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SECONDARY ASSOCIATION IN *GOSSYPIUM HERBACEUM* L. AND *GOSSYPIUM ARBOREUM* L.

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ABSTRACT

Secondary association was studied in Old World cottons comprising 18 cultures of *Gossypium herbaceum* and 13 of *Gossypium arboreum*. In *G. herbaceum* and *G. arboreum*, the frequency of bivalent associations 2(3)+3(2)+1(1) at MI was 33.3% and 32.7%, respectively. It is concluded that the basic chromosome number of the present Old World cottons was 6, and they are derivatives of secondary polyploidization of their ancestral types.

Key words: Cotton, bivalent associations, chromosome number.

Origin of diploid species of *Gossypium* as secondary polyploids has been postulated in the wild American *Gossypium* species [1, 2] and in New World cultivated cottons [3], Jacob [4, 5] did karyotypic analysis in *G. arboreum*, *G. herbaceum* and *G. stocksii*, and arrived at the conclusion that the basic chromosome number of genus *Gossypium* was 7. The present investigation aims at determining the nature of secondary association in different varieties of cultivated Old World cottons.

MATERIALS AND METHODS

Thirty one cultures of Old World cottons were obtained from the ICAR project on the commercial exploitation of hybrid vigour in *desi* cotton. Buds of 0.5 cm size with the corolla tip slightly visible were fixed in the fixative (propionic acid: chloroform: alcohol, 1:2:3) between 2.00 and 2.30 P.M. Two to three drops of saturated ferric chloride solution were added to 100 ml of fixative in order to improve chromosomal staining. The buds were kept in the fixative for 24 h and then transferred to 70% alcohol. The anthers were smeared in 1% propionocarmine. The bivalent associations at MI were observed in well spread out plates.

RESULTS AND DISCUSSION

The most frequently observed bivalent associations in *G. herbaceum* were 2(3)+3(2)+1(1), 2(3)+2(2)+3(1), and 3(3)+1(2)+2(1), which occurred with the average frequency of 33.3, 22.0 and 19.9%, respectively (Table 1). In *G. arboreum*, the bivalent associations 2(3)+3(2)+1(1), 2(3)+2(2)+3(1), 5(2)+3(1), 4(2)+5(1), and 3(3)+1(2)+2(1) were observed with the average frequency of 32.8 18.0, 16.1 15.8 and 11.8%, respectively (Table 2).

Table 1. Different types of secondary associations and their frequency at metaphase I in *Gossypium herbaceum* cultures

Type of association*	Number of PMC scored in different cultures																		Average frequency (%)
	Jayadhar	DB 3–12	R 51–238	2 5–B–6	MDS 42	SM 14	SM 41	SM 43	SM 73	SM 81	SM 88	SM 141	SM 143	SM 150	DM 125	1449	5479	6455	
2(5)+1(3)	—	5	—	—	—	2	—	—	—	—	4	—	—	—	—	—	—	—	1.2
1(4)+1(3)+1(2)+4(1)	2	—	1	—	1	2	—	1	2	—	—	—	—	—	1	1	—	1	1.3
1(4)+1(3)+2(2)+2(1)	—	—	2	—	1	—	—	—	2	1	—	1	—	—	1	1	1	—	1.2
1(4)+3(2)+3(1)	—	—	2	2	—	1	2	1	2	6	3	—	—	1	1	2	1	1	2.7
3(4)+1(1)	—	—	1	—	—	1	—	2	2	6	2	—	—	1	—	2	1	—	2.0
4(2)+5(1)	—	5	12	6	3	4	3	1	6	4	4	1	4	4	4	—	2	8	7.9
5(2)+3(1)	2	—	—	1	2	—	—	2	—	1	—	—	—	1	1	—	—	1	1.2
1(4)+2(2)+5(1)	—	3	—	1	—	—	—	1	1	1	—	—	—	1	1	2	2	—	1.4
2(4)+1(2)+3(1)	—	—	—	1	2	—	—	2	—	—	—	—	—	2	1	—	—	—	0.9
2(3)+3(2)+1(1)	24	20	19	15	20	12	20	12	15	12	13	18	20	18	19	16	12	15	33.3
2(3)+2(2)+3(1)	10	7	7	12	13	7	15	19	10	10	10	13	12	8	9	12	14	10	22.0
3(3)+1(2)+2(1)	5	10	6	13	7	19	10	7	10	10	9	12	10	7	8	14	16	6	19.9
1(3)+4(2)+2(1)	7	—	—	—	1	2	—	—	1	—	4	6	4	6	4	—	2	7	4.9
Total PMCs	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	—

*Values in the parentheses indicate the number of bivalents and outside the bracket the number of groups.

Table 2. Different types of secondary associations and their frequency at metaphase I in *Gossypium arboreum* cultures

Type of association	Number of PMC scored in different cultures													Average frequncey (%)
	Lohit	G27	824	853	860	875	1042	1187LD	124LD	132LD	133LD	135	HD 11	
1(4)+1(3)+1(2)+4(1)	—	—	1	2	—	—	—	1	—	—	—	—	—	0.6
1(4)+1(3)+2(2)+2(1)	—	—	—	2	—	—	—	1	—	—	1	—	1	0.8
1(4)+3(2)+3(1)	—	—	1	2	—	—	—	1	1	1	—	—	—	0.9
3(4)+1(1)	—	—	—	2	—	—	—	—	—	—	1	—	—	0.5
5(2)+3(1)	6	10	9	11	7	8	8	10	9	6	7	8	6	16.1
4(2)+5(1)	6	10	7	10	7	12	8	10	6	8	7	6	6	15.8
1(4)+2(2)+5(1)	—	—	—	—	—	—	—	—	—	—	2	1	1	0.6
2(3)+3(2)+1(1)	20	15	18	10	21	16	19	12	15	16	17	19	15	32.8
2(3)+2(2)+3(1)	10	10	9	6	9	8	9	8	10	10	8	9	11	18.0
3(3)+1(2)+2(2)	8	5	4	3	6	4	5	6	7	8	6	6	9	11.8
1(3)+4(2)+2(1)	—	—	1	2	—	2	1	1	2	1	1	1	1	2.0
Total PMCs	50	50	50	50	50	50	50	50	50	50	50	50	50	

Note. Cf. Table 1.

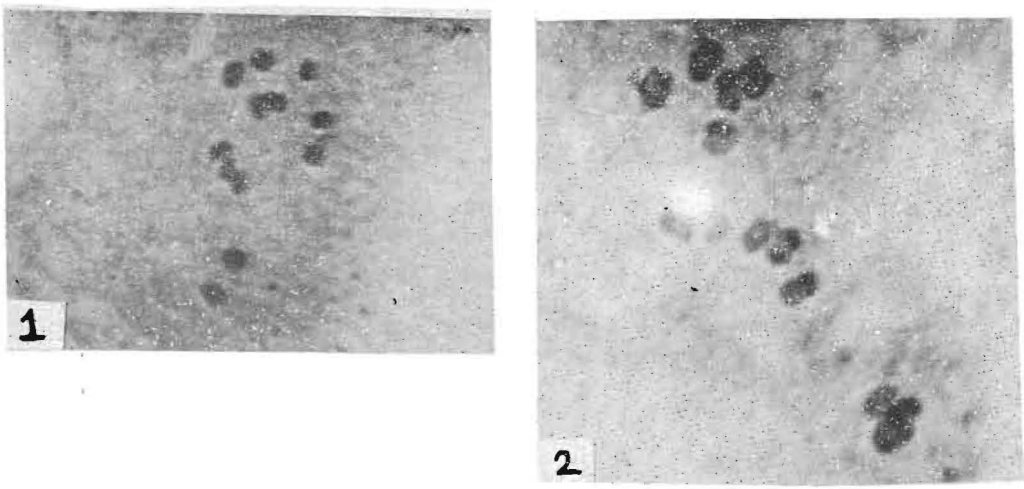

Fig. 1. Chromosomal associations at meiosis in *Gossypium herbaceum* (1) and *G. arboreum* (2).

Webber [6] and Stephens [7] postulated that the diploid *Gossypium* species are polyploid derivatives of the ancestral species. The basic chromosome number of such species was speculated to be 6 [2, 8]. This was confirmed later [9, 10].

However Jacob [4, 5] based on karyotypic studies of *G. arboreum, G. herbaceum* and *G. stocksii* concluded that the Old World diploid *Gossypium* species were derived from ancestral species with 7 basic chromosome number.

In the present study, the association of 2(3)+3(2)+1(1) has been noticed (Fig. 1; Tables 1, 2) with the maximum frequency of 33.3 and 32.8% in the varieties of *G. herbaceum* and *G. arboreum,* respectively, which indicates that the basic chromosome number of the ancestral species was 6. Two species with n = 6 after hybridization and subsequent chromosome doubling in such a way that two bivalents triplicated, three bivalents duplicated, and one bivalent remained single, resulted in a gametic number of 13 in the present diploid cottons.

REFERENCES

1. A. Skovsted. 1935. Chromosome numbers in the Malvaceae. I. J. Genet., **31:** 263–296.

2. A. Skovsted. 1937. Cytological studies in cotton. IV. Chromosome conjugation in interspecific hybrids. J. Genet., **34:** 97–134.

3. J. Ellenhorn. 1936. Differential chromosome staining at meiosis in *Gossypium peruvianum.* Cytologia, **7:** 213–218.

4. K. T. Jacob. 1941. Preliminary observations on the chromosomes morphology in Asiatic cottons with special reference to their phylogeny and interrelationships. in eight types of Asiatic cotton. Trans. Bose. Res. Inst., **15:** 17–27.

5. K. T. Jacob. 1942. Studies in cotton. IV. Morphology of somatic chromosomes in eight types of Asiatic cotton. Trans. Bose. Res. Inst., **15:** 17–27.

6. J. M. Webber. 1934. Interspecific hybridization in *Gossypium* and the meiotic behaviour of F_1 plants. J. Agric. Res., **51:** 1047–1070.

7. S. G. Stephens. 1942. Colchicine produced polyploids in *Gossypium*. I. An autotetraploid, Asiatic cotton and certain of its hybrids with wild diploid species. J. Genet., **44:** 272–295.

8. S. C. Harland. 1939. The Genetics of Cotton. Jonathan Cape, London: 46–48, 176–177.

9. L. D. Vijendradas and S. W. Mensinkai. 1968. Pollen mother cell analysis of intraspecific hybrids of *Gossypium arboreum* L., indicating secondarily balanced polyploidy. Cytologia, **33**(2): 188–194.

10. N. V. Thombre and S. S. Mehetre. 1977. Monoploid in *Gossypium arboreum* L. var. LD 132. Curr. Sci., **46**(10): 349–350.