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Effect of integrated nutrient management on growth indices and yield of direct seeded rice (*Oryza sativa* L.) under midland situations of Bastar Plateau

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Abstract
An experiment was conducted at the Instructional Cum Research Farm of S. G. College of Agriculture and Research Station, Jagdalpur, Chhattisgarh, India, during the Kharif season of 2021. The Inceptisol soil used in the experiment was acidic in nature, low in organic carbon, low in accessible N and P, and medium in K. With three replications and nine treatments, the experiment was conducted using a randomized block design (RBD). The results showed that the highest grain production, straw yield, dry matter accumulation, and leaf area index were achieved by treatment T_5 (100% NPK + 5 t FYM ha^{-1} + *Azospirillum* and PSB). However, different INM had significant effect on different growth indices of DSR *viz*., crop growth rate, relative growth rate and net assimilation rate.

Keywords: INM, DSR, FYM, bio-fertilizer, growth indices, LAI, CGR, RGR, NAR

Introduction

In India, rice cultivation covers 44 million hectares and yields 90 million tonnes annually at productivity of 2.0 tonnes per hectare. Every year, the need for rice rises, and it is predicted that 140 million tonnes would be needed in 2025. India must boost its rice yield by 3% annually in order to maintain its current level of food self- sufficiency and fulfill future food demands (Thiyagarajan and Selvaraju 2001) [24]. The uneven application of major nutrients is one of the factors contributing to India's declining or stagnating rice output (Reddy and Ahmed 2000). Applying the proper amount of fertilizer is the most important aspect in assuring agricultural profitability and environmental safety. Fertilizer is one of the most crucial and critical inputs in agriculture (Kimetu *et al*., 2004) [11]. Rice accounts for more than 80% of all cultivated land in Chhattisgarh State, which is referred to as "India's Rice Bowl." A rain-fed rice system is used to cultivate rice on the majority of land. One of the 27 districts in Chhattisgarh State with the highest cropping intensity is Dhamtari, where the predominant cropping pattern is rice-fallow. In terms of area, the district is ranked 11th, and in terms of production, it is ranked 4th in the state. (Anonymous, 2013-14) [1].

Despite several drawbacks, direct seeded rice cultivation is a common growingly substitute for transplanting in India, where it is grown on around one-third of the nation's total rice land. Even in non- traditional rice-growing regions, direct seeding is becoming more and more common because transplanting is a time- consuming and expensive process. Many farmers switched from transplanting to direct seeding as a result of the availability of selective herbicides and the development of early maturity cultivars. (Umashankar *et al*., 2005) [25].

In order to support soil health in relation to crop productivity, one possible strategy is integrated nutrient management of fertilizers and organic manures. (Bajpai *et al*., 2006) [3]. These inorganic fertilizers provide important plant nutrients, but utilizing a high dose of them is not a smart management strategy because it results in a number of problems like decreased production, poor water quality, soil deterioration, and so on. As a result, various plant nutrition sources can be used to maintain the health of our land and agricultural output. As a result, using nitrogenous fertilizers along with bio- inoculants like Azotobacter, *Azospirillum*, and others is becoming increasingly crucial. (Rawat and Agrawal, 2010) [16]. Recently, phosphorus solubilizing bacteria (PSB) have emerged as a productive element of the efficiently production system. (Raki *et al*., 2019) [14]. There are significant environmental issues as a result of the green revolution. As a result of inappropriate fertilizer application, farmers are increasingly complaining about poor soil fertility, soil salinity and alkalinity, and ground water pollution.

(Sharma, 1993) [18]. In conclusion, farmers may gain large advantages from INM. Numerous studies have revealed that INM affects paddy soil fertility, disease resistance, weed management, higher economic yield, and disease resistance. (Bhanuwati and Vaidya P., 2020) [5].

Material and Methods

The experiment took place during the 2021 Kharif season. In Inceptisol soil with an acidic pH, little organic carbon, little readily available nitrogen and phosphorus and medium potassium levels was found in the experimental field. Three replications of the randomized block design (RBD) experiment comprising nine treatments were used. i.e., T_1: 100% RDF, T_2: 75% RDF, T_3: 50% RDF, T_4: 25% RDF, T_5: 100% NPK + 5 t FYM ha^{-1} + *Azospirillum* and PSB, T_6: 75% NPK + 5 t FYM ha^{-1} + *Azospirillum* and PSB, T_7: 50% NPK + 5 t FYM ha^{-1} + *Azospirillum* and PSB, T_8: 25% NPK + 5 t FYM ha^{-1} +
Azospirillum and PSB, T_9: Control. The recommended dose of fertilizer for a rice field was 120:60:40 kg N: P: K ha^{-1}, which was supplied to all the plots except the control with urea, single super phosphate, and muriate of potash, respectively. The crop has been planted with 50% nitrogen, 100% phosphorus, and 100% potash, with the remaining 50% dose of nitrogen delivered at 25 to 30 days after sowing and
40 to 45 days after sowing. As the basal dose, Farm Yard Manure was combined with *Azospirillum* and PSB. All of the data obtained on various factors was statistically analyzed using the Randomized Block Design approach suggested by Gomez and Gomez (1984) [8].

Result and Discussion

Dry Matter Accumulation

Result exhibited in Table 1 revealed that at all growth stages, the treatment T_5 recorded the significantly largest amount of dry matter accumulation, but it was also found to be on par with the treatments T_1 and T_6, while the treatment T_2 was found to be on par with the treatment T_5 at the 90 and 120 days after sowing and at harvest.

Table 1: Effect of integrated nutrient management of direct seeded rice on dry matter accumulation, LAI, CGR, RGR and NAR at different growth stages

Treatment	Dry matter accumulation (g/plant)	Leaf Area Index	Crop Growth Rate ($g/m^2/day$)	Relative Growth Rate (g/g/day)	Net Assimilation Rate ($g/m^2/day$)
T_1	42.18	2.34	0.121	0.0013	0.0077
T_2	40.31	1.89	0.073	0.0008	0.0047
T_3	34.87	1.76	0.109	0.0014	0.0076
T_4	28.23	1.63	0.050	0.0008	0.0035
T_5	42.90	3.18	0.113	0.0012	0.0056
T_6	41.02	2.03	0.067	0.0007	0.0044
T_7	36.14	1.79	0.028	0.0003	0.0018
T_8	30.34	1.96	0.073	0.0011	0.0048
T_9	27.95	0.92	0.123	0.0021	0.0117
SEm±	1.97	0.08	0.004	0.001	0.001
CD @ 5%	5.95	0.25	0.012	0.001	0.001
CV%	9.46	7.26	8.06	6.77	7.95

Crop photosynthetic efficiency which ultimately affects crop output is strongly correlated with dry matter production. Also this may have enhanced soil aggregation, increased nutrient availability, and increased soil microbial activity, developing favorable soil conditions for improved nutrient uptake that improved plant vegetative growth and increased the area of leaves that can be used for photosynthetic respiration, which increased the production of dry matter. (Siddaram *et al*., 2010) [19]. Besides from that, nitrogen may have been involved in a wide range of physiological processes such as increased photosynthetic activity and improved light interception, leading to greater dry matter production (Haq *et al*., 2005) [9].

Leaf Area Index

The various INM significantly impacted the leaf area index. Table 1 and Fig. 1 reveals that treatment T_5 found significantly greater leaf area index but it was found at par with treatment T_1 and the lowest leaf area index was recorded by treatment T_9 among all the treatments. This might be caused by the quick release of nutrients from the inorganic source combined with the organic supply, which leads to greater vegetative development. Less leaves were present on each plant at harvest due to leaf senescence. (Siddaram *et al*., 2010) [19]. The growth of leaf area is a crucial factor that may affect how responsive a crop is to the addition of nitrogen. (Singh and Sharma 2005) [20].

Crop Growth Rate ($g/m^2/day$)

Perusal of data (Table 1 and Fig. 2) indicated that crop growth rate of rice was significantly affected by different integrated nutrient treatment. The data shows that the treatment T_5 recorded significantly maximum CGR between 30 to 60 days after sowing, treatment T_2 recorded maximum CGR between 60 to 90 days after sowing and treatment T_9 recorded maximum CGR between 90 to 120 days after sowing and between 120 days after sowing to at harvest. And lowest CGR was observed in treatment T_9 at 30 to 60 and treatment T_4 at 60 to 90 days after sowing, treatment T_8 in 90 to 120 days after sowing and treatment T_7 in 120 days after sowing to at harvest. Crop growth rate and output were found to be positively impacted by INM utilizing both inorganic fertilizers and organic manures. (Kumar and Prasad 2008 and Ahmed *et al*., 2014) [12, 2].

Between 30 and 60 days after transplanting, the crop's growth rate maximized. i.e. during the crop's grand growth stage. This could be related to increased leaf area and photosynthate production (Dahiphale *et al*., 2004) [6].

Relative Growth Rate (g/g/day): Perusal of data (Table 1 and Fig. 3) shows that treatment T_7 recorded significantly highest RGR at 30 to 60 days after sowing and treatment T_9 recorded highest RGR at 60 to 90 days after sowing, at 90 to 120 days after sowing and at 120 days after sowing to at harvest.

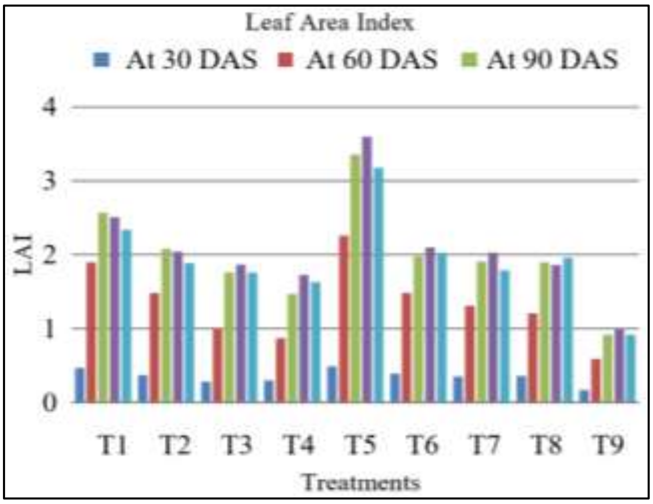

Fig 1: Leaf area index of direct seeded rice as influenced by different INM at various growth stages

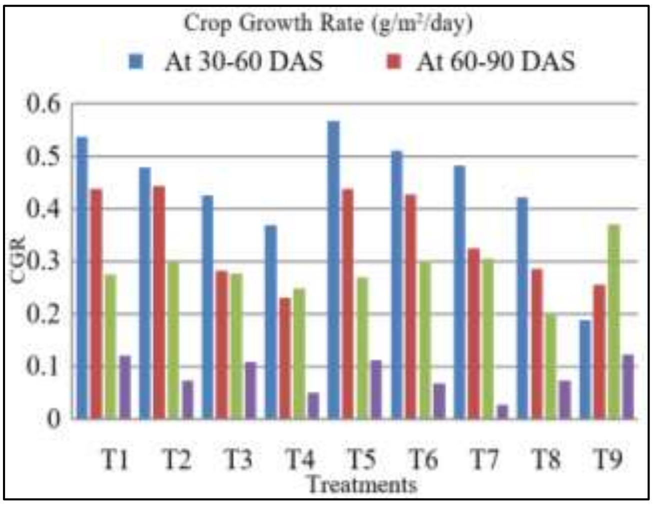

Fig 2: Effect of different INM on crop growth rate of direct seeded rice at various growth stages

The lowest RGR was recorded at treatment T_9 between 30 to 60 days after sowing, treatment T_4 between 60 to 90 days after sowing, treatment T_1 and treatment T_8 at 90 to 120 days after sowing and treatment T_7 between 120 days after sowing to at harvest. Such findings were also observed by Rao *et al*., 2020. The AGR and RGR of direct seeded rice were considerably impacted by various inorganic and organic nutrient sources (Venkatesha *et al*., 2015) [26].

Net Assimilation Rate (g/m^2/day): Table 1 and Fig 4, reveals that the treatment T_6 recorded significantly maximum NAR between 30 to 60 days after sowing and at 60 to 90 days after sowing and treatment T_9 at 90 to 120 days after sowing and 120 days after sowing to at harvest but treatment T_1, T_2, T_3, T_5 and T_7 was observed on par with treatment T_6 at 30 to 60 days after sowing, treatment T_1 and T_2 had similar results with treatment T_6 at 60 to 90 days after sowing. While the lowest NAR was recorded by treatment T_9 at 30 to 60 days after sowing, treatment T_4 between 60 to 90 days after sowing, treatment T_8 at 90 to 120 days after sowing and treatment T_7 at 120 days after sowing to at harvest.

Yield: According to Table 2, several INM treatments had a substantial impact on the yield of grain and straw as well as the harvest index. The data revealed that treatment T_5 had significantly greater grain and straw yield which had similar results with treatment T_1. However, lowest grain and straw yield was recorded in control. The early stages of crop growth have been promoted by the nitrogen available in urea (Zaidi *et al*., 2016) [27]. The improvement in grain yield with the INM treatment could be attributed to improved nutrient availability with more organics, which improved soil physicochemical and biological characteristics by providing essential minerals to microbes. (Subha *et al*., 2004) [23]. The improved production characteristics can be correlated with the soil's adequate and constant nitrogen supply capacity and nutrient translocation to the sink. (Subehia and Sepehya, 2012; Gautam *et al*., 2013 and Mahmud *et al*., 2016) [22, 7, 13]. The effect of INM on the harvest index was found to be significant in treatment T_7, but observed similar results with treatments T_1, T_2, T_3, T_4, T_5, T_6, and T_8. While the harvest index in control was the lowest. Higher rice grain yield per unit biological yield resulted in a higher harvest index. (Stoop *et al*., 2005 and Hussain *et al*., 2003) [21, 10].

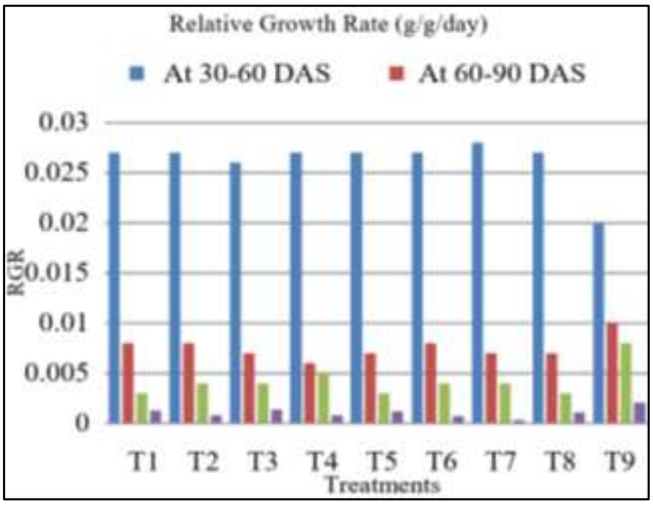

Fig 3: Effect of different INM on relative growth rate of direct seeded rice at different growth stages

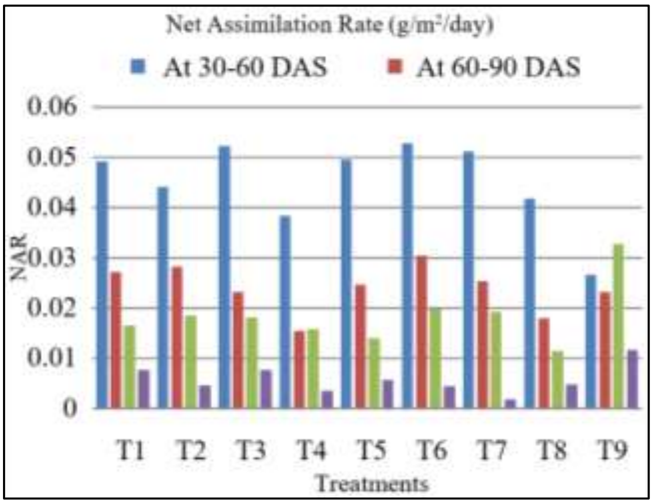

Fig 4: Effect of different INM on net assimilation rate of direct seeded rice at different growth stages

Table 2: Effect of different INM on grain yield, straw yield and harvest index of direct seeded rice

Treatment	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Harvest index (%)
T_1	46.97	68.10	40.76
T_2	33.13	47.37	41.13
T_3	28.90	42.99	40.18
T_4	24.65	35.98	40.62
T_5	50.95	73.00	41.13
T_6	41.07	60.26	40.55
T_7	32.41	45.37	41.62
T_8	25.61	39.95	39.02
T_9	15.97	30.77	34.38
SEm±	1.65	1.85	1.18
CD @ 5%	5.00	5.61	3.58
CV%	8.60	6.51	5.13

Conclusion

Based on the findings of the one-year trial, it has been determined that treatment T_5 was found most effective treatment for the yield of straw and grain, dry matter accumulation and leaf area index of rice crop. But different INM treatments had significant effect on crop growth rate, relative growth rate and net assimilation rate of rice. The study suggests using an integrated use of 100% NPK + 5 t FYM ha^{-1} + *Azospirillum* and PSB for direct seeded rice in order to promote improved growth, increased productivity, and higher profits.

References

1. Anonymous. Economic Survey of Chhattisgarh. Ministry of Agriculture government of India; c2013-14.
2. Ahmed S, Basumatary A, Das KN, Medhi BK, Srivastava AK. Effect of integrated nutrient management on yield, nutrient uptake and soil fertility in autumn rice on Inceptisol of Assam. Annals of Plant and Soil Research. 2014;16(3):192-197.
3. Bajpai RK, Chitale S, Upadhyay SK, Urkurkar JS. Long-term studies on soil physico-chemical properties and productivity of rice-wheat system as influenced by integrated nutrient management in Inceptisols of Chhattisgarh. Journal of the Indian Society of Soil Science. 2006;54(1):24-29.
4. Basha Jaffer S, Basavarajappa R, Babalad HB. Influence of organic and inorganic nutrient management practices on yield, economics and quality parameters of aerobic rice. Crop Res. 2016;17(2):178-187.
5. Bhanuwati, Vaidya P. A Review on Effect of Integrated Nutrient Management on Paddy. Int. J Curr. Microbiol. App. Sci. 2020;9(10):1160-1166.
6. Dahiphale AV, Giri DG, Thakre GV, Kubde KJ. Yield and yield parameters of scented rice as influenced by integrated nutrient management. Annals of Plant Physiology. 2004;18(1):207-208.
7. Gautam P, Sharma GD, Rachana R, Lal B. Effect of integrated nutrient management and spacing on growth parameters, nutrient content and productivity of rice under system of rice intensification. International Journal of Research in Bio Sciences. 2013;2(3):53-59.
8. Gomez KA, Gomez AA. Statistical procedures for agricultural research. A Willey- Inter Sci. Publication. John Willey & Sons, New York; c1984.
9. Haq SA, Lone BA, Wani S, Khan NM, Sofi NA. Effect of integrated nutrient management on growth and yield of rice (*Oryza sativa*) cv Pusa Basmati-I. Environ. Ecol. 2005;23(3):552-554.
10. Husain MM, Haque MA, Khan MAI, Rashid MM, Islam MF. Direct wet-seeded method of establishment of rice under irrigated condition. The Agriculturists. 2003;1(1):106-113.
11. Kimetu M, Mugendi DN, Palm CA, Mutuo PK, Gachengo CN, Nandwa S, *et al*. African network on soil biology and fertility. 2004;68:207-224.
12. Kumar V, Prasad RK. Integrated effect of mineral fertilizers and green manure on crop yield and nutrient availability under rice-wheat cropping system in Calciorthents. International of Soil Science. 2008;56(2):209-214.
13. Mahmud AJ, Shamsuddoha ATM, Nazmul HM. Effect of Organic and Inorganic Fertilizer on the Growth and Yield of Rice (*Oryza sativa* L.). Nature and Science. 2016;14(2):45-54.
14. Raki Tandon A, Kurre DK. Effect of integrated nutrient management practices on yield, nutrient content and uptake of aerobic rice. The Pharma Innovation Journal. 2019;8(1):211-213.
15. Rao A, Singh NB, Pandey D, Singh MP. Effect of integrated nutrient management on productivity and profitability of rice under SRI. Journal of Pharmacognosy and Phyto- chemistry. 2020;9(5):665-667.
16. Rawat A, Agrawal SB. Effect of soil enrichment in conjuction with bio-organics and chemical fertilizers on yield and quality of rice. Research J Agril. Sci. 2010;35(4):190-192.
17. Reddy KC, Ahmed SR. Soil test- based fertilizer recommendation for maize grown in Inceptisols of Jagtiyal in Andhra Pradesh. Journal of Indian Society of Soil Science. 2000;48(1):84-89.
18. Sharma AK. Sources of Differences in Input Use: The Case of Fertilizer in India. Journal of Indian School of Political Economy. 1993;5(2):320-329.
19. Siddaram Murali K, Manjunatha BN, Ramesha YM, Basavaraja MK, Patil AS. Effect of nitrogen levels through organic sources on growth, dry matter production and nutrient uptake of irrigated aerobic rice (*Oryza sativa* L.). Int. J. Agril. Sci. 2010;6(2):426-429.
20. Singh KM, Sharma IP. Influence of FYM, fertilizer and spacing on growth and yield of rice. RAU J Res. 2005;15(1-2):5-7.
21. Stoop WA, Uphoff N, Kassam A. A review of agriculture research issue raised by the system of rice intensification (SRI) from Madagascar: opportunities for improving farming system for resource-poor farmers. Agriculture

system. 2005;71:249-274.
22. Subehia SK, Sepehya S. Influence of long term nitrogen substitution through organics on yield, uptake and available nutrients in a rice-wheat system in an acidic soil. Journal of the Indian Society of Soil Science. 2012;60(3):213-217.
23. Subha KM, Chandrasekharan B, Parasuraman P, Sivakumar SD, Rubapathi K, Chozhan K. Performance of scented rice variety basmati 370 under organic farming. Madras Agric. J. 2004;91(7-12):353-358.
24. Thiyagarajan TM, Selvaraju R. Water saving in rice cultivation in India. In: Proceedings of an international workshop on water saving rice production systems. Nanjing University, China. 2001;9:15-45.
25. Umashankar R, Babu C, Kumar PS, Prakash R. Integrated nutrient management practices on growth and yield of direct seeded low land rice. Asian Journal of Plant Sciences. 2005;4(1):23-26.
26. Venkatesha MM, Krishnamurthy NG, Tuppad B, Venkatesh KT. Yield, economics and nutrient uptake of aerobic ice cultivars as influenced by INM practices. Res. Environ. Life Sci. 2015;8(1):113-118.
27. Zaidi SFA, Kumar S, Bharose R, Kumar R, Singh G, Verma KK. Effect of different nutrient resources on yield and quality of basmati/aromatic rice in Inceptisol of Eastern Uttar Pradesh, An Asian Journal of Soil Science. 2016;11(1):230-234.