World Academy of Science, Engineering and Technology
International Journal of Agricultural and Biosystems Engineering
Vol:6, No:9, 2012

Effect of Butachlor on the Microbial Population of Direct Sown Rice

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***Abstract*—**Field experiments were conducted at Annamalai University Experimental Farm, Department of Agronomy; to device suitable weed control measures for direct seeded puddled rice and to study the effect of the weed control measures on the soil microbial population. The treatments comprised of incorporation of pressmud @ 6.25 t ha^{-1} and application of herbicide butachlor @1.5 kg a. i. ha^{-1} with and without safener 4 days after sowing (DAS), 8 DAS alone and also in conjunction with hand weeding at 30 DAS. Hand weeding twice and a weedy check were also maintained. At maximum tillering stage, the population of bacteria was significantly reduced by butachlor application. The injury to microbes caused by herbicide disappeared with the advancement of crop's age and at flowering stage of crop, there was no significant difference among the treatments. The fungal and actinomycetes population remained unaltered by weed control treatments at both the stages of observation.

***Keywords*—**Butachlor, Herbicide, Direct sown rice, Microbial population

I. Introduction

IN India, area under direct seeded rice has increased considerably in recent years primarily because of scarcity of labour during peak season for transplanting of paddy and less cost of cultivation of direct sown paddy.

Further, more availability of rice herbicides enthused the rice farmers to take up direct seeding of rice. Manual weed control is usually practised in direct sown rice crop and is, no doubt, an effective one but alternative to such practise is required to avoid uncertainties associated with non-availability of labour in time and to reduce the cost of cultivation. Use of herbicides seems to be a better substitute [6]. Herbicides used may disturb and alter the biological equilibrium in soil [8].Herbicides applied in crop fields for weed control are reported to have affected the soil microorganisms living in soil and also in the rhizosphere of crops and weeds [12]. There was a temporary setback in microbial population due to the application of herbicides and microbes adopted themselves to the new substrate to grew normally 25 days after herbicide application [10].The population of soil heterotrophs was affected with herbicide application and these adverse effects reduced gradually with the passage of time [7-15] reported that up to 20 days of application of pre-emergence herbicides in rice, there was a decrease in bacterial, fungal and actinomycetes population and after 30 days, the microbes multiplied to their original number.

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A general reduction in soil microflora was observed due to herbicide application [11]. From the above literature, it is clear that field doses of herbicides are often safe for the soil microbes but their response to herbicide application cannot be predicted for all environments. This is because, the herbicide-microbe interaction depends not only on the molecular configuration of the herbicide, but also on many soil and climatic factors like temperature, soil moisture and acidity. The effect of herbicide butachlor on the microbial population has to be studied thoroughly for the effective use in the soil for better adoption of weed control measures to combat the menace of weeds in direct seeded rice.

II. Materials And Methods

Field experiments were conducted at Annamalai University Experimental Farm, Department of Agronomy, Annamalainagar, TamilNadu, India to device suitable weed control measures for direct seeded puddled low land rice. The treatments comprised of incorporation of pressmud @ 6.25 t ha^{-1} and application of rice herbicide butachlor 50 EC (N-butoxmethyl-2-chloro2,'6'-diethylacetanilide) @1.5 kg a. i. ha^{-1} with and without safener (fenclorim-4, 6-Dichloro-2-Phenylpyrimidine) 4 days after sowing (DAS), 8 DAS alone and also in conjunction with hand weeding at 30 DAS. Hand weeding twice and a weedy check were also maintained. A seed rate of 100 kg ha^{-1} was followed.

Soil samples collected were analysed following dilution plating procedures (Roy *et al.,* 1977) using soil extract agar (Lochhead and Chase, 1943) for estimating population of bacteria and actinomycetes and Martin Rose Bengal Agar (Chattopadhyay and Mukhopadhyay, 1967) for fungi. Plates were incubated 28 ± 2^0C for definite periods for each type of organisms and colony numbers per plate were counted.

III. Results And Discussion

The predominant microorganisms were bacteria - *Bacillus cereus* and *Azospirillum* sp., fungi - *Aspergillus niger*, *Aspergillus flavus*, *Penicilium crysogenum*, *Pythium* spp.; actinomycetes - *Streptomyces* sp., *Micromonospora* sp., *Nocardia* sp. and *Actinomyces* sp.

The results of effect of butachlor application on soil microflora in direct sown rice field as presented in Table I showed the following effects.

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TABLE I
EFFECT OF WEED CONTROL MEASURES ON MICROBIAL POPULATION (G^{-1} OF OVEN DRY SOIL X 10^4)

Treatments	Bacteria	
	At Tillering	At flowering
B. T_1 - Weedy check	298.41	310.60
T_2 – Hand weeding twice 20 and 40 DAS	302.63	309.16
T_3 – Butachlor without safener 4 DAS	284.16	304.70
T_4 – Butachlor with safener 4 DAS	285.60	304.96
T_5 – Butachlor without safener 8 DAS	282.09	302.27
T_6 – Butachlor with safener 8 DAS	283.83	302.42
T_7 - Butachlor with out safener 4 DAS + HW at 30DAS	287.04	305.53
T_8 – Butachlor with safener 4 DAS + HW at 30 DAS	288.10	306.10
T_9 – Butachlor with out safener 8 DAS + HW at 30DAS	285.84	303.86
T_{10} – Butachlor with safener 8 DAS + H.W at 30 DAS	286.37	304.32
SE_D	4.78	3.62
CD (P = 0.05)	10.04	NS

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 butachlor application when compared with that of unweeded control and twice hand weeding. The injury over microbes caused by herbicide disappeared with the advancement of crop's age and at flowering stage of crop, there was no significant difference among the treatments. The fungal and actinomycetes population remained unaltered by weed control treatments at both the stages of observation.

Bacterial population was significantly reduced by butachlor @ 1.5 kg a.i. ha^{-1} at maximum tillering stage but during flowering stage of rice there was resurgence in the bacterial population. As a result, there was no significant difference among the treatments in influencing the bacterial population at later stages. Weed control treatments had no influence over the fungi and actinomycete population at both the stages. Incorporation of organic manure into the soil has been reported to increase the population of microflora under flooded conditions (Charyulu and Rao, 1979).

The herbicides undergo degradation by microbes and during that process they exhibit inhibitory effects of varying magnitudes over the microorganisms. Some of the herbicide-microbe interactions show an initial lag period before the microbes rebound to degrade the compound.

TABLE II
EFFECT OF WEED CONTROL MEASURES ON MICROBIAL POPULATION (G^{-1} OF OVEN DRY SOIL X 10^4)

Treatments	*A. Fungi*		Actinomycetes	
	At Tillering	At flowering	At tillering	At flowering
T_1 – Weedy check	2.52	2.63	71.46	76.90
T_2 – Hand weeding twice 20 and 40 DAS	2.49	2.61	70.04	75.24
T_3 – Butachlor without safener 4 DAS	2.40	2.55	68.15	73.54
T_4 – Butachlor with safener 4 DAS	2.41	2.59	68.25	73.90
T_5 – Butachlor without safener 8 DAS	2.36	2.49	67.56	71.28
T_6 – Butachlor with safener 8 DAS	2.32	2.50	67.93	71.70
T_7 - Butachlor without safener 4 DAS + HW at 30DAS	2.43	2.58	68.56	73.20
T_8 – Butachlor with safener 4 DAS + HW at 30 DAS	2.45	2.60	69.18	74.76
T_9 – Butachlor without safener 8 DAS + HW at 30DAS	2.38	2.54	68.50	2.84
T_{10} – Butachlor with safener 8 DAS + H.W at 30 DAS	2.41	2.57	69.04	74.12
SE_D	0.08	0.04	2.01	2.20
CD (P = 0.05)	NS	NS	NS	NS

In case of butachlor, microbial degradation has been reported to be the principal avenue of dissipation (Beestman and Deming, 1974), especially through soil fungi (Chen and Chen, 1979). Hence soil fungi and actinomycete population remained unaltered by butachlor.

But bacteria experienced a lag period during maximum tillering stage. During this lag phase or adaptive phase they might have developed the capacity to degrade the chemical through mutation to form new strains and they also might have built up their population to the required level for detoxification. This could have been the reason for initial suppression of bacterial population due to butachlor treatment, which recovered later. Although bacterial population at initial phase was decreased due to butachlor, the restitution of bacteria occurred after 60 days (Ogawa and Yambe, 1980).

This kind of initial setback in microbial population and restitution after certain period was also reported (Anderson and Domsch, 1980). The results of the study clearly indicate that the microbial population of rice soil was adversely affected by butachlor only during the initial stages.

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The bacterial population was adversely affected, followed by fungi and actinomycetes in descending order. The adverse effects of herbicides were gradually reduced with passage of time and practically, there was no effect of butachlor on soil microbial population as a whole.

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