International Journal of Life Science and Agriculture Research

ISSN (Print): 2833-2091, ISSN (Online): 2833-2105

Volume 04 Issue 03 March 2025

DOI: https://doi.org/10.55677/ijlsar/V04I03Y2025-06

Impact Factor: 7.88 , Page No : 199-210

Evaluating T. Aman Rice Yield under the Combined Effects of Fertilizers, Manures and Allelopathy from *Eleocharis atropurpurea* and *Cyperus difformis*

A. N. M. Shibly Sadik[1,3], Bohiny Sarker[1], Zeba Humaira[1], Md. Rakibul Hasan Sanet[2], Md. Mezbaul Haque[2], Sadia Zaman Shormi[1], Fahmida Akter[1], Md. Shafiqul Islam[1]

[1]Department of Agronomy, Bangladesh Agricultural University, Mymensingh-2202

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

[3]Department of Agricultural Extension, Ministry of Agriculture, Government of the People's Republic of Bangladesh

ABSTRACT

To evaluate the combined effect of fertilizers and manures on transplant *aman* rice, an experiment was carried out at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh, from July to December 2019. The trial included two cultivars (Binadhan-13 and BRRI dhan34) and seven treatments such as Control, Residues 3 t ha^{-1} + Cowdung 5 t ha^{-1}, Residues 3 t ha^{-1} + Cowdung 2.5 t ha^{-1} + Fertilizers (N = 55 kg ha^{-1}, P = 30 kg ha^{-1}, K = 25 kg ha^{-1}, S = 15 kg ha^{-1}), Residues 3 t ha^{-1} + Vermicompost 5 t ha^{-1}, Residues 3 t ha^{-1} + Vermicompost 2.5 t ha^{-1} + Fertilizers (N = 55 kg ha^{-1}, P = 30 kg ha^{-1}, K = 25 kg ha^{-1}, S = 15 kg ha^{-1}), Residues 3 t ha^{-1} + Trichocompost 10 t ha^{-1}, Residues 3 t ha^{-1} + Trichocompost 5 t ha^{-1} + Fertilizers (N = 55 kg ha^{-1}, P = 30 kg ha^{-1}, K = 25 kg ha^{-1}, S = 15 kg ha^{-1}). The experiment was set up using a randomized complete block design (RCBD) with three replications. Plant height, number of effective tillers $hill^{-1}$, panicle length, grain yield, straw yield, biological yield, and harvest index were among the yield-contributing characteristics that were not significantly impacted by variety. BRRI dhan34 produced highest yield due to both the higher number of grains $panicle^{-1}$ and number of filled grain. The lowest grain yield and harvest index was found in T_1 (control). The study's findings suggest that fertilizer, manures, and residues interact in order to raise transplant aman rice output. Hence, the combination of manures and fertilizers with residues of *Cyperus difformis* and *Eleocharis atropurpurea* might serve as a source of yield-boosting tools for agricultural sustainability.

Published Online: March 27, 2025

Corresponding Author: Md. Shafiqul Islam

KEYWORDS: Allelopathy, Rice, Manures, Fertilizers, Yield.

INTRODUCTION

Rice is more than a food; it is an integral aspect of world culture, economics, and nutrition. Its diverse benefits, ranging from providing necessary nutrients to playing an important role in global food security, make it indispensable around the world. Rice grows in a variety of conditions, ranging from tropical to moderate. It is a crop that is resilient to climate problems because of its versatility. 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. Farmers used to add a specified amount of organic manure to the soil. These methods have been greatly curtailed since the majority of organic waste is now utilized by rural residents as fuel and fodder. The use of organic fertilizers, particularly to boost the efficacy of applied fertilizers and to preserve soil fertility, has gained importance at the moment. Although conventional farming boosts crop output, it has a negative impact on soil quality and nutrient usage efficiency since it heavily relies on chemical fertilizer inputs and pesticides (Li *et al*., 2016; Bitew *et al*., 2017; Mou et al., 2017; Zaman et al., 2018). 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; Nanjundappa *et al*., 2000; Ramamoorthy and Lourduraj, 2002) 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). Nambiar (1997) 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. Limited data are available on the growth, yield and nutrient content of agronomic crops treated with bio slurry, vermicompost and trichocompost. 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). Developing nutrient use efficiency for advanced farming is gaining attention as a way to reduce related issues without sacrificing crop output. Enhancing grain productivity is currently the most difficult problem in order to continue feeding humankind sustainably and with the least amount of environmental impact (Mueller *et al*., 2012; Morone *et al*., 2019). Herbicides and chemical fertilizers are two of the main causes of environmental pollution, but it's time to protect the soil environment by using allelochemicals instead of herbicides and organic fertilizers by using fewer chemical fertilizers. Using manures and fertilizers with weed residues increases soil fertility and lowers the cost of chemical fertilization and weeding.Therefore, the proposed study was undertaken to create an integrated nutrient management strategy in order to assess the impact of different varieties on T. *aman* rice production performance along with to evaluate the integrated effect of fertilizers, manure, and variety on T. *aman* rice production performance using C. *difformis* and E. *atropurpurea* residues.

MATERIALS AND METHODS

Experimental location and site

The experiment was carried out in the Agronomy field of Bangladesh Agricultural University (BAU), Mymensingh from June to November 2022. This region is under the Old Brahmaputra Floodplain, AEZ-9 and is defined by non-calcareous dark gray floodplain soil (Old Brahmaputra Alluvial Soil Tract). It is positioned at 24°75' N latitude and 90°50' E longitude with an average elevation of 18 meters above sea level.

Experimental soil and weather

The experimental site's soil was more or less neutral in response, with a pH of 6.8 and low levels of organic matter and fertility. The terrain was moderately high, with a silty loam texture. The research area was characterized by tropical weather patterns. While it was moderate, sunny, and somewhat dry throughout the rabi season (October to March), it was hot, damp and rainy during the kharif season (April to September).

Experimental treatments and design

The experimental treatment consisted of two factors. They are as follows: Factor A: Rice varieties: V_1=Binadhan-13 and V_2=BRRI dhan34. Factor B: Combination of manures and fertilizers with the residues of *Cyperus difformis* and *Eleocharis atropurpurea*: T_1=Control, T_2=Residues 3 t ha^{-1} + Cowdung 5 t ha^{-1}, T_3=Residues 3 t ha^{-1} + Cowdung 2.5 t ha^{-1} + Fertilizers (N = 55 kg ha^{-1}, P= 30 kg ha^{-1}, K = 25 kg ha^{-1}, S = 15 kg ha^{-1}),T_4=Residues 3 t ha^{-1} + Vermicompost 5 t ha^{-1},T_5=Residues 3 t ha^{-1} + Vermicompost 2.5 t ha^{-1} + Fertilizers (N = 55 kg ha^{-1}, P = 30 kg ha^{-1}, K = 25 kg ha^{-1}, S = 15 kg ha^{-1}),T_6= Residues 3 t ha^{-1} + Trichocompost 10 t ha^{-1},T_7= Residues 3 t ha^{-1} + Trichocompost 5 t ha^{-1} + Fertilizers (N = 55 kg ha^{-1}, P = 30 kg ha^{-1}, K = 25 kg ha^{-1}, S = 15 kg ha^{-1}).

The experiment was set up using three replications using a Randomized Complete Block Design. There were 42 plots in all. The unit plot measured 2 m by 2.5 m.

Crop Husbandry

Collection and preparation of crop residues

This study used residues from *Eleocharis atropurpurea* and *Cyperus difformis*. *Eleocharis atropurpurea* and *Cyperus difformis* plants were gathered at their peak vegetative stage from the Bangladesh Agricultural University's Agronomy Field and then allowed to dry in the shaded threshing floor. Finally the residues were chopped into little bits with a sickle.

Preparation of seedling nursery bed and seed sowing

On July 1, 2019, the sprouting seeds were evenly distributed in a nursery bed that had been prepared thoroughly by a tractor. The nursery bed's robust seedlings were raised with the right attention. As needed, weeds were pulled from the nursery bed.

Preparation of the experimental land

The land was opened and thoroughly prepared with tractor followed by laddering. Weeds and stubbles were removed from the field during land preparation. Finally the land was ready for transplantation and the field layout was done on the next day.

Application of residues, manures and fertilizers

The *Cyperus difformis* and *Eleocharis atropurpurea* residues along with manures were applied at 7 days before transplanting of *aman* rice at the time of final land preparation in accordance with experimental specification. After that crop residues were mixed well to the respective plots. According to treatment, urea, triple super phosphate, muriate of potash, and gypsum were used to fertilize the experimental plots. At the time of the last land preparation, the full amounts of gypsum, muriate of potash, and triple super phosphate were applied. Three doses of urea were administered at 15, 30, and 45 days after transplantation (DAT).

Transplanting of seedlings

Thirty-day-old seedlings were moved on July 30, 2019, at a pace of three seedlings per hill, with a spacing of 25 cm by 15 cm, on the prepared puddled field.

Harvesting and Processing

At full maturity, the crops were harvested (V_1 on 02-12-2019 and V_2 on 25-11-2019). Each plot's harvested crops were then individually packed, appropriately tagged, and transported to the threshing floor. Following the threshing of the crops, the fresh weights of grain and straw were measured from a 1 m^2 area in the center of each plot. After cleaning the grains, the weight was ultimately adjusted to achieve a 14% moisture content. The grain and straw $plot^{-1}$ yields were measured and converted to t ha^{-1} after the straw was sun-dried.

Data Collection Parameters

Five randomly chosen sample plants from each plot had their yield and yield-contributing characteristics documented based on the following criteria: plant height, number of total tillers $hill^{-1}$, number of effective tillers $hill^{-1}$, number of non-effective tillers $hill^{-1}$, grain yield (t ha^{-1}), straw yield (t ha^{-1}), biological yield (t ha^{-1}), panicle length (cm), number of grains $panicle^{-1}$, 1000-grain weight (g) and harvest index (%).

Statistical analysis

For statistical analysis, the recorded data were collated and tabulated. With the use of the computer program MSTAT, analysis of variance was completed. Duncan's Multiple Range Test was used to determine the mean differences between the treatments (Gomez and Gomez, 1984).

RESULTS

YIELD AND YIELD CONTRIBUTING CHARACTERS AT HARVEST

PLANT HEIGHT

Effect of variety

Plant height was non-significant with variety. The tallest plant (154.03 cm) was observed in Binadhan-13 and the shortest plant (153.93 cm) was observed in BRRI dhan34 (Table 1).

Effect of manures and fertilizers with residues of *C. difformis and E. atropurpurea*

Plant height was significantly affected by combination of manures and fertilizers with residues of *C. difformis and E. atropurpurea*. The tallest plant (161.87 cm) was found in T_5 (residues 3 t ha^{-1} + vermicompost 2.5 t ha^{-1} + fertilizers(N=55 kg ha^{-1}, P=30 kg ha^{-1}, K=25 kg ha^{-1}, S=15 kg ha^{-1}) treatment followed by T_3 (residues 3 t ha^{-1} + cowdung 2.5 t ha^{-1} + fertilizers (N=55 kg ha^{-1}, P=30 kg ha^{-1}, K=25 kg ha^{-1}, S=15 kg ha^{-1}) treatment and the shortest plant (147.31 cm) was found in T_4 (residues 3 t ha^{-1} + vermicompost 5 t ha^{-1}) treatment (Table 2).

Combined effect of interaction of variety and manures and fertilizers with residues of *C. difformis and E. atropurpurea*

The combined effect of interaction of variety and manures and fertilizers with residues of *C.difformis and E.atropurpurea* was significant for plant height. Numerically, the tallest (159.35 cm) plant was obtained from Binadhan-13 in T_5 (residues 3 t ha^{-1} + vermicompost 2.5 t ha^{-1} + fertilizers (N=55 kg ha^{-1}, P=30 kg ha^{-1}, K=25 kg ha^{-1}, S=15 kg ha^{-1}) treatment and BRRI dhan34 produced the shortest plant in T_1 (Control) treatment (Table 3).

NUMBER OF EFFECTIVE TILLERS $HILL^{-1}$

Effect of variety

Number of effective tillers $hill^{-1}$ was significantly influenced by variety. The highest number of effective tillers $hill^{-1}$ (10.08) was found in BRRI dhan34 and the lowest number of effective tillers $hill^{-1}$ was found in Binadhan-13 (9.88) (Fig. 1).

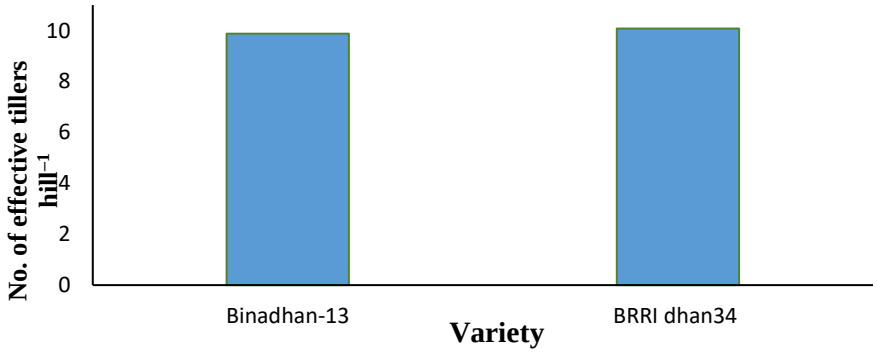

Fig.1. No. of effective tillers $hill^{-1}$ as influenced by variety

V_1 =Binadhan-13, V_2 = BRRI dhan34

Effect of manures and fertilizers with residues of *C. difformis and E. atropurpurea*

Number of effective tillers hill^{-1} was significantly influenced by the combination of manures and fertilizers with residues of *C. difformis and E. atropurpurea*. The highest number of effective tillers hill^{-1} (11.96) was produced by T_5 (residues 3 t ha^{-1}+vermicompost 2.5 t ha^{-1}+ fertilizers (N=55 kg ha^{-1}, P=30 kg ha^{-1}, K=25 kg ha^{-1}, S=15 kg ha^{-1})) treatment and the lowest number of effective tillers hill^{-1} (9.30) was produced by T_2 (residues 3 t ha^{-1}+cowdung 5 t ha^{-1}) treatment (Fig. 2).

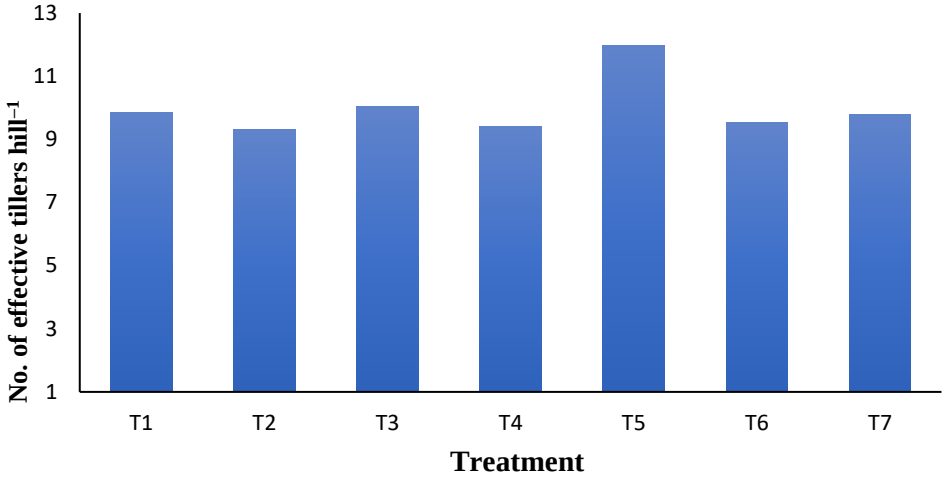

Fig.2.Effect of combination of manures and fertilizers with residues of *Cyperus difformis* (L.) *and Eleocharis atropurpurea* on no. of effective tillers hill^{-1}

T_1=control, T_2=residues 3 t ha^{-1}+cowdung 5 t ha^{-1}, T_3=residues 3 t ha^{-1}+cowdung 2.5 t ha^{-1}+fertilizers(N=55 kg ha^{-1}, P=30 kg ha^{-1}, K=25 kg ha^{-1}, S=15 kg ha^{-1}), T_4=residues 3 t ha^{-1}+vermicompost 5 t ha^{-1}, T_5= residues 3 t ha^{-1}+vermicompost 2.5 t ha^{-1}+ fertilizers(N=55 kg ha^{-1}, P=30 kg ha^{-1}, K=25 kg ha^{-1}, S=15 kg ha^{-1}), T_6=residues 3 t ha^{-1}+trichocompost 10 t ha^{-1}, T_7= residues 3 t ha^{-1}+trichocompost 5 t ha^{-1}+fertilizers(N=55 kg ha^{-1}, P=30 kg ha^{-1}, K=25 kg ha^{-1}, S=15 kg ha^{-1})

Combined effect of interaction of variety and manures and fertilizers with residues of *c. Difformis and e. Atropurpurea*

Significant variation was found in number of effective tillers hill^{-1} due to combined effect of interaction of variety and manures and fertilizers with residues of *C. difformis and E. atropurpurea*. The highest number of effective tillers hill^{-1} (12.5) was produced by Binadhan-13 in T_5 (residues 3 t ha^{-1} + vermicompost 2.5 t ha^{-1} + fertilizers(N=55 kg ha^{-1}, P=30 kg ha^{-1}, K=25 kg ha^{-1}, S=15 kg ha^{-1})) treatment, while the lowest number of effective tillers hill^{-1} (8.13) was found from Binadhan-13 in T_4 (residues 3 t ha^{-1} + vermicompost 5 t ha^{-1}) treatment (Table 3).

PANICLE LENGTH

Effect of variety

Panicle length was not significantly affected by different varieties. Numerically, the longest panicle (23.15 cm) was recorded in Binadhan-13 and the shortest panicle (23.05 cm) was recorded in BRRI dhan34 (Table 1).

Effect of manures and fertilizers with residues of *C. difformis and E. atropurpurea*

Panicle length was not significantly influenced by the combination of manures and fertilizers with residues of *C. difformis and E. atropurpurea*. Numerically, the longest panicle (23.37 cm) was observed in T_7 (residues 3 t ha^{-1}+trichocompost 5 t ha^{-1}+fertilizers (N=55 kg ha^{-1}, P=30 kg ha^{-1}, K=25 kg ha^{-1}, S=15 kg ha^{-1})) treatment followed by T_3 (residues 3 t ha^{-1}+cowdung 2.5 t ha^{-1}+fertilizers(N=55 kg ha^{-1}, P=30 kg ha^{-1}, K=25 kg ha^{-1}, S=15 kg ha^{-1})) treatment and the shortest one (22.8 cm) was observed in T_6 (residues 3 t ha^{-1}+trichocompost 10 t ha^{-1}) treatment (Table 2).

Combined effect of interaction of variety and manures and fertilizers with residues of *C. difformis and E. atropurpurea*

Panicle length was not significantly influenced by the combined effect of interaction of variety and manures and fertilizers with residues of *C. difformis and E. atropurpurea*. The longest panicle (23.87 cm) was observed from BRRI dhan34 in T_7 (residues 3 t ha^{-1}+trichocompost 5 t ha^{-1}+fertilizers (N=55 kg ha^{-1}, P=30 kg ha^{-1}, K=25 kg ha^{-1}, S=15 kg ha^{-1})) treatment and the shortest one was found in Binadhan-13 T_2 (residues 3 t ha^{-1}+cowdung 5 t ha^{-1}) treatment (Table 3).

NUMBER OF GRAINS PANICLE^{-1}

Effect of variety

Number of grains panicle^{-1} was significantly influenced by different varieties. The highest number of grains was observed in BRRI dhan34 and the lowest one was found in Binadhan-13 (Fig. 3).

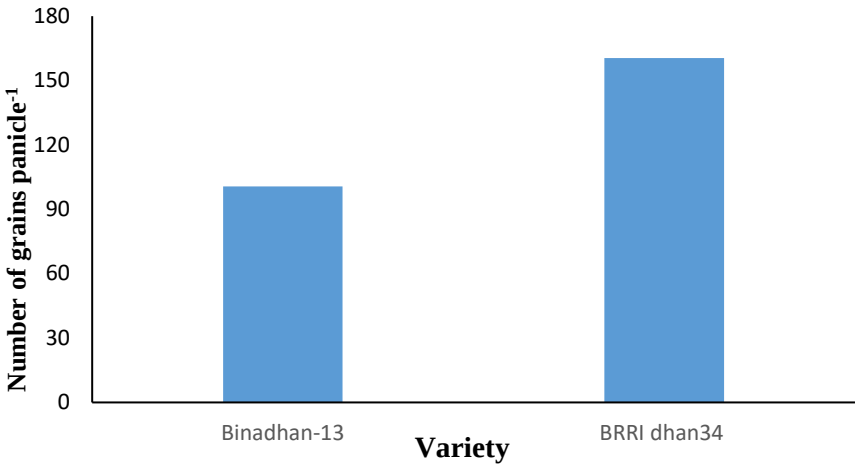

Fig.3. No. of grains panicle^{-1} as influenced by variety
V_1 =Binadhan-13, V_2 = BRRI dhan34

Effect of manures and fertilizers with residues of *C. difformis and E. atropurpurea*

Number of grains panicle^{-1} was significantly influenced by the combination of manures and fertilizers with residues of *C. difformis and E. atropurpurea*. The highest number of grains panicle^{-1} was produced by T_7 (residues 3 t ha^{-1}+trichocompost 5 t ha^{-1}+fertilizers (N=55 kg ha^{-1}, P=30 kg ha^{-1}, K=25 kg ha^{-1}, S=15 kg ha^{-1})) treatment followed by T_3 (residues 3 t ha^{-1}+cowdung 2.5 t ha^{-1}+fertilizers(N=55 kg ha^{-1} ,P=30 kg ha^{-1},K=25 kg ha^{-1},S=15 kg ha^{-1})) treatment while the lowest number of grains panicle^{-1} was produced by T_5 (residues 3 t ha^{-1}+vermicompost 2.5 t ha^{-1}+ fertilizers (N=55 kg ha^{-1}, P=30 kg ha^{-1}, K=25 kg ha^{-1}, S=15 kg ha^{-1})) treatment (Fig. 4)

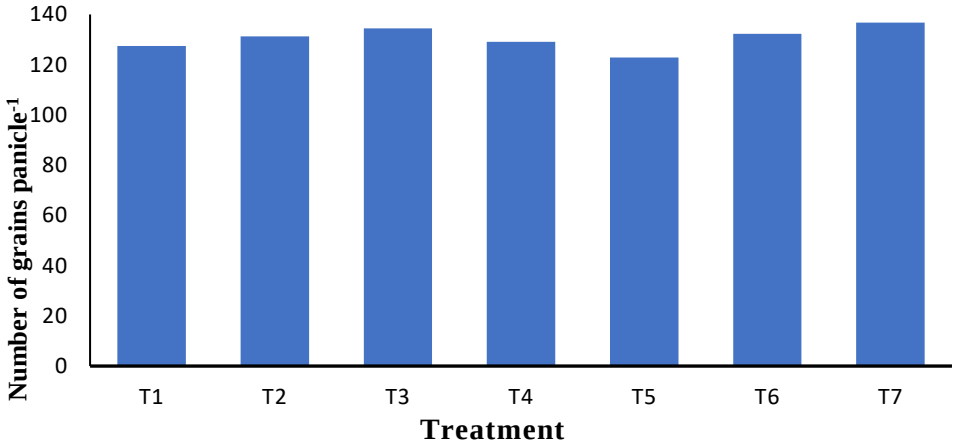

Fig.4. Effect of combination of manures and fertilizers with residues of *Cyperus difformis* (L.) *and Eleocharis atropurpurea* on no. of grains panicle^{-1}

T_1=control, T_2=residues 3 t ha^{-1}+cowdung 5 t ha^{-1}, T_3=residues 3 t ha^{-1}+cowdung 2.5 t ha^{-1}+fertilizers (N=55 kg ha^{-1}, P=30 kg ha^{-1}, K=25 kg ha^{-1}, S=15 kg ha^{-1}), T_4=residues 3 t ha^{-1}+vermicompost 5 t ha^{-1}, T_5= residues 3 t ha^{-1}+vermicompost 2.5 t ha^{-1}+ fertilizers (N=55 kg ha^{-1}, P=30 kg ha^{-1}, K=25 kg ha^{-1}, S=15 kg ha^{-1}), T_6=residues 3 t ha^{-1}+trichocompost 10 t ha^{-1}, T_7= residues 3 t ha^{-1}+trichocompost 5 t ha^{-1}+fertilizers (N=55 kg ha^{-1}, P=30 kg ha^{-1}, K=25 kg ha^{-1}, S=15 kg ha^{-1}).

Combined effect of interaction of variety and manures and fertilizers with residues of *C. difformis and E. atropurpurea*

Number of grains panicle^{-1} was significantly influenced by the combined effect of interaction of variety and manures and fertilizers with residues of *C. difformis and E. atropurpurea*. The highest number of grains panicle^{-1} was produced by BRRI dhan34 in T_7 (residues 3 t ha^{-1}+trichocompost 5 t ha^{-1}+fertilizers (N=55 kg ha^{-1}, P=30 kg ha^{-1}, K=25 kg ha^{-1}, S=15 kg ha^{-1})) treatment and the lowest number of grains panicle^{-1} was produced by Binadhan-13 in T_5 (residues 3 t ha^{-1}+vermicompost 2.5 t ha^{-1}+ fertilizers (N=55 kg ha^{-1}, P=30 kg ha^{-1}, K=25 kg ha^{-1}, S=15 kg ha^{-1})) treatment (Table 3).

1000-GRAIN WEIGHT

Effect of variety

Weight of 1000-grain was significantly affected by different varieties of rice. The highest thousand grain weight (20.17 g) was found in Binadhan-13 and the lowest one was found (14.49 g) in BRRI dhan34 (Table 1).

Effect of manures and fertilizers with residues of *C. difformis and E. atropurpurea*

Effect of 1000-grains was significantly affected by the combination of manures and fertilizers with residues of *C. difformis* and *E. atropurpurea*. The highest weight of 1000 grains (17.95 g) was recorded in T_3 (residues 3 t ha^{-1}+cowdung 2.5 t ha^{-1}+fertilizers (N=55 kg ha^{-1}, P=30 kg ha^{-1}, K=25 kg ha^{-1}, S=15 kg ha^{-1})) treatment and the lowest weight of 1000 grains (15.55 g) was produced by T_1 (control) treatment (Table 2).

Combined effect of interaction of variety and manures and fertilizers with residues of *C. difformis and E. atropurpurea*

Weight of 1000 grains was significantly affected by the combined effect of interaction of variety and manures and fertilizers with residues of *C. difformis* and *E. atropurpurea*. The highest weight of 1000 grains was recorded in V_1T_3 (V_1 =Binadhan-13 × residues 3 t ha^{-1}+cowdung 2.5 t ha^{-1}+fertilizers (N=55 kg ha^{-1}, P=30 kg ha^{-1}, K=25 kg ha^{-1}, S=15 kg ha^{-1})) treatment and the lowest weight of 1000 grains was produced by V_2T_1 (BRRI dhan34 × control) treatment (Table 3).

GRAIN YIELD

Effect of variety

The studied varieties non-significantly affected the grain yield. The highest grain yield 4.04 t ha^{-1} was obtained in BRRI dhan34 and the lowest grain yield 3.78 t ha^{-1} was obtained in Binadhan-13 (Fig. 5).

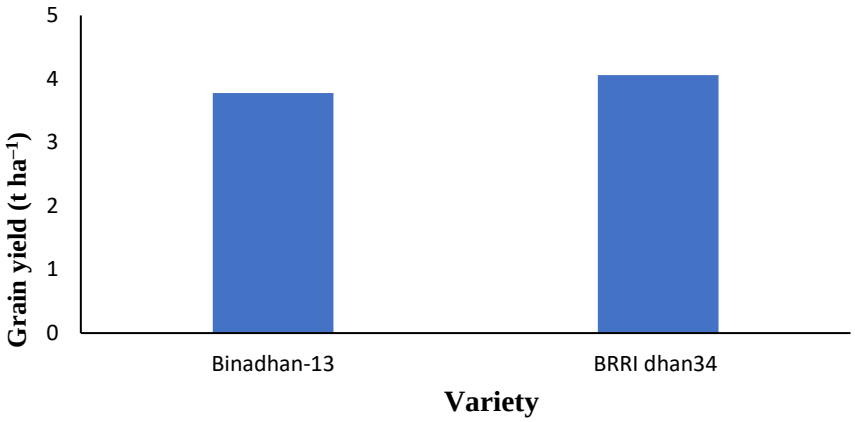

Fig.5. Grain yield as influenced by variety

V_1 =Binadhan-13, V_2 = BRRI dhan34

Effect of manures and fertilizers with residues of *C. difformis and E. atropurpurea*:

Grain yield was significantly influenced by the combination of manures and fertilizers with residues of *C. difformis* and *E. atropurpurea*. The highest grain yield (4.46 t ha^{-1}) was produced by T_3 (residues 3 t ha^{-1}+cowdung 2.5 t ha^{-1}+fertilizers (N=55 kg ha^{-1}, P=30 kg ha^{-1}, K=25 kg ha^{-1}, S=15 kg ha^{-1})) treatment, followed by 4.36 t ha^{-1} T_5 (residues 3 t ha^{-1}+vermicompost 2.5 t ha^{-1}+ fertilizers (N=55 kg ha^{-1}, P=30 kg ha^{-1}, K=25 kg ha^{-1}, S=15 kg ha^{-1})) treatment and lowest one 3.49 t ha^{-1} was produced by T_1 (control) treatment (Fig. 6).

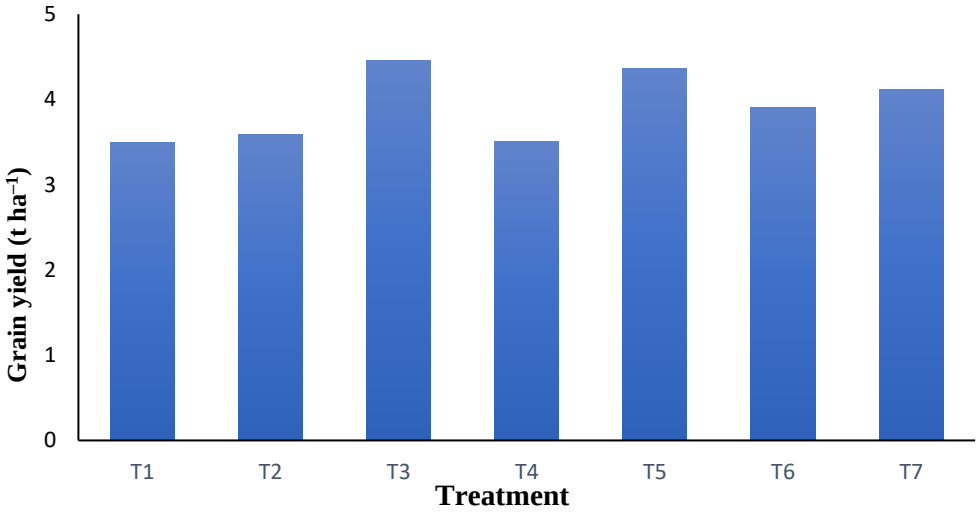

Fig.6. Effect of combination of manures and fertilizers with residues of *Cyperus difformis* (L.) *and Eleocharis atropurpurea* on grain yield

T_1=control, T_2=residues 3 t ha^{-1}+cowdung 5 t ha^{-1}, T_3=residues 3 t ha^{-1}+cowdung 2.5 t ha^{-1}+fertilizers (N=55 kg ha^{-1}, P=30 kg ha^{-1}, K=25 kg ha^{-1}, S=15 kg ha^{-1}), T_4=residues 3 t ha^{-1}+vermicompost 5 t ha^{-1}, T_5= residues 3 t ha^{-1}+vermicompost 2.5 t ha^{-1}+ fertilizers (N=55 kg ha^{-1}, P=30 kg ha^{-1}, K=25 kg ha^{-1}, S=15 kg ha^{-1}), T_6=residues 3 t ha^{-1}+trichocompost 10 t ha^{-1}, T_7= residues 3 t ha^{-1}+trichocompost 5 t ha^{-1}+fertilizers(N=55 kg ha^{-1}, P=30 kg ha^{-1}, K=25 kg ha^{-1}, S=15 kg ha^{-1})

Combined effect of interaction of variety and manures and fertilizers with residues of *C. difformis and E. atropurpurea*

Grain yield was significantly influenced by the combined effect of interaction of variety and manures and fertilizers with residues of *C. difformis* and *E. atropurpurea*. The highest number of grain yield was produced by V_1T_3 (V_1 =Binadhan-13 × residues 3 t ha^{-1}+cowdung 2.5 t ha^{-1}+fertilizers (N=55 kg ha^{-1}, P=30 kg ha^{-1}, K=25 kg ha^{-1}, S=15 kg ha^{-1})) treatment and the lowest number of grain yield was produced by V_1T_4 (V_1 =Binadhan-13 × residues 3 t ha^{-1}+vermicompost 5 t ha^{-1})) treatment (Table 3).

STRAW YIELD

Effect of variety

Straw yield was not significantly influenced by varieties. The highest straw yield (7.65 t ha^{-1}) was found in BRRI dhan34 and the lowest straw yield (7.42 t ha^{-1}) was found in Binadhan-13 (Fig. 7).

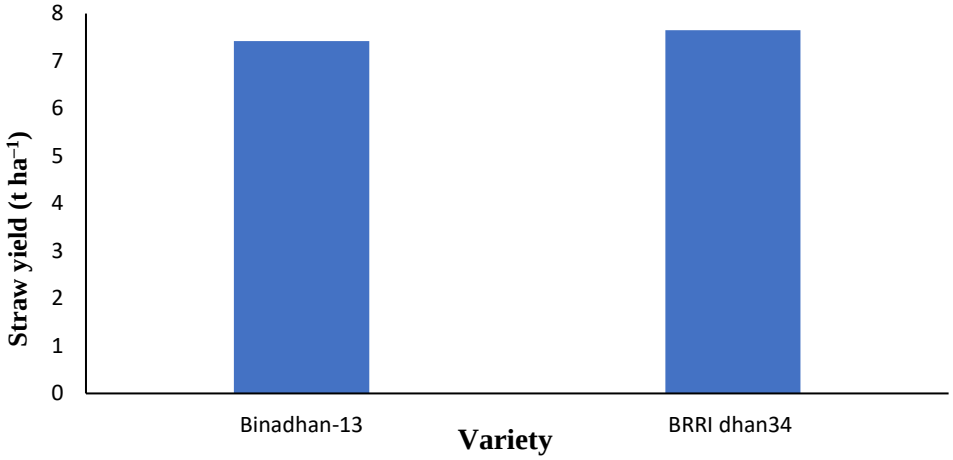

Fig.7. Straw yield as influenced by variety

V_1 =Binadhan-13, V_2 = BRRI dhan34

Effect of manures and fertilizers with residues of *C. difformis and E. atropurpurea*

Straw yield was significantly influenced by the combination of manures and fertilizers with residues of *C. difformis* and *E. atropurpurea*. The highest straw yield (8.52 t ha^{-1}) was observed in T_3 (residues 3 t ha^{-1}+cowdung 2.5 t ha^{-1}+fertilizers (N=55 kg ha^{-1}, P=30 kg ha^{-1}, K=25 kg ha^{-1}, S=15 kg ha^{-1}) treatment and the lowest straw yield (6.33 t ha^{-1}) was observed in T_1 (control) treatment (Fig. 8).

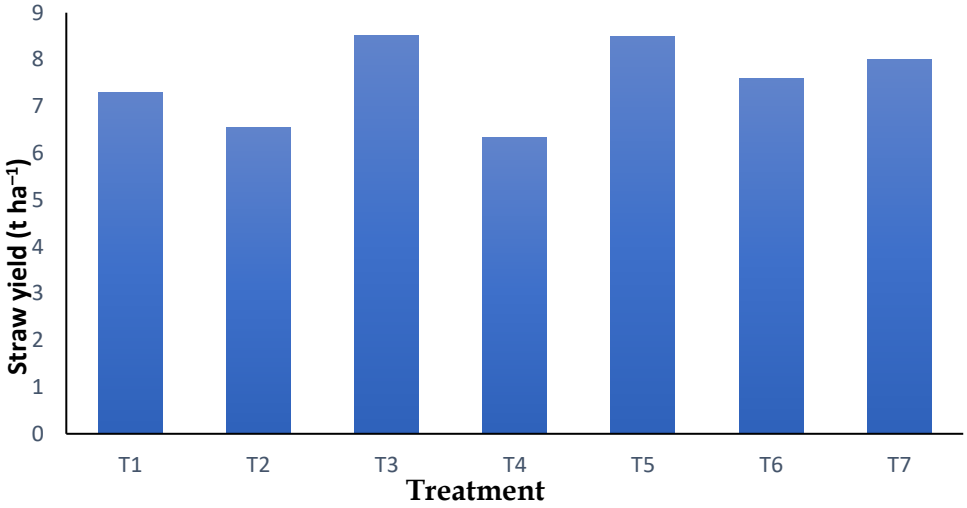

Fig.8. Effect of combination of manures and fertilizers with residues of *Cyperus difformis* (L.) *and Eleocharis atropurpurea* on straw yield

T_1=control, T_2=residues 3 t ha^{-1}+cowdung 5 t ha^{-1}, T_3=residues 3 t ha^{-1}+cowdung 2.5 t ha^{-1}+fertilizers (N=55 kg ha^{-1}, P=30 kg ha^{-1}, K=25 kg ha^{-1}, S=15 kg ha^{-1}), T_4=residues 3 t ha^{-1}+vermicompost 5 t ha^{-1}, T_5= residues 3 t ha^{-1}+vermicompost 2.5 t ha^{-1}+ fertilizers (N=55 kg ha^{-1}, P=30 kg ha^{-1}, K=25 kg ha^{-1}, S=15 kg ha^{-1}), T_6=residues 3 t ha^{-1}+trichocompost 10 t ha^{-1}, T_7= residues 3 t ha^{-1}+trichocompost 5 t ha^{-1}+fertilizers (N=55 kg ha^{-1}, P=30 kg ha^{-1}, K=25 kg ha^{-1}, S=15 kg ha^{-1}).

Combined effect of interaction of variety and manures and fertilizers with residues of *C. difformis and E. atropurpurea*

Straw yield was significantly influenced by the combined effect of interaction of variety and manures and fertilizers with residues of *C. difformis* and *E. atropurpurea*. The highest straw yield was produced by V_1T_3 (V_1 =Binadhan-13 × residues 3 t ha^{-1}+cowdung 2.5 t ha^{-1}+fertilizers (N=55 kg ha^{-1}, P=30 kg ha^{-1}, K=25 kg ha^{-1}, S=15 kg ha^{-1})) treatment and the lowest straw yield was produced by V_2T_1 (BRRI dhan34 × control) treatment (Table 3).

BIOLOGICAL YIELD

Effect of variety

Biological yield was not significantly affected by variety. The highest biological yield (11.71 t ha^{-1}) was found in Binadhan-13 and the lowest biological yield (9.29 t ha^{-1}) was found in BRRI dhan34 (Table 1).

Effect of manures and fertilizers with residues of *C. difformis and E. atropurpurea*

The combination of manures and fertilizers with residues of *C. difformis* and *E. atropurpurea* had significant influence on biological yield. The highest biological yield (12.99 t ha^{-1}) was obtained in T_3 (residues 3 t ha^{-1}+cowdung 2.5 t ha^{-1}+fertilizers (N=55 kg ha^{-1}, P=30 kg ha^{-1}, K=25 kg ha^{-1}, S=15 kg ha^{-1})) treatment and the lowest biological yield (9.85 t ha^{-1}) was obtained in T_4 (residues 3 t ha^{-1}+vermicompost 5 t ha^{-1}) treatment (Table 2).

Combined effect of interaction of variety and manures and fertilizers with residues of *C. difformis and E. atropurpurea*

Biological yield was significantly influenced by the combined effect of interaction of variety and manures and fertilizers with residues of *C. difformis* and *E. atropurpurea*. The highest biological yield was produced by V_1T_3 (V_1 =Binadhan-13 × residues 3 t ha^{-1}+cowdung 2.5 t ha^{-1}+fertilizers (N=55 kg ha^{-1}, P=30 kg ha^{-1}, K=25 kg ha^{-1}, S=15 kg ha^{-1})) treatment and the lowest biological yield was produced by V_1T_4 (V_1 =Binadhan-13 × residues 3 t ha^{-1}+vermicompost 5 t ha^{-1}) treatment (Table 3).

HARVEST INDEX (%)

Effect of variety

Harvest index was not significantly affected by variety. The height harvest index (34.65%) was found in BRRI dhan34 and the lowest harvest index (33.73%) was found in Binadhan-13 (Table 1).

Effect of manures and fertilizers with residues of *C. difformis and E. atropurpurea*

Harvest index was significantly influenced by combination of manures and fertilizers with residues of *C. difformis* and *E. atropurpurea*. The highest harvest index (35.35%) was observed in T_4 (residues 3 t ha^{-1}+vermicompost 5 t ha^{-1}) treatment, and the lowest harvest index (32.45 %) was observed in T_1 (control) treatment (Table 2).

Combined effect of interaction of variety and manures and fertilizers with residues of *C. difformis and E. atropurpurea*

Harvest index was significantly influenced by the combined effect of interaction of variety and manures and fertilizers with residues of *C. difformis* and *E. atropurpurea*. The highest harvest index was observed in V_1T_2 (Binadhan-13 × residues 3 t ha^{-1}+cowdung 5 t ha^{-1}) treatment and the lowest harvest index was observed in V_2T_1 (BRRI dhan34 × control) treatment (Table 3).

Table 1: Effect of variety on yield and yield contributing characters of rice

Variety	Plant height (cm)	Number of total tillers	Number of effective tillers	Panicle length (cm)	Number of sterile spikelets $panicle^{-1}$	Number of filled grains $panicle^{-1}$	1000 - grain weight (g)	Biological yield (t ha^{-1})	Harvest index (%)
V_1	154.03	10.21b	9.88	23.05	9.13b	91.54b	20.17a	11.21	33.73
V_2	153.93	11.51a	10.08	23.15	19.63a	140.86a	14.49b	11.71	34.65
$LSD_{(0.05)}$	3.71	0.88	0.91	0.31	1.72	4.84	0.41	1.07	1.33
Level of Significant	NS	**	NS	NS	**	**	**	NS	NS
CV%	3.80	12.89	14.42	2.12	15.95	6.58	3.73	4.80	6.14

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

NS = Not significant
V_1 =Binadhan-13, V_2 = BRRI dhan34

Table 2: Effect of combination of manures and fertilizers with residues of *Cyperus difformis* (L.) *and Eleocharis atropurpurea* on yield and yield contributing characters of rice

Treatment	Plant height (cm)	Number of total tillers	Number of non-effective tillers	Panicle length (cm)	Number of filled grains panicle^{-1}	Number of sterile spikelets panicle^{-1}	1000-grain weight (g)	Biological yield (t ha^{-1})	Harvest index (%)
T_1	148.96cd	10.66b	0.80ab	23.07	113.57ab	13.82ab	15.55b	10.79bc	32.45b
T_2	150.07cd	10.10b	0.80ab	23.00	119.06a	12.17b	17.31a	10.14bc	35.41a
T_3	158.07ab	11.23b	1.20a	23.34	119.53a	14.90ab	17.95a	12.99a	34.37ab
T_4	147.31d	9.83b	0.43b	22.98	114.90ab	14.23ab	17.78a	9.85c	35.35a
T_5	161.87a	13.26a	1.30a	23.12	108.53b	14.30ab	17.43a	12.85a	33.85ab
T_6	154.33bc	10.70b	1.16a	22.8	117.26ab	15.03ab	17.60a	11.50abc	33.94ab
T_7	157.25ab	10.26b	0.46b	23.37	120.57a	16.22a	17.70a	12.12ab	33.98ab
$LSD_{(0.05)}$	6.93	1.66	0.54	0.58	9.06	3.23	0.76	2.01	2.49
Level of Significant	**	**	**	NS	**	**	**	**	**
CV%	3.80	12.89	15.77	2.12	6.58	15.95	3.73	4.80	6.14

In a column, figures with the same letter do not differ significantly as per DMRT.
** = Significant at 1% level of probability
NS = Not significant
Here,T_1=control, T_2=residues 3 t ha^{-1}+cowdung 5 t ha^{-1}, T_3=residues 3 t ha^{-1}+cowdung 2.5 t ha^{-1}+fertilizers (N=55 kg ha^{-1} ,P=30 kg ha^{-1},K=25 kg ha^{-1},S=15 kg ha^{-1}), T_4=residues 3 t ha^{-1}+vermicompost 5 t ha^{-1}, T_5= residues 3 t ha^{-1}+vermicompost 2.5 t ha^{-1}+ fertilizers (N=55 kg ha^{-1} ,P=30 kg ha^{-1},K=25 kg ha^{-1},S=15 kg ha^{-1}), T_6=residues 3 t ha^{-1}+trichocompost 10 t ha^{-1}, T_7= residues 3 t ha^{-1}+trichocompost 5 t ha^{-1}+fertilizers(N=55 kg ha^{-1} ,P=30 kg ha^{-1},K=25 kg ha^{-1},S=15 kg ha^{-1})

Table 3: Combined effect of interaction of variety and manures and fertilizers with residues of *Cyperus difformis* (L.) *and Eleocharis atropurpurea* residues on yield and yield contributing characters of rice

Interaction	Plant height (cm)	Number of total tillers	Number of effective tillers	No of non-effective tillers	Panicle length (cm)	Number of grains panicle^{-1}	Number of filled grains panicle^{-1}	No. of sterile spikelets 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	156.68abcd	10.26cde	10.00bcd	0.26d	23.15	99.67d	90.01d	9.66e	17.51c	4.06abcd	8.29ab	12.36abc	32.95bc
V_1T_2	149.07def	9.80cde	9.66bcd	0.13d	22.70	100.87d	92.12d	8.75e	19.81b	3.16cde	6.51bcd	9.67cde	32.58bc
V_1T_3	160.83ab	10.40cde	9.93bcd	0.46d	23.63	101.20d	93.29d	7.90e	21.14a	4.65a	8.94a	13.59a	34.20bc
V_1T_4	144.71ef	8.20e	8.13d	0.06d	22.78	103.00d	93.74d	9.26e	20.95a	3.05de	5.76d	8.81e	34.60bc
V_1T_5	159.35abc	13.33a	12.53a	0.80bcd	23.40	95.20d	87.80d	7.40e	20.65ab	4.25ab	8.11abc	12.36abc	34.15bc
V_1T_6	149.07def	9.93cde	9.66bcd	0.26d	22.81	106.07d	94.11d	11.95de	20.56ab	3.26bcde	6.34cd	9.61cde	33.98bc
V_1T_7	158.51abcd	9.60de	9.26bcd	0.33d	22.87	98.78d	89.75d	9.03e	20.55ab	4.06abcd	8.00abc	12.06abcd	33.65bc
V_2T_1	141.23f	11.06abcd	9.73bcd	1.33abc	23.00	155.13bc	137.14bc	17.99bc	13.58e	2.92e	6.29cd	9.22de	31.94c
V_2T_2	151.07bcde	10.40cde	8.93cd	1.46ab	23.31	161.60abc	146.00ab	15.59cd	14.81d	4.03abcd	6.57bcd	10.61bcde	38.25a
V_2T_3	155.30abcd	12.06abc	10.13abcd	1.93a	23.05	167.67ab	145.77ab	21.90ab	14.76d	4.28ab	8.11abc	12.39abc	34.53bc
V_2T_4	149.90cdef	11.46abcd	10.66abc	0.80bcd	23.18	155.27bc	136.06bc	19.20abc	14.61de	3.98abcde	6.91bcd	10.89abcde	36.09ab
V_2T_5	164.40a	13.20ab	11.40ab	1.80a	22.84	150.47c	129.26c	21.21ab	14.21de	4.48a	8.87a	13.35ab	33.55bc
V_2T_6	159.60abc	11.46abcd	9.40bcd	2.06a	22.79	158.53bc	140.42abc	18.11bc	14.63de	4.55a	8.84a	13.39ab	33.90bc
V_2T_7	155.98abcd	10.93bcd	10.33abcd	0.60cd	23.87	174.80a	151.39a	23.41a	14.86d	4.17abc	8.00abc	12.17abc	34.31bc
$LSD_{(0.05)}$	9.81	2.35	2.42	0.76	0.82	14.78	12.82	4.57	1.08	1.06	1.90	2.84	3.52
Level of Significant	**	**	**	**	NS	**	**	**	**	**	**	**	**
CV%	3.80	12.89	14.42	15.77	2.12	6.75	6.58	15.95	3.73	6.13	5.03	4.80	6.14

In a column, figures with the same letter do not differ significantly as per DMRT.
** = Significant at 1% level of probability
NS = Not significant
Here,
V_1 =Binadhan-13, V_2 = BRRI dhan34
T_1=control, T_2=residues 3 t ha^{-1}+cowdung 5 t ha^{-1}, T_3=residues 3 t ha^{-1}+cowdung 2.5 t ha^{-1}+fertilizers(N=55 kg ha^{-1} ,P=30 kg ha^{-1},K=25 kg ha^{-1},S=15 kg ha^{-1}), T_4=residues 3 t ha^{-1}+vermicompost 5 t ha^{-1}, T_5= residues 3 t ha^{-1}+vermicompost 2.5 t ha^{-1}+ fertilizers(N=55 kg ha^{-1} ,P=30 kg ha^{-1},K=25 kg ha^{-1},S=15 kg ha^{-1}), T_6=residues 3 t ha^{-1}+trichocompost 10 t ha^{-1}, T_7= residues 3 t ha^{-1}+trichocompost 5 t ha^{-1}+fertilizers(N=55 kg ha^{-1} ,P=30 kg ha^{-1},K=25 kg ha^{-1},S=15 kg ha^{-1}).

DISCUSSION

Effect of variety on yield and yield contributing characters:

The tallest plant (154.03 cm) was observed in Binadhan-13 and the shortest plant (153.93 cm) was observed in BRRI dhan34 (Table 1). Plant height is a varietal character and it is the genetic constituent of the cultivar. But plant height was not significantly different among the varieties due to genetic similarity and ecological variation. The highest number of effective tillers hill^{-1} (10.08) was found in BRRI dhan34 and the lowest number of effective tillers hill^{-1} was found in Binadhan-13 (9.88) (Fig.1). This might have occurred due to differences in genetic makeup of the varieties tested. BRRI (1991) observed that the number of effective tillers produced by some transplanted *Aman* rice ranged from 14 to 42 and it significantly differed from variety to variety. Numerically, the longest panicle (23.15 cm) was recorded in Binadhan-13 and the shortest panicle (23.05 cm) was recorded in BRRI dhan34 (Table 1). BINA (1996) reported that panicle length was influenced due to variety. No varietal difference observed regarding the panicle length might be due to similarity in genetic make-up and environmental effect. The highest number of grains was observed in BRRI dhan34 and the lowest one was found in Binadhan-13. Varietal differences regarding the number of grains might be due to differences in genetic constituents (Chowdhury *et al.* 2016). The highest thousand grain weight (20.17 g) was found in Binadhan-13 and the lowest one was found (14.49 g) in BRRI dhan34 (Table 1). The variation in weight of thousand grains might be due to different size of grains that were partly controlled by genetic makeup of the studied varieties. Islam *et al.* (2010) also expressed similar view. The highest grain yield (4.04 t ha^{-1}) was obtained in BRRI dhan34 (Fig. 5) and the lowest grain yield (3.78 t ha^{-1}) was obtained in Binadhan-13 (Fig. 5). Grain yield differences might be genetic characteristics of the varieties. Sohel *et al.* (2009) reported variable grain yields among the varieties. The highest biological yield (11.71 t ha^{-1}) was found in Binadhan-13 and the lowest biological yield (9.29 t ha^{-1}) was found in BRRI dhan34 (Table 1). Variation in maturity and duration may be the reason for differences in biological yield. Chowhan *et al.* (2017) also reported the similar phenomenon. The height harvest index (34.65%) was found in BRRI dhan34 and the lowest harvest index (33.73%) was found in Binadhan-13 (Table 1). Kabir *et al.* (2004) reported variable harvest index among the varieties.

Effect of manures and fertilizers with residues of *C. difformis and E. atropurpurea:*

The tallest plant (161.87 cm) was found in T_5 (residues 3 t ha^{-1}+vermicompost 2.5 t ha^{-1}+ fertilizers (N=55 kg ha^{-1}, P=30 kg ha^{-1}, K=25 kg ha^{-1}, S=15 kg ha^{-1})) treatment whereas the shortest plant (147.31 cm) was found in T_4 (residues 3 t ha^{-1}+vermicompost 5 t ha^{-1}) treatment (Table 2). This might be due to the availability of more nutrients from a weed free environment. Yoseftabar (2013) reported that the plant height increased significantly with different crop residues. The highest number of grains panicle^{-1} was produced by T_7 treatment followed by T_3 treatment while the lowest number of grains panicle^{-1} was produced by T_5 treatment (Fig. 4). 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) observed that effective weed management increased number of grains due to more availability of water, nutrients and light. Similar results were supported by Islam *et al.* (2024). The highest grain yield (4.46 t ha^{-1}) was produced by T_3 (residues 3 t ha^{-1}+cowdung 2.5 t ha^{-1}+fertilizers (N=55 kg ha^{-1}, P=30 kg ha^{-1}, K=25 kg ha^{-1}, S=15 kg ha^{-1})) treatment and lowest one (3.49 t ha^{-1}) was produced by T_1 (control) treatment (Fig.6). Incorporation of weed residue 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 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. Hossain *et al*. (2024) also reported the similar results, where crop residues influenced in crop performance. The highest straw yield (8.52 t ha^{-1}) was observed in T_3 (residues 3 t ha^{-1}+cowdung 2.5 t ha^{-1}+fertilizers (N=55 kg ha^{-1}, P=30 kg ha^{-1}, K=25 kg ha^{-1}, S=15 kg ha^{-1}) treatment and the lowest straw yield (6.33 t ha^{-1}) was observed in T_1 treatment (Fig. 8). The highest biological yield (12.99 t ha^{-1}) was obtained in T_3 (residues 3 t ha^{-1}+cowdung 2.5 t ha^{-1}+fertilizers(N=55 kg ha^{-1}, P=30 kg ha^{-1}, K=25 kg ha^{-1}, S=15 kg ha^{-1})) treatment and the lowest biological yield (9.85 t ha^{-1}) was obtained in T_4 (residues 3 t ha^{-1}+vermicompost 5 t ha^{-1}) 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.

CONCLUSION

According to the study's findings, the incorporation of manures, fertilizers with residues of *Cyperus difformis* and *Eleocharis atropurpurea* improves T. *aman* rice's yield and yield-contributing traits. The best results were obtained with the variety Binadhan-13 and T_3 (Residues 3 t ha^{-1} + Cowdung 2.5 t ha^{-1} + Fertilizers (N = 55 kg ha^{-1}, P = 30 kg ha^{-1}, K = 25 kg ha^{-1}, S = 15 kg ha^{-1}) treatment followed by T_6 (Residues 3 t ha^{-1} + Trichocompost 10 t ha^{-1}) treatment for the majority of the traits under study. In light of this, residues from *Cyperus difformis* and *Eleocharis atropurpurea*, when paired with manures and fertilizers, could serve as an environmentally beneficial yield improvement technique for long-term crop development.

ACKNOWLEDGMENTS

The author would like to acknowledge the Ministry of Science and Technology, People's Republic of Bangladesh for funding this research work.

REFERENCES

1. BINA 1996: *Annual Report for 1993-1994.* Bangladesh Institute of Nuclear Agriculture P. O. Box. No. 4, Mymensingh. p. 175.
2. Bitew Y and Alemayehu M 2017: Impact of crop production inputs on soil health: a review. *Asian Journal Plant Science*, 16(3), 109-131.
3. BRRI 1991: *Annual Report for 75 - 76.* Bangladesh Rice Research Institute, Joydebpur, Gazipur. pp. 3-5.
4. Chowdhury SA, Paul SK and Sarkar MAR 2016: Yield performance of fine aromatic rice in response to variety and level of nitrogen. *Journal of Environmental Science and Natural Resources,* 9(1), 41-45.
5. Chowhan S, Haider MR, Hasan AFMF, Hoque MI, Kamruzzaman M and Gupta R 2017: Comparative on farm performance of five modern rice varieties with two local cultivars. *Journal of Bioscience and Agriculture Research,* 13(01), 1074-1086.
6. De Datta SK 1990: Weed control in rice in South East Asia. Ext. Bull. No. 146 FFTC. Taiwan. pp: 1-24.
7. Gomez MA, Gomez AA 1984: Statistical Procedures for Agricultural Research. John Willey and Sons. New York, Chichester, Brisbane, Toronto. pp. 97-129, 207-215.
8. Hossain MS, Mia ML, Sium MAR, Islam MS, Islam MS and Uddin MR 2024: Investigating the effectiveness of herbicides for weed suppression in late boro rice. European Academic Research, 11, 1339-1346
9. Islam MS, Hossain MR, Shammy US, Joly MSA, Shikder MM and Mia ML 2024: Integrated effect of manures and fertilizers with the allelopathy of *Fimbristylis dichotoma* (L.) on the yield performance of rice. *International Journal of Multidisciplinary Research and Growth Evaluation*, 5(2), 333-340. https://doi.org/10.54660/.IJMRGE.2024.5.2.333-340
10. Islam SS, Amin MHA, Parvin S, Amanullah ASM and Ahsanullah ASM 2010: Effect of pre and post emergence herbicides on the yield of transplant aman rice. *Bangladesh Research Public Journal,* 3(4), 1242-1252.
11. Kabir MH, Rahaman MS and Hossain SMA 2004: Effect growth and variety on the yield and yield components of aman rice. *Bangladesh Journal of Crop Science*, 12 (1&2), 139-144.
12. Kannaiyan S 2000: Biological fertilizers for sustainable rice (Oryza sativa) production.67-107
13. Li Y, Shao X, Guan W, Ren L, Liu J, Wang J, and Wu Q 2016: Nitrogen-decreasing and yield-increasing effects of combined applications of organic and inorganic fertilizers under controlled irrigation in a paddy field. *Polish Journal of Environmental Studies*, *25*(2), 673-680.
14. Morone P, Falcone PM and Lopolito A 2019: How to promote a new and sustainable food consumption model: A fuzzy cognitive map study. *Journal of Cleaner Production,* 208, 563-574.
15. Mou MRJ, Salam MA, Hossen K, Kato-Noguchi H and Islam MS 2017: Effect of weeding regime on the performance of transplanted aman rice. *Journal of Agroforestry and Environment,* 11(1&2), 261-266.
16. Mueller ND, Gerber JS, Johnston M, Ray DK, Ramankutty N and Foley JA Closing yield gaps through nutrient and water management 2012: *Nature***,** 490, 254-257.
17. Nambiar EKS and Brown AG 1997: Towards sustained productivity of tropical plantations: science and practice. pp. 527-557.
18. Nanjundappa G, Shivaraj B, Sridhana S and Janarjuna S 2000: Effect of organic and inorganic sources of alone and in combination on the growth and yield of fodder maize. *Mysore journal of agricultural science,* 34, 247-250.
19. Ramamoorthy K and Lourduraj AC 2002: INM in direct sown rainfed finger millet (*Eleucinecoracana* Garrtn.). *Madras Agricultural Journal*, 89, 33-35.

20. Sohel MAT, Siddique MAB, Alam MN and Karim MM 2009: Varietal performance of transplant aman rice under different hill densities. *Bangladesh Journal of Agricultural Research*, 34 (1), 33-39.
21. Suri VK, Jha S and Verma TS 1997: Efficient and economic fertilization of rainfed maize for its specific yields through soil testing and integrated Fertilizer levels. *Crop Research*, 13, 59-67.
22. Yoseftabar S 2013: Effect nitrogen management on panicle structure and yield in rice (*Oryza sativa* L.). *International Journal of Agriculture and Crop Sciences*, 5(11), 1224–1227.
23. Zaman F, Islam MS and Kato-Noguchi H 2018: Allelopathic activity of the *Oxalis europea* L. extracts on the growth of eight test plant species. *Research on Crops*, 19(2), 304-309. https://doi.org/10.5958/2348-7542.2018.00046.3