

Performance of Nitrogen Application Methods on Different Inbred and Hybrid Rice Varieties

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Abstract: To find out the influence of different forms of nitrogen application on the performance of some inbred and hybrid varieties of rice the experiment was carried out at research field of Sher-e-Bangla agricultural University, Dhaka, Bangladesh during the period from December, 2011 to May, 2012. The experiment was laid out split plot design with three replications. The results revealed that varietal effect of BRRI hybrid dhan 2 and treatment effect of NPK briquette showed the highest yield. While, interaction effect of BRRI hybrid dhan 2, ACI hybrid dhan1 and BRRI dhan29 with NPK briquette had significantly highest number of effective tillers per hill, non-effective tillers per hill, panicle per hill, panicle length, grains per panicle and thousand seed weight. So these treatments showed the highest grain yield, stover yield, biological yield and harvest index. The NPK briquettes showed higher agronomic efficiency than prilled urea and Urea Super Granule.

Key words: Prilled urea • Urea Super Granule • NPK briquette • Grain yield

INTRODUCTION

Rice (*Oryza sativa* L.) is the most important food crop in Bangladesh and serves as the basis of life for half of the world's population, particularly in East and South East Asia [1]. Production of rice has been given highest priority in the world in meeting the demands of its ever-increasing population [2]. The present nutritional situation of third world and some developing countries like Bangladesh is a matter of great concern [3] since most of the people are suffering from malnutrition [4-6]. Rice provides about 76% of the total calories and 66% of the protein intake of the people's diet [7, 8]. It is extensively grown in Bangladesh in three seasons namely, Aus, Aman and Boro, which covers 80% of the total cultivable area of the country [9]. Rice production needs to be increased by 50% or more above the current production level to meet the rising food demand [10, 11]. Horizontal expansion of rice area is not possible in Bangladesh due to limited resources and high population density. So, the only avenue left is to increase production of rice by vertical means, that is, management practices

and introduction of new high yielding varieties [12]. The application of fertilizer in proper amounts must be done to boost up agricultural production to an economically desirable level [13]. Judicious use of fertilizers can markedly increase the yield and improve the quality of rice [14]. Nitrogen is one of the most yield limiting nutrients in rice production around the world, especially in tropical Asian soils and almost every farmer has to apply N fertilizer to get a desirable yield of rice [15]. Nitrogen (N) level and organic matter contents in the soil of Bangladesh are very poor. Given the importance of N fertilization on the yield in grain, it is necessary to know what the best dose is for each variety as well as its influence on yield components and other agronomic parameters such as plant height, lodging and moisture content of the grain, in order to obtain better knowledge of said productive response [14]. Nitrogen is often applied to plants to ensure economically viable grain yields in large scale cropping systems. Yield levels presently achieved by Bangladeshi farmers depend on large amounts of N fertilizer. But excess fertilizers can reduce soil fertility. Urea is usually applied in prilled condition

by hand with application efficiency is only 35 to 40%. When it is applied in super granule form, its application efficiency is increased to 60 per cent [16]. Farmers in Vietnam and Cambodia obtained 25 % higher yields with deep placement of NPK briquettes over the broadcasting of fertilizer [17]. Therefore, the present study was undertaken to evaluate some inbred and hybrid varieties with improve nitrogen management options of rice for considerably increase the yield levels.

MATERIALS AND METHODS

The experiment was carried out at Agronomy Field Laboratory of Sher-e-Bangla agricultural University, Dhaka, Bangladesh during the period from December, 2011 to May, 2012. The soil of the experimental field lies in agro-ecological region of Madhupur Tract (AEZ 28). The experiment was laid out split plot design with three replications consisting four rice varieties viz., BRRi hybrid dhan 2, ACI hybrid dhan1, HIRA hybrid dhan and BRRi dhan 29 and four nitrogen application method viz., Control (No Urea application) + PKSzn from BRRi Recommended fertilizer dose, USG (2.7 gm) placement by hand+ PKSzn from BRRi Recommended fertilizer dose, broadcasting method of prilled urea+ PKSzn from BRRi Recommended fertilizer dose and NPK super granule +Szn from BRRi Recommended fertilizer dose. Treatments were assigned randomly in the 48 (2.5 m×3 m) plots. Forty day old seedlings were transplanted on 12th January, 2012 maintaining plant to plant and also row to row distance was 20 cm. In broadcasting method prilled urea applied in three split, USG and NPK briquette placement at 7 days after transplanting. BRRi recommended dose: N:P:K:S:Zn = 120:19:60:24:4 kg/ha. In control, broadcasting and USG treatment PKSzn and NPK briquette treatment Szn were applied during final land preparation as per BRRi (Bangladesh Rice Research Institute) recommended dose. Intercultural operations were done in order to ensure and maintain the normal growth of the crop asand when necessary. When 90% of grain became golden yellow in color, ten hills (excluding border hills) were randomly selected from each unit plot for recording data on different agronomic crop characters. Grain and straw yields were recorded from whole area in each unit plot. The collected data were analyzed statistically following the Analysis of Variance (ANOVA) technique and the significance of the mean differences were adjudged by Duncan's Multiple Range Test (DMRT) [18] using a statistical computer package program MSTAT-C.

RESULTS AND DISCUSSION

Varietal Effect on Yield Contributing Parameters:

BRRi dhan 29 and BRRi hybrid dhan 2 showed the similar number of effective tiller per hill (Table 1). Number of non-effective tillers per hill of hybrid varieties was significantly higher than inbred variety BRRi dhan 29. BRRi dhan 29 had significantly highest number of panicle per hill than other three hybrid varieties. The highest panicle length (19.45 cm) was found in BRRi dhan 29. Significantly highest grains per panicle (161) were found in both BRRi dhan 29 and ACI hybrid dhan 1. From thousand seed weight, it could say that Hybrid Hira dhan have bolder grain than BRRi dhan 29. The highest grain yield found in BRRi dhan 29 which was also comparable with BRRi hybrid dhan2. But BRRi hybrid dhan2 showed significantly highest stover yield than other hybrid and inbreed varieties. On the other hand BRRi dhan 29 had highest biological yield (15.32 t/ha) which was like wise BRRi hybrid dhan 2 but significantly higher than ACI hybrid dhan1 and Hybrid Hira dhan. As a result BRRi hybrid dhan 2 as well as BRRi dhan 29 had similar varietal effect on different source of nitrogen.

Fertilizer Treatment Effect on Yield Contributing Parameters:

NPK briquette showed the significant difference among the treatments in number of effective tiller per hill (Table 2). While, number of non-effective tiller per hill of control was significantly higher than other treatments. NPK briquette showed significantly highest number of panicle per hill than other three methods. The highest panicle length (21.20 cm) was found in NPK briquette which significantly similar with the Urea Super Granule (20.90 cm) treatment. Significantly highest grains per panicle were found in NPK briquette. From thousand seed weight, NPK briquette showed bolder grain than other treatments. The highest grain yield found in NPK briquette (7.87 t/ha) which was also comparable with Urea Super Granule (7.13 t/ha). But NPK briquette (9.00 t/ha) showed significantly highest stover yield which was comparable with prilled urea (8.79 t/ha). On the other hand NPK briquette had highest biological yield (16.80 t/ha) which was significantly higher than other treatments. May be NPK briquette effectively increase the plant physiological characters expression as well as yield also enhance. As a result most of the yields contributing characters are showed their optimum condition by NPK briquette application which is similar to the findings of [19].

Table 1: Varietal effect on yield contributing parameters as influenced by different inbred and hybrid rice

Variety	Effective tillers hill ⁻¹	Non-effective tillers hill ⁻¹	Number of panicle hill ⁻¹	Panicle length (cm)	Number of Grains Panicle ⁻¹	1000 seed weight (g)	Grain yield/ha	Stover yield/ha	Biological yield/ha
BRRRI hybrid dhan2	14.21 a	2.75 a	14.85 b	19.24 a	157 b	25.57 a	6.62 a	8.59 a	15.04 ab
ACI hybrid dhan1	13.62 ab	2.71 a	13.38 c	17.82 b	161 a	24.86 ab	6.46 ab	8.28 c	14.86 b
Hybrid Hiradhan	12.79 b	2.59 b	13.40 c	18.15 b	156 b	25.65 a	6.22 b	8.42 b	14.49 c
BRRRI dhan29	14.64 a	2.58 b	15.40 a	19.45 a	161 a	24.48 b	6.74 a	8.48 ab	15.32 a

Table 2: Effect of fertilizer treatments on yield contributing parameters of different inbred and hybrid rice

Treatments	Effective tillers hill ⁻¹	Non-effective tillers hill ⁻¹	Number of panicle hill ⁻¹	Panicle length (cm)	Number of Grains Panicle ⁻¹	1000 seed weight (g)	Grain yield/ha	Stover yield/ha	Biological yield/ha
N control+PKSZn	9.049 d	3.84 a	9.56 d	15.11 c	140 d	21.22 d	4.18 c	7.37 c	11.53 c
Urea Super Granule+PKSZn	14.62 b	2.25 c	15.57 b	20.90 a	167 b	26.22 b	7.13 ab	8.64 b	15.75 b
Prilled Urea+PKSZn	13.34 c	2.43 b	13.25 c	17.46 b	153 c	25.27 c	6.84 b	8.79 ab	15.62 b
NPK briquette+SZn	18.25 a	2.12 d	18.65 a	21.20 a	174 a	27.85 a	7.87 a	9.00 a	16.80 a

Table 3: Interaction effect of variety and urea on yield contributing parameters as influenced by different inbred and hybrid rice

Variety	Treatments	Effective tillers hill ⁻¹	Non-effective tillers hill ⁻¹	Number of panicle hill ⁻¹	Panicle length (cm)	Number of Grains Panicle ⁻¹	1000 seed weight(g)	Grain yield/ha	Stover yield/ha	Biological yield/ha
BRRRI hybrid dhan2	N control +PKSZn	8.547 h	4.16 a	8.213 g	15.98 h	135 h	19.51 k	4.34 f	7.46 f	11.79 de
	Urea Super Granule+PKSZn	14.72 c	2.26 de	17.28 b	20.93 c-e	167 c	26.84 c	7.18 bc	8.49 e	15.66 bc
	Prilled Urea+PKSZn	13.72 d	2.39 d	14.01 c	18.55 g	156 de	25.48 fg	6.87 de	8.87 bc	15.73 bc
	NPK briquette+SZn	19.87 a	2.21 de	19.88 a	21.50 bc	170 bc	29.46 a	8.18 a	9.11 a	16.96 a
ACI hybrid dhan1	N control +PKSZn	9.217 fg	3.99 a	10.22 ef	14.42 j	145 g	20.71 i	4.01 g	7.29 g	11.29 ef
	Urea Super Granule+PKSZn	14.42 c	2.31 de	14.28 c	19.92 f	170 bc	26.47 d	7.03 cd	8.55 e	15.57 bc
	Prilled Urea+PKSZn	13.02 e	2.32 de	11.81 de	16.18 h	152 ef	24.57 h	6.76 e	8.75 cd	15.50 bc
	NPK briquette+SZn	17.82 b	2.25 de	17.21 b	20.74 de	175 b	27.69 b	8.01 a	9.08 a	17.08 a
Hybrid Hiradhan	N control +PKSZn	8.817 gh	3.66 b	9.543 fg	14.84 ij	130 i	24.32 h	3.85 g	7.17 g	11.01 f
	Urea Super Granule+PKSZn	14.52 c	2.26 de	13.48 cd	21.12 b-d	166 c	26.08 e	6.96 de	8.74 cd	15.67 bc
	Prilled Urea+PKSZn	12.82 e	2.29 de	13.48 cd	16.27 h	158 d	25.76 ef	6.84 de	8.59 de	15.42 c
	NPK briquette+SZn	15.02 c	2.16 e	17.08 b	20.36 ef	170 bc	26.44 d	7.22 bc	8.63 de	15.84 bc
BRRRI dhan29	N control +PKSZn	9.617 f	3.55 b	10.28 ef	15.17 i	149 fg	20.33 j	4.51 f	7.53 f	12.03 d
	Urea Super Granule+PKSZn	14.82 c	2.19 de	17.21 b	21.62 b	167 c	25.50 fg	7.34 b	8.75 cd	16.08 b
	Prilled Urea+PKSZn	13.82 d	2.72 c	13.68 c	18.82 g	147 g	25.29 g	6.91 de	8.92 b	15.82 bc
	NPK briquette+SZn	20.32 a	1.87 f	20.41 a	22.19 a	181 a	26.81 c	7.96 a	9.15 a	17.32 a

Interaction Effect on Yield Contributing Parameters:

Combined effect of BRRRI hybrid dhan 2 and BRRRI dhan 29 with NPK briquette showed significant difference among the treatments in number of effective tiller per hill (Table 3). Mean while, number of non-effective tiller per hill of BRRRI hybrid dhan2 and ACI hybrid dhan 1 with control was significantly higher than other treatments. Furthermore, the highest significant number of panicles per hill showed by BRRRI hybrid dhan 2 and BRRRI dhan 29 in NPK briquette application. On the other hand the highest panicle length (22.19 cm) was found in BRRRI dhan29 of NPK briquette which was significantly higher than other treatments. In addition significantly highest grains per panicle were also found in BRRRI dhan 29 of NPK briquette. The highest grain yield found in BRRRI hybrid dhan 2 of NPK briquette (8.18 t/ha) which was also comparable with ACI hybrid dhan1 of NPK briquette (8.01 t/ha) and BRRRI dhan 29 of NPK briquette (7.96 t/ha). Similarly NPK briquette of BRRRI hybrid dhan 2, ACI hybrid dhan1 and BRRRI dhan29 showed significantly highest stover yield and biological yield than other treatments.

CONCLUSION

Nitrogen application method NPK briquette effectively increases the yield components of rice varieties than the Urea Super Granule and prilled urea application. As a result it increases the yield of BRRRI hybrid dhan2, ACI hybrid dhan1 and consequently the inbred variety BRRRI dhan29.

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