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Response of Hybrid Pigeonpea (*Cajanus Cajan* L.) to Planting Geometry and Nitrogen Levels

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ABSTRACT

A field experiment was conducted during *kharif*, 2017 at Agricultural College Farm, Bapatla to study the response of hybrid pigeonpea to planting geometry and nitrogen levels. The results revealed that the hybrid pigeonpea (ICPH-3762) recorded significantly higher seed yield (1820 kg ha^{-1}) at a plant geometry of 180 cm x 20 cm which was 13.11% higher as compared to wide plant geometry of 180 cm x 40 cm. The nitrogen level of 60 kg ha^{-1} resulted in higher seed yield (1853 kg ha^{-1}) which was 18.10% higher to lower nitrogen level of 20 kg ha^{-1} and was on a par with 40 kg N ha^{-1}. The maximum return per rupee investment was also obtained at a plant geometry of 180 cm x 20 cm with application of 40 kg N ha^{-1}.

Key Words: *Hybrid pigeonpea, Planting geometry, Nitrogen levels.*

Pigeonpea (*Cajanus cajan L.*) is the second most important pulse crop of India after chickpea. India has a virtual monopoly in pigeonpea production by accounting 90 per cent of the world's total production. India is the largest producer of pigeonpea with 2.6 M.t of production in an area of 4.0 M.ha with an average productivity of 646 kg ha^{-1}during 2015-16. Whereas, in Andhra Pradesh the average production of pigeonpea in an area of 2.2 M.ha is 1.3 Lakh tonnes with productivity of 600 kg ha^{-1} in 2015-16 (www.indiastat.com).

The productivity of pigeonpea is limited by agronomic, pathogenic, entomological, genetic factors and their interaction with environment. Among the different agronomic practices limiting the yield *viz.,* adoption of suitable geometry, maintenance of optimum plant population, application of balanced fertilizers are the most important factors. The low yield of pigeonpea is mainly attributed to inadequate plant population and imbalanced nutrient application particularly with respect to nitrogen which is one of the most important plant nutrient for crop production. Being a pulse crop, it utilizes the atmospheric nitrogen through symbiotic association. The varieties cultivated by the farmers are low yielding and susceptible to pests and diseases. The cultivation of hybrids help in increasing the productivity. The productivity in the state of Andhra Pradesh with respect to pigeonpea varieties is very low it is essential to replace varieties with new hybrids to achieve higher yields. Further, the adoption of proper plant geometry and nitrogen levels will go a long way in making efficient use of limited resources and thus to stabilize the productivity of pigeonpea. Hence, the study was undertaken to investigate the effect of plant geometry and nitrogen levels on hybrid pigeonpea (ICPH-3762).

MATERIAL AND METHODS

A field experiment was conducted at Agricultural College Farm, Bapatla during *kharif*, 2017. The experimental soils were clayey in texture having pH 7.4, low organic carbon (0.2), low available nitrogen (257 kg ha^{-1}), medium in available phosphorus (49 kg ha^{-1}) and medium in available potassium (212 kg ha^{-1}). The experiment was laid out in a split-plot design with three planting geometries (S_1 - 180 cm x 20 cm, S_2 - 180 cm x 30 cm and S_3 - 180 cm x 40 cm) assigned to main plots and three nitrogen levels (N_1 – 20 kg ha^{-1}, N_2 – 40 kg ha^{-1} and N_3 - 60 kg ha^{-1}) assigned to sub plots and replicated thrice. The recommended dose of phosphorus was applied as basal in the form of single super phosphate and nitrogen as per the treatments were applied as basal through urea. ICPH-3762 was used as a test hybrid. The crop was sown on 26th July, 2017 by dibbling one to two seeds upto 4 to 5 cm depth in the row at different spacings as per the treatments. The yield observations were recorded in five plants randomly selected from each treatment. The total rainfall received during the crop growth period was 692 mm. The crop was harvested on 28th January, 2018.

RESULTS AND DISCUSSION

In the present study, significantly higher number of pods plant^{-1} (619) were recorded at 180 cm x 30 cm as compared to180 cm x 20 cm (500) which was 23.8 per cent superior but it was on a par with 180 cm x 40 cm (Table 1). The maximum number of seeds pod^{-1} were recorded at wide plant geometry of 180 cm x 40 cm (3.5) and was significantly superior than other two plant geometries tested. This might be due to better plant development resulting in more uniform distribution

Table 1. Yield and yield attributes of hybrid pigeonpea ICPH- 3762 as influenced by varied plant spacing and levels of nitrogen

Treatments	Number of pods plant^{-1}	Number of seeds pod^{-1}	100 seed weight (g)	Seed yield (kg ha^{-1})	Stalk yield (kg ha^{-1})	Harvest index (%)
Planting geometry (S)						
180cm x 20cm	500	3.3	10.4	1820	5109	26.2
180cm x 30cm	619	3.4	10.9	1809	4668	27.8
180cm x 40cm	575	3.5	10.6	1609	4203	27.7
SEm±	19.04	0.04	0.13	43.54	146.52	0.73
CD (P = 0.05)	74.8	0.1	NS	171	445	NS
Nitrogen levels (N)						
20 kg ha^{-1}	490	3.4	10.4	1569	4357	26.5
40 kg ha^{-1}	513	3.5	11	1815	4705	27.8
60 kg ha^{-1}	690	3.4	10.5	1853	4917	27.4
SEm±	22.55	0.05	0.1	73.01	130.32	0.55
CD (P = 0.05)	69.5	NS	0.3	225	401.4	NS
Interaction (SXN)						
SEm±	39.06	0.08	0.18	126.45	225.67	0.96
CD (P=0.05)	120	NS	NS	NS	NS	NS

Table 2. Cost of cultivation, Gross returns, Net returns and Return per rupee investment of hybrid pigeonpea as influenced by varied plant spacings and levels of nitrogen

Treatments	Seed yield (kg ha^{-1})	Cost of cultivation (Rs ha^{-1})	Gross returns (Rs ha^{-1})	Net returns (Rs ha^{-1})	Return per rupee investment
Plant Spacing (S)					
180cm x 20cm	1820	36,172	76,436	39,314	1.1
180cm x 30cm	1809	36,172	75,965	39,084	1.1
180cm x 40cm	1609	36,172	67,571	30,850	0.8
SEm±	43.54	-	1828.63	1828.63	0.05
CD (P = 0.05)	171	-	7179	7179	0.2
Nitrogen levels (N)					
20 kg ha^{-1}	1853	35,920	65,907	29,251	0.8
40 kg ha^{-1}	1815	36,172	76,233	39,326	1.1
60 kg ha^{-1}	1569	36,425	77,832	40,671	1.1
SEm±	73.01	-	3066.31	3066.21	0.09
CD (P = 0.05)	225	-	9446	9446	0.3
Interaction (SXN)					
SEm±	126.45	-	5311.01	5311.01	0.14
CD (P=0.05)	NS	-	NS	NS	NS

of plants over cropped area, coupled with greater light interception, moisture utilization, nutrient and solar energy availability under lower degree of inter plant and intra plant competition. These results are in accordance with the previous findings of Telgote *et al.* (2004), Nandhini *et al.* (2015), Singh *et al.* (2016) and Ramanjaneyulu *et al.* (2017).

The adoption of closer plant geometry of 180 cm x 20 cm recorded maximum seed yield (1820 kg ha^{-1}) which was significantly superior than wider plant geometry of 180 cm x 40 cm but was on a par with plant geometry of 180 cm x 30 cm. Similarly, maximum stalk yield (5109 kg ha^{-1}) was recorded at closer geometry of 180 cm x 20 cm as compared to wider plant geometry of 180 cm x 40 cm (4203 kg ha^{-1}). The plant geometry of 180 cm x 30 cm recorded stalk yield of 4668 kg ha^{-1} and was on a par with 180 cm x 20 cm. The higher seed yield at closer plant geometry compared to wider plant geometry might be due to accommodation of more number of plants per unit area. The increased pod production at wider plant geometry however was not reflected in the total seed yield. Thus, it could be seen that increase in yield attributing characters like number of pods plant^{-1}, seeds per pod^{-1} and 100-seed weight at wider plant geometry could not compensate the yield loss due to lower plant population as compared to closer plant geometry. These results are in conformity with the findings of Kumar *et al*. (2014), Goud *et al.* (2016) and Ramanjaneyulu *et al.* (2017) (Table 1 and 2)

Application of 60 kg N ha^{-1} (1853 and 4917 kg ha^{-1}) had given 18.1 and 12.9 per cent higher seed and stalk yield, respectively over lower level of nitrogen application (20 kg ha^{-1}) (1569 and 4357 kg ha^{-1}) and was on a par with application of 40 kg N ha^{-1} (1815 and 4705 kg ha^{-1}). The higher seed yield at higher nitrogen level might be due to that added fertilizers enhanced the availability of nutrients to plants resulting in profuse shoot growth, and thereby activating greater absorption of these nutrients from soil. Increasing nitrogen levels delays senescence and increases the life cycle of the plant resulting the higher economic seed yield. These results are in close conformity with findings of Meena *et al.* (2011), Umesh and Shankar (2013) and Singh *et al*. (2016). The yield components like number of pod plant^{-1} (690) were higher with 60 kg N ha^{-1} which was significantly superior over 20 kg N ha^{-1} (490) but was on a par with 40 kg N ha^{-1} (513). Whereas, the 100 seed weight (11.0g) was registered higher at 40 kg N ha^{-1} over other two nitrogen levels. Similar results were also obtained by Sarvaiya *et al*. (1993) and Umesh and Shankar (2013).

The maximum gross returns (Rs. 76,436 ha^{-1}), net returns (Rs. 39,314 ha^{-1}) and return per rupee investment (1.1) was observed at a closer plant spacing of 180 cm x 20 cm. While, among the nitrogen levels, application of 60 kg N ha^{-1} registered the maximum gross returns (Rs. 77, 832 ha^{-1}), net returns (Rs. 40,671 ha^{-1}) and return per rupee investment (1.1) which was statistically on a par with application of 40 kg N ha^{-1} (Table 2). These results are in conformity with the findings of Goud *et al.* (2016), Singh *et al*. (2016) and Ramanjaneyulu *et al*. (2017).

CONCLUSION

It can be inferred from the above results that hybrid pigeonpea ICPH-3762 at plant spacing of 180cm x 20 cm is significantly superior in achieving higher seed yield over wider spacing and among the nitrogen levels, higher seed yield was achieved with application of higher levels of 60 kg N ha^{-1} and was on a par with 40 kg N ha^{-1}. The maximum gross returns, net returns and return per rupee investment was obtained with plant spacing of 180 cm x 20 cm. The higher gross returns, net returns and return per rupee investment were recorded with application of 60 kg N ha^{-1} and was on a par with 40 kg N ha^{-1}. So, in order to achieve better yield and economic benefits the cultivation of pigeonpea hybrid at a closer plant spacing of 180 cm x 20 cm and with application of 40 kg N ha^{-1} is found to be optimum.

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