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STUDIES ON HETEROSIS AND COMBINING ABILITY IN COTTON (*GOSSYPIUM HIRSUTUM* L.)

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Abstract

The present investigation was made to study the mean performance, combining ability and heterosis in a 6 × 6 diallel cross for seven quantitative characters *viz.,* days to first flowering, days to 50 per cent flowering, plant height, number of seeds per boll, seed cotton yield per plant in fifteen hybrids and their six parents namely LRA 5166, MCU 7, DHY 286-1, Surabhi, LRK 516 and AK 32. The combining ability analysis revealed that LRA 5166 was relatively good general combiner with highest *per se* performance for days to first flowering, days to 50 per cent flowering, number of bolls per plant, boll weight, number of seeds per boll and seed cotton yield per plant. Among the crosses, LRA 5166 × Surabhi was found to be good hybrid for days to first flowering, days to 50 per cent flowering, number of seeds per boll and seed cotton yield per plant. The cross LRA 5166 × AK 32 was found to be the best hybrid for plant height and the cross Surabhi × LRK 516 was found to be the best hybrid for number of bolls per plant and the cross MCU 7 × AK 32 was found to be the best hybrid for boll weight. The cross LRA 5166 × Surabhi recorded the highest percentage of standard heterosis for days to first flowering, days to 50 per cent flowering, number of bolls per plant, boll weight and seed cotton yield and the cross MCU 7 × LRK 516 recorded the highest percentage of standard heterosis for plant height and the cross Surabhi × AK 32 recorded high percentage of standard heterosis for number of seeds per boll. Among the crosses the parent involved LRA 5166 and Surabhi regarded the positive effects for most of the economic characters studied and it is recommended for commercial exploitation.

Key words : Cotton (*Gossypium hirsutum* L.), fibre crop, combination ability, commercial exploitation, biometrical methods.

Introduction

Cotton (*Gossypium hirsutum*) is one of the most important fibre crops playing a key role in economic and social affairs of the world. Among the cotton growing countries, India occupies nearly 8 million hectares with annual production of 19 M.T., which is almost 25 per cent of the world cotton acreage. During the last three decades the gradual increase in area and yield was made possible by evolution of high yielding varieties and heterotic hybrids. Plant breeding is a continuous process and the knowledge of genetic constitution of the population handled is quite essential for the breeder in a hybridization programme to decide suitable parents.

Among the several biometrical methods developed to identify superior parents for heterosis breeding, the diallel analysis has received considerable attention. It is a technique employed to gain information on hybrid vigour, combination ability and nature of gene action from the study of the first generation itself. Combining ability refers to the capacity or ability of a genotype to transmit its superior performance to its crosses. The GCA was attributed to additive effect of gene and SCA to dominant deviations and epistatic interactions.

Materials and Methods

A set of six parents and their fifteen crosses were formed the basic material to this investigation (table 1).

Six cotton genotypes were raised in the crossing block. Each genotype was raised in the ridges laid out 75 cm apart with interplant distance of 45 cm. The parents were crossed in all possible combinations and fifteen F_1 crosses were produced. The crossed seeds were collected carefully for evaluation. Selfed seeds also collected for further studies.

Observations were recorded on individual plant basis. Seven characters namely days to first flowering, days to 50 per cent flowering, plant height, number of bolls per plant, boll weight, number of seeds per boll and seed cotton yield per plant were studied.

Table 1 : Particulars of genetic materials studied.

S. no.	Genotypes	Parentage	Special feature
1.	LRA 5166	Triple cross derivative from the cross Laxmi × (Reba B 50 × AC 738)	Medium staple (29 mm), 40s, ginning 36.2%
2.	MCU 7	X-ray irradiation of XL 1143EE	Medium staple of (22.7 mm MHL) 40s early maturing with 33.2% ginning out turn
3.	DHY 286-1	Reselection from DHY 286	Leaf is light green, 3-5 lobes, thick and leathery, densely hairy (pilose)
4.	Surabhi (VRS 7)	MCU 5VT (MCU × *G. mexicanum* spp. *nervosum*)	Seed cotton yield 3000 kg/ha resistant to verticillium wilt. 160 days duration
5.	LRK 516 (Anjali)	LRA 5166 × (Reba B 50 × Khandava 2) Reba B 50 BC2	145 days, fairly big bolls with medium staple
6.	AK 32	Reselection from SRT-1 ´ yellow spotted parental forms	Plant height 100-150 cm. Boll size: medium, rounded pointed at apex, petal spot present

Results and Discussion

Among the genotypes LRA 5166 had significant positive *gca* effects for five traits namely plant height, number of boll per plant, boll weight, number of seeds per boll and seed cotton yield. Surabhi possess good *gca* effects for three yield contributing character.

Among the hybrids LRA 5166 × Surabhi showed significant effect for most the traits studied. While, Surabhi × AK 32 cross showed significant effect for plant height, number of bolls per plant and boll weight. In contrast the MCU 7 × LRK 516 and MCU 7 AK 32 showed significant *sca* effects for boll weight and seed cotton yield. It is interesting to note that MCU 7 found to be poor general combiner contributing more for the yield contributing traits. It indicated that additive as well as non-additive genetic components are of great importance. Similar findings were made by Khadi *et al.* (1996); Iyanar *et al*. (2005) and Leela Pratap *et al*. (2006) in cotton. High amount of heterosis also observed in the crosses LRA 5166 × Surabhi and Surabhi × AK 32. The high heterosis may be attributed to good combining ability of parents.

In the present study, the SCA variance was higher than GCA variance for four characters like days to first flower, days to 50 per cent flowering, number of seeds per boll and seed cotton yield per plant indicating the importance of non-additive gene action. This would mean that the heterosis observed in cotton is due to genetic interaction and dominance. Hence heterosis breeding may be suggested to improving these traits in cotton (table 3).

The traits like plant height, number of bolls per plant and boll weight showed highest value of GCA variance than SCA variance revealed the preponderance of additive gene action. Similar findings were reported by Iyanar *et al.* (2005) for boll weight in cotton. As suggested by Andrus (1963) recurrent selection may be utilized these traits like plant height, number of bolls per plant and boll weight, to obtaining high yielding segregants.

Parent LRK 516 was found to good general combiner for early flowering. This desirable character proves that the parent transmit additive genes for early flowering. Hence this parent could be used as one of the parent to obtain early flowering hybrids. These results on par with the findings of Sharma (1979) and Valarmathi (1996) in cotton.

The parent MCU 7 was found to exhibit maximum negative significant *gca* effects for short stature. Similar findings were reported by Patil (1989) and Gul Hassan *et al.* (2000) in cotton that GCA and SCA variances were influence the plant height.

Even the choice of parents based on *gca* effect should be cautiously done, since a parent possessing favourable genes for one trait may also possess genes governing unfavourable expression for some other traits (Kadambavanasundaram, 1980). According to Singh *et al*. (1991) the *per se* performance and *gca* effects of

Table 2 : Analysis of variance for the biometric character in cotton.

Source	df	Days to first flowering	Days to 50 per cent flowering	Plant height	No. of Boll/plant	Boll weight	No. of seeds per boll	Seed cotton yield
Replication	1	4.66**	7.71**	0.93	1.92	0.0468	2.3809*	4.50**
Genotype	20	92.72**	32.98**	253.01**	210.16**	0.9773	52.4000**	268.57**
Error	20	0.66	0.21	0.25	21.87	0.1122	0.8810	0.49

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

Table 3 : Analysis of variance for combining ability.

Source	Mean sum of squares						
	Days to first flowering	Days to 50 per cent flowering	Plant height	No. of boll/ plant	Boll weight	No. of seeds/ boll	Seed cotton yield
GCA	12.58**	5.482**	63.16**	42.224**	0.2085	6.843**	32.82**
SCA	27.82**	7.223**	0.0638	12.924**	0.0207	16.097**	91.19**
GCA/SCA	0.45	0.759	990.00	3.267	10.078	0.425	0.360

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

Table 4 : Mean performance of parents.

Parents	Days to first flowering	Days to 50 per cent flowering	Plant height	No. of boll/ plant	Boll weight	No. of seeds/ boll	Seed cotton yield
LRA 5166	42.50	52.50	120.15	78.00	4.75	30.50	135.30
MCU 7	59.00	58.50	78.35	64.50	2.75	22.50	108.55
DHY 286-1	63.50	58.50	104.15	73.50	4.05	17.50	119.65
Surabhi	48.00	57.00	113.05	67.50	4.25	33.00	126.85
LRK 516	46.00	52.50	98.35	45.50	3.15	20.50	110.95
AK-32	53.00	64.50	118.10	56.50	2.65	24.50	112.50

Table 5 : Mean performance of Hybrids.

Characters	Crosses	Mean performance
Days to first flowering	LRA 5166 x Surabhi	40.00
Days to 50 per cent flowering	LRA 5166 x Surabhi	49.50
Plant height	LRA 5166 x AK-32	120.60
No. of boll/plant	LRA 5166 x Surabhi	89.00
Boll weight	LRA 5166 x Surabhi	5.10
No. of seeds/boll	LRA 5166 x Surabhi	36.50
Seed cotton yield	LRA 5166 x Surabhi	149.25

the parents were directly related to each other. Hence, it is necessary to consider both *per se* performance and *gca* effects for the improvement of any character. In the present investigation, LRA 5166, Surabhi and AK 32 were best parents based on both *per se* and *gca* effects for some yield contributing Traits *viz.,* number of bolls per plant, boll weight, number of seeds per boll and seed cotton yield (tables 4 & 5).

Therefore, it could be concluded that crosses involving LRA 5166, Surabhi and AK 32 would results superior hybrids with favourable genes for yield and its components traits.

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