[From Department of Plant Protection, High Institute of Cotton, Soil Salinity and Alkalinity Laboratory, Ministry of Agriculture and Department of Plant Protection, Faculty of Agriculture, Alexandria University, Alexandria (Egypt)]

Studies on Soil Insecticides

XI. Effect of some Soil Insecticides on the Nitrogen Transformation in Treated Soils

A. A. A. Gawaad, M. Hammad, and F. H. El-Gayar

With 6 figures

Summary

This paper is concerned with the study of the effect of some soil insecticides, kepon- (Decachlorooctahydro-1,3,4-metheno-2H-cyclobuta (cd) pentalene-2-one), endrin (1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro 1,4, endo, endo. 5,8-dimethanonaphthalene), dyfonate (O-ethyl-S-phenyl-ethyl-phosphenodithioate), and PP 211 (Organophosphorus insecticide), on nitrogen transformation in treated soils. These soil insecticides were used at the rates of 10, 10, 5, and 5 kg. active ingredient/feddan, respectively. General results indicated that soil insecticides decreased ammonification of peptone and nitrification of ammonium sulphate. While nitrite accumulated in the treated soil, the nitrate decreased for the first 15 days.

Soil insecticides, especially chlorinated hydrocarbons, affected fungi, *Actinomyces*, and bacteria which are responsible for ammonification, and *Nitrobacter* which is responsible for changing nitrite to nitrate, but they have no effect on *Nitrosomonas* which is responsible for changing ammonia to nitrite.

Experiments were conducted during 1969 and 1970 in eight different localities to study the possibility of controlling the cotton leaf worm in the U.A.R. by soil insecticides (Gawaad et al. 1970, 1971). The point is whether their repeated use might result in the accumulation of harmful residues in the soil, thus affecting the soil microorganisms and their activity, or not.

The effect of some soil insecticides on the number of microorganisms and the CO_2 production was studied by the authors (Gawaad et al. 1970, 1971).

Eno and Everett (1958) applied heptachlor, chlordane, methoxychlor, lindane, aldrin, toxaphene, dieldrin, TDE, DDT, and BHC to fine sand at the rates of 12.5, 50, and 100 p.p.m. (about 25—200 pounds per acre) of active ingredient. Carbon dioxide increased by toxaphene, dieldrin, TDE, and DDT, while the other materials had no effect. No significant differences occurred in the bacterial numbers. There was a significant decrease in the nitrification rate with heptachlor, lindane, and BHC, and an increase with toxaphene, TDE, and DDT, one month after application. Sixteen months after application the nitrate production was significantly decreased by DDT, BHC; the other compounds showed no effect after this period.

Bollen et al. (1954) reported that stimulative effects of chlorinated hydrocarbon insecticides, such as DDT and BHC, act not only on the growth of microorganisms, but also upon the physiological activity, such as ammonification and nitrification, due to intervention of traces of insecticides in certain enzyme or other catalytic systems involved in cell growth.

teria and fungi or on their ability to carry out the normal function of organic residue decomposition and ammonium oxidation. [redacted] in the soil. The breakdown of plant material was slowed down in soils treated with aldrin where there were no earthworms, and this may have significance in some arable soils.

GAWAAD et al. (1970) indicated that kepone, endrin, lindane, dyfonate, and PP 211 at the rates of 10, 10, 10, 5, and 5 kg. active ingredient decreased the number of microorganisms in the first week after application, followed by a great increase for about seven days. After 15 days, the total number of microorganisms returned more or less to its normal level. CO_2 production, as indicator of the activity of microorganisms, followed nearly the same pattern.

Materials and Methods

Plots of 1/100 feddan at Sakha and El-Gimmeza were treated with kepone, endrin, dyfonate, and PP 211 at rates of 10, 10, 5, and 5 kg. active ingredient/feddan, respectively. Control replicates were left untreated to estimate nitrification and ammonification rates at field conditions.

Representative soil samples (0—15 cm.) were taken from each plot after 0, 7, 15, 30, and 60 days after application of the insecticides. Samples of three replicates of the same treatment were mixed, air-dried, sieved through a 20-mesh sieve, and kept at 10 °C.

The nitrification rate of ammonium sulphate of each of the soil samples was determined according to BOLLEN et al. (1954) by placing a 300 gm. portion of the soil sample in a plastic container: ammonium sulphate was added at the rate of 300 p.p.m. nitrogen, which was dissolved in a quantity of distilled water to obtain 70% of the field capacity of the tested soil, and incubated for 20 days at 28 °C. The procedure conducted by JACKSON (1962 was

nearly equal to the control. In the case of organophosphorous compounds (PP 211 and dyfonate), nitrification returned to its normal level or slightly more than the control 60 days after treatment, while with chlorinated hydrocarbons (lindane and kepone) nitrification reached its normal level, or less, 60 days after treatment.

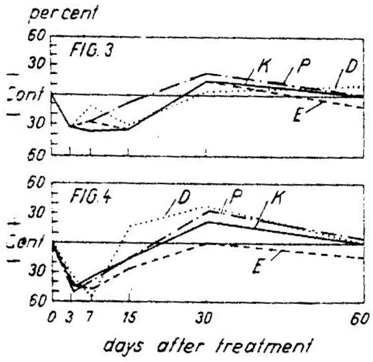

Fig. 3 and 4

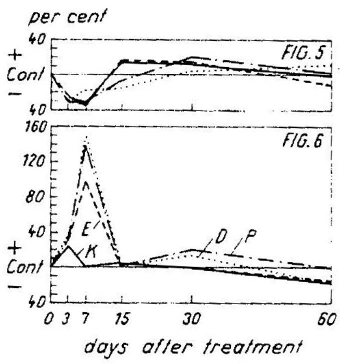

Fig. 5 and 6

Fig. 3. Effect of soil insecticides on nitrification rate in El-Gimmeza treated soil.
Fig. 4. Effect of soil insecticides on nitrification rate in Sakha treated soil. (D = dyfonate, P = PP211. K = kepone, and E = endrin)
Fig. 5. Effect of soil insecticides on NO_2-N production in Sakha treated soil.
Fig. 6. Effect of soil insecticides on NO_2-N production in Sakha treated soil. (D = dyfonate, P = PP211. K = kepone, and E = endrin)

Fig. 5 and 6 indicate that tested insecticides decreased the production of NO_2-N for 7—15 days, followed by a gradual increase. The results also indicate that after 60 days the nitrogen of NO_3 was more or equal to nitrogen of NO_3 in the control in the case of organophosphorous compounds. In the case of chlorinated hydrocarbon, the production of NO_3-N was lower than in the control.

In all treatments, NO_2-N increased greatly than control, especially in the case of organophosphorous compounds, for 15 days, followed by a decrease, until it reached the level of the control (30 days after treatment for chlorinated hydrocarbons, 45 days for dyfonate, and 60 days for PP 211).

Soil insecticides affected the nitrifying bacteria, especially the *Nitrobacter*. Therefore, in treated soils ammonia was converted to nitrite, and most of the nitrite accumulated in the soil for about 15 days. Tested insecticides had no effect on *Nitrosomonas*.

Zusammenfassung

Es wurde der Einfluß von Kepon, Endrin, Dyphonat und PP 211 auf die Stickstoffumsetzungen im Boden geprüft. Im allgemeinen setzten die Bodeninsektizide die Ammonifikation von Pepton und die Nitrifikation von Ammonsulfat herab. Nitrit reicherte sich an, während der Nitratgehalt zurückging.

Vor allem die chlorierten Kohlenwasserstoffe beeinflußten Pilze, Aktinomyzeten, Ammonifikanten und den Nitratbildner Nitrobacter, nicht hingegen den Nitritbildner Nitrosomonas.

Literature

ALEXANDER, M.: Introduction to soil microbiology. John Wiley and Sons, Inc., New York and London 1961. — BOLLEN, W. B., MORRISON, H. E., and CROWELL, H. H.: Effect of field treatments of insecticides on numbers of bacteria, *Streptomyces*, and molds in soil. J. Econ. Ent. 47 (1954), 2, 302—306. — CHANDRA, P., and BOLLEN, W. P.: Effect of nabam and nylone on nitrification, soil respiration, and microbial numbers in four Oregon soils. Soil Sci. 92 (1961), 278—296. — CHAPMAN, H. D., and PRATT, P. F.: Methods of analysis for soils, plants, and waters. Univ. California, Div. of Agric. Sci., 1961. — EDWARDS, C. A.: Some side effects resulting from the use of persistent insecticides. Ann. appl. Biol. 55 (1965), 2, 329—331. — ENO, C. F., and EVERETT, P. H.: Effect of soil application of 10 chlorinated hydrocarbon insecticides on soil microorganisms and the growth of Stringless Black Valentine Beans. Soil Sci. Soc. Amer. Proc. 22 (1958), 3, 235—238. — GAWAAD, A. A. A., EL-GAYAR, F. H., and EL-SHAZLI, A. Y.: Studies on soil insecticides. VI. Evaluation of some soil insecticides for controlling *Spodoptera littoralis* in bersim (*Trifolium alexandrinum*). Z. angew. Ent. 67 (1970), 1, 19—26. — GAWAAD, A. A. A., and EL-GAYAR, F. H.: Studies on soil insecticides. VII. The possibility of controlling *Spodoptera littoralis* by using soil insecticides. Z. angew. Ent. 67 (1971), 3, 246—255. — GAWAAD, A. A. A., HAMAD, M. A., and EL-GAYAR, F. H.: Studies on soil insecticides on soil microorganisms (1971, under publication). — JACKSON, M. L.: Soil Chemical Analysis. Constable Co., Ltd., London 1962. — MARTIN, J. P., and PRATT, P. F.: What pesticides do to soils? Fumigants, fungicides, and the soil. J. Agric. Food Chem. 6 (1958), 5, 344—353. — MARTIN, J. P., HARDING, R. B., CANELL, G. H., and ANDERSON, L. D.: Influence of five annual field applications of organic insecticides on soil biological and physical properties. Soil Sci. 87 (1959), 334. — SUSKI, Z. W., and DAWYDKO, B.: The results of investigations on the influence of BHC insecticides on the growth of fruit trees in the nursery and on nitrogen changes in the soil. Prace Inst. Sadwan. Skierniewice 5 (1961), 255—269 [c. f. Soils and Fert. 25 (1962), 3, 234, Nr. 1720].

Authors' addresses:

Dr. A. A. A. Gawaad, Department of Plant Protection, High Institute of Cotton, Saba Basha; Dr. M. Hammad, Soil Salinity and Alkalinity Laboratory, Ministry of Agriculture; Dr. F. H. El-Gayar, Department of Plant Protection, Faculty of Agriculture, Alexandria University, Alexandria (U.A.R.).

Verantwortlich für die Redaktion: Prof. Dr. G. Müller, 402 Halle (Saale). Verlag: VEB Gustav Fischer Verlag, 69 Jena, Villengang 2, Telefon 241 41, 241 42. Alleinige Anzeigenannahme: DEWAG-Werbung Leipzig, 701 Leipzig, Brühl 34–40, Telefon 297 40, gültige Preisliste Nr. 2. Satz und Druck: VEB Druckerei Rudolstadt, 682 Rudolstadt.