SPONTANEOUS CHROMOSOME ABERRATIONS IN DIPLOID SOLANUM

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ABSTRACT

Chromosome aberrations were observed in the tapetum and pollen-mother-cells, generally in form of chromosome bridges, fragments and elimination of univalent chromosomes and fragments. Chromatid bridge formation varied from 13.1 to 10.25% in the first and second anaphases respectively.

Endoreduplication with a high degree of ploidy was observed in tapetal cells. Chromosomal reduplication was so marked that the normal diploid chromosome number 24 reached 96.

The association of chromosomes in three, four, five and six occurred in 49.4% of the cases observed. The occurrence of high frequency of polyvalents in a diploid seemed to indicate the presence of translocation interchanges in S. venturii.

The frequency of univalents varied from 1.3 to 18.7%. Structural changes and gene mutation are probably responsible for failure of pairing among pairable chromosomes. The behaviour of univalents varied, they either pass to poles or lag and divide. The division and elimination of univalents causes unequal distribution of chromosomes on second metaphase plates. Univalents and fragments which failed to be included in the daughter nuclei formed micronuclei. The chromosome irregularities and abortion of pollen grains (45.4%) are presumably due to gene mutation which may have been enhanced in aged seeds.

The occurrence of spontaneous chromosome aberrations has been observed in various plants and animals. These aberrations consist largely of reciprocal translocations and inversions which when heterozygous result in characteristic configurations visible during mitosis and meiosis. Giles (7) demonstrated a high frequency of chromosome alterations, in microspores and root tips of Tradescantia, resulting from dicentric chromosomes and chromosome breaks.

Although the occurrence of irregularities in the form of chromosome bridges, quadrivalents, trivalents, univalents and endoploidy have been demonstrated in diploid Solanum (4, 9, 10) and Chilian S. tuberosum varieties, (1), respectively, no report has been made of endoreduplication and association of more than four chromosomes in diploid potatoes.

While studying the chromosomes of different wild diploid Solanums, various aberrations were observed in the tapetum and pollen-mother-cells of Solanum venturii which are reported here.

MATERIALS AND METHODS

Seeds of Solanum venturii Hawkes and Hjerting (PI 218220) were obtained from the Potato Introduction Station, USDA, Sturgeon Bay, Wisconsin, USA, which were harvested during August 1956. Plants were

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grown under controlled environmental conditions at 25 C in the growth chambers, Genetics Department, McGill University, Montreal, Canada, during 1966-1967.

The anthers were fixed in Carnoy's fluid (6:3:1) for 24 hours and stained with basic fuchsin (Feulgen) after hydrolysis in N HCl at 60 C for 8 min. The anthers were smeared in the usual manner and temporary smears were sealed with Kerr's sticky wax (obtainable from Kerr Manufacturing Co., Detroit, Mich.).

**RESULTS AND DISCUSSION**

Mitotic disturbance and meiotic aberrations were observed in the tapetum and pollen-mother-cells, respectively. The tapetal cells were binucleate prior to the time at which the pollen-mother-cells were at pachytene. A number of cells (5.6%) with chromatin bridges were observed interspersed among binucleate cells (Fig. 1). As expected, chromosomes which had formed bridges had difficulty separating.

Drastic environmental changes are likely to cause aberrations and mutations. Kato (8) reported seasonal variations in the frequency of mitotic irregularities in *Clivia* and indicated that high temperature might be one of the factors causing spontaneous aberrations. In the present case temperature would not appear to be a factor as the *Solanum venturii* plants were grown at a constant temperature of 25 C.

It has been demonstrated that aged seeds of *Crepis* show a pronounced increase in the frequency of spontaneous chromosomal structural changes. Navashin (11) showed spontaneous chromosome aberrations in only 0.1% *C. tectorum* seedling grown from fresh seeds but 80% of the seedlings from 5-6 year old seeds had chromosome aberrations.

Mutation and chromosome aberrations induced in maize in the presence of a recessive gene were reported by Beadle (2). The chromosome aberrations observed in tapetal cells seem to indicate that these disturbances were due to aging of seeds.

Gigantic tapetal cells with a high degree of ploidy were observed in *S. venturii*. The polyploidy presumably was the result of endoreduplication (1). Reduplication resulted in an increase from the normal diploid chromosome number of 24 to 96 (Fig. 2).

Early stages of meiotic division were not suitable for critical studies. Although 12 bivalents were usually seen at diakinesis, multivalents in the form of trivalents, quadrivalents, pentavalents and hexavalents were not infrequent (Figs. 3-7). The frequencies of various multivalents observed are presented in Table 1.

In a basic diploid species where each chromosome is present twice, association of more than two chromosomes is not expected. However, the occurrence of a high percentage of multivalents (49.4) indicate the presence of translocation heterozygotes (5). When such an exchange occurred in an organism, pairing between interchanged segments showed configurations of multivalents. The configurations depended on the number and position of chiasmata.

Patterns of different configurations of trivalents and quadrivalents observed in different pollen-mother-cells are shown in Figs. 4 (a, b, c, d, e) and 5 (a, b, c, d, e, f, g, h) respectively. Pentavalents (Fig. 6) and