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TRISOMICS IN *RAPHANUS RAPHANISTRUM* L.

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ABSTRACT

Meiosis in three trisomic plants in *Raphanus raphanistrum* L. (2n=18+1) was studied. The trisomic chromosome was identified as chromosome number 9—a nucleolus organiser in the diploid complement of this species. The associations formed by this chromosome at pachytene and at post-pachytene stages of meiosis are discussed.

INTRODUCTION

The selfed progeny of an autotriploid plant in *Raphanus raphanistrum* L. (2n=18 +1) contained three plants trisomic for chromosome number 9, a nucleolus-organising chromosome in the complement of diploid *Raphanus raphanistrum* L. (2n=18). Cytogenetic information to date in aneuploid *Raphanus* species by the several previous workers pertains to the post pachytene stages of meiosis. Since information on the pachytene chromosomes in the diploid complement of this species is obtained here, the trisomic chromosome is indentified at pachytene and the associations formed by this at pachytene and post-pachytene stages of meiosis are studied. Information of this type in this species is the first of its kind and the details are presented here.

MATERIALS AND METHODS

Fifty self-pollinations were made in autotriploid *Raphanus raphanistrum* L. by pollinating stigmas with pollen from the same flowers and enclosing them in butter paper bags, for subsequent seed-set. Twenty-five seeds were collected from 3 pods, 10 of which were sown in pots kept in a green house and the rest in open field. Three of these (one from greenhouse and 2 from field) contained the ninth chromosome in trisomic condition which were used in this study.

Fixations for meiotic studies were made at 10 a.m. in field in a fresh mixture of 1:3 acetic acid-absolute alcohol for 24 hours and stored in 70% alohol for further use. One per cent iron-acetocarmine was used as stain for chromosomes. Photographs and camera lucida drawings were made from fresh preparations in Oil with 15 × eye piece.

RESULTS AND DISCUSSION

Plant No 1 grown in pot under greenhouse conditions is very much reduced in general stature and vigor with about 100% sterility and with abortive pod and seed set, whereas, plants Nos. 2 & 3 grown under field conditions are comparatively more vigorous with a fair amount of pod and seed set (Tables I to III).

The cytological behaviour of these plants is found to be more or less similar regarding the types and frequency of the associations observed at pachytene and the subsequent meiotic stages. The trisomic chromosome in the three plants is found to be chromosome 9 at pachytene, which is a short subterminal

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TABLE-I

FREQUENCY OF CHROMOSOME ASSOCIATIONS AT DIAKINESIS IN TRISOMIC *Raohanus raphanistrum* L. (2n=18+1).

Association type			Number of nuclei in Plant No.		
III	II	I	1	2	3
1	8	0	1	7	5
0	9	1	34	35	44
0	8	3	1	1	1
Total nuclei studied :			36	43	50

TABLE-II

CHROMOSOME SEGREGATION AT ANAPHASE-I AND II IN TRISOMIC *Raphanus raphanistrum* L. (2n=18+1).

Division Phase	segregation	Number of nuclei in plant No.:		
Anaphase-I	10 : 9	25	35	55
	9½* : 9½*	5	5	2
Total nuclei at anaphase-I		30	40	57
Anaphase-II	10 : 9 :			
	10 : 9 :	30	49	44
	9½* : 9½* :			
	9½ : 9½*	10	1	6
Total nuclei studied at Anaphase-II	..	40	50	50
		—	—	—

N.B. * Half univalents.

TABLE-III

PERCENTAGE OF POLLEN STERILITY AND SEED GERMINATION IN TRISOMIC *Raphanus raphanistrum* L. (2n=18+1).

	Plant No.	2	3
Pollen sterility ..	..	6.4%	8.2%
Seed germination	..	93%	73%

nucleolus organiser in the complement of diploid *R. raphanistrum* L. This chromosome measured 32.5 μm in its total length with a short arm of 3.0 μm composed of a proximal darkly staining heterochromatic segment of 1.0 μm and a distal darkly staining heterochromatic satellite of 1.5 μm seen attached to the nucleous in several of the nuclei. The long arm is composed of a proximally darkly staining heterchocmatic segment of 1.0 μm followed by a lightly staining euchromatic segment of 27.0 μm (Fig. 1)

The trisome was observed as a trivalent in 15 nuclei during the analysis at pachytene in the three plants. The trivalent at diakinesis in these three plants conformed to the 7th type of Darlington (1937) which required a minimum of one exchange in the centromeric region

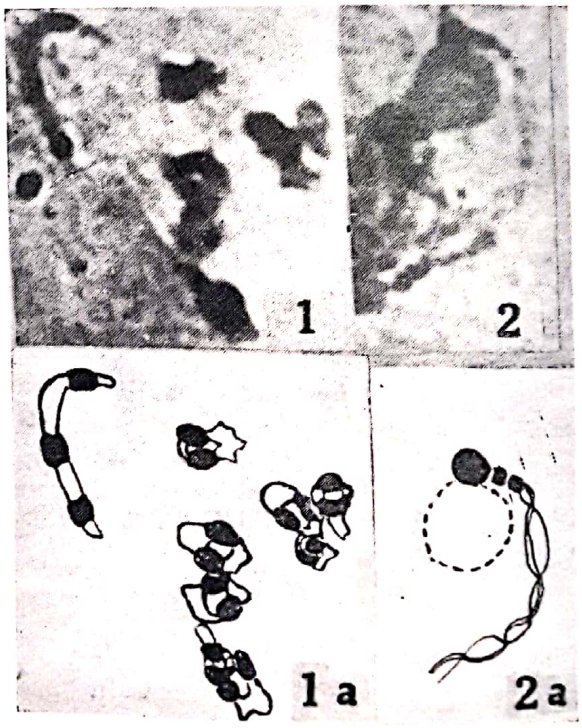

Fig. 1. Diakinesis with chain of three chromosomes and 8 bivalents in trisomic *Raphanus raphanistrum* L. (2n=18+1).

Fig. 2. Trivalent association of trisomic nucleolus organising chromosome at pachytenein trisomic *Raphanus raphanistrum* L. (2n = 18 + 1). (Magn. ×1500)

and a minimum of 2 chiasmata in the two arms (Figs. 1 & 2). As per the associations observed at diakinesis (Table —I) trivalents occurred in the lowest frequency, nine bivalents plus a single univalent being the most frequent type 8 and bivalents and 3 univalents in a few cases. This is either due to the absence of any chiasmata formation in the short arm of this trisome to hold it as a trivalent upto diakinesis resulting in 9 bivalents and a univalent or the chiasmata formed in the long arm might have got terminalised by diakinesis leaving the trivalent association as 3 univalents.

From the segregations at anaphase-I and-II (Tables II and III) the extra chromosome passed intact to either of the poles in a greater frequency of the nuclei. The absence of laggards and bridges at anaphase-I and II and the absence of micronuclei at Telophase-II indicates that the extra chromosome is not eliminated and that the transmission frequency through the male side is fairly high. This is evident also from the low percentage of pollen sterility of 6.4 and 8.2 observed in plants Nos. 2 and 3 respectively. The trisomic plants 2 and 3 resembled more closely their diploid mother in their phenotype. Distinct marker characters could not be located in their external morphology to associate them with the trisome. This is more probably due to the presence of duplicate factors in the genome of *Raphanus* as is evident from the previous reports of Tatebe (1939). Further duplication in the genome by the addition of one or two chromosomes alters the gene balance but little, there being no major effect on the phenotype, vigor or fertility of the trisomic. In this behaviour *R. raphanistrum* L. can be associated with the second group of trisomics of Rick and Khush (1973). The abortive flowers and pods in plant No. 1 are probably due to the physiological imbalance caused under the greenhouse conditions

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