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Performance of Parents and Hybrids of Pigeonpea (*Cajanus cajan* (L.) Millsp.) in terms of Yield and Yield Contributing Characters

J. Srivarsha[1,2], J. E. Jahagirdar[3], C. V. Sameer Kumar[1*], A. J. Hingane[1], D. K. Patil[3], V. K. Gite[3], H. B. Shruthi[1] and T. M. Bhosle[2]

[1]International Crops Research Institute for the Semi-Arid Tropics, Patancheru, Telangana

[2]College of Agriculture, Badnapur, VNMKV, Parbhani, Maharashtra

[3]Agricultural Research Station, Badnapur, VNMKV, Parbhani, Maharashtra

*Corresponding Author E-mail: c.sameerkumar@cgiar.org

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ABSTRACT

Twelve parents were used in the crossing programme to produce 27 hybrids in L×T fashion during kharif 2015-16. In the field conditions, parents and hybrids were planted in Randomized Block Design of three replications and evaluated for the performance in terms of yield and yield contributing characters during kharif 2016-17. Observations were recorded on ten characters viz., plant height, days to 50% flowering, days to maturity, number of primary branches per plant, number of secondary branches per plant, number of pods per plant, number of seeds per pod, 100 seed weight, grain yield per plant and harvest index. It was observed that increase in number of pods per plant directly contributed to increased yield. Among the twenty seven hybrids, ICPA 2039 × ICPL 161, ICPA 2039 × ICPL 90048 and ICPA 2039 × ICPL149 had high grain yield.

Key words: *Variability, Hybrid, Pigeonpea, Yield, Yield contributing character.*

INTRODUCTION

Pulses are major dietary sources of proteins among the vegetarians in India. Though India is the world's largest producer of pulses, it imports a large amount of pulses to meet the growing domestic needs as it is the largest consumer too. It has been estimated that India's population would reach 1.68 billion by 2030 from the present level of 1.21 billion. Accordingly, the projected pulse requirement for the year 2030 is 32 million tonnes with an anticipated required growth rate of 4.2%[3].

Among these protein rich group of crops, pigeonpea [*Cajanus cajan* (L.) Millsp.] occupy a prominent place among the farmers of Africa, tropics and sub tropics of Asia. In India, pigeonpea is grown in an area of 5.21 million hectares with a production of 4.23 million tonnes[1]. Although India leads the world both in area and production of pigeonpea, its productivity is lower (673 kg/ha) than the world average (762.4 kg/ha)[2].

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The development of commercial hybrid pigeonpea programme was innovated at ICRISAT in collaboration with ICAR (Indian Council of Agricultural Research). This resulted in the successful development of the first GMS based pigeonpea hybrid, released in 1991 in India[6]. Stagnant production, soaring prices and enhanced imports of pigeonpea made the researchers to focus on increasing pigeonpea productivity. Pigeonpea hybrids play a potential role to achieve quantum jump in pigeonpea productivity[8]. The information about *per se* performance of genotypes is of utmost importance for crop improvement. The range of mean values aids in presenting a rough estimate about the variation in magnitude of variability present among the genotypes. The characters showing wide range of variation have more scope for improvement. To identify best combination of parents which result in best hybrids with desirable yield contributing characters, evaluation of the parents and hybrids is done.

MATERIAL AND METHODS

The study was conducted at the fields of International Crops Research Institute for the Semi-Arid Tropics, Patancheru during *kharif* 2016-17. The experimental material consisted of 12 parents and 27 hybrids. Hybrids were produced by crossing 12 parents in L×T fashion. Two standard checks were also planted to evaluate the performance of hybrids. These were planted in a Randomized Block Design with three replications. Each genotype is planted at a spacing of 75 cm × 25 cm (four rows of four meter length for each genotype). The crop was given two irrigations, one at early vegetative growth and other at pod filling stage. Weeding was done as and when necessary depending upon the intensity of weeds. Observations were recorded on five randomly selected plants for yield and yield contributing characters like Plant height (cm), days to 50% flowering, days to maturity, number of primary branches per plant, number of secondary branches per plant, number of pods per plant, number of seeds per pod, 100 seed weight and harvest index (%). The data was recorded and analysed by standard statistical methods.

RESULTS AND DISCUSSION

The performance of the pigeonpea in terms of yield and yield contributing characters is presented in the table 1. In the present study, A lines and B lines are isogenic differing only for pollen fertility. So, the yield and yield contributing characters have been recorded from B-lines.

Plant height is one of the yield contributing character in pigeonpea because vigour in plant height may increase biomass as well as source-sink capacity, which in turn plays role for optimum yield[5]. The range of plant height was 106.20 to 182 cm with general mean of 142.85 cm. Among the lines, ICPA 2156 (133.67 cm) was very tall. Among the testers ICPL161 (152 cm) was the tallest tester. Among the crosses, ICPA2039 × ICPL149 (182 cm), recorded highest plant height followed by ICPA2039 × ICPL161 (171 cm). Plant height is influenced by maturity duration, photoperiod and environment. It can be substantially increased by the exposure to long-day conditions[4].

Early maturing pigeonpea hybrids are generally preferred. It determines the adaptation of the crop to fit into various ecological niches and cropping systems. Delaying in flowering takes place if the temperature during crop growth fluctuates rapidly. The range of days to 50 per cent flowering was 62 to 84 days with general mean of 75 days. Among the lines, ICPA 2156 (67 days) was earliest to flower. Among the testers, ICPL 88039 (62 days) was earliest in flowering. Among the crosses, ICPA 2089 × ICPL88039 (70 days) and ICPA 2156 × ICPL 86022 (70 days) took minimum days to flower. Days to maturity ranged from 105.00 to 135.00 days with general mean 124 days. The line ICPA 2156 (109 days) and the tester ICPL 88039 (105 days) were early to mature among lines and testers respectively. The cross ICPA 2089 × ICPL 86022 (118 days) was earliest

followed by ICPA 2039 × ICPL 88039 (119 days).

High productivity is said to be closely associated with more number of primary and secondary branches per plant. Number of primary branches per plant ranged from 7.75 to 12.10 with general mean of 10.10. Maximum number of primary branches per plant was observed in line ICPA2089 (10.63) and tester ICPL88034 (12.10) among the lines and testers. The crosses, ICPA2039 × ICPL81-3 (11.97) had relatively maximum number of primary branches per plant followed by ICPA2039 × ICPL90048 (11.27). The range of number of secondary branches per plant was 16.30 to 22.76 with general mean of 19.85. Among the lines ICPA 2156 (18.87) recorded highest number of secondary branches per plant and among testers ICPL 92047 (21.50) had highest number of secondary branches per plant. Among the crosses, ICPA 2156 × ICPL 88034 (22.77) recorded highest number of secondary branches per plant followed by ICPA 2039 × ICPL 90048 (22.38).

Hybrid vigour and hybrid productivity in pigeonpea is directly contributed by the increase in number of pods per plant. Number of pods per plant ranged from 114.00 to 454.17 with general mean of 214.20. Maximum number of pods per plant was recorded by ICPA 2039 (216.50) among the lines and ICPL 161 (347.73) recorded maximum number of pods per plant among testers. Among the crosses, ICPA 2039 × ICPL 161 (454.17) has recorded highest number of pods per plant followed by ICPA2039 × ICPL90048 (356.53).

Number of seeds per pod and 100 seed weight influence the yield potential. Number of seeds per pod ranged from 3.50 to 4.33 with general mean 3.79. Among the lines, ICPA 2089 (4.33) recorded maximum number of seeds per pod and among the testers ICPL90048 (4.00) recorded maximum number of seeds per pod. Among the crosses, ICPA 2156 × ICPL90048 (4.2) recorded highest number of seeds per pod. 100 seed weight ranged from 7.26 to 9.83 g with general mean of 8.19 (g). Among the lines ICPA 2039 (7.97g) and among testers ICPL88039 (9.83 g) had highest 100 seed weight. In the crosses, ICPA 2156 × ICPL 89 (9.07 g) recorded highest test weight followed by ICPA 2039 × ICPL 90048 (9.03 g).

Yield is a complex trait and an end product of many number of components which are under polygenic control. Any change in one or all the components would influence yield[5]. The range of yield per plant was 36.66 to 133.33 g with general mean of 63.04 (g). Out of three lines ICPA 2039 (63.67 g) yielded highest grain per plant while among the testers ICPL 161(100.43 g) recorded highest grain yield per plant. In the crosses, ICPA 2039 × ICPL161 (133.33 g) had highest grain yield per plant followed by ICPA 2039 × ICPL 90048 (116.67 g). This information is depicted in the graph 1.

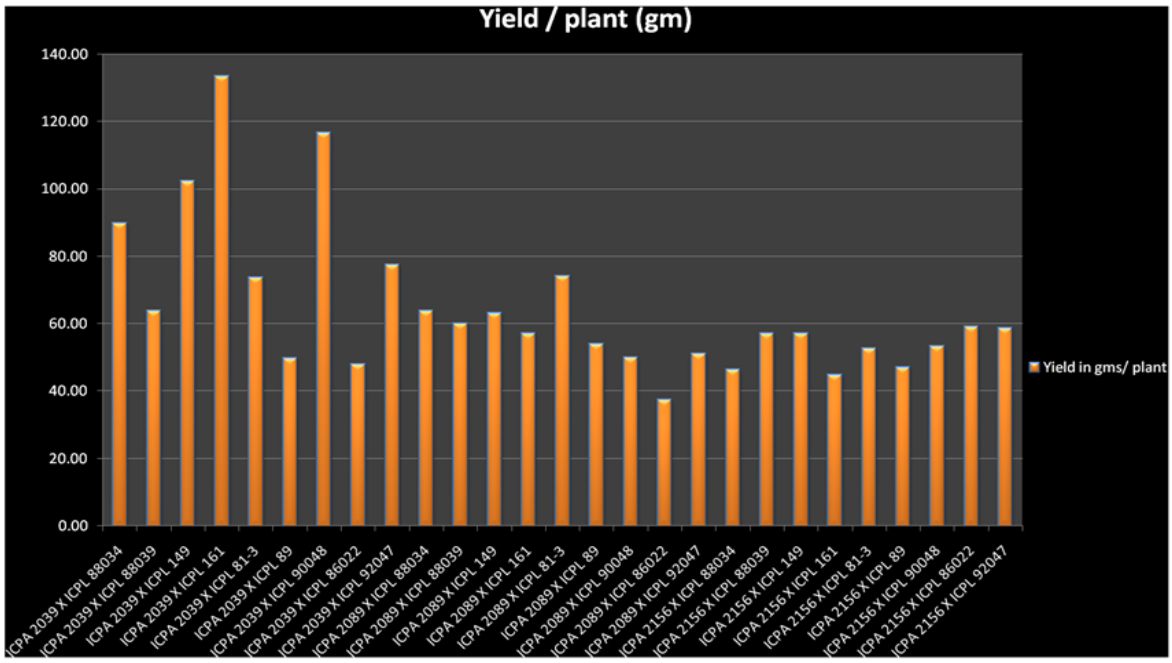
Partitioning photosynthates into source and sink is indirectly influenced by harvest index. The range of harvest index was 22.05 to 45.34 % with general mean of 34.76%. The line ICPA 2156 (36.76%) had highest harvest index out of the three. Among testers, ICPL161 (41.14%) recorded highest harvest index. Among the crosses, ICPA 2156 × ICPL90048 (45.34%) recorded highest harvest index followed by ICPA 2156 × ICPL92047 (42.63%).

Table 1: Mean values of parents and hybrids for yield and yield contributing characters.

Sr. No	Parents/crosses	Plant height (cm)	Days to 50 per cent flowering	Days to maturity	No. of primary branches per plant	No. of secondary branches per plant	No. of pods per plant	No. of seeds per pod	100 seed wt. (g)	Grain yield Per Plant (g)	Harvest Index (%)
PARENTS (FEMALE)											
1	ICPA 2039	106.20	77.00	125.00	9.20	16.30	216.50	3.73	7.97	63.67	34.13
2	ICPA 2089	131.33	68.00	113.00	10.63	18.33	118.43	4.33	7.53	37.67	23.58
3	ICPA 2156	133.67	67.00	109.00	10.07	18.87	114.00	3.73	7.60	36.67	36.76
PARENTS (MALE)											

4	ICPL 88034	134.67	83.00	132.00	12.10	18.97	183.43	3.63	8.07	54.33	33.47
5	ICPL 88039	131.67	62.00	105.00	10.30	19.87	198.33	3.73	9.83	70.33	29.70
6	ICPL 149	136.33	80.00	125.00	7.75	18.70	314.23	3.73	7.37	84.50	31.08
7	ICPL 161	152.00	81.00	127.00	9.80	19.27	347.73	3.73	7.93	100.43	41.14
8	ICPL 81-3	147.33	79.00	125.00	10.00	19.27	288.27	3.77	7.80	81.37	39.75
9	ICPL 89	126.20	72.00	117.00	9.67	19.43	136.90	3.67	7.80	38.67	40.18
10	ICPL 90048	129.67	72.00	122.00	9.07	19.67	138.93	4.00	8.63	53.00	22.06
11	ICPL 86022	116.67	66.00	111.00	9.23	19.31	162.33	3.77	8.07	40.00	34.81
12	ICPL 92047	141.00	78.00	127.00	10.40	21.50	212.73	3.73	8.27	58.33	37.12
13	ICPA 2039 × ICPL 88034	152.00	77.00	121.00	10.07	20.13	314.73	3.80	8.10	89.67	27.25
14	ICPA 2039 × ICPL 88039	144.67	73.00	119.00	10.03	22.23	203.67	3.80	8.00	63.67	34.15
15	ICPA 2039 × ICPL 149	182.00	84.00	135.00	10.13	19.80	352.00	3.73	8.33	102.33	35.29
16.	ICPA 2039 × ICPL 161	171.00	83.00	132.00	10.33	21.50	454.17	3.77	8.17	133.33	34.62
17.	ICPA 2039 × ICPL 81-3	169.33	84.00	133.00	11.97	20.90	251.67	3.70	8.43	73.67	30.64
18.	ICPA 2039 × ICPL 89	150.00	80.00	130.00	10.30	21.60	189.30	3.73	7.77	49.67	25.59
19.	ICPA 2039 × ICPL 90048	145.87	83.00	134.00	11.27	22.38	356.53	3.73	9.03	116.67	31.69
20.	ICPA 2039 × ICPL 86022	142.00	76.00	127.00	9.85	20.20	185.87	3.80	7.83	47.83	40.67
21.	ICPA 2039 × ICPL 92047	166.67	80.00	127.00	10.03	19.83	294.60	3.77	7.37	77.33	26.75
22.	ICPA 2089 × ICPL 88034	139.33	72.00	121.00	9.89	20.93	222.87	3.50	8.30	63.67	31.99
23.	ICPA 2089 × ICPL 88039	131.20	70.00	121.00	9.76	19.98	182.33	4.13	8.10	60.00	40.68
24.	ICPA 2089 × ICPL 149	163.33	75.00	121.00	10.02	20.27	245.33	4.00	7.40	63.00	33.98
25.	ICPA 2089 × ICPL 161	139.33	76.00	128.00	10.01	21.83	206.12	3.77	7.27	57.00	37.31
26.	ICPA 2089 × ICPL 81-3	146.33	74.00	123.00	10.00	21.35	243.87	3.80	8.13	74.00	35.23
27.	ICPA 2089 × ICPL 89	129.67	73.00	122.00	10.70	20.85	166.30	3.77	8.33	54.00	43.77
28.	ICPA 2089 × ICPL 90048	140.33	72.00	127.00	9.85	20.67	139.80	3.83	8.97	49.83	22.54
29.	ICPA 2089 × ICPL 86022	136.00	72.00	118.00	10.02	18.13	123.43	3.70	8.20	37.33	34.72
30.	ICPA 2089 × ICPL 92047	132.67	73.00	127.00	9.87	19.33	197.00	3.77	8.50	51.00	37.96
31.	ICPA 2156 × ICPL 88034	151.67	75.00	125.00	10.09	22.77	160.33	3.77	8.27	46.33	27.90
32.	ICPA 2156 × ICPL 88039	133.33	77.00	129.00	9.82	18.23	165.93	4.00	9.00	57.00	37.97
33.	ICPA 2156 × ICPL 149	143.00	76.00	128.00	9.76	17.17	213.53	3.73	8.03	57.00	42.09
34.	ICPA 2156 × ICPL 161	146.00	76.00	125.00	10.57	20.37	170.07	3.73	7.67	44.67	40.35
35.	ICPA 2156 × ICPL 81-3	151.67	76.00	124.00	10.10	19.70	161.33	3.80	8.90	52.63	39.53
36.	ICPA 2156 × ICPL 89	134.67	71.00	123.00	10.67	19.40	150.33	3.83	9.07	47.00	23.90
37.	ICPA 2156 × ICPL 90048	138.00	71.00	123.00	10.87	17.07	161.63	4.20	9.00	53.33	45.34
38.	ICPA 2156 × ICPL 86022	143.33	70.00	125.00	9.90	17.30	203.93	3.60	8.13	59.00	33.65
39.	ICPA 2156 × ICPL 92047	149.53	72.00	123.00	9.81	19.43	205.33	3.57	7.87	58.57	42.63
	Parental Mean	132.22	74.00	120.00	9.85	19.12	202.65	3.8	8.07	59.91	33.64
	Mean of crosses	147.14	76.00	126.00	10.21	20.12	219.33	3.79	8.22	64.42	33.74
	General Mean	**142.85**	**75.00**	**124.00**	**10.10**	**19.82**	**214.20**	**3.79**	**8.19**	**63.04**	**34.76**
	S.Em. ±	1.98	1.37	2.78	0.09	0.24	3.49	0.09	0.09	1.59	2.45
	C.D. 5%	12.12	3.82	7.19	1.50	2.40	19.36	0.32	0.73	9.01	6.91
	C.V.	5.22	3.13	3.57	9.15	7.45	5.56	5.20	5.48	8.79	12.22

Note: A lines and B lines are isogenic except for pollen fertility. The observations of yield and yield contributing characters except pollen fertility were recorded on B-lines (ICPB 2039, ICPB 2089 and ICPB 2156).



Graph 1: Graph depicting the grain yield/plant (gm) of hybrids

SUMMARY AND CONCLUSION

The long cherished goal of pigeonpea breeders is to break the yield barrier of the crop[7]. Economic yield is always the preferable trait in almost all the crops. On that basis, ICPA 2039 × ICPL 161, ICPA 2039 × ICPL 90048 and ICPA 2039 × ICPL 149 showed high yield among the experimental material. Further multilocation trails can be carried out and these hybrids can be evaluation in different agro ecologies.

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