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Original Research Article

Combining Ability Studies for Yield and Its Components in Desi Cotton (*Gossypium arboreum* L.)

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A B S T R A C T

Keywords

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Combining ability studies was conducted in 25 cross combinations by using 5 lines and 5 testers in cotton. The analysis of variance for combining ability revealed significant differences among the genotypes. Combining ability analysis helps in the evaluation of inbreds in terms of their genetic value and in the selection of suitable parents for hybridization. It also helps in the identification of superior cross combinations. The study revealed that lines and tester showed wide variation for most of the characters indicating their diversity. The estimates of specific combining ability effects revealed that of 25 crosses were having significantly desirable sca effects. The best sca effects and the highest per se performance was noted in the crosses PA 686 X AKA 9703, PAIG 332 X PA 255, PA 710 X RAC 024, PA 686 X JLA 794 and PAIg 332 X RAC AKA 8. The parental combination in aforesaid cross combinations is either high x high gca, high x low gca, low x high gca. Therefore, it appeared that for getting good cross combination at least one of the parents should have good gca effect.

Introduction

Cotton is crop of prosperity having a profound influence on men and matter is an industrial commodity of worldwide importance. It occupies the place of pride in Indian agriculture and economy by earning valuable foreign exchange. It provides employment opportunities to nearly 215 million people. Therefore, it plays pivotal role by producing lint, oil and protein. India has the largest area under cotton with an average productivity of 374 kg/ha, which is very low as compared to world productivity (504 kg/ha). Cotton hybrids played significant role to attain self-sufficiently in production in India. Presently, cultivation of varieties and hybrids of tetraploid cotton has become more risky and non-remunerative, creating socioeconomic problems among the cotton cultivars forcing them in to money lenders trap. The increased cost of cultivation in these cotton hybrids is due to high seed cost, more plant protection and high dose of fertilizer. On the contrary, diploids involve low seed cost, minimum or no cost of plant protection and plant nutrition. Looking to this, one will be really be optimistic for cultivation of *desi* cotton provided they yield on par with tetraploid cotton varieties and hybrids and must possesses equivalent fibre quality.

Allard (1960) pointed out that, the common approach for selection of parents for hybrid development on the basis of per se performance is not a good indication of their combining ability. The choice of parents in hybrid breeding particularly of rainfed areas has to be based on the complex genetic information and a knowledge of combining ability becomes more important for which various biomaterial tools have been developed for Identifying desirable parents. Among these L x T analysis (Kempthore, 1957) is useful technique suitable for identification of cross combination and parents to be used in crossing programme for hybrid breeding.

Materials and Methods

The present investigation was undertaken to study combining ability in cotton using 5 lines and 5 testers in 'Line X Tester' fashion during *Kharif* 2015 at Cotton Research Farm, Mahboob Baugh farm, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani. The experimental material consists of 25 crosses along with 10 parents and 2 checks viz. PKVDH 1 and PKV Suvarna. The genotypes were grown in randomized block design with three replications. Each genotype was planted in double row of 6.0 m row length with 60 X 30 cm spacing. All the recommended package of practices with necessary plant protection measures were followed to raise the healthy crop. Observations were recorded on randomly selected 5 plants in each treatment per replication. Observations on days to 50 % flowering, days to maturity, plant height (cm), number of monopodia per plant, number of sympodia per plant, number of bolls per plant, 100 seed weight (g), ginning out turn (%),staple length of fibre (mm) and seed cotton yield per plant were recorded. Data analysis was carried out as suggested by kempthorne (1957) and Panse and Sukhatme (1961).

Results and Discussion

The analysis of variance for combining ability revealed significant differences among the genotype for the characters studied indicating presence of genetic diversity among the genotypes for morphological traits which is important, pre-requisite in any breeding programme. The lines and testers differed significantly for most all the characters. The source of variation Lines x Testers showed significant differences for all the characters except days to maturity. This indicated that the selection of female and male parents appeared appropriate.

Since presence of desirable gca effect is related to additive and additive x additive interaction which represents preponderance of friable genetic variance. The parents with superior gca effects, should be exploited extensively in breeding programme. The parental lines showing gca effects are presented in Table 1. The parents PA 710 and JLA 794 recorded negative gca effect for days to maturity indicating that these parents are best combiners for early maturity. In case of plant height significant positive gca effect were recorded by the parents PA 774, PAIG 332, RAC 024 and AKA 9703. While PA 686 and JLA 794 exhibited significant positive gca effect for number of bolls per plant. The study of general combining ability revealed that three parents viz. PA 686, PA 710 and AKA 9703 exhibited significant gca effect for seed cotton yield. Utilization of such parents having considerable amount of fixable component for the trait in question, in a breeding programme may be fruitful.

Table.1 General combining ability effects (gca) for various characters

Genotypes	Days to 50 % flowering	No. of monopodia / plant	No. of sympodia / plant	No. of bolls/ plant	No. of seeds / boll	Boll weight (g)	Plant height (cm)	Staple length of fibre (mm)	Seed cotton yield/plant	Days to maturity
Lines										
PA 774	-0.35	-0.025	-0.43	1.03	-0.004	-0.24*	7.13**	1.14*	-5.10**	5.06**
PA 686	0.048	-0.082*	0.041	3.96**	0.82*	-0.01**	-5.73**	-1.22*	25.47**	3.26*
PA 710	0.40	0.089*	0.086	0.18	2.68**	1.57**	-2.87**	0.17	7.50**	-12.14**
PAIG 332	0.24	0.094*	0.061	-0.89	-3.40**	0.24*	6.27**	0.10	-9.94**	2.56
PA 713	-0.035	-0.075	0.24	-4.28**	-0.10	-0.54**	-4.80**	-0.20	-17.92**	1.26
SE (Gi)	0.50	0.03	0.33	0.70	0.31	0.07	1.08	0.37	0.36	1.00
Testers										
PA 255	0.69	-0.065	-0.32	0.74	-1.65**	0.79**	-1.08	0.47	-2.15**	0.91
RAC 024	0.29	0.11*	0.63	-2.14*	-0.82*	-0.46**	1.84	1.88**	-11.97**	-0.29
JLA 794	-1.19	0.004	-0.18	3.46**	-0.41	-0.56**	0.70	-0.28	2.75**	-1.64
AKA 9703	-2.25	-0.062	-0.42	-0.65	-1.08*	0.90**	1.68	-2.25**	10.46**	0.56
AKA 8	0.44	0.044	0.30	-1.39	3.84**	-0.65**	-3.15*	0.70	0.91	0.46
SE (Gi)	0.50	0.03	0.30	0.70	0.31	0.07	1.08	0.37	0.36	1.00

Table.2 Specific combining ability (sca) effects for various characters

Genotypes	Days to 50 % flowering	Days to maturity	No. of monopodia/plant	No. of sympodia/plant	Plant height (cm)	No. of bolls /plant	No. of seeds/boll	100 seed weight (g)	Seed cotton yield/plant (g)	Ginning out turn (%)	Staple length of fibre (mm)	Boll wt.(g)
PA 774 X PA 255	2.952	1.940	-0.269**	1.094	3.123	-0.747	-1.424*	-0.010	-8.880	0.687	0.728	0.044
PA 774 X RAC 024	3.352*	3.140	0.220**	0.539	7.796**	5.045**	2.046**	-0.063	10.610*	-1.684*	-0.812	-0.141
PA 774 X JLA 794	-2.908*	-1.260	0.035	-1.941*	-16.860**	2.302*	1.286	-0.301*	6.884	0.393	0.488	-0.301
PA 774 X AKA 9703	-1.848	-2.460	-0.197*	-1.956**	-2.849	-3.695	1.206	0.119	-0.709	0.320	0.318	0.284
PA 774 X AKA 8	-1.548	-1.360	0.210*	2.264**	8.796**	-2.905	-3.144**	0.256	-7.906	0.770	0.722	0.114
PA 686 X PA 255	0.802	-3.010	0.187*	-1.831**	-9.395**	-10.41**	-3.544**	-0.581**	-45.140**	1.667*	1.398	0.071
PA 686 X RAC 024	0.702	-1.310	-0.147	1.439*	-4.137	-8.080**	-0.674	0.347*	-40.200**	2.070*	-0.692	-0.264
PA 686 X JLA 794	-0.308	3.040	0.092	0.034	15.950**	4.462**	-5.984**	0.94	25.400**	0.142	0.558	-0.09
PA 686 X AKA 9703	-0.748	2.840	0.074	1.339*	4.268	8.205**	-2.864**	-0.606**	70.680**	-3.328**	-0.112	0.161
PA 686 X AKA 8	-0.448	-1.560	-0.207*	-0.961	-6.687**	5.820**	13.070**	0.746**	-10.740**	-0.550	-1.152	0.041
PA 710 X PA 255	-3.558*	6.390**	0.040	-0.576	1.033	5.705**	1.296	-0.266	-0.370	0.325	-4.142**	0.385*
PA 710 X RAC 024	-1.658	-3.910	0.055	-0.781	8.856**	1.348	-2.384**	-0.573**	32.150**	-0.886	3.468**	-0.920**
PA 710 X JLA 794	1.632	-5.060	-0.029	-0.161	-0.904	-8.410**	0.606	0.014	-10.670*	-1.503	0.768	0.404*
PA 710 X AKA 9703	1.392	0.240	-0.262**	0.774	-7.639**	-2.392	2.276**	0.324*	-37.020**	10.76	-1.402	0.275
PA 710 X AKA 8	2.192	2.340	0.195*	0.744	-1.344	3.748*	-1.794**	0.501**	15.910**	0.988	1.308	-0.144
PAIG 332 X PA 255	0.602	-6.81**	-0.144	0.799	0.782	2.680	-0.514	0.446**	50.740**	-3.728**	0.688	-0.942**
PAIG 332 X RAC 024	-0.498	0.890	-0.149	0.044	-7.744	1.123	0.156	-0.211	-14.680**	-0.875	-1.352	1.021**
PAIG 332 X JLA 794	0.492	2.240	-0.184*	0.739	8.546**	-1.560	3.446**	0.156	-21.230**	1.558	0.098	-0.203
PAIG 332 X AKA 9703	0.552	1.040	0.282**	-0.251	7.161**	1.433	2.866**	-0.074	-11.020*	0.271	0.378	-0.202
PAIG 332 X AKA 8	-1.148	2.640	0.165*	-1.331*	-8.744**	-3.677	-5.954**	-0.317*	-3.822	2.775**	0.188	0.327*
PA 713 X PA 255	-0.798	1.490	0.155*	0.514	4.458	2.770	4.186**	0.412**	3.645	1.049	1.328	0.441*
PA 713 X RAC 024	-1.898	1.190	0.020	-1.241	-4.769*	0.563	0.856	0.500**	12.120*	1.577*	-0.612	0.305
PA 713 X JLA 794	1.092	1.040	0.085	1.329	-6.729**	3.205**	0.646	0.037	-0.381	-0.590	-1.912*	0.110
PA 713 X AKA 9703	0.652	-1.660	0.102	0.114	-0.939	-3.552**	-3.484**	0.237	-21.940**	1.949*	0.818	-0.518**
PA 713 X AKA 9703	0.952	-2.060	-0.364**	-0.716	7.981**	-2.987	-2.204**	-1.186**	6.554	-3.983**	0.378	-0.338*

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

The parents PA 774 and RAC 024 were significantly positive indicating that these parents were best combines of staple length of fibre (mm). The parents PA 710, pAIG 332, AKA 9703 and PA 255 exhibited positive significant gca effect for boll weight indicating best combiners for the trait.

The estimates of sca effects are presented in Table 2. The best sca effects and the highest per se performance was noted in the crosses PA 686 X JLA 9703, PAIG 332 X PA 255, PA 710 X RAC 024, PAIG 332 X JLA 794 and PA 710 X PA 255.Only one cross PAIG 332 X PA 255 had both the parents showing high gca effects other crosses either involved poor x good, poor x poor or good x poor gca combination. The good x good gca combination could be due to additive and additive and additive type of gene action which is fixable in nature which had significant sca effects for seed cotton yield, number of bolls per plant and number of sympodia per plant. Moreover, PA 710 X PA 255 for days to 50 % flowering, boll weight and number of bolls per plant.

Whereas cross PA 710 X RAC 024 for plant height and staple length of fibre. These results are in accordance with the reports of Anandhan (2010), Deshmukh, *et al.*, (2010), Karademir and Gencer (2010), Dewdar (2011), Dhamayanthi (2011), Nadagundi *et al.*, (2011), (2012) Mendez-Natera *et al.*, (2012) and Kumar *et al.*, (2014)

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