

Original Research Article

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Effect of Different Genotype and Planting Geometry on Growth and Productivity of Rabi Season Pigeon Pea (*Cajanus cajan* L.)

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ABSTRACT

A field experiment was conducted during winter season of 2013-14 to study the performance of different genotypes pigeon pea with planting geometry. The genotype and planting geometry significantly influenced the growth parameter, seed yield, stalk yield, harvest index, yield attributes (*viz.* seed pod⁻¹, pod plant⁻¹, seed plant⁻¹ and 100 seed weight). Among the six genotypes (Asha, Rajeevlochan, RPS- 2007-106, Laxmi, RPS-2008-4 and RPS-2007-10) tested, genotype Asha (1281 kg ha⁻¹) recorded significantly highest seed yield over the other genotype. In the two planting geometry significantly maximum seed yield of 1235 kg ha⁻¹ was realized with spacing of 45 cm x 10 cm and was higher yield than the yield recorded with spacing of 60 cm x 10 cm (1085 kg ha⁻¹). The Genotype Asha gave maximum seed pod⁻¹ (4.23), pod plant⁻¹ (132.00), seed plant⁻¹ (557.27) and 100 seed weight (11.22 g) over rest of the genotypes. Pigeon pea sown with wider geometry of 60 cm x 10 cm gave maximum seed pod⁻¹ (4.05), pod plant⁻¹ (124.50), seed plant⁻¹ (496.67) and 100 seed weight (11.10) compared to narrow spacing of 45 cm x 10 cm. In conclusion among the genotype Asha was the best variety in terms of growth and yield in winter season planting of pigeon pea.

Keywords

Genotype, planting geometry, growth characters, productivity.

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Introduction

Pigeonpea (*Cajanus cajan* L.) is important component as it belong to leguminous family which enriches the soil by adding nitrogen, reduce soil erosion, improve physico-chemical properties of the soil. Plant geometry of crop has a great role in crop growth as well as seed production. Proper plant population reflects the higher yield of crop. Control of weed flora in pigeonpea was also very important factor for higher yield. The potential yield of genotypes within its genetic limit is set by environment where it is

grown. Genotypes are different in their yield potential depending on many complex physiological processes taking place in different parts of the plant, which are controlled by both genetic makeup of plant and the environment. In India it is occupying an area of 35 lakh ha with a production of 19 lakh tonnes with an average productivity of 753 kg ha⁻¹ (Anonymous, 2014a). In Chhattisgarh it occupies an area of 52.85 thousands ha with production of 23.68 thousand tones with average productivity 448

kg ha⁻¹ (Anonymous, 2014). Grain yield is product of plant populations and the single plant yield. Maximum yield in a particular cultivars and environment can be obtained at the density where competition between the plants is low. This will be attained at an optimum plant density, which not only utilizes light, moisture and nutrients more efficiently but also avoids excessive competition among the plants. Based on climatic conditions, researchers obtained differential response of mash bean in relation to row spacing. Results obtained by Davi *et al.*, (1995) deciphered that grain yield was highest at 15 cm intra-row spacing. Whereas, Nagaraju *et al.*, (1995) revealed that seed yield decreased with an increase in row spacing. Mehmud *et al.*, (1997) indicated that increased row spacing manifested increase in the seed weight plant⁻¹, pod weight plant⁻¹, and 1000 seed weight, but decreased plant height and seed yield unit area⁻¹. Kumar *et al.*, (1997) obtained. The highest seed yield with row spacing of 15 cm (1.09 t ha⁻¹). However, Mishra and Mishra (1995) concluded that seed yield was not affected by row spacing. The present investigation deals with impact of different genotypes and planting geometry in winter season pigeon pea on growth and its productivity.

Materials and Methods

A field experiment was carried out during the winter season of 2013-14 at the Instructional Cum Research Farm, I.G.K.V., Raipur (C.G.). Experiment was laid out in factorial randomized block design with three replications. The treatment consisted of six genotypes *viz.* – Asha, Rajeev lochan, Laxmi, RPS-2008-4, RPS-2007-10 and RPS- 2007-106 as factor one and two planting geometry *viz.* 60 cm x 10 cm and 45 cm x 10 cm as factor two. Geographically, Raipur is situated in the centre of Chhattisgarh and lies between 21⁰ 16' N latitude and 81⁰ 36' E longitudes

with an altitude of 298 m above the mean sea level. The climatic condition of Raipur is sub-humid to semi-arid and the average rainfall of locality is about 1325 mm year⁻¹. Soil sampling from the experiment field were taken with the help of a tube auger from 10 different points of the plots before starting of field experiment and were subsequently processed for further analysis for soil quality parameters. The oven dry soil samples (<2 mm) were analyzed for pH (Piper, 1967), organic carbon (Walkley and Black's rapid titration method, 1934), available N (alkaline KMnO₄ method by Subbiah and Asija, 1956), 0.5 M NaHCO₃ (pH 8.5) extractable P (Olsen *et al.*, 1984) and 1N NH₄OAc extractable K by Flame photometric method (Jackson, 1967). The physico-chemical properties of the field soil are depicted in Table1.

The crop was sown on 23rd November, 2013 and harvested during 5th to 10th May, 2014 as per genotype. Crop was fertilizes @ 20:50:20:20 kg N:P₂O₅:K₂O:S. Stomp 30 EC (*Pendimethalin*) was applied @ 2.5 lit ha⁻¹ as pre-emergence to control the weeds followed by two hand weeding at 40 and 65 DAS. Two spray of Curacron 10 % (*Profenophos*) 1 lit ha⁻¹ spray⁻¹ was done at 50 and 80 DAS as plant protection measures. The crop was given total four irrigations. The five random points in each plot were selected for recording the plant population and plant population was recorded with the help of 1 square meter quadrature.

The five plant in each plot were randomly selected and tagged for recording growth parameters and observations namely plant height, number of branches plant⁻¹ were recorded at harvest. However, plant population was studied at 20 DAS and at harvest. The data recorded for different characters under investigation were analyzed by following analysis of variance procedure as described by Gomez and Gomez (1984).

Results and Discussion

Genotypes

Plant population and growth characters

The result of present investigation revealed that among different genotypes, there was non-significant variation in plant population at 20 DAS but, it was found significant at harvest (Table 2). Among the genotype maximum plant density was observed in Asha (19.08 plant m²) but it was statistically at par with Laxmi, RPS-2008-4, RPS-2007-10. While, planting geometry did not significantly affect on plant population at both date of observation.

It is quite clear from Table 2, Pigeonpea genotype had significantly influence on plant height, number of branches plant⁻¹, number and dry weight of root nodules plant⁻¹. Among the genotypes, At harvest stage Asha produced significantly taller plants (104.65 cm) over rest of the genotypes. However, it was at par with Rajeevlochan, Laxmi and RPS-2007-106. This is genetic makeup of the plants or it has capability to respond better under optimum resource available. Similar observations have been reported by Soomrao and Khan (2003) Mehto *et al.*, (2005). The variety Asha recorded significantly highest LAI over rest of other genotypes of pigeonpea tested. However it was at par with Rajeevlochan, Laxmi and RPS-2007-106. The highest leaf area index recorded by genotype Asha might be due to its genetic makeup which expresses their superiority over genetic makeup of other genotype tested under Chhattisgarh plain agro climatic condition. These results are close confirmative with the findings of Pavan *et al.*, (2011).

Yield attributing characters

The data recorded for the yield attributing characters are presented in Table 2. Genotype

Asha recorded significantly higher number of pod plant⁻¹ (132 plant⁻¹), seeds pods⁻¹ (4.23), seeds plant⁻¹ (557) and 100-seed weight (11.22 g) over other genotype tested in the experiment, which was statistically at par with genotypes Rajeevlochan, Laxmi and RPS-2007-106. Variation in number of pods plant⁻¹ might be due to genetic makeup of genotypes and response of other growth factors. Similar observations have also been recorded by Kashyap *et al.*, (2003), Tikle and Gupta (2006).

Yield

It is quite clear from table 4 that genotype Asha recorded significantly higher seed yield (1281.42 kg ha⁻¹) and stover yield (5887.50 kg ha⁻¹) over other genotypes of pigeonpea tested in the experiment. It was statistically comparable with Rajeevlochan, Laxmi and RPS 2007-106. Asha recorded 18.03 %, 19.31% and 28.89 %, 30.86% higher seed yield and stover yield than RPS-2007-10 and RPS-2008-4, respectively. This might be due to higher number of pods plant⁻¹, more number of seeds pod⁻¹, number of seeds plant⁻¹, higher 100-seed weight and growth characters *viz.* plant height, branches, LAI, dry matter accumulation resulting into higher seed yield and stover yield in Asha genotype. Each genotypes has their own yield potential which expressed in shape of plant growth and ultimately to seed yield. Similar findings have also been reported by Goswami *et al.*, (1998). Genetic differences for seed yield have also been reported by Kashyap *et al.*, (2003), Umesh *et al.*, (2013).

Harvest index is a measure of physiological productivity potential of crop genotypes. It is the ability of a plant to convert the dry matter into economic yield. The difference in harvest index (%) due to genotypes was found non-significant.

Planting geometry

Plant population and growth characters

As regards to planting geometry, in case of plant population and plant height of pigeon pea were found with successive decrease in planting geometry from 45 cm x 10 cm to 60 cm x 10 cm. The results corroborate with the result recorded by Panwas and Sharma (2004) in urdbean crop. But other growth parameter was higher Significantly leaf area index, number of branches, numbers and dry weight of root nodules plant⁻¹ observed at 60 x 10 cm plant geometry over narrow planting geometry. The more number of branches plant⁻¹, numbers and dry weight of nodules plant⁻¹ in wider spacing might be due to better growth of plant because of optimum growth resources available to individual plant and their maximum utilization throughout the growth periods as per requirement of the crop. The proper and uniform density of plant stand plays the key role to increase the growth, yield attributes and seed yield of pigeonpea. If there are more plants per unit area the intra (within the plant among the plant components) and inter plant (among the plants in the area) competition for the growth

resources (space, moisture, sunlight and CO₂) will also increase. There is always competition for growth resources at all levels (micro and macro) in the field. It has established that arrangement of plants (number) per unit area should be in such a way that all plants get equal opportunity to harness the available growth resources so that variety can express their potential with respect to health and vigour which lead to yield. Singh (2012) also noted significant differences in plant population due to variation in seed rate. Similar results were recorded by Pavan *et al.*, (2011), Meena *et al.*, (2013) Subramani and Solaimalai (2000) and Rasul *et al.*, (2012).

Yield attributing characters

The results data of yield attributing characters are presented in table 3. Significantly maximum number of pods plant⁻¹ (124.50), seeds pods⁻¹ (4.05), seeds plant⁻¹ (496.67) and 100-seed weight (11.10) was recorded from the plot where crop was planted in 60 cm x 10 cm (S₂) over planting geometry of 45 cm x 10 cm.

Table.1 Physico-chemical properties of the experimental soil

No.	Particulars	Values	Rating	Methods
A.	Mechanical composition			
i.	Sand (%)	20.55		
ii.	Silt (%)	35.26		International pipette method (Black, 1965)
iii.	Clay (%)	43.08	Clay <i>Vertisols</i>	
B.	Chemical composition			
1.	Organic carbon (%)	0.54		Walkley and Black's rapid titration method (Jackson, 1967)
2.	Available N (Kg ha ⁻¹)	208	Low	Alkaline permanganate method (Subbiah & Asija, 1956)
3.	Available P (Kg ha ⁻¹)	13	Medium	Olsen's method (Olsen 1954)
4.	Exchangeable K (Kg ha ⁻¹)	274	Medium	Flame photometric method (Jackson,1967)
5.	pH value (1:2.5,soil:water)	7.7	Neutral	Glass electrode pH meter (Piper,1967)
6.	Electrical conductivity	0.15	Normal	Solubridge method, (Black,1965)

Table.2 Plant population and growth parameters of pigeon pea as influenced by genotypes and planting geometry

Treatment	Plant population (No. m ²)		Plant height (cm)	Number of branches	Leaf area index	Number of root nodules plant ⁻¹	Dry weight of root nodules plant ⁻¹
	20 DAS	At harvest					
Genotype							
Asha	20.08	19.08	104.65	9.66	1060.42	42.14	94.51
Rajeevlochan	20.18	17.85	102.73	9.55	1056.08	41.79	93.38
Laxmi	20.09	18.76	102.40	9.11	1021.98	40.85	91.73
RPS-2008-4	19.93	18.36	97.74	7.27	969.42	37.84	88.49
RPS-2007-10	20.04	18.87	98.16	8.11	1003.42	38.87	91.52
RPS- 2007-106	19.87	17.91	102.13	9.22	1055.75	41.84	92.93
SEm±	0.42	0.31	1.54	0.28	18.08	0.75	0.76
CD (P=0.05)	NS	0.93	4.51	0.82	53.02	2.19	2.22
Planting geometry							
45 cm x 10 cm	23.38	21.39	103.83	8.37	991.55	39.74	90.90
60 cm x 10 cm	16.79	15.55	98.78	9.27	1064.14	41.35	93.29
SEm±	0.24	0.18	0.88	0.16	10.44	0.43	0.44
CD (P=0.05)	0.71	0.53	2.61	0.48	30.61	1.26	1.28
Interaction	NS	NS	NS	NS	NS	NS	NS

Table.3 Effect of genotypes and planting geometry on yield attributing characters of pigeon pea

Treatment	No. of seed pod ⁻¹	No. of pod plant ⁻¹	No. of seed plant ⁻¹	100 Seed weight (g)
Genotype				
Asha	4.23	132.00	557.27	11.22
Rajeevlochan	4.22	129.33	544.69	11.16
Laxmi	3.83	123.22	471.98	10.90
RPS-2008-4	3.28	95.50	312.29	9.84
RPS-2007-10	3.44	105.19	361.89	10.08
RPS-2007-106	3.94	127.50	502.49	11.09
SEm±	0.20	4.7	17.27	0.35
CD (P=0.05)	0.58	13.8	50.66	1.01
Planting geometry				
45 cm x 10 cm	3.59	113.08	420.20	10.33
60 cm x 10 cm	4.05	124.50	496.67	11.10
SEm±	0.11	2.7	9.97	0.20
CD (P=0.05)	0.33	8.0	29.25	0.58
Interaction	NS	NS	NS	NS

Table.4 Seed yield, stalk yield and harvest index of pigeon pea as influenced by genotypes and planting geometry

Treatment	Seed yield (kg ha ⁻¹)	Stalk yield (kg ha ⁻¹)	Harvest index (%)
Genotype			
Asha	1281.42	5887.50	18.14
Rajeev lochan	1268.48	5784.17	18.32
Laxmi	1220.10	5578.82	18.33
RPS-2008-4	911.27	4070.48	18.33
RPS-2007-10	1050.38	4750.33	18.30
RPS- 2007-106	1226.47	5596.93	18.21
SEm±	63.4	295.4	0.09
CD (P=0.05)	185.9	866.5	NS
Planting geometry			
45 cm x 10 cm	1234.80	6172.72	16.67
60 cm x 10 cm	1084.60	4383.35	19.87
SEm±	36.58	170.6	0.056
CD (P=0.05)	107.31	500.3	0.165
Interaction	NS	NS	NS

Maximum number of pods plant⁻¹ seeds pods⁻¹, seeds plant⁻¹ and 100-seed weight in 60 cm x 10 cm (S₂) planting geometry might be due to higher number of branches and flowers plant⁻¹ with adequate supply of soil-moisture and nutrients. Similar results were also recorded by Antaravalli *et al.*, (2002), Islam *et al.*, (2008) and Kashyap *et al.*, (2003).

Yield: From the perusal of table 4. The crop planted with row spacing of 45 cm and plant to plant 10 cm recorded significantly higher grain yield (1234.80 kg ha⁻¹) and stover yield (6172.72 kg ha⁻¹) over wider row spacing 60 cm x 10 cm. narrow planting of pigeonpea (45 cm x 10 cm) recorded 12.16 % more yield over wider row spacing of 60 cm x 15 cm.

The seed yield is the chain reaction of growth parameters and yield attributing characters. In the present investigation wider spacing recorded higher value of vegetative and reproductive growth parameter of individual plants over narrow spacing. However, in terms of seed yield and stover yield narrow

spacing was statistically found superior over wider spacing might be due to the fact that total number of plants (2.22 lakh plants ha⁻¹) per unit area was higher over wider spacing and this higher number of plants per unit area neutralized the effect of vegetative and reproductive parameter registered in wider spaced crops. Optimum plant population is a pre-requisite for obtaining high yields (Nandan and Kumar 2005). The results are in accordance with the findings of Panwar and Sirohi (1987), Kumar and Sharma (1989), Das *et al.*, (1996), Ali *et al.*, (2011) and Singh *et al.*, (2011). Significantly maximum value of harvest index (19.87 %) was recorded under 60 cm x 10 cm (S₂) planting geometry, over narrow planting geometry of 45 cm x 10 cm (16.67) Similar results were recorded by Asaduzzaman *et al.*, (2010).

The interaction of planting geometry and genotypes of pigeon pea did not vary significantly in any growth and/or yield of winter season pigeonpea.

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