



## Effect of integration of herbicide with manual weeding on the performance of transplant *aman* rice cultivars

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### ABSTRACT

An experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh to evaluate the effect of integration of herbicide with manual weeding on the performance of transplant *aman* rice cultivars during the period from July to November 2017. The experiment consisted of three transplant *aman* rice cultivars viz., BR11, BRRI dhan49 and Binadhan-7 with seven weeding treatments viz., no weeding ( $W_0$ ), two hand weeding at 15 and 30 DATs ( $W_1$ ), application of pre-emergence herbicide Pretilachlor ( $W_2$ ), application of early post emergence herbicide Acetachlor + Bensulfuron methyl (Pediplast) ( $W_3$ ), application of Pretilachlor followed by application of Pediplast ( $W_4$ ), application of Pretilachlor followed by one hand weeding at 30 DAT ( $W_5$ ) and application of Pediplast followed by one hand weeding at 30 DAT ( $W_6$ ). The experiment was laid out in a randomized complete block design with three replications. Weed density and dry weight were significantly affected by cultivars and weeding treatments. The maximum weed growth was noticed with the BR11 and the minimum with cultivar BRRI dhan49 at 20 DAT. The highest weed density and dry weight were noticed in no weeding treatment and the lowest value was found in application of Pediplast followed by one hand weeding at 30 DAT. Cultivar and weeding treatment exerted significant effect on yield and yield attributes of transplant *aman* rice. BRRI dhan49 produced the highest grain yield which was statistically identical with BR11 and Binadhan-7 produced the lowest grain yield. Application of Pediplast followed by one hand weeding at 30 DAT produced the highest grain yield which was statistically identical with other weeding treatments except no weeding. Rice cultivar BRRI dhan49 with the application of Pediplast followed by one hand weeding at 30 DAT produced numerically the highest grain yield. From the economic analysis, it is observed that the highest BCR was recorded from the application of Pediplast with BRRI dhan49. Therefore, application of early post emergence herbicide Pediplast with the cultivar BRRI dhan49 is effective and economic than the other weed control treatments in controlling weeds effectively and producing higher grain yield as well obtaining highest economic return.

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### Introduction

Rice (*Oryza sativa* L.) is the most extensively cultivated crop in Bangladesh and it is the staple food for the peoples of Bangladesh. Bangladesh has three rice growing seasons including 11.62 million ha of land which produce 36.28 M tons of rice whereas T. *aman* rice covers 5.68 million ha of land (48.88% of total rice area) and contributes about 38.56% of the total rice production in the country (BBS, 2018). To feed the increasing population, it is necessary either to increase the crop area or to increase yield per unit area. Since horizontal expansion of rice area is not possible, the only avenue left is to increase the production of rice through use of improved cultivars and management practices. The growth process of rice plants under a given agro-climatic condition differs with cultivar. It is important to know the competitive ability of different varieties of rice against weeds and screening out of highly competitive rice varieties. Usually short stature variety face more weeds infestation than the taller ones (Sarker, 1979).

Researchers have identified differences in competitive ability among tall, traditional cultivars and modern semi-dwarf cultivars (Fischer, 1997; Gibson *et al.*, 2001). The competition between rice and weed is more serious when morphology and growth habit of rice weeds become similar to the rice plants. Thus through selection of weed competitive varieties, the weed emergence and its subsequent growth and development could be suppressed. Moreover, the amount of herbicide and the cost of weed control could be reduced. This will also substantially delay the development of herbicide resistance in weeds- a serious outcome of herbicidal weed control (Chauhan, 2012; Mahajan and Chauhan, 2013). So, to avoid weed infestation and to get maximum yield from rice, appropriate variety should be selected. Besides the selection of cultivar, the various factors responsible for low rice production, weeds are considered to be as one of major limiting factors due to manifold harmful effects (Kalyanasundaram *et al.*, 2006). In Bangladesh, substantial yield reduction of rice is occurred due to weed infestation. Moreover, due to

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weed infestation agricultural field is facing different adverse condition, such as increases competition with main crop for light, water, nutrition, decreases growth of plant and low soil fertility. Mamun (1990) pointed out the weed growth reduced the grain yield by 68–100% for direct seeded *aus* rice, 16–28% for *T. aman* rice. Therefore, this loss is a serious threat for food security of Bangladesh. So, it has been urgently needed to adopt different weed control methods viz. mechanical, cultural and chemical weed controls in combination with manual weeding. The application of pre-emergence and early post emergence herbicides could effectively control weeds in low cost in rice field but intensive and repeated use of herbicides might cause environmental pollution and development of resistant weed biotypes. Again, herbicides are effective in controlling weeds alone or in combination with hand weeding (Ahmed *et al.*, 2005). Herbicides in combination with hand weeding would help to obtain higher crop yield with less efforts and cost (Sathyamoorthy *et al.*, 2004). Therefore, an integrated approach of combining different weed control options and selection of suitable cultivar are essential for developing a cost effective, sustainable and eco-friendly farm management system for rice ecosystem to increase its productivity.

### Materials and Methods

The experiment was conducted to evaluate the effect of integration of herbicide with manual weeding on the performance of transplant *aman* rice cultivars at the Agronomy Field Laboratory, Bangladesh Agricultural University (BAU) during July to November 2017. The experiment consists of three rice cultivars namely BR11, BRRI dhan49 and Binadhan-7, and seven weed management practices viz. no weeding ( $W_0$ ), two hand weedings (HW) at 15 and 30 DATs ( $W_1$ ), application of pre-emergence herbicide Pretilachlor ( $W_2$ ), application of early post emergence herbicide Pediplast (Acetachlor + Bensulfuron methyl) ( $W_3$ ), application of Pretilachlor followed by application Pediplast ( $W_4$ ), application of Pretilachlor followed by one HW at 30 DAT ( $W_5$ ) and application of Pediplast followed by one HW at 30 DAT ( $W_6$ ). The experiment was randomized complete block design (RCBD) with three replications where each of the blocks (replication) comprised 21 unit plots ( $3 \times 7$ ). Thus, the total numbers of unit plots were 63. The size of unit plot was 4.0 m  $\times$  2.5 m and maintained 0.75 m distance between the plots and 1.0 m between the blocks. Seeds were collected from the Agronomy Filed Laboratory, BAU, Mymensingh. The sprouted seeds were sown in the nursery bed on 5 July 2017. Proper care was taken to raise the healthy seedlings in the nursery bed. Weeds were removed and irrigation was given in the nursery bed as and when necessary. After laying out the land fertilized with urea, triple super phosphate, gypsum and zinc sulphate @ 165, 90, 120, 60 and 10 kg ha<sup>-1</sup>, respectively as per recommendation of BRRI (2018). Seedlings were transplanted in the well prepared puddle field on 30 July 2017 at rate of two seedlings hill<sup>-1</sup>, maintaining row and hill distances of 25

cm and 15 cm, respectively. The experimental plots were irrigated as and when necessary. The rice variety Binadhan-7 was harvested on 7 November and BR11 & BRRI dhan49 was harvested on 24 November 2017 at full maturity. Five hills (excluding border) were selected randomly from each unit plot and uprooted before harvesting for recording the data of yield and yield attributes of rice. After sampling a harvest area of central 1m  $\times$  1m was selected from each unit plot. Then the harvested crops of each plot were bundled separately and properly tagged and brought to the threshing floor. Grains were separated from the plants by pedal thresher. The collected grains and straw were cleaned and weighed. The moisture content of the collected grains was measured by grain moisture meter. Then the grain moisture content was adjusted to 14% moisture content. Finally grain and straw yields per unit area were converted to t ha<sup>-1</sup>. The data on weed infestation as well as density were collected from three spots of each unit plot at 20, 40 and 60 DATs by using a 0.25 m  $\times$  0.25 m quadrat as per described by Cruz *et al.* (1986). The weeds within the quadrat were counted and converted to number m<sup>-2</sup>. At 20 DAT, 40 DAT, 60 DAT and 80 DAT weeds m<sup>-2</sup> area were uprooted from all individual plots, soil from roots was cleared and the weed plant was oven dried for 72 hours at a temperature of 80°C and then weighed. Data were compiled and tabulated in proper form for statistical analysis. The recorded data were statistically analyzed following the analysis of variance (ANOVA) technique and the means were adjudged by Duncan's Multiple Range Test (DMRT) using a computer operated program namely, MSTAT-C (Gomez and Gomez, 1984).

### Result and Discussion

#### *Weed infestation in the experimental field*

It is known that if the conditions become favorable for growing *aman* rice plants, it's also favorable for exuberant growth of numerous kinds of weed that compete and influence on crop plants. Ten weed species belonging to six families were found in the experimental plots (Table 1). Weeds found in transplanted *aman* rice field are aquatic; semi aquatic conditions which could withstand water logging usually enough to suppress the crop significantly, if not timely controlled (Mian and Gaffer, 1960).

#### *Effect of variety on weed density and dry weight*

Weed density and dry weight at 20 DAT were significantly affected by variety. On the other hand, weed density and dry weight at 40 and 60 DATs were not significantly affected by variety. At 20 DAT, the highest weed density (28.95 m<sup>-2</sup>) and dry weight (15.48 g m<sup>-2</sup>) were observed in BR11 while lowest weed density (23.86 m<sup>-2</sup>) was recorded in BRRI dhan49 and lowest weed dry weight (9.84 g m<sup>-2</sup>) was obtained in Binadhan-7 in this study. However, BRRI dhan49 was statistically identical with BR11 in respect of weed dry weight (Table 2).

Table 1. Infesting species of weed found growing in the experimental plots in transplant *aman* rice

Sl. No.	Local Name	Scientific Name	Family	Morphological Type
1.	Keshuti	<i>Eclipta alba</i> L.	Compositae	Broad leaved
2.	Mutha	<i>Cyperus rotundus</i> L.	Cyperaceae	Sedge
3.	Sabuj Nakful	<i>Cyperus difformis</i> L.	Cyperaceae	Sedge
4.	Shusni Shak	<i>Marsilea crenata</i> L.	Marsileaceae	Broad leaved
5.	Pani Long	<i>Ludwigia hyssopifolia</i> (G. Don) Exell.	Onagraceae	Broad leaved
6.	Chechra	<i>Scirpus juncooides</i> Roxb.	Cyperaceae	Sedge
7.	Angta	<i>Paspalum scrobiculatum</i> L.	Poaceae	Grass
8.	Shama	<i>Echinochola crusgalli</i> (L.) P. Beauv.	Poaceae	Grass
9.	Arail	<i>Leersia hexandra</i> Swartz.	Poaceae	Grass
10.	Pani Kachu	<i>Monochoria vaginalis</i> (Burm. F.) C. Presl.	Pontederiaceae	Broad leaved

Table 2. Effect of variety on weed density and weed dry weight at different days after transplanting

Variety	Weed density (no. m <sup>-2</sup> )			Weed dry weight (g m <sup>-2</sup> )		
	20 DAT	40 DAT	60 DAT	20 DAT	40 DAT	60 DAT
BR11	28.95a*	19.91	18.52	15.48a	24.42	21.37
BRR1 dhan49	23.86b	17.00	21.86	14.26a	21.61	24.10
Binadhan-7	25.86ab	17.62	21.00	9.84b	20.44	22.76
CV (%)	23.79	39.30	25.03	33.81	39.26	34.17
Level of significance	0.01	NS	NS	0.01	NS	NS

*Effect of weed management practices on weed density and dry weight*

Weed density was significantly influenced by different weed management practices at different days after transplanting (DATs) (Table 3). At 20, 40 and 60 DATs, the highest weed density (44.67, 30.67 and 36.67 m<sup>-2</sup>, respectively) was found in no weeding treatment. The lowest weed density (14.33 m<sup>-2</sup>) at 20 DAT was found in application of early post-emergence herbicide followed by one hand weeding at 30 DAT. At 40 DAT, the lowest weed density (11.78 m<sup>-2</sup>) was found in application of early post emergence herbicide treatment. Finally at 60 DAT, the lowest weed density (11.44 m<sup>-2</sup>) was found in application of early post-emergence herbicide followed by one hand weeding at 30 DAT. Similar research finding was also reported by Rekha *et al.* (2002) who opined that weed density was lower in all weeding practices compared to the unweeded control plot. Weed management practices exerted significant effect on weed dry weight at different DATs (Table 4). At 20, 40 and 60 DAT, the highest weed dry weight (28.78, 52.89 and 43.22 g m<sup>-2</sup>, respectively) was observed in no weeding treatment. The lowest weed dry weight (4.49, 9.73 and 12.40 g m<sup>-2</sup>) was found in

application of post-emergence herbicide followed by one hand weeding at 30 DAT treatment. In this study the highest weed dry weight at different DATs was found in no weeding condition and the lowest weed dry weight at different DAT was found in application of Padiplast followed by one hand weeding at 30 DAT (Table 3). This was due to the fact that in no weeding condition weed-crop competition was higher and hence weed dry weight was the highest and in application post-emergence herbicide followed by one hand weeding at 30 DAT treatment weed was controlled effectively and thus weed dry weight was lowest in this treatment. Similar research finding was also reported by Mou *et al.* (2017) who reported that application of early post-emergence herbicide Changer followed by one hand weeding at 35 DAT produced the lowest weed dry weight in *T. aman* rice field.

*Interaction effect of variety and weed management practices on weed density and dry weight*

Weed density and dry weight was not significantly affected by interaction of variety and weed management practices (Table 4).

Table 3. Effect of weed management practices on weed density and weed dry weight in *T. aman* rice

Weeding	Weed density (no. m <sup>-2</sup> )			Weed dry weight (g m <sup>-2</sup> )		
	20 DAT	40 DAT	60 DAT	20 DAT	40 DAT	60 DAT
W <sub>0</sub>	44.67a	30.67a	30.67a*	28.78a	52.89a	43.22a
W <sub>1</sub>	35.44b	20.89b	27.11b	18.46b	27.19b	27.81b
W <sub>2</sub>	29.00c	20.22b	22.44b	14.87bc	23.48bc	23.46bc
W <sub>3</sub>	24.78c	11.78d	17.56c	10.76cd	16.97cd	21.62bcd
W <sub>4</sub>	18.67c	14.22c	15.56cd	8.22de	13.39d	16.97cd
W <sub>5</sub>	16.67d	16.33c	12.44cd	6.789de	11.46d	13.72cd
W <sub>6</sub>	14.33d	13.11d	11.44d	4.489e	9.73d	12.40d
CV (%)	23.79	39.30	25.03	33.81	39.26	34.17
Level of significance	0.01	0.01	0.01	0.01	0.01	0.01

Table 4. Interaction effect of variety and weed management practices on weed density and weed dry weight of *T. aman* rice

Variety × Weeding	Weed density (no. m <sup>-2</sup> )			Weed dry weight (g m <sup>-2</sup> )		
	20 DAT	40 DAT	60 DAT	20 DAT	40 DAT	60 DAT
V <sub>1</sub> W <sub>0</sub>	45.00	41.33	36.000	31.47	54.93	42.467
V <sub>1</sub> W <sub>1</sub>	36.00	25.33	23.000	21.40	28.77	25.467
V <sub>1</sub> W <sub>2</sub>	28.00	22.00	18.667	15.33	24.97	21.933
V <sub>1</sub> W <sub>3</sub>	30.33	14.00	15.333	12.60	17.27	19.933
V <sub>1</sub> W <sub>4</sub>	24.00	12.66	14.667	11.80	16.33	16.167
V <sub>1</sub> W <sub>5</sub>	23.33	12.67	11.333	10.50	15.87	11.867
V <sub>1</sub> W <sub>6</sub>	16.00	11.33	10.667	5.27	12.80	11.733
V <sub>2</sub> W <sub>0</sub>	46.33	28.00	38.000	32.47	52.00	45.683
V <sub>2</sub> W <sub>1</sub>	34.67	16.00	28.000	19.17	26.67	30.400
V <sub>2</sub> W <sub>2</sub>	27.33	20.00	23.333	16.33	24.00	24.667
V <sub>2</sub> W <sub>3</sub>	21.00	9.33	20.000	12.60	18.93	23.733
V <sub>2</sub> W <sub>4</sub>	15.00	14.00	17.333	8.27	12.93	16.533
V <sub>2</sub> W <sub>5</sub>	12.67	17.00	14.000	6.00	9.17	14.900
V <sub>2</sub> W <sub>6</sub>	10.00	14.67	12.333	5.00	7.60	12.767
V <sub>3</sub> W <sub>0</sub>	42.67	22.67	36.000	22.40	51.73	41.500
V <sub>3</sub> W <sub>1</sub>	35.67	21.33	30.333	14.80	26.13	27.567
V <sub>3</sub> W <sub>2</sub>	31.67	18.67	25.333	12.93	21.47	23.767
V <sub>3</sub> W <sub>3</sub>	23.00	12.00	17.333	7.07	14.70	21.200
V <sub>3</sub> W <sub>4</sub>	17.00	16.00	14.667	4.60	10.90	18.200
V <sub>3</sub> W <sub>5</sub>	14.00	19.33	12.000	3.87	9.33	14.400
V <sub>3</sub> W <sub>6</sub>	17.00	13.33	11.333	3.20	8.80	12.700
CV (%)	23.79	39.30	25.03	33.81	39.26	34.17
Level of sig.	NS	NS	NS	NS	NS	NS

V<sub>1</sub>= BR11, V<sub>2</sub> = BRR1 dhan49, V<sub>3</sub> = Binadhan-7; W<sub>0</sub>: no weeding, W<sub>1</sub>: two hand weeding at 15 and 30 DATs, W<sub>2</sub>: application of Pretilachlor, W<sub>3</sub>: application of Pediplast, W<sub>4</sub>: application of Pretilachlor followed by application of Pediplast, W<sub>5</sub>: application of Pretilachlor followed by one hand weeding at 30 DAT and W<sub>6</sub>: application of Pediplast followed by one hand weeding at 30 DAT

#### Effect of variety on yield and yield attributes

Almost all the yield and yield contributing characters of rice were significantly affected by the effect of variety (Table 5). However, number of effective and total tillers hill<sup>-1</sup> and weight of 1000-grain were statistically identical among the varieties due to non-significant variation. Except that, the variety BRR1 dhan49 produced numerically the tallest plants (104.09 cm) followed by BR11 (102.49 cm) while it was shortest (100.19 cm) in Binadhan-7. The rapid increase of plant height was an indication of changing vegetative to reproductive phase of crop growth (Krishnan *et al.*, 2011). The highest number of grains panicle<sup>-1</sup> (116.92 cm) was observed in BRR1 dhan49 which was statistically identical (115.70 cm) with BR11 and the lowest number of grains panicle<sup>-1</sup> (93.46 cm) was found in Binadhan-7. Similarly, the highest grain yield (5.12 t

ha<sup>-1</sup>) and straw yield (6.02 t ha<sup>-1</sup>) were obtained in BRR1 dhan49 while it was statistically identical to BR11 (4.09 and 5.73 t ha<sup>-1</sup>, respectively). The increased of grain yield were significantly highest with the variety BRR1 dhan49 might be due to the variety produced highest number of grain panicle<sup>-1</sup>. On the other hand, the lowest yield of grain (4.10 t ha<sup>-1</sup>) and straw (5.14 t ha<sup>-1</sup>) were recorded in Binadhan-7. This difference was observed due to different cultivar characteristics of rice plant. BRR1 (1996) also reported variation in grain yield among the studied cultivars. Harvest index was also significantly influenced by different rice cultivars where the highest harvest index (46.05 %) was observed in BR11 which was statistically similar with BRR1 dhan49 and the lowest harvest index (43.74 %) was found in Binadhan-7 (Table 5).

Table 5. Effect of cultivars and different weed management practices on yield and yield components of *T. aman* rice

Variety	Plant height (cm)	No. of total tillers hill <sup>-1</sup>	No. of effective tillers hill <sup>-1</sup>	No. of grains panicle <sup>-1</sup>	Weight of 1000-grain (g)	Grain yield (t ha <sup>-1</sup> )	Straw yield (t ha <sup>-1</sup> )	Harvest index (%)
BR11	102.49ab	9.78	8.69	115.70a*	23.14	4.09a	5.73a	46.05a
BRR1 dhan49	104.09a*	9.80	8.02	116.92a	22.19	5.12a	6.02a	45.78a
Binadhan-7	100.19b	9.69	8.59	93.46b	23.43	4.10b	5.14b	43.74b
CV (%)	12.97	8.42	15.46	13.81	10.51	13.28	11.80	4.24
Level of sig.	0.05	NS	NS	0.01	NS	0.01	0.01	0.01

\*In a column, figures having common letter(s) do not differ significantly; NS= Not significant

#### Effect of weed management practices

All the yield and yield attributes except plant height and weight of 1000-grain were significantly affected by weed management practices (Table 6). Among the significant observation, the highest number of total (10.41) and effective (9.21) tillers hill<sup>-1</sup> were observed

in W<sub>6</sub> (application of Pediplast followed by one hand weeding at 30 DAT) treatment which was statistically similar among all other treatments except control in respect of effective tillers hill<sup>-1</sup>. On the other hand, the lowest number of total (7.81) and effective (6.67) tillers hill<sup>-1</sup> were found in W<sub>0</sub> (no weeding) treatment.

## Integration of herbicide with manual weeding on rice yield

In no weeding treatment weed–crop competition was higher and weed suppressed the rice plant growth, ultimately tiller number was reduced. In no weeding treatment weed–crop competition was higher and weed suppressed the rice plant growth, ultimately tiller number was reduced. Grey *et al.* (2000) examined the response of seven peanut (*Arachis hypogaea*) cultivars to two early post–emergence herbicides (imazapic and paraquat) and they revealed that one cultivar exhibited early–season injury up to 29%, however this injury did not affect yield.

The highest number of grains panicle<sup>-1</sup> (115.82 cm) was observed in W<sub>6</sub> (application of early post–emergence herbicide followed by one hand weeding at 30 DAT) treatment which was statistically similar to W<sub>1</sub> (two hand weeding at 15 and 30 DATs), W<sub>3</sub> (application of early post–emergence herbicide) and W<sub>4</sub> (application of pre–emergence followed by early post–emergence herbicide) treatment and the lowest number of grains panicle<sup>-1</sup> (86.67 cm) was found in W<sub>0</sub> (no weeding) treatment. Weed competition was higher in unweeded plot and hence lowest number of grains panicle<sup>-1</sup> was produced with this treatment. Similar research finding was also reported by Parvez *et al.* (2013) who reported that application of Pretilachlor herbicide followed by one hand weeding at 21 DAT produced the highest number of grains panilce<sup>-1</sup>. Similarly, the highest grain yield (5.32 t ha<sup>-1</sup>) was observed in W<sub>6</sub> (application of

Pediplast followed by one hand weeding at 30 DAT) which was statistically similar with W<sub>1</sub> (two hand weeding at 15 and 30 DATs), W<sub>2</sub> (application of Pretilachlor), W<sub>3</sub> (application of Pediplast), W<sub>4</sub> (application of Pretilachlor followed by Pediplast) and W<sub>5</sub> (application of Pretilachlor followed by one hand weeding at 30 DAT). Matsunaka (1970) and Parvez *et al.* (2013) also reported the significant increase in rice yield due to use of herbicides over hand weeding.

The lowest number of grain yield (2.98 t ha<sup>-1</sup>) was recorded in W<sub>0</sub> (no weeding) treatment. Straw yield was also significantly highest (6.03 t ha<sup>-1</sup>) in W<sub>5</sub> (Application pre–emergence herbicide followed by one hand weeding at 30 DATs) treatment which was statistically similar to other weeding management treatments except control. The lowest straw yield (4.13 t ha<sup>-1</sup>) was recorded in W<sub>0</sub> (no weeding) treatment. Similarly, the highest harvest index (46.81 %) was observed in W<sub>6</sub> (application of early post–emergence herbicide followed by one hand weeding at 30 DAT) which was statistically similar with other weed management practices except control. The lowest harvest index (40.95%) was recorded in W<sub>0</sub> (no weeding) treatment. This result corroborates the finding of Ahmed *et al.* (2005) who found the lowest harvest index in no weeding (control) plots.

Table 6. Effect of different weed management practices on the yield and yield components of *T. aman* rice

Weed management practices	Plant height (cm)	No. of total tillers hill <sup>-1</sup>	No. of effective tillers hill <sup>-1</sup>	No. of grains panicle <sup>-1</sup>	Weight of 1000–grain (g)	Grain yield (t ha <sup>-1</sup> )	Straw yield (t ha <sup>-1</sup> )	Harvest index (%)	Yield reduction (%)
W <sub>0</sub>	101.84	7.81c*	6.67b	86.67b	21.89	2.98b	4.13b	40.95b	43.98
W <sub>1</sub>	105.11	9.49b	8.17a	113.22a*	22.33	4.73a	5.64a	45.50a	11.09
W <sub>2</sub>	104.44	9.93ab	8.83a	106.30a	22.78	5.02a	5.96a	45.69a	5.64
W <sub>3</sub>	103.09	10.09ab	9.10a	115.31a	21.44	4.99a	5.90a	45.76a	6.20
W <sub>4</sub>	104.07	10.28ab	8.21a	113.74a	23.78	4.86a	5.73a	46.11a	8.65
W <sub>5</sub>	93.24	10.27ab	8.91a	110.14a	23.11	5.05a	6.03a	45.51a	5.08
W <sub>6</sub>	103.98	10.41a	9.21a	115.82a	22.78	5.32a	6.02a	46.81a	0
CV (%)	12.67	8.42	15.46	13.81	10.51	13.28	11.80	4.24	–
Level of sig.	NS	0.01	0.01	0.01	NS	0.01	0.01	0.01	–

\*In a column, figures having common letter(s) do not differ significantly; NS= Not significant; W<sub>0</sub>: no weeding, W<sub>1</sub>: two hand weeding at 15 and 30 DATs, W<sub>2</sub>: application of Pretilachlor, W<sub>3</sub>: application of Pediplast, W<sub>4</sub>: application of Pretilachlor followed by application of Pediplast, W<sub>5</sub>: application of Pretilachlor followed by one hand weeding at 30 DAT and W<sub>6</sub>: application of Pediplast followed by one hand weeding at 30 DAT

### Interaction effect of cultivar and weed management practices

The data of yield and yield attributes showed non-significant variation due to the effect of interactions of cultivar and weed management practices except grains panicle<sup>-1</sup> and harvest index. As well as the height of *T. aman* rice plant, the number of effective and total tillers hill<sup>-1</sup>, weight of 1000–grain, yield of grain and straw were statistically identical among the treatments of interactions of varieties and weeding regimes due to non-significant variation (Table 7).

It was found that significantly the highest number of grains panicle<sup>-1</sup> (134.37 cm) was produced by BR11 in W<sub>3</sub> (application of Pediplast) treatment and the lowest

number of grains panicle<sup>-1</sup> (72.04 cm) was produced by the variety BR11 in no weeding treatment. Crop–weed competition in different weed management treatments was lower and produced highest number of grains panicle<sup>-1</sup> but in no weedy treatment, weed–crop competition was higher and this treatment produced the lowest number of grains panicle<sup>-1</sup>. Similar research finding was reported by Parvez *et al.* (2013) who observed the lowest number of grains panicle<sup>-1</sup> in no weeding (control) plots. Similarly, numerically the highest harvest index (48.09%) was produced by BRR1 dhan49 in application of Pediplast followed by one hand weeding at 30 DAT. The lowest harvest index (35.71%) was produced by Binadhan-7 in no weeding treatment (Table 7).

Table 7. Interaction effect of cultivar and different weed management practices on the yield and yield components of *T. aman* rice

Interaction treatments	Plant height (cm)	No. of total tillers hill <sup>-1</sup>	No. of effective tillers hill <sup>-1</sup>	No. of grains panicle <sup>-1</sup>	Weight of 1000-grain (g)	Grain yield (t ha <sup>-1</sup> )	Straw yield (t ha <sup>-1</sup> )	Harvest index (%)	Benefit cost ratio (BCR)
V <sub>1</sub> W <sub>0</sub>	105.07	7.37	6.67	72.04	23.00	3.28	4.21	44.11b	1.17
V <sub>1</sub> W <sub>1</sub>	111.67	9.60	8.43	122.13	24.00	5.13	5.94	46.37ab	1.38
V <sub>1</sub> W <sub>2</sub>	107.20	10.07	9.13	114.83	25.67	5.27	6.03	46.66ab	1.76
V <sub>1</sub> W <sub>3</sub>	105.60	9.40	8.70	134.37	20.33	5.21	5.97	46.63ab	1.74
V <sub>1</sub> W <sub>4</sub>	104.27	10.20	9.23	119.21	22.33	4.94	5.92	46.08ab	1.65
V <sub>1</sub> W <sub>5</sub>	76.07	10.93	9.27	118.72	22.67	5.36	6.29	45.99ab	1.58
V <sub>1</sub> W <sub>6</sub>	107.53	10.87	9.37	128.80	24.00	5.02	5.74	46.51ab	1.47
V <sub>2</sub> W <sub>0</sub>	101.07	7.80	6.50	105.38	20.67	3.50	4.63	43.03b	1.26
V <sub>2</sub> W <sub>1</sub>	103.67	9.40	7.87	121.55	18.67	5.34	6.19	46.27ab	1.44
V <sub>2</sub> W <sub>2</sub>	105.33	9.93	8.57	116.32	22.00	5.03	6.07	45.33ab	1.69
V <sub>2</sub> W <sub>3</sub>	102.93	10.67	9.40	115.62	22.67	5.37	6.33	45.74ab	1.81
V <sub>2</sub> W <sub>4</sub>	105.13	10.33	6.07	119.68	25.00	5.43	6.32	46.18ab	1.58
V <sub>2</sub> W <sub>5</sub>	104.80	10.20	8.67	116.41	24.67	5.14	6.07	45.82ab	1.51
V <sub>2</sub> W <sub>6</sub>	105.67	10.27	9.07	123.57	21.67	6.04	6.54	48.09a	1.74
V <sub>3</sub> W <sub>0</sub>	99.40	8.27	6.83	82.59	22.00	2.16	3.54	35.71c	0.89
V <sub>3</sub> W <sub>1</sub>	100.00	9.47	8.20	95.98	24.33	3.74	4.78	43.86b	1.12
V <sub>3</sub> W <sub>2</sub>	100.80	9.80	8.80	87.62	20.67	4.75	5.77	45.08ab	1.74
V <sub>3</sub> W <sub>3</sub>	100.73	10.20	9.20	95.84	21.33	4.41	5.39	44.91ab	1.62
V <sub>3</sub> W <sub>4</sub>	102.80	10.30	9.33	102.12	24.00	4.18	4.95	46.06ab	1.51
V <sub>3</sub> W <sub>5</sub>	98.87	9.67	8.80	95.17	22.00	4.65	5.74	44.71ab	1.50
V <sub>3</sub> W <sub>6</sub>	98.73	10.10	8.93	94.93	22.67	4.88	5.78	45.83ab	1.56
CV (%)	12.67	8.42	15.46	13.81	10.51	13.28	11.80	4.24	–
Level of sig.	NS	NS	NS	0.01	NS	NS	NS	0.05	–

\*In a column, figures having common letter(s) do not differ significantly; NS= Not significant; V<sub>1</sub>= BR11, V<sub>2</sub> = BRRI dhan49, V<sub>3</sub> =Binadhan-7 W<sub>0</sub>: no weeding, W<sub>1</sub>: two hand weeding at 15 and 30 DATs, W<sub>2</sub>: application of Pretilachlor, W<sub>3</sub>: application of Pendiplast, W<sub>4</sub>: application of Pretilachlor followed by application of Pendiplast, W<sub>5</sub>: application of Pretilachlor followed by one hand weeding at 30 DAT and W<sub>6</sub>: application of Pendiplast followed by one hand weeding at 30 DAT

It is observed that the highest BCR was observed from the application pre-emergence herbicide followed by one hand weeding at 30 DATs in cultivar BR 11 but another two cultivars BRRI dhan49 and Binadhan-7 BCR was highest in treatment application of post-emergence (pediplast) herbicide followed by one hand weeding at 30 DATs (Table 7).

## Conclusion

Application of Pendiplast herbicide followed by one hand weeding at 30 DATs was effective and economic than the other weed control treatments in controlling weeds and in producing higher grain yield. Therefore, in order to control weed effectively and to maximize grain yield in *T. aman* rice, application of Pendiplast herbicide followed by one hand weeding at 30 DAT may be recommended.

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