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Bioefficacy studies of chlorimuron ethyl 25% WP in transplanted rice and its effect on soil microflora in inceptisol of West Bengal

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ABSTRACT

A field experiment was conducted at Kalyani 'C' Block Farm, Bidhan Chandra Krishi Viswavidyalaya during kharif seasons of 2012-13 and 2013-14 to study the bioefficacy of Chlorimuron Ethyl 25% WP on transplanted rice cv. Shatabdi (IET 4786) in Inceptisol of West Bengal. Chlorimuron Ethyl 25% WP from @ 3.0 - 12.0 g.a.i. ha–1 recorded better weed control efficiency and twice hand weeding recorded the highest grain yield . However, Chlorimuron Ethyl 25% WP@ 6.0, 9.0 and 12.0 g.a.i. ha–1 and Kloben @ 6g a.i. ha-1 were statistically at par with each other. There were no significant variations on the microbial population of the soil in the rhizospere region of the transplanted rice due to the application of testing herbicide chlorimuron ethyl 25% WP.

***Keywords*:** Bioefficacy, inceptisol, soil microflora, transplanted rice

In India, rice is the staple food for millions of people and is next to wheat. It plays a pivotal role in the economy of India. Feeding the 9 billion people expected to inhabit our planet by 2050 will be an unprecedented challenge for the mankind. Like other cereal crops, rice also suffers severely from weed competition. The diverse weed flora under transplanted conditions (grasses, sedges and broad-leaved weeds) can cause yield reduction up to 76% (Singh et al. 2004). In order to realize maximum benefit of applied monetary inputs, two to three hand weedings (HW) were effective against all types of weeds in this crop (Halder and Patra, 2007). Modern sustainable rice cultivation worldwide involves extensive use of agrochemicals such as insecticides, fungicides and herbicides. The goal of herbicide use is to kill or stunt weed infestation allowing the rice to grow and gain a competitive advantage. Weeds are the most important biological constraint to increasing yield. It has been estimated that without weed control, the yield loss can be as high as 90% (Ferrero and Tinarelli, 2007). Various methods like cultural, mechanical, biological and chemicals are used for weed control. The chemical weed control method is becoming popular among the farmers because it is the most efficient means of reducing weeds competition with minimum labor cost. As farmers continue to realize the usefulness of herbicides, larger quantities would be applied to the soil. But the fate of these compounds in the soil is becoming increasingly important since they can be leached down, in which case groundwater is contaminated or if immobile, they would persist on the top soil (Ayansina *et al.,* 2003). These herbicides can then accumulate to toxic levels in the soil and become harmful to microorganisms, plants, wild life and even human (Amakiri, 1982).

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MATERIALS AND METHODS

The present investigation was carried out during Kharif season 2012-13 and 2013-14 at Kalyani 'C' Block Farm of Bidhan Chandra Krishi Viswavidyalaya. The soil of the experimental field was sandy loam in texture with soil pH 6.85, organic C 0.583%, total nitrogen 0.0581%, available phosphorus 22.84 kg ha-1, available potash 131.82 kg ha-1, with low water holding capacity. The crop was grown under irrigated condition.

The experiment was laid out in randomized complete block design and replicated thrice with a net plot size of 5m×4m. The treatments were Control, Hand Weeding, Chlorimuron Ethyl 25% WP @ 3.0 g a.i. ha^{-1}, chlorimuron ethyl 25% WP @ 6.0 g a.i. ha^{-1}, chlorimuron ethyl 25% WP @ 9.0 g a.i. ha^{-1}, chlorimuron ethyl 25% WP @ 12.0 g a.i. ha^{-1}, check-standard chlorimuron ethyl 25% WP (Kloben) @ 6.0 g a.i. ha^{-1}. The herbicides as per the treatment schedule were applied as post-emergence by using 500 litres of water ha-1 with knapsack sprayer fitted with flat fan deflector nozzle.

Seeds of variety Shatabdi (IET 4786) were treated with Trichoderma viride @ 4 g kg^{-1} of rice seeds, kept under shade for one hour and then sown in the seed bed by manually during second week of August, 2012 and 2013. Adequate plant protection measures against insects and diseases were followed. Nitrogen @ 60 kg ha^{-1} through urea was applied in 4 splits i.e. at 5, 25, 50 and 65 DAT and full phosphorus through single super phosphate and full potash through muriate of potash both @ 30 kg ha-1 were applied as basal during final land preparation.

Soil samples from the experimental plots were collected from the space between the rows at a depth 0–15 cm on different dates viz. initial (pretreatment), 5 days after application (DAA), 15 DAA, 30 DAA and at harvest of applying herbicides. Soil sample from the different places per replicate for the same weed control treatment were pulled together and then requisite composite samples of each treatment were taken for microbial analysis by dilution plating following standard methods. Soil dilutions were prepared in sterile distilled water by constant shaking and plating was done separately in replicates in specific media: Total bacteria (Thornton's agar medium at 10-6 dilutions), fungi (Martin's rose bengal streptomycin agar medium at 10-4 dilutions), actinomycetes (Jensen's agar medium at 10-5 dilutions). The enumeration of the microbial population was done on agar plants containing appropriate media following serial dilution technique and pour plate method (Pramer and Schmidt, 1965). Plates were incubated at 30 °C and counts were taken at the 3rd day of incubation.

Data were subjected to statistical analysis by analysis of variance method (Gomez and Gomez, 1984). As the error mean squares of the individual experiments were homogenous, combined analysis over the years were done through unweighted analysis. Here, the interaction between years and treatments were not significant. The values wherever necessary were transformed into square root values as applicable for respective statistical analyses (Panse and Sukhatme, 1978).

Table 1: Weed density (No.m^{-2}) and weed dry weight under different treatments in transplanted rice (Pooled)

Treatment	Dose (g ha^{-1})	Weed density (no.m^{-2}) (DAA)						weed dry weight (g m^{-2}) (DAA)					
		Grass		Sedge		Broad-leaf		Grass		Sedge		Broad-leaf	
		15	30	15	15	15	30	15	30	15	30	15	30
T1	-	5.67	7.05	6.3	5.96	14.28	13.49	4.52	3.91	5.96	4.4	13.4	12.95
T2	-	0.89	0.84	0.85	0.73	6.78	1.93	1.26	0.82	0.95	0.85	4.81	2.3
T3	3	5.81	6.03	4.12	2.17	10.31	4.42	2.36	1.66	2.53	1.36	9.63	4.43
T4	6	5.52	6.34	2.32	1.76	8.88	3.72	1.86	1.22	1.96	1.03	12.86	3.44
T5	9	5.42	6.29	3.14	1.31	9.43	3.37	2.18	1.37	2.07	1.36	8.82	3.6
T6	12	5.67	6.29	2.92	0.86	8.21	2.77	1.93	1.41	1.84	0.89	8.42	3.04
T7	6	5.74	6.43	2.79	1.98	9.1	3.95	1.98	1.43	2.21	1.29	12.56	3.74
SEm (±)	**-**	**0.34**	**0.11**	**0.23**	**0.14**	**0.98**	**0.80**	**0.10**	**0.15**	**0.09**	**0.06**	**1.24**	**0.42**
LSD(0.05)	**-**	**0.98**	**0.35**	**0.67**	**0.43**	**2.89**	**2.47**	**0.35**	**0.51**	**0.25**	**0.19**	**3.78**	**1.24**

***Note:** T_1 – Control, T_2 - Hand Weeding, T_3 - Chlorimuron ethyl 25% WP @ 3.0 g.a.i. ha^{-1}, T_4 - Chlorimuron ethyl 25% WP @ 6.0 g.a.i. ha^{-1}, T_5 - Chlorimuron ethyl 25% WP @ 9.0 g.a.i. ha^{-1}, T_6 - Chlorimuron ethyl 25% WP @ 12.0 g.a.i. ha^{-1}, T_7 - Check-standard chlorimuron ethyl 25% WP (Kloben) @ 6.0 g.a.i. ha^{-1}*

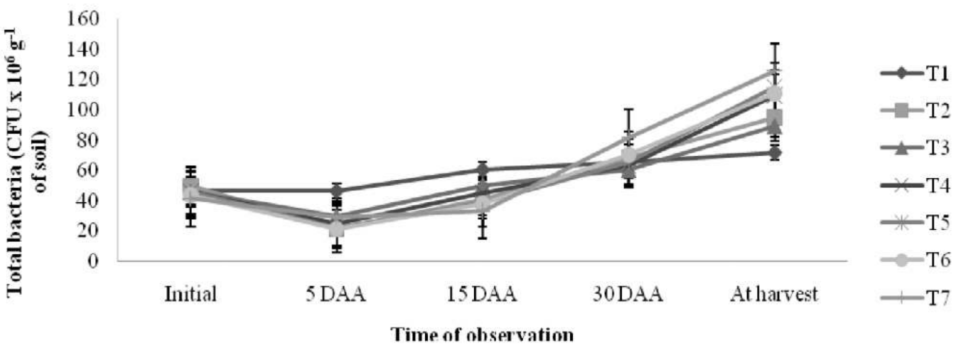

Fig. 1: Influence of treatments on total bacteria (CFU x 10^{6} g^{-1} of soil)

RESULTS AND DISCUSSION

In the experimental plots, the dominant grassy weed flora were Echinochloa crusgalli, Echinochloa colona and Leersia hexandra, while the sedge weed flora were Cyperus difformis, Cyperus rotundus, and Fimbristylis littoralis. Among the broadleaf weed flora Alternanthera philoxeroides, Ammania baccifera, Stellaria media, Hypericum japonicum, Spilanthus paniculata, Eclipta alba and Marsilea quadrifolia were dominant. Soni *et al*. (2012) also observed predominance of weeds like Echinochloa crusgalli, Cyperus iria, Ceasulia axillarius, Commelina communis and Eclipta alba in transplanted rice in Jabalpur (M.P.). Higher dose of chlorimuron ethyl 25% WP @ 12 g a.i. ha^{-1} recorded better grassy weed control efficiency in comparison to its lower dose (3 g a.i. ha^{-1}) but showed at par results with application of chlorimuron ethyl 25% WP @ 6, 9 g a.i. ha^{-1} and standard-chlorimuron ethyl 25% WP @ 6 g a.i. ha^{-1}. Hand weeding twice showed best weed control among all the treatments (Table 1). Similar findings were also reported that application of chlorimuron-ethyl 9 and 12 g ha^{-1} post-emergence reduced the population of sedges and broad-leaved weeds over its lower dose of 6 g ha^{-1} and weed control plot (Dubey et al. 2000).

Crop parameters like number of effective tillers m-2 (184.2), grains panicle-1 (163.8) was found higher under hand weeded treatment (Table 2). Among the different herbicide treated plots, chlorimuron-ethyl @12 g a.i. ha-1 found significant on the crop growth parameters. Effective tillers m-2 (178.5), grains panicle-1 (158.3) was recorded highest under 12 g a.i. ha-1 chlorimuron-ethyl treated plot. The control plot recorded lowest effective number of tillers m-2 (143.1), grains panicle-1 (94.3). Rice grain yield (5.743 t ha-1), straw yield (10.169 t ha-1) and weed control efficiency at 15 DAA (85.97%), 30 DAA (78.33%) were higher under hand weeded plot. Among the different doses, chlorimuron-ethyl 12 g a.i. ha-1 recorded higher grain yield (5.413 t ha-1), straw yield (10.512 t ha-1) and weed control efficiency at 15 DAA (81.69%), 30 DAA (73.56%). These results are conformity with the finding of Jayadeva et al. (2010) in case of transplanted rice and Kundu et al. (2011) in case of soybean. Due to higher cost of cultivation hand weeded plot recorded lowest B:C ratio (2.1). However, chlorimuron ethyl g a.i. ha-1 recorded highest B:C ratio (2.9), which was found at par to each other. The productivity of rice is mainly decided by the weed control efficiency of weed management methods as earlier observed by Singh, and Singh (2004). Kathepuri et al. (2007) have shown that grain yield reduction in rice is directly related to increasing weed density, dry weight and intensity of weed interference throughout the crop period. Due to heavy competition of weeds for nutrients, space, water and light lower grain yield in unweeded control plot was obtained.

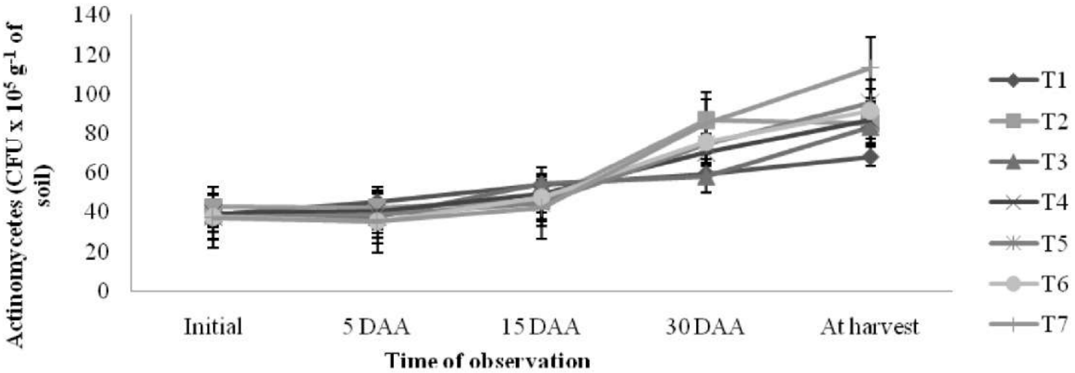

Fig. 2: Influence of treatments on actinomycetes (CFU x 105 g-1 of soil)

Initially, there was no significant influence on the population of total bacteria in rhizosphere of rice. Population significant varied between the treated and non treated plots after application of the herbicides and the population decreased up to 15 DAA. After 30 DAA, the population increased considerably in the herbicidal treated plots as compared to hand weeding and untreated control plots (Fig. 1). At harvest, herbicidal treatments recorded 32.09% to 75.34% higher population of total bacteria than control

Similar types of variations in actinomycetes population were recorded between the herbicide treated plots and the hand weeding and control plots after application of herbicides (Fig. 2). At harvest, herbicidal treatments recorded 25.95% to 65.85% higher population of actinomycetes than control.

Table 2: Crop growth, yield, weed index and weed control efficiency under different treatments in transplanted rice (Pooled)

Treatment	Dose (g ha^{-1})	Effective tillers m^{-2}	Grains $panicle^{-1}$	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest index (%)	WCE (%)		B:C ratio
							15 DAA	30 DAA	
T1	-	143.1	94.3	2.812	8.013	34.51	-	-	1.6
T2	-	184.2	163.8	5.743	10.169	56.82	85.97	78.33	2.1
T3	3	168.7	147.3	4.123	9.234	44.32	75.43	66.57	2.2
T4	6	176.8	157.1	4.421	9.824	45.32	77.37	70.48	2.4
T5	9	175.8	157.6	5.012	10.218	48.74	78.97	71.85	2.6
T6	12	178.5	158.3	5.413	10.512	51.52	81.69	73.56	2.9
T7	6	174.2	156.5	4.214	9.127	44.87	73.46	68.65	2.2
SEm(±)	**-**	**1.01**	**0.28**	**0.092**	**0.099**	**0.17**	**-**	**-**	
LSD(0.05)	**-**	**3.1**	**0.8**	**0.273**	**0.293**	**0.54**	**-**	**-**	

***Note:** T1 – Control, T2 - Hand Weeding, T3 - Chlorimuron ethyl 25% WP @ 3.0 g.a.i. ha–1, T4 - Chlorimuron ethyl 25% WP @ 6.0 g.a.i. ha–1, T5 - Chlorimuron ethyl 25% WP @ 9.0 g.a.i. ha–1, T6 - Chlorimuron ethyl 25% WP @ 12.0 g.a.i. ha–1, T7 - Check-standard chlorimuron ethyl 25% WP (Kloben) @ 6.0 g.a.i. ha–1*

Similar findings were reported by Sapundjieva et al (2008).

Up to 15 days after application of the herbicides, slight adverse effect on the population of fungi in rhizosphere region was observed. The data showed that population started to increase from 30 DAA. Further all the herbicide treated plots recorded higher fungi population than hand weeding and untreated control plots (Fig. 3). Herbicidal treatments recorded 18.07% to 52.98 % higher population of fungi than control at harvest.

However, initially total bacteria, fungi and actinomycetes did not vary significantly in all the doses of the herbicide chlorimuron ethyl but after herbicide application, they differ for a short period of time. Having the ability to degrade herbicides, microorganisms utilize them as a source of biogenic elements for their own physiological processes. As herbicides have toxic effects on microorganisms; they reduce their abundance, activity and consequently, the diversity of their communities before degradation. Immediately after application, the toxicity of herbicides is normally most severe as their concentration in soil is highest. With advancement of time, microorganisms degraded the herbicides and their concentration gradually reduced up to half-life. After that, carbon released from degraded organic

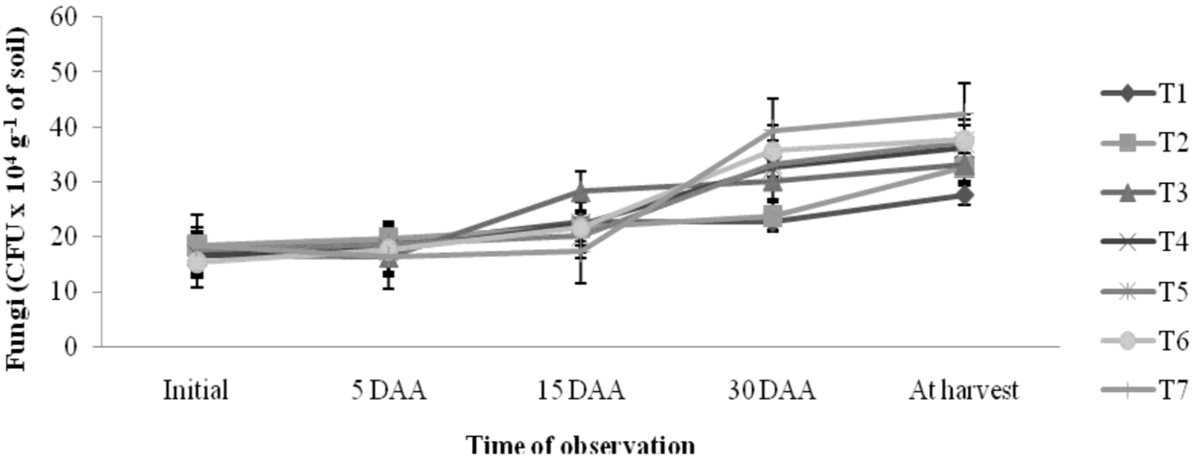

Fig. 3: Influence of treatments on fungi (CFU x 104 g-1 of soil)

herbicide leads to an increase of the soil microflora population (Bera and Ghosh, 2013).

Highest B: C ratio was noted under chlorimuron ethyl 25% WP @ 12 g.a.i. ha –1 (2.9) owing to higher seed yield and comparatively lower cost under this treatment (Table 2). Whereas the lowest B: C ratio was noted in control (1.6). Though twice hand weeding treatment recorded highest yield but it failed to obtain most profitable result with respect to B: C ratio (2.1) due to higher labour wages and this might be due to twice hand weeding is laborious, costly and non-availability of labours at the critical crop-weed competition period.

From this experiment, it may be suggested that rice can be grown in Gangetic medium land of south West Bengal and chlorimuron ethyl 25% WP @ 12 g a.i. ha^{-1} could be used for an alternative weed management measure in transplanted rice as this tratment (B: C ratio = 2.9) is superior over the hand weeding twice is (T2) (2.1) though T2 gives slighter higher yield (6.09%). Application of this safer organic chemical also proved that it does not hamper the microflora status of soil.

REFERENCES

Amakiri, M. A. 1982. Microbial degradation of soil applied herbicides. *Nigeria J. Microl.*, **2**: 17–21.

Ayansina, A.D. V., Ogunshe, A. A. O., Fagade, O.E. 2003. Environment impact assessment and microbiologist. An overview. *In*: Proceedings of 11th Ann.Nat. Conf. of Env. and Behaviour Asso. of Nigeria: 26–27.

Bera, S. and Ghosh, R.K. 2013. Soil physico-chemical properties and microflora as influenced by bispyribac sodium 10% SC in transplanted *kharif* rice. *Rice Sci.*, **20**. DOI: 10.1016/S1672-6308(13)60148-1.

Dubey, M.P., Tiwari, U.K., Kumarvanshi, S.M., Goswami, S.P. and Singh, R. 2000. Response of soybean and associate weed to pre emergence application of chlorimuron-ethyl and metalachlor. *Indian J. Weed Sci..*, **32** : 153-55.

Ferrero, A., Tinarelli, A., 2007. Rice cultivation in the E.U. Ecological conditions and agronomical practices. *In Pesticide Risk Assessment in Rice Paddies: Theory and Practice*. Elsevier Publishing Company, Amsterdam. Capri E. and Karpouzas D. editors, pp : 255.

Gomez K.A, Gomez A.A. 1984. *Statistical Procedures for Agricultural Research*. 2nd edn. Singapore: John Wiley & Sons.

Halder, J. and Patra, A.K. 2007. Effect of chemical weed control methods on productivity of transplanted rice (*Oryza sativa*). *Indian J. Agron.*, **52**: 111-13.

Jayadeva, H.M. 2010. Bioefficacy of post emergence herbicides in weed management of transplanted rice (*Oryza sativa* L.). *J. Crop and Weed.*, **6**: 63-66.

Kathepuri, J.V. Sankpal, V.Y. Ghadage, H.L. and Jawale, S.M. 2007. Weed management in irrigated onion (*Allium cepa* L.) under plane zone of Western Maharashtra. *Madras Agric. J.*, **94**: 123-30.

Kundu, R., Bramhachari, K., Bera, P.S., Kundu, C.K. and Roychoudhury, S. 2011. Bioefficacy of imazethapyr on the predominant weeds in soybean. *J. Crop Weed.*, **7**: 173-78.

Panse, V.G. and Sukhatme, P.V. 1978. *Statistical Methods for Agricultural Workers*, ICAR. New Delhi: 232.

Pramer D, Schmidt, E. L. 1965. Experimental Soil Microbiology. Minneapolis: Burgess Publ.

productivity of transplanted rice (*Oryza sativa*). *Indian J. Agron.* **52**: 111-13.

Sapundjieva, K., Kalinova, S., Kartalska, Y. and Naydenov, M. 2008. Influence of pendimetalin herbicide upon soil microflora. *Pochvoznanie, Agrokhimiya I Ekologiya.*, **42**: 49- 55.

Singh, V.P, Singh, G. and Singh, M. 2004. Effect of fenoxaprop-P-ethyl on transplanted rice and associated weeds. *Indian J. Weed Sci.*, **36**: 190-92.

Singh, V.P. and Singh, M. 2004. Effect of Bispyribac sodium on transplanted rice and associated weeds. *Indian J. Weed Sci.*, **36**: 190-92.

Soni, Monika., Upadhyay, V.B. and Singh, Poonam. 2012. Weed dynamics and production efficiency of rice-based cropping system. *Indian J. Weed Sci.*, **44**: 21–25.