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Bio-efficacy and phytotoxicity of Ethoxysulfuron on the weed control and yield performance of transplanted *kharif* rice in gangetic alluvial soil of West Bengal

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ABSTRACT

Field experiment was conducted on gangetic alluvial soil of West Bengal with nine treatments viz., T_1 : Ethoxysulfuron 60 WG @ 15 g ha^{-1} , T_2: Ethoxysulfuron 60 WG @ 17.5 g ha^{-1}, T_3: Ethoxysulfuron 60 WG @ 20 g ha^{-1},T4: Ethoxysulfuron 60 WG @ 40 g ha^{-1}, T_5: Ethoxysulfuron 15 WP @ 18.5 g ha^{-1}, T_6: Almix 20 WP @ 4 g ha^{-1} all applied at 15 DAT, T_7: 2, 4-DEE 38 EC @ 400 g ha^{-1} at 20 DAT, T_8: Hand weeding twice at 20 and 40 DAT and T_9: Unweeded control replicated thrice in kharif 2005-2006 to study the bio-efficacy and phytotoxicity of Ethoxysulfuron. Among the herbicidal treatments , Almix 20 WP @ 4 g ha^{-1} applied at 15 DAT as post – emergence effectively control all categories of weeds resulted minimum biomass production of weeds (4.45 g m^{-2}), minimum weed index (1.37) and higher weed control efficiency (90.44%) which ultimately produced higher grain yield(5.01 t ha^{-1}) and gave maximum monetary return (21801.98) and benefit : cost ratio (1.41). Although Hand weeding twice at 20 and 40 DAT recorded maximum grain yeld (5.08 t ha^{-1}), however, it was statistically at par with the previous treatment. The herbicide Ethoxysulfuron at different doses did not show any phytotoxic effect on crop except the highest dose which caused injury at initial stage of the crop but recovered within a short period.

Key Words : Bio-efficacy, phytotoxicity, ethoxysulfuron, *kharif* rice.

Severe infestation of weeds in rice field offer the major obstacle to achieve higher yield. Under transplanted condition, crop-weed competition during critical period (Upto 45 DAT) causes a reduction of 15-40% or even more grain yield. Our national average yield is far behind (nearly half) the world average due to several factors including weeds. So, an effective method of weed control to solve this acute weed problem is vitally important in rice field. Although environmental safe cultural method of weed control is to be given top most priority, yet chemical method of weed control is also gaining popularity as it is less costly and non-hazardous.

With the above idea, experiment was carried out at Kalyani 'Incheck' farm of Bidhan Chandra Krishi Viswavidyalaya during kharif seasons with the objectives i) To find out suitable herbicide with proper effective dose to control weeds in transplanted rice; ii) To study the efficiency of different promising herbicides on the growth and yield of transplanted rice; iii) To develop a safe, farmer's acceptable economic weed control measure.

MATERIALS AND METHODS

A field experiment was conducted at the 'C' Block (Incheck) farm of BCKV on gangetic alluvial soil having pH 6.9 during 2005 and 2006 with rice variety 'Satabdi'.

The experiment was laid out at Randomised Block Design having nine treatments viz., T_1 : Ethoxysulfuron 60 WG @ 15 g ha^{-1}, T_2 : Ethoxysulfuron 60 WG @ 17.5 g ha^{-1}, T_3 : Ethoxysulfuron 60 WG @ 20 g ha^{-1}, T_4 : Ethoxysulfuron 60 WG @ 40 g ha^{-1}, T_5 : Ethoxysulfuron 15 WP @ 18.5 g ha^{-1}, T_6: Almix 20 WP @ 4 g ha^{-1} all applied at 15 DAT, T_7 : 2, 4-DEE 38 EC @ 400 g ha^{-1} at 20 DAT, T_8 : Hand weeding twice at 20 and 40 DAT and T_9 : Unweeded control with three replications.

Weed density and weed biomass were taken at 30 and 60 DAT of the crop. Crop yield and benefit : cost ratio were recorded. Weed control efficiency and weed index were also computed.

RESULTS AND DISCUSSION

Predominant weeds in the experimental plot were Grasses – *Echinochloa crusgalli, E. glabrescens, E. colonum, Leersia hexandra, Cynodon dactylon*; Sedges – *Cyperus iria, C.*

difformis, Fimbristylis littoralis; Broadleaved – Alternanthera philoxeroides, Ludwigia parviflora, Ammania baccifera, Marselia quadrifolia, Eclipta alba, Stellaria media, Blainvillea latifolia, Oldenlandia corymbosa, Lindernia ciliata.

Effect of treatments on weeds

Among the chemical treatments, Ethoxysulfuron 60 WG @ 40 g ha^{-1} (T_4) as post emergence treatment gave best performance in reducing both the weed density and total weed biomass (Table-1) at 30 DAT, Whereas, Hand weeding twice treatment gave best performance in reducing both total weed density and total weed biomass at 60 DAT and they were statistically at par among themselves at both the dates of observation. Similar type of results were obtained by Rekha *et al.*, (2002) in transplanted rice.

The treatment Almix 20 WP @ 4 g ha^{-1} (T_6) as post emergence at 15 DAT was also promising in controlling weeds and did not differ significantly with the treatment Ethoxysulfuron 60 WG @ 40 g ha^{-1} (T_4).

Ethoxysulfuron 60 WG @ 20 g ha^{-1} (T_3) and Ethoxysulfuron 15 WP @ 18.75 g ha^{-1} (T_5)applied as post-emergence also showed promising result in controlling weeds as well as minimizing weed dry weight.

Highest weed control efficiency was observed in Almix 20 WP @ 4 g ha^{-1} (T_6) treatment among the chemical treatment and it has no significant difference with hand weeding treatment. Hand weeding at 20 and 40 DAT always showed excellent performance by registering the lowest weed biomass and this may mainly due to the fact that manual treatment receiving two hand weedings along with constant submergence kept the land almost weed free.

Hand weeding treatment also maintained its superiority regarding weed control efficiency. Among the chemical treatments, Ethoxysulfuron 60 WG @ 40 g ha^{-1} (T_4), Ethoxysulfuron 60 WG @ 20 g ha^{-1} (T_3) and Almix 20WP @ 4 g ha^{-1} (T_6) maintained its superiority in this respect. This is in conformity with the findings of Hess and Rose (1995). Similar types of results were also obtained by Singh *et al.* (2005) in directly sown rice under puddled condition.

Effect of treatments on Crop

Hand weeding twice treatment resulted highest grain yield because this treatment gave very little scope to weeds to compete with the crop preferably at the critical stage of crop-weed competition.

Table 1 : Effect of treatments on population of weeds and weed biomass (Mean data)

Treatments	Total Weed Population m^{-2}		Total Weed Biomass (g m^{-2})		Weed Control Efficiency (%)	
	30 DAT	60 DAT	30 DAT	60 DAT	30 DAT	60 DAT
T_1 Ethoxysulfuron 60WG @ 15 g ha^{-1} at 15 DAT	108.00	124.32	16.72	30.13	45.38 (50.67)	33.45 (35.31)
T_2 Ethoxysulfuron 60 WG @ 17.5 g ha^{-1} at 15 DAT	89.00	88.68	11.66	19.08	54.08 (65.60)	50.20 (59.03)
T_3 Ethoxysulfuron 60 WG @ 20 g ha^{-1} at 15 DAT	55.66	48.00	7.87	10.00	61.19 (76.78)	62.39 (78.53)
T_4 Ethoxysulfuron 60 WG @ 40 g ha^{-1} at 15 DAT	28.99	26.01	4.70	5.18	68.13 (86.13)	70.51 (88.87)
T_5 Ethoxysulfuron 15 WP @ 18.5 g ha^{-1} at 15 DAT	39.34	39.32	7.02	10.29	62.92 (79.29)	61.95 (77.90)
T_6 Almix 20 WP @ 4 g ha^{-1} at 15 DAT	33.67	33.66	5.81	4.45	65.54 (82.86)	71.98 (90.44)
T_7 2, 4-DEE 38 EC @ 400 g ha^{-1} at 20 DAT	146.56	135.00	16.80	17.58	45.25 (50.44)	52.09 (62.25)
T_8 Hand Weeding twice at 20 and 40 DAT	38.00	22.33	5.45	3.45	66.35 (83.92)	74.20 (92.59)
T9 Unweeded control	240.34	262.31	33.90	46.58	-	-
S. Em (±)	5.22	3.28	0.96	1.14	3.02	2.93
CD at 5%	15.60	9.80	2.87	3.40	9.02	8.76

N.B. Figures in the parenthesis are the efficiency value (DAT- Days after transplanting).

Table 2 : Effect of treatments on grain yield, weed index, net return and benefit : cost ratio (Mean data)

Treatments		Grain yield (t ha^{-1})	Weed Index (%)	Net return (Rs ha^{-1})	Benefit : cost ratio
T_1	Ethoxysulfuron 60WG @ 15 g ha^{-1} at 15 DAT	4.08	19.68	15074.50	1.00
T_2	Ethoxysulfuron 60 WG @ 17.5 g ha^{-1} at 15 DAT	4.16	18.11	15587.91	1.03
T_3	Ethoxysulfuron 60 WG @ 20 g ha^{-1} at 15 DAT	4.52	11.02	17741.68	1.18
T_4	Ethoxysulfuron 60 WG @ 40 g ha^{-1} at 15 DAT	4.68	7.87	19891.88	1.32
T_5	Ethoxysulfuron 15 WP @ 18.5 g ha^{-1} at 15 DAT	4.48	11.81	18294.17	1.21
T_6	Almix 20 WP @ 4 g ha^{-1} at 15 DAT	5.01	1.37	21801.98	1.41
T_7	2, 4-DEE 38 EC @ 400 g ha^{-1} at 20 DAT	4.15	18.30	15903.06	1.05
T_8	Hand Weeding twice at 20 and 40 DAT	5.08	-	19641.48	1.09
T9	Unweeded control	3.84	24.40	13756.48	0.93
S. Em (±)		0.261	0.787	-	-
CD at 5%		0.783	2.35	-	-

Almix 20 WP @ 4 g ha^{-1} as post-emergence resulted second highest grain yield and it has no significant difference with the best treatment (T_8) hand weeding twice (Table-2) due to the fact that application of Almix affected the production of essential amino acids in a considerable amount in different categories of weeds. This findings is in conformity with Mukherjee and Singh (2005).

Ethoxysulfuron 60 WG @ 40 g ha^{-1}(T_4), Ethoxysulfuron 60 WG @ 20 g ha^{-1} (T_3) and Ethoxysulfuron 15 WP @ 18.75 g ha^{-1} (T_5)all applied at 15 DAT showed promising result in achieving more grain yield and they were statistically at par among themselves.

Minimum weed index was recorded with Almix 20 WP @ 4 g ha^{-1} treatment. This treatment again obtained highest value of benefit : cost ratio in comparison to hand weeding treatment. Highest net profit was also obtained with this treatment.

Toxicity to rice plant caused by the herbicides is seen only in one case where the dose of Ethoxysulfuron was highest i.e. at 40 g ha^{-1}. But this toxicity did not affect the grain yield of rice due to its quick recovery. So, no phytotoxic effect on the crop was observed in the long run for the herbicides tested in this investigation.

So, it can be inferred from economic point of view, that among all the treatments tried in this investigation, Almix 20 WP @ 4 g ha^{-1} as post emergence at 15 DAT can profitably replace the tedious, time consuming and expensive hand weeding practice of weed control. Even Ethoxysulfuron 60 WG @ 40 g ha^{-1}, Ethoxysulfuron 60 WG @ 20 g/ha and Ethoxysulfuron 15 WP @ 18.75 g ha^{-1} all applied at 15 DAT as post emergence are also effective in this concern without any phytotoxic effect.

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