

## PERFORMANCE OF WEED MANAGEMENT PRACTICES FOR DIFFERENT ESTABLISHMENT METHODS OF RICE (*Oryza sativa* L.) IN DRY SEASON

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### Abstract

*Effect of rice establishment methods and weed management practices on associated weeds and grain yield of rice was studied at BRRI farm Gazipur and BRRI farm Bhanga, Faridpur District during dry seasons of 2006 and 2007. Seven weed control treatments were imposed inside three planting methods in Split Plot under RCBD. Herbicide MCPA 500 @ 500g a.i. ha<sup>-1</sup> showed some phytotoxicity in broadcasting and drum seeded system where other treatment combinations did not show any significant phytotoxicity on crops. Grass type weed were dominant in direct wet seeded rice whereas sedges and broad leaves were dominant in transplanting method of rice. Weed control efficiency varied from 80 to 85% during 2006 and 88-91% in 2007 against different weed control treatments. Weed number and weight was significantly higher in broadcast and drum seeded method resulting lower weed control efficiency than transplanting method. Different groups of herbicide + one hand weeding gave statistically similar yield compared with weed free treatments except MCPA500 @ 500g a.i. ha<sup>-1</sup> + one hand weeded treatments. Higher panicles m<sup>-2</sup> in broadcasting and drum seeded method led to higher grain yield than transplanting method. Interaction effect of ethoxysulfuron 150WG @ 15g a.i. ha<sup>-1</sup> + one hand weeding in broadcasted method and pretilachlor 500EC @ 500g a.i. ha<sup>-1</sup> + one hand weeding under drum seeding produced higher grain yield, whereas other combinations of treatments produced intermediate grain yield. Broadcasting and drum seeding method produced lower grain yield in unweeded condition as compared with transplanting method under the with same condition. It is thus, concluded that for realizing higher yields of rice drum and broadcast methods should be integrated with ethoxysulfuron and pretilachlor @150 and 500 g a.i. ha<sup>-1</sup>, respectively in combination with one hand weeding.*

**Key Words:** Rice, establishment method, weed management, herbicide.

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## INTRODUCTION

In Bangladesh, transplanting is the most popular planting method for rice establishment. There is an increasing trend to replace transplanting of rice by wet seeding. Effective weed control is one of the major requirements to ensure a successful wet seeded rice crop. The transformation in crop-establishment technique from transplanted to wet seeded rice cultivation has resulted in dramatic change in the type and degree of weed infestation (Subramaninan *et al.*, 2006). Weed Management is very critical factor for successful production of wet seeded rice, because the soil conditions favor simultaneous germination of weed seeds along with rice seeds. So it is difficult to control weeds by hand weeding in the early stage of crop growth in wet seeded rice (James, 1998). Uncontrolled weed growth causes nine percent greater reduction in grain in wet seeded rice than in transplanted rice (Moody, 1993). Herbicide is more efficient in timely control of weeds in wet seeded rice. Chemical weeding preferably the use of pre-emergence herbicide is vital for effective and cost-efficient weed control in such situation where weeds complete with the main crop right since the date of germination (Subramaninan *et al.*, 2006). Again herbicide alone does not solve the purpose of weed control satisfactorily in wet seeded rice unless it is supplemented with manual weeding. Continuous use of same herbicide having the same mode of action may lead to the development of resistance in weeds (Malik and Singh, 1993). Pre emergence herbicides mainly control weeds in the earlier stages and weeds emerging at later stages of rice growth are not controlled efficiently. So combination of chemical and manual weeding becomes essential for effective management of weeds to get good yield. Therefore the experiment were conducted with a number of pre and post emergence herbicides alone and its combination with hand weeding to develop an effective and viable weed management practice for wet seeded rice compare with transplanting method.

## MATERIALS AND METHODS

The Experiment was conducted at BRRI farm, Gazipur and Faridpur, Bangladesh, during the season of *Boro* 2006 and 2007, to scrutinize the effectiveness of herbicide along and its combination with one hand weeding to develop a useful weed management practices in broadcasting, drum seeding and transplanting method of rice. Seven weed control treatments were imposed inside three planting method system. Weed control treatments were oxadiazon 25EC @ 0.5kg a.i. ha<sup>-1</sup> + one hand weeding, pretilachlor 500EC @ 0.5kg a.i. ha<sup>-1</sup> + one hand weeding, ethoxysulfuran 150 WG @ 100g a.i. ha<sup>-1</sup> + one hand weeding, MCPA 500 @ 0.5kg a.i. ha<sup>-1</sup> + one hand weeding, butachlor 5G @ 1.25 kg a.i. ha<sup>-1</sup> + one hand weeding, weed free and the weedy

check (control). Rice establishment methods were broadcasting, drum seeding and transplanting. 'BRRI dhan29' was used as a variety. Rice establishment methods were placed in main plots and weeding methods in the subplots. Seeds were broadcasted @ 40kg ha<sup>-1</sup> on 5<sup>th</sup> December, 2006 and 7<sup>th</sup> December, 2007 at Gazipur and Faridpur, respectively and at the same time sprouted seeds were seeded by drum seeder used by single row thin layer. In the same day seeds were seeded in the seedbed for transplanting. Forty two days old seedlings were transplanted at 15 January, 2006 and 17 January, 2007 at Gazipur and Faridpur. Oxadiazon 25 EC, pretilachlor 500EC and butachlor 5G were applied in broadcasted and drum seeded plot at 6 DAS with a thin layer of water in the plot. In transplanted plot same herbicide was applied at 6 DAT. Post emergence herbicide ethoxysulfuron 150 WG was sprayed at 2 leaf stage of weeds (at 15 DAP) and MCPA 500 was applied at 3-4 leaf stage of weeds (20 DAP) in broadcasted, drum seeded plot and at the same approach was adopted in transplanted plot. Water was available in the plot during herbicide application. Fertilizer was applied as per BRRI recommended doses. Weeds were counted at 45 days after planting before one hand weeding. Weed control efficiency was calculated using weed dry weight data following the formula of Rao (1985). Phytotoxicity of the herbicide to rice plants was determined by visual observations (Yellowing of leaves, burring leaf tips, stunting growth etc). The degree of toxicity on rice plant was measured by the phytotoxicity rating as used by IRRI (1965) like 1. No toxicity 2. Slightly toxicity 3. Moderate toxicity 4. Severe toxicity and 5. Plant kill Phytotoxicity rating was done within a week after application of herbicides. Phytotoxicity was observed three times at 3, 5 and 7 days after application of herbicide and the mean rate was calculated from 10 sample plants of a until plot. Yields and yield contributing characters of rice were recorded after harvest. The data were analyzed following analysis of variance(ANOVA) technique and mean separation was done by multiple comparison test (Gomez and Gomez, 1984) using the statistical program MSTAT-C (Russell, 1986).

## RESULTS AND DISCUSSION

### Phytotoxicity of herbicides on rice plants

The degree of toxicity of different pre and post emergence herbicide to rice plants and the symptoms produced on plant are presented in Table-1. It is observed that butachlor 5G @ 1.25kg a.i. ha<sup>-1</sup> showed insignificant phytotoxicity in both broadcasting and drum seeded rice and in case of transplanting it showed no toxicity during 2006 and 2007. MCPA 500 @ 0.5 kg a.i. ha<sup>-1</sup> showed some toxicity in

**Table-1. Rating of herbicide toxicity under different rice establishment methods.**

Treatment	Rating		Broadcasted and drum seeded rice	
	2006	2007	Symptom observed on rice crop, 2006	Symptom observed on rice crop, 2007
T1	1.58	1.64	Temporary slight yellowing of leaves which required 9-11 days to recover	Temporary slight yellowing of leaves which required 10-12 days to recover
T2	1.45	1.62	Some times slightly yellowing of leaves.	Slight yellowing of leaves which required 7-10 days to recover
T3	1.40	1.45	Some times slightly yellowing of leaves.	Some times slightly yellowing of leaves.
T4	2.25	2.23	Slightly to moderate toxic. Yellowing of leaves, temporary stunting of growth. Plants required 10-17 days to regain their normal growth and leaf color after application of herbicide. Sometimes plant killed.	Slightly to moderate toxic. Yellowing of leaves, temporary stunting of growth. Plants required 10-15 days to regain their normal growth and leaf color after application of herbicide. Sometimes plant killed.
T5	1.30	1.32	Some times slightly yellowing of leaves.	Some times slightly yellowing of leaves.
<b>Transplanting</b>				
T1	1.35	1.45	Some times slightly yellowing of leaves.	Some times slightly yellowing of leaves.
T2	1.18	1.20	Some times very slightly yellowing of leaves.	Some times very slightly yellowing of leaves.
T3	1.13	1.12	No toxicity	No toxicity
T4	1.60	1.48	Temporary yellowing of leaves which required 10-16 days to recover	Temporary slightly yellowing of leaves which required 8-11 days to recover
T5	1.0	1.0	No toxicity	No toxicity

T1=Oxadiazon 25EC @ 0.5kg a.i. ha<sup>-1</sup> + 1HW, T2=Pretilachlor 500EC@ 0.5kg a.i. ha<sup>-1</sup> + 1HW, T3=Ethoxysulfuron 1500WG @ 15g a.i. ha<sup>-1</sup> + 1HW, T4=MCPA500 @ 0.5kg a.i. ha<sup>-1</sup> + 1HW, T5=Butachlor 5G @ 1.25 kg a.i. ha<sup>-1</sup> + 1HW.

broadcasting and drum seeded plot which cause temporary yellowing, stunted plants, leaf tips turned brown, a few number of injured leaves and some plants killed in both years of study. Others herbicides showed minor phototoxicity in both transplanted and direct seeded rice. It is also observed that phytotoxicity symptoms were more prominent in direct seeded wet rice than transplanting in both the years and locations.

#### Effect on weeds

Weed number, weed weight and weed control efficiency varied due to different weed management practices during 2006 and 2007 (Table-2). Weed number and weight was highest in weedy check plot followed by other weed management treatments in both the years. Weed control efficiency varied from 80% to 85% in 2006 and 88% to 91% in 2007 in different weed management treatments. Weed dynamics also varied in rice establishment method (Table-3). Weed number and weight was significantly higher in broadcast and drum seeded method, consequently these resulted in lower weed control efficiency than transplanted method. During 2006 among different groups of weeds, grasses constitute 63%, sedges 32% and broadleaf constituted only 5% of total population in broadcasting method. Drum seeded method attained 58%, 27% and 15% of grasses, sedges and broadleaves weeds, respectively. In case of transplanting, grasses constituted 29%, sedges 40% and broadleaves were 31%. Similar trend of data were observed in the year of 2007. So it is evident that grassy weeds were dominant in direct wet seeded rice whereas, sedges and broadleaf weeds were dominant in transplanting method (Table-3).

**Table-2. Weed density and weed control efficiency as affected by weed management practices.**

Treatment	Weed number (m <sup>-2</sup> )		Weed weight (g m <sup>-2</sup> )		*WCE (%)	
	2006	2007	2006	2007	2006	2007
T1	2.56b	2.70b	2.31c	1.35b	85	88
T2	2.64b	2.54b	2.62b	1.28b	81	89
T3	2.79b	2.65b	2.65b	1.29b	81	90
T4	2.93b	2.47b	2.71b	1.19b	80	91
T5	2.85b	2.45b	2.55bc	1.15b	82	91
T6	8.91a	6.74a	6.04a	3.92a	-	-
CV(%)	29.81	17.86	7.81	17.79	-	-
<b>LSD<sub>0.05</sub></b>	<b>1.36</b>	<b>0.58</b>	<b>0.29</b>	<b>0.43</b>	-	-

Weed data were transforming by square root transformation.

\* % Weed Control Efficiency was calculated regarding the treatment over no weeding.

T1 = Oxadiazon 25EC @ 0.5kg a.i. ha<sup>-1</sup> + 1HW, T2 = Pretilachlor 500EC@ 0.5kg a.i. ha<sup>-1</sup> + 1HW, T3 = Ethoxysulfuron 1500WG @ 15g a.i. ha<sup>-1</sup> + 1HW, T4 = MCPA500 @ 0.5kg a.i. ha<sup>-1</sup> + 1HW, T5=Butachlor 5G @ 1.25 kg a.i. ha<sup>-1</sup> + 1HW, T6 = Control (Unweeded).

**Table-3. Weed prevalence and weed control efficiency as affected by rice establishment methods.**

Treatment	Weed number (m <sup>-2</sup> )		Weed weight (g m <sup>-2</sup> )		WCE (%)		Weed species as group (%)			Weed species as group (%)		
	2006	2007	2006	2007	2006	2007	2006			2007		
							G	S	B	G	S	B
Broadcasting	4.04a	3.42a	3.31	1.96a	81.5	87.6	63	32	05	60	30	10
Drum seeding	3.82ab	3.72a	3.27	1.98a	82.0	88.8	58	27	15	56	32	12
Transplanting	3.45b	2.64b	2.86	1.15b	84.65	93.4	29	40	31	30	45	25
CV (%)	29.81	17.86	7.81	0.22	-	-	-	-	-	-	-	-
LSD <sub>0.05</sub>	0.48	0.43	ns	17.79	-	-	-	-	-	-	-	-

Weed data were transformed by square root transformation. G = Grass, S = Sedge, B = Broadleaf.

### Yield and yield components

Yield and yield contributing characters were significantly affected due to different weed management options (Table-4). Number of panicles was higher in weed free plot which is statistically alike with other weed management treatment except weedy check (control) plot during *boro* 2006 and 2007. Lowest number of panicle was found in the weedy check plot. Similar trend of results was found in case of filled grains panicle<sup>-1</sup> and 1000 grain weight although in *boro* 2006 there is no significant difference for panicle length. Among different weed management treatments weed free plot produced significantly higher grain yield (5.24 tha<sup>-1</sup>) which is statistically at par with other weed management treatments followed by MCPA 500 + one hand weeded plot which produced 4.66 t ha<sup>-1</sup> of grain yield, while the weedy check plot gave the lowest (1.61 tha<sup>-1</sup>) grain yield. Grain yield is higher during 2007 compared with 2006 due to single cropped area where yield potential is high.

Yield and yield components were also affected by rice establishment methods (Table-5). During 2006 yield and yield components did not vary significantly but in 2007 highest panicles m<sup>-2</sup> were found in drum seeded method that is statistically alike with broadcasting method. Lowest panicle m<sup>-2</sup> were found in transplanting

**Table-4. Yield and yield components of rice as affected by weed management practices.**

Treatment	Panicles m <sup>-2</sup>		Grains panicle <sup>-1</sup>		Panicle length (cm)		1000 grain weight (g)		Grain yield (t ha <sup>-1</sup> )	
	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007
T1	285a	465a	85a	113a	20.0	20.24bc	20.97a	22.40a	5.19a	7.97ab
T2	276a	466a	81a	114a	20.14	18.02bc	21.5a	21.46a	4.99ab	7.97ab
T3	260a	463a	79a	115a	20.05	21.55ab	21.34a	21.99a	4.81ab	7.94ab
T4	255a	458a	78a	113a	20.80	21.95ab	21.44a	21.89a	4.66b	7.93b
T5	270a	468a	82a	115a	20.25	19.64bc	21.09a	21.62a	4.98ab	7.97ab
T6	278a	484a	83a	124a	20.15	16.68c	20.92a	21.37a	5.24a	8.24a
T7	119b	264b	52b	91b	21.44	25.89a	20.18b	20.41b	1.61c	3.44c
CV(%)	11.16	5.23	7.45	5.99	6.33	22.17	2.90	5.28	8.57	5.17
LSD <sub>0.05</sub>	32.08	26.16	6.62	11.72	ns	4.17	0.70	0.95	0.44	0.27

T1=Oxadiazon 25EC @ 0.5kg a.i. ha<sup>-1</sup> + 1HW, T2=Pretilachlor 500EC@ 0.5kg a.i. ha<sup>-1</sup> + 1HW, T3=Ethoxysulfuron 1500WG @ 15g a.i. ha<sup>-1</sup> + 1HW, T4=MCPA500 @ 0.5kg a.i. ha<sup>-1</sup> + 1HW, T5=Butachlor 5G @ 1.25 kg a.i. ha<sup>-1</sup> + 1HW, T6=Weed free, T7=Control( Unweeded).

**Table-5. Yield and yield components as affected by rice establishment methods.**

Rice establishment method	Panicles m <sup>-2</sup>		Grains Panicle <sup>-1</sup>		Panicle length (cm)		1000 Grain Weight (g)		Grain Yield (t ha <sup>-1</sup> )	
	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007
Broadcasting	253	464a	79.38	106b	20.06	23.17b	20.97	21.03b	4.78	7.44a
Drum Seeding	252	471a	79.14	109b	20.69	23.70b	21.24	21.5b	4.51	7.49a
Transplanting	242	380b	72.57	118a	20.50	25.01a	20.98	22.38a	4.50	7.12b
CV(%)	11.16	5.23	7.45	5.99	6.33	4.64	2.90	5.16	8.57	5.17
LSD <sub>0.05</sub>	ns	14.52	ns	4.20	Ns	0.75	ns	0.75	ns	0.24

method but highest grains panicle<sup>-1</sup> were found in transplanted rice followed by drum seeded and broadcasting method of rice. Similar results were found for 1000 grain weight. Highest grain yield (7.49 t ha<sup>-1</sup>) was found from drum seeded method that is statistically alike with broadcasting method, but higher than the transplanted rice.

Interaction effect of weed management and rice establishment method significantly varied in weed number, panicles m<sup>-2</sup> and grain yield of rice during 2007 (Table-6). Among the interactions highest weed number was found in weedy check x drum seeded combination which is statistically alike with weedy check x broadcasting combination, followed by weedy check x transplanted rice.

**Table-6. Interaction effect of weed management and rice establishment method on weed, panicles m<sup>-2</sup> and grain yield of rice.**

Interaction effect (WxPM)	Weed number (m <sup>-2</sup> )		Panicles m <sup>-2</sup>		Grain yield (t ha <sup>-1</sup> )	
	2006	2007	2006	2007	2006	2007
T1P1	2.88	2.76c	274	489ab	4.98	8.17abc
T1P2	2.98	3.05c	268	504ab	5.08	8.16abc
T1P3	3.10	2.29c	263	404c	4.96	7.58bc
T2P1	3.15	2.44c	275	501ab	4.58	8.20abc
T2P2	2.92	2.87c	287	506ab	4.88	8.22ab
T2P3	9.23	2.32c	283	392c	5.33	7.48bc
T3P1	2.51	2.82c	122	508ab	1.54	8.23ab
T3P2	2.38	2.64c	288	497ab	5.29	8.13abc
T3P3	2.74	2.49c	287	385c	4.97	7.46c
T4P1	2.99	2.44c	280	473b	4.9	8.14abc
T4P2	2.88	2.92c	241	493ab	4.60	8.04abc
T4P3	9.53	2.06c	273	408c	5.0	7.6bc
T5P1	2.31	2.27c	275	499ab	5.18	8.21abc
T5P2	2.56	2.79c	121	502ab	1.68	8.13abc
T5P3	2.51	2.29c	294	405c	5.29	7.58bc
T6P1	-	-	272	520a	4.91	8.23ab
T6P2	-	-	238	517ab	4.58	8.51a
T6P3	-	-	250	417c	4.81	7.96abc
T7P1	2.64	7.81a	252	263d	5.10	2.92e
T7P2	2.73	8.02a	276	277d	5.22	3.24e
T7P3	7.97	4.39b	115	254d	1.62	4.16d
CV (%)	29.81	17.86	11.16	5.23	8.57	5.17
Lsd( .05)	ns	0.98	Ns	38.42	ns	0.63

Weed management:

T1 = Oxadiazon 25EC @ 0.5kg a.i. ha<sup>-1</sup> + 1HW, T2 = Pretilachlor 500EC @ 0.5kg a.i. ha<sup>-1</sup> + 1HW, T3 = Ethoxysulfuron 1500WG @ 15g a.i. ha<sup>-1</sup> + 1HW, T4 = MCPA500 @ 0.5kg a.i. ha<sup>-1</sup> + 1HW, T5 = Butachlor 5G @ 1.25 kg a.i. ha<sup>-1</sup> + 1HW, T6 = Weed free, T7 = Control (Unweeded)

Rice establishment method:

P1= Broadcasting; P2= Drum seeding; P3= Transplanting

Highest number of panicles m<sup>-2</sup> were found in weed free x broadcast method which is statistically similar with weed free x drum seeded plot. The lowest panicles m<sup>-2</sup> was recorded in weedy check x broadcasting plots which is statistically alike with weedy check x drum seeded plot and weedy check x transplanted plots. Highest grain yield (8.51 t ha<sup>-1</sup>) was produced from weed free x drum seeded plot and lowest (2.92 t ha<sup>-1</sup>) grain yield was harvested in weedy check x broadcasting plot which is statistically similar with weedy check x drum seeded plot followed by weedy check x transplanted plot. Other combinations of treatments produced intermediate grain yield. The above results support with the findings of James, (1998).

It is observed from the data in Table-7 that broadcasting and drum seeded methods produced lower yield in unweeded conditions compared with transplanting involving the same condition in both the years. Weed is the main cause to reduce grain yield in direct wet seeded rice. Subsequently direct seeding produced more weed prevalence than transplanting. These results suggest that for realizing higher yields of rice, drum and broadcast methods should be integrated with ethoxysulfuron and pretilachlor @150 and 500 g a.i. ha<sup>-1</sup>, respectively in combination with one hand weeding under dry season rice cultivation of Bangladesh.

**Table-7. Effect of method of crop establishment on rice yield (t ha<sup>-1</sup>) under weed free and weedy conditions.**

Rice Establishment Method	Grain yield ( t ha <sup>-1</sup> )			
	2006		2007	
	Weed Free	Weedy condition	Weed Free	Weedy condition
Broadcasting	5.33	1.53	8.23	2.92
Drum Seeding	5.17	1.67	8.51	3.24
Transplanting	5.22	1.62	7.96	4.16

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