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HETEROSIS AND MATERNAL EFFECTS FOR SEED-OIL CONTENT IN UPLAND COTTON

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ABSTRACT

Heterosis and maternal effects for seed-oil content were analysed in a set of crosses between agronomically promising and high-oil parents. Small amounts of positive and negative heterosis were observed for seed-oil content in the crossed (maternal) seed. Array means revealed strong maternal influence of the agronomic parents on seed index. The gca and sca components of variance were highly significant for oil percentage.

Key words: *Gossypium hirsutum*, oil content, maternal effects.

Abdel-bary et al. [1] concluded that heterosis and inbreeding depression is possible in Egyptian cotton for oil, protein, and seed index, depending on the parentage of particular crosses. Dani [2] observed marginal heterosis for oil content in some intra-*hirsutum* crosses, which showed significant reciprocal differences. As such, only limited information is available on these aspects in cotton [3, 4]. Maternal influence on seed development also affects oil content in F_1 [5]. It is, therefore, necessary to examine the nature and extent of maternal effects in relation to the expression of heterosis for seed oil content, as it may have implications in genetic studies. The present study aims to obtain such information with respect to cotton seed oil content.

MATERIALS AND METHODS

Material for this study was obtained from the germplasm collection maintained at the Central Institute for Cotton Research, Nagpur. Varieties PKV 081, SRT 1, Khandwa 2, and Narmada represent the contemporary elite cultivars. Stoneville 213, GM 2, ORS, and Tamcot SP 37 were obtained from Texas, USA. The crop was sown in the first week of July 1985 in randomized blocks replicated four times, in single-row plots of 20 plants in each repeat. Plants and rows were spaced at 60 cm. Recommended doses of fertilizers were applied. No irrigation was applied. Twelve crosses were attempted in partial diallel fashion, with Indian cultivars as female parents. Bolls were harvested manually at maturity. For estimation of oil content, 10 crossed bolls from each combination were chosen in each replication. Oil content was analysed in delinted and dried seeds from each boll with a 2 ml sample assembly,

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using a Newport nuclear magnetic resonance analyser. Average of 10 bolls was used for statistical analysis. Seed index (mg/seed) was estimated from a bulk sample of 100 seeds. Heterosis was determined over midparent averages. The analysis of variance was based on Kempthorne and Curnow [6].

Table 1. Mean squares from the analysis of variance including combining ability for oil content and seed index in cotton

Source	d.f.	Mean squares	
		seed-oil content	seed index
Crosses	11	3.69**	225.3**
gca	7	3.72**	332.9**
sca	4	3.66**	37.1
Error	33	1.36	13.8
gca/sca		1.02	9.0

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

RESULTS AND DISCUSSION

The differences between crosses and gca variance were highly significant for oil content and seed index (Table 1). The sca component for oil content was also significant. Heterosis for oil content in F_1 (maternal seeds) was small and generally positive, with a few exceptions (Table 2). The gca-sca ratio indicated that the gca effects were generally more important. Dani [2] reported gain in the F_2 seed-generations

Table 2. Heterosis (%) over midparent values for oil content and seed index in F_1 of eight parents

Cross	Seed-oil content	Seed index
SP 37 × S 213	−0.09	−22.46
PKV 081 × S 213	−4.06	−23.83
SRT 1 × S 213	1.63	−9.13
PKV 081 × GM 2	−5.20	−13.74
SRT 1 × GM 2	3.09	−12.85
Khandwa 2 × ORS	−4.30	−20.80
SRT 1 × ORS	−14.16	−17.98
Kjandwa 2 × ORS	−6.80	−31.51
Narmada × ORS	2.34	−6.56
Khandwa 2 × SP 37	1.14	−28.31
Narmada × SP 37	5.18*	−11.55
Narmada × PKV 081	2.32	1.29

*Significant at 5% level.

of some intra-*hirsutum* hybrids, following negative heterosis of similar magnitude for oil content and seed index. Singh et al. [3] concluded that oil content in cotton is primarily under the control of nonadditive genetic effects.

Table 3. Parent means and array averages of seed-oil content and seed index for cotton cultivars and their crosses

Parent	Seed-oil content (%)		Seed index (mg/seed)	
	parent mean	array mean	parent mean	array mean
PKV 081	21.26	20.60	62.25	58.50
SRT 1	20.87	20.83	66.50	64.33
Khandwa 2	23.27	20.83	63.75	64.33
Narmada	20.19	21.55	74.00	72.08
S 213	22.07	21.33	81.51	63.33
GM 2	21.83	21.34	82.10	61.58
ORS	22.63	20.66	82.26	61.33
SP 37	20.77	20.65	93.90	65.38
SE	0.13	0.05	1.39	0.50

In cotton, seed and embryo sizes are determined predominantly by the female parent [7]. Array means (Table 3) revealed existence of strong maternal effects on seed size due to the four commercial varieties. Paternal array means involving the exotic types were only marginally higher than the midparent averages. Dani and Kohel [8] have shown that variation in the period from first to last boll set markedly affects oil content in cotton. Maternal influence on seed size, as observed in the present study, also affects the seed-oil content [4]. The generations used in genetic analysis may, therefore, refer to the genotype of the concerned plant, which needs to be resolved through the test of maternal effects [4]. Dani [9] reported positive heterosis for oil content in seeds obtained from F_1 plants.

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