PRELIMINARY NOTE ON AUTOTETRAPLOIDY IN *CAJANUS INDICUS* SPRENG*

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Autotetraploidy was induced in *rahar* (*Cajanus indicus* Spreng) by the application of colchicine. The material used was a strain of *rahar* which had been maintained in the Economic Botanist's collection for over eight years. Previous experience with other plants had shown that for a satisfactory growth of the treated plants it was better to have a diploid root system. Therefore, the apical buds of seedlings were treated without the roots being affected in any manner. Success was obtained when 1 per cent. colchicine was applied by the agar-colchicine method (Kumar and Abraham†). Compared with *mung* (*Phaseolous radiatus* Linn.) which became affected when 0·4 per cent. solution of the drug was used *rahar* showed effect only when 1·0 per cent. solution was applied. The affected buds were very slow in developing compared with the control but after a fortnight produced the first few leaves which were thickened and deformed. Leaves developed later although appeared normal in shape, were thicker, more hairy and darker in colour. In vegetative growth although the affected plants were slow at first, once they recovered from the initial setback, grew as fast as the controls. Unlike *rahar*, affected *mung* plants of the first colchicine generation could not get over the initial setback and continued to lag behind the control in growth to the very end. The necessity of a stronger solution required to induce polyploidy and its ability to recover from the early set back would show that *rahar* has the capacity to overcome the effect of colchicine either by producing some thing that neutralises the effect of the drug or effecting a quicker elimination of the drug from the meristematic region.

A large number of seedlings were treated, but only 36 were transplanted in the field. As the treatment was given in early October 1941, and the plants were transplanted in the cold months that followed, the plants failed to flower

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† Kumar, L. S. S., and Abraham, A., *J. Bombay University*, 1942, **11**, 3, 30.

that year. In the summer of 1942 all the plants were pruned down and during the second year of their growth all the control plants flowered profusely and produced a large number of pods. Of those suspected to be polyploids from external appearance a few shed all their flowers and did not set a single pod. Cytological examination of all the plants showed that two were definitely tetraploid and all the rest diploid. The two tetraploids (plant Nos. 27 and 36) did not set pods until March 1943, when a certain number of pods with a few well formed seeds in each were obtained.

Several workers have reported the striking difference observed in respect of plant characters between the colchicine induced polypliod and its diploid progenitor. In many cases, the plant as a whole and its various parts have exhibited gigantism. For this reason, the two tetraploid individuals were carefully compared with their diploid controls for some of the quantitative and qualitative characters.

The following is a comparative feature of the tetraploid and diploid for some of the characters examined.

I. MORPHOLOGICAL AND ANATOMICAL

(*a*) *Quantitative Characters*	*Diploid*	*Tetraploid*
(i) Chromosome number $2n$ = ..	22	44
(ii) Leaf size—length ..	11·2 cm.	12 cm.
breadth ..	4·3 cm.	4·5 cm.
(iii) Pollen sterility ..	9%	64% to 74%
(iv) Pollen size—diameter ..	0·25 mm.	0·21 mm.
(v) Chlorophyll content of leaf ..	There was no marked difference between the diploid and tetraploid.	
(vi) Size of stomata ..		
(vii) Size of flower ..	Flower of the tetraploid are about 1½ times as large as those of the diploid.	

(*b*) *Qualitative Characters*

(i) Leaves of the tetraploid are somewhat darker green than those of the diploid. Transverse section of the leaves of the tetraploid compared with diploid showed no marked difference either in the thickness or internal anatomy.

(ii) Tetraploid is later in flowering than the diploid.

(iii) There is no pod formation during the greater part of the season and only a few pods are set towards the close of the season in the tetraploid. Diploid sets pod abundantly.

(iv) In the tetraploid, the pods when set mostly contain one or two seeds only as compared to three or four in the diploid.

(v) A good number of the tetraploid seeds are shrunken and shrivelled up and appear unhealthy while most diploid seeds are sound.

(vi) The germination percentage of the diploid seed is about 90 while that of the tetraploid is about 25 per cent. Tetraploid seeds take about a week more to germinate than diploid seeds.

From the above it will be seen that the usual effect of tetraploidy resulting in gigas characters is not to be seen in *rahar* except for increased leaf and flower size.

II. Cytological

Besides comparison of the morphological and anatomical features of the tetrapolid and the diploid *rahar*, the behaviour of the chromosomes during nuclear division in pollen mother cells of the two types were compared as explained below.

(*a*) *Diploid.*—Hundreds of P.M.C's. of the diploid *rahar* were examined and invariably in all of them only 11 bivalents were found. Pairing and anaphasic separation were normal.

(*b*) *Autotetraploid.*—A large number of P.M.C's. of the tetraploid plants were examined and chromosome conjugations in 52 of them were analysed. The results are tabulated below.

From Table I it will be observed that there is a high degree of multivalent formation. There is not even one P.M.C. in which there are not some multivalents atleast. The average number of multivalents per cell is 4·88. The extreme case, when the 44 chromosomes are present as 11 tetravalents has been met with rather more frequently in this case than in similar auto-tetraploids in other species. In 6 out of 52 P.M.C's., such a state is present. Muntzing (1936) has classified the autopolyploids into two main categories. (*a*) Organisms, wherein all the chromosomes may form multivalents with a variable number of other conjugations in different cells and (*b*) Organisms wherein only a very low percentage of chromosomes form multivalents. Autotetraploid *Cajanus*, therefore, seems to belong to the first category.

TABLE I

Chromosome conjugation at M. I. of Plant No. 27

Univalents	Bi	Tri	Tetra	Penta	No. of P. M. C.
1	9	7	1	..	1
1	9	3	4	..	1
1	13	3	2	..	1
1	14	5	..	..	1
1	5	7	3	..	2
1	6	5	4	..	2
1	14	1	3	..	1
1	20	1	..	..	2
1	17	3	..	..	1
1	14	3	1	..	1
2	6	10	..	..	1
2	8	6	2	..	1
2	15	3	..	..	1
3	7	5	3	..	1
3	12	3	2	..	1
3	16	3	..	..	1
3	8	3	4	..	1
2	14	2	2	..	1
..	8	..	7	..	1
..	14	4	1	..	4
..	9	6	2	..	1
..	7	2	6	..	1
..	4	4	6	..	1
..	2	4	7	..	1
..	10	..	6	..	1
..	10	4	3	..	2
..	6	4	5	..	1
..	13	6	..	..	1
..	11	6	1	..	2
..	17	2	1	..	1
..	14	2	..	..	1
..	12	4	2	..	2
..	6	8	2	..	1
..	15	3	..	1	1
..	8	8	1	..	1
..	3	2	8	..	1
..	2	..	10	..	1
..	..	..	11	..	6
32	278	142	111	1	52
Mean 0·61	5·34	2·73	2·13	0·2	

Fig. 1 and Figs. 3 to 6 show some of the chromosome groups of the tretaploid plant No. 27 while Fig. 2 is that of plant No. 27-6. Fig. 1 is that of a somatic plate from the root-tip showing 44 chromosomes. Figs. 2 and 3 represent respectively 22 bivalents and 11 tetra-valents at metaphase I in the pollen mother cells. Figs. 4, 5 and 6 show three different types of chromosome conjugation at metaphase I in the pollen mother cells.

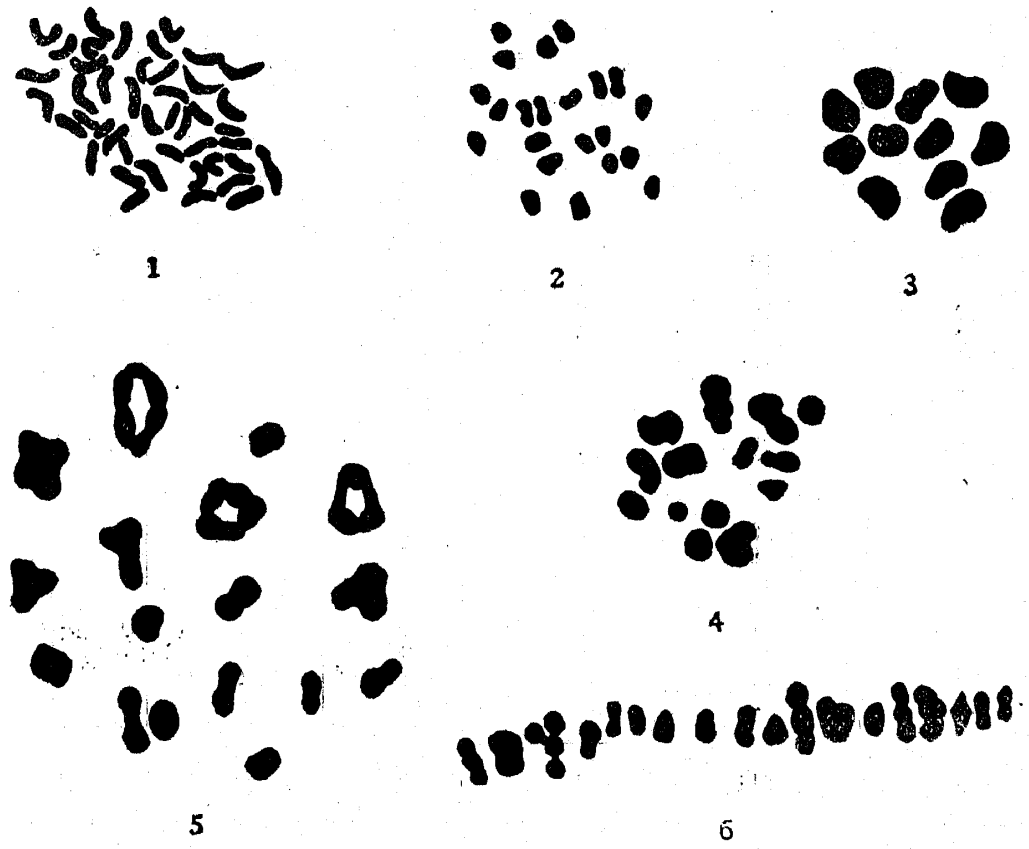

Fig. 1. Somatic metaphase plate ; $2n$ 44. × 2500. Fig. 2. M I ; 22 bivalents. × 2500 Fig. 3. M I ; 11 tetravalents. × 2500. Fig. 4. M I ; $4_{II} + 4_{III} + 6_{IV}$. × 2500. Fig. 5. M I ; $10_{II} + 4_{III} + 3_{IV}$. × 3250. Fig. 6. M I ; $11_{II} + 6_{III} + 1_{IV}$. × 2500. (Side view ; separated while drawing).

A few seeds from the tetraploid plant No. 27 were harvested for raising its progeny. These seeds gave very low percentage of germination and were very slow in developing. Out of a few seeds germinated one grew to maturity. This plant No. 27–6 showed large-sized, darkened leaves and bore flowers which were distinctly larger than those of the ordinary diploid plant. The behaviour of the chromosomes at meiosis of this plant was compared with that of its parent already given in Table I.

The chromosome conjugation in 27–6 is essentially similar to that in 27 The maximum association into 11 tetravalents, is not seen. This may be due to the smaller number of pollen mother cells examined. One instance of the association of the 44 chromosomes into 22 bivalentsi s also seen (Fig. 2).

TABLE II

Chromosome Conjugation at Metaphase I in Cajanus indicus 27-6 (*Progeny of the original tetraploid* Cajanus 27)

Univalents	Bi	Tri	Tetra	Penta	No. of P. M. C.
1	16	1	2	..	1
	2	1	9	..	1
2	18	2	..	..	2
3	14	3	1	..	2
3	15	1	2	..	1
4	17	2	..	..	1
5	15	3	..	..	1
..	16	..	3	..	1
..	14	4	1	..	1
..	16	4	..	..	2
..	3	2	8	..	1
..	9	6	2	..	1
..	8	..	7	..	1
..	19	2	..	..	1
..	22	..	..	..	1
..	11	6	1	..	1
..	13	2	3	..	1
..	14	4	1	..	1
..	2	..	10	..	1
19	244	43	50	Nil	22
Mean 0·72	11·1	2·0	2·3	Nil	

SUMMARY

Autotetraploidy was induced in *rahar* by the application of colchicine. The tetraploid progeny was compared with the diploid parent for various qualitative and quantitative characters. The results show that gigas characters are not present in the tetraploid progeny, except for increased leaf and flower size. A study of meiosis in the tetraploid plant revealed a high degree of multivalent formation resulting in partial sterility. A daughter tetraploid plant was raised from this tetraploid and a study of meiosis in the daughter plant revealed its similarity to that in the mother.