

## Heterosis Effects in 'Crinkled Leaf' Heterozygotes in *Gossypium arboreum* L.

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**Introduction:** The inheritance of 'crinkled leaf'—a new abnormal mutant spotted as a rogue in the seventh generation of an inter-racial cross in *G. arboreum* L. viz. *indicum* x *cernuum* was reported earlier (Balasubrahmanyam and Santhanam, 1951). This type which was characterised by abnormal leaf crinkles, gave monofactorial inheritance in crosses with normal-leaved parents. The F<sub>1</sub> exhibited partial dominance for leaf crinkling with intermediate grades of crinkled leaves and the F<sub>2</sub> segregated in the ratio of 1:2:1 respectively for normal, F<sub>1</sub> and crinkled phenotypes. Both the parental classes bred true in the F<sub>3</sub> while the 'intermediates' again threw out the three phenotypes in the ratio of 1:2:1.

It was sought to study heterosis effects, if any, in a segregating population drawn from the 'crinkled leaf' crosses, as the three genotypes were morphologically distinguishable here. In wheat, Granhall (1949) utilised a similar advantage in recognising heterozygous 'half-bearded' plants in a population for the 'beardness' factor and found that the heterozygotes in the F<sub>2</sub> were on an average more vigorous than the 'beardless' and 'bearded', parental class of segregates.

**Material and Methods:** Two crosses of the 'crinkled leaf' mutant with normal-leaved types CST 3 and '1274', both belonging to *G. arboreum* race *indicum* were taken up for study. In the case of CST 3 cross, the first backcross of the F<sub>1</sub> to the normal leaved-parent was also utilised in addition to the F<sub>2</sub> which was studied in both the crosses. In all the hybrid populations, the three genotypes could be easily marked out.

Data were gathered on final height and fresh weight of plants. The height measurements were made with a metre scale and reckoned to the nearest millimetre. The plants were then cut at the cotyledonary node and the weights recorded immediately. The weight of *kapas* collected from each of the plants was added to their respective fresh plant weights for obtaining total weight data.

Heterosis effects were sought to be recognised in terms of both these attributes viz. final plant height and total weight. The individual plant values under each of the three pheno and genotypes viz. homozygous normal (like parent); heterozygous (partially) 'crinkled' (like F<sub>1</sub>); and homozygous 'crinkled' (like parent) were tabulated separately and the respective means of population and errors of distribution worked out. The differences between the mean values of the heterozygote and the homozygotes were tested for significance with reference to *t* values of Fisher (1938).

**Experimental Results:** The data obtained from the first backcross and second generation hybrids of CST 3 x 'crinkled' and F<sub>2</sub> of 'crinkled' x '1274' are furnished in Table I.

TABLE I.  
Heterosis effects in 'crinkled leaf' heterozygotes

	Plant height in cm.	Total weight in gm.
I. (CST 3 x crinkled) F <sub>1</sub> x CST 3:		
Pheno and Genotypes { Heterozygous like F <sub>1</sub>	49.3	93.2
{ Homozygous normal	46.1	72.6
Difference of heterozygote from norm	+ 3.2	- 20.6
Significance of difference	No	Yes
II. CST 3 x Crinkled F <sub>2</sub> :		
Pheno and Genotypes { Homozygous crinkled	41.0	26.7
{ Heterozygous like F <sub>1</sub>	56.7	73.6
{ Homozygous normal	52.7	67.2
Difference of heterozygote from:		
(1) Crinkled	+ 15.7	- 46.9
(2) Normal	+ 4.0	- 6.4
Significance of difference: (1)	Yes	Yes
(2)	No	No
III. Crinkled x 1274 F <sub>2</sub> :		
Pheno and Genotypes { Homozygous crinkled	37.2	18.0
{ Heterozygous like F <sub>1</sub>	59.2	53.8
{ Homozygous normal	45.5	45.1
Difference of heterozygote from:		
(1) Crinkled	+ 22.0	- 35.8
(2) Normal	+ 13.7	- 8.7
Significance of difference: (1)	Yes	Yes
(2)	No	No

It is interesting to note that in the case of plant height as well as total weight, the heterozygotes have uniformly recorded higher values than the two homozygotes in all the segregating populations. However, the increase over the 'normal' is significant only in the case of total weight in the backcross population, while the positive differences of the 'heterozygote' from the 'crinkled' are significant in all cases.

**Discussion:** In many crop plants like *Sorghum*, barley, maize and wheat, instances of heterozygote superiority have been recorded. The term monohybrid heterosis has usually been applied to such manifestations of hybrid vigour in crosses between biotypes, genetically known to differ by a single allelic alteration.

In *Pisum*, Ramusson (1927) reported better germination for seeds harvested from plants heterozygous for the anthocyanin factor than these from the respective homozygous parents. Karper (1930) measured the height of plants in a segregating progeny of an *albina* cross in *Sorghum* and found the heterozygotes to be visibly, although slightly more vigorous than their normal sister plants. Dealing with barley crosses involving

white and yellow seedling lethals, Robertson and Austin (1935), found significant increases in length of culm or length of head in the heterozygous green plants. Jones (1945) found heterosis in several maize crosses involving recessive variations with the respective normal parent lines. Gustafsson (1946) reviewed the earlier results in both plants and animals and presented interesting examples of improved viability in heterozygotes from chlorophyll-deficient and other lethals in many barley crosses. The same author (1947) extended the study to dihybrid off-springs from *albina* and *xantha* crosses in barley and found them to be distinctly superior to their normal sister plants in yield characters.

It has generally been postulated that the above phenomena resulted either from multiple effects possessed by the gene, known as pleiotropism or due to linkage with other growth, yield and physiological factors. These effects may further not be mutually exclusive.

The 'crinkled' type used in the present study is an abnormal variation, late in maturity with a high 'node number' and carries with it chlorotic patches on the leaves and consequent lowered yield. The parents involved in its crosses are known to differ from the same in a major gene viz. *crA* and possibly in other minor modifiers as well, in view of their divergent sources of origin. Types CST 3 and '1274' are Coconada (*indicum*) lines from the Godavari tract, while the 'crinkled' mutant originated from an *indicum* x *cernuum* hybrid complex. The consistent intensification in height and weight exhibited by the 'crinkled heterozygote' may therefore be explained as due to pleiotropic effects of the *crA* gene and interaction of different modifier complexes contributed by either parent.

**Summary:** Two crosses of the 'crinkled leaf' mutant with normal leaved types in *Gossypium arboreum* L were studied for heterosis effects. The hybrid material offered the advantage of phenotypic distinction between the hetero and homozygotes.

The 'crinkled heterozygote' recorded uniformly higher values for plant height and total weight in all the segregating populations. However the increase over the 'normal' was significant in one instance only, while the positive differences of the 'heterozygote' from the 'crinkled' were significant in all cases.

Pleiotropic effects of *crA* gene and interaction of different modifier complexes are suggested as possible causes for the 'heterozygote vigour'.

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## Rainfall in the Ceded Districts

By

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**Introduction:** The districts of Anantapur, Bellary, Cuddapah and Kurnool form the zone known as the "Ceded Districts" in the Madras State. This zone is a typical dry-farming tract. Barring a few pockets of garden-lands, the major portion of the area under cultivation in these four districts is rainfed. Hence the nature of precipitation decides the success or failure of farming in this tract. The tract is situated between longitude  $3^{\circ} 4'$  to  $16^{\circ} 25'$  and latitude  $75^{\circ} 40'$  to  $79^{\circ} 33'$  and at an altitude that varies from 500 to 2500 feet. Bellary and Anantapur form the northern and North-Eastern extremity of the Mysore plateau and Kurnool and Cuddapah touch the East coast districts of Nellore and Guntur.