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GROWTH AND YIELD OF HYBRID AND INBRED BORO RICE AFFECTED BY DIFFERENT METHODS OF WEED CONTROL

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ABSTRACT

A field experiment was carried out at Sher-e-Bangla Agricultural University, Dhaka, Bangladesh during the period from December, 2008 to May, 2009 to evaluate the growth and yield of hybrid and inbred boro rice as affected by different weed control methods. The experiment comprised of seven weeding treatments and three varieties of boro rice. The experiment was carried out in RCBD with three replications. Eight weed species belonging to four families were identified in the experimental field. Densities of weeds were recorded from 7 DAT to 50 DAT at 7 days interval. It was found that among the weed control treatments, application of Sunrice 150WP (ethoxysulfuron) 125 g a.i. ha^{-1} showed best performance in respect of the highest plant height (103.35cm), maximum tillers hill^{-1} (22.00), the maximum plant dry matter (192.8g hill^{-1}), effective tillers hill^{-1} (20.34), lowest number of ineffective tillers hill^{-1} (1.33) and consequently produced highest grain yield (9.50 t ha^{-1}), straw yield (10.25 t ha^{-1}) and harvest index (41.16) in comparison to all other treatments. Among the weed control treatments-Sunrice 150WP (ethoxysulfuron) 125 g a.i. ha^{-1} controlled 81% weed population, whereas Commit 500EC pretidachlor gave 62% and hand weeding only 52% control. The highest grain yield, straw yield as well as benefit cost ratio was obtained from the variety Sonarbangla hybrid dhan 6. under Sunrice 150 WP (ethoxysulfuron) 125 g a.i. ha^{-1} which increased 22.58% grain yield than Commit 500EC (pretidachlor) 750 ml ha^{-1} and 34.58% grain yield than two hand weedings, due to higher number of panicles hill^{-1} and number grains panicle^{-1}.

Key Words: Hybrid and Inbred *boro* Rice, Weeding, Weed density, Yield.

INTRODUCTION

Geographical and agronomic conditions of Bangladesh are favorable for rice (*Oryza sativa* L.) cultivation. Rice is the leading food for more than two billion people in Asia and for hundreds of millions of

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people in Africa and Latin America (IRRI, 2006). In Bangladesh rice occupies 10.58 million hectares of land which is about 77 percent of the cultivated area (BBS, 2008). The population of Bangladesh will increase to 173 million in 2020 which is 31 percent higher than the present level (FAO, 1998). National Agricultural Commission says that to feed the increased population in 2020, 47 million tons of rice will be needed to produce in the country. For food security of the country, rice production is needed to be increased from 3 tons ha^{-1} to 5 tons ha^{-1} in next 20 years (Mahbub, *et al.,* 2001). Weeds are the most destructive agricultural pest. Most of the weeds drive their nourishment through rapid development and manifested by quick root and shoot development. Competitive abilities of weeds poses a serious negative effect in crop production and responsible for marked losses in crop yield (Mamun, 1990). According to Willocquet *et al*., (1999), the losses due to infestation of weeds are greater than the combined losses caused by insect, pest and diseases in rice. Mamun, *et al.,* (1993) reported that weed growth reduced the grain yield by 68-100% for direct seeded *aus* rice, 22-36% for modern *boro* rice and 16-48% for transplanted *aman* rice. This loss is, therefore, a serious threat for the food deficit countries like Bangladesh and necessitates proper weed management for rice production. A number of studies (Mondol, *et al.,* 1995; Gill, *et al.,* 1992; Panwar, *et al.,* 1992) showed that weed control through both traditional and chemical methods influence plant height, tiller number, crop growth rate, yield attributes and yield of *boro* rice. Herbicides are used successfully for weed control in rice fields for rapid effect, easier to apply and low cost involvement in comparison to the traditional methods of hand weeding (Hasanuzzaman, *et al.,* 2009). In Bangladesh, few studies have attempted to establish the most suitable and economic integrated weed management system in *boro* rice. Present work was carried out to evaluate different weed control methods including chemical control in different *boro* rice cultivars in terms of crop growth, productivity, profitability.

MATERIALS AND METHODS

An experiment was conducted on *boro* rice at Sher-e-Bangla Agricultural University farm, Dhaka, Bangladesh ($90^0 33´$ E longitude and $23^0 77´$ N latitude). The soil of the experimental site was clay loam with a pH of 5.47-5.63. The experiment was laid out in a Randomized Complete Block Design (RCBD) with 3 replications comprising seven different weeding treatments viz. no weeding, hand weeding at 30 days after transplanting (W_1), two hand weeding at 30 DAT and 50 DAT (W_2), Sunrice 150 WP (ethoxysulfuron) at 100g a.i. ha^{-1} (W_3), Sunrice 150 WP (ethoxysulfuron) 125 g a.i. ha^{-1} (W_4), Commit 500

EC (pretidachlor) 1000 ml ha^{-1} (W_5), Commit 500 EC (pretidachlor) 750 ml ha^{-1} (W_6). The seeds of inbred rice variety BRRI dhan29 was collected from Bangladesh Rice Research Institute, hybrid variety Hira-6 from Supreme Seed Company Ltd., Sonarbangla-6 was A. R. Malik's Co. (Priv.) Ltd., and sown in the seed bed on December 04, 2008. Thirty days old seedlings (2 for hybrid and 3 for inbred) were transplanted on January 04, 2009. The planting distance was maintained at 25 cm (row-row) × 15 cm (hill-hill). Fertilizers at 124:62:72:20:5 NPKSZn kg ha^{-1} were applied. All PKSZn were applied as basal dose at final land preparation. Urea (N) was top dressed in three equal installments; after seedling recovery (15 DAT) vegetative stage (35 DAT) and at 7 days before panicle initiation (50 DAT). Herbicides were sprayed with a hand sprayer in the mid-morning at 7 DAT. Intercultural operations such as gap filling, irrigation, insect and disease management were carried out as required. Density of weeds was recorded from 7 DAT to 50 DAT at 7 days interval. Plant growth characters were recorded from 20 DAT at 25 days interval. At harvest, yield contributing characters and yield were recorded. The collected data were analyzed using MSTST-C statistical package. Mean were compared with LSD test.

RESULTS AND DISCUSSION

Eight weed species belonging to four families were identified in the experimental field of which *Echinochloa colonum, Leersia hexandra, Cynodon dactylon, Cyperus rotundus, Scirpus mucronatus, Spilanthes acmella, Enhydra fluctuans* and *Desmodium trifolium.*

Weed control

The lowest weed density was observed in the hybrid variety Sonarbangla-6 (V_3) as compared to the other variety (Table-1). Weed density was significantly greater in the no weeding plots than other treatments (Tables-2&3). Similar results were also observed by Hasanuzzaman (Hasanuzzaman, *et al.,* 2007) and Ahmed *et al.* (1997). There was no significant difference in weed density at 30 DAT between one hand weeding (W_1) and two hand weeding (W_2) before second hand weeding. But, at 50 DAT, two hand weeding had lower weed density than one hand weeding. One hand weeding at 30 DAT (W_1) effectively reduced weed number which was similar to W_2 (two hand weeding; Fig.1). From Table-2 it was found that the lowest weed density was observed in the treatment Sunrice 150 WP (ethoxysulfuron) 125 g a.i. ha^{-1} (W_4) and Commit 500EC (pretidachlor) 750 ml ha^{-1} (W_6). The weed density was reduced by 81% with W_4 where W_6 it by 62%, Commit 500 EC (pretidachlor) 1000 ml ha^{-1} (W_5) by 56% and Sunrice 150 WP (ethoxysulfurao) at 100g a.i. ha^{-1} (W_3) by

55% which was higher than the hand weeding treatments (Fig.1). Gill *et al.,* (1992) also found similar results

Table-1. Weed density affected by different varieties of *boro* rice.

Treatment	Weed density m^{-2}						
	7 DAT	14 DAT	21 DAT	28 DAT	35 DAT	42 DAT	49 DAT
Hira-6 (V_1)	30.00	70.00	83.00	95.00	100.50	85.50	70.00
BRRI dhan29 (V_2)	25.00	62.00	68.00	76.50	36.50	30.00	23.00
Sonarbangla-6 (V_3)	22.00	52.00	67.00	74.00	35.50	29.50	21.00
$LSD_{0,05}$	5.783	5.067	10.65	8.869	10.15	12.53	11.13
CV (%)	14.23	10.75	16.57	10.05	12.80	17.96	18.95

Table-2. Weed density affected by different weed control methods of *boro* rice.

Treatment	Weed density m^{-2}						
	7 DAT	14 DAT	21 DAT	28 DAT	35 DAT	42 DAT	49 DAT
No Weeding	30.00	66.33	85.67	113.0	123.80	112.9	100.7
One (W_1)	25.00	44.00	67.83	76.50	36.33	30.17	23.67
Two weeding (W_2)	25.00	51.67	59.67	70.17	33.61	28.83	22.50
Sunrice 150 WG (Ethoxysulfuran) at 100g a.i. ha^{-1} (W_3)	20.00	9.00	17.33	34.50	39.17	31.83	25.67
Sunrice 150 WG (Ethoxysulfuran) 125 g a.i. ha^{-1} (W_4)	22.00	4.05	9.67	19.50	26.67	23.67	18.67
Commit 500 EC (Pretidachlor) 1000mlha^{-1}(W_5)	27.33	13.67	20.00	38.83	46.67	41.67	35.67
Commit 500 EC (Pretidachlor) 750 ml ha^{-} (W_6)	20.67	9.12	12.50	21.67	30.28	26.83	22.33
$LSD_{0,05}$	5.783	5.067	10.65	8.869	10.15	12.53	11.13
CV (%)	14.23	10.75	16.57	10.05	12.80	17.96	18.95

Table 3. Interaction effect of different weed control methods of *boro* rice.

Treatment	Weed density m^{-2}						
	7 DAT	14 DAT	21 DAT	28 DAT	35 DAT	42 DAT	49 DAT
V_1W_0	30	70	83	95	100.5	85.5	70
V_1W_1	25	52	68	76.5	36.5	30	23
V_1W_2	22	62	67	74	35.5	29.5	21
V_1W_3	20	11	13	29.5	40.5	30	22.5
V_1W_4	22	4	9.5	16	20	15	9
V_1W_5	25	11	16	36	45	38.5	30
V_1W_6	22	8.35	12.5	19	27.5	22	17.5
V_2W_0	35	70	93	134	146	133.3	118.5
V_2W_1	20	35	75.5	78	37	30	23.5
V_2W_2	30	58	65	71.5	34	28.5	21.5
V_2W_3	15	7.5	13.5	34.5	42	37.5	30
V_2W_4	20	3.65	9	12.5	20	18.5	15
V_2W_5	22	12	17	43.5	50	45.5	40
V_2W_6	24	9	12	16	22	20	17.5
V_3W_0	25	59	81	110	125	120	113.5
V_3W_1	30	45	60	75	35.5	30.5	24.5
V_3W_2	25	35	47	65	31.33	25	21
V_3W_3	30	15	25.5	39.5	35.5	30	24
V_3W_4	24	4.5	10.5	30	40	37.5	32
V_3W_5	35	18	27	37	45	41	37
V_3W_6	16	10	13	30	41.33	38.5	32
$LSD_{0,05}$	5.78	5.067	10.65	8.869	10.15	12.53	11.13
CV (%)	14.23	10.75	16.57	10.05	12.80	17.96	18.95

Agronomic traits

At both the stages, the weed infestation in the no weeding plots was severe resulting in intense competition with crop plants. The shortest plant height was observed in the hybrid variety (V_1-Hira-6 and V_3-Sonarbangla-6) with W_0 (no weeding; Fig. 2) and from Table-4 it was found that the tallest (103.35 cm) plants were in the inbred variety performed by the combined effect of BRRI dhan29 (V_3) and Sunrice 150 WP (ethoxysulfuron) 125 g a.i. ha^{-1} (W_4) (Table-4). The

weed competition affected the production of new tillers at early vegetative stage. The small number of tillers hill^{-1} was observed with W_0 (no weeding) and the highest number of tillers hill^{-1} (22.00) was observed in V_3W_4 which performed by the interaction effect of Sonarbangla-6 and Sunrice 150 WP (ethoxysulfuron) 125 g a.i. ha^{-1} (Table-4). Islam *et al*., (2009) also reported that hybrid variety had more tillering capacity than inbred variety. Dry matter is an important crop character which contributes to yield. The highest dry matter produced by the treatment Sunrice 150 WP (ethoxysulfuron) 125 g a.i. ha^{-1} (W_4) which was statistically similar to W_6 (Fig. 3)

Yield components and yield

Yield components of *boro* rice were significantly affected by weed control methods. Effective tillers hill^{-1}and fertile grains panicle^{-1} were significantly influenced by different treatments. Maximum number of effective tillers hill^{-1} and fertile grains panicle^{-1} were observed in hybrid variety (V_1-Hira-6 and V_3-Sonarbangla-6) than inbred variety V_2 (BRRI dhan29) which contributed towards higher grain yield (Table-5). From Table-6 it was found that the lowest number of effective tillers hill^{-1} and fertile grains panicle^{-1} were in W_0 (no weeding) and the highest number of effective tillers hill^{-1} and fertile grains panicle^{-1} were in Sunrice 150 WP (ethoxysulfuron) 125 g a.i. ha^{-1} (W_4) which was statistically similar to Commit 500EC (pretidachlor) 750 ml ha^{-1} (W_6). Weeds always compete with crop for resources like light, water, nutrient which are needed for crop plant to produce healthy grains (Antigua, *et al.*, 1988). In this study, maximum number of effective tillers hill^{-1} (20.34) and fertile grains panicle^{-1} (187.2) were observed in treatment V_3W_4 while no weeding condition in V_3W_0 gave the minimum number of effective tillers hill^{-1} (7.67) and fertile grains panicle^{-1} (100.8) due to interaction effect (Table-7). These results corroborated with the results of Ahmed *et al*. (2005) and Smith and Moody (1979). From the data in Table-6 it was observed that weight of 1000 grains was significantly affected by weed control methods in the Sunrice 150 WP (ethoxysulfuron) 125 g a.i. ha^{-1} (W_4) which was statistically similar to Commit 500EC (pretidachlor) 750 ml ha^{-1} (W_6).

Among the weed control methods, the highest grain yield (9.50 t ha^{-1}) of rice was observed in treatment V_3W_4 which was statistically similar to V_1W_4 (Table-7). The highest grain yield was attributed to effective tillers hill^{-1}, panicles hill^{-1}, fertile grains panicle^{-1}, 1000 grain weight and the highest weed control efficiency in that treatment. The lowest seed yield was observed in the no weeding plots (W_0). Ahmed *et al*., (2005) also found similar results. Highest harvest index (%) was observed in treatment V_3W_4 which was statistically similar to V_1W_4 (Table-7).

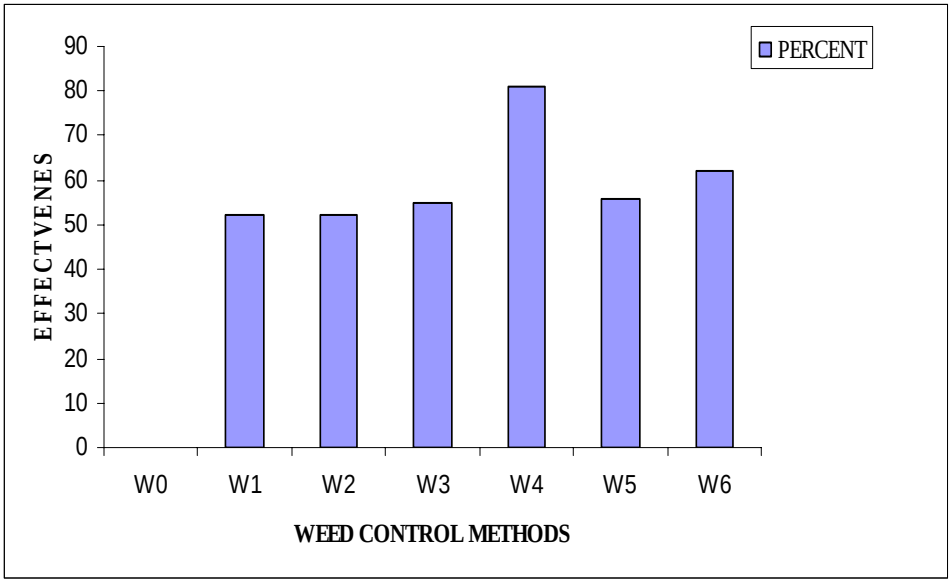

Fig. 1. Effectiveness of different weed control methods.

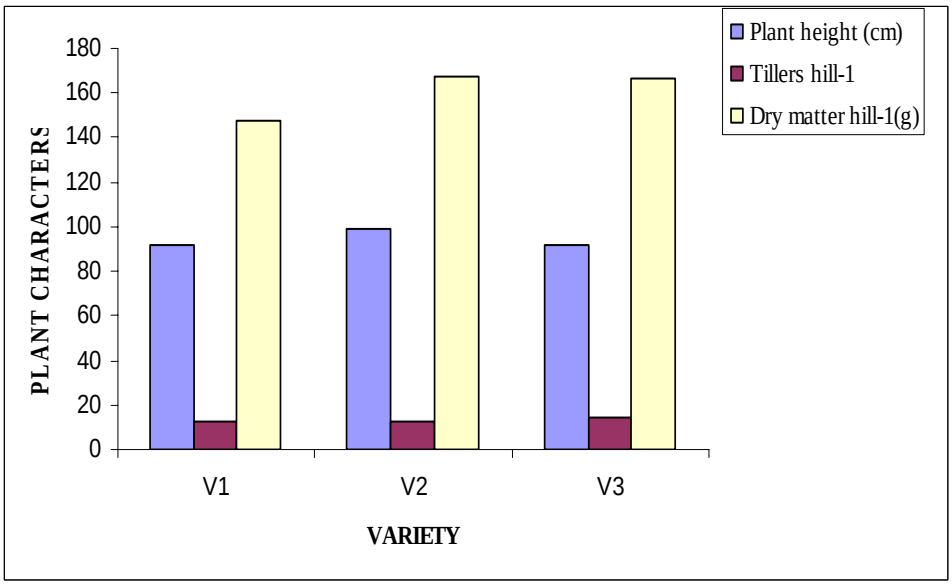

Fig. 2. Plant characters of *boro* rice affected by different varieties.

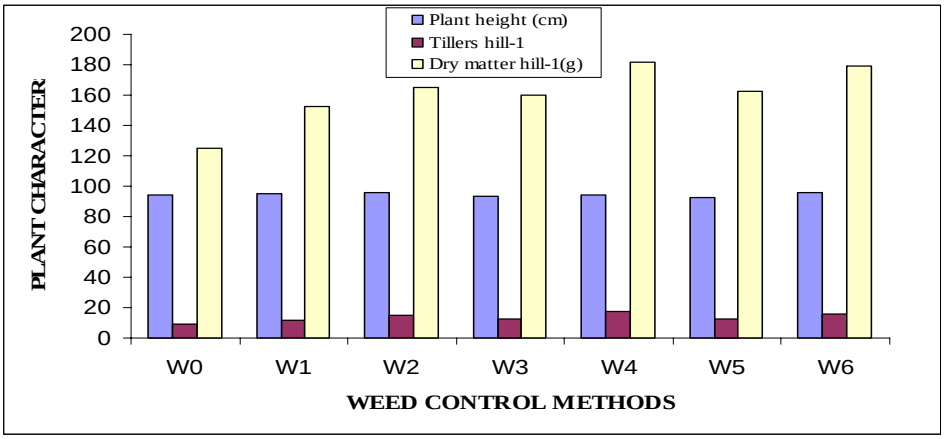

Fig. 3. Plant characters of *boro* rice affected by weed control methods.

Table-4. Interactive effect of different weed control methods on *boro* rice.

Treatment	Plant height (cm)	Tillers hill^{-1}	Dry matter hill^{-1} (g)
V_1W_0	90.74	8.11	118.8
V_1W_1	92.11	11.66	144.7
V_1W_2	92.37	13.55	152.1
V_1W_3	91.24	12.00	150.3
V_1W_4	93.56	14.89	160.7
V_1W_5	90.00	12.78	151.0
V_1W_6	95.11	14.00	158.2
V_2W_0	98.11	9.33	132.2
V_2W_1	100.80	11.22	165.7
V_2W_2	97.89	14.00	168.8
V_2W_3	100.60	12.89	158.8
V_2W_4	103.35	15.43	191.6
V_2W_5	99.89	12.45	166.7
V_2W_6	100.35	14.56	188.9
V_3W_0	92.55	9.33	122.9
V_3W_1	90.89	11.26	147.0
V_3W_2	97.67	16.36	174.1
V_3W_3	89.11	12.90	170.2
V_3W_4	92.33	22.00	192.8
V_3W_5	88.22	12.83	169.5
V_3W_6	91.56	18.86	190.5
$LSD_{0,05}$	5.843	1.926	6.769
CV (%)	3.75	8.74	2.55

Table-5. Yield contributing characters and yield of *boro* rice affected by different varieties.

Treatment	Effective tillers hill^{-1}	Fertile grain panicle^{-1}	1000-grain weight (g)	Grain yield (t ha^{-1})	Harvest Index (%)
Hira-6 (V_1)	13.56	155.9	24.29	6.28	34.86
BRRI dhan29 (V_2)	12.04	152.5	24.59	5.47	34.32
Sonarbangla-6 (V_3)	14.36	159.2	25.74	6.51	35.45
$LSD_{0,05}$	1.408	25.62	2.98	1.394	1.955
CV (%)	6.57	9.96	7.26	13.89	3.40

Table-6. Yield contributing characters and yield of *boro* rice affected by different weed control methods.

Treatment	Effective tillers hill^{-1}	Fertile grain panicle^{-1}	1000-grain weight (g)	Grain yield (t ha^{-1})	Harvest Index (%)
No Weeding	8.20	105.1	20.25	3.04	30.63
One (W_1)	10.74	140.8	23.72	4.73	34.42
Two weeding (W_2)	14.03	175.8	26.10	5.78	35.18
Sunrice 150 WG (Ethoxysulfuran) at 100g a.i. ha^{-1} (W_3)	12.59	154.3	24.89	6.75	33.95
Sunrice 150 WG (Ethoxysulfuran) 125 g a.i. ha^{-1} (W_4)	17.64	182.7	27.88	8.88	39.18
Commit 500 EC (Pretidachlor) 1000mlha^{-1} (W_5)	12.46	152.9	23.76	6.54	34.61
Commit 500 EC (Pretidachlor) 750 ml ha^{-1} (W_6)	15.25	179.4	27.50	6.87	36.18
$LSD_{0,05}$	1.408	25.62	2.98	1.394	1.955
CV (%)	6.57	9.96	7.26	13.89	3.40

Table-7. Interaction effect of different weed control methods on *boro* rice.

Treatment	Effective tillers hill^{-1}	Fertile grain panicle^{-1}	1000-grain weight (g)	Grain yield (t ha^{-1})	Harvest Index (%)
V_1W_0	8.87	108.9	22.19	3.19	30.44
V_1W_1	10.22	133.1	23.35	4.88	33.94
V_1W_2	12.48	174.7	25.06	5.93	35.19
V_1W_3	11.22	145.5	22.95	6.98	32.94
V_1W_4	15.80	180.0	26.16	9.10	40.23
V_1W_5	12.26	148.2	24.64	6.81	34.57
V_1W_6	13.44	176.9	25.67	7.04	36.69
V_2W_0	8.06	105.6	20.08	2.49	30.93
V_2W_1	11.56	140.4	23.63	4.18	34.57
V_2W_2	15.08	175.4	25.43	5.23	34.75
V_2W_3	14.11	159.4	24.83	6.17	34.57
V_2W_4	16.78	180.8	27.90	8.03	36.14
V_2W_5	13.78	150.7	22.52	5.98	34.21
V_2W_6	15.55	178.8	27.71	6.21	35.06
V_3W_0	7.67	100.8	18.48	3.45	30.53
V_3W_1	10.45	148.9	24.17	5.14	34.75
V_3W_2	14.52	177.3	27.80	6.19	35.60
V_3W_3	12.45	158.0	26.90	7.11	34.33
V_3W_4	20.34	187.2	29.58	9.50	41.16
V_3W_5	11.33	159.8	24.13	6.84	35.06
V_3W_6	16.77	182.4	29.12	7.35	36.75
$LSD_{0.05}$	1.408	25.62	2.98	1.394	1.955
CV (%)	6.57	9.96	7.26	13.89	3.40

CONCLUSION

Results suggest that different weed control methods greatly affected the weed control efficacy, crop characters, yield contributing characters and grain yield of *boro* rice. Application of Sun rice 150 WP (ethoxysulfuron) 125 g a.i. ha^{-1} increased grain yield by 22.58% than the application of Commit 500EC (pretidachlor) 750 ml a.i. ha^{-1} and increased 34.58% grain yield than two weeding. Weed control cost was the minimum for chemical weeding (herbicide) than hand weeding. Application of Sunrice 150 WP (ethoxysulfuron) 125 g a.i. ha^{-1} was also an effective weed control method which was more economic and effective than other treatments.

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