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Influence of different agronomic strategies on growth and yield of rice

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Abstract
The field Experiment was conducted at Annamalai University, Experimental Farm, Department of Agronomy during *Kuruvai* season of June – September, 2023, to study the influence of different agronomic strategies on growth and yield of rice. A short duration rice variety ADT 43 was selected for the study. The field experiment was laid out in Randomized Block Design (RBD) with nine treatments in three replications. Based on the experimental results, it may be concluded that the application of 50% RDN + RDF (P&K) + foliar application of nano N +$ZnSO_4$ + $FeSO_4$ at 25 and 45 DAT (T_9) effectively recorded highest crop growth rate, plant height, leaf area index, number of tillers hill^{-1} and dry matter production. The treatment T_1 recorded the lowest values of growth and yield.

Keywords: ADT 43, nano N, $ZnSO_4$, $FeSO_4$

Introduction
Rice is the most prominent crop of India as it is the staple food for most of the people of our country. India occupies an important position in area, production and consumption of rice. Over 90% of the world's rice is produced and consumed in Asia, additionally rice farming is the main livelihood opportunity for more than 200 million households throughout the world, making it one of the most significant crop for human (Tonini and Cabrera, 2011) [6]. Ensuring food security along with nutrition, simultaneously sustaining the environment are the major obstacles faced by the Asian nations presently, particularly India, whose population has surpassed 1.4 billion. World-wide, rice is grown over 163 M ha area and India ranks number one globally with about 45 million hectares and with production of 124 million tonnes next to China (Anonymous, 2023) [1]. The Fertilizer management is one of the most important agronomic management practices in modern day farming upon which the productivity of the crop is dependent. However increasing the cost of chemical fertilizer, energy crisis and environmental concern have created considerable for search of alternative sources of plant nutrients (Zaller, 2007) [7]. Nano-fertilizers had a own features which enhance plants growth in terms of ultra-high absorption, higher production, increased photosynthesis and significant expansion in the leaves surface area (Nongbet *et al.*, 2022) [4]. Besides, the controlled release of nutrients contributes in preventing eutrophication and pollution of water resources (Guo *et al.*, 2018) [3]. Replacement of conventional fertilizer by nano-fertilizer is beneficial, it releases nutrients for the plants steadily and in a controlled way. It also prevents the water pollution. It would have been very helpful if nano-fertilizers are used for specific crops such as rice to minimize the potential negative effects brought about by the extensive use of conventional chemical fertilizers without compromising production and nutritional benefits (Abdel *et al.*, 2018) [13]. Nano-urea have emerged as a trustable technology in the field of agriculture, offering notable solutions to improve nutrient uptake efficiency, enhance crop productivity and reduce environmental impacts and it also showed superior characteristics and performance on crops and therefore became a best alternative to conventional nitrogen (N) fertilizers. However, micro nutrient deficiency in soil is a major problem and thus, adequate supply is recommended to machinate. For normal growth of rice crop it needs only a small amount of zinc and iron to produce maximum yield. Keeping the above said facts in consideration, the present investigation was carried out to study the effect of

foliar application of nutrients on transplanted rice.

Materials and Methods

Field experiment was conducted at the Experimental Farm, Department of Agronomy, Faculty of Agriculture, Annamalai University during *Kuruvai* season of June – September, 2023. The Experiment was laid out in randomized block design with three replications using variety ADT- 43 as the test crop. The Experimental Farm is geographically situated at 11° 24' North Latitude and 79° 44' East Longitude and with an altitude of + 5.79 m above mean sea level. The Experimental Farm is characterized by tropical climate with a mean annual rainfall of 1500 mm. The soils of the experimental field was clay loam. The soil was clay in texture having pH 6.7, EC 0.34 ds/m, low in available N (246.50 kgha^{-1}) medium in available P (18.5 kgha^{-1}) and high in available K (280.75 kgha^{-1}). The experiment consists of nine treatments *viz*. absolute control (T_1), 100% RDF (T_2), 50% RDN + RDF (P&K) + foliar application of nano N at 25 and 45 DAT (T_3), 100% RDF + foliar application of $ZnSO_4$ at 25 and 45 DAT (T_4), 50% RDN + RDF (P&K) + foliar application of nano N + $ZnSO_4$ at 25 and 45 DAT (T_5), 100% RDF + foliar application of $FeSO_4$ at 25 and 45 DAT (T_6), 50% RDN + RDF (P&K) + foliar application of nano N + $FeSO_4$ at 25 and 45 DAT (T_7), 100% RDF + foliar application of $ZnSO_4$ + $FeSO_4$ at 25 and 45 DAT (T_8), 50% RDN + RDF (P&K) + foliar application of nano N +$ZnSO_4$ + $FeSO_4$ at 25 and 45 DAT (T_9).Twenty one day rice seedlings were transplanted in 5x4m plots with a spacing of 15 x 10cm. The variety was raised under optimum conditions of nutrient supply (120:40:45 kg NPK ha^{-1}) and plant protection measures in the field.Foliar spray of nano urea was applied at 25 and 45 DAT @ 1.45 l ha^{-1} at two equal splits with the spray volume of 500 l ha^{-1} by using a hand-operated knapsack sprayer, were done as per the treatment schedule. Foliar spray of micro nutrients, $FeSO_4$ and $ZnSO_4$ was applied at 25 and 45 DAT @ 2.5 kg ha^{-1} respectively. Observations on growth and yield attributes were taken on five randomly selected peg marked plants in periodical intervals. The mean values were used for statistical analysis as suggested.

Table 1: The influence of different agronomic strategies on growth attributes in rice

Treatments	Plant height (cm)	Number of tillers hill^{-1}	DMP (Kg ha^{-1})			LAI		CGR (g m^{-2} day^{-1})		Grain Yield (Kg ha^{-1})	Straw Yield (Kg ha^{-1})
	At Harvest		30 DAT	60 DAT	Harvest Stage	Tillering stage	Flowering stage	30 to 60 DAT	60 DAT to Harvest stage		
T_1	82.98	3.81	1258	2789	3659	1.43	2.13	4.89	2.00	1946	2951
T_2	93.02	7.04	4462	6091	9121	2.96	5.13	9.07	5.85	4342	6265
T_3	98.67	8.03	4722	7426	11341	3.34	5.51	11.48	7.40	5240	7172
T_4	98.28	7.92	4547	7445	11236	3.24	5.48	11.21	7.15	5196	7168
T_5	102.28	9.81	4771	7830	12333	3.99	6.05	12.44	8.32	5589	7562
T_6	96.09	7.35	4708	7273	11458	3.19	5.45	10.37	6.94	5040	7014
T_7	101.17	9.26	4877	7703	11987	3.62	5.81	12.10	7.97	5422	7386
T_8	99.97	8.63	4763	7594	11763	3.49	5.63	11.82	7.82	5328	7263
T_9	104.47	10.43	4938	7941	12533	4.37	6.23	12.78	8.46	5730	7735
S. Ed±	0.47	0.27	83.47	55.45	52.65	0.18	0.08	0.13	0.06	41.15	52.31
CD (P=0.05)	0.93	0.54	166.94	110.9	105.3	0.35	0.16	0.26	0.11	82.29	104.61

Result and Discussion

All the growth components *viz*., plant height, leaf area index, number of tillers plant $^{-1}$, dry matter production, and crop growth rate were significantly influenced by nano fertilizer and foliar spray of micro nutrients. Among the treatments application of 50% RDN + 100% RDF (P&K) + foliar application of nano N +$ZnSO_4$ + $FeSO_4$ at 25 and 45 DAT (T_9) recorded the maximum growth attributes, *viz*., plant height, number of tillers hill^{-1}, leaf area index, CGR and dry matter production at all the stages of crop growth respectively. The positive impact on plant height may be due to the continuous supply of essential plant nutrients in required amount through inorganic fertilizers. The maximum growth attributes might be due to availability of nutrients through foliar application which increased dry matter, plant assimilates which directly reflect into number of tillers plant $^{-1}$ and also higher growth characters (Ranjan *et al.*, 2023) [9]. Also, this might be due to the application of nano urea, which led to enhanced the meristematic activity and stimulation of cell elongation in plants. The increase in number of filled grains panicle^{-1} was found to be increased with the foliar application of nano urea fertilizer which could be due to the higher translocation of starch both from the active site of leaves and straw to grain (sink) and also higher nitrogen steadily supplied by nano urea in the required amount throughout the growth stages (Meena *et al.*, 2017) [12]. Also the cumulative and conjective application of Zn and Fe nutrients to the crop might have enjoyed with sufficient nutrient condition for a longer period of time and the nutrient uptake there by allowing the plant to perpetuate with all the yield components and yield (Sudha and Stalin, 2015) [5]. The increased in number of grains per panicle was due to cumulative effect of yield attributing characters, enhanced photo synthetic efficiency and improvement in the capacity of the reproductive sinks to utilize the incoming assimilates due to the exogenous application of Zn and Fe. These findings were in line with the results of Gewally *et al*. (2018) [2], Chandana *et al*. (2021) [11], Rath (2021) [10] and Ugile (2024) [8].

Conclusion

Based on the experimental results, it might be concluded that the treatment 50% RDN + RDF (P&K) + foliar application of nano N 2ml L^{-1} + $ZnSO_4$ 5g L^{-1} + $FeSO_4$ 5g L^{-1} at 25 and 45 DAT (T_9) registered maximum increase in the productivity and profitability of rice. Hence it is the effective treatment and considered as the most efficient way to increase the yield of rice.

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