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Influence of cow dung, poultry litter and chemical fertilizers on the yield of modern aromatic rice varieties in *aman* season

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Abstract: The experiment was conducted at the Hajee Mohammad Danesh Science and Technology University Farm, Dinajpur, Bangladesh during July to December 2009 to observe the influence of cowdung, poultry litter and NPKSZn chemical fertilizers for modern aromatic rice cultivation in respect of yield. The experiment was laid out in a randomized complete block design with three replications. The experiment comprised of four treatments viz., control (no fertilizer), cow dung @ 5 tha^{-1}, poultry litter @ 3 tha^{-1}, recommended dose of NPKSZn fertilizer and four modern aromatic rice varieties namely, BRRI dhan34, BRRI dhan37, BRRI dhan38 and Basmati. All the fertilizer treatments produced significantly higher grain yield than control. Growth attributes of aromatic rice such as plant height, total tillers $hill^{-1}$, fertile tillers $hill^{-1}$, spikelet $panicle^{-1}$, grain $panicle^{-1}$ and 1000 grain weight showed higher value with the recommended NPKSZn chemical fertilizers irrespective of varieties. Recommended NPKSZn chemical fertilizers produced the highest grain yield. Grain yield differed significantly among the varieties. Therefore, it is concluded that urea @ 200 $kgha^{-1}$, TSP @ 50 $kgha^{-1}$, MOP @ 100 $kgha^{-1}$, Gypsum @ 50 $kgha^{-1}$ and ZnSO4 @ 10 $kgha^{-1}$ may be used to get higher yield of modern aromatic rice in *aman* season under Dinajpur condition.

Key words: Fertilizer, Cow dung, Poultry litter, Yield, Modern aromatic rice.

Introduction

Availability of fertilizer at the right time is one of the major constraints now a day for rice production in Bangladesh. Moreover, use of cow-dung, organic waste, leaves and crop residues as fuel has been depriving the agricultural soils from their replenishment (Hossain *et al.*, 1995). It is known that poultry litter can be utilized for rice production (BRRI, 2002 and 2006). There are 72.71 million poultry in Bangladesh (BBS, 2003), a source of huge wastes, which creates environmental pollution in some locations. This waste contains various nutrients, which can be used successfully for crop production and ruminant feed (Jacob *et al.,* 1997; Kunkle *et al.,* 1997). The organic fertilizer is traditionally an important source for supplying nutrients for rice cultivation in Bangladesh but use of inorganic fertilizers has increased dramatically, whereas utilization of organic fertilizers decreased. Higher yields depend on rational and effective application of chemical fertilizers (Plucknett *et al.,* 1986). The cost of fertilizer is also high. So, poultry litter could be used under such conditions to supplement plant nutrients for rice production because it contains good amount of available nutrients (Jacob *et al.* ,1997). Aromatic rice is rated best in quality and fetches much higher price than high quality non-aromatic rice in the domestic and international market. The demand of aromatic rice for internal consumption and also for export is increasing day by day (Das and Baqui, 2000). Dinajpur region is a native area of some indigenous aromatic rice cultivars. About 30% of rice land in Dinajpur is covered by aromatic rice varieties during *'Aman'* season (Baqui *et al.,* 1997). Due to low yield and limited market facilities farmers seem to have little interest to continue growing these aromatic rice cultivars. This will ultimately economize fertilizer use and maintain soil productivity and yield. The information is limited on varietal quality responses to different organic and inorganic fertilizers with their interactions particularly in respect of yield of aromatic rice varieties. Therefore, the present investigation was aimed to feasibility study of using poultry litter as a source of plant nutrient for aromatic rice cultivation.

Materials and Methods

The experiment was conducted at the Hajee Mohammad Danesh Science and Technology University Farm, Dinajpur, Bangladesh during July to December of 2009. The experimental site was a medium high land with sandy loam soil having a pH value of 6.0. The experiment was laid out in a randomized complete block design with three replications. The experiment consisted of five fertilizer treatments viz., T_1= Control (No fertilizer), T_2=Cow dung @ 5 tha^{-1}, T_3= Poultry litter @ 3 tha^{-1}, T_4= Recommended dose of NPKSZn (urea @ 200 $kgha^{-1}$, TSP @ 50 $kgha^{-1}$, MOP @ 100 $kgha^{-1}$, Gypsum @ 50 $kgha^{-1}$ and ZnSO4 @ 10 $kgha^{-1}$) and four modern aromatic rice varieties namely, BRRI dhan34, BRRI dhan37, BRRI dhan38 and Basmati. The unit plot size was 4.0m X 2.5m. According to the experimental specification, no fertilizer was used under control treatment (T_1). P, K, S and Zn were applied as basal through TSP 50 kg, MOP 100 kg, gypsum 50 kg and $ZnSO_4$ 10 kg ha^{-1} at final land preparation. Well decomposed sun dry cow-dung @ 5 t ha^{-1} and poultry litter @ 3 t ha^{-1} was mixed in the specific plots at the time of final land preparation. Nitrogen was applied in the form of urea @ 200 kg ha^{-1} in two equal splits at 20 and 45 days after transplanting. Thirty-day-old seedlings were transplanted in the plots at a spacing of 20 cm X 15 cm using 3 seedlings $hill^{-1}$ on 25 July 2009. All other cultural practices were done uniformly as per recommendation. Whole plots were harvested to obtain grain yield. . Data were analyzed following the ANOVA technique and mean differences were adjudged with Duncan's Multiple Range Test (DMRT).

Results and Discussion

Plant height was significantly influenced by fertilizer treatment. The tallest plant (129.7 cm) was found with recommended dose of NPKSZn chemical fertilizers (T_4) that was statistically similar to poultry litter @ 3 t ha^{-1}. The lowest plant height (120.1cm) was observed in control treatment (T_1). This result agreed with the findings of

Hossain *et al*. (1997) and Sarkar *et al*. (2004). The highest number of total tillers hill^{-1} (12.3) was observed with recommended dose of chemical fertilizers (T_4). Lowest total tillers hill^{-1} (10.7) observed under control treatment (T_1, Table1). This result agreed with that of Ahmed and Rahman (1991). The highest fertile tillers hill^{-1} (11.2) was observed with NPKSZn chemical fertilizers (T_4). The lowest number of fertile tillers hill^{-1} (9.6) was found in control treatment (T_1, Table 1). Number of spikelets panicle^{-1} was significantly influenced due to fertilizer treatment. The highest number of spikelets panicle^{-1} (123.7) was observed in recommended dose of chemical fertilizers (T_4). The lowest number of spikelets panicle^{-1} (113.9) was obtained from control treatment (T_1,Table 1). The highest grains panicle^{-1} (109.1) was recorded in recommended dose of chemical fertilizers (T_4). Lowest number of grains panicle^{-1} (99.5) was found in control treatment (T_1, Table 1).

Table 1. Effect of fertilizer and varieties on the yield and yield contributing characteristics of modern aromatic rice varieties in *aman* season

Treatment	Yield and yield components								
	Plant height (cm)	Total tillers hill^{-1}	Fertile tillers hill^{-1}	Panicle length (cm)	Spikelets panicle^{-1}	Grains panicle^{-1}	1000 grain wt. (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
Fertilizer dose									
T_1	120.1b	10.7c	9.6c	22.9b	113.9b	99.5b	16.5c	1.6d	2.2c
T_2	121.2b	11.4b	10.1b	23.1b	119.8a	102.8bc	16.7bc	1.8c	2.4c
T_3	126.3a	12.1a	11.0a	23.5ab	123.1a	104.0bc	16.9ab	2.6b	2.7b
T_4	129.7a	12.3a	11.2a	23.8a	123.7a	109.1a	17.1a	2.9a	3.1a
Variety									
BRRI dhan34 (V_1)	145.9a	12.5a	12.0a	23.0b	144.9a	129.4a	10.8d	2.5a	2.6b
BRRI dhan37 (V_2)	126.3b	10.3d	8.7c	23.6b	117.0c	91.5c	18.2c	2.0c	2.7b
BRRI dhan38 (V_3)	128.1b	12.1b	9.6c	24.4a	95.7d	86.7d	19.6a	2.0c	2.7b
Basmati (V_4)	97.0c	10.9c	10.9b	22.3c	122.9b	103.8b	18.6b	2.2b	3.2a

*Figures in a column followed by different letters differ significantly but with common letter (s) do not differ significantly at 5% level of probability; T_1= Control (No fertilizer), T_2=Cow dung (5 tha^{-1}), T_3=Poultry litter (3 tha^{-1}), T_4= Recommended dose of NPKSZn (urea @ 200 kgha^{-1}, TSP @ 50 kgha^{-1}, MOP @ 100 kgha^{-1}, Gypsum @ 50 kgha^{-1}, Zn SO_4 @ 10 kgha^{-1})

Table 2. Interaction effect of fertilizer and variety on the yield and yield contributing characteristics of aromatic rice in *aman* season

Treatment	Yield and yield components								
	Plant height (cm)	Total tillers hill^{-1}	Fertile tillers hill^{-1}	Panicle length (cm)	Spikelets panicle^{-1}	Grains panicle^{-1}	1000 grain wt. (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
T_1 V_1	151.9a	10.2e	9.3f-h	22.9cd	141.2a	126.6a	10.5g	1.8d-f	2.2ef
T_1 V_2	148.8ab	12.2ab	11.6a-c	23.4a-c	109.cd	88.7ef	17.9e	1.5f	2.0f
T_1 V_3	141.4bc	11.6b-d	10.0ef	24.2a-c	89.0e	81.9f	19.3bc	1.4f	2.1ef
T_1 V_4	141.4bc	8.7f	7.4ef	21.1e	117.2bc	101.3b-d	18.2d	1.5f	2.6de
T_2 V_1	132.9cd	10.8de	9.4fg	22.9b-d	146.6a	130.9a	10.7fg	2.1cd	2.2ef
T_2 V_2	131.6c-e	12.5ab	11.9ab	23.4a-c	116.6bc	92.1d-f	18.1e	2.1cd	2.4df
T_2 V_3	129.7de	12.0a-c	10.8c-e	24.3a-c	94.7e	87.9ef	19.5ab	1.7ef	2.2ef
T_2 V_4	127.5de	10.3e	8.3h	21.6de	121.4bc	104.9b	18.5de	1.5f	2.8cd
T_3 V_1	125.0de	11.0de	9.7fg	23.0bc	146.0a	126.3a	10.9fg	2.1de	2.3d-f
T_3 V_2	124.9de	12.4ab	12.2a	23.6a-c	121.9bc	93.6c-e	18.3d	2.8b	2.7cd
T_3 V_3	124.3de	12.1ab	11.1b-d	24.4ab	99.3de	90.9ef	19.6ab	2.1de	2.5de
T_3 V_4	121.8e	10.8d	8.9gh	22.8cd	125.0b	106.4b	18.8cd	2.0d	3.1c
T_4 V_1	102.6f	11.6b-d	10.0ef	23.3a-c	146.6a	131.2a	11.1f	2.5bc	3.7b
T_4 V_2	99.1fg	12.8a	12.5a	23.9ac	120.2bc	91.7d-f	18.5de	3.3a	3.8ab
T_4 V_3	94.3fg	12.5a	11.6a-c	24.7a	99.8d	85.9ef	20.0a	2.5bc	3.8ab
T_4 V_4	92.1g	11.2cd	10.3d-f	23.5ac	128.2b	102.4bc	18.8cd	2.8b	4.2a

*Figures in a column followed by different letters differ significantly but with common letter (s) do not differ significantly at 5% level of probability; T_1= Control (No fertilizer), T_2=Cow dung (5 tha^{-1}), T_3=Poultry litter (3 tha^{-1}), T_4= Recommended dose of NPKSZn (urea @ 200 kgha^{-1}, TSP @ 50 kgha^{-1}, MP @ 100 kgha^{-1}, Gypsum @ 50 kgha^{-1}, Zn So$_4$ @ 10 kgha^{-1}), V_1= BRRI dhan34, V_2= BRRI dhan37, V_3= BRRI dhan38, V_4= Basmati

Grain yield was significantly affected due to fertilizer treatments. The application of NPKSZn chemical fertilizers showed a positive effect on the yield components of aromatic rice. This treatment significantly increased fertile tillers hill^{-1}, grains panicle^{-1} and 1000 grain weight which might have the contribution to highest grain yield (2.9 t ha^{-1}). Reduction of grain yield in control treatment might be attributed due to significant reduction in fertile tillers hill^{-1} and grains panicle^{-1}.The highest straw yield (3.1 t ha $^{-1}$) was obtained with recommended dose of chemical fertilizers. The lowest straw yield (2.2 t ha^{-1}) was found in control treatment (T_1). Plant height significantly influenced due to variety. The tallest plant (145.9 cm) was produced by BRRI dhan34 and shortest plant (97.0 cm) was observed in Basmati (Table 1). Lodging of the local varieties at mature stage was observed due to higher plant height. The highest number of total tillers hill^{-1} (12.5) was observed in BRRI dhan34 and lowest (10.3) in Basmati. The highest number of fertile tillers hill^{-1} (12.0) was found in BRRI dhan34. The lowest number of fertile tillers hill^{-1} (8.7) in BRRI dhan37 (Table 1). Length of panicle was significantly influenced by variety. Highest panicle length (24.4 cm) was observed in BRRI dhan38 (Table 1). Highest number of spikelets panicle^{-1} (144.9) was observed in BRRI dhan34 and lowest number of spikelets panicle^{-1} (95.7) was observed in BRRI dhan38 (Table 1). Significant variation was observed due to variety on grains panicle^{-1}. Highest number of grains panicle^{-1} (129.4) was observed in BRRI dhan34 and lowest number grains panicle^{-1} (86.7) was observed in BRRI dhan38 (Table 1). Significant variation of individual grain weight was observed among the tested varieties. Heaviest grain was found in BRRI dhan38 and the weight was less in BRRI dhan34 (Table 1). Among the tested varieties the BRRI dhan34 produced the highest grain yield (2.5 t ha^{-1}) and the lowest grain yield (2.0 t ha^{-1}) was obtained from BRRI dhan37 and BRRI dhan38 (Table.1).The highest straw yield (3.2 t ha^{-1}) was obtained from Basmati and the lowest straw yield (2.1 t ha^{-1}) was obtained from BRRI dhan34 (Table 1). The interaction effect of fertilizer and variety was significant in respect to plant height, total tillers hill^{-1}, fertile tillers hill^{-1}, Panicle length, Spikelets panicle^{-1}, Number of grains panicle^{-1}, thousand grain weight, grain yield and straw yield (Table 2). BRRI dhan34 gave the highest grain yield when applied recommended dose of NPKSZn chemical fertilizers. Modern aromatic rice varieties are more responsive to chemical fertilizer in respect of growth and yield. Therefore, it is concluded that urea @ 200 kgha^{-1}, TSP @ 50 kgha^{-1}, MOP @ 100 kgha^{-1}, Gypsum @ 50 kgha^{-1} and ZnSO4 @ 10 kgha^{-1} may be used to get higher yield of modern aromatic rice in *aman* season under Dinajpur condition.

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