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Seed Cotton Yield and Fibre Properties of F1 and F2 Hybrids of Upland Cotton

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Abstract: Relative yield and fibre properties of parents, F1 and F2 hybrids were compared. The variances among the genotypes were significant for yield, lint %, fibre length and fibre uniformity. Similarly, variances for all the four traits were significant among parents, F1 and F2 groups. In orthogonal contrast comparison, F2 hybrids expressed higher variance for yield and lint percent whereas for fibre length, F1s presented more variance and in fibre uniformity, parental lines have shown greater variance than the other two groups of genotypes. Orthogonal contrast comparisons were also made where parents versus F1 and F2 hybrids expressed more variance than F1 versus F2 hybrids for all the traits except fibre length. In relative performance, F1 and F2 hybrids, on an average produced 36.4 % and 20.1 % respectively, more yield than the parents. Though, F2 hybrids have shown 12.0% inbreeding depression, nevertheless six of the 12 F2 hybrids gave higher yield than F1 hybrids showing that potential in F2 hybrids exists to replace F1 hybrid crop development. Accordingly in Lint %, F1 and F2 hybrids were higher than parental lines but surprisingly F2 and not the F1s expressed 9.0 % and F1s only 3.0 % heterosis against parents, consequently F2s have shown 6.0% higher lint % than even F1 hybrids. In fibre length, F1s have demonstrated 3.0 % increase over parents whereas F2s were equal to parents. Both F1 and F2 gave 4.1% more uniform fibre over the parental lines.

Key words: Variance, F1 and F2 hybrids, seed cotton yield, upland cotton

Introduction

Vigor of F1 hybrids for yield and disease, pest and tolerance to stress conditions have long been realized. However, only limited heterosis has been exploited because of both complicated logistics of producing F1 seed and disappointingly small improvement in most fibre characteristics (Meredith, 1984; Sheetz and Quisenberry, 1986). These limitations have warranted plant breeders to seek potential alternative to increase per unit area cotton production. Theoretically, vigor of F2 hybrids decrease half to that expressed in F1 generation. Nevertheless, support exists both in the literature and in the industry to increase F1 seed and market F2 hybrids for commercial production. The prospects of F2 hybrids naturally raise question about positive and negative effects on yield and fibre properties of F2 hybrids against parents and F1 hybrids.

Meredith (1990) recorded the yield of seed cotton of parents, F1 and F2 hybrids as 953, 1065 and 1025 kg/ha respectively and two highest yielding F1 hybrids gave 8.0 % higher yield in F2 generation than their respective parental line. Turcotte and Percy (1990) observed that though F2 hybrids on an average yielded significantly lower than mid parents or better parents, however two highest yielding F2s also had longer fibre as compared to parents. Schoenhals and Gannaway (1990) evaluated five F1s and their F2s for yield, agronomic and fibre properties and its was revealed that two of the six F2 hybrids gave greater yield as compared to corresponding F1 hybrids. Their lint % however did not differ significantly. Baloch *et al.* (1991) observed that though none of the F2 hybrids were equal in yield to F1 but all the six F2 hybrids gave yields higher than the mid parent (6.10 to 21.15 %) and fewer F's were even high yielded than better parents (2.25 to 4.60 %). In lint %, none of the F's were better than respective parents, however in fibre length, two F2 hybrids were better than their respective high parents (increase of 0.28 to 0.84%).

Present study was therefore, initiated to determine the potentiality of utilizing F2 hybrid seed instead of F1 and also to identify parental lines that combine the favorable genes and still express and acceptable level of vigor in yield and fibre traits in F2 generation. Genetic variability is also essential to improve the characters in segregating generations and diverse parents are important to generate this variability.

Materials and Methods

The relative performance of parents (NH-26, CRIS-7A, CIM-240, NIAB-78, Alseemi-515, CRIS-127, CRIS-122, CRIS-5A, CRIS-52, CRIS-121, CRIS-54 and CIM-109), F1 and F2 hybrids of cotton were compared. The parental lines were randomly crossed to develop twelve F1 hybrids during 1994 and these F1 hybrids were then selfed to develop twelve F1 hybrids during 1994 and these F1 hybrids were then selfed to develop twelve F2 hybrids during 1995. The experimental material comprising of parents, F1s (seed of fresh crosses during, 1995) and F's hybrids was planted during 1996 in a randomized complete block design with four replications in a plot size of 4 rows, 40 feet long for each genotype. The row to row and plant to plant distances were kept as 2.5, and 9.0, respectively, hence 10 plants from each repeat making total of 40 plants from each entry were randomly tagged to record the observations. The data on seed cotton yield per plant weighed in grams, lint % calculated based on ginning out turn, fibre length measured in millimeters by fibreograph and fibre uniformity calculated as the ratio at 2.5 and 50 % span length.

The analysis of variance and orthogonal contrast comparisons were carried-out by using the statistical methods adopted by Gomez and Gomez (1984). The orthogonal comparisons were made to determine the variance between parents versus the average of F1 and F2 hybrids and F1 hybrids versus F2 hybrids. Heterosis of F1 and F2 hybrids over parents, on mean basis was calculated as percent increase (+) or decrease (-) whereas inbreeding depression in F2 was calculated with the formula.

$$\% \text{ Inbreeding depression} = \frac{F2 - F1}{F1} \times 100$$

Results and Discussion

Mean squares obtained from analysis of variance for various traits are presented in Table 1. The main effect of genotypes and individual group effect of parents, F1 and F2 hybrids for all the four traits were highly significant (p. 0.01). Among the three classifications of genotypes, F1 hybrids for yield showed maximum variance and the next was F2 hybrids. However, for lint % and uniformity ratio, F2 hybrids demonstrated maximum variance as compared to parents and F1 hybrids. Regarding fibre length, F1 hybrids exhibited higher variance against F2 and parental groups. Theoretically, F2 hybrids are expected to show more variance than the parents and F1 hybrids but it did not hold true may be due to less frequency of gene recombination. In fact, for uniformity ratio, the parental group presented more variance than both F1 and F2 hybrids. The variance of F1 hybrids for yield is about twice as great as F2 hybrids, that is probably due to more heterosis in F1 and considerable amount of inbreeding depression in F2 hybrids

Table 1: Analysis of variance of parents, F1 and F2 hybrids for yield and fibre traits in upland cotton

Source of variation	df	Seed cotton yield	Lint %	Fibre length	Uniformity ratio
Genotype	35	3444.3**	13.84**	4.26**	15.89**
Blocks	3	10738.3	1.16	7.38	36.16
Error	105	26.4	1.37	0.27	0.43
Contrasts					
Parents	11	397.0**	6.08**	1.83**	17.21**
F1 hybrids	11	2862.2**	6.94**	5.58**	9.52**
F2 hybrids	11	1429.2**	8.23**	4.55**	15.16**
Orthogonal contrasts					
Parents vs. F1 and F2 hybrids	1	29374.8**	141.44**	3.58**	94.19**
F1 vs. F2 hybrids	1	1104.3**	108.86**	14.18**	1.33

**Significant at 1 % probability level.

Table 2: Seed cotton yield and fiber properties of parents, F1 and F2 hybrids in upland cotton

Crosses/parents	F1 hybrids				F2 hybrids				Parents			
	Yield/plant (gm)	Lint%	Fibre length (mm)	Uniformity ratio	Yield/ plant (gm)	Lint%	Fibre length (mm)	Uniformity ratio	Yield/ plant (gm)	Lint%	Fibre length (mm)	Uniformity ratio
CRIS-7Ax NH-26	155.6	36.7	28.8	47.4	11.5	38.9	27.8	46.1	96.7	36.9	27.2	45.7
CIM-240x NIAB-78 CRIS-7A	164.0	36.5	26.7	45.5	79.6	37.9	26.8	45.6	76.7	34.1	25.7	43.3
Alseemi-515x NIAB-78 CIM-240	165.1	33.6	29.5	45.0	125.9	36.4	28.2	47.4	106.9	36.7	26.9	45.5
CRIS-127x CRIS-122 NIAB78	102.4	36.3	26.8	49.4	118.2	37.5	26.6	45.8	90.0	33.7	26.5	45.6
CRIS-127x CRIS-5A Alseemi-515	147.4	36.8	27.4	47.6	103.7	38.1	26.5	47.3	88.2	33.1	27.9	41.4
CRIS-52x CRIS-122 CRIS-127	102.0	33.3	28.2	48.6	139.4	37.1	27.7	44.9	97.9	34.2	25.7	48.0
CRIS-52x CRIS-121 CRIS-122	98.4	35.0	27.1	45.0	135.7	36.8	26.2	50.0	94.1	34.3	26.2	44.6
CRIS-54x CRIS-121 CRIS-5A	108.8	35.3	26.0	47.3	108.9	36.6	25.7	47.7	105.2	35.3	26.1	46.9
CRIS-121x CRIS-5A CRIS-52	108.3	34.4	26.0	45.4	101.2	35.4	24.7	48.5	91.9	32.9	26.0	44.2
NIAB-78x CRIS-52 CRIS-121	119.6	36.7	25.9	46.3	137.6	39.2	26.1	48.3	98.9	34.7	26.4	46.7
CRIS-7Ax CRIS-54 CRIS-54	99.3	35.6	26.4	45.1	130.5	38.7	25.0	46.1	73.7	34.7	26.2	41.2
CRIS-7Ax CIM-109 CIM-109	143.5	37.3	28.1	45.1	140.6	40.6	26.3	42.6	90.0	34.6	27.3	45.1
General mean	126.2	35.6	27.2	46.5	111.1	37.7	26.5	46.7	92.5	34.6	26.5	44.8
CD(0.05) 28.1	1.09	0.99	1.81	33.3	2.7	1.26	2.08	14.03	0.85	0.59	1.14	
Heterosis of F1 and F2 on mean basis against parents	36.4	3.0	3.0	4.0	20.1	9.0	0.0	4.0	-	-	-	-
Inbreeding depression (%)	-	-	-	-	-12.0	6.0	-3.0	0.4	-	-	-	-

(Table 2). In orthogonal contrast comparison, the parents versus F1 and F2 hybrids and F1 versus F2 hybrids were highly significant for all the characters except uniformity ratio, which was non-significant for F1 and F2 hybrids. However, the variance of first group orthogonal comparisons was almost always higher than the later group orthogonal. Dever and Gannaway (1990) compared the relative performance of parents, F1 and F2 hybrids for various fibre properties and noted significant variability between parents versus F1 and F2 hybrids for lint %. The performance of parents, F1 and F2 hybrids for yield and fibre characters are presented in Table 2. On an average, F1 hybrids gave 126.2 gm yield per plant against 111.1 gm of F2 and 92.5 gm of parents, thus F1 hybrids had shown 36.4 and 20.1 % yield increase over F2 and parental lines respectively.

Comparing F1 with F2 hybrids, six of the 12 hybrids gave higher yield over even F1 hybrids. It is possibly due to transgressive segregation in identified which may still give more yield than F1 hybrids. Heterosis in yield on mean basis of F1s and F2s over parental lines were 36.4 % and 21.1%, respectively whereas inbreeding depression in F2 was 12 %. Though F2 hybrids, on an average, gave substantial inbreeding depression yet some of F2s show better performance than F1 hybrids were also reported by several researchers (Meredith and Bridge, 1972; Olvey, 1986; Baloch *et al.*, 1991 and 1993; Schoenhals and Gannaway, 1990). Surprisingly, in lint %, F2s on an average ginned 37.7 % as compared to 35.6 and 34.6 % of F1s and parents respectively, suggesting that F2s produced 2.1 and 3.1 % higher lint than respective groups of genotypes. Similarly, F1s expressed 3.0 % and F2s 9.0 % heterosis over parental lines. Since F2s produced more lint% against F1s, therefore there was no inbreeding depression in F2 hybrids, yet F2s were 6.0 % higher than F1s (Table 2). Dever and Gannaway (1990) also noted that lint% did not deteriorate in F2 hybrids and held steady. The F1s, on an average gave fibre length of 27.2 mm as compared to 26.5 mm of F2s and parents. Thus, F1s gave 0.7 % more fibre length over both F2s and parents. The F1 hybrids exhibited 3.0 % heterosis over parental lines, however F2s demonstrated 3.0 % inbreeding depression in fibre length. Only one F2 hybrid, NIAB-78 x CRIS-52 gave about equal fibre length to that of F1 showing no inbreeding depression. Dever and Gannaway (1990) and Baloch *et al.* (1991) observed some deterioration in F2 hybrids for fibre length but they also noted that some of the F2 hybrids gave increased fibre length over F1s. The fibre uniformity ratio of F1s and F2s respectively were 1.7 and 1.9 % higher than the parental lines. Both the classes of hybrids (F1s and F2s) also expressed 4.0 % heterosis over the parents, nevertheless F2s showed 0.4 % heterosis over even F1 hybrids. These results suggest that there is strong potential of F2 hybrids for uniformity ratio. Heterosis and inbreeding depression were as evident for fibre uniformity as reported by Dever and Gannaway (1990) and Bacloch *et al*. (1991).

References

Baloch, M. J., G. H. Tunio and A. R. Lakho, 1991. Expression of heterosis in F1 and its deterioration in intrahirsutum F2 hybrids. Pakphyton, 3: 95-106.

Baloch, M. J., A. R. Lakho and A. H. Soomro, 1993. Heterosis in interspecific cotton hybrids. Pak. J. Bot., 25: 13-20.

Dever, J. K. and J. R. Gannaway, 1990. Relative fibre uniformity between parents, F1 and F2 generations in cotton. pp: 62. Beltwide Cotton Production Research Conferences, National Cotton Council of America, Las Vegas, NV.

Gomez, K. A. and A. A. Gomez, 1984. Statistical procedures for agricultural. Research (2nd ed). pp: 215-222. John Wiley and Sons.

Meredith, W. R., Jr. and R. R. Bridge, 1972. Heterosis and gene action in cotton. *Gossypium hirsutum* L. Crop Sci., 12: 304-310.

Meredith, W. R., 1984. Quantitative genetics. pp: 131-150. In. J. Kohel and C. F. Lewis (ed) Cotton Am. So. Agron., Medison, W. I.

Meredith, Jr. W. R., 1990. Yield and Fibre quality potential for F2 hybrids. pp: 69. Beltwide Cotton Production Research Conferences, National Cotton Council of America, Las Vegas, NV.

Olvey, J. M., 1986. Performance and potential of F2 hybrids. pp: 101. In. J. M. Brown (ed). Proc. Beltwide Cotton Prod. Res. Conf. Nat. Cotton. Council of America: Memphis, TN.

Schoenhals, L. and J. Gannaway, 1990. Yield and quality determination of F1 and F2 hybrids. pp: 69. Beltwide Cotton Production Research Conferences, National Cotton Council of America, Las Vages, NV.

Sheetz, R. H. and J. E. Quisenberry, 1986. Heterosis and combining ability effects in upland cotton hybrids. pp: 94-98. In: J. M. Brown (ed.) Proc. Beltwide Cotton Prod. Res. Conf. Nat. Cotton Council of America. Memphis, TN.

Turcotte, E. L. and R. G. Percy, 1990. Evaluation of yield potential and fibre properties of 15 F2 populations and their parents in Pima cotton. pp: 69. Beltwide Cotton Production Research Conferences, National Cotton Council of America, Las Vagas, NV.