Integrated effect of manures and fertilizers with the allelopathy of F*imbristylis dichotoma* (L.) on the yield performance of rice

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Abstract
Allelopathy plays an important role in weed control and crop productivity. In light of these, an experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh under the Old Brahmaputra Floodplain (AEZ-9) during the period from July 2021-June, 2022 to assess the combined effect of *Fimbristylis dichotoma* residues with manures and fertilizers on rice yield performance in *boro* season. The experiment consisted two rice varieties *viz*., BRRI dhan29 and BRRI dhan89; and six treatments of the combination of residues with manures and fertilizers *viz*., Control; Residues @ 3 t ha^{-1} + Recommended doses of inorganic fertilizers; Residues @ 3 t ha^{-1} + Tricho-compost @5 t ha^{-1}; Residues @ 3 t ha^{-1} + Tricho-compost @1.5 t ha^{-1} + 25% less than recommended doses of inorganic fertilizers; Residues @ 3 t ha^{-1} + Tricho-compost @2.5 t ha^{-1} + 50% less than recommended doses of inorganic fertilizers; Residues @ 3 t ha^{-1} + Tricho-compost @3.75 t ha^{-1} + 75% less than recommended doses of inorganic fertilizers. The experiment was laid out in a randomized complete block design (RCBD) with three replications. The highest grain yield was produced in T_4 (Residues 3 t ha^{-1} +Trichocompost @1.5 t ha^{-1} + 25% less than recommended fertilizers treatment). From the above results it was found that the variety BRRI dhan29 and T_4 (Residues 3 t ha^{-1} +Trichocompost @1.5 t ha^{-1} + 25% less than recommended fertilizers treatment) treatment exhibited the superior effect. The current study's findings indicate that the combination of manures and fertilizers increases yield and yield-contributing characteristics, and that *Fimbristylis dichotoma* residues have an herbicidal impact for inhibiting weed growth.

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Introduction
Bangladesh is an agro-based country and its economy greatly depend on agriculture. Agriculture comprises about 13.02% of the total GDP and agriculture is predominantly rice based. Rice cultivation covers about 11.70 million ha area with annual production about 37.608 million tons (BBS, 2021) [3]. According to the World Bank, Bangladesh's value added in agriculture, forestry, and fishery in 2021 was 11.63% (Selwyn *et al.* 2022) [26]. In 2020, the share of agriculture in Bangladesh's gross domestic product was 12.92 percent (Smith, 2021) [28]. Since the beginning of agriculture, weed has been a persistent problem and it interferes with natural resources, and documented as one of the major and oldest constraint in maximizing rice yield production (Piyatida *et. al*. 2012 [22]; Varanasi *et al*. 2016) [32].

Proper weed management is, therefore, necessary to produce more rice yield. Since the ancient times of agriculture, manual, cultural and mechanical weeding, and later on, herbicide applications have been the most preferable weed control methods (Riaz *et al*. 2009 [23]; Chauvel *et al*. 2012 [4]). But unavailability of labour, higher costs of machinery, negative impacts of using herbicides make to diversify to an alternative, sustainable weed control strategy (Sandham *et al*. 2010 [25]; Annett *et al*. 2014 [2] and Starling *et al*. 2014) [29].

The term allelopathy was invented by plant physiologist Hans Molisch of the University of Vienna, Austria. Allelon is the Greek word for "each other," and pathos is the Greek word meaning suffering. Pathos can be used to express both positive (sympathetic) and negative (pathetic) interactions because it also means feeling or sensitive (Gross, 1999) [11]. 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 (Khamare *et al.* 2019) [17].

To overcome weed infestation presently, researchers are giving more emphasis using different plant residues to suppress weed growth. With rising human health and ecological concerns about the adverse effects of indiscriminate use of farm chemicals research on alternative weed management methods is underway worldwide (Hossain *et. al.* 2024) [12]. Exploitation of allelopathic potential of different crop/plant species for weed management under field conditions is one such approach. Allelopathy includes plant release chemical that inhibits the growth and development of its surrounding plants. Plant residues control weeds by the release of such allelopathic substances through the decomposition of plant materials (El-Shora and Abd El-Gawad, 2014 [6]; Salam *et al*. 2017) [24]. The soil fertility status of Bangladesh soils is gradually declining day by day. Low organic matter content, imbalanced use of inorganic fertilizers, less use of organic manures and inadequate attention given for its improvement and maintenance made the situation difficult. It is well established that improvement in productivity, soil fertility status and economic returns could be made possible with the combined application of organic and inorganic fertilizers. A very large number of evidences (Suri *et al.* 1997 [30]; Nanjundappa *et al*. 2000) [21] confirm the fact that combination of inorganic fertilizers and organic manures bring about favorable and desirable results in terms of yield, quality of crop produces and fertility built up of soil. Manure or fertilizer alone cannot sustain soil fertility and crop yield over time, their combination is essential (FRG, 2012) [9]. Nambiar *et al.* (1997) [20] viewed that integrated use of organic manure and chemical fertilizers would be quite promising not only in providing greater stability in production, but also in maintaining soil fertility status. It is essential to develop a strong workable and compatible package of nutrient management through organic and inorganic sources for various crops based on scientific facts, local conditions and economic viability (Kannaiyan, 2000) [16]. Now, it is the time to protect the soil environment by using allelochemicals instead of herbicides, organic fertilizers by reducing the use of chemical fertilizers. Combined use of manures and fertilizers with plant residues increases soil fertility and reduces the cost of chemical fertilization and weeding. As the allelopathic potential of *Fimbristylis dichotoma* already identified (Islam and Kato-Noguchi, 2014) [13] this work, therefore, was conducted to combine the allelopathy of *Fimbristylis dichotoma* with manures and fertilizers to study their combined effects on yield performance of rice.

Materials and Methods

Experimental Location

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) [7].

Experimental Soil

The experimental field was medium high land with moderate drained condition. The soil was silty loam in texture having a soil pH value of 6.43, moderate in organic matter content.

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: V_1= BRRI dhan29, V_2= BRRI dhan89. Factor B: Combination of manures and fertilizers with residues of *F. dichotoma*: T_1= Control, T_2= Residues @ 3 t ha^{-1} + Recommended doses of inorganic fertilizers, T_3= Residues @ 3 t ha^{-1} + Tricho-compost @5 t ha^{-1}, T_4= Residues @ 3 t ha^{-1} + Tricho-compost @1.5 t ha^{-1} + 25% less than recommended doses of inorganic fertilizers, T_5=Residues @ 3 t ha^{-1} + Tricho-compost @2.5 t ha^{-1} + 50% less than recommended doses of inorganic fertilizers, T_6= Residues @ 3 t ha^{-1} + Tricho-compost @3.75 t ha^{-1} + 75% less than recommended doses of inorganic fertilizers

Experimental Design

The experiment was laid out in a randomized complete block design (RCBD) with three replications. The total number of plots was 36. Each plot size was 10 m^2 (4.0 m × 2.5 m).

Collection and Preparation of Residues

The residues of *Fimbristylis dichotoma* (L.) were used in this experiment. Residues were collected from the Agronomy Field Laboratory, BAU. 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 21 November 2021. The sprouted seeds were sown in nursery bed on 01 December 2021. 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 01 January, 2022. 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 F. *dichotoma* Residues

Fimbristylis dichotoma residue was applied at 05 January 2022 (7 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 12 January 2022 and they were immediately transferred to the main field. Healthy and similar sized seedlings were selected for transplanting.

Transplanting of Seedlings

Forty-two days old seedlings were transplanted in the well-prepared puddled field on 12 January 2022 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 9 May, 2021. 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) [10].

Results and Discussion

Yield and yield contributing characters at harvest

Effect of variety

The variety had non-significant on the plant height (Figure 1A). The tallest plant (91.36 cm) was observed in BRRI dhan29 and the shortest was observed in BRRI dhan89 (89.37 cm). These differences are mostly due to the genetic variation among the varieties. These results are consistent to those of Anjuman (2012) [1] who recorded variable plant height among varieties. Effect of variety on number of total tillers hill^{-1} was non-significant. The highest number of total tillers hill^{-1} (9.98) was found in BRRI dhan29 and the lowest number of total tillers hill^{-1} was found in BRRI dhan89 (9.92) variety (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 non-significant. The highest number of non-effective tillers hill^{-1} (1.33) was found in BRRI dhan89 and the lowest number of non-effective tillers hill^{-1} was found in BRRI dhan29 (1.11) variety (Figure 1D). Number of grains per panicle was significantly influenced by different varieties. The highest number of grains (22.55) was observed in BRRI dhan29 and the lowest one (21.36) was found in BRRI dhan89 (Figure 1E). Varietal differences regarding the number of grains might be due to differences in genetic constituents (Chowdhury *et al*. 2016) [5].

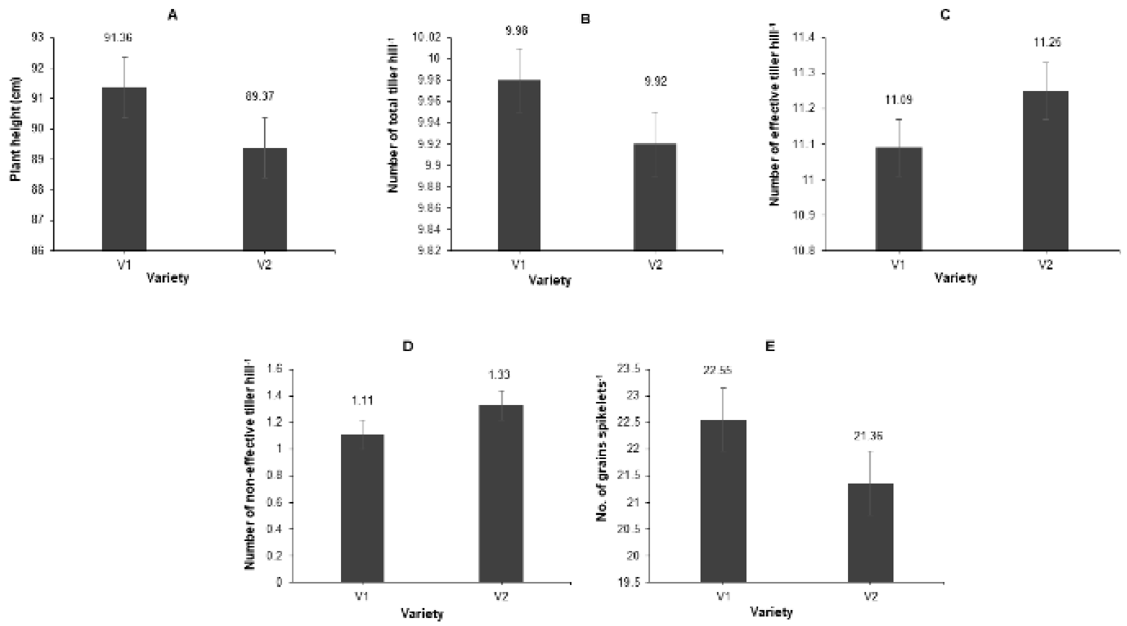

Fig 1: Effect of variety on the yield and yield contributing characters at harvest. Bar represents standard error mean**.** V_1= BRRI dhan29, V_2= BRRI dhan89

Weight of 1000-grain was significantly affected by different varieties of rice. The highest 1000-grain weight (23.66 g) was found in BRRI dhan29 and the lowest one was found (21.02 g) in BRRI dhan89 (Figure 2A). This confirms the report of Islam et al. (2001) [14] who reported the variable effect of variety on 1000-seed weight. The studied variety differed non-significantly in respect of grain yield. The highest grain yield (3.71 t ha^{-1}) was obtained in BRRI dhan29. The lowest grain yield (3.39 t ha^{-1}) was obtained in BRRI dhan89 (Figure 2B). This difference was observed due to different varietal characteristics of rice plant. Anjuman (2012) [1] also reported variation in grain yield among the varieties. Straw yield was non-significantly influenced by the selected varieties. The highest straw yield (4.52 t ha^{-1}) was found in BRRI dhan29 and the lowest straw yield (4.09 t ha^{-1}) was found in BRRI dhan89 (Figure 2C). The probable reason of the different straw yield due to the different yield parameters which was mainly influenced by the genetic make-up of the variety. The results are similar with Kirttania (2013) [18]; Jisan *et al*. (2014) [15] who found different straw yield among the varieties. Biological yield had non-significant effect on variety. The highest biological yield (8.24 t ha^{-1}) was found in BRRI dhan29 and the lowest biological yield (7.49 t ha^{-1}) was found in BRRI dhan89 variety (Figure 2D). Harvest index was significantly affected by variety. The highest harvest index (45.26%) was found in BRRI dhan89 rice variety and the lowest harvest index (45.01%) was found in BRRI dhan29 (Figure 2E). Mia *et al*. (2023) [19] also reported the similar phenomenon.

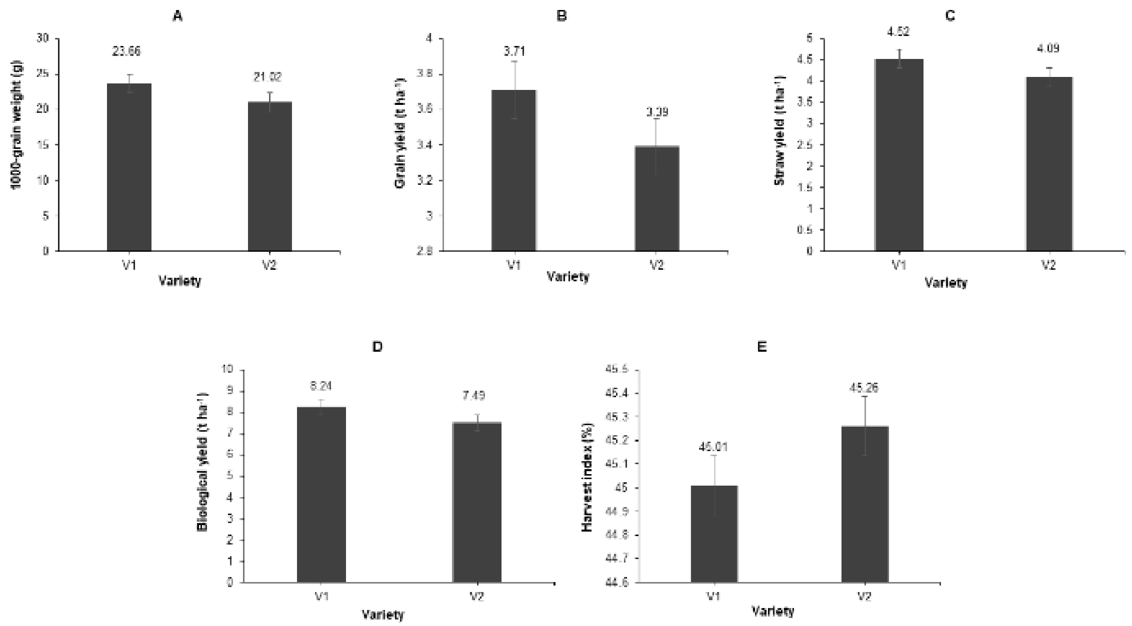

Fig 2: Effect of variety on the yield and yield contributing characters at harvest. Bar represents standard error mean. V_1= BRRI dhan29, V_2= BRRI dhan89

Effect of *Fimbristylis dichotoma* residues with manures and fertilizers

Plant height significantly affected by *Fimbristylis dichotoma* residues (Figure 3A). The tallest plant (93.05 cm) was found in T_2 (Residues @ 3 t ha^{-1} + Recommended doses of inorganic fertilizers) treatment and the shortest plant (86.27 cm) was found in T_1 (no residues) treatment. Similar findings were found by Anjuman (2012) [1], 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 influenced by *Fimbristylis dichotoma* residues non-significantly. The highest number of total tillers hill^{-1} (10.83) was produced @ T_4 and the lowest number of total tillers hill^{-1} (9.55) was produced at control (Figure 3B). *Fimbristylis dichotoma* residues was non-significant on number of effective tillers hill^{-1} (Figure 3C). Number of non-effective tillers hill^{-1} was non-significantly influenced by the residues of *Fimbristylis dichotoma*. The highest number of non-effective tillers hill^{-1} (1.77) was produced at T_4 and the lowest number of non-effective tillers hill^{-1} (0.77) was produced @T_2 (Figure 3D). The number of grains spikelets^{-1} was significantly influenced by residues of *Fimbristylis dichotoma*. The highest number of grains spikelets^{-1} (22.90) was produced by T_2 treatment while the lowest number of grains spikelets^{-1} (20.96) was found T_1 (no residue) treatment (Figure 3E). It indicated that weed free condition encouraged the number of grains spikelets^{-1} and negative effect of weeds on plant growth resulted in decreased number of grains spikelets^{-1}. Singh and Kumar (1999) [27] observed that effective weed management increased grains spikelets^{-1} due to more availability of water, nutrients and light.

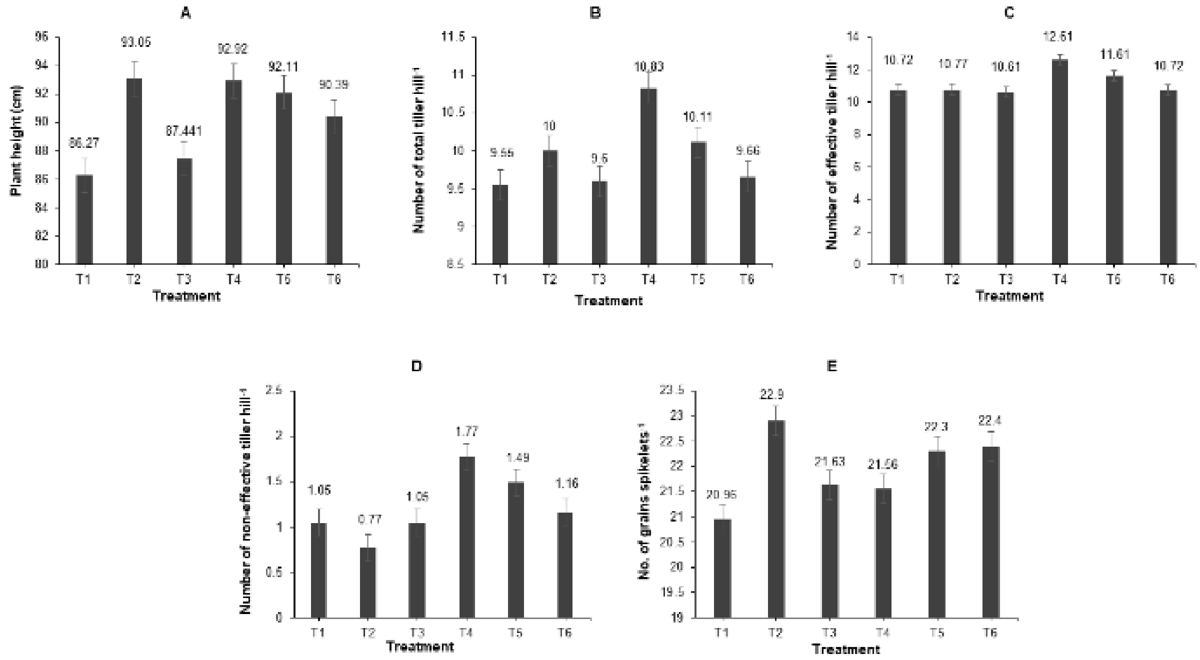

Fig 3: Effect of *Fimbristylis dichotoma* residues with manures and fertilizers on the yield and yield contributing characters at harvest. Bar represents standard error mean.

T_1= Control, T_2= Residues @ 3 t ha^{-1} + Recommended doses of inorganic fertilizers, T_3= Residues @ 3 t ha^{-1} + Tricho-compost @5 t ha^{-1}, T_4= Residues @ 3 t ha^{-1} + Tricho-compost @1.5 t ha^{-1} + 25% less than recommended doses of inorganic fertilizers, T_5=Residues @ 3 t ha^{-1} + Tricho-compost @2.5 t ha^{-1} + 50% less than recommended doses of inorganic fertilizers, T_6= Residues @ 3 t ha^{-1} + Tricho-compost @3.75 t ha^{-1} + 75% less than recommended doses of inorganic fertilizers

1000-grain weight was non-significantly affected by residues of *Fimbristylis dichotoma*. The highest 1000-grain weight (22.50 g) was recorded in R_2 treatment and the lowest 1000-grain weight (22.18 g) was observed in R_6 treatment (Figure 4A). Grain yield was significantly influenced by *Fimbristylis dichotoma* residues. The highest grain yield (4.45 t ha^{-1}) was produced by T_4 treatment and the lowest grain yield (2.91 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) [8]; Uddin and Pyon (2010) [31] also reported the similar results, where residues influenced in crop performance. Straw yield was significantly influenced by the residues of *Fimbristylis dichotoma*. The highest straw yield (5.30 t ha^{-1}) was observed in T_4 residue treatment, and the lowest straw yield (2.91 t ha^{-1}) was observed in T_1 (no residue) treatment (Figure 4C). Residues of *Fimbristylis dichotoma* had significant influence on biological yield of rice. The highest biological yield (9.75 t ha^{-1}) was obtained in R_4 (9.75 t ha^{-1}) treatment and the lowest biological yield (5.83 t ha^{-1}) was obtained in 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 and finally influenced straw yield as well as biological yield (Jisan *et al*. 2014) [14]. Harvest index was significantly influenced by *Fimbristylis dichotoma* residues. The highest harvest index (49.99%) was observed in T_1 (no residue) treatment, and the lowest harvest index (42.74%) was observed in T_3 treatment (Figure 4E).

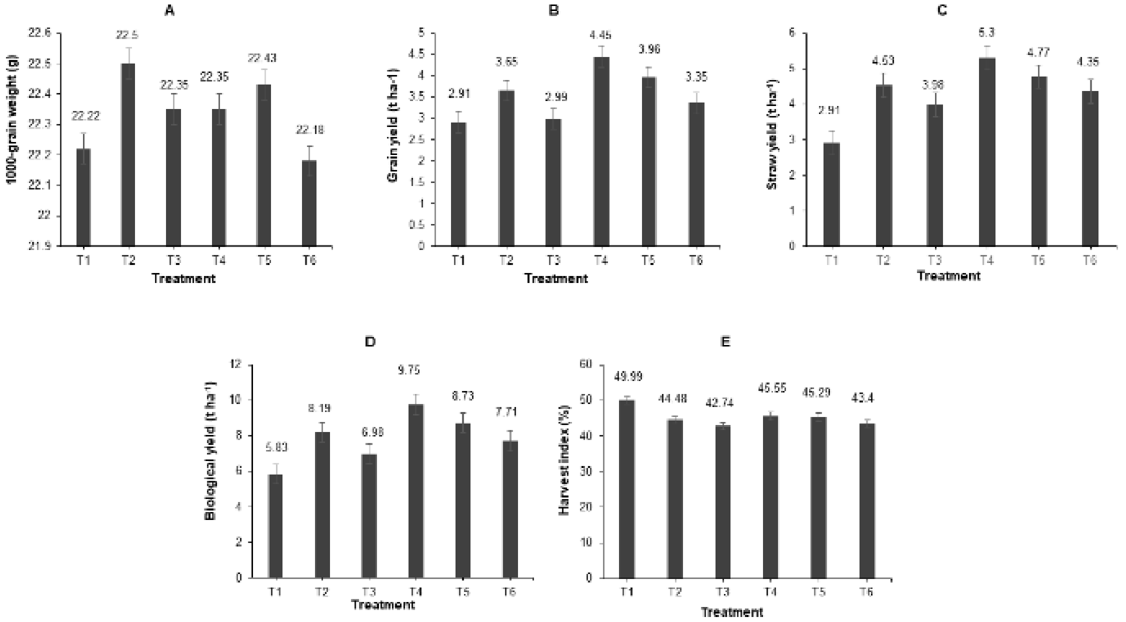

Fig 4: Effect of *Fimbristylis dichotoma* residues with manures and fertilizers on the yield and yield contributing characters at harvest. Bar represents standard error mean

T_1= Control, T_2= Residues @ 3 t ha^{-1} + Recommended doses of inorganic fertilizers, T_3= Residues @ 3 t ha^{-1} + Tricho-compost @5 t ha^{-1}, T_4= Residues @ 3 t ha^{-1} + Tricho-compost @1.5 t ha^{-1} + 25% less than recommended doses of inorganic fertilizers, T_5=Residues @ 3 t ha^{-1} + Tricho-compost @2.5 t ha^{-1} + 50% less than recommended doses of inorganic fertilizers, T_6= Residues @ 3 t ha^{-1} + Tricho-compost @3.75 t ha^{-1} + 75% less than recommended doses of inorganic fertilizers

Effect of interaction of variety and residues of *Fimbristylis dichotoma* with manures and fertilizers

The effect of interaction between variety and *Fimbristylis dichotoma* residues was significant for plant height. The tallest plant (97.96 cm) was obtained from BRRI dhan29 variety in T_4 (Residues @ 3 t ha^{-1} + Tricho-compost @1.5 t ha^{-1} + 25% less than recommended doses of inorganic fertilizers) treatment and BRRI dhan29 produced the shortest plant height (85.66 cm) in T_1 (no residue) treatment (Table 1). Non-significant variation was found in number of total tillers hill^{-1} due to interaction between variety and residues of *Fimbristylis dichotoma*. The highest number of total tillers hill^{-1} (11.22) was produced by BRRI dhan29 and T_5 combination, while the lowest number of total tillers hill^{-1} (9.00) was found from BRRI dhan89 with T_5 (Table 1). Non-significant variation was found in number of effective tillers hill^{-1} due to interaction between variety and residues of *Fimbristylis dichotoma* (Table 1). Non-significant variation was found in number of non-effective tillers hill^{-1} due to interaction between variety and residues of *Fimbristylis dichotoma* (Table 1). Number of grains spikelets^{-1} was significantly influenced by the interaction between varieties and residues of *Fimbristylis dichotoma*. The highest number of grains (23.40) was produced by BRRI dhan29 rice along with T_2 treatment and the lowest number of grains spikelets^{-1} (20.26) was produced by BRRI dhan89 with T_3 treatment (Table 1). There was significant difference in the weight of 1000-grains due to interaction between variety and residues of *Fimbristylis dichotoma*. The highest weight of 1000-grains (23.96 g) were recorded in V_2T_3 treatment and the lowest weight (20.56 g) was recorded in V_1T_6 treatment (Table 1). Grain yield was significantly influenced by the interaction between varieties and residues (Table 1). The highest grain yield (4.49 t ha^{-1}) was produced by V_1T_4 treatment and the lowest (2.67 t ha^{-1}) was produced by V_1T_1 (BRRI dhan29 × no residue) treatment. The lowest grain yield ha^{-1} in the control might be due to the poor performance of yield contributing characters like number of tillers hill^{-1} and grain spikelets^{-1}, because severe weed infestation occurred in the plots due to competition for moisture, nutrients between weed and rice plants. The study results were similar to that of Islam *et al.* (2001) [14]. Straw yield was significantly influenced by the interaction between variety and residues of *Fimbristylis dichotoma*. The highest straw yield (5.02 t ha^{-1}) was produced by V_1T_2 treatment and the lowest straw yield (2.84 t ha^{-1}) was produced by V_2T_1 treatment (Table 1). Biological yield was significantly influenced by the interaction between variety and residues of *Fimbristylis dichotoma* (Table 1). The highest biological yield (9.81 t ha^{-1}) was produced by V_1T_4 treatment and the lowest biological yield (5.75 t ha^{-1}) was produced by V_1T_1 (BRRI dhan29 × no residue) treatment. Harvest index was significantly influenced by the interaction between variety and residues (Table 1). The highest harvest index (52.38%) was observed in V_2T_1 treatment and the lowest harvest index (41.08%) was observed in V_2T_3 treatment.

Table 1: Interaction effect of *Fimbristylis dichotoma* residues with manures and fertilizers 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}	No. of grains spikelets^{-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	85.66cd	9.33	10.22	0.89	21.26bcd	20.82cd	2.67ef	2.99ef	5.70d	47.61ab
V_1T_2	93.66ab	9.89	10.66	0.77	23.40a	21.13cd	4.16abcd	5.02ab	9.18ab	45.21bc
V_1T_3	89.33bcd	9.11	9.89	0.77	23.00ab	20.73cd	3.31cdef	4.15bcd	7.47bcd	44.40bc
V_1T_4	97.96a	10.66	11.88	1.22	22.20abcd	20.76cd	4.49ab	5.40a	9.81a	44.80bc
V_1T_5	92.55ab	11.22	13.00	1.77	22.73abc	22.10bc	4.23abc	4.88abc	9.11ab	46.51bc
V_1T_6	89.00bcd	9.66	10.88	1.22	22.73abc	20.56d	3.46bcdef	4.72abcd	8.18abc	41.55c
V_2T_1	89.22bcd	10.00	11.22	1.22	20.66cd	23.63a	3.12ef	2.84f	5.96d	52.38a
V_2T_2	92.44ab	10.11	10.88	0.77	22.40abc	23.86a	3.15ef	4.05bcd	7.21cd	43.75bc
V_2T_3	83.22d	10.00	11.33	1.33	20.26d	23.96a	2.71f	3.81def	6.49cd	41.08c
V_2T_4	87.89bcd	11.00	13.33	2.33	20.93bcd	23.93a	4.41a	5.20a	9.69a	46.31bc
V_2T_5	91.66abc	9.00	10.22	1.22	21.86abcd	22.76ab	3.68abcde	4.66abcd	8.35abc	44.07bc
V_2T_6	91.78abc	9.44	10.55	1.11	22.06abcd	23.80a	3.24def	3.98cde	7.23cd	45.26bc
LSD $_{(0.05)}$	6.74	2.39	3.67	1.40	2.12	1.43	0.98	1.02	1.86	5.51
Level of Significance	**	NS	NS	NS	**	**	**	**	**	**
CV%	4.41	4.20	9.41	17.78	5.73	3.80	6.36	4.01	4.03	7.20

In a column, figures with the same letter do not differ significantly as per DMRT. * = Significant at 5% level of probability
NS = Not significant, V_1=BRRI dhan29; V_2= BRRI dhan89; T_1= Control; T_2= Residues @ 3 t ha^{-1} + Recommended doses of inorganic fertilizers; T_3= Residues @ 3 t ha^{-1} + Tricho-compost @5 t ha^{-1}; T_4= Residues @ 3 t ha^{-1} + Tricho-compost @1.5 t ha^{-1} + 25% less than recommended doses of inorganic fertilizers; T_5=Residues @ 3 t ha^{-1} + Tricho-compost @2.5 t ha^{-1} + 50% less than recommended doses of inorganic fertilizers; T_6= Residues @ 3 t ha^{-1} + Tricho-compost @3.75 t ha^{-1} + 75% less than recommended doses of inorganic fertilizers

Conclusion

From the above results it was found that the variety BRRI dhan29 and T_4 (Residues 3 t ha^{-1} +Trichocompost @1.5 t ha^{-1} + 25% less than recommended fertilizers treatment) treatment exhibited the superior effect. Results of present study reveal that combined effect of *Fimbristylis dichotoma* residues showed herbicidal activity for suppressing weed growth and the combination of manures and fertilizers enhances yield and yield contributing characters.

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