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EFFECT OF HERBICIDES BUTACHLOR, FLUCHLORALIN, 2,4-D AND OXYFLUORFEN ON MICROBIAL POPULATION AND ENZYME ACTIVITIES OF RICE FIELD SOIL

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APPLICATION of herbicides in modern agriculture is considered to be an efficient and economic method of weed control. These chemicals may exert an effect upon the saprophytic soil microbes (Wardle and Parkinson, 1990) and their biological activities. There is a need for additional studies on the effects of agricultural chemicals on non-target soil microorganisms. This study was conducted to determine the effect of herbicides on population of fungi and bacteria, and enzymatic activities of rice field soil.

Surface soil was collected from submerged rice field. The soil was sandy loam. Herbicides were those recommended for and commonly used on paddy. The chemical names, commercial names and recommended dosage of the herbicides were as follows: 2,4-D, 2,4-dichlorophenoxy acetic acid, Weedex (1.2 l/ha); fluchloralin, N propyl-N (2' chloroethyl)-2, 6 dinitro-n-trifluromethyl aniline, Basalin (1.7 l/ha); butachlor, 2-chloro 2'6' diethyl-n-butoxy-methyl acetanilide, Machete (2.4 l/ha); oxyfluorfen, 2-chloro-1-3 ethoxy-4-nitrophenoxy-4- (trifluro-methyl) benzene; Goal (1.5 l/ha). The manufacturers recommended dosage were converted to ml/kg soil. For these conversions certain standard assumptions were followed: (a) herbicides were distributed in the 5 cm of soil (b) the weight of a hectare soil to a depth of 5 cm was approximately 7.3 x 10^5 kg. With this assumption an application rate of 1.0 l/ha was thereby equivalent to 1.4 ml/kg. Manufacturers recommended dosages were used in case of all the herbicides. Control soil was sprayed with an equal volume of sterilized water. The final moisture content of each was adjusted to the field capacity. Soils were incubated in plastic pots at 34°C for 4 weeks. Three replicates were maintained for each treatment. Soil plate method was used to assess fungal propagules developing on rose bengal agar medium and dilution plate method was used to estimate bacterial population on nutrient agar medium (Johnson and Curl, 1972). Dehydrogenase, urease and phosphatase activities were estimated by the method of Casida (1977), McGarity and Myers (1967) and Tabatabai and Bremner (1969), respectively.

Initially, the fungal population increased on application of herbicides. In most cases, the population decreased during the later part of the study and values

Table 1. Influence of herbicides on microbial population and enzyme activities in rice field soil.

Time period days	Microbial population (Per gram dry soil)		Enzyme activity (Per gram dry soil)*		
	Fungi (x 10^3)	Bacteria (x 10^6)	Dehydrogenase (µg TPF/24h)	Urease (mg NH^+_4/3h)	Phosphatase (µg p-nitrophenyl/h)
(1)	(2)	(3)	(4)	(5)	(6)
Weedex					
0	4.0	0.30	110.0	500.0	301.0
4	3.9	0.35	200.0	580.0	215.0
7	3.7	0.40	69.0	582.0	237.0
14	3.0	1.00	45.0	580.0	235.0
21	2.1	1.00	20.0	581.0	210.0
28	1.8	0.39	20.0	516.0	203.0
Machete					
0	4.0	0.30	110.0	500.0	301.0
4	3.8	0.90	115.0	550.0	255.0
7	3.6	1.10	45.0	550.0	247.0
14	3.7	1.20	30.0	580.0	250.0
21	3.9	0.80	25.0	580.0	244.0
28	1.8	0.50	25.0	516.0	218.0
Goal					
0	4.0	0.30	110.0	500.0	301.0
4	5.0	1.10	290.0	590.0	285.0
7	3.2	1.10	47.0	582.0	263.0
14	2.0	1.20	39.0	592.0	265.0
21	2.0	1.20	38.0	590.0	254.0
28	1.8	0.70	18.0	527.0	249.0
Basalin					
0	4.0	0.30	110.0	500.0	301.0
4	5.0	0.38	105.0	600.0	287.0
7	2.6	0.56	60.0	610.0	281.0
14	2.7	1.60	60.0	615.0	280.0
21	2.0	1.60	105.0	600.0	290.0
28	2.1	1.50	39.0	575.0	276.0
Control					
0	4.0	0.30	110.0	500.0	301.0
4	4.5	0.30	110.0	580.0	305.0

-continued-

(1)	(2)	(3)	(4)	(5)	(6)
7	4.2	0.38	70.0	430.0	318.0
14	2.1	0.39	60.0	600.0	272.0
21	2.4	0.40	65.0	605.0	215.0
28	1.9	0.37	64.0	502.0	210.0
L.S.D. (p=0.05)	(0.7)	(0.23)	(53.7)	(28.5)	(31.6)

were nearly equal to that of control at the end of experiment (Table 1). Bacterial populations were also stimulated on application of herbicides.In Machete and Goal treated soils stimulation was recorded after 4 days, while in case of Weedex and Basalin, it was found after 7 days interval. Populations of bacteria remained higher with the herbicides treated soils till the end of experiment. Dehydrogenase activity in the herbicide treated soils increased just after application and peak was noted on the 4th day but thereafter it dropped rapidly during subsequent weeks. Urease activity did not show marked variation among herbicide treated soils and the control one. However, slightly higher activity was observed in Basalin treated soil throughout the experiment. Phosphatase activity was found to be increased in Machete, Goal and Basalin treated soils but it was reduced in Weedex treated soil during the later part of incubation period.

The problem of understanding the impact of herbicides on the soil microflora are complicated not only by the complex systems of multiple interaction which occurs between the chemicals and the soil but also the diversity of microorganisms in the soil and their activities (Gruzdyev *et al.*, 1988). Stimulation in the bacterial population could be attributed to the increment of resistant organisms which utilize the herbicides as a nutrient source (Wardle and Parkinson, 1990). Stimulation in fungal propagules showed that major part of the population could tolerate the herbicides and most possibly utilize the herbicides. The decrease in later period may be due to loss of degradation of herbicides. Dehydrogenase activity is thought to reflect the total range of oxidative activities of soil microflora. It appears that the herbicides were inert to urease producing microbes and their activity. Phosphatase activity as indicated by the release of p-nitrophenol, is an index of the activity of microflora involved in soil organic phosphate decomposition. These results indicate that herbicides had some effect but probably it was of low importance with regard to the microbial populations and the enzymatic activities in rice field soil.

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