Persistence of Organochlorine Insecticides in the Field in the Gezira Soil under Cotton

by G. A. El Zorgani
Agricultural Research Corporation, Wad Medani, Sudan

Various aspects of the persistence of organochlorine insecticides in soils have been the subject of numerous investigations. Most of the previous studies, however, were carried out on soils of temperate regions (GINSBERG, 1955; LICHTENSTEIN & SCHULZ, 1959; 1961; LICHTENSTEIN et al, 1971). The complex factors which affect the persistence of a pesticide in soil (LICHTENSTEIN, 1972), makes the extrapolation of earlier findings to predict analogous situation in tropical soils of a limited value. There is therefore a need for a more localized approach to these aspects. The Gezira (1.2×10^6 feddan+), the main area of irrigated cotton production in the Sudan is the site of systematic large scale application of organochlorine and other insecticides (ANON. 1969-72). The present investigation is a part of the effort to formulate a better understanding of the behaviour of persistent pesticides in the soil under the conditions prevailing in the Gezira.

Experimental

Part of a cotton field (2 months old) was sliced into two replicates of randomised blocks giving individual plots of 200 m^2. Cotton plants were cultured according to standard procedures (ANON. 1967). The insecticides DDT E.C. 25%, Endosulfan E.C. 35%, dieldrin W.P. 75% and aldrin W.P. 40% were applied at a dosage rate of 2 lbs a.i/feddan on ridge surface immediately under the plants, using high volume knapsack sprayers.

+) 1 feddan = 0.42 hectares

Bulletin of Environmental Contamination & Toxicology, Vol. 15, No. 3 © 1976 by Springer-Verlag New York Inc.

Soil sampling was done using an edged cylindrical sampler 2" diam. X3". Five samples were taken from each plot. Samples obtained from individual punctures were thoroughly mixed and a subsample of 10 g was removed for extraction. Sampling was carried out at weekly intervals.

The finely ground sample was extracted for 4 hours in a Soxhlet apparatus using hexane. The extract was evaporated to dryness and the residue redissolved in hexane (10 ml). This solution was diluted as required for analysis by gas-liquid chromatography (GLC). GLC was carried out on two liquid phases, SE52 and Apiezon L, under conditions which were essentially similar to those described earlier (El ZORGANI and OMER, 1974).

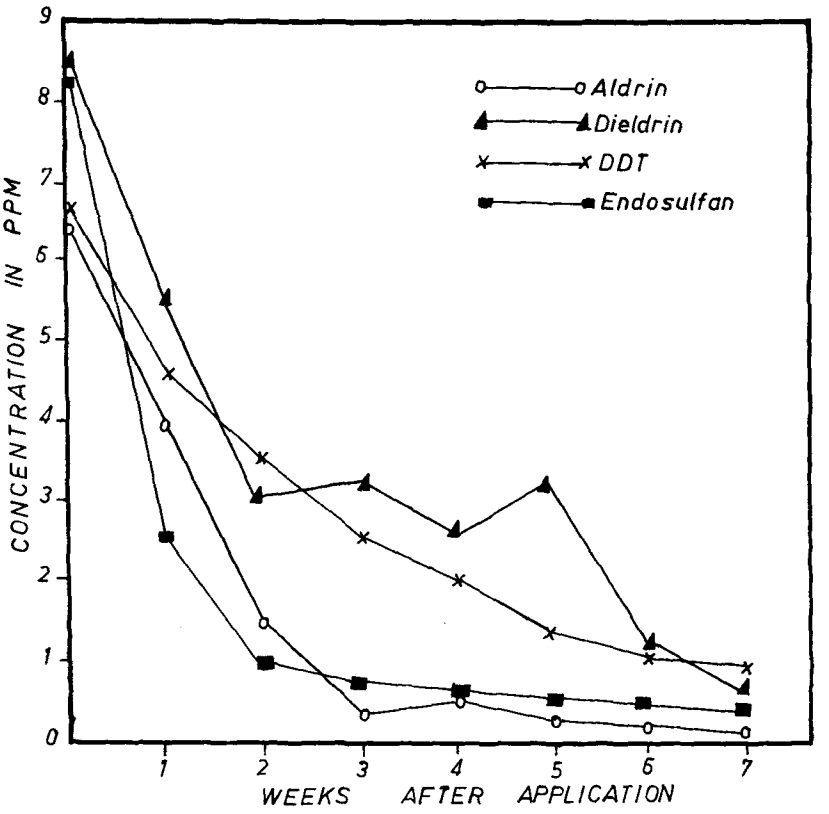

Fig. 1. Disappearance of residues in soil after surface application

TABLE 1

Concentration of Residues in the Soil (in ppm) at Various Intervals after Surface Application of Insecticides

Weeks after application	DDT				Endosulfan			Dieldrin	Aldrin		
	Op-DDT	pp'-DDT	pp'-DDE	Total	α-	β-	Total	HEOD	HHDN	HEOD	Total
0	1.75	4.90	-	6.65	5.30	3.00	8.30	8.50	6.50	-	6.50
1	0.85	3.88	-	4.73	1.44	1.02	2.46	5.65	3.57	0.46	4.03
2	0.58	3.05	-	3.63	0.65	0.35	1.00	2.87	1.40	0.14	1.54
3	0.20	2.46	0.02	2.68	0.48	0.24	0.72	2.85	0.48	-	0.48
4	0.05	1.88	0.05	1.98	0.35	0.30	0.65	2.40	0.55	-	0.55
5	0.02	1.15	0.05	1.22	0.39	0.16	0.55	2.85	0.09	0.08	0.17
6	-	0.85	0.10	0.95	0.17	0.27	0.44	1.08	0.05	0.07	0.12
7	-	0.69	0.10	0.79	0.15	0.10	0.25	0.64	-	0.02	0.02

Results and Discussion

In the case of DDT and aldrin treatments the quantities of DDE and dieldrin formed were added to the parent material in which term the total residual concentration is expressed.

The concentration of residues present at different intervals after application is shown in Table 1. The results show the remarkably fast rates of loss of surface deposits of organochlorine insecticides (Fig. 1).

Endosulfan and aldrin were found to be similarily labile with residue levels falling below 1 ppm only 3 weeks after application. The more stable dieldrin and DDT exhibited similar order of persistence, with their residues falling to the 1 ppm level after 7 weeks.

Previously the analysis of soil samples from the Gezira at the Tropical Products Institute, Gt. Britain (HASSAN, 1971) and at Wad Medani (EL ZORGANI, 1975) revealed unexpectedly low levels of DDT (0.2 ppm) despite the long history of the use of this insecticide in the Gezira (HASSAN, 1967). On basis of the present results, these findings should be easily comprehensible. The behaviour of endosulfan is consistent with the known instability of this insecticide in soils (GORBACH et al, 1971) and in biological systems (MAIER-BODE, 1967). Dieldrin is markedly more persistent than aldrin and the extent of its formation in soil from the latter is limited. Dieldrin has also been found to control soil-borne insects for a longer time than aldrin in the Gezira soil (KISHA, 1973). The rapid disappearance of aldrin could be partly explained in terms of its higher volatility (LICHTENSTEIN et al, 1968). In addition, active breakdown of aldrin through routes not involving dieldrin formation (KLEIN et al, 1973) is a distinct possibility.

The results of this study, when compared with findings in temperate regions, demonstrate clearly the shorter persistence of organochlorine insecticides under the Gezira conditions. During the study, the relative importance of, and factors contributing to this rapid loss of residues were not considered.

References

ANONYMOUS: Sudan Gezira Board, Annual Reports (1969-72)

ANONYMOUS: Agricultural Research Corporation, Technical Bulletin No. 1 (New Series), Khartoum University Press (1967)

EL ZORGANI, G.A. and OMER, M.E.H., Bull. Environ. Contam. Toxicol. 12, 182 (1974)

EL ZORGANI, G.A., Unpublished results (1975)

GINSBERG, J.M., Jr. Agr. Food Chem. 3, 322 (1955)

GORBACH, S., HARRING, R., KNAUF, W. and WERNER, H.J., Bull. Environ. Contam. Toxicol. 6, 193 (1971)

HASSAN, H.M., Personal communication (1971)

HASSAN, H.M., In Cotton Growth in the Gezira Environment (A Symposium) 232 (1967) Agric. Res. Corp., Wad Medani

KISHA, J., Annual Report, Agric. Res. Corp. (1973)

KLEIN, W., KOHLI, J. WIESBERGER, I. and KORTE, F., J. Agr. Food Chem. 21, 152 (1973)

LICHTENSTEIN, E.P. and SCHULZ, K.R., J. Econ. Entomol. 52, 124 (1959)

LICHTENSTEIN, E.P. and SCHULZ, K. R., J. Econ. Entomol. 54, 517 (1961)

LICHTENSTEIN, E.P. ANDERSON, J.P., FUHREMANN, T.W. and SCHULZ, K.R., Science 159, 1110 (1968)

LICHTENSTEIN, E.P., FUHREMANN, T.W. and SCHULZ, K.R., J. Agr. Food Chem. 19, 718 (1971)

LICHTENSTEIN, E.P., Notes for IAEA International Training Course, Vienna (1972)

MAIER-BODE, H., Arch. für Pflanzenschutz 3, 201 (1967)