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DEGRADATION OF DIAZINON IN SOILS

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A silty clay acid soil was treated with diazinon by 30, 300 and 3000 ppm levels at field capacity, air-dry moisture conditions, and incubated for 200 days under laboratory conditions. The residues were determined after 0, 10, 40, 80, 120, 160 and 200 days of incubation. The degradation of diazinon was rapid at field capacity moisture levels wherever the rate was very slow in air-dry soils. With high dosages, the compound persisted longer in both soil conditions. The fate was linear and are well fitted to the regression lines.

Key words: Degradation, Incubation, Residues.

Introduction

Organophosphorus pesticides are largely used in agriculture against a wide variety of insect pests [1-7]. Diazinon (0,0-diethyl,0-2-isopropyl-6-methylpyrimin-4 ylphosphorothioate) is a widely used organophosphorus pesticide against a large variety of insect pests in the crop fields and its degradation studied [8,9]. The microbial degradation of diazinon, the less toxic hydrolysis product (2-isopropyl-6-methyl-hydroxypyrimidin) resisted further degradation in rice soil (pH 6.6) under submerged conditions [10].

The chemical hydrolysis degradation rates, temperature, effects have been studied [11-14]. The diazinon residues were also detected from different soils alongwith other organophosphorus pesticides [7]. Although numerous results are available concerning the residues of diazinon in various soils but no information is recorded from Bangladesh soils. In the present investigation diazinon degradation was studied in a typical silty clay soil under air-dry and field capacity moisture conditions.

Materials and Methods

250 Grams air-dry silty clay (pH 6.5, organic matter 1.3%) soil treated with diazinon (Finn. Comp., 100% pure) at the rates of 30, 300 and 3000 ppm levels. The required amount of the pesticide was first diluted in ether, applied to soils, and mixed well in a china dish. Two soil conditions were created air-dry and field capacity moisture levels. For air-dry levels only pesticide concentration were applied and well mixed as described above. The treated soils were then transferred to the plastic bottles and kept for 200 days at room temperature (27 ± 3°). After uniform mixing of 20-25gm soil from each sample was collected after 0,10,20,40,80,120,160 and 200 days of incubation, and analysed the residues by gas chromatography [1,15].

Five or 10 gm of each soil sample was treated with 50 ml of solvent mixture of hexane-diethylether-dichloromethane-propanal (1:1:1:1; v/v) by a shaking method for 45 mins, and repeated the procedure with another 50 ml solvent mixture. The combined filtrate was dried by a rotavapour and prepared 10 ml solution with hexane. After necessary dilution the samples were injected to the Carlo Erba gas chromatograph with FID. The temperature was applied programmed from 100 to 200° with an increasing rate of 7°/min. The external standard solution (0.1% in hexane) was used [1,3,15].

Results and Discussion

The average results of the residue of diazinon in air-dry and field capacity moisture conditions are reported in Table 1. At low level (30 ppm) the degradataion was faster than that of 300 or 3000 ppm levels where the residue was not detected

TABLE 1. THE RESIDUES OF DIAZINON UNDER FIELD CAPACITY AND AIR-DRY CONDITIONS AT SILTY CLAY SOIL DURING DIFFERENT PERIODS OF OBSERVATION (EACH RESULT FROM AVERAGE OF FOUR CHROMATOGRAMS; PPM YIELDS).

Soil condition	Levels applied (ppm)	Incubation time (days)							
		1	10	20	40	80	120	160	200
Field capacity	30	30	25	20	14	8	4	0.4	–
	300	299	255	205	152	85	46	41	15
	3000	2997	2576	2118	1568	946	512	415	185
Air dry	30	30	28	26	23	20	17	15	12
	300	298	295	270	241	225	200	180	160
	3000	2996	2985	2810	2500	2300	2150	1900	1690

(–) Results not detected

after 200 days of observation. The similar phenomena was also recorded with other pesticides in various soil conditions [7, 16-18]. The degradation was very slow with air-dry soils during different periods of observation. Such slow release was also recorded with other pesticides under air-dry soil conditions [16,19]; including diazinon [12,13]. The residues of the three dosages remained in air-dry soils were 100, 94-98, 72-94, 60-69, 51-62, 45-58 and 36-49% after 0,10,20,40,80,120,160, and 200 days of incubation, respectively.

The results of Table 1 are calculated on percentage basis and the overall percent residues remained in field capacity and air- dry soils are reported in Fig. 1. The overall percent residues remaining in the soils are applied to the statistics i.e. in the linear regression equation: Y = ax+b (y=linear regression, a=slope, b=y-intercept; and r = correlation coefficient). The results are well fitted to the regression lines in Fig. 2 by plotting

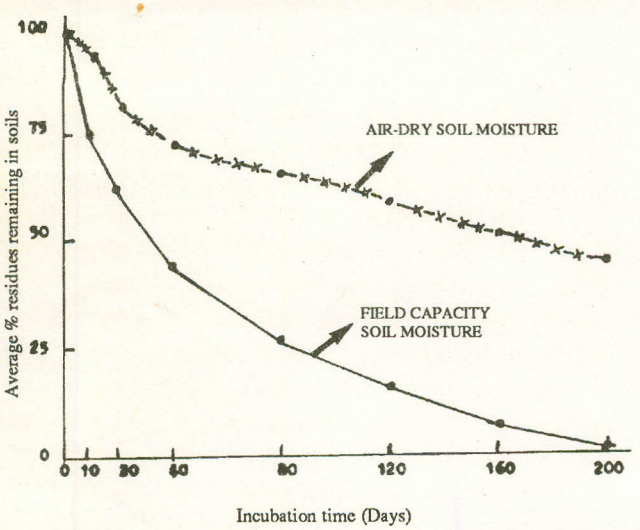

Fig. 1. The overall percent residues of diazinon remaining under field capacity and air-dry conditions in soils.

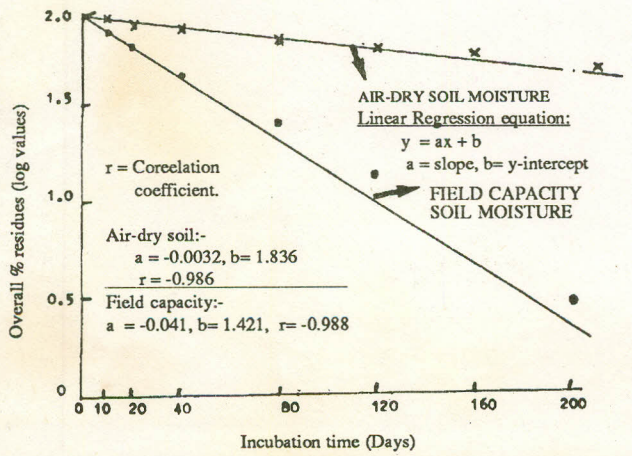

Fig. 2. Lorathims of the measured diazinon contents of the overall yields under field capacity and air-dry moisture conditions versus the incubation time, and the corresponding linear regression lines.

the log values of the residues remained (%) versus the observation time (days). The r values of -0.986 and -0.988 confirmed the fitting of the results in regression lines in air- dry and field capacity soil moistures, respectively. A first order rate constant also applied to the yields of diazinon, and the half life time was calculated. The similar calculation was also applied in numerous pesticide degradation studies in soils and other environmental samples [7, 19-22]. The calculated half life time in field capacity and air-dry soils were 17 and 217 days respectively. It is recorded that 50-55 factors sharply influence the rate of pesticide degradation in soils and other environmental samples [2, 23, 24]. In present investigation several factors sharply influenced the variation of residues under two soil conditions.

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