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OF THE EFFECT OF

SOME HERBICIDES ON PLANTS

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By

Awatif Ibrahim El-Nahas

(B.Sc.)

AIN SHAMS UNIVERSITY

Faculty of Science, Department of Botany

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This thesis has not been previously submitted for a degree at this or any other University.

Awatif Ibrahim El-Nahas.

Awatif El-nahas

بسم الله الرحمن الرحيم

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Awatif El-Nahas.

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I. INTRODUCTION

Herbicides are chemical compounds that are used to kill or reduce the growth of weeds without affecting the crop plant (Klingman, 1961). The first selective herbicide used is agriculture was copper sulphate which was used to control broad-leaved weeds in cereals. Other mineral salts were also used. Chemical weed control however developed rapidly only after the discovery in 1941 that the salts of the chlorinated phenoxyacetic acids were selectively herbicidal. It is true to say that, in the development of herbicides, understanding lags behind practice. Often, practical methods of chemical control have been developed whose success depends on scientific principles which are not fully understood.

Trifluralin is a toluidene herbicide (N,N-di-n-propyl-2-6-dinitro-4-triflurotoluidine); (Muzik, 1970), or (a,a,a-trifluro 2,6-dinitro N,N-dipropyl p-toluidine) (Hollist and Foy, 1971). It is purchased as a liquid formulation of 44.5% active ingredient manufactured by Elanco company under the trade name treflan. It is an effective chemical for selective weed control as a pre-emergence soil incorporated treatment in many crops including cotton, peanuts, soybeans, sunflowers and others.

It is non-flammable, non-toxic and non-volatile (Barrentine and Warren, 1971).

Miller et al (1964) reported outstanding season-long weed control in cotton from rates as low as 0.75 lb of trifluralin an acre. They cautioned that crop damage may occur with the use of trifluralin. In numerous commercial cotton fields in California, U.S.A., where trifluralin was incorporated into the soil with a disc before planting, the cotton seedlings - were retarded, and, where seedling diseases were prevalent, a greater number of young plants died where trifluralin had been used.

Thompson and Hardcastle (1965) reported that trifluralin may cause stunting, leaf abnormalities, leaf discoloration, and occasional swelling of the crown area of the cotton.

Kempen (1965) reported that applications of trifluralin disced in before the pre-sowing irrigation, were most successful in controlling weeds, and that the depth of incorporation, rather than the rate of herbicide used induced stunting of the cotton plant.

Oliver and Franz (1965) reported that injury to cotton was minimal at all depths of incorporation if the rate of application was kept below 1 lb an acre of trifluralin. In extensive field experiments in California, U.S.A. they have found that reduction in the early growth of cotton can be kept to a minimum by incorporating trifluralin only in the top three to four inches of soil and sowing the seed at 2 to 2.5 inches into the treated soil.

Standifer and Thomas (1965) reported that in green house studies, Johnsongrass, (Sorghum halepense (L.) Pers.) seedlings were killed when the first internode passed through soil treated with trifluralin. Shoots from rhizomes were not killed but lateral root development was inhibited on that stem portion in contact with treated soil. They concluded that trifluralin may control Johnsongrass seedlings, but is not likely that it will be useful in the control of established stands.

Amato, Hoverson and J. Hacskaylo (1965) found that when seeds of corn (Zea maize) and cotton (Gossypium hirsutum) were planted in sand and subsequently drenched with solutions of technical trifluralin, the levels of herbicide used inhibited growth of roots and shoots in both crops but cotton was more tolerant than corn to trifluralin. The roots failed to elongate normally but the lateral growth that continued gave the radicles a "club shaped" appearance especially in corn. The cells at the extreme tip of the treated roots were small and dense, many were multinucleate. Immediately behind this region the cells were abnormally large, thin-walled and emaciated. A disorganized type of nuclear division was evident, however, cell plate and cell wall formation was lacking. Thus some cells contained as many as five nuclei, but the binucleate condition was most prevalent. The normal sequence of mitosis was found to be lacking in cells of treated roots, whereas all stages of mitotic cell division were observed in the untreated roots.

Feeny (1966) reported that when, Clinton oat seeds were grown in the dark at 30°C in plastic petri-dishes, germination was not affected by 0.50 ppm of trifluralin in Hoogland nutrient solution media. The length of roots was, however greatly reduced. Trifluralin reduced the number of coleoptiles produced after 52 hours exposure and significantly reduced the length of coleoptiles.

Trifluralin at 1 ppm w did not significantly affect the rate of oxygen consumption by excised oat roots in an endogenous system at 30°C. He also reported that trifluralin is especially toxic to many annual monocotyledonous plants. He also found that this herbicide has little effect on established plants but stunts root growth during or shortly after germination, when oats, which are highly susceptible to trifluralin, were used. The growth of the primary root of both cotton and sunflower was reduced when high concentrations of trifluralin were used prior to germination (Mallory, Bayer and Foy, 1966). When the seedlings were allowed to germinate before treatment, the cells first affected were those several millimeter from the meristem. Other anatomical variations were observed.

Schultz, Funderburk and Negi (1966) found that, the addition of 3 ppm of trifluralin to the nutrient solution applied to maize, cotton and cucumber plants produced swelling of the root tips and cessation of secondary root formation. Splitting of primary roots of cucumber was also noted. Concentrations of 0.01 - 3 ppm had no effect on initial germination of maize, cucumber, sorghum, soybeans and cotton seeds. After 4 days, however, maize seedlings showed a decrease in root length and root number respectively at 0.1 ppm and 1 ppm, and the length of cucumber hypocotyl decreased slightly at 3 ppm. In sorghum, extreme stunting of cotyledons and roots occured at 0.1 ppm while soybean hypocotyls and roots were slightly stunted at 1 ppm and 3 ppm respectively. Autoradiographs of cotton, cucumber and maize which were grown in nutrient solutions containing trifluralin-propyl-1-C^{14} indicated that a small quantity of C^{14} was absorbed and translocated. Slight movement to roots and aerial portions of the plants occured following foliar application.

Bayer, Mallory and Cutter (1967) found that, the most obvious external effect of trifluralin on the primary root was an increase in the amount of radial expansion near the root tip. The initial radial expansion of the treated roots occured in the region of maximum elongation. With increased duration of treatment there was a gradual decrease in the extent of the meristematic tissue zone because of progressive vacuolation and subsequent differentiation. Although trifluralin disrupted the mitotic process, no one type of mitotic figure prevailed. Mitotic activity was not affected in all of the cells, some of which appeared to be undergoing a perfectly normal mitosis. Rates of trifluralin application sufficient to inhibit lateral root emergence without interfering with development of the primary root affected the pericycle and portions of the endodermis. The pericyclic cells were much enlarged in the regions opposite the proto-xylem and had undergone some of the initial phase of lateral root formation. These enlarged pericyclic cells correspond to what have been called primordiomorphs.

Schultz and Funderburk (1967) reported that, trifluralin has been shown to inhibit elongation of Avena coleoptile in the presence and absence of IAA. Studies were designed to determine whether the phytotoxicity and swelling of root tips induced by trifluralin may be caused by its effects on RNA and protein synthesis which proceed cell elongation. Germinating seeds of maize were exposed to trifluralin for 3 days and there after, the apical sections of the roots were excised and the dry weight, total nucleic acids, DNA, RNA and protein contents were determined. Dry weights of roots did not vary between treated and untreated plants. Micrograms of total nucleic acids DNA, RNA and protein per milligram of dry weight were reduced in the treated roots. Most of the reduction in nucleic acids was in the DNA fraction. Mg of total nucleic acids and DNA per mg of protein decreased slightly in the treated plants whereas those of RNA increased.

Trifluralin at 0, 1, 2 or 4 mg in 50 ml water was applied to the polting sand immediately after sowing maize (Cv-Jeras 28) and cotton (Cv. Deltalpine smooth leaf) and germinating seeds were removed for histological studies 5 days after sowing to determine changes in root cells caused by trifluralin at rates substantially greater than those recommended for weed control in cotton (Hacskaylo, Amato 1968). It was found that trifluralin treatment inhibited growth of maize (particularly root development) to much greater degree than that of cotton. Growth of the primary root was drastically reduced in treated seedlings but the lateral growth that continued gave the radicle a club-shaped appearance especially in maize. The cells at the apex of the