The Chromosome Numbers of Indian Cottons.

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THE importance of cytological studies in genetical investigations has been recognized in recent years. For a proper understanding of the mechanism of heredity a cytological knowledge of the material is very desirable. This is all the more important in an economic crop like cotton where, as is well known, the American or Egyptian cottons do not cross freely with the Indian types, and as such the chances of bringing about a desirable combination are very remote. Zaitzev (1) in Russia and Desai (2) in India claim to have brought about such a combination, but both report that the conjugate generation plants were completely sterile. Denham's (3) investigations on the cytology of the cotton plant show that the American, Egyptian, and Indian cottons fall into two distinct groups, the first two being characterized by double the number of chromosomes occurring in the latter. He suggests that this might perhaps explain the impossibility of crossing American or Egyptian cottons with the Indian types. The fact that chromosome numbers range in multiples of some basic number in the same genera has also been noted in other crops. Gaiser (4) states that the haploid chromosome number of *Triticum* and *Avena* are 7, 14, and 21, of *Nicotiana* 9, 12, 18, and 24; other cases are also on record. Interspecific crosses between these different groups have led to considerable sterility. As a rule the greater the difference in the chromosome numbers the greater the degree of sterility.

As Indian cottons differ considerably in their morphological and other characters, it was thought that a critical cytological study might reveal certain strains with a higher chromosome number than that obtained by Denham (3) for the Indian cottons. Besides, it would enable us to have a detailed knowledge of the chromosome numbers of Indian cottons and add further evidence to that obtained by previous workers on the chromosome numbers of the Old and New World cottons. With this in view the present work was undertaken.

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Material and Methods.

The material used in this investigation has been grown from selfed seeds obtained from various sources. Some of the material has been collected personally from different cotton-breeding centres in India. All the types examined cytologically have been grown from pure lines selfed over a number of years. Of the thirty-two types worked out, four are acclimatized American cottons which are widely cultivated in India for their superior qualities, the rest are indigenous Indian cottons of varying merit.

Two fixatives were first tried, Flemming's weak fluid and Allen's modified Bouin's fluid, the formula of which is given below.

Picric acid saturated aqueous solution	75 c.c.
Formalin (commercial)	25 c.c.
Glacial acetic acid	5 c.c.
Urea crystals	2 grm.
Chromic acid crystals	1·0 grm.

Fixation was very poor with Flemming's fluid. There was considerable shrinkage of the material and no detail was obtained. Bouin's fluid, on the other hand, gave very good results, and as such was exclusively used later. Collections of material were usually made on bright days between 12 and 4 p.m. Buds of various sizes ranging from 1·5 to 4 mm. in diameter were fixed. Those of larger size generally contained fully formed pollen grains or were in the tetrad stage. To facilitate penetration of the fluid, the bracts, perianth, and the ovary were completely removed before fixation. The fixing fluid was heated up to an initial temperature of 40° C. before fixation, and allowed to cool as material was collected. The material was kept in the fixing fluid for a period of twenty hours, after which it was run up to 70 per cent. alcohol in the course of an hour, and repeatedly washed in 70 per cent. alcohol every twelve hours till the green coloration disappeared. It was then dehydrated by passing through successive higher grades of alcohol, de-alcoholized in several ascending series of xylols, and imbedded in paraffin. Sections were cut 8 μ thick.

Flemming's triple strain and Heidenhain's iron-alum haematoxylin were used, the latter was found to be excellent for counting chromosomes.

The chromosomes were counted from the meiotic stages of the microspore mother cell. Check counts were taken from several buds to eliminate error due to abnormal pollen formation. Haploid chromosome number has been represented in all cases.

Types Examined.

	Chromosome number.
1. *The Acclimatized American Cottons.*	
Gossypium hirsutum, Mill.	
C. O. I. Seeds obtained from the Cotton Specialist, Government of Madras	26
440. Material obtained from Government Experiment Station, Dhulia. A Coimbatore selection of Cambodia cotton	26
4 F. A Punjab selection of American cotton	26
Buri. An American cotton selected and grown widely in Central Provinces	26
2. *The Herbaceum Cottons.*	
Gossypium herbaceum, Linn.	
Hagari 25. Seeds obtained from the Cotton Specialist, Government of Madras	13
Kumpta. Seeds of this and the next variety were obtained from the Cotton Botanist, Mysore Department of Agriculture	13
Mysore Local (Naked seeded). Classified by Gammie as *Gossypium herbaceum*, var. nov. *melanosperma*	13
Dharwar I. Seeds obtained from the Government Experiment Station, Dharwar	13
Seeds of the following were obtained from the Bombay Department of Agriculture, Poona:	
Broach. No. 6 (Wilt resistant)	13
Goghari. (A. 26)	13
Wagad. (8)	13
1027. *A. L. F.*	13
I. A. Cylindrical Boll	13
I. A. Long Boll	13
3. *The Neglectum Cottons.*	
Gossypium neglectum, Tod.	
G. neglectum, var. nov. *rosea* (Gammie). Material obtained from the Government Experiment Station, Dharwar	13
G. neglectum, sub. var. nov. *malvensis* (Gammie). Seeds of this and the following were sent by the Economic Botanist to the C. P. Government, Nagpur	13
G. neglectum, var. nov. *vera* (Gammie)	13
G. neglectum, sub. var. nov. *cutchica* (Gammie)	13
G. neglectum, sub. var. nov. *Kathiavarensis* (Gammie). Materials for this and the next were obtained from the Government Experiment Station, Dhulia	13
G. neglectum (Naked seeded)	13
W. N. 27. A selection of *neglectum roseum.* Seeds sent by the Cotton Botanist, Sind.	13
Wagale (Yellow flowered). Material obtained from the Government Experiment Station, Dharwar	13
Wagale C. 19 (Pale yellow-flowered). Isolated by the Cotton Breeder, Dhulia. Material obtained from that Station	13

	Chromosome number.
4. *The Indicum Cottons.*	
Gossypium indicum, Lamk.	
Nandayal 14. Seeds obtained from the Cotton Specialist, Government of Madras	13
Bani (Hyderabad). Seeds sent by the Department of Agriculture, Hyderabad	13
Bani (Nagpur). Seeds obtained from the Economic Botanist to the C. P. Government, Nagpur	13
Mungari 274. A Madras selection. Seeds obtained from the Government Experiment Station, Hagari	13
G. Indicum, var. nov. *Mollisoni* (Gammie). Seeds obtained from the Punjab Department of Agriculture	13
5. *Other Cottons.*	
Nadam (*G. obtusifolium*, Gammie). Seeds obtained from the Cotton Specialist, Government of Madras.	13
Cernuum (*G. cernuum*, Tod.). Material obtained from the Government Experiment Station, Dhulia	13
G. arboreum, Watt. Seeds of this and the next were sent by the Cotton Botanist to the Government of Punjab, Lyallpur	13
G. arboreum, var. *sanguinea*, Watt	13

The above list confirms Denham's investigations and leaves no doubt about the chromosome numbers of Indian cottons. The Arboreum and Nadam cottons, which differ considerably in their characters from the rest of the Indian cottons and which are grown as perennials in some parts of India, failed to reveal any difference from the typical chromosome number (13) of the Indian cottons. The Herbaceum and Neglectum groups also showed no variation in this respect. The wild cotton of India—*G. Stocksii* of Sind—which has been examined by Youngman and Pande (5), also showed thirteen chromosomes in the reduction division. It is very doubtful if there is any pure Indian cotton which has a higher number of chromosomes, but nothing definite can be said till all the Burmese cottons have been examined critically.

No appreciable difference in the size of the chromosomes was noted, though in some cases in the Indian cottons one slightly bigger chromosome was met with. The difference in the size and shape of the chromosomes (which are very small) might be explained by the fact that while in some sections parts of chromosomes are represented, in others the entire chromosomes are present.

An increase in the chromosome number is often brought about by crossing. This has been noted by Clausen (6) and others. It should be mentioned, however, that in these cases the parents differ in their chromosome numbers. The hybrid origin of these plants with a higher chromosome number could be made out by a careful cytological study. The irregular

meiotic divisions, and the indications of sterility are the determining factors. Certain Indian cottons show a certain amount of sterility, but no irregularities in the reduction division were noted except in the occurrence of a few sterile anthers.

SUMMARY.

The chromosome numbers of twenty-eight Indian and four acclimatized American cottons have been determined. The American cottons were found to contain twenty-six chromosomes and the Indian thirteen (Haploid). This agrees with the numbers obtained by Denham (3) for the Old and New World cottons.

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LITERATURE CITED.

1 ZAITZEV, G. S.: A Hybrid between Asiatic and American Cotton Plants. Agric. Journ., India, xx, iii. 213, 1925.
2. DESAI, B. B.: A Cross between Indian and American Cottons. Ibid., xxii, v, 1927.
3. DENHAM, H. J.: The Chromosome Numbers of Old and New World Cottons. Ann. Bot., xxxviii, pp. 433–8, 1924.
4. GAISER, L. O.: A List of Chromosome Numbers in Angiosperms. Genetica, viii. 401–66, 1926.
5. YOUNGMAN, W., and PANDE, S. S.: Occurrence of Branched Hairs in Cotton and upon *Gossypium Stocksii*. Nature, vol. cxix, p. 745, 1927.
6. CLAUSEN, J.: Increase of Chromosome Numbers in Viola experimentally induced by Crossing. Hereditas, v, p. 29, 1924.