

COLCHICINE INDUCED ASYNAPTIC CHROMOSOMAL BEHAVIOUR AT MEIOSIS IN CHILI PEPPER (*CAPSICUM ANNUUM* L.)

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SUMMARY

Cytological behaviour of one asynaptic plant induced in *Capsicum annuum* var. Local Kashmiri by colchicine treatment has been studied. This plant was identified during meiosis from colchicine treated seedlings. The asynaptic behaviour could be noticed in early as well as at late diakinesis/metaphase I. Abnormalities like univalents, irregular distribution of chromosomes and laggards were also observed at various stages of meiosis. Pollen fertility was found to be very low (56.45 %). The asynaptic obtained during the present investigation fits into the medium strong type.

Keywords: *Capsicum annuum*, asynapsis, colchicine, pollen fertility.

INTRODUCTION

Capsicum annuum (chili pepper), a common condiment and vegetable crop of tropics, belongs to the family Solanaceae and has assumed more economic importance after the isolation of the alkaloid capsaicin which is of considerable medicinal avail. Chili is rich in vitamins A and C. More recently, vitamin P is found in the pericarp of chili, enriching its nutritive value. Induced asynaptic mutants/chromosomal behaviour have been reported in various plant species by various workers (Ahirwar & Verma 2015, Goyal & Khan 2009, Joshi & Verma 2005, Kitada & Omura 1984, Panda et al. 1987, Sethi et al. 1970, Singhal et al. 2012, Sjodin 1970, Stephens & Schertz 1965, Stringam 1970 and Verma & Raina 1982).

Various physical and chemical mutagenic agents are used to induce favourable mutations in plants. Colchicine is generally used for the induction of polyploidy however; it is also a potent chemical mutagen. Colchicine acts by binding to the tubulin dimmers, preventing the formation of microtubules on the spindle fibers during cell division, so that the chromosome sets duplicated during the mitotic process in the absence cell division *per se* leading to polyploid cell formation. During the present investigation, one plant exhibited asynaptic behaviour in the colchicine treated seedlings. The present paper deals with meiosis in that plant of cultivar Local Kashmiri of chili pepper.

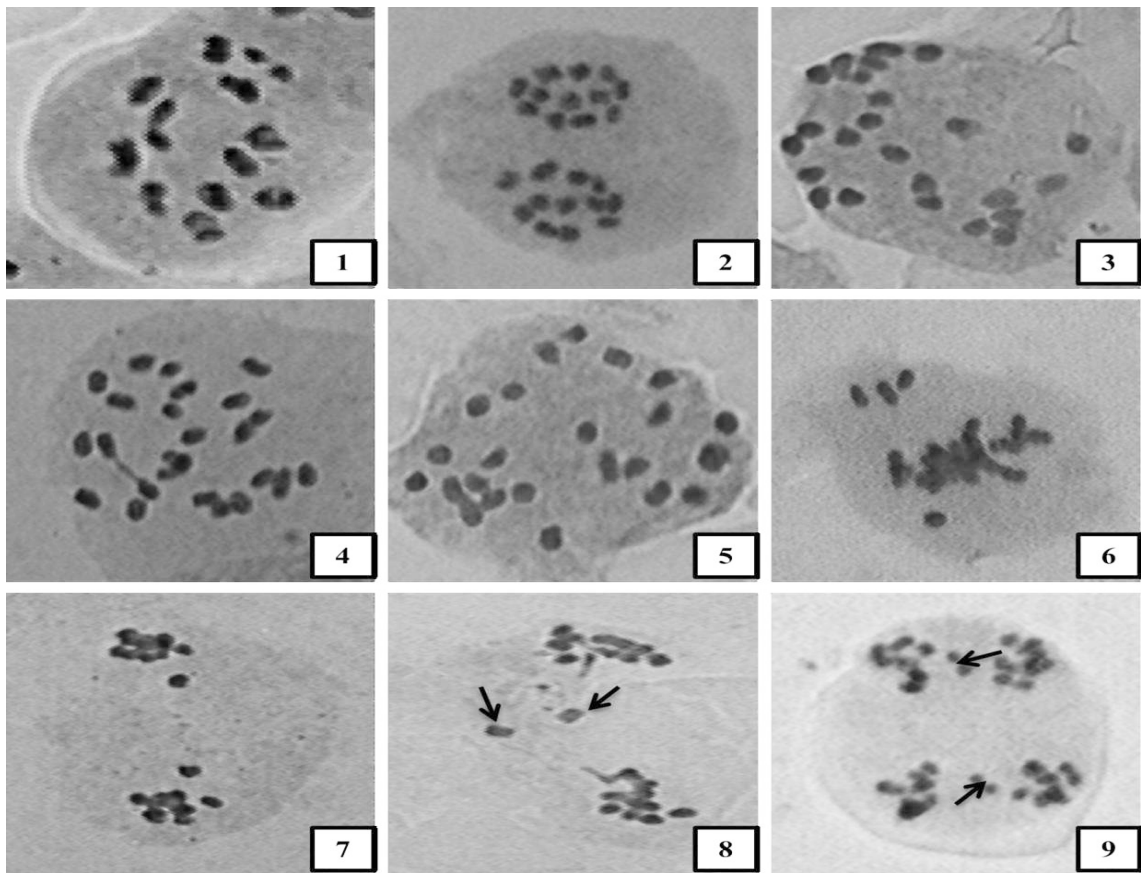
MATERIAL AND METHODS

Young one wk seedlings of *C. annuum* (var. Local Kashmiri) were treated with 0.2% aqueous solution of colchicine for 6 h. for 2 or 3 d using the “cotton swab method” (Verma et al. 1992). After treatment, seedlings were thoroughly washed with water. The plants flowered during January to February.

For meiotic studies, young floral buds of appropriate size from both control plants and colchicine treated plants were collected between 10 and 11A.M. and fixed for 24 h in freshly prepared Carnoy's fluid (absolute alcohol and acetic acid mixture in 3:1 ratio) and then transferred to 70% alcohol. Anthers were separated, teased in a drop of 2% iron-acetocarmine on a clean slide and squashed under a cover slip. Pollen mother cells (PMCs) from temporary preparations were analyzed for different stages of meiosis. Chromosomal associations, distribution of chromosomes at anaphase and other features were recorded and suitable cells were photographed under Olympus photomicroscope. The pollen fertility was calculated by staining pollen grains in 2% iron-acetocarmine. Stained pollen grains were considered as fertile while unstained as sterile.

OBSERVATIONS

Meiosis in the control plant was normal with 12 bivalents at diakinesis (Fig.1) showing equal segregation (12:12) at anaphase I (Fig. 2). Pollen fertility was 93.6%.



Figs 1–9: *C. annuum*. Meiotic stages in control and colchicine treated plants of *C. annuum*. All PMCs. 1–2. Meiosis in control plant 1. Diakinesis. 2. Anaphase I with 12:12 segregation. 3–9. Meiosis in asynaptic plant. 3. Diakinesis with 24 univalents. 4. Diakinesis with 10 II + 22 I. 5. Diakinesis with 2 II + 20 I. 6. Diakinesis with 10 II + 4 I. 7. Anaphase I showing unequal segregation (10:14). 8. Anaphase I showing unequal segregation (14:8 + 2 laggards) 9. Anaphase II with two laggards (arrows).

Out of sixteen colchicine treated plants studied for meiosis, one plant (CAs1) was identified on the basis of asynaptic behaviour of chromosomes at meiosis. However, meiosis in treated plants other than CAs1 has been found to be normal. The asynaptic behaviour was characterized by variable number of univalents at late diakinesis and metaphase I. At diakinesis and metaphase I, 76.33% of cells were abnormal in CAs1. Out of 55 cells analyzed, 23.64% were normal with 12 bivalents, 32.72% had 24 univalents (Fig. 3), 14.54% had one bivalent and 22 univalents (Fig. 4), 16.36% had 2 bivalents and 20 univalents (Fig. 5) and 12.72% had 10 bivalents and 4 univalents in each PMC (Fig. 6). At anaphase and telophase I and II also there were many irregularities such as unequal distribution of chromosomes and laggards (Figs 7–9). Consequently, when the pollen tetrad is formed, spores with unbalanced chromosomes were produced leading to pollen sterility. 300 pollen grains were scored to determine pollen fertility and the latter found to be relatively low (56.45%).

DISCUSSION

In the present study, one asynaptic plant was identified during meiosis. This plant (CAs1) showed high frequency of univalents (32.72%) at diakinesis and metaphase I. Prakken (1943) classified three type of asynaptic mutants (weak, medium strong and complete) according to frequency of univalents at metaphase I. Weak asynapsis is characterized by a few univalents in some of the cells, medium strong asynapsis by many univalents in most of the cells and complete asynapsis by univalents only. In the present investigation, the plants were medium strong asynaptic. La Cour & Wells (1970) examined suppression of zygotene I and pachytene I pairing and revealed the absence of synaptonemal complex in synaptic mutants of *Triticum durum*. Effect of colchicine on meiotic division also had been investigated by several workers as in *Secale cereale* by Pena et al. (1979) and in *Rhoeo* by Verma et al. (1992) and Verma & Ahirwar (2012). They observed meiotic division after the colchicine treatment and found failure in chromosome pairing at diakinesis/metaphase I. In the present study, 4–24 univalents in each PMC were observed at the diakinesis and metaphase I. The results indicate that perhaps colchicine lead to inhibited chromosome pairing. At the molecular level, several genes are known to be responsible for the formation of synaptonemal complex and chromosome pairing (Armstrong et al. 2002). Two groups of genes namely, *As* and *Ds* genes, control the homologous chromosome pairing and, if present in recessive state, result in failure of pairing. The *As* genes inhibit the synapsis during zygotene and the condition is known as asynapsis. The *Ds* genes act on paired chromosomes at diplotene-diakinesis stages, causing a reduction or total absence of chiasma formation leading to desynapsis i.e., formation of univalents, (Gottschalk & Klein 1976). Second meiosis was also irregular because cells inherit chromosomal abnormalities from first meiotic division. In the present investigation, at telophase I and II, univalents created high abnormality and showed unequal distribution and laggards. Univalent formation with high pollen sterility has also been reported in *Vicia faba* by Joshi & Verma (2005).

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