

Effect of 2, 4-D on Anatomical Changes in *Sidaacuta* Burm. f.

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Abstract-- The herbicidal activity of 2,4-dichlorophenoxyacetic acid (2,4-D) on *Sidaacuta* Burm. f. was investigated. Plants were treated with aqueous solutions of 2,4-D at concentrations ranging from 100 to 10,000 ppm. The herbicide induced significant anatomical changes in various plant organs. In the stem, proliferation of cambium and phloem tissues resulted in the formation of large masses of meristematic cells. Leaves showed desiccation of cells, proliferation of cambium in the midrib region, and distortion of vascular elements. Similar structural abnormalities were observed in roots and petioles. These anatomical changes disrupted normal physiological processes and ultimately resulted in the death of the weed. The study demonstrates the effectiveness of 2,4-D in controlling *Sidaacuta* through structural and physiological disruption.

Keywords-- Herbicide, 2,4-D, anatomical changes, *Sidaacuta*, weed control

I. INTRODUCTION

Sidaacuta Burm. f., a member of the family Malvaceae, is a widely distributed weed in tropical and subtropical regions. It is a branched shrubby plant that grows up to approximately one foot in height. The leaves are simple and lanceolate, while the flowers are yellow and occur singly or occasionally in pairs.

This plant is a pantropical weed commonly found in agricultural fields where it competes with crop plants for nutrients, water, and light, causing significant yield losses.

Chemical weed control has become an important component of modern agriculture. 2,4-dichlorophenoxyacetic acid (2,4-D) is a systemic phenoxy herbicide widely used for the control of broad-leaved weeds. It acts as a synthetic auxin and disrupts normal growth processes, leading to abnormal tissue development and eventual plant death.

The present study was undertaken to investigate the anatomical changes induced by 2,4-D in different plant organs of *Sidaacuta* in order to understand the mechanism of herbicidal action.

II. MATERIALS AND METHODS

2.1 Plant Material

Seeds of *Sidaacuta* Burm.f. were collected from naturally growing plants in different locations of the Vidarbha region of Maharashtra, India. Plants were raised in earthen pots as well as in field plots. The plants were allowed to grow until the flowering stage.

2.2 Herbicide Treatment

At the flowering stage, plants were sprayed with aqueous solutions of 2,4-D at concentrations ranging from 100 to 5000 ppm. A small quantity of sodium lauryl sulphate was added as a surfactant to enhance herbicide penetration.

Six pots were used for each concentration, each containing 5–8 plants. A separate set of six pots sprayed with water served as the control. Field experiments were also conducted on naturally growing plants arranged in randomized plots.

Spraying was carried out twice within one hour, preferably during the evening, when wind speed was low and temperature was comparatively lower.

2.3 Morphological Observations

Fresh and dry weights of shoots and roots were recorded after treatment. Morphological changes were observed and recorded regularly.

2.4 Anatomical Studies

For anatomical investigations, plant parts including roots, stems, petioles, and leaves were collected from treated and control plants.

Samples were fixed in F.A.A. (Formalin : Acetic acid : Alcohol) solution for 24 hours and later preserved in 70% alcohol.

The materials were embedded in paraffin wax following the method described by Sass (1951). Sections of 6–9 μm thickness were cut using a microtome. The sections were stained using the crystal violet–erythrosine staining method and mounted in D.P.X. Microphotographs were taken for comparison between treated and control tissues.

III. RESULTS

3.1 Stem

Significant abnormalities were observed in the stem after herbicide treatment. Phloem cells of vascular bundles became meristematic and proliferated to form masses of meristematic tissue in the cortex. Cells in the outer region of the pith also showed active division, pushing vascular tissues toward the periphery.

At 800 ppm, excessive phloem proliferation caused crushing of xylem elements. Epidermal cells lost their identity and ruptured in several regions. At 1400 ppm, disintegration of pith cells resulted in the formation of lacunae.

3.2 Root

In roots treated with 800 ppm 2,4-D, several cells in the xylem region and secondary cortex deteriorated, forming lacunae. Phloem cells became meristematic and proliferated into the cortical region. Epidermal cells were crushed due to increased cambial activity, and the cortex and endodermis sloughed off in many places.

3.3 Leaf

In leaves, proliferation of phloem tissues in the midrib region was observed at 800 ppm, exerting pressure on cortical and epidermal tissues and altering their shape. At 1400 ppm, laminar tissues underwent complete disintegration due to plasmolysis, resulting in the destruction of mesophyll tissues.

3.4 Petiole

The petiole became slightly flattened due to enlargement of cortical cells at 800 ppm. In some regions, cortical cells disintegrated forming lacunae. Proliferation of cambium exerted pressure on cortical and pith tissues, causing distortion of vascular bundles and plasmolysis of cells.

IV. DISCUSSION

The results of the present study demonstrate that 2,4-D induces severe anatomical abnormalities in various organs of *Sidaacuta*. One of the most prominent effects observed was the proliferation of phloem tissues, which resulted in the formation of meristematic cell masses.

Similar observations have been reported in several dicotyledonous weeds treated with auxin-type herbicides.

Excessive cell division in cambial and phloem tissues leads to disruption of normal vascular function, ultimately affecting the translocation of water and nutrients.

The destruction of mesophyll tissues observed in leaves may lead to reduced photosynthetic activity and metabolic imbalance. Rupture of epidermal tissues and destruction of cortical tissues may further facilitate microbial invasion, accelerating plant decay.

The increased meristematic activity induced by 2,4-D, along with enhanced respiration and depletion of food reserves, ultimately leads to the death of the weed.

V. CONCLUSION

The present investigation demonstrates that 2,4-D causes extensive anatomical alterations in *Sidaacuta*. These changes include proliferation of cambial and phloem tissues, distortion of vascular bundles, disorganization of mesophyll cells, and rupture of outer tissues.

Such abnormalities interfere with normal physiological processes and ultimately lead to weed mortality, confirming the effectiveness of 2,4-D as a herbicide for controlling *Sidaacuta*.

Acknowledgement

The author expresses sincere gratitude to Dr. B. M. Rajurkar, Principal, and Dr. J. J. Shende, Head of the Department of Botany, R. S. Bidkar College, Hinganghat, District Wardha, for their encouragement and valuable support.

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