Content list available at http://epubs.icar.org.in, www.kiran.nic.in; ISSN: 0970-6429

Indian Journal of Hill Farming

June 2018, Volume 31, Issue 1, Page 115-119

Performance of Black Rice with Different Nitrogen Management Practice under Mid Hill of Meghalaya

Phurailatpam Menaka Sharma* • Lala I.P. Ray

School of Natural Resource Management, College of Postgraduate Studies, (CAU, Imphal), Barapani-793103, Meghalaya

ARTICLE INFO

Article history:
Received 27 December 2017
Revision Received 19 May 2018
Accepted 6 June 2018

Key words:
black rice; nitrogen source; spacing; yield

ABSTRACT

The performance of Black rice (Oryza sativa L.) was assessed under four different nitrogen sources and three planting geometry under mid hills of Meghalaya during kharif season of 2016-17. An agronomical trial was laid out with four different sources of nitrogen fertilization *viz.* 100% Inorganic (F1), 100% Organic (F2), 50% Organic +50% Inorganic (F3) and Control (F0) and replicated thrice. Organic source of nitrogen was Farm yard manure (FYM) and inorganic source were urea and di-ammonium phosphate (DAP). Various growth parameters like plant height (cm), number of tillers per hill, leaf area index (LAI); yield parameters like number of panicles per hill, test weight, grain yield (t ha-1); quality attributes like percentage protein, iron and zinc content in grains; and Benefit Cost Ratio (BCR) were taken into account. Plants under 50% organic + 50% inorganic source performed best among all the treatments in terms of growth, yield and quality parameters. Benefit cost ratio (BCR) was maximum with 2.12 (F3) and superior over F0, F1 and F2. The highest recorded grain yield was 1.29 t ha-1 for F3 over other three nitrogen sources.

1. Introduction

Rice (Oryza sativa L.) is the most important cultivated cereal crop in the world. For nearly half of the world population, rice is the major food source (Kundu *et al.,* 2016). Rice plays an important role in the growth of annual Gross Domestic Product (GDP) of India by 15% and provides essential nutrient with 43% calorie to more than 70% of the total population (ICAR, 2006). The aromatic rice (Oryza sativa L.) is preferred over other rice varieties due to its immense flavour and palatability. In Eastern and North-Eastern parts of India, there is special place for Small Grain Aromatic rice. The most unique feature of this group of rice is its palatable aroma which has been considered as a high value trait for rice (Saha *et al.,* 2015). Low yield is a common character of aromatic rice which may be due to photoperiod sensitivity, susceptibility to lodging, pests and diseases, *etc.* (Golam *et al.,* 2011). Rice is major cereal crop and staple food for the people of Eastern and North Eastern India.

*Corresponding author: sharmamenaka11@gmail.com

The North Eastern Region (NER) having about 3.5 million hectare area under rice with a production of about 6.5 million tonnes, still deficit of about 11.2 percent rice grain. To assure food security in the rice consuming countries of the world, rice production would have to be increased by 50 percent in the countries by 2025, and this additional yield will have to be produced on less land with less usage of water, labour and chemicals (Zeng *et al.,* 2004). Rice farmers in NER Himalayas of India and many other countries are facing growing constraints of resources, most of the farmers are following age old practice of random planting, transplanting 30-40 days old seedling, 4-5 seedlings per hill and meagre and imbalanced fertilizer and manure application, continuous flooding, *etc.* (Islam *et al.,* 2014).

2. Materials and Methods

A field experiment was conducted during kharif season (2016-17) at the experimental farm of the College of Postgraduate Studies, Barapani (CAU, Imphal), to evaluate the performance of black rice (variety: Poireiton) under four nitrogen sources and three planting geometries. An experiment was laid out with four different sources of nitrogen fertilization, *viz.* 100% Inorganic (F1), 100% Organic (F2), 50% Organic +50% Inorganic (F3) and Control (F0) and replicated thrice. The experimental site is situated at 91˚18' E longitude and 25˚40' N latitude and at an altitude of 950 m above the mean sea level (MSL). Recommended doses of N, P and K = 80: 60: 40 kg ha-1 (Full doses P and K was applied at time of transplanting along with 50% of N and rest 25% of N at active tillering and 25% at panicle initiation stage). Organic source of nitrogen was supplied through Farm yard manure (FYM) and inorganic source through urea and di-ammonium phosphate (DAP). Disease free seedlings were selected and transplanted in the main field. Standard agronomic practices were followed during crop growth and crop was harvested at maturity. Also a standard plant protection method was followed. During the experiment the crop growth parameters, *viz.* plant height, number of tillers, leaf area index (LAI) were taken at 30 days interval. The yield of the plant (t ha-1) along with the number of panicles per plant and test weight (g) was recorded. Percentage grain protein, iron and zinc content were analysed by using standard procedures in laboratory. Meteorological data were recorded at meteorological station situated nearby the experimental site. Temperature maximum, temperature minimum, wind speed , bright sunshine hours, relative humidity minimum, relative humidity maximum and rainfall was recorded in the observatory and weekly data was averaged during the rice growing period. Figure 1 represents the meteorological data occurring during the cropping period.

Plant growth yield and quality attributes

The height of the plant in cm was determined from the sample tagged plants by measuring the height from the ground level to the topmost node of the plant at 30 days interval. Similarly, the number of tillers per hill was counted from tagged plants in each plot and averaged to express as number of tillers per hill. Only those tillers having three or more leaves were used for counting at 30 days interval. The leaf area index was formulated by multiplying the leaf area of the third leaf from each tagged plants by correction factor and then whole divided by ground area, Palaniswamy and Gomez, (1974). At the time of harvesting, the numbers of panicles per hill was counted from the tagged plants in each plot and were averaged to record number of panicles per plot. At the time of harvest grain yield was recorded by weighing the grain yield from each plot and after that converting it into tonnes per hectare. Similarly the benefit cost ratio of the treatment combinations was evaluated by taking a premier market price of ` 120 per kg. The protein, zinc and iron content of the grain were analysed treatment wise using standard protocols.

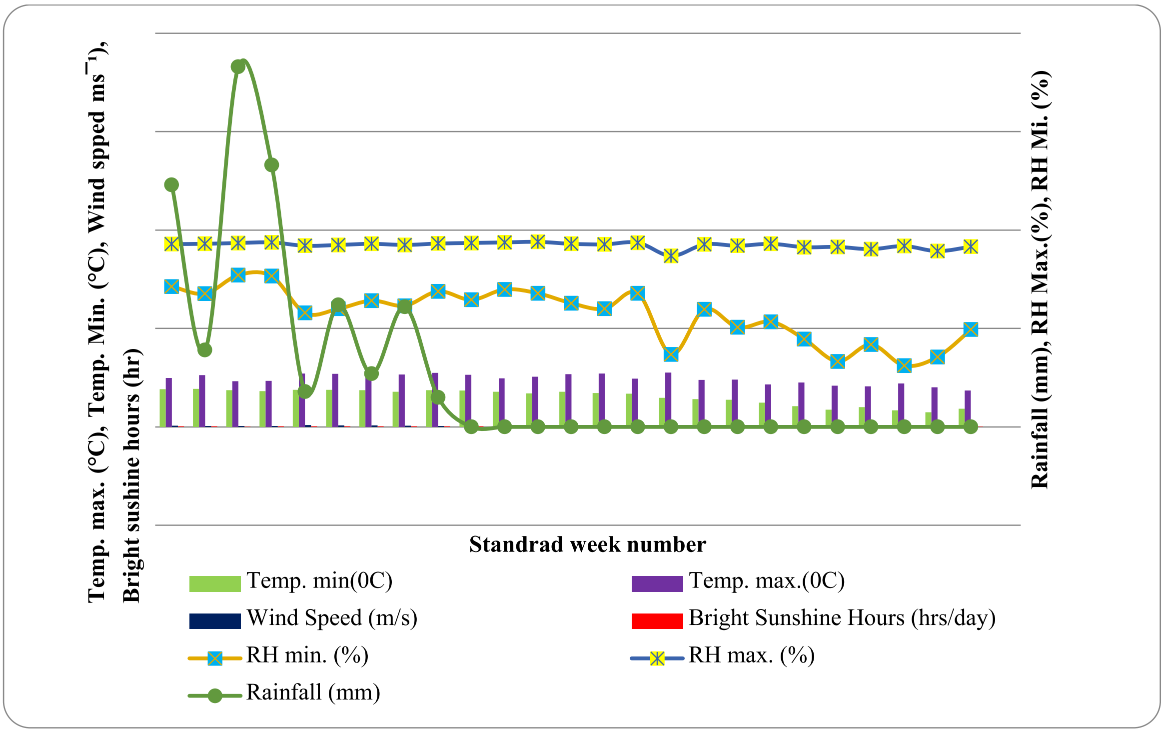

Figure 1. Weekly variation of rainfall, relative humidity and temperature during the crop growth period

Table 1. Growth parameters of black rice as influence by different nitrogen treatments

Parameters	Growth parameters														
Nitrogen Source	**Plant height (cm)**					**Number of tillers**					**Leaf Area Index (LAI)**				
	30 DAT	**60 DAT**	**90 DAT**	**120 DAT**	**Harvest**	**30 DAT**	**60 DAT**	**90 DAT**	**120 DAT**	**Harvest**	**30 DAT**	**60 DAT**	**90 DAT**	**120 DAT**	**Harvest**
Control (F_0)	47.47	101.66	128.34	142.59	151.18	5.83	6.13	9.26	8.73	8.72	2.70	7.19	9.81	9.08	8.81
100% Inorganic (F_1)	52.84	116.41	153.26	166.46	168.80	8.72	8.79	11.50	11.53	11.87	2.90	7.35	10.07	9.19	8.94
100% Organic (F_2)	53.26	117.20	153.17	169.46	171.69	7.80	8.07	11.14	11.66	12.07	2.83	7.26	9.98	9.17	8.88
50% Organic + 50% Inorganic (F_3)	56.62	119.85	162.20	176.11	180.16	9.59	9.98	12.62	12.29	12.70	2.87	7.35	10.05	9.31	9.03
S.E.(m) ±	1.21	2.68	4.69	3.73	3.38	0.46	0.43	0.51	0.33	0.42	0.05	0.10	0.09	0.07	0.08
C.D.(p=0.05)	3.34	7.40	13.00	10.25	9.29	1.26	1.18	1.41	0.92	1.15	NS	NS	NS	NS	NS

Table 2. Yield attributes of black rice

	Yield parameters		
Parameters	**Number of panicles per hill**	**Test weight (g)**	**Grain yield (t ha^{-1})**
Nitrogen Source			
Control (F_0)	11.78	26.55	0.71
100% Inorganic (F_1)	15.47	26.96	1.10
100% Organic (F_2)	17.42	27.27	1.20
50% Organic + 50% Inorganic (F_3)	17.71	27.96	1.29
S.E.(m) ±	0.08	0.07	0.01
C.D.(p=0.05)	0.21	0.20	0.03

3. Results and Discussion

The plant growth attributes, *viz.* plant height, number of tillers per hill and leaf area index is presented in Table. 1. The yield attributes, *viz.* number of panicles plant^{-1}, test weight (g) and grain yield (t ha^{-1}) is presented in Table. 2. The quality attributes, *viz.* the grain protein, iron and zinc content in percentage is presented in Table. 3. The BCR is represented in Table. 4.

Growth parameters

Significant results were found in plant height and number of tillers due to nitrogen sources. The results showed that the plant height increases with the advancement in crop growth period. The highest plant height observed was 180.16 cm (F_3). In rice cultivation, organic sources of nutrients supplemented with inorganic sources of nutrients application enhances the nutrient availability at different growth stages and helped in increasing the plant height (Rao *et al*., 2004; Malik *et al*., 2014; Dekhane *et al*., 2017). Maximum number of tillers of 12.70 (F_3) was found at the time of harvest. Combination of organic and inorganic fertilization increases number of tillers (Banik and Bijbaruah, 2004; Kundu *et al*., 2016; Wang *et al*., 2017). Non-significant result was found in case of leaf area index.

Yield parameters

Performance of the plants, planted under different nitrogen sources recorded significantly different from each other. Maximum number of panicles per hill of 17.71, test weight of 27.96 g and maximum grain yield was 1.29 t ha^{-1} was reported from F_3. It was found that nitrogen fertilization of organic and inorganic combination increases the yield contributing characters (Luikham *et al*., (2008); Dekhane *et al*., 2017).

BCR

Significant result was found on gross return, net return and BCR in different sources of nitrogen, where F_3 was significantly higher over F_0, F_1 and F_2. The maximum BCR recorded was 2.12. It was thus recorded that plants that were planted under 50% organic and 50% inorganic source performed best as the grain yield was also maximum (Malik *et al*., 2014).

Quality parameters

Quality attributes were found to have significant results from nitrogen sources. The protein content was found to be maximum of 8.35% for F_3. Organic nitrogen increases the protein content in grains (Chandel *et al*., 2010; Tayefe *et al*., 2014). Maximum iron and zinc content were 1.80% and 1.99%, respectively, from F_3. Organic matter content in the farm yard manure increases the availability of iron and zinc in rhizosphere, which in turn enhances the uptake, translocation and redistribution of iron and zinc content in rice (Chandel *et al*., 2010).

Table 3. Quality attributes of black rice

	Quality attributes		
Parameters	**Protein content (%)**	**Zinc content (%)**	**Iron content (%)**
Nitrogen Source			
Control (F_0)	7.82	1.57	0.94
100% Inorganic (F_1)	8.01	1.60	1.11
100% Organic (F_2)	8.13	1.73	1.69
50% Organic + 50% Inorganic (F_3)	8.35	1.99	1.80
S.E.(m) ±	0.01	0.01	0.01
C.D.(p=0.05)	0.04	0.03	0.03

Table 4. Benefit cost ratio of black rice cultivation

Parameters	**BCR**
Nitrogen Source	
Control (F_0)	1.45
100% Inorganic (F_1)	1.87
100% Organic (F_2)	1.90
50% Organic + 50% Inorganic (F_3)	2.12
S.E.(m) ±	0.01
C.D.(p=0.05)	0.03

Conclusions

Black rice was planted under nitrogen fertilization of 50% Organic + 50% Inorganic, (F_3) in the NEH region proved to be economically profitable to the farmers of this region, along with better yield and quality. Plants under F_3 treatment were compared to be better over other. Plants planted at F_3 had higher plant height (180.16 cm), higher number of tillers per hill (12.70) and LAI (10.05) which ultimately increases the number of panicles per hill (17.71) with high test weight (27.96 g) and high grain yield (1.29 t ha^{-1}) as compared to other nitrogen sources. Higher protein content (8.35%), iron content (1.80%) and BCR (2.12) were also recorded from F_3. So, it can be concluded that integrated nitrogen management of organic and inorganic sources is beneficial for black rice cultivation in Meghalaya.

Acknowledgement

The financial support received from the Central Agricultural University, Imphal; during the period of the Master degree programme is thankfully acknowledged. Sincere note of acknowledgements are due to the Dean, College of Postgraduate Studies (CAU, Imphal) for providing all logistic supports during the tenure of this field experiment and all the Research Advisory Committee Members for their valuable suggestions and timely guidance for conducting this field research.

References

Banik P and R Bejbaruah (2004). Effect of vermicompost on rice (Oryza sativa) yield and soil-fertility status of rainfed humid sub-tropics. *Indian J Agric Sci,* 74(9): 488-491.

Chandel G, Banerjee S, Se S, Meena R, Sharma DJ and SB Verulkar (2010). Effects of different nitrogen fertilizer levels and native soil properties on rice grain Fe, Zn and protein contents. *Rice Science,* 17(3): 213-227.

Dekhane SS, Mangave BD, Dhuri A and DJ Patel (2017). Effect of different nitrogen sources on growth and yield of rice. *International J Dev Res,* 7(4): 12380-12381.

Dekhane SS, Mangave BD, Dhuri A. and DJ Pate (2017). Effect of different nitrogen sources on growth and yield of rice. *International J Dev Res, 7*(4): 12380-12381.

Golam F, Hui Yin Y, Masitah A, Afnierna N, Majid NA, Khalid N and M Osman (2011). Analysis of aroma and yield components of aromatic rice in Malaysian tropical environment. *Australian J Crop Sci,* 5(11): 1318-1325.

ICAR (2006), Special Issue on 2nd International Rice Congress, 56(7).

Islam M, Nath LK, Patel DP, Das A, Munda GC, Samajdar T and SV Ngachan (2014). Productivity and socio-economic impact of system of rice intensification and integrated crop management over conventional methods of rice establishment in eastern Himalayas. *Paddy Water Environment,* 12(1): 193-202.

Kundu A, Roy AKS and PS Patra (2016). Responses of integrated nitrogen management on the performance of aromatic rice varieties under Terai zone of West Bengal. *International J Environ Sci Technol.* 5(4): 2406-2414.

Luikham E, Yamtong K and PS Mariam (2008). Effect of planting geometry and nitrogen levels on productivity of black rice (Oryza sativa) under rainfed conditions. *Agricultural Science Digest,* 28(2): 153-154.

Malik TH, Lal SB, Wani NR, Amin D and RA Wani (2014). Effect of different levels of nitrogen on growth and yield attributes of different varieties of Basmati rice (Oryza sativa L.). *International J Environ Sci Technol Res,* 3(3): 444-448.

Palaniswamy KM and KA Gomez (1974). Length- width method for estimating leaf area of rice. *Agron J* 66(3): 430-433.

Rao UV, Ramu YR, Kumari CR and CR Reddy (2004). Effect of organic and inorganic sources of nitrogen on growth, yield, nitrogen uptake and economics of lowland rice. *Madras Agric J,* 91(7-12): 389-393.

Saha PS, Islam MU, Islam MS and MA Salam (2015). Analysis of Yield Components and Aroma of Small Grain Aromatic Rice (Oryza sativa L.) in Bangladesh. *The Agriculturists*, 13(2): 17-24.

Tayefe M, Gerayzade A and AN Zade (2014). Effect of nitrogen on rice yield, yield components and quality parameters. *African J Biotechnol,* 13(1): 91-105.

Wang Y, Lu J, Ren T, Hussain S, Guo C, Wang S and X Li (2017). Effects of nitrogen and tiller type on grain yield and physiological responses in rice. *Plants*, 9(2): 1-12.

Zeng L (2004). Response and correlated response of yield parameters to selection for salt tolerance in rice. *Cereal Research Communications,* 32(4): 477-484.