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Macromolecular Drifts associated with the effect of Herbicides on the Rooting of Stem Cuttings and Rooting Potential of *Lantana camara* L. var. *aculeata*

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ABSTRACT

Rooting of stem cuttings and rooting potential of *Lantana camara* L. was studied alongwith the changes in protein and RNA content occuring during the rooting process in response to certain herbicides. Paraquat, butachlor, $CuSO_4$ and 2,4,5-T completely checked the rooting of the stem cuttings. Atrazine, TCA and 2,4-D retarded the rooting response. Low as well as high doses of paraquat and butachlor and only higher dose of atrazine were completely inhibitory. $CuSO_4$ could not check the rooting potential of the plant compared to the complete inhibition of the rooting of the stem cuttings. Paraquat, atrazine, butachlor and $CuSO_4$ altered protein and RNA contents significantly during different stages of rhizogenesis of the stem cuttings. The significance of study is discussed in the light of controlling the vegetative reproduction of *L.camara* which is a noxious weed on abandoned and arable lands.

Key words : *Lantana camara*, stem cuttings, rooting behaviour, rooting potential, herbicides, total protein and RNA.

INTRODUCTION

Lantana camara, an explosive shrub, native of tropics and subtropics of the western hemisphere, has ultimately got established as a noxious weed almost throughout the world. It has been rated as one of the ten most noxious weeds of the world.

Most of the methods including the use of biological methods tried were found to be ineffective in controlling and eradicating the weed. The main reason for it being the ease with which the plant propagates. The regenerative property is so great that any accidental fall of its twig on the ground results in a new plant.

It is increasingly felt that the effective way to deal with the problem lies in checking the vegetative propagation of the shrub. The paper deals with testing and identifying the chemicals that could prove useful in checking the vegetative reproductive potential of the plant and/or in checking the rooting of the stem cuttings.

MATERIAL AND METHODS

ROOTING BEHAVIOR

Eighty uniform stem cuttings grouped into eight with 10 cuttings in each were made from subapical branches of healthy plants of *L.camara*. Stem cuttings (35.0±2.0 cm long, 2.5 ± 0.5 cm in circumference) after washing with water dipped upto two-third of their lower cut end in 200 ml of each of the requisite concentration of the herbicides tried, for 24 hrs.

After treatment, the cuttings were planted with positive polarity in earthenware pots (8" dia.) filled with 3:1

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V/V sand and clay, keeping about 10 cm length of the cuttings under the soil of the pot. The pots were maintained at 28 ± 4°C and adequately watered daily. Final observations on the total number of rooted cuttings and number of roots per rooted cutting as well as number of leaves per sprouted cutting were made after 45 days of plantation of the cuttings. Cuttings were uprooted carefully under the pressure of running tap water from the pots ensuring that there was no damage to the roots.

ROOTING POTENTIAL

Adequate number of healthy plants of *L.camara* approximately of the same age, growing near the Botanical garden of Panjab University, were selected. These were sprayed with a mist of different concentrations of the herbicides tried Different set of plants were spray treated thrice on alternate days with 30 ml. plant^{-1} of each of the solution. Distilled water served as control. 24 h after the final spray, stem cuttings were made from treated and untreated (water treated) plants and planted as described in the above context. Eight cuttings per pot were maintained.

Observations for the initation of root primordia were taken weekly for three weeks and daily thereafter. Final observations of the rooting on the stem cuttings were made on the 45th day of the plantation.

A third set of experiments essentially similar to one (as described for rooting potential) was maintained for biochemic estimations. Cuttings from the plants pretreated with paraquat, atrazine, butachlor and $CuSO_4$ were planted with positive polarity in earthen pots (6"dia). Eight cuttings per pot from the plants treated with distilleld water were also maintained as control. For the study of biochemic changes, sampling was done at the following four stages. I. Initial or Plantation stage (24h after last treatment), II. Pre-root initiation stage, III. Root initiation stage IV. Post-root initiation stage.

For the estimation of total soluble proteins and RNA, treated and control cuttings were deplanted at various stage of rhizogensis, washed and portion of cuttings bearing root initiation zones were crushed in acetone. Total proteins and RNA content were measured by the methods given by Lowry *et al* (1951) and Mezbaum (1939), respectively.

RESULTS AND DISCUSSION

ROOTING BEHAVIOUR

Cuttings treated with paraquat, butachlor, $CuSO_4$ and 2,4,5-T did not show root primordial initiation, while in those treated with TCA and 2,4-D, the number of cuttings that rooted were nearly half of that of control. The results clearly show that as low as to 10 mg. L^{-1} concentration of paraquat, butachlor, 2,4,5-T and 5% $CuSO_4$ completely inhibit the rooting of the stem cuttings (Table 1). Among the TCA and 2, 4 D treated cuttings that rooted the number of roots per rooted cutting was less compared to that of control. Atrazine did not seem to show any effect in this regard (Table 1). These herbicides tried also checked the

Table 1 : Rooting behaviour of stem cuttings in response to different herbicides

Treatment (conc. mg. L^{-1})	Cuttings rooted (Relative number)	Roots per rooted cutting (Mean)	Leaves per sprouted cutting (Mean)
Control	1.0	5 ± 1.05	18.33
Paraquat (10)	0.0	0	0
Atrazine (10)	0.85	6.83 ± 3.87	14
Butachlor (10)	0.0	0	0
$CuSO_4$ ($1x10^4$)	0.0	0	0
TCA (10)	0.57	3.25 ± 1.20	10
2,4-D (10)	0.43	2.25 ± 1.0	0
2,4,5-T (10)	0.0	0	0

sprouting of buds. 2,4-D that retarded the rooting response totally checked the sprouting of buds. TCA and atrazine reduced sprouting.

ROOTING POTENTIAL

It is interesting to observe that these herbicides not only directly act in inhibiting the rooting of the stem cutting, but most of them tried, made the plant loose its ability to regenerate vegetatively. Results on the rooting of the stem cuttings obtained from pretreated plants reveal that as low as 5 mg. L^{-1} concentra-tion of paraquat and butachlor and 10 mg. L^{-1} that of atrazine when sprayed aerially on plants prevent the plant to retain its potentiality to produce adventitious roots and regenerate since none of the cuttings from such plants rooted. $CuSO_4$ (5 and 10%) and 2,4,5-T (5 and 10 mg. L^{-1}) retarded the rooting potential of plants as depicted from lesser relative number of rooted stem cuttings and mean number of roots and leaves per rooted/sprouted cuttings, respectively. TCA and 2,4-D on the other hand when sprayed on plant though did not prevent the plant cuttings to root, just retarded quantitatively the extent of initiation of root primordia. (Table 2) It is, however, apparent that the herbicides taken by the plant through leaves get translocation to the stem. There, these are probably retained in the cortical zone to interfere in the metabolic set-up of the system leading ultimately to inhibition of rooting. It can also be speculated that, these herbicides may also trigger/block the synthesis of some inhibitor-/metabolite that act as an

Table 2 : Rooting potential of stem cuttings in response to sprays with different concentrations of herbicides

Treatment	conc. (mg. L^{-1})	Cuttings rooted (Relative number)	Roots per rooted cutting (Mean)	Leaves per sprouted cutting (Mean)
Control	0	1.0	22.25 ± 7.16	27
Paraquat	5	0	0	0
	10	0	0	0
Atrazine	5	0.87	11.42 ± 5.52	15.2
	10	0	0	0
Butachlor	5	0	0	0
	10	0	0	0
$CuSO_4$	$1x10^4$	0.75	10.6 ± 6.76	9.4
	$2x10^4$	0.62	2.4 ± 1.41	5.4
TCA	5	1.0	21.87 ± 2.69	27.8
	10	1.0	10.25 ± 6.10	14.1
2,4-D	5	1.0	11.75 ± 3.22	14
	10	1.0	9.75 ± 2.92	15
2,4,5-T	5	0.38	13.0 ± 0.11	0
	10	0.38	2.66 ± 1.77	5.5

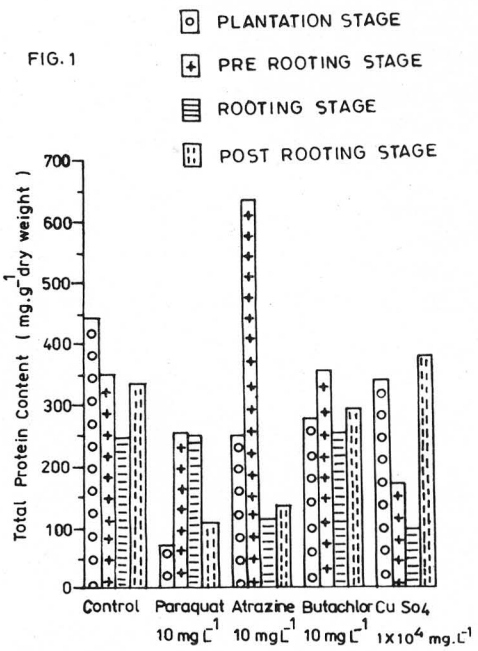
obstacle on the way to the division of cells for the formation of primordia.

The argument that these herbicides get retained in the stem gains support from the previous discussion on the rooting of stem cuttings. Irrespective, whether the cuttings were treated or the cuttings were made from treated plants, paraquat, butachlor and 2,4,5-T check the plant to root or sprout. It is an important observation from the practical point of view. The plant is known to spread very fast, wherever it starts growing, overtakes the whole population, thereby forming its own unending kingdom. It is so as a sequel of its fast regenerative potential and possibly allelopathic (Kushal Bala *et al* 1985) .

It is also observed that wherever the cuttings rooted the number of roots per rooted cutting in response to treatment was very less compared to untreated control. $CuSO_4$ and 2,4,5-T were more effective in this regard while the lower concentration of TCA did not affect rooting/sprouting response.

The content of total soluble proteins in cuttings from untreated control plants was seen to decrease gradually, so that it was maximum at the plantation stage followed by at the pre-rooting and rooting stages. After the root primordial initiation, it again showed an increase (Fig. 1) possibly for meeting the demand of elongating root primordia. The energy demand of the actively dividing cells increased appreciably to meet the demand, intermediary metabolic machinery gets geared-up and it appears that proteins get converted into energy

Total Protein content at different stages of root initiation in *Lantana camara* L. stem cuttings

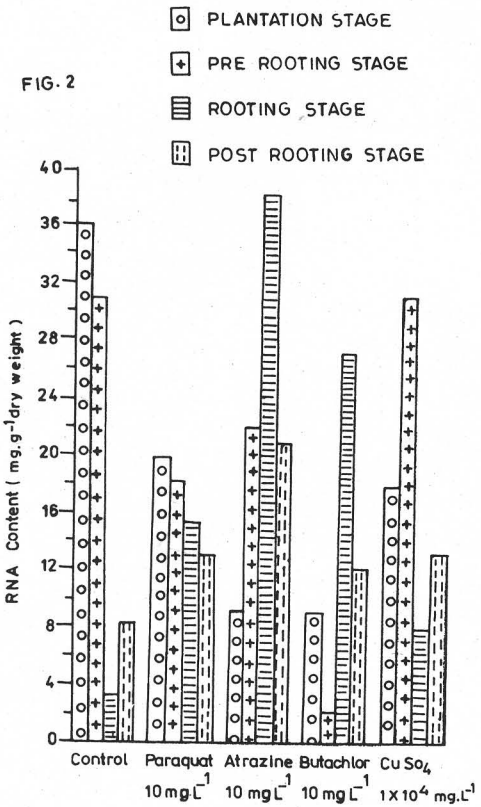


rich sugars (Bimlendra Kumari, 1984).

In the absence of any definite general trend of the drifts in the protein content in response to different herbicides, the mechanism of action of these herbicides tried in inhibiting the rooting response appears to be different. All the treated samples at the plantation stage showed a fall in the content of protein. This decrease 24h after the spray treatment reflects that the metabolic machinery gets predetermined to respond the stimulus of the herbicides.

The content of total RNA in untreated control plant cuttings showed a trend similar to that in the content of proteins as regards advancement in the stages of rooting. The content of RNA at the time of plantation stage (i.e. 24h after the treatment) in all the herbicides tried was seen to be low compared to that in

Total RNA content at different stages of root initiation in *Lantana camara* L. stem cuttings



control (fig. 2). The cuttings from paraquat treated plants like control showed gradual decrease in content of RNA with the advancement of rooting stages. Atrazine and $CuSO_4$ treated plants on the other hand showed increase in content after plantation till rooting stage in the former and pre-rooting stage in the latter. Cuttings from butachlor treated plants after plantation showed a fall in the content of RNA in the pre-rooting stage followed by an increase at the rooting stage and again a fall at the post-rooting stage. (Fig. 2).

The results from drifts in the RNA content reveal that till the rooting stage, no new protein is synthesized. It is supported from the data on the protein contents. However, slight increase in the protein and RNA content at the post-rooting stage suggest the synthesis of new macromolecules which are ultimately consumed for the growth of root primordia. Paraquat, butachlor, atrazine and $CuSO_4$ lower the content of RNA. However, further research in this regard is needed to ascertain the machanism indulging the decrease in RNA content.

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