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EFFECT OF DIFFERENT FERTILIZER PACKAGES ON THE YIELD AND YIELD ATTRIBUTES ON BRRI DHAN47 IN SALINE AREAS

ABMM HASAN, SM SHAMSUZZAMAN*, HAK CHOWDHURY, SM RASEL, NH KHAN, ME RAHMAN, M MEHNAZ AND AW SAMSURI[1]

Soil Resource Development Institute, Krishi Khamar Sarak, Dhaka-1215, Bangladesh

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Abstract

Fertilizer requirement of BRRI dhan47 was studied in saline soils of three villages during the Boro season. Treatment combinations were 100% of soil test based (STB) fertilizers with higher and lower dose of STB fertilizers. In all the villages number of effective tillers/hill, panicle length, filled grains/panicle and 1000-grain weight were highest in the treatment T_6 (100% STB fertilizers + 25% NPK of STB fertilizers). As a result the highest grain yields (6.14, 5.83 and 6.02 t/ha) and straw yields (6.54, 6.58 and 6.63 t/ha) were obtained in the treatment T_6 in the mentioned villages, respectively. Therefore, 25% increase of N, P and K fertilizers in STB fertilizer doses might be recommended for BRRI dhan47 cultivation in saline areas.

Introduction

Rice is the staple food of Bangladesh, provides nearly 40% of total national employment (48% of total rural employment), about 75% of the calories and 55% of the protein in the average daily diet of the people of the country. The use of modern varieties adjusted to different soils, climatic conditions, judicious management of fertilizers, irrigation and other intercultural operations can play important role to increase yield of rice. In Bangladesh over 30% of the net cultivable area lies in the coastal zone. But the agriculture of coastal belt is vulnerable because of several climatic and natural constraints; a) soil and water salinity remains above permissible limit during dry (Rabi and Kharif-1) seasons, and b) poor nutrient status of soils (SRDI 2009). Salt stress, a consequence of the accumulation of soluble salts in the soil and/or water, is considered as the major soil problem both in coastal and in inland rice growing areas. Plant growth in these soils is adversely affected because of reduced water uptake, salt toxicity, and nutrient imbalances (Munns *et al.* 2006).

Scientists of Bangladesh Rice Research Institute (BRRI) are trying to introduce high yielding salt tolerant rice varieties like BRRI dhan47, BRRI dhan53 and BRRI dhan54 in different parts of coastal belt in the prevailing soil, water and climatic condition. Information based on soils, crops and cropping pattern, BARC prepared Fertilizer Recommendation Guide - 2012 to adopt balanced fertilization for sustaining crop production in the country (FRG 2012). But often STB fertilizer dose cannot produce the optimum yield of the respective crops in different saline areas due to high salt concentration, but slight increase of fertilizer doses may result optimum yields (Ali *et al*. (2013). Hence, the present study was undertaken to determine the fertilizer requirements for BRRI dhan47 in saline soil with verifying and updating the existing soil test based fertilizer recommendation of BRRI dhan47.

*Author for correspondence: <shamsuzzamansm@gmail.com>. [1]Department of Land Management, Faculty of Agriculture, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia.

Materials and Methods

The experiment was set up at the farmer's fields of Jabusha (N-22°46´13.9˝, E-89°35´40.9˝), Teligati (N-22°53´49.3˝, E-89°29´08.8˝) and Gobindakathi (N-22°49´25.0˝, E-89°19´34.6) villages under Rupsha, Khulna Metro and Dumuria Upazila of Khulna district, respectively during the Boro season. The experimental fields were belonging to Alluvial Floodplain soil under agro-ecological Zone (AEZ 13). Initial soil samples were collected from 0 - 15 cm depth and prepared for initial physical and chemical analysis for assessing soil fertility and soil test based (STB) fertilizer recommendation of BRRI dhan47 according to FRG-2012. Soil samples were also collected from the experimental plots on mid of the months for monitoring salinity. Soil salinity was classified according to Upazila land and soil resource utilization guide (ULSRUG), Rupsha, 2008.

Treatment combinations were; T_1 = 100% of soil test based (STB) fertilizers ($N_{125.21}$ $P_{12.85}$ $K_{13.6}$ $Zn_{0.18\ kg/ha}$, $N_{120.09}$ $P_{19.76}$ $K_{30.25}$ $Zn_{1.51\ kg/ha}$ and $N_{106.77}P_{17.96}K_{10.75}Zn_{0.97\ kg/ha}$ for Jabusha, Teligati and Gobindakathi villages, respectively), $T_2 = T_1$ + 25%N of STB fertilizers, $T_3 = T_1$ + 25%NP of STB fertilizers, $T_4 = T_1$ + 25%NK of STB fertilizers, $T_5 = T_1$ + 25%PK of STB fertilizers, $T_6 = T_1$ + 25%NPK of STB fertilizers, T_7 = 75% of STB fertilizers and T_8 = Control. BRRI dhan47 was used as the test crop in this experiment. It is a high yielding salt tolerant variety of Boro season is being introduced by the scientists in the coastal belt of Bangladesh. As sources for N, P, K, and Zn urea, triple super phosphate, muriate of potash, and zinc sulfate-heptahydrate were used. The land was prepared thoroughly by puddling and cross puddling with a power tiller. After uniform leveling, the experiment containing 8 treatments with 3 replications was laid out in a RCBD. Fertilizers were applied to each plot as per treatment. Except urea, other fertilizers were applied to the individual plots during final land preparation. Urea was applied in three equal splits following 10 days after transplanting (DAT), 30 DAT (maximum tillering stage), and 55 DAT (panicle initiation stage). Thirty days old healthy seedlings were transplanted in the plots on keeping the spacing 20 cm × 20 cm, and three seedlings were transplanted in each hill. Intercultural operations like irrigation, weeding and insect and pest control were done as and when necessary following standard procedures. The crop was harvested at full maturity. Five hills were randomly selected from each plot at maturity to record the yield contributing characters like, number of effective tiller/hill, panicle length, number of filled grain/panicle and weight of 1000-grains. After threshing of the crop, grain and straw from each unit plot was dried and weighed. The results were expressed as t/ha on 14% moisture basis.

The analysis of variance for various growth components, grain and straw yields and nutrient uptakes were done following the F-test. Mean comparisons of the treatments were made by the DMRT.

Results and Discussion

The physical and chemical characteristics of the soil are presented in Table 1 which show that at Jabusha and Teligati soil pH was slightly alkaline while at Gobindakathi it was strongly alkaline. Soil salinity (EC) was strongly saline, moderately saline and slightly saline at Jabusha, Teligati and Gobindakathi villages, respectively. At Jabusha and Teligati %OM and %TN was medium and low, respectively while at Gobindakathi %OM and % TN was low and very low, respectively. Available P was medium, low and very low at the mentioned villages, respectively. At all the villages available S and Zn was very high and medium respectively. At Teligati and Gobindakathi villages available B was high, while at Jabusha available B was high. At Jabusha and Gobindakathi exchangeable K was very high while at Teligati it was medium.

Fig. 1 shows that the soil salinity (EC) ranged from 1.18 to 6.32 dS/m, 0.80 to 4.66 dS/m and 1.92 to 4.87 dS/m at Jabusha, Teligati, and Gobindakathi villages respectively which slightly decreased in February. In Novemder EC were recorded 1.18, 0.8 and 1.92 dS/m in the mentioned villages, respectively. From January, soil salinity showed an overall sharp increasing tendency in the following months and reached at their peak during April (6.32, 4.66 and 4.873 dS/m, restectively) at Jabusha, Teligati and Gobindakathi. The distribution pattern of soil salinity mostly depends on the rainfall pattern of the respective region. Similar distribution pattern of soil salinity in different months was also reported by SRDI (2014) through investigating several soils of Khulna region.

Table 1. Properties of initial soil of the experimental fields.

Location	Textural class	pH	EC (dS/m)	OM (%)	Total N (%)	P (ppm)	K(meq/ 100gsoil)	S (ppm)	Zn (ppm)	B (ppm)
Jabusha	Clay Loam	7.9 SA	13.50 MS	0.113 Medium	0.113 Low	13.62 Low	0.49 High	113.89 VH	1.32 Optimum	0.93 Optimum
Teligati	Clay Loam	7.7 SA	9.24 MS	2.23 Medium	0.120 Low	7.01 Low	0.18 Medium	71.57 VH	1.32 Medium	0.72 High
Gobind-akathi	Clay Loam	8.5 SA	6.73 SS	1.46 Low	0.086 VL	4.85 VL	0.43 VH	54.39 VH	0.93 Medium	0.64 High

SA = Slightly alkaline, MS = Moderately saline, SS = Slightly saline, VH = Very high and VL = Very low.

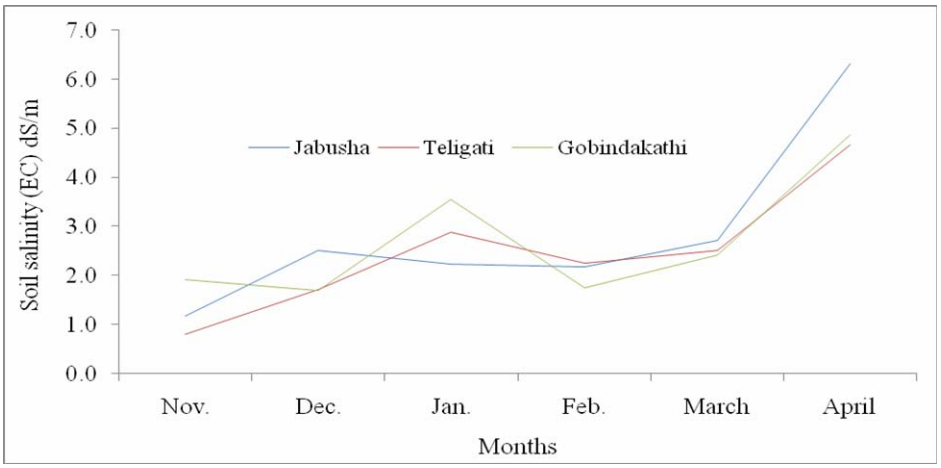

Fig.1. Month wise soil salinity during Boro season at Jabusha, Teligati and Gobindakathi village.

Table 2 represents straw yeild of BRRI dhan47 at Jabusha, Teligati and Gobindakathi, significantly affected by different treatments. The number of effective tillers/hill due to different treatments varied from 8.67 to 15.33, 8.34 to 12.00, and 8.34 to 14.78 at Jabusha, Teligati and Gobindakathi villages, respectively. The highest number of effective tillers/hill (15.33, 12.00 and 14.78) were found in the treatment T_6 (T_1 + 25% NPK) at all the villages, respectively. The highest number of effective tillers/hill found in the treatment T_6 at Jabusha, was statistically similar 14.67 recorded in T_2 (T_1 + 25% N) treatment , while at Teligati it was statistically similar to 11.67, 11.67, 11.30 and 11.33 recorded in the treatments T_2, T_3, T_4 and T_5, respectively and at

Gobindakathi it was statistically similar to 13.41, 13.56 and 14.00 recorded in the treatments T_2, T_3 and T_4, respectively .The minimum number of effective tillers/hill (8.67, 8.34 and 8.34) was found in the treatment T_8 (control) significantly different from all other treatments.

Table 2. Effect of different fertilizer packages on the yield and yield attributing characters of BRRI dhan47 at Jabusha, Teligati and Gobindakathi villages.

Treatment	Effective tillers/ hill (no.)	Panicle length (cm)	Filled grains/ panicle (no.)	1000-grain weight (gm)	Grain yield (t/ha)	Straw yield (t/ha)
Jabusha						
T_1	14.04b	22.94b	94.44b	25.22ab	5.22b	5.69b
T_2	14.67ab	24.71a	104.65ab	25.80ab	5.73ab	6.22ab
T_3	14.00b	24.98a	100.37ab	25.51ab	5.79ab	6.39ab
T_4	14.00b	23.96ab	99.51ab	26.07ab	5.87ab	6.32ab
T_5	13.34c	23.91ab	95.60b	25.68ab	5.48ab	6.20ab
T_6	15.33a	25.75a	112.26a	26.76a	6.14a	6.54a
T_7	11.00c	20.37c	84.52c	24.12b	3.84c	5.05c
T_8	8.67d	16.29d	59.96d	20.80c	2.42d	3.35d
CV (%)	5.01	5.41	7.87	3.65	4.28	4.73
Teligati						
T_1	11.00b	22.53b	73.62ab	25.85ab	5.14b	5.73b
T_2	11.67ab	24.19ab	77.54ab	26.05ab	5.77a	6.29ab
T_3	11.67ab	24.10ab	76.94ab	26.06ab	5.66ab	6.25ab
T_4	11.30ab	24.04ab	82.59ab	26.15ab	5.71ab	6.27ab
T_5	11.33ab	23.81ab	80.38ab	25.83ab	5.11b	5.90ab
T_6	12.00a	24.58a	91.79a	26.72a	5.83a	6.58a
T_7	10.47c	20.08c	71.28b	25.20b	3.62c	5.32c
T_8	8.34d	16.10d	45.77c	20.13c	2.06d	2.61d
CV (%)	5.18	6.99	6.34	3.92	6.64	6.15
Gobindakathi						
T_1	12.45b	22.57c	83.63b	25.66ab	5.28b	5.79b
T_2	13.41ab	24.20b	91.16ab	26.14ab	5.95ab	6.38ab
T_3	13.56ab	24.62ab	91.28ab	26.17ab	5.96ab	6.32ab
T_4	14.00ab	24.19b	92.09ab	26.29ab	5.99ab	6.36ab
T_5	12.56b	23.11c	84.87b	26.28ab	5.54ab	5.96ab
T_6	14.78a	25.69a	95.47a	26.85a	6.02a	6.63a
T_7	11.22c	19.99d	69.78c	24.75b	4.93c	5.37c
T_8	8.34cd	15.91e	53.59d	20.30c	2.30d	3.03d
CV (%)	5.78	5.19	6.77	3.22	5.01	5.13

Panicle length varied from 16.29 to 25.75, 16.10 to 24.58 and 15.91 to 25.69 cm at Jabusha, Teligati and Gobindakathi, respectively. The tallest panicles (25.75, 24.58 and 25.69) were found in the treatment T_6 at the mentioned villages, respectively. The tallest panicles found in the treatment T_6 (T_1 + 25% NPK) at Jabusha and Teligati villages were statistically similar to those

recorded in the treatments T_2 (T_1 + 25% N), T_3 (T_1 + 25% NP), T_4 (T_1 + 25% NK), and T_5 (T_1 + 25% PK). While at Gobindakathi, the tallest panicle found in the treatment T_6 was statistically similar to that recorded in the treatment T_3 (T_1 + 25% NP). The shortest panicles (16.29, 16.10 and 15.91cm) were found in the treatment T_8 (control). The panicle length of T_1 (100% STB) to T_7 (75%STB) treatments were about 3.98 to 9.78 cm taller than that found in treatment T_8.

The number of filled grains/panicle of different treatments ranged from 59.96 to 112.26, 45.77 to 91.79, and 53.59 to 95.47 at Jabusha, Teligati and Gobindakathi villages, respectively. The highest number of filled grains/panicle (112.26, 91.79 and 95.47) were found in the treatment T_6 (T_1 + 25% NPK) at the mentioned villages, respectively. The highest number of filled grains panicle^{-1} found in the treatment T_6 at Jabusha and Gobindakathi villages were statistically similar to those recorded in the treatments T_2 (T_1 + 25% N), T_3 (T_1 + 25% NP) and T_4 (T_1 + 25% NK), respectively. While at Teligati the highest number of filled grains panicle^{-1} found in the treatments T_6 was statistically similar to those recorded in all other treatments except T_7 (75% of STB) and T_8 (Control).

The lowest numbers of filled grains panicle-1 (59.96, 45.77 and 53.59) were found in the treatment T_8 at the mentioned villages, respectively. Similar results of effective tillers/hill, panicle length and filled grains/panicle were also obtained by Mondal *et al.* (1990) and Halder *et al.* (2000).

The 1000-grain weight of different treatments ranged from 20.80 to 26.76 g, 20.13 to 26.72 g, and 20.30 to 26.85 g at the Jabusha, Teligati and Gobindakathi villages respectively. The highest 1000-grain weight (26.76, 26.72 and 26.85 g) were found in the treatment T_6 (T_1 + 25% NPK) at the mentioned villages, respectively, which were statistically similar to those recorded in all other treatments except T_7 (75% of STB) and T_8 (control). The lowest 1000-grain weights (20.80, 20.13 and 20.30 g) were found in the treatment T_8 (control) significantly lower than all other treatments. Yoseftabar (2012) reported that tiller number, fertile tiller, total grain and 1000-grain weight increased significantly with nitrogen and phosphorus fertilizer. Salem *et al.* (2011) also reported that number of tillers/hill, 1000-grain weight, panicles length were increased by increasing nitrogen levels up to 165 kg N /ha.

The grain yields due to various treatments ranged from 2.42 to 6.14, 2.06 to 5.83 and 2.30 to 6.02 t/ha at Jabusha, Teligati and Gobindakathi villages, respectively. The highest grain yields (6.14, 5.83 and 6.02 t/ha) were found in the treatment T_6 at all the mentioned villages respectively The highest grain yields found in the treatments T_6 at Jabusha and Gobindakathi villages were statistically similar to those recorded in the treatments T_2 (T_1 + 25% N), T_3(T_1 + 25% NK), T_4(T_1 + 25% NP) and T_5(T_1 + 25% PK), respectively, while at Teligati highest grain yield was found in the treatment T_6 was statistically similar to those recorded in the treatments T_2, T_3 and T_4 respectively. The lowest grain yields (2.42, 2.06 and 2.30) were found in the treatment T_8 (control). All the treatments showed significantly higher grain yield over control. This implies that these nutrients had significant role on grain yield.

The straw yields due to various treatments ranged from 3.35 to 6.54, 2.61 to 6.58 and 3.03 to 6.63 t/ha at Jabusha, Teligati and Gobindakathi villages, respectively. The highest straw yields (6.54, 6.58 and 6.63 t/ha) were found in the treatment T_6 at the mentioned villages, respectively which were statistically similar to those recorded in the treatments T_2, T_3, T_4 and T_5. The lowest straw yields (3.35, 2.61, and 3.03 t/ha) were obtained in the treatment T_8 which were significantly lower than those recorded in all other treatments at all the mentioned villages, respectively. These types of findings of 1000-grain weight, grain and straw yield were also reported by Chaudhary *et al.* (2011). Yoseftabar (2012) reported that yield increased significantly with nitrogen and

phosphorus fertilizer. Salem *et al.* (2011) also reported that grain yield (ton/ha) was increased by increasing nitrogen levels up to 165 kg N /ha.

An increase of N, P and K fertilizer doses from STB recommended doses significantly increased yield and yield contributing parameters like effective tillers/hill, panicle length, filled grains/panicle and 1000 grain weight of BRRI dhan47 in all the villages. Greatest performance of yield and yield contributing parameters was shown by T_6 (25% more NPK of STB) treatment which resulted 12.55, 13.42 and 9.85% grain yield increase over T_1 (100% STB) at Jabusha, Teligati and Gobindakathi, respectively. As a result 25% increased dose of N, P and K fertilizers in soil test based fertilizer doses can be suggested for production of BRRI dhan47 in saline soils of Banglabesh.

References

Ali MM, Sobhan N, Sarker RR and Rahman MH 2014. Fertilizer recommendation for potato-boro-T. Aman cropping pattern in old Himalayan Piedmont Plain Soils of North-West Bangladesh. J. Environ. Sci. & Natural Resources **7**(1): 01- 06.

Chaudhary SK, Singh JP and Jhair S 2011. Effect of integrated nitrogen management on yield, quality and nutrient uptake of rice *(Oryza sativa* L.*)* under different dates of planting. Indian J. Agron. **56**(3): 228-231.

FRG (Fertilizer Recommendation Guide) 2012. Bangladesh Agricultural Research Council, Farmgate, New Air port road, Dhaka-1215.

Halder KP, Chowdhury MJU and Ahmed N 2000. Effect of planting methods and nitrogen rates on the yield and yield components of aus rice grown under rainfed condition at the coastal area of Bangladesh. Bangladesh J. Agril. Sci. **27**(1): 59-64.

Mondal SS, Joyaram D and Pradhan BK 1990. Effect of fertilizer and farmyard manure on the yield components of rice (*Oryza sativa* L.). Environ. Ecobiol. **8**(1): 223-226.

Munns R, Hussain S, Rivelli AR, James RA, Condon AG, Lindsay ES, Lagudah ES, Schachtman DP and Hare RA 2006. Avenues for increasing salt tolerance of crops, and the role of physiologically based selection traits. Plant Soil. **247**: 93-105.

Salem AKM, ElKhoby WM, Abou-Khalifa, AB and Ceesay M 2011. Effect of Nitrogen Fertilizer and Seedling Age on Inbred and Hybrid Rice Varieties. American-Eurasian J. Agric. Environ. Sci. **11:** 640-646.

SRDI (Soil Resource Development Institute) 2009. Saline soils of Bangladesh. 2009. Krishi Khamar sarak, Dhaka 1215, Bangladesh.

SRDI (Soil Resource Development Institute) 2014. Annual Report. Krishi Khamar sarak, Dhaka 1215, Bangladesh.

Yaqub M, Mahmood T, Akhtar M, Iqbal MM and Ali S 2010. Induction of mungbean as a grain legume in the annual rice-wheat double cropping system. Pakistani J. Bot. **42:** 3125-3135.

Yoseftabar S 2012. Effect of nitrogen and phosphorus fertilizer on growth and yield rice (*Oryza sativa* L.). Int. J. Agron. Plant Prod. **3**(12): 579-584.

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