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Research Article

# MITOTIC ABNORMALITIES INDUCED BY GLYPHOSATE IN *PSORALEA CORYLIFOLIA* L.

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**ABSTRACT**

The seeds of *Psoralea corylifolia* were treated with different concentrations (100, 200, 400, 600, 800,1000,1200 and 1400 ppm) of the herbicide glyphosate [ N- (Phosphonomethyl ) glycine ]. This herbicide induced various chromosomal aberrations such as clumping , grouping, bridges, precocious movement, stray chromosomes and fragments. The percentage of aberrations increased gradually as concentrations of herbicide increases. The mitotic index reduced to more than half as compared to control. Thus the dividing cells also decreased with increase in concentrations of herbicide glyphosate.

**Keywords**: *Psoralea corylifolia*, Glyphosate, Mitotic abnormalities.

## INTRODUCTION

*Psoralea corylifolia* L. is belonging to family Papilionaceae is an erect annual herb and grow to maximum height of1.5 m. The stem and branches are covered with conspicuous glands and white hairs. Leaves are round, dotted with black glands on both surface. Flower appears form the axil of leaves in bunches. It is commonly known as 'Bawachi'. This species is native to India and Arab (Brenchley, 1920). This plant has harmful effects on growing crops, interference in land uses, and rank among the most important enemies to agricultural production (Crafts and Robbins, 1973). Weeds reduce crop yields on account of their competition with crops for water, soil nutrients and light. Certain weeds may further reduce crop growth and subsequently field by releasing inhibitors or poisonous substances into the soil. They increase the cost of labour and equipment, render harvesting difficult, reduce the quality and marketability of agricultural commodities, harbor insects, fungal, viral and bacterial micro-organisms and some are poisonous to human being and cattle. These losses are far greater than usually realized.

The somatic chromosome number of the species is 2n=22. The karyotype is asymmetrical. In India it is distributed in M.P., U.P., Rajasthan, Bihar, Gujrat, A.P. and Maharashtra and found as weed in agricultural fields.

Weed is considered as harmful interference in land uses, rank among the most important enemies to agricultural production. Weed reduces crop yield on account of their competition with crops for water, nutrient and light. Certain weeds may further reduce crop growth and subsequently field crop by releasing inhibitors or poisonous substances into the soil. They increases the cost of labour and equipment, render harvesting difficult, reduces the quality and marketability of agriculture commodities, harbor insects, fungal, viral and bacterial microorganisms and some are poisonous to human being and cattle.

The crop fields were usually treated with some kind of herbicides. The herbicides have different mode of action at the same site or other parts of the crop plant Retzinger and Mallory-Smith(1997). The herbicides might interrupt the photosynthesis by competing with Quinone B(QB) binding region of D1 protein in photpsynthesis II(PSII) complex Feurst and Norman(1991); Ahrens(1994); Dhawan(1995), production of proteins, isoprenoids, flavonoids, lipids or fatty acids Gronwald(1991). The interruptions in fatty acid assembly result in inhibition of cell division Heap (2002). With this view in mind, the present investigation was undertaken to study the effect of glycine on cytology of weed.

## MATERIALS AND METHODS

The experiment was conducted in laboratory at Department of Botany, Institute of Science, Nagpur. Mechanically injured seeds of *Psoralea corylifolia* were treated with 50 ml of each of the concentrations (100, 200, 400, 600, 800, 1000, 1200 and 1400 ppm) of glyphosate which is freely dissolved in distilled water for 24 hours. After treatment seeds were washed thoroughly and allowed to germinate in petridishes lined with moistened double layered filter paper under laboratory condition . Seeds soaked in distilled water were also kept for germination under similar condition for control study. Glyphosate (N-phosphomethyl glycine-isopropylamine salt) belongs to aliphatic group. The herbicidal activity was first discovered in 1971 by Monsanto with trade name is 'Round up'. It is available in solid as well as liquid form. It is used as post-emergence and is rapidly absorbed by leaves and translocated from vegetative parts to underground roots, rhizomes or stolons of perennial grasses and broad leaved weed species giving good control of both above ground and underground organs.

The treated and control (untreated) seedling root tips of various ages were fixed for 24 hours in freshly prepared Carnoy's solution (3:1, ethanol: glacial acetic acid). They were washed thoroughly and subsequently stored in 70% alcohol in refrigerator. Root tips were hydrolyzed for 2 to 3 minutes in 1N HCL at 60°c. Slides were prepared by squash method using iron alum as a mordant and haematoxylin stain. Slides were made permanent using acetic acid-butanol grades and mounted in euparol.

The dividing cells in the metaphase and anaphase were scored for the chromosomal aberrations prior to the lethal doses. Mitotic index was calculated using the formula:

$$\text{Mitotic index} = \frac{\text{Total number of dividing cells observed}}{\text{Total number of cells}} \times 100$$

## RESULTS AND DISCUSSION

The root tip cells of *Psoralea corylifolia* in control were normal (Table 1). The glyphosate induced various chromosomal aberrations such as clumping (Fig. 1), grouping (Fig.2), bridges (Fig.3), precocious movement and stray chromosomes (Fig.4) and fragments (Fig.5). The percentage of abnormalities at 100, 200, 400, 600, 800, 1000, 1200 and 1400 ppm was 3.92, 4.55, 5.30, 6.00, 7.25, 8.10, 8.32 and 9.38, respectively (Table 1) . At 1400 ppm and 1600 ppm, there was no further chromosomal aberrations observed.

The herbicide induced mitotic abnormalities to greater extent; it was least effecctive to decrease the number of dividing cells. The frequency of aberrations found to be increased with the decrease in mitotic index. Glyphosate inhibited cell division. It might be due to mitodepressive and toxicity of herbicide on cell and cell cycle. Jain *et al*. (2002) reported the inhibition of cell division in groundnut due to the application of glyphosate, Tulankar (1998) in *Amaranthus lividus* reported increase in percentage of abnormalities with an increase in glyphosate concentration.

The grouping of chromosomes was observed in the present study. Many researchers Arnold and Nalewaja(1971); Bamberger(1971); Ostegren(1944) explained various causes of grouping of chromosomes in many dicotyledonous weeds treated with auxin herbicides.In the present study grouping occurs due to the metaphase chromosomes became thick and swollen and finally stick together forming a group. Similar findings were also observed by Nygren (1949) and Crocker (1953) in *Allium cepa*, Srinivasu (1986) in *Parthenium hysterophorus*. The precocious movement of chromosome which occurred in the present study was also noticed earlier by Dharurkar and Dnyansagar (1974) in *Eichhornia crassipes*. It might be occurred due to sudden contraction of some of the spindle fibres using to toxic effect of glyphosate.

The percentage of aberrations increased gradually as concentrations of herbicide increases. The total number of abnormal cells also decreased with increasing concentrations. In 1400 ppm, mitotic index reduced to more than half as compared to control i.e. from 5.11 to 1.89. Thus the mitotic index was 4.10, 3.95, 3.80, 3.00, 3.02, 2.85, 2.12 and 1.89 at 100, 200, 400,. 600, 800, 1000, 1200 and 1400 ppm, respectively (Table 1). The number of dividing cells also decreased with increase in concentrations of herbicide.

The observations are that treatments of a cell with toxic substances at sub lethal doses affects its enzyme system (Dustin, 1947). The pesticide may destroy, inhibit or enhance the synthesis of certain enzymes (Wuu and Grant, 1967 ). This led to the conclusion that the disturbance in the enzyme system might be resulting in disturbance of the homostasis of the cell by genetic variability induced by stickiness which result in chromosomal aberrations and decrease in the rate of cell division. Thus, the herbicides bring about physiological and structural effects which ultimately lead to cessation of growth. As noted by Linck (1976) various structural disturbances in cell organelles translated into physiological and metabolic events leading to the slowing down of the growth of the plant and finally to its death. The various chromosomal abnormalities in the mitotic cells of *Triticum aestivum* L. observed by Kumar (2010).

**Table 1: Mitotic index and frequency of various aberrations in root tip cells of *psoralea corylifolia* in different concentrations of herbicide glyphosate.**

| Herbicide | Concentra -tions (ppm) | Total number of cells observed | Total number of dividing cells | Mitotic index | Aberr -ation (%) | Percentage of aberrations | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Clumping | Bridges | Precocious movement | Stray chromosomes | Grouping | Fragments |
| | Control | 6320 | 328 | 5.11 | - | - | - | - | - | - | - |
| Glyphosate | 100 | 4270 | 177 | 4.10 | 3.92 | 1.12 | 0.55 | 1.13 | - | 0.55 | 1.56 |
| | 200 | 4250 | 175 | 3.95 | 4.55 | 1.14 | 0.57 | 1.70 | - | 0.57 | - |
| | 400 | 6735 | 260 | 3.80 | 5.30 | 1.50 | 1.10 | 1.15 | - | 0.38 | 1.15 |
| | 600 | 4428 | 134 | 3.00 | 6.00 | - | 1.75 | 2.20 | 2.25 | - | 1.70 |
| | 800 | 5969 | 289 | 3.02 | 7.25 | 2.70 | 1.70 | 1.38 | - | 0.68 | 0.68 |
| | 1000 | 7213 | 193 | 2.85 | 8.10 | 1.93 | 1.72 | 2.28 | - | 1.70 | 1.40 |
| | 1200 | 6220 | 132 | 2.12 | 8.32 | 1.51 | 3.03 | 3.03 | - | - | 0.75 |
| | 1400 | 9360 | 181 | 1.89 | 9.38 | 2.75 | 1.20 | 2.70 | - | 1.10 | 1.60 |

**Mitotic abnormalities induced by round up in *psoralea corylifolia* l.**

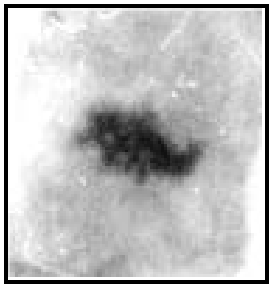

**Fig. 1: Clumping of chromosomes at 100 ppm.**

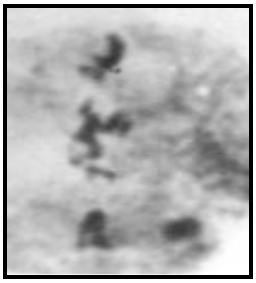

**Fig. 2: Grouping of chromosomes at 200 ppm.**

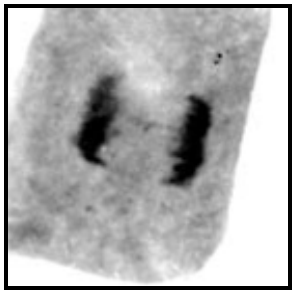

**Fig. 3: Bridge at 600 ppm.**

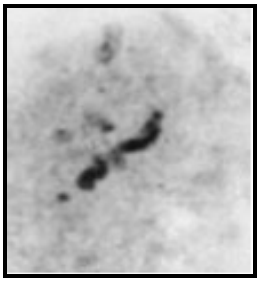

**Fig. 4: Precocious movement and stray chromosomes at 400 ppm.**

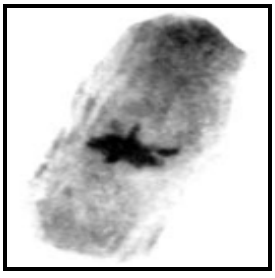

**Fig. 5: Fragments at 800 ppm**

**CONCLUSION**

Effect of glyphosate was found to affect the mitotic index suggesting the decreased activity of the meristems. Mitosis showed irregularities such as clumping, grouping, precocious movement of chromosomes, fragments, bridges, stray chromosome and rarely multinucleolus nucleus. The present aberrations increased with increasing concentration of glyphosate. At higher doses, the number of dividing cells decreased to its minimum.

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