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LINE X TESTER ANALYSIS OF COMBINING ABILITY IN COTTON

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ABSTRACT

In a line x tester study of cotton *(Gossypium hirsutum* L.) involving 11 lines and 3 testers (33 hybrids), it was found that all the characters studied (i.e., plant height, number of monopodia, days to 50% flowering, days to 50% boll bursting, boll weight and yield of seed cotton) are controlled by additive but predominantly non-additive gene action. The best general combiners in the parents were 138 F, 83 and MCU6 for earliness and for 50 per cent boll bursting and 133 F for higher boll weight. The hybrid 108F x MCU 6 was considered as the best cross, because it recorded significant positive *sca* effect for both yield of seed cotton and boll weight.

KEY WORDS : Cotton, Line x Tester Analysis, Combining Ability

The concept of combining ability plays a significant role in crop improvement, since it helps the breeder to determine the nature of gene action involved in the expression of quantitative traits of economic importance. Combining ability studies help in the identification of parents with general combining ability effects and in identifying cross combinations showing high specific combining ability effects. The line x tester analysis of Kempthorne (1957) is an useful tool for screening the lines with rapidity and with a reasonable degree of confidence. In the present investigation, 11 lines and 3 testers and their 33 hybrids were studied for combining ability of parents and best cross combinations.

MATERIALS AND METHODS

The materials consisted of 14 short duration varieties of cotton of 11 lines *viz.*, CRH 68, 2421Y, Tashkant 2, Tashkant 3, 138 F, Tashkant 1, 133F., 83, Cul-12, 108F, RF5-2, and 3 testers MCU 6, MCU 7, P216F. All the 14 parents (11 lines and 3 testers) and their constituent 33 hybrids were raised in a randomised block design with three replications adopting a spacing of 45 x30 cm during summer 1991. Observations were recorded for six characters *viz.*, plant height, number of monopodia, days to 50 per cent flowering, days to 50 per cent boll bursting, boll weight and yield of seed cotton. Combining ability analysis was performed as suggested by Kempthorne (1957).

RESULTS AND DISCUSSION

The analysis of variance (Table 1) for combining ability revealed that mean square due to testers is of greater magnitude in comparison with those of lines and hybrids except in the case of number of monopodia in which the hybrid mean square is high indicating greater diversity among testers for these characters. There was positive significant differences for the traits, plant height, number of monopodia in the case of hybrids, days to 50 percent flowering, number of bolls per plant, days to 50 percent boll bursting and yield of seed

Table 1. Analysis of variance for combinging ability in cotton (line x tester analysis)

Source	df	Mean sum of squares							
		Plant height at maturity	No. of monopodia	No. of sympodia	Days to 50% flowering	No. of bolls	Days to 50% boll bursting	Boll weight	Yield of seed cotton
Replication	2	55.313	0.0872	24.242	1.83	26.220	1.175	0	0.502
Hybrids	32	202.423*	0.395*	4.121	2.489	4.822	4.157	0.001	69.099
Lines	10	109.665	0.1917	2.977	2.633	6.038	2.498	0.193	70.520
Testers	2	633.933	0.375	7.287	6.607*	10.444*	31.436**	0.185	383.589**
Lines x testers	20	205.649*	1.804**	4.673	2.005	3.652	2.058**	0.127	36.923
Error	92	95.040	0.0235	4.983	1.541	2.869	0.843	0.084	73.534
2GCA		-0.6618	0.002	-0.074	0.098	0.24	0.388	0.004	6.598
2SCA		110.608	0.156	-0.308	0.462	0.78	1.414	0.042	36.60
GCA/SCA		-0.0059:1	0.012:1	0.240:1	0.212:1	0.307:1	0.274:1	0.095:1	-0.180:1

* Significant at 5% level; ** Significant at 1% level.

cotton in the case of testers. The variance components and also the ratio between *gca* and *sca* variances revealed that there is predominance of specific combining ability variance and thus the non-additive gene action could be exploited by heterosis breeding.

The *gca* effects of parents (Table 2) revealed that the parents RF5-2 and P216F for greater height, CRH 68, 138F, Tashkant- 1, MCU-6 for reduction in monopodia, 138F, 83 for earliness, 83, MCU-6 for days to 50 per cent boll bursting, 133F for higher boll weight were the best general combiners. Cross involving these parents should produce promising segregants with higher mean performance for respective traits. As regards to earliness 138 F 83 and MCU 6 were found to be the best general combiners.

The *sca* effects of hybrids (Table 3 revealed the importance of both additive and non-additive gene action for the different traits studied. In the case of yield of seed cotton, positive significant *sca* effects were seen for 108F x MCU 6 and Tashkant-3 x P216F and for other crosses it was non significant which indicated the involvement of

Table 2. General combining ability effects of parents

Parent	Plant height	No. of monopodia	Days to 50% floweing	Days to 50% boll bursting	Boll weight	Yield of seed cotton
Lines						
CRH68	-4.424	-0.173*	0.166	0.126	0.007	2.551
2421Y	-3.941	0.259*	0.333	-0.739	-0.186	-0.459
Tashkant-2	-2.407	0.193*	0.333	0.060	0.043	1.280
Tashkant-3	3.475	0.015	-0.166	0.926*	0.233	1.696
138F	-3.657	-0.386*	-1.167*	-0.506	-0.369*	-3.914
Tashkant-1	2.192	-0.173*	0.000	-0.339	-0.083	-4.514
133F	1.025	-0.040	0.166	0.493	0.419*	-1.514
83	5.125	-0.073	-1.333*	-0.906*	-0.068	7.463
Cul12	-1.241	0.026	0.666	0.960*	0.037	-1.481
108F	-4.191	0.026	0.500	0.926	-0.005	-3.648
RF5-2	8.125*	0.226*	0.500	-0.306	-0.028	2.540
Testers						
MCU6	-3.948	-0.097*	-0.515	-0.752*	0.050	-3.183
MCU7	-2.262	-0.052	-0.060	-0.239	-0.070	1.638
P216F	6.128*	0.147*	0.575*	0.296	0.018	1.545
SE lines	3.979	0.062	0.506	0.374	0.132	3.162
Testers	2.078	0.032	0.264	0.195	0.069	1.650

* Significant at 5% level.

Table 3. Specific combining ability effects of hybrids.

Crosses	Plant height	No. of monopodia	Days to 50% flowering	Days to 50% boll bursting	Boll weight	Yield of seed cotton
CRM68xMCU6	8.233	-0.136	-0.984	-0.609	-0.073	4.061
2421xMCU6	-0.549	0.030	-1.151	-0.142	-0.025	-1.427
Tashkant 2xMCU6	4.616	-0.203	0.348	0.657	-0.320	-6.613
Tashkant3xMCU6	-3.116	-0.236*	0.848	-0.209	0.293	-12.283*
138FxMCU6	1.666	-0.103	-0.151	0.424	-0.220	-2.807
Tashkant1xMCU6	-5.983	0.263*	0.681	-0.842	-0.325	-5.539
133FxMCU6	-6.966	0.130	0.015	0.424	-0.125	-7.539
83xMCU6	15.716*	0.463*	0.015	-0.175	-0.281	10.817
Cul12xMCU6	-6.349	-0.736	-0.984	-0.142	0.289	3.228
108FxMCU6	-1.799	0.063	1.181	0.390	0.521*	13.661*
RF5-2xMCU6	3.533	-0.136	0.181	0.224	0.266	5.440
CRH68xMCU7	-3.421	0.118	1.060	1.572*	0.177	0.072
2421YxMCU7	3.495	-0.015	1.393	-0.360	0.225	-0.515
Tashkant 2xMCU7	-6.737	0.351*	0.393	-0.160	0.227	4.478
Tashkant 3xMCU7	14.778*	0.118	-0.106	-1.627*	-0.356	-1.371
138FxMCU7	-4.787	0.351*	-0.606	-0.193	-0.299	3.272
Tashkant1xMCU7	4.662	0.218*	0.227	0.939	0.347	2.606
133FxMCU7	-10.521	-0.215	-0.439	-0.593	-0.175	4.206
83xMCU7	0.461	-0.281*	0.060	0.306	0.094	-6.039
Cul12xMCU7	0.445	0.180	1.060	1.939*	-0.023	0.738
108FxMCU7	-5.004	-0.381*	-1.772*	-0.527	-0.200	-7.838
RF5-2xMCU7	6.628	-0.281*	-1.172	-0.993	-0.017	0.381
CRH68xP216F	-4.812	0.018	-0.075	-0.963	-0.014	-4.133
2421xP216F	6.054	-0.015	-0.242	0.503	-0.200	1.942
Tashkant2xP216F	2.121	-0.148	-0.742	-0.196	0.093	2.135
Tashkant3xP216F	-11.662	0.118	-0.742	1.836*	0.063	14.654*
138FxP216F	3.121	-0.248*	0.757	-0.230	0.519*	-0.465
Tashkant1xP216F	1.321	-0.481*	-0.909	-0.960	-0.022	2.933
133FxP216F	17.481*	0.084	0.424	0.169	0.300	3.333
83xP216F	-16.178*	-0.181	-0.075	-0.130	0.187	-4.778
Cul12xP216F	5.904	0.118	-0.075	-1.796*	-0.266	-3.966
108FxP216F	6.804	0.318*	0.590	0.136	-0.321	-5.833
RF5-2xP216F	-10.162	0.481*	1.090	0.769	-0.249	-5.821
SE	6.893	0.108	0.878	0.649	0.230	5.486

* Significant at 5% level.

both additive and non additive gene action for this character. With regard to plant height 133F x P216F, Tashkant-3 x MCU-7 and 83 x MCU-6 recorded significant positive *sca* effects. The parent P216F alone had recorded significant positive *gca* effect for plant height. The crosses 108F x MCU 6 and 138F x P216F recorded significant positive *sca* effect for boll weight although the parent 138F recorded significant negative *gca* effect. In contrast to *gca* effect, *sca* effects represent dominance and epistatic components of variance which are not fixable in nature (Simmonds, 1979). But if the crosses showing high *sca* effects involve both the parents which are also good general combiners they could be successfully exploited for varietal improvement. In the present study, the cross 108F x MCU 6 has been considered as the best cross since it has recorded positive significant *sca* effect for both the traits namely yield of seed cotton and boll weight and the MCU 6 was a general combiner for earliness. Parents RF5-2, P216F, CRH68, 138F, Tashkant-1, 83 and MCU 6 could be utilised for recombination breeding programme.

This investigation revealed the importance of both additive and non-additive gene action for the characters studied. Similar results were reported by Valdia *et al.*, (1980) in their studies with *Gossypium arboreum*. Improvement in the characters is possible by simultaneous exploitation of both additive and non additive genetic components. This can be achieved by adopting biparental mating in F2 among selected crosses or following selection procedures such as diallel selective mating (Jensen, 1970).

The trial conducted showed that most of the characters are controlled by additive and predominantly non-additive gene action. The best general combiners in the parents were 138F, 83 for earliness, MCU 6 for earliness and for 50 per cent boll bursting and 133F for higher boll weight. So these parents can be used in the crossing programme to get the better hybrid. The hybrid 108F x MCU 6 was considered as the best cross because it recorded significant positive sca effect for yield of seed cotton and boll weight.

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PHOSPHORUS MANAGEMENT FOR LOW LAND TRANSPLANTED RICE: A TEST VERIFICATION TRIAL WITH 2% DAP SPRAY

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ABSTRACT

An experiment was conducted during June 1993 to February 1994 to study the effect of phosphorus levels and 2% DAP spray on lowland rice (*Oryza sativa* L.). Application of P at recommended dose (38 kg P_2O_5/ha) with 2% DAP spray given thrice at boot leaf, 50% flowering and post-milk stages would result in higher rice grain productivity and profitability. Considering soil health and increase in P fertilizer price, the farmer may choose to apply P at 50% of recommended dose (19 kg P_2O_5/ha) with 2% DAP spray twice at boot leaf stage and 50% flowering or at post milk stages if capital is constraint for the farmer. Based on the previous season result, test verification trial was conducted in the Rabi season with I.R.20 as test variety. Similar trend was also observed in the test verification trial. The effect on P uptake at different stages of crop growth and economics were also discussed.

KEY WORDS : Rice, Phosphorus, Management, Verification, DAP Spray

Rice (*Oryza sativa* L.) is the staple food of more than 60 per cent of the world's population and is grown in an area of about 145 million ha. Though India has the largest area under rice, its production per unit area of the farm is, by world standards, very low. Low level of fertilizer application is an important reason for low productivity in major parts of the rice growing belt. Among the fertilizer elements, phosphorus plays a key role in promoting root growth and proliferation, tillering, early maturity and ripening. Because of withdrawal of subsidy and higher cost, farmers are applying low quantities of phosphorus. The quantity applied is not sufficient to meet the crop requirement. Work done in India and abroad has shown that a single crop uses only about 20 per cent of applied P and the rest is retained in the soil, irrespective of the fact whether the soil is relatively low or high in P content (Tandon, 1987). Due to increase in fertilizer price and considering the soil health, it is