Asian J. of Bio Sci. (April, 2008) Vol. 3 No. 1 : (91-94)

Insecticide microflora interactions in banana rhizosphere

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(Accepted : January, 2008)

A field trial was conducted to study the impact of different insecticides recommended for the Control of pests of banana on different soil flora (Fungi, Bacteria and Actinomycetes) in the soil. The samples were drawn at monthly intervals till harvest of the crop. In carbaryl treatment, microbial population was low initially, but got restored later. With carbofuran, slight reduction of microbial population was observed immediately after the application of insecticides and got restored before harvest. But, with phorate, a slight enhancement of the population of bacteria and fungi was observed after the application of insecticides and it was restore at par with control before harvest of the crop.

Key words : Fungi, Actinomycetes, Bacteria Stimulatory effect, Suppressing effects.

INTRODUCTION

Banana (*Musa paradisiaca* L.) is the most important fruit in the tropical and subtropical regions. In India the crop is extensively grown in Kerala, Tamil Nadu, Maharashtra, Karnataka, Assam and Andhra Pradesh. In the northern districts of Kerala the production and productivity of the crop are seriously affected by the incidence of rhizome weevil and different species of nematode pests, while southern districts the incidence of devastating bunchy top disease is the major limiting factor in production. For containing these pests and disease problems , insecticides were applied as per the Kerala Agricultural University recommendations 2002 and the treatment is being extensively adopted by the farmers. Indeed, soil micro organisms play a major role in the degradation of organic wastes available in the agro ecosystem and which can be harnessed and utilized in the farming practices. Obviously the application of synthetic insecticides are highly toxic to nontoxic organisms. In this context an attempt to assess the extent to which the adoption of the recommended control measures against banana pests and diseases which in turn affect the useful soil flora in banana fields was studied in detail.

MATERIALS AND METHODS

A field trial was conducted at college of Agriculture, Vellayani, adopting a randomized block design using nendran variety of banana. The plot size is 120 m^2. The treatments were drenching rhizome and soil with carbaryl for controlling banana pseudostem weevil, application of carbofuran 1 g ai/plant (7.5 kg ai ha^{-1}) at planting and at 150 days after planting (DAP) for the control of nematodes; and application of phorate 2.5 g ai/plant (6.25 kg ai ha^{-1}) at 20^{th},75^{th} and 165^{th} DAP for the control of banana aphid. Phorate and Carbofuran granules were applied around the basins.

Population of the soil flora *viz.*, bacteria, actinomycetes and fungi was estimated in soil samples once prior to the planting and then at monthly intervals. Rhizosphere soil samples (10 g each) were collected from two different spots in each plot. Soil samples were taken from the basins one foot away form the basal region of the plant. Microflora were estimated by serial dilution and plating technique of Johnson and Curl (1972). Nutrient agar, Kauster's agar and Martin's rose Bengal agar were used for the isolation of bacteria, actinomycetes and fungi, respectively. Serial dilutions of different rhizosphere samples were prepared up to 10^{-7} dilution by using appropriate sterile water blanks. One ml each of 10^{-7}, 10^{-5} and 10^{-3} dilution was transferred to Petridishes of bacteria, actionmycetes and fungi with the appropriate medium. Then the plates were incubated at room temperature and counts were taken.

RESULTS AND DISCUSSION

Bacteria :

The results presented in Table 1 showed that the bacterial colonies in the carbaryl was generally lower than those of control through out the period of observation. But the

differences were statistically significant during the second, fifth and seventh month only. Since the application was not repeated these variations in carbaryl treated plots cannot be attributed to the insecticidal toxicity alone. The bacterial population was reduced immediately after the application of carbofuran and later on full revival of population was observed. An inhibitory effect of carbofuran on bacterial population in soil had been reported by an earlier worker, (Tu, 1972). The stimulatory effect observed in some cases (Visalakshy, *et al*., 1980; Kale and Raghu, 1989) was not observed in the banana ecosystem. Phorate also suppressed the bacterial population after the first and second applications at 20th and 75th DAP, respectively.

Table 1 : Mean number of bacteria in banana plots treated with different insecticides for pest control observed at monthly intervals after planting (Population expressed in 10 g soil x 10^{7} on wet basis)

Treatments	Pre-treatment population	Mean population in 10 g soil observed at different intervals after planting (months)									
		1	2	3	4	5	6	7	8	9	10
Carbaryl	50.2	43.8	44.9	59.0	46.2	36.8	46.0	37.4	37.2	51.2	46.9
	(7.1)	(6.6)	(6.7)	(7.7)	(6.8)	(6.1)	(6.8)	(6.2)	(6.1)	(7.2)	(6.9)
Carbofuran	75.3	66.0	32.4	68.3	26.8	30.4	26.0	51.3	43.4	72.3	78.1
	(8.7)	(8.1)	(5.7)	(8.3)	(5.2)	(5.6)	(5.1)	(7.2)	(6.6)	(8.5)	(8.8)
Phorate	65.3	35.5	68.7	93.1	52.7	36.4	57.5	80.5	40.6	66.8	65.9
	(8.1)	(6.1)	(8.3)	(9.7)	(7.3)	(6.1)	(7.6)	(9.0)	(6.4)	(8.2)	(8.1)
Control	76.3	64.5	72.1	74.2	66.7	62.4	31.8	77.9	72.4	77.3	50.8
	(8.7)	(8.0)	(8.5)	(8.6)	(8.3)	(7.9)	(5.7)	(8.8)	(8.5)	(8.8)	(7.2)
CD value		1.59	0.74		1.67	1.36	1.71	1.78			

Carbaryl drenching 0.2 per cent around rhizome and soil;
Carbofuran- 1 g ai/plant at planting and 105 days after planting (DAP)
Phorate- 2.5 g ai/plant at 20th, 75th and 165th days after planting (DAP)
Figures in parentheses are $\sqrt{X+1}$

Table 2 : Mean number of actinomycetes in banana plots treated with different insecticides for pest control observed at monthly intervals after planting (Population expressed in 10 g soil x 10^{5} on wet basis).

Treatments	Pre-treatment population	Mean population in 10 g soil observed at different intervals after planting (months)									
		1	2	3	4	5	6	7	8	9	10
Carbaryl	35.7	41.0	42.4	38.5	22.1	31.7	38.8	22.9	14.4	25.9	23.2
	(6.0)	(6.4)	(6.5)	(6.2)	(4.8)	(5.7)	(6.3)	(4.8)	(3.9)	(5.1)	(5.7)
Carbofuran	41.5	37.7	36.6	38.8	21.0	27.8	14.3	42.0	20.7	21.7	13.7
	(6.5)	(6.2)	(6.1)	(6.3)	(4.6)	(5.3)	(3.9)	(6.5)	(4.6)	(4.7)	(5.2)
Phorate	32.7	26.1	22.9	14.9	21.1	31.8	20.7	34.3	31.3	22.6	31.7
	(5.7)	(5.2)	(4.8)	(3.9)	(4.7)	(5.9)	(4.6)	(5.9)	(5.6)	(4.8)	(4.9)
Control	38.0	28.8	40.8	30.7	43.4	38.0	24.8	47.7	47.2	38.4	26.7
	(6.2)	(5.4)	(6.4)	(5.6)	(6.6)	(6.2)	(5.0)	(6.9)	(6.9)	(6.2)	(3.8)
CD value				0.92	1.40		1.12		1.65		

Carbaryl drenching 0.2 per cent around rhizome and soil;
Carbofuran- 1 g ai/plant at planting and 105 days after planting (DAP)
Phorate- 2.5 g ai/plant at 20th, 75th and 165th days after planting (DAP)
Figures in parentheses are $\sqrt{X+1}$

Suppression of bacterial population by phorate had been reported by an earlier worker Chendrayan and Prasad (1976) in groundnut fields. Das (1986) reported the stimulating effect of phorate on bacterial population in soil environment. Such stimulating effect was not significantly seen in the banana ecosystem though the third application of phorate at 165th DAP was followed by slight increase in bacterial population in the treated plots than control. The suppressing effect was more for carbofuran than for phorate and latter had shown slight stimulations when repeatedly applied in the soil.

Actinomycetes :

The results presented in Table 2 showed that the suppressing effect of actinomycetes was observed during the fourth and eighth month and a stimulatory effects was observed during the sixth month. Since the application of the insecticides did not synchronise with the variations in population, the latter cannot be attributed to the toxicity of pesticides. In the case of carbofuran, no significant reduction was noted. With phorate, significant reduction was observed after the first and second application of insecticides and the population was then restored and remained unaffected till harvest. The results agree with earlier findings also (Das, 1986). The stimulatory effect of the toxicant on actinomycetes population (Visalakshy *et al.*, 1981; Varshney and Rana, 1987) was not seen in any of the observations covered in the experiment.

Fungi :

The results presented in Table 3 showed that significant reduction of fungi was observed during the third and fourth month after planting in carbaryl treatment. In the case of carbofuran, slight reduction was noted after first and second application; then the population got restored. The insecticide did not show any stimulating effect in banana ecosystem though such an effect had been reported in another situation. (Mathur *et al.,* 1980). With phorate, slight reduction was observed after two applications and it was restored in the next month itself. The third application showed stimulatory effect and the population was higher than that observed in control in subsequent observations. Such stimulatory effect of phorate had been reported in the soil environment by the earlier workers (Visalakshy *et al*., 1981; Varshney and Rana, 1987; Das and Mukherjee, 1998).

In general stimulatory effect of soil flora was noticed due to the application of carbofuran & phorate after a period of time. This was in consonance with Das *et al.* (2005).

The inhibitory or stimulatory effect of insecticide depends on the initial concentration applied and its chemical structure. The data suggests that insecticides, by and large, do not produce deleterious effect on soil flora when applied at recommended dosage.

Table 3 : Mean number of Fungi in banana plots treated with different insecticides for pest control observed at monthly intervals after planting (Population expressed in 10 g soil x 10^3 on wet basis)

Treatments	Pre-treatment population	Mean population in 10 g soil observed at different intervals after planting (months)									
		1	2	3	4	5	6	7	8	9	10
Carbaryl	89.2	75.3	85.4	49.1	78.3	107.4	97.2	57.8	65.8	70.5	68.5
	(9.4)	(8.7)	(9.2)	(7.0)	(8.4)	(10.4)	(9.9)	(7.6)	(8.1)	(8.4)	(8.3)
Carbofuran	102.3	89.3	91.3	68.1	47.9	80.9	82.0	101.2	90.7	70.4	81.2
	(10.1)	(9.5)	(9.6)	(8.3)	(6.99)	(9.0)	(9.1)	(10.1)	(9.5)	(8.4)	(9.0)
Phorate	98.7	97.8	107.2	123.3	60.2	77.4	141.9	115.1	93.5	90.5	73.4
	(9.9)	(9.9)	(10.4)	(11.4)	(7.8)	(8.8)	(11.9)	(10.7)	(9.7)	(9.5)	(8.6)
Control	112.5	70.0	108.2	114.4	109.6	116.6	129.6	87.2	60.9	111.5	53.3
	(10.6)	(8.4)	(10.4)	(10.7)	(10.5)	(10.8)	(11.8)	(9.3)	(7.8)	(10.6)	(7.3)
CD value				1.85	2.05		2.15				

Carbaryl drenching 0.2 per cent around rhizome and soil;
Carbofuran- 1 g ai/plant at planting and 105 days after planting (DAP)
Phorate- 2.5 g ai/plant at 20th, 75th and 165th days after planting (DAP)
Figures in parentheses are $\sqrt{X+1}$

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