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HETEROSIS IN SINGLE AND THREE-WAY CROSSES IN PIGEONPEA

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Pigeonpea (*Cajanus cajan* (L.) Millsp.) is a predominant pulse crop of Indian subcontinent and constitutes a very important source of protein in the vegetarian diets. The grain yield of pigeonpea is generally low due to various physiological and management limitations [1]. The exploitation of hybrid vigour is one of the outstanding achievements of plant breeding. Though it has played an important role in allogamous crops, heterosis has been used to an advantage only in a few autogamous crops. Earlier, the emphasis was laid on single-cross hybrids. Recently, interest has been generated in developing three-way hybrids to reduce the cost of seed production and provide a broad genetic base to sustain climatic fluctuations, especially under rainfed cultivation. It is important to study the magnitude and direction of hybrid vigour and compare the performance of single and three-way crosses in pigeonpea in view of the limited number of studies on the above subject in this crop.

Two varieties, EE 76 and UPAS-120, were crossed with ten lines, viz. H77-216, H77-208, H76-19, H73-20, H72-44, ICPL 81, ICPL 87, Pant A2, Pant A4, and Pusa Ageti, to produce 20 single crosses. The F_1 of these varieties (EE 76 x UPAS-120) was, in turn, crossed as male with 20 plants of same ten lines used as female to produce 10 three-way crosses. Twelve varieties, including the two males, the F_1 male, 20 single crosses and 10 three-way crosses were compared. These 43 entries were evaluated in randomized block design with three replications during kharif at Hisar. Each population was represented by a single 3 m long row with 75 and 25 cm inter- and intrarow spacings, respectively. Data on ten competitive and randomly selected plants were recorded on eight characters including yield (Table 1). Heterosis over midparent (MP) and better parent (BP) was estimated according to the standard procedure.

The mean performance of three-way crosses was at par with single crosses (Table 1). Significant differences were observed for parents and the resulting 30 hybrids (20 single and

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Table 1. Mean performance of parents and hybrids of pigeonpea

Material	Days to maturity	Plant height, cm	Branches per plant	Clusters per plant	Pods per plant	Seeds per pod	100-seed weight, g	Yield per plant g
Parents (pooled)	123.3	193.0	13.4	78.1	266.8	3.0	6.9	47.0
Females	127.3	191.4	12.5	85.6	287.7	2.9	6.9	49.4
Males	119.2	180.5	13.5	49.8	186.7	3.1	6.5	37.9
Single cross (EE 76 x UPAS-120)	117.7	233.7	14.3	59.3	219.7	3.6	7.3	41.5
Single crosses (pooled)	125.1	196.3	16.3	121.3	381.1	3.8	6.5	84.4
Three-way crosses (pooled)	124.9	200.1	17.1	124.4	396.2	3.2	6.4	77.2
SE ±	2.8	10.6	1.4	8.7	50.7	0.2	7.6	18.3

10 three-way hybrids) for all the characters studied. Only one single cross (Pusa Ageti x EE 76) exhibited significant negative BP heterosis for days to maturity, whereas one three-way cross (ICPL 87 x EE 76 x UPAS-120) exhibited negative MP and BP heterosis for earliness. None of the crosses recorded even positive MP heterosis for 100-seed weight. For clusters per plant, ten single and five three-way crosses exhibited significant positive MP heterosis. The crosses ICPL 87 x UPAS-120 and Pusa Ageti x EE 76 x UPAS-120 showed the highest MP and BP heterosis.

Six single hybrids exhibited significant positive MP heterosis from 102.8 to 220.7% for pods per plant. Only two three-way hybrids recorded significant MP as well as BP heterosis. The cross Pusa Ageti x EE 76 x UPAS-120 recorded highest MP (224.3%) and BP (140.8%) heterosis. For seeds/pod, 12 single and 5 three-way crosses showed significant positive MP heterosis. The crosses ICPL 81 x EE 76 and H77-208 x EE 76 x UPAS-120 showed maximum MP and BP heterosis for this trait.

In respect of yield, 15 single hybrids recorded positive MP heterosis ranging from 40.6 to 238.0%. However, only 11 of them exhibited BP heterosis, the highest increase being 211.9%. Among the three-way crosses, 8 and 5 hybrids, respectively, recorded significant MP and BP heterosis. The three-way cross H73-20 x EE 76 x UPAS-120 showed highest MP (136.9%) and BP (113.9%) heterosis for yield. Out of 30 hybrids, the highest mean yield was obtained in the hybrids Pant A2 x EE 76 x UPAS-120; and H73-20 x EE76 x UPAS-120 and Pant A2 x EE76 x UPAS-120 (Table 2). It can be seen that although the overall values of mean heterosis were higher in the three-way crosses than in single crosses, a few individual single crosses recorded superiority for yield per plant over the three-way crosses. Doggett

Table 2. Mean performance of parents and the crosses showing highest heterosis for yield and its components

Cross or parent	Yield per plant, g		Pods per plant		Seeds per pod		100-seed weight, g	
	mean	heterosis	mean	heterosis	mean	heterosis	mean	heterosis
Pant A2 x EE 76	208.7	211.9**	552.0	70.8	3.4	17.0**	6.9	0.9
Pant A2 x UPAS-120	131.8	134.9**	356.2	10.2	3.5	6.1**	7.3	4.8
H 76-19 x EE 76	102.6	147.4*	472.7	46.2	3.0	1.2**	6.3	4.3
Pant A2 x EE 76 x UPAS-120	92.3	64.4**	307.0	5.0	3.6	10.1**	7.2	3.2
H73-20 x EE 76 x UPAS-120	88.9	113.9**	521.3	116.2*	3.0	9.1**	6.3	13.3
EE 76	21.5		130.7		2.9		6.0	
UPAS-120	54.4		243.3		3.3		7.0	
H 73-20	41.5		241.1		2.8		6.8	
Pant A2	56.0		323.2		2.9		6.9	
H 76-19	41.5		323.3		3.0		5.9	

*P = 0.05; **P = 0.01.

and Majisu [2] did not observe differences in mean yield between triple and single hybrids of sorghum. These authors also suggested that the triple hybrids deserve further study. But our study shows that their advantages are not very conspicuous. The present study also emphasizes the need for extensive testing of three-way crosses over a number of environments.

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