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Short Communication

Triallel analysis for number of bolls per plant in upland tetrapolid cotton (*Gossypium hirsutum* L.)

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Triallel analysis provides information on all types of gene actions *viz.*, additive, dominance and epistatic components besides giving information on order of parents in three-way cross combinations for obtaining superior trasgressive segregants [1]. A three-way cross symbolised by (AB)C has been defined as a cross between line C and the unrelated F_1 hybrid (AB), lines A and B being called grand parental lines and line C as full or immediet parental line [2]. But studies on three way cross hybrids are very scarce in cotton [3]. In the present study an attempt was made to obtain information on gene actions controlling the most important trait of number of bolls per plant in tetraploid cotton (*Gossypium hirsutum* L.) by using triallel analysis. 60 three-way cross hybrids were developed by crossing six diverse varieties of upland cotton *viz.*, 1. Narasimha 2. Renuka 3. DHY 286 4. MCU 5 5. LRA 5166 and 6. ADB 39 in a triallel mating design [2] and were evaluated under rainfed conditions during *kharif*, 1999 in a randomised block design with three replications at Agricultural Research Station, Mudhol of Acharya N.G. Ranga Agricultural University, A.P. Fifteen competitive plants were randomly selected from each plot for recording boll number. The mean data was subjected to triallel analysis [4].

The analysis of variance (Table 1) shows that general line and two line specific effects (both first and second) as well as three line specific effects were significant, thus suggesting the major role of all three types of epistatic components *viz.*, additive × additive, additive x dominance, dominance x dominance besides additive and dominance gene actions in expression of this trait.

General line effects: The two parents i.e. Narasimha and DHY 286 recorded positive and highly significant general line effects of both first kind (h_i) (7.729** and 3.421**) and second kind (g_i) (5.460** and 1.133**) respectively, indicating that these two parents were good general combiners for this trait of number of bolls per plant when used both as grand parents as well as immediate parents in three way crosses. Both of these parents were superior in grand parental performance than in parental performance as their h_i values were significantly higher than g_i values.

Table 1. Analysis of variance for number of bolls per plant in cotton (mean squares)

Source	df	Mean squares
Replications	2	0.098
General line effect of the first kind (h_i)	5	478.563**
General line effect of the second kind (g_i)	5	1401.633**
Two line specific effects of the 1st kind (d_{ij})	9	108.548**
Two line specific effects of the 2nd kind (S_{ij})	19	173.042**
Three-line specific effect (T_{ijk})	21	322.018**
Crosses	59	354.627**
Error	118	7.282

Although both lines i.e. Narasimha and DHY 286 exhibited high general line effects, they attain their high average performance by different means. The relatively low variations in the specific effects ($\sigma^2 d_i$, $\sigma^2 s_{.i}$ and $\sigma^2 s_i$) associated with parent DHY 286 indicate that line DHY 286 uniformly transmits its high boll number trait to all its three way crosses.

Two-line specific effects: The two line specific effects of first kind were positive and significant in six crosses among which the highest dij effect was observed in Renuka × LRA 5166(3.643), DHY 286 × ADB 39(2.803), MCU 5 × LRA 5166(1.843) indicating their superiority as grand parents in three way crosses. Two line specific effects of second kind (S_{ij}) were positive and significant in seven crosses among which the highest Sij effect was recorded by the cross Narasimha × DHY 286 (7.076) followed by Renuka × LRA 5166 (4.790).

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Three-line specific effects (T_{ijk}): These effects were found to be highly significant and positive in 27 three way crosses, among which the highest T_{ijk} effect was recorded by the triplet 3 × 6 × 2 (15.323) followed by 4 × 6 × 5 (11.827) (Table 2). In the best performing triplet of 3 × 6 × 2, DHY 286 and ADB 39 were good in their grand parental performance while Renuka was poor in parental performance. Two line specific effect of first kind of cross DHY 286 × ADB 39 was also good. Hence triplet 3 × 6 × 2 is the best because of DHY 286 and ADB 39 as grand parents and specific effects and interaction of parents in that particular order.

Table 2. Three line specific effects (T_{ijk}) for number of bolls per plant

Three-way cross No.	T_{ijk}	Three-way cross No.	T_{ijk}	Three-way cross No.	T_{ijk}	Three-way cross No.	T_{ijk}
1×2×3	3.628**	1×5×6	–1.416	2×5×4	–1.042	3×6×2	15.323**
1×2×4	–10.872**	1×6×2	–6.618**	2×5×6	4.815**	3×6×4	–14.408**
1×2×5	2.474**	1×6×3	5.522**	2×6×1	8.294**	3×6×5	–0.562
1×2×6	4.770**	1×6×4	8.560**	2×6×3	–11.832**	4×5×1	5.414**
1×3×2	–4.856**	1×6×5	7.465**	2×6×4	7.338**	4×5×2	3.849**
1×3×4	4.806**	2×3×1	–2.527**	2×6×5	–3.800**	4×5×3	–2.682**
1×3×5	1.935*	2×3×4	4.576**	3×4×1	–0.022	4×5×6	–6.582**
1×3×6	–1.884*	2×3×5	7.419**	3×4×2	0.644	4×6×1	–6.289**
1×4×2	5.143**	2×3×6	–9.468**	3×4×5	–8.791**	4×6×2	–9.636**
1×4×3	–6.729**	2×4×1	0.897	3×4×6	8.169**	4×6×3	4.098**
1×4×5	3.056**	2×4×3	5.313**	3×5×1	2.902**	4×6×5	11.827**
1×4×6	–1.470	2×4×5	–6.093**	3×5×2	–11.111**	5×6×1	–1.652
1×5×2	6.331**	2×4×6	–0.117	3×5×4	5.026**	5×6×2	0.931
1×5×3	–2.421**	2×5×1	–6.664**	3×5×6	3.183**	5×6×3	2.212*
1×5×4	–2.494**	2×5×3	2.891**	3×6×1	–0.353	5×6×4	–1.490

Parent order: Parent order effect was clearly elucidated in the triplet 3 × 6 × 2 which had the highest positive significant T_{ijk} effect (15.323) while its two other alternative combinations with same parents *viz.*, 2 × 3 × 6 (–9.468) and 2 × 6 × 3 (–11.832) had negatively significant T_{ijk} effects. Parent order effect in triallel was earlier illustrated in maize [1, 5] and in cotton [6].

The components of genetic variance indicated preponderance of domonance × dominance type of epistatic interaction (895.88) followed by additive × dominance (194.37) besides equally important role of dominance (89.34), additive (82.50) and additive × additive type (80.34) of gene actions. Such type of gene actions clearly emphasise the need for intermating in early segregating generations followed by selection so as to achieve fruitfull results.Thus, triallel analysis had clearly elucidated its advantages over diallel analysis by giving additional information on magnitude of types of epistatic components and also on order of parents to be crossed in three way crosses for obtaining superior transgressive segregants.

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