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Study on General Combining Ability in Upland Cotton (*G. hirsutum*)

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A B S T R A C T

The present investigation entitled was undertaken to study the pattern of heterosis, combining ability and gene action of the crosses (hybrids). The experiment was planted at Cotton Research Unit, Dr. PDKV, Akola. Ten genetically diverse parental lines were crossed in diallel fashion (excluding reciprocals). Ten parental lines, forty five hybrids and two checks were studied in *kharif*, 2009. Observations were recorded on fifteen characters *viz*; days to 50 per cent flowering, Days to maturity, Days to first boll bursting, plant height (cm), number of monopodia per plant, number of sympodia per plant, number of bolls per plant, boll weight (g), seed cotton yield (Kg/ha), seed index (g), lint yield (kg/ha), ginning out turn (%),2.5 per cent span length (mm), micronaire value (µg/inch), fibre strength (g/tex), and uniformity ratio. The genetic analysis was carried out as per model I, method II of Griffing (1956). Heterosis was estimated over mid parent, better parent, standard hybrid PKV Hy-2 and PKV Hy-5.

Introduction

The present investigation entitled "Heterosis and Gene action studies for yield and fibre properties in upland cotton (*G. hirsutum*L.)" was undertaken to study the pattern of heterosis, combining ability and gene action of the crosses (hybrids). The experiment was planted at Cotton Research Unit, Dr.PDKV, Akola.

Cotton is one of the most important sources of natural fibre. Its fibre is unmatched and universally preferred for clothing. In India, it is rightly called as "White Gold" as it occupies vital position in Indian agriculture and economy

Materials and Methods

Ten genetically diverse parental lines were crossed in diallel fashion (excluding reciprocals). Ten parental lines, forty five hybrids and two checks were studied in *kharif*, 2009. Observations were recorded on fifteen characters *viz.*, days to 50 per cent flowering, Days to maturity, Days to first boll bursting, plant height (cm), number of monopodia per plant, number of sympodia per plant, number of bolls per plant, boll weight (g), seed cotton yield (Kg/ha), seed index (g), lint yield (kg/ha), ginning out turn (%), 2.5 per cent span length (mm), micronaire value (µg/inch), fibre strength (g/tex), and uniformity ratio.

The genetic analysis was carried out as per model I, method II of Griffing (1956). Heterosis was estimated over mid parent, better parent, standard hybrid PKV Hy-2 and PKV Hy-5. Results are briefly summarized below. The most heterotic crosses over mid parent, better parent, standard hybrid for seed cotton yield per plant were AKH 08-22 x IET SPS-2, IET-2 x AKH-9913 and IET-2 x IET SPS-2 respectively. These hybrids also recorded highest seed cotton yield. The most heterotic crosses for important fibre properties were AKH08-22xAKH-9913 and AKH08-22 x AKH-9912 for 2.5 per cent span length, AKH 08-22 x IET-SPS-2 and AKH 08-22x BBP LS-43 for fibre strength.

Results and Discussion

Combining ability analysis

Genetic enhancement in the crops is a continuous process. In order to have break through for yield breeder look for the variability or to create the variability. The progress of genetic improvement depends on the type of parental lines selected, the inheritance of characters and the approach of handling the breeding material.

In a systematic breeding programme, the choice of suitable parents for hybridization depends upon general combining ability (gca of the parents). General combining ability is the average performance of parents in a several cross combinations and is important for varietals development programme. Whereas, specific combining ability tells the performance of a specific cross exhibiting the dominance and epistasis. In present investigation, the analysis of variance for combining ability in F_1 generation is presented in Table 1.

The results revealed that the mean sum of squares for general combining ability and specific combining ability were highly significant for all the characters except for sca variances for uniformity ratio, for fibre strength and for ginning percentage. It indicated the importance of both additive as well as non additive gene action in inheritance of these characters.

The importance of both additive and non additive gene action has been reported by Pavasia *et al*., (1990) for monopodial branches, sympodial branches, bolls per plant, ginning percentage, seed cotton yield per plant and mean fibre length. Similar results for seed cotton yield per plant, boll number and boll weight was reported by Bhatade *et al*., (1992); Mane and Bhatade (1992) for ginning percentage, fibre length and seed cotton yield; Alam *et al*., (1992) for sympodial branches, number of bolls, plant height, seed cotton yield and ginning percentage and Choudhari *et al*., (1993) for seed cotton yield, bolls per plant, halo length and ginning percentage Sambamurthy and Ranganadhacharyulu (1998) also noticed preponderance of both significant additive and non additive variances for days to 50 per cent flowering, monopodia, sympodia, height, boll weight, boll number, seed index and yield per plant. Khorgade *et al*., (2000) reported similar results for days to 50 per cent flowering, plant height, sympodia, boll number, boll weight, ginning percentage, seed index, micronaire value, fibre strength, 2.5 per cent span length and seed cotton yield per plant.

Deosarkar (2009) studied analysis of variance for combining ability and revealed that variances due to gca and sca were highly for all the characters.

Karademir (2009) reported that variance due to GCA and SCA were highly significant for all the traits under study. This indicated both additive and non additive gene effects were responsible for the investigated characters.

fibrelength, fibre fineness and fibre elongation were influenced by additive gene effects. While seed cotton yield, fibre yield, ginning percentage, fibre strength and fibre uniformity were influenced by non additive gene effects.

The ratio of 6^2gca/6^2 sca variance components indicated predominance of non additive gene action for all the characters except for uniformity ratio. The ratio of 6^2gca/6^2sca greater than unity for uniformity ratio indicated involvement of additive genes in control of these traits. Similar findings were also reported by Nirania *et al*., (1992), Koodalingam and Ramlingam (1992), Patil *et al*., (1992)

Estimates of general combining ability

The general combining ability gives an idea about the breeding behaviour of the parental lines and helps in screening of the lines for the varietal improvement programme.

The estimates of gca effects in Table showed that the parent AKH 08-22 found as best general combiner not only for seed cotton yield per plant but also for fibre strength and plant characters *viz*., days to 50 per cent flowering, number of sympodia per plant, number of bolls per plant, seed index and lint yield. This parent was involved in six out of top ten crosses for seed cotton yield per plant

The parents BGP Sel SPS-18 though found good general combiner for seed cotton yield per plant and other plant characters but were poor general combiners for important fibre properties *viz*., 2.5 per cent span length, micronarie value and uniformity.

For earliness, parents BGP Sel SPS-18, AKH08-22 and AKH-9913 were good general combiners. The parents AKH-9913, MCU-5VT and IET-SPS-2 were best combiners for plant height. For monopodia per plant IET-2 was best general combiner while the parents AKH08-22, IET-2 were best combiners for number of sympodia per plant and number of bolls per plant. For boll weight the parent MCU-5VT showed highest gca effect in desirable direction whereas for seed cotton yield(kg/ha) AKH 08-22 was best general combiner while parent AKH 08-22, AKH-9913 and BGP Sel SPS-4 were promising for seed index whereas AKH08-22 was promising for lint yield.IET SPS-2,AKH 08-22 and IET-2 were good general combiners for ginning percentage.

Characteristics of parental lines

Sr.No	Parents	Important features
1	AKH-08-22	High yielding, long staple length, high ginning outturn
2	IET-2	Medium tall, shortsympodia, compact plant type, early maturing
3	BGP Sel SPS-18	Tall,big boll,medium duration
4	IET-SPS-2	Dense hairy leaves, bigboll, resistant to sucking pest
5	AKH-9913	High yielder, goodbearing, medium duration
6	MCU-5VT	Long staple length, low micronaire value, verticillium wilt
7	AKH-9912	Medium tall, long staple length
8	BGP Sel SPS-4	Tall, high yielder, long staple length, low micronaire value
9	BBP Sel SPS-30	High yielding, long staple length with good strength
10	BBP LS-43	Hairy, bigboll, shortsympodia

Table.1 Analysis of variance for combining ability for various characters

Source of variation	df	Days to fifty flowering	Days to maturity	Days to First boll bursting	Plant height (cm)	No. of monopodia	No. of sympodia	No.of boll/plant	Boll weight (g)	Scy kg/ha	Seed index (g)
GCA	9	11.640 **	7.637 *	8.058 **	13.26	0.045	22.949 **	34.677**	0.272**	193395.0 **	1.534 **
SCA	45	5.917 **	5.389 *	5.498**	14.630 *	0.183 **	3.170 **	7.546	0.202**	59559.0 **	0.536 *
Error	108	0.732	3.396	2.272	7.980	0.064	1.354	0.655	0.034	5991.9	0.315
sl² g		0.909	0.353	0.482	0.44	-0.002	1.8	2.835	0.020	15616.9	0.102
sl² s		5.185	1.994	3.225	6.65	0.119	1.817	6.890	0.168	53567.0	0.221
GCA/SCA Ratio		0.175	0.177	0.149	0.066	-0.014	0.991	0.411	0.118	0.292	0.46

Table 1 : Contd..

Source of variation	df	Lint yield (kg/ha)	Ginning out turn (%)	2.5% span length (mm)	Micronaire (ug/inch)	Fibre strength (g/tex)	Uniformity ratio
GCA	9	29114.720 **	2.735 *	4.373 **	0.158 **	1.289 **	14.761 *
SCA	45	8987.311 **	1.403 *	1.823 *	0.126 **	0.648 **	6.761
Error	108	905.471	0.931	1.021	0.044	0.330	6.798
sl² g		2350.771	0.150	0.279	0.009	0.080	0.664
sl² s		8081.840	0.472	0.803	0.081	0.318	-0.037
GCA/SCA Ratio		0.291	0.318	0.348	0.116	0.251	-17.722

***, ** - Significant at 5 per cent and 1 per cent level, respectively**

Table 2: Top ranking parents, best general combiners and F_{1s} having high sca effects for different characters

S.N.	Character	Best parent per se	Best general combiner in F_1	Best F_{1s} per se	F_{1s} showing high sca
1.	Days to 50% Flowering	IET-2 (65.00) BGP Sel SPS-4 (65.00) BGP Sel SPS-18 (65.67)	BGP Sel SPS-18 (-2.022) AKH 08-22(-0.856) AKH-9913 (-0.383))	AKH08-22 x IET SPS -4(54.66) BGP Sel SPS-18 x MCU –5VT(57.33) AKH08-22 x BGP Sel SPS-4 (62.33)	**AKH08-22 x IET-2 (-7.75)** **IET SPS-2 x BBP Sel SPS-30 (-3.45)** **AKH08-22 x AKH-9912 (-3.31)**
2.	Days to maturity	BBP LS-43 (180.00) BGP Sel SPS-4 (180.00) AKH-9913 (180.33)	IET-SPS-2 (-1.494) AKH08-22 (-0.828) AKH 9913 (-0.494)	AKH-9913 x BGP Sel SPS-4 (176.33) IET-SPS-2 x BBP Sel SPS -30 (176.35) AKH-9913 x BBP Sel SPS -30 (175.67)	**AKH08-22 x AKH 9912 (-3.94)** **IET-2 x AKH-9913 (-3.94)** **MCU-5VT x BBP LS-43 (-3.75)**
3.	Days to first boll bursting	AKH-9912 (120) BBP Sel SPS-30 (119) BGP Sel SPS 4(119)	BGP Sel SPS-18 (-2.044) IET-2 (-0.628) MCU-5VT (-0.128)	BGP Sel SPS -18 x MCU-5VT (107) BGP Sel SPS-18 x BGP Sel SPS-4(112) AKH08-22 x IET-SPS-2 (113)	**BGP Sel SPS-18 x IET-SPS-2 (5.33)** **AKH08-22 x AKH-9913 (4.39)** **BGP Sel SPS-18 x BGP Sel SPS-4(3.22)**
4.	Plant height (cm)	IET-2 (111.33) AKH08-22	AKH-9913 (1.628) MCU-5VT (0.711)	AKH 9913 x BBP LS -43 (115)	**IET-2 x IET-SPS-2 (6.28)** **IET-2 x BGP Sel SPS-18**

		(109.33) BBP Sel SPS-30 (108.67)	IET SPS-2 (0.517)	IET -2 x MCU-5VT (114.33) IET-2 x AKH-9913 (113.67)	**(5.97) AKH08-22 x BGP Sel SPS-4 (5.78)**
5.(i)	Number of monopodia/ plant	BBP Sel SPS-30 (2.73) AKH-9913 (3.27) IET-SPS-2 (3.37)	IET-2 (-0.103) AKH 9912 (-0.075) MCU-5VT (-0.061)	IET-2 x IET-SPS-2 (2.43) IET-SPS-2 x BBP LS-43 (2.57) AKH-9912 x BGP Sel SPS - 4 (2.57)	**AKH-9913 x BBP LS-43 (-0.89) IET-SPS-2 x MCU-5VT (1-0.86) BBP Sel SPS-30 x BBP LS-43 (-0.77)**
5.(ii)	Number of sympodia per plant	MCU-5VT (11.60) IET-SPS-2 (13.93) BGP Sel SPS-4 (14.00)	AKH08-22(3.666) IET-2 (0.769)	AKH08-22 x IET-2 (25.33) AKH-08-22 x IET SPS-2 (24.06) AKH08-22 x BGP SelSPS-30 (20-93)	**AKH08-22 x BGP Sel SPS-18 (4.87) IET-2 x AKH-9913 (2.31) AKH-08-22 x BGP Sel SPS-4(2.27))**
6.	Number of bolls per plant	AKH 9913 (16.60) BGP SelSPS-4 (15.33) BBP LS-43 (11.93)	AKH08-22 (3.274) IET-2 (2.227) BGP Sel SPS-18 (0.718)	AKH08.22 x IET x SPS-2 (27.40) IET-2 x IET-SPS-2 (22.13) IET-2 x IET –SPS-2 (22.13)	**AKH08-22 x BGP Sel SPS-18 (8.71) AKH08-22 x IET-SPS-2 (6.29) IET-2 x BGP Sel SPS-18 (2.79)**
7.	Boll weight (g)	BBP Sel SPS-30 (3.77) BGP Sel SPS -18 (3.17) BGP Sel SPS-4 (3.47)	MCU-5VT (0.223) IET-SPS-2 (0.154) AKH-9913 (0.095)	AKH-9913 x BBP Sel SPS - 30 (4.17) IET-SPS-2 x BBP LS-43 (4.17) IET-SPS-2 x AKH-9912 (3.83)	**MCU -5VT x BGP Sel SPS-4 (0.84) IET-SPS-2 x BGP Sel SPS-4 (0.78) BGP Sel SPS-18 x BGP Sel SPS-30 (0.75)**
8.	Seed cotton yield per plant (kg/ha)	AKH08-22 (1687.66) AKH-9913 (1562.33) BGP Sel SPS -4 (1465.33)	AKH 08-22 (269.189) IET-2 (146.244) BGP Sel SPS-18()	AKH X IET – SPS- (2555) IET-2 x AKH 9913 (2056) IET-2 x IET -SPS -2 (2001)	**AKH 08-22 x BGP Sel SPS -18 (741-25) IET -2 x BGP Sel SPS-18 (365.17) IET-SPS-2 x AKH-9913 (33.109)**
9.	Seed index (g)	AKH -9912 (10.83) AKH-9913 (10.50) BBP LS-43 (10.17)	AKH 08-22 (0.818) AKH-9913 (0.271) BGP Sel SPS-4 (0.123)	AKH 08-22 x BBP Sel SPS - 30 (11.50) IET-SPS-2 x BBP Sel SPS-30 (11.33) AKH08-22 x MCU-5VT (11.33)	**IET-2 x BGP Sel SPS-18 (1.22) IET-SPS-2 x AKH-9913 (1.15) AKH08-22 x IET-2(1)**
10.	Lint yield (g)	AKH08-22 (617) AKH-9913 (563.66) BBP LS-30 (525.00)	AKH08-22 (104.96) IET-2 (60.87) BGP Sel SPS-18 (11.29)	AKH08-22 x IET – SPS-(924.33) IET-2 x AKH-9913(771.33) IET-2 x IET-SPS-2 (750.00)	**BGP Sel SPS-18 x BGP Sel SPS-4 (98.67) AKH08-22 x BBP Sel SPS-30 (83.89) BGP Sel SPS-18 x BBP LS-43 (75.09)**
11.	Ginning out turn (%)	AKH08-22 (36.53) IET-2 (36.47) BBP Sel SPS-30 (36.27)	IET – SPS-2 (0.558) AKH08-22 (0.492) IET-2 (0.469)	IET-2 x BBP LS-43 (38.50) IET-SPS-2 x AKH-9913 (38.80) AKH08-22 x BBP LS-43 (38.40)	**BGP Sel SPS-18 x BGP Sel SPS-4 (3.14) AKH08-22 x BBP Sel SPS-30 (2.24) IET-2 x BGP Sel SPS-4 (2.00)**
12.	2.5 % Span length	BGP Sel SPS-4 (31.33) BBP Sel SPS-30 (31.06) IET-2(27.57)	AKH-9913 (0.937) MCU. 5VT (0.651) BGP Sel SPS-18 (0.317)	MCU – 5 VT x BBP LS-43 (32.23) MCU-5VT X AKH -9912 (31.9) AKH08-22 X BGP Sel SPS-4 (31.66)	**AKH08-22 x AKH -9912 (2.39) IET-2 x IET-SPS-2 (2.26) AKH 08.22 x BGP Sel SPS-4 (2.16)**
13.	Micronaire value (ug/inch)	BGP Sel SPS-4 (3.60) AKH-9912 (3.60) BBP LS-43 (4.13)	AKH-9913 (-0.170) BGP Sel SPS-18 (-0.089) BBP Sel SPS-30 (-0.073)	BGP Sel SPS-18 x MCU-5VT (3.46) AKH08-22 x IET-SPS-2 (3.73) MCU-5VT x BBP Sel SPS-	**BGP Sel SPS-4 x BBP LS-43 (-0.71) IET-2 x IET – SPS-2 (-0.62) IET -2 X AKH-9912 (-0.51)**

				30 (3.80)	
14.	Fibre strength (g/tex)	BBP Sel SPS-30 (20.36) BGP Sel SPS-18 (20.10) AKH9913 (20.00)	BGP Sel SPS-18 (0.623) AKH08-22 (0.454) AKH-9913 (0.093)	BGP Sel SPS-18 x MCU-5VT (23.90) AKH08-22 x IET-SPS-2 (22.40) MCU-5VT x BBP LS-43 (21.10)	**AKH08-22 x BGP Sel SPS-18 (1.37)** **MCU-5VT x BBP LS-43 (1.26)** **AKH-9913 x BBP Sel SPS-30 (1.05)**
15.	**Uniformity ratio**	**IET-SPS-2 (53.20)** **BBP LS-43 (52.27)** **AKH-9913 (52.10)**	**IET-2 (1.055)** **BGP Sel SPS -18 (0.79)** **IET-SPS-2 (0.585)**	**IET-2 x BBP –LS-43 (52.33)** **IET-2 x BGP Sel SPS-18 (52.23)** **AKH08-22 x BGP Sel SPS-18 (52.23)**	**BGP Sel SPS -18 x AKH-9913 (2.38)** **AKH-9912 x BBP LS-43 (3.12)** **IET- 2x MCU-SVT (3.8)**

Among the fibre parameters the parents AKH-9913, MCU-5VT and BBP Sel SPS-18 were good general combiners for 2.5 per cent span length. AKH-9913, BGP Sel SPS-18 and BBP Sel SPS-30 for micronaire value; BGP Sel SPS-18, AKH 08-22 and AKH-9913 for fibre strength and IET-2, BGP Sel SPS-18 and IET-SPS-2 for uniformity ratio were good general combiners .

If *per se* performance of the parents is seen along with the gca effects, the parental lines showing high means were having good general combining ability in majority of characters studied. Hence it can be concluded that gca effects of the lines were concomitant with their *per se* performance. It suggests that while formulating breeding programme due weightage should be given to *per se* performance and gca effects of the parental lines. For good hybrid combinations gca of the parent is important because parent which showed good gca might be possessing the favourable genes for seed cotton yield and its components and therefore, required to be extensively used in breeding programme to combine desirable character. The close relationship between *per se* performance of the parents and their gca effects has been reported by Sambamurthy and Ranganadhacharyulu (1998) and Ahuja and Tuteja (2000). However, Nadarajan and Rangaswami (1990b) observed no association between gca effects of parents and sca effects of crosses with their *per se* performance.

Abro (2009) reported variety sadori to be best general combiner for plant height, number of bolls per plant and seed cotton yield.

In cotton significant improvement in yield could be achieved by improving number of bolls per plant, number of sympodia per plant, boll weight and seed index. In present investigation, the parental lines AKH08-22, BGP Sel SPS-18 indicated favourable gca effects for most of the characters. These parents should be extensively used in improvement program, so that optimum combinations of these components can be obtained which are necessary for achieving high yield levels. Their cross combinations are likely to yield transgressive segregants.

References

Abro,S.;M.M.Kandhro,S.Loghari,M.A.Arain and Z.A.Deho (2009):Combining ability and heterosis for yield contributing traits in upland cotton (*G. hirsutum* L..) Pak. J. Bot., 41(4):1769-1774

Ahuja, S.L. and O.P. Tuteja. 2000. Heterosis and combining ability for yield and its components traits in upland cotton. J. Cotton Res. Dev., 14 (2): 138-142.

Alam, A.K.M.R., N.C. Roy and H. Islam, 1992. Heterosis and combining ability in upland cotton (*Gossypium hirsutum*L.). Annals Bangladesh Agric., 2(1): 31-39.

Bhatade, S.S. and S.R. Rajeshwar. 1994. Heterobeltiosis and standard heterosis for yield and quality characters in some *Gossypium hirsutum* crosses. Madras Agric. J. 81(1): 34-35.

Choudhari, P.N., D.N. Borle, S.S. Patil and M.P. Deshmukh. 1993. Combining ability studies on quantitative components in *desi* cotton. J. Maharshtra Agric. Univ., 18(3): 418-420.

Griffing, B. 1956[a]. Concept of general and specific combining ability in relation to diallel crossing system. Aust. J. Biol. Sci. 2:463-493.

Griffing, B. 1956[b]. A generalised treatment of the use of diallel crosses in quantitative inheritance. Heredity. 10:31-50.

Khorgade, P.W.; I.V. Satange and L.D. Meshram. 2000. Diallel analysis in American Cotton (*Gossypium hirsutum*L.). Indian J. Agric. Res. 34(3):172-175

Mane, S.S. and S.S. Phatade, 1992. Combining ability analysis in F_1 and F_2 diallel for yield and quality in cotton (*Gossypium hirsutum*L.), Madras Agric. J. 79(10): 563-570.

Nadarajan, N. and S. Rangasamy. 1990[a]. Combining ability and variability studies in (*Gossypium hirsutum*L.). J. Indian Soc. Cotton Improv. 15(1): 16-18.

Nadarajan, N. and S. Rangasamy. 1990[b]. Study of heterosis and combining ability in (*Gossypium hirsutum*L.). J. Indian Soc. Cotton Improv. 15(2): 88-94.

Pavasia, M.J. and P.T. Shukla. 1997. Combining ability analysis for fibre characters over environments in upland cotton. J. Cotton Res. Dev. 11(2):148-155.

Pavasia, M.J.; P.T. Shukla and U.G. Patel. 1998. Combing ability studies for yield and its components over environments in upland cotton. J. Indian Soc. Cotton Improv. 23(2):140-143.

Pavasia, M.J.; P.T. Shukla and U.G. Patel. 1999. Heterobeltiosis in multiple environments for seed cotton yield and related characters in cotton *G. hirsutum* L. J. Indian Soc. Cotton Improv. 24(1): 14-17.

Sambamurthy, J.S.V. and N. Ranganadhacharyulu. 1998. Combining ability studies in diallel crosses of cotton. Ann. agric. Res. 19(4):441-444.

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