

MEIOTIC ANALYSIS IN FOUR LAC HOST PLANTS¹

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SUMMARY

The meiotic analysis in *M. macrophylla*, *M. chappar*, *D. lanceolaria* and *B. monosperma* showed that bivalents per pollen mother cells were 11, 11, 10 and 9, respectively. The highest value of rod bivalents per pollen mother cell was in *M. macrophylla* (16.36 per cent) while its lowest was in *M. chappar* (1.36 per cent). The highest value for half chiasma per chromosome was in *M. chappar* (1.13), whereas its lowest was in *M. macrophylla* (0.98). The formation of bridges at anaphase I was noted in case of *M. chappar* only. The inter and intraclass correlation showed positive correlations amongst all the plants except in *D. lanceolaria* where negative correlation was noted. The pollen fertility was quite high in all the plants except in *M. chappar*.

INTRODUCTION

The meiotic behaviour of chromosomes and asymmetrical karyotypes are responsible for the evolution of genetic system (Rees 1961). The structure and behaviour of the bivalents during meiosis not only provide an insight into the nature of chromosome complements and genome analysis but are also supposed to control the potentialities of genetic recombination within the species (Stebbins 1971). The present study has, therefore, been undertaken to analyse the chromosome behaviour during meiosis in different lac host plants and their role in evolution.

MATERIALS AND METHODS

The suitable flower buds of *Moghania macrophylla*, *Moghania chappar*, *Dalbergia lanceolaria* and *Butea monosperma*, collected from Indian Lac Research Institute Plantation, were fixed in aceto-alcohol (1 : 3 with a few drops of ferric chloride) for 24 hours and preserved afterwards in 70% alcohol. The anthers were squashed in 2% acetocarmine.

The chiasmata frequencies between and within the nuclei in different plants were analysed by partial analysis of variance (Mather 1936).

Pollen sterility was tested in 0.5 per cent acetocarmine solution. All the observations and microphotographs were taken from well spread temporary slides.

OBSERVATIONS

The data from the present investigations, set out in Table 1, indicate, (i) the number of regular bivalents per pollen mother cell as 11, 11, 10 and 9 for *M. macrophylla*, *M. chappar*, *D. lanceolaria* and *B. monosperma*, respectively; (ii) the variation in the percentage of rod bivalents per pollen mother cell revealing its highest value (16.36 per cent) in *M. macrophylla* and lowest (1.36 per cent) in *M. chappar*; (iii) the bridges at anaphase I in case of *M. chappar* only; (iv) the highest value (1.13) of

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TABLE I

Chromosome pairing and chiasma frequency in four lac host plants

	Bivalents per PMC		Total bivalents	Chiasmata per PMC		Terminalised chiasmata per PMC		Chiasmata per chromosome	Terminalisation coefficient		
	Ring	Rod		Range	Mean	Range	Mean				
	Range	Mean									
1.	7-11	9.2	1-4	1.80	11	18-24	21.60	14-20	17.70	1.96	0.82
2.	8-11	10.8	0-3	0.15	11	21-28	25.05	16-22	21.60	2.26	0.86
3.	8-10	9.3	0-2	0.70	10	21-25	23.10	15-20	17.40	2.10	0.73
4.	8-9	8.5	0-1	0.50	9	17-22	20.00	16-18	17.00	2.22	0.85

1. *M. macrophylla* 2. *M. chappar* 3. *D. lanceolaria* 4. *B. monosperma*

Ten PMCs were examined from each plant.

half chiasma per chromosome in *M. chappar* and lowest (0.98) in *M. macrophylla*; (v) the highest value (25.05) for mean number of chiasmata per pollen mother cell in *M. chappar* and lowest (20.00) in *B. monosperma*; (vi) the mean values of terminalised chiasmata per pollen mother cell as 17.70, 21.60, 17.40 and 17.00 for *M. macrophylla*, *M. chappar*, *D. lanceolaria* and *B. monosperma*, respectively and, (vii) the highest terminalisation co-efficient (0.86) in *M. chappar* and lowest (0.73) in *D. lanceolaria*. Pollen fertility was highest (70-80 per cent) in *M. macrophylla* and lowest (40-50) in *M. chappar*.

DISCUSSION

These results clearly reveal that the different species not only differ in their basic chromosome number, except in *Moghania* species (*M. macrophylla* and *M. chappar*), but also in the meiotic behaviour of their chromosomes, especially in the number of ring and rod bivalents, chiasmata per pollen mother cell and per chromosome (Table 1). Such a variability could possibly be due to their different genotypic constitution which might have evolved on different lines. The differences in their morphological characters also support the idea that they are carrying different gene pools. It has also been shown by various workers, such as Frost & Manna 1924, Levan 1936, Meda 1937, Darlington 1937 and Roy & Jha 1958 that the pairing behaviour of the chromosomes and localisation of chiasmata are under genetic control.

The minimum and maximum percentage of rod bivalents have been recorded as 1.36 and 16.36 per cent in case of *M. chappar* and *M. macrophylla*, respectively whereas the same plants were found to have the minimum and maximum percentage of ring bivalents but in a reverse order. These variations could probably be due to inconsistency in the configurations of bivalents which might have been produced as a result of heterogeneity in the chromosome complements of different plants under investigation or partial inactivity of genes or set of genes responsible for usual synapsis. On the basis of mean percentage of rod bivalents, *M. macrophylla* can be kept at the top and *M. chappar* at the bottom, whereas other plants occupy intermediate positions.

The value of half chiasma per chromosome also provides an important measure of the variability at cytological level in different species which has been recorded highest in *M. chappar* and lowest in *M. macrophylla*. These values depend upon many

factors, such as synaptic behaviour and shortening of chromosomes, lower recombinational values, behaviour of genes, naturally occurring spontaneous aberrations and variation in breeding behaviour (Garber 1956, Grant 1958 and Sinha & Acharia 1974).

The intraclass correlation (the mean square within the nuclei) in all the plants indicates that there could probably be a competition in the bivalents of a nucleus in the different species till a saturation point is reached, thus supporting the hypothesis of competition proposed by Mather (1936). Such observations have also been made by Basak & Jain (1963) in *Delphinium* and Acharia (1972) in *Lens*.

Considerable variation has been recorded in the variance ratio which ranges from 0.017 to 2.77 in case of *B. monosperma* and *D. lanceolaria*, respectively (Table 2) which could be due to differences in finer details of cytological and karyotypic set up.

TABLE 2
Analysis of variance of chiasma frequency in four lac host plants

Source of Variation	Mean Chiasmata P.M.C.	Mean square between nuclei	Mean square within nuclei	Variance ratio	Level of significance	rValue
<i>M. macrophylla</i>	21.60	0.322	0.280	0.869	N.S.	0.0042
<i>M. chappar</i>	25.05	0.342	0.180	0.526	N.S.	0.0682
<i>D. lanceolaria</i>	23.10	0.121	0.336	2.770	N.S.	-0.0721
<i>B. monosperma</i>	20.00	2.460	0.042	0.017	N.S.	0.8505

When the values of two mean squares (between and within the nuclei) are considered, these are generally known to differ amongst the different plants considerably and lead to correlation in the chiasmata frequencies which could either be positive or negative. Generally positive correlations are more common than negative ones. It will be rather interesting to recall the positive correlation found in *M. macrophylla*, *M. chappar* and *B. monosperma* and negative one in *D. lanceolaria*. Such positive correlations may result due to irregular distribution of chiasmata in some of the bivalents or groups of bivalents. These results conform to those of Elliott (1958). The negative correlation indicates that there is a variation in the number of chiasmata per bivalent even in the same nucleus.

Pollen fertility was quite high (70—80 per cent) in *M. macrophylla*, *D. lanceolaria* and *B. monosperma* and low (40—50 percent) in *M. chappar*. Such a differential fertility could either be due to differences in karyotypic structure of the various plants under investigation (Sinha & Kumar 1977) or meiotic abnormalities such as occurrence of bridges, during anaphase as observed in *M. chappar*. The role of such abnormalities producing inviability in gametes is well known, probably due to deficiencies and duplication in course of segregation. Similar differences in fertility due to karyotypic structure have also been reported in *Collinsia* (Garber & Gorsic 1956).

The foregoing discussion clearly reveals the highly variable structure and behaviour of the chromosomes during meiosis in these plant species. These variations might have been responsible for different phenotypic changes and creating in turn the different species and genera. Hybridization does not seem to be effective in these cases as meiosis was quite normal. However, the possibility of gene mutation creating these different species and genera can not be completely ignored. On the basis of karyo-

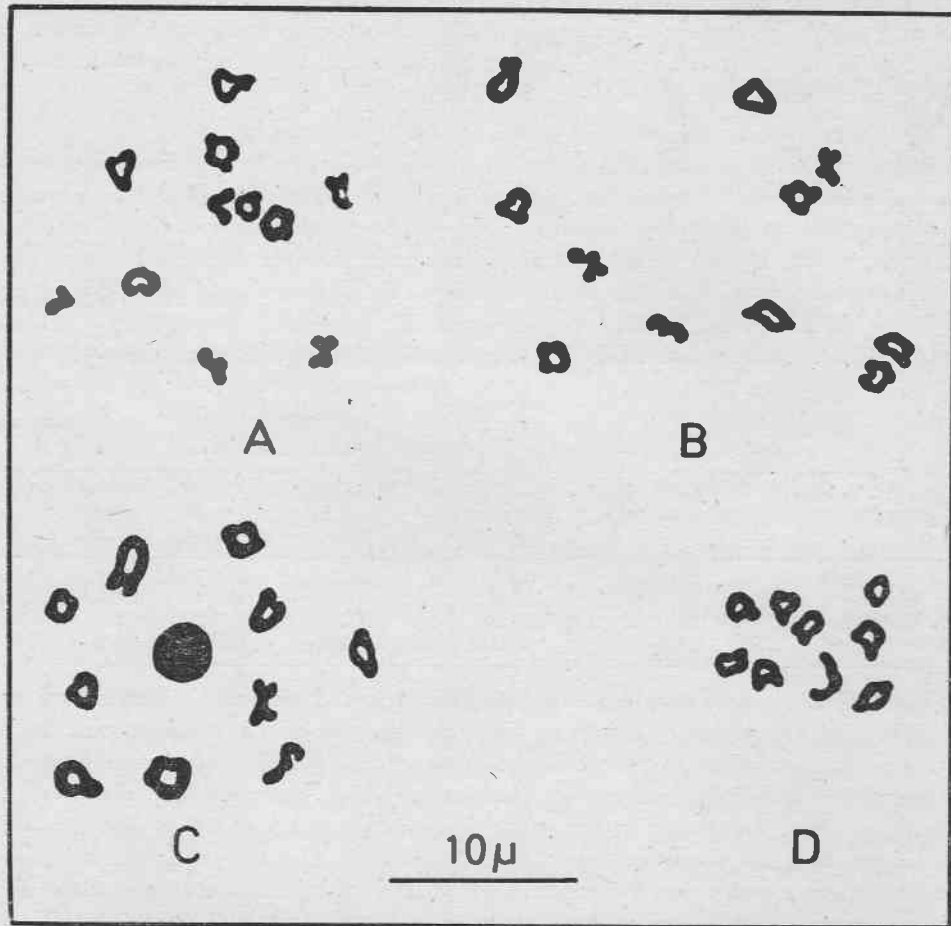


Fig. 1. Chromosome bivalents at metaphase I of *Moghania macrophylla* (A), *Moghania chappar* (B), *Delbergia lanceolaria* (C) and *Butea monosperma* (D).

typic structure also these plants differed very much (Sinha & Kumar 1977). Thus our results are in agreement with those of Dana (1966), Krishnan & Dey (1968) and Roy (1973).

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