A STUDY ON SOME PESTICIDES IN RELATION TO ION ABSORPTION AND PLANT GROWTH

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THESIS

Submitted in Partial Fulfilment of the Requirements
For the Degree of Master of Science
in
SOIL SCIENCE

Soils Department
Faculty of Agriculture
University of Ain Shams

1972

A C K N O W L E D G M E N T

The author sincerly wishes to acknowledge and appreciate the efforts introduced by Dr. Talaat El- Kobbia, Associate Prof., Soil Department, Faculty of Agriculture, Ain Shams University for his guidance and valuable criticisms during the investigation.

The author is most grateful to Dr. Adel El-Leboudi, Associate Prof., Soils Department, Faculty of Agriculture, Ain Shams University, for his supervision, suggesting the problem, valuable advice, fruitful assistance, unfailing interest and stimulating suggestions at all stages of this study and preparation of the manuscrip.

Appreciations are also extended to authorities cooperated; special appreciation is introduced to Dr. A. Zeddan, Entomology Department, Faculty of Agriculture, Ain Shams University and Dr. M. A. El-Abbasery, Soils Department, Ministry of Agriculture for providing certain facilities needed druring the laboratory work of the investigation.

بسم الله الرحمن الرحيم

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1. INTRODUCTION

Increased population together with the limited area of agricultural lands in the A.R.E. resulted in an emphasize on the problem of maximizing the yield of agricultural crops per unit area. Since cotton was and still considered to be the main economical crop in the A.R.E. and as its plants started to be vigorously attacked with various pests, the use of different pesticides pushed itself to be widely spread in all parts of the world particularly under climatic conditions such as those present in the A.R.E.

Recently, application of herbicides, systemic insecticides and fungicides is a usual agricultural practice at almost all locations of the agricultural lands in the A.R.E.

Since plants absorb from their environment certain mineral elements essential for growth and development, it would be helpful to know what effect pesticides could have on the uptake and distribution of these elements within various tissues. A knowledge of the influence of pesticide on the mineral nutrition may be of value in elucidating the mechanisms of pesticidal action. From the stand-point of public health, a knowledge of possible changes in the mineral content of crops treated with pesticides would also be useful.

Therefore the present study was designed for the purpose of investigating that behaviour of cotton plants as influenced with pesticide application; growth, nutrition and yield were all investigated.

2. REVIEW OF LITERATURE

To easily review the literature dealing with the effects of pesticides on the growth and nutrition of cotton seedlings, literature will be reported under the following headings :

1. Herbicides.
2. Insecticides.
3. Fungicides.

2.1. H e r b i c i d e s.

2.1.1. Effect of herbicides on dry matter and growth of plants.

Several investigators studied the effect of herbicide on growth and yield of different plants. Mitchell and Brown (1945) showed a decrease in the total dry weight of the 2,4-D treated plants. Brown (1946) grew bean seedlings sprayed with 2,4-D, mixed with carbowax as a dispersing agent, to show the toxic effects associated with some various physiological responses. At the end of 5 days seedlings sprayed with a 1000 ppm concentration level were permanently wilted and in 7 days they were dead. The total amount of water absorbed and transpired by sprayed plants during the 5 days immediately following treatment was 34% less than that for comparable untreated ones. Water uptake was not immediately limited by treatment, since the seedlings continued to transpire and they did not wilt until 5 days after spraying. Leaf growth was markedly inhibited when corn was sprayed with a level as low as 25 ppm. The solid matter content of the plant decreased after spraying with a relatively high concentration (1000 ppm) but increased accumulation of solid matter was noted in the basal region of the stems of those plants sprayed with lower concentration (25, 50 and 250 ppm). Wolf et al. (1950) found that treated plants receiving high nitrogen solutions were dead 14 days after the 2,4-D treatment was began. At this time the medium nitrogen plants showed severe chlorosis of leaves and stems whereas the low nitrogen plants showed only mild chlorosis. Gysin and Ekirusli (1960) found that atrazine apparently brought about an increase in the percent nitrogen by a reduction in growth of the plants rather than by the increase in nitrogen uptake. This decrease in growth may be the result of inhibition of photosynthesis by atrazine. Gast and Crob (1960) reported that a pre-emergence application of 1 and 2 lb/A of simazine and atrazine increased yield of forage corn to 23% compared to untreated plots and to 37% when these herbicides were applied at 5 lb/A. The same authors observed that dry weight, crude protein content and carbohydrate content of the fresh corn tissue increased. In contrast, post-emergence applications of simazine did not affect dry weight and carbohydrate content but increased crude protein content.

De Vries (1963) reported that the application of simazine generally reduced dry weight of tops and roots of corn and pinus radiata seedlings. Simazine always increased the top/root ratio in corn but generally decreased those of pine seedlings.

Allinson and Peters (1970) reported increases in the percentage of crude protein and generally a decrease in dry matter content in several forage crops treated with simazine.

2.1.2. Effect of herbicides on the carbohydrate content of plants.

Several investigations repeatedly suggested that the herbicidal action seemed to be related to interactions with carbohydrates in plant. Mitchell <u>et al</u>. (1940) found that naphthalen acetic acid herbicide and some other related compounds accelerated the rate of starch hydrolysis and depleted the supply of readily available carbohydrate reserves in been ~~leveas~~ leaves when these substances were applied as emulsion sprays.

Mitchell et al. (1940) and Mitchell and Brown (1945), working with <u>Ipomea lacunasa</u> (Annual Morning glury), found principal cause of plant death.

Rasmussen (1947) found that application of 2,4-D in herbicidal concentrations was principally the cause for distruction of carbohydrate reserves with most of the loss being accounted for by increased respiration. He believed, however, that these effects alone probably did not account for the lethal action of 2,4-D

Sell _et al_. (1949) reported that 1000 ppm 2,4-D applied to the foliage of Red kidney Bean resulted in a considerable reduction in carbohydrate reserves and a decrease in the acid hydrolyzable polysaccharides. Since they also found a large increase in protein of the stems of treated plants, they suggested that a large portion of the carbohydrates was utilized in protein synthesis.

Wolf _et al_. (1950) found that both total and reducing sugars were higher in 2,4-D treated plants than in those of control. Cooke (1955) demonstrated, however, that monuron caused a significant decrease in the carbohydrate content of terrestrial plants.

Rogers and Funder burk (1966) investigated the herbicidal and physiological effects of cotoran on plants. They found that a) in warburg manometry studies, cotoran at a concentration up to 10 ppm did not affect the respiration of cotton, bean, and cucumber in vitro b) Warburg and CO_2 fixation studies indicated that cotoran inhibited photosynthesis in cucumber and bean and to a lesser extent in cotton. Results indicated that the basic physiological and herbicidal behaviour of cotoran was typical of that associated with other phenyl substituted urea herbicides. Weldan and Blackburn (1969) applied propylene glycol butyl ether esters of silvex and 2,4-D to floating alligator-weed and determined the level of carbohydrates in the under water stems. One month after initial application the readily acid hydrolyzable carbohydrates had been depleted by an average of 23.8% in the tidal area and 14.5% in the non flowering one. Sorour and Hacskaylo (1968) found that monuron had no effect on the carbohydrate level of the leaves 24 hours following the treatment at cotton seedlings. However, one week later it caused the starch content of the leaves to decrease, which could be an indication of utilization of this reserve. Walsh and Graw (1971) reported that treatment of marine unicellular algae with diuron, monuron and fenuron herbicides (derivative urea) caused depressions in the concentration of carbohydrates in tissues.

2.1.3. Influence of herbicides on the nitrogen nutrition.

Studies were carried out by Smith et al. (1947) using convalvalus avenses plants (Bindweed). Results showed that

Bartély (1957) reported that corn plants treated with simazine "2 chloro 4,6 bis (ethyl amino)-5-triazine" were greener and taller than control plants not treated with simazine possibly due to the increase in total nitrogen content.

Tomizawa (1956) found that Linuron (substituted urea herbicides) increased the protein content of tall fescuse and orchard grass by a highly significant extent. Peach trees treated with a herbicidal mixture of simazine and amitrole plus ammonium thiocyanate (Amitrol T) were reported by Ries et al. (1963) to contain higher leaf nitrogen as compared to trees where weeds were controlled by hand. Ries and Gast (1964, 1965) showed that regardless of the nitrogen level, addition of simazine increased the percentage of nitrogen in corn plants, grown in sand culture, more than could be accounted for by the nitrogen available in the simazine. At the low rate of nitrogen, addition of 3 mg of simazine increased the total nitrogen content of corn as much as the addition of 570 mg of nitrogen as ammonium nitrate. Freney (1965) reported that corn plants treated with simazine took up more nitrogen than the control plants only when additional nitrogen was supplied. He concluded that simazine was not acting as an appreciable nitrogen source in these experiment.

Gramlich & Davis (1965) and Gramlich et al. (1966) observed an increase in the percentage of total, protein, non protein, and nitrate nitrogen in corn with atrazine treatment. Bogaev and Shkel (1966) found that nitrogen uptake by corn was sensitive to applications of the sodium salt of 2,4-D herbicie. Damage was decreased by the application of high rates of nitrogen.

Fink and Flechall (1967), in their studies on mature corn forage, showed that atrazine and simazine stimulated nitrogen uptake only when available soil nitrogen was inadequate. Eastin and Davis (1967) reported that one lb/A of atrazine increased the percentage of both protein and nitrate nitrogen in most species studied. Atrazine susceptibility apparently was related to its effect on percentage of the non protein and ammonia nitrogen in the species tested.

Burt and Muzik (1970) studied the effect of 3 amino 1,2,4 triazol (amitrole) on the alcohol soluble nitrogen compounds in Cirsium arvense ecotypes. One day after treatment with amitrole the concentration of all nitrogen compounds tested in the leaves of the susceptible ecotype was reduced, but none was eliminated. Five days after treatment the concentration of the same compounds increased in the leaves above the control. Changes in the soluble nitrogen compounds showed that when 2,4-D was added 3 days before the application of ^{32}P in the root zone, P uptake decreased with increasing rates of added 2,4-D. A period of 3 days was enough for the rate of 0.5 mg 2,4-D per Kg soil to decrease the phosphorus uptake to a third whereas that of 5 mg/Kg decreased it to one sixteenth; about 75% of the absorbed phosphorus was found to be retained in the roots. When 2,4-D was applied through the leaves, most of the herbicide accumulated in the growing points of aerial organs; root activity was less affected and most of the absorbed phosphorus was translocated to the aerial organs.

Monuron, which is similar to cotoran, was usually recommended for soil sterilization. This herbicide was found by Tomizawa (1956) to increase the inorganic-P in all parts of the soybean plants but decreased the incorporation of phosphorus into some metabolic intermediates.

Bingham and Upchnrch (1959) reported that 2 ppm concentration level of diuron "3,4 dichlorophenyl 1,1-dimethylurea", which is similar to cotoran, gave an almost linear increase for the response of cotton plants to phosphate. Italian ryegrass similarly behaved with application of diuron at a concentration of 0.25 ppm. Results also showed that even small additions of P acted to reduce diuron toxicity. Plant analyses indicated no inhibition of P uptake but rather suggested that diuron and P interacted and that the effect of diuron on growth was partly regulated by P level.

Ormard and William (1960) applied 2,4-D, at 50 ug level, as a spray. Results showed that the herbicide caused a striking increase in the acid soluble organic phosphorus and concurrent decrease in the inorganic fraction, the effect being as quickly as to be obtained one minute after treatment. In leaves of plants treat d with 500 ug. 2,4-D, there was a definit time lag before increases in acid soluble organic phosphorus were shown; in petioles and stems, however, this rate caused a reduction in this fraction. The data left little doubt that the action of these growth regulators or herbicides was closely related to phosphorus metabolism.

The effect of herbicide could be influenced by phosphorus application to the growth medium of plants. Bagaev and Shkel (1965) studied the effect of phosphorus on sensitivity of maize to the sodium salt of 2,4-D. They grew maize on a medium containing 0.5, 1, 3 or 4 times the amount of P in the control; Na salt of 2,4-D was sprayed at a concentration of 1 kg active gradient per 400 liters of water / ha. They found that NPK contents were higher in both stems and leaves of herbicide sprayed plants than those of control. Bagaev and Shkel (1965) reported that, in general, 2,4-D increased the