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Effect of SRI methods on the vegetative growth characters of boro hybrid rice cv. Jagoroni

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Abstract: An experiment was conducted during January to June, 2003 at the Agronomy Field Laboratory of Bangladesh Agricultural University, Mymensingh to study the growth attributes of boro hybrid rice cv. Jagoroni as affected by SRI (System of rice intensification) method and its various modifications. The experiment was laid out in a randomized complete block design with 3 replications. The treatments used in the experiment consisted of 4 soil-water-fertilizer management practices viz. aerated soil condition with NPK fertilizer AS (NPK), aerated soil condition with cowdung AS (C), saturated soil condition with NPK fertilizer SS (NPK), saturated soil condition with cowdung SS (C), and 4 seedling type viz. 16-day-old 1 seedling hill^{-1}(16/1), 16-day-old 3 seedling hill^{-1}(16/3), 8-day-old 1 seedling hill^{-1}(8/1) and 8-day-old 3 seedling hill^{-1}(8/3). Crop characters studied at vegetative stage of the crop were plant height and number of tillers hill^{-1}. Data revealed that plant height and number of tillers hill^{-1} studied during vegetative stage varied significantly due to effect of soil-water-fertilizer management practices and seedling (age and number hill^{-1}) treatments. AS (NPK) and 16/1 finally appeared as the best treatments to produce the tallest plant and SS (C) and 8/3 appeared as the worst one. The interaction effect of the treatments appeared to be non-significant in respect of plant height. SS (NPK) and 16/3 produced maximum number of tillers hill^{-1} while AS (C) and 16/1 produced the minimum one. In case of interaction, SS (NPK) and 16/3 was the best combination and AS (C) and 16/1 was the worst.

Key words: SRI, growth characters, vegetative and Jagoroni.

Introduction

Rice (*Oryza sativa* L.) is the staple food of a vast majority of people around the world (Rohilla *et al*. 2000) of which more than 60% of the worlds population depends on rice for their carbohydrate in diet (FAO, 2000). In respect of total cropped area and production rice ranks the top position in Bangladesh by covering about 10.80 million hectares of land from which 25.08 million tons of rice produced per annum (BBS, 2003). It provides about 75% calorie and 55% protein intake in daily diet of the people (Siddique, 2002). But the production of rice in Bangladesh is not satisfactory compared with other rice producing country of the world. The mathematically increasing rate of production can not fulfill the demand of food for geometrically increasing trend of population (Alam *et al*. 2002). So, the only avenue left is to increase the production of rice through vertical expansion. Over the last few decades, scientists over the world have made extensive investments in improving the yield potentials of rice. In this connection, a system of rice intensification developed in Madagascar in the early 1980s (*Le Systeme De Riziculture Intensive, SRI*) has been showing that yields can be doubled or more just by changing certain common practices for managing rice plants, soil, water and nutrients; by transplanting rice seedlings early, carefully, singly and widely spaced with soil kept well aerated i.e., moist but not saturated, during their vegetative growth phase (Laulanie, 1993). Method of SRI in Madagascar helped to increase the rice production from 2 to10 ton ha^{-1}(Tang, 1996). SRI has at least doubled the yield on any variety of rice (Saina, 2001). The average yield of SRI so far found in Bangladesh is 6.30 ton ha^{-1}, but there is evidence of obtaining rice yields even 17.56 ton ha^{-1} in China and 21.00 ton ha^{-1} in Madagascar (Fernandes and Uphoff, 2002). To achieve the benefits to phyllochron (the thermal time it takes for successive leaves on a shoot to reach the same developmental stage) tender age of seedling is regarded as a component of SRI to increase yield. In this regard Singh and Singh (1998) transplanted seedlings of 25, 35 and 45 day old and observed that yield and yield component values decreased with increasing age of seedlings. Where as, only 8-12 day seedlings are recommended for SRI method. The conventionally grown rice will have only 5 to 20 tillers, while under SRI the number could be 50-80. SRI still being evaluated as an approach to raising rice production. Its principles always need to be tested in varying environments, as there is no set formula for achieving the higher yield, SRI can produce. But in Bangladesh a very few research works have been done in this connection. Under this circumstance the study has been undertaken to know the performance of rice under SRI techniques and to evaluate the comparative performance of SRI with few modification against the conventional practices.

Materials and Methods

The experiment was conducted during January to June, 2003 at the Agronomy Field Laboratory of Bangladesh Agricultural University, Mymensingh to study the growth attributes (plant height and number of tillers hill^{-1}) of boro hybrid rice cv. Jagoroni as affected by SRI method and its various modifications. Soil of the experimental plot was under the agro-ecological region of the Old Brahmaputra Floodplain (UNDP and FAO, 1988), more or less neutral in reaction with low organic matter content and very low fertility level. The experiment was laid out in a randomized complete block design with 3 replications. The treatments used in the experiment consisted of 4 soil-water-fertilizer management practices viz. aerated soil condition with NPK fertilizer AS(NPK), aerated soil condition with cowdung AS(C), saturated soil condition with NPK fertilizer SS(NPK), saturated soil condition with cowdung SS(C), and 4 seedling type viz. 16-day-old 1 seedling hill^{-1}(16/1), 16-day-old 3 seedling hill^{-1}(16/3), 8-day-old 1 seedling hill^{-1}(8/1) and 8-day-old 3 seedling hill^{-1}(8/3). Full dose of cowdung @ 5 kg plot^{-1}, TSP 65gm plot^{-1}, MoP 60 gm plot^{-1}, gypsum 35 gm plot^{-1}, zinc sulphate 5 gm plot^{-1} and one third of urea (15 gm) were applied at the time of final land preparation and rest urea was top dressed at tillering and before panicle initiation stage. Eight-day old and 16 day old seedlings were carefully uprooted from nursery bed so that the seeds were attached to the seedlings and transplanted in unit plot (2.5m x 2m) within 30 minutes after uprooting maintaining a space of 25x25 cm. The placement of seedlings root in a manner of J and L shape during transplanting roots in 1-2 cm below surface. The first weeding was done at 12 DAT and then one weeding was done in each week by hand pulling but in case of conventional two hand pulling weeding was done at 25 and 45 DAT. Intercultural operations were done as and when necessary. Data on plant height and number of tillers hill^{-1} during relative stage of crop growth were recorded from 5 randomly selected hills excluding border hills and central 3 m^2 area. The collected data were analyzed following the ANOVA technique and the mean difference were adjusted by the Duncan's Multiple Range Test (Gomez and Gomez, 1984) using a computer package MSTAT.

Results and Discussion

Plant height: Jagoroni was significantly influenced at all sampling dates except 30 DAT due to the effect of soil-water and fertilizer management practices (Table 1). In all the cases, plant height increased with the increase of plant age up to 60 DAT i.e. up to the last sampling date. Plant height was the highest (43.40 cm at 15 DAT and 67.21 cm at 45 DAT) in saturated soil receiving NPK fertilizers during the early stage of crop establishment while at the later stage, aerated soil receiving NPK fertilizers produced the tallest plant (78.61 cm at 60 DAT). Plants from cowdung treated ultimately remained shorter. Availability of nutrients was plenty in plots fertilized with NPK fertilizers which help the plants to attain more height.

Table 1. Effect of soil-water-fertilizer on plant height of boro hybrid rice cv. Jagoroni

Fertilizer treatments	Plant height (cm)			
	15 DAT	30 DAT	45 DAT	60 DAT
AS(NPK)	41.31b	54.29	61.36b	78.61a
AS(C)	39.75c	52.09	58.80bc	72.08b
SS(NPK)	43.40a	55.54	67.21a	78.60a
SS(C)	43.36a	52.19	54.75c	70.85b
Level of significance	*	NS	**	*
CV(%)	6.71	7.48	11.53	4.27

In a column, figures having similar letter (s) or without letter (s) do not differ significantly, whereas figures bearing dissimilar letter (s) differ significantly as per DMRT. ** Significant at 1% level, * Significant at 5% level, NS= Not Significant

Table 2. Effect of seedling type on plant height of boro hybrid rice cv. Jagoroni

Seedling treatments	Plant height (cm)			
	15 DAT	30 DAT	45 DAT	60 DAT
AS(NPK)	43.02	55.27	63.54a	77.55a
AS(C)	41.75	53.51	60.37ab	74.63b
SS(NPK)	42.30	53.19	62.80a	75.36ab
SS(C)	40.73	52.15	55.41b	72.62b
Level of significance	NS	NS	*	*
CV(%)	6.71	7.48	11.53	4.27

In a column, figures having similar letter (s) or without letter (s) do not differ significantly, whereas figures bearing dissimilar letter (s) differ significantly as per DMRT. * Significant at 5% level, NS= Not Significant

Table 3. Interaction effect of soil-water-fertilizer and seedling type on plant height of boro hybrid rice cv. Jagoroni

Fertilizer treatments	Seedling treatments	Plant height (cm)			
		15 DAT	30 DAT	45 DAT	60 DAT
AS (NPK)	16/1	8.44c	12.78ef	62.76	84.14
	16/3	13.67a	18.00ab	59.81	78.31
	8/1	9.22de	13.67def	42.11	76.70
	8/3	10.89c	14.33cdef	60.78	75.31
AS (C)	16/1	8.11e	11.89f	58.11	70.78
	16/3	10.56c	13.00def	57.89	70.78
	8/1	8.67e	12.89def	61.89	73.97
	8/3	13.22a	16.78bc	57.34	72.82
SS (NPK)	16/1	10.45cd	14.78cdef	70.75	81.92
	16/3	14.00a	19.67a	65.89	77.38
	8/1	9.11e	12.78ef	69.23	79.20
	8/3	11.78bc	15.78bcde	23.00	75.93
SS (C)	16/1	11.00c	14.78cdef	62.55	73.38
	16/3	11.33bc	15.89bcd	57.92	72.05
	8/1	11.44bc	15.33bcde	58.00	71.57
	8/3	12.66ab	16.89bc	40.53	66.42
Level of significance		**	**	NS	NS
CV (%)		6.87	10.44	4.27	6.86

In a column, figures having similar letter (s) or without letter (s) do not differ significantly, whereas figures bearing dissimilar letter (s) differ significantly as per DMRT. ** Significant at 1% level, NS= Not Significant

Seedling age and number hill^{-1} produced significant variation in plant height during the later stage of crop growth (45 and 60 DAT) (Table 2). Plant height was the highest (63.45 cm at 45 DAT and 77.55 cm at 60 DAT) when 16-day-old 1 seedling hill^{-1} was planted though that was similar to 8-day-old 1 seedling hill^{-1}(62.80 cm at 45 DAT and 75.36 cm at 60 DAT) and 16-day-old 3 seedling hill^{-1}(60.37 cm at 45 DAT). Eight day old 3 seedling hill^{-1}produced the shortest plant (55.41 cm at 45 DAT and 72.62 cm at 60 DAT). Data presented in table 2 show that plants were taller when 1 seedling hill^{-1} was used. This is due to one seedling hill^{-1} reduced interplant competition and helped plants to attain more height. The result is similar to Shah *et al.* (1991) that plant height increased with the decreased of seedlings number hill^{-1}. The interaction of soil-water-fertilizer and seedling did not show any significant variation in terms of plant height (Table 3).

Table 4. Effect of soil-water-fertilizer on tiller production of boro hybrid rice cv. Jagoroni

Fertilizer treatments	Tiller hill^{-1}			
	45 DAT	55 DAT	65 DAT	75 DAT
AS(NPK)	10.55b	14.69ab	15.61ab	16.13
AS(C)	10.14b	13.64b	14.54b	16.58
SS(NPK)	11.60a	15.75a	16.49a	17.64
SS(C)	11.33a	15.72a	16.11a	16.49
Level of significance	**	**	**	NS
CV(%)	6.87	10.44	8.58	10.38

In a column, figures having similar letter (s) or without letter (s) do not differ significantly, whereas figures bearing dissimilar letter (s) differ significantly as per DMRT. ** Significant at 1% level, NS= Not Significant

Table 5. Effect of seedling type on tiller production of boro hybrid rice cv. Jagoroni

Seedling treatments	Tiller hill^{-1}			
	45 DAT	55 DAT	65 DAT	75 DAT
AS(NPK)	9.50b	13.55b	15.02b	15.41b
AS(C)	12.39a	16.64a	18.13a	17.08a
SS(NPK)	9.61b	13.66b	16.91a	14.27b
SS(C)	12.13a	15.94a	16.77a	17.00a
Level of significance	**	**	**	**
CV(%)	6.87	10.44	8.58	10.38

In a column, figures having similar letter (s) or without letter (s) do not differ significantly, whereas figures bearing dissimilar letter (s) differ significantly as per DMRT. ** Significant at 1% level, NS= Not Significant

Table 6. Interaction effect of soil-water-fertilizer and seedling type on tiller production of boro hybrid rice cv. Jagoroni

Fertilizer treatments	Seedling treatments	Tiller hill^{-1}			
		45 DAT	55 DAT	65 DAT	75 DAT
AS (NPK)	16/1	8.44e	12.78ef	14.22de	14.44cd
	16/3	13.67a	18.00ab	18.00abc	19.00a
	8/1	9.22de	13.67def	15.11cde	13.44cd
	8/3	10.89c	14.33cdef	17.22bcde	15.56bc
AS (C)	16/1	8.11e	11.89f	14.00e	12.89d
	16/3	10.56c	13.00def	17.44bcd	14.00cd
	8/1	8.67e	12.89def	16.00bcde	13.75cd
	8/3	13.22a	16.78bc	18.89ab	17.55ab
SS (NPK)	16/1	10.45cd	14.78cdef	15.89bcde	15.00bcd
	16/3	14.00a	19.67a	20.78a	19.66a
	8/1	9.11e	12.78ef	19.22ab	14.00cd
	8/3	11.78bc	15.78bcde	14.67cde	17.33ab
SS (C)	16/1	11.00c	14.78cdef	16.00bcde	15.33bcd
	16/3	11.33bc	15.89bcd	16.33bcde	15.67bc
	8/1	11.44bc	15.33bcde	17.33bcde	15.89bc
	8/3	12.66ab	16.89bc	16.33bcde	17.56ab
Level of significance		**	**	**	**
CV (%)		6.87	10.44	8.58	10.38

In a column, figures having similar letter (s) or without letter (s) do not differ significantly, whereas figures bearing dissimilar letter (s) differ significantly as per DMRT. ** Significant at 1% level, NS= Not Significant

Number of tiller hill^{-1}: Production of tillers hill^{-1} measured at 10 day intervals starting from 45 DAT varied significantly due to soil-water-fertilizer management in all sampling dates except 75 DAT (Table 4). Plants grown in saturated soil receiving NPK fertilizers produced the highest number of tillers hill^{-1}(11.60 at 45 DAT, 15.25 at DAT 55 and 16.49 at 65 DAT). However, that was equally good to those produced by plants grown in saturated soil receiving cowdung (11.33 at 45 DAT, 15.72 at DAT 55 and 16.11 at 65 DAT). In general, plants grown in aerated soil either receiving NPK fertilizer or cowdung produced significantly lower number of tillers $hill^{-1}$ than that produced by plants grown in saturated soil. Again, in saturated soil, plants receiving NPK fertilizers produced more tillers $hill^{-1}$ than that produced by plants receiving cowdung. More availability of nutrients in soil condition accompanied by NPK fertilization enhanced nutrient uptake by the plants and resulted in more tiller production.

Tillering ability of cv. Jagoroni was significantly influenced by seedling age and seedling number $hill^{-1}$ at all sampling dates (Table 5). Number of tillers $hill^{-1}$increased up to 65 DAT then decreased. Tillering was maximum (12.39 at 45 DAT, 16.64 at 55 DAT, 18.13 at 65 DAT and 17.08 at 75 DAT) when seedling age was 16 days@ 3 seedling $hill^{-1}$ and that was similar to 8-day-old seedling @ 3 seedling $hill^{-1}$(12.13 at 45 DAT, 15.94 at 55 DAT, 16.77 at 65 DAT and 17.00 at 75 DAT). Number of tillers $hill^{-1}$got reduced when 16 or 8-day-old 1 seedling $hill^{-1}$ was used. The cumulative tiller production by 3 seedlings $hill^{-1}$ resulted in greater number of total tillers $hill^{-1}$. Significant variation in number of total tillers $hill^{-1}$ was noticed due to the effect of interaction of Soil-water-fertilizer and seedling treatment (Table 6). The interaction SS (NPK) 16/3 produced the maximum number of total tillers $hill^{-1}$ (14 at 45 DAT, 19.67 at 55 DAT, 20.78 at 65 DAT and 19.66 at 75 DAT) while the minimum one was produced by AS (C) 16/1(8.11 at 45 DAT, 11.89 at 55 DAT, 14.00 at 65 DAT and 12.89 at 75 DAT).

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