Original Research Article

Comparative Performance of System of Rice Intensification (SRI) and Conventional Methods of Rice Cultivation in Gopalganj District of Bangladesh

Abstract

An experiment was conducted at BINA sub-station, Gopalganj during *Aus* season in 2019-20 to compare the performance between System of Rice Intensification (SRI) and conventional rice cultivation methods. In this experiment the treatments were system of rice intensification (SRI) and conventional method of rice cultivation and the test crop was Binadhan-14. In SRI method ($A_{10}S_2M$) seedling age (A) was 10 days, no. of seedlings/hill (S) was 2 and irrigated condition was moist (M). In conventional method ($A_{25}S_3F$) seedling age (A) was 25 days, no. of seedlings/hill (S) was 3 and irrigated condition was flooded (F). In terms of plant height, tillers/hill and dry matter partitioning SRI performed better than the conventional method of rice cultivation. SRI showed better performance in terms of yield contributing characters than conventional cultivation method. SRI showed the highest yield (7 t/ha) than conventional (6.67 t/ha) cultivation method.

Keywords: System of Rice Intensification (SRI), *Aus*, Binadhan-14, moist condition and dry matter partitioning.

Introduction

Rice (*Oryza Sativa L*) constitutes one of the most important staple foods of over half of the world's population. Globally, it ranks third after wheat and maize in terms of production (Bandyopadhay and Roy, 1992). Today's world person of 6.0 billion is expected to increase by 35% to reach about 8.0 billion by 2030. The increasing population will result in considerable additional demand for food. Simultaneously, water demand for non-agricultural sectors will keep increasing in both developed and developing countries. About 40% of the land in the world is under arid and semi-arid climatic conditions (Gamo, 1999). With a rapidly increasing world population, the pressure on limited fresh water resources increases. SRI is a rice cultivation method developed in Madagascar which increases rice productivity with reducing the external inputs like fertilizers and herbicides (Thakur et al., 2009 and Vermeule, 2009). Sustainable rice production would be possible by increasing yields on the same piece of land reducing the input like water, chemicals, fertilizers and labor (Bouman et al., 2005; Mati and Nyamai, 2009). SRI consists of some principles including transplanting of younger seedlings (< 15 days) at wider spacing in square grid pattern, only one seedling hill-

1, water management with alternate wetting and drying, mechanical weeding and use of organic compost fertilizer instead of chemical fertilizer (Stoop et al., 2002). Use of younger seedlings, wider spacing and a single seedling hill-1 facilitate the utilization of the resource to develop stronger individual plants in the rice field. System of Rice Intensification (SRI) method of paddy cultivation is very important because it needs less seed, less water, less fertilizer and fewer attacks of pest and disease but per hectare yield gain is over traditional method of paddy cultivation (Prusty, Ajay Kumar, et al. 2020). It has been recognized that the conventional method, which is based on high yield varieties and intensive uses of artificial inputs, is no longer acceptable since in many ways it has resulted in the degradation of natural resources and undermined rural values. At this time to be search for alternative or new methods of rice productivity which is capable of restoring the natural resources and while maintaining the high productivity of rice crop. Declining profitability owing to high input prices and low prices of rice is also leading to farmers' withdrawal from rice cultivation, and thus jeopardizing future rice supply (Thiyagarajan, 2001). There is a need to make rice cultivation more efficient in terms of returns on farmer investments and use of water resources. So the experiment was conducted to find out the proper method of sowing of rice in SRI and compare to conventional method.

Materials and Methods

This experiment was carried out at BINA sub-station, Gopalganj during Aus season in 2019-20 to compare the performance between System of Rice Intensification (SRI) and conventional rice cultivation methods. The rice variety was Binadhan-14. The experiment was laid out in a RCBD with three replications. The experiment was carried out in pot. The unit pot size was 60cm X 40cm. Two seedlings were transplanted in 15cm X 20cm spacing. The treatments were SRI and conventional methods of cultivation. In SRI method ($A_{10}S_2M$) seedling age (A) was 10 days, no. of seedlings/hill (S) was 2 and irrigated condition was moist (M). In conventional method ($A_{25}S_3F$) seedling age (A) was 25 days, no. of seedlings/hill (S) was 3 and irrigated condition was flooded (F). The irrigations were given as and when required depending upon the intensity of rains. Water level of 5±2 cm was maintained in treatment under conventional method during the crop growth period. In SRI, water level was maintained at soil saturation level by intermittent light irrigation coinciding with alternate wetting and drying. Willem et al., (2002) some further details of the SRI methodology are contrasted with the conventional practices for irrigated rice in Table 1.

Table 1. Comparison between major agronomic practices for SRI and for conventional irrigated rice production

	Seed requirement (kg/ha)	Age of seedlings (days)	Transplants per clump	Spacing of clumps (cm)	Transplants per m^2	Water management	Fertility management	Weed management
SRI method	5 - 10	8 – 15	1	25x25 to 50x 50	4 to 25	Moist soil; intermittent drying	Compost	3-4 rounds, with rotary hoe
Conventional production methods	80 - 120	20 - 30	3 to 4	10 x 10 to 20x20; usually in rows	75 to 150	Continuous flooding	Basal mineral fertilizer +N top dressing	2 rounds; may use herbicides

Source: W.A. Stoop / Agricultural Systems (2002)

Application of fertilizer and intercultural operations were done as recommended. At 30, 60 and 90 days after transplanting (DAT) data on different morphological characters were collected and data on yield and yield contributing characters were collected at harvest. The collected data were analyzed by using Statistix 10 package and the mean differences were adjusted by LSD test.

Results and Discussion

Plant height

Plant height is an important index for assessment of crop performance. There was a gradual increase in the plant height till maturity. This was mainly due to increase in the length of leaves and size of panicle till harvest. System of rice intensification recorded significantly higher plant heights than conventional method of cultivation at all the growth stages. Similar result was found by Patwardhan and Patel (2008). The tallest plants were recorded in SRI and shortest plant height found in conventional methods of cultivation. In both cultivation methods plant height increased up to 90 DAT (Fig.1). Similar significant variation in plant height was also found by Alam et al. (2009).

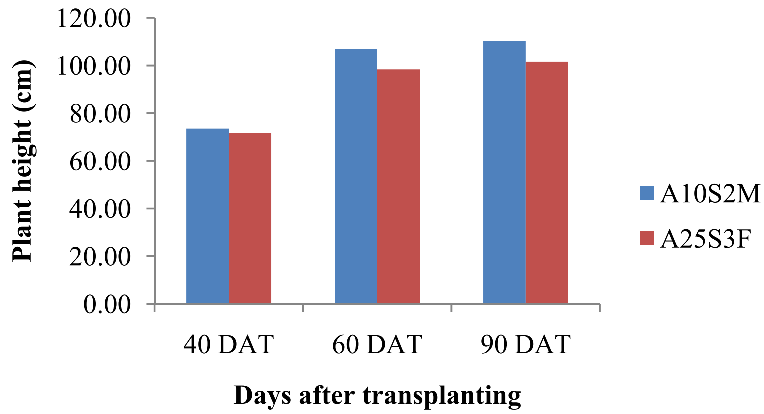


Fig. 1: Plant height (cm)

No. of tiller/hill

No. of tiller/hill was increased significantly with system of rice intensification. Tillering ability is genetically controlled, but is also much dependent on environmental factors. System of rice intensification has higher tillers number as under wide spacing each individual crop could have effectively utilized more available resources such as space, foraging area for root system, better root spread, more light interception etc. resulting in enhanced tiller production (Thavapraprakaash et al., 2008). SRI showed the highest no. of tiller/hill than conventional method of cultivation throughout the growing season (Fig.2). In both SRI and conventional cultivation methods no. of tiller/hill showed the similar trends throughout the growing season. These results are consistent with the work of Laulanié (1993) and Serpantié et al. (2013), showing that the technical methods of SRI avoid the growth-limiting factors introduced by transplanting stress when older seedlings are used and when transplanting is done quickly and carefully.

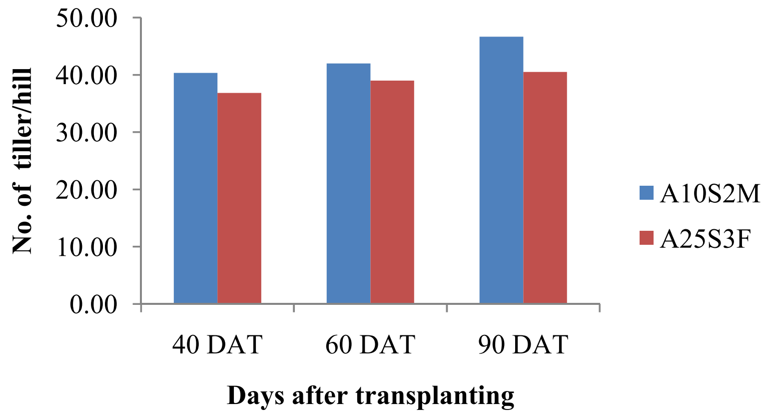


Fig. 2: No. of tiller/hill

Dry matter partitioning

The dry matter accumulation is increased as the growth progressed and the maximum value was observed at 60 DAT for both leaf and leaf sheath. On the other side the highest dry matter accumulation for panicle was recorded at 90 DAT. System of rice intensification increased plant height, tillers/hill and leaf area index indicating higher photosynthetic efficiency which in turn resulted in higher dry matter accumulation than conventional method of cultivation at all the growth stages. This was in conformity with the finding of Singh et al. (2005). SRI increased plant height, total tillers/hill and leaf area index indicating higher chlorophilic area improving photosynthesis efficiency of plant which in turn resulted in higher dry matter accumulation. Dry matter partitioning into leaf, stem and leaf sheath increased up to 55 days after transplanting while panicle dry weight continued to increase till maturity. Dry matter partitioning into vegetative organs decreased after 55 days after transplanting which indicated remobilization of assimilates from vegetative parts towards developing grain. Several authors (Barvestani and Pirdashti 2001; Ntanos and Koutroubus, 2002) showed that two physiological processes are involved in grain growth; utilization of photosynthates through current photosynthesis and remobilization and translocation of assimilates accumulated before anthesis. In present study, it seemed that stem had higher amount of dry matter remobilization than other vegetative organs of rice as reduction of stem reserve was more pronounced. This result was in consistent with the findings of Yang et al. (2003) and Kumar et al. (2006) and they reported that different rate of remobilization among the rice genotypes were reported to their agronomic and physiological characteristics.

Leaf dry weight/hill

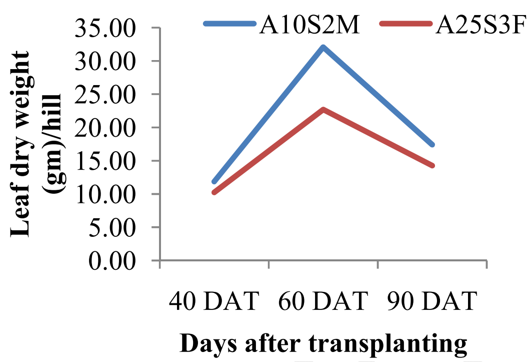
It was observed that leaf dry weight reached the highest plateau at 60 DAT in both the cultivation methods. SRI showed the highest leaf dry weight throughout the growing season than conventional cultivation method (Fig.3a).

Leaf sheath dry weight/hill

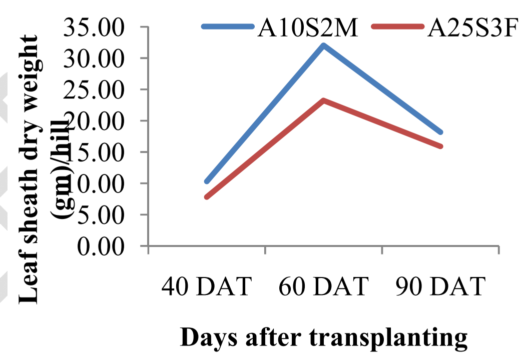
Leaf sheath dry weight also showed the similar trends as leaf dry weight throughout the growing season (Fig.3b). It was observed that dry matters partitioning were better at SRI than conventional cultivation method. It was might be due to efficient water use and no. of seedlings that lower the competition in SRI cultivation method.

Panicle dry weight/hill

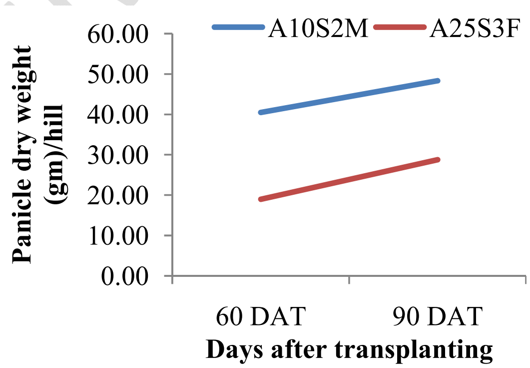
In SRI panicle dry weight decreased up to 90 DAT but conventional cultivation method showed the opposite trends. SRI showed the highest panicle dry weight than conventional cultivation method throughout the growing season (Fig.3c).



(3a)



(3b)



(3c)

Fig. 3: Dry matter partitioning in different plant parts.

Significant improvement in yield attributes i.e. effective tillers/hill, panicle length, spikelets/panicle, filled grain/panicle and 1000- grain weight was recorded under system of rice intensification (Table 2). This may be attributed to adequate availability and supply of resources under system of rice intensification and their translocation along with other nutrients to the sink. Lu et al. (2005) also reported that changes in management under SRI could form more photosynthetic organ, strengthen photosynthetic ability, produce higher dry matter, provide sufficient nutrient to sink continually, make the seed more plump, increase 1000-grain weight, seed setting percentage and filled grains per panicle. Conventional method of cultivation resulted in shorter grains, which was largely due to low rate of photosynthesis and poor supply of photosynthate to the developing sink.

All the yield contributing characters showed statistically similar except 1000 grains weight. SRI showed better performance in terms of yield contributing characters than conventional cultivation method. SRI showed the highest yield (7 t/ha) than conventional (6.67 t/ha) cultivation method (Table 2).

Table 2. Yield and yield contributing characters

Treatment	Effective tiller $hill^{-1}$	Non – effective tiller $hill^{-1}$	Panicle length (cm)	spikelets/panicle	Filled grains $panicle^{-1}$	Unfilled grains $panicle^{-1}$	1000 grains weight (gm)	Yield (t/ha)
$A_{10}S_2M$	36.17a	8.50a	24.60a	124.93a	96.80a	28.13a	23.57a	7.00a
$A_{25}S_3F$	32.83a	4.83a	22.21a	96.80a	77.87a	18.93a	21.29b	6.67a
LSD (5%)	18.44	11.13	5.99	76.38	96.32	44.73	2.14	1.05
CV%	15.21	47.53	7.28	19.61	31.39	54.11	2.72	5.71

Conclusion

SRI practice is more beneficial than the conventional method of rice cultivation at Gopalganj district especially in southern part of Bangladesh. The present study showed that rice cultivation adopting SRI produced (7 t/ha) higher yield over the conventional method (6.67 t/ha). Moreover, in SRI technique as very tiny seedlings was used that could be maintained easily in dapog seedbed and ready for transplanting in short time where it require 20 to 25 more in conventional method. In this experiment SRI proved their better performance over the conventional method of rice cultivation in terms of morphological characters, dry matter partitioning and yield and yield contributing characters.

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