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DATE OF CERTAIN PESTICIDES IN SOIL

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I N T R O D U C T I O N

Soil insects are a serious problem to agriculture. Until recently they were controlled satisfactorily by certain organochlorine insecticides. However because of the problems of resistance, some alternative insecticides have been developed, primarily the organophosphorus insecticides. Chemical control as such involved the problem of contamination of soil with insecticidal residues. The translocation of some residues from soils into the edible portion of crops has been reported. Because of the potential hazards to humans and wildlife, knowledge of the fate of insecticides in soil is essential. Accordingly, studies of residues of insecticides in soil and the factors responsible for the disappearance or persistence of these residues seem to be rather important in order to keep residues of insecticides in soil at reasonable levels.

The present investigation was carried out to determine the fate of certain insecticides in soil under different experimental conditions, i.e. chemical nature, dose, period, soil type, temperature, moisture, sterilization, stirring organic matter and mobility.

PART (I)

REVIEW OF LITERATURE

1. Fate of Toxicants in Soils :

Jurinak 1957, indicated that adsorption of EDB by naturally occurring soils is a function of the predominant clay mineral present in the soil. Kaolinite and illitic soil had higher adsorption per unit surface than montmorillonitic soils, which presenting a porous aggregate whose capillary restrict adsorption.

Ebeling and Wagner 1965, reported at previous work in 1961, 1962 that at 40 to 60% R.H. insects in direct contact with toxic residues were more likely to adsorb a lethal quantity from fine sand or pyrophyllite (non-sorptive) than from clay loam soil or Olancho (highly sorptive).

Studies conducted by Harris 1967, on three soil types : sandy loam, clay and muck indicated that insecticides bioactivity was dependent on soil type.

Jurinak 1957, reported that vapour adsorption of (1,2-dibromo-3-chloropropane) was limited to external surface of the clay fraction, which determining the adsorption capacity of the dry soil.

Swanson et al. 1954, found that the retention of lindane was related to soil porosity. This could be explained why fine textured soil require heavier applications of BHC for effective results than do coarse textured soils.

Lichtenstein 1959, reported that insecticides were most readily absorbed by carrots from sandy loam and least from a muck soil. Lindane was highly phytotoxic on a sandy loam, less on a Miami silt loam and almost non-toxic in muck soil.

Getzin and Chapman 1959, reported that greater residues and longer periods of insect kill resulted from soil drench applications with phosdrin, Demeton and phorate to sands and sandy soil than from applications to silt . loam, clay loam and muck soils.

Kiigemage et al. 1958, showed that the decline of Aldrin, Dieldrin and Heptachlor was almost equal for all three insecticides at all 11 months and the recovery ranged from 32% to 38% in silt loam.

Menn et al. 1960, stated that Trithion (S-(2-chloro-phenylthio)methyl O,O-diethyl phosphorodithioate) degraded in loamy soil much faster than several chlorinated insecticides and would offer seasonal control of soil borne insect pests without leaving residues.

Weidhaas et al. 1961, reported that the nature

of the functional group of insecticides appears to play a very important role in adsorption. The degree of loss of parathion and DDT from aqueous solution to soil was not a function of the water solubility of the two insecticides.

d. Effect of Temperature :

Alexander 1961, reported that a rise in temperature and the liming of acid soils tended to shorten the period of persistence of herbicides.

Barlow and Hadaway 1958 b, concluded that temperature appeared to have a small effect upon the rate of diffusion of DDT, while appeared more effect with Dieldrin.

Bailey and White 1964, reported that an increase in temperature would be expected to reduce adsorption and solubility, while favour the desorption.

Galbert and Fletchal 1965, reported that the adsorption of Simazine and Atrazine (Herbicides) was decreased by raising temperature.

Basson 1966, stated that high temperature resulted in more rapid decomposition, thus surface applied insecticides broke down sooner than those tilled into the soil.

Whitency 1967, indicated that the moist potting soil containing 5 p.p.m. Dursban, stored in closed

polyethylene bags for 82 days at 18°C. lost no activity, which appeared slightly faster lost when aged at 50°C than at 26°C.

Kiigemage et al. 1958, reported that soil temperature may be a contributing factor in the breakdown of aldrin, Dieldrin and Heptachlor. High temperature may either accelerate the breakdown of the material or it may cause a loss through volatilization.

3. Effect of Soil Moisture :

Swanson et al. 1954, reported that moisture reduced the adsorptive power of soil for Lindane.

Harris 1964, stated that Heptachlor, DDT, Parathion and Diazinon were more toxic in moist than in dry sand, while dry muck soil did not inactivate the insecticide to same extent. He also reported that soil moisture increased the initial biological activity of several organophosphate insecticides.

Barlow and Hadaway 1953 a, showed that an increase in relative humidity was followed by an increased effectiveness of K-BHC, DDT and Dieldrin deposited on mud blocks. The rates of sorption (initial and diffusion) were also directly related to humidity, decreased as humidity increased.

The longer persistence of Aldrin and Heptachlor residues in soils of low microbiological activity was demonstrated by Lichtenstein and Schulz 1964. They also reported that under these conditions practically no Aldrin was converted into Dieldrin. Results showed that Parathion was most persistent in the autoclaved soil, in which pH was some what lower than that of the other soils. Therefore the stability and degradation of Parathion in soil is a function of soil types, which differ widely in their biological activities.

Alexander 1961, reported that environmental modification resulting in enhanced microbial development and metabolism. He also added that some of the insecticides exhibited a very long persistence, i.e. BHC, and Chlordane which persisted for more than 10 years.

Lough 1945, reported that naphthalene disappeared more rapidly from soil previously treated with certain species of bacteria.

Lichtenstein and Schulz 1960, showed that Parathion was lost in the loam not by volatilization but by hydrolysis or reduction depending on the microflora. Yeast was primarily responsible for its reduction to aminoparathion while bacteria not to affect this reduction.

Lenn et al. 1960, 1962, showed that the persistence

of Trithion increased in autoclaved or fumigated soil. They also reported that partial destruction of soil micro-organisms increased the persistence of Imidan (N-C-mercapto-methyl) phthalimide-S-(O,O-dimethyl-phosphorodithioate) in the soil by approximately 50%.

Hall and Sun 1965, reported that soil microbial activity was an important factor in the decomposition of Aldrin (3-hydroxy-N,N-dimethyl-cis-croton-amid dimethyl phosphate). Such statement agreed with the results obtained by Ahmed and Casida 1958, who reported that micro-organisms played an important factor in the breakdown of Organophosphorus insecticides.

Bollen et al. 1958, reported that microbial activity appeared to be unimportant in the change of Aldrin to Dieldrin in soils.

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Barlow and Hadaway 1958 b, concluded that on Uganda soil, Y-BHC was almost uniform in its concentration throughout the blocks within eight weeks after spraying and Dieldrin after 24 weeks. On the other hand, loss of insecticides from glass plates by evaporation was rapid and progressive. About 50% was lost after 1 & 4 weeks respectively, and almost none remained 4 & 52 weeks.

Lichtenstein et al. 1962, reported that volatilization appeared to be the major factor in the loss of

Aldrin and Heptachlor insecticidal residues in treated soils.

c. Effect of Organic Matter

Getzin and Chapman 1959, reported that the degree of binding was correlated within organic content of the soil.

Bailey and White 1964, showed that the bioactivity of both tested herbicides and insecticides were lowest in soils ~~higher in~~ organic matter or clay content while the bioactivity was highest in the light textured soils.

The organic matter has the highest cation exchange capacity of all the soil constituents, and accordingly, a high potential adsorption capacity for both those pesticides which may act as cations as well as those that can be absorbed by physical adsorption. The presence and amount of such functional groups as the carboxyl, amino, hydroxyl and alcoholic hydroxyl would have a great effect on the cation and anion adsorption of pesticides.

Harris 1964, reported that in moist soils, inactivation of Heptachlor, DDT, Parathion and Diazinon was proportional to the organic matter content of the soil.

Swanson et al. 1954, reported that organic matter

might be expected to increase the retention of Lindane.

Jurinak 1957, studied the adsorption of 1,2 Dibromo-3-chloropropane vapour by soils and reported that the adsorption capacity of a dry organic soil was relatively low when compared with moist mineral soils.

Lichtenstein 1959, reported that insecticides are absorbed to the organic matter of the soil to such an extent that in a muck soil no phytotoxicity was noticeable and the breakdown of insecticides was slowed down. It is also possible that the insecticides are dissolved in the organic matter of a muck soil, and therefore are less available for metabolism or pick up by plants. The binding of insecticides to the organic matter in soils might explain why most of the Lindane was found in crops grown in a sandy loam and least in crops grown in a muck soil.

Harris and Warren 1964, reported that desorption of herbicides was more ready from bentonite than from organic soil.

Falbert and Fletchall 1965, concluded that the adsorption of Simazine and Atrazine increased by increasing organic matter and or clay in the soil. Organic materials (peat, peat mass) were generally much more