

CYTOLOGICAL STUDIES IN *Nicotiana plumbaginifolia* VIV.

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Key words : *Nicotiana plumbaginifolia*, Mitosis, Meiosis, General purpose genotype.

Cytological studies have been carried in a population of *Nicotiana plumbaginifolia* of the family Solanaceae. Both mitotic and meiotic studies have been done. Somatic chromosomes showed $2n=20$ and length of chromosome varied from 1.60μ to 3.67μ . The gametic number was recorded as $n=10$. Meiotic anomalies included desynapsis, multivalents, univalents, chromosomal bridges and laggards. Pollen sterility was recorded as fourteen percent. On the basis of cytological evaluation it was concluded that the weed *Nicotiana plumbaginifolia* possess general purpose genotype as it is well adapted to the locality.

INTRODUCTION

Nicotiana plumbaginifolia viv, belonging to the family Solanaceae, grows as a weed in different parts of Bihar and other states. In the present study cytological studies of a population of *Nicotiana plumbaginifolia* has been carried out in detail. Under cytological study, both mitosis and meiosis of the population were observed. Populations are the gene pool base of genetic system in plants. The genetic system refers to all the intrinsic genetic processes that affect genetic recombination in a population. The major components of genetic system include karyotype, behaviour of chromosome during meiosis and the breeding system. Keeping these points under consideration the present study has been undertaken.

MATERIALS AND METHODS

Materials for mitosis and meiosis of *Nicotiana plumbaginifolia* were collected from the white house area of Gaya town. The population was named as Np0101.

For mitotic study the root tips were pre- treated in para-dichlorobenzene for three hours at low temperature ($4-8^{\circ}\text{C}$). Pre-treated root tips were fixed in 1:3 aceto-alcohol and stained in 2% acetocarmine. Total form percentage was calculated by the formula given by Huziwara (1962). Meiotic studies were done from anther squash preparation. For staining 2% acetocarmine was used. Mitotic and meiotic slides were made permanent according to the method of Celarier (1956) and mounted in euparal. Microphotographs were taken from temporary as well as permanent slides.

OBSERVATIONS

Mitosis

Somatic chromosome number in population Np0101 was found as $2n=20$ (Fig-1). Length of the chromosome varied from 1.60μ to 3.67μ . After analysis of the detailed karyotype, it was found that four pairs of chromosomes were median while four pairs of chromosomes were sub-median and rest two pairs of chromosomes were sub-terminal. Terminal type of chromosomes and chromosomes with secondary constriction were not observed. The chromosomes pairs have been represented in the idiogram (Fig-2). The detailed chromosome measurements are summarized in Table-1

Meiosis

The meiotic division was found to be of non-synchronized type. The gametic number as $n=10$ was recorded in the present study. At diakinesis, some of the pollen mother cells were found to contain bivalents showing desynapsis. At metaphase-I, $n=10$ was observed in most of the pollen mother cells (Fig-3) Clumping of chromosomes (Fig-5) and precocious separation of chromosome were recorded at this stage. Besides these anomalies, some of the pollen mother cells revealed different types of multivalent. Details of chromosomal association and chiasma frequency have been summarized in Tables- 2 & 3 respectively.

At anaphase-I, besides equal distribution of chromosomes at two poles, the abnormally dividing pollen mother cells were also recorded. The anomalies recorded were chromosomal bridges (Fig-6), laggards (Fig-4), unequal separation of chromosomes (Fig-7) and clumping of chromosomes (Fig-8). At anaphase-II, some irregularly dividing pollen mother cells were observed. These consisted of clumping of the chromosomes at four poles and chromosomal laggards. These cells formed micronuclei at the quartet stage. Pollen sterility was calculated to be 14 percent (Table-4).

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Table-1
Details of Somatic Chromosome of *Nicotiana plumbaginifolia*

Sl number of chromosome pairs	Chromosome type	Position of the constriction		Length of the component portion in μ		Total length in μ	T.F.
		Primary	Secondary	Long arm	Short arm		
1	B	M		1.81	1.81	2.63	38.49
2	E	M		1.51	1.12	3.27	
3	E	ST		1.72	0.41	2.13	
4	C	M		1.53	1.51	3.04	
5	B	M		1.85	1.82	3.67	
6	E	SM		1.22	1.01	2.23	
7	C	SM		2.11	1.01	3.12	
8	E	ST		1.83	0.31	2.14	
9	E	SM		1.41	0.81	2.22	
10	F	SM		1	0.6	1.6	

Total Chromatin length is 54.08 μ

The karyotype formula for this locality is , 2(BM) + 1(EM) + 1(CM) + 1(CSM) + 2 (ESM) + 2(EST) + 1(FSM).

Table-2
Nature and frequency of chromosome association at Metaphase-I of the Population Np 0101.

Chromosome association						Frequency of PMCs: Populations
VI	V	IV	III	II	I	
0	0	0	0	10	0	30
0	0	0	0	8	4	8
0	0	1	0	8	0	6
0	0	3	1	2	1	4
0	0	1	1	6	1	2

Table-3

Chromosome pairing and Chiasma frequency at Metaphase-I of the Population Np 0101

Population	No. Of PMC Studied	No. of bivalents per PMC				Total	Chiasmata per PMC		Terminilized Chiasmata		$\frac{1}{2}$ Chiasma per chromosome	Term coeff.
		Ring		Rod			Range	Mean	Range	Mean		
		Range	Mean	Range	Mean							
Np 0101	50	04-06	5	04-06	5	10	14-16	15	09-12	10.5	0.76	0.67

Table -4

Pollen analysis of the Population Np 0101

Population	No. of Pollen	No. of Normal ollen	No. of Sterile Pollen	Percentage of Sterile Pollen
Np 0101	1000	860	140	14

DISCUSSION:

The mitotic study of the population of *Nicotiana plumbaginifolia* showed total form value as 38.49%. The shortest chromosome was 1.60 μ in length while the longest chromosome was found to measure 3.67 μ (Table-1). Four median chromosomes pairs, four sub-median chromosomes pairs and two sub-terminal chromosome pairs were reported in the population. By looking to the size of the chromosome, it can be said that chromosomes on the whole, are smaller in size and such chromosomes fit into the pattern known for the families of advanced status (Stebbins, 1971; Langer & Kaul, 1980 and Sinha, Renu, 2002). Total form value indicates that chromosomes are of asymmetrical type.

The meiotic study showed the gametic number as n=10. The division was highly non-synchronised and the half chiasma per chromosome was found to be 0.76. The abnormalities recorded during meiosis included clumping of chromosome, multivalent and univalent formation at metaphase-I. At anaphase-I the anomalies were simple chromosomal bridges, chromosomal laggards and clumping of chromosomes. Pollen sterility was 14 percent. The presence of univalents in the population may occur due to failure of the chromosome pairing or may be due to precocious disjunction of the chromosome. High temperature may also be a cause of univalent formation (Frankle 1975 and Sinha, Renu 2002). On the other hand multivalent formation is indicative of real homology along several pairs of chromosomes of different individuals within the populations. Simple chromosomal bridge at anaphase-I may arise due to failure of terminalisation of the chiasmata as a result they remain sticky in the midway of two poles (Sax, 1960 and Saylar and smith 1966). Chromosomal laggards may occur as a result of desynaptic effect (Rao & Rao 1977). Although cytological anomalies were present in the population of *Nicotiana plumbaginifolia*, the plant was adapted to the locality in a very organized manner as a weed, therefore, it is very appropriate to conclude that weeds possess general purpose genotype (Baker 1965).

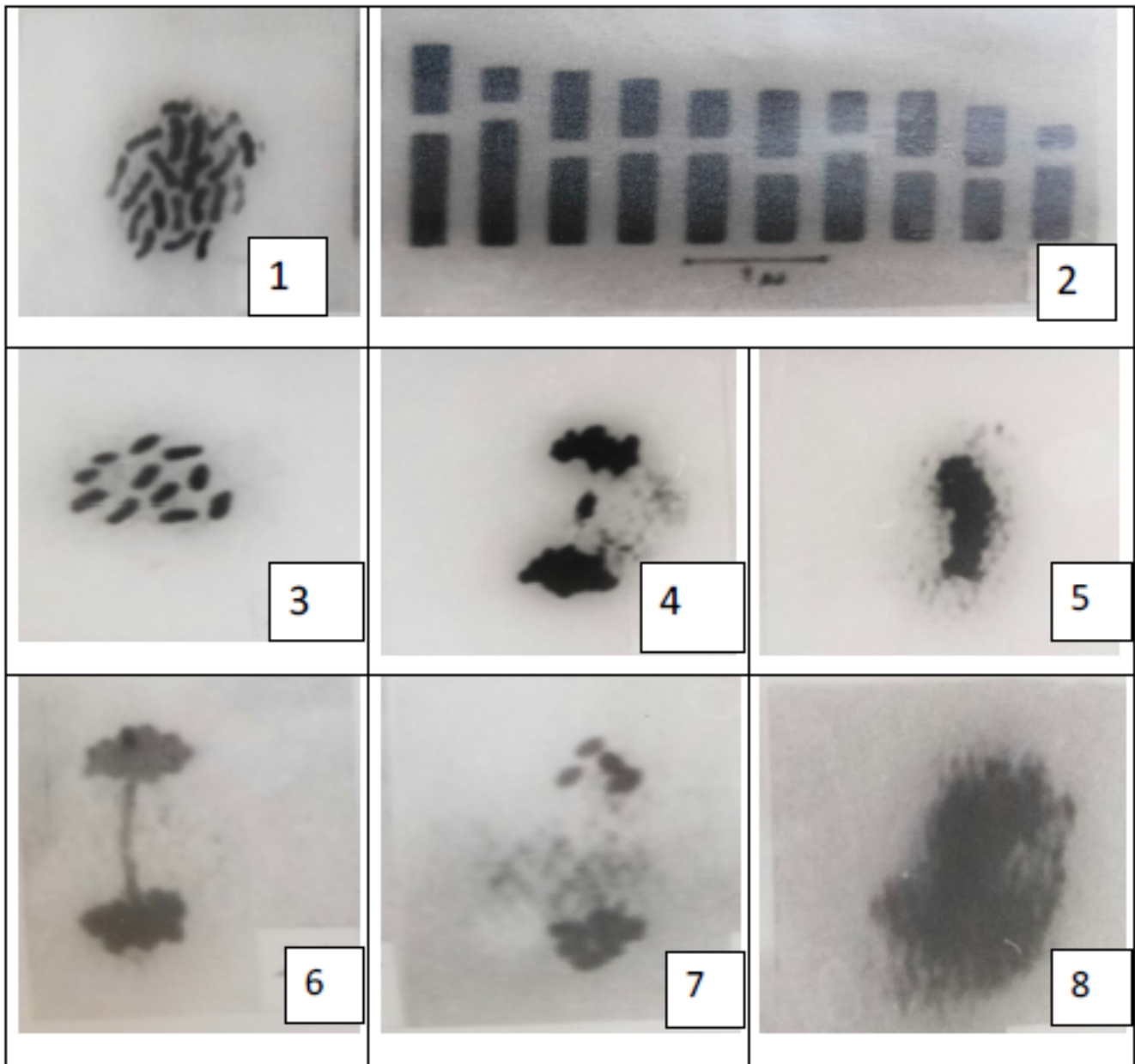


Fig 1-Mitotic chromosome showing 20 chromosomes.

Fig 2-Idiogram

Fig 3-PMC at metaphase-I showing bivalents

Fig 4-PMC at anaphase-I showing chromosomal laggard

Fig 5-PMC at metaphase-I showing clumping of chromosomes

Fig 6-PMC at anaphase-I showing chromosomal bridge

Fig 7-PMC at anaphase-I showing unequal separation of chromosome

Fig 8-PMC at anaphase-I showing clumping of chromosomes

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