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Evaluation of SRI and Their Contribution towards Enhancement of Rice Grain Yield and Yield Attributes

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A B S T R A C T

System of Rice Intensification (SRI) with weed management is an imperative to convince the today's crop production in a sustainable way. Due to scarcity of water and energy, the weed competition is going to be the major constraint in achieving higher production in transplanted rice. System of Rice Intensification (SRI) is a six components like young seedlings transplanted at wider spacing using, use of organics, conoweeding and saturation moisture package aimed at realizing higher rice production using less inputs especially, seed, water and fertilizers. Since entire package may not possible to adopt in all cases, In order to Evaluation of principles of SRI and their contribution towards enhancement of grain yield, two field experiments were conducted during *Rabi* 2012-13 and *Kharif* 2013 at Perunthalaivar Kamaraj Krishi Vigyen Kendra (PKKVK), Puducherry State experimental farm in a randomized block design with three replication. The treatments were T1-SRI (use of 8-12 day old seedlings, raised bed nursery, careful transplanting at a spacing of 25 cm x 25 cm, weed management with cono weeder (4 times), Saturation of water management, and use of (75%) inorganic along with (25%) Organic, T2- T1 with 3-4 seedlings per hill (instead of 1 seedling per hill), T3- T1 with 30 to 35 day old seedlings (instead of 8-12 day old seedlings), T4- T1 with 20 x 10 cm spacing (instead of 25 x 25 cm spacing), T5- T1 with only inorganic (RDF) (instead of organic + inorganic), T6- T1 with herbicide + manual weeding (instead of cono-weeding), T7- T1 with alternate wetting and drying (instead of situation of water management) and T8-Conventional transplanting management practices that were tested on System of Rice Intensification crop. The findings of two seasons, use of 8-12 days young seedlings with four times conoweeding at spacing of 25cm x 25cm, saturation of water management and use of (75%) inorganic along with (25%) Organic with 3-4 seedlings per hill (T2) was performed excellent by registering higher yield attributes and grain yield of 8080 and 8500 kg ha^{-1} during *Kharif* 2012 and *Rabi* 2012-13 respectively, besides it also gave higher net return by reducing the cost production particularly in edging out higher inorganic fertilizers, wider spacing and conoweeding without affecting the grain yield in rice was proved by the study.

Introduction

Rice is the staple food for about 50 per cent of the world's population that resides in Asia, where 90 per cent of the world's rice is grown and consumed in Asia. For India, it is estimated that the demand, of rice will be 140 million tons in 2025 for 70 per cent over the

next 30 years. India has the largest area under rice (43.0 million ha) accounting for 29.4 per cent of the global rice area and it stood next only to China in the world with respect to rice production. Irrigated rice occupies about 50 per cent total rice area and contribution nearly 70 per cent to total rice production of the country with an average yield of 3.1 t ha-1. India's food security largely depends on irrigated rice which consumes nearly 50-60 per cent our finite fresh water resources. Conventional rice transplanting requires about 900-2200 mm of water (average 1500 mm) depending on the water management, soil and climate factor. It is estimated that rice needs about 3000-5000 litters of water to produce one kg of grain which is three to five times more than the other cereals like wheat, corn etc. So rice will have to be produced on less land with less usage of water, labour and chemicals.

The System of rice intensification results in saving of 30-40 per cent irrigation water; 85 per cent on seed, chemical fertilizers, and promotes soil microbial activity which improves the soil health. SRI even offers advantages for seed multiplication Saving on seed cost as the seed requirement is less, Saving on water as alternate wetting and drying method is followed, Cost of external inputs gets reduced as chemical fertilizers and pesticides are not used Incidence of pests and diseases is low as the soil is allowed to dry intermittently. More healthy and tasty rice as a result of organic farming practices. Higher yields due to profuse tillering, increased panicle length and grain weight Seed multiplication with less quantity of parent seed. Farmers can produce their own quality seed**.** In this background, the System of Rice Intensification (SRI) with weed management is an imperative to convince the today's crop production in a sustainable way. Due to scarcity of water and energy, the weed competition is going to be the major constraint in achieving higher production in transplanted rice. SRI is a six components like young seedlings transplanted at wider spacing using, use of organics, conoweeding and saturation moisture package aimed at realizing higher rice production using less inputs especially, seed, water and fertilizers (Uphoff, 2002). Since entire package may not possible to adopt in all cases, in order to Evaluation of principles of SRI and their contribution towards enhancement of grain yield with following objectives to study the effect of principles and interactions effect on grain yield.

Materials and Methods

Two field experiments were conducted during *Rabi* 2012-13 and *Kharif* 2013at Perunthalaivar Kamaraj Krishi Vigyen Kendra (PKKVK), Puducherry State experimental research farm in a randomized block design with three replication. The rice variety ADT 45 during Kharif 2013. The soil type was clay loam in texture and Acidic in reaction (pH 6.91), acidic having electrical conductivity (EC) of 0.23 dSm^{-1} and available N,P,K content were 145.6 kg ha^{-1}, 42.66 kg $ha^{-1}$and 163 kg ha^{-1} in Kharif 2013 during The rice variety ADT 43 during Rabi 2012-13. The soil type was clay loam in texture and Acidic in reaction (pH 7.31), acidic having electrical conductivity (EC) of 0.61 dSm^{-1} and available N,P,K content were 179 kg ha^{-1}, 21.2 kg $ha^{-1}$and 168 kg ha^{-1} in Rabi 2012-13 with field duration of 105 days, was used in the trial. The treatments were T1-SRI (use of 8-12 day old seedlings, raised bed nursery, careful transplanting at a spacing of 25 cm x 25 cm, weed management with cono weeder (4 times), Saturation of water management, and use of (75%) inorganic along with (25%) Organic, T2- T1 with 3-4 seedlings per hill (instead of 1 seedling per hill), T3- T1 with 30 to 35 day old seedlings (instead of 8-12 day old seedlings), T4- T1 with 20 x 10 cm

spacing (instead of 25 x 25 cm spacing), T5- T1 with only inorganic (RDF) (instead of organic + inorganic), T6- T1 with herbicide + manual weeding (instead of cono-weeding), T7- T1 with alternate wetting and drying (instead of situation of water management) and T8-Conventional transplanting management practices that were tested on SRI crop.

Results and Discussion

The findings of two seasons, use of 8-12 days young seedlings with four times conoweeding at 10, 20, 30 and 40 DAT at spacing of 25cm x 25cm, saturation of water management and use of (75%) inorganic along with (25%) Organic with 3-4 seedlings per hill (T2) was performed excellent by registering higher yield attributes and grain yield of 8500 and 8080 kg ha^{-1} (Table 1, 2 & 3) during *Kharif 2012* and *Rabi* 2012-13 respectively, besides it also gave higher net return by reducing the cost production. The SRI principles had significant effect on yield attribute and yield of rice. Number of panicles per m^2, panicle length, panicle weight, number of filled grains per panicle was significantly higher under all six principles of SRI as compared to old aged seedling i.e. 21 days old seedling and conventional transplanting.

The favourable condition for formation of higher number of effective tillers also resulted in production of higher number of panicles. Almost similar was obtained by Hussain *et al.,* (2004). For the formation of more number of productive tillers such as increase in CO2 assimilation rate, delay in the senescence of flag leaf and effective translocation of photosynthates from source to sink resulted in production of higher number of panicle with longer panicle (Watanabe and Yoshida, 1970). Under SRI cultivation biomass-portioning efficiency increases distinctively, Higher translocation of assimilates *viz.,* dry matter, carbohydrates, nitrogen, and their conversion rates enhanced the grain filling and spike weight in SRI rice (Wang Shao Hua *et al.,* 2002). Under younger seedlings combination, increased leaf area and subsequent increase in photosynthetic activity were exhibited through increased biomass production as a major portion of photosynthates accounted for dry matter and all these factors favoured the yield components under SRI practices. Wider spacing was the reason for less below and above ground competitions for better grain filling, higher grain weight and more number of filled grains per panicle. Optimum supply of irrigation water with mechanical weeding resulted in higher nutrient availability subsequently resulting in better source to sink conversion and in turn enhanced the production of more total number of seeds and filled seeds per panicle (Lu *et al.,* 2005). SRI, tillers and grains per panicle were increased by having more space between plants, which respond positively in their greater exposure to sunlight and circulatory air but closer spacing caused greater sterility percentage than wider spacing (Verma *et al.,* 2002).

As far as contribution of different principles towards yield was concerned, a reduction of 33.3%, 22.7% was observed when 21 days old seedling instead 10 days old seedling was used. These results are in agreement with findings of Nayak *et al.,* (1998) and Barison (2002). Maximum grain yield achieved in SRI was due to higher leaf area index (LAI) and light interception at wider spacing between plants gained from open plant structure. This resulted in higher LAI and greater leaf size, leading to a vigorous root system and more adequate room to grow. In the conventional method at closer spacing between rice plants, the number of panicles per unit area increases but with shorter panicles containing fewer grains, resulting in lower yield. This result is in confirmation with result obtained by Pandian (2010).

Table.1 Evaluation of SRI and their contribution towards enhancement of grain yield

Treatment		*Kharif* 2012 Grain Yield (t/ha)	*Rabi* 2012-13Grain Yield (t/ha)
T1	SRI (use of 8-12 days old seedlings, raised bed nursery, careful transplanting at spacing of 25 cm x 25 cm. weed management with cono weeder (4 times). saturation of water management, and use of (75%) inorganic along with (25%) organic.	8.35	7.85
T2	T1 with 3-4 seedlings per hill (instead of 1 seedling per hill)	8.50	8.08
T3	T1 with 30 to 35 days old seedlings (instead of 8-12 day old seedlings)	7.14	6.77
T4	T1 with 20 x10 cm spacing (instead of 25 x25 cm spacing)	7.39	6.85
T5	T1 with only inorganic (RDF) instead of organic + inorganic)	8.42	7.89
T6	T1 with herbicide + manual weeding (instead of Cono-weeding)	8.22	7.47
T7	T1 with 2+5 standing water during crop growth (instead of Saturation / alternate wetting and drying of water management)	8.00	7.13
T8	Conventional transplanting(Location specific best management practices with 30 day old nursery, planted at a spacing of 20 x 15 cm spacing, 3-4 seedlings per hill and 2+5 standing water during crop growth)	6.67	6.21
	CD (0.05)	**0.86**	**0.68**
	C.V. (%)	**7.47**	**5.40**

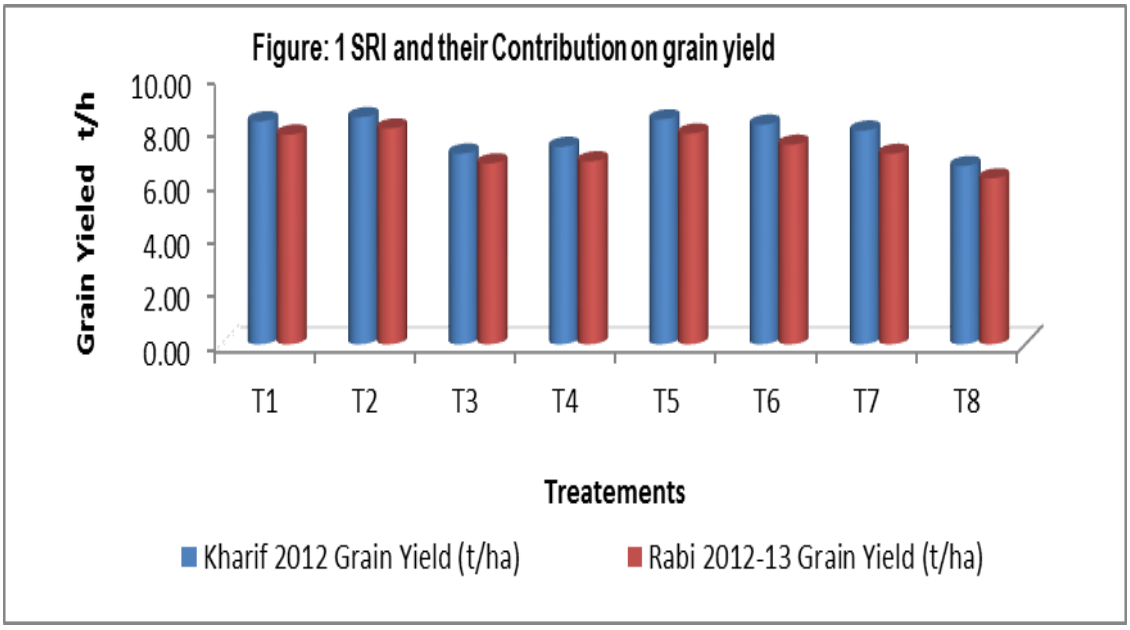


Table.2 Evaluation of SRI and their contribution towards enhancement of panicle number (m^2)

Treatment		Kharif 2012 panicle number / m^2	Rabi 2012-13 panicle number / m^2
T1	SRI (use of 8-12 days old seedlings, raised bed nursery, careful transplanting at spacing of 25 cm x 25 cm. weed management with cono weeder (4 times). saturation of water management, and use of (75%) inorganic along with (25%) organic.	443	372
T2	T1 with 3-4 seedlings per hill (instead of 1 seedling per hill)	472	452
T3	T1 with 30 to 35 days old seedlings (instead of 8-12 day old seedlings)	409	305
T4	T1 with 20 x10 cm spacing (instead of 25 x25 cm spacing)	422	323
T5	T1 with only inorganic (RDF) instead of organic + inorganic)	465	402
T6	T1 with herbicide + manual weeding (instead of Cono-weeding)	437	352
T7	T1 with 2+5 standing water during crop growth (instead of Saturation / alternate wetting and drying of water management)	433	335
T8	Conventional transplanting(Location specific best management practices with 30 day old nursery, planted at a spacing of 20 x 15 cm spacing, 3-4 seedlings per hill and 2+5 standing water during crop growth)	407	301
	CD (0.05)	**56**	**31.97**
	C.V. (%)	**8.72**	**5.14**

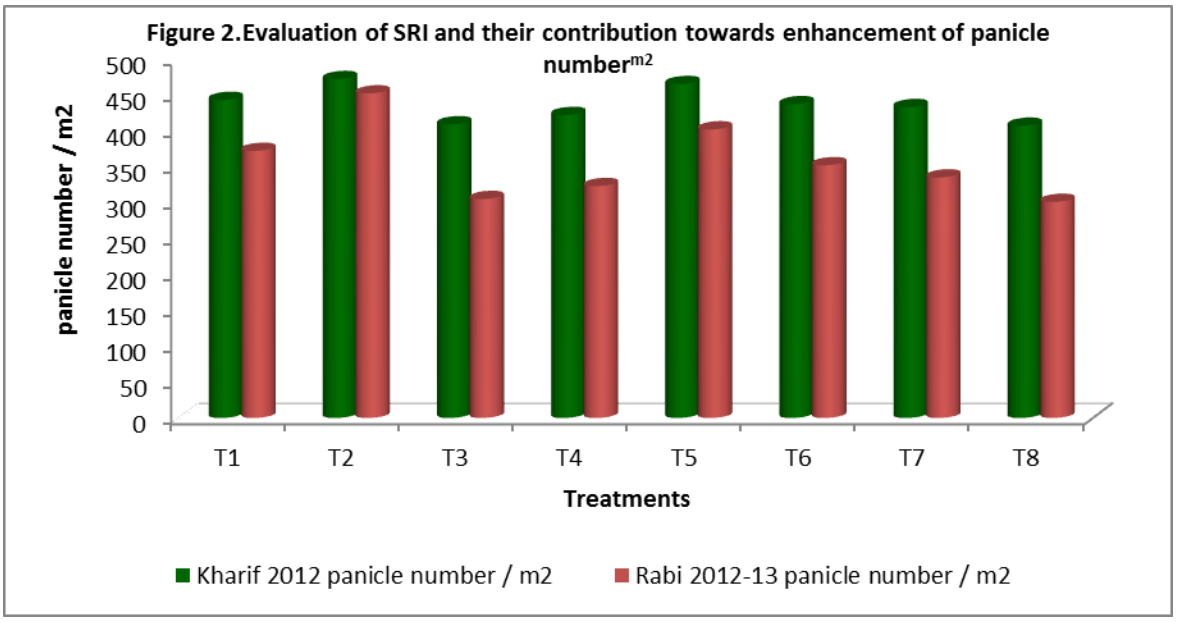
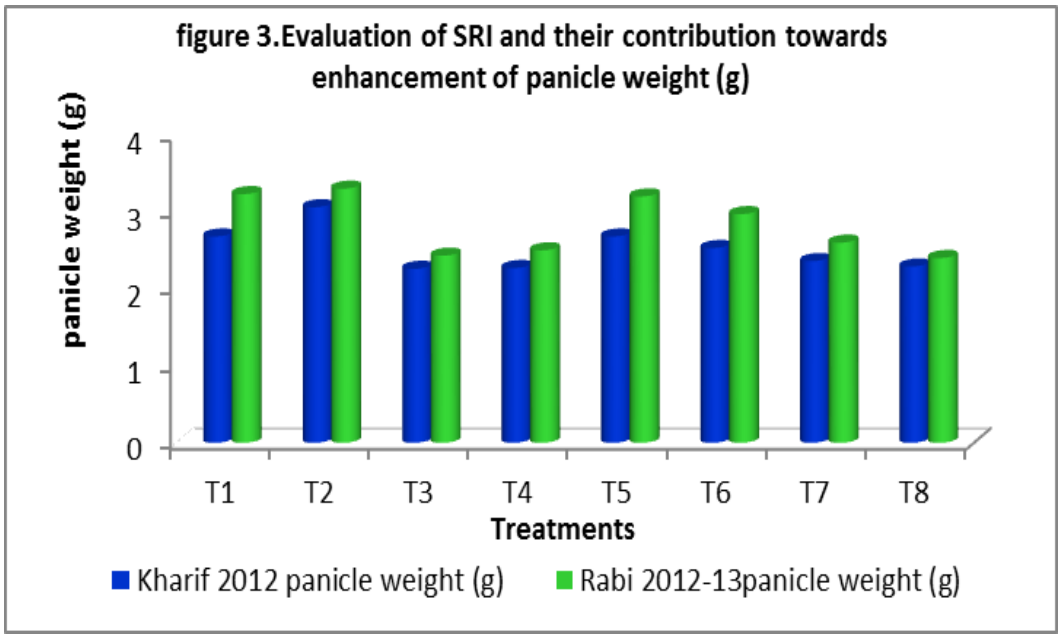


Table.3 Evaluation of SRI and their contribution towards enhancement of Panicle Weight (g)

Treatment		Kharif 2012 panicle weight (g)	Rabi 2012-13 panicle weight (g)
T1	SRI (use of 8-12 days old seedlings, raised bed nursery, careful transplanting at spacing of 25 cm x 25 cm. weed management with cono weeder (4 times). saturation of water management, and use of (75%) inorganic along with (25%) organic.	2.68	3.23
T2	T1 with 3-4 seedlings per hill (instead of 1 seedling per hill)	3.06	3.30
T3	T1 with 30 to 35 days old seedlings (instead of 8-12 day old seedlings)	2.26	2.43
T4	T1 with 20 x10 cm spacing (instead of 25 x25 cm spacing)	2.27	2.50
T5	T1 with only inorganic (RDF) instead of organic + inorganic)	2.68	3.20
T6	T1 with herbicide + manual weeding (instead of Cono-weeding)	2.53	2.97
T7	T1 with 2+5 standing water during crop growth (instead of Saturation / alternate wetting and drying of water management)	2.36	2.60
T8	Conventional transplanting(Location specific best management practices with 30 day old nursery, planted at a spacing of 20 x 15 cm spacing, 3-4 seedlings per hill and 2+5 standing water during crop growth)	2.29	2.40
	CD (0.05)	**0.46**	**0.49**
	C.V. (%)	**12.39**	**9.98**



A decrease in leaf area causes a reduction in area for interception and absorption of the specific wavelength of light necessary for photosynthesis. The results supported the findings of Vijayakumar *et al.,* (2006). An increased conversion of tillers into productive tillers per flowering panicles with the adoption of SRI management.

The findings of two seasons, use of 8-12 days young seedlings with four times conoweeding at 10, 20, 30 and 40 DAT at spacing of 25cm x 25cm, saturation of water management and use of(75%) inorganic along with (25%) Organic with 3-4 seedlings per hill (T2) was performed excellent by registering higher yield attributes and grain yield of 8500 and 8080 kg ha^{-1} (Figure 1, 2 and 3) during *Kharif 2012* and *Rabi* 2012-13 respectively, besides it also gave higher net return by reducing the cost production. It may be concluded that in SRI, with young seedlings coupled with conoweeding four times at 10, 20, 30 and 40 DAT favorably increased the growth parameter which ultimately reflected in higher yield. This favourable influence might be due to efficient utilization of resources and less inter-and-intra-space competition under SRI management, which may be assigned as the reason for superiority in such yield attributes of rice and consequently increased yield (Gani *et al.,* 2002). This observation was confirmed by the earlier findings of Tao *et al.,* (2002), Radhamani *et al.,* (2012) and Meyyappan *et al.,* (2013).

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