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Variability Heritability and Expected Genetic Advance in F_2 Generation of Four Cowpea Crosses

D. R. Mehta and P. P. Zaveri

Department of Botany, College of Agriculture,
Gujarat Agricultural University, Sardar Krushinagar

Cowpea (*Vigna unguiculata* (L.) Walp) is one of the most important early, multiseason, multipurpose, annual leguminous crops in the tropics and substropics. Selection is basically most important tool in the hand of plant breeders for developing high yielding genotypes and its efficiency depends upon nature and amount of genetic variability present in breeding materials. With this view, four F_2 populations viz., (1) Pusa Falguni x V 269, (2) GC 1 x RC 8, (3) GC 2 x V 16 and (4) GC 2 x V 240 were planted on 6th March 1991 at the College Instructional Farm, Gujarat Agricultural University, Sardar Krushinagar alongwith its parents. Each F_2 was grown in 9.0 m long block accommodating 14 rows with a spacing of 45 x 15 cm. The population size of F_2 was 794, 792, 791 and 785 plants for cross 1 to cross 4, respectively. Two rows each of the seven parents were grown next to F_2 populations in 9.0 m row length plots. Observations were recorded for pods per plant and seed yield per plant on 250 plants in each of the F_2 populations and 10 plants in each of the parents. Measurements on days to 50 per cent flowering and days to maturity were noted on plot basis. Genotypic variance was calculated by substrating suqare root of product of variance of parents from variance of F_2. The genotypic and phenotypic coefficients of variation (GCV and PCV), heritability in broad sense and expected genetic advance were computed according to Burton (1952), Mahmud and Kramer (1951) and Allard (1960), respectively.

Variability parameters, heritability and expected genetic advance were estimated for pods per plant and seed yield per plant in original unselected F_2 population of four cowpea crosses and days to 50 per cent flowering and days to maturity in F_2 and parents (Table 1). The maximum and minimum phenotypic range were observed in cross 2 and cross 3, respectively for number of pods per plant and seed yield per plant. Among the crosses, the highest number of pods per plant were observed in cross 4 (17.8) which was significantly higher than rest of the crosses. The highest seed yield per plant was also recorded in cross 4 (16.5 g) which was statistically at par with cross 2 (16.1 g) but significantly higher than cross 1 and cross 3. Phenotypic and genotypic variance for both the traits were highest in cross 2 and lowest in cross 3. The maximum phenotypic and genotypic coefficient of variation of both the

TABLE 1

(a) Variability parameters for number of pods per plant and seed yield per plant in F_2 generation of four cowpea crosses.

Parameters	*Pusa Falguni x V 269 (cross 1)*		*GC 1 x RC 8 (cross 2)*		*GC 2 x V 16 (cross 3)*		*GC 2 x V 240 (cross 4)*	
	Pods per plant	*Seed yield per plant*	*Pods per plant*	*Seed yield per plant*	*Pods per plant*	*Seed yield per plant*	*Pods per plant*	*Seed yield per plant*
Range	4.0 - 36.0	3.5 - 31.5	7.0 - 42.0	4.5 - 44.5	7.0 - 36.0	5.0 - 31.5	7.0 - 41.0	6.0 - 36.5
%								
Mean ± S. E.	16.1^{ab} ± 0.4	15.0^{b} ± 0.4	16.6^{a} ± 0.5	16.1^{ab} ± 0.5	15.2^{b} ± 0.4	13.5 ± 0.3	17.8 ± 0.4	16.5^{a} ± 0.4
σ_p^2	36.4	32.8	49.7	51.8	30.5	26.7	39.2	35.0
σ_g^2	25.3	25.2	39.5	45.7	21.9	14.6	28.4	25.1
σ_e^2	11.1	7.6	10.2	6.1	8.6	12.1	10.7	9.9
PCV (%)	37.5	38.3	42.5	44.8	36.2	38.2	35.2	35.9
GCV (%)	31.2	33.5	37.8	42.1	30.7	28.3	30.0	30.4
h^2 (%)	69.4	76.8	79.5	88.3	71.9	54.7	72.6	71.2
GA	7.4	7.7	9.8	11.2	6.9	4.9	8.0	7.4
GA (% mean)	45.8	51.6	59.2	69.4	45.7	36.7	44.8	44.8
P_1^{++} Mean	12.4 ± 1.2	11.3 ± 0.5	12.0 ± 1.1	10.3 ± 0.6	19.8 ± 1.2	18.1 ± 1.1	19.8 ± 1.2	18.1 ± 1.1
P_2^{++} Mean	16.4 ± 0.9	21.7 ± 1.4	14.9 ± 0.9	12.9 ± 1.0	13.1 ± 0.7	21.4 ± 1.1	16.9 ± 0.9	20.4 ± 0.9

(b) Mean days to 50% flowering (DF) and days to maturity (DM) for F_2 and parents, summer season, 1991

	Days to 50% flowering	*Days to maturity*	*Days to 50% flowering*	*Days to maturity*	*Days to flowering*	*Days to maturity*	*days to 50% flowering*	*Days to maturity*
$\overline{F}_2$	49	70	47	67	51	80	54	82
$\overline{P}_1$	46	63	47	61	45	62	45	62
$\overline{P}_2$	55	72	43	60	57	76	54	70

$ For each character. values with common superscript do not differ significantly from each other at P = 0.05 as determined by Z-test.

* The population size of F_2 generation was 794. 792. 791 and 785 plants in cross 1 to 4. respectively.

** The first parent is P_1 and second is P_2 in all the four crosses.

characters were observed in cross 2. The estimates of PCV were lowest for both the traits in GC 2 x V 240.

The estimates of heritability in broad sense was high and ranged from 69.4% (cross 1) to 79.5% (cross 2) for pods per plant and from 54.7% (cross 3) to 88.3% (cross 2) for seed yield per plant. Similarly, the expected genetic advance as per cent of mean was found to be maximum in cross 2 and minimum in cross 3 for both these traits. High heritability coupled with high expected genetic advance as per cent of mean observed for both the traits in F_2 populations of all the four crosses indicated presence of good variability and possibilities of genetic gain through selection in these populations.

The reservior of genotypic variation is basic requirement of breeding crop plants. For any kind of selection scheme to be effective, presence of adequate genetic variability in the population is a pre-requisite. Wider the genetic variability, more the chances of improvement through selection. In autogamous crops, additive genetic variance is apparently more important than non-additive type of variance (Matzinger, 1963). In the present study, high mean performance, wider range of variation, along with higher values of genotypic and phenotypic variances as well as its coefficient of variation displayed relatively higher amount of genetic variability for pods per plant and seed yield per plant in all the four crosses (Table 1). The extent to which the genetic segregation is expected in later generation of cross is largely a reflection of the heritability of the characters in question (Mahmud and Kramer, 1951). The heritability was calculated by utilizing the variability among spaced F_2 plants in relation to the variability among spaced plants of the non-segregating parents. High heritability coupled with high expected genetic advance as per cent of mean was observed for pods per plant and seed yield per plant for all the four crosses which indicated the predominant role of additive gene action in the expression of both the traits. The present findings are akin to the results reported by Chauhan and Joshi (1981), Patil and Bhapkar (1986), Patil and Shete (1986), Patel (1988) and Patel (1991) in cowpea.

The parents involved in the four crosses showed a considerable range of variation for all the characters studied. It is worth mentioning here that the parents Pusa Falguni, GC 1 and RC 8 were low yielder but were earlier in flowering and maturity. Whereas the parents V 16, V 240 and V 269 were high yielder with delayed flowering and maturity. GC 2, earlier in flowering and maturity coupled with high seed yield, is a best cultivated variety available in this part of the country. It was also observed that except for days to maturity in cross 2, 3 and 4, the F_2 had intermediate values to their parents for days to 50 per cent flowering and days to maturity.

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