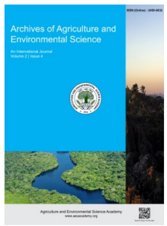
Archives of Agriculture and Environmental Science 6(4): 542-547 (2021)
https://doi.org/10.26832/24566632.2021.0604017

e-ISSN: 2456-6632

This content is available online at AESA

Archives of Agriculture and Environmental Science

Journal homepage: journals.aesacademy.org/index.php/aaes



ORIGINAL RESEARCH ARTICLE

Impact of vermicompost based nitrogen management and plant spacing on the performance of short duration transplant *Aus* rice (cv. Parija)

Shubroto Kumar Sarkar[1*], Swapan Kumar Paul[1], Kallyan Kanty Saha[1], Artho Baroi[2] and Md. Abdur Rahman Sarkar[1]

[1]Department of Agronomy, Bangladesh Agricultural University, Mymensingh, BANGLADESH
[2]Bangladesh Agricultural University, Mymensingh, BANGLADESH
[*]Corresponding author's E-mail: shubroto.agronomy@bau.edu.bd

ARTICLE HISTORY

Received: 22 September 2021
Revised received: 26 November 2021
Accepted: 19 December 2021

Keywords

Fertilizer
Nutrient
Plant density
Yield
Parija

ABSTRACT

An investigation was carried out at the Agronomy Field Laboratory, Bangladesh Agricultural University to inspect the effect of vermicompost based nitrogen management and plant spacing on the yield performance of short duration transplant *Aus* rice (cv. Parija). The study comprised three spacing *viz.* 20 cm × 20 cm, 20 cm × 15 cm and 20 cm × 10 cm, and five nitrogen management *viz.* no nitrogen, 75 kg N ha^{-1}, 55 kg N ha^{-1} + vermicompost @1.25 t ha^{-1}, 35 kg N ha^{-1} + vermicompost @2.5 t ha^{-1} and vermicompost @5 t ha^{-1}. The experiment was laid out in a Randomized Complete Block Design with three replications. At harvest, both the spacing of 20 cm × 20 cm and 20 cm × 15 cm produced the tallest plants, the highest number of total tillers hill^{-1} and effective tillers hill^{-1}. The highest grain yield (3.59 t ha^{-1}) was recorded in 20 cm × 15 cm spacing which was at par with the grain yield (3.52 t ha^{-1}) in 20 cm × 10 cm spacing. The 20 cm × 10 cm spacing also produced the highest straw yield (4.88 t ha^{-1}) and biological yield (8.40 t ha^{-1}). The lowest grain, straw and biological yields were recorded at the wider spacing of 20 cm × 20 cm. In contrast, the highest grain yield (3.79 t ha^{-1}), straw yield (4.99 t ha^{-1}) and biological yield (8.79 t ha^{-1}) were found in 75 kg N ha^{-1} which was as good as the yields of 55 kg N ha^{-1} N+ vermicompost @1.25 t ha^{-1}. The highest number of total tillers hill^{-1} (14.11) and effective tillers hill^{-1} (12.67) were found in the interaction effect of 20 cm × 20 cm spacing with 75 kg N ha^{-1}. The interaction between 20 cm × 15 cm and 55 kg N ha^{-1} N+ vermicompost @1.25 t ha^{-1} gave the highest grain yield (4.58 t ha^{-1}), straw yield (5.71 t ha^{-1}) and biological yield (10.29 t ha^{-1}). The lowest grain yield (2.03 t ha^{-1}), straw yield (3.49 t ha^{-1}) and biological yield (5.52 t ha^{-1}) were found in the interaction between 20 cm × 20 cm and no nitrogen. Therefore, usage of 20 cm × 15 cm spacing fertilized with 55 kg N ha^{-1} + vermicompost @1.25 t ha^{-1} appeared as the promising practice of transplant *Aus* rice cv. (Parija) cultivation.

Citation of this article: Sarkar, S. K., Paul, S. K., Saha, K. K., Baroi, A., & Sarkar, M. A. R. (2021). Impact of vermicompost based nitrogen management and plant spacing on the performance of short duration transplant *Aus* rice (cv. Parija). *Archives of Agriculture and Environmental Science*, *6*(4), 542-547, https://dx.doi.org/10.26832/24566632.2021.0604017

INTRODUCTION

Rice (*Oryza sativa*) is the most dominating cultivated cereal crop in Bangladesh. Besides, it is the staple food for more than two billion Asian people and four hundred millions of people in Africa and Latin America (IRRI, 2010). Rice sector contributes one-half of the agricultural GDP and one-sixth of the national income in Bangladesh. There are three distinct rice seasons *i.e.*, *Aus*, *Aman* and *Boro* in Bangladesh, which are cultivated during the period of April to July, August to December and January to May, respectively. Despite the favorable edaphic and climatic condition for year round rice cultivation in Bangladesh, the yield of this crop is much below the potential level. Both the area (1.09 million ha) and yield (2.52 t ha^{-1}) of *Aus* rice are very low

compared with other two seasons (BBS, 2020). Recently, a short duration transplant *Aus* rice namely, Parija has been popular in Northern part of Bangladesh as it can be grown during the off season in between *Boro* and *Aman* rice to keep the rice production in an increasing trend towards ensuring food security despite the adverse impacts of climate change. The yield of transplant *Aus* rice might be increased with improved agronomic practices *viz.* proper planting spacing, nutrient management etc.
The efficient nutrient management increases crop yield and at the same time reduces fertilization cost (Sapkota *et al.*, 2021). Soil fertility status of Bangladesh is gradually declining. Most of the soil of Bangladesh has organic matter less than 1.5% and, in many cases, it is less than 1% (BARC, 2005). Use of fertilizer is an essential component of modern farming (Prodhan, 1992) but extensive and improper use of chemical fertilizers in the soil causes soil degradation in an alarming level. Since vermicompost provides essential plant nutrient elements, increases cation exchange capacity and improves water holding capacity, it has been used as soil additive to decrease the practice of mineral fertilization (Tejada and Gonzalez, 2009). It not only increases the yield of rice but can also substitute chemical fertilizer to some extent (Sharma *et al.*, 2008; Guera, 2010, Ray *et al.*, 2015 and Biswas *et al.*, 2016). Nitrogen is an essential macro element which is being wasted in many ways in the field. Plants growth is seriously hampered when lower dose of nitrogen is applied and drastically reduced grain yield (Ray *et al.*, 2015). Application of vermicompost with chemical fertilizers can maximize the yield of rice (Mahmud *et al.*, 2016).
Plant spacing is an important factor which plays a significant role on growth, development and yield of rice (Paul *et al.*, 2017). It directly affects normal physiological activities through intra-species competition (Halder *et al.*, 2018) and provides scope to the plants for efficient utilization of solar radiation and nutrients (Paul *et al.*, 2017). Proper spacing supports the plants to uptake more nutrients from the soil. It may help to receive maximum LAI and light interceptions which facilitate efficient photosynthesis and ultimately yield of rice (Bhowmik *et al.*, 2012; Anwar *et al.*, 2011; Jahan *et al.*, 2017). Management of optimum plant density may lead to increase the grain yield of transplant *Aus* rice. Therefore, it is essential to find an appropriate package of agronomic practices for successful cultivation and yield maximization of transplant *Aus* rice. Apart from traditional management practices, a suitable combination of vermicompost based nitrogen management with proper plant spacing is necessary for yield boosting. Keeping these particulars in mind, the present research was designed and conducted to study the impact of vermicompost based nitrogen management and plant spacing on the yield performance of short duration transplant *Aus* rice (cv. Parija).

MATERIALS AND METHODS

Experimental site and design

The research was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during April to July of the year. This experimental site was located at 24°75´ N latitude and 90°50´E longitude having an elevation of 18m. The site belongs to the Sonatala series of Old Brahmaputra Floodplain Agroecological Zone (AEZ-9) having non -calcareous dark grey floodplain soils (UNDP and FAO, 1988; Islam *et al.*, 2011). The field was medium high land having sandy loam soil with pH 6.8. The experiment comprised three plants spacing *viz.*, 20 cm × 20 cm, 20 cm × 15 cm and 20 cm × 10 cm and five vermicompost based nitrogen management *viz.* no nitrogen, 75 kg N ha^{-1}, 55 kg N ha^{-1} + vermicompost @1.25 t ha^{-1}, 35 kg N ha^{-1} + vermicompost @2.5 t ha^{-1}, and vermicompost @2.5 t ha^{-1}. The experiment was laid out in a Randomized Complete Block Design with three replications. The size of the unit plot was 10.0 m^2 (4 m × 2.5 m) and the spaces between blocks and plots were 1m and 0.5 m, respectively.

Variety selection and land preparation

Parija, a short duration local *Aus* rice variety was selected for this experiment. Life span of *Parija* rice is around 90 days with an average yield 3.5 t ha^{-1}. The germinated seeds were broadcasted on a well-prepared nursery bed on April 20th. The land was prepared by ploughing and cross ploughing with a country plough and subsequently levelled by laddering. All weeds and stubble were removed from the land. The field was finally prepared and the plots were laid out on May 10th. At the time of final land preparation, each unit plot was fertilized with different levels of vermicompost and other fertilizers as per treatments. A basal dose each of triple super phosphate, muriate of potash, gypsum and zinc sulphate were applied @ 90, 60, 38 and 8 kg ha^{-1}, respectively. The vermicompost were thoroughly mixed with the soil. Nitrogen fertilizer in the form of urea was applied as per treatment used in the experiment in two equal splits at 10 DAT and 30 DAT. All the plots were transplanted maintaining 3 different plants spacing on May 12th. Intercultural operations were done for ensuring and maintaining normal growth of the crop when necessary.

Sampling, harvesting and processing

The crop was harvested at full maturity. The date of harvesting was confirmed when 90% of the grain became golden yellow in color. Five hills (excluding border rows) were randomly selected from each unit plot to record necessary data on yield contributing descriptors such as plant height, number of total tillers hill^{-1}, effective tillers hill^{-1}, panicle length, grains panicle^{-1}, sterile spikelets panicle^{-1} and 1000-grain weight. After sampling, a harvest area of central 1 m × 1 m was selected from each unit plot. The harvested crops of each plot were separately bundled, properly tagged and brought to threshing floor. The grains were threshed, cleaned and sun dried to moisture content of 14%. Straws were also dried properly. Finally grain and straw yields plot^{-1} were recorded and converted to t ha^{-1}. Harvest index (%) was calculated with the following formula:

$$\text{Harvest index (\%)} = \frac{\text{Grain yield}}{\text{Biological yield}} \times 100$$

Statistical analysis of data

Data were analyzed statistically using "Analysis of Variance" technique and differences among treatments means were adjudged by Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Effect of vermicompost based nitrogen management

Vermicompost based nitrogen management exerted significant influence on yield components and yield of transplant *Aus* rice (cv. Parija) except panicle length, sterile spikelets panicle^{-1} and 1000-grain weight (Table 1). The highest plant height (117.90 cm) was recorded at 75 kg N ha^{-1} which was statistically identical to 55 kg N ha^{-1} + Vermicompost @1.25 t ha^{-1} and the shortest plant was found in no nitrogen treatment. The nitrogen from both the vermicompost and urea induced the maximum vegetative growth of rice. Sarkar *et al.* (2014), Jisan *et al.* (2014) and Biswas *et al.* (2016) also found the highest plant height in higher nitrogen containing nutrient management treatment during their studies. The highest number of total tillers hill^{-1} (11.59), effective tillers hill^{-1} (10.07) were obtained in 75 kg N ha^{-1} and the lowest value was recorded at vermicompost @ 5 t ha^{-1}. The rapid release of nitrogen from the chemical fertilizer enhanced the tillering of rice plant. The increase in number of tillers hill^{-1} might be due to vital role of nitrogen in cell division (Hasanuzzaman *et al.*, 2010). The highest number of grains panicle^{-1} (125.40) was observed in 55 kg N ha^{-1} + vermicompost @1.25 t ha^{-1} while the lowest value (117.90) was found in 75 kg N ha^{-1} (Fig. 1). The highest grain yield (3.79 t ha^{-1}), straw yield (4.99 t ha^{-1}) and biological yield (8.79 t ha^{-1}) were found in 75 kg N ha^{-1} which was as good as the yield in 55 kg N ha^{-1} + vermicompost @1.25 t ha^{-1}. The lowest grain yield (2.78 t ha^{-1}) and biological yield (6.84 t ha^{-1}) were recorded in no nitrogen (Fig. 2, Table 1). Paul *et al.* (2017) found the highest yield of *T. Aus* rice applying 70 kg N ha^{-1}. Significant increase in rice grain yield through application of NPK fertilizers were observed by Satyanarayana *et al.* (2002). Sarkar *et al.* (2014); Biswas *et al.* (2016); Paul *et al.* (2019) found the highest rice grain yield when chemical fertilizers were combined with the organic manures. Among different combinations of manure application, vermicompost influenced the grain yield and quality better by improved plant growth and nutrient uptake (Taheri *et al.*, 2018). The highest (45.85) and lowest (39.42) harvest index were recorded in 35 kg N ha^{-1} + Vermicompost @ 2.5 t ha^{-1} and Vermicompost @ 5 t ha^{-1}, respectively. Kirttania *et al.*, 2013; Jisan *et al.*, 2014 and Ray *et al.*, 2015 observed harvest index varied due to application of different level of nitrogen. This might be occurred due to nitrogen had ultimate effect on grain yield and straw yield. Harvest index mainly depend on grain yield and straw yield.

Table 1. Effect of vermicompost based nitrogen management on yield and yield contributing characters of short duration transplant *Aus* rice (cv. Parija).

Fertilizer doses	Plant height (cm)	No. of total tillers hill^{-1}	No. of effective tillers hill^{-1}	Panicle length (cm)	Sterile spikelets panicle^{-1}	1000 grain weight (gm)	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
N_0	107.30 c	9.85 b	8.33 c	22.14	13.34	21.31	4.05 b	6.84 d	40.29bc
N_1	117.60 a	11.59 a	10.07 a	21.97	14.11	21.41	4.99 a	8.79 a	43.15ab
N_2	117.90 a	10.92 a	9.11 b	22.48	13.39	21.27	4.93 a	8.63 a	42.84ab
N_3	113.30 b	11.33 a	9.74 a	22.12	13.73	21.37	3.96 b	7.32 c	45.85a
N_4	113.10 b	8.33 c	7.07 d	22.15	13.65	21.33	4.85 a	8.04b	39.42c
$LSD_{0.05}$	2.97	0.98	0.57	0.38	0.67	0.21	0.15	0.38	3.05
$S\bar{x}$	1.03	0.34	0.20	0.13	0.23	0.07	0.05	0.13	1.05
Level of significance	**	**	**	NS	NS	NS	**	**	**
CV (%)	2.70	9.78	6.69	1.78	5.11	1.04	3.50	5.00	7.46

** = Significant at 1% level of probability, NS = Not significant; N_0 = No nitrogen, N_1 = 75 kg N ha^{-1}, N_2 = 55 kg N ha^{-1} + vermicompost @1.25 t ha^{-1}, N_3 = 35 kg N ha^{-1} + vermicompost @2.5 t ha^{-1}, N_4 = vermicompost @5 t ha^{-1}.

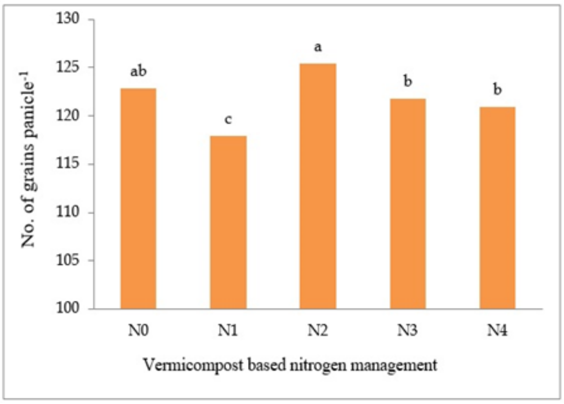


Figure 1. *Effect of vermicompost based nitrogen management on number of grains panicle^{-1}.*

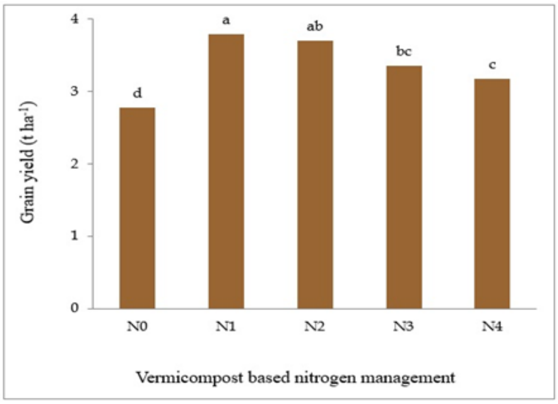


Figure 2. *Effect of vermicompost based nitrogen management on number of grain yield^{-1}.*

Table 2. Effect of plant spacing on yield and yield contributing characters of short duration transplant *Aus* rice (cv. Parija).

Plant spacing	Plant height (cm)	No. of total tillers hill^{-1}	No. of effective tillers hill^{-1}	Panicle length (cm)	Sterile spikelets panicle^{-1}	1000 grain weight (g)	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
20 cm × 20 cm	116.0 a	11.13 a	9.40 a	22.09	13.57	21.35	4.16 c	7.14 b	41.60
20 cm × 15 cm	114.6 a	11.00 a	9.51 a	22.23	13.65	21.38	4.64 b	8.23 a	43.61
20 cm × 10 cm	110.9 b	9.09 b	7.68 b	22.20	13.70	21.29	4.88 a	8.40 a	41.72
$LSD_{0.05}$	2.30	0.76	0.44	0.30	0.52	0.17	0.12	0.30	2.36
$S\bar{x}$	0.79	0.26	0.15	0.10	0.18	0.06	0.04	0.10	0.82
Level of significance	**	**	**	NS	NS	NS	**	**	NS
CV (%)	2.70	9.78	6.69	1.78	5.11	1.04	3.50	5.00	7.46

** = Significant at 1% level of probability, NS = Not significant.

Table 3. Effect of interactions between plant spacing and vermicompost based nitrogen management on yield and yield contributing characters of short duration transplant *Aus* rice (cv. Parija).

Vermicompost & N doses × Plant spacing	Plant height (cm)	No. of total tillers hill^{-1}	No. of effective tillers hill^{-1}	Panicle length (cm)	Sterile spikelets panicle^{-1}	1000 grain weight (g)	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
N_0S_1	107.9	8.44efg	6.77e	22.32	13.20	21.23	3.49h	5.52g	36.84cd
N_1S_1	119.8	14.11a	12.67a	21.84	14.18	21.53	4.62e	7.89de	41.48abc
N_2S_1	120.3	11.78bc	9.11cd	22.50	13.02	21.23	3.98g	7.01f	43.24ab
N_3S_1	115.1	11.22bc	9.89c	21.73	13.84	21.43	3.79g	7.04f	46.17ab
N_4S_1	116.7	10.11cde	8.55d	22.04	13.62	21.30	4.92d	8.23de	40.28bc
N_0S_2	111.4	10.11cde	8.44d	21.95	13.31	21.53	3.87g	6.77f	42.54abc
N_1S_2	117.8	10.44cd	8.99cd	22.22	13.98	21.40	5.43b	9.38b	42.12abc
N_2S_2	120.7	12.55ab	11.22b	22.60	13.29	21.17	5.71a	10.29a	44.50ab
N_3S_2	110.8	13.78a	11.89ab	22.38	14.22	21.47	3.82g	6.89f	44.58ab
N_4S_2	112.3	8.11fg	7.00e	22.00	13.47	21.33	4.33f	7.79e	44.30ab
N_0S_2	102.7	11.00bc	9.77c	22.13	13.51	21.17	4.8de	8.21de	41.49abc
N_1S_3	115.1	10.22cde	8.55d	21.87	14.18	21.30	4.92d	9.08bc	45.85ab
N_2S_3	112.7	8.44efg	7.00e	22.34	13.84	21.40	5.08cd	8.58cd	40.77abc
N_3S_3	114.0	9.00def	7.44e	22.25	13.11	21.20	4.26f	8.03de	46.81a
N_4S_3	110.2	6.78g	5.66f	22.42	13.85	21.37	5.30bc	8.08de	33.69d
$LSD_{0.05}$	5.14	1.70	0.99	0.66	1.17	0.37	0.26	0.66	5.28
$S\bar{x}$	1.78	0.59	0.34	0.23	0.40	0.13	0.09	0.23	1.82
Level of significance	NS	**	**	NS	NS	NS	**	**	**
CV (%)	2.70	9.78	6.69	1.78	5.11	1.04	3.50	5.00	7.46

** = Significant at 1% level of probability, NS = Not significant; N_0 = No nitrogen, N_1= 75 kg N ha^{-1}, N_2 = 55 kg N ha^{-1} + Vermicompost @1.25 t ha^{-1}, N_3 = 35 kg N ha^{-1} + Vermicompost @2.5 t ha^{-1}; N_4= Vermicompost @5 t ha^{-1}; S_1 = 20 cm × 20 cm, S_2 = 20 cm × 15 cm, S_3 = 20 cm × 10 cm.

Effect of plant spacing

Most of the yield contributing characters and yield of transplant *Aus* rice (cv. Parija) were significantly influenced by plant spacing (Table 2). The highest plant height (116 cm) and number of total tillers hill^{-1} (11.13) were found in 20 cm × 20 cm spacing which was statistically similar with that of 20 cm × 15 cm spacing. The 20 cm × 15 cm spacing also gave the highest effective tillers hill^{-1}(9.51) while the lowest plant height (110.9 cm), total tillers hill^{-1} (9.09) and effective tillers hill^{-1}(7.68) were recorded in 20 cm × 10 cm spacing. Wider spacing produced higher number of effective tillers hill^{-1}, where the plant could exploit more sunlight for photosynthesis resulting in the accumulation of more carbohydrate, thereby increasing the number of effective tillers hill^{-1}. Wider spacing of planting produced the longest plant stature and the highest number of tillers as recorded by Roy *et al.*, 2018; Shel *et al.*, 2019; Jahan *et al.*, 2017; Salahuddin *et al.*, 2009. The highest number of grains panicle^{-1} (123.20) was recorded at 20 cm × 10 cm spacing followed by 20 cm × 15 cm (Fig. 3). The highest grain yield (3.59 t ha^{-1}) was recorded in 20 × 15 cm spacing which was statistically similar with that (3.52 t ha^{-1}) of 20 × 10 cm spacing (Fig. 4). Rahman *et al.* (2007) also found the highest grain yield from 20 cm × 15 cm spacing. The highest straw yield (4.88 t ha^{-1}) and biological yield (8.40 t ha^{-1}) were obtained at the closer spacing of 20 cm × 10 cm followed by 20 cm × 15 cm. It might be due to the fact that the closer row spacing provided highest grain yield and straw yield which resulted in the highest biological yield (Paul *et al.*, 2017; Halder *et al.*, 2018). The lowest grain yield (2.98 t ha^{-1}), straw yield (4.16 t ha^{-1}) and biological yield (7.14 t ha^{-1}) were recorded at the wider spacing of 20 cm × 20 cm. Similar result were also observed by Saha *et al.* (2020) and Paul *et al.* (2017). Plant spacing did not have any significant effect on panicle length (cm), sterile spikelets panicle^{-1}, 1000-grain weight (g) and harvest index (%) of transplant *Aus* rice (cv. Parija).

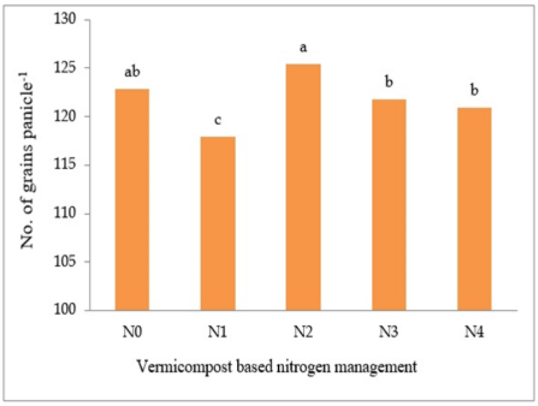


Figure 3. *Effect of plant spacing on number of grain panicle^{-1}.*

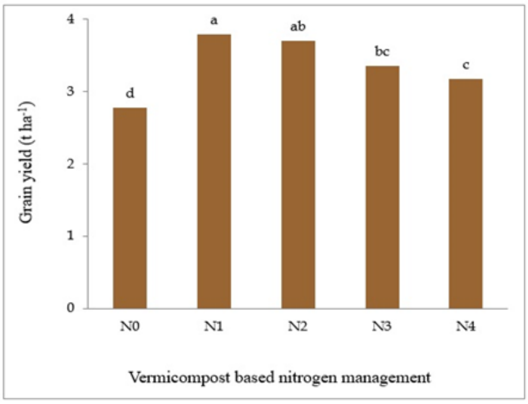


Figure 4. *Effect of plant spacing on grain yield (t ha^{-1}).*

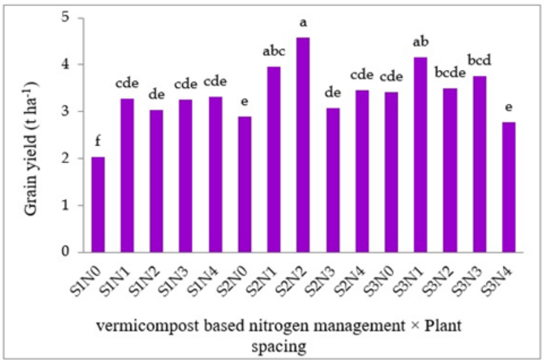


Figure 5. *Interaction effect of vermicompost based on nitrogen management and plant spacing on number of grain yield ha^{-1}.*

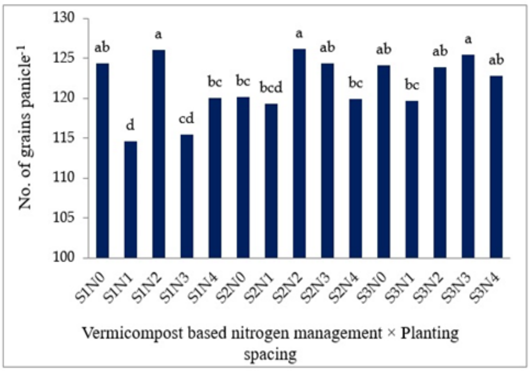


Figure 6. *Interaction effect of vermicompost based on nitrogen management and plant spacing on number gains panicle^{-1}.*

Interaction effect of spacing and vermicompost based nitrogen management

The interaction effect of spacing and vermicompost based nitrogen management was significant on contributing descriptors yield and yield of transplant *Aus* rice (cv. Parija) except plant height, panicle length, sterile spikelets panicle^{-1} and 1000-grain weight (Table 3). The highest number of total tillers hill^{-1}(14.11) and effective tillers hill^{-1} (12.67) was found in the combination of 20 × 20 cm spacing and 75 kg N ha^{-1} which was statistically identical to 20 × 15 cm spacing with 35 kg N ha^{-1} + vermicompost 2.5 t ha^{-1}. The highest grain panicle^{-1}(126.2) was found in 20 cm × 15 cm spacing with 75 kg N ha^{-1} + vermicompost 1.25 t ha^{-1} which was at par with both the spacing (20 × 20 cm and 20 × 10 cm) combination with 75 kg N ha^{-1} + vermicompost 1.25 t ha^{-1} and the lowest value was observed in the treatment combination of 20 × 20 cm spacing and 75 kg N ha^{-1}(Fig. 5). The result of interaction between 20 cm × 15 cm and 75 kg N ha^{-1} + vermicompost @1.25 t ha^{-1}showed superiority in terms of grain yield (4.58 t ha^{-1}) (Fig. 6), straw yield (5.71 t ha^{-1}) and biological yield (10.29 t ha^{-1}) of *T. Aus* rice (Table 3). The highest yields in that treatment were due to the cumulative effect of higher number of effective tillers hill^{-1}and the highest grain panicle^{-1}. Mahmud *et al.*, 2016 observed that application of the combination of vermicompost with chemical nitrogenous fertilizer gave the maximum yield the highest effective tillers hill^{-1}, flag leaf length, panicle length, filled grains panicle^{-1} and 1000-grain weight. Similar trend was also reported by Paul *et al.* (2017); Laila *et al.* (2020). On the other hand, the lowest grain yield (2.03 t ha^{-1}), straw yield (3.49 t ha^{-1}) and biological yield (5.52 t ha^{-1}) were found in the interaction between 20 cm × 20 cm spacing with no nitrogen. The highest harvest index was found in 20cm × 10 cm spacing with 35 kg N ha^{-1} + vermicompost @2.5 t ha^{-1} but the lowest harvest index was found in the same spacing with vermicompost @5 t ha^{-1}.

Conclusion

Better performance of the yield contributing descriptors *i.e.*, number of total tillers hill^{-1}, effective tillers hill^{-1} and grains panicle^{-1} was observed when the crop was transplanted maintaining the spacing of 20 cm × 15 cm and fertilized with 55 kg N ha^{-1} + vermicompost @1.25 t ha^{-1}, which resulted in the highest grain and straw yield. Therefore, use of 20 cm × 15 cm spacing and 55 kg N ha^{-1} + vermicompost @1.25 t ha^{-1} might be recommended for maximizing the yield of short duration transplant *Aus* rice (cv. Parija).

ACKNOWLEDGEMENT

The financial assistance under Research and Development (R & D) by Ministry of Science and Technology (MoST), Government of the People's Republic of Bangladesh to conduct the research project is thankfully acknowledged.

Conflict of interest

The authors declare that there is no conflict of interests regarding the publication of this paper.

REFERENCES

Anwar, M. P., Juraimi, A. S., Puteh, A., Selamat, A., Man, A., & Hakim, M.A. (2011). Seeding methods and rate influence on weed suppression in aerobic rice. *African journal of Biotechnology*, *10*(68), 15259-15271.

BBS (Bangladesh Bureau of Statistics), (2020). Statistical Yearbook of Bangladesh. Bangladesh Bur. Stat., Stat. Div., Min. Plan., Govt. People's Repub. Bangladesh, Dhaka. pp. 32-50.

Bhowmik, S. K., Sarkar, M. A. R., & Zaman, F. (2012). Effect of spacing and number of seedlings per hill on the performance of aus rice cv. NERICA 1 under dry direct seeded rice (DDSR) system of cultivation. *Journal of Bangladesh Agricultural University*, *10*(2), 191-195.

Biswas, T., Paul, S. K., Sarkar, M. A. R., & Sarkar, S. K. (2016). Integrated use of poultry manure with prilled urea and urea super granules for improving yield and protein content of aromatic rice (cv. BRRI dhan50). *Progressive Agriculture*, *27* (2), 86-93.

Gomez, K. A., & Gomez, A. A. (1984). Statistical Procedures for Agricultural Research. International Rice Research Institute, John Wiley and Sons. New York, Chichester, Brisbane, Toronto, Singapore. p. 680.

Guera, R. D. (2010). Vermicompost production and its use for crop production in the Philippines. *International Journal of Global Environmental Issues*, *10*(3-4), 378-383, https://doi.org/10.1504/IJGENVI.2010.037278

Halder, J., Rokon, G. M., Islam, M. A., Salahin, N., & Alam, M. K. (2018). Effect of planting density on yield and yield attributes of local aromatic rice varieties. *Bangladesh journal of Agricultural Research*, *43*(3), 489-497.

Hasanuzzaman, M., Ahamed, K. U., Rahmatullah, N. M., Akhter, N., Nahar, K., & Rahman, M. L. (2010). Plant growth characters and productivity of wetland rice (*Oryza sativa* L.) as affected by application of different manures. *Emirates Journal of Food and Agriculture*, *22*(1), 46-58.

IRRI (International Rice Research Institute). (2010). Rice Yield by Country and Geographical Region. World Rice Statistic. Intl. Rice Res. Inst., Los Banos, Laguna Philippines. pp. 1-8.

Islam, A. K. M. M., Meirvenne, M. V., & Islam, M. M. (2011). Proximal soil sensing system for paddy field variability mapping: the potential of a proximal soil sensor for soil properties mapping. *Saarbrücken*, Germany: VDM Verlag Dr. Müller.

Jahan, S., Sarkar, M. A. R., & Paul, S.K. (2017). Effect of Plant Spacing and Fertilizer Management on the Yield Performance of BRRI dhan39 under Old Brahmaputra Floodplain Soil. *Madras Agricultural Journal*, *104*(1-3), 37-40.

Jisan, M. T., Paul, S. K., & Salim, M. (2014). Yield performance of some transplant *Aman* rice varieties as influenced by different levels of nitrogen. *Journal of Bangladesh Agricultural University*, *12* (2), 321-324.

Kirttania, B., Sarkar, M. A. R., & Paul, S. K. (2013). Performance of transplant *Aman* rice as influenced by tiller seedlings and nitrogen management. *Journal of Bangladesh Agricultural University*, *11*(2), 249-256.

Laila, N., Sarkar, M. A. R., Paul, S. K., & Rahman, A. (2020). Yield performance of aromatic fine rice as influenced by integrated use of vermicompost and inorganic fertilizers. *Journal of Bangladesh Agricultural University*, *18*(2), 260–265, https://doi.org/10.5455/JBAU.90309

Mahmud, A. J., Shamsuddoha, A. T. M., Haque, M. N. (2016). Effect of Organic and Inorganic Fertilizer on the Growth and Yield of Rice (*Oryza sativa* L). *Natural Science*,*14*(2), 45-54, https://doi.org/doi:10.7537/marsnsj14021607

Paul, S. K., Roy, B., Hasan, A. K., & Sarkar, M. A. R. (2017). Yield and yield components of short duration transplant Aus rice (cv. Parija) as influenced by plant spacing and nitrogen level. *Fundamental and Applied Agriculture*, *2*(2), 233-236.

Paul, S. K., Ray, M. C., Sarkar, M. A. R., & Sarkar, S. K. (2019). Effect of water, nutrient and weed management on the yield and quality of aromatic boro rice (cv. BRRI dhan50). *Bangladesh Agronomy Journal*, *22*(1), 57-69, https://doi.org/10.3329/baj.v22i1.44937

Prodhan, S. B. (1992). Status of fertilizer use in developing countries of Asia and Pacific region. Proclamation Regional FADINAP Seminar, Chiang Mai, Thailand. pp 37-47.

Rahman, M.S., Anwar. M.P., Rahman, M.M., Islam, M.A., & Rahman, M.M. (2007). Effect of spacing and weeding regime on the performance of *aus* rice *cv.* BR 26. *Bangladesh Journal of Progressive Science and Technology*, *5*(1), 129-132.

Ray, S., Sarkar, M. A. R., Paul, S. K., Islam, A. K. M. M., & Yeasmin, S. (2015). Variation of growth, yield and protein content of transplant Aman rice by three agronomic practices. *Agricultural and Biological Sciences Journal*, *1*(4), 167-176.

Roy, B., & Paul, S. K. (2018). Growth analysis of short duration transplant Aus rice (*Oryza sativa* L. cv. Parija) under irrigated ecosystem. *Archives of Agriculture and Environmental Science*, 3(1), 68-72,

Saha, K. K., Paul, S. K., & Sarkar, M. A. R. (2020). Influence of spacing of planting on the yield performance of some aromatic rice varieties in *Boro* Season. *Sustainability in Food and Agriculture*, *1*(1), 10-14.

Salahuddin, K. M., Chowhdury, S. H., Munira, S., Islam, M. M., & Parvin, S. (2009). Response of nitrogen and plant spacing of transplanted Aman rice. *Bangladesh journal of Agricultural Research*, *34*(2), 279-285.

Sapkota, T. B., Jat, M. L., Rana, D. S., Khatri-Chhetri, A., Jat, H. S., Bijarniya, D., & Majumdar, K. (2021). Crop nutrient management using Nutrient Expert improves yield, increases farmers' income and reduces greenhouse gas emissions. *Scientific Reports*, *11*(1), 1-11.

Sarkar, S. K., Sarkar, M.A.R., Islam, N., & Paul, S. K. (2014). Yield and quality of aromatic fine rice as affected by variety and nutrient management. *Journal of Bangladesh Agricultural University*, *12*(2), 279-284.

Satyanarayana, V., Prasad, P. V., Murthy, V. R. K., & Boote, K. J. (2002). Influence of integrated use of farmyard manure and inorganic fertilizers on yield and yield components of irrigated lowland rice. *Journal of Plant Nutrition*, 25(10), 2081-2090.

Sharma, D. K., Prasad, K., & Yadav, S. S. (2008). Effect of integrated nutrient management on the performance of dwarf scented rice (*Oryza sativa* L.) growth in rice wheat sequence. *International Journal of Agricultural Sciences*, *4*(2), 660- 662.

Shel, S. K., Paul, S. K., Uddin, F. M. J., & Rahman, M. M. (2019). Effect of row spacing on yield of short duration transplant *Aman* rice varieties. *Acta Scientifica Malaysia*, *3*(2), 01-06.

Taheri, R. E., Ansari, M. H., & Razavi Nematollahi, A. (2018). Influence of cow manure and its vermicomposting on the improvement of grain yield and quality of rice (*Oryza sativa* l.) in field conditions. *Applied Ecology and Environmental Research*, *16*(1), 97-110.

Tejada, M., & Gonzalez, J.L. (2009). Application of two vermicompost on a rice crop: effects on soil biological properties and rice quality and yield. *Agronomy Journal*, *101*(2), 336-344, https://doi.org/10.2134/agronj2008.0211

UNDP and FAO (1988). Land Resources Appraisal of Bangladesh for Agricultural Development, Report No. 2. Agro-ecological Regions of Bangladesh. United Nations Dev. Prog. And Food and Agric. Organ. pp. 212-221.