J. Agrofor. Environ. 4 (1): 121-123, 2010 ISSN 1995-6983

Feasibility of using poultry litter with local aromatic rice 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 of 2009 to study the feasibility of using poultry litter as a source of plant nutrient for aromatic rice cultivation compared to cow dung and NPKSZn fertilizers in respect of yield of local aromatic rice varieties. 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 @ 5t ha^{-1}, poultry litter @ 3t ha^{-1}, recommended dose of NPKSZn fertilizer and five local aromatic rice varieties namely, Kataribhog, Badshabhog, Radhunipagal, Kalizera and Shakhorkora. 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 $hill^{-1}$, spikelets $panicle^{-1}$, grains $panicle^{-1}$ and 1000 grain weight showed higher value with the incorporation of poultry litter @ 3 t ha^{-1}. Poultry litter @ 3 t ha^{-1} produced the highest grain yield that was statistically similar to Cow dung @ 5 t ha^{-1} and recommended NPKSZn chemical fertilizers. Grain yield differed significantly among the varieties. Therefore, it is suggested that poultry litter @ 3 t ha^{-1} may be used to get higher yield of local aromatic rice.

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

Introduction

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). 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). Availability of fertilizer at the right time is one of the major constraints now a day for rice production in Bangladesh. 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. Therefore, the present investigation was aimed to study the feasibility 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 @ 5t ha^{-1}, T_3= Poultry litter @ 3t ha^{-1}, T_4= Recommended dose of NPKSZn and five local aromatic rice varieties namely, Kataribhog (V_1), Badshabhog ($V_{2)}$ Radhunipagal(V_3), Kalizera(V_4), Shakhorkora ($V_{5)}$. 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 (151.1 cm) was found with recommended dose of NPKSZn chemical fertilizers (T_4) that was statistically similar to cow dung @ 5 t ha^{-1} and poultry litter @ 3 t ha^{-1}. The lowest plant height (145.0 cm) was observed in control treatment (T_1). The tallest plant with recommended dose of NPKSZn might be due to sufficient supply of nitrogen to crop. This result agreed with the findings of Hossain *et al*. (1997) and Sarkar *et al*. (2004). The highest number of total tillers $hill^{-1}$ (10.4) was observed with recommended dose of chemical fertilizers (T_4) and poultry litter @ 3 t ha^{-1}. Lowest total tillers $hill^{-1}$ (9.8) observed under control treatment (T_1) (Table1). This result agreed with that of Ahmed and Rahman (1991). The highest fertile tillers $hill^{-1}$ (10.2) was observed with poultry litter @ 3 t ha^{-1} (T_3). The lowest number of fertile tillers $hill^{-1}$ (8.6) 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} (137.0) was observed in recommended dose of chemical fertilizers (T_4). The lowest number of spikelets panicle^{-1} (128.7) was obtained from control treatment (T_1) (Table 1). The highest grains panicle^{-1} (123.7) was recorded in poultry litter @ 3 t ha^{-1} (T_3) and it was statistically similar to cow dung @ 5 t ha^{-1} and recommended dose of chemical fertilizers (T_4). Lowest number of grains panicle^{-1} (96.99) was found in control treatment (T_1) (Table 1). Grain yield was significantly affected due to fertilizer treatments. The application of poultry litter @ 3 t ha^{-1} (T_3) showed a positive effect on the yield components of aromatic rice. This treatment significantly increased fertile tillers hill^{-1} and grains panicle^{-1} which might have the contribution to highest grain yield (2.53 t ha^{-1}) that was statistically similar to cow dung @ 5 t ha^{-1} and recommended dose of NPKSZn chemical fertilizers (T_4) (Table 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 (5.32 t ha $^{-1}$) was obtained with recommended dose of chemical fertilizers. The lowest straw yield (4.4 t ha^{-1}) was found in control treatment (T_1).

Table 1. Effect of fertilizer and varieties on the yield and yield contributing characteristics of aromatic rice

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	145.0b	9.8b	8.6c	22.7	128.7c	111.9b	11.9b	2.02b	4.4b
T_2	148.1ab	10.0b	9.7b	22.9	133.3b	119.5a	12.13a	2.46a	4.7b
T_3	149.9a	10.4a	10.2a	22.8	135.7ab	123.7a	12.12a	2.53a	5.01a
T_4	151.1a	10.4	9.4b	23.0	137.0a	120.8a	12.11a	2.42a	5.32a
Variety									
Kataribhog (V_1)	142.8c	11.2a	10.6a	25.3a	93.8d	80.5d	13.69a	2.58a	4.77ab
Badshabhog (V_2)	145.8bc	10.1b	9.4b	21.5c	151.8a	142.4a	10.63e	2.46ab	5.13a
Radhunibhog (V_3)	149.1ab	9.4c	9.1b	21.4c	146.1b	128.4b	11.61d	2.36b	5.08a
Kalizera(V_4)	153.1a	9.9b	8.9b	23.1b	149.1ab	125.0bc	12.43b	2.33b	4.88a
Shakorkora(V_5)	151.8a	8.8d	8.1c	23.2b	127.7c	118.7c	12.06c	2.06c	4.36b

*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})

Plant height significantly influenced due to variety. The tallest plant (153.1cm) was produced by Kalizera and shortest plant (142.2 cm) was observed in Shakorkora (Table 2). Lodging of the local varieties at mature stage was observed due to higher plant height. A tallest plant is more susceptible to lodging and less responsive to nitrogen (Yoshida, 1981).The highest number of total tillers hill^{-1} (11.2) was observed in Kataribhog and lowest in Shakorkhora. The highest number of fertile tillers hill^{-1} (10.6) was found in Kataribhog. The lowest number of fertile tillers hill^{-1} (8.1) in Shakorkhora (Table 2). Length of panicle was significantly influenced by variety. Highest panicle length (25.3 cm) was observed in Kataribhog (Table 2).Highest number of spikelets panicle^{-1} (151.1) was observed in Badshabhog and lowest number of spikelets panicle^{-1} (93.8) was observed in Kataribhog (Table 2). Significant variation was observed due to variety on grains panicle^{-1}. Highest number of grains panicle^{-1} (142.4) was observed in Badshabhog and lowest number grains panicle^{-1} (80.5) was observed in Kataribhog (Table 2). Significant variation of individual grain weight was observed among the tested varieties. Heaviest grain was found in Kataribhog and the weight was less in Badshabhog (Table 2). Among the tested varieties the Kataribhog produced the highest grain yield (2.58 t ha^{-1}) which was statistically similar to Badshabhog, it might be due to the contribution of higher number of fertile tillers hill^{-1}. The lowest grain yield (2.06 2t ha^{-1}) was obtained from Shakhorkora (Table.2).The highest straw yield (5.13 t ha^{-1}) was obtained from Badshabhog and the lowest straw yield (4.36 t ha^{-1}) was obtained from Shakhorkora (Table 2). 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 3). Kataribhog, Badshabhog, Radhunipagal, Kalizera and Shakhorkora gave the highest grain yield when applied poultry litter @ 3 t ha^{-1}. Local variety is more responsive to organic fertilizer in respect of growth and yield. Therefore, it is concluded that poultry litter @ 3 t ha^{-1} may be used to get higher yield of local aromatic rice considering fertilizer cost and environment.

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

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	139.7e	9.1cd	8.2hi	25.1a	88.3h	76.4e	13.5a	2.0f	4.4c-e
T_1 V_2	142.0de	11.1a	10.0d-f	21.3e	146.5bc	134.4a-c	10.7g	2.1d-f	4.8a-d
T_1 V_3	145.4b-e	11.4a	9.6e-g	21.1e	142.9c	120.9cd	11.4f	2.2c-f	4.6b-e
T_1 V_4	148.2a-e	9.4c	8.1ij	23,0bc	145.2bc	118.6cd	12.3bc	1.9f	4.4c-e
T_1 V_5	149.9a-d	8.1e	7.4j	23.1b	120.7f	109.5d	12.0de	1.9f	3.8e
T_2 V_1	143.0de	9.2cd	9.1g	25.8a	94.5g	80.4e	13.8a	2.4b-e	4.6a-e
T_2 V_2	145.4b-e	11.2a	10.6a-d	21.5de	150.5ab	143.4ab	10.7g	2.8a	5.0a-d
T_2 V_3	148.0a-e	11.5a	11.3a	21.1e	145.8bc	128.3bc	11.5f	2.5a-c	4.9a-d
T_2 V_4	151.1a-d	9.7bc	9.1g	22.9bc	149.7a-c	125.6c	12.5bc	2.4a-e	4.6b-e
T_2 V_5	153.2ab	8.6de	8.2hi	23.2b	126.oef	119.9cd	12.2cd	2.1d-f	4.1de
T_3 V_1	145.3b-e	9.6bc	9.4fg	25.0a	96.1g	83.5e	13.7a	2.6ab	4.9a-d
T_3 V_2	146.9a-e	11.4a	11.1ab	21.4de	154.5a	148.1a	10.6g	2.8ab	5.3a-c
T_3 V_3	150.0a-d	11.6a	11.2ab	20.9e	145.6bc	133.0a-c	11.7	2.6ab	5.4ab
T_3 V_4	152.2a-c	10.2b	10.2c-e	23.3b	151.2ab	129.9bc	12.4bc	2.5a-c	5.1a-d
T_3 V_5	155.0a	9.1cd	9.0g	23.5b	131.0de	123.8cd	12.7cd	2.2c-f	4.4c-e
T_4 V_1	143.3c-e	9.6bc	9.0g	25.2a	96.4g	81.6e	13.7a	2.5a-d	5.2a-c
T_4 V_2	148.9ab	11.3a	10.9a-c	21.5de	155.5a	143.7ab	10.5g	2.6ab	5.3a-c
T_4 V_3	155.7a	11.5a	10.3b-e	22.2cd	150.0ab	131.4bc	11.9de	2.5a-d	5.6a
T_4 V_4	154.3ab	10.2b	8.9gh	23.2b	150.3ab	125.7e	12.5b	2.4a-e	5.5ab
T_4 V_5	3.11	9.4c	8.0ij	23.0bc	132.9d	121.6cd	11.9de	2.1ef	5.1a-d

*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 $kgha^{-1}$), V1=Kataribhog, V_2=Badshabhog, V_3=Radhunibhog, V_4=Kalijera, V_5=Shakhorkhora

Acknowledgement: Special Allocation (2009-2010) received from the Ministry of Science and Information & Communication Technology, Government of the People's Republic of Bangladesh for this research work is gratefully acknowledged.

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