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ALTERATIONS INTHE SYNTHESIS OFMACROMOLECULESINDUCED BY PARAQUAT IN *PSORALEA CORYLIFOLIA* L.

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Abstract
One of the most common problems encountered by farmers throughoutthe world is of control of unwanted, pernicious and harmful plants which interfere with agricultural operations, increase labour, add to the cost of cultivation and reduce yield of crops.Such plants are known as weeds.The present investigation deals with Alterations in the Synthesis of Macromolecules i.e. DNA, RNA and protein content Induced by Paraquat in weed *Psoralea corylifolia* L. belonging to family Fabaceae. It is commonly known as 'Bawachi' growing in a wild and cultivated field in Vidarbha region of Maharashtra State, India. The seeds were collected from different places of Nagpur. The seeds was treated with different concentrations (100, 200, 400 and 600 ppm) of paraquat and grown to get seedlings. Six days old seedlings were taken for extraction and estimation of nucleic acids and total proteins. As the concentrations of paraquat increased the percentage of DNA, RNA and protein content gradually decreased. The percentage of DNA in treated seedling decreased from 5.72×10^{-3} to 5.06×10^{-3} at 100 to 600 ppm respectively. The percentage of RNA decreased from 3.48×10^{-2} to 1.06×10^{-2} at 100 to 600 ppm, respectively. The percentage of protein gradually decreased after herbicidal treatment from 3.40 to 1.50 at 100 to 600 ppm, respectively. The percentage of DNA, RNA and protein content of control seedlings were 7.20×10^{-3}, 9.80×10^{-2} and 6.35 percent respectively. It may be conclude that paraquat reduced DNA, RNA and protein content at all concentrations.
Key words:*Psoralea corylifolia,* seedlings, paraquat, DNA, RNA, protein.

Introduction

The weed control problem is the most serious concern in the countries. But, unfortunately it did not receive much attention it deserves. Recently, however, some efforts are being made to solve this problem. The use of certain growth regulating substances as herbicides has recently attracted much attention and has led to important practical applications.Although, a number of herbicides are produced, choice of herbicide is very important because herbicides differ widely in their selectivity of crops and weeds. Rarely two herbicides will control exactly the same kind of weed species. Hence, foremost criterion of a good herbicide should be its capability to kill the target plants for a desired period with acceptable selectivity to the non-target plants and other organisms. Other criteria for a good herbicide are that a)it should be low in cost and economic to use, b)safe for other plants, c)safe to human beings and animals, and d)availability in market etc.

For the satisfactory solution of the problem of weed control as well as to study the mode of action of herbicides, it is necessary to study the effect of herbicides at cellular and molecular levels which would enable us to build more new specific molecules of the herbicides. This will be helpful in determining the proper dosage of herbicides to be used for eradication of obnoxious weeds without deleterious effect on the crops. With this view in mind, the presentinvestigation was undertaken to study the effect of Paraquat on macromolecular content of treated and untreated seedlings of weed *Psoralea corylifolia* Linn.*Psoralea corylifolia*(Vern. Bawachi) belonging to family Fabaceae which is the noisome weed in fields fallows and waste land in Vidarbha and Marathwada regions of Maharashtra State.

Particulars about Paraquat

Paraquat (1, 1-dimethyl l-4, 4-biphyridiliumdichloride) is introduced by the Agricultural Chemical Division of ICI, England. This is a heterocyclic organic compound under biphyridylium or diphyridilium quaternary ammonium. Paraquat is a general contact herbicide. It is bound so tenaciously by soil components by means of base exchange that Ashton and Craft (1973) considered it to be essentially biologically inactive in moist soils. Therefore, it may be used selectively in treatment provided direct contact with the crop is avoided i.e. pre-plant, pre-emergence or as post-emergence. Paraquat is a fast-acting, herbicide that is absorbed by the foliage. It destroys plant tissue by disrupting photosynthesis and rupturing cell membranes, which allows water to escape leading to rapiddesiccation of foliage (Dinis-Olivera et al 2006).

Material and Methods

The experiment was conducted in labortary at department of Botany, Institute of Science, Nagpur. The seeds of *Psoralea corylifolia* were treated with different concentrations (100, 200, 400 and 600 ppm) of Paraquat which is dissolved freely in distilled water for 24 hrs.After treatment, seeds were washed thoroughly with distilled water and kept for germinationin petridishes, lined with double layers of moistened filter paper under laboratory condition. Seeds soaked in distilled water for 24 hours were used as control. The treated and untreated seeds were allowed to grow for six days.Each sample containing one gram fresh weight of six days old seedlings were taken for extraction and estimation of nucleic acids and total proteins. The number of seedlings per gram were counted and noted every time. For extraction of nucleic acids, the method suggested by Ogur and Rosen (1950) and Schneider (1945) were adopted. Protein was extractedby the Kjeldahl's method as suggested by Jackson (1967). The four replicates were used for each sample at each concentration of herbicide.

The DNA content of sample was calculated from standard graph of calf-thymus DNA.

The DNA per seedling in sample was calculated by using formula

$$\text{DNA per seedling} = \frac{\text{Total DNA}}{\text{Total number of seedlings per sample}} \times 100$$

The RNA content in sample was calculated by using standard graph of yeast RNA (Fig.109). The RNA per seedling in a sample was calculated by the formula

$$\text{RNA per seedling} = \frac{\text{Total RNA}}{\text{Total number of seedlings per sample}} \times 100$$

The percentage of nitrogen in the seedling was calculated by using formula

$$N2\% = \left[\begin{matrix}\text{Normality of} \\ \text{XXX} \\ \text{Standard acid}\end{matrix}\quad \begin{matrix}\text{Volume of} \\ \\ \text{Acid}\end{matrix}\right) - \left[\begin{matrix}\text{Normality of} \\ \\ \text{alkali}\end{matrix}\quad \begin{matrix}\text{Volume of14} \\ \\ \text{Alkali1000wt.sample}\end{matrix}\right) \times 100 \quad \frac{\quad}{\quad}$$

(500mg)

From the obtained nitrogen percentage, the total protein of sample was calculated as followed
Total protein = Nitrogen percentage x 6.25.
Similarly the percentage of protein per seedling was calculated as follows

$$\text{Protein per seedling} = \frac{\text{Total protein}}{\text{Total number of seedlings per sample}} \times 100$$

Result and Discussion

The gradual decrease in percentage of DNA per seedling was observed after treatment of paraquat. The DNA percentage at 100, 200, 400and 600 ppm was $5.72x10^{-3}$, $5.34x10^{-3}$, $5.26x10^{-3}$and $5.06x10^{-3}$, respectively **(Table 1)** as against $7.20x10^{-3}$ in control. The decrease in percentage of DNA wasminimum in each concentration.The percentage of RNA per seedling at control was $9.80x10^{-2}$whereasthe percentage at 100, 200,400 and 600 ppm was $3.48x10^{-2}$, $1.97x10^{-2}$, $1.30x10^{-2}$and $1.06x10^{-2}$ respectively. The RNA percentage decreased suddenly at 100 and200 ppm from the control. Thus the percentage of RNA at control, 100 and 200 ppmwas $9.80x10^{-2}$, $3.48x10^{-2}$ and $1.97x10^{-2}$, respectively. After this it decreasedgradually at respective concentrations of paraquat**(Table 1)**.

This paraquat affected the nucleic acids and protein contents of the seedling. The DNA percentage of the seedling decreased with increase in concentrations of paraquat. Similarly the percentage of RNA in the seedlings retarded with proportionate increase in gramoxone concentrations. Further it also affected the protein content. Therefore, it may be concluded that this herbicidereduced DNA, RNA and protein content at all concentrations. Similar results were obtained by Schneider and Gunther (1974) and found that root applied paraquat inhibits the growth of pea seedlings and severely reduces the level of r-RNA, probably reflecting damage to the ribosomes, the DNA-RNA fraction was little changed. Similarly, Bell *et al.* (1976) studied the DNA synthesis by following gramoxone treatment in root tips of *Vicia faba* and they stated that this herbicide inhibited DNA synthesis, resulting decrease in

the cell division. In the present study, the reduction in nucleic acids content may be due to the mode of action of paraquat (gramoxone). It involves the formation of free radical (OH^-) by reduction of the ion and subsequent autoxidation to yield the original ion. The OH - radical or H_2O_2 which is formed during the autoxidation process appears to be the primary toxic agent which affects the nucleic acid content. Kolhe (1979) noticed decrease in DNA, RNA and protein contents in *Tephrosia hamiltonii*, *Solanum surattens*e and *Celosia argentea* with increase in gramoxone concentrations. Fedtke (1982) observed inhibition of RNA and protein synthesis by gramoxone in corn root. Srinivasu (1986) in *Partheniumhysterophorus* observed the gradual decrease in macromolecular contents of seedlings by gramoxone treatment. Bobde (1993) in *Crotalaria juncea* observed progressive decrease in nucleic acids and protein content after gramoxone treatment. Jain (1993) in *Chenopodium album* noticed some reduction of RNA, DNA and protein content and Tulankar (1998) in *Amaranthus lividus*, Dudhe (2002) in *Hyptis suaveolens* and Taduwadi (2004) in *Cleome viscosa* reported progressive reduction in DNA, RNA and protein content as the concentrations of paraquat increased.

The protein percentage of seedling was gradually decreased. Thus at 100, 200, 400 and 600 ppm it was 3.40, 2.52, 2.06 and 1.50, respectively. In control it was 6.35 **(Table 1)**. Paraquat showed strong effect on protein percentage of seedlings. The percentage of protein at control and 100 ppm was 6.35 and 3.40, respectively i.e. it reduced to half from control and onwards 100 ppm, the gradual reduction was observed as the concentration of paraquat increased.

In the present investigation, decrease in protein content of seedlingswas also observed as the concentration of herbicideincreased. This might bedue to the paraquat inhibits the activity of chloroplast and mitochondrial ribosomes, and it have a direct effect on transcription and ultimately protein synthesis was inhibited. Sharma and Vanden Born (1970) in wheat concluded that paraquat has a role in altering both RNA and protein synthesis and some processes in the degradative metabolism of these constituents.

Table 1: Showing effect of paraquat on DNA, RNA and protein content of seedling of *Psoralea corylifolia* L.

Herbicide	Concentration in ppm	Percentage of DNA seedling^{-1}	S.E. (±)	Percentage of RNA seedling^{-1}	S.E. (±)	Percentage of protein seedling^{-1}	S.E. (±)
	Control	7.20×10^{-3}	0.01	9.80×10^{-2}	0.02	6.35	0.04
Paraquat	100	5.72×10^{-3}	0.02	3.48×10^{-2}	0.02	3.40	0.03
	200	5.34×10^{-3}	0.03	1.97×10^{-2}	0.03	2.52	0.02
	400	5.24×10^{-3}	0.02	1.30×10^{-2}	0.02	2.06	0.03
	600	5.06×10^{-3}	0.01	1.06×10^{-2}	0.01	1.50	0.02

Conclusion

The herbicide paraquat affected the nucleic acid and protein contents of the seedlings. The DNA percentage of the seedlings decreased with increase in concentrations of paraquat. Similarly the percentage of RNA in the seedlings related with proportionate increase in paraquat concentrations. Further it also affected the protein content.

Paraquat probably blockedthe DNA synthesis resulting in the decrease of RNA as well as protein content of the seedlings. Similarly, due to decrease in the synthesis of nucleic acids, the rate of cell division was reduced. Therefore, it may be conclude that this herbicide reduced DNA, RNA and protein content at all concentrations.

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