

TRANSLOCATION HETEROZYGOSITY IN *ALOE VERA* (L.) BURM. F.

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**Abstract:** A population of *Aloe vera* (L.) Burm. F. (a diploid species with  $2n=14$  chromosomes), from village Kiharian District Jammu, J&K State (India) was studied for reduction division in male track. Of the 16 plants studied, pollen mother cells of 15 plants showed normal chromosome behavior at diakinesis and metaphase I and equal separation of chromosomes at anaphase I. Pollen viability of these plants averaged 76%. Meiosis in the remainder plant is characterized by the presence of 22% cells with multivalents at diakinesis and equal anaphasic segregations. The pollen viability of this cytotype was low (58.5%). As normal diploids and the translocation heterozygote did not show fruit and seed formation, it indicates that apart from anomalous chromosome behaviour, some other factors are also adversely affecting the reproductive potential of *A. vera*.

**Keywords:** *Aloe vera*, Multivalent formation, Chiasma frequency

## INTRODUCTION

*Aloe vera*, an important member of family Aloaceae is cultivated throughout India for its therapeutic properties. It is commonly used for treatment of stomach ailments, skin diseases, wounds, cancer and as a source of cosmoceuticals (Winters *et al.* 1981; Shelton 1991; Hegggers and Pelley 1993; Surjushe *et al.* 2008; Gupta and Sharma 2011). This plant flowers profusely but sets few to negligible seeds (Chaudhari and Chaudhari 2012). Although the plant has efficient means of vegetative propagation through suckers, inability to set seed blocks the major path to generate genetic variations. For sorting out the reasons behind the loss of sexual potential, a detailed analysis of meiosis is prerequisite.

Study on meiosis in male track was carried out in a population of *A. vera* growing in the Botanical Garden of University of Jammu (J & K State, India). Sixteen plants analysed of this population were diploid ( $2n=14$ ) and showed normal chromosomal behavior except one. In this plant, meiosis is characterized by the presence of multivalents, the phenomenon hitherto unreported for *A. vera*. Meiotic details of this variant as well as those of fifteen normal plants are described in the present paper.

## MATERIAL AND METHOD

A population of *A. vera*, comprising of sixteen plants, was studied presently. For meiotic studies, flower buds of appropriate size were collected from individual plants and fixed in 1:3 acetic-alcohol solution for 24 hours and then preserved in 70% alcohol. Anthers were squashed in 1% acetocarmine. Well stained and squashed cells from temporary preparations were examined for chromosome structure and behaviour and appropriate cells were

photographed. Pollen stainability was determined by squashing freshly dehisced anthers in 1% acetocarmine. The filled up, spherical and deep red grains were counted as viable and weakly stained, small sized and irregularly shaped grains were considered non-viable. The studies were carried out in the month of October when the atmospheric temperature in the area ranges between 15.6-32.8°C and relative humidity is 74-100%.

## Observations and discussion

Plants of *A. vera* studied presently are small, herbaceous, perennial, have shallow root system, bear fleshy sword-shaped grey-green leaves and bright orange colored pendulous flowers on unbranched or branched scapes. These resemble each other in overall morphology. The behaviour of chromosomes in the pollen mother cells (PMCs) of sixteen individuals of a population was analysed at diakinesis, metaphase I and anaphase I. Of these, pollen mother cells of fifteen plants had 7 bivalents, 4 large and 3 small. These showed normal anaphasic segregation with 7 chromosomes at each pole. Pollen viability of these plants was found to be 76%. No fruit was set on these plants. As mentioned above, meiosis in a single plant of this population is characterized by the presence of 22% cells with multivalents and bivalents. Of the 54 PMCs of this plant analysed at diakinesis, three cells (5.5%) had 1VI+4II (Fig. 1a) and nine cells (16.5%) had 1IV+5II (Fig. 1b) with the remaining cells having seven bivalents (Fig. 1c). In the formation of multivalents, only larger chromosomes were involved.

Stickiness of chromosomes noticed by earlier workers in *A. vera* is also evident in the chromosomes of the present cytotype (Vig 1968; Hegggers *et al.* 1993; Imery 2007; Chaudhari and Chaudhari 2012). Chiasmata were randomly distributed along bivalents and multivalents.

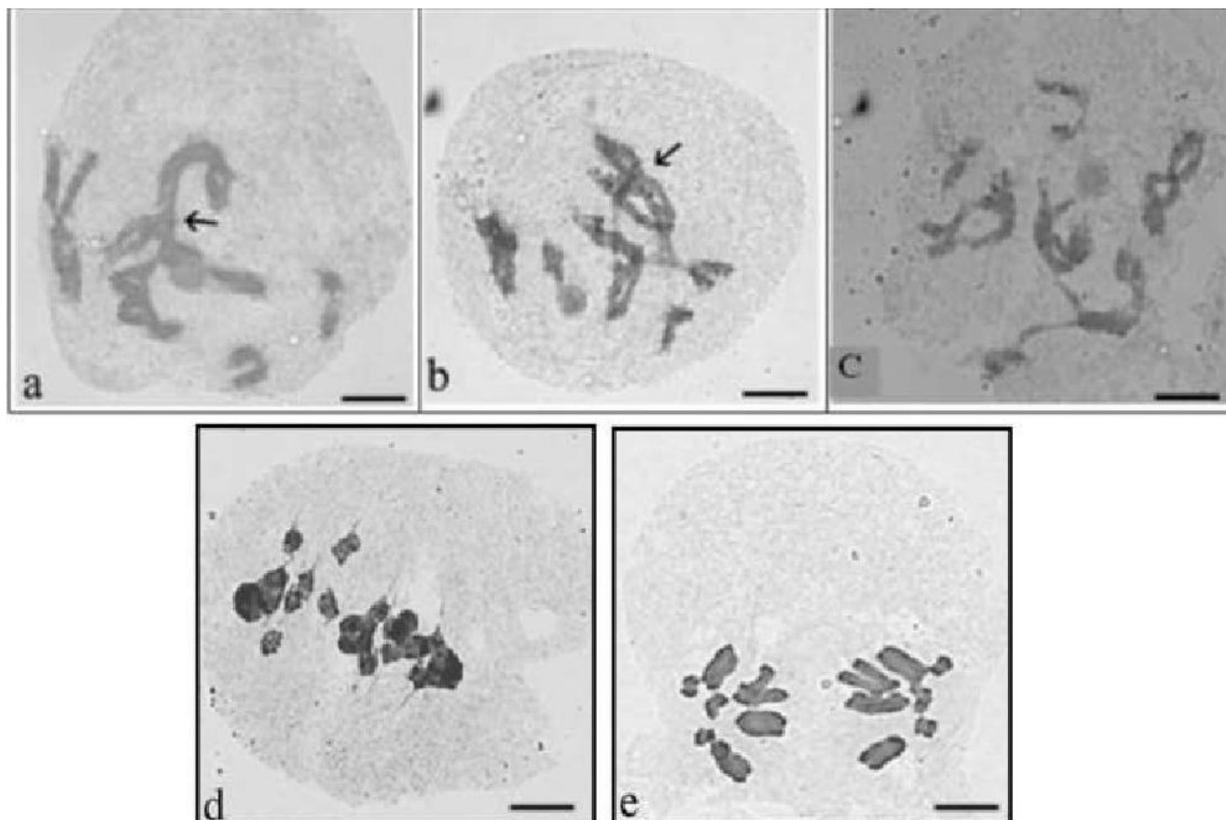
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Chiasma frequency per cell as determined from 20 PMCs at diakinesis was 12.6 (range=12-13). Fifty PMCs scored at metaphase I had seven bivalents. Also the 15 PMCs available at anaphase I showed equal segregation of chromosomes (Fig. 1e). However, the pollen viability was low and averaged only 58.5%.

Though complex associations are known to occur in many plant taxa including some members of *Aloe* namely, *A. elgonica*, *A. pubescens* and *A. rabaiensis* (Koul 1963a,b; Brandham and Johnson 1977; Gohil and Koul 1978; Carr and Carr 1983; Sharma and Gohil 2003; Imery 2007; Sharma and Gohil 2011a, b), authors have not come across any report on *A. vera* with this kind of anomaly. As such, presence of multivalents in the PMCs of a diploid cytotype indicates that its chromosomes during the course of evolution have undergone translocations, the phenomenon known to have great potential for creating and conserving specific gene combinations. Associations involving upto six chromosomes as noticed at diakinesis of present variant can form by the exchange of segments between a minimum of three non-homologous chromosomes. Missing of multivalents at metaphase I may be attributed to

terminalisation of chiasmata in the interchanged regions of the chromosomes.

Despite exhibiting regular segregations of chromosomes at anaphase I, pollen viability of present variant is low. As per Swanson *et al.* (1973), four chromosomes constituting a quadrivalent can segregate by three putative ways i.e. one alternate and two adjacent. Burnham (1956), on the other hand suggested that for each adjacent type arrangement, there is an equal opportunity of an alternate type orientation. While the alternate arrangements produce viable gametes, adjacent arrangements result in products deficient for some and duplicate for other segments and hence, inviable gametes. Low pollen viability (58.5%) of the variant as compared to that noticed in normal diploids (76%) is probably is owing to adjacent segregations of quadrivalents. As both normal diploids and the translocation heterozygote do not show fruit formation, it appears that apart from meiotic anomalies, some other factors are adversely affecting the reproductive capacity of this species. Detailed studies involving breeding experiments are underway to determine the factors inducing sterility in *A. vera*.



**Figs.** a-c. Pollen mother cells at diakinesis with 1VI+4II, 1IV+5II and 7II (hexavalent and quadrivalent are arrowed); Fig. 1d. A pollen mother cells at metaphase I with 5II+4I; Fig. 1e. A pollen mother cell at anaphase I with 7:7 separation of chromosomes. Bar=10 $\mu$

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