Reprint

ISSN 1991-3036 (Web Version)

International Journal of Sustainable Crop Production (IJSCP)

(*Int. J. Sustain. Crop Prod.*)

Volume: 18	Issue: 1	February 2023

Int. J. Sustain. Crop Prod. 18(1): 10-18 (February 2023)

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ISSN-1991-3036 (Online)
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EFFECT OF INTEGRATED NUTRIENT MANAGEMENT ON THE YIELD PERFORMANCE OF INBRED AND HYBRID RICE

M.L. MIA[1], M. BEGUM[1], I.J. RIZA[1], M.H. KABIR[2], F.A. NESHE[3], S. MONIRA[1], F. ZAMAN[1] AND M.S. ISLAM[1*]

[1]Department of Agronomy, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh; [2]Department of Seed Science and Technology, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh; [3]Department of Agroforestry, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh.

Accepted for publication on 10 January 2023

ABSTRACT

Mia ML, Begum M, Riza IJ, Kabir MH, Neshe FA, Monira S, Zaman F, Islam MS (2023) Effect of integrated nutrient management on the yield performance of inbred and hybrid rice. *Int. J. Sustain. Crop Prod.* 18(1), 10-18.

In addition to fulfilling the nutrient turnover in the soil-plant systems, it has been discovered that the integrated use of organic and inorganic fertilizers has potential for attaining sustainable crop yield over the long term under modern intensive cropping. A field trial was conducted to evaluate the effect of integrated nutrient management on the yield performance of inbred and hybrid rice. In this experiment two *boro* rice varieties *viz.*, BRRI dhan58 (V_1), Hybrid SL-8H (V_2) and six nutrient managements *viz* control (no application of manures and fertilizer) (T_1), recommended dose of inorganic fertilizer for the varieties (T_2), vermicompost (3 t ha^{-1}) (T_3), cowdung (5 t ha^{-1}) (T_4), 50% less then recommended dose of inorganic fertilizer + vermicompost (1.5 t ha^{-1}) (T_5), 50% less then recommended dose of inorganic fertilizer + cowdung (2.5 t ha^{-1}) (T_6) were used. The experiment revealed that the longest plant height (77.09 cm), the highest number of total tillers hill^{-1} (15.90), number of effective tillers hill^{-1} (13.01), longest panicle length (22.27 cm), highest number of grains panicle^{-1} (134.43), 1000-grain weight (21.56), grain yield (7.72 t ha^{-1}), straw yield (8.24 t ha^{-1}), were found in hybrid SL-8H. Different nutrient managements also exerted significant influences on the yield and yield contributing characters of *boro* rice. Total number of tillers hill^{-1} (16.14), number of effective tillers hill^{-1} (14.73), number of grains panicle^{-1} (140.65), 1000-grain weight (23.35 g), grain yield (7.95 t ha^{-1}), straw yield (8.9 t ha^{-1}), and harvest index (47.39%) were found highest when 50% less then recommended dose of inorganic fertilizer + vermicompost (1.5 t ha^{-1}) was applied. In case of interaction, the highest total number of tillers hill^{-1} (16.00), number of grains panicle^{-1} (141.14), 1000-grain weight (23.37 g), grain yield (8.40 t ha^{-1}), straw yield (9.00 t ha-¹), harvest index (48.27%) were observed from Hybrid SL-8H with 50% less then recommended dose of inorganic fertilizer + vermicompost (1.5 t ha^{-1}). From this result, it may be suggested that hybrid SL-8H could be cultivated with 50% less then recommended dose of inorganic fertilizer + vermicompost (1.5 t ha^{-1}) as promising variety in *boro* season. So, it can be concluded that integrated nutrient (chemical fertilizer along with vermicompost) greatly influenced the yield contributing characters and yield of *boro* rice.

Key words: *boro rice, integrated nutrient management, inbred, hybrid, yield*

INTRODUCTION

Rice (*Oryza sativa* L.) is one of the most important staple food crops, which supplies major source of calories for about 45% of world population, particularly to the people of Asian countries. Rice stands second in the world after wheat in area and production. Asia produces and consumes 90% of world's rice. More than 756.7 Mt of rice was produced globally in 2020 (FAO 2022). Rice is the most important cereal crop in Asia and approximately 90% of annual production is grown and consumed. But the mean yields in Asia are low compared to global mean yields (Haider 2018). The United States Department of Agriculture (USDA 2021)'s November grain forecast for FY 2021-22 shows Bangladesh's rice output may be 35.5 Mt this year amid a poor harvest in *aus* season. The primary estimates of the Bangladesh Bureau of Statistics (BBS 2021) showed rice output was above 36.3 Mt in FY21.Taking into account the latest USDA forecast, rice yield might fall by 0.8 Mt in FY22 here.

For marketing year (MY) 2021-22, rice production in Bangladesh may be 35.5 Mt on 11.42 M ha which are 2.2% and 2.1% respectively lower than the USDA's official forecast earlier, according to the latest USDA report. Rice production area is decreasing day by day due to high population pressure. Therefore, attempts should be taken to increase the yield per unit area by using integrated nutrient management practices. Cultivation of improved varieties and proper nutrient management are the most effective means to achieve the goal. The Bangladesh Rice Research Institute (BRRI) has released 100 modern varieties of rice suitable for cultivation in one or more rice growing season of Bangladesh (BRRI 2021). The use of inorganic fertilizer in rice cultivation has been progressively increasing since its introduction. However, available reports indicate that the repeated use of chemical fertilizer alone fails to sustain desired yield, impairs soil physical condition and exhausts organic matter content (Mohammad 2010). Integrated nutrient management seems to be suitable approach to achieve the goals. The limitations associated with inorganic sources of plant nutrients are often overcome when they used in judicious combination with organic manures. Combine application of organic and inorganic fertilizer may also reduce the cost of production by lowering the need for chemical fertilizers. To improve the current soil condition and mitigate the yield gap among other higher rice yielding countries and Bangladesh, the best remedy is to apply a combination of both organic and inorganic fertilizers where inorganic fertilizer provides nutrients and the organic fertilizers increases soil organic matter and improve soil structure as well as ameliorate the buffering capacity of the soil.

Corresponding author & address: Md. Shafiqul Islam, E-mail: shafiqagron@bau.edu.bd
Md. Liton Mia, Mahfuza Begum, Israt Jahan Riza, Muhammad Humayun Kabir, Fauzia Akter Neshe, Sirajam Monira, Farhana Zaman and Md. Shafiqul Islam*

Use of organic amendment like cowdung and poultry manure is generally considered as a key to the soil health and sustainability in intensive rice-based cropping systems, both in terms of maintaining the amount and quality of soil organic matter and in terms of supplying important nutrients (Ali *et al*. 2009). Moreover, a suitable combination of variety and rate of fertilizer dose is necessary for obtaining better yield. Though rice is one of the most important crops in Bangladesh, enough information regarding the varieties of rice and their response to organic manure and inorganic fertilizers combinedly are scarce. Extensive research works are necessary to find out appropriate variety and optimum rate of cowdung, vermicompost in combination with inorganic fertilizers to obtain satisfactory yield and quality of rice. Keeping the above points in view the current work was conducted to evaluate the effect of integrated nutrient management on the yield performance of inbred and hybrid rice.

MATERIALS AND METHODS

Experimental Site

At Bangladesh Agricultural University (BAU), Mymensingh's Agronomy Field Laboratory, the experiment was carried out. Old Brahmaputra Floodplain, 24.75° N latitude, 90.50° E longitude, was the chosen region (AEZ-9). It is elevated 18 meters above sea level with a non-calcareous dark grey floodplain soil. The field had a pH of 6.7, was flat, and had a well-drained surface.

The experiment was conducted at the Agronomy Field Laboratory, BAU, Mymensingh during the period from November 2019 to April 2020. The field is located at $24^0 75'$ N latitude and $90^0 50'$ E longitude with an altitude of 18m above the mean sea level. The research field belongs to the agro-ecological zone of the Old Brahmaputra Floodplain (AEZ-9).

Experimental Treatments

The experiment consists of two factors; factor A: rice varieties *viz*., BRRI dhan58, Hybrid SL-8H; factor B: Nutrient management *viz*., Control (No application of manures and fertilizer), Recommended dose of inorganic fertilizer for the varieties, vermicompost (3 t ha^{-1}), cowdung (5 t ha^{-1}), 50% less then recommended dose of inorganic fertilizer + vermicompost (1.5 t ha^{-1}), 50% less then recommended dose of inorganic fertilizer + cowdung (2.5 t ha^{-1})

Experimental Design

The experiment will be laid out in a randomized complete block design (RCBD) with three replications. The size of each plot was $5m^2$ (2.5 m × 2.0 m). The total number of plots was 36 (3 × 12). The space between blocks and plots were and 0.5 m, respectively.

Preparation of nursery bed and experimental land

Vermicompost was applied as basal dose (as per treatment) on 30 January before transplanting of rice seedlings. Cowdung was applied as basal dose (as per treatment) on 30 January before transplanting of rice seedlings. Urea, triple super phosphate, muriate of potash, gypsum and zinc sulphate @ 250, 130, 120, 60 and 10 kg ha^{-1}, respectively (BRRI 2016). The whole amount of triple super phosphate, muriate of potash, gypsum and zinc sulphate were applied at the time of final land preparation as per experimental specification. Urea was applied in 3 equal splits at 15, 30, and 45 days after transplanting (DAT).

Transplantation and cultivation practices

The nursery beds were made wet by application of water both in the morning and evening on the previous day before uprooting seedlings to make nursery bed soft. 55 days old seedlings were uprooted carefully from the nursery beds on 15th January 2020 for transplantation. For this purpose, the nursery beds were made wet by the application of water on the previous day before uprooting the seedlings to minimize mechanical injury of roots.

General observation of the experimental field

The field was investigated from time to time to detect the visual difference between the treatment and any kind of infestation by weeds, insects, and diseases so that considerable losses by pests could be minimized. No bacterial and fungal disease was observed in the field.

Harvesting and processing

The maturity of the crop was determined when 90% of the grains became golden yellow. Harvesting was done on 30^{th} April 2020. Five hills per plot were preselected randomly from which different growth and yield attribute data were collected and $1m^2$ areas from a middle portion of each plot were separately harvested and bundled, properly tagged, and then brought to the threshing floor for recording grain and straw yield. Threshing was done by using a pedal thresher. The grains were cleaned and sun-dried to a moisture content of 14% approximately. Straw was also sun-dried properly.

Data recorded at harvest

Five hills were randomly selected from each plot excluding boarder rows prior to harvest for recording data on yield contributing characters. Experimental data on yield and yield contributing characters were recorded 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}, nanicle length, number of sterile spikelets panicle^{-1}, number of grains panicle^{-1}, neight of 1000-grains (g), grain yield (t ha^{-1}), straw yield (t ha^{-1}), biological yield (t ha^{-1}), and harvest index (%).

Harvest Index (%)

It denotes the ratio of grain yield to biological yield and was calculated with the following formula.

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

Statistical analysis

The recorded data were compiled and tabulated for statistical analysis. Analysis of variance was done with the help of an R Studio programming language (R Core Team 2021). Collected data were analyzed using the "Analysis of variance" technique and the significance of the mean differences was adjudged by Duncan's Multiple Range Test (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Effect of Variety on the Yield Contributing Characters and Yield of *boro* rice

The plant height of *boro* rice was significantly influenced by different varieties (Figure 1). The result revealed that the variety BRRI dhan58 produced the taller plant (90.52 cm) than the variety hybrid SL-8H (77.09 cm). These differences might be due to variation in the genetic make-up of the varieties. Tyeb *et al.* (2013) observed such variation in plant height due to varietal differences. Number of total tillers hill^{-1} was significantly influenced by the variety of *boro* rice (Figure 1). The higher number of total tiller hill^{-1} (14.41) was obtained from hybrid SL-8H and the lower number of tiller hill^{-1} (14.04) was found from BRRI dhan58. The number of total tillers hill^{-1} varied due to varietal differences (Sarker 2012). Effective tillers hill^{-1} was significantly influenced by rice varieties at 5% level of probability (Figure 1). The higher number of effective tillers hill^{-1} (13.01) was found in hybrid SL-8H and BRRI dhan58 produced the lower number of effective tillers hill^{-1} (12.74). The probable reasons of difference in producing the number of effective tillers hill^{-1} was mainly genetic make-up of the variety. This was confirmed by Kabir *et al.* (2004) who stated that effective tillers hill^{-1} varied with variety. Non-effective tillers hill^{-1} was not significantly influenced by rice varieties (Figure 1). However, numerically the higher number of non-effective tillers hill^{-1} (1.46) was found in hybrid SL-8H and BRRI dhan58 produced the lower number of non-effective tillers hill^{-1} (1.46). Panicle length was significantly influenced by variety (Figure 1). Results showed that hybrid SL-8H produced the longer panicle length (22.27 cm) whereas BRRI dhan58 produced the shorter panicle length (21.78 cm). This difference might be due to genetic variation among the varieties (Hossain *et al.* 2003). Grains panicle was significantly influenced by the varieties at 5% level of probability (Figure 1). The number of grains panicle^{-1} (134.43) of hybrid SL-8H was statistically lower than BRRI dhan58 (132.62). The variation in grains panicle^{-1} production between varieties might be due to their genetic make-up. Hasanuzzaman *et al.* (2012) in different varieties of rice where they showed that the grains panicle^{-1} of hybrid Heera1 varied for the treatment inorganic fertilizers like Na and P. Number of sterile spikelets panicle^{-1} was not significantly influenced by rice varieties (Figure 1). The number of sterile spikelets panicle^{-1} was maximum (11.65) was observed from hybrid SL-8H and minimum (11.48) was obtained from BRRI dhan58. Varietal differences regarding the number of sterile spikelets panicle^{-1} might be due to their differences in genetic constituents (Chowdhury *et al*. 2016). The weight of 1000-grain was not significantly influenced by the varieties (Figure 1). The higher weight of 1000-grain (21.56 g) was observed from hybrid SL-8H and the lower weight of 1000-grain (21.44 g) was observed from BRRI dhan58. Masum *et al*. (2012) conducted an experiment and reported that the weight of 1000-grain varied among varieties. Variety exerted significant effect on grain yield (Figure 1). Hybrid SL-8H produced the higher grain yield (7.72 t ha^{-1}). On the other hand, BRRI dhan58 produced the lower one (6.83 t ha^{-1}). Chakraborty *et al.* (2020) reported that grain yield may differ due to genetic characteristics of the varieties. Straw yield was significantly influenced by varieties (Figure 1). It was recorded that the higher number of straw yield (8.24 t ha^{-1}) was obtained from Hybrid SL-8H and the lower one (8.05 t ha^{-1}) was obtained from BRRI dhan58. The results are in agreement with the findings of Maksudul and Elora (2015), who reported that varietal differences in straw yield might be due to genotypic variation. Biological yield was significantly influenced by varieties at 1% level of probability (Figure 1). The higher biological yield (15.96 t ha^{-1}) was obtained from hybrid SL-8H and the lower one (14.88 t ha^{-1}) was obtained from BRRI dhan58. Harvest index was significantly influenced by varieties at 1% level of probability (Figure 1). The higher harvest index (48.32%) was obtained from hybrid SL-8H and the lower one (45.84%) was obtained from BRRI dhan58.

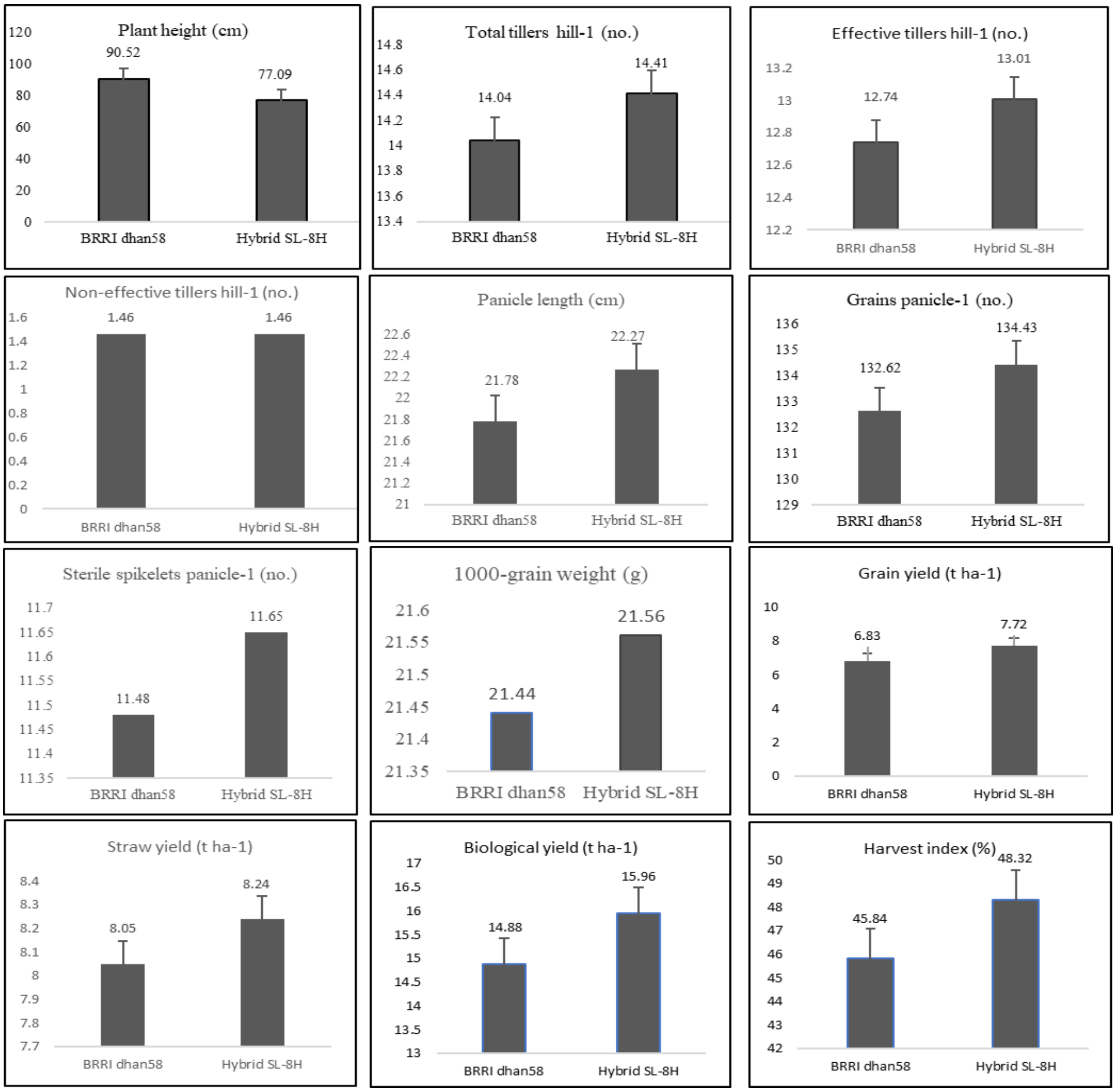

Fig. 1. Effect of variety on the yield contributing characters and yield of *boro* rice

Effect of Nutrient Management on the Yield Contributing Characters and Yield of *boro* rice

Integrated nutrient management had significant effect on plant height (Figure 2). The longest plant height (88.98 cm) was found in 50% less then recommended dose of inorganic fertilizer + vermicompost (1.5 t ha^{-1}) and the lowest plant height (74.47 cm) in control which was statistically identical to the treatment cowdung (5 t ha^{-1}) and 50% less then recommended dose of inorganic fertilizer + cowdung (2.5 t ha^{-1}). Adhikari *et al.* (2018) also reported the similar phenomenon. Integrated nutrient management had significant effect on number of total tillers $hill^{-1}$ (Figure 2). The highest number of total tillers $hill^{-1}$ (15.90) was obtained with 50% less then recommended dose of inorganic fertilizer + vermicompost (1.5 t ha^{-1}) and that was the lowest (11.12) with control. Sahiduzzaman (2008) viewed differently that organic and inorganic fertilizers increased tiller number $hill^{-1}$. Integrated nutrient management had significant effect on number of effective tillers $hill^{-1}$ (Figure 2). The highest number of effective tillers $hill^{-1}$ (14.73) was obtained with treatment of 50% less then recommended dose of inorganic fertilizer + vermicompost (1.5 t ha^{-1}) and the lowest (9.63) with control. Similar phenomenon was also reported by Chamely *et al.* (2015). Integrated nutrient management was not significant effect on number of non- effective tillers $hill^{-1}$ (Figure 2). The highest number of non-effective tillers $hill^{-1}$ (1.52) was obtained with treatment of 50% less then recommended dose of inorganic fertilizer + cowdung (2.5 t ha^{-1}) and the lowest (1.37) with treatment of vermicompost (3 t ha^{-1}). Integrated nutrient management had significant effect on panicle length (Figure 2). The highest length of panicle (23.26 cm) was obtained with treatment of 50% less then recommended dose of inorganic fertilizer + vermicompost (1.5 t ha^{-1}). On the other hand, the lowest was (19.43 cm) in control. Chakma (2006) found that shorter panicle length might be in lower doses of fertilizer. Number of grains $panicle^{-1}$ was significantly influenced by nutrient management (Figure 2). The amount of grains $panicle^{-1}$ was maximum (140.65) at 50% less then recommended dose of inorganic fertilizer +

vermicompost (1.5 t ha^{-1}) and minimum (124.10) at control. Integrated nutrient management had significant effect on number of sterile spikelets panicle^{-1} (Figure 2). The number of sterile spikelets panicle^{-1} was maximum (12.01) at treatment of 50% less then recommended dose of inorganic fertilizer + vermicompost (1.5 t ha^{-1}) and minimum (10.81) at control which was significant at 1% level of probability. 1000-grain weight was significantly affected by integrated nutrient management (Figure 2). The highest 1000-grain weight (23.35 g) was found at treatment of 50% less then recommended dose of inorganic fertilizer + vermicompost (1.5 t ha^{-1}) and the lowest (18.90 g) was found in control. Adhikari *et al.* (2018) also reported the similar phenomenon. Grain yield was significantly affected by integrated nutrient management (Figure 2). The highest grain yield (7.95 t ha^{-1}) was recorded from the treatment of 50% less then recommended dose of inorganic fertilizer + vermicompost (1.5 t ha^{-1}) and the lowest (5.95 t ha^{-1}) from control treatment. Chakraborty *et al.* (2020) also reported the similar phenomenon. Integrated nutrient management exerted significant effect on straw yield (Figure 2). The highest straw yield (8.90 t ha^{-1}) was found in the treatment of 50% less then recommended dose of inorganic fertilizer + vermicompost (1.5 t ha^{-1}). The lowest straw yield (7.00 t ha^{-1}) was recorded from control. Nath *et al.* (2018) also found similar result. Biological yield was significantly affected by integrated nutrient management (Figure 2). The highest biological yield (16.85 t ha^{-1}) was obtained from treatment of 50% less then recommended dose of inorganic fertilizer + vermicompost (1.5 t ha^{-1}) and the lowest biological yield (12.95 t ha^{-1}) was obtained from control. Harvest index was significantly affected by integrated nutrient management (Figure 2). The highest harvest index (47.39%) was recorded in the treatment of 50% less then recommended dose of inorganic fertilizer + vermicompost (1.5 t ha^{-1}). On the other hand, the lowest harvest index (45.94%) was found in control treatment.

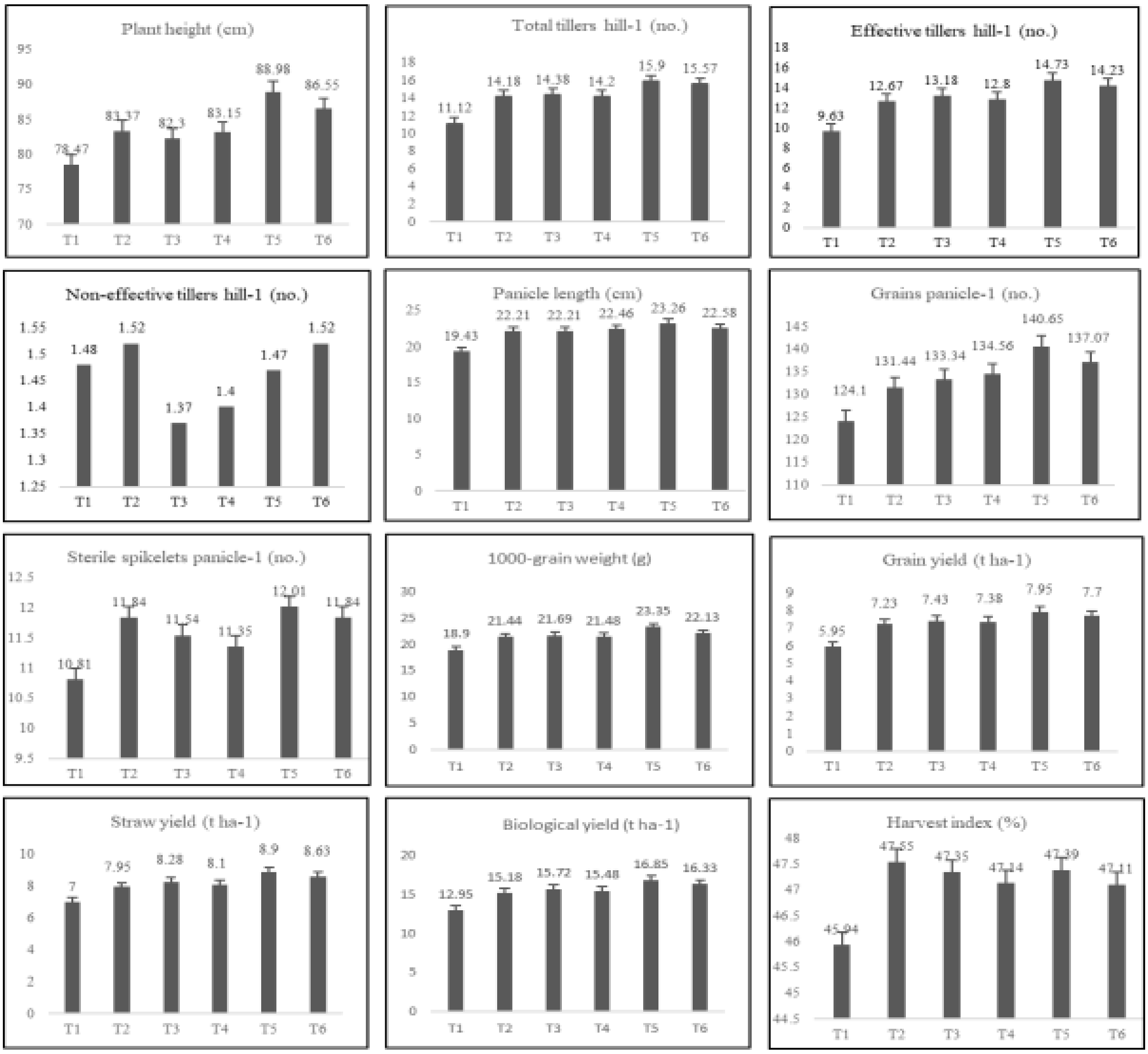

Fig. 2. Effect of nutrient management on the yield contributing characters and yield of *boro* rice

Where T_1 = control, T_2 = recommended dose of inorganic fertilizer for the varieties, T_3 = vermicompost (3 t ha^{-1}), T_4 = cowdung (5 t ha^{-1}), T_5 = 50% less then recommended dose of inorganic fertilizer + vermicompost (1.5 t ha^{-1}), and T_6 = 50% less then recommended dose of inorganic fertilizer + cowdung (2.5 t ha^{-1})

Interaction Effect of Variety and Nutrient Management on the Yield Contributing Characters and Yield of *boro* rice

Interaction of variety and nutrient management had significant effect on plant height (Table 1). The tallest plant (95.43 cm) was obtained from BRRI dhan58 with the treatment of 50% less then recommended dose of inorganic fertilizer + vermicompost (1.5 t ha^{-1}) and the shortest plant (72.20 cm) was obtained in Hybrid SL-8H when applied no application of manures and fertilizer). Romana *et al.* (2020) also observed that inorganic fertilizers with combination of organic manure gave the highest plant height. Number of total tillers $hill^{-1}$ was significantly influenced by the interaction between variety and nutrient management (Table 1). Number of total tillers $hill^{-1}$ was gradually increased up to certain period thereafter it becomes decreased. The highest number of tillers $hill^{-1}$ (16.00) was obtained from Hybrid SL-8H and 50% less then recommended dose of inorganic fertilizer + vermicompost (1.5 t ha^{-1}) and the lowest one (10.77) was obtained from BRRI dhan58 with no application of manures and fertilizer. The interaction effect of nutrient management and rice varieties was statistically significant in terms of number of effective tillers $hill^{-1}$ (Table 1). The highest number of effective tillers $hill^{-1}$ was found (14.97) in BBRI dhan58 and 50% less then recommended dose of inorganic fertilizer + vermicompost (1.5 t ha^{-1}) and lowest number of effective tiller was found (9.10) in BBRI dhan58 and control. Romana *et al.* (2020) also found similar result where they found that, for integrated nutrient at 35 DAT, the highest tiller number (121) was found in 75% of recommended dose (BRD) + 2.5 t ha^{-1} of decomposed poultry manure which is 34.4% and 40.7% higher than BRD and 75% BRD, respectively.

The interaction effect of nutrient management and variety was significant in terms of number of non-effective tillers $hill^{-1}$ (Table 1). The lowest number of non-effective tillers $hill^{-1}$ (1.30) was obtained from hybrid SL-8H and control. The highest number of non-effective tiller $hill^{-1}$ (1.67) was found in BBRI dhan58 and control (no application of manures and fertilizer). The interaction effect of nutrient management and variety was significant in terms of panicle length (Table 1). The highest number of panicle length (23.33 cm) was observed in hybrid SL-8H and 50% less then recommended dose of inorganic fertilizer + vermicompost (1.5 t ha^{-1}) and the lowest number of panicle length (19.23 cm) was observed in BRRI dhan58 and control (no application of manures and fertilizer). The interaction effect of nutrient management and rice varieties were statistically significant in terms of grains $panicle^{-1}$ (Table 1). The highest number of grains $panicle^{-1}$ (141.14) was found in hybrid S-8H and 50% less then recommended dose of inorganic fertilizer + vermicompost (1.5 t ha^{-1}) and the lowest number of grains panicle¹ (120.67) in BRRI dhan58 and control (no application of manures and fertilizer). The interaction effect of variety with nutrient management on sterile spikelets $panicle^{-1}$ (Table 1). The number of sterile spikelets $panicle^{-1}$ was maximum (12.08) at hybrid SL-8H and 50% less then recommended dose of inorganic fertilizer + vermicompost (1.5 t ha^{-1}) and minimum (10.78) at the treatment of hybrid SL-8H and control (no application of manures and fertilizer) which was significant at 1% level of probability. The interaction effect of variety with nutrient management on 1000-grain weight (Table 1). The highest 1000-grain weight (23.37 g) was found at treatment of hybrid SL-8H and 50% less then recommended dose of inorganic fertilizer + vermicompost (1.5 t ha^{-1}) and the lowest (18.67 g) was found in the treatment of BRRI dhan58 and control (no application of manures and fertilizer). Grain yield was significantly affected by the interaction between variety and nutrient management (Table 1). The highest grain yield (8.40 t ha^{-1}) was achieved from the variety of hybrid SL-8H and 50% less then recommended dose of inorganic fertilizer + vermicompost (1.5 t ha^{-1}) and the lowest grain yield (5.80 t ha^{-1}) was found in BRRI dhan58 and control (no application of manures and fertilizer). Similar result was reported by Chakraborty *et al.* (2020). The interaction effect of variety with nutrient management on straw yield was significant (Table 1). The highest straw yield (9.00 t ha^{-1}) was obtained from V_2T_5 [Hybrid SL-8H and 50% less then recommended dose of inorganic fertilizer + vermicompost (1.5 t ha^{-1})] and the lowest straw yield (6.97 t ha^{-1}) was achieved from V_1T_1 [BRRI dhan58 and control (no application of manures and fertilizer). The effect of interaction of variety and nutrient management on biological yield was significant (Table 1). The highest biological yield (17.40 t ha^{-1}) was obtained from hybrid SL-8H and 50% less then recommended dose of inorganic fertilizer + vermicompost (1.5 t ha^{-1}). The lowest biological yield (12.77 t ha^{-1}) was obtained from BRRI dhan58 and control. The effect of interaction of variety and nutrient management on harvest index showed significant effect (Table 1). The highest harvest index (48.87%) was obtained from hybrid SL-8H and vermicompost (3 t ha^{-1}). The lowest harvest index (45.43) was obtained from BRRI dhan58 and control treatment.

Table 1. Interaction effect of variety and weeding regime on the yield contributing characters and yield of *boro* rice

Variety: Nutrient management	Plant height (cm) (no.)	Total tillers hill^{-1} (no.)	Effective tillers hill^{-1} (no.)	Non-effective tillers hill^{-1} (no.)	Panicle length (cm)	Grains panicle^{-1} (no.)	Sterile spikelets panicle^{-1} (no.)	1000-grain weight	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
V_1:T_1	84.73d	10.77f	9.10f	1.67a	19.23e	120.67d	10.84cd	18.67c	5.80h	6.97h	12.77f	45.43b
V_1:T_2	89.00c	14.00d	12.60d	1.40ab	22.15cd	131.27bc	11.65a-c	21.50b	6.63f	7.83g	14.47e	45.85b
V_1:T_3	90.23bc	14.20cd	12.90cd	1.30b	21.91d	134.80a-c	11.63a-c	21.50b	6.90e	8.23d-f	15.13d	45.83b
V_1:T_4	89.83bc	14.07cd	12.67d	1.40ab	21.93d	132.40bc	11.32b-d	21.53b	6.87ef	7.87fg	14.73de	45.62b
V_1:T_5	95.43a	15.80ab	14.97a	1.43ab	23.18ab	140.17a	11.95ab	23.33a	7.50d	8.80ab	16.30bc	46.50b
V_1:T_6	93.87ab	15.40b	14.20b	1.53ab	22.31b-d	136.43ab	11.49a-d	22.10b	7.27d	8.60b-d	15.87c	45.81b
V_2:T_1	72.20h	11.47e	10.17e	1.30b	19.63e	127.53cd	10.78d	19.13c	6.10g	7.03h	13.13f	46.45b
V_2:T_2	77.73fg	14.37cd	12.73d	1.63a	22.28cd	131.61bc	12.03ab	21.38b	7.83c	8.07e-g	15.90c	49.26a
V_2:T_3	74.37gh	14.57c	13.47c	1.43ab	22.51a-d	131.89bc	11.45a-d	21.88b	7.97bc	8.33c-e	16.30bc	48.87a
V_2:T_4	76.47fg	14.33cd	12.93cd	1.40ab	22.99a-c	136.71ab	11.37b-d	21.43b	7.90bc	8.33c-e	16.23c	48.66a
V_2:T_5	82.53de	16.00a	14.50ab	1.50ab	23.33a	141.14a	12.08ab	23.37a	8.40a	9.00a	17.40a	48.27a
V_2:T_6	79.23ef	15.73ab	14.27b	1.50ab	22.85a-c	137.71ab	12.20a	22.15b	8.13b	8.67a-c	16.80b	48.41a
$S\bar{x}$	**2.27**	**0.47**	**0.50**	**0.03**	**0.38**	**1.64**	**0.13**	**0.40**	**0.24**	**0.19**	**0.41**	**0.43**
Level of significance	*	*	*	*	*	*	*	*	**	*	*	*
CV (%)	**2.79**	**1.95**	**3.04**	**13.41**	**2.12**	**3.04**	**4.16**	**2.23**	**1.97**	**2.66**	**1.99**	**1.50**

Means with the same letters within the same column do not differ significantly. ** = Significant at 1% level of probability, *= Significant at 5% level of probability. V_1 = BRRI dhan58, V_2 = Hybrid SL-8H, T_1 = Control (No application of manures and fertilizer), T_2 = Recommended dose of inorganic fertilizer for the varieties, T_3 = Vermicompost (3 t ha^{-1}), T_4 = Cowdung (5 t ha^{-1}), T_5 = 50% less then recommended dose of inorganic fertilizer + vermicompost (1.5 t ha^{-1}), T_6 =50% less then recommended dose of inorganic fertilizer + cowdung (2.5 t ha^{-1}).

CONCLUSION

Farmers will not forsake yield, so integrated nutrient management must be used to maintain a satisfactory output. For future demand, we should be concerned about the health of the soil, and to that end, organic fertilizer should be used in rice farming. According to the study's results, integrated nutrient management significantly improved boro rice's yield performance. According to the findings, hybrid SL-8H rice had the maximum yield when inorganic fertilizer was applied at a dose that was 50% lower than recommended and combined with vermicompost. However, multi-location field trials would be required for the verification of the results.

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