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Effect of Organophosphorus Insecticides on Soil Microflora, Nodulation and Yield of Groundnut

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The effect of three organophosphorus insecticides, viz., fensulfothion, quinalphos and disulfoton on the microflora of a red loamy soil and growth characteristics of groundnut (POL 1 variety) was assessed in a field trial. The insecticides favoured increases in bacteria, actinomycetes and *Azotobacter* but not fungi. However, the effect of insecticides on various groups of soil microflora varied with time. Nodulation, shoot and root length and dry weight of plants were not adversely affected by the application of organophosphorus granular insecticides to the soil. However, yield of pods decreased when soil was treated with quinalphos. But application of fensulfothion and disulfoton increased the pod yield.

Application of potent granular insecticides has become the order of the day for the control of insect pests in modern agriculture These chemicals are reported to cause considerable changes in soil microflora (Naumann, 1959; Sivasithambaram, 1970; Oblisami *et al.*, 1972; Sreenivasalu and Rangaswami, 1973). But, little information is available on the interaction of insecticides applied to soil on the nodulation and growth of leguminous plants (Diatloff, 1970; Pareek and Gaur, 1970; Gilberg, 1971). Therefore this study was undertaken to examine the effect of three organophosphorus insecticides on the microbial populations of red loamy soil and nodulation and growth characteristics of groundnut (*Arachis hypogaea*).

MATERIALS AND METHODS

A randomised replicated trial with three organophosphorus, granular insecticides, viz., fensulfothion, quinalphos and disulfoton was laid out in the University Experimental Farm, Coimbatore, under irrigated conditions. The insecticides were applied to the soil at 2.0 kg (a. i)/ha and rhizobium treated seeds of POL-1 variety of groundnut were sown. The plots having no insecticide application served as control. A composite soil sample was taken from each treatment on 0, 45, 85 and 115 days after sowing and serial dilutions of soil samples were made to estimate the bacterial, actinomycetes, azotobacter and fungal populations employing soil extract, Kuster's, Waksman's 77 and Martin's rose bengal agar media, respectively. The nodule number, root and shoot length and dry weight of plants were estimated by collecting the plant samples on 30 and 75 days after sowing. When the plants were 110 days old, they were harvested and yield of pods was recorded.

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RESULTS AND DISCUSSION

The results on the effect of the three organophosphorus insecticides on the microbial populations of the red loamy soil of the experimental farm are presented in Tables I and II.

The application of fensulfothion and quinalphos had caused an increase in the total microbial load of the soil while the application of disulfoton had no such effect. Earlier reports indicated that most of the organophosphorus insecticides have stimulatory effect on soil microflora (Verona and Picci, 1952; Naumann, 1959; Sivasithambaram, 1970; Sreenivasalu and Rangaswami, 1973) presumably due to their degradation products serving as nutrient sources (Matsumura and Boush, 1966 and 1968). Fensulfothion and quinalphos could have been degraded like-wise and exerted the stimulatory effect on the microflora. It is possible that disulfoton might have been rapidly absorbed by microbial cells and released slowly (Ahmed and Casida, 1958). Hence it could not have any striking stimulatory effect on the microflora of the soil. Among different groups of organisms enumerated, bacterial population was high, followed by actinomycetes, fungi and *Azotobacter*. In the presence of fensulfothion and quinalphos, the bacterial and *Azotobacter* populations increased. Perhaps, bacteria being more efficient degrader than the other groups, they could have multiplied more rapidly which resulted in large population (Verona and Picci, 1952; Naumann, 1959; Sreenivasalu and Rangaswami, 1973). Fensulfothion alone stimulated the populations of fungi and actinomycetes while quinalphos and disulfoton did not cause any such alteration. As

TABLE I. Effect of organophosphorus insecticides on soil microflora

Treatment	Bacteria (10^6/g oven dry soil)				Azotobacter (10^2/g oven dry soil)			
	*0	45	85	115	0	45	85	115
Control (No insecticide)	1.7	20.3	27.1	14.7	1.0	33.3	116.7	20.0
Fensulfothion	4.3	32.0	31.7	15.3	3.3	16.7	110.0	80.0
Quinalphos	6.7	26.3	31.7	15.0	3.0	46.7	140.0	66.7
Disulfoton	4.3	23.7	21.3	15.7	2.0	23.3	80.0	56.7

* Days after sowing

TABLE II. Effect of organophosphorus insecticides on soil microflora

Treatment	Actinomycetes (10^4/g over dry soil)				Fungi (10^4/g over dry soil)			
	* 0	45	85	115	0	45	85	115
Control (No insecticide)	2.7	50.0	63.3	33.3	1.3	16.7	30.0	30.0
Fensulfothion	1.3	56.7	90.0	43.3	2.0	100.0	106.7	40.0
Quinalphos	2.7	53.3	70.0	40.0	1.3	20.0	16.7	40.0
Disulfoton	3.7	60.0	70.0	40.0	1.3	43.5	56.7	60.0

* Days after sowing

TABLE III. Effect of organophosphorus insecticides on plant chracteristics of groundnut (POL-I variety - Bunch type)

Treatment	Nodules (No./plant)		Root length (cm/plant)		Shoot length (cm/plant)		Dry weight (g/plant)	
	* 30	75	30	75	30	75	30	75
Control (No insecticide)	19	20	9.50	11.20	18.12	20.98	8.75	20.50
Fensulfothion	21	17	9.55	11.05	19.80	22.18	9.00	16.50
Quinalphos	26	15	9.88	10.68	19.40	20.28	10.50	15.00
Disulfoton	15	16	8.10	10.00	18.02	20.18	11.00	16.25

* Age of the plant in days

reported by Matsumura and Boush (1968) the organophosphorus insecticide, fensulfothion, could have exerted selective stimulatory action on fungal flora, whereas fensulfothion and quinalphos enhanced the population of *Azotobacter*, disulfoton did not have any effect. This is in accordance with the data of Sreenivasalu and Rangaswami (1973).

The results on the effect of organosphosphorus insecticides on the nodulation, growth characteristics and yield of groundnut are presented in Table III and IV.

Much of variation in plant characteristics occurred due to the application of the granular organophosphorus insecticides to the soil. In quinalphos treated plots, the number of nodules was highest on the 30th day but, on the 75th day number of nodules was minimum. The insecticide treatment did not appreciably alter the root and shoot length of the plants except disulfoton which reduced the root length of plants. Furthermore, insecticide application favoured an increase in the dry matter in 30 days old plants but reduced it on the 75th day.

TABLE IV. Effect of organophosphorus insecticides on pod yield of groundnut (Pol-I variety - Bunch type)

Treatment	Pod yield (kg/ha)	% over control
Control (No insecticide)	1640	—
Fensulfothion	1762	+ 7.41
Quinalphos	1175	—28.48
Disulfoton	1980	+20.60

It is somewhat difficult to explain these results based on the available information in literature. We believe that these results might be due to the delayed action of the insecticides or accumulation of higher concentration of insecticides in the plant which might exert deleterious effect on the rhizobium-legume symbiosis. Compared to the control, pod yield increased by 7.4 and 20.6 per cent in fensulfothion and disulfoton treatments. But, pod yield in quinalphos treated plot decreased to the extent of 28.5 per cent.

Eventhough all the three insecticides are organophosphorus compounds they seem to differ in the mode of

action, at least on rhizobium-groundnut symbiosis and consequently affected the pod yield. Detailed studies are therefore needed to understand the mode of action of these insecticides on pod yield, eventhough it did not cause any harmful effect on plant growth and nodulation characteristics.

REFERENCES

AHMED, M. K., and J. E. CASIDA, 1958. Metabolism of some organophosphorus insecticides by microorganisms. *J. econ. Ent.* 51 : 59-63.

DIATLOFF, A., 1970. The effects of some pesticides on the root nodule bacteria and subsquent nodulation. *Arch. J. Exp. Agric. Anim. Husb.* 10 : 562-67.

GILLBERG, B. O., 1971. On the effect of some pesticides on *Rhizobium* and isolation of pesticides resistant mutants. *Arch. Microbiol.* 75 : 203-208.

MATSUMURA, F. and G. M. BOUSH., 1966. Malathion degradation by *Trichoderma viride* and a *Pseudomonas* sp. *Science* 153 : 1278-80.

MATSUMURA, F. and G. M. BOUSH., 1968. Degradation of insecticides by a soil fungus. *Trichoderma viride*. *J. econ. Ent.*, 66 : 610-12.

NAUMANN, K., 1959. The effect of pesticides on the soil microflora. *Mitt. biol. Bund. Aust. Berl.* 97 : 107-17.

OBLISAMI, G., T. NATARAJAN and D. J. BAGYARAJ, 1972. Effect of granular carbamate insecticide, carbofuran on the microflora of Hebbal red soil. *Abst. XIII. Ann. Cong. AMI. Ludhiana.* p-30.

PAREEK, R. P., and A. C. GAUR., 1970. Effect of dichlorodiphenyl trichloroethane (DDT) in symbiosis of *Rhizobium* sp. with *Pha. seolus aureus* (Groengram) - *Pl. Soil.*33 : 297-304.

SIVASITHAMBARAM, K., 1970. Some effects of an insecticide 'Dursban' and weedicide 'Linuron' on the microflora of a submerged soil. *Riso*, 19: 339-46.

SREENIVASALU, S. and G. RANGASWAMI, 1973. Studies on the effect of three granular organophosphorus insecticides on soil microflora. *Indian J. Microbiol.* 13 : 89-95.

VERONA, G. and G. PICCI., 1952. The effect of systemic insecticides on the microflora of soil. *Agri. Ital.* 52 : 61-70.