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EFFECT OF METALAXYL ON SOIL MICROBIAL POPULATION

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Abstract: Influence of metalaxyl [Methyl N-(2 methoxyacetyl)-N-(2, 6, xylyl)-DL alanihate] on total microbial population and nitrifying organisms was studied in a sandy loam soil under laboratory conditions. Low concentration of metalaxyl stimulated the bacterial and actinomycete population, but its higher levels significantly inhibited the population. However, different doses of metalaxyl inhibited fungal and *Azotobacter* population at all slates of observation. In general, metalaxyl recorded low microbial counts during later period of incubation. Interestingly, 0.5 ppm and 1 ppm of metalaxyl did not affect *Nitrosomonas* and *Nitrobacter* population: however, at higher concentration it significantly inhibited the nitrification process.

Key words: Metalaxyl, microbial population, nitrification. *Azotobacter*, fungicide.

INTRODUCTION

Metalaxyl [Methyl N-(2-methoxyacetyl)-N-(2,6, xylyl)-DL alaninate] is a systemic fungicide extensively used in Indian agriculture for seed treatment, foliar spray or soil drench to control plant diseases caused by oomycetous fungi. Currently, little information is available on effect of metalaxyl on microbial population and nitrifying organisms in soil. However, application of fungicides in general to soil or plant and its effects on soil microflora have been widely investigated (Anderson, 1978; Moorman, 1989; Thopate *el al.*, 1990). As the nitrifying organisms are extremely sensitive to environmental changes, the nitrogen transformation is one of the most widely used parameters to study the deleterious effects of agrochemicals (Naidu, 1972). Several workers reported that application of fungicides at recommended rate did not affect the nitrification process in soil (Faassen, 1974; Goring and Laskowaki, 1982; Tanaki *et al.*, 1985). Interestingly, a fungicide, zineb completely inhibited *Nitrosomonas* in liquid medium under laboratory conditions, but not the *Nitrobacter* population (Encheva and Rankov, 1990). The present investigation was undertaken to assess the effect of metalaxyl on total microbial population and also on nitrifying organisms in a sandy loam soil.

MATERIALS AND METHODS

Sandy loam soil was collected from IARI Farm, New Delhi. The soil contained 0.18% organic carbon, 0.026% total nitrogen, 3.2 kg ha^{-1} available phosphorus and 140 kg ha^{-1} available potassium. The pH of the soil was 7.2 (1:2.5 soil-water suspension). Metalaxyl, is a pre-emergence fungicide was obtained from the Agricultural Division, Ciba-Geigy Ltd., Basle, Switzerland.

One hundred grams of finely sieved (<2 mm) soil was transferred to each of 2.50 ml Erlenmeyer flasks. The varying concentrations of metalaxyl 0.5, 1.0, 2.5, 5.0 and 25 ppm were mixed and moisture content of the soil was made up to one third of its water holding capacity. The flasks were plugged with sterile rubber cork and incubated at 30°±1° C for 12 weeks. Five replications for each treatment were maintained. The sampling was done at 4, 8 and 12 weeks of incubation. The dilution plate method was followed to enumerate the total number of bacteria (Allen, 1959), fungi (Martin, 1950), actinomycetes (Allen, 1959) and *Azotobacter* (Jensen, 1951). The microbial population was calculated and expressed as number of cells per gram of soil. The effect of metalaxyl on nitrifier population in soil was determined by the most probable number method of Alexander (1965).

RESULTS AND DISCUSSION

The results (Table 1) revealed that 0.5 ppm of metalaxyl enhanced the mean bacterial population (33.67 x 10^6 g^{-1}) when compared to control (30.50 x 10^6 g^{-1}). Metalaxyl significantly inhibited the bacterial population in other treatments. Application of different doses of metalaxyl inhibited the fungal population at 4, 8 and 12 weeks of incubation. The maximum inhibition was recorded at 12 weeks when compared to that of 4 and 8 weeks. The actinomycete population (Table

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Table 1. Effect of metalaxyl on bacterial and fungal population in soil

Treatments (fungicide, ppm)	Bacteria, 10^6 g^{-1}				Fungi, 10^4 g^{-1}			
	Incubation period, weeks				Incubation period, weeks			
	4	8	12	Mean	4	8	12	Mean
0.0	46.00	27.50	18.00	30.50	13.00	13.67	6.67	11.11
0.5	35.50	41.50	24.00	33.67	7.00	9.17	4.00	6.72
1.0	34.33	35.17	13.00	27.50	7.33	10.00	4.17	7.17
2.5	47,17	24.00	7.00	26.06	6.33	7.50	3.33	5.72
5.0	30.00	22.83	5.67	19.50	7.00	4.00	3.67	4.89
25.0	30.17	12.17	2.67	15.00	5.00	4.50	1.33	3.61
Mean	37.19	27.19	11.72	25.57	7.61	8.14	3.86	6.54
	Period	Treat	PxT		Period	Treat.	PxT	
SEm ±	1.242	1.757	3.043		0.574	0.812	1.407	
CD (0,.05)	3.568	5.047	8.741		1.650	2.333	4.041	

Table 2. Effect of metalaxyl on actinomycetes and *Azotobacter* population in soil

Treatments (fungicide ppm)	Actinomycetes, 10^4 g^{-1}				*Azotobacter*, 10" g"^{1}			
	Incubation period, weeks				Incubation period, weeks			
	4	8	12	Mean	4	8	12	Mean
0.0	21.83	32.33	11.00	21.72	26.33	20.33	18.50	21.72
0.5	33.83	39.17	9.33	27.44	22.33	20.67	14.67	19.22
1.0	22.83	28.50	17.33	22.89	22.83	18.00	10.33	17.06
2.5	18.67	12.33	5.17	12.06	19.67	3.00	13.33	15.33
5.0	15.00	14.33	5.67	11.67	21.00	10.33	9.83	13.72
25.0	11.33	4.50	3.00	6.28	15.33	9.00	8.00	10.78
Mean	20.58	21.86	8.58	17.01	21.25	15.22	2.44	16.31
	Period	Treat	PxT		Period	Treat.	PxT	
SEm ±	0.937	1.325	2.295		0.824	1.165	2.018	
CD (0,.05)	2.691	3.806	6.591		2.367	3.347	5.797	

Table 3. Effect of metalaxyl on most probable number of *Nitrosomonas* and *Nitrobacter* in soil (number of cells x 10V of soil)

Treatments (fungicide ppm)	*NITROMONAS*				*NITROBACTER*			
	Incubation period, weeks				Incubation period, weeks			
	4	8	12	Mean	4	8	12	Mean
0.0	92.0	35.0	18.0	48.33	35.0	28.0	24.0	29.00
0.5	92.0	54.0	28.0	58.00	35.0	24.0	22.0	27.00
1.0	92.0	28.0	22.0	47.33	28.0	35.0	24.0	29.00
2.5	54.0	14.0	17.0	28.33	17.0	28.0	22.0	22.33
5.0	24.0	18.0	4.0	15.33	22.0	14.0	7.0	14.33
25.0	35.0	7.9	3.3	15.40	3.2	2.1	4.6	3.30
Mean	64.83	26.15	15.38	35.45	23.36	21.85	17.26	20.82
	Period	Treat	PxT		Period	Treat.	PxT	
SEm ±	0.236	0.846	1.120		0.810	0.927	1.360	
CD (0,.05)	1.021	2.371	2.821		1.26	2.947	3.719	

2) was significantly stimulated by metalaxyl at 0.5 ppm at 4 weeks (33.83 x 10^4 g^{-1}) and 8 weeks (39.17 x 10^4 g^{-1}). However, the population decreased with increase in fungicide concentrations. The maximum inhibition was observed at 12 weeks of incubation. In gen-

eral, different levels of fungicide reduced the *Azotobacter* population at all stages of observation.

The present investigation revealed a significant stimulation of mean bacterial population at 0-.5 ppm at all stages of incubation. This observation is in agreement with some of the earlier works, which reported that realistic usage of metalaxyl had no effect on beneficial soil microorganisms (Golovelena and Finkel'shtein, 1988) and also on plant pathogenic bacterial population (Kokoskova, 1992). It was observed that different doses of metalaxyl suppressed the fungal population in soil. Anti-fungal activity of metalaxyl may be attributed to inhibition of RNA biosynthesis by this compound (Davidse, *ct al.,* 1983; Fisher and Hayes, 1982). Further, Davidse and co-workers (1984) reported the anti-fungal activity of metalaxyl and also confirmed the presence of an alanine methyl ester in the basic carboxamilide structure, which is important for high anti-fungal activity. In the present experiment, it was observed that metalaxyl inhibited the *Azotobacter* population in all the treatments. In contrast to this, Golovelena and Finkel'shtein (1988) found that application of normal levels of metalaxyl to a forest soil did not affect the nitrogen fixation. However, metalaxyl at 0.5 ppm and 1 ppm showed little or no effect on *Nitrosomonas* and *Nitrobacter* population (Table 3). This is in agreement with the earlier work of Golovelena and Finkel'shtein (1988), who reported that metalaxyl at normal application rates, did not affect the nitrification process in soil.

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