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CHROMOSOME INTERCHANGE IN PIGEONPEA

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ABSTRACT

Meiotic analysis of F_1 hybrid of normal pigeonpea x mustard mutant of pigeonpea revealed that the mutant carried an interchange between two nonhomologus chromosomes. This was concluded from a quadrivalent at metaphase I. The asynapsis expressed by 2 to 10 univalents indicated structural hybridity among the homologues.

Key words: Mustard mutant, *Cajanus cajan*, interchange, quadrivalent, chromosome marker.

A mustard – like mutant of pigeonpea [1] has been used in breeding pigeonpea for improved plant type for the last few years at Akola. Few transgressive segregates for resistance against *Helicoverpa* and *Phytopthora* have been isolated [2]. The mustard mutant was earlier assumed to be pleiotropic in nature [1]. The mutant syndrome has segregated discretely [3]. It produces unifoliate leaves, short stature, long inflorescence with very limited foliage [Fig. 1] and is slow in growth with abnormalities in floral whorls. However, the segregation pattern did not explain its mode of inheritance. Moreover, the segregating progenies varied widely in pollen sterility. Therefore, meiosis was studied in the hybrid obtained by crossing the mutant with normal sister plants with a view to determine homology between the chromosomes of the two.

MATERIALS AND METHODS

Progeny No. 23017-30B from F_{10} generation of the cross T. Vishakha-1 x mustard mutant, which was fixed for normal plant type (without any segregation of mutant for last three generations) was used as female parent and crossed with the mustard mutant (a segregate from sister progeny of same parentage). Meiosis was studied in pollen mother cells (PMC) of F_1 plants after fixing the buds in 1:3 propionic-alcohol. The anthers were smeared in 2% propionocarmine.

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RESULTS AND DISCUSSION

Roy [4] reported the chromosome number of pigeonpea as n=11 for the first time. Later it was confirmed by many workers [5–7]. The chromosome associations observed at diakinesis and metaphase I in the hybrid plants are listed in Table 1. It is interesting to note that none of the PMCs had normal association of 11 bivalents. There were quadrivalents (Fig. 2) in 42% PMCs and 2 to 10 univalents in 86% PMCs. The average association of the chromosomes was 3.00 univalents + 8.66 bivalents + 0.42 quadrivalents.

Table 1. Chromosome association at diakinesis and metaphase I in F_1 hybrid of pigeonpea

S. No.	Chromosome configurations				Total PMCs scored
	I	II	III	IV	
1	2	10	—	—	19
2	—	9	—	1	7
3	2	8	—	1	10
4	6	8	—	—	4
5	4	7	—	1	4
6	8	7	—	—	4
7	10	6	—	—	2
Mean	3.00	8.66	—	0.42	—

At anaphase I, 26.7% of the 30 PMCs studied showed irregularities, such as, one to two laggards, bridges (Fig. 2) and irregular

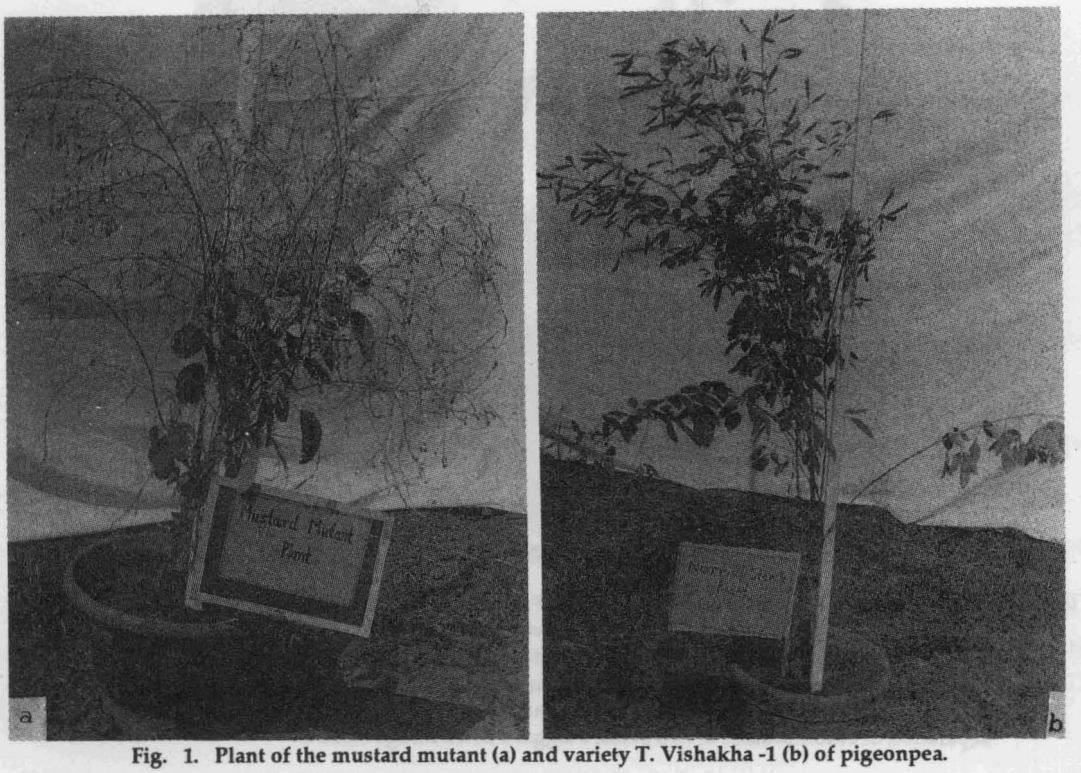

Fig. 1. Plant of the mustard mutant (a) and variety T. Vishakha -1 (b) of pigeonpea.

distribution of chromosomes (12–10) to the poles. Pollen fertility ranged from 32 to 48% in the hybrid.

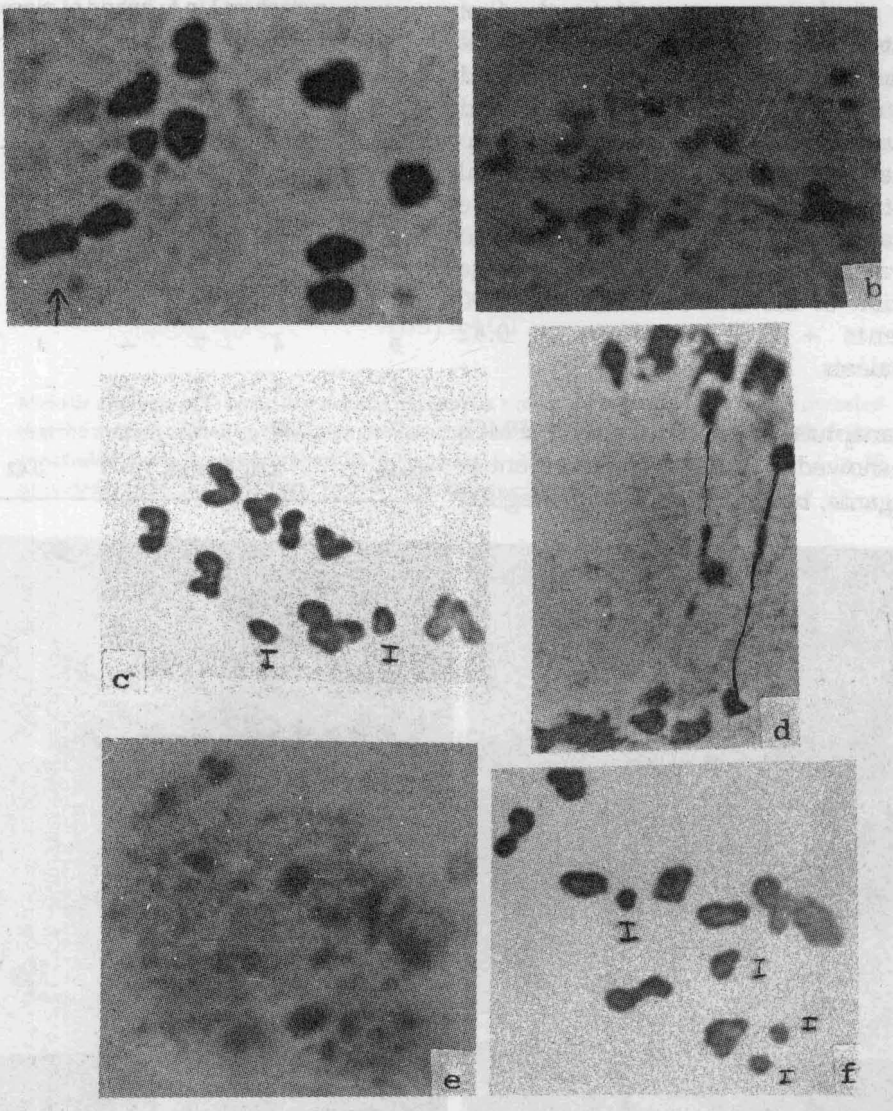

Fig. 2. Chromosomal associations during meiosis of F_1 plants of the cross between normal pigeonpea plant and mustard mutant: a) metaphase-I in F_1 showing one quadrivalent (arrow) and nine bivalents (1000 x); b) PMC of F_1 plant showing 10 bivalents and 2 univalents (1000 x); c) camera lucida drawings of Fig. 2b; d) metaphase I in F_1 showing 1 quadrivalent associated with 9 univalents and 7 normal bivalents (1000 x); e) camera lucida drawings of Fig. 2d; and f) PMC of F_1 plant showing anaphase I with irregular separation of chromosomes at two poles, a laggard and a bridge (1000 x).

The presence of 2–10 univalents suggests asynaptic nature of the chromosomes. Failure of pairing, leading to chromosome bridge at anaphase-I, may be due to the presence of inversions as has been documented in barley [8], or due to cryptic structural hybridity among the homologus chromosomes.

Chiasmata formation, which holds the chromosomes together until anaphase I, is also an evidence of genetic recombination and synapsis of homologous segments [9]. Multivalents may arise when homologous segments involve more than one homologous pair of chromosomes. It may be an indication of duplicated segments on the chromosomes or heterozygous translocations [10]. Bridge formation at anaphase I is an indication of existence of crossovers within the inversion loop in the heterozygote pairs of chromosomes in F_1 [11]. Semisterility [32–48%] observed in the hybrids indicated the possibility of existance of interchange heterozygote. In the segregating generation, the interchange chromosomes are likely to be present in normal as well as mutant individuals, in heterozygous or homozygous condition. The observations on pollen sterility showed that few sterile pollen grains occurred in normal as well as mutant plants. The interchange stocks in pigeonpea may thus be established and would be used further in genetic analysis as a chromosome marker.

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