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Heterosis in cowpea (*Vigna unguiculata* L. Walp)

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Cowpea is an important legume crop of the tropics area, having various uses like vegetable, grains, dry haulms and as fodder. It is an expensive source of vegetable protein and a handy crop well adapted to relatively dry environment. The exploitation of hybrid vigour in any crop depends on substantial heterosis for yield, coupled with an economical method of producing hybrid seeds. The heterosis reveals, type of gene action involved and therefore, it help in the selection of suitable breeding methodology and parameters which are to be employed for crop improvement. Very little work has been done in studying characters in relation to green pod yield in cowpea, which would be helpful in the development of cultivars for long, tender and green poded cowpea.

Nine parents having different origin, viz; Pusa Falguni, GC-4, CGD-25, CGD-118, CGD-77, CGD-340, CGD-352, CGD-370 and CGD-402 were crossed in all possible combinations (excluding reciprocals) to get 9 x 9 diallel set. The 45 genotypes (36 F_1s, and 9 parents) were laid out in randomized block design (RBD) with three replications at Agronomy Instructional Farm, Sardarkrushinanagar Dantiwada Agricultural University, Sardarkrushinagar Gujarat during summer 2007-08. Seed were dibbed at a distance of 45 cm between row and 10 cm between plants and the recommended agronomic practices and plant protection measures were adopted for raising a good crop. The observation, were recorded by selecting randomly five plants for days to 50 per cent flowering, days to first picking, plant height (cm), number of branches per plant, pod length (cm), number of seeds per pod, number of pods per plant, green pod weight per plant (g), protein content (%) and crude fiber content (%). Heterosis over MP, BP and SC was calculated. The statistical analysis was done by employing method 2, model-1 of Griffing (1956).

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The mean square due to genotype was highly significant for all the characters, indicating the diversity present among parents. The range of heterosis i.c. MP, BP & SC for green pod yield(g) per plant was -17.63 to 55.62%, -27.28 to 47.99% and -30.22 to 20.32%, respectively (Table: 1) and 24.15 and six hybrids showed significant positive heterosis over MP, BP & SC. These finding are in agreement with Bhaskaraish *et al.,* (1978) and Singh (1983).

For the development of desirable cultivars, the characters *viz.,* days to 50 per cent flowering, days to first picking and plant height negative heterosis will be desirable. For the character days to 50% flowering, highest heterosis was recorded in CGD-370 x CGD-118 (-8.67%), CGD-370 x CGD-118 (-6.44%) over mid parent and better parent and none of heterosis over standard check out 36 crosses four, one and zero showed desired heterosis over MP, BP and SC respectively, Bhushana *et al.,* (2000) and Mehta (2000) obtained close result. For days to first picking 4, 1 and none hybrids showed highest heterosis over MP, BP and SC respectively. The results are agreement with sawarkar (1998).

Out of 36 crosses, 23, 2 and 7 showed significant heterosis over MP, BP and SC respectively and hybrid GC-4 x CGD-118 (-35.66%), CGD-118 x CGD-402 (-10.54%) and pusa falguni x CGD-340 (-15.78) showed highest heterosis for MP, BP and SC respectively for plant height. Similar observations were made by Mehta (2000) and Haibatpure (2003).

The highest heterosis recorded for branches per plant were 39.53% (CGD-118 x CGD-340), 38.43% (CGD-340 x CGD-25) and 24.05% (CGD-352 x CGD-118) over MP, BP and SC respectively. The numbers of positive significant hybrids were 4, 15 and 12 respectively. These result agreements with Singh and Arora (2003). For Pod length and number of seeds per pod exhibited highest heterosis recorded GC-4 x CGD-370 (35.79%), GC-4 x CGD-370 (32.31%) and CGD-118 x CGD-402 (33.31%) and pusa falguni x CGD-402

Table 1: Range of heterosis over Mid parent (MP), Better parent (BP) and Standard Check (SC) for different character along with best hybrids in cowpea.

Characters	Range of heterosis (%) and Best hybrid		
	MP	BP	SC
Days of 50% flowering	-8.67 to 13.76 CGD-370 x CGD-118	-6.44 to 21.16 CGD-370 x CGD-118	4.84 to 29.26 CGD-370 x CGD-118
Days to first picking	-6.72 to 12.81 CGD-402 x CGD-25	-6.03 to 16.79 CGD-402 x CGD-25	3.43 to 24.38 pusa falguni x CGD-352
Plant height (cm)	-35.66 to 18.81 GC-4 x CGD-370	-21.92 to 35.36 CGD-118 x CGD-402	-15.78 to 47.78 pusa falguni x CGD-370
Branches per plant	-0.39 to 39.53 CGD-118 x CGD-340	-21.92 to 38.43 CGD-118 x CGD-402	-10.77 to 33.31 CGD-118 x CGD-402
Pod length (cm)	-14.97 to 35.79 GC-4 x CGD-370	-19.49 to 32.31 GC-4 x CGD-370	-10.77 to 33.31 CGD-118 x CGD-402
Seeds per pod	-13.41 to 52.26 pusa falguni x CGD-402	-21.45 to 50.41 pusa falguni x CGD-402	6.94 to 60.45 pusa falguni x CGD-402
Pods per plant	-17.28 to 58.24 CGD-370 x CGD-25	-19.73 to 57.48 CGD-370 x CGD-25	-24.14 to 29.07 GC-4 x CGD-402
Green pod yield(g)	17.63 to 55.62 CGD-370 to CGD-25	-27.28 to 47.99 CGD-370 x CGD-25	-30.22 to 20.32 pusa falguni x CGD-402
Protein content	-21.17 to 16.33 CGD-77 x CGD-340	-24.82 to 13.46 CGD-352 x CGD-25	-20.40 to 7.86 CGD -370 x CGD-352
Crude fiber	-24.22 to 80.94 CGD-370 x CGD-352	-35.08 to 70.7 CGD-370 x CGD-402	-32.49 to 22.13 pusa falguni x GC-4

Table 2: Comparative study of most promising heterotic hybrid for green pod yield with useful and component characters showing desired heterosis.

Hybrid	Heterosis for green yield over			Useful and significant heterosis over MP for component trait	Useful and significant heterosis over BP for component trait	Useful and significant heterosis over BP for component trait
	MP	BP	SC			
Pusa falguni x CGD-370	50.11**	24.48**	20.52**	PH,PL,SP,PP,GP	PL,SP,PP,GP	PL,SP,PP,GD
GC-4 x CGD-25	63.37**	39.88**	19.43**	PH,B,SP,PP,GP	BP,SP,PP,GP	BP,SP,PP,GP
Pusa falguni x CGD-402	34.67**	22.62**	18.53**	PL,SP,GP	PL,SP,GP	PL,SP,GP

** Signigicant at 1% level

Where, **BP**=Branches per plant **PP**=pod per plant **PL** = pod length (cm)
GP=Green pod yield (g) **PH**=Plant height (cm) **SP**=Seeds per pods

(52.26%), pusa falguni x CGD-402 (50.41%) and pusa falguni x CGD-402 (60.45%) over MP, BP and SC respectively, out of these 20, 17 and 16 and 20,17 and 31 crosses showed significant over MP, BP and SC respectively. These finding are close related with Sawarkar (1998) and Valarmathi and Surendran (2007). For number as pods per plant, which is main component of yield, 21, 16 and 13 hybrids manifested significant positive heterosis over MP, BP and SC respectively and CGD-370 x CGD-25 (58.24%), CGD-370 x CGD-25 (57.48) and GC-4 x CGD-402 (29.07) hybrid showed highest heterosis over MP, BP and SC respectively. Similar results are obtained by Sawarkar (1998).

The hybrid CGD-77 x CGD-340 (16.33%), CGD-352 x CGD-25 (13.45%) and CGD-370 x CGD-352(7.86%) and CGD-370 x CGD-352 (80.94%), CGD-370 x CGD-402 (70.7%) and pusa falguni x GC-4 (22.13%) highest heterosis over MP, BP and SC respectively for protein content and crude fiber content. The number of positive heterosis 16, 9 and 10 and 22, 16 and 3 for protein content and crude fiber content over MP,BP and SC respectively. Similar result obtained by Valarmathi and Surendran (2007).

The comparative study of most promosing three hybrids for green pod yield per plant (g) with useful and component characters showing desired heterotic hybrids

for green pod yield did not show all component characters in common. In fact, appreciable heterosis for one or two components was sufficient to manifest heterosis for green pod yield. The result are agreement with the findings of Patil and Shete 1987. The high heterotic effects of grain yield in these cases were mainly with significant heterotic effects of pods per plant, seed per pod, pod length and branches per plant.

The hybrids pusa falguni x CGD-370, GC-4 x CGD-25 and pusa falguni x CGD-402 were found high heterotic hybrids for green pod yield per plant(g). They also had high heterosis for mainy yield attributing characters in desired direction. These hybrids offer best possibilities of further exploitation for development of high yielding varieties.

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