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Herbicidal impact on soil micro-flora, micronutrient and productivity of summer rice

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ABSTRACT

A field experiment was conducted during winter (rabi) seasons of 2001-02 and 2002-03 at "C" Block Farm, B.C.K.V., Nadia, West Bengal to study the effect of herbicides on soil micro flora and soil micro nutrients. Highest yield of rice was obtained from the treatment PSF 10 WP @ 100 g/ha. Pyrazosulfuron-ethyl proved stimulatory for both the beneficial organisms such as phosphate solubilizing bacteria and non-symbiotic N-fixing bacteria where as acetochlor showed negative response. Though availability of micronutrients did not follow any definite pattern of change with crop growth but higher availability was found in case of PSE 10 WP over acetochlor.

Key words : Herbicides, Micronutrient, Micro-flora, Transplanted rice

Rice (*Oryza sativa.* L.), one of the most important staple food crops is grown through out the world, ranking second (next to wheat) in terms of area harvested as well as production.

Several factors are responsible for low productivity of rice but severe infestation of weeds in rice field offer the major obstacle to achieve the higher yield. In general the yield loss due to uncontrolled weed growth ranges between 18-20% (Balasubramanian and Duraiswamy, 1996). Though several herbicides for controlling weeds in transplanted rice have been evolved but the use of herbicides is quite limited due to lack of technology regarding dose, proper time and method of application.

The indiscriminate use of synthetic herbicides for controlling weeds may offer potential hazards to user, consumers, live stocks, wild lives, soil micro flora and also to other soil environments. Modern agricultural fields are generally treated with high doses of synthetic nitrogenous fertilizers, pesticides, and herbicide having adverse effects on the soil chemical and biological environment. With this background, the present investigation has been conducted to identify the effect of low dose herbicides like pyrazosulfuron- ethyl and acetochlor on soil environment in transplanted summer rice.

MATERIALS AND METHODS

A Field experiment was conducted under medium land situation at "C" Block Farm of Bidhan Chandra Krishi Viswavidyalaya, Kalyani, Nadia, West Bengal (latitude 22.5'N, longitude 89'E with an altitude of 9.75m above mean sea level), to study the impacts of herbicide on soil environment under transplanted condition. The experiment was laid out in Randomized Block Design with 9 treatments replicated thrice. Besides un-weeded control, hand weeding at 20 and 40 DAT, 4 doses of PSE 10WP (20,25,50 and 100 g/ha) and 3 doses of acetochlor (100,150 and 200ml/ ha) were used. The soil of the experimental site was sandy clay loam in texture, typical Gangetic Alluvial having pH of 6.9, containing 0.06% total N, 20kg available P_2O_5 /ha and 120 kg available K_2O/ha. All the herbicides were applied as pre-emergence at 5 DAT. Satabdi was the variety of rice. Data on yield was taken at harvest. Effect of above treatments on soil micro flora and soil micronutrients was studied. All the other agronomic practices and plant protection measures were adopted as per standard recommendations.

The enumeration of the microbial population was done on agar plates containing appropriate media following serial dilution technique and pour plate method (Pramer and Schmidt, 1964). The count was taken out 3rd and 5th day of incubation. Jensen's agar medium was used for counting aerobic non-symbiotic nitrogen fixing bacteria. Total number of phosphate solubilizing microorganisms was estimated in pikovskaia's agar medium. The extraction of available micronutrients of soil sample was done with D.T.P.A solution. The reading was taken by automic absorption spectrophotometer.

RESULT AND DISCUSSION

Effect on grain and straw yield

The data revealed that T_4 treatment that received pyrazosulfuron- ethyl @ 100g/ha (7.19 t / ha) recorded the maximum grain yield but maximum straw yield was recorded in T_8 treatment (11.00 t/ ha) where hand weeding was done at 20 and 40 DAT. Minimum grain and straw yield (3.37 t/ ha and 6.93 t/ ha, respectively) were found in T_9 treatment i.e., in un-weeded control plot. All the treatments where herbicides were applied and also hand weeding recorded significantly higher grain yield as compare to un-weeded control. This was in agreement with the earlier findings of Mukhopadhyay *et. al.* (1990).

Effect on soil micro flora

Higher level of pyrazosulfuron-ethyl caused a significant enhancement in the proliferation of both non-symbiotic nitrogen fixers and phosphorus solubilizer over that of control in the soil rhizosphere of summer rice at each stage of sampling (Table-1). There was however a progressive increase in the population of non-symbiotic N – fixing bacteria and P- solubilizing bacteria in the soil rhizosphere of summer rice by the application of PSE from 20g/ha to 100g/ha. Highest microorganism population was recorded when PSE 10WP was applied @ 100g/ha. On the other hand, acetochlor exerted harmful effect on the population of non-symbolic N fixing bacteria as well as on phosphorus solubilizing bacteria.

Effect on soil micronutrients

It is clearly evident from (Table-2) that all the micronutrients (Fe, Mn, Cu, Zn) did not follow any definite pattern of changes with crop growth. As available ranges of Fe, Mn, Cu and Zn vary due to several factors that include pH, organic matter content of soil, extent of soil aeration etc. (Barber, 1995). The inconsistency in these nutrient contents in available form is often expected in a heterogeneous soil system. However, the availability of micronutrients in soil increased with application of PSE 10WP over acetochlor. Maximum increase was found where PSE 10 WP @ 100 g/ha was applied. Thus it can be concluded that application of pyrazosulfuron-ethyl @ 100 g/ha is more effective in increasing the rice yield by favouring the growth of beneficial soil microorganisms and by increasing the availability of soil micronutrients.

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Table 1 Effect of different weed control treatments on rice yield and soil micro flora CFU x 10^4 /g (mean of 2 years)

Treatments	Grain yield	Straw yield	Non symbiotic N fixing bacteria			P solubilising bacteria		
	(t/ha)	(t/ha)	30 DAT	45DAT	At harvest	30 DAT	45DAT	At harvest
T_1- PSE 10WP @ 20g/ha	5.19	7.15	180.5	193.5	215.0	19.0	35.0	43.5
T_2- PSE 10WP @ 25g/ha	5.23	8.05	212.0	222.0	232.0	21.5	59.0	64.5
T_3- PSE 10WP @ 50g/ha	6.20	8.41	226.0	233.0	248.5	25.5	59.6	75.0
T_4- PSE 10WP @ 100g/ha	7.19	9.11	237.0	249.5	266.0	31.5	63.5	82.5
T_5 - Acetochlor @ 100ml/ha	5.70	8.20	173.5	262.5	151.0	16.0	13.5	11.0
T_6 - Acetochlor @ 150ml/ha	6.02	8.20	157.5	149.0	140.0	19.0	10.0	8.0
T_7 - Acetochlor @ 200ml/ha	6.30	9.07	136.0	127.5	116.0	9.0	9.0	5.0
T_8 -Hand weeding at 20 and 40 DAT	6.11	11.0	157.0	163.0	173.5	13.5	23.5	36.0
T_9 –Control (Weedy check)	3.73	6.93	178.0	180.5	212.5	18.5	30.5	39.0
CD (P=0.05)	1.26	2.11	10.0	15.84	11.80	5.84	5.25	5.63

Table 2 Effect of different weed control treatments on availability of soil micronutrients (mg/kg) at different stages of summer rice (Mean of 2 years)

Treatments	Fe			Mn			Cu			Zn		
	30 DAT	45 DAT	At Harvest	30 DAT	45 DAT	At Harvest	30 DAT	45 DAT	At Harvest	30 DAT	45 DAT	At Harvest
T1- PSE 10WP @ 20g/ha	15.59	17.05	21.43	6.06	16.31	41.34	0.92	1.08	1.04	0.63	0.31	0.26
T2- PSE 10WP @ 25g/ha	19.84	20.33	18.54	0.026	33.19	16.92	1.1	0.05	0.03	0.81	0.45	0.53
T3- PSE 10WP @ 50g/ha	22.08	15.56	15.17	18.33	20.19	0.19	1.09	1.01	0.027	0.20	0.24	0.32
T4- PSE 10WP @ 100g/ha	23.78	12.67	0.94	30.2	20.65	26.63	0.65	0.96	1.11	0.25	0.49	0.29
T5 Acetochlor @ 100ml/ha	2.48	6.42	12.49	24.17	6.72	25.98	1.15	1.30	0.047	0.27	0.33	0.35
T6 Acetochlor @ 150ml/ha	9.24	18.37	13.54	13.54	6.38	2.78	0.02	0.02	0.85	0.38	0.4	0.28
T7 Acetochlor @ 200ml/ha	15.92	3.76	14.67	6.94	3.43	33.74	1.08	0.99	1.20	0.50	0.39	0.021
T8 -Hand weeding at 20 and 40 DAT	19.81	24.09	0.48	24.28	23.07	5.10	1.36	1.26	1.23	0.26	0.88	0.78
T9 –Control (Weedy check)	18.46	16.15	1.56	29.09	22.79	15.5	3.68	1.13	0.04	0.23	0.58	0.031
CD (P=0.05)	5.11	4.17	4.01	4.06	3.71	4.87	0.08	0.064	0.05	0.04	0.047	0.054