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Short Communication

Genetics and order effects of seed cotton yield in upland cotton (*Gossypium hirsutum* L.) — Triallel analysis

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The yield of seed cotton (*Gossypium hirsutum* L.) is a complex character. The information on gene action for seed cotton yield is very essential for deciding the effective selection method in segregating generations. The additive and dominance gene effects may have great value on the improvement of seed cotton yield. The information on epistatic gene effect is also important for the yield improvement in cotton, therefore, the analysis of the gene action of seed cotton yield through triallel analysis proposed by Rawlings and Cockerham [1] and further developed by Ponnuswamy *et al.* [2] was made through this study. All possible 60 three-way crosses (TWC) involving six divergent upland cotton genotypes *viz.*, MCU 5, MCU 7, TCH 1002, SVPR 1, Sharada and JR 36 were utilized and triallel analysis was under taken according to Ponnuswamy *et al.* [2].

The analysis of variance for three-way crosses (triallel analysis) showed significant general line, two line (both first and second kind) and three-line specific effects indicating the importance of additive and non-additive gene effects in the expression of this character. However, the estimates of genetic components of variance indicated the importance of additive, additive × dominance, dominance × dominance type of non-allelic interaction for this trait. Similar gene effects was also made by Gesos and Putlov [3]. The relative magnitude of epistatic genetic components revealed the predominance of additive × dominance gene effect for seed cotton yield per plant (Table 1). Hence improvement of this trait would, therefore, need delayed selection and intermating the segregants followed by recurrent selection.

Table 1. Magnitude of components of genetic variance for seed cotton yield per plant

Components	Estimates
Additive	292.48
Dominance	–866.89
Additive × Additive	–518.06
Additive × dominance	2877.84
Dominance × Dominance	653.84

General line effect of first and second kind (h_i and g_i) indicated that the lines SVPR 1 and Sharada could be utilized as grand parents which showed good general combining ability of both kinds whereas, lines MCU 7 and JR 36 were poor general combiners as evident from negative h_i and g_i estimates (Table 2). The significant general line effect of second kind (g_i) for MCU 5 suggested that it could be used as immediate parent in three-way crosses. The positive and significant two line specific effect of first kind (d_{ij}) in five combinations *viz.*, MCU 5/MUC 7, MCU 5/SVPR 1, MUC 7/Sharada, TCH 1002/Sharada and SVPR 1/JR 36 showed that they could produce significant effects in their order (Table 2). These combinations were good specific combiners for seed cotton yield as grand parents in three-way crosses. This was evident in the case of MCU5/SVPR 1//JR 36 for seed cotton yield (Table 3).

The two line specific effect of second kind (s_{ij}) was positive and significant in the crosses MCU 5//MCU 7, MCU 5//SVPR 1, MCU 7//Sharada, TCH 1002// Sharada and SVPR//JR 36 indicating the usefulness of these cross combinations as good specific combiners for seed cotton yield. Such crosses that were identified as good specific combiners had reciprocal effect (s_{ij}) in SVPR 1//MCU 5, SVPR 1//TCH 1002, and JR 36//SVPR 1 pointing out to the importance of order effects in the three-way cross hybrids. The two line order effect is due to interaction between additive × dominance gene effects and all three factors or higher epistatic effects except the all dominance type (Rawlings and Cockerham 1962).

The three line specific effect (t_{ijk}) was positive and significant in twenty-two triplet combinations of which the triplet combination namely MCU 5/SVPR 1//JR 36 showed superior *per se* and significantly superior t_{ijk} effect. This cross combination can be exploited in heterosis breeding. Four TWC hybrids *viz.*, MCU 5/TCH 1002//SVPR 1, TCH 1002/SVPR 1//Sharada, TCH 1002/Sharada//MCU 5 and Sharada/JR

Table 2. Estimation of general line and two line specific effects in cotton

Parent	General line effects First kind (h_i)	Second kind (g_i)	Two lines specific effects of the First kind d_{ij}. Figures in parentheses correspond to estimates of S_{ij} (upper half) and s_{ij} (lower half) MCU 5	MCU 7	TCH 1002	SVPR 1	Sharada	JR 36
MCU 5	−0.912	3.740**	-	9.215** (3.244**)	−10.338** (−2.973**)	6.833** (4.127**)	−2.632** (−6.013)	−3.078** (1.616)
MCU 7	−6.446**	−9.591**	9.215** (7.638**)	-	0.097 (−1.827)	−6.338** (1.771)	2.323** (3.596**)	−5.297** (−11.178**)
TCH 1002	0.282	0.67	−10.338** (−1.342)	0.097 (0.710)	-	−0.018 (−1.351)	9.230** (2.903**)	1.030 (−0.920
SVPR 1	3.969**	5.772**	6.833** (−8.938**)	−6.338** (−7.144**)	−0.018 (2.275**)	-	−8.372** (−4.940**)	7.895** (18.748**)
Sharada	5.057**	2.657**	−2.632** (1.408)	2.323** (2.011**)	9.230** (7.114**)	−8.372** (−2.266**)	-	−0.550 (−8.266**)
JR 36	−1.951**	−3.253**	−3.078** (1.234)	−5.297* (1.179)	1.030 (−4.588**)	7.895** (−2.280**)	−0.550 (4.454**)	-

SE (h_i) = 0.459 SE (g_i) = 0.581 SE (d_{ij}) = 0.810 SE (s_{ij}) = 0.711; **Significant at 1 per cent level

Table 3. Estimates of three line specific effect (t_{ijk})

Grand Parental line	Parental Line MCU 5	MCU 7	TCH 1002	SVPR 1	Sharada	JR 36
MCU 5/MCU 7	-	-	5.843**	−0.452**	10.843**	−7.234**
MCU 5/TCH 1002	-	10.046**	-	2.628	−4.205**	−8.468**
MCU 5/SVPR 1	-	−5.902**	−15.925**	-	5.379**	15.639**
MCU 5/Sharada	-	−6.870**	11.179**	−4.372**	-	0.063
MCU 5/JR 36	-	1.917	−1.097	11.197**	−12.017**	-
MCU 7/TCH 1002	−2.961**	-	-	7.617**	−9.148**	4.492**
MCU 7/SVPR 1	−6.383**	-	14.568**	-	−5.523**	−2.661
MCU 7/Sharada	4.335**	-	−20.488**	10.730**	-	−5.403**
MCu 7/JR 36	4.990**	-	0.077	−8.894**	3.828**	-
TCh 1002/SVPR 1	6.048**	−6.934**	-	-	2.655	1.768
TCH 1002/Sharada	2.566	−1.159	-	−7.150**	-	5.743**
TCH 1002/JR 36	−5.652**	−1.952	-	−3.094**	10.699**	-
SVPR 1/Sharada	−3.623**	10.010**	4.823**	-	-	11.210**
SVPR 1/JR 36	3.959**	2.017	−3.465**	-	−2.510	-
Sharada/JR 36	−3.297**	−1.981	4.486**	0.792	-	-

SE (t_{ijk}) = 1.129; **Significant at 1 per cent level

36//SVPR 1 had high *per se* and non-significant t_{ijk} effect indicating that these hybrids were highly useful in recombination breeding for further selection and improvement of seed cotton yield/plant.

All the three-way crosses showed invariably order effect for seed cotton yield. The triplet combination MCU5/SVPR1//Sharada showed positive and significant t_{ijk} effect, but the same parent involved in the other two triplet combinations MCU 5/Sharada//SVPR 1 and SVPR 1/Sharada // MCU 5 gave negative t_{ijk} effects. Similar results were also reported in maize (Ponnuswamy *et al.*, 1974), in barley (Chaudhary *et al.*, 1975; Chaudhari and Singh 1976 and Chaudhari, 1978), in wheat (Joshi, 1990) and in rice (Ram *et al.*, 1994). In best performing triplet MCU 5/SVPR 1//JR 36, lines MCU 5 and SVPR 1 were good general combiners as a grand parent, while line JR 36 was a poor combiner both as grand and immediate parent. The two line specific effect of the first kind for the cross MCU 5/SVPR 1 was significant and positive, revealing that this combination was good specific combiners as grand parent. The immediate parent JR 36 involved in the cross SVPR 1//JR 36 could produce significantly positive two line specific effect of second kind (s_{ij}) which might be due to additive × dominance gene effects. Because of the above, the triplet combination of MCU 5/SVPR 1//JR 36 produced significant three line effect and highest *per se* for seed cotton yield.

References

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