Agric. Res. J, Kerala, 1985, 23 (2) 189—192

INFLUENCE OF TWO PESTICIDES ON CERTAIN SOIL ENZYMES

Ever-increasing use of agrochemicals in modern agriculture demands keen attention on extensive screening programme for ecological side-effects of pesticides. The study on the effects on soil environment deserves great concern since pesticides ultimately reach the soil where the microflora make a major contribution to soil fertility by their role in the recycling of nutrients.

Reports have shown that the enzyme activity may be correlated with microbial activity (Burns, 1 977} and hence soil enzymes can be regarded as indicators of soil physiological activities (Greaves, 1977). The organophosphorus insecticides were reported to affect soil enzymes at varying magnitude depending on their chemical nature (Lethbridge and Burns, 1976). But work on carbamate insecticides are seldom reported. Among herbicides urea- and carbamate herbicides applied at recommended rates inhibited strongly the activities of protease and dehydrogenase (Krozel and Musial, 1969). From the earlier reports, it is clear that the depressive or stimufating effects depend on the kind of chemicals, their concentration and/or environmental conditions (Gupta and Moolani, 1970).

This paper presents the results of the study on the effects of two commonly applied pesticides, Furadan and Basalin, on certain soil enzymes.

Two hundred and fifty grams of air-dried, sieved (2 mm) red soil of Alfisol order (org. C 0,33%, pH 7.2) was taken in wide-mouth bottles to which the pesticides, Furadan 3G and Basalin 48 EC, were added at three different doses viz., 2 ppm, 5 ppm, and 10 ppm of active ingredient. The replicated treatments were maintained at 37 + 1°C and 50% maximum water holding capacity. The soil samples were drawn periodically and the enzyme activities were assayed. The invertase and amylase activities were estimated by the modified procedure or Balasubramanian *et al*. (1970) and the results were expressed in milliunits (mU). One mU represents the amount of enzyme activity which will catalyse the hydrolysis of carbohydrates to give 1 X 10^3 micromoles of glucose per min at 37°C (Ross, 1965). The dehydrogenase activity was estimated by the method of Klein *et al,* (1971) and the urease activity by the method of Tabatabai and Bremner (1972).

The invertase and dehydrogenase activities of soil were decreased due to the application of Furadan in 5 ppm and 10 ppm levels but the difference was not statistically significant (Table 1). However the amylase activity was significantly stimulated in5 ppm and 10 ppm treatments (Table 2). The urease activity of soil with 2 ppm Furadan was significantly stimulated while that of 5 ppm treatment was on par with control. But 10 ppm caused significant reduction in urease activity. These results evidently show that Furadan has definite influence on soil microbial activities especially at a higher level (10 ppm). Jeyachandran and Chandramohan (1977) reported that Furadan at 1 kg/ha stimulated the invertase and amytase activities of rice rhizosphere which conform the present results. In the present studies, the stimulating or inhibiting effects of Furadan on different

enzymes could be attributed to the possibility that Furadan might have affected specific groups of microflora and hence resulted in the proliferation of the resistant and/or degrading microorganisms.

With reference to Basalin, harmful effect of the chemical at higher doses (5 ppm and 10 ppm) was noticed, with all the four enzymes (Tables 3 and 4). However, at recommended rate the herbicide had no significant effect. The suppressing nature of the herbicide is comparable to the report of Tyunyayeva *et al*.

Table 1
Effect of Furadan on invertase and dehydrogenase

Incubation time (weeks)	Invertase [1]				Dehydrogenase [2]			
	0 ppm	2 ppm	5 ppm	10 ppm	0 ppm	2 ppm	5 ppm	10 ppm
Initial	8.49	8.53	8.30	8.67	3.21	3.56	3.00	3.57
1	12.49	14.40	13.49	14.46	4,27	4.54	5.30	6.51
2	14.69	15,43	18.69	18.62	5,60	4.73	6.52	5.09
3	13.37	13.62	16.55	15.55	6.60	6.34	5.69	5.33
4	11.53	11.00	11.60	13,52	5,51	5.56	4.88	4.91
5	12.70	12.23	9.72	10.43	4.40	6.52	5.52	4.47
6	10.39	11.57	7.72	7.55	6.57	5.58	4.52	3.76
7	11.99	10.26	7.01	4.99	4.27	4.52	3.69	1.60
8	12.57	9.91	7.48	5.54	5.47	5.31	3.53	2.40
C.D (0.05)	Not significant				Not significant			

[1] Enzyme activity as mU/g dry soil
[2] Enzyme activity as nmoles of formazan formed/g soil/min

Table 2
Effect of Furadan on amylase and urease

Incubation time (weeks)	Amylase [1]				Urease [2]			
	0 ppm	2 ppm	5 ppm	10 ppm	0 ppm	2 ppm	5 ppm	10 ppm
Initial	1.27	1.38	1.32	1.30	23.75	23.75	24.45	23.05
1	1.79	2.21	1,72	1.48	30.05	36,35	27.25	16.75
2	1.43	2.23	1.87	1.91	44.05	46.85	27.25	16.75
3	1.21	2.10	2.18	2.59	36.35	37.05	34.25	16.05
4	1.82	2.18	2.64	3.20	22.70	36.00	36.35	16.75
5	1.51	2.21	2.66	2.81	16.75	16.75	19.55	17.45
6	1.48	1.99	2.72	2.74	16.05	16.40	17.45	18.85
7	1.71	1.77	2.19	2.70	17.45	17.45	16.40	19.20
8	1.77	2.03	2.52	2.70	15.70	16.40	17.45	18.50
C.D (0.05)				0.62				1.02

[1] mU/g dry soil
[2] mg of NH_4–N formed/g dry soil/h

Table 3

Effect of Basalin on invertase and dehydrogenase

Incubation time (weeks)	Invertase[1] 0 ppm	2 ppm	5 ppm	10 ppm	Dehydrogenase[2] 0 ppm	2 ppm	5 ppm	10ppm
Initial	8.49	8.54	8.56	8.44	3.21	3.71	3.21	3.44
1	12.49	11.45	10.70	9.55	4.27	4.24	4.50	3.57
2	14.69	13.43	9.76	6.52	5.50	4.74	4.67	3.27
3	13.37	12.61	8.65	5.57	6,60	5.30	3.71	2.73
4	11.53	10.74	8.59	6.33	5.51	6.69	3.61	2.31
5	12.70	11.33	7.30	4.91	4.40	5.75	3.05	1.52
6	10.39	12.14	8.46	5.05	6.57	4.78	3.20	1.11
7	12.57	10.98	5.43	460	5.47	5.21	2.62	N.D
8	11.99	11.52	5.57	4.50	4.2	5.26	3.01	N.D
C.D (0.05)				2.50				1.90

N. D—Not detectable

[1] mU/g dry soil

[2] nmoles of formazan formed/a dry soil/min

Table 4

Effect of Basalin on amylase and urease

Incubation time (weeks)	Amylase[1] 0 ppm	2 ppm	5 ppm	10 ppm	Urease[2] 0 ppm	2 ppm	5 ppm	10 ppm
Initial	1.27	1.22	1.28	1.28	23.75	23,05	23.05	23.75
1	1.79	1.67	1.20	1.08	30.05	23.05	23.75	17.45
2	1.43	1.61	0.99	0.79	44.05	29.35	24.25	16.05
3	1.21	1.21	0.80	0.65	36.35	37.05	19.55	13.25
4	1,84	1.11	0.87	0.58	22.70	36.35	17.80	10.45
5	1.51	1.30	0.86	0.48	16.75	16.75	16.05	6.75
6	1.48	1.28	0,80	0.52	16.75	16.75	13.05	5.55
7	1.77	1.29	0.80	0.44	17.45	16.45	13.40	4.85
8	1.71	1.18	0,69	0.53	15 60	16.75	12.20	4.85
C.D P=0.05				0.39				0.77

[1] mU/g dry soil

[2] mg of NH_4-N fomed/g dry soil/h

(1974) who found that trifluralin, a similar trinitroaniline compound, suppressed the urease activity at 3 ppm level. The invariable impact of the herbicide, at higher rates of application, on all the enzymes tested, indicates the toxic effect on total biological system of the soil that could endanger the soil fertility. Hence care must be taken to avoid frequent use or higher rate of application of dinitroaniline herbicides that may lead to residue accumulation in soil.

സംഗ്രഹം

ഫ്യൂറഡാൻ, ബാസലിൻ എന്നീ കീടനാശിനികളും വിവിധ അളവിൽ മണ്ണിൽ ചേർക്കുമ്പോൾ അവ മണ്ണിലെ എൻസൈമുകളെ എങ്ങിനെ ബാധിക്കുന്നുവെന്നു പഠിക്കുകയുണ്ടായി. ഫ്യൂറഡാൻ കുറഞ്ഞ അളവുകളിൽ അമിലേസു, യൂറിയേസു എന്നിവകളുടെ പ്രവർത്തനത്തെ വർദ്ധിപ്പിക്കുന്നതായി കാണപ്പെട്ടു. എന്നാൽ കൂടിയ അളവുകളിൽ (10 ppm) ഇൻവെർടേസു, ഡീഹൈഡ്രോജിനേസു, യൂറിയേസു എന്നിവകളുടെ പ്രവർത്തനത്തെ കുറക്കുകയും raras'ിലേസിന്റെ പ്രവർത്തനത്തെ വർദ്ധിപ്പിക്കുകയും ചെയ്യുന്നു. ബാസലിൻ 5ppm, 10ppm എന്നീ അളവുകളിൽ മേൽ പറഞ്ഞ rnoej" എൻസൈമുകളുടേയും പ്രവർത്തനത്തെ പരിമിതപ്പെടുത്തുന്നതായി കാണപ്പെട്ടു.

Agricultural College & Res. Institute
Madurai 625 104

S. P. Palaniappan[1]
A. Balasubramanian

[1] Present address: Fishsries College, Tuticorin 628 008

References

Balasubramanian, A., Joseph Bagyaraj, D. and Rangaswami, G. 1970. Studies on the influence of foliar application of chemicals on the microflora and certain enzyme activities in the rhizosphere of *Eleusine coracana* (Linn.) Gaertn. *Pl. Soil* 82: 198-206.

Burns, R, G. 1977. *Soil Enzymology*, Oxf. Press, p 275

Greaves, R. P. 1977. A review of long-term effects of herbicides. Long-term effects of herbicides on soil microorganisms *Ann. App. Biol.* **91**: 120-132

Gupta, U. S. and Moolani, M. K. 1970. Effects of applied herbicides on soil microorganisms and their activity. *Indian J. Weed Sci.* 11: 142–159

Jayachandran, S. and Chandramohan, N. 1977. Influence of insecticides on the phyllosphere and rhizosphere of rice crop *Riso* 4: 323-330

Klein, D. A., Loh, T. C. and Goulding, R. L, 1971. A rapid procedure to evaluate the dehydrogenase activities of soils low in organic matter. *Soil Biol Biochem* **3**:385–387

Krozel, Z, and Musial, M. 1969. The effect of herbicides on soil microflora. II. The effects of herbicides on enzymatic activity of the soil. *Acta Microbiol. Pol.* **1**: 93-97

Lethbridge, G. and Burns, R. G. 1976. Inhibition of soils and urease by organophosphorus insecticides. *Soil Biol. Biochem.* 8: 99–102

Ross, D. J. 1965. A seasonal study of oxygen uptake of some pasture soils. and activities of enzymes hydrolysing sucrose and starch. *J. Soil Sci.* **16**: 73–85

Tabatabai, M. A, and Bremmer, J. M. 1972. Assay of urease activity in soils. *Soil Biol. Biochem.* 4: 474-487

Tyunyayeva, G. N., Mineko, A. K. and Pen'kov, L. A. 1974. Effect of Trifluralin on the biologicai properties of soil. *Agrokhimiya* 6: 110–114