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**Research Article**

# Frequency of superior segregants as influenced by hybridization ($F_2$) and hybridization followed by irradiation ($F_2M_2$) using selected parents for important component traits in desi cotton

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**Abstract**

Impact of hybridization and irradiation in isolation of superior segregants in four crosses of desi cotton were studied and compared between $F_2$ and $F_2M_2$ progenies. The $F_2M_2$ progenies of four crosses recorded higher per cent of superior segregants compared to $F_2$ progenies for boll number, boll weight and halo length excepting in KS-16 x MB-3200 cross. Out of four $F_2M_2$ progenies, RDC-53 x 9747 cross produced higher percentage of superior segregants for number of bolls per plant, boll weight and seed cotton yield per plant as compared to remaining progenies. The superior segregants identified for rare combination of traits revealed that $F_2M_2$ progenies of four crosses in general produced more number of superior segregants for combination of traits as compared to $F_2$. The $F_2M_2$ progenies of the KS-16 x MB-3200 recorded more number of superior segregants for combination of seed cotton yield and halo length. Similarly $F_2M_2$ progenies of KS-16 x 9747 and RDC-53 x 9747 recorded more number of superior progenies for combination of seed cotton yield and boll weight traits compared to remaining progenies. These results indicate that use of irradiation involving selected parents in cross combination was better option to get higher number of promising progenies as compared to hybridization alone.

**Key words:** Intraspecific and interspecific cross, irradiation, $F_2M_2$ population, Combination of traits, limiting traits.

## Introduction

India has the distinction of growing all the four cultivated species of cotton on commercial scale, viz. *G. herbaceum, G. arboreum, G. hirsutum* and *G. barbadense*. During pre-independence era about 97 per cent of the cotton area was under asiatic (*desi*) types. Now upland cotton and its hybrids (both intra and inter specific) covers about 76 per cent area in the country and the remaining 20 per cent of area above is under asiatic cotton (Singh, 1998).The cultivation of asiatic cotton was restricted to a few pockets because of low yield level and non preference of modern textile mills due to their low fiber length and strength. But these cultivars have immense potential for adaptation to any of the soil types and climatic conditions. By improvement in yield level and fiber quality, these cultivars can become good choice in present day fluctuating climatic conditions and rainfed area of south zone.

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Hence, any proposal to improve productivity of desi cotton through the improvement in component traits like boll weight, boll number and fibre quality traits would be an ideal solution in the present day context. But in desi cotton it is difficult to combine these traits alone by conventional breeding procedure. Therefore we need to follow the complex procedure supplemented with conventional breeding to combine these characters**.** There is growing realization that major gains can be achieved through the use of induced variability along with conventional crop breeding programme. Mohan and Sharma (1995) experimentally demonstrated in pea, it was important that additional variation could be generated in the $F_2$ by irradiation at $F_1$ stage. This is also evident from the fact that many mutant varieties have resulted by using induced mutations in crossing programme in comparison to those which resulted through direct release of mutants (Kharkwal *et al* 2001). Kajjidoni *et al* (2008) have developed new improved variety in blackgram by utilizing both gamma rays induced and hybridization. Hence, in the present investigation it is proposed to use of irradiation in combination with hybridization involving adapted parents, selected donor for boll weight, boll number and fibre quality traits and to generate comparative information on use of irradiation in combination with hybridization *vs* hybridization alone for isolation of superior segregants with improved seed cotton yield and fibre quality traits.

**Material and Methods**

The experimental martial comprised six donor parents KS-16,9747, RDC-53, MDL-2582, MB-3200, RAHS-14(*G.arboreum*) which were collected from different centers working on desi cotton and were used as donors for each of the limiting traits of productivity and fibre quality viz., KS-16 for fiber quality, 9747 for boll weight , RDC-53, MDL-2582 and MB-3200 for boll number and RAHS-14 (adapted variety in Karnataka).The parents were crossed in following combinations viz., KS-16 X 9747 , KS-16 X MB-3200 and RDC-53 X 9747 as intraherbaceum crosses, RAHS-14 X MDL-2582 as interspecific crosses (*G.arboreum X G.herbaceum*) .The $F_1$ seeds of these four crosses were subjected to gamma radiation with 50 Gy dose at BARC, Mumbai during 2005-06 and untreated seeds were used to raise the control progenies. The evaluation of $F_2$ and $F_2M_2$ generations was made during kharif 2007 at Main Agricultural Research Station, Dharwad along with local check Jayadhar.The bulk seed of $F_1$ and $F_1M_1$ harvest were utilized to grow $F_2$ and $F_2M_2$ generation . Nearly 1000 $F_2$ and $F_2M_2$ plants were maintained for each progenies in unreplicated design. At the time of harvest observations were recorded on visually selected plants in each progenies for boll number, boll weight, halo length and seed cotton yield. The superior segregants were identified in each population on the basis of superior plants over Jayadhar mean plus one standard deviation for important yield component and quality traits. Effort was also made to isolate superior segregants for combination boll number with boll weight and seed cotton yield with halo length in each populations.

**Results and Discussion**

The superior segregants were identified mainly for number of bolls per plant, boll weight, halo length and seed cotton yield per plants in different progenies which is presented in Table-1. In general, number of superior segregants varied considerably across the traits and the populations.The number of superior segregants was high for boll weight followed by halo length across all crosses. It was noticed that $F_2M_2$ populations recorded higher per cent of superior segregants for boll number, boll weight and halo length in three crosses and seed cotton yield in two crosses compared to their corresponding $F_2$ populations. These results suggest that hybridization followed by irradiation has enhanced the frequency of promising plants for economic traits of desi cotton, similarly Saini and Sharma(1975) also concluded hybridization followed by irradiation may be a better than the hybridization alone for improvement of various economic characters in rice.

Among the populations, the $F_2M_2$ population of the cross RDC-53 X 9747 recorded highest percentage of superior segregants for number of bolls per plant, boll weight and seed cotton yield (13.33, 54.66 and 20.00 respectively) as against corresponding $F_2$ populations (5.00, 39.00 and 9.00 respectively). Similarly $F_2$ population of the cross KS-16 X MB-3200 and $F_2M_2$ population of the cross RDC-53 X 9747 exhibited higher percentage of superior segregants for halo length.

In general KS-16 X 9747 and RDC-53 X 9747 crosses recorded high percentage of superior segregants for boll weight among the crosses. It was because of high contribution of 9747 parent towards expression of boll weight trait. These results again suggest that the parent 9747 can be used in hybridization programme as one of the donor parents for boll weight improvement and it was also noticed that $F_2M_2$ populations of above crosses exhibited higher percentage of superior segregants for boll weight compared to their corresponding $F_2$ populations. It indicates use of donor parent in cross combination formed by irradiation is better option to get more number of superior segregants.

The common superior segregants for seed cotton yield and halo length in different populations were identified (Table 2).The $F_2M_2$ populations of KS-16 x MB-3200 produced more number (7) of superior segregants followed $F_2M_2$ population of RDC-53 x 9747 (3) and $F_2$ populations of RAHS-14 X MDL-2582. The $F_2$ of RDC-53 X 9747 did not produce any plants which are superior for seed cotton yield and halo length. These results suggest that irradiation has enhanced the frequency of promising plants with higher seed cotton yield and fiber length compared to hybridization alone.

In similar exercise, superior segregants identified for combination of number of bolls and boll weight traits indicates that in general $F_2M_2$ populations of all crosses exhibited more number of segregants compared to their corresponding $F_2$ populations and $F_2M_2$ populations of KS-16 X 9747 and RDC-53 X 9747 crosses produced higher number of superior segregants (6 and 5 respectively) as against corresponding $F_2$ populations (1 and 3 respectively) while $F_2M_2$ populations of KS-16 x MB-3200 and RAHS-14 X MDL-2582 produced 4 and 3 superior segregants respectively.

The over all comparison of number superior segregants between four $F_2$ Vs $F_2M_2$ for important component traits is presented in Table-3, the irradiated progenies ($F_2M_2$) produced higher number of superior segregants for all the four traits under study.Out of four traits, relatively higher number of superior segregants were observed for boll weight (192) followed by halo length (117) in $F_2M_2$ generation compared to $F_2$ generation(89 and 59 respectively). This indicates that irradiation has enhanced the more number of promising plants for highly limiting traits of desi cotton viz, boll weight and halo length. Similarly number of bolls per plant and seed cotton yield exhibited more number of superior segregants (57 and 61 respectively) in $F_2M_2$ generations compared to $F_2$ generation (37 and 22 respectively).

The number of superior segregants between four $F_2$ *vs* $F_2M_2$ populations was compared for combination of traits. In general desirable combination of superior segregants was high in $F_2M_2$ populations (Table-3). The chances of developing genotype with desirable combination of seed cotton yield and halo length was high in $F_2M_2$ as 12 plants had desirable recombination as against only 3 plants derived from hybridization. The $F_2M_2$ populations also recorded maximum number (18) of superior plants for combination boll number and boll weight as against 3 in $F_2$ populations.Higher number of desirable combinations may be attributed to breakage of linkage, as reported earlier by Jenson (1970) and Ansingkar and Bhale (1984) in cotton.

In an attempt to compare frequency of superior segregants based on their percent contribution to the total number of the superior plants considering all the four traits, the percent contribution of $F_2M_2$ generation varied from 62 (seed cotton yield per plant) to 72 percent ( number of bolls per plant). Out of four traits, number of bolls per plant (72 percent) and boll weight (68 percent) had higher percentage of superior segregants compared to other two traits in $F_2M_2$ generation. In a similar comparison made considering combination of traits for $F_2M_2$ generation indicated higher percent contribution of $F_2M_2$ for seed cotton yield plus halo length trait combination (80%) compared to number of bolls plus boll weight combination (69%).

In general the results of present investigation indicate the positive role of irradiation in enhancing recombination between linked traits thereby increasing the contribution of limiting traits and also useful to recover the promising genotypes over normal breeding procedure adopted. Therefore, it would offer better chance for the breeder to isolate more number genotypes having desirable combination of characters leading to higher seed cotton yield and improved fibre length over the standard check.

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**Table 1. Frequency of superior segregants over check for important seed cotton yield and its component traits in different progenies of desi cotton.**

| Progenies | No. of bolls per plant | | Boll weight (n) | | Halo length (n) | | Seed cotton yield per plant (n) | |
|---|---|---|---|---|---|---|---|---|
| | n | Per cent | n | Per cent | n | Per cent | n | Per cent |
| **KS-16 x 9747** | | | | | | | | |
| $F_2$ | 3 | (3.40) | 21 | (24.40) | 8 | (9.30) | 7 | (8.13) |
| $F_2M_2$ | 8 | (6.15) | 53 | (40.76) | 25 | (19.23) | 12 | (9.20) |
| **Jayadhar (mean)** | 31.8 | | 1.20 | | 19.25 | | 33.4 | |
| **KS-16 x MB-3200** | | | | | | | | |
| $F_2$ | 10 | (13.03) | 22 | (24.44) | 32 | (35.53) | 15 | (16.66) |
| $F_2M_2$ | 18 | (12.67) | 25 | (17.60) | 30 | (21.12) | 10 | (7.52) |
| **Jayadhar (mean)** | 25.7 | | 1.34 | | 20.24 | | 32.55 | |
| **RDC-53 x 9747** | | | | | | | | |
| $F_2$ | 5 | (5.00) | 39 | (39.00) | 12 | (12.00) | 9 | (9.00) |
| $F_2M_2$ | 20 | (13.33) | 82 | (54.66) | 22 | (14.66) | 30 | (20.00) |
| **Jayadhar (mean)** | 24.5 | | 1.39 | | 19.72 | | 28.60 | |
| **RAHS-14 x MDL-2582- Interspecific cross** | | | | | | | | |
| $F_2$ | 4 | (4.54) | 7 | (13.20) | 7 | (9.09) | 6 | (11.36) |
| $F_2M_2$ | 11 | (9.16) | 32 | (26.30) | 40 | (33.33) | 9 | (7.50) |
| **Jayadhar (mean)** | 26.3 | | 1.33 | | 19.84 | | 28.1 | |

Figures in parenthesis indicate percentage value, n – indicates number of superior segregants

**Table 2.. Number of superior segregants identified for combination of important characters in four crosses of desi cotton.**

| Progenies | Seed cotton yield +halo length | Number of bolls+ boll weight |
|---|---|---|
| **KS-16 x 9747** | | |
| $F_2$ | 1 | 1 |
| $F_2M_2$ | 1 | 6 |
| **KS-16 x MB-3200** | | |
| $F_2$ | 2 | 3 |
| $F_2M_2$ | 7 | 4 |
| **RDC-53 x 9747** | | |
| $F_2$ | 0 | 3 |
| $F_2M_2$ | 3 | 5 |
| **RAHS-14 x MDL-2582** | | |
| $F_2$ | 0 | 1 |
| $F_2M_2$ | 1 | 3 |

**Table 3. Comparison of number of superior segregants in four crosses between $F_2$ V/S $F_2M_2$ and percent contribution of $F_2M_2$ generation to the total numberssuperior segregants for combination of important component characters in desi cotton.**

| **Characters** | Generation | Number of superior segregants | Percent contribution of $F_2/F_2M_2$ generation to the total number of segregants |
|---|---|---|---|
| | $F_2$ | 37 | 38 |
| Seed cotton yield per plant(g) | $F_2M_2$ | 61 | 62 |
| Number of bolls per plant | $F_2$ | 22 | 28 |
| | $F_2M_2$ | 57 | 72 |
| Boll weight(g) | $F_2$ | 89 | 32 |
| | $F_2M_2$ | 192 | 68 |
| | $F_2$ | 59 | 34 |
| Halo length(mm) | $F_2M_2$ | 117 | 66 |
| | $F_2$ | 8 | 31 |
| Number of bolls+ boll weight | $F_2M_2$ | 18 | 69 |
| Seed cotton yield +halo length | $F_2$ | 3 | 20 |
| | $F_2M_2$ | 12 | 80 |