Bangladesh Agron. J. 2015, 18(2): 9-14

RESPONSE OF NERICA RICE TO NITROGEN FERTILIZATION

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Key words: NERICA, nitrogen fertilizer, nitrogen use efficiency, yield

Abstract

An experiment was conducted during T. *Aman* season, 2014 at the Agronomy Research Field, Bangladesh Rice Research Institute, Gazipur to determine the optimum rate of nitrogen fertilizer for higher yield in nerica rice. The experiment comprised of three rice varieties viz. NERICA1, NERICA10 and BRRI dhan57; and five nitrogen levels viz. 0, 23, 46, 69 and 92 kg ha^{-1}. The rice var. BRRI dhan57 with 69 and 92 kg N ha^{-1} produced significantly identical with higher panicles m^{-2}. But NERICA1 and NERICA10 produced higher number of panicles with 46 and 69 kg N ha^{-1}, respectively. However, BRRI dhan57 with 46 kg N ha^{-1} produced highest grains $panicle^{-1}$ but NERICA1 and NERICA10 produced higher number of grains $panicle^{-1}$ with 23 kg N ha^{-1}. The highest percentage of sterility was recorded in NERICA10 with 69 kg N ha^{-1}. The regression analysis gave the optimum dose of nitrogen for NERICA1, NERICA10 and BRRI dhan57 which were 69.25, 74.25 and 85.75 kg N ha^{-1}, respectively.

Introduction

Rice (*Oryza sativa* L.) is the most extensively cultivated cereal crop in Bangladesh, which covers about 74% of the total cropped area (BBS, 2013). In respect of area and production of rice, Bangladesh ranks fourth following China, India and Indonesia (FAO, 2014). The area, production and yield of rice in the country are 11.42 million ha, 33.85 million tons and 2.96 t ha^{-1}, respectively (BBS, 2013). Previous studies revealed that proper use of fertilizer can increase the yield and improve the quality of rice significantly (Awan *et al.*, 2003; Ahmed *et al*., 2005; Oikeh *et al*., 2008). NERICA1 and NERICA10 is a new rice variety in Bangladesh which is short duration as well as drought tolerant. Development of proper fertilizer management strategy is one of the most important agronomic practices for its successful adoption in Bangladesh, especially in the drought prone areas. Among the agronomic practices, management of nitrogenous fertilizer plays the most important role for augmenting the rice yield.

Okeleye and Kehinde (2009) reported that application of 30 kg N in NERICA1 enhanced the number of tillers by 10% only at 21 days after transplanting (DAT) compared to zero-N. These results were also supported by Adigbo and Okeleye (2006) and Oikeh *et al.* (2008). Therefore, judicious dose of nitrogen fertilizer in *Aman* rice cv. NERICA1 and NERICA10 is necessary under Bangladesh condition. The present study was therefore conducted to determine the optimum rate of nitrogen fertilizer for getting higher yield in NERICA1 and NERICA10 varieties and compare with BRRIdhan 57.

Materials and Method

A field experiment was conducted during T. *Aman* season 2014 at the Agronomy Research Field, Bangladesh Rice Research Institute, Gazipur. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. Plot size was 4m × 3m. The experiment comprised of

three rice varieties viz. NERICA1, NERICA10 and BRRI dhan57; and five nitrogen levels viz. 0, 23, 46, 69 and 92 kg ha^{-1}. Triple super phosphates, muriate of potash, gypsum and zinc sulphate were applied at 70-60-50-5 kg ha^{-1}. The whole dose of triple superphosphate, muriate of potash, gypsum, zinc sulphate and one third of nitrogen were applied at the time of sowing. The remaining doses of nitrogen were applied in two splits at tillering and panicle initiation. Data on yield and yield component were recorded at harvest and mean differences were depicted by multiple comparison test (Gomez and Gomez, 1984) using the statistical program MSTAT-C (Russell, 1986).

Nitrogen use efficiency

The efficiency of applied N was assessed using the following indices (Dobermann and Fairhurst, 2000).

a. Agronomic efficiency (AE)

Agronomic efficiency is the kg grain yield increase kg^{-1} N applied. Often used as nitrogen use efficiency (NUE).

$AE_N = (GY_{+N} - GY_{0N}) / FN$

Where, AE_N = Agronomic efficiency of N; GY_{+N} = Grain yield due to addition of FN; GY_{0N} = Grain yield without addition of N; FN = Amount of N applied (kg ha^{-1}).

b. Partial factor productivity (PFP)

Partial factor productivity is the kg grain yield kg^{-1} N applied.

$PFP_N = GY_{+N} / FN$

Where, PFP_N = Partial factor productivity of N; GY_{+N} = Grain yield due to addition of FN; FN = Amount of N applied (kg ha^{-1}).

Results and discussion

Yield components

Among the yield components, panicles m^{-2} and sterility (%) showed significant effect with different rates of fertilizer. BRRI dhan57 with nitrogen rate 69 and 92 kg ha^{-1} produced panicles m^{-2} which was 202 and 203 respectively significantly higher and statistically similar. The highest number of panicles m^{-2} was found from NERICA1 and NERICA10 with 46 and 69 kg N ha^{-1}, respectively. Nitrogen rates did not show any significant effect on grains $panicle^{-1}$. However, BRRI dhan57 with 46kg N produced highest grains $panicle^{-1}$ (151). Besides NERICA1 and NERICA10 with 23kg N/ha produced 68 and 79 grains/panicles, respectively. Increase in grain yield for application of N was mainly due to improvement in yield components i.e. number of effective tillers and grains $panicle^{-1}$.

Thousand grain weight did not significantly influenced by N level in cultivated rice varieties. However, numerically maximum 1000-grain weight was recorded from NERICA1 with 69 kg N ha^{-1}. The highest sterility percent was recorded in NERICA10 with 69 kg N ha^{-1} (43.40%). In contrary the lowest sterility percent (22.37%) from BRRI dhan57 with 0 kg N ha^{-1} (Table 1).

Table 1. Effect of nitrogen fertilizer on yield components of three rice varieties

N added (kg ha^{-1})	Panicles m^{-2}	Grains $panicle^{-1}$	1000- grain weight (g)	Sterility (%)
NERICA1				
0	121g	52	26.90	33.57 a-e
23	115h	68	27.23	27.90 cde
46	146d	65	25.47	34.77 a-d
69	135e	73	28.90	25.87 cde
92	132ef	75	28.63	29.47 cde

		NERICA10		
0	131ef	68	24.13	32.70 a-e
23	127fg	79	25.13	30.93 b-e
46	143d	77	22.83	28.87 cde
69	150d	76	24.90	43.40 a
92	147d	74	25.26	42.10 ab
		BRRI dhan57		
0	176b	129	18.73	22.37 e
23	167c	133	18.47	24.43 de
46	178b	151	18.57	24.30 de
69	202a	144	17.83	27.80 cde
92	203a	141	18.33	28.77 cde
CV (%)	2.52	17.68	6.42	19.87

** and * indicates significant at 1 and 5% level, NS = not significant and similar letters within the column did not differ significantly by DMRT

Grain yield

The variety BRRI dhan57 with 69 kg N ha^{-1} produced higher yield (4.16 t ha^{-1}) which was 53.50% higher than control plot. Besides NERICA1 and NERICA10 did not show response with different levels of nitrogen. NERICA1 with 69 kg N ha^{-1} produced 128.21% higher yield than 0 kg N treated plot which was statistically similar with 92 kg N ha^{-1}, produced 127.35% higher yield than control plot. Uddin *et al.* (2013) reported that NERICA1 produced the highest grain yield (2.96 t ha^{-1}) with 80 kg N ha^{-1}.

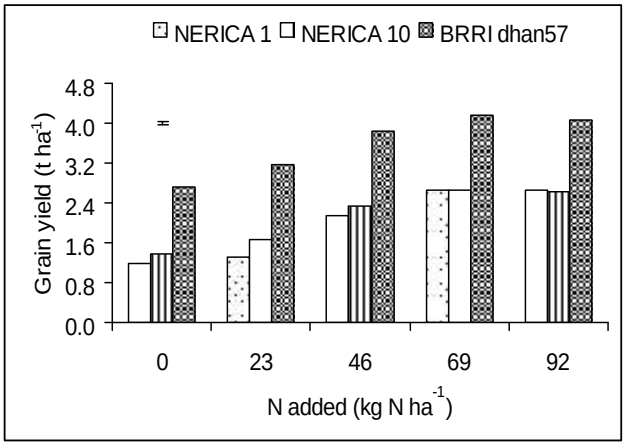

Fig. 1. Effect of different N doses on grain yield of NERICA rice.

Furthermore, NERICA10 with 69 kg N/ha produced 127.35% higher yield than control plot which was statistically similar with 92 kg N/ha, produced 100% higher yield than control plot. It revealed that BRRI dhan57 responded higher with increased rate of nitrogen fertilizer but NERICA1 and NERICA10 have lower response with nitrogen fertilizer. Kisetu *et al.* (2013) stated from different reports that very low response of NERICA4 rice cultivar to various N levels in different parts of Tanzania.

Straw yield

BRRI dhan57 with 69 kg N ha^{-1} produced the highest straw yield (4.20 t ha^{-1}) whereas NERICA1 and NERICA10 produced straw yield of 4.20 and 3.33 t ha^{-1} with 46 kg N ha^{-1} (Fig. 2). Irshad *et al.* (2000) stated that N application increased straw yield over the absolute control.

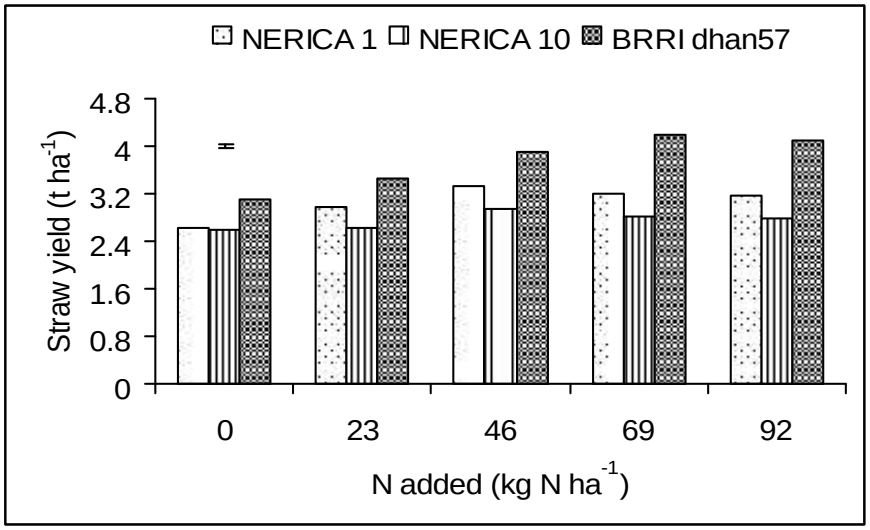

Fig. 2. Effect of different N doses on straw yield of NERICA rice

Calculation of optimum nitrogen doses for nerica rice

The regression line clearly indicated the relationship among three varieties with different rates of nitrogen fertilizer. Moreover, calculation for optimum nitrogen rates for three different rice varieties depicts that for getting higher yield in BRRI dhan57 it requires 85.75 kg N ha^{-1}. However, NERICA 1 could gave higher yield at 69.25 kg N ha^{-1} and NERICA 10 with 74.25 kg N ha^{-1} but grain yield is much lower than BRRIdhan 57 (Fig. 3)

Agronomic use efficiency and Partial factor productivity

The rice var. BRRI dhan57 with fertilizer rates 46 kg N ha^{-1} showed higher agronomic use efficiency (24.5). Besides, the lowest (14.6) was found in BRRI dhan57 with 92 kg N ha^{-1}. In case of NERICA1 variety the highest agronomic use efficiency (21.7) was found in 69 kg N ha^{-1}. However, NERICA10 showed higher agronomic use efficiency at 46 kg N ha^{-1} (21.3). On the other hand, the var. BRRI dhan57 with fertilizer rates 0 kg N ha^{-1} showed higher partial factor productivity (137.6) among three varieties whereas NERICA1 and NERICA10 showed lowest with higher rates of nitrogen level (Table 2).

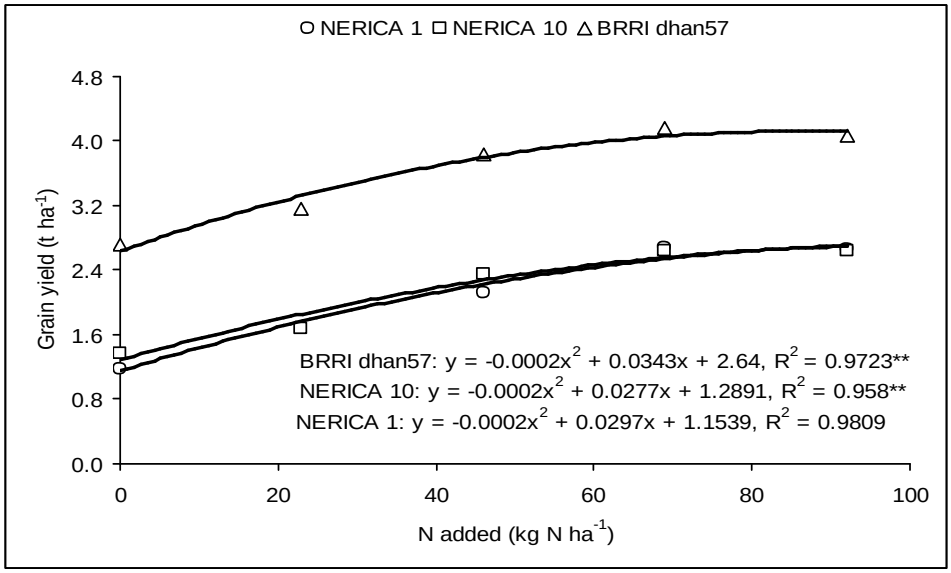

Fig. 3. Calculation of optimum nitrogen fertilizer dose for NERICA rice

Table 2. Agronomic use efficiency and Partial factor productivity of Nerica rice

N applied (kg ha^{-1})	Agronomic use efficiency (AUE) (kg grain per kg N applied)			Partial factor productivity (PFP) (kg grain per kg N applied)		
	NERICA1	NERICA10	BRRI dhan57	NERICA 1	NERICA 10	BRRI dhan57
23	6.5	13.0	20.0	57.3	72.5	137.6
46	20.8	21.3	24.5	46.2	51.0	83.3
69	21.7	18.5	21.0	38.6	38.3	60.2
92	16.2	13.8	14.6	28.9	28.6	44.1

Conclusion

It could be concluded that rice var. BRRIdhan 57 showed higher grain yield with 85 N Kg/ha whereas NERICA1 and NERICA10 with 69.25 and 74.25 kg N ha^{-1} during T. *Aman* season but this two variety gave much lower grain yield than the former one.

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