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Studies on the Influence of Nitrofen on the Microbial Activity of soil Under Ragi Crop

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ABSTRACT

The pre-emergence herbicide, Nitrofen at 1.5 lit. a.i./ha imposed an initial depression of the general microbial activity which after 55 days steadily increased. The rhizosphere soil of ragi crop revealed more number of azotobacter following the herbicide treatment than were found in non-rhizosphere and control soils. The rhizosphere soil at all stages of crop growth harboured more number of microorganisms tolerant to 500 ppm of the herbicide than the other soil samples. Bioassay of the herbicide treated soil using mustard seedling revealed that the toxicity of Nitrofen was lost within 50-65 days after application.

INTRODUCTION

Several herbicides have been observed to impose hazardous effects on soil microorganisms and their activities (Chandra *et al.*, 1960; Van Schreven *et al.*, 1970). However, these herbicides are degraded in due course by soil microorganisms. The rhizosphere microorganisms of plant species are quite discrete qualitatively and quantitatively from the non-rhizosphere microorganisms (Katznelson and Rouatt, 1957; Parkinson, 1967). Only scarce information is available on the activities of rhizosphere microflora under the influence of serveral biocides. The present paper reports the activities of the rhizosphere microorganisms of ragi under the influence of the herbicide, nitrofen.

MATERIALS AND METHODS

The pre-emergence herbicide, Nitrofen (2.4-Dichlorophenyl, 4-nitrophenyl ether 25% a.i.) was applied (1.5 lit./ha) to ragi (*Eleusine coracana* Gaertn) raised in garden lands. The herbicidial spray was given 24 hr after transplanting ragi seedlings. Soil samples collected from the rhizosphere, non-rhizosphere and control soils (which received no herbicide treatment) were air-dried and ground to fine powder.

The general microbial activity was studied by observing the respiratory rates of soil in a Warburg manometer (Ross and Robert, 1968). Two g of soil was taken in the reaction chamber containing 2.5 ml of 0.1 M phosphate buffer pH 7.0). The central well contained 0.2 ml of 20 per cent potassium hydroxide. Measurements of oxygen

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uptake were taken for 3 hr, equilibrating the manometers for 30 min at 28°C. The azotobactor counts were made using Waksman 77 agar medium (Pramer and Schmit, 1965).

The occurrence of herbicide resistant microorganisms was studied by a modified method (Handerson, 1960). Plain agar discs (8 mm dia.) carrying 500 ppm of the herbicide were incubated in the soil sample for 3 days at room temperature keeping the soils at 50 per cent moisture holding capacity. The discs were withdrawn after carefully removing the adhering soil particles and the microorganisms which persisted thereon were estimated by dilution plate technique (Pramer and Schmidt, 1965). The persistance of Nitrofen in soil was also assessed using mustard seed bioassay (Walker, 1954).

RESULTS AND DISCUSSION

The data reveal that Nitrofen imposed a depression on the microbial activity; neverthless, the rhizosphere soil samples did not register as much reduction in activity as the non-rhizosphere soil, in the initial stages (Table I). After 50 days of plant growth, the microbial activity increased steadily, more than in the control soil. The population of azotobacter, recorded a greater increase in the rhizosphere soil Nearly three times increase in the azotobacter count was observed in the rhizosphere soil (Table II). However, when the crop reached maturity the azotobacter population stabilised itself. In general, the rhizosphere soil contained more number of fungi, bacteria and actinomycetes resistant to 500 ppm of the herbicide than the other two soil samples (Table III). The herbicide, presumably underwent a rapid degradation in soil and its toxicity was lost within 50-65 days after application (Table IV).

TABLE I. Microbial activity in ragi field soil as influenced by Nitrofen application

Plant age (Days)	Micromoles of Oxygen uptake/g of soil on dry basis		
	Rhizosphere soil	Non-rhizosphere soil	Control soil
15	17.0	7.0	8.2
25	16.0	6.0	7.9
35	16.0	7.8	11.0
45	19.0	11.0	9.5
55	23.5	19.5	10.5
65	18.5	23.0	13.0
75	16.5	28.0	19.5
85	16.8	21.5	25.5

Mean of three estimations

TABLE II. Azotobacter population in ragi field soil as influenced by Nitrofen application

Plant age (days)	(Population $X10^3$/g of soil on oven dry basis		
	Rhizosphere soil	Non-rhizosphere soil	Control soil
15	2.45	2.00	4.80
25	1.95	1.55	4.20
35	3.20	1.81	5.22
45	7.86	2.65	4.81
55	14.85	3.62	3.28
65	11.85	7.62	6.10
75	19.61	10.31	5.82
85	22.16	8.61	6.85

Mean of three estimations

The microorganisms in the rhizosphere of ragi are little altered in their activities due to Nitrofen application

TABLE III. Occurrence of herbicide resistant microorganisms in soil *

Age of the crop (days)	Rhizosphere			Non-rhizosphere			Control		
	Fungi	Bacteria	Actinomycetes	Fungi	Bacteria	Actinomycetes	Fungi	Bacteria	Actinomycetes
15	11.50	176.0	15.0	3.0	78.0	3.0	3.5	48.0	2.0
50	12.0	116.0	12.0	10.5	97.0	5.5	11.3	84.0	5.0
80	13.0	156.0	13.0	8.5	112.0	7.0	4.0	96.0	7.0
100	8.5	120.0	22.0	6.5	96.0	15.0	5.8	68.0	13.0

* Microbial population expressed 10^2/agar disc.

TABLE IV. Degradation of Tok-E-25 in soil (Mustard Seed Bioassay)

Age of the crop in days	Per cent inhibition of germination*		
	Control soil	Non-Rhizosphere	Rhizosphere
15	0	30	28
25	0	28	30
35	0	30	22
50	0	24	22
65	0	22	15
80	0	20	8
95	0	12	4
100	0	4	2

while those from the non-rhizosphere soils were inhibited; furthermore, the azotobacter population was stimulated in the rhizosphere of ragi. The microflora in the rhizosphere of ragi seems to be relatively more resistant to the herbicide Nitrofen. The rhizosphere soil at all stages of ragi plant growth harboured more number of microbes resistant to 500 ppm of the herbicides than the non - rhizosphere or control soils. In one of our earlier observations with cotton rhizosphere (unpublished data) more number of fungi, bacteria and actinomycetes resistant to the systemic fungicide, Thiqbendozole than the non - rhizosphere soil were found. The organic compounds exuded from the root system of plants are believed to play significant role in altering the microflora. They may alter the permeability of the root cells, modify the root - metabolism and microbial assimilation of substances (Clark and Paul, 1970) which might explain the occurrence of herbicide resistant microorganisms in the rhizosphere.

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