

## GENE EFFECTS AND HETEROSIS FOR SOME QUANTITATIVE CHARACTERS IN CLUSTERBEAN

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### ABSTRACT

Studies on gene effects, heterosis and inbreeding depression for eleven quantitative characters in two crosses of clusterbean [*Cyamopsis tetragonoloba* (L.) Taub.] revealed that additive, dominance and additive x additive genetic components were predominant in Mills x Durgajay whereas HFG60 x Durgajay exhibited dominance x dominance gene effects for most of the traits. Both duplicate and complementary type of epistasis were involved in most of the characters in both the crosses. High heterosis and less inbreeding depression were observed for pods/plant and seed yield/plant in Mills x Durgajay.

### INTRODUCTION

Clusterbean has diverse industrial uses on account of the gum contained in its endosperm. Studies on inheritance of quantitative characters in clusterbean are very limited. Chaudhary (1979), Hooda (1981) and Jhorar *et al.* (1984) reported the importance of additive as well as dominant components of variation for the regulation of most of the quantitative traits. This paper reports information on gene effects, epistatic effects, heterosis and inbreeding depression for some quantitative characters in two crosses in clusterbean.

### MATERIAL AND METHODS

Parents and F<sub>1</sub>, F<sub>2</sub> and F<sub>3</sub> generations of each of the two crosses (Mills x Durgajay and HFG 60 x Durgajay) were sown under rainfed conditions in a Randomised Block Design with 3 replications at the research area of Department of Plant Breeding, H.A.U., Hisar. The material was sown on July 10, 1978 in 3-metre row plots spaced 45 cm apart by dibbling two seeds per hill at a distance of 10 cm. Thinning was done after 3 weeks to retain one plant per hill. Five plants each from parents and F<sub>1</sub> and 15 plants each from F<sub>2</sub> and F<sub>3</sub> were used for recording observations on 11 quantitative characters. Chemical analysis for total protein (McKenzie

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and Wallace, 1954) and gum content (Das *et al.*, 1977) was done. Gene effects were calculated following Hayman (1958). Heterosis (%) was calculated over better parent and inbreeding depression were estimated as the per cent decrease of  $F_2$  performance over  $F_1$  performance.

## RESULTS AND DISCUSSION

The additive gene effects were important for the inheritance of days to first flowering, plant height, clusters/plant, pods/plant, pod length, seeds/pod, seed yield/plant and days to maturity in Mills x Durgajay and plant height and protein content in HFG 60 x Durgajay (Table 1).

Dominance gene effect was of greater importance compared to additive gene effects for pod length in both the crosses, and for seed yield/plant, days to maturity and protein content in Mills x Durgajay; and for plant height in HFG 60 x Durgajay. The sign of 'h' was negative for days to first flowering in HFG 60 x Durgajay, thereby indicating dominance for earliness.

Additive x additive interactions were significant for pod length in both the crosses, for days of maturity and protein content in Mills x Durgajay and for plant height in HFG 60 x Durgajay. Dominance x dominance type of epistasis was present for plant height and pod length in Mills x Durgajay; and for days to first flowering, branches/plant, clusters/plant, days to maturity and gum content in HFG 60 x Durgajay.

Duplicate epistasis was present for most of the characters in both the crosses. Complementary type of epistasis was observed for clusters/plant, pods/plant seed yield/plant and protein content in HFG 60 x Durgajay, whereas, significant heterosis was recorded for pods/plant only. Heterosis for other traits could not be observed in this cross, because either the value of 'h' was not high enough to counter balance the value of 'd' and 'i' effects or, it was negative. Significant inbreeding depression for pods/plant and gum content was noted in HFG 60 x Durgajay.

Pods/plant, seed yield/plant and protein content indicated significant heterosis and duplicate type of epistasis in Mills x Durgajay. Although in duplicate epistasis heterosis is not expected, yet this is possible due to internal cancellation of effects of various components. In these cases values of 'h' are very high in comparison to 'd', thus heterosis was actually present. Saini and Jhorar (1979) reported heterosis for seed yield in different  $F_1$  hybrids of *guar* of the order of 85.18% over better parent and 100.27% over best check. Pods/plant and seed yield/plant did not show any significant depression, though it was recorded for protein content in Mills x Durgajay.

The significant occurrence of additive, dominance and epistatic components necessitated a breeding methodology which would best utilize all these types of gene

Table 1. Gene effects, heterosis and inbreeding depression for some quantitative characters in clusterbean

<sup>1</sup> Crosses	Genetic Parameters				l	Heterosis over better parent (%)	Inbreeding depression (%)
	m	d	h	i			
Days to first flowering							
1	59.60**	8.60**	1.45	-5.17**	-13.76**	37.80	-3.80
2	57.36**	0.40	-3.59*	-3.30	12.32*	0.19	2.18
Plant height							
1	145.22**	10.07**	-33.52**	-53.75**	136.15**	6.67	10.63
2	179.10**	5.27*	20.65**	20.63**	-112.97**	-3.16	-11.12
Branches/plant							
1	15.07**	1.23	-3.57	-5.76*	4.55	7.05	-4.51
2	11.87**	0.63	-0.04	-3.66	19.75*	21.64	29.30
Clusters/plant							
1	46.00**	6.83**	2.77	-13.11	11.45	21.97	8.46
2	32.58**	2.00	2.99	-8.03	48.57	24.23	29.49
Pods/plant							
1	133.98**	16.70**	40.29	-10.63	-41.50	31.20**	6.80
2	106.16**	6.30	24.55	-20.71	-107.43	37.58**	26.93*
Pod length							
1	6.01**	0.44**	1.12**	-1.35**	1.81**	-9.78	1.80
2	5.62**	0.11	0.43*	0.47*	-1.23*	-2.67	-1.63
Seed/pod							
1	8.04**	0.34**	-0.02	-0.06	0.27	-3.57	0.74
2	8.09**	0.17	0.23	0.19	-0.52	-1.57	-0.25
Seed yield/plant							
1	25.98**	4.48**	19.07**	6.18	-25.94	40.76*	10.51
2	19.05**	2.13	7.12	-0.34	9.02	26.95	24.07
Days to maturity							
1	130.69**	1.83**	2.88**	2.13*	-16.25**	1.91	-2.05**
2	130.44**	0.33	-0.68	-1.19	-6.16*	0.64	0.19
Protein content							
1	31.17**	0.20	7.97**	5.37*	-0.27	7.34*	11.17*
2	29.77**	2.43**	1.34	-0.69	2.00	-2.73	3.78
Gum content							
1	30.91**	0.85	0.55	1.92	-14.27	-7.44	-11.19
2	28.64**	1.03	-4.62	-8.46**	-25.68**	9.8	12.55*

\*P ≤ 0.05; \*\* P ≤ 0.01 <sup>1</sup>Cross 1-Mills × Durgajay; Cross 2-HFG 60 × Durgajay.

effects. Dominance component could be exploited through heterosis breeding. But the exploitation of heterosis in a strictly self-pollinated crop like clusterbean is not possible because of floral biology and the practical difficulties involved in producing hybrid seed. To make use of additive component of genetic variation, pedigree method of selection would be more desirable, however, presence of duplicate epistasis may hinder the progress through the procedure of selection to which additive component is amenable. Eberhart (1972), however, suggested adoption of biparental crossing or population building approach for making use of additive component of genetic variance in sorghum.

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