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DDT Residues in Soil of Areas Surrounding a DDT Manufacturing Factory in Delhi, India

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The problem of environmental contamination by persistent chlorinated hydrocarbon pesticides still evokes major concern due to the presence of their residues in the environment and in human tissues. In developing countries like India, organochlorine insecticides,especially DDT, are extensively being used in agriculture and vector control programmes. In addition, DDT manufacturing factories, some located in the midst of the metropolitan areas also contribute to the contamination of the environment. Yadav et al. (1981)reported high levels of DDT residues in soil and earthworms from 50 sites surrounding a DDT manufacturing factory in Delhi. The data reported here are part of a continuing monitoring programme of DDT and its metabolites in the soil of Delhi area in order to assess the extent and magnitude of the DDT pollution. The results were compared with those obtained in an investigation of the same sites in 1974.

MATERIALS AND METHODS

Soil samples were collected in 1978 and 1983 from 50 selected sites already surveyed in 1974 for organochlorine insecticide residues. Each soil sample was extracted and cleaned up according to a previously described procedure (Yadav et al. 1981). Residues were detected by electron capture gas liquid chromatography, using Packard A-7300 instrument on a 2m x 2 mm i.d.glass column packed with 1.5% OV_{17} and 1.95% QF_1 on Gas Chrom Q (100-120 mesh), carrier gas was nitrogen at a flow rate of 60 ml/min. Peaks were identified by comparing relative retention times with those of standards. Results were confirmed by injection into a 5 % DEGS on Gas Chrom Q (100-120 mesh) glass column. Further confirmation was carried out by thin layer chromatography using silica gel and rhodamine spray for detection.

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Recovery of DDT and its metabolites from spiked samples was more than 88 %.

RESULTS AND DISCUSSION

Soil is an enviromental reservoir for the residues of pesticides from where they move into the atmosphere, water and living organisms. It is evident from the present data (Table 1) that soils of Delhi area are contaminated with high levels of DDT and its metabolites. In 1978, the total DDT ranged from 0.34 to 6.69 ppm with a mean value of 1.43 ppm and in 1983 total DDT ranged from 0.49 to 7.27 ppm with a mean value of 1.67 ppm. This represents a five-fold increase compared to the levels reported in 1974. DDT residues in soil were also reported in surveys conducted in USA (Carey 1979; Carey et al.1979 a,b), Canada (Brown et al. 1975; Miles and Harris 1978), Bulgaria(Kuyumdzhieva 1979)and India (Tripathi 1966; Yadav et al.1981).

Table 1. Trends in DDT residues in soil of 50 sites surrounding a DDT manufacturing factory in Delhi, India (ppm)

Metabolites	Range of concentrations and means±S.D.		
	1974*	1978	1983
p,p'-DDE	0.00-0.81 0.11±0.18 (48)	0.00-6.30 0.45±0.88 (49)	0.14-1.99 0.48±0.38 (50)
o,p'-DDT	0.00-0.27 0.01±0.04 (15)	0.00-0.57 0.14±0.15 (47)	0.00-1.52 0.16±0.23 (45)
p,p'-DDD	0.00-0.60 0.06±0.14 (29)	0.00-2.13 0.32±0.35 (48)	0.07-1.37 0.34±0.23 (50)
p,p'-DDT	0.00-1.20 0.15±0.25 (43)	0.04-3.00 0.49±0.53 (50)	0.19-2.76 0.69±0.46 (50)
Total DDT	0.00-2.61 0.34±0.49 (50)	0.34-6.69 1.43±1.16 (50)	0.49-7.27 1.67±1.16 (50)

*Survey conducted by Yadav et al. (1981)
Figures in parentheses indicate the number of positive samples

In the present study the highest concentration of DDT, 6.69 ppm in 1978 and 7.27 ppm in 1983 was found at Durga Nagar where the DDT manufacturing factory is located. Other areas contained moderate to high levels of DDT residues in soil. In this survey,the distance from the DDT manufacturing factory appears to be one of the

important factors in determining the levels of DDT residues in soil. It was observed that residues of DDT decreased with increasing distance from the DDT factory. The agricultural lands were reported to contain less total DDT residues as compared to urban soils. A similar trend was reported by Yadav et al.(1981) in their 1974 survey of Delhi soils. Total DDT as high as 29.45 ppm in agricultural soil (Carey et al.1979b) and 388.16 ppm in urban soils (Carey 1979) has been reported from the United States.

It is clear from the present study that soil residues of p,p'-DDE, o,p'-DDT, p,p'-DDD and p,p'-DDT have shown an upward trend from 1974 (Table 1). The volatilization and subsequent dispersal of DDT in the vicinity of the factory might have contributed to the build up of high levels of DDT residues in the soils of Delhi area. DDT has been shown to volatilize into the atmosphere (Sundaram 1974), from where it ultimately reaches the surface soil. In addition to dispersal from the factory, the large scale use of DDT in malaria control programs in recent years might have resulted in widespread contamination of Delhi soils. The long persistence of DDT residues in soil also contributes increasingly high concentration of residues in soil. The average time for 95% disappearance of DDT was reported to be 10 years (range, 4-30 years) with an average of about 50%(range, 26-76%) remaining after three years in soil (Edwards 1966).

In developing countries like India, there is an urgent need to monitor residues of organochlorine pesticides from time to time if irreparable damage to wildlife, man and his environment is to be prevented.

REFERENCES

Brown JR, Chow LY, Chai FC (1975) Distribution of organochlorine pesticides in an agricultural environment, Holland Marsh, Ontario, 1970-72. Pestic Monit J 9:30-33.

Carey AE (1979) Monitoring pesticides in agricultural and urban soils of the USA. Pestic Monit J 13:23-27

Carey AE, Douglas P, Thai H, Mitchell WG, Wiersma GB (1979a) Pesticide residue concentrations in soils of 5 USA cities, 1971: Urban Soil Monitoring Programme. Pestic Monit J 13:17-22

Carey AE, Gowen JA, Tai H, Mitchell WG, Wiersma GB (1979b) Pesticide residue levels in soils and crops from 37 states, 1972. National Soil Monitoring Programme (IV). Pestic Monit J 12:209-229

Edwards CA (1966) Insecticide residues in soils. Res Rev 13:83-132

Kuyumdzhieva T (1979) Organochlorine pesticide levels in soils of Bulgaria. Khig Zdraveopaz 22:163-168

Miles JRW, Harris CR (1978) Insecticide residues in organic soils and six vegetable growing areas in South Western Ontario, 1976. J Environ Sci Health 13:199-209
Sundaram KMS (1974) DDT residues may be lost from soil by indirect volatilization. Bimonthly Res Notes Can For Serv 30:14-15
Tripathi HC (1960) Organochlorine insecticide residues in agriculture and animal products in Tarai areas. MSc Thesis, UP Agric Univ, Pant Nagar, India
Yadav DV, Mittal PK, Agarwal HC, Pillai MKK (1981) Organochlorine insecticide residues in soil and earthworms in the Delhi area, India. August-October, 1974. Pestic Monit J 15:80-85
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