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A Study on the Relationship Between the Dissipation of Insecticides and Rhizosphere Microflora of Paddy

By

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ABSTRACT

A study on the interrelationship between the dissipation of two granular insecticides and different microbial populations in the rhizosphere soil of paddy crop indicated a positive correlation between the residues of phorate and actinomycete and *Azotobacter* populations. However, no such definite relationship could be recorded with carbofuran and various groups of microflora.

INTRODUCTION

When chemical pesticides are deposited on soil after the application to plants or after being applied directly to soil for the control of various soil pests, a variety of physical, chemical and biological factors affect their dissipation resulting finally in a residue consisting of the originally applied compound or various metabolites or both (Lichtenstein, 1972). Much information is not available on the relationship between the dissipation of insecticides with reference to different microbial load in the rhizosphere of plants. The present investigation was aimed to assess the relationship between the different groups of microflora and the amount of degraded insecticides in the rhizosphere soil of paddy (variety, IR 20).

MATERIALS AND METHODS

A randomised replicated trial with the systemic granular insecticide phorate (0,0 - diethyl S - (ethylthio) methyl phosphorodithioate) and carbofuran (2,2-dimethyl 2,3-dihydrobenzofuranyl-7-N methylcarbamate) was laid out in the University Experimental Farm. The insecticides were applied in two split doses at the rate of 1.25 kg a. i./ha first 15 days after transplanting and another at 30 days after the application of first dose at the root region. A composite rhizosphere soil sample was taken from each treatment on the 3, 5, 10, 20 and 30th day after first dose of application of insecticides and on 3, 10, 20 and 30th day after second dose of application of insecticides to estimate the residue levels of the insecticides and the microbial populations. The method of Schumann and Olson (1964) was adopted for estimating the phorate residues while carbofuran residues were estimated as per the procedure described by Gupta and Dewan (1971). Serial ten fold dilutions of soil samples were made to estimate the fungal, bacterial, actinomycete and *Azotobacter* populations,

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employing Martin's rose bengal, soil extract, Kuster's and Waksman's '77 agar medium, respectively.

RESULTS AND DISCUSSION

The amount of residues of insecticides present on different sampling periods and the changes in microbial populations are presented in Tables 1 and 2. After application of insecticides the residues got reduced with time interval. Application of phorate significantly increased the bacterial and fungal populations at all periods after the second dose of application. Stimulation of bacterial and fungal population due to application of other organophosphorus compounds like pestox, schradan and parathion has also been reported earlier (Verona and Picci, 1952; Naumann, 1958; Sivasithambaram, 1970). Carbofuran, however, significantly depressed the bacterial population and numerically lowered the prevalence of fungal population at all stages of sampling after the first dose of application of insecticides while an increase was observed on 3rd and 10th day in fungal and bacterial populations, respectively. Although no reports are available on the effect of carbofuran on soil microorganisms, Kandasamy *et al.* (1974) reported that application of aldicarb, a carbamate group of insecticide, at 1.0 kg. a.i/ha reduced the bacterial population with a simultaneous increase in fungal population. Actinomycete population got decreased significantly at all stages after the second dose of application of both insecticides whereas an increase was observed at all stages of sampling after first dose of application except on 5th day. *Azotobacter* population increased at 10 and 20 days after application of first dose of insecticides and after 10 days of second dose of application. Stimulation as well as suppression of actinomycetes and *Azotobacter* due to application of various organophosphorus compounds and carbamate insecticides have been reported by Gunner *et al.* (1966), Gaur and Misra (1970) and Kandasamy *et al.* (1974).

Apparently no attempts have been made earlier to correlate the microbial population and the residue of the insecticide in the rhizosphere soil of crop plants. An approach in that direction revealed the existence of a positive correlation between quantity of phorate dissipated and the actinomycete and *Azotobacter* populations in the rhizosphere soils of paddy (Fig. 1). An enhanced growth of actinomycetes in the presence of insecticides like DDT and diazinon was reported earlier (Ko and Lockwood, 1968; Sethunathan and MacRae, 1969). In a study on the utilization of disyston, an organophosphorus insecticide by different soil microflora, Bhaskaran *et al.* (1973) reported that *Streptomyces* spp., were more efficient degraders than certain soil fungi. An enhanced growth of *Azotobacter* was recorded in disyston treated soils as well as in nutrient medium containing organophosphorus insecticides (Sreenivasalu and Rangaswami, 1973; Kandasamy *et al.*, 1974). However, no definite correlation was recorded between bacteria and fungi and the dissipation of phorate. Also no correlation was observed between any group of microflora and the dissipation of carbofuran. This may, perhaps, be due to the fact that the surviving organisms which might be either tolerant and capable of accumulating

TABLE 1. Changes in the rhizosphere microflora of paddy as influenced by granular application of phorate and its dissipation

(Population expressed in 10^x per g of moisture free soil)

Days after application of insecticide	Fungal population (X 10^3) C	Fungal population (X 10^3) T	Bacterial population (X 10^6) C	Bacterial population (X 10^6) T	Actinomycete populations (X 10^5) C	Actinomycete populations (X 10^5) T	*Azotobacter* population (X 10^2) C	*Azotobacter* population (X 10^2) T	Residue (ppm)
First split dose									
3	1.85	64.10	6.76	10.96	3.72	4.92	34.08	21.93	2.90
5	4.49	0.52	6.09	5.77	6.92	4.19	34.60	13.91	1.36
10	1.55	2.92	7.14	10.96	3.37	3.65	4.31	8.77	0.94
20	1.70	1.40	5.52	6.90	1.26	2.79	4.13	4.79	0.25
30	2.64	2.50	8.65	7.75	2.75	3.61	16.50	12.50	0.07
Second split dose									
3	3.20	8.20	10.53	12.75	7.27	5.85	42.76	31.70	3.16
10	5.12	21.30	9.42	13.75	6.78	4.68	20.50	26.62	1.25
20	7.05	15.62	10.31	15.50	9.21	4.60	31.20	12.70	0.15
30	7.63	42.53	11.02	16.25	12.65	5.02	46.64	20.41	Not detectable

C : Control; T : Insecticide applied at 1.25 kg. a. i / ha.

Fungi	*C. D.*	*Bacteria*	*C. D.*	*Actinomycetes*	*C. D.*	*Azotobacter*	*C. D.*
Treatment Vs control	: 0.222	Treatment Vs control	: 0.109	Treatment Vs control	: 0.041	Treatment Vs Control	: 3.79
Period within control	: 0.665	Period within control	: 0.327	Period within control	: 0.125	Period within control	: 11.31
Treatment split	: 0.319	Treatment split	: 0.155	Treatment split	: 0.059		
Period within split treatment	: 0.665	Period within split treatment	: 0.327	Period within split treatment	: 0.125	Treatment split	: 5.36

TABLE 2. Change in rhizosphere microflora of paddy as influenced by granular application of carbofuran and its dissipation

Days after application of insecticide	Fungal population ($X 10^3$)		Bacterial population ($X 10^6$)		Actinomycete population ($X 10^5$)		Azotobacter population ($X 10^2$)		Residue (ppm)
	C	T	C	T	C	T	C	T	
First split dose									
3	1.85	4.88	6.76	6.74	3.72	5.86	34.08	15.62	7.33
5	4.49	1.33	6.09	3.11	6.92	3.99	34.60	20.77	5.20
10	1.55	1.25	7.14	9.13	3.37	8.08	4.31	8.08	2.86
20	1.70	0.93	5.52	3.72	1.26	3.72	4.13	5.72	1.93
30	2.64	1.52	8.65	5.65	2.75	5.20	16.50	3.85	1.55
Second split dose									
3	3.20	7.25	10.53	8.34	7.27	4.20	42.76	7.50	8.44
10	5.12	6.20	9.42	12.12	6.78	3.75	20.50	27.66	3.72
20	7.05	3.13	10.31	14.75	9.21	5.62	31.20	15.00	2.66
30	7.63	4.64	11.02	18.63	12.65	7.40	46.64	26.05	2.12

C : Control; T : Insecticide applied at 1.25 kg a. i / ha level

Fungi	*C. D.*	*Bacteria*	*C. D.*	*Actinomycetes*	*C. D.*	*Azotobacter*	*C. D.*
Period within control :	3.90	Treatment Vs control :	0.016	Treatment Vs control :	0.016	Treatment Vs control :	0.237
Treatment split :	1.85	Period within control :	0.047	Period within control :	0.047	Period within control :	0.711
		Treatment split :	0.022	Treatment split :	0.022	Treatment split :	0.337
		Period within split treatment :	0.047	Period within split treatment :	0.047	Period within split treatment :	0.711

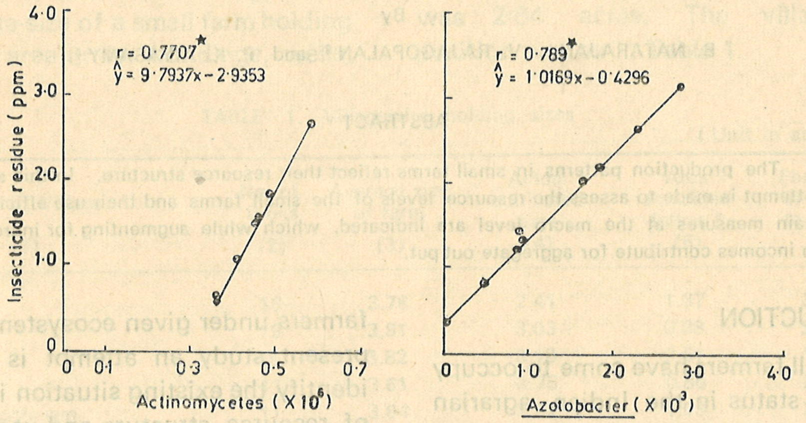

FIG. 1 RELATIONSHIP BETWEEN THE RESIDUES OF PHORATE AND ACTINOMYCETE AND AZOTOBACTER POPULATIONS IN THE RHIZOSPHERE SOIL OF PADDY

and storing the chemical in unaltered form in their cells or able to degrade the insecticide to a less toxic form (Matsumura and Boush, 1971).

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