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FIELD CROPS

Performance of Rice under System of Rice Intensification (SRI) at CNR, Lobesa

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ABSTRACT

Rice production trials using SRI methods in a few locations in Bhutan have shown positive effects. This paper reports the performance of four rice varieties: IR 64, Bajo Maap 2, and Khangma Maap, and a local variety Nyabja using SRI practices conducted at Lobesa. IR 64 showed the highest yield performance of 10.1 t/ha followed closely by Nyabja and Bajo Maap 2 with 9.7 t/ha each. For all varieties tested, the SRI method out yielded the conventional methods. Statistical analysis showed significant differences ($p<0.01$) in yield among the cultivars and the two methods tested. Input cost for seed, fertilizer and water reduced with SRI methods. These results show that SRI techniques may provide an efficient option for farmers to enhance their rice production.

KEY WORDS: Lobesa, conventional methods, SRI, yields, varieties, methods.

INTRODUCTION

In Bhutan, one of the major constraints for achieving nation-wide food security is the current low rice yield. In 2006 the average national rice production was 2.7 t/ha (MoA, 2006), which is far less than the global yield of 3.8 t/ha (Uphoff, 2004). There have been several measures undertaken to raise rice productivity in Bhutan, for instances, like introduction of high-yielding varieties and certain technological developments. Yet, enhancing rice production still remains a priority goal of the Ministry of Agriculture (Ghimiray et al., 2008).

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The System of Rice Intensification (SRI) which is reported to be an efficient, economical and environmentally sound method of growing rice has received attention of the global farming community (Goud, 2008; Mishra et al., 2006; Stoop et al., 2002). SRI method shows promise for overcoming low yields. Studies in a number of countries like China and India have shown significant increases in rice yield, with substantial savings of seeds (80-90%), water (25-50%), and cost (10-20%) compared to conventional methods (Uphoff, 2004).

SRI is not a technology, but a set of simple ideas and principles that help produce more productive and robust plants from any rice genotype by providing an improved growing environment (Uphoff, 2005). Reduced use of seedlings, remarkable plant and root growth, profuse tillering from a single seedling, and bumper harvest for the farmers are important features of this method. Further, in the face of declining resources (land, water and labour), deteriorating soil health, increasing environmental concerns, and increasing cost of cultivation, SRI may mitigate or could overcome those resource constraints that confront the rice sector in the 21st century (Uphoff, 2004). Therefore, SRI method is considered a resource-conserving technique of rice production that is good for farmers, consumers, and the environment.

In Bhutan, following successful SRI tests in the preceding two years, both at farmer's field and in research centres, the method is gaining acceptance (Lhendup et al., 2008; Ghimiray and Thinley, 2008; Lhendup, 2008; Chhetri, 2007 & Lhendup, 2007). Further, it was felt necessary to carry out evaluation tests to affirm the performance of rice varieties at different localities using SRI method. Therefore, the study was undertaken to verify the performance of four different varieties: three improved rice varieties (IR 64, Bajo Maap 2 and Khangma Maap) and a local variety (Nyabja) at the College of Natural Resources (CNR) farm using SRI practices.

MATERIALS AND METHODS

Study site

The study was carried out in the 2008 season at the CNR farm, located at an altitude of 1450 masl. The site falls under typical dry valley along the Punatsangchu in west Bhutan with potential evapotranspiration ratio of 1.2. The relative air humidity is 75.5%. The site receives mean annual precipitation of 883 mm. The annual mean temperature is 17.70C (maximum of 23.20C and 9.90C minimum). The site has sandy clay loam soil and vegetation consists of dry habitat shrubs and mostly chirpine tree species (Wangda and Ohsawa, 2006).

Experimental Design

A modified complete randomized block design was used for the study with three replications using two methods (SRI and conventional) and four varieties (treatments). The four rice varieties tested using both SRI methods and conventional methods are IR 64, Bajo Maap 2, Khangma Maap and Nyabja. Treatments with SRI methods were assigned plots randomly and were separated by 50 cm wide spacing from each other. Similarly, treatments with conventional methods were randomly laid and were separated by 50 cm wide spacing. A bund was constructed within the field to separate the treatments with SRI methods and those with conventional methods to minimize cross-plot effects. The size of each plot was 6 m x 3.5 m.

Nursery and Seedling Transplanting

Nursery was established using pre-soaked incubated seeds on third week of May 2008. The rate of seeds used was 3.0 kg per acre (7.4 kg per ha). For SRI methods, transplanting of three leaf stage seedlings was done singly and at shallow depth (2-3 cm) without removing soil attached to the seedling roots into well-puddled and moist soil following a square pattern of 25 x 25 cm spacing (plant to plant and row to row). Three leaf stage seedlings were attained and transplanted at about 15-18 days after seeding in the nursery. For conventional methods, transplanting of older seedlings of 40-45 days in flooded field was done randomly at close spacing of less than 15 cm and in bunches of two to four seedlings.

Application of Organic Matter

Application of farm yard manures at the rate of 2 t/ha was done in both the SRI and conventional plots during land preparation. To be consistent with the conventional plots, no inorganic fertilizers were applied.

Water Management

After transplanting the SRI plots were left moist but without flooding for at least 12-14 days. This was then followed by alternate wetting and drying (AWD) until the end of the vegetative stage. This was done by irrigating the field for three to six days and then draining the field to dry out for a similar number of days. The field was completely left dry for about two to three weeks before harvest. In conventional plots however the field was kept flooded until two to three weeks before harvest.

Weeding

A total of three weedings were done on SRI plots using a rotary weeder, small locally- made tools followed by hand weeding. The first weeding was carried out between 16-18 days after transplantation and the subsequent weedings were done at an interval of two to three weeks.

Application of Herbicide

The pre-emergence selective herbicide (Butachlor) was not applied for this study although practiced by farmers in this locality.

Data analysis

Data analysis was done using SPSS. Analysis of variance was performed to determine the significance of difference between methods and within treatments besides simple statistical test.

RESULTS AND DISCUSSION

Results

Yield (t/ha)

Table 1 presents the mean yield and yield difference of four rice varieties evaluated using SRI and conventional methods. The average yield performance was better on SRI plots than conventional plots for all varieties. Among the cultivars, better yield response to SRI methods was observed with all four varieties against the conventional methods (Figure 1).

Yield performance of IR 64 was the highest with 10.1 t/ha followed closely by Nyabja and Bajo Maap 2 varieties with 9.7 t/ha each (Table 1). Increase in yield using SRI methods compared to conventional methods from the same varieties was 14%, 31% and 14% respectively. Mean yields comparison of four varieties applying two methods showed a significance of difference ($p<0.01$) between methods and varieties

(Table 1). However, interaction between variety and method is not significant (p=0.12).

Table 1. Mean yield and yield difference of four rice varieties tested using SRI and conventional methods.

Method	Spacing	Rice variety and yield (t/ha)			
		IR 64	Bajo Maap 2	Khangma Maap	Nyabja
SRI method	25 x 25 cm	10.1	9.7	5.2	9.7
Conventional method	Farmers random	8.7	6.7	3.7	8.3
% difference (yield)		14	31	29	14
		F pr			LSD
Method and variety interaction		0.115 ns			
Methods		0.000**			0.68
Varieties		0.000**			0.48

** Significance difference at 1% level; ns non significance; CV% = 4.2

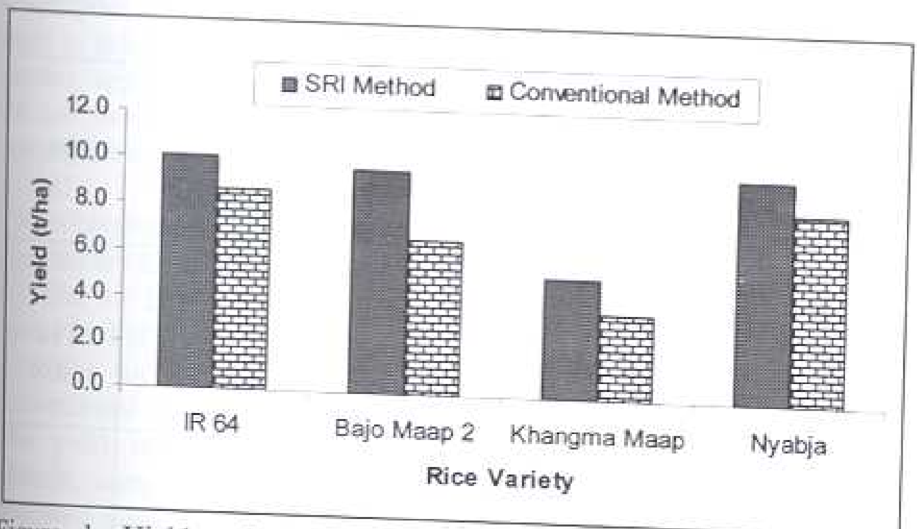

Figure 1. Yields of four rice varieties evaluated using SRI and conventional methods.

Number of Fertile Tillers

Table 2 presents the result for number of fertile tillers, a main yield-contributing parameter of the four rice varieties evaluated at the CNR farm. In all four varieties tested, the average number of fertile (effective) tillers per hill was higher in the SRI plots than in conventional plots. Among the varieties, the highest number of productive tillers was found with Nyabja (38), followed by IR 64 (30). This was an increase of 53% and 33% compared to same-variety results with conventional methods. The number of tillers for Bajo Maap 2 is close to IR 64. However, the number of tillers for Khangma Maap was lower.

Inputs

Average seeds use was 3.0 kg per acre in SRI methods as compared to 22.5 kg seeds per acre for conventional methods. Use of inorganic fertilizer was nil in SRI methods and irrigation water use was reduced through AWD compared to flooding practiced in conventional methods.

Table 2. Yield-contributing parameters for four rice varieties at CNR farm (average of three replications).

Sl. No.	Parameters	Rice variety			
		IR 64	Bajo Maap 2	Khangma Maap	Nyabja
1	**Fertile tillers/hill**				
	SRI method	30	28	19	38
	Conventional method	20	19	13	18
2	**Plant height (cm)**				
	SRI method	91	115	150	110
	Conventional method	90	110	155	108
3	**Number of hills/6m^2**				
	SRI method	96	96	96	96
	Conventional method	110	125	100	118

Discussion

The average yield performance was better on SRI plots than conventional plots for all varieties. This is supported by the absence of significance of difference in interaction between variety and method. The significant ($p<0.01$) increase in yield with SRI methods for all varieties is mainly attributed to the increased number of productive tillers. Transplanting of young seedlings singly seems to preserve the potential within plants for profuse tillering and root growth. According to Stoop (2005), the extensive root development under SRI translates into accelerated vegetative development phase and an increased nutrient uptake capacity leading to an extended, more effective, grain filling phase (Stoop, 2005).

The increase in yield for all varieties also indicates that all cultivars respond positively to SRI methods as reported by Uphoff (2004). According to Uphoff (2004) SRI practices improve the growing environment of plant by managing soil, water and nutrients differently so that more productive phenotypes having much larger root systems can result from any rice genotype. Alternate wetting and drying processes seem to facilitate root growth by accessing both adequate water and air. Further, application of FYM in SRI methods not only seems to improve the soil structure but also enhances the number and diversity of useful soil organisms in the field.

Yields obtained for IR 64 and Bajo Maap 2 varieties with SRI methods reported are higher than average yields obtained for IR 64 (6-8 t/ha) and 6-7 t/ha for Bajo Maap 2 at RC station (Ghimiray et al., 2008). The recent trial at Bajo using SRI method also showed an average yield of 8.56 t/ha for IR 64, an increase in yield by 15-20% compared to conventional practice in Bajo on station (Ghimire and Thinley, 2008). The yield for Khangma maap, although recommended for higher altitude, using SRI methods is comparable or slightly higher than the observed yield of 5.12 t/ha at the Khangma Research station (ibid). Study done by Lhendup et al. (2008) at Khangma research station reported higher yield for this variety using SRI methods. Yield increase for these varieties may be because of the favorable soil and climatic conditions. According to Anthofer (2004), highest yield for any variety can be expected under favorable environmental conditions with SRI methods. Such conditions are met where soil fertility is higher, rainfall is sufficient and well distributed, and crop management is sufficiently good (ibid).

Additionally, with SRI methods there is a saving of inputs like seed, water, and fertilizer. Use of seed reduced by about 86% (considering average use of 22.5 kg seeds per acre for conventional methods against a maximum use of 3.0 kg seed per acre with SRI methods). This could be attributed to transplanting of young seedlings singly in wider spacing which reduces plants' competition for nutrients, water and sunlight. This result can be interpolated to reduction of cost for the purchase of about 20 kg of seeds per acre. Likewise there was no need to use inorganic fertilizer.

CONCLUSION

The results showed positive effect of SRI methods on the yield and yield-contributing parameters assessed in this study. The higher yield obtained for IR 64 and Bajo Maap 2 varieties with SRI methods compared to the conventional practice in RC Bajo indicates a significant impact of SRI methods on rice productivity. Even local variety like Nyabja seems to perform equally better using SRI methods. Further, seed use was reduced by about 86% compared to the conventional methods. Use of additional inputs like inorganic fertilizer was not necessary thereby saving cost. Thus there is a potential for subsistence farmers in the country to eventually achieve higher yields with reduced costs using SRI techniques. This will provide farmers with the opportunity to supplement their incomes through the sale of excess products. Hence, the adoption of SRI techniques by farmers could be encouraged to contribute to higher rice production and ensure household food security. However, further studies using SRI methods are required to understand the cost benefit analysis, effective crop establishment methods and straw yield.

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