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Performance of Rice under SRI as Influenced by Rice Cultivars and Graded Levels of Nitrogen

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Abstract

With an aim of fine tuning a suitable rice cultivar and nutrient level under SRI method of rice cultivation, two consecutive field experiments, were conducted during spring seasons of 2014 and 2015 in factorial randomized block design, replicated thrice with five popular rice varieties and four different fertilizer schedules at Annamalai University experimental farm, Tamil Nadu, India. Significant variation among varieties as well as nutrient levels was noticed as influenced by the treatments. Among the rice varieties, plant height, LAI, DMP, root volume, panicle number, filled grains per panicle and grain yield were the highest with ADT 43 and comparable to that of ADT 47. The grain yield ranged from 4370 to 5821 Kg/ha, increase in yield with ADT 43 compared to ADT 36, IR 64 and CO 47 were 33, 20 and 11% respectively. Among different nutrient levels, 150% N of RDF registered the maximum grain yield (6027 kg ha-1) and straw yield (8308 kg ha-1) that was 10 and 22% increase over 125% RDF and 100% RDF, respectively. Nutrient uptake was also significantly influenced by cultivars as well as nutrient levels with a similar trend as that of rice grain yield.

Key words: system of rice intensification, Sri, rice variety, nutrient levels, N uptake

Abbreviations Used

t: Tones, Kg: Kilogram, ha: Hectare, DAT : Days After Sowing, %: Percent, @: at the rate of FYM: Farm Yard Manure, LAI : Leaf Area Index DMP: Dry Matter Production, RDF: Recommended dose of fertilizers

Introduction:

The food production required has to be enhanced to provide nutritional security to the growing population. Tamil Nadu is one of the leading rice growing states of India, as it is endowed with all favourable climatic conditions suitable for rice growing. Paddy is grown in Tamil Nadu in a unique three-season pattern viz., *Kuruvai* (April-July), *Samba* (August to November) and *Navarai* (December to March). Paddy accounted for 30.7% of the total cropped area with a productivity of 2817 Kg/ha (Season and crop report, 2008). In order to increase the productivity and to meet the demand, some innovative rice production agro-technique is needed. Under this scenario, the system of rice intensification (SRI) may be an appropriate practice. SRI has higher B-C ratio than that of the conventional practices due to an important trait of SRI: increase in production with reduced cost (Barah, 2009). Farmers have been widely encouraged to adopt SRI as they also realized that the conservation of water and soil ensures long-term sustainability. In Tamil Nadu, SRI was adopted in an area of 0.75 million hectares (Meyyappan *et al*., 2016). Farmers normally accept the recommended dose of fertilizers for their local popular rice varieties to achieve the maximum yield. As SRI provide wider opportunities, an attempt has been made to test its performance with an aim of selecting a suitable cultivar and an optimum dose of nutrients, to augment the rice yield.

Materials and methods

A field experiment was conducted in the wetlands of Annamalai University experimental farm (11°24’ North Latitude, 79°44’ East Longitude with an altitude of + 5.79M above MSL). The soil was clay, low in organic carbon, low in available N, medium in available P and high in available K. Five rice varieties *viz.,* IR 64, CO 47, ADT 43, ADT 47 and ADT 36, and four nutrient levels *viz.* 100% N of RDF, 75% N of RDF, 125% N of RDF and 150% N of RDF were tested in randomized block design using factorial technique, replicated thrice. RDF indicate N (120 kg/ha), P_2O_5 (40 kg/ha) and K_2O (40 kg/ha). Urea, super and muriate of potash, were the fertilizers used as per the treatment schedule. Half of the specified dose of N and full dose P and K were applied basally. The remaining N was top dressed in two equal splits during active tillering and panicle primordial initiation stages. Seedling raised from Mat nursery was gently transplanted at 12 days @ 1 seedlings per hill in a square planting of 25 cm. Mat nursery was prepared in a flat surface, spread with polythene sheet of convenient size, over that a mixture of equal proportion of sand and FYM was spread as thin layer (5 cm) and water was sprinkled to moist the mixture. Rice seeds were sown on 10th January and 12th January in 2014 and 2015 respectively. A sowing depth of 1 to 2 cm was adopted and water sprinkled periodically and transplanted with 12 days old seedlings. Irrigation was done at the sight of hair line crack formation in the main field to a depth of 2cm till the active tillering stage of the crop and later on submergence at 5cm was maintained till physiological maturity of the crop. Weed management was done with *Conoweeder* between rows, first weeding at 10 to 12 days after planting, further weeding was undertaken depending on the necessity at 10 to 15 days' interval until crop reaches active tillering stage. The crop was harvested at the end of April and beginning of May in 2014 and 2015, respectively.Plant height and DMP was observed at harvest, while LAI and root volume was recorded at flowering stage of the crop. The observed data was pooled, statistically analyzed and means compared at 5% probability levels that attained significance (Gomez and Gomez, 1984).

Results and discussion

All the growth and yield contributing characters were significantly altered by rice varieties and nitrogen levels, except test weight. In both the experiments, the results in Table 1 and 2 indicated that the five tested cultivars significantly differed in plant height, LAI, root volume, DMP, panicle and filled grain number, grain and straw yield. Cultivar ADT 43 produced the tallest plants (119.3 cm), maximum LAI (6.1), the largest DMP (13065 Kg/ha), the highest root volume (114.8 cc), maximum number of panicles, filled grains (332/m^2 and 136/panicle, respectively), the maximum grain, and straw yield (5821 and 7981 Kg/ha respectively). The performance of ADT 43 was comparable to that of ADT 47 in all the growth and yield characters. Differential performance of two cultivars may be attributed to differences in genetically back ground and constitution of these cultivars. ADT 43 and ADT 47, both were characterized by strong growth, a lot of tillers, higher root volume and panicles. The lowest performance was registered with cultivar ADT 36. The second-best yielder was CO 47 that registered 5235 Kg/ha which was 10% lesser than that of ADT 43. The results were parallel with earlier reports (Panigrahi*et al*., 2014).

Table 1: Growth and yield attributes of rice varieties as influenced by different levels of N (pooled data of 2 years)

Treatment	Plant height (cm)	LAI	DMP (kg ha^{-1})	Root volume (cc)	Panicles m^{-2}	Filled grains panicle^{-1}
IR 64	104.3	5.32	10740	99.6	291	94
ADT 43	119.3	6.10	13065	114.8	332	136
CO 47	111.0	5.62	11606	108.0	312	102
ADT 47	117.0	5.92	12709	111.8	336	139
ADT 36	97.1	5.02	9720	91.3	278	89
100% N of RDF	106.0	5.34	11091	100.2	304	108
75% N of RDF	101.2	5.08	9615	91.7	290	98
125% N of RDF	113.0	5.76	12333	108.6	316	115
150% N of RDF	118.8	6.18	13233	119.9	329	126
CD (P=0.05)	4.95	0.19	605	2.78	10.38	3.82

Table 2: Yield and uptake of rice varieties as influenced by different levels of N (pooled data of 2 years)

Treatment	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	N uptake (kg ha^{-1})	P uptake (kg ha^{-1})	K uptake (kg ha^{-1})
IR 64	4830	6898	98.15	26.99	106.49
ADT 43	5821	7981	113.87	31.42	124.81
CO 47	5235	7410	105.03	28.63	114.32
ADT 47	5672	7845	112.13	30.73	123.54
ADT 36	4370	6445	90.89	25.14	97.03
100% N of RDF	4918	7010	99.02	27.10	107.98
75% N of RDF	4312	6251	84.87	23.29	93.15
125% N of RDF	5484	7695	111.25	30.52	121.02
150% N of RDF	6027	8308	120.92	33.42	130.80
CD (P=0.05)	308.08	365.36	5.32	1.27	6.98

Among four N levels tried, during both the years of study, all the growth and yield parameters as well as grain yield of rice was significantly influenced by graded N levels and it was increased significantly from 75 to 150% RDF. Increasing the levels of N significantly enhanced the number of panicles/m^2, filled grains/panicle and consequently the grain yield (Tables 1 and 2) at all stages of observation. 150% N of RDF registered the maximum yield (6027 kg/ha) and it was 40, 18 and 9% increase compared to that of 75%, 100% and 125% N of RDF, respectively. The enhancement in yield with 150% N of RDF was due to better availability and uptake of nutrients, which in turn lead to efficient metabolism. High level of biomass accrual (13065 Kg/ha) and efficient translocation of photosynthates from source to sink might be responsible for the production of elevated level of yield structure. Rice plants when grown under saturated condition develop hairy, branched secondary adventitious roots near the root-soil interface (20% increased root volume compared to RDF) in order to absorb dissolved oxygen in the oxidized layer and take up more nutrients resulting in higher yields. It is noteworthy to record that the root volume and uptake of nutrients was the highest with 150% N of RDF that could have resulted in a higher yield ultimately. The results are in conformity with those of (Malik *et al*., 2014). Many workers, earlier, reported positive response of rice up to 180 kg N/ha under agro-ecological situation (Meena*et al*., 2014).

It is inferred that, by adopting SRI technique, the highest grain yield was obtained in rice variety ADT 43 or with ADT 47 along with a nutrient schedule of 150% N of RDF (180 Kg N, 40 Kg P_2O_5 and 40 Kg K_2O/ha).

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