

CYTOLOGICAL AND MORPHOLOGICAL STUDIES ON ALLOTETRAPLOIDS OF (*G. ARBOREUM* x *G. STOCKSII*) AND (*G. STOCKSII* x *G. ARBOREUM*)

M. ANWAR MALIK and A. LATIF SHEIKH
Cotton Research Institute, Multan, Pakistan.

Abstract

Allo-tetraploids of (*G. arboreum* x *G. stocksii*) (A) and (*G. stocksii* x *G. arboreum*) (B) were obtained by colchicine treatments.

Cytological studies of the allotetraploids revealed 2.2 I, 24.6 II and 0.21 III with 88.35 pollen stainability percentage in (A) and 6.7 I, 20.6 II, 1.1 III and 0.2 IV with 83.7 pollen stainability percentage in (B).

Morphological studies were also undertaken and comparing to diploid hybrids the allotetraploids were luxuriant in growth, resistant to pest and drought with increased pollen stainability and fertility (fruit setting), indicating complete sterility of the diploid hybrids which was overcome by colchicine treatments.

Introduction

Interspecific hybrids of *Gossypium arboreum* and *G. stocksii* were obtained by crossing these two species reciprocally, which were reported sterile, (Malik & Latif, 1974). Some of the seedlings obtained were given Colchicine treatments to change the ploidy level and to regain the fertility for use in crossing with commercial varieties of *G. hirsutum*, to have more cytogenetic information and genomic relationship of the species involved.

Review of Literature

The literature on these cross combinations is sporadic as a few research workers have conducted experiments in this respect. However, a few relevant references available are reviewed as under.

Afzal *et al* (1933) obtained four hybrid seedlings of the combination *G. arboreum* x *G. stocksii* which were sterile, and no attempt was made to regain fertility. Abraham (1940a) reported an average of 7.13 bivalents in a cross of *G. stocksii* x *G. arboreum* and found a maximum of 7 chromosomes homologous between *G. stocksii* and old world cottons and suggested that the remaining 6 have different origin. Ansari (1958) recorded that the plants of *G. stocksii* were free of pests and diseases and speculated the possibility of usefulness of this species in producing drought and disease resistant cultivated cotton by hybridization. Mahbub *et al* (1964) obtained six F1 seedlings of *G. arboreum* x *G. stocksii* combination which were reported dwarf indicating dominance of *G. stocksii* and resistant to drought. Malik & Latif (1974) reported sterile hybrids of *G. arboreum* x *G. stocksii* and *G. stocksii* x *G. arboreum* with partial dominance of *G. stocksii* and resistant to pests and drought, with 6.0 and 2.9 bivalents respectively and .23 trivalents in the latter combination.

Materials and Methods

These studies were conducted at Cotton Research Institute, Multan during the years 1971-73. The material under study was:—

- (i) F_1 *G. arboreum* x *G. stocksii* (A)
- (ii) F_1 *G. stocksii* x *G. arboreum* (B).

Seedlings of both the combinations at diploid level were given colchicine treatments of 0.2 percent aqueous solution for 72-96 hours with intervals of 24 hours each after every 24 hours.

Flower buds were fixed in Carnoy's solution and preserved in 70% alcohol. Usual acetocarmine squashes were made for cytological studies and 50 pollen mother cells (PMC's) were studied of each plant but a few of those could be analysed at Metaphase-I and Anaphase-I.

Results and Discussion

The hybrids (A) and (B) were diploid and sterile. It was necessary to regain their fertility for transference of desirable characters to the cultivated cottons. Three seedlings of (A) were dipped in 0.2% colchicine solution for 72 hours and three seedlings of (b) for 72-96 hours, with an interval of 24 hours after every 24 hours at room temperature during Feb., 1972. Two plants of (A) and one plant of (B) could survive to reach maturity. The detail is given in Table 1.

TABLE 1. Colchicine treatments.

Material	No. of seedlings treated	Concentration %	Duration Hours	Interval	Remarks
<i>G. arboreum</i> x <i>G. stocksii</i>	3	0.2	72	Two	Two seedlings survived.
<i>G. stocksii</i> x <i>G. arboreum</i>	2	0.2	72	Two	One seedling survived.
<i>G. stocksii</i> x <i>G. arboreum</i>	1	0.2	96	Three	Died

The growth of the treated plants remained retarded for a longer period in early stages and later became luxuriant. The morphological characters of these plants showed that the ploidy has really taken place. The comparison of morphological characters of diploids and colchloids (allo-tetraploids) is summarized in Table 2.

From Table 2 it is concluded that retarded growth, thick and darkgreen leaves, thickness of pedicel, bracts and petals, increase in pollen size and pollen stainability percentage and restoration of fertility (fruit setting) confirm the polyploidy of colchloids.

TABLE 2. Comparison of morphological characters.

Diploid hybrids	Colchipooids (Allo-tetraploids)
1. Growth normal with semi-bushy habit.	1. Growth retarded but luxuriant later on with semi-bushy habit.
2. Young portions of stem sparsely covered with small hairs.	2. Young portions of stem thickly covered with small hairs.
3. Leaves, petioles, thin in texture, green and sparsely hairy.	3. Leaves, petioles, thick, dark-green with profuse hairs.
4. Flower smaller in size, with thin pedicel.	4. Flower larger in size with thick pedicel.
5. Bracteoles thin in texture with 7-9 superficial dentation, size (1.7 × 1.4 cms).	5. Bracteoles thick with 9-11 superficial dentations, size (1.8 × 1.6 cms).
6. Petals smaller, thin, papery, size 2.5 x 1.57 cms.	6. Petals larger, thick, leathery, size 3.1 x 2.6 cms.
7. Pollen stainability 5.87% (A) and 7.31% (B). Pollen size smaller.	7. Pollen stainability 88.35% (A) and 83.7% (B). Pollen size larger.
8. No fruit formation at all.	8. Fruit setting present but shy.
9. Resistant to pests and drought.	9. Resistant to pests and drought.
10. Verticle depressions or lenticel-like structures develop on the older portions of stem and branches. (Absent in <i>arboreum</i> and <i>stocksii</i>).	10. Verticle depressions or lenticel-like structures develop on the older portions of stem and branches (Just like diploid hybrids).

The colchipooid plants, are also observed resistant to pests and drought. The Cytological studies at Metaphase-I and Anaphase-I of both the treated combinations revealed that the plants were polyploids with 52 somatic chromosome number. Details of cytological studies of the treated combinations are given in Table 3.

There was more frequency of multivalent formation in combination (B). The percentage of normal spors per pollen mother cell was higher (86.1%) in (A) with higher pollen stainability (88.35%). The differences in (A) and (B) may be assigned to univalent, bivalent, and multivalent-formation percentages.

In combination (A), univalents were 2.2 per cell, bivalents 24.6, trivalents 0.21 and no quadrivalents (Fig. 1), whereas in combination (B), there were 6.7 univalents, 20.6 bivalents, 1.1 trivalents and 0.2 quadrivalents per cell (Fig. 4) which confirmed the above statement.

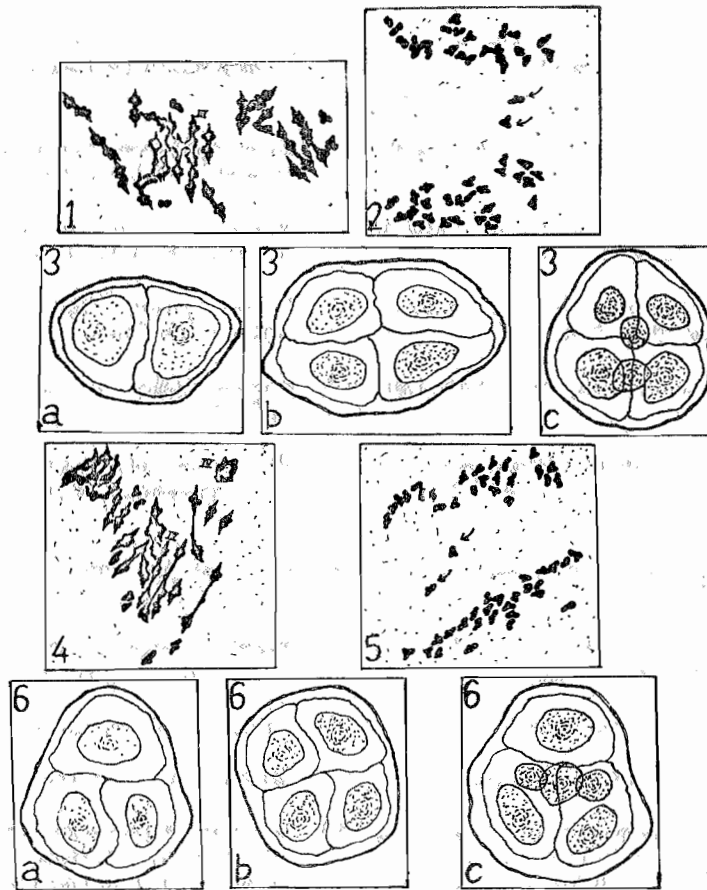


Fig. 1. Metaphase-I, showing 7I—21II—11II.

Fig. 2. Anaphase-I, showing 2 lagging chromosomes.

Fig. 3. Pollen Mother cells with (a) 2, (b) 4 and (c) 6 sporads.

Fig. 4. Metaphase-I, showing 7I—19II—11II—11V.

Fig. 5. Anaphase-I, showing 2 lagging chromosomes.

Fig. 6. Pollen Mother cells with (a) 3, (b) 4 and (c) 6 sporads.

TABLE 3. Details of cytological studies.

PMC's	I	II	III	IV	Total	Remarks
<i>G. arboreum</i> x <i>G. stocksii</i> (A)						
3	0	26	0	0	52	0-3 laggards observed at Anaphase-I in a few cells. Fig. 2 PMC's with II, III, IV, V & VI, sporads of .9%, 1.9%, 86.1%, 8.5% & 2.6% respectively were also observed Fig. 3. The pollen stainability was 88.35%.
2	1	24	1	0	52	
6	2	25	0	0	52	
1	4	24	0	0	52	
1	6	23	0	0	52	
1	7	21	1	0	52	
Total 14	Range 0-7	21-26	0-1,	x		
	Average 2.2	24.6	0.21,	x		
<i>G. stocksii</i> x <i>G. arboreum</i> (B)						
1	5	20	1	1	52	2-5, Laggards observed in a few cells at A Fig. 5 Anaphase-I. Fig. 5 PMC's with II, III, IV, V & VI sporads of 2.1%, 6.3%, 84.5%, 4.9% and 2.1% respectively were recorded Fig. 6 pollen stainability recorded was 83.7%.
2	5	22	1	—	52	
1	6	20	2	—	52	
3	7	21	1	—	52	
1	7	19	1	1	52	
2	9	20	1	—	52	
Total 10	Range 5-9	19-22	1-2,	0.1		
	Average 6.7	20.6,	1.1	0.2		

The allotetraploids were also recorded with more luxuriant vegetative growth of semi-bushy type with plenty of flowers in normal season but less fruiting in both the combinations indicating complete sterility of diploid hybrids. This was overcome by colchicine treatments.

The speculation of Ansari (1958) may come to be true and it is possible that we may get such commercial variety by crossing this material with *G. hirsutum* types. The studies are being carried out on these lines and results will be reported later on.

References

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