Original Research Article

Effect of N nutrient management on the growth and yield of local *aman* rice cultivars

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ABSTRACT

Aims: To identify suitable nutrient management practices for local fine and aromatic rice cultivars.
Study design: Randomized Complete Block design

Place and duration of the study: Farmer's field at Jointapur, Sylhet region of Bangladesh during the period from August 2017 to December 2017.

Methodology: The experiment was replicated thrice in randomized complete block design assigning factor A. rice cultivars viz. Beruin (V_1), Moinasail (V_2), Nagrasail (V_3) and, BRRI dhan49 (Control, check variety) (V_4) and factor B. N sources viz. N 100% chemical (F1) , 50% N from FYM + 50% from Urea (F2) , 50% N from Vermicompost+ 50% from Urea (F3) and farmers practice (F4). Nutrients, PKS & Zn (100%) were supplied from chemical sources of Triple Super Phosphate, Muriate of Potash and Zinc Sulphate. Only N was supplied from different organic and inorganic (urea) sources. Fertilizers were applied at the rate of 140-33-38 kg ha^{-1} of NPK for farmers' practice, 90-15-60-12-1 kg ha^{-1} NPKS & Zn for the variety of BRRI dhan49 and 45-9-33-9-1 kg ha^{-1} NPKS and Zn for 3 local rice varieties.

Results: The results indicate that, BRRI dhan49 (V_4) gave the highest yield (2.97 t ha^{-1}) among the varieties and among the local varieties Nagrasail (V_3) gave the highest yield (2.24 t ha^{-1}). In case of farmers practice, highest grain yield was obtained F_4 (3.50t ha^{-1}) followed by F_1 (2.32 t ha^{-1}). Interaction effect also revealed, the highest grain yield (3.23 t ha^{-1}) in ($V_4 \times F_4$). Among the local varieties Nagrasail gave highest grain yield (2.58 t ha^{-1}) along with F_4.

Conclusion: Farmer's practice fertilizer management is a promising option, and Nagrasail is the best one for local T. *aman* cultivars cultivation in Sylhet region of Bangladesh.

Keywords: Local T aman rice, Nutrient management, Organic Fertilizer, FYM, Vermicompost

1. INTRODUCTION

It is necessary to enhance rice production in Bangladesh through increasing land productivity to meet up the increasing demand for food and strengthen food security. Rice provides 35%–60% of the dietary calories for more than three billion people in the world [1]. The worldwide demand for milled rice is about 5.33 × 108 t [2]. In Sylhet region, there is a great genetic diversity of local rice cultivars which can be able to cope-up with climate changes. Still a good number of indigenous genotypes of fine, aromatic and glutinous rice remain under cultivation in Sylhet region competing with HYV's due to special qualities fetches high price locally and good demand in the ethnic market in UK and USA. Local cultivars cover about 2478 ha (5.23%) of Aus rice area, 50890 ha (36.3%) of Aman rice area and 10990 ha (13.82%) of Boro rice area in the Sylhet district only [3]. Yield of these varieties is low because of unavailability of recommended agronomic management packages like organic and inorganic fertilizer management, planting geometry, seedling age etc. which needs to be developed to boost-up yield and productivity.

Biodiversity based ecological agriculture needs extension and establishment in the interest of farmers and against the present overwhelming environmental situation also. Nitrogen (N) is the most limiting nutrient of rice based cropping system in Bangladesh. Continuous use of chemical fertilizers without organic sources will lead to gradual decline of organic matter content and change of native N status in the soils, which results in lower productivity in the rice based system [4][5]. Although rice is a heavy N consumer, the N fertilizer utilization efficiency in rice is very low under tropical conditions where it rarely exceeds 50% and usually ranges from 15% to 35% [6]. N use efficiency is important for the economic sustainability of a cropping systems [7][8]. Adequate N sources and rates are very important, which can not only increase yield but also reduce the cost of production and environmental pollution [9]. The difference in nutrient absorption from different N source combinations greatly influences rice growth and yield potential [10].

In the cropping system based on modern rice (*Oryza sativa* L.), low productivity [11] [12][13] and low soil fertility are the consequences of unbalanced use of N fertilizers. Hence, research is needed to develop appropriate agronomic management organic and inorganic sources of nutrient specially N for the local T. *aman* rice cultivars traditionally grown in the Sylhet region. Therefore, the present study was conducted for the following objectives.

i. To identify suitable nutrient management practices for local fine and aromatic rice cultivars.
ii. To increase local fine and aromatic T. *aman* rice productivity through development of cultivar specific nutrient management practices for Sylhet region of Bangladesh.

2. MATERIAL AND METHODS

An experiment were conducted as the farmer's field at Chicknagul, Jointapur, Sylhet region of Bangladesh to evaluate the effect of organic and inorganic N nutrients on the growth and yield of local rice cultivars during the period from August 2017 to December 2017. The treatments included in the experiment were four (04) variety viz., i) Beruin, (V_1) , ii) Moinasail(V_2), iii) Nagrasail(V_3), iv) BRRI dhan49 (HYV & Control) (V_4) and four (04) sources of N nutrients: 4 viz., i) 100% N from Urea (F_1), ii) 50% N from FYM + 50% N from Urea (F_2), iii) 50% N from Vermicompost + 50% N from Urea (F_3), iv) Farmers practice. (F_4). Four varieties (V_1, V_2, V_3, V_4) of T. *aman* rice were considered as Factor A while four sources of N nutrient (F_1, F_2, F_3 and F_4) were considered as Factor B treatments in the experiment and combinations of these two factors were assigned in the plots randomly without biasness. There were 16 treatment combinations in the experiment. Each combination replicated thrice and the experiment was laid out in a split plot design assigning variety in the main plot and N nutrient sources in the sub-plot. The unit plot size was (3m X 2m). There was a bund of 0.50 m width between two experimental plots. Nutrients, PKS & Zn (100%) were supplied from chemical sources of Triple Super Phosphate, Muriate of Potash and Zinc Sulphate. Only N was supplied from different organic and inorganic (urea) sources. In case of farmers' practice 140-33-38 kg ha^{-1} of NPK, respectively were applied as per opinion of the local farmers. Nitrogen composition in FYM and Vermicompost was considered 0.5% and 0.7%, respectively during calculation of N dose from organic and inorganic sources. Fertilizers like Urea, Triple Super Phosphate, Muriate of Potash, Gypsum and Zinc Sulphate were applied according to recommended dose (BRRI, 2011). The fertilizers were applied @ 90-15-60-12-1 kg ha^{-1} NPKS & Zn for the variety of BRRI dhan49. For 3 local rice varieties 45-9-33-9-1 kg ha^{-1} NPKS and Zn, respectively were applied. Unit plot size was 6 m^2 (3m X 2m). For BRRI dhan49, in each plot, 20g TSP, 60g MoP,40g Gypsum and 1.7 g Zinc Sulphate were applied as basal: urea was applied into three equal splits-1/3rd at final land preparation, 1/3rd at 21 DAT (tillering stage) and 1/3rd at 36 DAT (active tillering stage) in each plot. For Beruin, Moinasail and Nagrasail 12 g TSP and 40 g MoP, 30 g Gypsum and 1.8 g Zinc sulphate were applied as basal. 60 g Urea was also applied into three equal splits- 1/3rd at final land preparation, 1/3rd at 21 DAT (tillering stage) and 1/3rd at 36 DAT (active tillering stage) in each plot. All PKSZn, FYM and Vermicompost were applied during final land preparation. Seeds of BRRI dhan49 were collected from Bangladesh Agricultural Development Corporation (BADC), Sylhet and seeds of other local varieties of Beruin, Moinasail, and Nagrasail were collected from local farmers. Seed was used @ 10 kg ha^{-1} for each variety having germination percentages 93%, 95%, 92% and 95% for Beruin, Moinasail, Nagrasail and BRRI dhan49, respectively. Weeding, gap filling, controlling insect-pest and irrigation were done according to necessary. Data were recorded on the growth, yield attributes and yield from the sample plants during the course of experiment. Observations were made on plant height (cm), number of effective tillers hill^{-1}, number of non-effective tiller shill^{-1}, number of panicles hill^{-1}, number of filled grains panicle^{-1}, number of unfilled spikelets panicle^{-1}, 1000-grain weight, percentage of filled spikelet, grain weight plot^{-1}.

Percentage of filled spikelet: Number of filled spikelet and unfilled spikelet panicle^{-1} constitutes total number of spikelets. From these data percentage of filled grains were calculated by using the following formula.

$$\text{Percentage of filled spikelet} = \frac{\text{No. of filled spikelets per panicle}}{\text{No. of total spikelets per panicle}} \times 100$$

Collected data were analyzed by using computer software R. Mean separations were done at 5% level of significance by Least Significant Difference (LSD) Test wherever F values were significant at either 1% or 5% level of probability.

3. RESULTS AND DISCUSSION

3.1 Plant height of rice varieties at 15-day intervals irrespective of organic and inorganic N nutrient

Plant height at 15-day intervals varied significantly among the varieties (Table 1). Plant height at 30 DAT varied significantly among the varieties . The tallest plant (62.30 cm) was obtained from the local variety Moinasail (V_2) and the shortest plant (42.50 cm) was obtained from BRRI dhan49. Both the local varieties Beruin (V_1) and Nagrasail (V_3) produced moderate plant height (57.15 cm and 56.30 cm, respectively. Like 30 DAT, plant height also differed significantly at 45 DAT and the tallest plant (99.333 cm) was obtained from the same variety of V_2 as in case of 30 DAT. The high yielding variety BRRI dhan49 produced the shortest plant (64.78 cm). A significant variation was observed for plant height at 60 DAT among the varieties. The same variety V_2 had the tallest plant (106.52 cm) while the HYV BRRI dhan49 had the shortest plant (67.17 cm). Other two varieties V_1 and V_2 had moderate plant height (99.6 cm & 104.07 cm, respectively). Plant height at 75 DAT differed significantly and the tallest plant (113.15 cm) was obtained from the local variety V_2. The shortest plant (71.63 cm) was obtained from BRRI dhan49. Finally, plant height at harvest differed significantly and the results revealed that the same variety Moinasail (V_2) always had the highest values in respect of plant height at 15-day intervals. The variety V_2 had the tallest plant (115.73 cm) followed by the variety V_3 (112.73 cm). The variety BRRI dhan49 produced the shortest plant (77.17 cm). It was observed that plant increased sharply from 30 DAT to 45 DAT and thereafter increment was sluggish and up to harvest plant height was found to be increased a very small even.

Table 1. Plant height of T. *aman* rice varieties at 15-day intervals irrespective of organic and inorganic N nutrient during T. *aman* season

Variety	Mean plant height (cm)				
	30 DAT	45 DAT	60 DAT	75 DAT	Harvest
V_1	57.15 b	93.58b	99.61b	106.50b	107.98b
V_2	62.30 a	99.33a	106.52a	113.15a	115.73a
V_3	56.30 b	95.03b	104.07ab	110.03ab	112.73a
V_4	42.50 c	64.78c	67.17c	71.63c	77.17c
CV(%)	6.30	3.91	7.19	3.99	3.75

$LSD_{0.05}$	3.43	3.45	6.78	3.40	3.87

NB: V_1= Beruin,V_2= Moinasail,V_3=Nagrasail,V_4= BRRI dhan49

3.2 Plant height of rice varieties as influenced by organic and inorganic N nutrient

There was no significant variation found in terms of plant height due to organic and inorganic N nutrient (Table 2) . However, at 30 DAT the plant height varied from 52.92 cm in F_2 to 55.58 cm in F_1. Like plant height at 30 DAT, it did not differ significantly at 45 DAT and plant height varied from 87.57 in F_3 to 88.90 cm in F_1 (Table 2). The plant height increment was sharp from 30 DAT to 45 DAT. There was no significant variation at 60 DAT and plant height ranged from 92.17 cm to 95.40 cm in F_1. The increment of plant height was not so much from 45 DAT to 60 DAT like 30 DAT to 45 DAT. Results revealed that plant height at 75 DAT did not differ significantly. However, plant height varied from 99.70 in F_4 to 95.40 cm in F_1. Plant height variation at harvest varied from 102.82 cm in F_4 (Farmer's) to 103.98 cm in F_2. Final plant height at harvest was found to be increased slightly from the previous plant height at 75 DAT.

Table 2. Plant height of T. *aman* rice varieties at 15-day intervals as influenced by organic and inorganic N nutrient during T. *aman* season

N nutrient	Mean plant height (cm)				
	30 DAT	45 DAT	60 DAT	75 DAT	Harvest
F_1	55.88	88.90	95.40	100.57	103.18
F_2	52.92	88.07	95.03	100.88	103.98
F_3	54.13	87.57	94.77	100.17	103.63
F_4	55.32	88.20	92.17	99.70	102.82
CV(%)	7.41	3.46	4.91	2.27	2.23
$LSD_{0.05}$	3.41	2.57	3.91	1.92	1.95

NB: F_1=N (100% chemical as per FRG, 2012), F_2=50% N from FYM + 50% N from Urea (chemical as per FRG, 2012), F_3=50% N from Vermicompost + 50% N from Urea (chemical as per FRG, 2012), F_4=Farmers practice (140- 33-38 kg/ha of NPK, respectively).

3.3. Number of tillers hill^{-1} of rice varieties irrespective of organic and inorganic N nutrient

Number of tillers hill^{-1} at 30 DAT differed significantly and the highest of number of tillers (15.63 hill^{-1}) was found in the variety BRRI dhan49 (V_4). The lowest number of tillers (13.25 hill^{-1}) was found in the variety Moinasail (V_2) while the other two varieties V_1 and V_3 produced moderate number of tillers (14.45 & 14.17 hill^{-1}, respectively (Table 3). Number of tillers hill^{-1} at 45 DAT differed significantly among the rice varieties. It was found that the highest of number of tiller (18.58 hill^{-1}) was produced by the variety BRRI dhan49 (V_4) which was statistically similar to that of Beruin (V_1) and Nagrasail (V_3) (17.71 & 17.46 hill^{-1}, respectively) (Table 3). Local variety Moinasail (V_2) gave the lowest number of tillers (13.08 hill^{-1}) at 45 DAT. Number of tillers hill^{-1} at 60 DAT did not differ significantly among the varieties irrespective of organic and inorganic N nutrient. The highest of number of tillers (18.83 hill^{-1}) was found in the variety BRRI dhan49 (V_4) while the lowest number of tillers (15.79 hill^{-1}) was found in the local variety Moinasail (V_2) (Table 3). Other two varieties Beruin (V_1) and Nagrasail (V_3) produced number of tillers 18.50 and 17.29 hill^{-1}, respectively. Number of tillers hill^{-1} at 75 DAT differed significantly and the highest of number of tillers (17.21 hill^{-1}) was found in the variety BRRI dhan29. Other three varieties produced statistically similar while the lowest number of tillers (13.46 hill^{-1}) was found in the variety Moinasail (V_2) (Table 3). Finally at harvest, number of tiller hill^{-1} among the varieties differed significantly having the highest of number of tillers (17.82 hill^{-1}). The variety BRRI dhan49 gave the lowest number of tillers (11.07 hill^{-1}). The results revealed that at later stage from 75 DAT to harvest mortality rate of tillers hill^{-1} was much higher in the HYV BRRI dhan49 (Table 3). In other two varieties V_2 and V_3 number of tiller hill^{-1} reduced to some extent at harvest than the earlier date of 75 DAT.

Table 3. Number of tiller hill^{-1} of T. *aman* rice varieties at 15- day intervals irrespective of organic and inorganic N nutrient during T. *aman* season

Variety	Mean number of tiller hill^{-1}				
	30 DAT	45 DAT	60 DAT	75 DAT	At harvest
V_1	14.45ab	17.71a	18.50	15.88ab	17.82a
V_2	13.25b	13.08b	15.79	13.46b	12.33bc
V_3	14.17ab	17.46a	17.29	15.08ab	13.01b
V_4	15.63a	18.58a	18.83	17.21a	11.07c
CV(%)	11.06	12.50	17.51	17.78	13.48
$LSD_{0.05}$	1.59	2.09	3.08	2.74	1.83

NB: V_1= Beruin,V_2= Moinasail,V_3=Nagrasail,V_4= BRRI dhan49

3.4 Number of tillers hill^{-1} of rice varieties as influenced by organic and inorganic N nutrient

Number of tillers hill^{-1} at 30 DAT did not differ significantly by organic and inorganic N nutrient. Number of tillers hill^{-1} varied from 14.00 in F_2 to 14.63 in F_1 (Table 4). Number of tillers hill^{-1} at 45 DAT also did not differ significantly. Maximum number of tillers (17.25 hill-1) was obtained from F_1 and minimum number of tillers (16.33 hill-1) was obtained from F_3 (Table 4). Unlike 30 and 45 DAT, number of tillers hill^{-1} at 60 DAT differed significantly and the highest of number of tillers (19.00 hill^{-1}) was found in F_1 (Table 4). Nutrient treatment F_3 produced the lowest number of tillers (16.46 hill^{-1}). Treatments F_2 and F_4 produced number of tillers hill^{-1} similar with that of F_1 and F_3. Number of tillers hill^{-1} at 75 DAT also differed significantly like 60 DAT and the highest of number of tillers (16.58 hill^{-1}) was found in the treatment F_1. The treatments F_2 and F_4 produced similar number of tillers hill^{-1} to that of F_1 while the lowest number of tillers (14.17 hill^{-1}) was produced in F_3(Table 4). Number of tillers $hill^{-1}$ at harvest differed significantly at harvest and finally the highest of number of tillers (17.40 $hill^{-1}$) was found in F4 (farmer's practice). The lowest number of tillers (12.37 $hill^{-1}$) was obtained from F3 which was similar to that of F2. The treatment F1 produced similar number of tillers (13.87 $hill^{-1}$) to that of the highest number of tillers $hill^{-1}$ produced by the treatment F4 (Table 4).

Table 4. Number of tiller $hill^{-1}$ of T. aman rice varieties at 15-day intervals as influenced by organic and inorganic N nutrient

N nutrient	Mean number of tiller $hill^{-1}$				
	30 DAT	45 DAT	60 DAT	75 DAT	Harvest
F_1	14.63	17.25	19.00a	16.58a	13.87ab
F_2	14.00	16.63	17.46ab	15.00ab	13.29bc
F_3	14.37	16.33	16.46b	14.17b	12.37c
F_4	14.50	16.63	17.50ab	15.88a	14.70a
CV(%)	9.59	8.69	11.16	12.77	9.42
$LSD_{0.05}$	1.16	1.22	1.66	1.66	1.08

NB: F_1= N (100% chemical as per FRG, 2012), F_2=50% N from FYM + 50% N from Urea (chemical as per FRG, 2012), F_3=50% N from Vermicompost + 50% N from Urea (chemical as per FRG, 2012), F_4=Farmers practice (140-33-38 kg ha^{-1} of NPK, respectively).

3.5 Yield components and yield

3.5.1 Performance of rice varieties

Number of effective tillers hill-1 differed significantly and the highest number of effective tiller (17.82 $hill^{-1}$) was recorded from the local variety Beruin (V1) (Table 5). The lowest number of effective tillers (11.07 $hill^{-1}$) was recorded from the variety BRRI dhan49 (V4). Other two varieties Moinasail (V2) and Nagrasail (V3) produced similar number of effective tillers $hill^{-1}$ but significantly lower than that of V1. The results revealed that non-effective tillers $hill^{-1}$(%) was significantly highest in the variety V4 and the lowest in V1. The result clearly indicated that number of non-effective tillers $hill^{-1}$(%) was considerably lower in all the local varieties. Both filled and unfilled spikelets $panicle^{-1}$ differed significantly among the varieties (Table 5). The highest number of filled spikelets $panicle^{-1}$ was found in the variety BRRI dhan49 (V_4) while the lowest number was found in the variety Beruin (V_1). Statiscally similar and moderate number of filled spikelet $pabicle^{-1}$ was found in the varieties V_2 and V_3. These varieties were significantly different from the other two varieties. The variety V_4 produced the highest percentage of unfilled spikelets $panicle^{-1}$ (33.48) while the lowest percentage of unfilled spikelet $panicle^{-1}$ (20.40) was found in the variety V_3. The results revealed that 1000-grain weight varied significantly among the varieties (Table 5) where the variety V1 produced the highest (23.45 g). The variety V_4 produced the lowest 1000- grain weight (18.64 g) which was significantly different from the rest two varieties. The results specified that all local varieties produced the coarse grain compared to HYV BRRI dhan49. That is, BRRI dhan49 had the smaller grain size which is more preferable to the consumers. Results presented in Table 5 indicated that grain yield variation was significant among the rice varieties. The highest grain yield 2.97 t ha^{-1} was obtained from the HYV, BRRI dhan49 which was significantly different from others. The highest grain yield in the HYV was mainly due to the highest number of filled spikelet $panicle^{-1}$ in spite of lower number of effective tiller $hill^{-1}$and smaller grain size. The lowest grain yield 1.99 t ha^{-1} was obtained from the local variety V_1, Beruin because of the lowest number of filled spikelet $panicle^{-1}$. Among the local varieties,V_3 i.e. Nagrasail performed better and yielded these condition highest grain yield 2.24 t ha^{-1} attributed by the moderate number of filled spikelet $panicle^{-1}$, effective tiller $hill^{-1}$ and bolder grain size. The variety V_4 had the highest percent 25.35 of non-effective tiller $hill^{-1}$ and 33.48 of unfilled spikelet $panicle^{-1}$. This indicates the variety V_4 was under the low temperature stress as the crop was transplanted in the month of late September after recession of flood water.

Table 5. Yield attributes and yield of rice varieties irrespective of nutrient fertilizers

Variety	Tillers $hill^{-1}$		Spikelets $panicle^{-1}$		1000-grain weight (g)	Grain yield (t ha^{-1})
	Effective (no.)	Non-effective (%)	Filled (no.)	Unfilled (%)		
V_1	17.82a	10.41c	44.33c	24.98b	23.45a	1.99c
V_2	12.33bc	12.94b	55.10b	22.34c	20.80b	2.01c
V_3	13.01b	14.19b	56.22b	20.40d	20.45b	2.24b
V_4	11.07c	25.35a	71.50a	33.48a	18.64c	2.97a
CV(%)	13.48	14.92	7.82	5.30	5.08	8.69
$LSD_{0.05}$	1.83	2.34	4.43	1.34	1.06	0.20

Figures in a column with same letter(s) did not differ significantly at 5% level of significant; V_1= Beruin; V_2= Moinasail; V_3=Nagrasail; V_4=BRRI dhan49

3.5.2 Effect of organic and inorganic N nutrient

Both number of effective tillers $hill^{-1}$ and percent non-effective tillers $hill^{-1}$ did not differ significantly due to variation in organic and inorganic sources of N nutrient (Table 6). The results indicated that sources of N nutrient either organic or inorganic produced similar effect on the formation of effective tiller $hill^{-1}$. The results revealed that number of filled spikelet $panicle^{-1}$ and per cent unfilled spikelet $panicle^{-1}$ differed significantly among the organic and inorganic N nutrient sources (Table 6). Farmers' practice i.e. F_4 produced the highest number of filled spikelet (61.45 $panicle^{-1}$) which was statistically similar to that of F_1. Both the organic sources of N nutrient produced significantly lower number of filled spikelet $panicle^{-1}$. Inorganic sources of N also produced higher percentage of unfilled spikelet $panicle^{-1}$. Thousand grain weights did not differ significantly among the organic and inorganic sources of N (Table 6). The results revealed that sources of N either organic or inorganic have equal effect on the grain size of rice. The result presented in Table 6 showed that grain yield of rice was influenced significantly by different levels of nutrients. The nutrient level used in the farmers' practice (F_4) gave the highest grain yield (2.50 t ha^{-1}) which was significantly different from the other nutrient levels. The lowest grain yield 2.13 t ha^{-1} was obtained from the nutrient level F_3 (50% N from Urea + 50% N from Vermicompost). Grain yields from F_1 and F_2 (2.32 and 2.26 t ha^{-1} respectively) were statistically similar. Higher number of effective tiller $hill^{-1}$ and filled spikelet $panicle^{-1}$ were the main attributes to produce the higher grain yield. The results indicated that nutrient level F_4 had the highest 26.63% unfilled spikelet $panicle^{-1}$.There was no significant difference among the nutrient levels in respect of 1000-grain weight. The increase in rice yield is associated with the increase in yield attributes. The increase in 1000-grain weight after the application of organic sources may be due to better nutrient availability and uptake by plants [14][15]. Combined application of organic and inorganic N is better than sole organic source on increasing rice yield components and grain yield [16][17][18]. Our results did not agree with this result. The difference in nutrient absorption from different N source combinations greatly influences rice growth and yield potential.

Table 6. Yield attributes and yield as influenced by nutrient fertilizers irrespective of rice varieties

Nutrient levels	Tillers $hill^{-1}$		Spikelets $panicle^{-1}$		1000-grain weight (g)	Grain yield (t ha^{-1})
	Effective (no.)	Non-effective (%)	Filled (no.)	Unfilled (%)		
F_1	13.87	16.41	59.18a	25.66ab	21.33	2.32b
F_2	13.29	16.36	53.88b	23.80b	20.43	2.26bc
F_3	12.37	15.78	52.63b	25.12ab	21.03	2.13c
F_4	14.70	14.34	61.45a	26.63a	20.54	2.50a
CV(%)	9.42	15.68	4.79	7.88	7.44	6.79
LSD 0.05	1.08	2.08	2.29	1.99	1.31	0.13

NB: F_1=N (100% chemical as per FRG, 2012), F_2=50% N from FYM + 50% N from Urea (chemical as per FRG, 2012), F_3=50% N from Vermicompost + 50% N from Urea (chemical as per FRG, 2012), F_4=Farmers practice (140-33-38 kg ha^{-1} of NPK, respectively).

3.6 Interaction of rice varieties and sources of N nutrient

Number of effective tillers $hill^{-1}$ differed significantly due to interaction of variety and organic and inorganic sources of N nutrient (Table 7). The results showed that V_1 produced significantly higher number of effective tillers $hill^{-1}$ at all organic and inorganic sources of N. The combination ($V_4 \times F_3$) produced the lowest number of tillers $hill^{-1}$. The variety V_4 produced higher percentage of non-effective tillers $hill^{-1}$ with all sources of organic and inorganic N sources. Both filled spikelets and unfilled spikelets panicle differed significantly due to in teraction of variety and organic and inorganic sources of N (Table 7). The highest number of filled spikelet (76.67 panicle^{-1}) was obtained from the combination of ($V_4 \times F_1$) while the lowest number of filled spikelets (40.00 panicle^{-1}) was obtained from the combination ($V_1 \times F_2$). The results showed that both organic and inorganic sources of N had inferior effect compared to inorganic source of N on the number of filled spikelets panicle^{-1}. Thousand grain weights were found significantly higher in the variety V_1 in combination with all sources of nutrient N (Table 7). Other combinations except the combination of ($V_3 \times F_3$) produced lower 1000-grain weight than all combinations of V_1 with all sources of N nutrient. The lowest 1000-grain weight (18.04 g) was obtained from the combination (V_2 ×F F_3) which was closely followed by the combination ($V_4 \times F_2$). In general, V_4 had the lower 1000-grain weight with all sources of N. This proved that grain size is smaller in V_4 compared to all other varieties. Results presented in Table 7 revealed that the highest grain yield (3.23 t ha^{-1}) was obtained from the interaction ($V_4 \times F_4$) which was statistically similar to that of ($V_4 \times F_1$) (3.00 t ha^{-1}). Among the local variety V_3 along with F_4 i.e. ($V_3 \times F_4$) produced the highest grain yield (2.58 t ha^{-1}). The lowest grain yield (1.89 t ha^{-1}) was found in ($V_2 \times F_3$). Grain yield was determined by the number of effective tiller hill^{-1}, number of filled spikelet panicle^{-1} and 1000-grain weight in all interaction levels. Grain yield is the manifestation of yield attributing characters in rice [19]. It was found that the highest grain yield in ($V_4 \times F_4$) was attributed by the combined effect of number of effective tiller hill^{-1}, number of filled spikelet panicle^{-1} and 1000-grain weight in spite of lower number of filled spikelet panicle^{-1} in the interaction ($V_4 \times F_3$). In ($V_4 \times F_3$) the lower yield was mainly due to the lower 1000-grain weight and number of effective tiller hill^{-1}. The lowest grain in ($V_2 \times F_3$) was due to the lower number of effective tiller hill^{-1}, filled spikelet panicle^{-1} and 1000-grain weight. The results showed that in case of all varieties, the nutrient F_3 i.e. 50% N from Urea and 50% N from vermicompost produced the lowest grain yield. This indicated that organic source of N of vermicompost did not work properly to supply nutrient N for the growth and development of the rice varieties. The increase in rice yield is associated with the increase in yield attributes. Application of N through chemical fertilizer brought about significant improvement in grain yield and established superiority over the application of organic N source [20].

Table 7. Yield attributes and yield of rice varieties as influenced by the interaction of rice varieties and nutrient fertilizers

Interaction (V x S)	Tillers hill^{-1}		Spikelets panicle^{-1}		1000-grain weight (g)	Grain yield (t ha^{-1})
	Effective (no.)	Non-effective (%)	Filled (no.)	Unfilled (%)		
V_1F_1	17.20a	11.8d-h	47.13g	28.50c	22.82ab	1.98ef
V_1F_2	17.80a	11.1e-h	40.47h	19.03def	24.30a	1.97ef
V_1F_3	17.20a	10.4fgh	40.00h	19.27ef	24.04a	1.92ef

V_1F_4	19.07a	8.4h	49.73fg	33.10ab	22.62ab	2.09def
V_2F_1	12.33cde	9.4gh	54.93cde	19.90de	24.59a	2.02def
V_2F_2	11.20def	14.4c-f	55.07cde	28.00c	19.71cde	2.04def
V_2F_3	11.20def	15.1cde	53.00def	22.07d	18.04e	1.89f
V_2F_4	14.60b	12.9c-g	57.40cd	19.40def	20.85bcd	2.08def
V_3F_1	14.01bc	16.4c	58.00c	20.60de	19.37de	2.26d
V_3F_2	13.34bcd	12.5c-h	50.60efg	16.13f	20.64b-e	2.16de
V_3F_3	11.61def	12.4c-h	49.07fg	27.20c	22.24abc	1.95ef
V_3F_4	13.07bcd	15.6cd	67.20b	17.67ef	19.54de	2.58c
V_4F_1	11.93cde	28.1a	76.67a	33.63ab	18.37de	3.00ab
V_4F_2	10.80ef	27.5a	69.40b	32.03b	18.14e	2.87b
V_4F_3	9.47f	25.3a	68.47b	31.93b	18.74de	2.76bc
V_4F_4	12.07cde	20.5b	71.47b	36.33a	19.31de	3.23a
CV(%)	9.42	15.68	4.79	7.87	7.43	6.79
$LSD_{0.05}$	1.08	4.15	4.58	3.36	2.61	0.26

NB: Figures in a column with same letter(s) did not differ significantly at 5% level of significant; V_1= Beruin, V_2= Moinasail, V_3= Nagrasail, V_4= BRRI dhan49

4. CONCLUSION

The results of the experiment indicated that none of the local varieties produced better yield than the HYV rice BRRI dhan49. Among the local varieties Nagrasail showed better performance than the other local varieties. Vermicompost did not perform well while nutrient level of farmers' practice was found better than the BARC recommended fertilizer dose. The experiment needs to be conducted in the next year for confirmation of the results.

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