Comparison of Productivity of System of Rice Intensification and Conventional Rice Farming Systems in the Dry-Zone Region of Sri Lanka

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Abstract

Productivity of System of Rice Intensification (SRI) method was evaluated with conventional rice farming systems in Sri Lanka. An experiment was carried out in the dry zone region during 2002 (Oct)/2003 (March) Maha season and a popular rice variety B.G. 358 (3.5 months duration) was used. Four treatments namely; SRI (T1; one plant per hill with 25 cm x 25 cm spacing), conventional transplanting (T2; three plants per hill with 15 cm x 15 cm spacing), conventional broadcasting (T3; 100 kg seeds/ha) and high density broadcasting (T4; 300 kg seeds/ha) were arranged in a randomized complete block design with four replication. Growth parameters and dry matter distribution in every two weeks intervals and yield components and grain yield at maturity were measured.

Dry weights of stems, leaves, and roots and the total dry weights, leaf area and total root length per hill during the growing period and the tiller number per plant at heading were significantly higher in SRI (T1) compared to other treatments. However, all these parameters, when expressed per unit area basis, were not significantly different. Average plant height growth and leaf chlorophyll content during the growing stages were also similar among treatments. Yield components of number of panicles per hill and number of spikelets per panicle were remarkably higher in the SRI (T1) though the total panicle number per unit area was higher in T3 and T4 treatments. Grain yield was 7.6 t/ha in the SRI and it was 9%, 20% and 12% greater than the conventional transplanting (T2), and normal (T3) and high density (T4) broadcasting. Inorganic chemicals and irrigation water used were less in the SRI systems, though 2-3 additional manual weeding was carried out.

Overall results suggested that the higher grain yield production in the SRI farming system may be attributed to the vigorous and healthy growth, development of more productive tillers and leaves ensuring greater resource utilization in the SRI compared to conventional transplanting and broadcasting systems. Therefore, SRI farming systems could be introduced to small-scale rice farmers in Sri Lanka as a sustainable farming system.

Media Summary

System of rice intensification (SRI) farming method produce greater grain yield compared to commonly use conventional transplanting and broadcasting rice farming systems in Sri Lanka.

Key words

Paddy farming systems, organic farming, dry matter distribution, low cost farming, yield potential, rice.

Introduction

Rice is the staple food and paddy farming is the main source of employment for the majority of the rural population in Sri Lanka. Contribution of agriculture sector to GDP in 2000 is 15.9%, out of that 20% is from paddy farming (Central Bank Report 2001). The world demand for rice is projected to increase by as much as 70% over the next 30 years (IRRI Progress Report, 1997). Sri Lanka still imports 14% of the total requirement of 3.1 million Mt per year (Central Bank Report 2000). Conventional rice farming methods could achieve average yield of 3.5 – 3.8 t/ha though the country's potential yield is about 9 t/ha

(Meththananda, et al., 1990). Use of agro chemicals are expensive and cause several environmental problems, and the conventional paddy farming is becoming unsustainable and unprofitable.

System of Rice Intensification (SRI) farming method (Uphoof, 1999) was first introduced to Madagaskar and has been practiced in several other countries as an alternative sustainable low-cost system to the conventional farming systems (Batuvitage, 2002; http://ciifad.cornel.edu). SRI farmers have reported that their cost of production is usually half of conventional system and the yield was high (Shao-hua et al., 2002). SRI does not require the application of agrochemicals such as fertilizer or pesticides. Increased weeding is required, because rice fields are not kept continuously flooded. Farmers reported that with SRI methods, their rice plants are better able to resist damage from pests and diseases, making agrochemicals usually unnecessary (http://ciifad.cornell.edu/sri/). Though several farmers are using the SRI system in Sri Lanka, its production potential had not been studied in detail and not formally accepted as a viable farming technique by the Sri Lankan government (Batuvitege, 2002). This study was initiated to investigate production potential of SRI system in the major rice growing areas compared with the conventional paddy farming systems commonly used in the region.

Materials and methods

The experiment was carried out in a Seed Farm (CIC-Hinguraggoda) in the agro-ecological zone of low country dry zone ($08^0 03^1$ N, $80^0 55^1$ E) of Sri Lanka during 2002 (Oct)/2003(March). Experimental site is having Reddish Brown Earth (RBE) and Low Humic Gley soils (LHG), and the average annual rainfall and temperature range from 1960 mm to 906 mm and from 24^0C to 29^0C respectively.

The experiment consisted of four treatments (T); T1 - Crop establishment according to SRI method (8 days old seedlings were planted [one plant per hill] at a spacing 25 cm x 25 cm) ; T2 - Conventional transplanting (21 days old seedlings were planted [3 seedlings per hill] at a spacing 15 cm x15 cm); T3 - Conventional broadcasting (seed rate is 100 kg/ha); T4 - High-density broadcasting (seed rate is 300 kg/ha). Treatments were replicated four times and arranged using a Randomized Complete Block Design (RCBD). Plot size was 9 m x 3 m = 27 m^2. At the land preparation stage, cow dung (dry) was applied (1 kg/m^2) only to SRI experimental plots. Popular new improved rice variety of B.G.358 (3.5 months duration) was used.

Soil was kept moistened, without standing water in the SRI treatments. After heading 1 – 2 cm water level was maintained. For other treatments, a continuous water level was maintained. First manual weeding was done 10 days after transplanting and two more weeding with 14 days interval thereafter, using rotary hoe only in the SRI (T1) treatments. All other treatments were applied with Sofit 30 EC at a rate of 640 ml/ac to control weeds. Only for SRI treatment, 2nd top dressing and 3rd top dressing were applied at a rate of 1/5 of the Department recommendation. All other management practices were carried out as recommended for each farming system. Sampling was carried out at 2 week intervals (from an area of 2500 cm^2) to take growth and physiological measurements. Yield components and final yield were taken at physiological maturity from an area of 4 m^2.

Results and Discussions

Growth parameters

Plant height increment was similar among all the treatments reaching to about 90-110 cm just before heading. Dry weights of stems, leaves, roots and the total plant weight per hill was greater throughout the growing season in the SRI treatment (T1) resulting nearly 20 time higher total dry weight compared to T3 and T4 and 4 times higher dry weight compared to T2 at the maturity. However, dry matter distribution and total dry weight per unit area basis showed no difference due to density differences. Average tiller number per plant was 29, 4, 2 and 1.5 in the SRI, T2, T3 and T4 treatments respectively.

Per hill leaf area is significantly higher in T1 (0.48 m^2) at heading stage compared to T2 (0.1 m^2), T3 (0.03 m^2) and T4 (0.02 m^2) treatments. This increased of leaf area may be due to production of higher number

of tillers per plant and leaves per tiller in the SRI treatment. However, the leaf area index were similar in the T1 and T4, and it was highest in the T3 and lowest in the T2 treatments. Leaf chlorophyll content was similar throughout the experimental period, though there was a tendency to have slightly lower values in the T1 and T2 treatments which may be due to transplanting stress.

Yield components and grain yield

The number of panicles per unit area was significantly different among the treatments. The broadcast treatments of T3 (355 panicles/ m^2) and T4 (410 panicles/ m^2) had significantly higher panicle number per unit area, because of higher plant densities while the panicle numbers were 290/m^2 and 242/m^2 in the transplanting treatments of T1 and T2 respectively. However, the grain number per panicle showed the opposite relations. The SRI (T1) had the highest grain number (290) followed by the T2 (242), T3 (180) and T4 (156) treatments. Grain yield data showed that the SRI (T1) treatment had the highest grain yield production (7.6 t/ha) while T2, T3 and T4 had 6.9, 6.3 and 6.8 t/ha respectively.

Overall results indicated that even though the plant density was much lower in the transplanted treatments especially in the SRI (T1) they produced a greater number of productive tillers with more leaves producing higher dry matter comparable to the broadcast, high density treatments T3 and T4. About 24-29 productive tillers from one single seedling and an average of 290 seeds per panicle resulted 9%, 20% and 12% greater grain yield in SRI (T1) treatment compared to conventional transplanting (T2) and conventional normal (T3) and high density (T4) broadcast farming systems respectively. In the SRI treatment inorganic chemical used was minimal and water use was less. However, greater ground exposure due to low plant density and no standing water enhanced weed growth in the SRI treatment. As a result several additional weedings were carried out. This may be a limitation for large scale rice farmers in adapting SRI system. It was also observed that a greater proportion of plants were lodged in the broadcast treatments of T3 and T4, indicating greater yield losses if mechanical harvesting was used.

SRI methods change the way plants, soil, water and nutrients are managed, rather than utilizing inorganic fertilizers or other agrochemicals. SRI also reduced the need for irrigation water by about half and diminished the requirement for capital and seed (Uphoff, 2003). Many studies carried out in the developing tropics reported similar yield responses with the SRI faming compared to conventional systems. Studies confirmed that the yield increment is mainly attributed to greater tiller number (over 30 tillers per hill), number of grains per panicle (>200) and resulting healthier plants with low pest and diseases problems that enhance efficient resource capture and portioning of dry matter for grain production (cedac@cmnet.com.kh; Longxing et al., 2002, Stoop et al., 2002; www.dfid-psp.org/highlights/2001/sri.html).

Conclusions

Overall results of growth and yield parameters suggest that rice plants in the SRI farming systems grow vigorously, producing more tillers and leaves ensuring enhanced resource utilization and more dry matter as grain, resulting in greater grain production compared to conventional transplanting and broadcasting systems.

Considering all productive, environmental and economic benefits and considering practical limitations, SRI farming systems can be introduced to small-scale rice farmers in Sri Lanka as a sustainable farming system.

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