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Yield of Fine Rice Varieties as Influenced by Integrated Management of Poultry Manure Urea Super Granules and Prilled Urea

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Abstract
Higher grain yield (2.45 t ha^{-1}) was obtained in BRRI dhan34 than that of Kalizira (2.23 t ha^{-1}). Fertilizer application @ 1.8g USG and other inorganic fertilizer (full dose for T. *aman* + PM at 3.5 tha^{-1}) gave the highest grain yield (2.85 t ha^{-1}) and lowest grain yield (1.52 t ha^{-1}) was found at control (no PM and NPKS). Grain yields were affected by the interaction of variety and nutrient management. The highest grain yield (2.88 t ha^{-1}) was found in BRRI dhan34 coupled with 1.8g USG and other inorganic fertilizer (full dose for T. *aman*) + PM at 3.5 t ha^{-1} and the lowest grain yield (1.24 t ha^{-1}) was found in Kalizira coupled with control (no PM and NPKS). The combination of fine rice BRRI dhan34 and 1.8g USG and other inorganic fertilizer (full dose for T. *aman*) + PM at 3.5t ha^{-1} appeared as the best treatment combination for the highest grain yield.

Keywords: BRRI dhan34, Kalizira, Manure, Yield

Introduction

Rice is the staple food crop of the people of Bangladesh covering an area of about 64.52 million hectares, producing about 28.93 million metric tons and the average production is about 2.23 t ha^{-1}(BBS, 2008). Like other crops, the yield level of rice is very low (2.23 t ha^{-1}) compared to other rice growing countries like South Korea and Japan where the average yield is 6.00 and 5.22 t ha^{-1} respectively (FAO, 2004). Rice grain is categorized into coarse, medium and fine with different colors based on physical properties. In Bangladesh, a number of fine rice cultivars are grown by the farmers. Some of them have special appeal for their aroma. Such common cultivars are Chinisagar, Basmati, Badshabhog, BRRI dhan34, Kalizira, Tulsimla, Dulabhog, BRRI dhan37 and BRRI dhan38. Fine rice is mainly used by the people in the preparation of palatable dishes and sold at a higher price in the market due to its special appeal for aroma and acceptability. Bangladesh has bright prospect for export of these fine rice thereby earning foreign exchange. The yield of fine rice is lower than that of coarse and medium rice. The reason for low yield are mainly associated with lack of improved varieties and judicious fertilizer management especially of organic fertilizer like poultry manure and inorganic fertilizer like urea super granules (USG), prilled urea (PU) etc. Selection of a potential variety, planting in appropriate method and application of optimum amount of nutrient elements can play an important role to increase yield. However, fine rice is grown well under lower levels of inputs.

In Bangladesh, nutrient stresses of soils are increasing day by day. Use of fertilizer is an essential component of modern farming of today with about 50% of the world crop production (Prodhan, 1992). Among the management practices, application of poultry manure, nitrogen fertilizer and variety are the important ones. Kabir *et al.* (2009) reported that a considerable portion (31.25%) of PU nitrogen saved by using USG (1.8g) together with other inorganic fertilizers or with PM at 2.5 t ha^{-1}. Hasan *et al.* (2004) also stated that BRRI dhan34 fertilized with 75% NPKS + poultry manure at 5 t ha^{-1} produced the highest grain yield than Kalizira. Though rice is one of the most important crops of the world, enough information regarding the varieties of fine rice and their response to poultry manure and nitrogen are scarce in the world literature. Extensive research works are necessary to find out appropriate variety and optimum rate of poultry manure and nitrogen to obtain satisfactory yield and quality of fine rice. Therefore, the present study was undertaken to achieve the following objectives: to evaluate the yield performance and the appropriate nutrient management for two fine rice varieties and also find out the interaction among integrated management of poultry manure, urea super granules and prilled urea on the yield of fine rice (Kalizira & BRRI dhan34).

Materials and Methods

The experiment was conducted at the Agronomy Field laboratory, Bangladesh Agricultural University, Mymensingh-2202 during the period from August to December, 2009. The experimental field was a medium high land with silty clay loam soil having pH value of 6.5. The study consisted of the following factors and treatments- Factor A: Varieties of fine rice such as i. Kalizira and ii. BRRI dhan34 and Factor B: Nutrient management such as T_1 = Control (no PM and NPKS), T_2 = PM at 7.0 t ha^{-1}, T_3 = PM at 3.5 t ha^{-1}, T_4 = Recommended dose of prilled urea and other inorganic fertilizers (i.e. 80, 60, 40, 10, 5 kg N, P_2O_5, K_2O, S and $ZnSO_4$, respectively ha^{-1}), T_5 = Full dose of USG, T_6 = 1/2 PU + PKSZn + PM at 3.5 t ha^{-1}, T_7 = 0.9g USG + PM at 7.0 t ha^{-1}, T_8 = 0.9g USG + PM at 3.5 t ha^{-1}, T_9 = 1.8g USG and other inorganic fertilizer (full dose for T. *aman*) + PM at

7.0 t ha^{-1}, T_{10} = 1.8g USG and other inorganic fertilizer (full dose for T. *aman*) + PM at 3.5 t ha^{-1}. The experiment was laid out in a randomized complete block design with three replications. There were 60 unit plots in the experiment and the size was 4.0 m x 2.5 m. The sprouted seeds were sown in the nursery beds on 18 July 2009. Forty days aged seedlings were transplanted on 28 August 2009 in the well puddled plot. Three seedlings were transplanted in each hill with a spacing of 25 cm x 15 cm. In the experiment, chemical fertilizers were applied at the rate of 60, 40, 10 and 5 kg ha^{-1} of P_2O_5, K_2O, S and $ZnSO_4$, respectively. The whole amount of poultry manure, TSP, MOP, gypsum and $ZnSO_4$ were applied at the time of final land preparation. USG @ 100 kg ha^{-1} was applied in the middle of 4 hills of two adjacent rows at a time at 15 DAT. Prilled urea was applied at 15, 30 and 45 DAT, respectively. Intercultural operations such as weeding, irrigation, drainage and plant protection measures were done as and when necessary. The crop was harvested plot-wise at full maturity when 90% of the grains turned into golden yellow. Hills from central 5 m^2 area of each plot were harvested for collecting data on grain and straw yields. The harvested crop was then bundled separately, tagged properly and brought to the threshing floor and processed as usual. Prior to harvest five hills were selected at random from each plot and carefully uprooted to collect data on yield and yield contributing characters. The collected data were analyzed statistically and the mean differences were adjudged by Duncan's Multiple Range Test (Gomez and Gomez, 1984) using MSTAT computer program.

Results and Discussion

Varietals performance

Variety influenced significantly all the yield contributing characters and yield except number of total tiller $hill^{-1}$ and panicle length (Table 1). Kalizira produced the highest plant height (125.4 cm) compared to BRRI dhan34 (110.32cm). Highest number of effective tillers (13.07) $hill^{-1}$ and non-effective tillers $hill^{-1}$ (4.80) were also produced by Kalizira but the lowest number of these two yield contributing characters were found in BRRI dhan34. Grains $panicle^{-1}$ was found the highest (169.68) in BRRI dhan34 and the lowest (167.43) in Kalizira but incase of unfilled grains $panicle^{-1}$ it was reversed. More weight of 1000 grain (11.63g) was recorded in Kalizira than BRRI dhan34 (11.54g). Highest grain yield (2.45 t ha^{-1}), biological yield (5.51 t ha^{-1}) and harvest index (44.33%) were observed in BRRI dhan34 and the lowest of these parameters were found in Kalizira. On the other hand, Kalizira was produced the highest straw yield (3.16 t ha^{-1}) which was found lowest (3.06 t ha^{-1}) in BRRI dhan34. Hasan *et al.* (2004) reported similar result.

Table 1. Effect of varieties on the yield components and yield of fine rice (Kalizira and BRRI dhan34)

Varieties	Plant height (cm)	Number of effective tillers $hill^{-1}$	Number of non-effective tillers $hill^{-1}$	Length of panicle (cm)	Grains $panicle^{-1}$	1000-grain wt (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
V_1	125.4a	13.07a	4.80a	24.04	167.43b	11.63a	2.23b	3.16a	5.39b	40.96b
V_2	110.32b	11.90b	3.57b	23.89	169.68a	11.54b	2.45a	3.06b	5.51a	44.33a
S $\overline{X}$	1.25	0.29	0.28	0.46	4.68	0.68	0.22	0.16	0.28	1.71
Sig. Level	**0.01**	**0.05**	**0.01**	**NS**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**

In a column, figures with same letter or without letter do not differ significantly whereas figures with dissimilar letter differ significantly (as per DMRT).
0.05 = Significant at 5% level of probability, 0.01 = Significant at 1% level of probability
NS = Not significant, V_1= Kalizira and V_2=BRRI dhan34

Effect of nutrient management

Nutrient management exerted significant influenced on the entire yield contributing characters as well as yield on fine rice varieties except 1000-grain weight (Table 2). The highest plant height (124.67 cm) was recorded in full doses of USG (T_5) and the lowest from the control treatment (no PM and NPKS). The maximum number of effective tiller $hill^{-1}$ (15) was observed in recommended doses of prilled urea and other inorganic fertilizer (T_4) whereas full doses of USG (T_5) produced the maximum number of non effective tillers $hill^{-1}$(5.67). The longest panicle length (25.68 cm) was produced from 1.8 g USG and other inorganic fertilizer full dose for T. *aman* + PM at 3.5 t ha^{-1} (T_{10}). Maximum number of grains $panicle^{-1}$ (200.21) was observed in recommended doses of prilled urea and other inorganic fertilizer (T_4). The highest grain yield (2.85 t ha^{-1}), biological yield (6.24 t ha^{-1}) and harvest index (45.80%) was recorded from 1.8 g USG and other

inorganic fertilizer full dose for T. *aman* + PM at 3.5 t ha^{-1} (T_{10}) whereas full doses of USG (T_5) produced the highest straw yield (3.54 t ha^{-1}). No PM and NPKS (T_0) gave the lowest result on all the yield and yield contributing parameters. Similar result also reported by Kabir *et al.* (2009).

Table 2. Effect of nutrient management on the yield components and yield of Kalizira and BRRI dhan34

Fertilizers	Plant height (cm)	Number of effective tillers $hill^{-1}$	Number of non-effective tillers $hill^{-1}$	Length of panicle (cm)	Number of grains $panicle^{-1}$	1000-grain wt. (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
T_1	106.50e	8.50c	3.17cd	21.93e	119.61f	11.46	1.52e	2.54g	4.05g	37.21d
T_2	107.33e	10.17c	4.50abc	22.35e	138.87e	11.61	1.86bc	2.83f	4.68f	39.66c
T_3	119.00cd	12.33b	4.17abc	24.15bcd	176.50bc	11.67	1.94d	2.94ef	4.88e	39.77c
T_4	117.75d	15.00a	1.83d	23.35d	200.21a	11.57	2.57bc	3.20c	5.77c	44.49ab
T_5	124.67a	13.83ab	5.67a	24.33bc	171.03c	11.48	2.52bc	3.54a	6.06ab	41.49c
T_6	117.67d	9.67c	5.17ab	23.47cd	153.43d	11.61	2.50bc	3.02de	5.52d	45.27ab
T_7	122.67ab	14.50ab	4.67abc	24.65b	184.10b	11.74	2.46c	3.18cd	5.64cd	43.61b
T_8	119.83bcd	12.50b	4.00bc	24.67b	167.00c	11.68	2.59bc	3.10cd	5.69cd	45.46ab
T_9	121.83abc	14.33ab	3.83bc	25.07ab	175.80bc	11.44	2.61b	3.37b	5.98b	43.66b
T_{10}	121.33bc	14.00ab	4.83ab	25.68a	198.97a	11.58	2.85a	3.39ab	6.24a	45.80a
$S\overline{X}$	1.06	0.729	0.512	0.46	3.094	0.0428	0.22	0.054	0.056	0.525
Level of Sig.	**0.01**	**0.05**	**0.01**	**0.05**	**0.01**	**NS**	**0.01**		**0.01**	**0.01**

In a column, figures with same letter or without letter do not differ significantly whereas figures with dissimilar letter differ significantly (as per DMRT). 0.05 = Significant at 5% level of probability, 0.01 = Significant at 1% level of probability, NS = Not significant.

Legend:

T_1 = Control (No PM and NPKS), T_2 = PM at 7.0 (t ha^{-1}), T_3 = PM at 3.5 t ha^{-1}, T_4 = Recommended dose of prilled urea and other inorganic fertilizers (i.e. 80, 60, 40, 10 and 5 kg N, P_2O_5, K_2O, S and $ZnSO_4$, respectively ha^{-1}), T_5 = Full dose of USG, T_6 = 1/2 PU + PKSZn + PM at 3.5 t ha^{-1}, T = 0.9g USG + PM at 7.0 t ha^{-1}, T_8= 0.9g USG + PM at 3.5 t ha^{-1}, T_9 = 1.8 g USG and other inorganic fertilizer full dose for T. *aman* + PM at 7.0 t ha^{-1}, T_{10} = 1.8g USG and other inorganic fertilizer full dose for T. *aman* + PM at 3.5 t ha^{-1}.

Effect of interaction of varieties and nutrient management

The effect of interaction of variety and combined level of fertilizers had significant influence on all the parameters except number of non-effective tillers and 1000-grain weight (Table 3). The highest plant height (135.83 cm) was observed in Kalizira and full doses of USG ($V_1 \times T_5$). The maximum number of effective tillers $hill^{-1}$ (16) was recorded from Kalizira and 0.9 g USG + PM at 7.0 t ha^{-1} ($V_1 \times T_7$) treatment combination. Kalizira and 1.8 g USG and other inorganic fertilizer full dose for T. *aman* + PM at 3.5 t ha^{-1} ($V_1 \times T_{10}$) combinations gave the longest panicle (25.93 cm), the greatest number of grains $panicle^{-1}$ (207.60), the highest straw yield (3.63 t ha^{-1}) and biological yield (6.45 t ha^{-1}).

On the other hand, BRRI dhan34 and 1.8 g USG and other inorganic fertilizer full dose for T. *aman* + PM at 3.5 t ha^{-1} ($V_2 \times T_{10}$) combinations produced the highest grain yield (2.88 t ha^{-1}) and harvest index (47.83 %). This result is agreement with findings of Hasan *et al*. (2004) and Islam *et al.* (2007). The control treatment (no PM and NPKS) gave the lowest result in all the parameters irrespective of fine rice varieties (Kalizira and BRRI dhan34).

Conclusions

The result of the experiment revealed that the performance of BRRI dhan34 was better than that of Kalizira in terms of grain yield in the *Aman* season. Among the different nutrient 1.8g USG and other inorganic fertilizer (full dose for T. *aman*) + PM at 3.5 t ha^{-1} gave better performance. It can be conducted that fine rice variety BRRI dhan34 fertilized with 1.8g USG each four alternate hills and other inorganic fertilizer (full dose for transplant *aman* rice) + poultry manure at 3.5 t ha^{-1} gave the highest grain yield with only 55kg N ha^{-1} in USG form as against 80 kg N ha^{-1} in the form of prilled urea, which could be a profitable N-management technique.

Table 3. Interaction effect of variety and nutrient management on the yield components and yield of Kalizira and BRRI dhan34.

Interaction (V×T)	Plant height (cm)	Number of effective tillers hill^{-1}	Number of non - effective tillers hill^{-1}	Length of panicle (cm)	Number of grains Panicle^{-1}	1000-grain wt(g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
$V_{1\times}T_1$	106.83h	8.00f	3.00	22.37gh	128.08h	11.42	1.24j	2.63hi	3.78j	32.05j
$V_1\times T_2$	115.33fg	11.33cde	5.00	21.63h	130.20h	11.77	1.75i	2.90d-g	4.65h	37.67i
$V_1\times T_3$	121.50de	11.67b-e	4.67	25.23abc	192.20bcd	11.68	1.90hi	3.04c-f	4.95g	38.48hi
$V_1\times T_4$	127.83bc	15.00ab	2.33	23.17fg	197.25abc	11.76	2.44edf	3.28bc	5.72de	42.53d-g
$V_1\times T_5$	135.83a	14.67abc	7.33	23.70d-g	152.93fg	11.57	2.37g	3.53a	5.90cd	40.22ghi
$V_1\times T_6$	129.50bc	11.33cde	6.00	23.23fg	150.27g	11.51	2.40fg	2.88efg	5.28f	45.54abc
$V_1\times T_7$	130.17b	16.00a	5.67	25.07a-d	186.67cd	11.69	2.32g	3.12cde	5.43ef	42.61d-g
$V_1\times T_8$	132.50ab	14.67abc	5.33	25.37ab	168.20e	11.84	2.60cde	3.10cde	5.71de	45.62abc
$V_1\times T_9$	125.00cd	15.00ab	3.67	24.70a-e	160.87efg	11.66	2.44efg	3.49ab	5.92cd	41.13fgh
$V_1\times T_{10}$	129.50bc	13.00a-d	5.00	25.93a	207.60a	11.40	2.82ab	3.63a	6.45a	43.77b-f
$V_2\times T_1$	106.17h	9.00ef	3.33	21.50h	111.13i	11.50	1.80hi	2.44i	4.24i	42.37efg
$V_2\times T_2$	99.33i	9.00ef	4.00	23.07fg	147.53g	11.45	1.96h	2.75gh	4.71gh	41.65fg
$V_2\times T_3$	116.50fg	13.00a-d	3.67	23.07fg	160.80efg	11.66	1.97h	2.83fgh	4.81gh	41.06fgh
$V_2\times T_4$	107.67h	15.00ab	1.33	23.53efg	203.16ab	11.39	2.70a-d	3.11cde	5.81cd	46.45ab
$V_2\times T_5$	113.50g	13.00a-d	4.00	24.97a-d	189.13bcd	11.38	2.66bcd	3.56a	6.21ab	42.77c-g
$V_2\times T_6$	105.83h	8.00def	4.33	23.70d-g	156.60efg	11.72	2.59def	3.17c	5.76cd	45.00a-e
$V_2\times T_7$	115.17fg	13.00a-d	3.67	24.23b-f	181.53d	11.78	2.61cde	3.24c	5.84cd	44.62b-e
$V_2\times T_8$	107.17h	10.33def	2.67	23.97c-f	165.80ef	11.53	2.57def	3.10cde	5.67de	45.31a-d
$V_2\times T_9$	118.67ef	13.67a-d	4.00	25.43ab	190.73bcd	11.23	2.79abc	3.25c	6.04bc	46.19ab
$V_2\times T_{10}$	113.17g	15.00ab	4.67	25.43ab	190.33bcd	11.76	2.88a	3.15cd	6.03bc	47.83a
$S\overline{X}$	1.510	1.032	3.00	0.427	4.376	11.42	0.051	0.078	0.093	0.885
Level of Sig.	**0.01**	**0.05**	**NS**	**0.01**	**0.01**	**NS**	**0.01**	**0.01**	**0.01**	**0.01**

In a column, figures with same letter or without letter do not differ significantly whereas figures with dissimilar letter differ significantly (as per DMRT). 0.05 = Significant at 5% level of probability, 0.01 = Significant at 1% level of probability, NS = Not significant.

Legend:

T_1 = Control (No PM and NPKS), T_2 = PM at 7.0 (t ha^{-1}), T_3 = PM at 3.5 t ha^{-1}, T_4 = Recommended dose of prilled urea and other inorganic fertilizers (i.e. 80, 60, 40, 10 and 5 kg N, P_2O5, K_2O, S and $ZnSO_4$ respectively ha^{-1}), T_5 = Full dose of USG, T_6 = 1/2 PU + PKSZn + PM at 3.5 t ha^{-1}, T = 0.9g USG + PM at 7.0 t ha^{-1}, T_8 = 0.9g USG + PM at 3.5 t ha^{-1}, T_9 = 1.8 g USG and other inorganic fertilizer full dose for T. *aman* + PM at 7.0 t ha^{-1}, T_{10} = 1.8g USG and other inorganic fertilizer full dose for T. *aman* + PM at 3.5 t ha^{-1}.

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