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# HETEROSIS IN THE INTRA AND INTER SUB-SPECIFIC CROSSES OF GROUNDNUT (ARACHIS HYPOGAEA L.)

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ABSTRACT

The Inter-subspecific crosses involving Spanish x Virginia genotypes exhibited greater magnitude of heterobeltiosis for pod yield, pod number, pod and kernel weights than the intra- subspecific crosses. The intra-subspecific crosses were superior for plant height. Negative heterosis was observed for shelling percentage in both the types of crosses.

KEY WORDS : Groundnut, Heterosis

Groundnut (*Arachis hypogaea* L.) is the ıost important oilseed crop in India. eveloping hybrid varieties of groundnut is ɔt possible because of the difficulties ıvolved in producing hybrid seed on ommercial scale due to non-availability of ıale sterility and problems related to floral :ructure. However, the yield potential of ne existing cultivars can be improved and his can be done by identifying potential :ross combinations on the basis of ıeterosis. The present study is oriented to ɜstimate the extent of heterosis in the intra ınd inter-subspecific crosses of groundnut.

## ИATERIALS AND METHODS

Six Spenish Bunch cultivars (sub sp. *'astigiata* var. *vulgaris*) *viz.*, TMV 2, TMV 7, ΓMV 9, TMV 12, Co 1 and J 11 were used as ɔvule parents and two Valenecia genotypes (sub sp. *Fastigiata* var. *fastigiata*) *viz.*, Gangapuri and EC 21137-1 and one Virginia :ype (sub sp. *hypogaea* var. *hypogaea*) Robut 33-1 were used as pollen parents. The resulting 18 F1 hybrids were grown along with nine parents in randomised block design replicated thrice. A spacing of 30 x 15 cm was adopted. At maturity, observations were recorded on plant height, pod number, pod yield, 100 pod and kernel weights and shelling percentage on five hybrid plants selected at random. The heterosis and heterobeltiosis were estimated. The test of significance of heterosis was tested by adopting the usual method.

## RESULTS AND DISCUSSION

The results of analysis of variance for six traits are presented in Table 1. The variances due to genotypes observed for the six traits under study were significant. The mean values of the parents and hybrids are furnished in Table 2. Heterosis and heterobeltiosis are presented in Table 3.

For plant height, all the 12 crosses involving the Valencial genotypes as pollen parents showed significant heterobeltiosis. Wherever the Virginia type Robut 33-1 was

Table 1. Analysis of variance for six traits in groundnut

| Source | df | Mean squares | | | | | |
|---|---|---|---|---|---|---|---|
| | | Plant height | Pod No. per plant | 100 pid weight | Shelling % | 100 kernel weight | Pid yield per plant |
| Genotypes | 26 | 290.62** | 16.87** | 209.28** | 50.32 | 72.30* | 13.42** |
| Error | 54 | 29.09 | 7.45 | 60.43 | 24.25 | 29.32 | 5.75 |

*, ** Significant at 5% and 1% levels respectively

Table 2. Mean values of parents and hybrids

| Parents/Hybrids | Plant height (cm) | Pod No. per plant | 100 pod weight (g) | Shelling (%) | 100 kernel weight (g) | Pod yield per plant (g) |
|---|---|---|---|---|---|---|
| Spanish | | | | | | |
| TMV 2 | 45.9 | 9.0 | 66.8 | 68.7 | 30.9 | 6.1 |
| TMV 7 | 42.5 | 6.9 | 68.3 | 70.4 | 30.4 | 4.7 |
| TMV 9 | 41.7 | 10.7 | 67.4 | 64.4 | 27.3 | 7.3 |
| TMV 12 | 40.3 | 7.8 | 69.2 | 69.7 | 30.2 | 5.4 |
| CO 1 | 41.6 | 9.8 | 56.6 | 65.3 | 26.6 | 5.8 |
| J 11 | 37.4 | 20.1 | 71.6 | 72.2 | 30.3 | 7.2 |
| Valencia | | | | | | |
| Gangapuri | 43.3 | 6.6 | 89.8 | 56.4 | 32.2 | 5.9 |
| EC 21137-1 | 41.5 | 7.6 | 75.2 | 63.9 | 31.0 | 5.7 |
| Virginia | | | | | | |
| Robut 33-1 | 24.5 | 10.1 | 64.0 | 64.9 | 29.7 | 6.5 |
| Spanish x Valencia | | | | | | |
| TMV 2 x Gangapuri | 55.9 | 10.0 | 76.6 | 60.3 | 36.3 | 7.6 |
| TMV 7 x Gangapuri | 57.5 | 10.6 | 91.0 | 62.3 | 36.3 | 9.7 |
| TMV 9 x Gangapuri | 56.5 | 8.8 | 65.7 | 57.0 | 32.3 | 6.1 |
| TMV 12 x Gangapuri | 60.9 | 10.9 | 71.3 | 55.2 | 32.8 | 7.8 |
| CO 1 x Gangapuri | 61.8 | 11.5 | 65.9 | 63.8 | 42.0 | 7.7 |
| J 11 x Gangapuri | 57.0 | 9.9 | 73.6 | 60.5 | 34.6 | 7.3 |
| TMV 2 x EC 21137-1 | 56.0 | 14.8 | 65.5 | 61.4 | 35.3 | 9.8 |
| TMV 7 x EC 21137-1 | 61.3 | 10.6 | 84.1 | 66.0 | 32.7 | 8.9 |
| TMV 9 x EC 21137-1 | 55.7 | 12.9 | 80.5 | 57.9 | 35.6 | 10.4 |
| TMV 12 x EC 21137-1 | 60.2 | 7.9 | 77.9 | 57.8 | 32.7 | 5.9 |
| CO 1 x EC 21137-1 | 54.5 | 11.2 | 68.6 | 74.9 | 38.3 | 8.0 |
| J 11 x EC 21137-1 | 50.2 | 11.8 | 73.2 | 65.2 | 36.4 | 8.6 |
| Spanish x Virginia | | | | | | |
| TMV 2 x Robut 33-1 | 35.7 | 12.1 | 77.1 | 66.1 | 37.4 | 9.2 |
| TMV 7 x Robut 33-1 | 40.3 | 13.4 | 89.2 | 66.4 | 35.4 | 12.2 |
| TMV 9 x Robut 33-1 | 39.8 | 16.3 | 81.6 | 66.8 | 44.6 | 13.3 |
| TMV 12 x Robut 33-1 | 41.3 | 12.4 | 71.8 | 62.3 | 30.9 | 9.0 |
| CO 1 x Robut 33-1 | 39.4 | 11.2 | 72.8 | 63.7 | 32.1 | 8.4 |
| J 11 x Robut 33-1 | 39.5 | 14.1 | 75.2 | 68.4 | 31.6 | 10.7 |
| SE m± | 3.1 | 1.6 | 4.5 | 2.8 | 3.1 | 1.4 |

involved in crosses, there had been considerable reduction in hybrid vigour extending even towards the negative side. Hybrid vigour for plant height was also reported by Seshadri (1962) and Parker *et al.* (1970).

All but two hybrids produced more number of pods than their corresponding better parents. However, two cross combinations *viz.*, TMV 9 x Robut 33-1 and TMV 2 x EC 21137-1 exhibited heterobeltiosis. Heterobeltiosis ranged from -17.8 to 64.4 per cent. The over all potentiality for the production of pods in the inter subspecific crosses was 29.7 per cent over the better parents whereas it was 21.6% in the intra-subspecific crosses.

**Table 3: Specific combining ability effects in a 7 X 7 diallel in greengram**

| Crosses | Plant height | | Pod No. per plant | | 100 pod weight | | Shelling % | | 100 kernel weight | | Pod yield per plant | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MP | BP | MP | BP | MP | BP | MP | BP | MP | BP | MP | BP |
| Spanish x Valencia | | | | | | | | | | | | |
| TMV 2 x Gangapuri | 25.3** | 21.8* | 28.2 | 11.1 | -2.20 | -14.7* | -3.6 | -12.2 | 15.1 | 12.7 | 26.7 | 24.6 |
| TMV 7 x Gangapuri | 34.0** | 32.8** | 57.0 | 53.6 | 15.1 | 1.3 | -1.7 | -11.5 | 16.0 | 12.7 | 83.0* | 64.4 |
| TMV 9 x Gangapuri | 33.6** | 31.2** | 1.7 | -17.8 | -16.4* | -26.8** | -5.6 | -11.5 | 8.6 | 0.3 | -7.6 | -16.4 |
| TMV 12 x Gangapuri | 45.7** | 40.6** | 51.4 | 39.7 | -10.3 | -20.6** | -12.5 | -20.8** | 5.1 | 1.9 | 38.1 | 32.2 |
| CO 1 x Gangapuri | 45.6** | 42.7** | 40.2 | 17.3 | -10.0 | -26.6** | -4.8 | -2.3 | 42.9** | 30.4* | 31.6 | 30.5 |
| J 11 x Gangapuri | 41.3** | 31.6** | 18.6 | -2.0 | -8.8 | -18.0* | -5.9 | -16.2** | 10.7 | 7.5 | 11.5 | 1.4 |
| TMV 2 x EC 21137-1 | 28.1** | 23.0* | 78.3** | 64.4** | -7.7 | -12.9 | -7.4 | -10.6 | 14.1 | 13.9 | 66.1* | 60.7 |
| TMV 7 x EC 21137-1 | 46.0** | 44.2** | 46.2 | 39.5 | 17.2 | 11.8 | -1.7 | -6.3 | 6.5 | 5.5 | 71.2 | 56.1 |
| TMV 9 x EC 21137-1 | 33.9** | 33.6** | 41.0 | 20.6 | 12.9 | 7.0 | -9.7 | -10.1 | 22.1 | 14.8 | 60.0* | 42.5 |
| TMV12 x EC 21137-1 | 47.2** | 45.1** | 2.6 | 1.3 | 7.9 | 3.6 | -3.5* | -17.1** | 6.9 | 5.5 | 6.3 | 3.5 |
| CO1 x EC 21137-1 | 31.2** | 31.0** | 28.7 | 14.3 | 4.1 | -8.8 | 15.9* | 14.7* | 33.0* | 23.5 | 39.1 | 37.9 |
| J11 x EC 21137-1 | 27.2* | 21.0* | 33.3 | 16.8 | -0.3 | 2.7 | -4.2 | -9.7 | 18.8 | 17.4 | 33.3 | 19.4 |
| Mean | 36.6 | 33.1 | 35.6 | 21.6 | 0.1 | -8.5 | -3.8 | -9.5 | 16.7 | 12.2 | 38.3 | 29.7 |
| Spanish x Virginia | | | | | | | | | | | | |
| TMV 2 x Robut 33-1 | 1.4 | -22.2* | 26.7 | 19.8 | 17.9 | 15.4 | 1.0 | -12.2 | 23.4 | 21.0 | 46.0 | 41.5 |
| TMV 7 x Robut 33-1 | 20.3 | -5.2 | 57.6* | 32.7 | 34.8** | 30.6** | -1.8 | -5.7 | 17.8 | 16.4 | 117.9** | 87.7** |
| TMV 9 x Robut 33-1 | 20.2 | -4.6 | 56.7* | 52.3* | 24.2** | 21.1* | 3.3 | 2.9 | 56.5** | 50.2** | 92.8** | 82.2** |
| TMV 12 x Robut 33-1 | 27.5* | 2.5 | 38.5 | 22.8 | 7.8 | 3.8 | -7.4 | -10.6 | 0.2 | -0.7 | 51.3 | 38.5 |
| CO1 x Robut 33-1 | 19.2 | -5.3 | 12.6 | -10.9 | 20.7* | 13.8 | -2.2 | -2.5 | 14.3 | 8.1 | 36.6 | 29.2 |
| J11 x Robut 33-1 | 27.6* | 5.6 | 39.6 | 39.6 | 10.9 | 5.0 | -0.2 | -5.3 | 5.3 | 4.3 | 56.2* | 48.6 |
| Mean | 19.4 | -4.9 | 38.6 | 29.7 | 19.4 | 15.0 | -1.3 | -4.2 | 19.6 | 16.6 | 66.8 | 54.6 |

* Significant at P = 0.05 ** Significant at P = 0.01

The two female parents *viz.*, TMV 7 and TMV 9 produced significantly superior hybrids for pod weight when involved in crosses with Robut 33-1. When Gangapuri was involved in the crosses negative heterosis was observed in five out of six crosses. In contrast, all the hybrids involving Robut 33-1 exhibited positive heterosis for pod weight. The inter-specific crosses produced bolder pods than the intra-subspecific crosses, the mean heterobeltiosis values being 15.0 and -8.5 per cents respectively.

For shelling percentage, 16 hybrids exhibited negative heterosis. Though 17 cross combinations showed positive heterosis for kernel weight, only in two crosses *viz.*, TMV 9 x Robut 33-1 and Co 1 x Gangapuri, it was significant. The inter-subspecific crosses yielded bolder kernels than the intra-subspecific crosses. The former hybrids recorded a mean heterobeltiosis of 16.6 percent as against 12.2 percent of the latter.

Seventeen cross combinations recorded heterobeltiosis in the positive direction for pod yield. However, only two ovule parents *viz.*, TMV 7 and TMV 9 when involved in crosses with Robut 33-1 produced significant heterotic hybrids over their better parents. These two hybrids also exhibited heterosis for pod number, pod and kernel weights indicating that heterosis of pod yield may be due to the simultaneous improvement of these characters. The best hybrid for pod yield was TMV 7 x Robut 33-1 which recorded 87.7 per cent heterobeltiosis. The inter-subspecific hybrids produced better hybrids for pod yield than the intra-subspecific hybrids, the mean heterobeltiosis percentages being 54.6 and 29.7 respectively.

In general, the inter-subspecific crossess exhibited greater magnitude of heterobeltiosis for pod number, pod and kernel weights and ultimately for pod yield than the intra subspecific crosses. The reports of Hammons (1973), Garet (1976) and Ramakrishna Raju *et al.*, (1979) are also in agreement with these findings. Reddy (1980) while suggesting the stretegy for varietal improvement also states that the Spanish x Virginia types would result in superior hybrids because the desirable attributes are clustered separately in each group and the intrasubspecific crosses may be avoided (unless a specific trait is to be incorporated) since no superior derivatives are likely to be recorded in such a programme.

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# GENETICS OF RUST (PUCCINIA ARACHIDIS SPEG.) IN GROUNDNUT

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ABSTRACT

Rust (**Puccinia arachidis** Speg.) resistant groundnut genotype NC Ac 17090 was crossed with susceptible genotype VG5 and their segregating populations of $F_1$, $F_2$ and $B_1$ and $B_2$ were studied for the reaction to the disease. The additive component (d) was significant, while the dominance (h) was not significant. The epistatic interactions, additive x dominance (j) and dominance x dominance (l) were not significant.

KEY WORDS : Groundnut, Rush resistance, Gene action

Groundnut rust caused by *Puccinia arachidis* Speg. has become of increasing economic importance over the last few years. It has long been regarded as endemic to the western hemisphere (Bromfield, 1971). Since 1969, rust has been reported in all major groundnut producing areas of the world according to Hammons (1977). In India it was first observed in 1969 and subsequently, severe damage in major groundnut growing states was reported by subrahmanyam *et al.*, (1979). In the semi-arid tropics, where chemical control is rarely used, losses in excess of 50% are common (Gibbons, 1979). Although the disease can be controlled by certain fungicides, these are costly and are not readily available to small farmers in developing counteries. Hence evolving resistant genotypes with good