Bull. Environ. Contam. Toxicol. (1986) 37:705–709

Bulletin of Environmental Contamination and Toxicology

Persistence of Methyl Parathion in a Carp Rearing Pond

A. K. Sabharwal and D. K. Belsare*

School of Biological Science, Bhopal University, Bhopal 462026, India

Methyl parathion (O, O-dimethyl-O-p-nitrophenyl phosphorothioate is an organophosphate pesticide marketed under the trade name 'Metacide' and is widely used for controlling insect pests. Although its persistence in water (Eichelberger and Lichtenberg 1971; Chigareva 1973; Kostovetskji et al 1976) and soil (Obuchowska 1967; Lichtenstein et al 1977; Molozhanova 1978) has been studied. The information on its bioaccumulation in aquatic macrophytes is conspicuously absent.

MATERIALS AND METHODS

Four circular plastic pools (60 cm depth, 100 cm diameter) were used for rearing carp fingerlings. Each pool contained 450 L of well water and 400 g of Hydrilla verticilla. Black soil was added to make 8 cm thick bed to support plant roots. 450 g of common carp (3-4 cm) were reared in each pool and were fed with commercial food daily. 0.05% acetonic solution of methyl parathion (4 mg/L) was added dropwise to this aquatic ecosystem with constant stirring. Samples were drawn periodically for analysis of methyl parathion content according to the method developed by Getz and Watts (1964) as modified by Jain et al (1974). The sample (100 ml of water, 50 g of soil, 25 g of macrophyte or 50 g of fish) was extracted with chloroform, washed with n-hexane and acetonitrile and evaporated to dryness at 50°C. It was dissolved in acetone, filtered and extracted with chloroform. After washing it with sodium sulphate and adding 1% diethylene glycol, it was evaporated to dryness. The colour was developed by adding cyclohexylamine (2% V/V) and p-nitrobenzyl pyridine (2% V/V) in equal proportion and heating it at 175°C. The absorbance was read at 540 nm using a spectrophotometer. The methyl parathion content was determined from a previously prepared calibration curve.

* Correspondence and reprint requests.

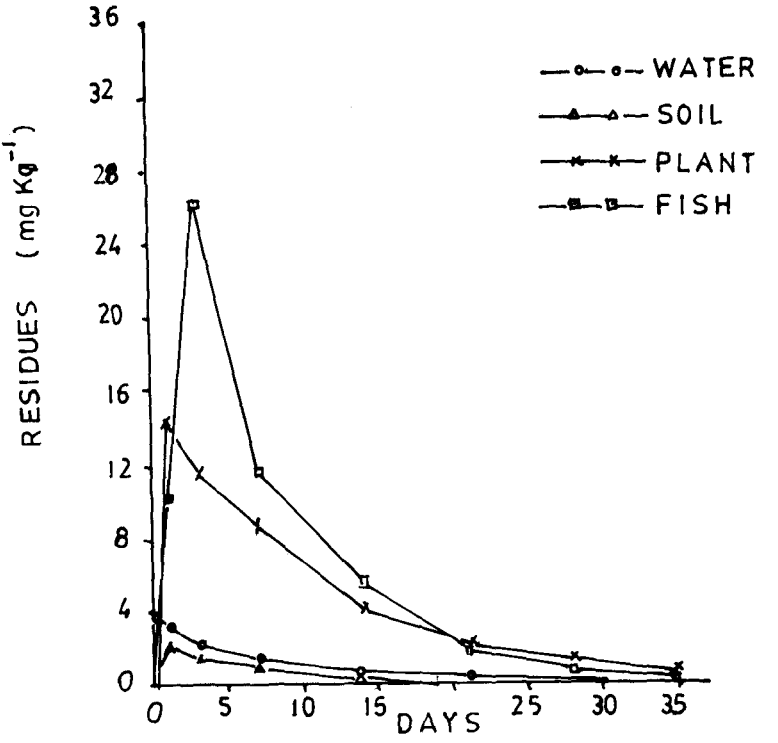

Fig. 1. Persistence of methyl parathion in carp pond

RESULTS AND DISCUSSION

The methyl parathion sensitivity mg/Kg from water, soil, macrophyte and fish was 0.0066, 0.1200, 0.0478 and 0.0746 ppm and its per cent recovery as 9, 85, 87 and 81 respectively. It is seen that methyl parathion in water was reduced from its initial values of 3.77 mg/L to 3.15 mg/L showing dissipation of 16% within one day (Fig. 1). After 3, 7 and 14 days the residue values were 2.16, 1.50 and 0.60 mg/L and its dissipation rate as 42, 60 and 84% respectively. After 21 days the detectable level of residue was 0.28 mg/L and after 28 days it was not detected at all. In soil the initial residue of methyl parathion was 0.52 mg/Kg. It increased to an average of 2.28 mg/Kg within one day, but degraded to 1.52 mg/Kg having a dissipation of 33% within 3 days and was below detectable level 28 days after addition of the pesticide. In macrophyte it increased from its initial value of

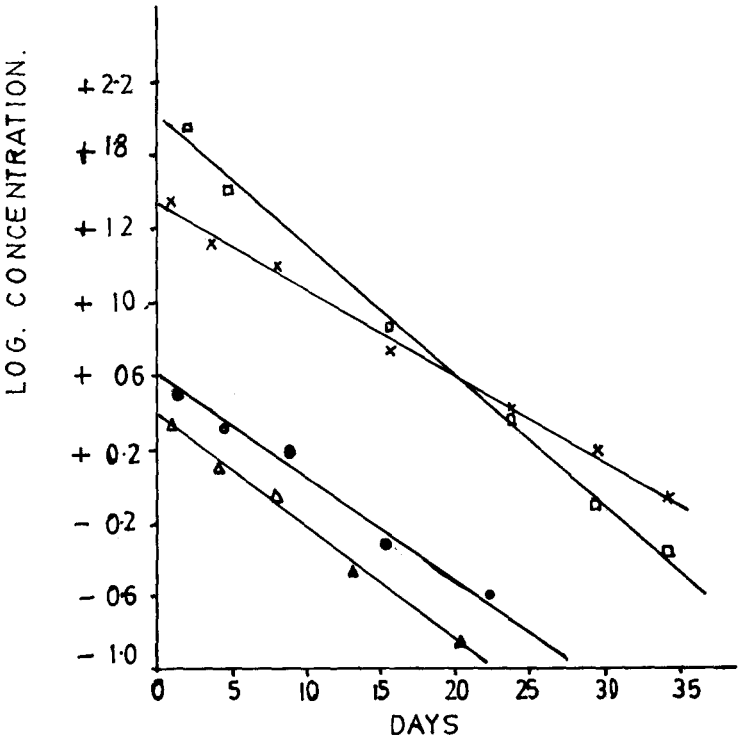

Fig. 2. Degradation rate of methyl parathion in carp pond

1.20 mg/Kg to 14.41 mg/Kg within one day, but thereafter it reduced to 11.73, 8.98, 4.16, 2.24 and 1.42 mg/Kg after 3, 7, 14, 21 and 28 days respectively. After 35 days the residue value was 0.73 mg/Kg with a dissipation rate of 94%. In fish the methyl parathion residue was increased from its initial concentration of 0.52, to 10.26 and 26.17 mg/Kg within 1 and 3 days respectively. However, it degraded to 11.74 mg/Kg 7 days after with a dissipation rate as 55%. The residue was further degraded to 5.67, 2.06 and 0.83 mg/Kg after 14, 21 and 28 days respectively, registering thereby a dissipation rate as 78, 92 and 96% during this period. After 28 days the residue value was 0.48 mg/Kg and a dissipation rate 98%. Thus dissipation of methyl parathion in fish was fast during first two weeks, but slowed down during succeeding weeks.

The degradation of pesticide followed the first order of reaction i.e. the logarithmic concentration was proportional to time elapsed (Fig. 2). The half lives in water

soil, plant and fish were 5.68, 4.98, 7.92 and 5.42 days respectively.

Methyl parathion residue was immediately degraded in water, but accumulated in flooded soil, plant and fish within one day. Thereafter, its degradation was observed in soil and plant, but it continued to accumulate in carp even after the 3rd day. Chigavera (1973) reported more concentration of methyl parathion in carp within first week, whereas Apperson et al (1976) observed it in blue gill sunfish within one day, after exposure to it. Kanazawa (1975) reported the persistence of malathion, diazinon and fenitrothion as 150, 211 and 162 mg/Kg respectively in motsugo fish within 3-4 days after exposure to them. Our data agree with those reported by Chigareva (1973) in carp where degradation of methyl parathion is 85% after second week.

Eichelberger and Lichtenberg (1971) and Chigareva (1973) reported 90% degradation of methyl parathion in water after two weeks, which is similar to that reported in the present case. Its persistence in soil is reported for 6-18 weeks under various conditions (Kostovetskji et al 1976; Molozhanova 1978). Our findings on soil agree with those reported by Molozhanova (1978).

Although numerous studies are reported on the persistence of methyl parathion in non-aquatic plants (Virk and Ahmed 1975; Singh et al 1978, practically no work is done on submerged aquatic macrophyte. It seems that persistence of this pesticide in Hydrilla verticilla is slightly higher than in soil and water. Its half life is about one week which is more than the one reported in pea, Pisum sativum (Singh et al 1978).

REFERENCES

Apperson C, Elston R, Castle W (1976) Biological effects and persistence of methyl parathion in clear lake, California. Environ Entomol 5(6): 1116-1120.

Chigareva OI (1973) Metaphos distribution in fish organs and tissues. Tr Vres Naucheno Issled Inst Vet Sanit 46: 102-104.

Eichelberger JW, Lichtenberg JJ (1971) Persistence of pesticides in river water. Environmental Sci Tech 5: 541-544.

Getz E, Watts RR (1964) Application of 4-(p-nitrophenzyl) pyridine as a rapid quantitative reagent for organophosphorus pesticides. J.Assoc Off Agric Chem 47(6): 1094-1096.

Jain HK, Pandey SY, Agnihotri NP, Dewan RS (1974) Rapid estimation of organophosphorus insecticides. Indian J Ent 36(2): 145-148.

Kanazawa Jun (1975) Uptake and excretion of organophosphorus and carbamate insecticides by fresh water fish, motsugo. Bull Environ Toxicol 14(3): 346-352.
Kostovetskji Ya, I Naishtein S Ya, Tolstopyatova GV, Chegrinets G Ya (1976) Hygienic aspects of pesticide use in the catchment areas of water bodies. Vodn Resur. 1: 167-172.
Molozhanova EG (1978) Distribution dynamics of organophosphate pesticides in soil and their migration in the soil water ecological system. Tr Vres Sovesch 2nd 232-234.
Obuchowska, Irena (1967) Stability of organophosphorus pesticides (methyl parathion) in soils. Rocz Pantsw Zakl Hig 18: 655-659.
Singh S and Singh AP (1978) Persistence of methyl and ethyl parathion in soil and plant. Pesticides 12: 39-41.
Virk MA, Ahmed M (1975) Residual analysis of methyl parathion on some vegetables. Nucleus 12: 47-49.
Received January 14, 1985; accepted January 31, 1986.