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Studies on integrated plant nutrient supply system for maximizing the growth and yield of rice (*Oryza sativa* L.) in SRI

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Abstract

The study was conducted during the year 2021 at the experimental farm, Department of Agronomy to Studies on integrated plant nutrient supply system for maximizing the growth and yield of rice (*Oryza sativa* L.) in SRI method. The experiment was conducted with twelve treatments with different quantities of nitrogen, green manure, pressmud biocompost, goat manure, seaweed extract and phosphate solubilizing bacteria was employed on the rice crop and study was conducted using the variety TRY3. The treatments were replicated thrice, and the field trial was laid out using randomised block design (RBD). According to the research outcome, among the different treatments, 100% RDN + 25% N as Pressmud biocompost + PSB resulted in higher morphological characters, including plant height (93.07), leaf area index (3.32), dry mater production (6576), number of tillers/hill (18.89) and yield characteristics, including maximum number of tillers/hill (11.15), grains/panicle (134.81), and filled grain/panicle (95.72), grain yield (2634 kg ha^{-1}) and straw yield (4602 kg ha^{-1}) of rice. Multiple parameters in the control treatment scenario indicated lower production and inadequate growth and development. The study revealed that application of 100% RDN + 25% N as Pressmud biocompost + PSB could be considered a better option for achieving the growth and yield attributes of TRY 3 under SRI method.

Key words : Growth and Yield, Pressmud Biocompost, Rice, System of Rice Intensification.

"Rice is Life" is the ideal rice motto in India. In India, rice is a vital food. According to reports, India is the country with the biggest global rice consumption. More than two billion

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people in Asia consume rice and rice-derived products for 60–70% of their energy needs; rice is a member of the poaceae family[7]. With 328 M hectares of land, agriculture in India significantly contributes to the country's economic development. Rice is farmed over 45 M hectares of land beneath this area, producing a total of 121.46 million tonnes. 7.18 million tonnes of rice are produced in Tamil Nadu from 1.91 million ha of cropland[2].

To meet future food demands and maintain self-sufficiency, India must increase its crop output by 3% annually. IPNSS and agronomic methods must be used to meet the rising demand for rice grain production and also to maintain crop sustainability; system of rice intensification (SRI) was one of the methods for increasing rice output under IPNSS practices. This strategy might be used in small-scale farming to lower production costs by lowering the need for chemical inputs, water use, and seed. Due to less external inputs and the use of organic fertiliser and pesticides, the SRI strategy also correlates to resource conservation and beneficial environmental benefits[1,4]. Therefore, the SRI may also be suitable as a farming practice working towards sustainable agriculture.

The rice intensification system saves 30–40% of the water used for irrigation, 85% of the cost of seeds and chemical fertilisers, and encourages soil microbial activity, which boosts the soil's health. SRI provides benefits for seed multiplication as well. Saving money since less seed is needed, conserving water because alternate soaking and drying techniques are used, Due to the absence of chemical fertilisers and pesticides, the cost of external inputs decreases. Because the soil is periodically permitted to dry out, the prevalence of pests and diseases is limited. Organic agricultural techniques result in more nutritious and delicious rice. Higher yields as a result of extensive tillering, longer panicles, and heavier grains, seed multiplication using fewer parent seeds. Farmers can produce their own quality seed[5].

SRI is growing in popularity among farmers today, although it has been noted that many times, due to ignorance or an inability to adhere to all six SRI principles, farmers were unable to obtain the maximum grain yield of rice. Therefore, it is critical to understand how each component contributes so that farmers can use the elements that are most crucial to boosting rice harvest. In order to ascertain how SRI principles affect rice economics, yield attributes, and growth characteristics, the current investigation was conducted.

A field experiments were conducted to examine how to maximize rice growth and yield under integrated plant nutrition supply at the Experimental Farm of the Department of Agronomy at Annamalai University in Tamil Nadu, India, during the year 2021. The experimental site is situated at an altitude of +5.79 m above mean sea level, at 11°24'N latitude and 79°44'E longitude. Twelve treatments were used in this experiment, each of which was replicated three times, T_1 was the Absolute Control (No application), T_2 was 75% RDN, T_3 was 100% RDN, T_4 was 125% RDN, T_5 was 100% RDN + 25% N as Green Manure + PSB, T_6 was 100% RDN + 25% N as Pressmud Biocompost + PSB, and T_7 was 100% RDN+ 25% N as Goat manure + PSB, T_8 – 100% RDN + 25% N as Seaweed

Table-1. Effect of IPNSS on plant height, leaf area index, dry mater production, number of tillers hill^{-1} at harvest stage of the crop

Treatment	Plant height (cm)	Leaf area index	Dry mater production (kg ha^{-1})	Number of tillers/ hill
T_1 - Control	93.07	3.32	6576	18.89
T_2 - 75% RDN	96.52	3.58	7436	19.51
T_3 - 100% RDN	99.96	3.84	7955	20.12
T_4 - 125% RDN	100.53	3.97	8186	20.27
T_5 - 75% RDN + 25% N as Green Manure + PSB	112.08	4.88	10884	22.25
T_6 - 75% RDN + 25% N as Pressmud Biocompost + PSB	115.51	5.13	11408	22.86
T_7 - 75% RDN + 25% N as Goat manure + PSB	108.64	4.61	10363	21.63
T_8 - 75% RDN + 25% N as Seaweed Extract + PSB	103.97	4.22	9461	20.88
T_9 - 100% RDN + 25% N as Green Manure + PSB	122.38	5.65	12581	24.07
T_{10} - 100% RDN + 25% N as Pressmud Biocompost + PSB	125.82	5.92	13206	24.68
T_{11} - 100% RDN + 25% N as Goat manure + PSB	118.95	5.39	12019	23.47
T_{12} - 100% RDN+25% N as Seaweed Extract+PSB	105.20	4.34	9725	21.02
S.Ed	1.65	0.11	217.86	0.29
CD	3.42	0.23	450.98	0.59

Extract + PSB, T_9 – 125% RDN + 25% N as Green Manure + PSB, T_{10}–125% RDN+ 25% N as Pressmud Biocompost + PSB, T_{11} - 125% RDN + 25% N as Goat manure + PSB, T_{12} - 125% RDN + 25% N as Seaweed Extract + PSB. Employing urea, pressmud biocompost, seaweed extract, green manure, and goat manure, at various growth stages was administered to rice. At the harvest stage, the yield and the growth characteristics were taken randomly from each plot. The organic manures along with PSB were incorporated in soil 30 days before transplanting of paddy. Growth and Yield attributes was recorded from individual plots. The data were subjected to statistical analysis as prescribed by Gomez and Gomez[3].

Growth attributes :

The treatments had a big impact on growth factors such plant height, tiller count, leaf area index (LAI), chlorophyll content, dry matter accumulation, and root length and volume. T_{10}-100% RDN+25% N as Pressmud Biocompost + PSB recorded the highest levels of plant height (125.82 cm), leaf area index (5.92), dry mater production (13206 kg ha^{-1}), number of tillers per/hill (24.68) among the treatments evaluated. This treatment was followed by T_9 - 100% RDN + 25% N as

Table-2 Effect of IPNSS on productive tillers/hill, grains/panicle, filled grains/panicle, grain yield and straw yield at harvest stage of the crop

Treatment	Panicles/ hill	Grains/ panicle	Filled grains/ panicle	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})
T_1 - Control	11.15	134.81	95.72	2634	4602
T_2 - 75% RDN	11.51	136.58	98.34	3369	4893
T_3 - 100% RDN	11.89	138.34	102.37	3657	5181
T_4 - 125% RDN	12.09	139.32	103.10	3760	5335
T_5 - 75% RDN + 25% N as Green Manure + PSB	15.01	145.70	115.10	5385	6708
T_6 - 75% RDN + 25% N as Pressmud Biocompost + PSB	15.45	147.47	117.98	5668	7007
T_7 - 75% RDN + 25% N as Goat manure + PSB	14.63	143.94	112.27	5101	6413
T_8 - 75% RDN + 25% N as Seaweed Extract + PSB	14.01	141.08	105.81	4546	5966
T_9 - 100% RDN + 25% N as Green Manure + PSB	16.19	151.04	125.36	6388	7590
T_{10} - 100% RDN + 25% N as Pressmud Biocompost + PSB	16.57	152.84	129.91	6797	7876
T_{11} - 100% RDN + 25% N as Goat manure + PSB	15.83	149.23	122.37	6062	7292
T_{12} - 100% RDN + 25% N as Seaweed Extract + PSB	14.26	142.19	106.64	4681	6124
S.Ed	0.16	0.84	1.08	114.7	133.01
CD	0.34	1.74	2.25	237.39	275.32

Seaweed Extract + PSB (Table-1). This resulted due to the integrated application of both organic and inorganic nutrients together. The availability of nutrients has an impact on the crop's growth traits. Nitrogen is a crucial nutrient for crop growth and development, hence using different fertiliser sources in different proportions can permit crop development[7]. The addition of pressmud biocompost increased the amount of nutrients that were available in the soil at different stages of crop growth, possibly because nutrients were released when the crop required them. In the beginning, inorganic fertilisers provide the crop with the nitrogen it needs; later, Pressmud biocompost mineralization may coordinate the release of nitrogen for the crop, fostering growth and development[6,8].

Yield attributes :

Among the IPNSS practices, yield attributes like productive tillers/hill, grains/ panicle, filled grains/panicle grain yield and straw yield were significantly influenced by the treatment T_{10} – 100% RDN + 25% N as Pressmud Biocompost + PSB recored the maximum number of number of panicles/hill (16.57), grains/panicle (152.84), filled grains/ panicle (129.91) grain yield (6797 kg ha^{-1}) and straw yield (7876 kg ha^{-1}) of rice. This treatment was followed by T_9 - 100% RDN + 25% N as Seaweed Extract + PSB (Table-2). The microbial stimulating impact of organic manures and the long-term availability of vital plant nutrients through slow mineralization may both contribute to the rise in yield qualities. This improved source and sink connections, which in turn improved yield attributes, led to an increase in photosynthetic assimilation. The research by Yadav *et al.*[10], supported these conclusions.

The field experiment with the integrated application of 100% RDN + 25% N as Pressmud Biocompost + PSB prescribed to the rice appears to be more promising for increasing crop yield and productivity of rice. Based on the aforementioned findings, utilising pressmud biocompost in combination with inorganic fertiliser performs better than other treatments. The study found that rice requires the right amount of nutrients to grow and produce in a desirable way.

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Conflicts of interest

The authors report no conflicts of interest in this research work.

Ethical approval

This study does not involve any experiments on human or animal subjects.

Data availability

All data generated and analysed or included with in the research.

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