INTERCHROMOSOME DISTRIBUTION OF CHIASMATA IN ANNUAL CHRYSANTHEMUM

ALTHOUGH interchromosome effects for chiasma formation have been reported in a number of organisms, their significance has not been fully understood primarily because of their variable nature both at inter- and intraspecies levels.[1-3] More recently however it has been found that the different plants of *Delphinium ajacis* are remarkably consistent in showing negatively correlated chiasma formation in their chromosomes.[4,5] The present brief report relates to another plant in which the interchromosome correlation for chiasmata tends to be consistently of the positive type. It is obvious that finding of organisms which invariably show a particular type of interchromosome effect and differ from one another with regard to its direction can be of considerable help in analysing the factors controlling the interchromosome distribution of chiasmata.

FIG. 1. Pollen mother cell at prometaphase showing an interchange multiple of four chromosomes and seven bivalents, × 2,880.

The nine pairs of chromosomes in structrally homozygous plants of annual chrysanthemum (*Chrysanthemum carinatum*) do not show such size differences as will make it possible to distinguish some of the bivalents from others. A number of interchange heterozygotes, however, were available from a previous study in which it was found possible to separate the chromosomes into two groups of 4 and 14 chromosomes; chromosomes of the first group forming the interchange multiple, those of the second appearing in the form of 7 bivalents (Fig. 1). Fifteen such plants were analysed for the frequency of chiasmata in the two groups of chromosomes at metaphase I. The cytological technique employed and the method of analysing the observations have been described in an earlier paper.[4] The method involved the determination of internuclear variance which measures the variation in the total number of chiasmata among the pollen mother cells, and inherent variance (redesignated as intranuclear variance) which provides a measure of variation in the number of chiasmata between the two groups of chromosomes in individual cells. The observations on mean chiasma frequency and the estimates of two variances are presented in Table I. It will be seen from this table

TABLE I

Analysis of variance of chiasma frequency

Plant no.	Mean chiasmata per cell	Internuclear variance	Intranuclear variance	Correlation
1	14·30	0·6000	0·3448	+‡
2	14·04	0·1875	0·1838	+‡
3	14·36	0·2565	0·1342	+*
4	14·93	0·3924	0·1322	+†
5	14·40	0·2113	0·1308	+‡
6	15·10	0·2931	0·1068	+†
7	16·23	1·3768	0·3889	+†
8	16·46	0·5710	0·4896	+‡
9	18·00	1·0030	0·1989	+†
10	15·10	0·3703	0·2120	+‡
11	15·30	0·3993	0·1503	+†
12	15·76	0·4189	0·1412	+†
13	15·13	0·5113	0·0941	+†
14	15·13	0·4041	0·1351	+†
15	15·33	0·2324	0·1303	+‡

† Correlation positive, significant at 1% level.
* Correlation positive, significant at 5% level.
‡ Correlation not significant.

that for each of the 15 plants, the internuclear variance exceeds the intranuclear, thus indicating a tendency for positively correlated chiasma frequencies in the two groups of chromosomes. A statistical analysis shows that in nine of the plants, the difference in the magnitudes of the two variances is highly significant, which confirms the positive correlation in these plants.

The negative interchromosome correlation for chiasma formation has been considered by Mather[1] to be a function of an upper limit on chiasma formation in a nucleus. Interchromosomal effects for genetic recombination in *Drosophila* have likewise been interpreted as indicating the availability of a fixed amount of energy for crossing over.[6] If the negative correlation is indicative of a tendency to limit the number of chiasmata, a positive correlation of the type observed in annual chrysanthemum suggests a mechanism which ensures maximization of crossing over in the nucleus. Stebbins,[7] among others, has discussed how the recombination index has been selected to favour a greater or lesser release of genetic variability in different types of populations. The analysis described by this author in the family Compositæ indicates that changes in the recombination index constitute an important part of the process of adaptive alterations of the genetic system. In view of these considerations, it may be supposed that the negative and positive types of interchromosome distribution of chiasmata reflect such differences of the genetic system in different organisms.

The fact that all the fifteen plants, although differing in their mean chiasma frequency, either show or indicate a tendency for a particular type of interchromosomal correlation is of further interest from the point of view of analysis of the mechanisms which ensure a positive correlation in the present case and a negative one in plants like larkspur. As a first step towards such analysis, it is proposed to confirm the consistent nature of the positive correlation in *Chrysanthemum* through a more comprehensive study.

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FUNCTIONAL MALE-STERILITY IN *BRASSICA CAMPESTRIS* VAR. BROWN *SARSON*

IN five varieties of brown *sarson* (*Brassica campestris* var. brown *sarson*), Das and Pandey[3,4] reported genic male-sterility where the anthers were small, pointed and contained no viable pollen grains. This note records another case of male-sterility in brown *sarson* where the anthers were normal-looking but did not dehisce. This was observed in 1960-61 in a few plants arising from a cross between M-18 and variety A of brown *sarson*. There was no morphological difference between the plants with normal (dehiscent) and non-dehiscent anthers