GENETIC ANALYSIS OF THREE DEVELOPMENTAL PLANT CHARACTERISTICS IN UPLAND COTTON

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Mean squares obtained from combining ability analysis showed that gca, sca and reciprocal effects were significant for height of the main stem, number of monopodial and sympodial branches. The relative contribution of each of the components towards total variance indicated the presence of additive genetic effects in the genetic control of height of the main stem, whilst genetic expression of monopodial and sympodial branches were revealed to be influenced by the genes acting non-additively. The two lines, PO/695-F6 and E 288 proved to be the best general combiners for the three characters and their combination PO/695-FG x E288 showed superiority for all the traits.

INTRODUCTION

An understanding about the genetic mechanism of variation in different characters of cotton plant is fundamental of a breeding programme. Therefore, a research programme was undertaken to study the genetic behaviour of variation in different characteristics of cotton plant belonging to *hirsutum* species. The authors had reported the genetic basis of yield and its components and quality characters (Azhar and Rana, 1993 a, b). This paper reports the genetic mechanism of height of the main stem, monopodial and sympodial branches of cotton plant.

MATERIALS AND METHODS

The plant materials used to develop F_1 seed and procedure of experimentation for the study had been given (Azhar and Rana, 1993 a). When apical growth of the plant ceased final height of the main stem was measured from the first cotyledonary node to the apical bud. Number of monopodial and sympodial branches on each plant were counted in the three replications.

The mean values of the 16 genotypes in three replications were obtained and subjected to analysis of variance to determine the significance of genotypic differences in the characters. For genetic analysis of the data 'Method I' and 'Model II' of Griffing's technique (1956) were followed.

RESULTS AND DISCUSSION

The analysis of variance of height of the main stem, number of monopodial branches and sympodial branches indicated significant ($P<0.01$) differences in the characters (Table 1), combining ability analysis of the data (Table 2) showed the effects of general combining ability (gca), specific combining ability (sca) and reciprocals to be significant in the expression of all the characters. The greater magnitude of variance resulting from gca effects for plant height (38.03%) appeared primarily due to the genes acting additively as assumed by Griffing (1956) and in contrast the higher values of variance for monopodial branches (49.72%) and sympodial branches (57.61%) due to reciprocal differences and sca, respectively were influenced by the genes showing non-additive effects (Table 3).

The comparison of the four parents regarding their gca (Table 4) showed that accessions/lines PO/695-FG and E288, both exotics, with their minimum values of -9.03 and -9.23, respectively were the best general

Table 1. Mean sqaures from analysis of variance of three developmental plant characteristics in upland cotton

Source of variation	DF	Height of main stem	Number of monopodial branches	Number of sympodial branches
Blocks	2	76.85	0.59	1.20
Genotypes	15	1488.85**	14.85**	23.00**
Error	30	28.12	0.38	1.00

Table 2. Mean squares from combining analysis of three developmental plant characteristics in upland cotton

Source of variation	DF	Height of main stem	Number of monopodial branches	Number of sympodial barnches
gca	3	1875.92**	13.09**	5.45**
sca	6	226.39**	1.19**	8.63**
Reciprocals	6	72.27**	4.65**	7.83**
Error	30	9.37	0.13	0.33

Table 3. Estimates of components of variance for three developmental plant characteristics in upland cotton (values given in the parentheses are the percentages of variance due to respective source)

Variance components	Height of main stem	Number of monopodial branches	Number of sympodial branches
gca ($\sigma^2 g$)	224.12 (38.03)	1.50 (33.00)	-0.32 (-3.61)
sca ($\sigma^2 s$)	133.55 (23.21)	0.66 (14.52)	5.11 (57.61)
Reciprocals ($\sigma^2 r$)	208.28 (36.20)	2.26 (49.72)	3.75 (42.28)
Error ($\sigma^2 e$)	9.37 (1.63)	0.13 (2.75)	0.33 (6.02)

Table 4. Estimates of gca of four parental lines for three developmental plant characteristics in upland cotton

Varieties	Height of main stem	Number of monopodial branches	Number of sympodial branches
LSS	22.73	1.77	0.09
PO/695-FG	-9.03	-0.67	0.77
ABG0904	-4.46	0.05	-1.16
E288	-9.23	-1.15	0.30
SE (g_i - g_j)	8.94	2.45	1.69

Table 5. Estimates of sca and reciprocal effects for three developmental plant characteristics in upland cotton (values given in parentheses are for the reciprocal effects for the characters)

Crosses	Height of main stem	Number of monopodial branches	Number of sympodial branches
PO/695-FG x LSS	9.14 (-14.50)	1.15 (-1.36)	1.52 (-1.70)
E288 x LSS	8.48 (-19.34)	-0.23 (-2.83)	0.53 (-0.59)
ABG0904 x LSS	6.82 (0.22)	0.87 (-0.94)	1.64 (-2.84)
PO/695-FG x ABG0904	5.09 (-14.33)	0.01 (-1.00)	0.76 (-1.53)
E288 x ABG0904	-0.08 (-10.50)	0.47 (-1.47)	0.18 (1.17)
PO/695-FG x E288	-3.32 (-3.91)	0.24 (-0.20)	1.47 (-2.92)
SE (S_{ij} - S_{ik})	9.82	1.15	1.85
SE (r_{ij} - r_{ik})	11.34	1.30	2.11

combiners for shorter plant height. Similarly for lesser number of monopodial branches both the lines proved to be good combiners by attaining numerical values of -0.67 and -1.15, respectively. The positive values of 0.77 and 0.30 attained by PO/695-FG and E288 indicated their best gca for number of sympodial branches, respectively. This information suggests that crossing of these two lines, PO/695-FG and E288 may be useful to the breeders for the development of desirable genotypes.

The combination PO/695-FG x E288 with negative value for plant height (-3.32), decreased value for monopodial branches (0.24) and the higher value for sympodial branches (1.47) expressed its best gca as for as selection for a combination showing harmonious combination for the three characters is concerned (Table 5). This situation provided evidence that varieties/genotypes which are good general combiners, they also have the potential to produce good hybrids (Gupta, 1987; Hussain and Khan, 1991). But this does not seem to be true in all the cases, for example, cross ABGO904 x LSS displayed its good sca for number of sympodial branches and both the parents involved were poor general combiners for this character. These data indicated that for production of hybrids the selection of parents based upon their gca is not always necessary, sometimes parents showing poor gca may show their ability to produce good hybrids. Evidence on the behaviour of the parents similar to observed here is available in the literature (Baluch and Chang, 1970; Azhar *et al.*, 1983).

The variation in plant height appeared to be additively controlled and is thus highly heritable (Falconer, 1981). The larger part of the variation in monopodial branches (49.72%) was conditioned by the genes with non-additive effects, nonetheless 33% of the variation appeared to be influenced by the alleles acting additively and provided sufficient evidence that selection of plants bearing minimum number of monopodial branches may easily be made. As the plant height and monopodial branches are positively correlated, selection of plants having minimum number of monopodial branches with shorter plant height may simultaneously be made.

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