Effect of different system of rice intensification on yield, water requirement and water use efficiency (WUE)

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Rice (*Oryza sativa*) is an important food crop of the world. With the growing world population, production has to be increased to 810 million tones by the year 2025. Similarly Indian rice production has to be stepped up to 140 million tones. Increasing the production and productivity of rice with decreasing land and water resources is a herculean task. Agriculture accounts for 80 per cent of the total water consumption in India and about 60 per cent is consumed by paddy alone. Traditionally flooding method of irrigation is used for growing paddy with 2-3 centimetres of water on the field throughout the growing period. Paddy fields are allowed to dry-up only before the harvesting. This practice of irrigation results in large scale evaporation losses and low water use efficiency. Appropriate method of planting together with a suitable high yielding variety should be adopted for commercial cultivation to increase the production and productivity.

A field experiment was carried out during the *Kharif*, 2005 at Agricultural Research Station, Siruguppa. The soil was deep black clay in texture, neutral in pH (8.22) and low in electrical conductivity (0.28 ds/m). It was low in available nitrogen (265 kg ha^{-1}), high in available phosphorus (30.5 kg ha^{-1}) and medium in available potassium content (365 kg ha^{-1}), total rain-fall of 627.8mm were received during the crop growing season. There were 15 treatment combinations comprising of three methods of planting (M_1- Normal method, M_2- Recommended SRI method, M_3- Modified SRI method)as main treatments and five age of seedlings (9, 12, 15, 18 and 21 days) as sub treatments and were laid out in split plot design with three replications. The gross plot size was 4 x 3 m. IET-16933 was used as test variety. The spacing followed was 20 x 10 cm (M_1), 25 x 25 cm (M_2 and M_3). The crop received a fertilizer dose of 150:75:75 kg NPK ha^{-1}. Full dose of P_2O_5 and K_2O and half of nitrogen was applied at the time of transplanting and remaining half of nitrogen was applied in two equal splits at 30 and 55 days after transplanting. An average of 3cm and 5cm depth of irrigation were given to normal method and SRI method respectively. All the recommended cultivation practices were followed. The crop was harvested after attaining physiological maturity.

The grain yield of rice was significantly higher with modified SRI method (6342 kg ha^{-1}) followed by recommended SRI method (6213 kg ha^{-1}) over the normal method of planting (5105 kg ha^{-1}). This may be attributed to wider spacing, optimum water and sufficient nutrient in root zone to support the tillering. This in turn helped in conversion of more of tillers into panicles. Thus, owing to the integration of all favourable yield components *viz* number of grains per panicle (167.25, 163.70 and 124.67 respectively), panicle length (21.17cm, 21.63cm and 18.95cm respectively), test weight (20.83g, 20.51g and 19.49g respectively), number of panicles per hill (61.52, 60.75 and 18.19 respectively).

Crop grown with 9 and 12 days old seedlings recorded significant higher grain yield of 6017 and 6018 kg ha^{-1} respectively, the rest of the treatments. Nine and twelve days old seedlings increased the number of tillers (49.27 and 48.83 respectively), number of panicles (48.93 and 48.17 respectively), number of grains per panicle (159.33 and 158.13 respectively) and boldness of seeds thereby increased the 1000 seed weight (20.74 and 20.58 respectively) and also under the planting of 9 and 12 day seedlings the sterility percentage was reduced (13.50 and 13.64 respectively). This may be due to the fact that seedlings of early age had higher vigour and had greater capacity to absorb soil nutrients to fill higher number of spikelets efficiently.

The decrease in the tiller number with old seedlings (15, 18 and 21days) might be due to concomitant effect on establishment of crop, lesser tillering period and crop duration in the main field when compared with planting of 9 and 21 days old seedlings. The straw yield observed similar trend to that of grain yield. In present study modified SRI and recommended SRI method of rice cultivation, generally alternate wetting and drying method in

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followed. This brought down the water requirement by 47 per cent over normal method. Water requirement was maximum in normal method of planting (124.96 cm) when compared to SRI methods (84.96 cm). While the water use efficiency was higher in modified SRI method (74.66 kg ha^{-1} cm^{-1}) closely followed by recommended SRI method (73.13 kg ha^{-1} cm^{-1}) and these were significantly superior over normal SRI method (40.85 kg ha^{-1} cm^{-1}). Thus, modified SRI method and recommended SRI method here lower water requirement and higher water use efficiencies when compared to normal method.

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Table 1. Grain and straw yield of rice as influenced by methods of planting and age of seedlings

Method of planting	Grain yield (kg ha^{-1})						Straw yield (kg ha^{-1})					
	Age of seedling (DAS)											
	9	**12**	**15**	**18**	**21**	**Mean**	**9**	**12**	**15**	**18**	**21**	**Mean**
M_1	5397	5327	4997	4910	4893	**5105**	6433	6263	5990	5950	5903	**6108**
M_2	6377	6313	6153	6143	6080	**6213**	7240	7216	7093	7100	7073	**7144**
M_3	6440	6416	6226	6260	6370	**6342**	7383	7327	7143	7140	7173	**7233**
Mean	**6071**	**6018**	**5792**	**5771**	**5781**		**7019**	**6935**	**6742**	**6730**	**6716**	
			S.Em(±)		**LSD (P=0.05)**				**S.Em(±)**		**LSD (P=0.05)**	
Main treatments (M)			**3.9**		**15.3**				**5.1**		**20.2**	
Sub treatments (S)			5.2		15.2				5.4		15.9	
S at same M			9.0		NS				9.4		NS	
M at same or different S			8.9		NS				9.9		NS	

M_1 – Normal method (Application of RDF through inorganics FYM @ 10 t ha^{-1} , and 20 x 10 cm spacing)
M_2 – Recommended SRI (RDN through organics and at 25 x 25 cm spacing)
M_3 – Modified SRI (RDF through inorganics, FYM @ 10 t ha^{-1} and 25 x 25 cm spacing)

Table 2. Water requirement, and water use efficiency as influenced by methods of planting and age of seedlings

Treatments	Water requirement (cm)						Water use efficiency (kg ha^{-1}cm^{-1})					
	Age of seedling (DAS)											
	9	**12**	**15**	**18**	**21**	**Mean**	**9**	**12**	**15**	**18**	**21**	**Mean**
M_1	124.96	124.96	124.96	124.96	124.96	**124.96**	43.18	42.62	39.98	39.29	39.16	**40.85**
M_2	84.96	84.96	84.96	84.96	84.96	**84.96**	75.05	74.31	72.43	72.31	71.56	**73.13**
M_3	84.96	84.96	84.96	84.96	84.96	**84.96**	75.80	75.52	73.28	73.68	74.98	**74.66**
Mean	**98.29**	**98.29**	**98.29**	**98.29**	**98.29**		**64.68**	**64.15**	**61.90**	**61.76**	**61.90**	
								SEm(±)			**LSD(P=0.05)**	
Main treatments (M)								**0.30**			**1.19**	
Sub treatments (S)								**0.53**			**1.56**	
S at same M								**0.92**			**NS**	
M at same or different S								**0.88**			**NS**	

M_1 – Normal method (Application of RDF through inorganics FYM @ 10 t ha^{-1} , and 20 x 10 cm spacing)
M_2 – Recommended SRI (RDN through organics and at 25 x 25 cm spacing)
M_3 – Modified SRI (RDF through inorganics, FYM @ 10 t ha^{-1} and 25 x 25 cm spacing)