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Performance of Pigeonpea (*Cajanus cajan.* L) Varieties under Different Spacings During Rabi Season

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Authors' contributions

This work was carried out in collaboration among all authors. Author KIR designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors AVR and MVNK managed the analyses of the study. Authors CVSK and MVR managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

An experiment was conducted with the objective of ascertaining the feasibility of cultivation of pigeonpea during *rabi* season in the alfisols of Southern Telangana Zone. Further, it was designed to understand the performance of pigeonpea genotypes at various plant densities and also the economics of pigeonpea cultivation during *rabi* season. It consisted of 12 treatments with four plant densities in main plots and three genotypes in sub plots in split plot design. The pooled data of 2015-16 and 2016-17 revealed that significantly higher seed yield (1532 kg ha^{-1}) was recorded at plant density of 60 cm × 10 cm spacing than at 45cm × 10cm (1332 kg/ha), 75 cm × 10 cm (1321 kg/ha) and 90 cm × 10 cm (1141 kg/ha). Among the genotypes, the seed yield in PRG-158 (1547 kg/ha) and Asha (ICPL 87119) (1591 kg/ha) was on par with each other but significantly higher than

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in PRG-176 (857 kg/ha). The higher gross returns (Rs. 77366 ha^{-1}), net returns (Rs.46733 ha^{-1}) and benefit cost ratio (2.53) was recorded at plant density of 60 cm × 10 cm spacing than at other tested plant densities (45 cm × 10 cm, 75 cm × 10 cm and 90 cm × 10 cm). Among the genotypes, Asha (ICPL 87119) registered highest gross returns (Rs. 80346 ha^{-1}), net returns (Rs.49711 ha^{-1}) and benefit cost ratio (2.62) followed by PRG-158 (gross returns of Rs. 78124ha^{-1}, net returns of Rs.47489 ha^{-1} and benefit cost ratio of 2.55) and PRG-176 (gross returns of Rs. 43279ha^{-1}, net returns of Rs.13144 ha^{-1} and benefit cost ratio of 1.44). Thus, the spacing of 60 cm × 10 cm is recommended for the cultivation of pigeonpea during *rabi* season in alfisols of Southern Telangana Zone with long duration varieties like PRG-158 and Asha (ICPL-87119).

Keywords: Alfisols; genotypes; plant density; rabi pigeonpea.

1. INTRODUCTION

Pigeonpea (*Cajanus cajan.* L) is one of the most important pulse crop of India occupying an area of 5.58 m.ha (55,83,059 hectares) and with production of 4.29 m. tonne (42,90,000 tonnes) with an yield of 768 kg ha^{-1} [1]. Pigeonpea contributes a major share in pulses providing the nutritional security of the people. However, the production of pigeonpea is insufficient for consumption and thus 2.97 m.tonnes (29,75,367 tonnes) of pulses imported annually [2]. Thus, the increase in the production of pigeonpea would benefit the national economy and also provide the food security to the nation. Hence, in view to increase the pigeonpea production, cultivation of pigeonpea during *rabi* season is a good option and that would contribute substantial production. But there are research gaps in confirming the suitable variety and plant geometry for profitable cultivation of pigeonpea with optimum yield. So this experiment was conducted to study the suitable plant geometry of three popular pigeonpea varieties in Telangana State of India.

2. MATERIALS AND METHODS

A field experiment was conducted for two years during *rabi* 2015-16 and 2016-17 at Regional Agricultural Research Station, Palem, Nagarkurnool district of Telangana state--509215 (India). It was consisted of 12 treatments with four plant densities S1- 45 cm × 10 cm, S2- 60 cm × 10 cm, S3- 75 cm × 10 cm and S4- 90 cm × 10 cm in main plots and three genotypes V1- PRG-158, V2- PRG-176 and V3- Asha (ICPL-87119) in subplots. The experiment was laid out in split plot design and replicated thrice. The experimental site is located at 16.51703° North latitude and 78.2469° East longitude and an altitude of 642 m above mean sea level. The soil at the site was Alfisol with low organic carbon (0.24%) and N (210 kg ha^{-1}), high in available P (75 kg P_2O_5 ha^{-1}) and available K (455 kg K_2O ha^{-1}). The crop was irrigated at every 10 to 15 days interval based on feel and appearance of soil moisture estimation method. The crop was sown on 14th October, 2015 and 14th October, 2016 by dibbling method. Pendimethalin herbicide was sprayed within 48 hours after sowing. Hand weeding was done and kept weed free upto 60 days after sowing. Gross plot size of 9 m × 3 m was maintained for each treatment. Nitrogen dose of 20 kg N $ha^{-1}$and 50 kg P_2O_5 ha^{-1} was applied as basal dose. Both nitrogen and phosphorus were applied to the crop through DAP (Diammonium Phosphate). The data was collected on five tagged plants in each plot of each treatment. Observations on growth, yield and yield components i.e., plant height (cm), plant population hectare $^{-1}$, number of pods plant $^{-1}$, seed weight plant^{-1} (g), 100 seed weight (g), seed yield (kg ha^{-1}), stalk yield (kg ha^{-1}) were recorded and harvest index (HI) was estimated as per the formula suggested by Donald [3] and expressed as percentage. The data recorded for different characters under investigation were analyzed by following analysis of variance procedure as described by Gomez and Gomez [4]. The Benefit Cost (B:C) ratio was calculated by using the cost of cultivation, gross returns and net returns.

3. RESULTS AND DISCUSSION

3.1 Effect of Plant Densities and Varieties on Growth, Yield Attributes and Yield of Pigeonpea During *Rabi* Season

On analysis of pooled data of 2 years (2015-16 and 2016-17), the results in Table 1 revealed that plant height was not significantly influenced by the spacings but among the varieties, plant height of V1 (PRG-158) (85.5 cm) and V3 (Asha) (83.3 cm) was significantly higher than the V2

(PRG-176) (65.1 cm) and on par with each other. On the other hand, plant population was significantly influenced by the spacings and varieties. Significantly higher plant population was recorded in S1 (45 cm × 10 cm) (1,69,012 plants/ha) than the other spacings. However, S2 (60 cm × 10 cm) (1,40,494 plants/ha), S3 (75 cm × 10 cm) (1,33,827 plants/ha) and S4 (90 cm × 10 cm) (1,27,448 plants/ha) were on par with each other. Further, the plant population establishment was lower in S1 (45 cm × 10 cm) (1,69,012 plants/ha) and S2 (60 cm × 10 cm) (1,40,494 plants/ha) due to the very high density among the plants and thus the plants could not put forth the branches and flowering.

Number of pods per plant was significantly higher in S2 (156.7 pods/plant) than in S4 (106.6 pods/plant) but on par with S1 (120.9 pods/plant) and S3 (134.3 pods/plant). Among the varieties number of pod per plant in V1 (PRG-158) (124.3 pods/plant) and V3 (Asha) (157.9 pods/plant) was significantly superior over the V2 (PRG-176) (106.4 pods/plant). Variation in number of pods plant-1 might be due to genetic nature of varieties. Similar observations have also been recorded by Kashyap et al. [5], Tikle and Gupta [6], Birendra et al. [7].

Seed weight per plant was not significantly influenced under the plant geometry of four spacings and the similar findings were reported by Parameswari et al. [8]. Among the varieties, seed weight per plant in V1 (PRG-158) (31.8 g/plant) was significantly higher than V2 (PRG-176) (20.2 g/plant) and V3 (Asha) (30.6 g/plant).

The results in Table 2 revealed that 100 seed weight was not significantly influenced under the plant geometry of four spacings and the finding was in accordance with that of Islam et al. [9] and Parameswari et al. [8]. Among the varieties, V3 (Asha) (10.3 g) was significantly higher than V2 (PRG-176) (9.2 g) and on par with V1 (PRG-158) (10.0 g). There was no significant interaction between the effects of planting geometry and genotypes on the yield attributes of pigeonpea.

During *rabi,* 2015-16, highest seed yield was recorded under S2 (60 cm × 10 cm) (1302 kg/ha) and it was significantly higher than S4 (90 cm × 10 cm) (663 kg/ha) but on par with S1 (45cm × 10cm) (1137 kg/ha) and S3 (75 cm × 10 cm) (1158 kg/ha). Among the genotypes, the seed yield in V1 (PRG-158) (1206 kg/ha) and V3 (Asha) (1209 kg/ha) was on par with each other but significantly higher than V2 (PRG-176) (780 kg/ha). During *rabi*, 2016-17, highest seed yield was recorded under S2 (60 cm × 10 cm) (1762 kg/ha) and it was significantly higher than S1 (45 cm × 10 cm) (1528 kg/ha), S3 (75 cm × 10 cm) (1485 kg/ha) and S4 (90 cm × 10 cm) (1619 kg/ha). Similarly, among the genotypes, the seed yield in V1 (PRG-158) (1888 kg/ha) and V3 (Asha) (1972 kg/ha) was on par with each other but significantly higher than V2 (PRG-176) (935 kg/ha).

Table 1. Effect of plant densities and varieties on plant height at harvest, plant population, number of pods/plant and Pod weight of pigeonpea during *rabi* season (Pooled data of 2015-16 and 2016-17)

Treatments	Plant height at harvest (cm)	Plant Population/ha	Number of pods/plant	Seed weight (g)/plant
Spacing				
S1-45cm × 10cm	77.5	169012	120.9	27.5
S2-60cm × 10cm	82.4	140494	156.7	27.1
S3-75cm × 10cm	78.0	133827	134.3	27.8
S4-90cm × 10cm	73.9	127448	106.6	27.8
SEm±	3.2	6669	15.0	0.6
CD (0.05)	NS	23016	49.3	NS
Varieties				
V1- PRG-158	85.5	141790	124.3	31.8
V2- PRG-176	65.1	156204	106.4	20.2
V3- Asha (ICPL 87119)	83.3	130092	157.9	30.6
SEm±	2.6	3855	17.2	0.4
CD (0.05)	8.1	11559	50.4	0.9
A * B	NS	NS	NS	NS
B * A	NS	NS	NS	NS

Table 2. Effect of plant densities and varieties on 100 seed weight, seed yield, stalk yield and harvest index of pigeonpea during *rabi* season (Pooled data of 2015-16 and 2016-17)

	100 seed weight (g)	Seed yield (kg/ha)			Stalk yield (kg/ha)	Harvest Index (%)
Spacing		**2015**	**2016**	**Pooled**		
S1-45cm × 10cm	9.7	1137	1528	1332	2449	35.23
S2-60cm × 10cm	9.8	1302	1762	1532	2571	36.96
S3-75cm × 10cm	9.9	1158	1485	1321	2344	35.97
S4-90cm × 10cm	10.0	663	1619	1141	1931	36.40
SEm±	0.3	76	35	46	135	1.20
CD (0.05)	NS	261	121	142	336	NS
Varieties						
V1- PRG-158	10.0	1206	1888	1547	2884	34.74
V2- PRG-176	9.2	780	935	857	1842	32.85
V3- Asha (ICPL 87119)	10.3	1209	1972	1591	2245	40.83
SEm±	0.1	81	47	52	124	1.06
CD (0.05)	0.3	242	142	163	264	2.28
A * B	NS	NS	NS	NS	NS	NS
B * A	NS	NS	NS	NS	NS	NS

From the pooled data of 2015-16 and 2016-17, it was found that highest seed yield was recorded under S2 (60 cm × 10 cm) (1532 kg/ha) and it was significantly higher than S1 (45 cm × 10 cm) (1332 kg/ha), S3 (75 cm × 10 cm) (1321 kg/ha) and S4 (90 cm × 10 cm) (1141 kg/ha). The seed yield increased with reduction in the inter row space from 90 cm to 60 cm and the similar finding was reported by Jeevan Kumar et al. [10] and Ashokareddy et al. [11] but with further reduction in inter row space to 45cm could not deliver higher yield that might be due to higher interplant competition for light, moisture and nutrients in the limited space and the results were in contrary with the findings of Meena et al. [12]. Significantly lowest seed yield was recorded under S4 (90 cm × 10 cm) (1141 kg/ha). Similarly, among the genotypes, the seed yield in V1 (PRG-158) (1547 kg/ha) and V3 (Asha) (1591 kg/ha) was on par with each other but significantly higher than V2 (PRG-176) (857 kg/ha). The higher seed yield in varieties PRG-158 and Asha was due to the longer crop duration nature of the varieties than PRG-176. There was no significant interaction between the effects of planting geometry and genotypes on the seed yield pigeonpea.

Stubble yield was significantly higher under S2 (60 cm × 10 cm) (2571 kg/ha) than S4 (90 cm × 10 cm) (1931 kg/ha) but on par with S1 (45 cm × 10 cm) (2449 kg/ha), S3 (75 cm × 10 cm) (2344 kg/ha). Among the genotypes, significantly higher stubble yield was recorded in V1 (PRG-158) (2884 kg/ha) than V2 (PRG-176) (1842 kg/ha) and V3 (Asha) (2245 kg/ha).

Harvest index was not significantly influenced by the plant geometry of four spacings. The results were in contrary with results of Asaduzzaman et al. [13] but among the genotypes, harvest index in V3 (Asha) (40.83%) was significantly higher than in V1 (PRG-158) (34.74%) and V2 (PRG-176) (32.85%).

3.2 Effect of Plant Densities and Varieties on Economics of Pigeonpea Cultivation during Rabi Season

Mean data of 2015-16 and 2016-17 in Table 3 revealed that highest gross returns (Rs. 77366 ha^{-1}), net returns (Rs.46733 ha^{-1}) and benefit cost ratio (2.53) were realized in at plant density of 60 cm × 10 cm spacing followed by at 75 cm × 10 cm (Rs. 66711 ha^{-1}, Rs.36517 ha^{-1}, 2.21), 45 cm × 10 cm (Rs. 67266 ha^{-1}, Rs.36083 ha^{-1}, 2.16) and at 90 cm × 10 cm (Rs. 57621 ha^{-1}, Rs.27757 ha^{-1}, 1.93). Among the genotypes, Asha (ICPL 87119) registered highest gross returns (Rs. 80346 ha^{-1}), net returns (Rs.49711 ha^{-1}) and benefit cost ratio (2.62) followed by PRG-158 (gross returns of Rs. 78124ha^{-1}, net returns of Rs.47489 ha^{-1} and benefit cost ratio of 2.55) and PRG-176 (gross returns of Rs. 43279ha^{-1}, net returns of Rs.13144 ha^{-1} and benefit cost ratio

Table 3. Effect of plant densities and varieties on gross returns, cost of cultivation, net returns and benefit cost ratio of pigeonpea cultivation during rabi season (Mean data of 2015-16 and 2016-17)

Treatments	Gross returns (Rs./ha)	Cost of Cultivation (Rs./ha)	Net returns (Rs./ha)	B:C Ratio
Spacing				
S1-45cm × 10cm	67266	31183	36083	2.16
S2-60cm × 10cm	77366	30633	46733	2.53
S3-75cm × 10cm	66711	30193	36517	2.21
S4-90cm × 10cm	57621	29863	27757	1.93
Varieties				
V1- PRG-158	78124	30635	47489	2.55
V2- PRG-176	43279	30135	13144	1.44
V3- Asha (ICPL 87119)	80346	30635	49711	2.62

of 1.44). The variation in the cost of cultivation is due to the variation in the seed rate at different plant densities. Among the genotypes, lower cost of cultivation (Rs.30135ha^{-1}) was recorded in PRG-176 than in PRG-158 and Asha (ICPL 87119) (Rs. 30365 ha^{-1}) due to early maturity and saving of two irrigations.

4. CONCLUSION

From the results of experimentation during *rabi,* 2015-16 and 2016-17, it can be concluded that the spacing of 60 cm × 10 cm is recommended for the cultivation of pigeonpea during *rabi* season in alfisols of Southern Telangana Zone and long duration varieties like PRG-158 and Asha (ICPL-87119) are recommended for cultivation during *rabi* season.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. FAO STAT. Food and agricultural organization. agricultural statistics; 2018.
2. DGCIS, Annual export, 2019-20 Directorate general of commercial intelligence and statistics.
3. Donald CM. In search of yield. J. Aust. Institute Agric. Sci. 1962;28:171-178.
4. Gomez KA, Gomez AA. Statistical procedures for agricultural research. A Willey- Inter Science Publication. John Willey & Sons, New York; 1984.
5. Kashyap TL, Shrivastava GK, Lakpale R, Choubey NK. Productivity potential of pigeonpea (*Cajanus cajan L. Millsp*) genotypes in response to growth regulators under Vertisols of Chhattisgarh plains. Annals of Agricultural Research. 2003;24(2):449-452.
6. Tikle AN, Gupta SC. Variability for nodulating ability of pigeonpea genotypes under field conditions. Indian Journal of Pulses Research. 2006;19(1):124-125.
7. Birendra Tigga DK, Chandraker Tej, Ram Banjara, Sushil Kumar Bhagat, Manoj Dev. Effect of different genotype and planting geometry on growth and productivity of rabi season pigeonpea (*Cajanus cajan* L.). Int.J.Curr.Microbiol.App.Sci. 2017;6(3):2188-2195.
8. Parameswari K, Vanangamudi K, Kavitha S. Effect of spacing on hybrid seed yield of pigeonpea hybrid CoPH2-. Madras Agricultural Journal. 2003;90(10-12):691-696.
9. Islam S, Nanda MK, Mukherjee AK. Effect of date of sowing and plant density on growth and yield of rabi pigeonpea. Journal of Crop and Weed. 2008;4(1):7-9.
10. Jeevan Kumar K, Balusamy M, Latha KR. Effect of plant geometry on the growth, yield and economics of rabi pigeonpea. International Journal of Tropical Agriculture. 2014;32(3-4):509-511.
11. Ashokareddy Y, Sagar kumar reddy RV, Prabhakara reddy G, Pushpavathi Y. Response of pigeonpea (Cajanus cajan) varieties to varying plant Population during rabi in southern agro-climatic zone of Andhra pradesh. International Journal of

Agricultural Science and Research. 2016;6(6):73-76.

12. Meena BK, Hulihalli UK, Arvind Kumar BN, Meena MK. Biomass production, its distribution and yield of hybrid pigeonpea as influenced by plant geometries and fertility levels. Research Journal of Agricultural Sciences. 2011;2(4):833-836.

13. Asaduzzaman M, Sultana S, Roy TS, Masum SM. Weeding and pant spacing effects on the growth and yield of blackgram. Bangladesh Research Publications Journal. 2010;4(1):62-68.

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