INCOMPLETE PREFERENTIAL PAIRING IN A TETRAPLOID SECALE HYBRID CARRYING TRANSLOCATIONS: MULTIVALENT CONFIGURATION FREQUENCIES AND MARKER SEGREATION

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Meiotic configurations and segregation were studied in tetraploid hybrids (4n = 28) between Secale cereale (2n = 14) carrying a reciprocal translocation between chromosomes II and VI and a derivative of Secale montanum (2n = 14), naturally differing from S. cereale in a translocation involving chromosomes I, III and V. Multivalent frequencies of the translocation complexes were reduced compared to expected but of still appreciable magnitude, which was ascribed to incomplete preferential pairing. Marker segregation (one of the S. cereale translocation chromosomes) also suggested partial preferential pairing.

Introduction

Multivalent formation and segregation in tetraploids depend on the affinity between the homologous (homeologous) chromosomes. On one end of the scale are the pan-autotetraploids with four identical chromosomes, on the other end the good allopolyploids with two sets of two homologues. There is perfect inhibition of pairing between the sets, but unrestricted pairing between chromosomes within the sets. All gradations between the two extremes can be found. SVED (1966) described the relation between marker segregation and multivalent frequency, and applied his model successfully to data collected by PHILLIPS (1964) on several Gossypium hybrids. Chromosomal markers can be used equally well for studying segregation, but the effect of the marker on multivalent formation and on segregation must be taken into account. When the marker is a translocation, the behaviour of the multivalent at meiosis can be used to estimate the degree of preferential pairing between corresponding chromosome segments. REIMANN-PHILIPP & EICHMANN-ROHDE (1970) analysed meiosis in tetraploid hybrids between Secale cereale and S. montanum, which two species are differentiated by two translocations

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involving three chromosomes. As the frequency of large configurations was much lower than expected on the basis of LINNERT’s (1962) random pairing model, the authors concluded that preferential pairing must have been considerable, especially for the translocated chromosomes. On the other hand, there were strong indications that much of the multivalent break-down was due to failure of chiasmata.

In the analysis presented here again a tetraploid *S. cereale* × *S. montanum* hybrid is involved, but the translocation studied is an induced one which has been studied before at the diploid level. It can be recognized at mitosis and therefore also used as a marker in a study of segregation. In the tetraploid hybrid there are two translocation sets of chromosomes of *S. cereale* origin. The two normal sets are of *S. montanum* origin. With decreasing homology between the chromosomes the translocation sets tend to pair among them, as do the normal sets. The result is an increase in gametes which combine a normal with a translocation set (NT) at the expense of gametes with two normal sets (NN) and two translocation sets (TT). In the models used (SYBENGA, 1973) failure of chiasmata in short translocation segments is accounted for in the calculation of expected configuration frequencies and segregations. The chromosomes involved in this translocation (II and VI) are not those of the natural translocation (chromosomes I, III, V) according to VAN HEEMERT & SYBENGA (1972).

**Material and Methods**

A plant of rye (*Secale cereale*) carrying translocation 240 (between chromosomes II and VI, compare SYBENGA & WOLTERS, 1972) was crossed with a plant of *Secale montanum* from a stock originally obtained from the Plant Breeding Institute, Cambridge. This stock had become contaminated with rye but in the hybrids used in this study the typical translocation complex that differentiates the two species was present.

Hybrid seeds were treated with colchicine (SYBENGA, 1973) and of the resulting chimaeral plants diploid and tetraploid ears were fixed (acetic-alcohol 1:3) for study of meiosis in permanent aceto carmine squash preparations. Other tetraploid ears were allowed to develop and were used as pollen spenders in crosses with normal tetraploid rye for the study of the segregation of translocation 240. The chromosomal constitution of the segregating progeny was determined in seedling root tips stained according to Feulgen after bromonaphthalene pretreatment, and fixation and hydrolysis in 1 N HCl at 59°C. The natural translocations could not with certainty be recognized in mitosis. All plants were grown in a conditioned greenhouse (day 21°C, night 16°C).