

But only one branch proved to be affected and the pollen grains of this showed a marked change. Most of them were bigger in size and full of contents. These flowers with good pollen are developing capsules. The progeny of the newly produced double diploid or amphidiploid is expected to provide material for further study and the work is in progress at the Cytogenetics section, Agricultural College and Research Institute, Coimbatore.

#### LITERATURE CITED.

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#### EXPLANATION OF PLATES.

- Fig. 1— *Sesamum indicum* Linn. TMV 1. Female parent.  $2n=26$ .  
 Fig. 2a—  $F_1$  hybrid of *S. indicum* x *S. laciniatum*.  $2n=13 \times 16$ .  
 Fig. 2b— Colchicine treated plant.  
 Fig. 3— *Sesamum laciniatum* (wild species) male parent.  $2n=32$ .

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## Herbicides and their Scope in South India

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**Introduction:** Weeds are undesirable plants. Muenscher (35) has defined weeds as plants which grow where they are not wanted or where it is desired that something else should grow. In short, they are plants out of place. Weeds compete with crops for light, moisture, plant food and space. They seed profusely and thrive even under adverse conditions, unlike crop plants. The seriousness of weed competition has been recognised ever since man began the cultivation of crops; but despite rapid advancement of science, weed control still remains a problem.

The annual loss due to weeds alone in the United States of America is estimated to be over 300 million dollars, greater than the losses sustained by the farmer due to livestock diseases, insect pests and plant diseases.

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**Methods of control:** Measures to control weeds are chiefly ; prevention, eradication and extermination. The preventive measures aim at the use of clean seeds of crops and preventing seed production of weeds. The methods eradication can be classified into three groups, viz; mechanical, cultural and chemical.

Mechanical means of eradication lie in the use of machines and implements. These are in vogue in several countries in the West. The cultural methods of control are based on the rotation of crops, mixed cropping, use of smother crops and interculture with suitable implements. Interculture is the most economical device aiming at moisture conservation along with weed control. Its main drawback lies in its failure to control deep-rooted weeds. Yet it remains as one of the most successful and practicable methods of weed control. Weed control through biological agencies is risky as the crop is rarely immune when the less susceptible weeds get the infection. One example of success achieved in this field relates to the control of prickly pear (*Opuntia sp.*) by the coccid insect introduced from abroad. Owing to the limited scope of weed control by this method, early investigators concentrated on chemical means for successful weed control.

**Chemical means of weed control:** The birth of this century saw the utilisation of chemicals as a means of weed control. These are known as herbicides or weedicides or popularly as weedkillers. These are largely in use in foreign countries and can be grouped into soil sterilisers, translocated and contact poisons, according to their mode of action.

The possibility of destroying weeds by herbicides was discovered in France a few decades back. The earliest substances to be used were copper sulphate and sodium chlorate. Arsenical organic compounds came into usage later. These are poisonous, toxic to soil, plants and animals. Owing to these drawbacks their use was discouraged. Ammonium thiocyanate, which did not have these drawbacks drew attention for sometime; but its prohibitive cost limited its use. Sulphuric acid and copper sulphate gained currency as contact poisons. There are low-priced and easily available, but are corrosive and are unable to exterminate deep-rooted weeds.

**Contact poisons:** In 1932, a dyestuff known as dinitro-ortho-cresol was found to have the property of killing herbaceous plants. This was relatively harmless to animals and inexpensive. It gained foothold in several countries and became very popular. Several products in the form of powders, pastes or emulsions entered the market and these are in use even to day. Sandoz, Dinoc, Dinocate, Sinox etc., are some of the commercial names of weed killers of this class containing dinitro-ortho-cresol as their main ingredient. These substances have proved to be only

contact poisons as they are not absorbed and translocated in plants. These are specially in use against succulent and herbaceous weeds growing among cereal crops. Most of the annual weeds are controlled by spraying five to ten pounds of the substance in 100 gallons of water over an acre.

**Translocated poisons:** The idea of using synthetic growth-regulating substances as weedicides originated simultaneously in U.S.A. and in the United Kingdom during the last war. Several growth-regulating substances largely used in horticulture for inducing rooting, improving fruit-set, controlling fruit drop etc., when used in high concentrations were found to induce overgrowths and malformations in plants resulting ultimately in their death. Wyndham Murray (57) states that this toxic property with selective action in these substances was discovered in 1940 by a team of British scientists headed by Blackman. Later, several investigators showed that these substances could be used effectively for destroying weeds among crop plants. Soon after the war, several articles appeared in many scientific journals on the utility of growth-regulating substances as weedkillers. The commercial preparations largely advertised and recommended for use are Sinox, Weedone, Weed No More, Weedanal, Weedust, Barweed, Tufor, Fernoxone, Agroxone, Methoxone etc. Most of these substances are derivatives of phenoxy-acetic acids. Of these, 2·4-dichloro-phenoxy-acetic acid, popularly known as 2·4-D, is the most effective substance discovered so far. Kaphart (24) used the term 'revolutionary discovery' for this substance because it opened up a new approach to weed control, by growth regulation through translocation in the plant system.

These herbicides are stated to be superior to the old type of chemicals in that they are inexpensive, selective in their action, harmless, to man and soil, non-poisonous to animals, non-corrosive and non-inflammable. As a result of these features, growth-regulating substances have become widely publicised, and exploited as proprietary products of commercial firms. Many firms in South India are now importing 2·4-D or closely related derivatives for sale to agriculturists.

**Mode of action of growth-regulating herbicides:** Commercial weedkillers containing as their main principle, derivatives of phenoxy acetic acids are readily absorbed by the plant and are transmitted from foliage to root. Their movement occurs mainly through the xylem and is limited by the factors which influence transpiration. The changes induced by them occur in places far removed from the place of application. Even underground parts are stated to succumb to these substances. These derange growth metabolism, increase respiratory activity leading to depletion of carbohydrates. The visible changes are, distortions of growth, malformations, bending of stems, twisting of

leaves and inhibition of growth at the meristem. The effects are characteristic of all phenoxy-acid derivatives. Beal (6) calls them as 'telemorphic' effects. Hamner and his associates (16) have shown that the esters are more effective than acids and acids more effective than salts. Several investigators, Marth and Davis (34), Hamner and Turkey (15), Mitchel and Marth (29), Beal (9), Weaver and Rose (53) and Weaver and his associates (54) have proved that sunshine, dry weather, high temperature etc. accelerate their efficacy and organic matter, rain, moisture etc. retard or mitigate the adverse effect of herbicides. Young plants as a rule are more susceptible than older ones.

These substances are relatively non-toxic to animals. Bucher (10) has shown that only 280 mgms. per kilogram of body weight was lethal to mice. These are selective in action, destroying some plants while not killing others and also have a persistent effect. In the beginning, these selective herbicides were stated to be effective in killing mostly dicotyledonous plants and popular literature went to the extent of saying that their efficacy was limited to dicotyledonous plants only. This led to the misconception that all noncotyledonous plants were resistant. At present all broad-leaved plants are stated to be more effectively controlled by phenoxy-acetic acid derivatives than narrow-leaved plants.

**Work in India:** The virtues of these herbicides, their increasing use in temperate countries as well as their wide publicity, has induced the committee of the Indian Council of Agricultural Research on Soils and Crops held in Patiala in March 1950, to draw up a scheme of large-scale trials in different parts of India.

Very little systematic survey has been made in South India of crop plants and weeds susceptible or resistant to herbicides. A beginning has recently been made. Padwick (37) was the first to use growth regulators as herbicides under our conditions. Later Thomas and Srinivasan (48) and Kumar and his associates (28) have published some lists of susceptible weeds under our conditions. So far no popular bulletin on herbicides has been published in India similar to the ones released by the U. S. Department Extension Service bulletins.

The control of weeds using herbicides is a new venture in South India and is full of risks. As these herbicides are lethal to non-cereal crops, indiscriminate use may result in a total loss of crop. Before launching any such large-scale trials in India, an attempt has been made here to review the existing voluminous literature on herbicides, useful to our conditions, and conduct preliminary trials at the Agricultural College, Bapatla, to assess their influence on crops, weeds etc. and the limit of safety of these compounds under South Indian conditions, with a view to evaluate their future possibilities.