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Effect of Tillage Practices and Nitrogen Rates on the Nitrogen Content and Nitrogen Uptake in Rice Var. Binasail

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Abstract: An experiment was conducted to evaluate the effect of tillage practices and nitrogen rates on the %N content in grain, straw and N uptake by grain, straw, plants in rice var. Binasail.. The %N content in grain, N uptake by grain and total N uptake by plant were significantly influenced by different tillage practices. Maximum N content in grain (1.12%), N uptake by grain (34.54 kg ha^{-1}) and total N uptake by plant (43.23 kg ha^{-1}) were observed in 20 cm deep tillage treatment (T_2). Minimum N content in grain (1.09%), N uptake by grain (26.87 kg ha^{-1}) and total N uptake by plant (35.41 kg ha^{-1}) were found in no tillage treatment (T_0). The nitrogen content (%) in grain and straw, N uptake by grain and straw and total N uptake by plant were also significantly influenced by different rates of nitrogen application. The maximum N content in grain (1.17%) was recorded in no nitrogen (N_0) and the minimum (1.04%) with the application of 105 kg N ha^{-1} (N_3). The interaction effect of tillage operations and nitrogen application on %N content in grain, straw and total N uptake (kg ha^{-1}) by plant found to be significant.

Key words: Tillage, nitrogen rates, %N content, N uptake, rice

Introduction

Rice (*Oryza sativa*) is one of the most important cereal crops of the world. In Bangladesh it is the staple food crop. About 80% of the total cultivated land of Bangladesh are used for rice cultivation (AIS, 1992). Now a days the farmers cultivate some HYV rice but their cultivation techniques are conventional. As a result the yield is low. Specially the farmers have no attention to the depth of tillage and level of nitrogen fertilizers application. Tillage is the most fundamental activity of human being for crop production. Tillage create improved physical conditions of soil. Different tillage operations may influenced the physical properties of soil. As a result soil becomes permeable, aerated and having good physical conditions for crop production. Deep tillage breaks the hard layers to help the root to extent in the deep layers (Campbell *et al.,* 1974). Deep tillage looses the soil for easy root penetration horizontally and vertically. It facilitates easy uptake of water as well as nutrients by the roots from different soil layers efficiently, which consequently increased the root growth and density. Thus the deep tillage favours for root growth as well as crop yield compared to shallow tillage. Among the plant nutrients nitrogen is the one that deserves special attention because of its large requirements by the plants and instability in soil. This important element is found to be at a deficient level in most agricultural soil of the world including Bangladesh. The importance of nitrogen fertilizer in increasing yield is widely recognized, which is especially true for the modern HYV varieties of rice (Lakhdive and Prasad, 1970). Out of all nutrients the requirements of N for plant is for more than other elements (Gill *et al.*, 1978). Moreover the applied nitrogen use efficiency by rice plants is very low. The average nitrogen recovery ranges from 10-20% only with the highest values of 30 to 40% (De Datta *et al.,* 1978). In this view the experiment was designed and conducted to find out the effect of tillage operations and rate of nitrogen application on the %N content in grain and straw and N uptake in rice var. Binasail.

Materials and Methods

The experiment was conducted at Bangladesh Agricultural University Farm, Mymensingh during aman season in 1998 to study the effect of tillage practices and nitrogen rates on the %N content and N uptake in rice var. Binasail. The soil was sandy loam having pH 6.9. The experiment was laid out in a split-plot design with 3 replications. The tillage and nitrogen treatments were assigned to the main plot and sub-plots respectively. The

3 tillage practiced used in this experiment were T_0 –no tillage, T_1 and T_2 allowing tillage up to 10 cm and 20 cm, respectively. The four nitrogen treatments were N_0–no nitrogen, N_1, N_2 and N_3 application of nitrogen @ 35, 70 and 105 kg ha^{-1}, respectively. Aman rice variety Binasail was selected as test crop. The unit sub-plot size was 4.0x2.5 m. The experimental plots were fertilized P_2O_5 @ 40 kg ha^{-1} and K_2O @ 33 kg ha^{-1} with TSP and MP during final land preparation. Urea was top dressed in 3 instalments after 10, 25 and 40 days after transplanting. Thirty five days old seedlings were transplanted in 20 cm apart rows maintaining 20 cm hill to hill distance and three seedlings per hill. The soil samples were taken from 3 different depth and spots at the area to make a composite soil sample before transplanting and after harvest. The samples were air dried and ground to pass through a 2 mm (10 mesh) sieve. The ground samples were stored in clean plastic containers for chemical analysis. Plot wise randomly collected grain and straw samples were cleaned and sun dried. The samples were dried at 65^0C for 48 h in an oven and finally grounded by grinding machine and stored in containers for chemical analysis. The soil, grain and straw were analysed for the determination of nitrogen content in the laboratory of Soil Science Department, BAU, Mymensingh. Nitrogen contents of the soil, grain and straw were determined by modified – Kjeldahal method after digestion with conc. H_2SO_4, catalyst mixture (K_2SO_4+$CUSO_4$, $5H_2O$+Se powder, 100:10:1) and H_2O_2 and then distillation with 10 N NaOH solution. The ammonia distilled over was absorbed in H_3BO_3 indication solution and titrated with 0.01 N H_2SO_4 (Jackson, 1973). The results were expressed in percentages. The collected data were subjected to a statistical Analysis of Variances techniques (ANOVA) with the help of a computer package programme (MSTAT-C). The means were compared with Duncan's Multiple Range Test (DMRT).

Results and Discussion

N content (%) in grain: Tillage operations significantly influenced N content in grain of Binasail rice (Table 1). Maximum N content of 1.12% was recorded in 20 cm deep tillage (T_2) which was significantly dissimilar from all other treatments. The minimum N content (1.09%) was observed in no tillage (T_0) treatment. Deep tillage favored better root extension thereby increased the absorbing capacity of nutrients. As a results high amount of mineral nutrient was absorbed by roots which increased vegetative growth and accumulated high level of nitrogen in grain. Maximum N content (1.17%) was recorded by control (N_0) and minimum (1.04%) was found under 105 kg ha^{-1} (N_3) treatment. Application of higher level of nitrogen decreased the N content (%) in grain (Table 1). The highest nitrogen content (1.18%) was observed by T_1N_0 which was significantly similar to T_0N_0 and T_2N_0 The lowest nitrogen content (1.03%) was found T_1N_3 which was statistically identical to T_0N_3. The result is in conformity with that of Meraz (1995) and Lima *et al.* (1986).

N content (%) in straw: Nitrogen content in straw was statistically non significant due to different tillage practices. But nitrogen content in straw was influenced by increasing level of nitrogen (Table 1). Maximum N content (0.29%) was recorded by higher level of nitrogen (105 kg N ha^{-1}) application and minimum (0.18%) was found in no nitrogen (N_0). Application of higher doses of nitrogen enhanced in positive role on nitrogen accumulation in straw. Similar result was observed by Chowdhury and Chowdhury (1977). The highest N content (0.30%) was observed in T_1N_3 which statistically identical to T_2N_3 due to interaction effects of tillage and nitrogen level.

N uptake by grain: Nitrogen uptake of rice was significantly influenced by different tillage operations and level of nitrogen (Table 1). The highest N uptake (34.54 Kg N ha^{-1}) was recorded by 20 cm deep tillage (T_2). Deep tillage favoured for plant growth and nutrient uptake from soil as a result nitrogen uptake becomes higher than control. The maximum N uptake (33.96 kg ha^{-1}) was observed in highest dose of nitrogen (105 kg N ha^{-1}) application which was significantly different to other treatments. The maximum N uptake (38.54 kg ha^{-1}) was recorded in T_2N_3 and minimum (20.75 kg N ha^{-1}) was observed in T_0N_0 due to the combined effect of tillage and nitrogen level (Table 2).

N uptake by straw: Tillage could not change N uptake in straw. The N uptake ranged for tillage operations from 8.54 to 9.28kg N ha^{-1} (Table 1). Nitrogen uptake of straw also significantly influenced due to different level of nitrogen. The maximum N uptake (11.64 kg ha^{-1}) was recorded under highest dose of nitrogen (N_3) which was statistically different from all other treatments. The minimum N uptake (5.60 kg ha^{-1}) was found in control (N_0). The highest N uptake (12.66 kg ha^{-1}) was observed in T_1N_3 and minimum (5.04 kg ha^{-1}) was found in T_2N_0 which was statistically identical to T_1N_0 (Table 2).

Total N uptake by plants: Total N uptake by Binasail rice plant was significantly influenced due to different tillage practices and nitrogen level (Table 1). The highest N uptake (43.23 kg ha^{-1}) was recorded by deep tillage (T_2) and the lowest N uptake (35.41 kg ha^{-1}) was found under no tillage (T_0). Deep tillage favoured better growth and

Table 1: Effect of tillage practices and nitrogen rates on the %N content and N uptake in rice var. Binasail

Treatments	%N content		N uptake (kg ha^{-1})		Total N uptake plant (kg ha^{-1})
	Grain	Straw	Grain	Straw	
Tillage practices					
T_0	1.09c	0.238	26.87c	8.54	35.41c
T_1	1.10b	0.246	31.35b	9.28	40.63b
T_2	1.12a	0.248	34.54a	8.69	43.23a
C.V (%)	0.90	4.09	2.93	6.81	3.01
Nitrogen level					
N_0	1.17a	0.180d	25.02d	5.60d	30.62d
N_1	1.13b	0.220c	31.34c	7.87c	39.22c
N_2	1.09c	0.260b	33.36b	10.22b	43.58b
N_3	1.04d	0.290a	33.96a	11.64a	45.60a
C.V (%)	0.54	2.65	1.67	3.32	1.50

In a column, means having similar letter (s) do not differ significantly at 5% level of probability

Table 2: Interaction effect of tillage practices and nitrogen rates on the %N content and N uptake in rice var. Binasail

Treatemtn combination	Nitrogen content (%)		N uptake (kg ha^{-1})		Total N uptake Plant (kg ha^{-1})
	Grain	Straw	Grain	Straw	
T_0N_0	1.17a	0.196h	20.75h	6.51g	27.25i
T_0N_1	1.13b	0.213g	26.40g	7.56f	33.96g
T_0N_2	1.05e	0.254de	30.12e	9.14d	39.26f
T_0N_3	1.03f	0.290ab	30.22e	10.97b	41.19e
T_1N_0	1.18a	0.178h	26.61g	5.26h	31.87h
T_1N_1	1.13b	0.234f	32.43d	8.10e	40.53e
T_1N_2	1.09d	0.270cd	33.23d	11.09b	43.32d
T_1N_3	1.03f	0.302a	33.12d	12.66a	45.78c
T_2N_0	1.17a	0.183h	27.71f	5.04h	32.75h
T_2N_1	1.14b	0.238ef	35.19c	7.98ef	43.16d
T_2N_2	1.10c	0.274bc	36.74b	10.44c	47.18b
T_2N_3	1.09d	0.297a	38.54a	11.29b	49.84a
C.V (%)	0.54	2.65	1.67	3.32	1.50

In a column, means having similar letter (s) do not differ significantly at 5% level of probability.

development of plants thereby N uptake increased. Without any tillage practice, plant growth and development restricted which reduced N uptake. Similar result was also reported by Rahman (1990). The maximum N uptake (45.60 kg ha^{-1}) was observed by higher level of nitrogen (N_3) and minimum N uptake (30.62 kg ha^{-1}) was found in control treatment (N_0). The present results was supported by Khanda and Dexit (1996). The highest N uptake (49.84 kg ha^{-1}) was observed by T_2N_3 treatment due to the combined effect of tillage and nitrogen (Table 2). It was concluded that % N content and N uptake in rice var. Binasail was significantly influenced due to different tillage practices and application rates of nitrogen.

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