

EFFECTS OF SOIL ENHANCER (XXL) ON YIELD ATTRIBUTES OF BRRI DHAN29 AND HYBRID DHAN TAJ1 CULTIVARS OF RICE IN *BORO* SEASON

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Abstract

The present study used two varieties (BRRI dhan29 and Hybrid dhan Taj1) of rice and (control) and six different concentrations of soil enhancer XXL [125% (1.88/1.5 g/l), 100% (1.5/1.5 g/l), 75% (1.125/1.5 g/l), 50% (0.75/1.5 g/l), 33% (0.50/1.5 g/l) and 25% (0.38/1.5 g/l)] with recommended doses of (N, P, K, S and Zn) fertilizers. Significant variation was observed in different yield contributing characters with soil enhancer (XXL) application. Among the different soil enhancer (XXL) concentrations, 75% XXL provided the highest yield (10.58 t/ha). With 75% XXL, BRRI dhan29 and Hybrid dhan Taj1 provided their highest grain yield (11.09 t/ha and 10.07 t/ha, respectively). However, BRRI dhan29 performed well due to yield attributes (fertile tillers/hill, panicle length and shoot dry matter/hill which were 11.94, 23.95 cm and 21.59 g, respectively) than that of Hybrid dhan Taj1 with 75% XXL applied.

Introduction

Rice is the staple food of Bangladesh and it covers 75% of the total cropped area (Rekabdar 2004). However, the average yield of rice in Bangladesh is 4.35 t/ha which is less than the world average yield (4.53 t/ha) (USDA 2018). *Boro*, which is grown usually during November to April, contributes to around 55% of the total rice production in Bangladesh (DAE 2014). The trend of *boro* rice production in Bangladesh is increasing day by day but its yield level is still very low as compared to other rice growing countries.

Now it is essential to find out sustainable technology for ensuring food security for increasing population. Soil enhancer XXL is a complex substance which is made of million years of highly compressed organic humus in the tropical rainforests and consists of different organic substances including humic acid, fulvic acid, 40 different trace elements and other plant hormones. XXL has two main functions: (i) soil improvement and (ii) fertilizer enhancer. Plant growth enhancer is a newly developed complex mixtures of plant growth hormones, nutrients and organic compounds use of which has been demonstrated beneficial results in plant growth and yield performance. It improves soil physical properties adding organic substances. It enhances nutrient availability and improves the nutrient use efficiency of plants (Rahman *et al.* 2018, Venkateshprasath *et al.* 2017).

Previous research findings proved the advantageous effect of plant growth regulators, organic substances and nutrients on plant growth, development and yield. Plant growth regulators IAA, Kn and GA₃ play important role in plant growth, development, yield and qualities formation of rice cultivars (Kariali and Mohapatra 2007). The application of humic and fulvic acids together led to significant increases of rice yield and N, P and K content of grain and straw (Khatab *et al.* 2013). The application of humic acid (HA) and poultry manure (PM) showed the positive trend in plant grain and straw yield of BRRI dhan39 (Saha *et al.* 2013).

Integration of XXL and chemical fertilizers may facilitate the utilization of nutrients for crop growth and productivity and help replenish the organic matter status in soil. Organic matter of soil

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provides nutrients, increases cation exchange, and improves soil ventilation and moisture retention in addition to preserving greater quantities of water in the soil, which influences plant growth (Singer *et al.* 2007). However, information on the effect of soil enhancer on *boro* rice productivity is rather scarce in Bangladesh. Therefore, the present study was designed to investigate the effect of various concentrations of soil enhancer XXL on yield and yield attributing characters of BRRI dhan29 and Hybrid dhan Taj1 cultivars of rice during *boro* season.

Materials and Methods

The experiment was conducted at the Research Field of Sher-e-Bangla Agricultural University, Dhaka-1207 during November, 2015 to July, 2016. The soil of the experimental area was silty clay in texture. Soil pH was 6.7 and has organic carbon 0.45%.

The experiment consisted of control and six different concentrations of XXL [125% (1.88/1.5 g/l), 100% (1.5/1.5 g/l), 75% (1.125/1.5 g/l), 50% (0.75/1.5 g/l), 33% (0.50/1.5 g/l) and 25% (0.38/1.5 g/l)], which were applied four doses at every seven days interval (one was basal application and rest three after seedling transplanting). The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. There were 14 plots of 3m² (2 m × 1.5 m) in size in each of 3 replications resulting 42 plots in total.

Two seedlings of 21 days old were transplanted in each hill with the plant to plant distance of 15 cm and row to row distance of 20 cm. Since XXL was a powder it was diluted to get a working solution. XXL solution was applied in the form of spray in the soil by knapsack sprayer. The sprays were made at early hours to avoid dehydration effect.

Ten pre-selected hills (avoiding border plants) per plot were used and data were collected from them. Data on the following parameters were recorded during the course of the experiment such as: number of fertile and sterile tillers/hill, panicle length, number of filled and unfilled grains/panicle, shoot dry matter/hill (g), 1000-grain weight (g) and grain yield (t/ha).

All the collected data were tabulated and analyzed statistically using analysis of variance technique and subsequently, least significance difference (LSD at 5%) for comparing the treatment means, by MSTAT-C software (Gomez and Gomez 1984).

Results and Discussion

The data on various yield parameters showed statistically significant variation due to rice varieties, different concentrations of XXL and their interaction effect except for 1000-grain weight.

The maximum number of fertile tillers, such as 11.94, 11.35 and 13.63/hill were recorded from the BRRI dhan29, 75% XXL and their combination effect, respectively (Tables 1, 2 and 3). Yasari (2016) noticed that the effects of humic acid and organic matter on the number of fertile tillers of rice were significantly increased. Shaha *et al.* (2013) observed that both humic acid and poultry manure had a significant effect on the number of effective tillers/hill and the highest result was obtained when humic acid was applied @ 3 L/ha. However, the minimum number of sterile tillers, such as 0.53, 0.50 and 0.50 and 0.37/hill were recorded from Hybrid dhan Taj1, (75% and 125%) XXL and the combination of Hybrid dhan Taj1 with 75% XXL, respectively (Tables 1, 2 and 3).

The longest panicle was observed from the BRRI dhan29 (Table 1), 75% XXL (Table 2) and their combination effect (Table 3), which were 23.95, 24.26 and 24.62 cm, respectively. Shaha *et al.* (2013) found a significant difference in panicle length of rice obtained with the application of humic acid and the longest panicle length (24.78 cm) obtained with humic acid applied @ 6 L/ha

and the shortest at the control. Turkmen *et al.* (2005) observed that humic acid and organic matter application to the soil increased flower length of pepper plants. GA₃ positively increased panicle exertion, duration of floret opening, angle of floret opening and panicle length of hybrid rice (Surahman *et al.* 2014). Yasari (2016) showed a significant effects of organic matter and humic acid on panicle length of rice.

The highest number of filled grains/panicle was recorded from the Hybrid dhan Tajl (Table 1), 75% XXL (Table 2) and their combination effect (Table 3), which were 125.67, 130.2 and 133.1, respectively and the lowest number of unfilled grains/panicle was recorded from the same treatment, which were 13.50, 15.14 and 10.59, respectively. Yasari (2016) showed that the number of seeds per panicle of rice significantly increased when the level of humic acid application was raised. Rezvantalab *et al.* (2009) noticed in their research that the application of bio-fertilizers significantly increased the number of seeds per row in corn. Application of humic acid extensively influenced the number of filled grains/panicle and produced the highest number of filled grains/panicle (137.56) when applied @ 6 L/ha and the lowest at control treatment (Shaha *et al.* 2013).

BRRl dhan 29 (Table 1), 75% XXL (Table 2) and their interaction effect (Table 3) showed the maximal shoot dry matter content of 21.59, 22.72 and 24.45 g/hill, respectively. Turkmen *et al.* (2005) observed that humic acid and organic matter application to the soil increased dry matter and yield of pepper plants. ABA, BA and CCC treatment caused a substantial increase in shoots dry weight of rice plant (Gurmani *et al.* 2006). Foliar applications of humic acid led to higher leaf and stem dry matter contents of tomato than the control treatment (Yildirim 2007). Celik *et al.* (2010) observed that the greatest dry weight and copper (Cu) and sodium (Na) uptakes of maize were obtained from the 0.01% humic acid treatment.

Non-significant variation was observed in 1000-grain weight of rice but the maximum 1000-grain weight was found from the BRRl dhan29 (Table 1), 50% XXL (Table 2) and their combined effect of BRRl dhan 29 with 75% XXL (Table 3), which were 23.57, 23.75 and 23.89 g, respectively. Osman (2013) found that foliar application of humic and fulvic acids together led to increases of 1000 grain weight (g) and N, P and K content of grain and straw of rice. Shaha *et al.* (2013) observed that 1000-grain weight was influenced by the application of humic acid and the highest 1000-grain weight (20.16 g) was obtained when humic acid was applied @ 6 L/ha and the lowest at control treatment.

Table 1. Effect of variety on yield contributing characters of rice.

Variety	Fertile tillers/hill	Sterile tillers/hill	Panicle length (cm)	Filled grains/panicle	Unfilled grains/panicle	Shoot dry matter/hill (g)	1000-grain weight (g)	Grain yield (t/ha)
BRRl dhan29	11.94 ^a	1.02 ^a	23.95 ^a	116.06 ^b	25.16 ^a	21.59 ^a	23.57 ^a	9.92 ^a
Hybrid dhan Tajl	8.31 ^b	0.53 ^b	23.05 ^b	125.67 ^a	13.50 ^b	19.36 ^b	23.32 ^a	9.09 ^b
LSD _(0.05)	0.54	0.05	0.42	5.73	1.15	1.12	NS	0.35
CV (%)	8.46	11.01	2.82	7.47	9.42	8.59	5.88	5.84

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly by LSD at 0.05 level of probability.

The highest grain yield was recorded from the BRRl dhan29 (Table 1), 75% XXL (Table 2) and their combination effect (Table 3), which were 9.92, 10.58 and 11.09 t/ha, respectively. Yasari (2016) showed that seed yield of rice improved with increase in the concentration of humic acid in

Table 2. Effect of different concentrations of soil enhancer XXL on yield contributing characters of rice.

Treatments	Fertile tillers/hill	Sterile tillers/hill	Panicle length (cm)	Filled grains/panicle	Unfilled grains/panicle	Shoot dry matter/hill (g)	1000-grain weight (g)	Grain yield (t/ha)
0% XXL	8.75 ^d	1.42 ^a	22.46 ^c	112.7 ^b	23.44 ^a	18.66 ^c	23.31 ^a	8.3 ^d
125% XXL	10.20 ^{bc}	0.50 ^d	23.90 ^{ab}	121.1 ^{ab}	19.42 ^b	20.28 ^{bc}	23.43 ^a	9.27 ^c
100% XXL	9.83 ^{bc}	0.95 ^b	23.46 ^b	115.7 ^b	19.08 ^b	19.93 ^{bc}	23.23 ^a	9.1 ^c
75% XXL	11.35 ^a	0.50 ^d	24.26 ^a	130.2 ^a	15.14 ^c	22.72 ^a	23.68 ^a	10.58 ^a
50% XXL	10.85 ^{ab}	0.53 ^d	23.74 ^{ab}	123.3 ^{ab}	18.05 ^b	21.30 ^{ab}	23.75 ^a	10.15 ^{ab}
33% XXL	9.72 ^{cd}	0.90 ^b	23.30 ^b	119.7 ^{ab}	20.08 ^b	19.57 ^{bc}	23.45 ^a	9.45 ^c
25% XXL	10.17 ^{bc}	0.63 ^c	23.38 ^b	123.4 ^{ab}	20.09 ^b	20.86 ^{ab}	23.24 ^a	9.62 ^{bc}
LSD _(0.05)	1.02	0.10	0.79	10.72	2.16	2.09	NS	0.66
CV (%)	8.46	11.01	2.82	7.47	9.42	8.59	5.88	5.84

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly by LSD at 0.05 level of probability.

Table 3. Interaction effect of variety and XXL on yield contributing characters of rice.

Treatments	Fertile tillers/hill	Sterile tillers/hill	Panicle length (cm)	Filled grains/panicle	Unfilled grains/panicle	Shoot dry matter/hill (g)	1000-grain weight (g)	Grain yield (t/ha)
BRR1 dhan29 ×								
0% XXL	0.87 ^d	2.03 ^a	2.77 ^{de}	08.5 ^d	28.55 ^a	9.96 ^{cde}	23.46 ^a	8.82 ^{gh}
125% XXL	11.67 ^{bc}	0.57 ^{efg}	24.07 ^{ab}	110.1 ^{cd}	27.59 ^a	20.21 ^{cde}	2370 ^a	9.01 ^{efgh}
100% XXL	11.83 ^{bc}	1.20 ^b	23.93 ^{abc}	114.5 ^{bcd}	23.67 ^b	20.74 ^{bcd}	23.33 ^a	9.93 ^{bcd}
75% XXL	13.63 ^a	0.63 ^{def}	24.62 ^a	127.3 ^{ab}	19.70 ^c	24.45 ^a	23.89 ^a	11.09 ^a
50% XXL	12.99 ^{ab}	0.63 ^{def}	24.46 ^a	118.1 ^{abcd}	23.30 ^b	23.23 ^{ab}	23.64 ^a	10.47 ^{ab}
33% XXL	11.40 ^c	1.33 ^b	23.89 ^{abc}	114.7 ^{bcd}	27.46 ^a	20.13 ^{cde}	23.56 ^a	9.97 ^{bcd}
25% XXL	12.20 ^{abc}	0.73 ^{cd}	23.91 ^{abc}	119.1 ^{abcd}	25.86 ^{ab}	22.40 ^{abc}	23.36 ^a	10.13 ^{bc}
Hybrid dhan Taj1 ×								
0% XXL	7.63 ^e	0.80 ^c	22.15 ^e	116.9 ^{bcd}	18.33 ^c	17.35 ^e	23.16 ^a	7.64 ⁱ
125% XXL	8.73 ^{de}	0.43 ^{gh}	23.73 ^{abcd}	132.1 ^a	11.24 ^e	20.35 ^{bcd}	23.17 ^a	9.52 ^{cdefg}
100% XXL	7.83 ^e	0.70 ^{cde}	23.00 ^{bode}	116.9 ^{bcd}	14.49 ^d	19.12 ^{de}	23.13 ^a	8.49 ^{hi}
75% XXL	9.07 ^{de}	0.37 ^h	23.90 ^{abc}	133.1 ^a	10.59 ^e	21.00 ^{bcd}	23.47 ^a	10.07 ^{bc}
50% XXL	8.70 ^{de}	0.43 ^{gh}	23.03 ^{bode}	128.4 ^{ab}	12.79 ^{de}	19.36 ^{de}	23.85 ^a	9.83 ^{bcd}
33% XXL	8.03 ^e	0.47 ^{gh}	22.71 ^{de}	124.7 ^{abc}	12.71 ^{de}	19.02 ^{de}	23.33 ^a	8.94 ^{fgh}
25% XXL	8.13 ^e	0.53 ^{fg}	22.85 ^{cde}	127.6 ^{ab}	14.33 ^d	19.31 ^{de}	23.12 ^a	9.12 ^{defgh}
LSD _(0.05)	1.44	0.14	1.11	15.16	3.05	2.95	NS	0.93
CV (%)	8.46	11.01	2.82	7.47	9.42	8.59	5.88	5.84

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly by LSD at 0.05 level of probability.

the substrate and the highest seed yield (1447 g/3m²) was achieved when humic acid was applied at 6 ppm. Humic acid and organic matter application in wheat increased seed yield by 22% (Delfine *et al.* 2005). Shaha *et al.* (2013) observed that the per cent grain yield increase over control was influenced by the application of humic acid and the grain yield increased 0.32% when humic acid was applied @ 3 L/ha and 3.56% when applied @ 6 L/ha.

Among the six different soil enhancer concentrations, 75% XXL with the normal dose of fertilizers improved the soil condition and provided the best environment to the plant for nutrient uptake, so that plant can achieve the best growth rate and potential. However, more than 75% XXL with fertilizers is harmful or unsuitable to plants for nutrients uptake and thus growth rate and potential was lower than that of 75% XXL. On the contrary minimum or lowest values of all the yield related parameters, such as fertile tillers/hill, panicle length, filled grains/panicle, shoot dry matter content/hill and grain yield were recorded from the control treatment (0% XXL), except 1000-grain weight. The present study revealed that BRRI dhan 29 performed better than that of Hybrid dhan Taj1 with 75% applied XXL. Irrespective of varieties and doses, fertile tillers/hill, length of panicle, filled grains/panicle, shoot dry matter content/hill, 1000-seed weight and grain yield increased by 18.29, 5.39, 8.46, 11.36, 18.15 and 18.00%, respectively with the application of XXL than those of control. However, further study may be needed regarding the effect of XXL on growth and yield of test rice varieties in different Agro-ecological zones (AEZ) of Bangladesh to recommend a package of technology for use at the farmers' level.

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