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Optimization of Nitrogen Dose for Yield Maximization of BRRIdhan49

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Abstract

An experiment was conducted during Transplant Aman season to determine the optimum dose of nitrogen on growth and yield of BRRI dhan49. The experiment was laid out following the Randomized Complete Block Design (RCBD). There were seven treatments with three replications. All yield contributing characters like plant height, effective tillers hill^{-1}, panicle length, filled grains panicle^{-1}, grain yield and straw yield except 1000 grains weight of BRRI dhan49 significantly responded to different levels of applied nitrogen and varied from 81.50 to 89.55 cm, 7 to 11, 20.67 to 22.44cm, 104 to 142, 3.75 to 6.17 t ha^{-1} and 4.52 to 7.50 t ha^{-1}, respectively. The highest grain yield of 6.17 t ha^{-1} was recorded in the treatment T_7 (90 kg nitrogen ha^{-1}). The highest straw yield of 7.50 t ha^{-1} was also noted in the treatment T_7 (90 kg nitrogen ha^{-1}). The grain and straw yield due to the different treatments increased by 20 to 64.53% and 21.02 to 65.93% respectively over control. The nitrogen content and uptake by grain and straw were significantly influenced by the application of different levels of nitrogen. The results indicated that the use of 90 kg nitrogen ha^{-1} had better performance on the grain and straw yields. Therefore, the application of 90 kg nitrogen ha^{-1} for BRRI dhan49 cultivation is the best for higher yield at Old Brahmaputra Floodplain soil.

Keywords

Optimization, Nitrogen, Uptake, Yield, BRRI Dhan49 (*Oryza Sativa* L.)

1. Introduction

Bangladesh is a densely populated country and rice is considered as staple food. Rice is the main food of Bangladesh and geographical situation as well as climate and edaphic condition are favorable for year round rice cultivation. Rice (*Oryzae sativa*) belongs to cereal crop under Graminae family. It is the most important cereal crop in Asia which accounts for about 92% of the world rice (IM, 1995). Bangladesh is mainly an agro-based country and agriculture contributes to her gross domestic products to about 20% (BBS, 2011). According to BBS (2011), Bangladesh produces 31-98 million tons of rice per annum from 11.7 million ha of land. Although Bangladesh ranks 4th in the world in terms of both acreage and production but the yield of rice is much lower (2.35 ton ha^{-1}) compared to that in other leading rice growing countries such as China (6.23 ton ha^{-1}), Korea (6.59 ton ha^{-1}), Japan (6.7 ton ha^{-1}) and USA (7.04 ton ha^{-1}) (FAO, 2004).

Nitrogen is the key element in the production of rice. Application of nitrogen as urea gives good yield and urea has been found to be very effective nitrogenous fertilizer through the rice growing regions. Optimum dose of nitrogen, split application of fertilizer have a decisive effect on the yield of rice. Judicious application of fertilizer is one of the most effective means for maximum yield of rice. The fact is that rice plants require more nutrients to produce more yields. Yield increase (70-80%) of field rice could be obtained by the application of nitrogen fertilizer. Nitrogen is one of the major nutrients, which is required in adequate amount at early, mid tillering and panicle initiation and at ripening stage for better grain development. Nitrogen is the element most often required for high yield of rice. Nitrogen fertilizer increases tillering and vegetative growth, increases plant height, grain and straw yield and number of heads usually are proportionally to the amount of nitrogen added to soil. Almost all the soils of Bangladesh are low in organic matter and hence of nitrogen. Among many factors, deficiency of nitrogen considered as major reason for low yield of rice in Bangladesh.

Nitrogen is the most limiting nutrient in crop production all over the world. Understanding the behavior of nitrogen in soil is essential for maximizing crop productivity and profitability on one hand and for reducing the possible negative impact of nitrogen fertilization on the environment on the other hand. The loss of nitrogen from the soil is mainly due to crop removal and leaching, but under certain conditions gaseous loss seldom exceeds 30-40% applied to wet land rice when higher nitrogen use efficiency is, however, possible through appropriate nitrogen management techniques. Application of total nitrogen fertilizer in several splits matching the demand of the crop for nitrogen at critical stages of growth, deep placement of nitrogen in the reduced zone of the soil or thorough incorporation in the soil, use of coated/modified fertilizers are some of the useful techniques which improve nitrogen -use efficiency in rice. Application of nitrogen fertilizer in three splits for rice and 2-3 splits for other irrigated upland crops is recommended for better efficiency. For wetland rice loss of nitrogen in gaseous forms may be reduced by applying urea in saturated soil rather than in standing water. The basal fertilizer is best applied by broadcasting at final pudding followed by harrowing and leveling, so that the nitrogen gets incorporated in the soil. Top dressing of fertilizer nitrogen should also be done, wherever possible, in saturated fields followed by incorporation along with weeding. As nitrogen fertilizer is the main promoter of crop growth and yield, it is important to improve management practices that minimize nitrogen losses and increase the recovery of applied nitrogen by the crop. This will increase productive efficiency and reduce negative impact of nitrogen use on the environment. In the light of above points, the present study in the BAU farm soil was undertaken with the following objectives: to optimize the dose of nitrogen on the growth and yield of BRRI dhan49 and to assess the effect of nitrogen on the nutrient content and uptake by BRRI dhan49.

2. Materials and Methods

The experiment was conducted during Transplant Aman season. There were 7 treatments including one control treatment. The treatment combinations for the experiment were T_1 : Control (No fertilizer),T_2: Recommended Fertilizer Dose (RFD) of $PKSN_0$,T_3: RFD of $PKSN_{50}$,T_4: RFD of $PKSN_{60}$,T_5: RFD of $PKSN_{70}$,T_6: RFD of $PKSN_{80}$,T_7: RFD of $PKSN_{90}$.Recommended Fertilizer Dose: 50kg P ha^{-1}+ 35 kg K ha^{-1} + 10 kg S ha^{-1}. The experiment was laid out in Randomized Complete Block Design (RCBD). The entire experimental area was divided into three blocks representing three replications to reduce soil heterogeneity and each block was sub-divided into 7 plots with raised bunds as per treatment. Thus, the total numbers of the unit plots were 21 (3x7). The unit plot size was 4m x 2.5m; the plots were separated from each other by 0.5 m bunds. There were 1 m drains between the blocks. The treatments were randomly distributed to each block. The full dose of Triple Super Phosphate (TSP), Muriate of Potash (MoP) and gypsum were applied in *T. aman* rice at the time of final land preparation. Urea was applied in three equal split; one-third 12 days after transplanting, second installment after 30 days of transplanting i.e. at maximum tillering stage and third installment after 50 days of transplanting i.e. at panicle initiation stage or booting stage of crop. Plant spacing was 20 cm x 20 cm. The number of rows and hills per plot was equal in all plots. Five hills were randomly selected from each plot at maturity to record yield contribution characters like plant height, number of tillers $hill^{-1}$, panicle length, number of grains $panicle^{-1}$, 1000-grain weight. The selected hills were collected before the crop harvest and necessary information were recorded accordingly. Grain and straw yields were recorded plot wise and expressed as ton ha^{-1} on sundry basis. Grain and straw sub-samples were kept for chemical analysis.

2.1. Nutrient Uptake

After chemical analysis of straw and grain samples, the nutrient uptake was calculated from the nutrient content and yield of rice crop by the following formula:

$$\text{Nutrient uptake} = \frac{\text{Nutrient content (\%)} \times \text{yield (kg ha} - 1)}{100}$$

2.2. Statistical Analysis

The analysis of variance for various crop characters and also for various nutrients concentrations and nutrient uptake was done following the F-test. Mean comparisons of the treatments were made by the Duncan's Multiple Range Test, DMRT (Gomez and Gomez, 1984). Correlation statistics was performed to examine the interrelationship among the plant characters under study.

3. Results

3.1. Yield Components of BRRIdhan49

3.1.1. Plant Height

The plant height of BRRI dhan49 was significantly affected by the application of different levels of nitrogen (Table 1). All the treatments significantly increased the plant height over control. Plant height varied from 81.50cm in T_1 (control) treatment to 89.55cm in T_3 (50 kg N ha^{-1}) treatment (Table 1). The tallest plant (89.55 cm) was recorded in the treatment T_3 (50 kg N ha^{-1}). T_7 (90 kg Nha^{-1}) gave the second highest result (89.44cm) which was statistically similar to that observed in the treatment T_3 (50 kg N ha^{-1}), T_6 (80 kg N ha^{-1}), T_5 (70 kg N ha^{-1}) and T_2 (0 kg N ha^{-1}) with values of 89.55cm, 88.28cm, 87.11cm and 86.78cm respectively. These were statistically similar. The lowest plant height was 81.50cm in the treatment T_1 (control).

3.1.2. Effective Tillers $Hill^{-1}$

There was a significant effect of different fertilizer treatments on the production of tillers $hill^{-1}$ of rice plants. The number of tillers $hill^{-1}$ due to different treatments varied from

7 to 11 (Table 1). The highest number of tillers hill^{-1} (10.33) was found in the treatment T_7(90 kg N ha^{-1}) which was statistically similar to those recorded in the treatments T_6(80 kg N ha^{-1}), T_5(70 kg N ha^{-1}), T_4(60 kg N ha^{-1}), T_3(50 kg N ha^{-1}) and T_2(0 kg N ha^{-1}) with values of 10, 10, 9, 9 and 8 respectively. These were statistically similar. The minimum number of tillers hill^{-1} (7) was found in the treatment T_1 (control).

3.1.3. Panicle Length

The application of different levels of nitrogen fertilizer significantly increased the panicle length of rice. Panicle length due to different treatments varied from 20.67cm to 22.44 cm (Table 1). The highest panicle length (22.44cm) was observed in T_6 (80 kg N ha^{-1}) which was statistically identical with the treatments T_7(90 kg N ha^{-1}), T_3 (50 kg N ha^{-1}), T_4 (70 kg N ha^{-1}), T_5 (70 kg N ha^{-1}) and T_2 (0 kg N ha^{-1}) having the values of 21.83cm, 21.72cm, 21.67cm, 21.55cm and 21.28cm, respectively. The relationship between panicle length and grain yield is positively correlated (r=0.883**) and statistically significant as shown in the Figure 1.

3.1.4. Filled Grains Panicle^{-1}

The different treatments significantly increased the number of filled grains panicle^{-1} of BRRIdhan49. The number of filled grains panicle^{-1} due to different treatments ranged from 104 to 142 (Table 1). The highest number of filled grains panicle^{-1} (142) was obtained from T_7 (90 kg N ha^{-1}) treatment, which was statistically identical to those observed in T_6(80 kg N ha^{-1}), T_5(70 kg N ha^{-1})and T_4(60 kg N ha^{-1}) treatments with values of 140, 136 and 124 respectively. The lowest number of filled grains panicle^{-1} (104) was obtained from the treatment T_1(control). The number of filled grains of T_3(50 kg N ha^{-1}) was (112) more than that of treatment T_1(control).

Table 1. *Effect of different treatments of Nitrogen on the yield contributing characters of BRRIdhan49*

Treatments	Plant height (cm)	Effective tillers hill^{-1}(no.)	Panicle length (cm)	Filled grains panicle^{-1} (no.)	1000 grain wt. (g)
T_1: control	81.50b	7.00b	20.67b	104.00c	19.73
T_2:PKSN$_0$	86.78a	8.00a	21.28ab	108.00bc	20.30
T_3: PKSN$_{50}$	89.55a	9.00a	21.72ab	112.00bc	20.77
T_4:PKSN$_{60}$	83.22b	9.00a	21.67ab	124.00ab	20.33
T_5:PKSN$_{70}$	87.11a	10.00a	21.55ab	136.00a	21.13
T_6:PKSN$_{80}$	88.28a	10.00a	22.44a	140.00a	20.80
T_7: PKSN$_{90}$	89.44a	11.00a	21.83ab	142.00a	20.70
SE (±)	0.90	0.32	0.23	3.80	0.13
CV (%)	1.04	3.41	1.08	3.07	0.65

Figures in a column having common letter(s) do not differ significantly at 5% levels of significant.
CV: Coefficient of variation
SE (±): Standard error of means

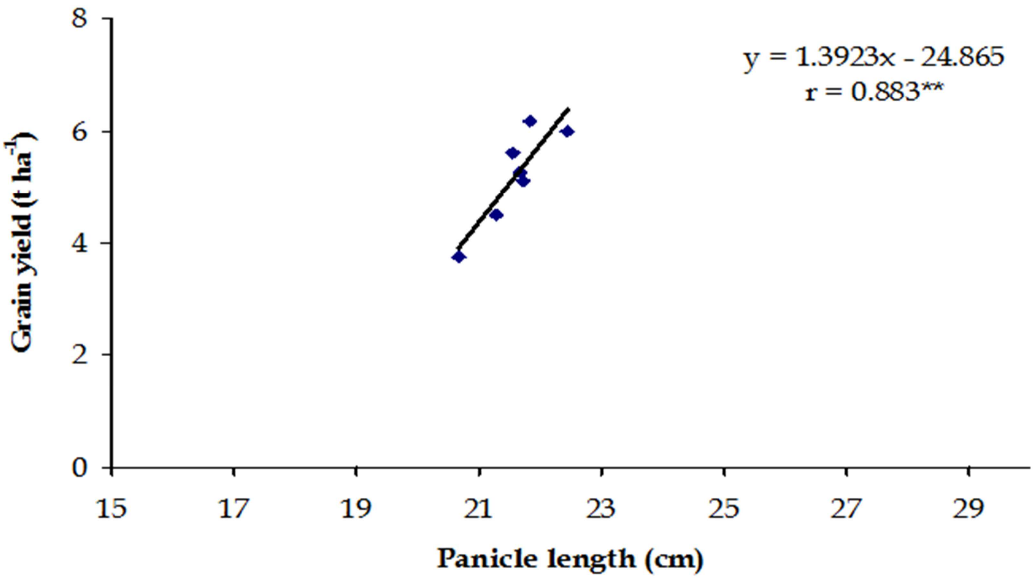

Figure 1. *Relationship between grain yield and panicle length of BRRIdhan49*

The relationship between filled grains panicle^{-1} and grain yield is strongly correlated (r=0.883**) and statistically significant as shown in the Figure 2.

3.1.5. 1000-Grain Weight

There was an insignificant effect of different nitrogen levels on 1000 grain weight of BBRI dhan49. The grain weight varied from 19.73g to 21.13g (Table 1). The maximum 1000 grain weight (21.13 g) was found in treatment T_5 (70 kg N ha^{-1}) and minimum (19.73 g) value obtained in the treatment T_1 (control).

3.2. Effect of Different Treatment on Grain and Straw Yields

3.2.1. Grain Yield

The grain yield of T. aman rice (cv. BRRI dhan49) responded significantly to integrated use of inorganic nitrogenous fertilizer (urea) and results have been presented in the table 2. The grain yields of rice ranged from 3.75 t ha^{-1} to 6.17 t ha^{-1} due to different treatments. All the treatments produced significantly higher grain yield over control. The highest grain yield of 6.17 t ha^{-1} was obtained in the treatment T_7 (90 kg N ha^{-1}). The lowest grain yield 3.75 t ha^{-1} was obtained in the treatment T_1 (control) which was statistically different from all other treatments. The increase in grain yield over control ranged from 20 to 64.53% (Table 4.2 and Fig. 4.4). The highest percentage (64.53%) of increased grain yield over control was recorded in the treatment T_7 (90 kg N ha$^{-1)}$. The lowest percentage (20%) of increased grain yield over control was recorded in the treatment T_2 (0 kg N ha^{-1}). Graphical presentation of the effect of different levels N on percent yield increase of BRRI dhan49 over control is shown in the Figure 3.

3.2.2. Straw Yield

Like grain yield, the straw yield of T. aman rice (cv. BRRI dhan49) responded significantly to the application of different levels of urea-N fertilizer. The straw yield varied from 4.52 to 7.50 t ha^{-1} (Table 2). The highest straw yield (7.50 t ha^{-1}) was recorded in treatment T_7 (90 kg N ha^{-1}). Which was 65.93% increased over control. The lowest straw yield (4.52 t ha^{-1}) was recorded in the treatment T_1 (control). The percent increase in straw yield over control ranged from 21.02 to 65.93%. However, the highest percent increase in straw yield (65.93%) was recorded in treatment T_7 (90 kg N ha^{-1}). It was presented in then Figure 3.

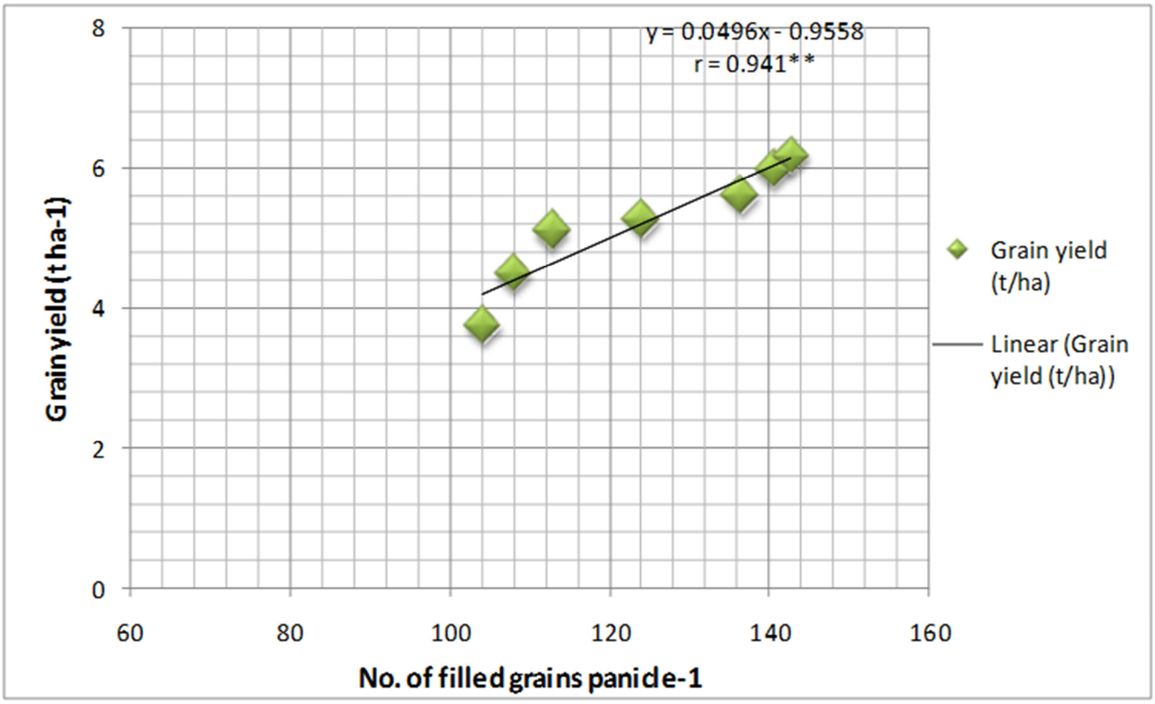

***Figure 2.** Relationship between grain yield and number of filled grain panicle-1 of BRRIdhan49*

***Table 2.** Effect of different treatments of Nitrogen on grain and straw yields of BRRI dhan49*

Treatments	Grain yield(t ha^{-1})	%Increased over control	Straw yield(t ha^{-1})	%Increasedover control
T_1 : control	3.75g	-	4.52g	-
T_2 : $PKSN_0$	4.50f	20	5.47f	21.02
T_3:$PKSN_{50}$	5.11e	36.27	6.33e	40.04
T_4:$PKSN_{60}$	5.27d	40.53	6.57d	45.35
T_5:$PKSN_{70}$	5.61c	49.60	6.93c	53.32
T_6:$PKSN_{80}$	5.99b	59.73	7.29b	61.28
T_7($PKSN_{90}$)	6.17a	64.53	7.50a	65.93
SE (±)	0.18	-	0.22	-
CV (%)	3.39	-	3.44	-

Figures in a column having common letter(s) do not differ significantly at 5% levels of significant.
CV: Coefficient of variation
SE(±): Standard error of means

3.2.3. Nitrogen Content and Uptake by Grain and Straw

Grain and straw of transplanted aman BRRI dhan49 were analyzed for determining N content. The results of N content of grain and straw have been presented and discussed under the following sub-sections.

3.2.4. Nitrogen Content in Rice Grain and Straw

The nitrogen content in grain and straw of BRRI dhan49 was significantly influenced by the various treatments. The N content in grain ranged from 0.58 to 0.85% (Table 3). The highest N content (0.85%) in grain was found in treatment T_7 (90 kg N ha^{-1}). The lowest N content (0.58%) in grain was observed in treatment T_0 (control).

In the case of straw, the N content ranged 0.45 to 0.69% (Table 4.3). The highest N content (0.69%) was recorded in treatment T_7 (90 kg N ha^{-1}) which was statistically identical with the treatments T_6 (80 kg N ha^{-1}), T_5 (70 kg N ha^{-1}), T_4 (60 kg N ha^{-1}) and T_3 (50 kg N ha^{-1}) with values of 0.64, o.61, 0.57 and 0.52%, respectively. As expected the lowest N content (0.45%) in straw was observed in treatment T_0 (control).

3.2.5. Nitrogen Uptake by Rice Grain and Straw

Like nitrogen content, nitrogen uptake by grain and straw of T. aman rice was also significantly influenced due to different treatments. The N uptake by grain and straw varied from 21.76 to 52.45 kg ha^{-1} and 20.35 to 51.76 kg ha^{-1}, respectively (Table 3 and Figure 4). The highest N uptake by grain was recorded in treatment T_7 (52.45 kg ha^{-1}) and the lowest N uptake (21.76 kg ha^{-1}) by grain was found in treatment T_1 (control).

The maximum N uptake by straw was 51.76 kg ha^{-1} recorded in treatment T_7 (90 kg N ha-1) which was statistically similar with the treatments T_6 (80 kg N ha^{-1}) and T_5 (70 kg N ha^{-1}) with the values of 46.65 kg ha^{-1} and 42.27 kg ha^{-1}, respectively. The minimum N uptake by straw 20.35 kg ha^{-1} was found in treatment T_1 (control).

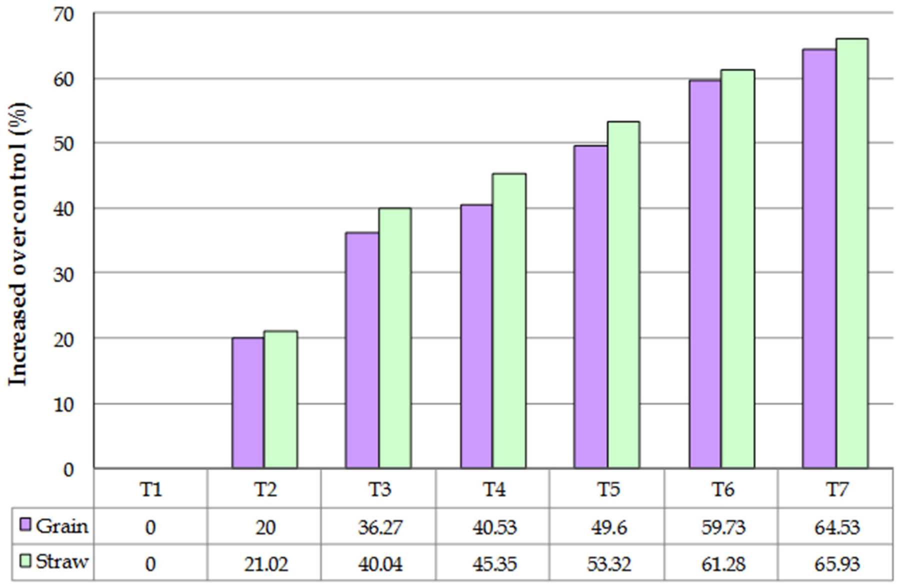

Figure 3. *Effect of different levels of Nitrogen on percent yield increase over control of BRRIdhan49*

Table 3. *Effect of different treatments on Nitrogen content and uptake by grain and straw of BRRI dhan49*

Treatments	Nitrogen Content (%)		Nitrogen uptake(kg ha^{-1})		Total Nitrogen uptake (kg ha^{-1})
	Grain	Straw	Grain	Straw	
T_1: control	0.58g	0.45b	21.76g	20.35e	42.11f
T_2: $PKSN_0$	0.63f	0.49b	28.35f	26.81de	55.15ef
T_3: $PKSN_{50}$	0.67e	0.52ab	34.24e	32.92cde	67.16de
T_4: $PKSN_{60}$	0.73d	0.57ab	38.47d	37.44bcd	75.99cd
T_5: $PKSN_{70}$	0.77c	0.61ab	43.21c	42.27abc	85.49bc
T_6 : $PKSN_{80}$	0.80b	0.64ab	47.92b	46.65ab	94.58ab
T_7: $PKSN_{90}$	0.85a	0.69a	52.45a	51.76a	104.18a
SE(±)	0.02	0.03	2.25	2.61	4.74
CV (%)	2.81	4.53	5.92	7.09	6.33

Figures in a column having common letter(s) do not differ significantly at 5% levels of significant.
CV: Coefficient of variation
SE (±) : Standard error of means

The ranges of total N uptake both by grain and straw were 42.1 to 104.2 kg ha^{-1}. The highest total N uptake (104.2 kg ha^{-1}) was recorded in treatment T_7 (90 kg N ha^{-1}) which was statistically similar with the treatment T_6 (80 kg N ha^{-1}) with the value of 94.58 kg ha^{-1}. The lowest total N uptake (42.1 kg ha^{-1}) was observed in treatment T_1 (control). A linear relationship between nitrogen uptake by grain and grain yield has been presented in Figure 4.

4. Discussion

Yield of grain, straw and other yield attribute influenced significantly with increasing Nitrogen level. From the result presented it is clear addition of urea-N resulted significant effect on plant height. Nitrogen application at levels higher than the recommended dose consistently increased the plant height which is the indication of the response of BRRI dhan49. The results also revealed that the treatment T_3 (50 kg N ha^{-1}) produced the highest plant height and this treatment was the best among all other treatments (Table 1). The present findings are in agreement with Andrade and AmorinNeto (1996) they concluded that increasing rates of applied nitrogen increased plant height significantly.

Results also showed that increasing the rate of nitrogen application has significant effect on the number of effective tillers hill^{-1}. The maximum number of effective tillers hill^{-1} was recorded in T_7 (90 kg N ha^{-1}) whereas the lowest value was recorded in T_1 (control) (Table 1).Addition of increasing different levels of N in soil increased the number of effective tillers hill^{-1}.Similar result was found by Singh and Singh (2002).

The influence of N on panicle length was increased significantly. It was also remarkable that the increasing rate of panicle length was very steady. The highest panicle length was recorded in T_6 (80 kg N ha^{-1}). The lowest panicle length was observed by T_1 (control) (Table 1). Panicle length was increased significantly with increasing different levels of N. The similar result was also observed by Azad *et al. (*1995) who reported that the panicle length increased significantly with the increasing level of nitrogen. The relationship between filled grains panicle^{-1} and grain yield is strongly correlated (r=0.883**) and statistically significant which is shown in the Figure 2.

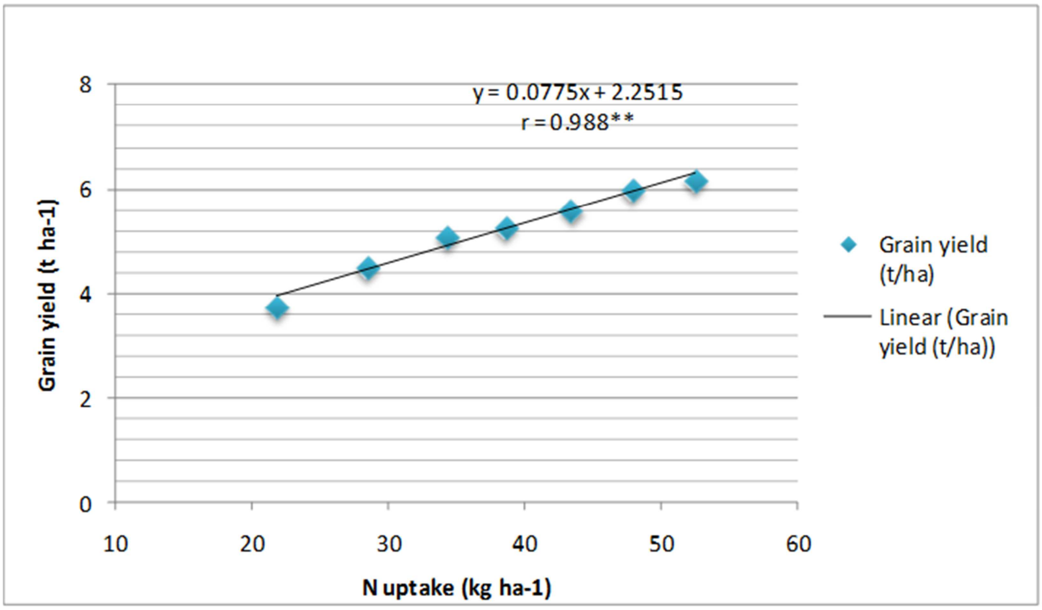

Figure 4. *Relationship between grain yield and Nitrogen uptake by grain of BRRIdhan49*

Results revealed that different nitrogen levels exerted effect on the number of filled grains panicle^{-1}.The highest number of filled grains panicle^{-1} and the lowest number of filled grains panicle^{-1} were found inT_7 (90kg Nha^{-1})and T_1(control) (Table 1). The present result was accorded with the findings Mendhe *et al*. (2002) they found that increasing applied N significantly increased the number of grains panicle^{-1}.

Increasing rates of N fertilizer significantly influences the 1000grain weight. The highest 1000grain weight was found in T_5 (70 kg N ha-1) treatment and minimum value was found in T_1 (control). From the above result, it is clear that increasing levels of N was significantly influenced the 1000 grain weight (Table 1).Similar result was observed from the study of Ehsanullah *et al*. (2001) who found that the split application of N fertilizer at different growth stages significantly affected the 1000 grain weight and also the grain and straw yields.

Results also showed that, increasing rate of applied N fertilizer increased the grain yield of BRRI dhan49.The highest grain yield was recorded in T_7 (90 kg N ha^{-1}) while applying the different fertilizers as a recommended dose. The treatments can be ranked in the order of decreasing $T_7>T_6>T_5>T4>T_3>T_2>T_1$ in term of grain yield (Table 2).This finding was supported by Sahrawat *et al*. (1999).

The results revealed that the application of higher dose of nitrogen exerted pronounced effect in producing higher straw yields of BRRI dhan49.The highest straw yield was recorded in T_7 (90 kg N ha^{-1}) while applying the different fertilizers as a recommended dose (Table 4.2).In producing increase straw yield, the treatments may be ranked in order of increasing $T_7>T_6>T_5>T_4>T_3>T_2>T_1$. This result was in agreement with Sahrawat *et al*. (1999).

Regression analysis showed that every unit increase of applied N fertilizer in soil also increased the N uptake in straw and grain. The highest N content in grain was 0.85% and lowest N content was 0.58% found in T_7 (90 kg N ha^{-1}) and T_1 (control) respectively. Whereas the highest N content in straw was 0.69% and lowest N content was 0.45% observed in T_7 (90 kg N ha^{-1}) and T_1 (control) respectively (Table 4.3).The results observed that the N content was higher in grain than that of straw. This finding was supported by Vennila (2007) who reported that in a rice crop with increasing level of N the concentration of N in paddy grain increased significantly.

From the results it is observed that the nitrogen uptake by grain and straw of T. aman rice was also significantly influenced due to different treatments of N. The highest N uptake by grain was 52.45 kg ha^{-1} and lowest N uptake was 21.76 kg ha^{-1}, found in T_7 (90 kg N ha^{-1}) and T_1 (control) respectively. The highest N uptake by straw was 20.35 kg ha^{-1} and lowest N uptake was 51.76 kg ha^{-1} found in T_7 (90 kg N ha^{-1}) and T_1 (control) respectively (Table 3).The results observed that the N content was higher in grain than that of straw. A linear relationship between nitrogen uptake by grain and grain yield has been presented in Fig. 4.4 which indicated that grain yield increased positively (r=0.988**) with the increase of nitrogen uptake. This result was in agreement with Mazumder *et. Al.*(2005) they found that the different levels of N had significant effect in augmenting the uptake of N in grains as well as straw yield of rice.

The total nitrogen uptake by grain and straw of T. aman rice was also significantly influenced due to different treatments of N. The highest total N uptake was found in T_7 (90 kg N ha^{-1}) and lowest in T_1 (control).The total N uptake by BRRI dhan49 due to different treatments ranked in order of $T_7>T_6>T_5>T_4>T_3>T_2>T_1$ (Table 3).This finding was supported by Sengar *et al*. (2000) who observed that N uptake by rice grain and straw increased significantly with the application of nitrogenous fertilizer.

5. Conclusion

It may be concluded from the present study that BRRI dhan49 responded to the application of 90 kg $ha^{-1}$of nitrogenous fertilizer (urea) and showed better performances in respect of grain yield and yield contributing characters, nutrient content and uptake compared to other fertilizers. So, 90 kg N fertilizer (urea) ha^{-1} will be applied for yield maximization of T. aman BRRI dhan49.

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