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Allelopathic Potential of Amrul Shak (*Oxalis europea)* Residues on the Yield Performance of T. *Aman* Rice

[1] Most. Sumaiya Siddika, [2] Md. Liton Mia, [3] Nishat Salsabil, [4] Asraful Alam, [5] Md. Rakibul Hasan Sanet, [6] Md. Harun Rashid, [7] Md. Rashedur Rahman, [8] Md. Shafiqul Islam, [9] Farhana Zaman

[1, 2, 6, 7, 8, 9] Department of Agronomy, Faculty of Agriculture, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh

[3] Department of Crop Botany, Faculty of Agriculture, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh

[4, 5] Faculty of Agriculture, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh

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Corresponding Author: **Farhana Zaman**

Abstract

The experiment was conducted at the Agronomy Field Laboratory of Bangladesh Agricultural University, Bangladesh during *aman* season (June-November) of 2019 to investigate the allelopathic potential of amrul shak residues on crop performance of T. *aman* rice. The experiment consisted of three cultivars i.e. Binadhan-7, BR11 and BRRI dhan49 and five different amrul shak residues such as no crop residues, 0.5 t ha^{-1}, 1.0 t ha^{-1}, 1.5 t ha^{-1}, 1.5 t ha^{-1} + Farmers' practice (one hand weeding). The experiment was laid out in a randomized complete block design with three replications. The grain yield as well as the yield contributing characters produced by BRRI dhan49 was the highest among the studied varieties. The highest reduction of grain yield was obtained in T_1 (no crop residues) treatment and the lowest was obtained in T_5 [1.5 t ha^{-1} + Farmers' practice (one hand weeding)]. The highest number of effective tillers $hill^{-1}$, number of grains $panicle^{-1}$, 1000-grain weight, grain and straw yields were observed in T_5 [1.5 t ha^{-1} + Farmers' practice (one hand weeding)] treatment. BRRI dhan49 under T_5 treatment condition produced the highest grain and straw yield. Results of this study indicate that amrul shak residues showed potentiality to suppress weed growth. Therefore, amrul shak residues could be a potential source of efficient weed management tool for production of T. *aman* rice.

Keywords: Allelopathy, Amrul Shak, Yield performance, T. *Aman* rice, Weed

Introduction

Rice (*Oryza sativa* L.) is the main food crop in Asia and the staple food of the majority of the population in many regions of the world. Rice is the most important food, eaten by more than half of the world's population. In Asia, where 90% of rice is consumed, ensuring there is enough affordable rice for everyone. In Africa and Latin America, rice is becoming a more important staple food too (IRRI, 2015) [15]. There are two cultivated and twenty-one wild species of genus *Oryza*. Geographic and agronomic conditions of Bangladesh are favorable for rice cultivation.

About 1,14,17183 hectares of cropped area of Bangladesh are used for rice production, with annual production of 36.60 million tons (BBS, 2020) [3]. In Bangladesh there are three distinct classes of rice based on the season of cultivation, namely *aus*, *aman* and *boro*. Although the average yield of *boro* is the highest it cannot fulfill the demand of our country, that's why *aman* is important in Bangladesh. In the 2020-2021 financial year, total area under *aman* crop has been estimated 55, 59, 964 hectares which is 0.87% higher than that of last year. Total *aman* production of Financial Year 2020-2021 has been estimated 1,44,37763 metric tons compared to 1, 42, 03197 metric tons of financial year 2019-20 which is 1.65% higher (BBS, 2020) [3].

Plant allelopathy would be an alternative to weed management since allelopathy involves a plant releasing chemicals into its surroundings that prevent the growth of other plants. Crop allelopathy and allelochemicals are effective alternatives to chemical herbicides for the control of weeds (Islam *et al.* 2024a) [16]. Using plant residues and plant release substances are the sustainable way of managing weeds in agriculture (Bajwa, 2014) [2]. Further, to reduce the dependence on synthetic herbicides to control weeds, the use of bio-herbicides from allelopathic plants is time demanding which are cost-effective and

environment-friendly (Carr *et al.* 2013) [7]. Currently, researchers are giving more emphasis using different plant residues to suppress weed growth. In allelopathy, the release substance also affects the growth of surroundings crops (Islam *et al.* 2024b) [19].

The amount of nutrients that may be added to soils each year is limited by weeds in addition to the significant residues of commonly grown crops, which should be taken into account (Kaur *et al.* 2018) [21]. Research on alternative weed management techniques is being conducted all over the world as is concerned about the negative effects of the careless use of agricultural herbicides on human health and the environment grow (Islam *et al*. 2024c) [18].

Oxalis europea family oxalidaceae with about 800 species and is widely distributed in tropical, sub-tropical and temperate zones (Shiraishi *et al*. 2005) [22]. The weed prefers dry and moist soil but cannot grow in shade (Hossain *et al*., 2010). Its leaves have also been used as a treatment for rheumatism, arthritis, gout, kidney stones or hyperacidity (Bown, 1995) [5]. Though the pharmacological properties of *O. europea* is well documented but allelopathic experiment of *O. europea* in field conditions is not found in the literature. A preliminary laboratory screening of the *O. europea* on allelopathy has been found, but before going to farmers' fields it is needed to make field trial first.

Materials and Methods

Experiment site

The experimental field was located at 24°25' N latitude and 90°50' E longitude at an elevation of 18m above the sea level belonging to non-calcareous dark grey floodplain soil under the Sonatola series of the Old Brahmaputra Floodplain which falls under Agro-ecological region of the Old Brahmaputra Floodplain (AEZ-9) (FAO and UNDP, 1988) [10].

Experimental treatments

The experimental treatment consisted of two factors. They are as follows: Factor A: Amrul shak residues (5): T_1 = Control, T_2 = 0.5 t ha^{-1}, T3 = 1.0 t ha^{-1}, T_4 = 1.5 t ha^{-1}, T_5 = 1.5 t ha^{-1}+ Farmers' practice (one hand weeding). Factor B: Rice varieties (3): V_1 = Binadhan-7, V_2 = BR11, V_3 = BRRI dhan49.

Experimental design

The experiment was laid out in a randomized complete block design (RCBD) with three replications. The total number of plots was 5 × 3 × 3 = 45. Each plot size was 10 m^2 (4 m ×2.5 m).

Collection and Preparation of Crop Residues

Amrul shak residue was used in this study. This weed was collected from different era of Agronomy Field Laboratory, BAU. After collection, the weed residues were dried under shade in the cover threshing floor of Agronomy Field Laboratory of BAU. Then the studied weed residues were cut as small as possible by using sickle.

Preparation of seedling nursery bed and seed sowing

A piece of land was selected for raising seedlings. The land was puddled well with country plough followed by levelling with a ladder. The sprouted seeds were sown uniformly in a well-prepared nursery bed on 26 June, 2019. Proper care was taken to raise the healthy seedlings in the nursery bed. Weeds were removed in the nursery bed as and when necessary.

Preparation of land

The land was opened with a tractor on 25 July 2019. The field was thoroughly prepared with tractor followed by laddering. Weeds and stubbles were removed from the field during land preparation. The land was finally prepared on 26 July 2019 and the field layout was done on the next day.

Fertilizer application

The experimental plots were fertilized with urea, triple superphosphate, muriate of potash, gypsum and zinc sulphate @ 200, 115, 125, 100 and 12 kg ha^{-1}, respectively. Except urea, the whole amount of other fertilizer was applied before final land preparation. Urea was top dressed in three installments at 15, 30 and 45 days after transplanting (DAT).

Transplanting of seedlings

Seedlings were transplanted in the well-prepared puddle field on 28 July 2019 at the rate of three seedlings hill^{-1} maintained row and hill distance of 25 cm and 15 cm, respectively.

Sampling, harvesting and processing

The crops were harvested at full maturity. Maturity of crops was determined when 90% of the grains became golden yellow in color. The Binadhan-7 was harvested on 15 November, 2019. BR11 and BRRI dhan49 were harvested on 27 November, 2019. Then the harvested crops of each plot except 5 hills plot $^{-1}$ was bundled separately, properly tagged and brought to threshing floor. The crops were then threshed and the fresh weights of grain and straw were recorded from an area of l m in the middle of each plot. The grains were cleaned and finally the weight was adjusted to a moisture content of 14%. The straw was sun dried and the yields of grain and straw plot $^{-1}$ were recorded and converted to t ha^{-1}.

Data Collection Parameters

Data of yield and yield contributing characters were recorded from five randomly selected sample plants from each plot on the following parameters: Plant height, Number of total tillers hill^{-1}, Number of effective tillers hill^{-1}, Number of non-effective tillers hill^{-1}, Panicle length (cm), Number of grains panicle^{-1}, 1000- grain weight (g), Grain yield (t ha^{-1}), Straw yield (t ha^{-1}), Biological yield (t ha^{-1}), Harvest index (%).

Harvest index (%): Harvest index is the relationship between grain yield and biological yield. Harvest index was calculated by using the following formula:

$$\text{Harvest index (\%)} = \frac{Grain\ yield}{Biological\ yield} \times 100$$

Statistical analysis

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) [13].

Results and Discussion

Yield and Yield Contributing Characters at Harvest

Effect of variety

The plant height varied significantly among the varieties. The tallest plant (106.84 cm) was observed in BRRI dhan49 and the shortest plant was observed in Binadhan-7 (99.61 cm) (Table 1). Plant height is a varietal character and it is

the genetic constituent of the cultivar, therefore, plant height was different among the three varieties. The results are consistent with the findings of Bisne *et al.* (2006) [4] who observed plant height differed significantly among the varieties. Effect of variety on total number of tillers hill^{-1} was significant. The highest total number of tillers hill^{-1} (10.70) was found in BRRI dhan49 variety and lowest one (9.38) was found in Binadhan-7 (Table 1). Number of effective tillers hill^{-1} was significantly influenced by variety. The highest number of effective tillers hill^{-1} (9.41) was found in BRRI dhan49 and the lowest number of effective tillers hill^{-1} (8.36) was found in Binadhan-7 (Table 1). Effect of variety on number of non-effective tillers hill^{-1} was not significant. The highest number of non-effective tillers hill^{-1} (1.28) was found in variety BRRI dhan49 (Table 1) and the lowest number of non-effective tillers hill^{-1} (0.86) was found in BR11. Panicle length was not significant by different varieties (Table 1). Numerically the longest panicle length (23.32 cm) was recorded in variety BR11 and the shortest panicle (23.25 cm) was recorded in BRRI dhan49. Number of panicles was significantly influenced by different varieties (Table 1). The highest number of grains (105.10) was observed in BRRI dhan49 and the lowest one (98.73) was found in Binadhan-7. Hasan (2015) [14] reported variable number of grains among the varieties. Varietal differences regarding the number of grains might be due to differences in genetic constituents. Weight of 1000-grain was significantly affected by different varieties of rice. The highest thousand grain weight (25.06 g) was found in BR11 and the lowest one was found (23.07 g) in Binadhan-7 (Table 1). The studied variety differed significantly in respect of grain yield. The highest grain yield (6.28 t ha^{-1}) was obtained in BRRI dhan49 (Fig. 1A). The increased yield might be due to the lowest number of sterile spikelet panicle^{-1}. The lowest grain yield (5.29 t ha^{-1}) was obtained in Binadhan-7. This difference was observed due to different varietal characteristics of rice plant. BRRI (2005) [6] also reported variation in grain yield among the varieties. Straw yield was significantly influenced by three varieties. The highest straw yield (6.98 t ha^{-1}) was found in BRRI dhan49 and the lowest straw yield (5.85 t ha^{-1}) was found in Binadhan-7 (Fig. 1B). These results are in conformity with that obtained by Chowdhury *et al.* (2003) [8] who reported the differences in straw yield among the varieties.

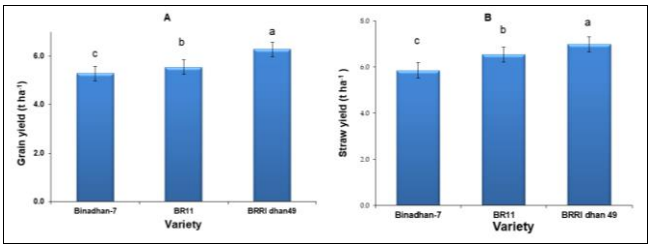

Fig 1: Grain yield and Straw yield as influenced by variety

Figure with similar letter (s) do not differ significantly whereas figure with dissimilar letter differ significantly as per DMRT.

Biological yield was significantly affected by variety (Table 1). The highest biological yield (13.26 t ha^{-1}) was found in BRRI dhan49 and the lowest biological yield (11.14 t ha^{-1}) was found in Binadhan-7 variety. Harvest index was not significantly affected by variety (Table 1). The highest harvest index (47.53%) was found in Binadhan-7 rice variety followed by (47.39%) in BRRI dhan49 and the lowest harvest index (46.00%) was found in BR11.

Table 1: Effect of variety on yield and yield contributing characters of *T. aman rice*

Variety	Plant height (cm)	Total tillers hill^{-1} (no.)	Effective tillers hill^{-1} (no.)	Non-effective tillers hill^{-1} (no.)	Panicle length (cm)	Grains panicle^{-1} (no.)	1000-grain weight (g)	Biological Yield (t ha^{-1})	Harvest Index (%)
Binadhan-7	99.61c	9.38c	8.36c	1.01	23.31	98.73c	23.07b	11.14c	47.53
BR11	105.56b	9.74b	8.88b	0.86	23.32	102.99b	25.06a	12.07b	46.00
BRRI dhan49	106.84a	10.70a	9.41a	1.28	23.25	105.10a	23.48b	13.26a	47.39
LSD $_{(0.05)}$	0.74	0.28	0.12	0.33	0.37	2.01	0.77	0.34	1.26
Level of Significant	**	**	**	NS	NS	**	**	**	NS
CV%	1.94	3.76	3.66	18.00	2.10	2.59	4.29	3.77	3.55

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 1% level of probability, NS = not significant.

Effect of amrul shak residues

Plant height was significantly affected by amrul shak residues. The tallest plant (106.23 cm) was found in T_5 [1.5 t ha^{-1}+ Farmers' practice (one hand weeding)] treatment and the shortest plant (101.16 cm) was found in T_1 (no crop residue) treatment (Table 2). The results revealed that application of 1.5 t ha^{-1}+ Farmers' practice (one hand weeding) produced the highest plant height. This might be due to the availability of more nutrients from a weed free environment. Similar findings were found by Islam *et al.* (2024) [20], who reported that the highest plant height was produced due to weed free condition and the lowest plant height was in no weeding condition. Number of total tillers hill^{-1} was significantly influenced by amrul shak residues. The highest number of total tillers hill^{-1} (10.82) was produced by T_5 treatment and the lowest number of effective tillers hill^{-1} (8.94) was produced by T_1 treatment (Table 2). Number of effective tillers hill^{-1} was significantly influenced by amrul shak residues. The highest number of effective tillers hill^{-1} (9.67) was produced by T_5 [1.5 t ha^{-1}+ Farmers' practice (one hand weeding)] treatment. The lowest number of effective tillers hill^{-1} (8.16) was produced by T_1 (no crop residue) treatment (Table 2). Number of non-effective tillers hill^{-1} was not significantly influenced by amrul shak residues. The highest number of non-effective tillers hill^{-1} (1.18) was produced by T_3 (1.0 t ha^{-1}) treatment and the lowest number of non-effective tillers hill^{-1} (0.78) was produced by T_1 (no crop residue) treatment (Table 2). Panicle length was not significantly influenced by amrul shak residues (Table 2). The longest panicle (23.47 cm) was observed in T_5 [1.5 t ha^{-1}+ Farmers' practice (one hand weeding)] treatment and the shortest one (23.14 cm) was observed in T_3 (1.0 t ha^{-1}) treatment. Number of panicles was significantly influenced by amrul shak residues (Table 2). The highest number of grains panicle^{-1} (109.70) was produced by T_5 [1.5 t ha^{-1}+ Farmers' practice (one hand

weeding)] treatment followed by T_4 (1.5 t ha^{-1}) treatment while the lowest number of grains panicle^{-1} (92.76) was found T_1 (no crop residue) treatment. It indicated that weed free condition encouraged the number of grains panicle^{-1} and negative effect of weeds on plant growth resulted in decreased number of grains panicle^{-1}. De Datta (1990) [9] observed that effective weed management increased number of grains due to more availability of water, nutrients and light. Similar results were supported by Singh *et al.* (1999) [23]. Amrul shak residues was significantly affected the weight of 1000-grains. The highest 1000-grain weight (25.07 g) was recorded in T_4 (1.5 t ha^{-1}) treatment followed by T_2 (0.5 t ha^{-1}) and the lowest 1000-grain weight (22.94 g) was observed in T_3 (1.0 t ha^{-1}) treatment (Table 2). Grain yield was significantly influenced by amrul shak residues. The highest grain yield (5.91 t ha^{-1}) was produced by T_5 [1.5 t ha^{-1}+ Farmers' practice (one hand weeding)] treatment and the lowest grain yield (5.42 t ha^{-1}) was produced by T_1 (no crop residue) treatment (Fig. 2A). Incorporation of 1.5 t ha^{-1}+ Farmers' practice (one hand weeding) 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. Farhat *et al.* (2023) [11]; Uddin and Pyon (2010) [24] also reported the similar results, where crop residues influenced in crop performance. Straw yield was significantly influenced by amrul shak residues (Fig. 2B). The highest straw yield (6.87 t ha^{-1}) was observed in 1.5 t ha^{-1}+ Farmers' practice (one hand weeding) treatment, and the lowest straw yield (5.89 t ha^{-1}) was observed in T_1 (no crop residue) treatment. Amrul shak residues had significant influence on biological yield (Table 2).

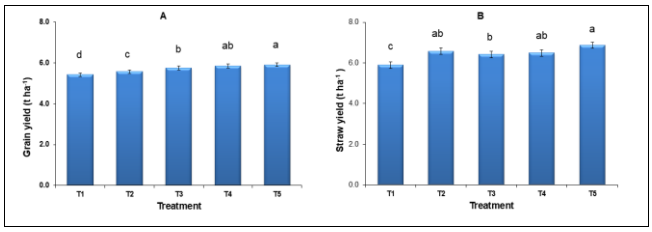

Fig 2: Grain yield and Straw yield as influenced by amrul shak residues

Figure with similar letter (s) do not differ significantly whereas figure with dissimilar letter differ significantly as per DMRT. 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 = 1.5 t ha^{-1}+ Farmers' practice (one hand weeding).

The highest biological yield (12.78 t ha^{-1}) was obtained in T_5 [1.5 t ha^{-1}+ Farmers' practice (one hand weeding)] treatment and the lowest biological yield (11.32 t ha^{-1}) was obtained in T_1 (no crop residue) treatment (Table 2). Variations in biological yield among the weed control treatment were dependent upon the severity of weed infestation and climatic condition. Higher weed infestation not only reduced grain yield and finally influenced straw yield as well as biological yield. Harvest index was not significantly influenced by amrul shak residues (Table 2). The highest harvest index (47.96%) was observed in T_1 (no crop residue) treatment, and the lowest harvest index (45.87%) was observed in T_2 (0.5 t ha^{-1}) treatment.

Table 2: Effect of amrul shak 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)	Grains panicle^{-1} (no.)	1000-grain weight (g)	Biological Yield (tha^{-1})	Harvest Index (%)
T_1	101.16d	8.94d	8.16c	0.78	23.41	92.76e	23.64bc	11.32c	47.96
T_2	103.31c	9.63c	8.50b	1.13	23.16	99.35d	23.98b	12.16b	45.87
T_3	104.84b	9.88c	8.70b	1.18	23.14	102.80c	22.94c	12.18b	47.30
T_4	104.47b	10.44b	9.39a	1.04	23.29	106.76b	25.07a	12.35ab	47.38
T_5	106.23a	10.82a	9.67a	1.14	23.47	109.70a	23.71bc	12.78a	46.36
LSD $_{(0.05)}$	0.98	0.37	0.16	0.44	0.49	2.66	1.03	0.46	1.68
Level of Significant	**	**	**	NS	NS	**	*	**	NS
CV%	1.94	3.76	3.66	18.00	2.10	2.59	4.29	3.77	3.55

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 =1.5 t ha^{-1}+ Farmers' practice (one hand weeding).

Effect of interaction between variety and amrul shak residues

The effect of interaction between variety and amrul shak residues was significant for plant height. Numerically, the tallest plant (109.58 cm) was obtained from BRRI dhan49 variety in T_5 [1.5 t ha^{-1}+ Farmers' practice (one hand weeding)] treatment and BR11 produced the shortest plant height (96.73 cm) in T_5 [1.5 t ha^{-1}+ Farmers' practice (one hand weeding)] (Table 3). Significant variation was found in number of total tillers hill^{-1} due to interaction between variety and amrul shak residues. The highest number of total tillers hill^{-1} (12.29) was produced by BRRI dhan49 in T_5 [1.5 t ha^{-1}+ Farmers' practice (one hand weeding)] treatment, while the lowest number of total tillers hill^{-1} (8.50) was found in V_1T_1 (Binadhan-7× no crop residue) (Table 3). The effect of interaction between variety and amrul shak residues was significant for effective tillers hill^{-1}. The highest number of effective tillers hill^{-1} (10.12) was produced by BRRI dhan49 in T_5 [1.5 t ha^{-1}+ Farmers' practice (one hand weeding)] treatment, while the lowest number of effective tillers hill^{-1} (7.49) was found from V_1T_1 (Binadhan-7× no crop residue) treatment combination (Table 3). Number of non-effective tillers hill^{-1} was not significantly influenced by the interaction between variety and amrul shak residues. The highest number of non-effective tillers hill^{-1} (2.16) was produced by BRRI dhan49 in T_5 [1.5 t ha^{-1}+ Farmers' practice (one hand weeding)] treatment, while the lowest number of non-effective tillers

hill^{-1} (0.43) was found from BRRI dhan49 × 1.0 t ha^{-1} crop residues (Table 3). The effect of interaction between variety and amrul shak residues was not significant for panicle length (Table 3) but numerically the longest panicle (23.75 cm) was observed in V_3T_3 (BRRI dhan49 × 1.0 t ha^{-1} practice) treatment and the shortest (22.98 cm) one was found in V_3T_2 (BRRI dhan49 × 0.5 t ha^{-1}) treatment. Number of grains panicle^{-1} was significantly influenced by the interaction between varieties and crop residues. The highest number of grains (112.70) was produced by V_3T_5 (BRRI dhan49 × 1.5 t ha^{-1}+ Farmers' practice (one hand weeding) treatment and the lowest number of grains panicle^{-1} (90.90) was produced by V_1T_1 (Binadhan-7 × no crop residue) treatment (Table 3). Weight of 1000-grain was significantly affected by the interaction between variety and crop residues. Apparently, the highest 1000-grains weight (26.40 g) was recorded in V_3T_2 (BRRI dhan49 × 0.5 t ha^{-1}) treatment and the lowest one (21.74 g) was found in V_1T_3 (Binadhan-7 × 1.0 t ha^{-1}) treatment (Table 3). Grain yield was significantly influenced by the interaction between varieties and crop residues (Table 3). The highest number of grain yield **(**6.55 t ha^{-1}) was produced by V_3T_5 [BRRI dhan49 × 1.5 t ha^{-1}+ Farmers' practice (one hand weeding)] treatment followed by (6.43 t ha^{-1}) in V_3T_2 (BRRI dhan49 × 0.5 t ha^{-1}) and the lowest number of grain yield (4.95 t ha^{-1}) was produced by V_1T_1 (Binadhan-7 × no crop residue) treatment. The lowest grain yield ha^{-1} in the control plot might be due to the poor performance of yield contributing characters like number of tillers hill^{-1} and grain panicle^{-1}, Because severe weed infestation occurred in the plots due to competition for moisture, nutrients between weed and rice plants. Similar results were also observed by Gogoi *et al.* (2000) [12], Islam *et al.* (2001) [17] and Attalla and Kholosy (2002) [1]. Straw yield was not significantly influenced by the interaction between variety and crop residues (Table 3). The highest straw yield (7.60 t ha^{-1}) was produced by V_3T_5 [BRRI dhan49 × 1.5 t ha^{-1}+ Farmers' practice (one hand weeding)] treatment followed by (7.09 t ha^{-1}) in V_3T_4 (BRRI dhan49 × 1.5 t ha^{-1}) and the lowest straw yield (5.26 t ha^{-1}) was produced by V_1T_1 (Binadhan-7 × no crop residue) treatment. Biological yield was significantly influenced by the interaction between variety and crop residues (Table 3). The highest biological yield (14.15 t ha^{-1}) was produced by V_3T_5 [BRRI dhan49 × 1.5 t ha^{-1}+ Farmers' practice (one hand weeding) treatment and the lowest biological yield **(**10.21 t ha^{-1}) was produced by V_1T_1 (Binadhan-7× no crop residue) treatment. Harvest index was not significantly influenced by the interaction between variety and crop residues (Table 3). The highest harvest index (48.49%) was observed in V_1T_1 (Binadhan-7 × no crop residue) treatment and the lowest harvest index (44.47%) observed in V_3T_4.

Table 3: Combined effect of variety and amrul shak residues on yield and yield contributing characters of *T. aman rice*

Interaction	Plant height (cm)	Total tillers hill^{-1} (no.)	Effective tillers hill^{-1} (no.)	Non-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	99.73f	8.50g	7.49f	1.01	23.13	90.90f	23.28bc	4.95g	5.26	10.21h	48.49
V_1T_2	101.85e	8.99fg	8.33cde	0.65	23.48	93.09f	25.92a	5.42f	5.99	11.41fg	47.49
V_1T_3	101.89e	9.34ef	8.66cd	0.67	23.62	94.29f	21.74c	5.91d	6.43	12.34cde	47.90
V_1T_4	99.87f	9.30ef	8.13de	1.17	23.27	93.85f	22.81bc	5.13g	6.33	11.46fg	44.78
V_1T_5	103.59d	9.60def	8.76c	0.83	23.06	99.32e	26.05a	5.45f	6.51	11.96ef	45.69
V_2T_1	106.47c	10.00cd	8.60cde	1.4	23.16	104.88cd	23.07bc	6.15c	6.90	13.06bc	47.13
V_2T_2	100.87ef	9.50def	8.06e	1.43	23.07	100.43e	23.33bc	5.39f	5.78	11.17g	48.24
V_2T_3	106.43c	9.85cde	8.33cde	1.52	23.14	102.94de	23.32bc	5.54ef	6.41	11.95ef	46.4
V_2T_4	107.24bc	10.28c	9.70ab	0.58	23.21	105.03cd	22.18c	6.34bc	7.08	13.42b	47.25
V_2T_5	96.73g	9.69cde	8.65cd	1.04	23.32	103.20de	22.85bc	5.48ef	5.96	11.44fg	47.91
V_3T_1	107.67bc	10.03cd	9.55b	0.48	23.55	108.52bc	25.96a	5.64e	6.64	12.29de	45.92
V_3T_2	109.01ab	11.60b	9.98ab	1.62	22.98	108.58abc	26.40a	6.43ab	6.88	13.32b	48.31
V_3T_3	100.87ef	9.92cde	9.48b	0.43	23.75	105.30cd	23.10bc	5.52ef	5.92	11.45fg	48.25
V_3T_4	108.25ab	10.26c	9.41b	0.85	23.38	111.09ab	24.05b	5.65e	7.09	12.74bcd	44.47
V_3T_5	109.58a	12.29a	10.12a	2.16	23.28	112.70a	23.99b	6.55a	7.60	14.15a	46.36
LSD $_{(0.05)}$	1.84	0.70	0.61	0.83	0.92	4.98	1.93	0.21	0.81	0.86	3.14
Level of Significant	**	**	**	NS	NS	**	**	**	NS	**	NS
CV%	1.94	3.76	3.66	18.00	2.10	2.59	4.29	2.00	6.74	3.77	3.55

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 1% level of probability, NS = not significant. Here, V_1=Binadhan-7, V_2= BR11, 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 = 1.5 t ha^{-1}+ Farmers' practice (one hand weeding)

Conclusion

So, it is clear from the above discussion that there is immense prospect of amrul shak weed residues as a weed management tool. A successful allelochemical for weed management. Therefore, amrul shak residues could be a prospective source of weed control tool for crop production in modern agricultural science.

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