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MEIOTIC STUDIES IN FOUR POPULATIONS OF Argemone Mexicana L. FROM MATHURA TOWN

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Key words : *Argemone mexicana,* Meiosis, Heterozygous, Heterogeneous

Four populations of *Argemone mexiana* L. were studied meiotically from four different places of Mathura town. In all the populations the gametic number was found to be n=14. In these populations meiotic anomalies consisted of univalents and multivalents at metaphase-I, formation of translocation chain, clumping of chromosomes and precocious separation of chromosomes. At anaphase-I, unequal segregation of chromosomes, simple chromosomal bridge and laggards were reported. Meiotic studies have revealed that each locality favours its own form of individuals and the populations have been termed heterozygous and heterogeneous.

INTRODUCTION

Population is a reproductive community sharing a common gene pool through sexual reproduction and cross fertilization. Thus populations are the general base of genetic system in plants. Population studies are, therefore, reflection of the genetic components and the factors affecting them. Major component of genetic system includes chromosome behaviour during meiosis. The natural population is affected by both genetic drift and forces of natural selection. The role of drift is quite insignificant in large populations, but forces of natural selection play a major role in such populations. However, in small populations selection is ineffective and chance of fluctuation becomes significant due to genetic drift (Stebbins, 1965, Davis and Heywood, 1973; Trivedi and Sinha, 1986 and Gupta and Srivastava, 2008).

Keeping the above attributes in consideration, meiotic studies have been undertaken in four populations of Argemone mexicana L., popularly known as prickly poppy or *bharbhand* or *satyanasi* and belonging to the family papaveracae. It is an annual herbaceous weed spread all over India and growing usually mixed with crops like wheat and mustard. Results have been analyzed and interpreted in view of relevant population tendencies and attributes and available reports of similar studies.

MATERIALS AND METHODS

Meiotic studies were carried out from flower buds collected in between 6.30 to 7.30 am. Materials were fixed in 1:3 acetoalcohol and staining was done in 2% acetocarmine. Slides were made permanent according to the method of Celarier (1956).

OBSERVATIONS

All the four populations of *Argemone mexicana* L. namely *Am0208, Am'0208, Am''0308* and *Am'' '0308* were collected from four different places of Mathura town.

AM0208

This population of ***Argemone mexicana*** consisted of fifty two plants and hence it was considered a large population. The gametic number was found to be n= 14 in all preparations. Fourteen distinct bivalents were clearly noticed at diakinesis and metaphase-I stages (Fig. I). Irregularities in meiotic division were also observed in this population. Univalent and multivalent,mainly quadrivalent formations were of frequent occurrence. The nature and frequency of chromosome association at metaphase-I have been given in Table-1. Details of chiasma frequency and analysis of ring and rod bivalents have also been summarized in Table-2. The other anomalies like precocious separation and clumping of chromosomes were also observed. At anaphase-I, about 10 per cent of the pollen mother cells showed abnormalities like chromosomal bridge, unequal separation, chromosome laggards, clumping of chromosomes at two poles and unequal distribution of chromosomes at both the poles (Fig. 2). Pollen sterility was calculated to be thirteen per cent (Table-3).

Am'0208

Plants of this population were growing in a barren land near Railway station and this was comparatively a small population as it consisted of thirteen plants only. Here also gametic number was n=14. Diakineses and metaphase-I stages showed fourteen bivalents. Abnonnalities like univalents and multivalents were noticed in some pollen mother cells.The nature and frequency of chromosome association at this stage have been summarized in Table-1. Clumping of chromosomes, precocious separation of chromosomes and translocation chain were observed (Fig. 3). Details of chiasma frequency and analysis of rod and ring bivalents have been summarized in Table-2. At anaphase-I, unequal distribution of chromosomes at two poles, chromosomal laggards and chromosomal bridges (Fig. 4) were noticed. Pollen sterility was found to be nine per cent (Table-3).

Am''0308

This population consisted of twenty nine plants only which were growing in a wasteland area of Krishna Janambhoomi, Mathura. A chromosome count of n-14 is also determined. Meiosis in the material was found to be highly non-synchronized. Fourteen bivalents were observed at late diakinesis. The common abnormalities were univalent and different kinds of multivalents. The nature and frequency of chromosome association in different pollen mother cells have been summarized in Table-I. Details of chiasma frequency

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and analysis of rod and ring bivalents have been summarized in Table-2. Some anomalies like simple chromosomal bridges, chromosomal laggards (Fig.5) and unequal separation of chromosomes were noticed in some pollen mother cells. However, maximum pollen mother cells showed equal distribution of chromosomes on four poles (Fig. 6). The pollen sterility was calculated to be 5.5 per cent (Table-3).

Am‴0308

This was considerably a large population and consisted of about 83 plants at Gokul of Mathura town. The gametic number was also found to be n=14. In a few pollen mother cells at diakinesis, some multivalents were recorded. At metaphase-I some abnormalities like clumping of chromosomes (Fig.7), precocious of separation of chromosomes, multivalents, univalents and translocation chain and rings were recorded. Among multivalents, quadrivalents were found to be as high as six. Translocation chains and rings were represented only about in three per cent of the pollen mother cells studied. Details of chromosome association and chiasma frequency have been summarized in Tables-1 and 2 respectively. At anaphase-I, equal distribution of chromosomes were observed at two poles in most of the pollen mother cells (Fig. 8). However, anomalies like simple chromosomal bridges, chromosomal laggards, clumping of chromosomes, unequal separation of chromosomes at two poles, formation of dyads (Fig. 9), triads and pentads at the quartet stage were observed. Pollen sterility was calculated to be sixteen per cent (Table-3). Pollen grains were of one size and one type (Fig.-l0)

TABLE-1 : Nature and frequency of Chromosome association at metaphase- I of populations of *Argemone mexicana* L. studied from Mathura

Chromosome association						:Frequency	Populations
VI	V	IV	III	II	I	of PMCs	
1	0	0	1	9	1	5	*Am 0208*
0	0	2	0	9	2	8	
0	0	0	0	10	8	7	
0	0	0	0	14	0	25	
0	0	1	1	10	1	5	
0	0	0	0	10	8	7	*Am' 0208*
0	0	1	1	10	1	3	
0	0	2	0	9	2	2	
0	0	0	0	14	0	30	
0	0	2	0	10	0	8	
0	0	0	0	14	0	28	*Am'' 0308*
0	0	1	0	10	4	7	
0	0	0	2	11	0	4	
1	1	0	0	8	1	6	
0	0	2	1	8	1	5	
0	0	2	0	10	0	8	*Am'' 0308*
0	0	0	0	14	0	22	
1	0	0	0	10	2	7	
0	0	2	0	10	0	8	
0	0	0	0	8	12	5	

TABLE-2 : Chromosome pairing and chiasma frequency at metaphase- I of different populations of *Argemone mexicana* L. from Mathura

Populations	No. of PMCs studied	No. of bivalents per PMC				Total	Chiasma per PMC		Terminalised Chiasmata		½ chiasma per chromosome	Term. coeff.
		Ring		Rod								
		Range	Mean	Range	Mean		Range	Mean	Range	Mean		
Am0208	50	3-5	4	9-11	10	14	16-20	18	15-19	17	0.64	0.94
Am'0208	50	2-4	3	10-12	11	14	19-22	20.5	17-20	18.5	0.73	0.90
Am''0308	50	4-6	5	8-10	9	14	18-22	20	17-20	18.5	0.71	0.92
Am'''0308	50	3-6	4.5	8-11	9.5	14	20-24	22	18-22	20	0.78	0.90

TABLE-3 : Pollen analysis of populations of *Argemone mexicana* L. from Mathura

Populations	No. of Pollen studied	No. of normal pollen	No. of sterile pollen	Percentage of sterile pollen
Am0208	1000	870	130	13
Am'0208	1000	910	90	9
Am''0308	1000	945	55	5.5
Am'''0308	1000	840	160	16

DISCUSSION

Different populations of *Argemone mexicana* showed gametic number as n= 14. In all the populations, the meiotic division was non-synchronized and abnormalities like clumping of chrmosomes, univalent, multivalents at metaphae-I, chromosomal bridge, laggard and unequal separation of chromosomes, at anaphase -I were reported. Half chiasma per chromosome was found to vary trom 0.63 to 0.78 (Table-2). Pollen sterility was found to vary from 5.5 to 16 per cent in different populations (Table-3) Comparative analysis of chiasma frequency of the four populations revealed that the populations exhibit more degree of heterozygosity. In fact, the basic chromosome number and chiasmata per nucleus constitute the recombination index in species (Darlington, 1956).

From the observations it is apparently revealed that the degree of anomalies is not always the same in the studied populations. They have been found to vary according to locality and season. Thus it becomes evident that each locality favours its own form of individuals within species. The structural characteristics of a population shows heterozyogosity (Geiger, 1978). In a heterogeneous population individuals differ in their adaptivity to the environmental condition. The population as a whole can survive under wide range of variations and the optimum degree of heterogeneity of a variety depends upon the ecological condition for which the material is destined (Kumar *et al.*, 2008 and Beevi *et al.*,2009).

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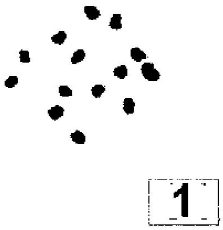

Fig. -1 PMC at diakinesis showing randomly arranged bivalents 1375 ×

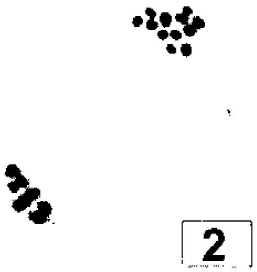

Fig. -2 PMC at anaphase-I showing unequal separation of chromosomes on two poles 1375 ×

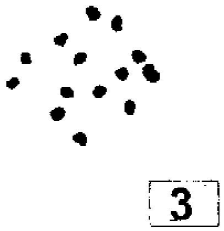

Fig. -3 PMC at metaphase-I showing translocation chain 1300 ×

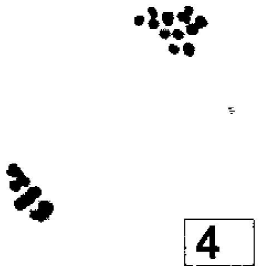

Fig. -4 PMC at anaphase-I showing simple bridge 1350×

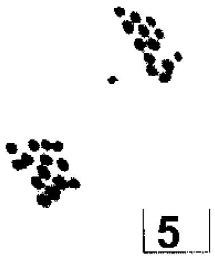

Fig. -5 PMC at anaphase-I showing laggards 1350×

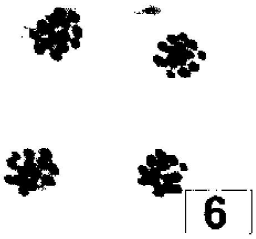

Fig. -6 PMC at anaphase-II showing normal distribution of chromosomes 1200 ×

Fig.-7 PMC at metaphase-1 showing clumped chromosome 1200 ×

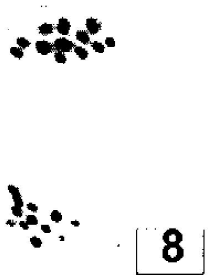

Fig.-8 PMC at anaphase-1 showing normal distribution of chromosomes on both poles 1350×

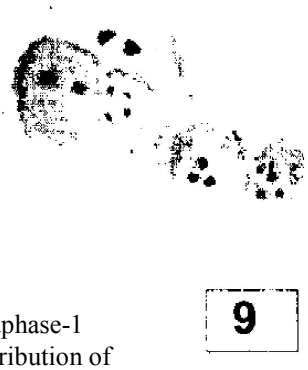

Fig.-9 Dyads with micronuclei 1150×

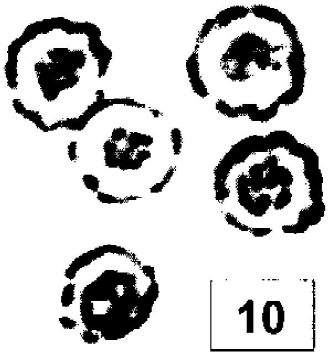

Fig.-10 Normal pollen grains 1350×