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Influence of System of Rice Intensification on Growth, Yield and Nutrient Uptake of Rice (*Oryza sativa*. L)

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A field experiment was carried out to investigate the effect of System of Rice Intensification (SRI) practices on the growth, yield and nutrient uptake of short duration rice variety ADT 43 at the tail end of Cauvery delta zone during *kharif,* 2005. Twelve treatment combinations (YOSC, NOSC, YMSC, YOSH, NMSC, NOSH, YMSH, YORH, NMSH, YMRH, NORH and NMRH) were replicated thrice in a Randomised Block Design. The results revealed that when all the four components of SRI *viz*., young seedling (14 days old), one seedling hill^{-1}, square planting with wider spacing (22.5cm x 22.5cm) and conoweeding (YOSC) were practiced, it profoundly enhanced the growth and nutrient uptake which in turn improved the yield attributes and yield. The enhancement in the performance of rice was linearly proportional to the number of SRI components being practiced. As the SRI components increases, the performance of rice enhances.

Key words: Rice, system of rice intensification (SRI), growth, yield attributes, nutrient uptake, yield

Rice, known as 'wonder cereal', is cultivated in a variety of ecological zones with wide variations in productivity. The major constraints in rice production are lack of integrated management practices involving land, labour, crop, water and inputs such as seeds, fertilizers, optimum plant population, etc. System of Rice Intensification (SRI), a new method of rice cultivation is found to increase the productivity by exploiting the genetic potential of rice and create a better growing environment, enhance soil health; reduce inputs (seeds, water and labour) and addresses the major constraints affecting the livelihoods of small and poor farmers (Gujja and Thiyagarajan, 2009). Many countries like Indonesia, Madagascar, Bangladesh, etc. reported two fold increase in rice grain yield with SRI system. Hence, the present investigation was carried out to study the effect of SRI practices on the growth and yield attributes, nutrient uptake and grain yield of rice in the tail end of Cauvery delta zone.

Materials and Methods

A field experiment was conducted at Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal, Union Territory of Pondicherry during *kharif* 2005. The objective was to study the effect of System of Rice Intensification (SRI) practices on the yield and yield attributes of rice. The short duration (110 days) rice variety ADT 43 was used as test variety.

The soil of the experimental site was sandy loam in texture with a pH 7.20, EC 0.33 dSm^{-1} and organic carbon content 0.49%. The fertility status of the soil was low in available N (188.3 kg ha^{-1}), medium in available P (17.8 kg ha^{-1}) and medium in available K (235 kg ha^{-1}).

Totally, there were 12 treatment combinations (YOSC, NOSC, YMSC, YOSH, NMSC, NOSH, YMSH, YORH, NMSH, YMRH, NORH and NMRH) replicated thrice in a Randomised Block Design in which Y refers to young seedlings of 14 days old raised in a modified rice mat nursery; N refers to normal seedlings of 21 days old raised in a conventional nursery; O refers to one seedling hill^{-1}; M refers to multiple seedlings (3 seedlings hill^{-1}); S refers to square planting with wider spacing (22.5 cm x 22.5 cm); R refers to rectangular planting with closer spacing (12.5cm x 10.0 cm); C refers to conoweeding between rows in both directions with hand operated conoweeder and H refers to hand weeding.Conoweeding was done four times at weekly intervals starting from 15 DAT to 36 DAT. Hand weeding was done twice at 20 DAT and 40 DAT.

The recommended fertilizer schedule of 120: 38: 38 kg NPK ha^{-1} for the short duration rice variety was followed for all the treatments. Zinc sulphate @ 25 kg ha^{-1} was applied as basal before transplanting.

Various observations on growth and yield attributes, nutrient uptake and yield were recorded at harvest. Plant samples collected for dry matter estimation at harvest stage were oven dried and finely ground in Willey mill. Then, nitrogen, phosphorus and potassium contents were estimated by standard procedures. The data on

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various parameters were subjected to statistical scrutiny as suggested by Gomez and Gomez (2010).

Results and Discussion

Growth characters

The SRI practices significantly influenced the growth characters (Table 1). Combination of YOSC (Young seedling, one/single seedling, square planting and conoweeding) favourably improved the growth characters *viz*., plant height, dry matter production and root dry weight which might be attributed to enhanced photosynthetic activity of young seedlings, less intra plant competition, larger foraging area, root pruning by conoweeding. This result corroborates with the finding of Vijayakumar *et al*. (2006).

Nutrient uptake

Nutrient uptake was significantly varied due to various SRI components (Table 1). Uptake being a product of nutrient concentration and dry matter production, higher nutrient uptake in the combination YOSC involving all the four components of SRI *viz*., young seedling (14 days old), one seedling hill^{-1}, square planting with wider spacing (22.5cm x 22.5cm) and conoweeding (YOSC) was mainly attributed to better root activity and increased DMP. Kumar *et al*. (2007) found that a well developed and healthy root system plays an important role in uptake and translocation of nutrients from the soil.

Table 1. Effect of SRI practices on growth characters and nutrient uptake at harvest of rice

Treatment	Plant height (cm)	DMP (kg ha^{-1})	Root dry weight (kg ha^{-1})	Nutrient uptake (kg ha^{-1})		
				Nitrogen	Phosphorus	Potassium
T_1: YOSC	78.47	8664	741	86.93	18.06	56.83
T_2: NOSC	75.70	7625	692	81.34	16.72	54.44
T_3: YMSC	77.80	8328	717	81.92	17.20	54.08
T_4: YOSH	76.40	7254	632	76.95	16.09	51.15
T_5: NMSC	75.63	6914	612	71.47	14.81	45.40
T_6: NOSH	71.95	6590	557	66.16	13.85	42.97
T_7: YMSH	75.56	6867	653	73.87	15.17	47.64
T_8: YORH	74.20	6798	693	72.06	14.92	48.67
T_9: NMSH	70.51	6081	549	60.22	12.66	41.61
T_{10}: YMRH	72.29	6657	701	65.52	14.39	45.82
T_{11}: NORH	69.51	6185	741	59.64	13.05	41.80
T_{12}: NMRH	68.41	5981	612	58.81	12.55	40.99
SEd	1.40	182	42	0.80	0.82	2.58
CD (P=0.05)	2.90	378	86	1.65	1.70	5.35

Yield attributes and grain yield

The yield attributes *viz*., number of panicles m^{-2}, number of filled grains panicle^{-1}, panicle length, panicle weight and test weight and grain yield were significantly altered by the various SRI practices and its combinations (Table 2). Higher yield attributes and grain yield were observed in the combination of four components of SRI *viz*., young seedling, one

Table 2. Effect of SRI practices on yield attributes and yield of rice

Treatment	Number of panicles hill^{-1}	Number of panicles m^{-2}	Panicle length (cm)	Panicle weight (g)	Test weight (g)	Number of filled grains panicle^{-1}	Grain yield (kg ha^{-1})
T_1: YOSC	17.33	341	23.00	2.13	14.58	100.50	3683
T_2: NOSC	15.07	301	21.63	1.81	14.55	93.33	3339
T_3: YMSC	16.00	320	22.93	2.06	14.58	97.50	3487
T_4: YOSH	14.93	299	22.20	1.76	14.40	89.43	3249
T_5: NMSC	14.73	295	21.53	1.48	14.29	88.90	2993
T_6: NOSH	14.53	291	21.30	1.43	13.80	79.53	2732
T_7: YMSH	14.53	291	21.75	1.45	14.11	89.78	3103
T_8: YORH	4.80	354	19.80	1.32	13.70	70.87	2864
T_9: NMSH	14.07	271	21.33	1.43	13.78	85.90	2414
T_{10}: YMRH	4.73	353	19.03	1.22	13.70	70.20	2550
T_{11}: NORH	4.60	342	19.30	1.22	13.39	68.30	2306
T_{12}: NMRH	4.40	326	18.75	1.15	13.40	67.23	2189
SEd	0.38	13	0.49	0.03	0.02	2.52	130
CD (P=0.05)	0.79	28	1.01	0.06	0.04	5.23	272

seedling, square planting and conoweeding (YOSC) due to improved plant growth characters, reduced competitions for nutrients and solar radiation etc., higher nutrient availability resulted in better source to sink conversion which in turn enhanced the yield attributes. This result is in agreement with the finding of Chandrapala *et al*. (2010) who found that square geometry with wider spacing, planting of single seedling hill^{-1} reduced the above and below ground competition, enhanced

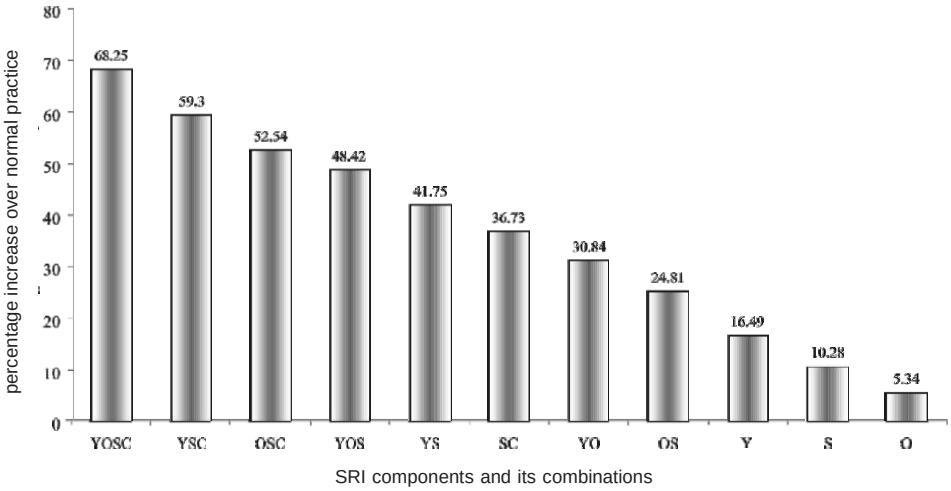

Fig. 1. Contribution of individual component and combination of components of SRI to grain yield as compared to normal practice

solar radiation interception and nutrients uptake, thus resulting in an increased rate of grain filling, higher test weight, more number of grains panicle^{-1}. There is a considerable yield advantage when any one, two or three components of SRI are followed as compared to normal practice of rice cultivation. But the yield increase was more with more number of components (Fig. 1). This is in accordance with the findings of Hugar *et al*. (2009) who stated that SRI gave higher grain yield due to large root volume, strong tillers with improved yield attributes.

The present investigation suggested that agronomic manipulation like planting of young seedling (14 days old) singly planted at 25 cm x 25 cm and conoweeding had tremendously contributed for the enhancement of growth, nutrient uptake and yield of rice during *kharif* season.

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