficient utilization of solar radiation, nutrients and water which leads plants to better filling of available space by initiating branches. The study was in close conformity with Shukla *et al*. (2017) [12], Singh *et al*. (2014), Bandini *et al.* (2011), and Kamithi *et al.* (2009) [7]

Table 1: Effect of different planting densities and fertility levels on growth attributes of chickpea (*Cicer arietinum* L.)

Treatments	Plant height (cm)	No. of primary branches per plant	Dry weight (g/plant)	Crop growth rate(g/m2/day)	Relative growth rate (g/g/day)	No. of nodules per plant
T1- 30cm x 15cm + 40 kg P/ha	44.97	7.47	9.32	1.71	0.0093	37.55
T2- 30cm x 15cm + 50 kg P/ha	44.66	7.60	9.59	2.14	0.0113	38.00
T3- 30cm x 15cm + 60 kg P/ha	46.31	8.13	9.44	2.13	0.0113	38.44
T4- 40cm x 15cm + 40 kg P/ha	46.85	8.00	10.26	1.55	0.0103	39.44
T5- 40cm x 15cm + 50 kg P/ha	45.06	8.07	11.19	1.51	0.009	39.44
T6- 40cm x 15cm + 60 kg P/ha	49.61	8.27	14.42	2.34	0.011	40.66
T7- 50cm x 15cm + 40 kg P/ha	46.95	7.87	11.62	1.33	0.011	39.44
T8- 50cm x 15cm + 50 kg P/ha	46.41	7.60	11.55	1.60	0.0117	39.88
T9- 50cm x 15cm + 60 kg P/ha	47.43	7.60	11.61	1.59	0.0113	37.55
S.Em (+)	0.75	0.13	0.20	0.16	0.01	0.59
CD (0.05%)	2.24	0.40	0.59	0.48	0.02	1.76

Yield attributing characters and yield

Data related to yield attributes was recorded at harvest and presented in Table 2.The significantly highest numbers of pods per plant (45.20) was observed with the application of T6- 40cm x 15cm + 60 kg P/ha whereas, T9 was found to be statistically at par with T6.Significantly highest no. of seeds per pod (1.27) was recorded in T6 which was significantly superior over rest of the treatments. Highest seed index (28.38g) was recorded with the application of T6 whereas, T2,T3,T5,T7 AND T8 were found to be statistically at par with T6. Significantly maximum yield (18.65q/ha) was recorded in T6.Similarly maximum straw yield (20.45q/ha) was recorded in T6 which was significantly superior over all the treatments except T4,T5 and T8. Significantly higher harvest index was recorded in T6 whereas, T3,T5 and T7 were found to be statistically at par with T6.

The increase in yield might be due to effective utilization of applied nutrients along with maintaining proper plant density. The positive and significant improvement in Dry matter and nodulation noticed at different stages, increase in yield attributes due to application of phosphorous which contributed to the effective metabolic activities coupled with increased rate of photosynthesis, leading to better translocation of nutrients and better growth in plant which resulted in enhanced grain and straw yield. These results are also in agreement with findings of Chauhan and Raghav (2017) [3]. Phosphorous also contributed in increase stalk during vegetative stage and stem strength, root growth and development also promotes respiration, photo synthesis, Nucleic acid synthesis and act as a catalyst lead to faster growth and a greater allocation of biomass to the harvestable parts (Kruse *et al.* 2015) [8]. P supplement in legumes has great potential for promoting growth and higher yield, increases nodule number, as well as enhances symbiotic establishment for increased N-fixation .The increased in the availability of phosphorous to plant might have stimulated the metabolic and enzymatic activities thereby increasing the growth of the crop. Similar findings were also reported by (Singh *et al*. 2010). Wider plant spacing which intercepted more photosynthetically active radiation owing to better geometric situation resulted in vigorous plant growth, higher accumulation and assimilation food reserves and better source to sink relationship in wider spaced rows which might have adversely affected the pod development Similar findings were reported by Singh *et al.* (2010). It also reduced competition and higher availability of growth resources leading to more space available for plants, lesser competition for moisture and nutrients between plants, hence, better grain filling which ultimately affects the number of seeds per pod. Similar reports were also reported by Mondal (2000) [10] Wider row spacing plays an important role in reducing the competition for available space, light, water and nutrients, also helps in reduction of the population of weeds by occupying the area. It also contributed in increasing dry matter leads to increased biological yield. Similar findings were also reported by Shukla *et al*. (2017) [12].

Table 2: Effect of different planting densities and fertility levels on yield attributing characters and yield of Chickpea (*Cicer arietinum* L.)

Treatments	Pods Per plant	Seeds Per pod	Seed Index (gm)	Grain Yield (q/ha)	Straw Yield (q/ha)	Harvest Index (%)
T1- 30cm x 15cm + 40 kg P/ha	42.33	1.00	27.45	16.14	18.84	46.15
T2- 30cm x 15cm + 50 kg P/ha	39.80	1.00	28.88	15.46	18.32	45.72
T3- 30cm x 15cm + 60 kg P/ha	41.00	1.07	28.21	16.16	18.64	46.39
T4- 40cm x 15cm + 40 kg P/ha	39.87	1.07	27.76	16.25	19.53	45.38
T5- 40cm x 15cm + 50 kg P/ha	42.20	1.07	28.38	16.80	19.41	46.36
T6- 40cm x 15cm + 60 kg P/ha	45.20	1.27	29.16	18.65	20.45	47.69
T7- 50cm x 15cm + 40 kg P/ha	41.53	1.00	27.90	16.53	18.65	46.98
T8- 50cm x 15cm + 50 kg P/ha	41.80	1.07	28.45	16.54	19.91	45.37
T9-50cm x 15cm + 60kg p/ha	43.40	1.00	26.90	15.88	19.22	45.19
S.Em (+)	0.80	0.05	0.43	0.53	0.39	0.51
CD (P = 0.05)	2.39	0.15	1.29	1.60	1.18	1.52

Table 3: Effect of different planting densities and fertility levels on economics of Chickpea (*Cicer arietinum* L.)

Treatments	Cost of cultivation-1(INR ha)	Gross returns-1(INR ha)	Net returns-1(INR ha)	B:C Ratio
T1- 30cm x 15cm + 40 kg P/ha	35937.7	91,734	55796.3	1.55
T2- 30cm x 15cm + 50 kg P/ha	36937.7	88,006	51068.3	1.38
T3- 30cm x 15cm + 60 kg /ha	37937.7	91,736	53798.3	1.41
T4- 40cm x 15cm + 40 kg P/ha	35937.7	92,640	56702.3	1.57
T5- 40cm x 15cm + 50 kg P/ha	36937.7	95,385	58447.3	1.58

T6- 40cm x 15cm + 60 kg P/ha	37937.7	1,05,340	67402.3	1.77
T7- 50cm x 15cm + 40 kg P/ha	35937.7	93,628	57690.3	1.60
T8- 50cm x 15cm + 50 kg P/ha	36937.7	94309	57371.3	1.55
T9-50cm x 15cm + 60kg P/ha	37937.7	90598	52660.3	1.38

Economics

Highest gross return (105340 INR/ha) was obtained with the application of 40cm x 15cm + 60 kg of Phosphorous per ha along with Net return (67402.3 INR/ha) and Benefit: cost ratio (1.77).

Conclusion

On the basis of research result, it may be concluded that in Chickpea crop the application of 40cm x 15cm + 60kg phosphorous per ha is the suitable combination for obtaining better growth attributes like plant height, no. of primary branches per plant, dry weight, Crop growth rate, relative growth rate, no. of nodules per plant and higher yield attributes of chickpea like pods per plant, seed per plant, seed index, grain yield, straw yield, harvest index and can be recommended to the farmers of Prayagraj region for sustaining productivity and profitability of chickpea.

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References

1. Anonymous. Project Co-Ordinator's report. All India Coordinated Research Project on Chickpea, Indian Institute of Pulses Research, Kanpur 2016, 25-26.
2. Badini SA, Khan M, Baloch SU, Baloch SK, Baloch HN, Basir W. Effect of Phosphorus Levels on Growth and Yield of Chickpea (*Cicer aretinum* L.) Varieties. Journal of Natural Sciences Research 2015;5(3):169-176.
3. Chauhan SVS, Raghav BS. Effect of phosphorous and phosphate solubilizing bacteria on growth, yield and quality of chickpea (*Cicer aretinum* L.). Annals Plant Soil Research 2017;19(3):303-306
4. Das AK, Khaliq QA, Haque MM, Islam MS. Effect of phosphorus fertilization on dry matter accumulation, nodulation and yield in chickpea. Bangladesh Research Publication Journal 2008;1:47-60.
5. Gulpadiya VK, Chhonkar DS. Effect of phosphorus on growth, productivity and economics of chickpea varieties. Annals Plant Soil Research 2014;16:334-37.
6. Islam M, Akmal M, Khan MA. Effect of phosphorus and sulphur application on soil nutrient balance under chickpea (*Cicer arietinum* L.) monocropping. Romanian Agricultural Research 2013a;30:223-32.
7. Kamithi DK, Kibe AM, Akuja TE. Effects of nitrogen fertilizer and plant population on growth, yield and harvest index (HI) of chickpea (*Cicer arietinum* L.) under dryland conditions in Kenya. Journal of Applied Biosciences 2009;22:1359-1367.
8. Kruse J, Abraham M, Amelung W, Baum C, Bol R, Kühn O *et al*. Innovative methods in soil phosphorus research: a review. Journal of Plant Nutrient and Soil Science 2015;178:43-88
9. Madzivhandila T, Ogola JBO, Odhiambo JJO. Growth and yield response of four chickpea cultivars to phosphorus fertilizer rates. Journal of Food Agriculture and Environment 2012;10:451-55.
10. Mondal S. Response of chickpea (*Cicer arietinum* L.) varieties to dates of sowing and row spacing under late sown condition. M.Sc. (Agronomy) Thesis, G.B. Pant University of agriculture and technology, Pantnagar, 2000.
11. Nosheen F, Shafique Nosheen. Effect of phosphorus application on the growth and nodulation of inoculated chickpea (*Cicer arietinum* L.). Pakistan Journal of Agricultural Research 2006;19:65-69.
12. Shukla RD, Singh A, Verma S, Singh AK, Dubey D, Kumar S. Effect of crop geometry and phosphorus levels on growth and productivity of chickpea (*Cicer arietinum* L.) Journal of Pharmacognosy and Phytochemistry. 2017;6(5):659-661.
13. Singh G, Sekhon HS, Ram H, Sharma P. Effect of farmyard manure, phosphorus and phosphate solubilizing bacteria on nodulation, growth and yield of Kabuli chickpea. Journal of Food Legumes 2010b;23:226-29.
14. Singh G, Sekhon HS, Ram H, Sharma P. Effect of farmyard manure, phosphorus and phosphate solubilizing bacteria on nodulation, growth and yield of kabuli chickpea. Journal of Food Legumes 2010;23:226-229.
15. Singh R, Pratap T, Singh D, Singh G, Singh AK. Effect of phosphorous, Sulphur and biofertilizers on growth attributes and yield of chickpea (*Cicer arietinum* L.). Journal of Pharmacognosy and Phytochemistry 2018;7(2):3871-3875.
16. Verma JP, Yadav J, Tiwari KN, Kumar A. Effect of indigenous Mesorhizobium sp. and plant growth promoting rhizobacteria on yield and nutrient uptake of chickpea (*Cicer arietinum* L.). Ecological Engineering 2013;51:282-86.