

MEIOTIC STUDIES IN SOME POPULATIONS OF *Nicotiana plumbaginifolia* FROM GAYA AND DHANBAD TOWNS

Amit Kumar Singh and Praveen Sinha

Key words : *Nicotiana plumbaginifolia*, Meiosis, Population, Chiasma Frequency.

Six populations of the weed, *Nicotiana plumbaginifolia* belonging to the family Solanaceae have been studied meiotically from two different towns namely Gaya and Dhanbad. In all the six populations, the gametic number has been reported as $n=10$. However, many chromosomal anomalies like clumping of chromosomes, univalents and multivalents at metaphase I, chromosomal bridges, laggards and unequal separation of chromosomes during anaphase I have also been observed. Variation in chiasma frequency was found to be quite pronounced in different populations. Meiotic behaviour of all the populations has been found more or less similar but in terms of chiasma frequency, these populations differ considerably.

INTRODUCTION

Population studies are the reflection of genetic system in plants comprising all the intrinsic genetic processes that affect genetic recombination in a population. The major components of the genetic system are the chromosomal organization and their behaviour during meiosis (Kumari, 2013). Keeping these points in consideration, meiotic studies have been carried out in six different populations of the weed *Nicotiana plumbaginifolia* of the family Solanaceae. Three populations from Gaya and Dhanbad towns each were studied meiotically and observed chromosomal anomalies have been interpreted.

MATERIALS AND METHODS

Six different populations of *Nicotiana plumbaginifolia* from different ecological conditions of Gaya and Dhanbad towns were studied from meiotic point of view. The three populations selected from Gaya were named Np0312, Np'0312 & Np''0312 whereas three populations selected from Dhanbad were Np0412, Np'0412 and Np''0412. For meiotic studies, buds were fixed in 1:3 aceto-alcohol and squashed in 2% aceto-carmine. The slides were made permanent according to the method of Clearier (1956) and mounted in euparal.

OBSERVATIONS

Np0312 - Materials for meiotic study were collected from the plants growing along roadside of Chand Chaura, Gaya. The growth of plants was good as they were growing near water source. Population consisted of fifteen plants only.

The meiotic behaviour was found to be of non-synchronised type. The gametic number was recorded as $n=10$. At diakinesis, ten bivalents were observed with one bivalent attached with the nucleolus (fig. 1). Clumping of chromosomes and precocious separation of chromosomes were recorded at this stage. Besides these anomalies, some of the pollen mother cells revealed different types of multivalents. Details of chromosomal association and chiasma frequency have been summarized in Tables -1 and 2.

At anaphase I, the anomalies recorded were chromosomal bridge, laggards and clumping of chromosomes. At anaphase II, some irregularly dividing pollen mother cells were observed. These consisted of clumping of chromosomes at four poles

and chromosomal laggards. These cells formed micronuclei at the quartet stage. Pollen sterility was calculated to be 14 per cent (Table - 3).

Np'0312 - Flower buds were collected from plants growing in Gaya College campus. Ten bivalents were recorded both at diakinesis and metaphase I stages. PMC at anaphase I showed equal distribution of chromosomes at both the poles (fig-2). Abnormalities recorded were multivalents, univalents, clumping of chromosomes and precocious separation of chromosomes. Details of chromosomal association and chiasma frequency have been given in Tables - 1 and 2. Pollen sterility was found to be 7 per cent approximately (Table - 3).

Np''0312 - Flower buds for meiotic study were collected from the plants growing in and around Railway Colony, Gaya.

In this population also the chromosome number was observed to be $n=10$. Abnormalities like multivalent formation was recorded in some of the pollen mother cells. At anaphase I some of the pollen mother cells showed clumping of chromosomes (Fig.-3). Details of chromosome pairing and chiasma frequency are summarised in Tables 1 and 2 respectively. Pollen sterility was calculated to be 12 per cent (Table - 3).

Np0412 - Flower buds for meiotic studies were collected from the plants growing in I.S.M. campus in Dhanbad.

The gametic number $n=10$ was recorded. At diakinesis, intermingled chromosomes were observed in a few pollen mother cells. Besides observing normal metaphase I, this stage was characterized by the presence of multivalents, univalents, clumping of chromosomes and two groups of bivalents scattered in a few pollen mother cells. Some PMCs at anaphase I showed chromosomal laggard (Fig-4). Details of chromosomal association and chiasma frequency have been summarised in Tables 1 and 2 respectively. Pollen sterility was observed to be eight per cent (Table - 3).

Np'0412 - Materials for meiosis were collected from plants growing from Jharudih in Dhanbad. In this population at metaphase I, $n=10$ was observed in most of the pollen mother cells. Anomalies included clumping of chromosomes and precocious separation of chromosomes at metaphase I stage. At anaphase I, besides equal distribution of chromosomes,

some abnormally dividing pollen mother cells were also recorded. The abnormalities observed were chromosomal bridge (fig - 5), laggards and unequal separation of chromosomes.

Details of chromosomal association and chiasma frequency are summarised in Tables 1 and 2 respectively. Pollen sterility was calculated to be 14 per cent (Table 3).

Np''0412 - In this population collected from R.Y. Road, Dhanbad, very few samples showed presence of multivalents,

univalents and clumping of chromosomes. Details of chromosomal association and chiasma frequency have been summarised in Tables 1 and 2 respectively.

Anaphase I was characterized by equal distribution of chromosomes at both the poles. However, chromosomal bridge, clumping of chromosomes and chromosomal laggards were observed in a few pollen mother cells. Subsequent stages were found to be normal. Pollen sterility was observed to be six per cent (Table - 3).

TABLE - 1 : Nature and frequency of chromosomal association at metaphase I of different populations of *Nicotiana plumbaginifolia*.

Population	Frequency of PMC	Chromosome Association					
		I	II	III	IV	V	VI
<u>Np_0312</u>	30	0	10	0	0	0	0
	8	4	8	0	0	0	0
	6	0	8	0	1	0	0
	4	1	2	1	3	0	0
	2	1	6	1	1	0	0
<u>Np'0312</u>	32	0	10	0	0	0	0
	6	2	9	0	0	0	0
	4	0	6	0	2	0	0
	5	0	8	0	1	0	0
	3	3	7	1	0	0	0
<u>Np''0312</u>	40	0	10	0	0	0	0
	5	3	7	1	0	0	0
	3	1	6	1	1	0	0
	2	0	8	0	1	0	0
<u>Np0412</u>	26	0	10	0	0	0	0
	14	2	9	0	0	0	0
	5	1	8	1	0	0	0
	3	3	7	1	0	0	0
	2	2	6	2	0	0	0
<u>Np'0412</u>	30	0	10	0	0	0	0
	8	4	8	0	0	0	0
	6	0	8	0	1	0	0
	4	1	6	1	1	0	0
	2	0	7	2	0	0	0
<u>Np''0412</u>	33	0	10	0	0	0	0
	7	2	9	0	0	0	0
	4	1	2	1	3	0	0
	5	0	6	0	2	0	0
	1	0	8	0	1	0	0

TABLE - 2 : Chromosome pairing and Chiasma frequency at metaphase I of different populations of *Nicotiana plumbaginifolia*.

Population	No. of PMCS Studied	No. of bivalent per PMC				Total	Chiasma per PMC		Terminalised Chiasma		½ chiasma per chromosome	Term. coeff.
		Ring		Rod			Range	Mean	Range	Mean		
		Range	Mean	Range	Mean							
<u>Gaya</u> <u>Np0312</u>	50	4-6	5.0	4-6	5.0	10	14-16	15.0	9-12	10.5	0.75	0.70
<u>Np'0312</u>	50	4-7	5.5	3-6	4.5	10	16-18	17.0	10-12	11.0	0.85	0.64
<u>Np''0312</u>	50	4-6	5.0	4-6	5.0	10	14-18	16.0	10-14	12.0	0.80	0.75
<u>Dhanbad</u> <u>Np0412</u>	50	5-7	6.0	3-5	4.0	10	18-20	19.0	14-16	15.0	0.95	0.78
<u>Np'0412</u>	50	5-6	5.5	4-5	4.5	10	14-16	15.0	10-12	11.0	0.75	0.73
<u>Np''0412</u>	50	4-5	4.5	5-6	5.5	10	10-12	11.0	6-8	7.0	0.55	0.63

TABLE - 3 : Pollen analysis of different populations of *Nicotiana plumbaginifolia* from Gaya and Dhanabad.

Populations	No. of Pollen Studied	No. of Normal Pollen	No. of Sterile Pollen	Percentage of Sterile Pollen
Np0312	1000	860	140	14
Np'0312	1000	930	70	7
Np''0312	1000	880	120	12
Np0412	1000	920	80	8
Np'0412	1000	860	140	14
Np''0412	1000	940	60	6

DISCUSSION

Six different populations of *Nicotiana plumbaginifolia* of the family Solanaceae have been studied from two ecologically distinct towns namely Gaya and Dhanbad. The gametic number was found to be $n=10$ in all the populations. Meiotic anomalies observed included clumping of chromosomes, separation of chromosomes, formation of univalent and multivalent at metaphase I, chromosomal bridges, laggards and clumping of chromosomes at anaphase I. Pollen sterility varied from seven to fourteen per cent in the populations of Gaya town, while in the populations of Dhanbad town, it varied from six to fourteen per cent. Half chiasma per chromosome was found to vary from 0.75 to 0.85 in the populations of Gaya town. In the populations of Dhanbad town this variation was very much significant. Half chiasma per chromosome varied from 0.55 to 0.95 (Table - 2).

A comparative analysis of the chiasma frequency of the populations of Dhanbad revealed that half chiasma per chromosome decreases gradually from the first population to the third population. But there were not much variations in the presence of rod and ring bivalents of the three populations. It can be said that the gradual decrease in half chiasma per chromosome reveals more degree of heterozygosity. The degree of heterozygosity resulting from random mating decreases if inbreeding is practised. In the small populations,

individuals got more and more related to each other in course of generation, if mating at random. This may lead to increase in homozygosity. This fact is of utmost significance in cross fertilizing species as revealed in different populations of *Nicotiana plumbaginifolia* (Geiger, 1978; Beevi *et al.*, 2007; Ara *et al.*, 2011). Comparative meiotic features in the populations of *Nicotiana plumbaginifolia* indicate that the meiotic behaviour is more or less similar in the populations of Gaya and Dhanbad towns. However, these populations are contradistinctive in terms of chiasma frequency.

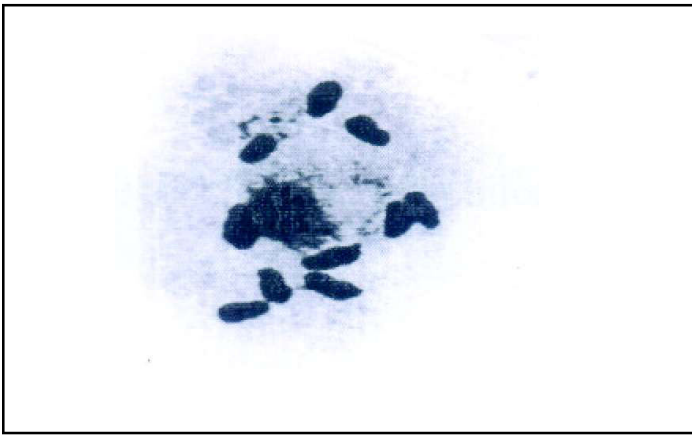


Fig. 1 : PMC at diakinesis showing one bivalent attached with the nucleolus

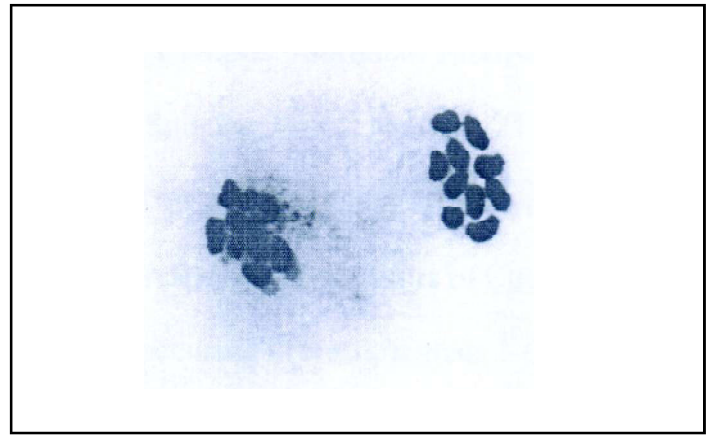


Fig. 2 : PMC at anaphase I showing equal distribution of chromosomes at both the poles

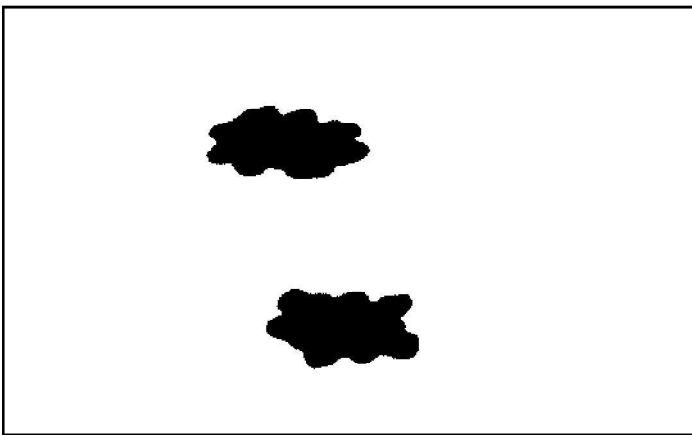


Fig. 3 : PMC at anaphase I showing clumping of chromosomes

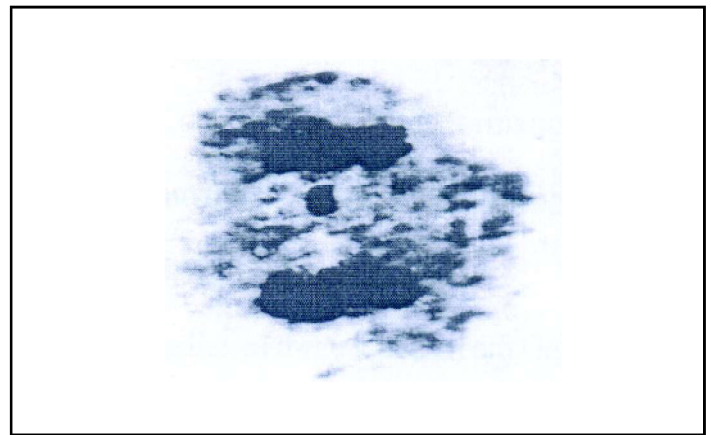


Fig. 4 : PMC at anaphase I showing chromosomal laggard

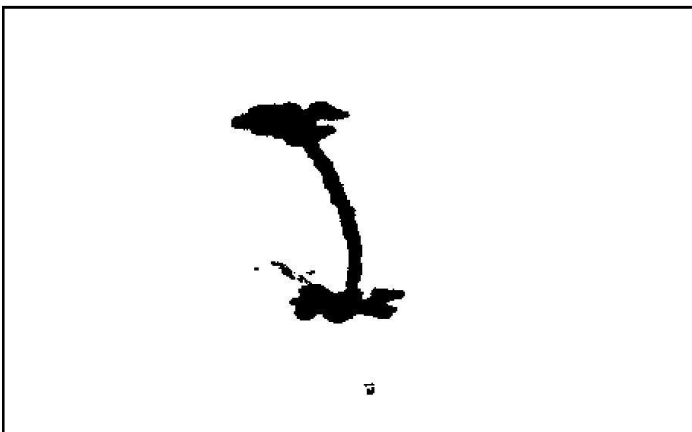


Fig. 5 : PMC at anaphase I showing chromosomal bridge.

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