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Studies on Transgressive Segregation in F_2 Generation in *Deshi* Cotton (*Gossypium arboreum* L.)

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ABSTRACT

The identification of transgressive segregants for economically important trait such as seed cotton yield along with quality is an important aspect of any practical breeding programme. The F_2 of three diverse cotton (Gossypium spp.) crosses were evaluated for the number of transgressive segregation. The experimental material consisted of six diverse parents involving three crosses. Female parent's viz., JLA-794, AKA-7 and PA-183 were crossed with male parents viz.,JLA-505, PA-255 and PA-710. The F_2 of cross JLA-794 x JLA -505 exhibited the highest frequency of transgressive segregants for seed cotton yield per plant (39) followed by AKA-7 x PA-255 (32) and PA-183 x PA-710 (26). Plant No. 92 (F_2) was the most transgressive sergeant in cross no. one (JLA-794 x JLA-505) for seed cotton yield, recording 82.2% higher seed cotton yield in addition to higher intensity of expression for sympodia per plant, bolls per plant and ginning percentage. The transgressive segregants in plant no. 42 was the most promising in cross no.two (AKA-7 x PA-255) which out yielded the parent by 79.7% in addition to higher intensity of expression for sympodia per plant, bolls per plant, average boll weight and ginning percentage. In cross three (PA-183 x PA-710) plant no. 103 out yielded the increasing parent by 82.87% in addition to higher intensity of expression for sympodia per plant, bolls per plant and halo length.

Key words: *Diverse cross, F_2 population, Parents, Segregants and Traits.*

INTRODUCTION

Cotton is an important fibre crop of global importance. It is known as the "king of fibre" and recently called as "White gold". The most vital crop of commerce to many countries including India. In India, currently, *Gossypium* includes 50 species, four of which are cultivated, 44 are wild diploids and two are wild tetraploids[7]. Out of the four cultivated species, *Gossypium hirsutum L.* and *Gossypium barbadense L.* commonly called as new world cottons which are tetraploids (2n = 4x = 52) whereas, *Gossypium herbaceum L.* and *Gossypium arboreum L.* are diploids (2n = 2x = 26) are commonly called as old world cottons.

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The chief merit of *deshi* cotton is that it is fairly more tolerant to pest and drought. It is found to be more suited for diversified condition due to its deep root system[10]. *Deshi* cotton possesses better ginning outturn, fibre strength and tensile strength than American cotton and is therefore found more suitable for blending with synthetic fibre[9]. Many plant breeders have reported transgressive segregants in hybrid progenies and suggested that transgressive segregation may be used as a positive tool in plant breeding. Transgressive breeding aims at improving yield or its contributing characters through transgressive segregation. Such plants are produced by an accumulation of the plus or favorable genes from both the parents as a consequence of recombination. Obviously, the parents involved in hybridization must combine well with each other and preferably be genetically diverse that is quiet different.

In such a situation, each parent is expected to contribute different plus genes, which when brought together by recombination gives rise to transgressive segregation. As a result, the intensity of character in the transgressive segregants that is in the new variety is greater than that in either of the parents. Genetic studies indicates that transgressive segregation mostly results from the appearance, in individual genotypes, of combination of alleles from both the parents that have effects in the same direction (complementary gene action);[2]That is, hybrid individuals those combine 'plus' *alleles* from both parents or 'minus' alleles from both the parents are likely to have the extreme phenotypes.

MATERIAL AND METHODS

The present investigation was carried out at Botany Section Farm, College of Agriculture Dhule, M.P.K.V., Rahuri. The material for the present investigation was generated by involving six genotypes *viz.,* JLA-794, AKA-7 and PA-183 as female parents, JLA-505, PA-255 and PA-710 as male parents. The three crosses were made for the present investigation to generate breeding material. The F_2 progenies of different cross combinations were used for the study were., JLA-794 x JLA-505, AKA-7 x PA-255 and PA-183 x PA-710. All the three single crosses (F1s) were advanced to F2 generation during *Kharif* 2013. The experiment was laid out in a randomized block design with two replications. The sowing was done on 19th July 2014 with a spacing of 30 cm between plants and 45 cm between rows with row length of 4.5 meters. Two rows were assigned to each of P1, P2 and F_1, while 24 rows to F_2 generation for each cross. The standard agronomic practices were followed throughout the period of growth. The biometrical observations were recorded on randomly selected five plants of parents, F_1 and 100 plants in each F_2 generation of three crosses per replication. Observations were recorded on different characters viz., Days to first flowering, plant height, number of sympodia per plant, number of bolls per plant, average boll weight, ginning percentage, halo length and seed cotton yield per plant. Percentage of transgressive segregation was obtained by defining extreme progeny as significantly transgressive segregates by calculating the lines that exceeded their better parent mean and L.S.D at 0.05 probability by the model suggested Panse and Sukhatme[5].

RESULTS AND DISCUSSION

Frequency of the transgressive segregants for seed cotton yield and components in the F_2 generation of cotton is presented in Table 1. It is interesting to note that in the present investigation, transgressive segregants were recorded in each of the three crosses for all the eight characters (Fig 2 to 19.5). In F_2 generation of three crosses highest proportion of transgressive segregants were recorded for seed cotton yield per plant (97) followed by number of sympodia per plant(74), halo length (73), number of bolls per plant (70), average boll weight (59), plant height (54), ginning percentage (51) and days to flowering (21) On the basis of performance of transgressive segregants, it was concluded that, when the desired intensity of a character is not available in the parents, transgressive breeding can be successfully used to extend the limit of expression of character by accumulation of favourable/plus genes, in the hybrid derivatives from both the parents, involved in hybridization. Frequency of transgressive segregants varied from cross to cross for different characters.

In case of seed cotton yield per plant 13.0 to 19.5% individuals transgressed beyond the increasing parent in three crosses. Transgressive segregants were 2 to 5.5% for days to first flowering, 4.5 to13% for plant height, 10.5 to 13.5% for number sympodia per plant, 9.5 to 13% for number of bolls per plant, 9.0 to 10.5% for average boll weight, 4.5 to 15% for ginning percentage and 7 to 19% for halo length in three crosses. Kamalanathan[3] and Narayanan *et al*[4]., reported transgressive segregation in F_2 and F_3 generation for number of bolls per plant, ginning percentage and halo length. Pawer[6] reported transgressive segregation for days to flowering, plant height, number of sympodia per plant, number of bolls per plant, boll weight, ginning percentage and seed cotton yield per plant. Pradeep and Sulmani[8], reported transgressive segregation for number of bolls per plant, kapas yield per plant, boll weight, halo length and ginning percentage.

Table 1: Frequency of transgressive segregants for important seed cotton yield and its component traits in different segregating populations of desi cotton

Characters	Cross-1	Cross-2	Cross-3
Days to first flowering	4 (50-52)	11 (50-53)	6 (51-53)
Plant height	9 (95-103)	26 (77-92)	19 (80-95)
Number of sympodia per plant	26 (22-27)	27 (22-26)	21 (23-28)
Number of bolls per plant	19 (35-45)	26 (33-43)	25 (32-44)
Average boll weight	21 (2.97-3.24)	18 (2.70-2.98)	20 (2.71-3.01)
Ginning percentage	30 (41.9-48.4)	12 (43.4-46.1)	9 (38.4-41.6)
Halo length	14 (23.1-25.4)	21 (23.3-25.5)	38 (25.3-29.0)
Seed cotton yield per plant	39 (70-114)	32 (62.93)	26 (68-102)

Figures in parenthesis indicate range of intensity of expression of character
Cross-1 : JLA-794 x JLA-505, **Cross-2** : AKA-7 x PA-255, **Cross-3** : PA-183 x PA-710.

Apart from the frequency of transgressive segregants, it will be of great interest to examine the intensities of characters achieved in the transgressants in each of the crosses. This will provide an insight into the extended limits and intensities of the expression of desired characters which can be achieved by transgressive segregation. The extended limits achieved by transgressants in respect of various characters in three crosses in the present investigations are given in Table 2.

Table 2: The extended limits achieved by transgressants for eight characters in three crosses

Characters	Highest intensity of character expression in transgressive segregants in F_2 generation of three crosses		
	Cross-1	Cross-2	Cross-3
Days to first flowering	50 (55.3)	50 (55.7)	51 (56.1)
Plant height	95 (114.2)	77 (103.8)	80 (107.6)
No.of sympodia/ plant	27 (19.4)	26 (18.1)	28 (19)
No. of bolls per/ plant	45 (31.1)	43 (27.1)	44 (27)
Average boll weight	3.24 (2.75)	2.98 (2.54)	3.01 (2.58)
Ginning percentage	48.42 (39.45)	46.12 (40.24)	41.66 (36.44)
Halo length	25.4 (22.6)	25.5 (21.9)	29.0 (24.1)
Seed cotton yield per plant	114 (58.7)	93 (49.5)	102 (55.4)

∗ Figures in the parenthesis are the mean values of increasing parent for respective characters.

From this data it is evident that when the desired intensity of a character is not available in the parents, the concept of transgressive segregation can be employed to extend the limit of character expression. The success in obtaining the desired transgressive segregants depends upon obtaining genetic recombination between both linked and unlinked alleles[1]. It is therefore, concluded that the concept, transgressive segregation, is effective for extending the limit of character expression when the plant breeder is interested in isolating the rare genotypes. In this approach when greater selection pressure is imposed, results in the higher recovery of characters than that of other breeding approaches.

Table 3: Promising transgressive segregants (T.S.) having combinations of desirable attributes

Generation	Pl. No.	DAF	PLH (cm)	SYM	BOL	ABH (g)	GIN (%)	HLG (mm)	SCY (g)	Per cent seed cotton yield increased over increasing parent
Cross-1 JLA-794 x JLA-505										
F_2	92	57	128	24*	38*	2.72	44.44*	21.8	107*	82.2
JLA-794		55.3	114.2	18.6	24.2	2.75	35.77	21.6	50.2	
JLA-505		59.3	146.1	19.4	31.1	2.65	39.45	22.1	58.7	
Cross-2 AKA-7 x PA-255										
F_2	42	55	148	24*	37*	2.85*	42.12*	2.33	89*	
AKA-7		55.7	103.8	16.6	22.8	2.29	40.24	17.8	39.9	79.7
PA-255		57.0	126.4	18.1	27.1	2.54	39.41	21.9	49.5	
Cross-3 PA-183 x PA-710										
F_2	103	58.0	130	27*	40*	2.64	32.14	2.76*	94*	82.87
PA-183		56.1	107.6	17.3	21.6	2.46	35.56	24.1	46.2	
PA-710		58.1	132.7	19.0	27.0	2.58	36.44	21.9	51.4	

∗ Intensity of expression of character higher than the increasing parent PL.NO = Plant number, DAF = Days to first flowering, PLH = Plant height, SYM Number of sympodia per plant, BOL = Number of bolls per plant, ABW=Average boll weight, GIN = Ginning percentage, HLG = halo length, SCY = Seed cotton yield per plant

Plant No.92 (F_2) was found to be the most promising transgressive segregant in the cross JLA-794 x JLA-505 for seed cotton yield giving 82.2 per cent higher seed cotton yield. In addition to this it had higher intensity of expression than the increasing parent for number of sympodia per plant, number bolls per plant and ginning percentage (Table 3).

The transgressive segregant, No.42 was found to be most promising in Cross AKA-7 X PA-255. It out yielded the increasing parent by 79.7 per cent. In addition higher intensity of expression than the increasing parent was noticed for number of sympodia per plant, number of bolls per plant, average boll weight and ginning percentage (Table3).

In Cross PA-183 x PA-710, the worth noting transgressive segregant was No 103, which out yielded the increasing parent by 82.87 per cent. In addition to this, it expressed higher intensity for number of sympodia per plant, number of bolls per plant and halo length than the increasing parent. (Table 3).

CONCLUSION

From this study, it is suggested that the most promising transgressive segregants listed in table No.3 need to be evaluated further, for consistency in their performance for further generations.

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