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Cytogenetic studies of *Psoralea corylifolia* Linn. due to exposure of physical mutagens (Gamma radiations)

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Mutations are the important tools to produce many cultivars with improved economic value and study of genetics and plant development phenomena. Various mutagenic agents are used to induce favourable mutations at high frequency that include ionizing radiation and chemical mutagens. In the present study, the effect of physical mutagens *i.e.* gamma radiations have been studied on the cytogenetic of *Psoralea corylifolia* Linn. seeds. Different dosages of gamma rays were used to irradiate ranging from 5KR to 80KR. The frequency of dividing cells were increased at lower exposures while found decreased at higher exposures in M1 generations of *Psoralea corylifolia.* The mitotic index increased upto 20KR while it decreased at high exposures. Various chromosomal aberrations were recorded in mitosis like laggards, bridges, clumping of chromosomes and precocious movement of chromosomes. The frequency of abnormalities increased with increase in dose of gamma rays.

Key words : *Psoralea corylifolia*, Physical mutagens, Chromosomal abnormalities

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INTRODUCTION

Psoralea corylifolia is considered to be very effective plant in Indian indigenous system of medicine (Gidwani, 2011). It is a common herbaceous weed of road sides, cultivated fields and waste places, found mainly in Bengal, Bombay, throughout Indian plains and in Pakistan, Srilanka, Burma and China (Kirtikar and Basu, 1994). It has been extensively used in dental caries (Mukherjee, 2002), diarrhoea (Rangari and Agarwal, 1992), aphrodisiac (Kirtikar and Basu, 1994) and inflammatory diseases of skin (Uniyal and Ghandhak, 1998). Mutations are the tools to study the nature and function of genes which are the building blocks and basis of plant growth and development, thereby producing raw materials for genetic improvement of economic crops (Adamu and Aliyu, 2007). Induced mutations have great potentials and serve as a complimentary approach in genetic improvement of crops (Mahandjiev *et al.,* 2001). It is highly instrumental in plant biology to induce genetic variability in a great number of crops (Boureima *et al.,* 2009). Gamma radiations have been found to be very useful both for sterilisation in medicine and the preservation of food and cereals in nutrition and agriculture (Mokobia and Anomohanran, 2004). In the present investigation, the study was carried out to observe the effectiveness of gamma radiations (physical mutagens) in the M1 generation of *Psoralea corylifolia* seeds. The attempts made in the present study can be useful as a guideline for mutation breeding using gamma radiations.

RESEARCH METHODOLOGY

The attempt made in the present study was carried out to observe the effectiveness of gamma radiations (physical mutations) in the M1 generations of *Psoralea corylifolia* as well as to estimate the dosages of mutagen to bring cytogenetic changes. The seeds of *Psoralea corylifolia* L. were procured from the Amravati University Campus for the experiment and the exposures to gamma radiations was performed in the gamma cell of USIC, Nagpur University, Nagpur. The seeds were exposed with gamma rays at different dosages *i.e.* 5, 10, 20, 40, 60 and 80KR at dose rate 10KR/inute by cobalt-60 source.

The air dried seeds of *Psoralea corylifolia* were exposed to different doses of gamma rays *i.e.* 5-80KR from cobalt source-60 source. Five-hundred seeds of each treatment were sown in the field on the same day in the evening and watered immediately. Control seeds were handled in the same way as the treated ones. Chromosomal abnormalities in mitosis were

scored at least from 500 cells from many root tips of different plants selected at random for each treatment. The karyotype study was based on metaphase plate. The karyological nomenclature as suggested by Levan *et al.* (1964) was followed. The location of centromere was expressed as the difference between the long arm 'l' and short arm's' (d=l-s) or as the ratio r-l/s. The ratio between the arms is calculated as the centromere index. I=100xs/c where I is length of short arm and c is the total length of chromosomes. The total form percentage (TF %) represents the ratio in percentage of the total sum of short arm lengths to the total sum of chromosome lengths (Haga, 1937).

While making the karyotype analysis, the position of the centromere was determined by finding the arm ratio(r). Centromere index (i) and d-value using the formula suggested by Levan *et al.* (1964).

$$R = \frac{l}{S} \qquad D = \frac{100(r-l)}{(r+l)} \qquad l = \frac{(100 \times s)}{C}$$

where,

l is the long arm length

S is the short arm length

C is the total length.

For convenience, in comparing the size of different chromosomes, the relative length was used which represents the ratio of the percentage of the length of the individual chromosome to that of the longest chromosomes.

$$\text{Relative length of chromosome} = \frac{\text{Length of particular chromosome}}{\text{Length of longest chromosome}} \times 100$$

The total form percentage TF was calculated following Haga (1937).

$$TF\ \% = \frac{\text{Total sum of short arm length}}{\text{Total sum of chromosome length}} \times 100$$

RESEARCH FINDINGS AND ANALYSIS

The experimental findings of the present study have been presented in the following sub heads:

Cytological changes :

Bakale and Sharma (1982) observed the karyotype of *Psoralea corylifolia*. The chromosomes were very small in length, satellite chromosomes were observed, 2n=22 chromosomes were recorded. Some cytological changes had been observed after exposure to gamma rays at different dosages.

Mitotic index :

Mitosis was normal. The somatic chromosome number was found to be 2n=22 as given in Fig. 1. In control, the mitotic index was 11.50 but it increased after being exposed to gamma rays. The mitotic index increased up to 20KR while later on it decreased at the higher exposures. The maximum stimulation was observed at 20KR *i.e.* 13.07 whereas the maximum reduction was at 80KR *i.e.* 10.18 as shown in Table 1. The same results were observed in *Dolichos biflorous* (Pocchi, 1983); *Lepidum sativum* (Kadu, 1981).

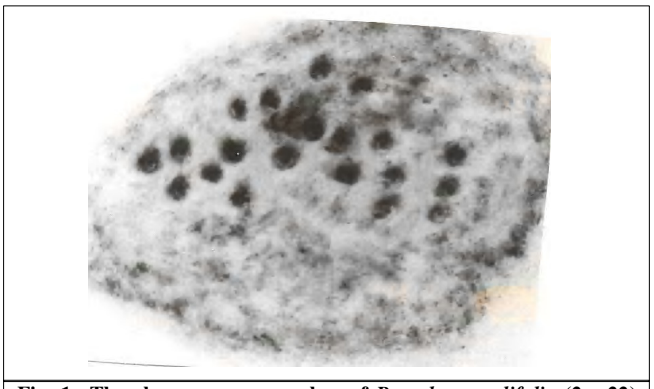

Fig. 1 : The chromosomes number of *Psoralea corylifolia* (2n=22)

Table 1 : Per cent of cells showing mitotic division in root tips of seedling obtained from irradiated seeds

Dose	Total number of cells observed	Total number of cells dividing	Frequency of cells showing division
Control	5571	641	11.50
5KR	5479	644	11.75
10KR	4535	581	12.81
20KR	4985	652	13.07
40KR	4541	520	11.45
60KR	4791	521	10.87
80KR	4481	507	10.18

Mitotic abnormalities :

The mitotic abnormalities were scored in metaphase and anaphase. In control, the abnormalities were not recorded whereas after treatment with gamma rays, the abnormalities like laggards, bridges, clumping of chromosomes, precocious movement of chromosomes, grouping and persistent nucleolus at metaphase were noticed. The frequency of chromosomal anomalies increased with increase in gamma exposure doses. Same observations were reported by Heiner (1971). It varied from 1.90 to 7.31 at metaphase and from 3.39 to 13.39 at anaphase. The total frequency of abnormalities was highest (20.7) at 80KR while lowest (5.29) at 5KR treatment as shown in Table 2. Similar observations were recorded by Amar and Mikhael (1972) in *Vicia faba.*

In present study, the chromosomes have been classified into five groups. Out of eleven pairs of chromosomes, six

Table 2: Effect of gamma rays on the frequency of abnormal cells in mitosis

Dose	Metaphase			Anaphase			% total abnormality
	Total no. of cells scored	No. of abnormal cells	% abnormality	Total no. of cells scored	No. of abnormal cells	% abnormality	
Control	685	3	0.43	730	6	0.82	1.25
5KR	473	9	1.90	619	21	3.39	5.29
10 KR	521	13	2.49	582	33	5.67	8.16
20 KR	631	35	5.54	541	42	7.76	13.30
40 KR	479	30	6.26	608	63	10.36	16.62
60 KR	520	36	6.92	411	47	11.43	18.35
80 KR	465	34	7.31	463	62	13.39	20.70

pairs have median centromere and remaining five show submedian centromere. Also it has been observed that short arm of the longest chromosomes pair of group A is provided with terminal satellite. Same was reported by Chennaveeriah and Patil (1973) in some species of *Crotalaria* like *C. shevaroyensis, C. leschenaultia*.The karyotype of *Psoralea corylifolia* is asymmetrical since chromosomes have median and sub-median centromere. According to Stebbins (1950), a symmetrical karyotype is to be considered as an unspecialised and asymmetrical one is considered as specialised type.

Stanislav *et al.* (2005) showed that doses above 25Gy give apparent linear increase in cytogenetic damage with increasing radiation dose. Similar studies were performed by Soheir *et al.* (1969) where various chromosomal aberrations were observed like anaphase/telophase bridges, fragmentation, lagging chromosomes.

In present investigation, the method of Levan *et al.* (1964) was used for determining the centromeric position. The length of chromosomes varied from 0.961 to 2.567 microns. In *Psoralea corylifolia*, various types of chromosomal aberrations were recorded which were may be due to change in the synthesis of nuclear acids inducing physiological and structural changes in the cytoplasm during cell division. Pocchi (1983) stated the same findings. Azad (2011) reported different kinds of meiotic chromosomal abnormalities with different frequencies in M1 generation of mungbean in different mutagenic treatments.

Conclusion :

Induced mutations have been used as a tool to improve major crops such as wheat, barley; rice etc.The present study is an attempt to study the effects of gamma rays on *Psoralea corylifolia.* The frequency of dividing cells showed an increase at lower exposures while decreased at higher exposures in M1 generation Also the chromosomal abnormalities were recorded in mitosis after exposures to physical mutagen like laggards, bridges etc. These cytological changes were common and observed in all the treatment of mutagens. The frequencies of abnormalities were found to be increased with increase in gamma exposure doses.

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