THE EFFECTS OF CHEMICAL PEST CONTROL OPERATIONS IN COTTON FIELDS ON THE ECOSYSTEM OF WATER SOURCES IN TREATED AREAS

BY

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INTRODUCTION

Pesticides enter the aqueous environment through a number of pathways **(Westlake and Gunther, 1966)**, the most direct of which is, probably, the use of herbicides for the control the aquatic weeds especially in rice fields. The use of various pesticides for the control of agricultural pests generally involve the direct introduction of these chemicals into the aqueous environment mainly through drainage water.

The method of application partly determines the fates of agricultural pesticides. **Hindin et al. (1966)** reported that less than 35% of DDT and other pesticides applied by aircraft spraying reached the target area. He suggested that a part of the remaining 65% drifts to surface water and into the atmosphere.

Atmospheric and water means of pesticides transportation are major routs by which DDT and related compounds reach other untreated areas **(Risebrough, 1969** and **Woodwell et al., 1971)**. Ground application of insecticides, fungicides, and herbicides result in transporting these chemicals to rivers and drainage waters via the soil.

Haque and Freed (1975) reported that pesticides may remain dissolved in the water, but pesticides in sediments will probably also be present in the overlying water, at least in trace quantities. Pesticides present in water may have a number of fates. They may be absorbed by the sediments, degraded by microorganisms, taken up by organisms or diluted in water.

In Egypt, the widespread and increasing use of insecticides in the last few decades have resulted in problems caused by their interaction with natural biological systems. A problem due to pesticide residues may appear far away, both in time and space, from the intial point of introduction into the environment.

The object of the present work is to determine the presence of residues of pesticides, used in controlling cotton pests, in irrigation and drainage waters. The determination was based on the microbial densities (bacteria, fungi, algae and protozoa) in water canals, as well as the densities of larvae and pupae of mosquitoes and other arthropods . The interaction between microflora, fauna and pesticide residues was also investigated.

REVIEW OF LITERATURE

Despite the beneficial uses of pesticides, they represent one of the eminent dangers to Man. some highly toxic chemicals and their breakdown products persist in the environment for long periods of time and may move into the water of streams and rivers or be carried in the atmosphere. This high mobility of pesticides is substantiated by the fact that almost no area of this planet is, today, free from at least some level of pesticidal contamination **(Higgens and Burns, 1975).**

I. Effect of Pesticides on Different Organisms:

Pesticdes influence the population of organisms either directly by changing their metabolic and physiological activities, or indirectly by affecting associated plants, animals and microorganisms.

By studying the pesticide organism interaction, it was found by several investigators that when pesticides are applied in large amounts and at frequent intervals, there are signs of more permanent quantitative and qualitative changes in the community of water flora and fauna appear **(Shane, 1948; Ukeles, 1962; Butler, 1963; Cook and Connors, 1963; Sanders and Cope, 1966; Morgan, 1976; Tu and Miles, 1976 and McEwen and Stephenson, 1979).**

1.1. Microorganisms:

1.1.1. Bacteria:

The literature on effects of pesticides on bacteria in soil is greater than the literature on its effects in water. However, as many of the same species of bacteria occur both in water and in soil, the results of the reviewed literature could apply to the water-bacteria.

Several investigators reported that insecticides at different levels depressed the bacterial growth (**Kasting and Woodward,** 1951; **Chairo,** 1953; **Bollen et al.,** 1954a,b; **Gray,** 1956; **Augusto and Allessandro,** 1959; **El-Hoseiny,** 1964; **Mahmoud et al.,** 1972; **Ramadan and Zidan,** 1975a,b; **Tu and Miles,** 1976; **Antoun et al.,** 1980; **Ishac et al.,** 1981; **Neweigy et al.,** 1982; **Ramadan et al.,** 1983; **El-Hoseiny et al.,** 1982; 1985; **Gohar et al.,** 1985 and **El-Shinnawi,** 1986).

In Egypt, **Mahmoud et al. (1972)** studied the effect of the insecticide Disyston on total bacterial count, nitrifiers and anaerobic N_2-fixing bacteria in cotton rhizosphere. They found that Disyston has an adverse effect on the studied bacterial groups. Higher levels of the insecticide inhibited bacterial growth which extended for a period.

The effect of insecticides Cyolane, Gardona, Tamaron, Curacron, Monocrotophos and Dursban on total bacterial count in soil was investigated in Egypt by **Ramadan and Zidan (1975).** The results revealed that all tested insecticides cause deleterious effects on bacterial densities (except in the case of anaerobic cellulose decomposers and aerobic N_2-fixers), especially after the first two weeks following application. The effects were more pronounced with Cyolane, Gardona, Tamaron, Curacron and Dursban, but less pronounced with Monocrotophos.

Tu and Miles (1976) working with pure cultures of bacteria (29 species) and 21 insecticides (3 carbamates, 9 organophosphates, 9 chlorinated hydrocarbons) concluded that, at recommended dosage, the tested insecticides are unlikely to have marked effect on bacterial number in the soil. In some cases temporary growth suppression was noted, while in others the presence of pesticides was stimulatory. They also found that Escherichia coli, Klebsiella aerogenes and three species of Pseudomonas common to both soil and water were not affected by any of the nine chloronated hydrocarbon insecticides, while growth of Bacillus megaterium was inhibited by all tested insecticides.

The fact that morphological and physiological changes in bacterial cells can occur due to pesticide application is demonstrated by researcheres **O'Neil and Langlois (1976)**, who observed that Heptachlor caused a thickening in the cell wall and disruption of cell wall structure in Staphylococcus aureus causing some growth inhibition.

Effect of the insecticide Volaton on the bacterial growth and activity was studied by **Antoun et al. (1980).** They reported that Volaton depressed bacterial respiration for 5 days at the beginning of the experiment, but enhanced it later on and up to 46 days.

Ishac et al. (1981) in Egypt observed that Lannate and Cyolane insecticides showed an inhibitory effect on asymbiotic nitrogen fixing bacteria specially at high levels of application.

An experiment was conducted by **Neweigy et al. (1982)** to study the effect of Cytrolane and Dursban at the rates of 1 and 10 L/fed on the counts of Azotobacter and Clostridium pasteurianum in Egyptian soils. They found that application of both insecticides deleteriously affect the number of Azotobacter for three weeks, then the counts were restored to normal thereafter. In the case of Clostridium, application of Cytrolane or Dursban showed significantly lower counts than control.

Ramadan et al. (1982) investigated the effects of Lannate and Cyolane insecticides on total bacterial count, aerobic N_2-fixers, and nitrifiers in Egyptian soils. They noted that counts of bacteria and aerobic N_2-fixers were reduced by the presence of both insecticides, while a slight reduction or no effect were detected in nitrifying bacterial counts.

El-Hoseiny et al. (1985) studied the effects of carbaryl (Sevin), methomyl (Lannate) and Zineb on culture growth and nitrogen fixation potency of three species of Azotobacter. Their results revealed that inhibitory effects occurred with the concentration recommended by the Egyptian Ministry of Agriculture (2500 ppm) for each pesticide, with quarter of the recommended dose (625 ppm), with half the recommended dose (1250 ppm), with double the recommended dose (5000 ppm) and with four fold the recommended dose (10,000 ppm).

Gohar et al. (1985) studied the effects of 3 organophosphorus insecticides (Volaton, Cidial and Dimethoate) on Azotobacter population, and found that application of such insecticides relatively inhibited or slightly favoured this group of bacteria.

The effect of 13 granular insectidcies (Birlane, Curacron, Cyolane, Cytrolane, Dimilin, Dotan, Dursban, Gardona, Hostathion, Oftanol, Phosvel, Tokuthion and Volaton) used in the control of cotton pests (leaf- and boll-worms), on the number of Azotobacter in a cotton cropped soil was studied in Egypt by **El-Shinnawi (1986).** He noticed that all insecticides tested suppressed the bacterial activities to about 36% on average. The non-halogenic compounds (Cyolane, Cytrolane, Hostathion, Oftanol and Volaton) gave relatively high inhibition of bacterial activities, while Dimilin and Phosvel were the most inhibitory.

On the other hand, a number of investigators reported that some chloronated hyrocarbons and organophosphorus insecticides have a stimulatory effect on bacterial growth due to the capability of the bacteria to decompose such insecticides and to utilize them as carbon sources.

Lemire and Fredette (1961) stated that DDT has a stimulating effect on some species of bacteria, whereas **Salonius (1972)** reported that treatment with DDT (112 kg/ha) did not alter bacterial population number.

Naumann (1971) showed that high levels of Lindane (0.5%) or Toxaphene (0.05 to 0.5%) stimulated slightly but significantly the growth of bacterial populations for a period of time.

The effect of some insecticides (Lindane, Dyfonate and Basudine) on the physiological behaviour of two Azotobacter species were studied in a liquid culture medium by **Salem and Gulyas (1971).** They stated that the activity of the tested bacteria enhanced by the presence of the insecticides, and added that the insecticides gradually decomposed by special adaptive enzymes produced by the bacteria only in the presence of these chemicals. Accordingly, they concluded that these insecticides could be used in pest control operations without any harmfull effects on the activity of Azotobacter.

Stojanovic et al. (1972) studied the effects of Malathion and Carbaryl, and other pesticides, on different microorganisms. They found that formulated Malathion and most of the other chemicals reduced the bacteria. With formulated Carbaryl the bacterial population was higher than that of the control.

Mahmoud et al. (1972) obtained higher densities of aerobic N_2-fixing bacteria than the control in the presence of low concentrations of the insecticide Disyston, while higher levels of this insecticide caused slight inhibition.

Ramadan and Zidan (1975a & b) found that Monocrotophos, Tamaron, Cyolane and Gardona insecticides exerted significant stimulations of anaerobic mesophilic cellulose decomposing bacteria. They found that counts of aerobic N_2-fixers gradually increased to reach the same level of their counts in control treatment after 3-4 weeks from application.