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Research Article

EFFECT OF SPRAY APPLICATION OF HERBICIDE GRAMOXONE ON MORPHOANATOMICAL CHARACTERS OF WEED *PSORALEA CORYLIFOLIA* L.

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ABSTRACT

Gramoxone sprayed plants of *Psoralea corylifolia* showed drying effect at all concentrations tested (100-600 ppm). Plants sprayed with 100-600 ppm gramoxone were showed whitish to yellowish spots developed on the adaxial surfaces of leaves, which went on enlarging with the passage of time and ultimately the leaves and the plants in the 600 ppm dried completely on the tenth day of spraying. Therefore, 600 ppm was determined as a lethal dose for this weed. At 100-400 ppm leaves showed inrolling of the lamina. The branches showed the development of yellowish patches and flowers were also dried. The fresh and dry weights of shoots and roots decreased with the increase in concentration of herbicide gramoxone.

The anatomical changes occurred due to sudden desiccation in plants after spray application of gramoxone (100-400 ppm concentration). Stem of gramoxone treated plants showed lacunae in cortex and ruptured the epidermal layer. It showed plasmolysis and disorganization of cortical and pith cells. Xylem and phloem cells were distorted. The leaves of treated plants were crumpled at all concentrations. The palisade and spongy cells of mesophyll lost chloroplast and they became colourless. The midrib vascular bundle was crumpled due to rapid plasmolysis of cells.

Keywords: Weed *Psoralea corylifolia*, Gramoxone, Morphology, Anatomy, Leaf, Stem, Root, Foliar spray.

INTRODUCTION

Weed *Psoralea corylifolia* Linn. belonging to family Fabaceae. It is commonly known as "Bawachi". The species is native to India and Arab. One of the most common problems encountered by farmers throughout the 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. Man was always struggling for successfully controlling these weeds to get better yields. With this view in mind, the present investigation was undertaken to study the effect of herbicide gramoxone.

MATERIALS AND METHODS

Seeds of *Psoralea corylifolia* were collected from naturally growing population at different places of Nagpur and same were grown in earthen pots for two months till they attained the height of 8 to 10 inches. (i.e. vegetative growth).

Different concentrations (viz., 100, 200, 400 and 600 ppm) of herbicide gramoxone were prepared. Six pots, each containing 2-4 plants were given a very through foliage spray of each concentration. The herbicide solution contained a small quantity of sodium lauryl sulphate as surfactant. The field and pot culture experiments were started in the month of October and November 2003. Spraying was done in the evening when the wind was slow and the temperature was comparatively lower than rest of the hours of the day to reduce evaporation and to help absorption of herbicide solution by the leaves. To avoid contamination of the surrounding with herbicide concentrations, the pots were kept in high walled card board at the time of spraying or the pots to be sprayed were taken away to a considerable distance. Control pots were sprayed with water.

After 48 hours of spray, pots were watered daily. All pots were kept preferably in shade in order to get the maximum effects on them. Similarly field trial was conducted on naturally growing plants in plots of the size of approximately 4 x 4 square feet.

Fresh and dry weight of shoots and roots of control and treated plants were taken after 8-10 days of spraying to determine the desiccation of plants. The morphological changes were noted daily till the death of the plants.

In order to study the anatomical changes induced by the herbicides, the plant parts mainly root, stem, leaf and petiole of the treated as well as the control plants were fixed in F.A.A. (Formialin-Acetic Acid-Alcohol) solution for 24 hours, washed and stored in 70% alcohol. The materials were embedded in paraffin wax following customary method (Sass, 1951). Sections were cut as 15-20 microns, stained according to the crystal violet-erythrosin schedule and mounted in D.P.X. (Synthetic resins). Microphotographs of various sections of both control and treated plants were taken.

RESULTS AND DISCUSSION

Morphological responses

The control plants of *Psoralea corylifolia* were growing luxuriantly in the field as well as in earthen pots (Fig. 1,3C, 4C). Gramoxone sprayed plants of *Psoralea corylifolia* showed drying effect in 2-3 days at all concentrations. In 600 ppm concentration, the plants dried on the tenth day after spraying. In 100-600 ppm whitish to yellowish spots developed on the adaxial surfaces of leaves (Fig. 5) which went on enlarging with the passage of time and ultimately the leaves and the plants in 600 ppm dried completely on the tenth day. Therefore, 600 ppm was determined as a lethal dose for this weed (Fig. 3 and 4). The leaves in this case did not show crumpling in 100-400 ppm but slight inrolling of the lamina was observed towards the marginal side. The leaves at 600 ppm were highly crumpled and showed the folding of the lamina (Fig. 6). The branches also showed the development of yellowish patches which increase with the laps of time. The flowers were also dried. Field trials showed the similar results (Fig. 2).

Spray treatment of gramoxone to *Psoralea corylifolia* resulted in morphological changes such as wilting or scorching of leaves, crumpling and yellowing of flowers and drying of leaves at higher concentrations. After application of gramoxone the desiccation of plants was observed. This desiccation caused great loss of water from plants and leaves became dry within a few days, leading the plants to death. In their pioneer work Bucha and Todd (1951) stated that "the initial effect generally is leaf tip dieback beginning on the older leaves. This is followed by progressive chlorosis and retardation of growth, ending in the death of the plant". Ashton and Crafts (1973) studied the effect of gramoxone on some plants and noticed that wilting was an early symptom of this desiccation and this was followed by necrosis, ultimately the death of leaves occurred. They also found that gramoxone caused loss of integrity of cell membrane and chloroplast membranes at cellular level. Baur *et al*. (1969) investigated the effect of gramoxone on the ultrastructure of mesophyll cells of fully expanded leaves of honey mesquite with gross morphological symptoms and observed the disruption of membrane integrity resulting in wilting, necrosis and

ultimate death of leaves. In the present study, it was observed that most of the morphological changes occurred in the leaves due to dehydration and loss of turgidity in the epidermal and mesophyll cells of leaves.

For controlling this weed gramoxone was found to be very effective. The lethal dose of gramoxone for *Psoralea corylifolia* was determined as 600 ppm. Green (1963) and Amiling *et al*. (1963) found that gramoxone was efficient in controlling the various weeds growing in coffee and apple plantations respectively. In present study, herbicide caused rapid desiccation of the plants and ultimately death of entire plants occurred.

In present study the fresh and dry weight of shoots and roots decreased with the increase in concentration of herbicide (Table 1). This result indicated the progressive desiccation of plants with the increase in the herbicide concentrations. Sharma and Singh (2006) reported that gramoxone Intean 25L and gramoxone max 35L@840 &1120 g a.i. ha^{1} showed complete control of grasses and broad leaf weeds.

Table 1: Effect of herbicide on fresh and dry weight (g) of shoots and roots of *Psoralea corylifolia*

Herbicides	Concentration in ppm	Shoot		Root	
		Fresh weight (g)	Dry weight (g)	Fresh weight (g)	Dry weight (g)
Gramoxone	100	16.75	06.45	4.25	1.30
	200	11.20	04.50	2.10	1.15
	400	05.15	02.20	1.65	0.70
	600	05.15	02.20	1.65	0.70

✶ Average of four replications

Anatomical changes in *Psoralea corylifolia* as influenced by gramoxone spray

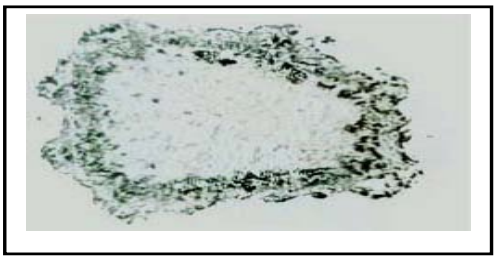

Fig. 1 : T.S. stem, control

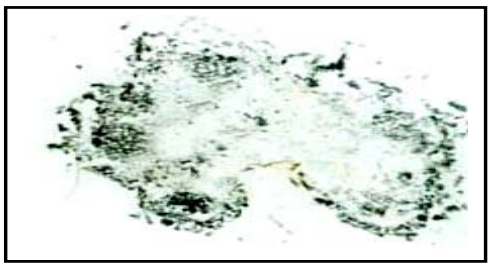

Fig. 2 : T.S.petiole, control.

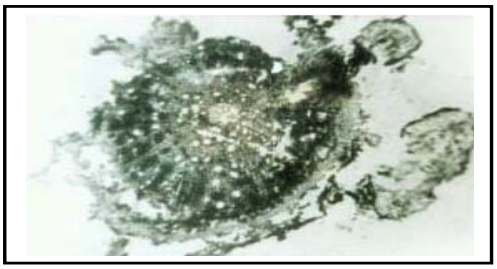

Fig. 3 : T.S. root, control.

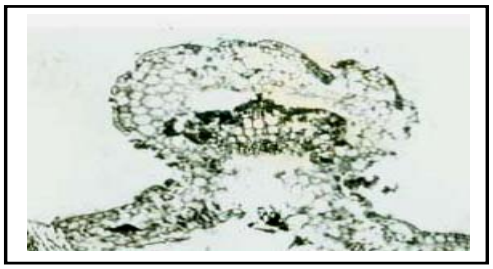

Fig. 4 : T.S. leaf, control.

Fig. 5 : T.S. stem at 200 ppm.

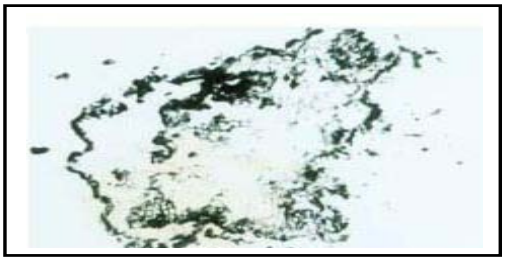

Fig. 6: T.S. petiole at 100 ppm.

Fig. 7 : T.S. root at 200 ppm.

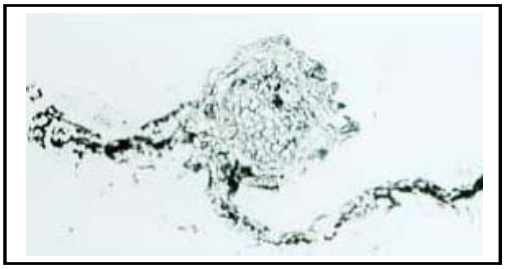

Fig. 8 : T.S. leaf at 400 ppm.

Anatomical responses

The control stem of *Psoralea corylifolia* showed a typical dicotyledonous structure with ridges and furrows bounded by the epidermis. The outer region of cortex, bordering the epidermis includes collenchyma. The pericycle was in the form of intermittent ring of fibers. Vascular bundles are arranged in a ring and encloses a large parenchymatous pith (Fig. 1). Petiole in control showed five large vascular bundles, one below each ridge alternating with 1-2 small vascular bundles below the furrows. Collenchyma in the ridges was prominently seen, and it was a single layered below the furrow followed by two layers of chlorenchymatous ground tissue (Fig. 2). The root showed secondary growth and consisted of an outer epidermis and parenchymatous cortex, followed by a band of secondary phloem. The xylem formed a cylinder in the centre of the root (Fig. 3). The leaf lamina had upper and lower epidermis and mesophyll in between them. The mesophyll comprised upper palisade and lower spongy tissue. The midrib was formed of parenchyma tissue, embedding vascular bundles (Fig. 4).

The anatomical changes occurred due to sudden desiccation in plants after spray application of gramoxone. Stem of gramoxone treated plants showed lacunae in cortex and ruptured the epidermal layer at 100 ppm. At 200 ppm stem showed plasmolysis and disorganization of cortical and pith cells. Epidermis lost its continuity. Xylem and phloem cells were distorted (Fig. 5). Disorganization and shrinking of cells occurred in petiole at 100 ppm, the epidermis lost its continuity, vascular bundles were crushed, parenchymatous ground tissue was plasmolysised and shrinked resulting in deformation. Disintegration of cortex was seen at some places. Due to rapid plasmolysis and destruction of tissues the whole structure of petiole became crumpled (Fig. 6).

This herbicide induced anatomical changes such as destruction of cortical and pith cells in stem and root. Since gramoxone are contact herbicide, it causes plasmolysis, which leads to destruction of tissues like epidermis, cortex pith and cracking of secondary xylem and ultimately the death of plant was observed. In the present study, cortical cells of stem, root and pith cells of roots showed disintegration following gramoxone treatment Esteven *et al.* (1990) studied effect of some herbicide including gramoxone showed hypertrophy of cellular parenchyma formation of undifferentiated cell masses, contraction and consequent of deformation of parenchyma when treated with gramoxone at 8 to 9 leaf stage in *Cassia tora*.

The cells of cortex, xylem cylinder and pith of the root showed desiccated and disorganization at all concentrations of gramoxone. These cells lost its cellular structure and formed lacunae at respective regions (Fig. 7). The leaves of treated plants were crumpled at all concentrations. The palisade and spongy cells of mesophyll lost chloroplast and they became colourless. The vein bundles were disintegrated, the pressure exerted by spongy parenchyma on lower epidermis due to which it ruptured. The midrib vascular bundle was crumpled due to rapid plasmolysis of cells. The shape of the leaf became irregular and section appeared shrinked (Fig. 8)

In the present study the petioles of the plants sprayed with gramoxone showed distortion of epidermal, cortical and pith cells, phloem was observed to be proliferated due to which the vascular bundles splitted in parts. It might be due to hydrogen peroxide (H_2O_2) which appeared to be vitally important in the activity of paraquat. H_2O_2 may increased the permeability of the membranes followed by drastic disruption of the cell organization. Thus, hydrogen peroxide acts as a toxicant causing rapid injury to plants. Zweig *et al*. (1965) reported that paraquat competitively inhibit the reduction of NADP to NADPH by removing electrons from the electron transport system PS II. Tulankar (1998) and Taduwadi (2004) also reported destruction of cortical and pith cells in petiole and Rao (2000) stated that gramoxone affects more rapidly in light than in dark. The site of action of gramoxone is photosystem I (electron diversion). It directly inhibit photosynthesis, thus causing rapid desiccation and finally death of the plant as in present study.

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