Journal of Agricultural Engineering and Food Technology
p-ISSN: 2350-0085; e-ISSN: 2350-0263; Volume 5, Issue 1; January-March, 2018 pp. 50-53

http://www.krishisanskriti.org/Publication.html

Effect of Integrated Plant Nutrition System on the Growth and Yield of Boro Rice Varieties in the *haor*areas of Bangladesh

T K Saha[1], M A Kashem[2], M N H Miah[3] and M Jahiruddin[4]

[1]*PhD Student, Department of Soil Science, Sylhet Agricultural University, Sylhet-3100*
[2]*Professor, Department of Soil Science, Sylhet Agricultural University, Sylhet-3100*
[3]*Professor, Department of Agronomy and Haor Agriculture, Sylhet Agricultural University, Sylhet-3100*
[4]*Professor, Department of Soil Science, Bangladesh Agricultural University, Mymensingh-2202*

Abstract—*The experiment was conducted at farmer's field in the Haluagaon village of Sadarupazilla under Dekarhaor of Sunamganj district, Bangladesh during November 2016 to April 2017 to find out the effect of IPNS on the growth and yield of boro rice varieties in the haorareas. Two varieties- V_1= BRRI dhan29 and V_2= BRRI dhan58; and six fertilizers treatments- F_1=$N_{150}P_{20}K_{35}S_{6.0}Zn_{1.3}$ (FRG- 2012), F_2= $N_{131}P_{38}K_{103}S_{13}Zn_{1.0}$ (Soil Test Based), F_3= IPNS [Cowdung + $N_{81}P_{23}K_{80}S_{13}Zn_{1.0}$], F_4= IPNS [Poultrymanure + $N_{69}P_{3.0}K_{56}S_{13}Zn_{1.0}$], F_5= $N_{57}P_{12}K_{12}S_{4.0}Zn_0$ (Farmer's practice) and F_6= Control. The experiment was laid out in randomized complete block design with three replications. The rice crops were transplanted on 28 December 2016 and harvested from 22-28 April 2017 from the experimental field. The data on growth and yield parameters were taken as per objectives of the study. Plant height, number of total tillers hill^{-1}, number of effective tillers hill^{-1}, number of non-effective tillers hill^{-1} and panicle length varied significantly between two rice varieties where BRRI dhan58 showed the better performance.Growth and yield contributing characters varied significantly among different fertilizers treatments. Best results were observed in IPNS [Poultrymanure + $N_{69}P_{3.0}K_{56}S_{13}Zn_{1.0}$] treatment. BRRI dhan58 produced the highest grain yield with IPNS [Poultrymanure + $N_{69}P_{3.0}K_{56}S_{13}Zn_{1.0}$] treatment.*

Keywords*: Haor, Boro rice, Fertilizer, IPNS, Yield.*

1. INTRODUCTION

Bangladesh is an agriculture based country. Total rice growing area in the year 2015-16 was 11.38 million hectares in Bangladesh which covers 74.85% of the total cultivable area and the total production was 36.05 million metric tons[2].Bangladesh is a high dense populated country but land resource is limited. To supply sufficient food for the huge population, there is no alternative to increase crop yield per unit area. *Haor* basin is more significant for crop production. *Haor* goes under water between April to November each year. So *haor* region is only rabi crop based and mainly boro rice cultivated area. Geographically most of the *haors*are situated in seven districts of the North-East Bangladesh[9].Fertilizers are applied to soil to enhance the ability of a soil to supply nutrients to plants adequate as well as proportionately in order to overcome nutrient deficiency and to ensure higher crop yield. Inorganic fertilizers have been introduced in this country during early 1950's as a supplemental source of plant nutrients. During the past few years, total fertilizer nutrients use in Bangladesh has increased significantly. Integrated Plant Nutrient System (IPNS) is the management of all available plant nutrient sources organic and inorganic to provide optimum and sustainable crop production conditions within the prevailing farming system [1].

OBJECTIVES

i. To recommend rice variety (ies) based on yield and other performance for the *haor* areas.

ii. To recommend the appropriate combination of organic and inorganic fertilizers to maintain long term soil fertility for farmers.

2. MATERIALS AND METHODS

The experiment was conducted at farmer's field in the Haluagaon village of Sadarupazilla under Dekar*haor* of Sunamganj district, Bangladesh during November 2016 to April 2017. Two varieties- V_1= BRRI dhan29 and V_2= BRRI dhan58; and six fertilizer treatments- F_1=$N_{150}P_{20}K_{35}S_{6.0}Zn_{1.3}$(AEZ basis fertilizer recommendation through FRG-2012), F_2=$N_{131}P_{38}K_{103}S_{13}Zn_{1.0}$(Soil Test Based), F_3= IPNS [Cowdung+$N_{81}P_{23}K_{80}S_{13}Zn_{1.0}$], F_4= IPNS [Poultrymanure+$N_{69}P_3K_{56}S_{13}Zn_{1.0}$], F5= $N_{57}P_{12}K_{12}S_{4.0}Zn_0$(Farmer's practice) and F_6= Control. The experiment was laid out in randomized complete block design with three replications. Each replication was divided into twelve plots where varieties and fertilizers are allocated at random. The size of unit plot was 5 m × 4 m e.i. 20 m^2. The total number of unit plots was 36. Initial soil sample of the experimental plots wascollected and analyzed. Two rice

seedlings were transplanted in each hill with the spacing of 20 cm × 15 cmon 28 December 2016. All fertilizers were applied during final land preparation except urea. Cowdung and poultrymanure were applied 7 days before transplanting. Urea was applied in three equal splits by topdressing at 15, 35 and 55 DAT. The experimental field was frequently monitored and necessary management practices such as irrigation, weeding, pesticide application were done as per required. The data on growth and yield parameters were taken as per objectives of the study. Two rice varieties were harvested from 22-28 April 2017 from the experimental field. The data were analyzedfollowing randomized completely block design and mean separation was done by DMRT (Gomez and Gomez, 1984) [5].

3. RESULTS AND DISCUSSION

Plant heights varied significantly between two rice varieties and among the different fertilizers treatments (Table 1). BRRI dhan58 produced the taller plant (85.67 cm) over BRRI dhan29 (Table 1). The tallest plant (88.23 cm) was observed in IPNS [Poultrymanure + $N_{69}P_3K_{56}S_{13}Zn_{1.0}$] treatment which was identical with $N_{150}P_{20}K_{35}S_{6.0}Zn_{1.3}$ (AEZ), $N_{131}P_{38}K_{103}S_{13}Zn_{1.0}$(STB) and IPNS [Cowdung + $N_{81}P_{23}K_{80}S_{13}Zn_{1.0}$] treatments.

The highest number of total tillers (17.50) hill^{-1} was observed in IPNS [Poultrymanure + $N_{69}P_{3.0}K_{56}S_{13}Zn_{1.0}$] treatment (Table 1).Meena*et al.* (2003) found that application of 125 kg K ha^{-1} increased the number of totaltillers hill^{-1}[11] and Wang (1976) also observed for 12 and 24 kg S ha^{-1} increased the number of total tillershill^{-1} by 42 and 80% [13], respectively.

BRRI dhan58 produced the higher number of effective tillers (12.47) hill^{-1}in comparison to BRRI dhan29 (Table 1). The highest number of effective tillers (14.43) hill^{-1} was observed in IPNS [Poultrymanure + $N_{69}P_{3.0}K_{56}S_{13}Zn_{1.0}$] treatmentwhich was identical withIPNS [Cowdung + $N_{81}P_{23}K_{80}S_{13}Zn_{1.0}$] treatment (Table 1). Kalita*et al*. (2002) described that the number of effective tillers hill^{-1} increased significantly at 100 kg K ha^{-1} as applied MoP in 2 splits [8].

BRRI dhan29 produced the higher number of non-effective tillers (4.72) hill^{-1}over BRRI dhan58.BRRI dhan58 produced the taller panicle (21.39 cm) in comparison to BRRI dhan29 (Table 1).Kabir*et al.* (2004) who found that the cultivar Chinigura produced the tallest panicle length (26.86 cm) followed by Begunbitchi and Kalijira varieties [7]. Hossain*et al*. (2014) also found the similar results for different cultivars [6].

The tallest panicle (21.72 cm) was observed inIPNS [Poultrymanure + $N_{69}P_3K_{56}S_{13}Zn_{1.0}$] treatment and the shortest panicle (19.61 cm) was observed in control treatment(Table 1).Masthan*et al*. (1999) observed that due to the application of 60 kg P_2O_5 ha^{-1} increased the panicle length [10].

Table 1: Effect of variety and fertilizer on growth and yield characters of modern boro rice of *haor* areas

Treatments	Growth and yield characters					
	Plant height (cm)	Total tillers hill^{-1} (no.)	Effective tillers hill^{-1} (no.)	Non-effective tillers hill^{-1} (no.)	Panicle length (cm)	Total spikelets panicle^{-1}(no.)
Variety						
BRRI dhan29	81.32b	15.74	11.02b	4.72a	20.19b	149.02b
BRRI dhan58	85.67a	14.81	12.47a	2.34b	21.39a	162.49a
LS	**	NS	*	**	**	*
Fertilizer						
$N_{150}P_{20}K_{35}S_{6.0}Zn_{1.3}$ (AEZ)	85.58a	15.13abc	11.57abc	3.57	20.66ab	158.60ab
$N_{131}P_{38}K_{103}S_{13}Zn_{1.0}$(STB)	86.32a	15.90ab	12.17ab	3.73	21.04a	161.83ab
IPNS [Cowdung+ $N_{81}P_{23}K_{80}S_{13}Zn_{1.0}$]	86.82a	16.90ab	13.47a	3.43	21.39a	169.20ab
IPNS Poultrymanure+ $N_{69}P_{3.0}K_{56}S_{13}Zn_{1.0}$]	88.23a	17.50a	14.43a	3.07	21.72a	183.33a
$N_{57}P_{12}K_{12}S_{4.0}Zn_0$ (Farmer's practice)	79.18b	13.83bc	10.03bc	3.80	20.35ab	147.73b
Control	74.83c	12.38c	8.78c	3.60	19.61b	113.83c
$S_{\bar{x}}$	0.85	0.75	0.71	-	0.33	6.31
LS	**	**	**	NS	**	**

Table 1 (Continued) Effect of variety and fertilizer on growth and yield characters of modern boro rice of *haor* areas

Treatments	Growth and yield characters					
	Grains panicle^{-1} (no.)	Sterile spikelets panicle^{-1}(no.)	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest index (%)
Variety						
BRRI dhan29	119.72b	29.30	21.55	5.38	8.58a	38.22b
BRRI dhan58	135.76a	26.73	21.90	6.41	7.75b	45.00a
LS	*	NS	NS	*	*	**
Fertilizer						
$N_{150}P_{20}K_{35}S_{6.0}Zn_{1.3}$ (AEZ)	127.03b	31.57abc	21.60bc	5.86ab	8.13abc	41.61
$N_{131}P_{38}K_{103}S_{13}Zn_{1.0}$(STB)	135.27ab	26.57bcd	21.93abc	6.09ab	8.53ab	41.50
IPNS [Cowdung+ $N_{81}P_{23}K_{80}S_{13}Zn_{1.0}$]	148.07ab	21.13cd	22.03ab	6.39a	8.72ab	42.06
IPNS Poultrymanure+$N_{69}P_{3.0}K_{56}S_{13}Zn_{1.0}$]	166.17a	17.17d	22.68a	7.09a	9.02a	44.06

$N_{57}P_{12}K_{12}S_{4.0}Zn_0$ (Farmer's practice)	114.50b	33.23ab	21.17 bc	5.69 ab	7.65 bc	42.61
Control	75.40 c	38.43a	20.93 c	4.25 b	6.93 c	37.84
$S_{\bar{x}}$	8.85	2.70	0.25	0.46	0.42	-
LS	**	**	**	**	*	NS

In a column, the figure(s) having similar letter(s) do not differ significantly whereas dissimilar letter(s) differ significantly

** = Significant at 1 % level of probability, * = Significant at 5 % level of probability, NS= Not significant, LS= Level of significance, STB= Soil Test Based, AEZ= Agro Ecological Zone

BRRI dhan58 produced the higher number of total spikelets (162.49) panicle^{-1} in comparison to BRRI dhan29 (Table 1). The highest number of total spikelets (183.33) panicle^{-1} was observed in IPNS [Poultrymanure + $N_{69}P_{3.0}K_{56}S_{13}Zn_{1.0}$] treatment and the lowest number of total spikelets (113.83) panicle^{-1} was observed in control treatment (Table 1).

BRRI dhan58 produced the higher number of grains (135.76) panicle^{-1} over BRRI dhan29(Table 1). The highest number of grains (166.17) panicle^{-1} was observed in IPNS [Poultrymanure + $N_{69}P_{3.0}K_{56}S_{13}Zn_{1.0}$] treatment and the lowest number of grains (75.40) panicle^{-1} was observed in control treatment(Table 1).Mizan (2010) reported that the highest number of grains (137.57) panicle^{-1} was obtained from 120 kg N ha^{-1}[12].

The lowest number of sterile spikelets (17.17) panicle^{-1} was observed in IPNS [Poultrymanure + $N_{69}P_{3.0}K_{56}S_{13}Zn_{1.0}$] treatment and the highest number of sterile spikelets (38.43) panicle^{-1} was observed in control treatment (Table 1).

The highest 1000-grain weight (22.68 g) was observed in IPNS [Poultrymanure + $N_{69}P_{3.0}K_{56}S_{13}Zn_{1.0}$] treatment and the lowest 1000-grain weight (20.93 g) was observed in control treatment (Table 1).

Grain yield varied significantly between two rice varieties and among the different fertilizers treatments. BRRI dhan58 produced the higher grain yield (6.41 t ha^{-1}) overBRRI dhan29 (5.38 t ha^{-1}) (Table 1). The highest grain yield (7.09 t ha^{-1}) was observed in IPNS [Poultrymanure + $N_{69}P_{3.0}K_{56}S_{13}Zn_{1.0}$] treatment and the lowest grain yield (4.25 t ha^{-1}) was observed in control treatment(Table 1).Choudhury and Khan (2002) reported that yield of rice significantly increased with application of 120 kg N ha^{-1} over farmer's practice (80 kg N ha^{-1}) [4]. Biswas*et al*. (2001) found the highest grain yield (6.27 t ha^{-1}) with the application of K @ 60 kg ha^{-1} [3]. Straw yield also followed similar patterns as in grain yield.

Harvest index varied significantly between two rice varieties with higher harvest index (45 %) in BRRI dhan58 (Table 1).

Table 2: Interaction effect of variety and fertilizer on growth and yield characters of modern boro rice of *haor* areas

Variety and Fertilizer	Plant height (cm)	Total tillers hill^{-1} (no.)	Effective tillers hill^{-1} (no.)	Non-effective tillers hill^{-1} (no.)	Panicle length (cm)	Total spikelets panicle^{-1} (no.)
V_1 F_1	83.10	15.00	10.13	4.87	20.05	151.87
V_1 F_2	83.27	16.20	10.93	5.27	20.36	154.73
V_1 F_3	84.10	17.67	12.93	4.73	20.73	166.13
V_1 F_4	86.07	18.27	14.07	4.20	21.07	173.13
V_1 F_5	78.23	14.47	9.87	4.60	19.82	143.87
V_1 F_6	73.13	12.83	8.17	4.67	19.13	104.40
V_2 F_1	88.07	15.27	13.00	2.27	21.26	165.33
V_2 F_2	89.37	15.60	13.40	2.20	21.71	168.93
V_2 F_3	89.53	16.13	14.00	2.13	22.04	172.27
V_2 F_4	90.40	16.73	14.80	1.93	22.36	193.53
V_2 F_5	80.13	13.20	10.20	3.00	20.88	151.60
V_2 F_6	76.53	11.93	9.40	2.53	20.08	123.27
LS	NS	NS	NS	NS	NS	NS

Table 2 (Continued) Interaction effect of variety and fertilizer on growth and yield characters of modern boro rice of *haor* areas

Variety and Fertilizer	Grains panicle^{-1} (no.)	Sterile spikelets panicle^{-1} (no.)	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest index (%)
V_1 F_1	119.67	32.20	21.67	5.23	8.50	37.84
V_1 F_2	124.40	30.33	21.80	5.50	8.93	37.84
V_1 F_3	141.93	24.20	21.97	5.68	9.15	38.08
V_1 F_4	153.53	19.60	22.43	6.71	9.28	42.02
V_1 F_5	110.53	33.33	20.90	5.17	8.53	38.51
V_1 F_6	68.27	36.13	20.53	3.98	7.28	35.01
V_2 F_1	134.40	30.93	21.53	6.49	7.76	45.37
V_2 F_2	146.13	22.80	22.07	6.68	8.13	45.15
V_2 F_3	154.20	18.07	22.10	7.09	8.30	46.05
V_2 F_4	178.80	14.73	22.93	7.48	8.75	46.09
V_2 F_5	118.47	33.13	21.43	6.22	6.98	46.71
V_2 F_6	82.53	40.73	21.33	4.51	6.59	40.66
LS	NS	NS	NS	NS	NS	NS

V_1= BRRI dhan29, V_2= BRRI dhan58

F_1= $N_{150}P_{20}K_{35}S_{6.0}Zn_{1.3}$ (AEZ), F_2= $N_{131}P_{38}K_{103}S_{13}Zn_{1.0}$(STB), F_3= IPNS [Cowdung+ $N_{81}P_{23}K_{80}S_{13}Zn_{1.0}$], F_4= IPNS [Poultrymanure+ $N_{69}P_{3.0}K_{56}S_{13}Zn_{1.0}$)], F_5= $N_{57}P_{12}K_{12}S_{4.0}Zn_0$ (Farmer's practice), F_6=Control

NS= Not significant, LS= Level of significance

4. CONCLUSION

The experimental results showed that BRRI dhan58 produced the highest grain yield (7.48tha^{-1})withIPNS [Poultrymanure + $N_{69}P_{3.0}K_{56}S_{13}Zn_{1.0}$] treatmentwhich was similar to IPNS [Cowdung + $N_{81}P_{23}K_{80}S_{13}Zn_{1.0}$] treatment. Moreover BRRI dhan58 required 7-8 days less field duration in comparison to BRRI dhan29 which can avert the early flash flood in *haor* area. Farmers of the *haor* area suggested to plant BRRI dhan58 following IPNS fertilizer application for sustainability of soil and crop yield.

5. ACKNOWLEDGEMENT

The authors thankfully acknowledged to Krishi Gobeshona Foundation (KGF) for providing PhD fellowship and research cost under the project of "Farm Productivity Improvement in *Haor* Areas through Integrated Farming Systems Approach".

REFERENCES

[1] BARC.2012. Fertilizer Recommendation Guide, Bangladesh Agricultural Research Council (BARC), Farmgate, Dhaka-1215.p.58.

[2] BBS. 2016. Bangladesh Bureau of Statistics, The Yearbook of Agricultural Statistics of Bangladesh Stat. Div. Ministry of Planning, Govt. People's Republic of Bangladesh, Dhaka.pp. 34-49.

[3] Biswas, J. C., Ahmed, M. T. and Islam, M. R. 2001.Lodging vs. non-lodging in BRRI dhan.BangladeshJ.Train.Dev. 14(1&2). pp. 107-113.

[4] Choudhury, A.T. and Khan, Y.M. 2002.Effect of nitrogen, copper and magnesium fertilization on yield and nutrition of rice.Pakistan J. Sci. and Ind. Res. 45(2).pp.102-107.

[5] Gomez, K. A. and Gomez,A. A. 1984. Statistical Procedure for Agricultural Research (2nd ed.). John Willey & Sons, New York. pp. 28-192.

[6] Hossain, M.M., Sultana, F. and Rahman, A.H.M.A. 2014. A comparative screening of hybrid, modern varieties and local rice variety for brown leaf spot disease susceptibility and yield effect.Archives of Phytopathology and Plant Protection. 47(7). pp. 795–802.

[7] Kabir, M.E., Kabir, M.R., Jahan, M.S., and Das, G.G. 2004. Yield performance of three aromatic fine rice in a coastal medium high land. Asian J. Plant Sci. 3(5). pp. 561-563.

[8] Kalita, U., Suhrawardy, J. and Das, K. R. 2002.Effect of seed priming with potassium salt and potassium levels on growth and yield of direct seeded summer rice (*Oryza sativa* L.) under rainfed upland condition.Indian J. Hill Farming.15(1). pp. 50-53.

[9] Master Plan of Haor Areas. 2012. Bangladesh Haor and Wetland Board. Ministry of Water Resource.Govt. of the People's Republic of Bangladesh.p.1.

[10] Masthan, S.C., Reddy, S.N., Reddy, T.M.M. and Mohammad, S. 1999. Productivity potential of rice sunflower green gram cropping system as influenced by rational use of phosphorus.Indian J. Agron.44 (2). pp. 232-236.

[11] Meena, S.L., Singh, S. and Shivay, Y.S. 2003. Response of rice (O*ryza sativa)* to N and K application in sandy clay loam soils. Indian J. Agril.Sci. 73 (1). pp. 8-11.

[12] Mizan, R. 2010. Effect of nitrogen and plant spacing on the yield of *Boro*rice cv. BRRI dhan45.pp. 32.

[13] *Wang, C. H. 1976. Sulfur fertilization of rice. In food and fertilizer Tech. Center, ASPC, Taiwan. pp. 149-169.*