

DRR's Experience of SRI Method of Rice Cultivation in India

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Abstract

Multilocation and on stations trials were conducted during 2004 and 2005 to evaluate System of Rice Intensification (SRI) method of rice cultivation in comparison with normal transplanting (NT) and Integrated Crop Management (ICM) methods . Grain yield recorded under SRI was significantly higher under SRI compared to that under NT at 53% of the locations, while it was similar to that under ICM at 33% of locations involved. Higher grain yield under SRI was recorded in diverse soil types, with wide range of soil pH (6-8) and different regions which could be associated with increased number of panicles per unit area, biomass and panicle weight. However, the cultivars used had significant interaction with method of cultivation at 28% of the locations. Rice hybrids responded better than varieties. Normal transplanting with wider spacing or SRI method with older seedlings did not enhance grain yield in the on station studies at DRR. Significantly, SRI could be adopted successfully even under late transplanting conditions.

Introduction

The System of Rice Intensification (SRI) developed in Madagascar by Fr. Henri de Laulanie in association with Non-Governmental Organization – Association Tefy Saina (ATS) and many small farmers in the 1980's is spreading to many countries. SRI cultivation is a 'system' rather than a 'technology'. It is based on the insights that rice has the potential to produce more tillers and grain than now observed and that early transplanting and optimal growth conditions (optimal spacing, humidity, biologically active and healthy aerobic soil conditions during vegetative phase) can fulfill this potential (Uphoff, 2002). However, Sheehy *et al.*, 2004 reported that SRI has no inherent advantage over conventional system and extraordinary high yields are likely to be the consequence of error. Such contrasting claims on SRI have come from different countries where the system is being introduced. India is no exception. However, in view of the looming crisis of water for rice cultivation in the times to come, it is imperative to address these issues in the right perspective and get the scientific facts of SRI established.

With this background, DRR has been organizing multi-location and station trials to evaluate SRI method vs normal transplanting by taking several cultivars, under variable soil conditions, different time of transplanting with variable age of seedlings etc. in order to understand the scientific basis of the merits of the system, fine tune the system for wider adaptability and to note limitations, if any. Salient features of the results obtained so far in multi-location and on station studies are presented here and discussed in light of previous and current claims made.

Multi-location studies :

Kharif 2004 :

Four crop establishment methods were compared. These were:

S1 – Standard transplanting

S2 – System of rice intensification (SRI)

S3 – Integrated crop management (ICM) with modified mat nursery

S4 – Direct Seeding with drum seeder

Three genotypes viz., variety Krishnahamsa, rice hybrid KRH-2 and Local check variety were used. Studies were conducted under identical nutrient management conditions across the treatments.

Test sites : 21

Kharif 2005 :

Four crop establishment methods were compared. These were:

S1 – Standard transplanting

S2 – System of rice intensification (SRI)

S3 – Integrated crop management (ICM) with modified mat nursery

S4 – Direct Seeding with drum seeder

Only one local popular rice variety was used. Studies were conducted under identical nutrient management conditions across the treatments.

Test sites : 21

Results

Kharif 2004 :

Out of 18 locations which recorded significant differences among the treatments, only at 3 locations (ARI- Rajendranagar, Patna, Almora) SRI treatment resulted in significantly higher grain yield compared to other crop establishment methods across the genotypes. However, SRI method gave significantly higher grain yield (7-42%) than normal transplanted crop at 8 more locations *viz.*, Siruguppa, Mandya, Adhuthurai, Jagdalpur, Karjat, Ranchi, Titabar and Arundhatinagar irrespective of climate and soil type (Fig. 1). ICM practice was better than SRI at Coimbatore and Aduthurai; while SRI and ICM method of crop establishment were comparable at Mandya, Jagdalpur, Karjat and Ranchi and were superior to the standard method of transplanting. At Malan and Kapurthala normal transplanting recorded significantly higher grain yield than SRI method. There was significant interaction between crop establishment method and genotype at 5 locations. At ARI, Rajendranagar, rice variety Krishnahamsa and local check M-7 recorded significantly higher grain yield with SRI method compared to the other treatments, while the rice hybrid KRH-2 registered comparable yields both with SRI and ICM methods. At Adhuthurai also KRH-2 recorded significantly higher yield with SRI method.

At 8 of the 11 locations which recorded higher grain yield under SRI, the increased yield could be attributed to higher number of panicles per unit area and panicle weight. These 11 locations covered all the soil types *viz.*, sandy loam (no. of locations=2), clay (2), clay-loam (4) and silty loam (3). However, at Kapurthala (loam soil) and Malan (acidic soil and high altitude), SRI was not found as much promising. Nevertheless, SRI response in terms of higher grain yield was relatively more in clay-loam soils (22%) as compared to sandy-loam, clay or silty loam soils. Likewise, grain yield under SRI was of higher order (9.7-14.5%) in slightly acidic soil (5.4-6.5 pH) as compared with that observed in alkaline soils with 7.5 to 8.1 pH. Region-wise, SRI system recorded higher grain yield in southern region as compared with eastern, northern and hills.

Kharif 2005 :

At ten locations (ARI-Rajendranagar, Coimbatore, Aduthurai, Siruguppa, Mandya, Jagdalpur, Varanasi, Rewa, Karjat, Mandya) grain yields under SRI were significantly higher than those under normal transplanting. At five locations (Raipur, Nawagam, Maruteru, Karimgunj, Chatha) the yields did not differ significantly between the two, while at four locations (Karaikal, Kauprthala, Pusa, Malan) normal transplanting recorded higher grain yield than SRI (Fig. 2). At seven locations grain yield recorded under SRI and ICM did not differ significantly. Only at Rewa and Aduthurai SRI recorded significantly higher grain yield compared with ICM treatment. Similar to the observations during 2004, at both Kapurthala and Malan normal transplanted crop gave significantly higher grain yield than those raised under SRI or ICM methods.

Of the ten highlighted locations, at three locations number of panicles per unit area accounted for yield increase under SRI. Except at Maruteru, all the other five locations in the south recorded better performance of SRI. Likewise, four of the five locations in central part of the country recorded better yields under SRI. At four locations the soil was clay loam while at three it was sandy loam. Soil was slightly acidic at six locations (pH 7.1 to 7.7) while being alkaline (6.1 to 6.5) at two locations. Another significant fact was that at the 11 locations recording higher grain yields under SRI, transplanting was done during the period stretching from July to August. This indicated the suitability of SRI even under late transplanted conditions.

Studies at DRR :

Rabi 2003

S1 – Standard transplanting

S2 – System of rice intensification (SRI) with 12 day old seedlings

S3 – System of rice intensification (SRI) with 25 day old seedlings

S4 – Standard transplanting with 25 X 25 cm spacing

Varities : 7

Two hybrids - PHB-71, DRRH-1, four high yielding varieties – Jaya, Rasi, Krishnahamsa, Tulasi and a scented variety – Pusa Basmati

Kharif 2004 & 2005

Four crop establishment methods were compared. These were:

S1 – System of rice intensification (SRI) transplanting 8 day old seedlings immediately after uprooting

S2 – System of rice intensification (SRI) transplanting 8 day old seedlings 12 hours after uprooting

S3 – System of rice intensification (SRI) transplanting 8 day old seedlings 24 hours after uprooting

S4 – System of rice intensification (SRI) transplanting 8 day old seedlings 48 hours after

Varieties : 2

Results :

Rabi 2003

Mean over the varieties, SRI method gave 16.6% higher grain yield over normal transplanting. There was wide variability among cultivars in their response to SRI and normal transplanting. SRI method gave, 46 – 48% higher yield in hybrids (PHB-71, DRRH-1), 5.2 to 17 % in high yielding varieties (Tulasi, Rasi, Krishna hamsa and Jaya) while decreased yield in Pusa basmati (-35 %). The increased yield under SRI method was due to higher number of effective tillers in unit area and total biomass. SRI method involving planting of 25 day old seedlings, or normal transplanting at wider spacing (25 X 25 cm) did not record better yields than the standard practice of SRI with 12 day old seedlings. These results indicated that all the varieties were not suited for SRI cultivation method. Rice hybrids recorded better response to SRI method as compared to high yielding and scented varieties during *rabi* season under vertisols (clay soils) of Deccan plateau.

Kharif 2004 and 2005

Results of these studies clearly brought out superior performance of the treatment involving transplanting 8 day old seedlings immediately after uprooting in comparison with other treatments . Delay in transplanting by 12 – 48 hours after uprooting gradually decreased grain yield (4- 22% in 2004 and 8 – 20% in 2005).

Discussion :

The basic principal of SRI cultivation has been that rice plants do best when their roots grow large because young seedlings are transplanted at shallow depth and wider spacing, soil is kept well aerated and rich with diverse microorganisms. SRI differs from normal flooded rice in 1) transplanting of 8-10 day old seedlings, 2) wider spacing 3) reduced use of water by avoiding continuous submergence and 4) use of more compost and organic manures. SRI has been claimed to result in phenomenal increase in grain yield as much as 2 to 4 folds, save water by 50% or more, besides saving on seed and fertilizer cost using only fraction of the quantity otherwise recommended. SRI is also claimed as variety independent system. While enthusiastic proponents of SRI have unsubstantiated overblown claims, cynical conservatives have turned down these claims without even seriously testing them.

The present studies, even though representing only the beginning, have addressed some of the issues involved. It is significant to note that in only 11 of the 18 locations during 2004 and 10 out of 21 locations during 2005 significant yield advantage of SRI was seen. The quantum of this yield gain was 4 to 55 percent. Failure to realize yield advantage at other locations may be either due to lack of stringent application of procedures involved in SRI or inherent limitations of the site. As yield gain was seen in the second year at Coimbatore, more testing might help to resolve the cause. Though increased panicle number per unit area and panicle weight appear to be responsible for yield advantage, more critical studies are certainly needed to investigate physiological basis.

An alternative to SRI has been developed and popularized by IRRI as ICM system which makes use of some of the procedures of SRI but tends to be more flexible. The fact that at 6 of 18 and 7 of 21 locations during 2004 and 2005, respectively, ICM registered comparable or superior grain yield in comparison with that obtained from SRI emphasizes the scope of flexibility of the systems and their adoption as per suitability.

The claim that SRI is genotype independent was not substantiated with the data from multi-location tests of 2004 or station trials at DRR. Thus choice of variety is important if not critical for SRI system. Our results did not associate SRI success in terms of yield gain with soil type, soil pH or regional differences. The consistent poor performance of SRI at Kapurthala and Malan calls for more detailed studies. Studies at DRR clearly showed that only the wider spacing adopted by SRI is not a significant contributing factor but age of seedling at transplanting is critical.

One of the critical claim of SRI system is water saving. Though in our studies, irrigation schedule was strictly followed as prescribed which led to considerable saving in water, quantitative data on this parameter were not collected. Studies now in progress are planned to generate these data. Other independent studies at DRR in clay soil indicated a saving of 20-24% in irrigation water with intermittent flooding which improved the water use efficiency by 13-28% depending on season and nutrient management (DRR, 2004). Saving on seed cost was evident from the fact that only 5 kg seed per hectare were used for SRI treatment as against 30-40 kg for normal transplanting.

Preliminary studies on soil samples from farmers field showed substantial differences in soil microbiological, soil biological and soil chemical parameters under SRI system as compared with normal submerged cultivation (Rupela, personal communication). How critical are these factors in yield enhancement are being studied in collaborative studies with ICRISAT at Hyderabad.

Studies done by Ganesh et al. (2006) showed 25% higher grain yield when SRI was adopted for seed production purpose. They also reported that SRI method reduced the duration for crop maturity by six days.

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Conclusions :

Based on data collected for two seasons, SRI appears to be more promising in terms of grain yield although gains observed were genotype and location specific. Further studies are required to confirm these results.

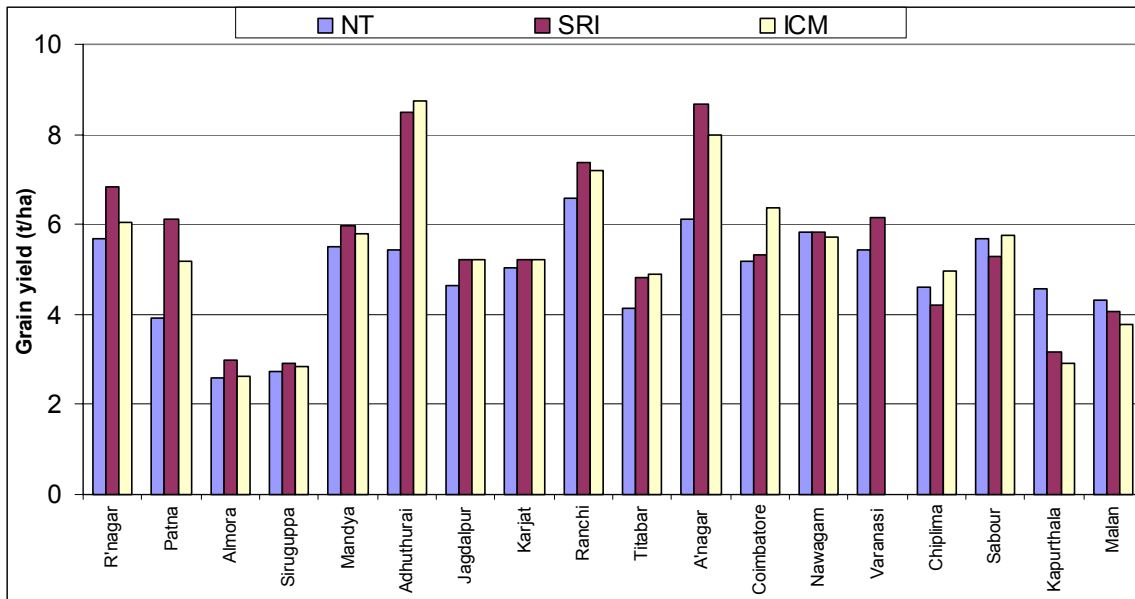


Fig. 1 : Mean grain yield recorded at different test sites under three methods of crop management, Kharif 2004

NT- Normal transplanting; SRI – System of Rice Intensification ; ICM – Integrated Crop Management

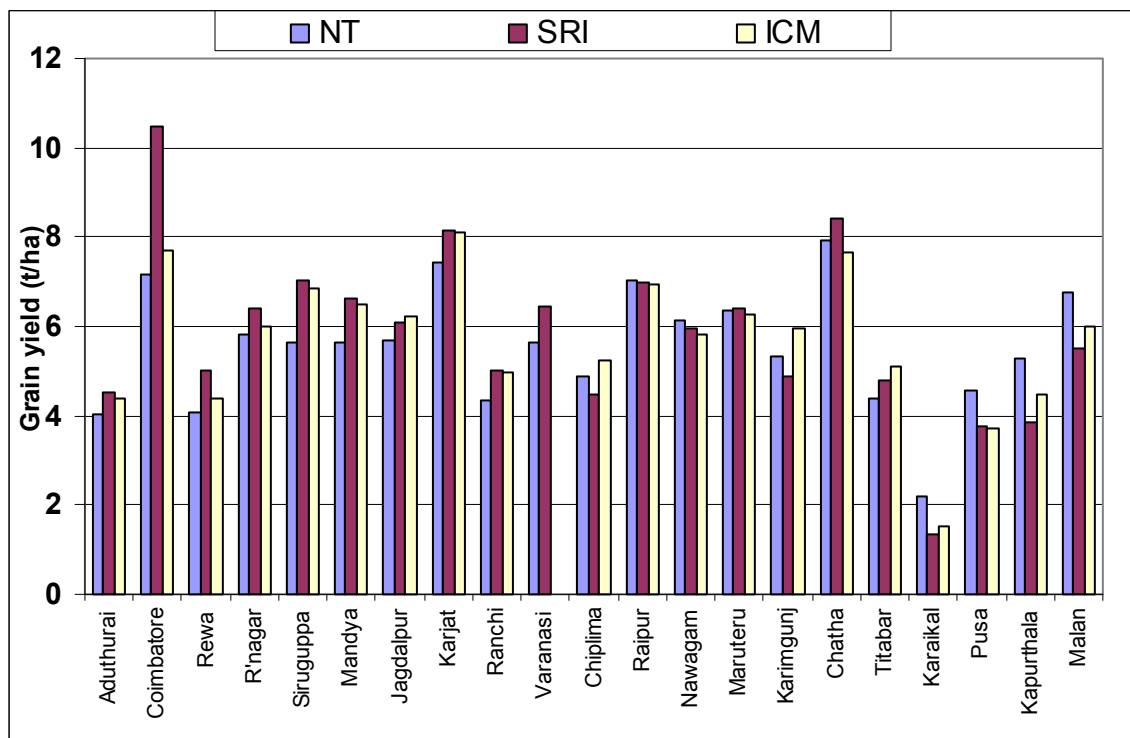


Fig. 2 : Mean grain yield recorded at different test sites under three methods of crop management, Kharif 2005

NT- Normal transplanting; SRI – System of Rice Intensification ; ICM – Integrated Crop Management