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Growth and Yield Performance of BRRI Dhan29 to Manures and Fertilizers under Both Conventional and SRI System

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Authors' contributions

This work was carried out in collaboration between all authors. All authors read and approved the final manuscript.

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ABSTRACT

A field experiment was carried in the Agronomy Field, Bangladesh Agricultural University, Mymensingh to study the effect of integration of fertilizer and manure on the yield performance of *Boro* rice (BRRI dhan29) under the system of rice intensification (SRI). The experiment included ten treatments of rice production method viz. conventional method (CM) with recommended dose of fertilizer (RDF), conventional method with 15 ton/ha of cowdung, conventional method with 5ton/ha of cowdung + RDF, SRI with 15 ton/ha of cowdung, SRI with 10 ton/ha of cowdung, SRI with 10 ton/ha of cowdung + 50% RDF, SRI with 5ton/ha of cowdung + 100% RDF, SRI with 100% RDF, SRI with 150% RDF and SRI with 100% RDF + biofertilizer (200 g/plot). The results indicated that all crop characters except number of non-bearing tillers/hill, sterile spikelets/panicle and harvest index were significantly influenced due to integration of fertilizer and manure. The SRI method performed better than conventional method. Among the SRI, integration of fertilizer and manure and fertilizer more than 100% of the recommended and biofertilizer rate produced the

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highest grain yield. The results showed that the best option for the cultivation of BRRI dhan29 during the Boro season was SRI with 100% RDF and biofertilizer (200 g/plot). This integration not only reduced the production cost but also had a long term impact on improvement of soil properties.

Keywords: SRI; integration; conventional; cowdung; biofertilizer.

1. INTRODUCTION

Rice (*Oryza sativa*) is the dominant food crop of Bangladesh. Rice, as such, as the staple food of 164 million people of the country and historically associated with our cultures, rites and rituals. Production of rice sector contributes one-half of the agricultural GDP and one sixth of the national income in Bangladesh. Almost all of 13 million farm families grow rice in our country. The people of Bangladesh depend on rice as staple food and have tremendous influence on agrarian economy of the country. According to the provisional data by the Bangladesh Bureau of Statistics has been reported that Bangladesh's FY 2014-15 (July 2014 – June 2015), the production of milled rice reached a record high of around 34.71 million tons, slightly up from around 34.41 million tons in 2013-14 [1]. The cultivation of *Boro* rice shows an increasing trend since few years with the rapid intensification of land. The area and production of *Boro* rice in the country were 4.14 million hectares and 15.89 million tons, respectively in 2012-2013 and yield was 3.83 tha^{-1} [2]. The output of *Boro*, which accounts for 55% of the total annual production, fell 1.32% from a year earlier to 189.38 lakh tones during the production of fiscal year 2015-16, according to preliminary estimate of [1].

The System of Rice Intensification (SRI), offers an opportunity to improve food security through increased rice productivity by changing the management of plants, soil, water and nutrients while reducing external inputs like fertilizers and herbicides [3,4,5,6]. The system proposes the use of single, very young seedlings (less than 15 days) with wider spacing, intermittent wetting and drying, use of a mechanical weeder which also aerates the soil, and enhanced soil organic matter [7]. SRI is a technique that is a set of practices and a set of principles rather than as a "technology package" [8]. SRI is not a technology like the seed of high-yielding varieties or like a chemical fertilizer or insecticide. It is a system for managing plants, soil, water or nutrient together in mutually beneficial ways, creating synergies [9]. With SRI, management practices control or modify the microenvironment so that existing genetic potentials can be more fully expressed and realized. The most obvious advantage from SRI appears to be the yield increase in farmers' field without any new seeds or chemical and mechanical inputs [10] and that is reported to be from 50% to 200% [11].

New management practice in paddy field for increasing the yield of rice crops is critically needed considering the increased in population growth as well as the climate change. SRI is among the ways of increasing the yield especially by increasing the number of tillers per hill. Aims of this study was to find out the best option of manure and fertilizers dose combination with SRI and conventional method of planting.

2. MATERIALS AND METHODS

The experiment was conducted at Bangladesh Agricultural University (BAU), Mymensingh (24.75° N latitude and 90.50°E longitude at an elevation of 18 m above the sea level). The soil of the experimental field was characterized by non-calcareous dark grey floodplain soils with 1.29% organic matter content. The experimental field was a medium high land with flat and well drained condition. The general range of pH value of the soil is 5.9-6.5.

A single factorial experiment was carried out in the randomized complete block design (RCBD) with four replications. The size of each plot was 4 m x 2.5 m. The treatments consisted of T_1- conventional method with recommended dose of fertilizer, Urea 270 $Kgha^{-1}$, TSP 130 $Kgha^{-1}$, MoP 180 $Kgha^{-1}$, Gypsum 70 $Kgha^{-1}$ and Zinc Sulphate 10 $Kgha^{-1}$ (RDF), T_2- conventional method with 15 ton/ha of cowdung, T_3- conventional method with 5 ton/ha of cowdung + RDF, T_4- SRI with 15 ton/ha of cowdung, T_5- SRI with 10 ton/ha of cowdung, T_6- SRI with 10 ton/ha of cowdung + 50% RDF, T_7- SRI with 5 ton/ha of cowdung + 100% RDF, T_8- SRI with 100% RDF, T_9- SRI with 150% RDF and T_{10}- SRI with 100% RDF + biofertilizer (pit soil 500 g, husk of black gram 500 g and trichoderma) (200 g/plot).

Table 1. Effects of treatments on yield and yield contributing characters of rice production

Treatments	Plant height (cm)	No. of total tillers hill^{-1}	No. of effective tillers hill^{-1}	No. of non-effective tillers hill^{-1}	Panicle length (cm)	Filled grains panicle^{-1}	Unfilled grains panicle^{-1}	1000 grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
T_1	86.2^{abcd}	12.0^{e}	9.0^{e}	2.0^{a}	21.1^{bc}	96.0^{de}	26.7^{a}	23.0^{abc}	4.4^{f}	6.1^{c}	10.4^{f}	41.7^{c}
T_2	82.9^{cd}	10.0^{f}	8.0^{f}	2.0^{c}	20.7^{c}	96.0^{e}	22.9^{b}	23.0^{abc}	5.8^{d}	6.6^{c}	12.4^{e}	46.9^{a}
T_3	85.5^{abcd}	13.0^{e}	10.0^{e}	2.0^{b}	21.4^{bc}	108.0^{cd}	26.7^{a}	22.7^{bc}	6.5^{c}	7.8^{b}	14.3^{cd}	45.1^{ab}
T_4	81.5^{d}	16.0^{d}	14.0^{d}	1.0^{ef}	21.7^{bc}	109.0^{cd}	15.7^{d}	22.7^{bc}	6.9^{b}	8.6^{ab}	15.6^{ab}	44.6^{b}
T_5	84.1^{bcd}	15.0^{d}	13.0^{d}	2.0^{b}	21.9^{ab}	119.0^{bc}	18.3^{c}	22.5^{bc}	5.1^{e}	6.5^{c}	11.6^{e}	43.5^{bc}
T_6	84.2^{bcd}	20.0^{c}	18.0^{c}	1.0^{e}f	22.1^{ab}	108.0^{cde}	24.6^{ab}	22.0^{c}	6.0^{d}	7.8^{b}	13.8^{d}	43.3^{bc}
T_7	85.3^{abcd}	19.0^{c}	17.0^{c}	1.0^{d}	22.0^{ab}	105.0^{de}	19.7^{c}	21.7^{c}	6.5^{c}	8.4^{ab}	14.9^{bc}	43.5^{bc}
T_8	88.5^{abc}	19.0^{c}	18.0^{c}	1.0^{f}	22.0^{ab}	128.0^{ab}	15.8^{d}	23.5^{ab}	7.0^{b}	8.8^{ab}	15.7^{ab}	44.3^{b}
T_9	89.6^{ab}	22.0^{b}	21.0^{b}	1.0^{g}	22.2^{ab}	131.0^{ab}	17.8^{cd}	22.5^{bc}	6.8^{bc}	8.5^{ab}	15.3^{bc}	44.4^{b}
T_{10}	90.9^{a}	25.0^{a}	23.0^{a}	1.5^{e}	22.9^{a}	135.0^{a}	12.2^{e}	24.3^{a}	7.5^{a}	9.1^{a}	16.5^{a}	45.3^{ab}
Grand mean	90.9	25.0	23.0	2.0	22.9	135.0	26.7	24.3	7.5	9.1	16.5	46.9
$LSD_{0.05}$	5.58	1.67	1.55	0.092	1.05	11.39	2.30	1.25	0.387	0.881	1.01	1.94
Level of significance	*	**	**	**	**	**	**	*	**	**	**	**
CV (%)	**4.48**	**6.63**	**6.88**	**3.43**	**3.31**	**6.89**	**7.89**	**3.79**	**4.26**	**7.75**	**4.93**	**3.02**

*** = Significant at 1% level of probability, * = Significant at 5% level of probability*

T_1-conventional method with recommended rate of fertilizer (RDF), T_2- conventional method with 15 ton/ha of cowdung, T_3-conventional method with 5 ton/ha of cowdung + RDF, T_4- SRI with 15 ton/ha of cowdung, T_5- SRI with 10 ton/ha of cowdung, T_6- SRI with 10 ton/ha of cowdung + 50% RDF, T_7- SRI with 5 ton/ha of cowdung + 100% RDF, T_8- SRI with 100% RDF, T_9- SRI with 150% RDF and T_{10}- SRI with 100% RDF + biofertilizer (200 g/plot)

BRRI dhan29 was used as tested variety. The 11 days old seedlings were uprooted from the seedbed and transplanted in field. The spacing was maintained plant to plant 15 cm and row to row 25 cm. Data on yield attributes was determined from randomly selected five hills of each plot. Grain and straw yields were recorded from the inner rows leaving border lines at 160 days after transplanting. Crops of each plot were separately harvested, bundled, tagged and then brought to the threshing floor for recording grain and straw yield. Threshing was done using pedal thresher. The grains were cleaned and sun dried to a moisture content of 14% measured by moisture meter. Straw was also sun dried properly. Finally grain and straw yields were determined and converted to ton ha^{-1}.

3. RESULTS AND DISCUSSION

Manure and fertilizer status significantly influenced the number of total tillers $hill^{-1}$. The highest number of tiller (25.0) was obtained from T_{10} and the lowest number (10.0) from T_2. Number of effective tiller has important for grain yield. The highest number of effective tillers $hill^{-1}$ (23.0) was obtained from T_{10}. The lowest effective tillers $hill^{-1}$ (8.0) was obtained from T_2. Hossaen et al. [12] conducted an experiment to evaluate the efficacy of different organic manure and inorganic fertilizer and recorded maximum number of effective tillers $hill^{-1}$ from the treatment of 70% NPKS + 2.4 t manure ha^{-1}. The highest number of filled grains $panicle^{-1}$ (135.0) was obtained from T_{10} which was statistically similar with T_8 and T_9 and the lowest number filled of grains $panicle^{-1}$ (96.0) was recorded from T_2 that was statistically similar to T_1 (Table 1). Basunia [13] reported that frequent combined application of cowdung plus inorganic fertilizer rates increased production from successive filled grains $panicle^{-1}$. There was no significant effect among the different manural status in respect of weight of 1000-grains though the numerically maximum 1000-grains weight (24.3 g) was observed at T_{10} and the minimum (21.7 g) in T_7. Manural status has significant effect on grain yield. T_{10} produced significantly the highest grain yield (7.5 t ha^{-1}). The lowest (4.4 t ha^{-1}) grain yield was obtained from T_1. Das [14] earlier stated that soils with high fertility influence the grain yield.

4. CONCLUSION

The integrated use of manure and inorganic fertilizer significantly influenced the yield and yield contributing characters of boro rice. The higher values of yield parameters and yields were recorded in the treatments where fertilizer, manure and biofertilizer were used. The highest number of tiller/hill, effective tillers/hill, filled grain/panicle, 1000 grain wt., grain and straw yields were found from T_{10} treatment. From present study it can be concluded that the integration of SRI with 100% RDF and biofertilizer (200 g/plot) is the best to obtain the highest grain yield (7.5 tha^{-1}) of BRRI dhan29.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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