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Herbicidal activities of wheat residues in transplant *Aman* rice

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Abstract

Allelopathic potentiality of crop residues may be helpful to minimize the serious problems in the present agricultural production such as environmental pollution, unsafe products, human health concerns, depletion of crop diversity, soil sickness and reduction of crop productivity. In this phenomenon an experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during June to November, 2015 to evaluate the effect of crop residues of wheat on weed management and crop performance of T. *Aman* rice. The experiment consisted of three varieties (cv. BRRI dhan32, BRRI dhan33 and BRRI dhan49) and five different treatments (*viz.* no crop residues, wheat crop residues @ 0.5, 1.0, 1.5 and 2.0 t ha^{-1}). The experiment was laid out in a randomized complete block design with three replications. Five weed species belonging to three families infested the experimental plots. Weed population, weed dry weight and percent inhibition of weed were significantly influenced by wheat crop residues and cultivar. The maximum weed growth was noticed where no crop residues was incorporated and the minimum was found where @ 2.0 tha^{-1} wheat crop residues was incorporated. The grain yield as well as the other yield contributing characters produced in BRRI dhan49 was the highest among the studied varieties. The highest percent inhibition of 75.32, 58.24, 72.60, 57.45 and 82.24 was in Shama, Panishapla, Pani chaise, Panikachu and Susnishak, respectively which was caused by the application of wheat crop residues @ 2 t ha^{-1}. The highest loss of grain yield was obtained where no crop residues were incorporated. The highest numbers of tillers $hill^{-1}$, numbers of grains $panicle^{-1}$, 1000-grain weight, grain yield, straw yield were observed where wheat crop residues were incorporated @ 2.0 t ha^{-1}. The results of this study indicate that different amount of wheat crop residues showed potential activity to suppress weed growth.

Key words: Herbicidal activities, wheat crop residues, weed population, dry weight, percent inhibition, grain yield.

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Introduction

Food security of Bangladesh depends on rice agriculture. Rice is the staple food for more than two billion people in Asia and four hundred millions of people in Africa and Latin America (IRRI, 2010). The performance of this sector has an overwhelming impact on major macroeconomic objectives of the country like employment generation, poverty alleviation, human resources development and food security. About 77.07 % of cropped area of Bangladesh is used for rice production. The annual production of rice is 34.71 million metric tons from 11.42 million acres of land (BBS, 2015). Various factors are responsible for lowering of rice yield and weeds are considered as a major constraint. In Bangladesh, weed infestation reduces the grain yield by 70-80% in *aus* rice, 30-40% for transplanted *Aman* rice and 22-36% for modern

Boro rice (Mamun, 1990; BRRI, 2008). The prevailing climatic and edaphic condition of Bangladesh is very much favourable for luxuriant growth of numerous species of weeds that strongly compete with rice plants severely for space, nutrients, air, water and light by adversely affecting plant characteristics. High competitive ability of weeds exerts a serious negative effect on crop production causing significant losses in crop yield. Proper weed management ensures higher yield. Weeding keeps the land clean and soil becomes well aerated and this facilitates the absorption of more nutrients, moisture and higher reception of solar radiation for better growth and yield of rice. The traditional method of weed control is hand weeding which is very much laborious and time consuming. To reduce the cost of rice production, it has been urgently needed to adopt alternative method of weed control. Mechanical weeding and herbicides are the alternatives to hand weeding. Herbicides in combination with hand weeding would help to obtain higher crop yield with less efforts and cost (Shathyamoorthy *et al*., 2004). In present condition herbicide application has become the most widely adopted method for controlling weeds for successful crop production, but their non-judicious use also registers ill effects on soil, water, air, humans and animal health. In view of the numerous problems arising from the chemical weed control, questions have been raised about the continuous use of herbicides. Alternative approaches needs to be considered which is free from such problems. Use of crop residues as herbicidal activities for weed control is a sound alternative of chemical herbicide. Crop residues are defined as crop or its parts left in field for decomposition after it has been thrashed or harvested (Kumar and Goh, 2000). Earlier these were regarded merely as waste, but now because of their usefulness they are considered an important resource that can bring significant physical, chemical, and biological changes in the agricultural soil after amendment. Crop allelopathy controls weeds by the release of allelochemicals from the living plants and or through decomposition of phyto-toxic plant residues (Belz, 2004; Khanh *et al.,* 2005).Crop residues can interfere with weed development and growth through alteration of soil physical, chemical, and biological characteristics. Currently, researchers are giving more emphasis using different crop residues to suppress weed growth. Information regarding crop residues for suppression of weed is very limited in Bangladesh. However, in Bangladesh, so far, a little attempt has been done to exploit the allelopathy of plants for possible weed control purposes in the agriculture sector. Keeping the above points in views the present work was carried out to investigate the weed suppressing ability of wheat crop residues, to determine the optimum dose of wheat crop residues for weed management of T. *Aman* rice and to establish an easy, economic and sustainable method for efficient weed management and better yield.

Materials and Methods

The experiment was conducted at the Agronomy Field Laboratory of Bangladesh Agricultural University (BAU), Mymensingh during June to November2015 in order to investigate the herbicidal activities of wheat crop residues in transplant *Aman* rice. The experiment consisted of the following treatments. i) Rice cultivars *viz.* BRRI dhan32 (V_1), BRRI dhan33 (V_2), BRRI dhan49 (V_3) ii) Wheat crop residues rate *viz.* no wheat crop residues ha^{-1} (T_1), 0.5 t wheat crop residues ha^{-1} (T_2), 1.0 t wheat crop residues ha^{-1} (T_3), 1.5 t wheat crop residues ha^{-1} (T_4), 2.0 t wheat crop residues ha^{-1} (T_5).The experimental field was non-calcareous dark grey flood plain soil under the Sonatala series of the Old Brahmaputra Floodplain which falls under Agro-ecological region of the Old Brahmaputra Floodplain AEZ-9 (FAO and UNDP, 1988). The experiment was laid out in a randomized complete block design (RCBD) with three replications. The total number of plot was 45. The unit plot size was (2.5 m× 2m). The experimental plots were fertilized with urea, triple super phosphate, muriate of potash and gypsum @ 150, 52, 82, 60 kg ha^{-1}, respectively for the variety of BRRI dhan32 and BRRI dhan33. Besides 195 kg urea, 52 kg triple super phosphate, 82 kg muriate of potash and 60 kg gypsum per hectare were applied to the field for BRRI dhan49. The prepared wheat crop residue was incorporated in the field before seven days of rice transplanting as per experimental specification. After that crop residues were mixed well to the respective plots by a spade. All management practices were done as and when necessary. Plant height and dry weight after transplanting were recorded at 25 and 50 DAT in this study. Plant height measured from the collar zone of the plant to the tip of the tallest leaf. Data on weed population were collected from each plot of the rice plants by using 0.25 m × 0.25 m quadrate as per method described by Cruz *et al.* (1986). The weeds within the quadrate were counted in number m^{-2} area. Maturity of crops was determined when 90% of the grains became golden yellow in color. Then the harvested crops of each plot were bundled separately, properly tagged and brought to threshing floor. After threshing, the grains were cleaned and sun dried to maintain moisture content of 14%. The straw was also sun dried properly. Finally the grain and straw yields were recorded and converted to t ha^{-1}. Data collected on different parameters were statistically analyzed using software, named MSTAT-C program. Mean comparisons of the effect of treatment and interactions from the analysis of variance (ANOVA) were made by Duncan's Multiple Range Test (DMRT) as laid out by (Gomez and Gomez, 1984).

Results and Discussion

Effect of interaction between variety and wheat crop residues on Shama (Echinochloa crusgalli): The interaction between variety and wheat crop residue was found to be significant on weed population, dry weight and percent inhibition. The highest weed population (14.00) was found in V_2T_1 (BRRI dhan33 × No crop residues), second highest weed population (12.67) was found in V_1T_1 (BRRI dhan32 × No crop residues). The highest weed dry weight (17.87 g) was found in V_2T_1 (BRRI dhan33 × No crop residues), and the lowest weed dry weight (4.10 g) was in V_3T_5 (BRRIdhan49 × 2.0 t ha^{-1}). Percent inhibition of weed was the highest in V_3T_5 (BRRI dhan49 × 2.0 ton wheat crop residues ha^{-1}) and the lowest one was observed in V_1T_1 (BRRI dhan32 × No crop residues) presented in Table 1.

Table 1. Combined effect of variety and wheat crop residues on weed population, dry weight and percent inhibition of Shama (*Echinochloa crusgalli)*

Treatment combination	*Echinochloa crusgalli*		
	Weed population (no/m^2)	**Dry weight (g/m^2)**	**% inhibition**
V_1T_1	12.67 b	17.87 b	0.00 g
V_1T_2	10.00 d	13.25 d	25.89 f
V_1T_3	6.67 f	8.35 f	53.26 d
V_1T_4	5.33 h	6.27 g	64.90 bc
V_1T_5	4.00 i	4.51 hi	74.79 a
V_2T_1	14.00 a	20.67 a	0.00 g
V_2T_2	10.67 c	15.21 c	26.07 f
V_2T_3	8.67 e	11.17 e	45.72 e
V_2T_4	6.67 f	8.23 f	59.73 c
V_2T_5	4.67 hi	5.12 ghi	75.11 a
V_3T_1	12.67 b	17.13 b	0.00 g
V_3T_2	10.00cd	11.92 e	30.40 f
V_3T_3	6.00 fg	6.32 g	63.08 bc
V_3T_4	5.33 gh	5.51 gh	67.84 b
V_3T_5	4.00 i	4.10 i	76.06 a
Sx	0.23	0.40	1.97
Level of sig.	**	**	**
CV (%)	4.88	6.72	7.73

In a column, figures with the same letter do not differ significantly as per DMRT, ** = Significant at 1% level of probability, V_1= BRRI dhan32, V_2= BRRI dhan33, V_3= BRRI dhan49, T_1= No crop residue, T_2 = 0.5 t ha^{-1}, T_3 = 1.0 t ha^{-1}, T_4 = 1.5 t ha^{-1}, T_5 = 2.0 t ha^{-1}.

Effect of interaction between variety and wheat crop residues on Panishapla (Nymphaea nouchali)**:** The interaction between variety and wheat crop residues was found to be significant on weed population, dry weight and percent inhibition of panishapla. The highest weed population of panishapla was (14.67) in V_2T_1 (BRRI dhan33 × no crop residues), and the lowest was found in V_3T_5 (BRRI dhan49 × 2.0 t ha^{-1})

treatment (Table 2). The highest weed dry weight (3.61 g) was found in V_2T_1 (BRRI dhan33 × no crop residues), and the lowest weed dry weight was in V_3T_5 (BRRI dhan49 × 2.0 t ha^{-1}) treatment (Table 2). Percent inhibition of weed was the highest in V_2T_5 (BRRI dhan33 × 2.0 t ha^{-1}) and the lowest one was observed in V_1T_1 (BRRI dhan32 × no crop residues) treatment presented in (Table 2).

Table 2. Combined effect of variety and wheat crop residues on weed population, dry weight and percent inhibition of Panishapla *(Nymphaea nouchali)*

Treatment combination	***Nymphaea nouchali***		
	Weed population (no/m²)	**Dry weight (g/m²)**	**% inhibition**
V_1T_1	10.00 b	2.90 b	0.00 g
V_1T_2	8.67 bcd	2.17 de	25.06 e
V_1T_3	8.00 de	1.87 f	35.40 d
V_1T_4	6.67 efg	1.61 g	44.60 c
V_1T_5	5.33 h	1.29 h	55.40 b
V_2T_1	14.67 a	3.61 a	0.00 g
V_2T_2	9.33 bc	2.33 d	35.49 d
V_2T_3	8.00 cde	1.97 ef	45.29 c
V_2T_4	6.67 fg	1.64 g	54.53 b
V_2T_5	5.33 h	1.31 h	63.58 a
V_3T_1	9.83 b	2.61 c	0.00 g
V_3T_2	8.67 bcd	2.11 e	17.89 f
V_3T_3	7.33 def	1.78 fg	31.32 d
V_3T_4	5.33 gh	1.35 h	48.31 c
V_3T_5	4.67 h	1.15 h	55.74 b
Sx	0.42	0.07	1.45
Level of sig.	**	**	**
CV (%)	9.29	5.85	7.36

In a column, figures with the same letter do not differ significantly as per DMRT, ** = Significant at 1% level of probability, V_1= BRRI dhan32, V_2= BRRI dhan33, V_3= BRRI dhan49, T_1= No crop residue, T_2 = 0.5 t ha^{-1}, T_3 = 1.0 t ha^{-1}, T_4 = 1.5 t ha^{-1}, T_5 = 2.0 t ha^{-1}.

Effect of interaction between variety and wheat crop residues on Chesra (Scirpus juncoides): The highest chesra weed population (16.00) was found in V_2T_1 (BRRI dhan33 × no crop residue), and the lowest was found in V_3T_5 (BRRI dhan49 × 2.0 t ha^{-1}) treatment (Table 3). The highest weed dry weight (4.89 g) was found in V_2T_1 (BRRI dhan33× no crop residue), and the lowest weed dry weight (1.09 g) was in V_3T_5. Percent inhibition of weed (72.82) was the highest in V_3T_5 (BRRI dhan49 ×2.0 t ha^{-1}), and the lowest one was observed in V_1T_1 (BRRI dhan32 × no crop residue) treatment (Table 3).

Table 3. Combined effect of variety and wheat crop residues on weed population, dry weight and percent inhibition of Chesra (*Scirpus juncoides)*

Treatment combination	***Scirpus juncoides***		
	Weed population (no/m²)	**Dry weight (g/m²)**	**% inhibition**
V_1T_1	14.00 b	4.82 a	0.00 h
V_1T_2	11.33 d	3.43 d	28.84 fg
V_1T_3	8.67 f	2.94 ef	38.95 e
V_1T_4	6.00 h	1.70 h	64.70 bc
V_1T_5	4.67 i	1.34 ij	72.21 a
V_2T_1	16.00 a	4.89 a	0.00 h
V_2T_2	12.00 cd	3.75 c	22.88 g
V_2T_3	10.00 e	3.19 de	34.58 ef
V_2T_4	7.33 g	2.23 g	54.38 d
V_2T_5	4.67 i	1.43 hi	70.77 ab
V_3T_1	12.67 c	4.38 b	0.00 h
V_3T_2	9.33 ef	2.67 f	39.16 e
V_3T_3	7.33 g	2.27 g	47.81 d
V_3T_4	6.00 h	1.65 hi	62.13 c
V_3T_5	4.00 i	1.09 j	72.82 a
Sx	0.41	0.11	2.36
Level of sig.	*	**	*
CV (%)	7.94	6.82	10.02

In a column, figures with the same letter do not differ significantly as per DMRT, ** = Significant at 1% level of probability; * =Significant at 5% level of probability, V_1= BRRI dhan32, V_2= BRRI dhan33, V_3= BRRI dhan49, T_1= No crop residue, T_2 = 0.5 t ha^{-1}, T_3 = 1.0 t ha^{-1}, T_4 = 1.5 t ha^{-1}, T_5 = 2.0 t ha^{-1}.

Effect of interaction between variety and wheat crop residues on Panikachu (Monochoria vaginalis): The interaction between variety and wheat crop residues was found to be significant on weed population, dry weight and percent inhibition of panikachu. The highest weed population (12.00) of panikachu was found in V_2T_1 (BRRI dhan33 × no crop residues) and the lowest was found in V_3T_5 (BRRI dhan49 × 2.0 t ha^{-1}) treatment (Table 4). Percent inhibition of weed was the highest in V_3T_5 (BRRI dhan49 × 2.0 t ha^{-1}) and the lowest one was observed in V_1T_1 (BRRI dhan32 × no crop residues) treatment combination.

Table 4. Combined effect of variety and wheat crop residues on weed population, dry weight and percent inhibition of Panikachu *(Monochoria vaginalis)*

Treatment combination	***Monochoria vaginalis***		
	Weed population (no/m^2)	**Dry weight (g/m^2)**	**% inhibition**
V_1T_1	10.67 b	4.85 b	0.00 i
V_1T_2	9.33 cd	3.75 d	22.57 h
V_1T_3	6.00 ef	2.73 f	43.61 ef
V_1T_4	5.33 fg	2.41 g	50.21 cd
V_1T_5	4.67 gh	2.13 h	56.13 ab
V_2T_1	12.00 a	5.65 a	0.00 i
V_2T_2	10.00 bc	4.47 c	20.87 h
V_2T_3	8.67 d	3.84 d	32.07 g
V_2T_4	6.67 e	2.98 e	47.29 de
V_2T_5	5.33 fg	2.41 g	57.43 ab
V_3T_1	10.00 bc	4.63 c	0.00 i
V_3T_2	6.67 e	3.13 e	32.31 g
V_3T_3	6.00 ef	2.72 f	41.22 f
V_3T_4	4.67 gh	2.16 h	53.34 bc
V_3T_5	4.00 h	1.91 i	58.79 a
Sx	0.28	0.07	1.36
Level of sig.	**	**	**
CV (%)	6.56	3.72	6.83

In a column, figures with the same letter do not differ significantly as per DMRT, ** = Significant at 1% level of probability, V_1= BRRI dhan32, V_2= BRRI dhan33, V_3= BRRI dhan49, T_1= No crop residue, T_2 = 0.5 t ha^{-1}, T_3 = 1.0 t ha^{-1}, T_4 = 1.5 t ha^{-1}, T_5 = 2.0 t ha^{-1}.

Effect of interaction between variety and wheat crop residues Susnishak (Marsilea quadrifolia): The interaction between variety and crop residue was found to be significant on weed population, dry weight and percent inhibition of susnishak. The highest weed population (36.67) was found in V_2T_1 (BRRI dhan33 × no crop residues) followed by V_1T_1 (BRRI dhan32 × no crop residues), and the lowest was found in V_3T_5 (BRRI dhan49 × 2.0 t ha^{-1}) treatment (Table 5). The highest weed dry weight (15.71 g) was found in V_2T_1 (BRRI dhan33 × no crop residues), and the lowest weed dry weight was in treatment combination (Table 5). Percent inhibition of weed was the highest in V_3T_5 (BRRI dhan49 × 2.0 t ha^{-1}) and the lowest one was observed in V_1T_1 (BRRI dhan32 × no crop residues) treatment combination (Table 5).

***Effect of variety on grain yield*:** The studied variety differed significantly in respect of grain yield The highest grain yield (3.72 t ha^{-1}) was obtained in BRRI dhan49 (Figure 1). The increased yield might be due to the lowest number of sterile spikelet panicle^{-1}. The lowest grain yield (3.03 t ha^{-1}) was obtained in BRRI dhan33. This difference was observed due to different varietal characteristics of rice plant. BRRI (2005) also reported variation in grain yield among the varieties.

***Effect of wheat crop residues on grain yield*:** Grain yield was significantly influenced by wheat crop residues. The highest grain yield (3.84 t ha^{-1}) was produced by T_5 (2.0 t ha^{-1}) treatment and the lowest grain yield (2.75 t ha^{-1}) was produced by T_1 (no crop residue) treatment (Figure 2). Incorporation of 2.0 ton wheat crop residue ha^{-1} decrease weed emergence in the rice field and produced maximum grain yield also. The weeds compete with the crop for nutrient, water, air, sunlight and space and so grain yield decreased. Uddin and Pyon (2010) also reported the similar results, where crop residues influenced in crop performance.

***Effect of variety on yield and yield contributing characters*:** Yield and yield contributing characters was significantly influenced by three varieties. The highest plant height, effective tillers hill^{-1}, panicle length, grain panicle^{-1}, grain yield, straw yield, biological yield were found in BRRI dhan49. On the other hand, the lowest plant height, effective tillers hill^{-1}, panicle length, grain panicle^{-1}, grain yield, straw yield, biological yield was found in BRRI dhan33 (Table 6).

Table 5. Combined effect of variety and wheat crop residues on weed population, dry weight and percent inhibition of Susnishak *(Marsilea quadrifolia)*

Treatment combination	*Marsilea quadrifolia*		
	Weed population (no/m^2)	**Dry weight (g/m^2)**	**% inhibition**
V_1T_1	31.33 b	12.80 b	0.00 i
V_1T_2	20.67 d	8.45 c	33.96 h
V_1T_3	16.00 ef	6.21 e	51.51 f
V_1T_4	9.33 g	3.82 f	70.16 d
V_1T_5	6.00 hi	2.52 gh	80.32 b
V_2T_1	36.67 a	15.71 a	0.00 i
V_2T_2	23.33 c	9.31 c	40.44 g
V_2T_3	16.00 ef	6.59 de	58.01 e
V_2T_4	9.33 g	4.07 f	73.97 c
V_2T_5	8.00 gh	2.65 gh	83.02 a
V_3T_1	29.33 b	12.47 b	0.00 i
V_3T_2	17.33 e	7.43 d	40.51 g
V_3T_3	14.67 f	6.04 e	51.25 f
V_3T_4	8.67 g	3.45 fg	72.31 cd
V_3T_5	5.33 i	2.07 h	83.38 a
Sx	0.75	0.35	0.89
Level of sig.	**	**	**
CV (%)	7.70	8.74	3.14

In a column, figures with the same letter do not differ significantly as per DMRT, ** = Significant at 1% level of probability, V_1= BRRI dhan32, V_2= BRRI dhan33, V_3= BRRI dhan49, T_1= No crop residue, T_2 = 0.5 t ha^{-1}, T_3 = 1.0 t ha^{-1}, T_4 = 1.5 t ha^{-1}, T_5 = 2.0 t ha^{-1}.

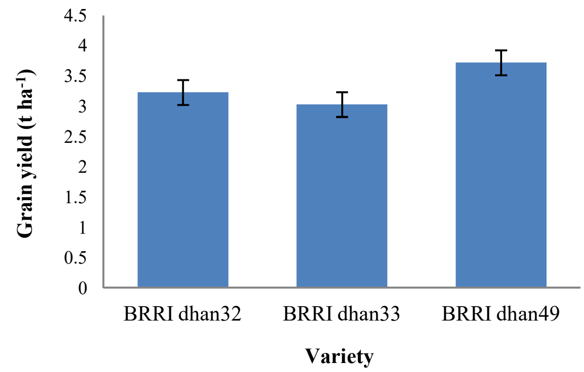

Figure 1. Grain yield as influenced by (Bar represents standard error mean)

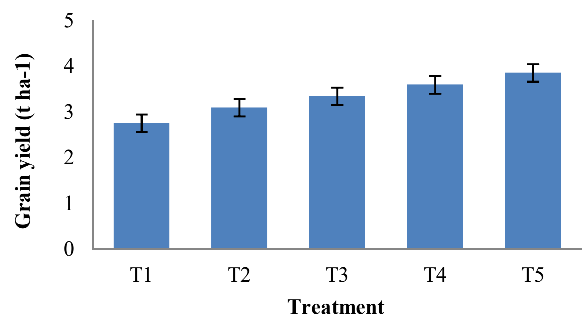

Figure 2. Grain yield as influenced by wheat crop residues (Bar represents standard error mean)

***Effect of wheat crop residues on yield and yield contributing characters*: **Plant height, total number of tillers hill^{-1}, number of effective tillers hill^{-1}, grain yield panicle^{-1} were significantly influenced by wheat crop residues. Panicle length, grain weight and harvest index were nonsignificantly influenced by wheat crop residues. The highest plant height, total number of tillers hill^{-1}, number of effective tillers hill^{-1}, panicle length, grain panicle^{-1}, grain yield, straw yield were found in T_5 treatment where 2.0 t ha^{-1} wheat crop residues was incorporated. The lowest plant height, total number of tillers hill^{-1}, number of effective tillers hill^{-1}, panicle length, grain panicle^{-1}, grain yield, straw yield were found in T_1 treatment where no wheat crop residues was incorporated (Table 7).

Table 6. Effect of variety on yield and yield contributing characters of T. *Aman* rice

Variety	Plant height (cm)	Effective tillers hill^{-1} (no.)	Panicle length (cm)	Grains panicle-^{1} (no.)	1000-grain weight (g)	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
BRRI dhan32	111.30 ab	9.05 b	23.07 b	120.70 b	24.01 a	4.29 b	7.52 b	49.36 a
BRRI dhan33	109.40 b	8.45 c	21.23 c	108.30 c	22.40 b	3.97 c	6.99 c	43.35 b
BRRI dhan49	113.20 a	10.32 a	24.28 a	130.50 a	24.07 a	4.79 a	8.51 a	37.92 c
Sx	0.91	0.08	0.23	1.39	0.21	0.03	0.09	0.34
Level of significance	*	**	**	**	**	**	**	**
CV (%)	3.17	3.35	3.83	4.51	3.50	2.51	4.61	3.04

In a column, figures with same letter(s) or without letter do not differ significantly whereas figures with dissimilar letter differ significantly as per DMRT, ** = Significant at 1% level of probability, * = Significant at 5% level of probability.

Table 7. Effect of wheat crop residues on yield and yield contributing characters of T. *Aman* rice

Treatment	Plant height (cm)	Total tillers hill^{-1} (no.)	Effective tillers hill^{-1} (no.)	Non-effective tillers hill^{-1} (no.)	Panicle length (cm)	Filled grains panicle^{-1}	1000-grain weight(g)	Straw yield (t ha^{-1})	Harvest index (%)
T_1	108.10 b	8.94 e	8.17 e	0.77 c	22.43	109.10 d	23.27	3.69 e	42.90
T_2	110.50 ab	9.58 d	8.74 d	0.84 bc	22.66	115.40 c	23.41	4.04 d	43.64
T_3	111.80 a	10.18 c	9.42 c	0.76 c	22.76	117.30 c	23.50	4.29 c	43.98
T_4	112.40 a	10.72 b	9.79 b	0.93 b	23.13	125.30 b	23.63	4.71 b	43.40
T_5	113.60 a	11.31 a	10.25 a	1.06 a	23.31	132.20 a	23.65	5.01 a	43.79
Sx	1.18	0.08	0.10	0.04	0.29	1.80	0.27	0.04	0.44
Level of significance	*	**	**	**	NS	**	NS	**	NS
CV (%)	3.17	2.22	3.35	13.36	3.83	4.51	3.50	2.51	3.04

In a column, figures with same letter(s) or without letter do not differ significantly whereas figures with dissimilar letter differ significantly as per DMRT, ** = Significant at 1% level of probability, * = Significant at 5% level of probability, NS =not significant, Here, T_1=No crop residue, T_2 = 0.5 t ha^{-1}, T_3 =1.0 t ha^{-1}, T_4 =1.5 t ha^{-1}, T_5 = 2.0 t ha^{-1}.

Combined effect of variety and wheat crop residues on yield and yield contributing characters of T. Aman rice: The highest plant height, total number of tillers hill^{-1}, number of effective tillers hill^{-1}, panicle length, grain panicle^{-1}, grain yield, straw yield were found in V_3T_5 (BRRI dhan49 × 2.0 t ha^{-1}) treatment combination (Table 8). On the other hand, the lowest plant height, total number of tillers hill^{-1}, number of effective tillers hill^{-1}, panicle length, grain panicle^{-1}, grain yield, straw yield were found in V_2T_1 (BRRI dhan33 × no wheat crop residues) treatment combination (Table 8).

Table 8. Combined effect of variety and wheat crop residues on yield and yield contributing characters of T. *Aman* rice

Treatment combination	Plant height (cm)	Effective tillers hill^{-1} (no.)	Panicle length (cm)	Grains panicle^{-1}(no.)	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield(t ha^{-1})	Harvest index (%)
V_1T_1	107.20	7.92 gh	22.37	111.10 de	23.72	2.62 i	3.74 gh	6.36	48.90 b
V_1T_2	110.50	8.33 fg	22.73	121.20 bc	24.06	3.04 gh	4.01 f	7.05	48.09 b
V_1T_3	112.30	9.10 de	22.90	121.90 bc	24.07	3.24 efg	4.25 e	7.49	49.59 b
V_1T_4	112.90	9.40 cd	23.64	123.50 bc	24.08	3.56 cd	4.65 cd	8.21	47.77 b
V_1T_5	113.70	10.50 b	23.68	125.90 b	24.10	3.67 c	4.82 c	8.49	52.44 a
V_2T_1	106.90	7.59 h	20.90	100.70 f	22.05	2.52 i	3.37 i	5.89	42.74 c
V_2T_2	108.70	8.00 gh	21.06	102.70 ef	22.12	2.86 h	3.59 h	6.45	44.33 c
V_2T_3	109.40	8.68 ef	21.13	104.70 ef	22.38	3.06 g	3.86 fg	6.93	44.17 c
V_2T_4	110.00	8.97 de	21.35	110.10 def	22.72	3.28 ef	4.30 e	7.59	43.31 c
V_2T_5	111.90	9.00 de	21.71	123.40 bc	22.73	3.42 de	4.68 cd	8.10	42.20 c
V_3T_1	110.10	9.00 de	24.01	115.50 cd	24.04	3.11 fg	3.96 f	7.07	37.07 d
V_3T_2	112.50	9.89 c	24.19	122.20 bc	24.05	3.39 de	4.50 d	7.89	38.52 d
V_3T_3	113.60	10.48 b	24.26	125.40 bc	24.07	3.72 c	4.77 c	8.49	38.17 d
V_3T_4	114.30	11.00 ab	24.40	142.30 a	24.08	3.93 b	5.18 b	9.11	39.11 d
V_3T_5	115.20	11.25 a	24.54	147.30 a	24.13	4.45 a	5.53 a	9.98	36.73 d
Sx	2.04	0.18	0.51	3.12	0.47	0.07	0.06	0.20	0.76
Level of significance	NS	*	NS	**	NS	*	*	NS	**
CV (%)	3.17	3.35	3.83	4.51	3.50	3.48	2.51	4.61	3.04

In a column, figures with same letter(s) or without letter do not differ significantly where figures with dissimilar letter differ significantly as per DMRT, * = Significant at 5% level of probability, **= Significant at 1% level of probability, NS = not significant, Here,V_1= BRRI dhan32, V_2= BRRI dhan33, V_3= BRRI dhan49, T_1=No crop residue, T_2 = 0.5 t ha^{-1}, T_3 = 1.0 t ha^{-1}, T_4 = 1.5 t ha^{-1}, T_5 = 2.0 t ha^{-1}.

Conclusion

It was found that wheat crop residues had significant effect on grain yield. BRRI dhan49 with 2.0 t ha^{-1}wheat crop residue performed the best in reducing weed infestation and highest yield of T. *Aman* rice. The highest grain yield (4.45 t ha^{-1}) was produced in V_3T_5 (BRRI dhan49 × 2.0 t ha^{-1}) and the lowest dry weight of weed produced in that combination. It also showed best performance with respect to most yield attributes e.g. total number of tillers hill^{-1}, grains panicle^{-1}, grain yield tha^{-1} and straw yield tha^{-1} of BRRI dhan49. It can be concluded that BRRI dhan49 with 2 t ha^{-1} wheat crop residues was found to be the best possible combination for achieving higher grain yield.

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