EFFECT OF HERBICIDES ON MYCOFLORA OF RICE FIELD SOILS

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Abstract

Microbial degradation occurs when microbes such as fungi and bacteria utilize the pesticide as a source of food. An increase in the biological capacity of the soil to degrade pesticides/ herbicides is attributed to the proliferation of microbes using the pesticide as a source of carbon and Nitrogen/ or energy. Herbicides glyphosate, topstar and butachlor are used in Nalgonda district of Andhrapradesh, for controlling weeds in rice fields. The impact of herbicide application on soil mycofloristics was assessed in the present study employing czapek dox agar (CZA) during Kharif and Rabi seasons. The fungi, thus isolated from different herbicide treated soils were tested for their ability to tolerate the herbicide butachlor. The herbicide butachlor has no effect on fungus growth at 20ppm concentration. Majority of fungi tolerated low levels (20ppm) of butachlor as evident from their high growth. At 50ppm concentration some fungi failed to grow well while many could exhibit good growth even at this concentration. At 100ppm concentration majority of fungi failed to grow well while few fungi exhibited good growth even at this concentration. These fungi include Aspergillus niger, A. terreus, Trichoderma aureoviride, T. atroviride and T. longibrachiatum. These fungi were selected for further studies to assess their ability to utilize and degrade the selected herbicide, butachlor.

Key words: *Rice, soils, glyphosate, oxydiargyl, butachlor, fungi*

Introduction

Repeated application of xenobiotic compounds such as pesticides and herbicides for a long period of time results in pollution of environment. Persistence of various pesticides and herbicides in soil has become lethal to the soil microbial community affecting the overall soil microbial dynamics. Besides photochemical degradation, microbial degradation is an important natural phenomenon in the mineralization of pesticides in soil.

Biodegradation is a process that exploits the catabolic abilities of micro organisms to degrade harmful chemicals such as herbicides. The success of biodegradation depends on the availability of microbial strains that can mineralize high levels of recalcitrant substances and withstand adverse conditions to complete under natural conditions.

Microbial degradation occurs when microbes such as fungi and bacteria utilize the pesticide as a source of food. An increase in the biological capacity of the soil to degrade pesticides/ herbicides is attributed to the proliferation of microbes using the pesticide as a source of carbon and / or energy.

Cal-A-de et al (1993) isolated bacteria and fungi from herbicide treated soil by soil washing technique. They have isolated species of *Mucor,Fusarium, Trichoderma, Penicillium* and *Acremonium.*Salices et al (1999) screened 39 strains of micromycetes known to be good degraders of polychlorinated aromatic compounds

and tested for fluoranthene degradation. Wyss et al (2006) isolated atrazine degrading bacteria from contaminated soils. Two strains of bacteria, AG1 and ADG1, capable of efficiently degrading atrazine, were isolated from atrazine contaminated soils directly on plates coated with soil extracts and atrazine. Existence of pesticides in soil may affect the non-target microflora and influence the microbes to adjust and adapt to the new situations. This phenomenon is crucial for the microbes and affects the persistence of applied herbicides in soil. Microbial degradation is the major avenue of butachlor degradation from soils (Pal et al 2006). Rhizosphere soils provided a favourable micro-ecosystem for the proliferation of soil microorganisms and in turn accelerated the microbial degradation of butachlor insoil (Yun- Long Yu and Chi-feng 2004). Surface sorption of glyphosate allowed microbial degradation but retarded the microbial activity (Schnurer et al 2006). In view of the importance of soil and rhizospheremicroflora in herbicide treated soils, the fungi were isolated from soils of rice fields from two regions of Nalgonda district, Andhra Pradesh and and studied to estimate the impact of herbicides on soil fungi.

Materials and Methods

Sampling of herbicide treated soils. Soil samples from different pre-emergence herbicides treated rice fields during kharif season from Miryalguda and Deverkonda areas of Nalgonda district during 2007-08 were investigated for mycoflora. Herbicides used were glyphosate (Roundup 50 EC), oxydiargyl (Topstar 80EC) and butachlor (Machette 50 EC). Miryalguda rice fields soils were black in color with pH 7.0 and irrigated with river water while Deverkonda rice fields were red in color with pH 7.2 and irrigated by ground water. All herbicides applied before transplanting 20-25 d old rice seedlings. Glyphosate and butachlor (@ 1l a.i./ha) were spray applied while oxydiargyl (@ 500g/ha) was applied by mixing with sand. N:P:K was applied at 80:60:30 uniformly in the fields. All the other agronomical practices followed were nearly the same in fields at both sites. Soil samples were collected at 15 and 30 d after herbicide application at random from five spots in each of the fields at the two sites. A composite soil sample was prepared by mixing these samples from each rice field independently for each of the herbicide and kept separately in clean sterile polythene bags. The mycoflora were isolated by employing dilution plate method (Waksman 1952) on Czapak Dox agar medium. Soils samples were also collected from nearby fields that were not applied with herbicides to serve as control samples.

Results and Discussion

Fungal diversity of rice field soils of Nalgonda district of Andhra Pradesh was affected by the application of herbicides, glyohosate, oxydiargyl and butachlor. About 27 species of fungi belonging to seven different genera were isolated and identified. *Aspergilli, Penicillia* and *Trichodermas* were predominant

Table.1. Effect of Butachlor on the growth of fungi isolated from soils of various rice fields

S.No	Fungi	Herbicide PPM			
		20	50	100	150
1	*Aspergillus flavus*				
2	*A. fumigatus*	+++	++	+	-
3	*A. niger*	+++	+++	++	+
4	*A. niveus*	+++	+	-	-
5	*A. ochraceus*	++	++	+	-
6	*A. ornatus*	++	+	-	-
7	*A. sydowia*	++	+	-	-
8	*A. terreus*	+++	+++	++	+
9	*A. versicolor*	+++	++	+	-
10	*Alternaria alternata*	++	+	-	-
11	*Curvularia lunata*	++	+	-	-
12	*Fusarium oxysporum*	++	+	-	-
13	*F. solani*	+++	++	+	-
14	*Penicillium citrinum*	+++	++	+	-
15	*P. glaucum*	+++	++	+	-
16	*P. miczynski*	++	+	-	-
17	*P. rubrum*	+++	++	-	-
18	*P. verrucosum*	+++	++	+	-
19	*Rhizopus nigricans*	+++	++	+	-
20	*Trichoderma aureoviride*	+++	+++	++	+
21	*T. atroviride*	+++	+++	++	+
22	*T. citrinoviride*	+++	++	+	-
23	*T. fertile*	+++	++	+	-
24	*T. hamatum*	+++	++	+	-
25	*T. longibrachiatum*	+++	+++	+	-
26	*T. koningii*	+++	++	+	-
27	*T. strctipilis*	++	+	-	-

+++ = > 3cm ++ = < 2cm + = < 1cm

Among fungi isolated from glyphosate treated soils during Kharif season were *Aspergillus terreus, Trichoderma aureoviride* and *T. longibrachiatum* that dominated the mycoflora from Miryalguda. Glyphosate treated soils from Deverkonda rice fields, on the other hand were dominated by *Aspergillus fumigatus* and *A. niger*. During Rabi season, *A. flavus* and *A. niger* along with *Rhizopus nigricans* were encountered frequently.

Topstar treated soils from Miryalguda during Kharif season supported *Aspergillus terreus* predominantly while *Trichoderma* species were predominant from Deverkonda soils. Species of

Penicillium were encountered more during Rabi season.

Microbial population dynamics and the fate of the herbicide in the soil. Mycodegradation of butachlor by selected fungi *in vitro* and in rhizosphere soils was investigated. Wilkinson and Lucas (1969) reported the interaction between *T. viride, F. culmorum* to the advantage of *Fusarium*. Butachlor application was detrimental to nitrogen fixing bacteria as evidenced from their recovery 28 d after transplantation in rice fields in China (Yu et al 1993). Soil microbes such as *Penicillium citrinum, P. glaucum, Aspergillus niger, Trichoderma viride, Fusarium oxysporum* and *Bacillus subtilis* were found to be associated with butachlor treated soils in Taiwan (Wu 1978). Tora-Reventos et al (2004) isolated *Aspergillus niger* from the thiocarbamate herbicide treated paddy field soils in Japan. *Trichoderma aureoviride* and *T. longibrachiatum* along with *Aspergillus terreus* were frequently encountered during Kharif season in butachlor treated soils from Miryalguda. Similarly species of *Trichoderma* were predominant in butachlor treated soils from Deverkonda.

The fungi, thus isolated from different herbicide treated soils were tested for their ability to tolerate the herbicide butachlor. The herbicide butachlor has no effect on fungus growth at 20ppm concentration. Majority of fungi tolerated low levels (20ppm) of butachlor as evident from their high growth. At 50ppm concentration some fungi failed to grow well while many could exhibit good growth even at this concentration.

At 100ppm concentration majority of fungi failed to grow well while few fungi exhibited good growth even at this concentration. These fungi include *Aspergillus niger, A. terreus, Trichoderma aureoviride, T. atroviride and T. longibrachiatum.* Thoese fungi were selected for further studies to assess their ability to utilize and degrade the selected herbicide, butachlor.

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