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Effect of Carbofuran on Phosphomonoesterase Activity in Red and Black Soils using Gingelly as a Test Crop

D Srinivas and Saroja Raman
Department of Soil Science and Agricultural Chemistry, College Agriculture, Rajendranagar, Hyderabad-30, Andhra Pradesh, India

ABSTRACT

A pot culture experiment was conducted in red and black soil to evaluate the effect of insecticides on soil phosphomonoesterase (acid phosphatase and alkaline phosphatase) activity using Gingelly as a test crop. The soil applied insecticide viz., Carbofuran @ 1.65 and 3.3 kg ha^{-1} along with a untreated control in red soil and Phorate @ 3.3 kg ha^{-1} and 6.6 kg ha^{-1} along with untreated control in black soil were used in the study. The results indicated that Carbofuran applied @ 1.65 kg ha^{-1} (recommended dose) resulted in significant increase in the acid and alkaline phosphatase activity from 0-45 days after sowing. Both the phosphatases exhibited three to four fold increased activity at its peak compared to control. Application of Phorate at higher rates (3.30 kg ha^{-1} in black soil) resulted in reduced activity of acid and alkaline phosphatases. The decreased activity might be related to proteolysis of non-stabilized extra-cellular enzymes.

Key words : Carbofuran ,Gingelly, Phosphomonoesterase activity.

Any compound which alters the number and activity of micro-organisms could affect the soil biochemical processes (Tu and Bollen,1968) and ultimately the soil fertility and plant growth. In recent years, insecticides have been applied to agricultural soils to control the soil borne pathogens. The effect of insecticides on soil enzyme complex are extremely varied, complex and often mediated through changes in microorganisms present in the soil. The present paper examines the effect of insecticides i.e., Carbofuran on the phosphomonoesterase activity in gingelly grown on red and black soils.

MATERIAL AND METHODS

Pot culture experiment was conducted using red and black soils at College of Agriculture, Rajendranagar, Hyderabad. The red soil has pH of 7.1, clay content of 18 per cent and organic carbon of 2.7 g kg^{-1}. The black soil has pH of 8.4, clay content of 47 per cent and organic carbon of 5.9 g kg^{-1}. Five kilograms of soil was taken into earthen pots. A basal dose of 30, 30 and 20 kg ha^{-1} of N , P_2O_5 and K_2O were given in the form of urea , single super phosphate and muriate of potash respectively. Carbofuran, a soil applied systemic insecticide of Carbamate group was used in the study. The treatments in red soil comprised of untreated control, Carbofuran @ 1.65 and 3.30 kg ha^{-1} while the treatments in black soil comprised of untreated control, Carbofuran @ 3.3 and 6.6 kg ha^{-1}. The experiment was conducted in Randomized Block Design with four replications. Six seeds of Cowpea were sown and were later thinned to four per pot. Calculated quantities of the carbofuran were applied in the form of granules (one day after the sowing of crop) as per the treatment on the surface. The crop was irrigated as and when required. The initial soil sample was collected immediately after application of Carbofuran and subsequent samples were collected at 15 days interval till the harvest of the crop and were analysed for the activities of acid and alkaline phosphatase Tabatabai and Bremner (1969) and Eivazi and Tabatabai (1977), respectively and expressed as µg of 4-nitrophenol released g^{-1} soil h^{-1}. The data was subjected to two-way analysis of variance taking phorate treatments as one factor and stages of the crop growth as the second factor.

RESULTS AND DISCUSSION

The effect of Phorate on the activity of acid phosphatase and alkaline phosphatase under Cowpea in red soil and black soil are presented in Tables 1,2,3 and 4, respectively.

Acid and alkaline phosphatase activity of carbofuran applied soils were significantly higher than the untreated control, over the growth period of 30-60 DAS in both the soils under study. The enzyme levels in the beginning of the crop growth (0-15 DAS) and at the end of crop growth (90-105 DAS) were

Table 1. Effect of Carbofuran on soil acid phosphatase activity in red soil using Gingelly as a test crop.

Treatment	Acid phosphatase activity (μg of 4-nitrophenol released g^{-1} soil h^{-1})								
	0	15	30	45	60	75	90	105	Mean
	Days after sowing (DAS)								
Untreated Control	17.4	23.2	42.4	62.7	47.3	35.5	27.0	18.1	34.0
Carbofuran @ 1.65 kg ha^{-1}	18.2	34.5	60.9	82.6	62.4	40.9	31.0	21.3	44.1
Carbofuran @ 3.30 kg ha^{-1}	19.0	30.7	53.7	74.5	53.0	38.8	26.9	23.3	44.0
Mean	18.2	29.5	52.8	73.3	54.2	38.4	28.3	21.1	
Analysis of Variance			F test		CD at 5%	S.Ed			
Treatments			* *		2.7	1.4			
Days after sowing			* *		4.4	2.2			
Treatments X DAS			* *		7.5	3.9			

Table 2. Effect of Carbofuran on soil acid phosphatase activity in black soil using Gingelly as a test crop.

Treatment	Acid phosphatase activity (μg of 4-nitrophenol released g^{-1} soil h^{-1})								
	0	15	30	45	60	75	90	105	Mean
	Days after sowing (DAS)								
Untreated Control	15.4	21.3	46.4	50.6	37.0	21.1	18.0	12.5	27.8
Carbofuran @ 3.30 kg ha^{-1}	17.1	30.6	57.1	69.4	52.2	36.8	27.0	18.1	35.8
Carbofuran @ 6.60 kg ha^{-1}	16.6	26.3	39.7	57.2	46.8	30.0	21.9	16.3	31.9
Mean	16.4	26.1	47.7	59.1	45.3	29.2	22.3	15.6	
Analysis of Variance			F test		CD at 5%	S.Ed			
Treatments			* *		2.9	1.5			
Days after sowing			* *		4.8	2.4			
Treatments X DAS			* *		8.3	4.2			

Table 3. Effect of Carbofuran on soil alkaline phosphatase activity in red soil using Gingelly as a test crop.

Treatment	Alkaline phosphatase activity (µg of 4-nitrophenol released g^{-1} soil h^{-1})								
	0	15	30	45	60	75	90	105	Mean
	Days after sowing (DAS)								
Untreated Control	26.2	40.4	68.8	111.1	71.3	65.1	41.3	27.0	57.7
Carbofuran @ 1.65 kg ha^{-1}	27.8	67.0	104.2	121.8	106.7	88.7	71.6	52.9	82.8
Carbofuran @ 3.30 kg ha^{-1}	28.4	53.4	100.3	118.3	85.2	71.7	57.6	36.0	68.9
Mean	27.5	53.6	76.8	121.1	87.7	75.2	56.8	38.6	
Analysis of Variance			F test		CD at 5%		S.Ed		
Treatments			* *		5.2		2.6		
Days after sowing			* *		8.7		4.3		
Treatments X DAS			* *		14.7		7.5		

Table 4. Effect of Carbofuran on soil alkaline phosphatase activity in black soil using Gingelly as a test crop.

Treatment	Alkaline phosphatase activity (µg of 4-nitrophenol released g^{-1} soil h^{-1})								
	0	15	30	45	60	75	90	105	Mean
	Days after sowing (DAS)								
Untreated Control	30.1	61.7	90.4	109.5	91.2	66.4	48.0	38.2	66.9
Carbofuran @ 3.30 kg ha^{-1}	31.5	82.4	122.9	152.2	127.1	94.6	66.7	45.7	91.4
Carbofuran @ 6.60 kg ha^{-1}	32.3	70.3	104.5	134.9	103.5	79.8	51.4	41.3	77.3
Mean	31.3	71.5	105.9	132.2	107.1	80.3	55.4	41.7	
Analysis of Variance			F test		CD at 5%		S.Ed		
Treatments			* *		5.3		2.7		
Days after sowing			* *		8.7		4.4		
Treatments X DAS			* *		15.0		7.7		

not significantly influenced by carbofuran treatments.though the activity is higher than control it showed a decreasing trend.

Acid phosphatase and alkaline phosphatase showed maximum activity at active growth of the crop plants (45 DAS). The acid phosphatase in geral exhibited a five fold increased activity in red soil and four fold increased activity in black soil in both the seasons. The alkaline phosphatase showed a four fold increased activity in red soil swhile in black soil a five fold increased activity was observed at its peak compared to zero DAS (control) under both the seasons.

Among the Carbofuran treatments, acid phosphatase in red and black soils was in the order of Carbofuran @1.65 g ha^{-1} > Carbofuran @ 3.30 kg ha^{-1} > Untreated Control. Similarly, the alkaline phosphatase activity in red and black soils was in the order of Carbofuran @ 3.30 kg ha^{-1} > Carbofuran @ 6.60 kg ha^{-1} > Untreated Control. Insecticides can affect soil enzymes through their action on soil microorganisms, which in turn contribute to accumulated enzyme activity. The observance of decreased activity of acid and alkaline phosphatases at higher levels of Carbofuran might be due to the toxic effect of these chemicals on soil microorganisms which inturn influence the extra-cellular enzyme activity. Similar results were reported by Perucci *et al.* (1988). A similar hypothesis has been put forth by Cerevelli *et al.* (1978). The subsequent decrease in phosphatase activity was probably related to proteolysis of non-stabilized extra-cellular enzymes. These effects are more evident at the higher herbicide application rate. The results also indicated that insecticides are not detrimental to enzyme levels when applied at lower levels or recommended doses but prolonged application in large quantities might alter the status of enzymes in soil. Similar results were reported by Smith (1982).

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LITERATURE CITED

Cerevelli S, Nannipieri P and Sequi P 1978. Interactions between Agrochemicals and soil enzymes. In soil enzymes (ed R G Burns) Academic press, London.

Eivaji F and Tabatabai M A 1977. Phosphatases in soils. Soil Biology and Biochemistry 9:167-172.

Perucci P, Scarponi L and Monotti M 1988. Interference with soil phosphatase activity by maize herbicidal treatment and incorporation of maize residues. Biology and Fertility of Soils 6:289-291.

Smith A E 1982. Herbicides and the soil environment in Canada. Can.J.Soil Sci.62: 433-460.

Tabatabai M A and Bremner J M 1969. Use of p-nitrophenyl phosphate for assay of soil phosphatase activity. Soil Biology and Biochemistry 1:301-307.

Tu C M and Bollen W B 1968. Effect of Paraquat on microbial activity in soils. Weed Res. 8:28-35.

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