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Research Paper

Nutrient Harvest Index and Soil Available Nutrients of Rice (Oryza Sativa) as Influenced by System of Rice Intensification (Sri) Practices

Agriculture

KEYWORDS : SRI, Nutrient uptake, Nutrient harvest index, yield and soil available nutrients

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ABSTRACT

A field study was conducted in sandy loam soil during kharif to evaluate the different SRI practices in lowland rice ecosystem. The treatments viz., YOSC, NOSC, YMSC, YOSH, NMSC, NOSH, YMSH, YORH, NMSH, YMRH, NORH and NMRH were replicated thrice in a Randomised Block Design in which Y refers to young seedlings of 14 days old; N refers to normal seedlings of 21 days old; O refers to one seedling hill-1; M refers to multiple seedlings (3 seedlings hill-1); S refers to square planting (22.5 cm x 22.5 cm); R refers to rectangular planting (12.5 cm x 10.0 cm); C refers to conoweeding and H refers to hand weeding. The results revealed that the combination of Young seedling, One seedling, Square planting and Conoweeding (YOSC) recorded higher nutrient uptake, nitrogen harvest index, soil available nitrogen, yield and grain harvest index.

INTRODUCTION

Rice is the staple food of India, providing 43 per cent of calorie requirement for more than 70 per cent of the Indian population. To meet the demands of increasing population and maintain self sufficiency, the present production level of 102 million tonnes needs to be increased up to 125 million tonnes by the year 2020 (Chandrasekaran, 2008). The System of Rice Intensification (SRI), a new method of rice cultivation is found to increase the productivity by exploit the genetic potential of rice and create a better growing environment, enhance soil health; reduce inputs (seeds, water, labour) and addresses the major constraints affecting the livelihoods of small and poor farmers (Gujja and Thiyagarajan, 2009). Hence, the present investigation was carried out to study the impact of System of Rice Intensification (SRI) practices on nutrient uptake, nutrient harvest index, soil available nutrient status and yield of rice in the Karaikal region of Pondicherry Union Territory.

MATERIALS AND METHODS

A field experiment was carried out at Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal during *kharif* season. ADT 43 rice variety was used as test variety. The soil of the experimental plot was sandy loam in texture, low in available nitrogen (188.3 kg ha^{-1}), medium in available phosphorus (17.8 kg ha^{-1}) and potassium (235 kg ha^{-1}). Totally, there were 12 treatments (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 from a modified rice mat nursery; N refers to normal seedlings of 21 days old from 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 (12.5 cm x 10.0 cm); C refers to conoweeding between rows in both directions with hand operated conoweeder and H refers to hand weeding twice at 20 DAT and 40 DAT. Conoweeding was practiced four times at weekly intervals starting from 15 DAT to 36 DAT. The recommended fertilizer schedule of 120: 38: 38 kg NPK ha^{-1} was followed. Nitrogen was applied as urea in three splits *viz*., 50 per cent at 30 DAS and 25 per cent each at 50 DAS and 70 DAS. The entire dose of phosphorus as single super phosphate was applied as basal before transplanting. Potassium in the form of muriate of potash was applied in two splits *viz*., 50 per cent each at basal and at 50 DAS. Zinc sulphate @ 25 kg ha^{-1} was applied as basal before transplanting.

Grain and straw samples of rice were collected at harvest and analyzed for total N using a micro-Kjeldahl method, while total P and K were determined using sulphuric-nitric perchloric acid digest as per Prasad (1998). Nutrient removal was estimated by multiplying the NP and K concentration (%) of grain and straw with their respective yield (kg/ha) and finally the nutrient uptake by grain and straw was sum up to obtain total nutrient uptake.

Nutrient harvest index was computed by using the following formula (Das *et al*., 2010):

$$\text{Nutrient harvest index}\,(\%) = \frac{\text{Uptake of that particular nutrient by grain}}{\text{Total uptake of that nutrient in biomass}} \times 100$$

The post harvest soil samples were collected from 0-15 cm depth for analyzing available nutrient status. The soil samples were analyzed for alkaline permanganate oxidizable N, 0.5 M NaHCO3 extractable P and 1 N NH4OAC exchangeable K as per the procedure described by Prasad (1998). The data were analysed as suggested by Gomez and Gomez (2010).

RESULTS AND DISCUSSION

Nutrient uptake

Significant difference was noticed among various components of SRI in respect of nutrient (NPK) uptake by grain and straw at harvest (Table 1). The combination of Young seedling, One seedling, Square planting and Conoweeding (YOSC) registered the highest nutrient uptake which could be ascribed to better root activity and increased DMP, besides less intra-plant competition (Rajesh and Thanunathan, 2003). Moreover, conoweeding might have contributed for greater biological N fixation, quick organic matter (weeds etc.) decomposition (Das and Mandal, 1986). Further, root pruning due to conoweeding might have induced new fresh roots which results in increased nutrient uptake.

Nutrient harvest index

In general, nutrient harvest index values were higher for phosphorus harvest index (PHI), followed by nitrogen harvest index (NHI). Lower values were observed for potassium harvest index (KHI) (Table 2). The nitrogen harvest index and potassium harvest index significantly differed due to various SRI components. Whereas, phosphorus harvest index was not influenced by SRI practices. The higher nitrogen harvest index with YOSC and potassium harvest index with YMSC might be due to the reason that Young seedling, less intra and inter plant competition and conoweeding resulted in more root growth and biological nitrogen fixation enhanced the nutrient uptake and translocation of nutrients to the grain.

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Post harvest soil available nutrients

The SRI components of various treatments significantly influenced the soil available nitrogen (Table 3). The combination of Young seedling, One seedling, Square planting and Conoweeding (YOSC) recorded more soil available nitrogen. This might be due to planting of young seedling at the rate of one seedling hill^{-1} increase root growth in terms of root length, root volume and root dry weight. This further got increased with conoweeding. In addition to that mechanical weeding might have induced biological N fixation besides incorporating considerable biomass of weeds and dead and decayed roots *insitu* (Uphoff, 2002). The soil available P and K did not differ significantly due to different treatments.

Yield and harvest index

The grain and straw yield and harvest index were significantly influenced by SRI components of different combinations. The combination of Young seedling, One seedling, Square planting and Conoweeding (YOSC) showed its superiority by registering the highest grain yield of 3,683 kg ha^{-1}, straw yield of 5,010 kg ha^{-1} and harvest index of 42.4 per cent. The supremacy of YOSC is attributable to higher growth, yield attributes and nutrient uptake. This is in confirmity with the findings of Hugar *et al.* (2009) who stated that SRI gave higher grain yield due to larger root volume, strong tillers with improved yield attributes. The YOSC recorded higher harvest index which might be due to better soil aeration provided by rotary weeding and better translocation of photosynthates from vegetative parts to grains.

CONCLUSION

The results of the present investigation revealed that planting of young seedling of 14 days old singly at wider spacing of 22.5 cm X 22.5 cm in square pattern along with Conoweeding for four times at weekly interval starting from 15 days after transplanting had significantly improved the nutrient uptake, nitrogen harvest index, soil available nitrogen content and yield of lowland rice during *kharif* season.

Table 1. Effect of SRI practices on nutrient uptake (kg ha^{-1}) at harvest

Treatments	Nitrogen		Phosphorus		Potassium	
	Grain	Straw	Grain	Straw	Grain	Straw
T_1: YOSC	51.14	35.79	10.95	7.11	13.11	43.72
T_2: NOSC	46.63	34.71	9.99	6.73	12.33	42.12
T_3: YMSC	47.86	34.06	10.28	6.92	12.77	41.31
T_4: YOSH	45.11	31.84	9.78	6.32	11.34	39.80
T_5: NMSC	41.56	29.91	8.88	5.94	10.26	35.14
T_6: NOSH	37.93	28.23	8.34	5.51	9.60	33.37
T_7: YMSH	42.09	31.78	9.01	6.16	11.69	35.95
T_8: YORH	39.31	32.75	8.54	6.38	11.13	37.54
T_9: NMSH	33.13	27.09	7.47	5.19	9.05	32.56
T_{10}: YMRH	35.00	30.52	8.12	6.27	9.09	36.72
T_{11}: NORH	31.66	27.98	7.31	5.75	8.50	33.30
T_{12}: NMRH	30.57	28.25	6.87	5.67	7.65	33.34
CD (P=0.05)	1.15	0.99	1.17	0.96	1.17	4.75

Table 2. Effect of SRI practices on nutrient harvest index (%)

Treatments	NHI	PHI	KHI
T_1: YOSC	58.85	60.69	23.08
T_2: NOSC	57.39	59.75	22.70
T_3: YMSC	58.43	59.79	23.63
T_4: YOSH	58.62	60.72	22.16
T_5: NMSC	58.21	59.90	22.60
T_6: NOSH	57.31	60.23	22.33
T_7: YMSH	56.99	59.50	24.53
T_8: YORH	54.55	57.28	22.88
T_9: NMSH	55.08	59.09	21.79
T_{10}: YMRH	53.45	56.46	19.85
T_{11}: NORH	53.10	55.96	20.35
T_{12}: NMRH	52.12	54.90	18.84
CD (P=0.05)	2.55	NS	2.10

Table 3. Effect of SRI practices on post harvest soil available N, P and K (kg ha^{-1})

Treatments	Nitrogen	Phosphorus	Potassium
T_1: YOSC	168	18.65	278
T_2: NOSC	165	19.52	286
T_3: YMSC	166	19.81	286
T_4: YOSH	156	19.00	271
T_5: NMSC	160	18.96	261
T_6: NOSH	151	18.37	289
T_7: YMSH	160	17.73	264
T_8: YORH	152	16.44	290
T_9: NMSH	146	17.33	294
T_{10}: YMRH	150	17.89	281
T_{11}: NORH	154	19.28	270
T_{12}: NMRH	155	18.96	284
CD (P=0.05)	13	NS	NS

Table 4. Effect of SRI practices on yield (kg ha^{-1}) and grain harvest index (%)

Treatments	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Grain harvest index (%)
T_1: YOSC	3683	5010	42.4
T_2: NOSC	3339	4858	40.7
T_3: YMSC	3487	4935	41.4

T_4: YOSH	3249	4613	41.3
T_5: NMSC	2993	4283	41.1
T_6: NOSH	2732	3997	40.6
T_7: YMSH	3103	4604	40.3
T_8: YORH	2864	4744	37.6
T_9: NMSH	2414	3879	38.4
T_{10}: YMRH	2550	4473	36.3
T_{11}: NORH	2306	4053	36.3
T_{12}: NMRH	2189	3999	35.4
CD (P=0.05)	272	471	1.4

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