



Allelopathic potential of mustard crop residues on weed management and performance of transplant *Aman* rice

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Abstract

Crop allelopathy may be useful to minimize serious problems in the present agricultural production such as environmental pollution, unsafe production, 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 to evaluate the effect of crop residues of mustard on weed management and crop performance of *T. aman* rice. The experiment consisted of three cultivars of *T. aman* rice viz., BR11, BR23 and BRRI dhan49 and five different level of mustard crop residues such as no crop residues, mustard 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 mustard crop residues and cultivar. The maximum weed growth was noticed with the cultivar BR23 and the minimum was found in the cultivar BR11. The grain yield as well as the other yield contributing characters produced by BR11 was the highest among the studied varieties. The highest percent inhibition of 71.17, 69.19, 80.88, 70.48 and 86.97 was in Shama (*Echinochloa acrusgalli*), Panishapla (*Nymphaea nouchali*), Panichaise (*Scirpus juncooides*), Panikachu (*Monochoria vaginalis*) and Susnishak (*Marsilea quadrifolia*), respectively which was caused by the application of mustard 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 mustard crop residues were incorporated @ 2.0 t ha⁻¹. BR11 cultivar with all treatments produced the highest grain and straw yield among the treatment combination. The results of this study indicate that different amount of mustard crop residues showed potential activity to suppress weed growth.

Introduction

Bangladesh is an agricultural country and its agriculture is predominantly rice based. About 77.07 % of cropped area of Bangladesh is used for rice production. Food security of Bangladesh depends on rice agriculture. Rice (*Oryza sativa*) is also 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 annual production of rice is 34.71 million metric tons from 11.42 million acres of land (BBS, 2015). Transplant *aman* rice covers 5.53 million acres of land with a production of 13.19 million metric tons (BBS, 2015). 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). Various factors are responsible for lowering of rice yield and weeds are considered as a major constraint. High competitive ability of weeds exerts a serious negative effect on crop production causing significant losses in crop yield. 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 allelopathy and allelochemicals for weed control is a sound alternative of chemical herbicide.

Crop residues can interfere with weed development and growth through alteration of soil physical, chemical, and biological characteristics. 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). Crop residues controls weeds by the release of allelochemicals through decomposition of phytotoxic plant materials (Belz, 2004; Khanh *et al.*, 2005). 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, a little attempt has been done to investigate the weed suppressing ability of mustard crop residues and its optimum dose to establish an easy, economic and sustainable method for efficient weed management of *T. Aman* rice.

Materials and Methods

The experiment was conducted at the Agronomy Field Laboratory of Bangladesh Agricultural University, Bangladesh during *aman* season (June-November) of 2015. The experimental treatment consisted of two factors. In factor A, 5 mustard crop residues– i) No crop residue (T₁), ii) 0.5 t ha⁻¹ (T₂), iii) 1.0 t ha⁻¹ (T₃), iv) 1.5 t ha⁻¹ (T₄), v) 2.0 t ha⁻¹ (T₅) and in factor B, 3 rice variety viz. i) BR11 (V₁), ii) BR23 (V₂), iii) BRRI dhan49 (V₃) were used. The experiment was laid out in a randomized complete block design (RCBD) with three replications. The total number of plot was 45. Each plot size was (2.5m × 2m). The distance maintained between the individual unit plots was 0.5 m and distance between the replication was 1.0 m. Land preparation for rice cultivation was done by 3–4 times of ploughing and cross ploughing followed by laddering. The studied crop residues were cut as small as possible by using sickle. The prepared mustard crop residues was applied seven days before transplanting and mixed well to the respective plots by a spade in the prepared field. 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 BR11 and BRRI dhan49. On the other hand 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 BR23. Except urea, the whole amount of other fertilizer was applied before final land preparation. Urea was top dressed in three instalments at 15, 30 and 45 days after transplanting (DAT). Transplanting was done in 30 July 2015 at the rate of three seedlings hill⁻¹ maintained row and hill distance of 25 cm and 15 cm, respectively. Data on weed population, weed dry weight and different parameters of rice plant was taken at different growth stage of rice plants from each plot. After attaining full maturity the crops were harvested on 15 November, 2015. Data on grain and straw yields were collected from an area of 1 m² in the middle of each plot. The data on other crop characters were randomly sampled from the region outside 1 m² area (excluding the border hills)

which was kept for taking data on grain and straw yields. Data recorded for different parameters were compiled and tabulated in proper form and subjected to statistical analysis. The Analysis of variance was done with the help of computer package MSTAT-C program. The mean differences among the treatments were adjudged by Duncan's Multiple Range Test (DMRT) as laid out by Gomez and Gomez (1984).

Results and Discussion

Infested weed species in the experimental field

Five weed species belonging to five families infested the experimental field. Local name, scientific name, family, morphological type and life cycle of the weed in the experimental plot have been presented in Table 1. The weeds of the experimental plots were *Echinochloa crusgalli*, *Nymphaea nouchali*, *Scirpus juncooides*, *Monochori vaginalis*, *Marsilea quadrifolia*. Among the weed species 3 were broad leaf, one sedge and one grass type morphology. There were three perennial and two annual weed species in the experimental plot.

Effect of interaction between variety and mustard crop residues on *Echinochloa crusgalli*

The interaction between variety and crop residue was found to be significant on weed population, dry weight and percent inhibition. The highest weed population (25.32) was found in V₂T₁ (BR23 × No crop residues), second highest weed population (21.32) was found in V₁T₁ (BR11 × No crop residues) treatment (Table 2). The highest weed dry weight (39.32 g) was found in V₂T₁ (BR23 × No crop residues), and the lowest weed dry weight (5.68 g) was in V₃T₅ (BRRI dhan49 × 2.0 t ha⁻¹). Percent inhibition of weed was the highest in V₂T₅ (BR23 × 2.0 ton mustardcrop residue ha⁻¹) and the lowest one was observed in V₁T₁ (BR11 × No crop residue) presented in Table 2. Similar findings were reported by Uddin and Pyon (2010), who found significant weed control efficacy by different crop residues.

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

Sl. No.	Local name	Scientific name	Family	Morphological type	Life cycle
1	Shama	<i>Echinochloa crusgalli</i>	Poaceae	Grass	Annual
2	Panishapla	<i>Nymphaea nouchali</i>	Nymphaeaceae	Broad leaf	Perennial
3	Chechra	<i>Scirpus juncooides</i>	Cyperaceae	Sedge	Perennial
4	Panikachu	<i>Monochoria vaginalis</i>	Pontederiaceae	Broadleaf	Perennial
5	Susnishak	<i>Marsilea quadrifolia</i>	Marsileaceae	Broadleaf	Annual

Table 2. Combined effect of variety and mustard crop residues on *Echinochloa crusgalli*

Treatment combination	<i>Echinochloa crusgalli</i>		
	Weed population (no. m ⁻²)	Dry weight (g m ⁻²)	% inhibition
V ₁ T ₁	21.32 b	33.76 b	0.00 k
V ₁ T ₂	17.32 c	27.08 c	18.78 j
V ₁ T ₃	9.32 e	14.72 f	55.73 g
V ₁ T ₄	6.68 fg	10.56 gh	69.17cd
V ₁ T ₅	4.00 h	6.2 ij	76.53 ab
V ₂ T ₁	25.32 a	39.32 a	0.00 k
V ₂ T ₂	16.0 c	24.48 d	38.12 i
V ₂ T ₃	13.32 d	20.32 e	48.46 h
V ₂ T ₄	9.32 e	14.44 f	62.75 ef
V ₂ T ₅	5.32 gh	8.24 hi	78.75 a
V ₃ T ₁	21.32 b	32.24 b	0.00 k
V ₃ T ₂	16.0 c	21.84 e	33.53 i
V ₃ T ₃	8.0 ef	10.92 g	64.88 de
V ₃ T ₄	6.68 fg	9.0 gh	72.04 bc
V ₃ T ₅	4.0 h	5.68 j	58.24 fg
Level of sig.	*	**	**
CV (%)	11.18	7.44	7.76

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, V₁= BR11, V₂= BR23, V₃= BRR1 dhan49, T₁= No crop residue, T₂= 0.5 t ha⁻¹, T₃= 1.0 t ha⁻¹, T₄= 1.5 t ha⁻¹, T₅= 2.0 t ha⁻¹.

Effect of interaction between variety and mustard crop residues on *Nymphaea nouchali*

The interaction between variety and mustard crop residues was found to be significant on weed population, dry weight and percent inhibition of *Nymphaea nouchali*. The highest weed population was (25.32) in V₃T₁ (BRR1 dhan49 × no crop residue), second highest weed population (17.31) was found in V₂T₁ (BR23 × no crop residue), and the lowest was found in V₂T₅ (BR23 ×

2.0 t ha⁻¹) treatment (Table 3). The highest weed dry weight (6.20 g) was found in V₃T₁ (BRR1 dhan49 × no crop residue), and the lowest weed dry weight was in V₂T₅ (BR23 × 2.0 t ha⁻¹) treatment (Table 3). Percent inhibition of weed was the highest in V₃T₅ (BRR1 dhan49 × 2.0 t ha⁻¹) and the lowest one was observed in V₁T₁ (BR11 × no crop residue) treatment presented in (Table 3).

Table 3. Combined effect of variety and mustard crop residues on *Nymphaea nouchali*

Treatment combination	<i>Nymphaea nouchali</i>		
	Weed population (no. m ⁻²)	Dry weight (g m ⁻²)	% inhibition
V ₁ T ₁	16.0 bc	4.20 c	0.00 h
V ₁ T ₂	13.32 cde	3.2 def	21.89 g
V ₁ T ₃	12.0 def	2.92 efg	29.72 f
V ₁ T ₄	9.32 fg	2.28 h	46.15 d
V ₁ T ₅	6.68 gh	1.60 i	62.42 b
V ₂ T ₁	17.32 b	4.80 b	0.00 h
V ₂ T ₂	13.32 cde	3.36 de	28.19 f
V ₂ T ₃	10.68 ef	2.56 gh	44.05 d
V ₂ T ₄	6.64 gh	1.68 i	65.21 b
V ₂ T ₅	5.32 h	1.28 i	72.32 a
V ₃ T ₁	25.32 a	6.20 a	0.00 h
V ₃ T ₂	14.68 bcd	3.64 d	39.54 e
V ₃ T ₃	12.0 def	2.76 fgh	51.73 c
V ₃ T ₄	9.32 fg	2.22 h	62.34 b
V ₃ T ₅	6.64 gh	1.64 i	72.82 a
Level of sig.	**	**	**
CV (%)	13.84	10.34	6.13

In a column, figures with the same letter do not differ significantly as per DMRT,

** = Significant at 1% level of probability.

V₁= BR11, V₂= BR23, V₃= BRR1 dhan49

T₁= No crop residue, T₂= 0.5 t ha⁻¹, T₃= 1.0 t ha⁻¹, T₄= 1.5 t ha⁻¹, T₅= 2.0 t ha⁻¹.

Effect of interaction between variety and mustard crop residues on *Scirpus juncooides*

The interaction between variety and crop residue was found to be significant on weed population, dry weight and percent inhibition. The highest weed population (28.0) was found in V₂T₁ (BR23 × no crop residue) and the lowest was found in V₃T₅ (BRRI dhan49 × 2.0 t ha⁻¹) treatment (Table 4). The highest weed dry weight (8.80

g) was found in V₂T₁ (BR23 × no crop residue), which was statistically identical with V₁T₁ (BR11 × no crop residue), and the lowest weed dry weight (1.20 g) was in V₃T₅. Percent inhibition of weed (84.47) was the highest in V₃T₅ (BRRI dhan49 × 2.0 t ha⁻¹) and the lowest one was observed in V₁T₁ (BR11 × no crop residue) treatment (Table 4).

Table 4. Combined effect of variety and mustard crop residues on *Scirpus juncooides*

Treatment combination	<i>Scirpus juncooides</i>		
	Weed population (no. m ⁻²)	Dry weight (g m ⁻²)	% inhibition
V ₁ T ₁	24.0 b	8.64 a	0.00 k
V ₁ T ₂	18.68 cd	6.52 c	23.33 ij
V ₁ T ₃	16.0 de	5.40 d	36.80 h
V ₁ T ₄	10.68 fg	3.36 fg	61.10 e
V ₁ T ₅	5.32 hi	1.84 hi	77.06 bc
V ₂ T ₁	28.0 a	8.80 a	0.00 k
V ₂ T ₂	20.0 c	7.20 bc	16.96 j
V ₂ T ₃	13.32 ef	4.88 de	44.20 g
V ₂ T ₄	8.0 gh	2.40 gh	70.94 cd
V ₂ T ₅	5.32 hi	1.68 hi	81.12 ab
V ₃ T ₁	21.32 bc	7.76 ab	0.00 k
V ₃ T ₂	14.68 e	4.32 ef	29.16 i
V ₃ T ₃	10.68 fg	3.56 f	52.88 f
V ₃ T ₄	8.0 gh	2.32 gh	69.72 d
V ₃ T ₅	4.0i	1.20 i	84.47 a
Level of sig.	**	*	**
CV (%)	12.77	13.03	9.58

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
 V₁=BR11, V₂=BR23, V₃= BRRI dhan49
 T₁= No crop residue, T₂= 0.5 t ha⁻¹, T₃= 1.0 t ha⁻¹, T₄= 1.5 t ha⁻¹, T₅= 2.0 t ha⁻¹.

Effect of interaction between variety and mustard crop residues on *Monochoria vaginalis*

The interaction between variety and mustard crop residues was found to be significant on weed population, dry weight and percent inhibition of *Monochoria vaginalis*. The highest weed population (20.0) was found in V₃T₁ (BRRI dhan49 × no crop residue) and the lowest was found in V₃T₅ (BRRI dhan49 × 2.0 t ha⁻¹) treatment (Table 5). The highest weed dry weight (9.32 g) was found in V₃T₁ (BRRI dhan49 × no crop residue) and the lowest dry weight of weed was in V₂T₅ (BR23 × 2.0 t ha⁻¹) treatment (Table 5). Percent inhibition of weed was highest in V₃T₅ and the lowest one was observed in V₂T₁ treatment combination.

Effect of interaction between variety and mustard crop residues on *Marsilea quadrifolia*

The interactions between variety and crop residue was found to be significant on weed population, dry weight and percent inhibition of *Marsilea quadrifolia*. The highest weed population (69.32) was found in V₃T₁ (BRRI dhan49 × no crop residue) followed by V₁T₁ (BR11 × no crop residue) and the lowest was found in V₃T₅ (BRRI dhan49 × 2.0 t ha⁻¹) treatment (Table 6). The highest weed dry weight (29.84 g) was found in V₃T₁, and the lowest weed dry weight was in V₃T₅ treatment combination (Table 6). Percent inhibition of weed was the highest in V₃T₅ (BRRI dhan49 × 2.0 t ha⁻¹) and the lowest one was observed in V₁T₁ (BR11 × no crop residue) treatment combination.

Table 5. Combined effect of variety and mustard crop residues on *Monochoria vaginalis*

Treatment combination	<i>Monochoria vaginalis</i>		
	Weed population (no. m ⁻²)	Dry weight (g m ⁻²)	% inhibition
V ₁ T ₁	17.32 b	7.72 b	0.00 i
V ₁ T ₂	16.0 bc	6.96 bc	10.28 h
V ₁ T ₃	13.20 d	5.68 d	24.42 g
V ₁ T ₄	9.32 e	3.96 e	47.48 ef
V ₁ T ₅	6.68 fg	2.80 fg	62.01 cd
V ₂ T ₁	16.0 bc	7.28 bc	0.00 i
V ₂ T ₂	9.32 e	4.28 e	40.31 f
V ₂ T ₃	8.0 ef	3.44 ef	50.31 e
V ₂ T ₄	6.68 fg	2.84 fg	61.08 d
V ₂ T ₅	5.32 gh	2.24 gh	69.30 bc
V ₃ T ₁	20.0 a	9.32 a	0.00 i
V ₃ T ₂	14.68 cd	6.84 c	23.78 g
V ₃ T ₃	8.0 ef	3.48 ef	64.30 cd
V ₃ T ₄	5.32 gh	2.32 gh	74.64 ab
V ₃ T ₅	4.0 h	1.80 h	80.12 a
Level of sig.	**	**	**
CV (%)	12.25	9.92	10.75

In a column, figures with the same letter do not differ significantly as per DMRT,

** = Significant at 1% level of probability.

V₁= BR11, V₂= BR23, V₃= BRR1 dhan49

T₁= No crop residue, T₂= 0.5 t ha⁻¹, T₃= 1.0 t ha⁻¹, T₄= 1.5 t ha⁻¹, T₅= 2.0 t ha⁻¹.

Table 6. Combined effect of variety and mustard crop residues on *Marsilea quadrifolia*

Treatment combination	<i>Marsilea quadrifolia</i>		
	Weed population (no m ⁻²)	Dry weight (g m ⁻²)	% inhibition
V ₁ T ₁	58.68 b	24.0 b	0.00 j
V ₁ T ₂	30.68d	13.24 de	29.33 i
V ₁ T ₃	25.32 d	10.48 e	56.30 e
V ₁ T ₄	14.68 e	6.04 fg	74.84 c
V ₁ T ₅	9.32 efg	3.68 gh	83.98 b
V ₂ T ₁	54.68 b	23.36 b	0.00 j
V ₂ T ₂	37.32 c	15.32 cd	32.79 h
V ₂ T ₃	28.0 d	10.80 e	52.68 f
V ₂ T ₄	14.68 e	6.52 f	72.09 c
V ₂ T ₅	8.0 fg	3.44 gh	85.21 b
V ₃ T ₁	69.32 a	29.84 a	0.00 j
V ₃ T ₂	42.68 c	17.16 c	41.37 g
V ₃ T ₃	28.0 d	11.64 e	60.42 d
V ₃ T ₄	13.32 ef	5.24 fgh	82.35 b
V ₃ T ₅	6.68 g	2.56 h	91.73 a
Level of sig.	**	**	**
CV (%)	12.17	12.74	3.66

In a column, figures with the same letter do not differ significantly as per DMRT

** = Significant at 1% level of probability.

V₁= BR11, V₂= BR23, V₃= BRR1 dhan49

T₁= No crop residue, T₂= 0.5 t ha⁻¹, T₃= 1.0 t ha⁻¹, T₄= 1.5 t ha⁻¹, T₅= 2.0 t ha⁻¹.

Yield and Yield Contributing Characters at Harvest

Grain yield as influenced by variety

The studied variety differed significantly in respect of grain yield. The highest grain yield (4.09 t ha⁻¹) was obtained in BR11 (Fig. 1). The increased yield might be

due to the lowest number of sterile spikelet panicle⁻¹. The lowest grain yield (3.72 t ha⁻¹) was obtained in BRR1 dhan49. This difference was observed due to different varietal characteristics of rice plant. BRR1 (2005) also reported variation in grain yield among the varieties.

Grain yield as influenced by mustard crop residues

Grain yield was significantly influenced by mustard crop residues. The highest grain yield (4.14 t ha^{-1}) was produced by T_5 (2.0 t ha^{-1}) treatment and the lowest grain yield (3.52 t ha^{-1}) was produced by T_1 (no crop residue) treatment (Fig 2). Incorporation of 2.0 ton mustard crop residue ha^{-1} decrease weed emergence in the rice field and produced maximum grain yield also. It might be due to application of crop residues added organic matter to the soil and enhance grain yield. On the other hand, control plot (no crop residue) showed maximum weed population and highest dry weight of

weed. 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.

Straw yield as influenced by mustard crop residues

Straw yield was significantly influenced by mustard crop residues (Fig. 3). The highest straw yield (7.51 t ha^{-1}) was observed in 2.0 ton mustard crop residue ha^{-1} treatment and the lowest straw yield (6.41 t ha^{-1}) was observed in T_1 (no crop residue) treatment.

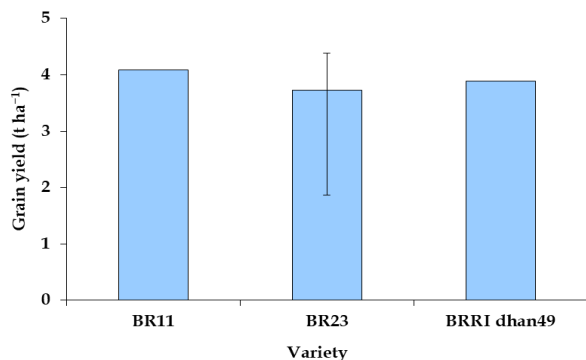


Fig. 1. Grain yield as influenced by variety (Bar represents standard error mean)

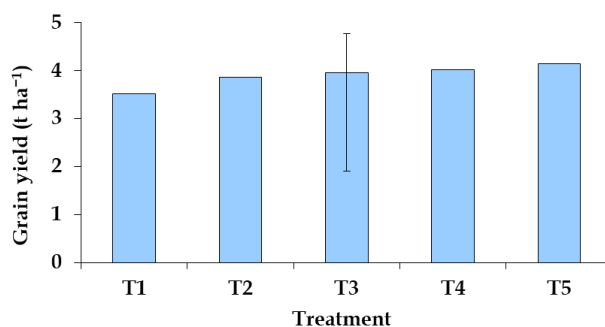


Fig. 2. Grain yield as influenced by mustard crop residues (Bar represents Standard error mean)
Here, T_1 = No crop residue, $T_2 = 0.5 \text{ t ha}^{-1}$, $T_3 = 1.0 \text{ t ha}^{-1}$, $T_4 = 1.5 \text{ t ha}^{-1}$, $T_5 = 2.0 \text{ t ha}^{-1}$.

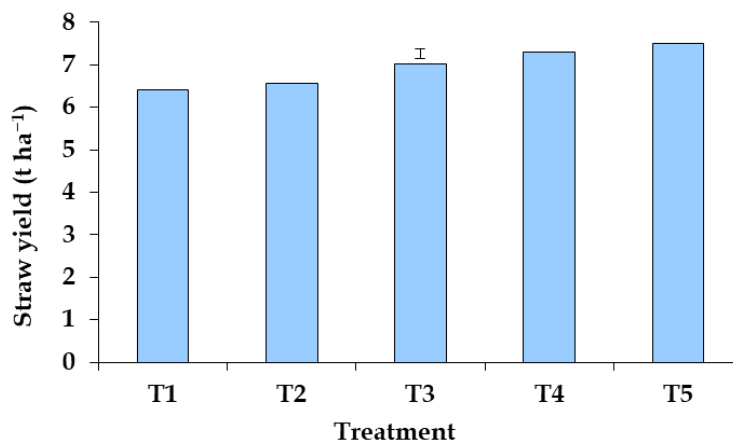


Fig. 3. Straw yield as influenced by mustard crop residues (Bar represents standard error mean)
Here, T_1 = No crop residue, $T_2 = 0.5 \text{ t ha}^{-1}$, $T_3 = 1.0 \text{ t ha}^{-1}$, $T_4 = 1.5 \text{ t ha}^{-1}$, $T_5 = 2.0 \text{ t ha}^{-1}$.

Table 7. Combined effect of variety and mustard 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 ₁ T ₁	100.00	8.09	22.13	99.46 gh	24.45	3.65 g	6.44 gh	10.10 gh	36.19 bc
V ₁ T ₂	100.90	8.14	22.18	108.90 ef	24.55	4.00 cd	6.60 efg	10.60 ef	37.74 a
V ₁ T ₃	101.70	8.22	22.31	112.10 e	24.68	4.17 b	7.42 bc	11.59 bc	36.01 bc
V ₁ T ₄	102.40	8.35	22.50	114.90 de	24.77	4.24 ab	7.71 ab	11.95 ab	35.51 c
V ₁ T ₅	103.40	8.60	22.72	117.00 de	24.83	4.38 a	7.97 a	12.34 a	35.47 c
V ₂ T ₁	96.07	6.59	22.26	90.81 i	22.22	3.48 h	6.16 h	9.64 h	36.12 bc
V ₂ T ₂	96.67	6.73	22.34	94.12 hi	22.43	3.69 g	6.25 gh	9.94 gh	37.11 ab
V ₂ T ₃	97.25	6.86	22.45	96.92 ghi	22.51	3.74 fg	6.53 fgh	10.27 fg	36.38 bc
V ₂ T ₄	97.73	7.00	22.53	99.98 gh	22.64	3.80 efg	6.98 de	10.79 de	35.26 c
V ₂ T ₅	98.27	7.12	22.58	102.60 fg	22.73	3.91 de	7.10 cd	11.01 de	35.48 c
V ₃ T ₁	97.87	8.73	22.14	121.40 d	24.12	3.41 h	6.62 efg	10.03 gh	34.00 d
V ₃ T ₂	98.30	8.95	22.21	136.50 c	24.23	3.89 def	6.84 def	10.74 def	36.23 bc
V ₃ T ₃	99.97	9.09	22.34	143.30 bc	24.33	3.96 de	7.11 cd	11.07 de	35.79 bc
V ₃ T ₄	101.40	9.21	22.40	149.40 ab	24.41	4.00 cd	7.21 cd	11.21 cd	35.70 c
V ₃ T ₅	102.00	9.70	22.56	153.40 a	24.53	4.15 bc	7.47 bc	11.61 bc	35.70 c
Level of sig.	NS	NS	NS	*	NS	*	*	*	*
CV (%)	2.29	3.37	1.45	3.84	1.31	2.25	3.13	2.49	1.96

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, NS = not significant.

Here, V₁= BR11, V₂= BR23, V₃= BRR1 dhan49

T₁=No crop residue, T₂= 0.5 t ha⁻¹, T₃= 1.0 t ha⁻¹, T₄= 1.5 t ha⁻¹, T₅= 2.0 t ha⁻¹.

Conclusion

Weed population, weed dry weight, percent inhibition were significantly affected by variety, mustard crop residues and their interaction. It is found from this study that incorporation of mustard crop residue was really able to suppress weed infestation. Mustard crop residues might be a successful weed management tool which can inhibit the germination of several weed species and not inhibit the growth performance of the crop. It may be useful to minimize hazardous environmental issues, excessive uses of synthetic herbicide and provide better soil health. So it is clear from the study that mustard crop residues have an immense prospect on weed management and sustainable agricultural development. In addition, further research using different crop residues needs to be done for getting conclusive result.

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