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Cowdung based integrated nutrient management for transplant *Aman* rice varieties

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ABSTRACT

A field experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh to evaluate the effect of integrated nutrient management on the performance of three transplant *Aman* rice varieties. The treatments included were three varieties of transplant *Aman* rice viz. BRRI dhan31, BRRI dhan39 and BRRI dhan41 and five different integrated nutrient managements viz. recommended dose of chemical fertilizers (RF), Cowdung @ 10 t ha^{-1}, 50% RF + Cowdung @ 5 t ha^{-1}, 75% RF + Cowdung @ 2.5 t ha^{-1} and 100% RF + Cowdung @ 5 t ha^{-1}. The experiment was laid out in a randomized complete block design with three replications. It was found that variety had significant effect on all the crop characters except panicle length and 1000-grain weight. Among the three varieties of transplant *Aman* rice, BRRI dhan31 produced the highest grain yield and BRRI dhan39 produced the lowest grain yield. All the characters were significantly influenced by different integrated nutrient managements except panicle length and 1000-grain weight. The highest grain yield was obtained from 50% RF + Cowdung @ 5 t ha^{-1} and the lowest grain yield was received from RF. Interaction effect of variety and integrated nutrient management was significant on all crop characters except panicle length and 1000-grain weight. The highest grain yield was obtained from BRRI dhan31 with 50% RF + Cowdung @ 5 t ha^{-1}. The same variety with Cowdung @10 tha^{-1} also produced identical grain yield. The performance of 50% RF + Cowdung @ 5 t ha^{-1} was found to be superior to any other nutrient management and BRRI dhan31 was found to be the best among the varieties. Therefore, BRRI dhan31 with 50% RF + Cowdung @ 5 t ha^{-1} can be recommended for obtaining higher grain yield.

Introduction

Bangladesh is an agro-based country and thus most of our economic activities are related to agriculture. The total area and production of rice in Bangladesh are about 10.53 million hectares and 26.53 million metric tons, respectively (BBS, 2006). About 76.69% of total cultivable land in Bangladesh is used for rice production, which contributes 21.12% total agricultural production and engages about 48% of total agricultural forces (BBS, 2007). Bangladesh earns about 23.87% of its gross domestic product (GDP) from agriculture (Krishi Diary, 2009). It is cultivated in the countries of all continents except Antarctica from 53º N to 40º S latitude (Lu & Chang, 1980). Out of the total production in this country about 48, 45, and 7% come from Boro, Aman and Aus crop, respectively (BBS, 2000). Although Bangladesh ranks 4th in the world both in acreage and production of rice (FAO, 2000), it ranks 39th in the yield (IRRI, 1995).

The horizontal expansion of the rice area in Bangladesh is not possible due to high population pressure and total rice area is continuously declining due to urbanization and industrialization. Soil health is continuously deteriorating for intensive cultivation and no organic matter is used for cultivation. Soil fertility declining day by day is a major reason for lower crop yield in Bangladesh. Intensive cropping use of modern varieties, imbalanced use of fertilizer and higher decomposition of organic matter are the principal factors for soil fertility depletion in the country. A crop production system with high yield targets cannot be sustainable unless balanced nutrient inputs are supplied to soil against nutrient removal by crops (Bhuiyan et al., 1991). Available data indicate that the soil fertility in Bangladesh is in declining trend (Karim et al., 1994; Ali et al., 1997) which is responsible for declining crop yields (Anon., 1996; Cassman et al., 1995). Depletion of soil fertility has been identified as a major constraint for higher crop yield. The role of fertilizers and manures in increasing the productivity of crop is well known. Repeated use of inorganic fertilizer alone fails to sustain desired yield, impairs the physical condition and reduce the organic matter content of soils (Rabindra et al., 1985; Bhatia & Shukla, 1982; Lal & Mathur, 1988). Integrated use of organic and inorganic fertilizer has been found to be promising for sustainable crop production. This has been amply proved by the long term fertilizer experiments (Nambiar and Abrol, 1989). This indicates that an integrated use of organic and inorganic fertilizers proposed to be an effective approach for sustainable crop production (Rabindra et al., 1985; Bhatia & Shukla, 1982). The use of chemical fertilizer as supplemental source of nutrients has been increasing steadily in

Bangladesh. However most of the farmers' usually do not apply fertilizer in balanced proportion (Anon. 1997).

The present system of fertilizer replication is mostly based on the nutrient requirement of individual crops ignoring the carry-over effect of the manure or fertilizer applied to the preceding crop. Organic sources of nutrients applied to preceding crop can benefit the succeeding crop to a great extent (Singh et al., 1996) through integrated use of organic and inorganic sources of nutrients (Singh & Yadav, 1992). Nambiar (1997) views that integrated use of organic manure and chemical fertilizers would be quite promising not only in providing greater suitability in production but also for maintaining better soil fertility status. Among the management practices, application of organic fertilizers such as cowdung is more profitable and economic than other inorganic fertilizers to avoid attack of insects, pests and disease. Cowdung plays a key role in rice production among the fertilizer elements and it required in larger amount compared to other inorganic fertilizers. It influences the vegetative growth, development and yield has been widely recognized, particularly after the development of modern varieties (BRRI, 1990).

The long term research of Bangladesh Rice Research Institute (BRRI) reveals that the application of dung manure at 5 t $ha^{-1}y^{-1}$ improved soil resource from degradation (Bhuiyan, 1994). Mobasser et al. (2005) reported that numbers of panicles $hill^{-1}$ were significantly higher in cowdung treated plots compared with unfertilized control. BINA (1996) reported that the highest number of productive tillers $hill^{-1}$ was obtained from the highest level ($15tha^{-1}$) of cowdung. Brar and Dhillon (1994) reported that grain yield of rice increased significantly with the increasing levels of cowdung, the highest yield ($6.7\ tha^{-1}$) was obtained using 40 t cowdung ha^{-1} over 4 years. Average yield of rice was significantly more when cowdung was applied in 4 equal splits than as a single application. Cowdung response is less conspicuous than other nutrients in terms of grain yield of rice. They also reported that the straw yield increase significantly with increasing rates of cowdung. The highest weight of 1000 grains was obtained from 15 t cowing ha^{-1} and the lowest from the control (Rafey et al., 1989). It is indicated that increasing cowdung levels up to 15 t ha^{-1} significantly increased grain yield. BRRI (1989) showed that straw yield also increased with each increment of levels of cowdung.

Thus, cowdung is the key pivot of nutrient availability and maintenance of better physical condition of the soil. It is an essential factor for crop productivity. Moreover, use of cowdung not only acts as a source of N and other nutrients but also increase efficiency of applied nitrogen. The present study was undertaken to observe the effect of cowdung based integrated nutrient management on yield of transplant *Aman* rice cv. BRRI dhan31, BRRI dhan39 and BRRI dhan41 and also to select proper dose and combination of cowdung and NPKS fertilizers in order to obtain higher yield of rice cv. BRRI dhan31, BRRI dhan39 and BRRI dhan41.

Materials and Methods

Experimental treatment and design

The experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh in *Aman* season. The treatments included were three varieties of transplant *Aman* rice viz. BRRI dhan31, BRRI dhan39 and BRRI dhan41 and five different integrated nutrient managements viz. recommended dose of chemical fertilizers (RF), Cowdung @ 10 t ha^{-1}, 50% RF + Cowdung @ 5 t ha^{-1}, 75% RF + Cowdung @ 2.5 t ha^{-1} and 100% RF + Cowdung @ 5 t ha^{-1}. The experiment was laid in a randomized complete block design with three replications. The whole experimental area was divided into three blocks each representing one replication and every block was sub-divided into15 plots. Thus total numbers of plots were 45 and the size of each unit plot was 5 m^2 (2.5 m × 2 m). Block to block distance was 1.0 m and plot to plot distance was 0.75 m.

Cultivation procedure

Each plot was fertilized as per experimental specifications. The recommended fertilizer included urea, triple superphosphate, muriate of potash, gypsum and zinc sulphate @ 150, 100, 70, 60 and 10 kg ha^{-1}, respectively. Except urea, all the chemical fertilizers were applied before final land preparation. Urea was top dressed in three equal splits at 15, 30 and 45 days after transplanting (DAT). Cowdung, where applicable were incorporated into the soil just after first ploughing.

Data recording

The crop was harvested at full maturity i.e. when 90% of the grain became matured. Five hills (excluding border hills and the hills of central 1 m^2 harvest area) were selected randomly from each experimental plot before harvesting to record necessary data. After maturity, the central 1 m^2 area for each plot was harvested. The harvested crop of each plot was separately bundled, properly tagged and then brought to the clean threshing floor. The crop was threshed with a pedal thresher. Grains were then sun dried and cleaned. Straws were also sun dried properly. Finally, grain and straw yields were recorded and converted to ton per hectare.

Statistical analysis

The recorded data were statistically analyzed using "Analysis of Variance" with the help of a computer package programme MSTATC and the mean differences were adjudged by Duncan's Multiple Range Test (Gomez & Gomez, 1984).

Results and Discussion

Effect of variety on the growth and yield of transplant *Aman* rice

Variety difference showed significant effect on crop characters, yield and yield components of transplant *Aman* rice (Table 1). The tallest plant (127.65 cm) was produced by BRRI dhan41 and the shortest one (95.82 cm) by BRRI dhan39 and plant height of variety BRRI dhan31 was of intermediate height. BRRI (2000a) reported that plant height differed significantly among varieties. The highest number of total tillers hill^{-1} (14.25) was found in BRRI dhan39 variety and the lowest one (12.88) was found in BRRI dhan31. These results are in agreement with those of Hossain et al. (1989) who reported that number of total tillers hill^{-1} differed among varieties. The variation in number of total tillers hill^{-1} might be due to varietal characteristics. The highest number of effective tillers hill^{-1} (8.62) was found in BRRI dhan31 variety and the lowest one (7.81) was found in BRRI dhan39 variety. The results are in agreement with those reported by Chowdhury et al. (1993) who stated that effective tillers hill^{-1} is the genetic makeup of the variety which is primarily influenced by heredity. The highest number of non-effective tillers hill^{-1} (6.44) was found in BRRI dhan39 rice variety and the lowest one (4.26) was found in BRRI dhan31 variety. The longest panicle (25.17) was obtained from BRRI dhan41 and the shortest one (23.72) was obtained from BRRI dhan39 variety. This variation as assessed might be mainly due to genetic characteristics which are influenced by heredity. Variety BRRI dhan41 produced the highest number of grains panicle^{-1} (157.06) and the lowest one (133.24) was produced by the variety BRRI dhan39. BRRI (1994) also reported that the number of grains panicle^{-1} was influenced significantly due to variety as it is mostly governed by heredity. BRRI dhan31 variety produced the highest number of sterile spikelets panicle^{-1} (19.25) and the lowest one (13.54) was found in BRRI dhan39. BINA (1993) reported differences in number of sterile spikelets panicle^{-1} due to varietal differences. This variation might be due to genetic characteristics of the varieties. Heaviest 1000-grains (26.39 g) were found in BRRI dhan41 variety and the lowest 1000-grain weight (25.5 g) was found in BRRI dhan31 variety of rice. Varietal differences regarding 1000-grain weight might be due to their differences in genetic makeup. These results are in conformity with that of Shamsuddin et al. (1988) and Chowdhury et al. (1993) who reported that weight of 1000-grain differed among the varieties. The highest grain yield was found in BRRI dhan31 (5.64 tha^{-1}) followed by BRRI dhan41 and BRRI dhan39. Dwivedi (1997) and BRRI (2000b) also reported grain yield variation among the varieties. The highest straw yield (6.85 tha^{-1}) was produced in BRRI dhan31 variety and the lowest one (5.69 tha^{-1}) was produced by the variety BRRI dhan39. The highest biological yield (12.49 tha^{-1}) was recorded from the BRRI dhan31 and the lowest one (10.25 tha^{-1}) was obtained from BRRI dhan39 rice variety. The highest harvest index (45.76%) was recorded from the BRRI dhan41 and the lowest harvest index was (44.29%) was obtained from BRRI dhan39 rice variety.

Effect of integrated nutrient management on growth and yield of transplant *Aman* rice

Integrated nutrient management showed significant effect on yield and yield components of transplant *Aman* rice (Table 2). The tallest plant was found in 75% RF + Cowdung @ 2.5 tha^{-1} followed by 100% RF + Cowdung @ 5 t ha^{-1}, RF and Cowdung @ 10 tha^{-1} while the shortest one was found in 50% RF + Cowdung @ 5t ha^{-1}. It is found that plant height at harvest increased due to increased application of chemical fertilizers. Similar results were also obtained by Kobayashi et al. (1989) and Reddy et al. (1988). Increased levels of fertilizers might be associated with stimulating effect of fertilizers on various physiological processes including cell division and elongation of the plant. The highest number of total tillers hill^{-1} (15.07) was found in 100% RF + cowdung @ 5 t ha^{-1} and the lowest one (11.49) was found in Cowdung @ 10 t ha^{-1}. Ahmed and Rahman (1991) also reported that combined application of organic and chemical fertilizers increased tillers of rice plants. The highest number of effective tillers hill^{-1} (9.33) was found in 50% RF + cowdung @ 5 t ha^{-1} and the lowest one (6.69) was found in Cowdung @ 10 tha^{-1}. These results are in partial agreement with Kant and Kumar (1994), who reported that increasing rate of amendment with organic manure, increased number of effective tillers hill^{-1} significantly. The highest number of non-effective tillers hill^{-1} (6.22) was found in 100% RF + Cowdung @ 5 t ha^{-1} and the lowest one (4.01) was found in 50% RF + Cowdung @ 5 t ha^{-1}.The longest panicle (25.08) was found in 75% RF + Cowdung @ 2.5 t ha^{-1} and the shortest one (24.11) was found in 100% RF + Cowdung @ 5 t ha^{-1}. The highest number of grains panicle^{-1} (154.16) was found in 100% RF + Cowdung @ 5tha^{-1} and the lowest one (132.37) was obtained from RF. The highest number of sterile spikelets panicle^{-1} (17.34) was found in 75% RF + Cowdung @ 2.5tha^{-1} and the lowest one (14.92) was recorded in RF. The highest 1000-grain weight (25.51 g) was recorded from the 100% RF + cowdung @ 5 t ha^{-1} and the lowest one (25.13 g) was recorded from the RF. The highest grain yield (5.86 t ha^{-1}) was obtained from the 50% RF + Cowdung @ 5 t ha^{-1} followed by 75% RF + Cowdung @ 2.5t ha^{-1}, 100% RF + Cowdung @ 5 t ha^{-1} and Cowdung @ 10 t ha^{-1}. The lowest one (4.19 tha^{-1}) was obtained from RF. The highest straw yield (6.87 tha^{-1}) was obtained from the 50% RF + Cowdung @ 5 tha^{-1} followed by 75% RF + Cowdung @ 2.5 tha^{-1}, 100% RF + Cowdung @ 5 tha^{-1}, and Cowdung @ 10 tha^{-1}. The lowest one (5.35 tha^{-1}) was obtained from RF. The highest biological yield (12.73 tha^{-1}) was obtained from 50% RF + Cowdung @ 5 tha^{-1} and the lowest one (9.54 tha^{-1}) was obtained from RF. The highest harvest index (46.04%) was obtained from 50% RF + Cowdung @ 5tha^{-1}. The lowest one (43.71%) was obtained from RF.

Table 1. Effect of variety on crop characters, yield and yield components of transplant *Aman* rice

Variety	Plant height (cm)	No. of total tillers hill^{-1}	No. of effective tillers hill^{-1}	No. of non-effective tillers hill^{-1}	Panicle length (cm)	No. of 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_1	111.73b	12.88b	8.62a	4.26c	25.03	141.33b	19.25a	25.5	5.64a	6.85a	12.49a	45.15b
V_2	95.82a	14.25a	7.81b	6.44a	23.72	133.24c	13.54c	24.24	4.55c	5.69c	10.25c	44.29c
V_3	127.65c	12.91b	7.91b	5.00b	25.17	157.06a	16.17b	26.39	5.15b	6.08b	11.23b	45.76a
$S\bar{X}$	0.39	0.23	0.17	0.17	0.39	1.04	0.37	0.03	0.03	0.04	0.06	0.2
Level of significance	**	**	**	**	NS	**	**	NS	**	**	**	**

In a column, figures with same letter or without letter do not differ significantly whereas figures with dissimilar letter differ significantly (as per DMRT).
NS=Not significant, * = Significant at 5% level of probability and ** = Significant at 1% level of probability.
V_1=BRRI dhan31, V_2=BRRI dhan39 and V_3=BRRI dhan41

Table 2. Effect of integrated nutrient management on yield and yield components of transplant *Aman* rice

Integrated nutrient management	Plant height (cm)	No. of total tillers hill^{-1}	No. of effective tillers hill^{-1}	No. of non-effective tillers hill^{-1}	Panicle length (cm)	No. of 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 (%)
F_1	111.70b	13.07b	7.31c	5.76ab	24.63	132.37d	14.92b	25.13	4.19d	5.35d	9.54d	43.71c
F_2	110.80bc	11.49c	6.69c	4.80c	24.38	136.68c	16.53a	25.35	5.11c	6.17c	11.28c	45.22b
F_3	109.49c	13.33b	9.33a	4.01d	24.98	144.70b	16.50a	25.48	5.86a	6.87a	12.73a	46.04a
F4	114.34a	13.78b	8.4b	5.38bc	25.08	151.47a	17.34a	25.41	5.37b	6.33b	11.70b	45.91ab
F_5	112.33b	15.07a	8.85ab	6.22a	24.11	154.16a	16.31ab	25.51	5.05c	6.31bc	11.36c	44.45c
$S\bar{X}$	0.51	0.3	0.22	0.22	0.5	1.34	0.48	0.04	0.04	0.05	0.07	0.25
Level of significance	**	**	**	**	NS	**	**	NS	**	**	**	**

In a column, figures with same letter or without letter do not differ significantly whereas figures with dissimilar letter differ significantly (as per DMRT).
NS = Not significant. * = Significant at 5% level of probability and ** = Significant at 1% level of probability.
F_1= RF, F_2= Cowdung @ 10 t ha^{-1}, F_3= 50% RF+Cowdung @ 5 t ha^{-1}, F_4=75% RF + Cowdung @ 2.5 t ha^{-1} and F_5= 100% RF + Cowdung @ 5 t ha^{-1}

Table 3. Interaction effect of variety and integrated nutrient management on yield and yield components of transplant *Aman* rice

Interaction (V×F)	Plant height (cm)	No. of total tillers hill^{-1}	No. of effective tillers hill^{-1}	No. of non-effective tillers hill^{-1}	Panicle length (cm)	No. of 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_1×F_1	114.03de	11.67ef	8.00bcd	3.67e	24.33	106.77h	16.11bcd	25.30	5.05c	6.11fg	11.16e	45.28cde
V_1×F_2	108.70f	11.13f	6.73efg	4.40de	24.47	137.07f	18.67b	25.55	6.09a	7.10b	13.19b	46.15bc
V_1×F_3	108.17f	13.67cd	9.98a	3.68e	25.74	152.21bc	22.37a	25.58	6.29a	7.59a	13.88a	45.32cde
V_1×F_4	115.30d	12.87de	9.40a	3.47e	25.15	150.85cd	23.24a	25.51	5.56b	6.72c	12.28c	45.27cde
V_1×F_5	112.47e	15.07bc	9.00abc	6.07bc	25.47	159.72a	15.88cd	25.56	5.21c	6.72c	11.93cd	43.70f
V_2×F_1	94.57h	14.40bcd	6.13g	8.27a	23.57	128.84g	14.19def	24.03	3.32g	4.53i	7.86i	42.31g
V_2×F_2	96.40gh	10.53f	6.33fg	4.20de	23.47	127.40g	13.08ef	24.22	4.52de	5.48h	10.00g	45.21cde
V_2×F_3	94.53h	15.47ab	8.93abc	6.53bc	23.50	123.61g	12.43f	24.32	5.53b	6.65c	12.18c	45.41cd
V_2×F_4	97.67g	14.13bcd	7.67de	6.47bc	23.92	141.79ef	13.48def	24.23	5.00c	6.21ef	11.20e	44.59def
V_2×F_5	95.93gh	16.73a	10.00a	6.73b	24.13	144.56de	14.52def	24.37	4.40ef	5.61h	10.00g	43.94ef
V_3×F_1	126.50bc	13.13de	7.80cde	5.33cd	25.99	161.51a	14.48def	26.06	4.18f	5.42h	9.60h	43.55fg
V_3×F_2	127.30bc	12.80de	7.00d-g	5.80bc	25.21	145.57cde	17.84bc	26.28	4.72d	5.93g	10.65f	44.31def
V_3×F_3	125.77c	10.87f	9.06ab	1.80f	25.71	158.28ab	14.71def	26.54	5.75b	6.39de	12.14c	47.38ab
V_3×F_4	130.07a	14.33bcd	8.13bcd	6.20bc	26.17	161.76a	15.31cde	26.48	5.57b	6.06fg	11.63d	47.86a
V_3×F_5	128.60ab	13.40cd	7.53def	5.87bc	22.73	158.20ab	18.53b	26.61	5.55b	6.60cd	12.15c	45.69cd
$S_{\bar{X}}$	0.88	0.51	0.39	0.38	0.87	2.32	0.83	0.07	0.08	0.08	0.13	0.44
Level of significance	**	**	**	**	NS	**	**	NS	**	**	**	**

In a column, figures with same letter or without letter do not differ significantly whereas figures with dissimilar letter differ significantly (as per DMRT).
NS=Not significant, * = Significant at 5% level of probability and ** = Significant at 1% level of probability
V_1=BRRI dhan31, V_2=BRRI dhan39 and V_3=BRRI dhan41; F_1= RF, F_2= Cowdung @ 10 t ha^{-1}, F_3= 50% RF + Cowdung @ 5 t ha^{-1}, F_4=75% RF + Cowdung @ 2.5 t ha^{-1} and F_5= 100% RF + Cowdung @ 5 t ha^{-1}

Effect of interaction of variety and integrated nutrient management on growth and yield of transplant *Aman* rice

Interaction effect of variety and integrated nutrient management was also found to affect yield and yield components of transplant *Aman* rice significantly (Table 3). The tallest plants (130.07 cm) were found in the combination of BRRI dhan41 × 75% RF + cowdung @ 2.5 t $ha^{-1}$and the shortest one (94.53 cm) was in the combination BRRI dhan39 and 50% RF + Cowdung @ 5 t ha^{-1}. The highest number of total tillers $hill^{-1}$ (16.73) was found in the treatment combination of BRRI dhan39 × 100% RF + Cowdung @ 5 t ha^{-1} and the lowest number of total tillers $hill^{-1}$ (10.53) were found in BRRI dhan39 × Cowdung @ 10 t ha^{-1} treatment combination. The highest number of effective tillers $hill^{-1}$ (9.98) was found in the treatment BRRI dhan31 × 50% RF+ Cowdung @ 5 tha^{-1} and the lowest number of effective tillers $hill^{-1}$ (6.13) were found in the treatment BRRI dhan39 x RF. The present findings closely resemble to those of Apostol (1989) who found that organic and inorganic fertilizers increased effective tillers $hill^{-1}$. The highest number of non-effective tillers $hill^{-1}$ (8.27) was found in the treatment combination of BRRI dhan39 x RF and the lowest one (1.80) were found in the treatment combination of BRRI dhan41 × 50% RF + Cowdung @ 5 tha^{-1}. The longest panicle (26.17) was found in the combination of BRRI dhan41 with 75% RF + Cowdung @ 2.5 tha^{-1} and the shortest one (22.73) was found in the combination of BRRI dhan41 variety with 100% RF + Cowdung @ 5 tha^{-1}. The highest number of grains $panicle^{-1}$ (161.76) was found in the combination of BRRI dhan41 with 75% RF + Cowdung @ 2.5 t ha^{-1} and the lowest one (106.77) was found in the combination of BRRI dhan31 with RF. The highest number of sterile spikelets $panicle^{-1}$ (23.24) was found in the combination of BRRI dhan31 with 75% RF + Cowdung @ 2.5 tha^{-1} and lowest one (12.43) was found in the combination of BRRI dhan39 variety with 50% RF + Cowdung @ 5 tha^{-1}.But numerically the highest 1000-grain weight (26.61 g) was obtained from the combination of BRRI dhan41 with 100% RF + cowdung @ 5 tha^{-1} and the lowest one (24.03 g) was obtained from the combination of BRRI dhan39 with RF. The highest grain yield (6.29 tha^{-1}) was found in BRRI dhan31 with 50% RF + Cowdung @ 5 tha^{-1} which was statistically identical with the interaction between BRRI dhan31 and Cowdung @ 10 tha^{-1} (6.09 tha^{-1}). The lowest one (3.32 tha^{-1}) was obtained from the combination of BRRI dhan39 with RF. The highest straw yield (7.59 tha^{-1}) was found in BRRI dhan31 variety with 50% RF + Cowdung @ 5 tha^{-1} and the lowest one (4.53 tha^{-1}) was found in BRRI dhan39 variety with RF. The highest biological yield (13.88 tha^{-1}) was obtained from 50% RF + Cowdung @ 5 tha^{-1} and the lowest one (7.86 tha^{-1}) was obtained from the combination of BRRI dhan39 with RF. The highest harvest index (47.86%) was achieved from the combination of BRRI dhan41 with 75% RF + Cowdung @ 2.5 tha^{-1} and the lowest one (42.31%) was obtained from the combination of BRRI dhan39 variety with RF.

Conclusion

From the above discussion it can be summarized that for the highest grain yield (6.29 tha^{-1}) BRRI dhan31. Application of 50% recommended fertilizer + cowdung @ 5 tha^{-1} performed best and Cowdung @ 10 tha^{-1} showed the identical and highest grain yield. Therefore, it can be concluded that BRRI dhan31 with 50% RF + Cowdung @ 5 tha^{-1} was found to be the best one in respect of yield components and yield of transplant *Aman* rice.

References

Ahmed, M. & Rahman, S. (1991). Influence of organic matter on the yield and mineral nutrition of modern rice and soil properties. *Bangladesh Rice J.* 2, 1-2, 107-112.

Ali, M. M., Shaheed, S. M., & Kubota, D. (1997). Soil degradation during the period of 1967-1995 in Bangladesh II. Selected chemical characters. *Soil Sci. Plant Nurt.* 43, 879-890.

Anonymous. (1997). Fertilizer Recommendation Guide. Published by BARC, Dhaka, Bangladesh.

Anonymous (1996). . Annual Report. The Bangladesh Rice Research Institute, Gazipur-1701, Bangladesh.

Apostol, E. D. F. (1989). Influence of mirasoil organic and X-rice fertilizer in combination with inorganic liquid on IR 66 and BPIR rice varieties. Malaben. Metro, Manila , Philippines. p. 73.

BBS (Bangladesh Bureau of Statistics). (2000). Statistical year book of Bangladesh. Stat. Div. Mins. Planning, Govt. People's Repub. of Bangladesh, Dhaka.

BBS (Bangladesh Bureau of Statistics). (2006). Statistical year book of Bangladesh. Bangladesh Bureau of Statistics, Ministry of Planning Govt. People's Repub. of Bangladesh, Dhaka. pp. 47-50.

BBS, (Bangladesh Bureau of Statistics). 2007. Year book of agricultural Statistics. Bangladesh Bureau of Statistics, Ministry of Planning Govt. People's Repub. of Bangladesh.

Bhatia, K. S. & Shukla, K. K. (1982). Effect of continuous application of fertilizers and manures on some physical properties of (eroded) alluvial soil. *J. Indian Soc. Soil Sci.* 30, 1, 33-36.

Bhuiyan, N. I., Shaha, A. L., & Panaullah G. M. (1991). Effect of NPK fertilizer on the grain yield of transplanted rice and soil fertility. Long term study. *Bangladesh J. Soil Sci.* 22, 1&2, 41-50.

BINA (Bangladesh Institute of Nuclear Agriculture). (1996). Annual Report for 1993-1994. Bangladesh Inst. Nucl. Agril. P. O. Box. No. 4, Mymensingh. p. 175.

BINA. (Bangladesh Institute of Nuclear Agriculture). (1993). Annual report for 1992-93. Bangladesh Inst. Nucl. Agric. P.O.Box No. 4, Mymensingh. pp. 52-143.

Brar, B. S. & Dhillon, N. S. (1994). Effect of Farm yard manure application on yield and soil fertility in rice wheat rotation. *Int. Rice Res. Notes.* (Philippines). 19(2):23.

BRRI (Bangladesh Rice Research Institute). (1989). Annual Report for 1988. Bangladesh Rice Res. Inst., Joydevpur, Bangladesh. p. 10.

BRRI (Bangladesh Rice Research Institute). (1990). Annual Report for 1988. Bangladesh Rice Res. Inst., Joydebpur, Gazipur. pp. 08-14.

BRRI (Bangladesh Rice Research Institute). (1994). Annual Report for 1991. Bangladesh Rice Res. Inst., Joyebpur, Gazipur. pp. 57, 166.

BRRI (Bangladesh Rice Research Institute). (2000a). *Adhunik Dhaner Chaste* (in Bangla). Joydebpur, Gazipur. 9th Edn. p. 7.

BRRI (Bangladesh Rice Research Institute). (2000b). Annual report for 1997. Bangladesh Rice Res. Inst., Joydebpur, Gazipur, Bangladesh. Pub. No. 134, pp. 88-256.

Cassman, K. G., Datta de S. K., OIK, D.C., Alcantra, J., Sason, M., Descalsota, J., & Dizon. (1995). Yield decline and the nitrogen economy of long term experiment on continuous irrigated rice system in the tropics. pp. 181-222. In: R. Lal and Stewart, B. A. (eds) Soil Management: Experimental basis for sustainability and environmental quality. lewis Publisher, London.

Chowdhury, M.J.U., Sarker, A.U., Sarker, M.A.R., & Kashem, M.A. (1993). Effect of variety and number of seedlings hill^{-1} on the yield and its components on late transplant aman rice. Bangladesh J. Agril. Sci. 20(2): 311-316.

Dwivedi, D.K. (1997). Response of scented rice *(Oryza sativa)* genotype to nitrogen under mid-upland situation. *Indian J. Agron.* 42, 1, 74-76.

FAO (Food and Agriculture Organization). (2000). Production Year Book. Food and Agricultural Organization of the United Nations, Rome:76-77.

Gomez, K. A., & Gomez, A. A. (1984). Statistical procedures for Agric. Research. 2nd Edn., John Wiley and Sons. New York. pp. 139-240.

Hossain, T., Jilani, G., & Ghaffar, A. (1989). Influence of rate and time of N application on growth and yield of rice in Pakistan. *Intil. Rice Res. Newsl.* 14, 6, 18.

IRRI (International Rice Research Institute). (1995). Annual Report for 1994. IRRI. Los Banos, Languna, Philippines. pp. 179-181.

Kant, S. & Kumar, R. (1994). A comparative study on the effect of four soil amendments on the uptake of Fe, Mn and yield of rice in salt affected soil. *Indian J. Agric. Chem.* 27, 283, 57-70.

Karim, Z., Miah, M. M. U., & Razia, S. (1994). Fertilizer in the national economy and sustainable environmental development. *Asia Pacific J. Environ. Dev.* 1, 48-67.

Kobayashi, Y., Abe, S., & Matamoto, M. (1989). Growth and yield of paddy rice under natural cultivation [Cited from soil and Fert. 1991. 54(12): 1931].

Krishi Diary. (2009). Agricultural Information Service. Khamarbari, Farmgate, Dhaka.pp. 442-446.

Lal, S., & B. S. Mathur. (1988). Effect of long term manuring, fertilization and liming on crop yield and some physical properties of acid soil. *J. Indian Soc. Soil Sci.* 36, 113-119.

Lu, J., & Chang T. T. (1980). Rice in its temporal and spatial perspectives pp. 1-74. In: Luh (eds). Rice production and Utilization. AVI, Davis, California.

Mobasser, H. R., Mohamadi, G. N., Fallah, V. M., Darvish, F., & Majid S. (2005). Effects of nitrogen rates and splitting on grain yield of rice (*Oryza sativa* L.) *J. Agril. Sci. Islamic Azad University*, Tehran Iran. 11, 3, 109-120.

Nambiar, K. K. M. (1997). Soil health and organic matter: changing scenario Proc. Nat. ACAD. Sci. India Spl. Issue pp. 141-160.

Nambiar, K. K. M., & Abrol, I. P. (1989). Long term fertilizer experiments in India an overview. *Fertilizer News*, 34, 4, 11-20.

Rabindra, B., Narayanawamy, G.V., Janardhan, N.A., & Shivanagappa. (1985). Long range effect of manure and fertilizers on soil physical properties and yield of sugarcane. *J. Indian Soc. Soil Sci.* 33, 704-706.

Rafey, A., Khan, P. A., & Srivasta, V. C. (1989). Effect of manure on growth, yield and nutrient uptake of upland rice. *Indian J Agron.* 34, 1, 133-135.

Reddy, J. V., Singh, J. N., & Verma, A. K. (1988). Effect of time of nitrogen application on growth and yield of rice *(Oryza sativa* L.*). Agric. Sci. Digest. India*. 5, 83-85.

Shamsuddin, A. M., Islam, M. A., & Hossain, A. (1988). Comparative study on the yield and yield agronomic characters of nine cultivars of rice. *Bangladesh J. Agril. Sci.* 15, 1, 121-124.

Singh, G. B., & Yadav, D. V. (1992). INSS in sugarcane and sugarcane based cropping system. *Fert. News* 37, 4, 15-22.

Singh, Y., Chaudhary, D. C., Singh, S. P., Bhardwaj, A. K., & Singh, D. (1996). Sustainability of rice (*Oryza sativa*) - wheat (*Triticum aestivum*) sequential cropping through manure crops in the system. *Indian J. Agron.* 41, 4, 510-514.