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Assessment of Allelopathic Effect of *Albizia Lebbeck* Leaf Residues on the Yield Performance of Rice

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Abstract

An experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during the period from August 2022 to June 2023 to study the effects of the residues of *Albizia lebbeck* on the yield performance of *boro* rice. The field experiment consisted of two rice varieties *viz.*, BRRI dhan28 and BRRI dhan29, and five residual treatments of *A. lebbeck* leaves such as 0, 1.0, 2.0, 0.3 and 4.0 t ha^{-1}. The experiment was laid out in a randomized complete block design (RCBD) with three replications. Variety had significant effect on most of the yield and yield contributing characters except number of total tillers hill^{-1}, number of effective tillers hill^{-1}, number of non-effective tillers hill^{-1} and harvest index. On the other hand, *A. lebbeck* residues had also significant effect on yield and yield contributing characters of rice yield except number of non-effective tillers hill^{-1}, panicle length, grains panicle^{-1}, number of sterile spikelets, and 1000-gain weight. The highest number of total tillers hill^{-1}, highest number of effective tillers hill^{-1}, higher 1000-grain weight, grain yield, straw yield and biological yield was obtained from BRRIdhan29 and residues applied @ 3.0 t ha^{-1}. The lowest grain yield and others yield contributing characters were found in T_1 (control) treatment due to lower number of effective tillers hill^{-1} and higher number of sterile spikelet panicle^{-1}. From the above results it was found that the variety BRRI dhan29 and residues @ 3.0 t ha^{-1} produced superior effect. Therefore, *Albizia lebbeck* residues could be a potential source of biological weed management and yield enhancement tool for sustainable crop production.

Keywords: Allelopathic, *Albizia lebbeck*, Leaf Residues, Yield Performance, Rice

Introduction

Rice (*Oryza sativa*) is the cereal crop belonging to the family Poaceae. Most of Asia, as well as other warm regions of Africa, Northern Italy, and the western part of North America, eat it as a staple diet. Bangladesh ranks third in the world in terms of rice growing area and production (FAO, 2022) [10]; 78% of the cropped land in the nation is used for rice cultivation, with an annual output of 36.32 million metric tons from 11.75 million hectares of land (BBS, 2021) [5]. This region has three distinct growing seasons for rice: *aus* (April to August), *aman* (June to December), and *boro* (November to May). Of the overall rice area, *boro* rice makes up 4.8 million acres (41.82%) and accounts for 55% of the nation's annual rice production (BBS, 2022) [6]. Aman and *aus* rice are lower in average yield than *boro* rice. On the other hand, it cannot satisfy the country's demand. In order to ensure food security, *boro* rice is essential.

Weeds are thought to be the main factor limiting rice productivity among other variables. Removing weeds from the ground is essential to obtaining the full benefits of the rice field. Due to decreased crop yields, increased production costs, and decreased quality, weeds cost rice producers' money (Buhler *et al.* 1998) [9]. If weeds are not managed, they may potentially result in an entire failure of rice yield. Selection of a suitable variety with high genetic potentiality which can be adopted to the wider range of environmental conditions that contribute to a much better performance to different yield attributes (Islam *et al*. 2023) [15]. According to Abbas *et al*. (2021) [1] there are more yield losses from weed infestations in rice cultivation than from insects and diseases put together. Weeds take nutrients, especially nitrogen, which reduces soil fertility in addition to drastically reducing yield (Ahmed *et al*. 2014) [2]. Weed-related losses to rice yield have been estimated to be roughly 10% of global production (Oerke and Dehne, 2004) [20]. Hand weeding is a difficult and time-consuming traditional method of controlling weeds in Bangladesh. The alternatives to hand weeding are pesticides and mechanical weeding. While hand weeding and herbicides work well together to control weeds, the use of herbicides harms the environment (Ahmed *et al*. 2014) [3]. Herbicides and manual weeding could increase agricultural yield, but the cost of production would be significant (Prasad and Rafy, 1995) [21].

To overcome weed infestation presently, researchers are giving more emphasis using different crop residues to suppress weed growth. Crop residues are a tremendous natural resource not a waste (Kaur *et al*. 2021) [17]. Residue management has a variety of impacts on the physical, chemical, and biological aspects of soil, it is gaining a lot of attention. 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. 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. One such strategy is to use the allelopathic capabilities of several agricultural plant types for weed control in the field (Sathyamoorthy *et al.* 2004) [22]. *Albizia lebbeck* leaf residues released allelochemicals and affect both weeds and rice crops negatively and/or positively, but such has been conducted in laboratory condition. Before going to farmers field, it is mandatory to check its suitability in field trial.

Materials and Methods

Experimental Location

The experiment was carried out at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during the period from August 2022-June, 2023 to determine the effect of *Albizia lebbeck* leaf residues on weed control and yield performance of *boro* rice. The experimental field was located at 24°25' N latitude and 90°50' E longitude at an elevation of 18 m above the sea level belonging to non-calcareous dark grey floodplain soil under the Sonatala series of the Old Brahmaputra Floodplain which falls under AEZ-9 (Old Brahmaputra Floodplain) (FAO and UNDP, 1988) [11].

Experimental Soil

The land was medium high and the soil was silty loam in texture. The soil of the experimental land, was more or less neutral in reaction with pH value 6.82, low in organic matter content and its fertility level was low.

Climate

The experimental area experiences a sub-tropical climate where the *kharif* season (April to September) starts with high temperature and decreases when the season proceeds towards *rabi* season (October to March). The maximum temperature was recorded in the month of August and goes down in December. Maximum rainfall occurs in the month of June, July, August (*kharif*) and scanty rainfall occurs during *rabi* season. The relative humidity increases from June to September (80% or above) and declines to a minimum in the winter.

Experimental Treatments

The experimental treatment consisted of two factors. They are as follows: Factor A: Variety (2): BRRI dhan28 (V_1), BRRI dhan29 (V_2). Factor B: *Albizia lebbeck* leaves residues (5): Control (T_1), 1.0 t ha^{-1} (T_2), 2.0 t ha^{-1} (T_3), 3.0 t ha^{-1} (T_4), 4.0 t ha^{-1} (T_5)

Experimental Design

The experiment was laid out in a randomized complete block design (RCBD) with three replications. The total number of plots was 30. Each plot size was 10 m^2 (4.0 m × 2.5 m).

Experimental Details

Collection and preparation of residues

The residues of *Albizia lebbeck* were used in this experiment. Residues were collected from the Sutiakhali village, Mymensingh Sadar, Mymensingh near a rice field. After collection, the residues were sun dried and then cut into small pieces using sickle.

Rice seed collection

Rice varieties were collected from the Agronomy Field Laboratory, BAU and Bangladesh Rice Research Institute.

Seed sprouting

Healthy seeds of the rice were selected by specific gravity method. Seeds were immersed in water in a bucket for 24 hours. After that these were taken out of water and kept thickly in gunny bags. The seeds started sprouting after 48 hours and got ready to sow.

Preparation of seedling nursery bed and seed sowing

A piece of land was selected for raising seedlings. The land was ploughed and cross-ploughed with a tractor followed by leveling with a ladder on 10 November 2022. The sprouted seeds were sown in nursery bed on 25 November 2022. 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.

Preparation of the experimental land

The main field was prepared on 05 January, 2023. The field was ploughed with a tractor drawn plough followed by laddering. The layout of the field was made after final land preparation. Weeds and stubbles were removed and cleaned from individual plots.

Application of *Albizia lebbeck* residues

Albizia lebbeck residue was applied at 08 January 2023 (3 days before transplanting of rice. After that, residues were mixed well to the respective plots by a spade.

Uprooting seedlings

The nursery bed was made wet by application of water one day before uprooting the seedlings. The seedlings were uprooted on 11 January 2023 and they were immediately transferred to the main field. Healthy and similar sized seedlings were selected for transplanting.

Transplanting of seedlings

Forty-five days old seedlings were transplanted in the well-prepared puddled field on 11 January 2023 at the rate of three seedlings hill^{-1} maintaining row and hill distance of 25 cm and l5 cm, respectively.

Fertilizer application

The experimental plots were fertilized with Urea, Triple Super Phosphate, Muriate of potash, Gypsum and $ZnSO_4$ @ 300, 112, 100, 87 and 12 kg ha^{-1}, respectively. The entire amount of Triple Super Phosphate, Muriate of Potash, Gypsum and Zinc Sulphate were applied at the time of final land preparation. Urea was applied in three equal installments at 15, 30 and 45 DAT.

Irrigation and drainage

Experimental field was given flood irrigation to maintain a constant level of standing water up to 6 cm in early stage to enhance tillering and 10-12 cm at later stage to discourage late tillering. The required amount of irrigation water was provided to the filed as when as necessary throughout the growing season.

Sampling, harvesting and processing of rice

The crops were harvested at full maturity. Maturity of rice was determined when 90% of the grains became golden yellow in color. The harvesting was done on 14 April, 2023 for BRRI dhan28 and 29 April, 2023 for BRRI dhan29. Then the harvested crops of each plot were 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^2 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 yield were recorded and converted to t ha^{-1}.

Data Collection Parameters

Data on yield and yield contributing characters were recorded from five randomly selected sample plants from each plot on the following parameters. Plant height (cm), 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 grains yields and biological yield. Harvest index was calculated by using the following formula:

$$Harvest\ Index\ (\%) = \frac{Grain\ Yield}{Biological\ Yield} \times 100$$

Statistical Analysis

The data were compiled and tabulated in proper form and subjected to statistical analysis. 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) [14].

Results and Discussion

Yield and yield contributing characters at harvest

Effect of variety

The plant height varied significantly among the varieties. The tallest plant (86.88 cm) was observed in BRRI dhan28 and the shortest plant was observed in BRRI dhan29 (83.13 cm) (Figure 1A). Plant height is a varietal character and it is the genetic constituent of the cultivar, therefore, plant height was different among the selected varieties. The results are consistent with the findings of Bisne *et al*. (2006) [7] who observed plant height differed significantly among the varieties. Effect of variety on number of total tillers $hill^{-1}$ was non-significant (Figure 1B). Effect of variety on number of effective tillers $hill^{-1}$ was non-significant (Figure 1C). Effect of variety on number of non-effective tillers $hill^{-1}$ was found non-significant (Figure 1D). Number of grains $panicle^{-1}$ was significantly influenced by different varieties. The highest number of grains (125.66) was observed in BRRI dhan29 and the lowest one (90.76) was found in BRRI dhan28. (Figure 1E). Singh and Pillai (1996) [23] reported variable number of grains among the varietals. Varietal differences regarding the number of grains might be due to differences in genetic constitutions. Panicle length was significantly influenced by different varieties. The longest panicle length (22.90 cm) was observed in BRRI dhan29 and the lowest one (21.36 cm) was found in BRRI dhan28 (Figure 1F).

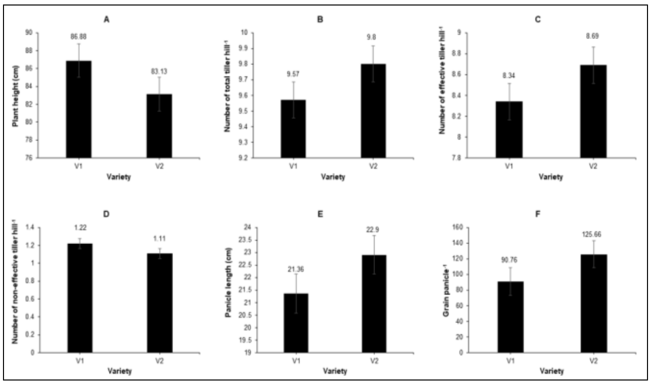

Fig 1: Effect of variety on the yield and yield contributing characters at harvest. V_1= BRRI dhan28, V_2= BRRI dhan29

Weight of 1000-grain was significantly affected by different varieties of rice. The highest thousand grain weight (24.30g) was found in BRRI dhan29 and the lowest one was found (21.33g) in BRRI dhan28 (Figure 2A). The studied variety differed significantly in respect of grain yield. The highest grain yield (4.32 t ha^{-1}) was obtained in BRRI dhan29. The increased yield might be due to the highest number of effective tillers $hill^{-1}$. The lowest grain yield (3.85 t ha^{-1}) was obtained in BRRI dhan28 (Figure 2B). The difference was observed due to different varietal characteristics of rice plant. BRRI (2005) [8] also reported variation in grain yield among the varieties. Straw yield was significantly influenced by two varieties. The highest straw yield (4.32 t ha^{-1}) was found in BRRI dhan29 and the lowest straw yield (3.80 t ha^{-1}) was found in BRRI dhan28 (Figure 2C). Under Mediterranean conditions, the rice crop produces a lot of straw, about 10 t ha^{-1}, with significant variation between varieties. Individual varieties had a significant effect on the majority of the straw yield, which reduces the accuracy of estimations based on average rice crop values (Matías *et al.* 2019) [19]. Variety had significant effect on biological yield. The highest biological yield (8.38 t ha^{-1}) was found in BRRI dhan29 and the lowest biological yield (7.65 t ha^{-1}) was found in BRRI dhan28 variety (Figure 2D). Harvest index was non-significantly affected by variety (Figure 2E).

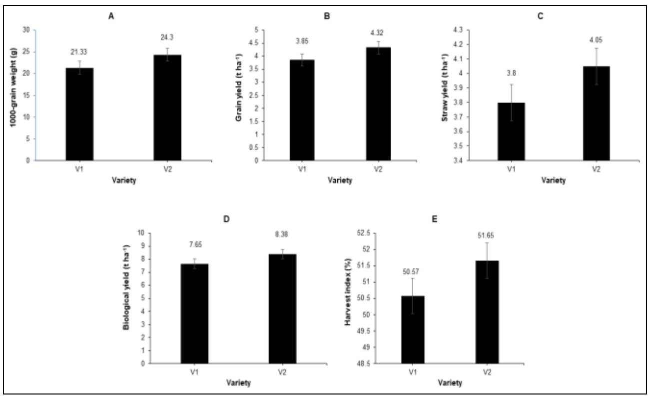

Fig 2: Effect of variety on the yield and yield contributing characters at harvest. V_1= BRRI dhan28, V_2= BRRI dhan29

Effect of *Artocarpus heterophyllus* leaves residue

Plant height was non-significantly affected by *A. lebbeck* leaves residue (Figure 3A). Number of total tillers hill^{-1} was influenced by *A. lebbeck* residues significantly. The highest number of total tillers hill^{-1} (11.47) was produced at T_4 (3.0 *A. lebbeck* residues ha^{-1}) and the lowest number of total tillers hill^{-1} (8.44) was produced at control (Figure 3B). Number of effective tillers hill^{-1} was significantly influenced by *A. lebbeck* residue. The highest number of effective tillers hill^{-1} (10.15) was produced by T_4 (3.0 t ha^{-1}) treatment. The lowest number of effective tillers hill^{-1} (7.38) was produced by T_1 (no residue) treatment (Figure 3C). Number of non-effective tillers hill^{-1} was non-significantly influenced by the residues of *A. lebbeck* (Figure 3D). Number of grain panicle^{-1} was non-significantly influenced by *A. lebbeck* leaves residue (Figure 3E). Panicle length was non-significantly influenced by *A. lebbeck* leaves residue (Figure 3F).

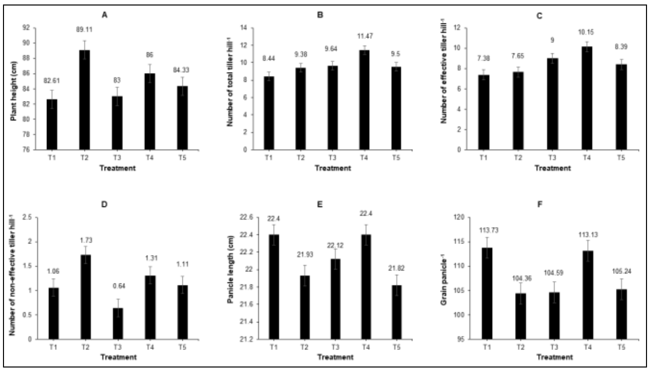

Fig 3: Effect of *Albizia lebbeck* residues on yield and yield contributing characters at harvest.

T_1= Control, T_2= Residues @ 1.0 t ha^{-1}, T_3= Residues @ 2.0 t ha^{-1}, T_4= Residues @ 3.0 t ha^{-1}, T_5=Residues @ 4.0 t ha^{-1}

Weight of 1000-grain was non-significantly affected by *A. lebbeck* leaves residue (Figure 4A). Grain yield was significantly influenced by *A. lebbeck leave* residues. The highest grain yield (4.55 t ha^{-1}) was produced by T_4 (3.0 t ha^{-1}) treatment and the lowest grain yield (3.81 t ha^{-1}) was produced by T_1 (no residue) treatment (Figure 4B). It might be due to application of residues added organic matter to the soil and enhance grain yield. Farhat *et al*. (2023) [12]; Uddin and Pyon (2010) [24] also reported the similar results, where residues influenced in crop performance. Straw yield was significantly influenced by *A. lebbeck* residue. The highest straw yield (4.91 t ha^{-1}) was observed in T_4 (3.0-ton *A. lebbeck* residue ha^{-1}) treatment, and the lowest straw yield (3.41 t ha^{-1}) was observed in T_5 (4.0-ton *A. lebbeck* residue ha^{-1}) treatment (Figure 4C) which is similar to that of straw was found in control treatment. Kouyaté *et al*. (2000) [18] also reported an increase in cereal grain and straw yields by 37 and 49%, respectively when crop residues were incorporated as compared to no residue's incorporation treatment. *A. lebbeck* residue had significant influence on biological yield. The highest biological yield (9.47 t ha^{-1}) was obtained in T_4 (3.0 t ha^{-1}) treatment and the lowest biological yield (7.23 t ha^{-1}) was obtained in T_1 (no residue) treatment (Figure 4D). 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 (Uddin and Pyon, 2010) [24]. Harvest index was significantly influenced by *A. lebbeck* residue. The highest harvest index (53.74 %) was observed in T_4 (4.0 t ha^{-1}) treatment, and the lowest harvest index (49.94 %) was observed in T_3 (3.0 t ha^{-1}) treatment (Figure 4E).

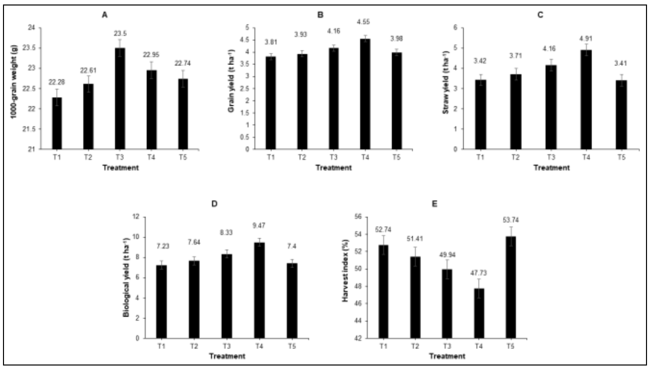

Fig 4: Effect of *Albizia lebbeck* residues on yield and yield contributing characters at harvest

T_1= Control, T_2= Residues @ 1.0 t ha^{-1}, T_3= Residues @ 2.0 t ha^{-1}, T_4= Residues @ 3.0 t ha^{-1}, T_5=Residues @ 4.0 t ha^{-1}

Effect of interaction between variety and *A. lebbeck* leaves residue

The interaction effect between variety and *A. lebbeck* leaves residue was significant for plant height (Table 2). Numerically, the tallest plant (89.00 cm) was obtained from BRRI dhan28 variety in T_4 (3.0 *A. lebbeck* residues ha^{-1}) treatment; and BRRI dhan29 produced the shortest plant height (80.00 cm) in R_1 (2.0-ton *A. lebbeck* residues ha^{-1}) treatment (Table 2). Significant variation was found in number of total tillers hill^{-1} due to interaction between variety and *A. lebbeck* residues. The highest number of total tillers hill^{-1} (12.18) was produced by BRRI dhan29 and *A. lebbeck* residues @ 3.0 t ha^{-1} combination, while the lowest number of total tillers hill^{-1} (8.00) was found from BRRI dhan28 with no residue's combination (Table 2). The effect of interaction between variety and *A. lebbeck* leaves residue was significant for effective tillers hill^{-1}. The highest number of effective tillers hill^{-1} (10.62) was produced by BRRI dhan29 in T_4 (3.0 t ha^{-1}) treatment, while the lowest number of effective tillers hill^{-1} (7.33) was found from V_1T_1 (BRRI dhan28 × 0 t ha^{-1}) treatment combination (Table 2). Non-significant variation was found in number of non-effective tillers hill^{-1} due to interaction between variety and residues of *A. lebbeck* (Table 2). Number of grains panicle^{-1} was non-significantly influenced by the interaction between varieties and residues (Table 2). Panicle length was non-significantly influenced by the interaction between varieties and residues (Table 2). There was significant difference in the weight of 1000-grains due to interaction between variety and residues of *A. lebbeck*. The highest weight of 1000-grains (22.32 g) were recorded in V_2T_3 treatment which was statistically similar to V_2T_4 treatment and the lowest weight (20.44 g) was recorded in V_1T_1 treatment (Table 2). Grain yield was significantly influenced by the interaction between varieties and residues. The highest number of grain yield (4.93 t ha^{-1}) was produced by V_2T_4 (BRRI dhan29 × 3.0 t ha^{-1}) treatment and the lowest number of grain yield (3.57 t ha^{-1}) was produced by V_1T_1 (BRRI dhan28 × 0-ton ha^{-1}) treatment (Table 2). 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 grains 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) [13], Islam *et al*. (2001) [16] and Attalla (2002) [4]. Straw yield was significantly influenced by the interaction between variety and residues of *A. lebbeck*. The highest straw yield (5.13 t ha^{-1}) was produced by V_2T_4 (BRRI dhan29 × 3.0 t ha^{-1}) treatment and the lowest straw yield (3.17 t ha^{-1}) was produced by V_1T_1 (BRRI dhan28 × no residue) treatment (Table 2). Biological yield was significantly influenced by the interaction between variety and residues. The highest biological yield (10.07 t ha^{-1}) was produced by V_2T_4 (BRRI dhan29 × 3.0 t ha^{-1}) treatment and the lowest biological yield (6.86 t ha^{-1}) was produced by V_1T_5 (BRRI dhan28× 3.0 t ha^{-1}) treatment which is similar to V_1T_1 (BRRI dhan28× 0 t ha^{-1}) (Table 2). Harvest index was non-significantly influenced by the interaction between variety and residues (Table 2).

Table 2: Interaction effect of variety and *Albizia lebbeck* residues on yield and yield contributing characters at harvest

Interaction	Plant height (cm)	Number of total tiller hill^{-1}	Number of effective tiller hill^{-1}	Number of non-effective tiller hill^{-1}	Panicle length (cm)	Grain panicle^{-1}	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
V_1T_1	83.44	8.00c	7.33d	0.66	22.22	81.25	20.44abc	3.57b	3.17d	6.89d	54.05
V_1T_2	92.11	9.77abc	7.53d	2.24	20.61	81.63	24.35ab	3.80ab	3.68c	7.48cd	50.79
V_1T_3	86.00	9.93abc	8.72bcd	1.21	21.59	88.44	24.68a	3.98ab	4.16b	8.14bc	48.88
V_1T_4	89.00	10.77ab	9.68ab	1.08	21.63	94.12	24.56a	4.17ab	4.69a	8.87ab	47.02
V_1T_5	83.88	9.37bc	8.44bcd	0.93	20.77	83.90	24.49a	3.72b	3.29cd	6.86d	52.08
V_2T_1	81.77	8.89bc	7.43d	1.45	22.58	121.74	21.12c	3.90ab	3.67c	7.57cd	51.43
V_2T_2	86.11	9.00bc	7.77cd	1.22	23.25	127.09	20.87c	4.05ab	3.74bc	7.80bcd	52.02
V_2T_3	80.00	9.34bc	9.27abc	0.06	22.65	120.75	22.32abc	4.34ab	4.17b	8.51bc	50.99
V_2T_4	83.00	12.18a	10.62a	1.55	23.17	132.13	21.33bc	4.93a	5.13a	10.07a	48.44
V_2T_5	84.77	9.63bc	8.34bcd	1.28	22.87	126.58	21.00c	4.40ab	3.54cd	7.94bcd	55.39
LSD $_{(0.05)}$	12.94	2.46	1.51	2.16	2.61	51.15	3.08	1.20	0.46	1.21	7.49
Level of significance	NS	*	*	NS	NS	NS	*	**	**	**	NS
CV (%)	5.20	8.70	6.08	13.05	4.03	16.15	4.62	10.08	4.02	5.19	5.01

In a column, figures with the same letter do not differ significantly as per DMRT. * = Significant at 5% level of probability, ** = Significant at 1% level of probability, NS = Not significant, NS = Not significant, V_1=BRRI dhan28, V_2= BRRI dhan29, T_1= Control, T_2= Residues @ 1.0 t ha^{-1}, T_3= Residues @ 2.0 t ha^{-1}, T_4= Residues @ 3.0 t ha^{-1}, T_5=Residues @ 4.0 t ha^{-1}

Conclusion

From the above results it was found that the variety BRRI dhan29 treatment exhibited the superior effect with T_4 treatment (3.0 t ha^{-1} *A. lebbeck* residues). Results of the study showed that application of *A. lebbeck* residues for *boro* rice may have positive effect on yield. Therefore, *Albizia lebbeck* residues could be a prospective source of crop production in modern agriculture.

References

1. Abbas T, Ahmad A, Kamal A, Nawaz MY, Jamil MA, Saeed T, *et al*. Ways to use allelopathic potential for weed management: A Review. International Journal of Food Science and Agriculture. 2021; 5(3):492-498. Doi: http://10.26855/ijfsa.2021.09.020
2. Ahmed N, Bunting SW, Rahman S, Garforth CJ. Community-based climate change adaptation strategies for integrated prawn–fish–rice farming in Bangladesh to promote social–ecological resilience. Reviews in Aquaculture. 2014; 6(1):20-35. Doi: https://doi.org/10.1111/raq.12022
3. Ahmed S, Salim M, Chauhan BS. Effect of weed management and seed rate on crop growth under direct dry seeded rice systems in Bangladesh. PloS one. 2014; 9(7):e101919. Doi: https://doi.org/10.1371/journal.pone.0101919
4. Attalla SI, Kholosy AS. Effect of weed control treatments on transplanted rice (*Oryza saliva* L.). Egyptian Journal of Agricultural Sciences. 2002; 53(4):531-538.
5. BBS. Bangladesh Bureau of Statistics. The Year Book of Agricultural Statistics of Bangladesh. Stat. Div. Minis. Planning, Govt. Peoples Repub. Bangladesh, Dhaka, 2021.
6. BBS. Bangladesh Bureau of Statistics. The Year Book of Agricultural Statistics of Bangladesh. Stat. Div. Minis. Planning, Govt. Peoples Repub. Bangladesh, Dhaka, 2022.
7. Bisne R, Motiramani NK, Sarawgi AK. Identification of high yielding hybrids in rice. Bangladesh Journal of Agricultural Research. 2006; 31(1):171-174.
8. BRRI. Adhunik Dhaner Chash. Bangladesh Rice Research Institute, Joydebpur, Bangladesh, 2005, 28-35.
9. Buhler DD, Netzer DA, Riemenschneider DE, Hartzler RG. Weed management in short rotation poplar and herbaceous perennial crops grown for biofuel production. Biomass and Bioenergy. 1998; 14(4):385-394. Doi: https://doi.org/10.1016/S0961-9534(97)10075-7
10. FAO. World Food and Agriculture - Statistical Yearbook Rome, 2022.
11. FAO, UNDP. Land resources Appraisal of Bangladesh for Agricultural Development, Report. 2. Agro-Ecological Regions of Bangladesh. BARC/UNDP, New Airport Road, farmgate, Dhaka, 1207, 1988, 212-221.
12. Farhat M, Mia ML, Talukder SK, Yesmin SS, Monira S, Zaman F, *et al*. Assessment of combined effect of Eleocharis atropurpurea and Fimbristylis dichotoma residues on the yield performance of T. aman rice. Journal of Agriculture Food and Environment. 2023; 4(1):2708-5694. Doi: https://doi.org/10.47440/JAFE.2023.4103
13. Gogoi AK, Rajkhowa DJ, Kandali R. Effect of varieties

and weed-control practices on rice (*Oryza sativa*) productivity and weed growth. Indian Journal of Agronomy. 2000; 45(3):580-585.
14. Gomez KA, Gomez AA. Duncan's, Muitiple Range Test. Statistical Procedures for Agricultural Research, 2nd Edition, A Wiley Inter-Science Publication, John Wiley and Sons, New York. 1984, 202-215.
15. Islam MS, Sarker AK, Mia ML, Talukder SK, Neshe FA, Sarkar M, *et al*. Effect of seedlings per hill and harvesting time on the yield performance of purple rice European Academic Research. 2023; 11:637-647.
16. Islam T, Bhowmick MK, Ghosh RK, Sounda G. Effect of pretilachlor on weed control and yield of transplanted paddy. Journal of Ecology and Environment. 2001; 19(2):256-268.
17. Kaur R, Kaur S, Deol JS, Sharma R, Kaur T, Brar AS, *et al*. Soil Properties and weed dynamics in wheat as affected by rice residue management in the rice–wheat cropping system in south Asia: A Review. Plants. 2021; 10(5):953. Doi: https://doi.org/10.3390/plants10050953
18. Kouyaté Z, Franzluebbers K, Juo AS, Hossner LR. Tillage, crop residue, legume rotation, and green manure effects on sorghum and millet yields in the semiarid tropics of Mali. Plant and soil. 2000; 225:141-151. Doi: https://doi.org/10.1023/A:1026589528352
19. Matías J, Cruz V, García A, González D. Evaluation of rice straw yield, fibre composition and collection under Mediterranean conditions. Acta Technologica Agriculturae. 2019; 22(2):43-47. Doi: https://doi.org/10.2478/ata-2019-0008
20. Oerke EC, Dehne HW. Safeguarding production losses in major crops and the role of crop protection. Crop protection. 2004; 23(4):275-285. Doi: https://doi.org/10.1016/j.cropro.2003.10.001
21. Prasad K, Rafey A. Effect of integrated weed management on weed growth, nutrient uptake, economics and energetics in rainfed upland rice *(Oryza sativa*). Indian Journal Agricultural Science. 1995; 65(4):260-264.
22. Sathyamoorthy NK, Mahendran S, Babu R, Ragavan T. Effect of integrated weed management practices on total weed dry weight, nutrient removal of weeds in rice-rice wet seedbed system. Journal of Agronomy. 2004; 3:263-267.
23. Singh SP, Pillai KG. Performance of rice varieties under various weed control measures in rainfed upland condition. Annals of Agricultural Research. 1996; 17(2):158-162.
24. Uddin MR, Pyon JY. Herbicidal activity of rotation crop residues on weeds and selectivity to crops. Korean Journal of Agricultural Science. 2010; 37(1):1-6. Doi: https://doi.org/10.7744/cnujas.2010.37.1.001