

Effect of Pesticides on Rice Crop-Field's Soil Microflora

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Abstract: Weed control management should include careful herbicide selection, use of active agent mixtures, alteration of herbicides with different mode of action, and adoption to the cultivated crop, selectivity and persistency. So, if the pesticides are applied at higher rates, they endanger to the safety of environment and the toxicological justification of application, which lead to a limitation of their use. In view of this, the present study has been undertaken to evaluate the dimensions of soil pollution by different herbicides in crop fields of Saran (Chapra), Bihar. Pesticides such as 2,4-dichlorophenoxy-acetic acid (2,4-D) led to an increase in microorganisms which degraded the herbicide; a phenomenon that could significantly affect microorganism community structure in soil.

Keywords: Pesticide, Rice crop field's soil, Microflora

1. Introduction

Soil biota were significantly influenced by their abiotic environment. Agricultural practices that included the application of pesticides which affected the physical, biological and chemical properties of the soil (Magdoff and Vanes 2000) could have major ecological implications (Avidano *et al.*, 2005; Eisenhauer *et al.*, 2009). The addition of biological agents might also lead to the inhibition of beneficial microorganisms

Pesticides also alter non-target soil microorganisms. The application of pesticides such as λ -Cyhalothrin (Lupwayi *et al.*, 2009). Azadirachtin (Gopal *et al.*, 2006) caused changes to bacterial community structures in soil at a functional level that leads to a decline in soil fertility. Applications of organophosphate and chlorinated hydrocarbon based insecticides were found to directly kill non-target organisms in soil (Das and Mukhejee, 1999). This leads to increases of available N and P in soil. Fungi were generally more resistant to insecticides. Part of a pesticide application usually reaches the soil, even if sprayed on the growing crop, and so may have an effect on organisms living in the soil. Therefore, it is important to study the possible effects of specific practices on soil properties. Such possibilities are of particular concern where pesticides are applied at high rates, as occurs in crops such as paddy which often receive applications of several pesticides during a single growing season.

Soil is a dynamic living system with a variety of micro-and macro-flora and fauna including bacteria, actinomycetes, fungi, nematodes, arthropods, crustaceans and earthworms. They play a primary role in the degradation of plant and animal residues and other organic matter in the environment as well as in nitrogen fixation, nitrification and the release of nutrients from soil minerals. Anything that affects their activities might affect the function of soils in crop production.

The study was undertaken to observe the performance of different Pesticides compared with control and selection of

suitable pesticide in controlling weeds of transplanting Parmal rice in agro-climatic region of Chapra to increase the crop yield and to lessen negative impact on health of microflora and other constituents of the soil.

2. Materials and Method

Samples from the plough layer (upper 15-cm zone) of the different such as control; 2,4-D, Isoproturon, Metalachlor, MCPA and Bromoxynil treated experimental fields were used for assessment of soil bioactivity. A minimum of 5 bags per plot (rice-crop field) were collected, pooled and mixed thoroughly before use. Sieved soil (5 mm mesh) samples, from experimental and control plots, were adjusted to about 55% maximum water holding capacity and kept, till use in a dessicator in a temperature regulated chamber at 24 °C. Soil samples were not stored more than two weeks.

To determine changes in microbial population, soil samples were subjected to a soil dilution plate method, using sodium albuminate agar for bacteria, Jenson's medium agar for actinomycetes and rose bengal streptomycin agar for fungi.

3. Result and Discussion

In our observations, the application of 2,4-D only enhanced bacterial population in rice crop fields except this all other pesticides applied in experimental crop-fields showed decreased bacterial population in soil as compared to control.

Table 1: Effect of Pesticides on Bacterial Population (of Oven Dry Soil X 10⁴)

Sl. No	Treatments	Bacterial population (at the rate of pergram of soil)	
		At Tillering	At flowering
T ₀	Control	298.41	310.60
T ₁	2,4-D	302.63	309.16
T ₂	Isoproturon	284.16	304.70
T ₃	Metolachlor	285.60	304.96
T ₄	MCPA	282.09	302.27
T ₅	Bromoxynil	283.83	302.42

The bacterial population at maximum tillering stage was significantly influenced by weed control treatments. At maximum tillering stage, the population of bacteria was significantly reduced by pesticide application except 2,4-D when compared with that of unweeded control. All bacterial and fungal population determination were done after harvest of crop in all experimental fields.

Table 2: Effect of Pesticides on Microbial Population (G^{-1} of Oven Dry Soil $\times 10^4$)

Sl. No	Treatments	Fungi		Actinomycetes	
		At Tillering	At Flowering	At Tillering	At Flowering
T_0	Control	2.52	2.63	71.46	76.90
T_1	2,4-D	2.49	2.61	70.04	75.24
T_2	Isoproturon	2.40	2.55	68.15	73.54
T_3	Metolachlor	2.41	2.59	68.25	73.90
T_4	MCPA	2.36	2.49	67.56	71.28
T_5	Bromoxynil	2.32	2.50	67.93	71.70

The numbers of bacteria occurring in soils are usually higher than those of the other groups; however, because of their small size in relation to the large cell size and extensive filaments of the other groups, bacteria account for less than half of the total microbial biomass in soil. The pesticide treatment schedule used in the present investigation did not cause any adverse effect on bacterial numbers. An increase in bacterial number from was observed in the pesticide treated field with 2,4-D. A temporary adverse effect with a little decrease in numbers was noticed with Isoproturon, Metolachlor, MCPA and Bromoxynil treatments.

Although numerically much less abundant than bacteria, fungi are the major contributors to soil biomass. Most soil fungi are opportunistic. They grow and conduct their activities when environmental conditions (e.g., nutrients, moisture, temperature, aeration) are favourable. The acidic side of pH is generally more favorable for fungi. Fungi were quite resistant to the pesticides used in the present investigation as no noticeable adverse effect on fungal numbers was observed after pesticides treatments. However, a little decrease in fungal numbers was observed in the treated fields which showed that the population in concerned field could not recover either due to treatment or due to some synergistic effect. But all treated crop-fields soil both at tillering stage and flowering stage showed decreased fungal population as compared to control.

Actinomycetes are more abundant in surface soil. They are more abundant in soils with high pH. Pesticides had no major adverse effect on actinomycetes population in all treatments but slightly reduce their number.

Actinomycetes number tend to remain significantly less immediately after treatment, however recovery was observed in another ten days and at the end of the experimental period actinomycetes numbers were more-or-less similar in both treated and untreated fields again indicating that the pesticides used had only temporary effects. Stimulatory effects of insecticides on actinomycetes have been confirmed by same authors whereas significant and lasting reductions were reported by others and no effect of insecticides on actinomycetes were also reported.

Lupwayi *et al.*, (2009) found no significant changes in microbial diversity with the application of organic manure, but a decrease when chemical fertilizers were applied. The non-target effect of fungicides, herbicides and pesticides on microbial organisms has always been a topic of interest (Lupwayi *et al.*, 2009). Long-term fungicide and herbicide inputs may result in a reduction of soil processes mediated by microbial organisms. For example the application of fungicides, results in a decrease in nutrient cycling, nitrogen dynamics and enzyme activities in soil due to the direct toxic effect of these chemicals on microbes (Zhang *et al.*, 2009). In our observation the population of bacteria and fungi showed initial inhibition after the application of pesticides (Tables-1 and 2), which is in accordance with the above mentioned studies.

4. Conclusion

The finding of this study should a milestone in direction of better institutional policy and incentive framework within which pesticides could be effectively used for agriculture with minimal environmental and health impacts. Hence, the results of this research could provide key insights helping to respond to the needs of the communities more effectively.

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