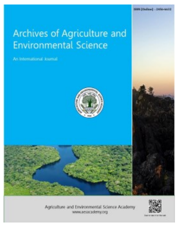
Archives of Agriculture and Environmental Science 2(3): 202-205 (2017)

e-ISSN: 2456-6632

This content is available online at AESA

Archives of Agriculture and Environmental Science

Journal homepage: www.aesacademy.org



ORIGINAL RESEARCH ARTICLE

Evaluation of potential rice (*Oryza sativa* L.) genotypes with different levels of N under rainfed shallow lowland situation

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ARTICLE HISTORY

Received: 24 July 2017
Accepted: 24 August 2017

Keywords

Nitrogen levels
Potential rice varieties
Rainfed shallow lowland
Rice genotypes

ABSTRACT

A field experiment was conducted to evaluate the yield of potential rice genotypes during *kharif* season, 2012 and 2013 at Rice Research Station, Bankura, West Bengal, India on sandy loam soil of slightly acidic in reaction (pH: 5.7). This experiment was conducted in split-plot design with three replications. The results indicated that 105 kg N ha^{-1}, the yield attributes recorded maximum number of panicles m^{-2} (307.9), panicle length (25.3cm), panicle weight (2.32g), number of filled grains per panicle (117.8), 1000-grains weight (24.5g) and finally recorded highest grain yield (4.80 t ha^{-1}) than lower fertilities. While, 70 kg N ha^{-1} was remained closed to 105 kg N ha^{-1} in number of panicles m^{-2}, panicle weight and number of filled grains per panicle. Among the potential rice varieties '*Sampriti*' (IET 21987) recorded the highest grain yield (4.66 t ha^{-1}) under rainfed shallow lowland situation of red and laterite zone of West Bengal. The highest grain yield (4.80 t ha^{-1}) was obtained at 105 kg N ha^{-1}and it was statistically at par with 70 kg N ha^{-1} (4.62 t ha^{-1}). Therefore, the increased in grain yield of rice by the varieties due to overall respective performance in growth and appreciable improvement in the yield attributing characters.

Citation of this article: Jana, K., Mallick, G.K., Das, S.K., Biswas, B., Kundu, M.K., Koireng, R.J. and Puste, A.M. (2017). Evaluation of potential rice (*Oryza sativa* L.) genotypes with different levels of N under rainfed shallow lowland situation. *Archives of Agriculture and Environmental Science*, 2(3): 202-205.

INTRODUCTION

Rice (*Oryza sativa* L.) is an important cereal crop and grown across the world. Most of people of the world depend on rice for their secured livelihood and a way of life. It is the staple food for more than 65 per cent of the people and provides employment and livelihood to 70 per cent of the Indians. There is a need to enhance the productivity of the rice to meet the growing demand under conditions of declining quantity and quality of land (Raju, 2013). Nitrogen plays an important role to promote the plant growth and ultimately in determining the yield of rice. Nitrogen is the key element in the production of rice and gives by far the largest response. It is the most essential element in determining the yield potential of rice and nitrogenous fertilizer is one of the major inputs to rice production (Mae, 1997). However, recovery of applied nitrogen in rice is very low owing to various losses. Optimization of applied nitrogen at critical growth stages, coinciding with the period of efficient utilization is essential to meet the nitrogen requirement of crop throughout the growing season (Pandey *et al*., 2002). Almost every farmer has the tendency to apply costly N fertilizer excess to get a desirable yield of Aman rice (Saleque *et al*., 2004; Jahan *et al.,* 2017), but the imbalance use of N fertilizer causes harm to the crop and decreases grain yield. It is also a fact that improper use of nitrogenous fertilizer, instead of giving yield advantage, may reduce the same. Nitrogen management is an important aspect for obtaining good yield of rice. Optimum dose and schedule of fertilizer application is necessary to achieve higher yields, minimize lodging and damage from insect pests (DRR, 2013). Sangeetha and Balakrishnan (2011) reported that lower grain yield of rice obtained with absolute control which did not receive organic manures and recommended NPK addition. Nitrogen fertilization and proper time of its application is the major agronomic practice that affects the yield and quality of rice crop (Lampayan *et al*., 2010). Different varieties may have varying responses to N-fertilizer depending on their agronomic traits. Now a days the identification and release of high yielding rice varieties, it becomes imperative to make a comparative assessment of the growth studies and their influence on grain yield under different nutrient combination. Of the mineral nutrients, nitrogen plays a major role in utilization of absorbed light energy and photosynthetic carbon metabolism in many biochemical and physiological activities of plant (Huang *et al*., 2004; Kato *et al*., 2003). Its deficiency or excess application may adversely affect these processes and ultimately reduces crop yield. On other hand, genetic character of a variety limits the expression of yield. Rice cultivars differ in their potential to respond to high fertility conditions. Selection of suitable varieties and their nutrient requirements have great relevance in boosting up productivity of lowland rice. Selection of proper variety suitable to the specific ecological situation may prove to be a boon to the farmer. Keeping these points in view the present research was taken up. Hence this study was proposed to identify suitable variety, N level and varietal response under different levels of N in rainfed shallow lowland situation of red and laterite zone of West Bengal.

MATERIALS AND METHODS

To evaluate the yield of potential rice genotypes as influenced by different doses of nitrogen under *'kanali'/'sol'* situation of red and laterite zone of West Bengal, a field experiment was conducted during *kharif* season during the years 2012 and 2013 at Rice Research Station, Bankura, West Benagl, India. Main objective of this experiment was to test the yield performance of IET 21987 before release as '*Sampriti*' in the year 2014 by State Variety Release Committee, West Bengal along with three rice varieties with different levels of nitrogen under rainfed shallow lowland situation. The soil of experimental field was sandy loam in texture. The experiment was laid out in a split plot design in 3 replications with three levels of nitrogen [35 kg N ha^{-1}= 50% recommended dose of nitrogen (RN), 70 kg N ha^{-1}= 100% RN, 105 kg N ha^{-1}= 150% RN.] randomly allotted in the three main plots; while four promising rice varieties [*Dhruba* (IET 20761), *Sampriti* (IET 21987), *Dhiren* (IET 20760) and *Swarna* (MTU 7029)] were randomly allotted in the four sub-plots of each main plot. The recommended fertilizer dose (RFD) in rainfed shallow lowland situation was N, P_2O_5 and K_2O @ 70, 35 and 35 kg ha^{-1}, respectively. The source of N, P_2O_5 and K_2O were urea, single super phosphate (S.S.P.) and muriate of potash (M.O.P.), respectively. 25% of recommended dose of N and full dose of P_2O_5 and 75 % of K_2O were applied as basal. 50% of recommended dose of nitrogen was top dressed at active tillering stage and rest 25% N along with 25% K_2O were applied at panicle initiation stage. The field was drained before application of fertilizers and one week before harvest. Initial soil sample were collected and were analyzed for important properties using standard procedures. The soil was slightly acidic (pH 5.7) in nature, EC: 0.16 dsm^{-1}, organic carbon (%): 0.41, available P_2O_5 44 kg ha^{-1} and K_2O 185 kg ha^{-1}, respectively. Plot size was 4m × 3m, whereas the crop geometry was 20cm × 15cm. Planting of 30 days old seedlings was done with 2-3 seedlings per hill. For weed management, Butachlor 50EC @ 1.5 kg *a.i* ha^{-1} applied at 5 DAT (days after transplanting) followed by two hand weeding at 35 and 55 DAT. The crop was raised as per recommended package of practices throughout the period of crop growth. Observation on yield parameters and grain yield were statistically analyzed. Potential rice varieties, namely *Dhruba* (IET 20761), *Sampriti* (IET 21987) and *Dhiren* (IET 20760) were developed at Rice Research Station, Bankura and released by State Variety Release Committee, West Bengal for cultivation in rainfed shallow lowland areas under transplanted condition in West Bengal. Swarna (MTU-7029) was notified in the year of 1987, developed at Maruteru (ANGRAU) and recommended for rainfed lowland condition. Its duration is about 140 days [Source: Rice Knowledge Management Portal (http://www.rkmp.co.in)].

RESULTS AND DISCUSSION

The effects of various levels of N and varieties on various parameters have been presented in Tables 1 and 2; Figure 1 and 2.

Nitrogen levels: The yield attributes of potential rice varieties were found to be differed due to applied nitrogen levels. Each increase in the N-level increased plant height and number of panicles m^{-2} resulting higher yield attributes (Table 1). Thus, at 105 kg N ha^{-1}, the yield attributes recorded maximum number of panicles m^{-2} (307.9), panicle length (25.3cm), panicle weight (2.32g), number of filled grains per panicle (117.8), 1000-grains weight (24.5g) and finally recorded highest grain yield (4.80 t ha^{-1}) than lower fertilities. While, 70 kg N ha^{-1} was remained closed to 105 kg N ha^{-1} in number of panicles m^{-2}, panicle weight and number of filled grains per panicle during investigation. The experimental results revealed that among the nitrogen levels, the highest grain yield (4.80 t ha^{-1}) was recorded with 105 kg N ha^{-1}, but it was statistically similar with 70 kg N ha^{-1} (4.62 t ha^{-1}) and significantly higher than 35 kg N ha^{-1} (3.64 t ha^{-1}). There was a significant increase in grain yield with the increase in N level from 35 to 70 kg ha^{-1} and further increase in N level up to 105 kg ha^{-1} could not increase the grain yield significantly.

The improvement in yield attributing traits may be ascribed to the improved vegetative growth due to nitrogen fertilization, facilitating photosynthesis, thereby increasing translocation of organic food materials towards the reproductive organs; which enhanced the formation of panicles with fertile grains. The improvement in yield components due to increased nitrogen levels also have been reported by many workers Shukla *et al.* (2015), Pandey *et al*. (2007) and Singh *et al*. (2008). The productivity *i.e.* grain yield of rice was found to be differed with different level of nitrogen during investigation. This might be due to better growth in plant height and appreciable improvement in yield attributing characters. This could be attributed to the fact that higher dose of nitrogen being constituent of enzymes and protein enhanced cell expansion and various metabolic processes. Grain yield production increased significantly with incremental levels of N up to 70 kg ha^{-1}. This could attributed to the higher nitrogen application which might have increased the chlorophyll formation and improved photosynthesis and thereby increased the plant height, number of panicles per unit area and number of filled grains per panicle leading to the production of high grain yield. Similar results have also evinced by Luikhan *et al*. (2004).

Varieties: There were significant differences among the potential rice varieties in plant height, yield attributes and grain yield. All yield attributing characters were remained differed with different varieties. Among the four varieties, *Sampriti* (IET 21987) recorded maximum plant height (124.5 cm), number of panicles m^{-2} (304.7), panicle length (26.2cm), panicle weight (2.37g), number of filled grains per panicle (126.2), 1000-grains weight (26.2g) and finally recorded highest grain yield (4.66 t ha^{-1}). While, *Dhruba* (IET 20761) was remained closed to *Sampriti* (IET 21987) in number of panicles m^{-2}, panicle weight and number of filled grains per panicle during investigation. Experimental results revealed that among the potential rice varieties, *Sampriti* (IET 21987) recorded the highest grain yield (4.66 t ha^{-1}), which was significantly higher to that of *Dhiren* (4.22 t ha^{-1}) and *Swarna* (4.16 t ha^{-1}) and at par with that of *Dhruba* (4.37 t ha^{-1}) (Table 1). However, *Dhruba* (IET 20761) exerted second promising yield attributing characters during investigation. The climatic condition and genetic makeup of variety had better interaction under which could be enhanced growth and development of panicles. The photoperiodic responses and genetic potentiality on variation of yield attributes of improved varieties have also been reported by Lar *et al*. (2007). Productivity of crop is collectively determined by vegetative growth coupled with higher yield attributes resulting in higher grain yield. Increased in grain yield through greater partitioning of assimilates from shoot to grain. The increased in grain yield by the varieties due to overall respective performance in growth and appreciable improvement in the yield attributing characters. Significant variations in grain yield of rice varieties have also been reported by many workers (Lar *et al*., 2007; Singh and Tripathi, 2008 and Jana, 2014).

Table 1. Growth and yield attributes of potential rice genotypes as influenced by levels of nitrogen and genotypes (Pooled value of 2 years).

Nitrogen levels (N)	Plant height (cm)	No. of Panicles m^{-2}	Panicle length (cm)	Panicle wt. (g)
35 kg N ha^{-1}	115.3	195.0	21.6	1.95
70 kg N ha^{-1}	122.2	297.8	24.8	2.24
105 kg N ha^{-1}	123.7	307.9	25.3	2.32
S.Em (±)	0.21	5.08	0.09	0.04
CD (P = 0.05)	0.82	19.95	0.36	0.18
Potential rice varieties (V)				
Dhruba (IET 20761)	121.2	266.7	25.4	2.18
Sampriti (IET 21987)	124.5	304.7	26.2	2.37
Dhiren (IET 20760)	120.3	253.6	23.6	2.11
Swarna (MTU 7029)	117.1	242.6	21.7	2.02
S.Em (±)	0.32	12.02	0.14	0.09
CD (P = 0.05)	1.28	36.52	0.56	0.25

Table 2. Grain yield and ancillary characters of potential rice genotypes as influenced by levels of nitrogen and varieties (Pooled value of 2 years).

Nitrogen levels (N)	No. of filled grains/panicle	1000-seed wt. (g)	Grain yield (t ha^{-1})
35 kg N ha^{-1}	80.2	20.2	3.64
70 kg N ha^{-1}	105.3	23.5	4.62
105 kg N ha^{-1}	117.8	24.5	4.80
S.Em (±)	1.31	0.04	0.13
CD (P = 0.05)	5.23	0.16	0.38
Potential rice varieties (V)			
Dhruba (IET 20761)	120.3	25.4	4.37
Sampriti (IET 21987)	126.2	26.2	4.66
Dhiren (IET 20760)	112.7	23.6	4.22
Swarna (MTU 7029)	98.6	21.7	4.16
S.Em (±)	1.06	0.07	0.13
CD (P = 0.05)	4.24	0.28	0.39

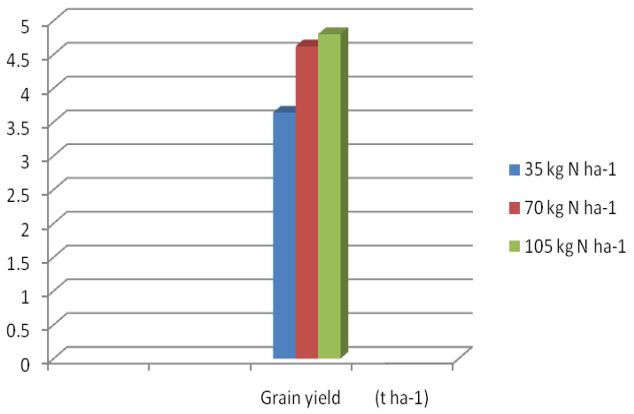

Figure 1. *Grain yield of rice genotypes as influenced by levels of nitrogen.*

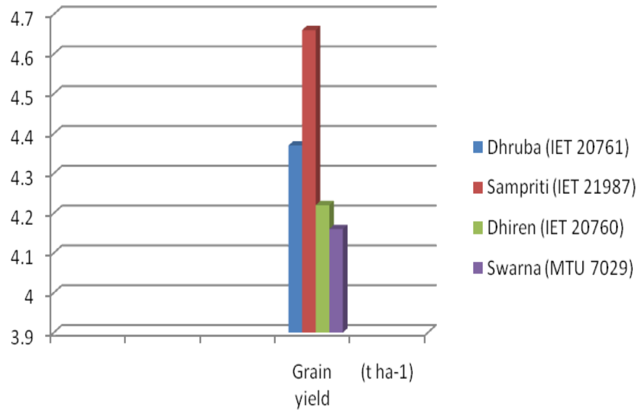

Figure 2. *Grain yield as influenced by rice genotypes.*

Conclusions

From the present study, it may be concluded that among the potential rice varieties '*Sampriti*' (IET 21987) proved most impressive by recording the highest grain yield and *Dhruba* (IET 20761) exerted second promising rice varieties under rainfed shallow lowland situation of red and laterite zone of West Bengal. Sampriti (IET 21987) has the potential to be an alternative/replacement for *Swarana* (MTU 7029) in rainfed shallow lowland areas of West Bengal. The highest grain yield was obtained at 105 kg N ha^{-1}and it was statistically at par with 70 kg N ha^{-1}. Therefore, the increased in grain yield of rice by the varieties due to overall respective performance in growth and appreciable improvement in the yield attributing characters.

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