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Effect of integrated nutrient management on the performance of aromatic fine rice

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Abstract: An experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during the period from June to December 2017 to study the effect of integrated nutrient management on the performance of aromatic fine rice. The experiment consisted two varieties along with ten nutrient managements *viz.*, Control (recommended dose of NPKSZn at @ 46, 11, 53, 11 and 1.3 kg ha^{-1}), 75% of the recommended dose of N + 25% N from cowdung, 50% of the recommended dose of N +50% N from cowdung, 25% of the recommended dose of N + 75% N from cowdung, 75% of the recommended dose of N + 25% N from poultry manure, 50% of the recommended dose of N + 50% N from poultry manure, 25% of the recommended dose of N + 75% N from poultry manure, 75% of the recommended dose of N + 25% N from vermicompost, 50% of the recommended dose of N + 50% N from vermicompost, 25% of the recommended dose of N + 75% N from vermicompost. The experiment was laid out in a randomized complete block design with three replications. Kalizira produced the taller plant (126.52 cm) at 75 DAT and higher total dry matter hill^{-1} (37.35 g) at 75 DAT. On the other hand, Chinigura produced the shorter plant (115.67 cm) and the higher number of total tillers hill^{-1} (10.99) at 50 DAT. The application of 25% of the recommended dose of N + 75% N from poultry manure showed superiority in terms of highest plant height (128.30 cm) and the highest total dry matter production (38.03 g) at 75 DAT. The highest total dry matter (48.07 g hill^{-1}) was found in Kalizira × 50% of the recommended dose of N + 50% N from poultry manure. The tallest plant (142.80 cm) was recorded in the treatment combination of Kalizira × 25% of the recommended dose of N + 75% N from poultry manure and the highest number of total tillers hill^{-1} (12.44) was found in Chinigura × 75% of the recommended dose of N + 25% N from poultry manure. The highest plant height (158.68 cm), longest panicle length (22.42 cm), highest sterile spikelet panicle^{-1} (17.0), heaviest 1000-grain weight (11.48 t ha^{-1}), and highest straw yield (4.31 t ha^{-1}) were recorded in Kalizira. The application of 25% of the recommended dose of N + 75% N from poultry manure showed superiority in terms of the highest plant height (163.90 cm), highest number of total tillers hill^{-1} (13.28), highest number of effective tillers hill^{-1} (12.33), longest panicle length (23.173 cm) and highest grain yield (3.49 t ha^{-1}). Though grain yield was not statistically significant, numerically the highest grain yield was recorded from the variety Chinigura and 25% of the recommended dose of N + 75% N from poultry manure treatment. From the results of the study it may be concluded that the variety Chinigura and application of 25% of the recommended dose of N+75% N from poultry manure might be used for obtaining highest grain yield.

Key words: Aromatic fine rice, Growth, Integrated nutrient management, Variety, Yield.

Introduction

Rice (*Oryza sativa* L.) is one of the major food crops of the world. It is consumed as the staple food and has been given the highest priority in meeting the demands of its ever-increasing population. In Bangladesh *aman* rice covers largest acreage among the three rice growing seasons. Total *aman* rice production of financial year 2016-17 has been estimated 13.66 million metric tons compared to 13.02 million metric tons of financial year 2013-14 which was 4.64% higher (BBS, 2018). In recent years, aromatic rice has been introduced to the global market. Aromatic rice is also named as fine rice, scented rice or fragrance rice. Scented rice occupies an important status in domestic as well as in International market due to its several outstanding qualities and therefore earns premium prices. Total area devoted to aromatic rice production in *aman* and *boro* seasons of 2013-14 was 127 thousand hectares with total production of 188 thousand tons only (DAE, 2015). The average area belongs to aromatic rice production in the transplant *aman* season was 12.5% with an average yield of 2.0 t ha^{-1} (Islam *et al.*, 1996). Most of the aromatic rice varieties in Bangladesh are of traditional type, photoperiod-sensitive and are grown during *aman* season in the rainfed condition and lowland ecosystem. Baqui *et al*. (1997) revealed that among the aromatic rice varieties, Chinigura is the predominant one which covers more than 70% farms in the northern districts of Bogra, Noagaon and Dinajpur. In these districts, 30% of rice lands are covered by aromatic rice varieties during *aman* season. The other important and well known cultivated aromatic rice variety Kalijira is predominant in greater Mymensingh region and Kataribhog variety is predomnant in greater Dinajpur reigon. Islam *et al*. (1996) observed that the yield of aromatic rice was lower (1.5-2.0 t ha^{-1}) but its higher market price and low cost of cultivation generated higher profit margins compared to other varieties grown in the area.

The productivity of aromatic rice in Bangladesh is very low due to improper use and management of fertilizer. Since use of fertilizer is an expensive and precious input, determination of appropriate doses both would be economical and judicious use to enhance productivity for constant profit margins (Subudhi *et al*., 2006). A good cultivable soil should have organic matter content of about 2.5% (BARC, 2012). Von Uexkull (1968) noticed that rice grain was small with rough surface, poor milling outturn (%) due to inadequate K, which could be minimized by the combined application of organic and inorganic sources of nutrients. Integrated nutrient management (INM) involves maintenance of soil fertility, sustainable agricultural productivity and improvement in farmer`s profitability through the combined use of chemical fertilizer, organic manures and biofertilizer, etc. The efficient nutrient management increases crop yield and at the same time reduces fertilization cost. Moreover, a suitable combination of variety and rate of fertilizer dose is necessary for better yield. 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 organic manures with inorganic fertilizers to obtain satisfactory yield and quality of fine rice. The present study was undertaken to evaluate the effect of variety on the growth and yield of aromatic fine rice and to find out the effect of integrated nutrient management on the growth and yield of aromatic fine rice.

Materials and Methods

The research work was carried out at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh, during the period from June to December 2017. The experimental site belongs to the Sonatola series of the dark grey floodplain soil type under Old Brahmaputra Floodplain Agro-Ecological Zone (AEZ-9). The field was a medium high land with well drained silty-loam texture having pH value 6.5 and 1.67% organic matter content. The experiment was laid out in a two factor randomized complete block design with three replications. The experiment comprised two aromatic fine rice varieties *viz.* Kalizira and Chinigura and ten nutrient managements *viz.* Control (Recommended dose of NPKSZn at @ 46, 11, 53, 11 and 1.3 kg ha^{-1}, 75% of the recommended dose of N + 25% N from cowdung, 50% of the recommended dose of N +50% N from cowdung, 25% of the recommended dose of N + 75% N from cowdung, 75% of the recommended dose of N + 25% N from poultry manure, 50% of the recommended dose of N + 50% N from poultry manure, 25% of the recommended dose of N + 75% N from poultry manure, 75% of the recommended dose of N + 25% N from vermicompost , 50% of the recommended dose of N + 50% N from vermicompost, 25% of the recommended dose of N + 75% N from vermicompost. The experiment was laid out in a randomized complete block design with three replications. Each of the replication represented a block in the experiment. Each block was divided into 20 unit plots where 20 treatment combinations were allocated at random. There were 60 unit plots in the experiment. Seeds of the aromatic fine rice varieties were collected from the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh. Healthy seeds were selected by specific gravity method. Seeds were then immersed in water in a bucket for 24 hours. Then seeds were taken out of water and kept thickly in gunny bags. The seeds started sprouting after 48 hours and were sown after 72 hours of steeping. The nursery beds were puddled with country plough, cleaned and leveled with ladder. Then the sprouted seeds were sown in the nursery beds on 30 June 2017. At the time of final land preparation, respective unit plots were amended with organic and inorganic fertilizers according to treatment specification. During final land preparation, urea was top dressed in three equal splits at 15, 30 and 45 days after transplanting (DAT). Full dose of triple super phosphate, muriate of potash, gypsum and zinc sulphate were applied at final land preparation. Thirty-day old seedlings were transplanted on 30 July 2017 with three seedlings hill^{-1}. Weed infestation appeared to be a severe problem during the early stage of crop establishment. Early post emergence herbicide (Pediplus 18WP) was applied at the recommended dose (75 g ha^{-1}) at 10 days after transplanting. Then the plots were kept weed free by two hands weeding at 25 and 45 days after transplanting (DAT). Experimental field was irrigated as and when necessary to maintain a constant level of standing water up to 4 cm in early stage to enhance tillering and 10-12 cm at later stage to discourage late tillering. The field was finally drained out before 15 days of harvest to enhance maturity.

Five hills (excluding border hills) were selected randomly from each unit plot and uprooted to record data on plant height, tiller number hill^{-1} and total dry matter production hill^{-1} at 15day intervals beginning from 25 DAT up to 75 DAT. After sampling, the whole plot was harvested at full maturity. Prior to harvest, five hills plot^{-1} were randomly selected excluding border hills and central 1m^{2} area from each unit plot for recording data on yield and yield contributing characters of rice. The crop was harvested at full maturity. Both the varieties Kalizira and Chinigura were harvested on 10 December 2017. The harvested crop of central 1m^{2} area from each plot was separately bundled, properly tagged and then threshed. The grains were cleaned and sun dried to moisture content of 14%. Finally grain and straw yields m^{-2} were converted to t ha^{-1}. The collected data were compiled and tabulated in proper form for statistical analysis. Data were analyzed using analysis of variance (ANOVA) technique with the help of computer package programme MSTAT, and mean differences were adjudged by Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1984).

Results and Discussion

Effect on growth parameters

Effect of variety: Plant height was significantly affected by variety at 50 and 75 DATs (Fig. 1). Plant height in both the varieties increased progressively with the advancement of time from 25 to 75 DAT. The taller plant (126.52 cm) was recorded in Kalizira at 75 DAT, and the shorter one (115.67cm) was recorded in Chinigura at the same DAT. (Fig. 1). The variation in plant height between the varieties was probably due to heredity or varietal characters. Significant differences were observed for producing number of total tillers hill^{-1} due to varieties at 75 DAT (Fig. 3). The tiller production was increased with the advancement of time from 25 to 50 DAT but the number of total tillers hill^{-1} decreased after 50 DAT. The higher number of total tillers hill^{-1} (10.99) was recorded in Chinigura at 50 DAT and thereby decreased to 8.90 at 75 DAT.

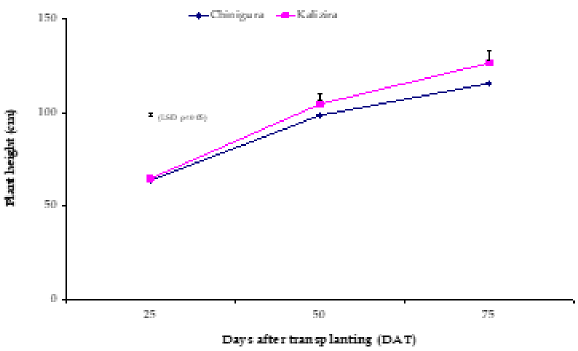

Fig. 1. Effect of variety on plant height at different DATs

The lower number of total tillers hill^{-1} (10.82) was found in Kalizira at 50 DAT which also reduced to 8.49 at 75 DAT for the same variety (Fig. 3). Total dry matter production hill^{-1} was significantly influenced by varieties at all DATs (Fig. 5). Result shows that the total dry matter accumulation increased with the increase of time. It is observed that the Kalizira produced the higher dry matter hill^{-1} (37.35g) and Chinigura produced the lower value (27.67) at 75 DAT (Fig. 5).

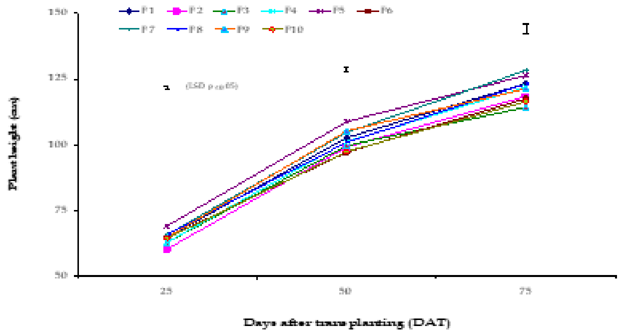

Fig. 2. Effect of nutrient management practices on plant height at different DATs

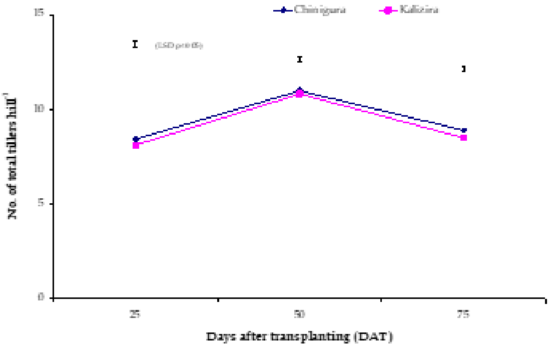

Fig. 3. Effect of variety on number of total tillers hill^{-1} at different DATs

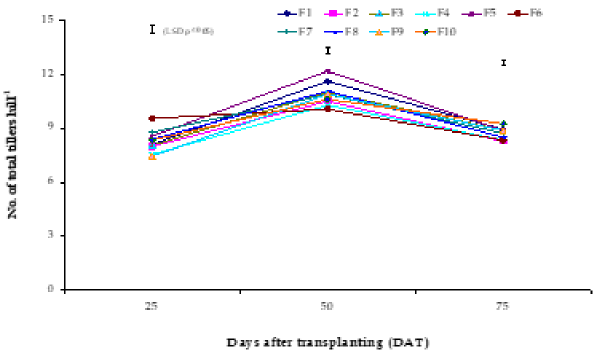

Fig. 4. Effect of nutrient management practices on number of total tillers hill^{-1} at different DATs

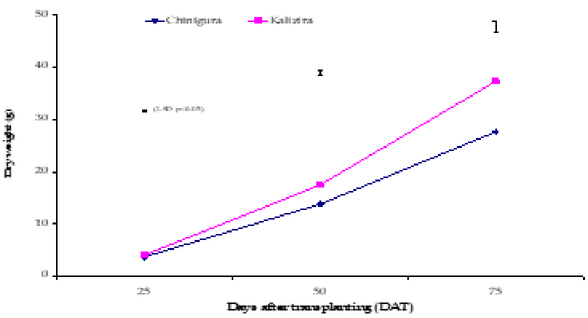

Fig. 5. Effect of variety on dry matter (g hill^{-1}) production at different DATs

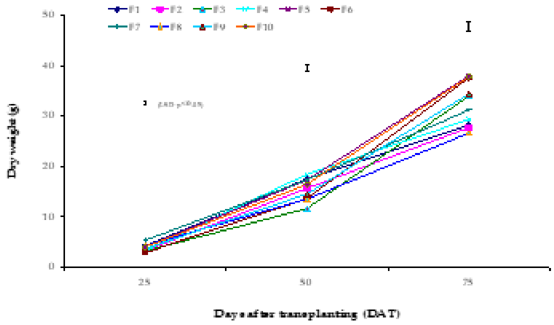

Fig. 6. Effect of nutrient management practices on dry matter (g hill^{-1}) production at DATs

Effect of integrated nutrient management

Integrated nutrient management exerted significant effect on plant at 25 and 50 DATs. At both the DATs the tallest plants (68.89 cm and 108.70 cm, respectively) were recorded in 75% of the recommended dose of N +25% N from poultry manure treatment. At 25 DAT, the shortest plant (60.11 cm) was obtained from 75% of the recommended dose of N + 25% N from cowdung and at 50 DAT the shortest plant (98.00 cm) was obtained from 50% of the recommended dose of N + 50% N from poultry manure (Fig. 2). The number of total tillers hill^{-1} was significantly affected by integrated nutrient management at all the sampling dates. The treatment 75% of the recommended dose of N + 25% N from poultry manure produced the highest number of total tillers hill^{-1} (12.17) which was statistically identical with recommended doses of fertilizers at 50 DAT (Fig. 4). The number of total tillers hill^{-1} increased with increasing days after transplanting up to 50 DAT due to application of different levels of fertilizers and manures. The highest number of total tillers hill^{-1} occurred due to the absorption of more nutrient, moisture and also for availability of more sunlight in the treatment combination of 75% of the recommended dose of N +25% N from poultry manure. Similar research finding was also reported by Islam *et al.* (2017) who reported the highest number of total tillers hill^{-1} in combination of inorganic fertilizer with organic manure. The treatment 50% of the recommended dose of N + 50% N from poultry manure produced the lowest number of total tillers hill^{-1} (10.06) at 50 DAT. Total dry matter production hill^{-1} varied significantly due to nutrient management at all the DATs (Fig. 6). Total dry matter production hill^{-1} increased progressively with the advancement of time from 25 DAT to 75 DAT due to nutrient management (Fig. 6). At 75 DAT, the highest total dry matter accumulation (38.03 g hill^{-1}) was observed at 75 DAT in 75% of the recommended dose of N + 25% N from poultry manure followed by 25% of the recommended dose of N + 75% N from vermicompost. The lowest dry matter accumulation (26.63 g hill^{-1}) was observed in 75% of the recommended dose of N +25%N from vermicompost.

Interaction effect of variety and nutrient management

The interaction effect of variety and level of nutrient management on plant height was significant at 50 and 75 DATs (Table 1) was significant at 5% level of probability. It is observed that the tallest plant stature (142.8 cm) was found at 75 DAT in Kalizira × F_7 (25% of the

Recommended dose of N +75% N from poultry manure) and the shortest plant (110.0 cm) was found in Chinigura × (25% of the recommended dose of N + 75% N from cowdung). Total tillers hill^{-1} was significantly affected by interaction of variety and level of nutrient management (Table 1). It is observed that the highest number of total tillers hill^{-1} (12.44) was recorded at 50 DAT in Chinigura × recommended dose of fertilizers followed by V_1F_5 and V_1F_3, respectively. The number of total tillers hill^{-1} increased with the advancement of time up to 50 DAT due to application of different levels of fertilizers and manures and then tiller production was declined at 75 DAT. The lowest number of total tillers hill^{-1} (8.00) was found in Kalizira × F_6 (50% of the recommended dose of N + 50% N from poultry manure) at 75 DAT. The interaction effect of variety and nutrient management on total dry matter production hill^{-1} from 25 DAT to 75 DAT was significant at 1% level of probability (Table 1). Total dry matter increased progressively with the advancement of time due to varieties and nutrient management from 25 to 75 DAT. At 75 DAT, the interaction $V_2 \times F_6$ (Kalizira × 50% of the recommended dose of N + 50% N from poultry manure) performed the best in terms of total dry matter production (48.07 g). The interaction $V_1 \times F_8$ (Chinigura × 75% of the recommended dose of N + 25% N from vermicompost) produced the lowest total dry matter (18.20g) at 75 DAT (Table 1).

Table 1. Interaction effects of variety and nutrient management practices on number of total tillers hill^{-1} at different days after transplanting on the performance of aromatic fin rice

Interaction (Variety × Nutrient management)	Plant height (cm) at different DATs			Total tillers hill^{-1} (no.) at different DATs			Total dry matter (g hill^{-1}) at different DATs		
	25	50	75	25	50	75	25	50	75
$V_1 \times F_1$	65.11	103.6bcd	126.00bc*	8.56bcd	12.44a	9.00bc	3.86fghi	13.27fg	30.60 de
$V_1 \times F_2$	62.00	97.78cd	116.71bc	7.89c-f	9.78fg	8.11def	2.46jk	12.27g	24.73 f
$V_1 \times F_3$	61.89	96.89d	113.00c	7.89c-f	11.56abc	8.33c-f	2.73jk	10.93h	26.07 f
$V_1 \times F_4$	60.89	94.33d	110.00c	8.11c-f	10.67d-f	8.89bcd	2.33k	17.70d	25.80 f
$V_1 \times F_5$	66.67	102.10bcd	118.32bc	8.44cd	12.44a	9.78a	3.66hi	14.33f	33.13cd
$V_1 \times F_6$	62.22	95.78d	115.81bc	10.33a	9.44g	8.67b-e	2.267k	13.00fg	27.13 f
$V_1 \times F_7$	65.11	98.55cd	113.82c	8.78bcd	10.55def	8.78b-e	4.40de	13.40fg	32.67cd
$V_1 \times F_8$	65.11	97.22cd	112.20c	7.67def	10.56def	8.78b-e	5.73b	13.07fg	18.20g
$V_1 \times F_9$	63.11	99.89cd	114.20c	7.00ef	10.67c-f	8.89bcd	4.93c	16.13e	26.27f
$V_1 \times F_{10}$	65.89	99.78cd	116.71bc	9.78ab	11.78ab	9.88a	4.06e-h	13.73fg	32.13de
$V_2 \times F_1$	63.89	101.60bcd	120.61bc	7.67def	10.78cde	8.88bcd	4.67cd	21.87a	25.93f
$V_2 \times F_2$	58.22	100.20bcd	120.21bc	8.11c-f	11.22bcd	8.44c-f	4.13e-h	19.07c	30.73de
$V_2 \times F_3$	63.33	102.20bcd	115.60bc	8.22cde	10.45def	9.44ab	3.73ghi	12.40g	41.93b
$V_2 \times F_4$	64.44	107.80abc	133.92ab	7.00ef	9.89efg	7.78f	4.20efg	19.27c	32.93cd
$V_2 \times F_5$	71.11	115.20a	134.43ab	8.66bcd	11.89ab	7.99ef	4.33def	20.33bc	42.93b
$V_2 \times F_6$	66.67	98.22cd	119.40bc	8.78bcd	10.67c-f	8.00ef	3.53i	14.33f	48.07a
$V_2 \times F_7$	66.11	110.61ab	142.82a	8.78bcd	11.22bcd	8.67b-e	6.33a	21.33ab	29.73e
$V_2 \times F_8$	66.33	104.42bcd	133.90ab	9.11bc	11.56abc	8.22c-e	2.87j	14.07f	35.07c
$V_2 \times F_9$	65.89	110.62ab	128.31abc	7.89c-f	11.11bcd	8.89bcd	2.46jk	12.97fg	42.60b
$V_2 \times F_{10}$	62.56	94.78d	116.1bc	6.89f	9.44g	8.62cde	3.93e-i	19.20c	43.60b
Level of sig.	NS	0.05	0.05	0.01	0.01	0.01	0.01	0.01	0.01
CV (%)	5.60	5.35	7.98	8.00	4.62	4.74	6.75	4.96	4.26

*In a column figures having common letter(s) do not differ significantly as per DMRT. V_1 = Chinigura, V_2 = Kalizira, F_1 = Control (Recommended dose of NPKSZn at @ 46, 11, 53, 11 and 1.3 kg ha^{-1}), F_2= 75% of the Recommended dose of N + 25%N from cowdung , F_3= 50% of the recommended dose of N + 50%N from cowdung, F_4 = 25% of the recommended dose of N + 75%N from cowdung, F_5 = 75% of the Recommended dose of N +25%N from poultry manure, F_6 = 50% of the recommended dose of N + 50%N from poultry manure, F_7 = 25% of the recommended dose of N + 75%N from poultry manure, F_8= 75% of the recommended dose of N + 25%N from vermicompost, F_9 = 50% of the Recommended dose of N +50%N from vermicompost, F_{10} = 25% of the recommended dose of N + 75%N from vermicompost.

Effect on yield and yield contributing characters

Effect of variety: Variety exerted significant effect on all the yield and yield contributing characters of rice except length of panicle, straw yield and harvest index (Table 2). The taller plant (158.68 cm), higher number of total and effective tillers (12.78 cm and 9.59 cm, respectively) hill^{-1}, higher number (194.17) grains panicle^{-1} were recorded in Chinigura. On the other hand, the higher number of non effective tillers hill^{-1} (1.19), higher number of sterile spikelets panicle^{-1} (17.00) and heavier 1000-grain weight (11.48 g) were recorded in Kailzira variety. The higher grain yield (2.75 t ha^{-1}) was observed in the variety Chinigura which was might be duet the higher number of total and effective tillers hill^{-1}, higher number of grains panicle^{-1} and lowest number of sterile spikelets panicle^{-1}. This finding corroborates the findings of Islam *et al.* (2013), Mou *et al.* (2017) and Tasmin *et al.* (2019) who reported the variable effect of variety on the number of effective tillers hill^{-1} and grains panicle^{-1} as well as grain yield. The variation in plant height, number of total tillers and effective tillers hill^{-1} and number of grains panicle^{-1} between the varieties were probably due to heredity or varietal characters. Kalizira also gave the lower number of total tillers hill^{-1} (10.52) and effective tillers hill-^{1} (9.59) and lower number of non effective tillers hill^{-1} (0.93) and lower number of grains panicle^{-1} (177.77) which ultimately attributed the lower grain yield in the variety Kalizira.

Effect of nutrient management practices: Almost all the yield and yield contributing characters except length of panicle, sterile spikelets panicle^{-1}, 1000-grain weight, straw yield and harvest index (Table 3). The application of 25% of the recommended dose of N + 75% N from poultry manure showed superiority in terms of the highest plant height (163.90 cm), highest number of total and effective tillers hill^{-1} (13.28 and 12.33, respectively) and numerically the longest panicle (23.17 cm). This findings partially corroborates the findings of Islam *et al.* (2013) found significantly enhanced number of effective tillers hill^{-1}, panicle length, number of grain panicle^{-1} and grain yield in 50% recommended dose of chemical fertilizer + 4 t ha^{-1} poultry manure treatment. The highest grain yield (2.76 t ha^{-1}) and harvest index (40.39%) were resulted from 50% of the recommended dose of N + 50% N from poultry manure. Probably this treatment provided adequate nutrients to the plants and exhibited the best performance due to absorption of more nutrients, moisture. These results are in agreement with that of Sikdar (2000) and Kabir *et al.* (2004) who found differences in yield and yield contributing characters due to different levels of nutrient management. The lowest number of total and effective tillers hill^{-1} (10.30 and 9.39, respectively) was found from the control (recommended dose of NPKSZn) treatment. The treatment control (recommended dose of NPKSZn) gave the lowest values for the same parameters due to lack of proper nutrient uptake.

Table 2. Effect of variety on the yield and yield contributing characters of aromatic fine rice

Variety	plant height (cm)	Total tillers hill^{-1}	Effective tillers hill^{-1}	Length of panicle (cm)	Grains panicle^{-1}	Sterile spikelets panicle^{-1}	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	HI (%)
Chinigura	153.39b	12.78a	11.60a	22.18	194.17a	14.78b	11.01b	2.75a	3.90	39.80
Kalizira	158.68a	10.52b	9.59b	22.42	177.77b	17.00a	11.48a	2.12b	4.31	30.27
Level of sig.	0.01	0.01	0.01	NS	0.01	0.01	0.01	0.01	NS	0.01
CV (%)	3. 87	12.29	11.76	4.96	12.44	10.84	2.61	17.48	21.55	18.76

*In a column figures having common letter(s) do not differ significantly as per DMRT, NS=Non significant

Table 3. Effect of nutrient management practices on the yield and yield contributing characters of aromatic fine rice

Nutrients management	Plant height (cm)	Total tillers hill^{-1}	Effective tillers hill^{-1}	Length of panicle (cm)	Grains panicle^{-1}	Sterile spikelets panicle^{-1}	1000-grain weight (g)	Grain yield (t ha-^{1})	Straw yield (t ha^{-1})	HI (%)
F_1	154.00bc	10.30c	9.385d	21.957	156.6ef	16.06	11.20	2.07c	4.39	31.66
F_2	154.80bc	10.50bc	9.615cd	22.060	193.1cd	15.81	11.28	2.092bc	3.98	31.48
F_3	154.51bc	11.07bc	10.07bcd	21.950	223.5ab	15.46	11.40	2.607abc	3.93	36.76
F_4	156.82abc	11.35bc	10.40bcd	21.523	247.5a	15.93	11.13	2.468abc	3.95	37.37
F_5	149.80c	12.34ab	11.20abc	22.013	197.1bcd	16.75	11.27	2.655ab	4.26	35.24
F_6	156.33abc	12.25ab	10.89a-d	22.798	189.3cd	15.39	11.23	2.76a	3.87	40.39
F_7	163.90a	13.28a	12.33a	23.173	138.1fg	15.62	11.32	2.33abc	4.13	30.81
F_8	159.00ab	11.70abc	10.65bcd	22.368	215.2bc	15.80	11.18	2.72a	4.36	33.33
F_9	157.11abc	11.74abc	10.15bcd	22.708	172.9de	15.96	11.32	2.34abc	4.14	38.64
F_{10}	154.1bc	12.03abc	11.31ab	22.438	126.3g	16.09	11.12	2.30abc	4.04	34.67
Level of sig.	0.05	0.05	0.01	NS	0.01	NS	NS	NS	NS	NS
CV (%)	3. 87	12.29	11.76	4.96	12.44	10.84	2.61	17.48	21.55	18.76

*In a column figures having common letter(s) do not differ significantly as per DMRT, NS=Non significant

Table 4. Interaction effects of variety and nutrient management practices on yield and yield contributing characters of aromatic fine rice

Interaction (Variety × Nutrient management)	Plant height (cm)	Total tillers hill^{-1}	Effective tillers hill^{-1}	Length of panicle (cm)	Grains panicle^{-1}	Sterile spikelets panicle^{-1}	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	HI (%)
$V_1 \times F_1$	153.93	10.67	9.80	22.47	148.77	15.64	10.80	2.18	4.45	33.57
$V_1 \times F_2$	153.82	11.87	11.10	22.23	192.80	15.39	11.06	2.22	3.77	33.57
$V_1 \times F_3$	155.87	12.73	11.83	21.96	237.57	14.24	11.03	2.79	3.90	41.88
$V_1 \times F_4$	155.40	12.37	11.56	21.39	261.80	15.06	10.83	2.83	3.73	43.46
$V_1 \times F_5$	143.73	13.37	12.17	20.98	214.61	14.87	11.16	2.98	4.14	41.61
$V_1 \times F_6$	152.07	13.90	12.17	22.67	204.98	14.02	11.10	3.10	3.74	42.96
$V_1 \times F_7$	162.17	14.90	13.83	23.56	157.29	14.31	11.26	3.49	3.77	40.26
$V_1 \times F_8$	152.27	13.26	12.07	22.05	209.00	14.87	11.06	2.90	4.02	42.22
$V_1 \times F_9$	151.60	12.82	11.63	22.27	190.32	14.54	10.86	2.54	3.66	42.71
$V_1 \times F_{10}$	153.06	11.99	10.92	22.22	124.53	14.84	10.90	2.46	3.86	35.63
$V_2 \times F_1$	154.13	9.93	8.97	21.45	164.35	16.47	11.60	1.96	4.33	29.75
$V_2 \times F_2$	155.87	9.13	8.13	21.89	193.41	16.23	11.50	1.97	4.20	29.40
$V_2 \times F_3$	153.07	9.40	8.30	21.94	209.36	16.69	11.76	2.42	3.97	31.63
$V_2 \times F_4$	158.20	10.33	9.23	21.66	233.15	16.81	11.43	2.10	4.18	31.29
$V_2 \times F_5$	155.93	11.30	10.23	23.05	179.68	18.63	11.36	2.33	4.40	28.86
$V_2 \times F_6$	160.60	10.60	9.60	22.93	173.71	16.77	11.36	2.43	4.00	37.82
$V_2 \times F_7$	165.67	11.67	10.83	22.79	118.97	16.93	11.36	1.76	4.48	21.37
$V_2 \times F_8$	165.73	10.13	9.27	22.69	221.48	16.74	11.30	1.94	4.70	24.35
$V_2 \times F_9$	162.53	10.67	9.67	23.15	155.44	17.39	11.76	2.13	4.61	34.56
$V_2 \times F_{10}$	155.13	11.70	12.08	22.66	128.16	17.34	11.33	2.15	4.21	33.71
Level of sig.	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CV (%)	3. 87	12.29	11.76	4.96	12.44	10.84	2.61	17.48	21.55	18.76

*In a column figures having common letter(s) do not differ significantly as per DMRT.

Interaction effect of variety and nutrient management

Non significant variation in all the yield and contributing characters due to the interaction of variety and nutrient management was observed (Table 4). Numerically the highest number of total tillers hill^{-1} and effective tillers (14.90 and 13.83, respectively), longest panicle h (23.56 cm), and highest grain yield (3.49 t ha^{-1}) were recorded in variety Chinigura × application of 25% of the recommended dose of N + 75% N from poultry manure. But apparently the highest number of grains panicle^{-1} (261.80) and highest harvest index (43.46 %) were recorded in the interaction of Chinigura and 25% of recommended dose of N+ 75% N from cowdung. From the results of the study it might be concluded that the fine aromatic rice variety Chinigura with application of 25% of the recommended dose of N + 75% N from poultry manure might be used for obtaining highest grain yield.

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