

# INFLUENCE OF SYSTEM OF RICE INTENSIFICATION (SRI) ON GROWTH, YIELD AND QUALITY PARAMETERS OF RICE (*Oryza sativa* L.)

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## INTRODUCTION

Rice (*Oryza sativa* L.) is one of the important staple food crop feeding more than a third of the world's population and grow on 11% of the world's cultivated area (Khush, 1993). More than 90 % of the world's rice is produced and consumed in Asia. India is the largest producer of rice next to China in the world. In India, rice is produced in an area of 43.97 million hectare with a production of 104.32 million tonnes and productivity is 2372 kg ha<sup>-1</sup> (Anon., 2014). The rice productivity is less than 2 tonnes per hectare in most of the states (Dash, 2009). Importance of rice production is increasing day by day because of rising population. The additional rice will have to be produced with SRI method. System of Rice Intensification cultivation (SRI) is visualized as one of the water saving rice cultivation. It is reported that the rice yields obtained in this method are similar or higher to the yields obtained under conventional system with reduced (30-40%) water. SRI cultivation method offers to minimize water consumption for rice cultivation and to increase the productivity (Laulanie, 1993). Good quality and healthy seed is a basic and critical input for the sustained agriculture production. Successful agriculture depends on the quality of seeds used for sowing. The establishment of the seedling depends upon the vigour of the seed, demanding each and every seed readily germinate and produce vigorous seedlings under SRI method of cultivation (Krishna *et al.*, 2008b).

System of rice intensification, developed in Madagascar in the 1980s, is a system approach to increase rice productivity with less external and inexpensive inputs. By adopting this system of cultivation we could save water, protect soil productivity, save environment by checking methane gas from water submerged paddy cultivation practices, bring down the input cost, besides increasing the production for providing food to the growing population (Satyanarayana *et al.*, 2007). Higher grain yields of rice have been reported when rice is grown by SRI method as compared to the conventional transplanting (Thakur *et al.*, 2010). Further, there was a differential response of different duration cultivars for SRI cultivation. Identification of suitable cultivars which responds well for SRI and maximise the yields is the paramount importance. Keeping the above views in mind, a study was undertaken on influence of System of Rice Intensification (SRI) on growth, yield and quality parameters of rice (*Oryza Sativa* L.).

## MATERIALS AND METHODS

Field experiment was conducted at Directorate of Rice Research farm, ICRISAT

## ABSTRACT

The studies on influence of System of Rice Intensification (SRI) on growth, yield and quality parameters of rice (*Oryza Sativa* L.) was conducted at Directorate of Rice Research farm, ICRISAT campus, Patancheru, Hyderabad during *Kharif* 2013 using fifteen rice varieties of different groups. Plant height (115.78 cm), number of effective tillers per m<sup>2</sup> (304.63) and seed yield per ha (5851.71 kg ha<sup>-1</sup>) were found to be higher under SRI method of cultivation compared to conventional transplanting (CT) method. Days to 50% flowering recorded an average 5 - 6 days earlier flowering in SRI method compared to conventional transplanting method. Among all the varieties, US 382 recorded the significantly higher seed yield per ha (7340.33 kg ha<sup>-1</sup>) under SRI method. Except seed germination all other seed quality parameters *viz.*, seedling length and vigour index I (31.40 cm) (3005.82), respectively recorded significantly higher values in SRI method.

## KEY WORDS

System of Rice Intensification  
Conventional Transplanting  
Growth  
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campus, Patancheru, Hyderabad during *kharif* 2013, while laboratory studies were carried out at Directorate of Rice Research, Rajendranagar, Hyderabad. The field experiment was laid out in split-plot design with three replications with two methods of cultivation, System of Rice Intensification (SRI) and Conventional transplanting (CT) as main treatments and fifteen rice varieties of different groups as sub treatments *viz.*, Tulasi, Ravi, Varadhan, Triguna, Jaya, Akshayadhan, Swarnadhan, Phalguna, Dhanrasi, DRRH 3, PA 6444, US 382, Kasturi, Sugandhamathi and Vasuma. The sprouted seeds were broadcasted uniformly at the rate of 5 kg ha<sup>-1</sup> on the nursery beds and covered with thin layer (1 cm) of soil and FYM mixture in 1:1 proportion. The beds were irrigated with a rose can daily in the morning and evening. Nursery beds were thoroughly irrigated before transferring the seedlings to the main field. Marker was used to lay out the plot into wider spacing *i.e.*, 25 cm x 25 cm row to row and plant to plant. Twelve days old young seedlings having only two leaves were transplanted in the main field with no standing water. At each hill, only one seedling was transplanted. Alternate wetting and drying was practiced throughout the vegetative phase. From panicle initiation to flowering, thin film of water was maintained like that of normal method. The water can be drained after 70 per cent of the grains in the panicle get hardened. The rotary weeder was employed 3 times at 15 days interval during the crop growth period. The weeds around the plants were removed manually and trampled in the field. Separate land preparation and cultural practices were followed conventional transplanting method.

In these study observations on plant height, days to 50% flowering, number of effective tillers m<sup>-2</sup> and seed yield ha<sup>-1</sup> were recorded on three randomly selected plants. Pure seed fractions of freshly harvested seeds were used to assess the seed quality parameters such as germination per cent, seedling

length and vigour index I. Seed vigour index I was calculated by multiplying germination per cent with seedling length (cm) (Abdul - Baki and Anderson, 1973). The experimental data recorded on various parameters were analyzed statistically following the analysis of variance procedure described by Gomez and Gomez (1984).

## RESULTS AND DISCUSSION

Data for growth and yield parameters of rice are presented in Table 1 and 2, respectively. Plant height was recorded significantly higher in SRI method (115.78 cm) compared to CT method (96.97 cm) at harvest. Significant differences were also observed among all the varieties. Triguna recorded the highest plant height (126.57 cm) at harvest. The lowest plant height was observed in Tulasi (94.83 cm) at harvest. Interaction effects were found to be non-significant at harvest. The plant height was more in SRI method of cultivation due to increased availability of space among the plants due to the planting of single seedling per hill at wider spacing which have ensured for maximum utilization of light and nutrients. These results were also conformity with the findings of Krupakar Reddy (2004), Kavitha *et al.* (2010), Sri Rajitha (2011), Sridevi and Chellamuthu (2012), Singh *et al.* (2013) and Dwivedi *et al.* (2015).

Days to 50% flowering was significantly higher in conventional transplanting (100 days) compared to SRI (95 days). Significant differences were also observed among all the varieties. Dhanrasi which is long duration variety took more days for 50% flowering (111.50 days) followed by Phalguna (107.50 days). The variety Tulasi had early 50% flowering (81.67 days) among all varieties in the study. The interaction effect between the methods of cultivation and varieties were indicated significant difference. Among all the varieties, Dhanrasi variety

**Table 1: Plant height (cm) at harvest and days to 50% flowering of various rice varieties as influenced by SRI and Conventional transplanting methods**

Varieties	Plant height at harvest			Days to 50% flowering		
	SRI	CT	Mean	SRI	CT	Mean
Tulasi	106.55	83.12	94.83	79.67	83.67	81.67
Ravi	119.80	98.21	109.00	86.33	91.33	88.83
Varadhan	119.97	100.20	110.09	86.00	91.00	88.50
Triguna	131.79	121.35	126.57	86.67	93.00	89.83
Jaya	109.87	94.33	102.10	91.33	99.67	95.50
Akshayadhan	118.98	95.45	107.21	93.33	98.00	95.67
Swarnadhan	115.30	94.60	104.95	101.67	109.00	105.33
Phalguna	109.80	93.70	101.75	102.00	113.00	107.50
Dhanrasi	116.59	94.66	105.63	109.00	114.00	111.50
DRRH 3	120.35	100.89	110.62	97.67	102.67	100.17
PA 6444	120.41	100.33	110.37	100.67	102.00	101.33
US 382	123.18	108.17	115.68	95.00	101.67	98.33
Kasturi	107.22	87.95	97.58	96.67	100.67	98.67
Sugandhamathi	109.71	93.64	101.67	99.67	102.33	101.00
Vasumathi	107.14	87.96	97.55	100.00	104.00	102.00
Mean	115.78	96.97	106.37	95.04	100.40	97.72
For comparing means of	SEm ±		CD at 5%	SEm ±		CD at 5%
Methods (M)	1.20		7.39	0.40		2.49
Varieties (V)	2.26		6.39	0.71		2.01
M × V	3.31		NS	1.05		3.50
V × M	4.64		NS	1.56		3.34

SRI - System of Rice Intensification; CT - Conventional transplanting

**Table 2: Number of effective tillers m<sup>-2</sup> and seed yield (kg ha<sup>-1</sup>) of various rice varieties as influenced by SRI and Conventional transplanting methods**

Varieties	Number of effective tillers m <sup>-2</sup>			Seed yield (kg ha <sup>-1</sup> )		
	SRI	CT	Mean	SRI	CT	Mean
Tulasi	286.67	233.00	259.83	4833.33	4600.00	4716.67
Ravi	294.00	234.00	264.00	5392.00	5054.44	5223.22
Varadhan	329.33	269.99	299.66	6105.00	5780.00	5942.50
Triguna	297.00	234.57	265.79	6080.73	5122.44	5601.59
Jaya	298.27	235.67	266.97	6001.07	5076.67	5538.87
Akshayadhan	316.33	243.87	280.10	6017.40	5761.33	5889.37
Swarnadhan	287.72	233.44	260.58	5281.60	5022.22	5151.91
Phalguna	299.00	238.87	268.93	5867.63	5093.33	5480.48
Dhanrasi	301.33	241.40	271.37	6094.40	5246.67	5670.53
DRRH 3	349.67	271.67	310.67	6900.00	5866.67	6383.33
PA 6444	364.79	272.33	318.56	7303.47	5966.67	6635.07
US 382	365.00	273.33	319.17	7340.33	6191.11	6765.72
Kasturi	238.33	223.33	230.83	4602.87	4330.89	4466.88
Sugandhamathi	270.00	229.51	249.75	4767.47	4500.00	4633.73
Vasumathi	271.99	231.97	251.98	5188.33	4939.00	5063.67
Mean	304.63	244.97	274.55	5851.71	5236.76	5544.24
For comparing means of	SEm ±		CD at 5%	SEm ±		CD at 5%
Methods (M)	2.37		14.65	45.37		279.92
Varieties (V)	5.74		16.26	113.92		322.80
M × V	8.19		25.51	162.12		501.75
V × M	9.20		25.28	175.73		498.60

SRI - System of Rice Intensification; CT - Conventional transplanting

**Table 3: Vigour index I (Germination% × seedling length) of various rice varieties as influenced by SRI and Conventional transplanting methods**

Varieties	Germination (%)			Seedling length(cm)			Vigour index I		
	SRI	CT	Mean	SRI	CT	Mean	SRI	CT	Mean
Tulasi	93.67	90.67	92.17	30.42	27.30	28.86	2848.90	2474.48	2661.69
Ravi	95.33	94.33	94.83	32.04	28.59	30.31	3053.17	2696.64	2874.91
Varadhan	98.00	97.00	97.50	32.89	30.21	31.55	3224.27	2930.33	3077.30
Triguna	94.67	93.67	94.17	29.40	27.13	28.26	2782.53	2541.98	2662.26
Jaya	96.00	95.33	95.67	30.77	28.43	29.60	2953.50	2710.25	2831.87
Akshayadhan	97.67	96.00	96.83	34.80	32.08	33.43	3398.87	3079.99	3239.43
Swarnadhan	95.00	92.67	93.83	30.37	27.53	28.95	2886.04	2550.82	2718.43
Phalguna	95.67	94.00	94.83	30.72	27.60	29.16	2938.61	2595.04	2766.83
Dhanrasi	97.33	95.67	96.50	29.62	27.20	28.41	2882.87	2601.17	2742.02
DRRH 3	98.33	97.67	98.00	34.11	30.57	32.34	3354.39	2984.95	3169.67
PA 6444	98.67	98.00	98.33	34.53	31.81	33.17	3406.67	3117.54	3262.11
US 382	99.00	98.33	98.67	34.41	31.19	32.80	3406.59	3067.13	3236.86
Kasturi	90.33	89.33	89.83	29.48	27.08	28.28	2661.38	2419.20	2540.29
Sugandhamathi	91.33	90.67	91.00	28.21	24.63	26.42	2574.79	2233.97	2404.38
Vasumathi	92.67	91.67	92.17	29.30	26.92	28.11	2714.67	2467.47	2591.07
Mean	95.58	94.33	94.96	31.40	28.55	29.97	3005.82	2698.06	2851.94
For comparing means of	SEm ±		CD at 5%	SEm ±		CD at 5%	SEm ±		CD at 5%
Methods (M)	0.37		NS	0.07		0.46	6.64		40.93
Varieties (V)	0.55		1.56	0.39		1.10	37.38		105.93
M × V	0.84		NS	0.54		NS	51.50		NS
V × M	1.44		NS	0.28		NS	25.70		NS

SRI - System of Rice Intensification; CT - Conventional transplanting

took more days to 50 per cent flowering under CT (114.00 days). Tulasi recorded lesser days to 50 per cent flowering under SRI (79.67 days). Days to 50% flowering was on an average 5 to 6 days earlier in SRI compared to CT in all the varieties. It might be due to the young seedlings were transplanted along with intact soil, thus making the plants to establish quickly and grow at faster rate in SRI method. Similar observations were also found by Laulanie (1993), Krupakar

Reddy (2004), Uday kumar (2005) and Krishna *et al.* (2008b). Number of effective tillers m<sup>-2</sup> was recorded significantly higher in SRI (304.63) method compared to CT (244.97). Significant differences were also observed among all the varieties. The hybrid US 382 recorded the highest number of effective tillers m<sup>-2</sup> (319.17), which was on par with PA 6444 and DRRH 3. The lowest number of effective tillers m<sup>-2</sup> was observed in Kasturi (230.83). Interaction effect between methods of cultivation

and varieties SRI and CT showed significant interaction with all the varieties in number of effective tillers  $m^{-2}$ . Among all the varieties US 382 recorded highest number of effective tillers  $m^{-2}$  in SRI (365.00). The lowest number of effective tillers  $m^{-2}$  was produced by variety Kasturi under CT (223.33). In SRI method, increase in the effective tillers  $m^{-2}$  might be due to the better spacing provided to the plants by planting in square method. This might have facilitated better utilization of resources by the plants converting majority of the tillers in to effective tillers. Similar results were reported by Gani *et al.* (2002), Sarath and Thilak (2004), Udaykumar (2005), Prabhakar setty *et al.* (2007), Krishna and Biradarpatil (2009), Singh *et al.* (2012), Gopalakrishnan *et al.* (2013) and Thawait *et al.* (2014).

In both the methods of cultivation, seed yield  $ha^{-1}$  was significantly higher in SRI (5851.71  $kg\ ha^{-1}$ ) compared to CT (5236.76  $kg\ ha^{-1}$ ). Significant differences were also observed among all the varieties. Variety US 382 recorded the higher seed yield (6765.72  $kg\ ha^{-1}$ ), which was on par with PA 6444. The lowest seed yield was recorded by variety Kasturi (4466.88  $kg\ ha^{-1}$ ). Interaction effect between methods of cultivation and varieties SRI and CT showed significant interaction with all the varieties in the production of seed yield  $ha^{-1}$ . Among all the varieties US 382 recorded highest seed yield under SRI (7340.33  $kg\ ha^{-1}$ ), while the lowest seed yield was recorded by variety Kasturi under CT (4330.89  $kg\ ha^{-1}$ ). Seed yield was recorded higher in SRI method; it might be due to planting young seedlings, favourable soils conditions were incorporate with rotary weedings provides better aeration, more spacing and less competition to grown rice plants took up more macronutrients than did the roots of conventionally managed plants, which was reflected in the higher SRI yields. Similar results were reported by Nissanka and Bandara (2004), Udaykumar (2005), Subba Rao *et al.* (2007), Kavitha *et al.* (2010), Mohanty and Mohanty (2010), Barison and Uphoff (2011), Kanaka Durga (2012), Sridevi and Chellamuthu (2012), Thakur *et al.* (2013), Dwivedi *et al.* (2015) and Shivkanth *et al.* (2016).

### Quality parameters

Data for quality parameters of rice are presented in Table 3. In both the methods of cultivation, germination per cent exhibited no significant difference. Significant differences were observed among all the varieties. Variety US 382 recorded the higher seed germination (98.67%), which was on par with PA 6444, DRRH 3 and Varadhan. The lowest germination was recorded by variety Kasturi (89.83%). Interaction effect between methods of cultivation and varieties were found to be non - significant in the germination per cent. However, SRI method recorded higher germination due to higher test weight values. These results are in conformity with the results of Nandisha and Mahadevappa (1984), Udaykumar (2005) and Singh *et al.* (2013).

Seedling length was significantly higher in SRI (31.40 cm) compare to CT (28.55 cm). Significant differences were also observed among all the varieties. Variety Akshayadhan recorded the highest seedling length (33.43 cm), which was on par with PA 6444, US 382 and DRR 3. The lowest seedling length was recorded by variety Sugandhamathi (26.42 cm). Interaction effect between methods of cultivation and varieties were found to be non - significant. In the present investigation,

the seedling length was higher in SRI compare to CT. This may be due to under wider spacing to better filling of seed. Similar findings were also observed by Kanaka Durga (2012). Seed vigour index I was significantly higher in SRI (3005.82) compare to CT (2698.06). Significant differences were also observed among all the varieties. Variety PA 6444 recorded the higher seed vigour index I (3262.11), which was on par with Akshayadhan, US 382 and DRRH 3. The lowest seed vigour index I was recorded by variety Sugandhamathi (2404.38). Interaction effect between methods of cultivation and varieties were found to be non - significant. The SRI method produced seeds have better quality than CT. It might be due to better filling of seeds and higher test weight, which indicates the better food reserves in the seeds produced with SRI method, might have resulted in better quality parameter. These results are in agreement with the observations of Nandisha and Mahadevappa (1984), Udaykumar (2005), Krishna *et al.* (2008a) and Kanaka Durga (2012).

On the basis of the above study it can be concluded that seed yield  $ha^{-1}$  higher in SRI method of cultivation compared conventional transplanting. Hybrids recorded higher seed yield  $ha^{-1}$  under SRI cultivation than other varieties. These methods of rice cultivation help in increasing the production as well as produce the quality seed.

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