

Cytological studies in *Argemone mexicana* L. from Gaya Town

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Abstract: Mitotic and Meiotic studies were carried in one natural population of *Argemone mexicana* L. a member of family Papaveraceae from Gaya town. The somatic chromosome number was recorded as $2n=28$. In this population mitotic studies revealed that the chromosome is showing the tendency of symmetrical nature. The other important thing observed in this case is the small size of the chromosomes. While meiotic studies has also been concluded here that variable chiasma frequency might have been due to the failure of chromosome to pair or due to the fact that the sequence of gene might have been altered on account of translocation.

(Keywords: *Argemone mexicana* L. mitosis, meiosis, Idiogram, Karyotype, translocation.)

Introduction

Cytological studies clearly show the importance of cytology for dealing the relationship in a population, between population and species. Mitotic and Meiotic studies contribute to the taxonomy in an outstanding way (Solbrig¹, 1970). Chromosomes are closely related to the mechanism of heredity and hence they provide direct evidences regarding the origin of species in evolution (Stebbins², 1971 and Davis & Heywood³, 1973). In this context, Love⁴ (1960) has given a very beautiful quotation, "The chromosome plays an important role in determining the characters but characters do not determine the chromosomes."

In the present investigation cytological studies were carried in *Argemone mexicana* L.

which belongs to family papaveraceae. *Argemone mexicana* L. is a species of poppy found in Mexico and now widely naturalized in many parts of the world. An extremely hardy pioneer plant, it is tolerant of drought and poor soil, often being the only cover on new road cuttings or verges. It is locally called prickly poppy or Satyanashi.

Experimental:

Material and Methods:

For mitotic studies young and growing root tips were saturated aqueous solution of 1,4-Dichloro-benzene for 3 to 3½ hours. The pre-treated root-tips were fixed in a mixture of one part of acetic acid and three parts of ethyl alcohol. The fixed root tips were stained in 2% acetocarmine. Meiotic studies were done from anther squash preparation. The slides were made permanent according to the method of Celarier⁵ (1956).

Observation:

Both mitotic and meiotic studies were carried in one large population (Am 0316) which was growing near Gaya College, Gaya town.

Mitosis:

Mitotic studies were carried out from the root tip cells and the chromosome number was found to be $2n=28$ (fig.-1). The chromosomes were variable in size. They varied in their relative length from 1.02 μ to 1.82 μ . On the basis of their length two types of chromosomes were distinguished. Among them three pairs were of F types and 11

pairs were of G type. All the chromosomes had a primary constriction but the position of centromere was variable. The Karyotypic analysis showed that six pairs of Chromosomes were of median type, five pairs of Sub-median type and three pairs of Sub-terminal types. The chromosome pairs are represented in the idiogram (fig.2) and detailed Chromosome Measurements are summarized in (Table-1). No chromosome with secondary constriction was observed.

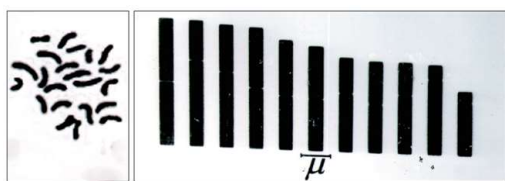


Fig. 1. Mitotic chromosome at metaphase

Fig. 2 Idiogram of Somatic chromosomes

Table-1
Details of Somatic chromosomes of *Am0316*

Serial No. of Chromosome pairs	Chromosome type	Position of the constructions		Length of the component portion of μ		Total length in μ	T.F. %
		Primary	Secondary	Long arm	Short arm		
1	F	M		0.90	0.92	1.82	
2	F	SM		0.92	0.64	1.56	
3	G	SM		0.74	0.58	1.42	
4	G	ST		0.98	0.32	1.40	
5	F	M		0.78	0.72	1.50	
6	G	SM		0.85	0.54	1.39	
7	G	SM		0.64	0.84	1.48	
8	G	ST		0.96	0.28	1.24	42.46
9	G	M		0.62	0.64	1.26	
10	G	ST		0.90	0.32	1.22	
11	G	M		0.58	0.60	1.18	
12	G	SM		0.68	0.52	1.20	
13	G	M		0.56	0.54	1.10	
14	G	M		0.52	0.50	1.02	

Total chromation length is 37.58 μ . The Karyotype formula for this locality is: 6(GM) + 5(FSM) + 3(GST)

Meiosis:

Materials for meiotic studies were collected from plants grown in the same

population and chromosome count of $n=14$ observed. Meiosis in the materials was found to be highly non-synchronized. Fourteen bivalents were observed at late diakinesis (fig.-3). Besides this univalent, formation was observed at this stage also.

At metahpase-1 fourteen bivalents were recorded. However abnormalities were also noticed at this stage. The common abnormalities were univalents multivalents and translocation (fig.-4)

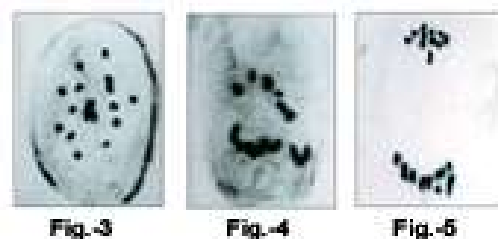


Fig.-3 PMC at diakinesis showing fourteen bivalents

Fig. - 4 PMC at metaphase showing univalents, multivalents and translocation

Fig. -5 PMC at anaphase showing unequal separation of Chromosomes

Table-2
Nature and frequency of chromosome association at metaphase-1 of the different population of *Argemone mexicana L.*

Chromosome association						Frequency of PMCS	Population
VI	V	IV	III	II	I		
0	0	0	0	14	0	28	Am 0316
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	

The nature and frequency of chromosomal association in different pollen mother cells have been summarized in (table-2). Clumping of chromosomes and precocious separation of Chromosomes were also noticed at this stage. Details of Chromosomal association and chiasma frequency have been summarized in (table-3).

At anaphase-1 was characterised by equal distribution of two poles. But anomalies like simple chromosomal bridge, chromosomal laggards (fig. 5) and unequal separation of chromosomes were noticed in some pollen mother cell. These abnormalities persisted throughout in the subsequent stages of meiosis resulting in the formation of tripolar condition. The pollen sterility was calculated to be 7.5 percent (Table-4). The normal pollen grains were of same size and shape.

Table-3

Chromosome pairing and chiasma frequency at metaphase-1 of the populations of *Argemone mexicana* L.

Population	No. of PMCs studied	No. of bivalent per PMC				Total	Chiasma Per PMC		Terminolised chiasmate		½ chiasma per chromosome	Term coefficient
		Ring		Rod			Range	Mean	Range	Mean		
		Range	Mean	Range	Mean							
Am0316	50	2-4	3	10-12	11	14	16-20	18	15-19	17	0.63	0.94

Table-4

Pollen analysis of the populations of *Argemone mexicana* L.

Population	No. of Pollen Studied	No. of normal Pollen	No. of Sterile pollen	Percentage of Sterile Pollen	Micropollen	Macropollen
Am0316	1000	925	75	7.5%	1	2

Results and Discussion

Both mitotic and meiotic studies contribute to the taxonomy in an outstanding way (Solbrig, 1970). In any natural population, the

study of Karyotype is essential for a proper understanding of trends in chromosomal evolution (Trivedi & Kumar⁶, 1984; Trivedi & Sinha⁷, 1986)

A critical study of the mitotic chromosome has been done in the population of *Argemone mexicana* L. collected from Gaya town. The somatic chromosome of *Argemone mexicana* was found to be smaller in length. The largest chromosome measured 1.82µ in length while the smallest chromosome measured 1.02µ in length. The total chromatin length was found to be 37.58µ. The total form value was 42.46%. Out of fourteen pairs of chromosome, six pairs were of median type, five submedian type and rest three were of subterminal type. The total form value indicates that the chromosome is showing the tendency of symmetrical nature.

A critical examination of chromosome behaviour at meiosis from the points raised above may bring about the reproductive behaviour of the species in the studied population. In meiotic study of *Argemone mexicana* from Gaya town and gametic number was reported as $n=14$. Meiotic anomalies like Clumping of Chromosomes, precocious separation of chromosomes and translocations, formation of univalents and multivalents at metaphase-1 were also present. At anaphase-1 also typical anomalies like chromosomal laggards, lagging bivalents, chromosomal bridges and clumping of chromosome were observed. Pollen sterility also varied from population to population.

References

1. O.T. Solbrig, Principles and methods of Plant Biosystematics. The Macmillan Co. London (1970)
2. G. L. Stebbins, Adaptive radiation of reproductive characteristics in angiosperm. *Ann. Rev. Ecol. Syst* 2, 237 (1971)
3. P H Davis and V. H. Heywood, Principles of Angiosperm Taxonomy. Robot E. Krieger publishing company. Huntington, New York (1973)
4. A. Love and D. Love Chromosome number of central and northwest European plant species. Opera botanical London (1961).

5. R. P. Celarier Tertiary butyle alcohol dehydration of chromosomes Smear Strain Tech. 31, 155 (1956).
6. R.N. Trivedi and Rajesh Kumar: Cytomorphological studies in natural populations of *Eclipta alba* (L) Hesak I. *cytologia* **49**: 731-738. (1984)
7. R. N. Trivedi and A. K. Sinha. Karyomorphological studies in three polutions of *Solanum surattense* a weed *Cytologia* **51**, 157 (1986).

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