Vol.11 No. 2, Page No. 93–100 (2022)
Received: November, 2022; Accepted: December, 2022

Effect of Crop Geometry and Varieties on Yield Attributes and Yield of Chickpea (*Cicer arietinum* L.)

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Abstract

Field experiment was conducted at JNKVV, College of Agriculture, Tikamgarh (Madhya Pradesh) during rabi 2020-21 to study the effect of crop geometry and varieties on yield attributes and yield of chickpea. The experiment was conducted in split-plot design with three replications and comprised of four crop geometry viz., G1: 30x10 cm, G2: 45x10 cm, G3: 30x15 cm and G4: 45x15 cm as main plot treatments and three cultivars viz., V1: JG-12, V2: JG-36 and V3: RVG 201 as sub-plot treatments. Results revealed that crop sown with crop geometry of 45x15cm resulted into significantly more numbers of pods (103.6 plant^{-1}) and 100-seed weight (21.0 g) and the lowest with 30x10cm (89.3 plant^{-1} and 18.0 g, respectively) crop geometry. Similarly, the significantly higher seed yield (2265 kg ha^{-1}), straw yield (3894 kg ha^{-1}), biological yield (6159 kg ha^{-1}) were also recorded with crop geometry of 30x10cm and the lowest (1909 kg ha^{-1}, 3008 kg ha^{-1} and 4917 kg ha^{-1}, respectively) with crop geometry of 45x15cm . Among varieties, cv. RVG-201 produced significantly more number of pods (104.2 plant^{-1}) and seed index (20.9g) followed by cv. JG-36 (95.8 plant^{-1} and 18.9g, respectively) and the lowest in cv. JG-12 (90.7 plant^{-1} and 17.7g, respectively). The significantly higher seed yield (2410 kg ha^{-1}), straw yield (3635 kg ha^{-1}), biological yield (6045 kg ha^{-1}) were also recorded with cv. RVG-201 and significantly the lowest in cv. JG-12 (1845 kg ha^{-1}, 3115 kg ha^{-1} and 4960 kg ha^{-1}, respectively). Cultivar RVG-201 recorded 24.1% and 30.6% higher seed yield over cvs. JG-36 and JG-12, respectively. The interaction effect between crop geometry of 30x10cm with cv. RVG-201 was found superior over rest of the combination for seed yield with an increase in seed yield by 28.8% to 78.8% over rest of the combinations.

Key words: *chickpea, crop geometry, yield, yield attributes, varieties*

Introduction

Chickpea (*Cicer arietinum* L.) belongs to family Leguminoceae, sub family Papilionaceae and originated from Southwest Asia. It is one of the most chief pulse crop grown in semi-arid and tropical climate. It is the second-most main pulse crop after pigeon pea in the humankind for diet and other use. It is also an important winter season pulse crop in India grown as a dry pulse crop or as a green vegetable with the former use being most common. Due to economical and high protein content, it is one of favorite pulse of weaker class of the societies in the developing world[17]. Its seed is having high protein content (23%), rich in carbohydrates (47%), starch (6%), ash (3%), fat (5%) and 6.0% crude fiber[7]. India is the leading producer of chickpea in the world giving out 65% area and 70% of total global production. India is the principle chickpea producing country in the world with a total production of 10.13 million tonnes and cultivated area of 9.44 million hectare with an average yield of 1073 kg ha^{-1}. In Madhya Pradesh, it is cultivated over an area of 3.43 million hectare and total production of 4.61

million tonnes with an average yield of 1344 kg ha^{-1}.

Among different agronomic managing practices *viz*., crop geometry and use of different varieties contributing to higher yield[1]. Plant spacing in the field is very important factor to smooth the progress of aeration and light penetration into plant canopy for optimizing rate of photosynthesis. Increases in geometry decreases the total population, but with extra nutrition to the individual plant grows healthier and yield more and vice-verse. It is reported that row spacing of 45 cm increased chickpea yield compared to 30 cm and 50 cm spacing while others indicated that row spacing had no significant effect on seed yield[13]. The grain yield of chickpea is greatly dependent on plant population. The optimum row spacing with suitable geometry of planting is dependent on variety, its growth habit and agro-climatic situation[7]. Grain yield increases with decreased crop geometry up to an optimum limit which changes according to genotypes[2]. Keeping these facts in view, an experiment was conducted to study the effect of crop geometry on yield attributes and yield of chickpea varieties.

Materials and Method

Field experiment was conducted at Agronomy Research Area, J.N.K.V.V., College of Agriculture, Tikamgarh, Madhya Pradesh (24° 43' N latitude and 78° 49' E longitude at an altitude of 358m above mean sea level) during *rabi* 2020-21. The experimental site is of sub-tropical climate characterized by hot dry summers and cool dry winter lies in the Bundelkhand Zone (Agro-climatic Zone-VIII). The soil of experimental field was medium to deep black and clayey loam in texture having pH 7.1, EC 0.12 dS m^{-1}, organic carbon 0.5%, available N 265 kg ha^{-1}, available P_2O_5 26 kg ha^{-1} and available K_2O 260 kg ha^{-1}. The average annual rainfall of this region is about 1000 mm, which is mostly received between June to September and a little rainfall of 90 mm is also obtained during October to May. The average temperature ranges between 4.5°C to 45°C. The experiment was conducted in split-plot design with three replications and comprised of four crop geometry *viz*., G1: 30x10 cm, G2: 45x10 cm, G3: 30x15 cm and G4: 45x15 cm as main plot treatments and three cultivars *viz*., V1: JG-12, V2: JG-36 and V3: RVG 201 as sub-plot treatments. The full recommended doses of nitrogen (20 Kg N ha^{-1}), phosphorus (40 Kg P_2O_5 ha^{-1}) and potassium (20 kg K_2O ha^{-1}) were applied at sowing. The chickpea crop was sown in lines 30 cm apart using a seed rate of 80 kg ha^{-1}. All other agronomic and plant protection measures were applied as per recommendations. Yield attributes were recorded from the five plants sample collected at the time of harvest. The crop harvested from net plot area was threshed after 4-5 days of sun drying and the seed yield of net plot was then converted into kg ha^{-1}. Before threshing of the crop harvested from net plot, the sun dried whole plant samples were weighed and then converted into kg ha^{-1} to obtain biological yield. Straw yield is obtained by subtracting seed yield (kg ha^{-1}) from biological yield (kg ha^{-1}). The results were analyzed statistically to draw suitable inference as per standard ANOVA technique[6].

Results and discussion

Effect of crop geometry on yield attributes and yield

Data pertaining to yield attributes (Table 1) and seed yield (Table 2) was significantly influenced due to different crop geometry except number of seeds pod^{-1}. Crop sown with crop geometry of 45x15cm resulted into significantly more numbers of pods (103.6 plant^{-1}) and 100-seed weight (21.0 g) followed by 45x10cm (98.5 plant^{-1} and 19.0 g, respectively), 30x15cm (96.3 plant^{-1} and 18.7 g, respectively) and the lowest yield attributes with 30x10cm (89.3 plant^{-1} and 18.0 g, respectively) crop geometry. This was ascribed mainly due to the increase in assimilate supply to the individual plant due to more free space of ground area, adequate moisture, nutrients availability and sunlight for better overall growth in sparse spaced plant geometry than dense crop geometry. These results corroborate the findings of other workers in chickpea[1,9]. However, number of pod plant^{-1} and seed index (g) did not differ significantly among 30x10cm, 45x10cm and 30x15cm crop geometries. Similar results were also reported by other worker in chickpea[2].

Table 1 Effect of crop geometry and varieties on yield attributes of chickpea

Treatments	**Number pods plant^{-1}**	**Number seeds pod^{-1}**	**Seed index (g)**
Crop geometry			
G1 : 30x10cm	89.3	1.73	18.0
G2 : 45x10cm	98.5	1.60	19.0
G3 : 30x15cm	96.3	1.76	18.7
G4 : 45x15cm	103.6	2.06	21.0
S.Em ±	2.68	0.12 3	0.5
CD (P=0.05)	9.28	NS	1.83
Varieties			
V1 : JG-12	90.7	1.59	17.7
V2 : JG-36	95.8	1.75	18.9
V3 : RVG-201	104.2	2.03	20.9
S.Em ±	1.84	1.22	0.36
CD (P=0.05)	5.52	NS	1.08
Interaction (crop geometry x variety)			
G1V1	82.9	1.40	16.7
G1V2	84.7	1.73	17.0
G1V3	100	2.07	20.3
G2V1	92.7	1.53	17.6
G2V2	102	1.53	20.2

G2V3	100	1.73	19.1
G3V1	93.8	1.49	17.9
G3V2	97.3	1.73	17.9
G3V3	97.7	2.07	20.1
G4V1	93.3	1.93	18.7
G4V2	98.7	1.99	20.3
G4V3	119	2.27	24.0
S.Em ±	3.69	0.24	0.72
CD (P=0.05)	11.1	NS	2.15

Table 2 Effect of crop geometry and varieties on yield of chickpea

Treatments	Seed yield (kg ha^{-1})	Biological yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Harvest index (%)
Crop geometry				
G1 : 30x10cm	2265	6159	3894	36.6
G2 : 45x10cm	1989	5143	3154	38.7
G3 : 30x15cm	2100	5794	3693	36.7
G4 : 45x15cm	1909	4917	3008	38.8
S.Em ±	47.5	104.2	82.2	0.55
CD (P=0.05)	164.5	360.7	284.6	1.91
Varieties				
V1 : JG-12	1845	4960	3115	37.3
V2 : JG-36	1942	5504	3562	36.0
V3 : RVG-201	2410	6045	3635	36.9
S.Em ±	51.9	81.2	85.1	0.98
CD (P=0.05)	155.9	243.4	255.2	NS
Interaction (crop geometry x variety)				
G1V1	2019	5601	3583	36.0
G1V2	1812	6283	4471	28.9
G1V3	2964	6593	3629	45.0
G2V1	1661	4755	3039	34.9
G2V2	2004	4674	2670	42.9
G2V3	2301	5997	3699	38.3
G3V1	2041	4829	2788	42.4
G3V2	1994	6006	4012	33.2

G3V3	2265	6545	4280	34.6
G4V1	1658	4655	2997	35.8
G4V2	1957	5052	3095	38.9
G4V3	2111	5045	2934	41.8
S.Em ±	103.9	162.3	170.2	1.97
CD (P=0.05)	311.8	486.7	510.4	5.90

The significantly higher seed yield (2265 kg ha^{-1}), straw yield (3894 kg ha^{-1}), biological yield (6159 kg ha^{-1}) were recorded with crop geometry of 30x10cm followed by 30x15cm (2100 kg ha^{-1}, 3693 kgha^{-1} and 5794, respectively), 45x10cm (1989 kg ha^{-1}, 3154 kg ha^{-1} and 5143 kg ha^{-1}, respectively) and the lowest (1909 kg ha^{-1}, 3008 kg ha^{-1} and 4917 kg ha^{-1}, respectively) with crop geometry of 45x15cm . The significantly highest grain yield (kg ha^{-1}) under dense crop geometry (30x10cm) compared to sparse spaced crop geometry (45x15cm) could be due to more plant population per unit area in dense crop geometry. On the other hand, the significantly lowest seed yield (kgha^{-1}) under sparse crop geometry might be attributed due to the fact that significantly higher number of pods plant^{-1} and seed index (100 seeds weight) under sparse spacing could not compensate the yield loss due to less plant population. Similar results have also been reported by other workers in chickpea[18,14,11,1,12].

The significantly highest harvest index was recorded in sparse spaced crop geometry (45x15cm) compared to dense crop geometry (30x10cm). Similar variation in harvest index with different crop geometry was also reported by other workers[9]. They reported highest harvest index from the sparse spaced crop geometry of chickpea than dense crop geometry.

Effect of varieties on yield attributes and yield

Among varieties, *cv*. RVG-201 produced significantly more number of pods (104.2 plant^{-1}) and seed index (20.9g) followed by *cv*. JG-36 (95.8 plant^{-1} and 18.9g, respectively) and the lowest in *cv*. JG-12 (90.7 plant^{-1} and 17.7g, respectively). However, number of pods plant^{-1} and seed index (g) did not differ significantly between *cvs*. JG-12 and JG-36. Similarly, number of seeds pod^{-1} was also not differed significantly among different varieties (Table 1). The differences in yield attributing characters of these varieties could be attributed to their genetic constitution. The differences in yield attributes of different chickpea varieties had also been well documented by other workers in chickpea[3].

The significantly higher seed yield (2410 kg ha^{-1}), straw yield (3635 kg ha^{-1}), biological yield (6045 kg ha^{-1}) were recorded with *cv*. RVG-201 followed by *cv*. JG-36 (1942 kg ha^{-1}, 3562 kg ha^{-1} and 5504, respectively) and significantly the lowest in *cv*. JG-12 (1845 kg ha^{-1}, 3115 kg ha^{-1} and 4960 kg ha^{-1}, respectively). However, seed yield (kg ha^{-1}) did not differ significantly between *cvs*. JG-12 and JG-36. The higher seed yield in *cv*. RVG-201 might be due to more number of pods plant^{-1} and seed index. This was in agreement with results of other workers[15]. Cultivar RVG-201 recorded 24.1% and 30.6% higher seed yield over *cvs*. JG-36 and JG-12, respectively. The significantly lowest grain yield (kg ha^{-1}) in *cv*. JG-12 might be due to minimum number of pods plant^{-1} and lower seed index. The varietal differences in seed yield of chickpea had also been reported by other workers[3,16]. The harvest index among different varieties was found non-significant but numerically higher harvest index was recorded with variety JG-12 than RVG-201 and JG-36. The varietal differences in harvest index had also been reported by other workers[3,15]. The harvest index among different varieties was found non-significant but numerically higher harvest index was recorded with variety JG-12 than RVG-201 and JG-36.

Interaction effect on yield attributes and yield

The significantly more number of pod plant-1 and seed index (100 seeds weight) were recorded with interaction of sparse spaced crop geometry (45x15cm) with variety RVG-201 and the minimum under in interaction of dense crop geometry (30x10cm) with variety JG-12. This was ascribed mainly due to the increase in assimilate supply to the individual plant due to more free space of ground area, adequate moisture, nutrients availability and sunlight for better overall growth in sparse spaced plant geometry than dense crop geometry and the differences in yield attributing characters of these varieties could be attributed to their genetic constitution. However, number of seed pod^{-1} did not differ significantly due to different interaction as also been reported by other workers[17,8].

The significantly highest grain yield (kg ha^{-1}) under the interaction of dense crop geometry (30x10cm) with variety RVG-201 compared to interaction of sparse spaced crop geometry (45x15cm) with variety JG-12 could be due to more plant population per unit area in dense crop geometry and the differences in yield attributing characters of these varieties could be attributed to their genetic constitution[17]. The significantly highest biological yield (kg ha^{-1}) straw yield (kg ha^{-1}) were recorded with interaction of dense crop geometry (30x10cm) with variety RVG-201 compared to interaction of sparse spaced crop geometry (45x15cm) with variety JG-12. It might be due to the fact that dense crop geometry had the significantly more plant population per unit area and the differences in yield attributing characters of these varieties could be attributed to their genetic constitution[17].

The significantly highest harvest index was recorded with interaction of sparse spaced crop geometry (45x15cm) with variety RVG-201 compared to interaction of dense crop geometry (30x10cm) with variety JG-12. Similar results have also been reported by other workers[17,8,4].

Conclusion

Present investigation concluded that crop geometry of 45x15cm recorded significantly improved yield attribute over 45x10cm, 30x15cm and 30x10cm respectively in chickpea varieties. However, crop geometry of 30x10cm recorded significantly higher seed yield over 45x10cm, 30x15cm and 45x15cm, respectively in chickpea varieties. Crop geometry of 30x10cm increased the seed yield (kg ha^{-1}) by 7.85%, 13.9% and 18.6% over 45x10cm, 30x15cm and 45x15cm, respectively. Among chickpea varieties, RVG-201 was found significantly superior over other varieties and variety RVG-201 increased the seed yield (kg ha^{-1}) by 24.1% and 30.6% over JG-36 and JG-12, respectively. The interaction effect between crop geometry of 30x10cm with *cv.* RVG-201 was found superior over rest of the combination for seed yield with an increase in seed yield by 28.8% to 78.8% over rest of the combinations.

References

1. Bavalgave, V.G., Gokhale, D.N., Waghmar, M.S.E. and Jadhav, V.P.J. (2009). Growth and yield of Kabuli chickpea varieties as influenced by different spacing. *International Journal of agriculture science*, 5(1): 115-119.
2. Biabani, A. (2011). Effects of plant density on yield and yield component of chickpea (*Cicer arietinum* L.) grown under environmental condition of Golestan, Iran. *Journal of Agricultural Science and technology*, 5:32-33
3. Chaitanya, S.K. and Chandrika, V. (2006). Performance of chickpea varieties under varied dates of sowing in Chittoor district of Andhra Pradesh. *Legume Research,* 29(2): 137-139.
4. Chala, B., Abera, T. and Nandeshwar, B. (2020). Influence of Inter and Intra Row Spacing on Yield and Yield Components of Chickpea (*Cicer arietinum* L.) in Jimma Horro District, Western Ethiopia. *International Journal of Plant & Soil Science,* 32(15): 32-42.
5. Gallani, R. Dighe, Sharma, J.M. and Sharma, P.K. (2005). Relative performance of different chickpea (*Cicer arietinm* L.) genotypes grown on vertisols. *Research on Crops,* 6(2): 211-213.
6. Gomez, K.A. and Gomez, A.A. (1984). Statistical Procedures for Agriculture Research. 2nd Edition. *A Wiley Inter-Science Publication, New York (USA).*
7. Gour, P.M., Mula, Myer and Gozales, Farnando. (2010). Chickpea seed production manual. *International Crops Research Institute for the semi-arid Tropics, Patancheru* 502324, 17: 2-4.
8. Kena, H. (2018). Effect of inter row spacing on yield components and yield of Soybean (*Glycine Max* L. Merrill) varieties in Dale Sedi District, Western Ethiopia. *Agricultural Research & Technology Open Access Journal*, 2471-6774.
9. Khan, E.A., Aslam, M., Ahmad, H.K., Ayaz, M. and Hussain, A. (2010). Effect of row spacing and seeding rates on growth yield and yield components of chickpea. *Sarhad Journal of Agriculture,* 26(2): 201-211.
10. Kumar, S. and Kadian, V.S. (2006). Response of chickpea genotypes to planting and fertility levels. *National Journal of plant Improvement,* 8(1): 58-61.
11. Mahapatra, A.K., Paikaray, R.K., Mishra, R.C. and Mohapatra, A.K.B.

(1995). Response of chickpea to row spacing nitrogen and phosphorus in acid red soils. *International Journal of Chickpea and Pigeonpea Newslett,* 2:25-26.

12. Munirathnam, P., Ashok, K.K., Jayalakshmi, V. and Padmalatha, Y. (2015). Suitability of chickpea 'NBeG 47' for mechanical harvesting under rainfed condition. *Journal of Food Legumes,* 28(2): 1-3.
13. Parihar, S.S. (1996). The effect of row and plant spacing on growth and yield of chickpea. *Indian Journal of Agronomy,* 41(4): 604-607.
14. Pawar, H.K. and Wasnik, D.D. (1991). Effects of spacing and varieties on growth and yield of gram. *Journal of Maharashtra Agriculture University,* 16: 289-290.
15. Shamsi, K. (2010). The effect of sowing date and row spacing on yield and yield components on Hashem chickpea variety under rainfed condition. *African Journal of Biotechnology,* 9(1): 007-011.
16. Sharma, K.K., Mathur, B.P., Jayanand, B. (2003). Chickpea (*Cicer arietinum* L.) Methods in molecular biology. *Agrobacterium protocols*, second edition. 10.1385/1-59745- 130-4: 313.
17. Shiferaw, M., Tamado, T. and Asnake, F. (2018). Effect of Plant Density on Yield Components and Yield of Kabuli Chickpea (*Cicer arietinum* L.) Varieties at Debre Zeit, Central Ethiopia. *International Journal of Plant & Soil Science,* 21(6): 1-6.
18. Veeranna, V.S., Shanthamauaish, N.R. and Patil, M.S. (1980). Close spacing of Bengal gram increase yield. *Current Research,* 9(6): 95-98.