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Effect of integrated nutrient management on rice (*Oryza sativa* L.) yield under Surguja district

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Abstract
The present investigation entiled "Effect of integrated nutrient management on rice (*Oryza sativa* L.) yield under Surguja district" was conducted at Research Station, Ajirma, Ambikapur, Chattishgarh during *kharif* season 2021-22. The experimental, consisted of eight treatment, was laid out in Randomized Block Design, where each treatment was Replication three. Revealed that various observations on growth characteristics, including plant height, number of tillers hill^{-1}, and dry matter production (gm^{-2}), the crop growth rate was significantly greater. The grain and straw yields of the rice crop were noted, including panicle length (cm), number of grains panicle^{-1}, test weight (g), etc. Among different INM treatments, application of 50% RDF + 50% N through GLM to rice produced maximum grain yield (44.90 q ha^{-1}), closely followed by 100% RDF (43.66 ha^{-1}). The INM treatments led to record significantly higher grain yield than 100% RDF. Other INM treatments *viz*. 50% RDF + 50% N through FYM (43.56 q ha^{-1}), 75% RDF + 25% N through FYM (40.20) ha^{-1}), and 75% RDF + 25% N through GLM (40.56 q ha^{-1}) gave lesser yields in terms of grain than100% RDF. Application of 50% RDF + 50% N through green leaf manure followed by 100% NPK fetched maximum NMR (56201 Rs. ha^{-1}) with the B:C ratio (2.32), which was at par to 50% + 50% N GLM (57353.8 Rs. ha^{-1}) with B:C ratio (2.33). The interaction of FYM in place of green leaf manure was equally good with regards to NMR and B:C ratio.

Keywords: Rice, INM, Growth, Yield

Introduction
Rice (*Oryza sativa* L.) is one of the most important staple food grain crops in the world. It belongs to family Poaceae (Gramineae). It is a high calories food which contains 75% starch, 6-7% protein, 2-2.5% fat, 0.8% cellulose and 5-9% ash. In Asia, more than two billion people are getting 60-70% of their energy requirement from rice and its derived products (Tomar *et al*., 2018) [12]. In India it is cultivated in an area of 43.66 million hectares with a production of 118.87 million tonnes and productivity 2722 kg ha^{-1}. However, in Chhattisgarh total cultivated in an area 3.67 million hectares production of 6.77 million tonnes and average productivity 1848 kg ha^{-1}(AD&FW 2019-20).

Rice is the major nutrient draining crop, there will be huge deficit in the soil nutrients in rice. To overcome the problem and maintain soil fertility, there is need for integration of nutrients from organic and inorganic sources which can help in obtaining good crop yields as well as the production sustainability (Shankar *et al*., 2020) [11].

Integrated nutrient management (INM) involving organic and inorganic sources of nutrient are very important in rice production. Many of our problems on declining productivity can be traced to improper and inefficient use of nutrients. Improper nutrient management has resulted in the nutrient imbalances in the soil with nutrients in excess while other nutrients depleted. Through this, farmers can increase agricultural productivity and safeguard the environment as they efficiently use fertilizer. (Ram *et al*., 2020) [10] Revealed that yield improvements with INM were due to instantaneous and rapid supply of nutrient through chemical fertilizers and steady supply through mineralization of FYM for prolonged period. The application of organics along with chemical fertilizers perhaps minimizes the loss of N and increases its availability throughout the crop growing period through formation of organic – mineral complexes. Also (Khursheed *et al*., 2013) [5] found that rice grain yield increased by 10.9, 21.8 and 28.5% respectively through conjunctive use of farm yard manure, green manure with NPK as compared to no manure treatment and NPK alone.

Farm Yard manure is the most commonly used organic manure and its application leads to improve soil structure, nutrient exchange, and maintains soil health. FYM is a heterogeneous composted organic material consisting of dung, crop residue, and household sweeping in

various stages of decomposition. It also had effect on residual phosphorus and potassium in soil. FYM is rich nutrient and contains 0.5% nitrogen, 0.2% phosphorus and 0.5% potassium. Inorganic fertilizer is not be enough to maintain the present levels of crop productivity of high yielding varieties.

Green manuring is the process of turning of green plant into the soil either by raising them in same field or plant growth elsewhere at the green stage before flowering and incorporate into the soil. It is a good management practice in agriculture production, because it can improve soil fertility and quality (Lee *et al*., 2010) [6] and also supply N, a primary limiting nutrient for crops (Pypersa *et al*.,2005) [9]. Although many green manure crops are available, sunhemp is very quick growing leguminous crop. Further adds 60kg N ha^{-1} to the soil. In addition, it also improves the soil physical, microbiological and physical-chemical properties. In addition to increasing organic matter, reducing soil pH and increasing water-holding capacity, the direct and residual response of sunhemp green manuring is quite encouraging in rice.

Materials and Method

The present investigation entiled "Effect of integrated nutrient management on rice (*Oryza sativa* L.) yield under Surguja district" was conducted at Research Station, Ajirma, Ambikapur, Chattishgarh during *kharif* season 2021-22. Geographically, Ambikapur is situated in the north of Chhattisgarh and lies between 23°10' North latitude and 83º15' East longitude having an altitude of 623 meter above mean sea level. The climate of Surguja region is sub- humid with hot and dry summer and cold winter. Surguja comes under central eastern plateau and hill agro-climate zone. (120:60:40 NPK kg ha^{-1}). These treatments were tested in randomized block design with four replications on rice maintaining the 20 cm x 15 cm planting geometry. Data on growth parameters (plant height cm), number of tillers $hill^{-1}$ and dry matter production (gm^{-2}) at 30 DAT, 60 DAT and 90 DAT stages and leaf area index at 30 DAT, 60 DAT and 90 DAT).

Result and Discussion

Growth parameters

The observation on plant height, number of tillers $hill^{-1}$, dry matter production and crop growth rate at 30, 60 and 90 days after transplanting (DAT) were analyzed statistically and presented in the Table 1. The nutrient management treatment played a major role on growth characteristics of rice. The maximum height of the plants was recorded at 90 DAT in the treatment receiving 50% RDF + 50% N through green leaf manure (T_6) and it was closely followed by T_1 (100% RDF), T_4 (50% RDF + 50% N through FYM), T_7 (75% RDF + 25% N through green leaf manure), T_5 (75% RDF + 25% N through FYM) and all the treatment were statistically at par in expression of plant height. However, the treatment with 50% RDF + 50% N through green leaf manure (T_4) was significantly superior to 100% RDF (T_1), 50% RDF (T_2), 75% RDF (T_3) and control (T_8). As expected the control treatment (T_8) revealed the lowest plant height at 90 DAT. The results are in conformity with the finding of (Shankar *et al*., 2014 and Yadav and Meena 2014)) as they noted different proportion of organic manure and chemicals fertilizers influenced on plant height of the rice. Similar result was observed in case on number tillers $hill^{-1}$ and crop growth rate as observation recorded at 30, 60 and 90 DAT (Table 1). The maximum values of number of tillers $hill^{-1}$ were found at 90 DAT. The treatment with 50% RDF + 50% N through green manure (T_6) recorded the maximum number of tiller $hill^{-1}$and it remained statistically at par with other treatment except control (T_8). Data related to dry matter accumulation (gm^{-2}) at 30, 60 and 90 DAT stages of rice. Application of 50% RDF + 50% N through green manure in rice recorded significantly highest (T_6) and crop growth rate (CGR) which was at par to all treatment where either 75% RDF + 25% N through (T_4, T_5, T_6, T_7) as compared to unfertilized plots (T_2, T_3, T_8) at all the growth stages. The results have got close conformity with the findings of Dutta and Chauhan and Murthy (2012) [7].

Yield attributing characters

In the present investigation yield and yield attributing characters *viz*. number of panicle, panicle length, grains $panicle^{-1}$ and test weight (Table 2.) were discussed. Distinct positive effect of INM was noticed on these yield attributes. All these parameters attained higher values with increasing NPK level from unfertilized to 100% RDF and further when 25 or 50% nutrients substituted through organic sources *viz*. FYM, GML brought about appreciable increase in yield attributing characters and finally grain as well as straw yield. Significantly higher yield attributes (number of panicle, panicle length, grains $panicle^{-1}$ and test weight) were recorded with T_5 (50% RDF + 50% N as GLM) which remained at par to all the yield attributes were higher with the substitution of green manure/FYM in combination with 50% and 75% RDF due slow release and continuous supply of nutrients in balance quantity throughout the various growth stages enables the rice plants to assimilate sufficient photosynthetic products and thus, increased the dry matter and source capacity, resulted in the production of increased panicles with more number of fertile grains and higher test weight, grain and straw yield. Similarly, Pandey *et al*., (2010) [10] and Singh *et al*., (2015) [12].

Yield

The grain yield and straw yield and harvesting, index are analyzed statically and presented in the Table 2. The grain yield and the straw yield were observed to follow the same trend as noted in growth parameters. The grain yield and the straw yield were found maximum in treatments receiving 50% RDF + 25% N through green leaf manure (T_6) and it was closely followed by the treatment with 100% RDF (T_1) and 75% RDF + 25% RDF through green leaf manure (T_7). This was due to high inorganic nitrogen supply to the crop which helped to exhibit growth parameters like dry matter accumulation and number of tillers resulting in the better productivity with the treatments. The lowest grain and straw yields were found in the control (T_8) as there was lack of nutrients as reflected in other growth parameters. The harvest index did not vary significantly among the different nutrient management practices in rice. The results corroborate with the finding of earlier researches (Jeyajothi and Durairaj, (2015) [4], Shankar *et al*., (2020) [11] and Hayat *et al*., (2019) [3].

Table 1: Effect of integrated nutrient management on rice of plant height (cm), total number of tillers hill^{-1}, dry matter production (gm^{-2}) and crop growth rate g plant^{-1}day^{-1}

Treatments	Plant height (cm)			Total number of tillers hill^{-1}			Dry matter production (gm^{-2})			Crop growth rate (g plant^{-1}day^{-1})		
	30 DAT	60 DAT	90 DAT	30DAT	60DAT	90DAT	30DAT	60DAT	90DAT	30 DAT	60DAT	60DAT
T_1- 100% RDF	57.23	74.13	96.70	9.23	15.13	16.20	164.93	426.35	848.23	5.22	9.08	12.67
T_2 - 50% RDF	45.23	57.23	69.36	5.90	10.13	11.80	98.96	205.92	425.18	3.58	3.75	7.19
T_3 - 75% RDF	51.90	60.53	74.33	6.86	12.40	13.36	125.19	243.41	517.03	4.20	4.69	10.04
T_4 - 50% RDF +50% N FYM	55.40	72.43	95.46	9.16	15.30	15.90	162.13	422.86	821.10	5.06	9.00	12.51
T_5- 75% RDF + 25% N FYM	54.40	65.69	92.70	8.23	14.03	14.70	160.13	404.31	815.07	4.35	8.15	12.22
T_6 - 50% RDF + 50% N GLM	59.66	76.23	98.20	9.56	15.30	16.16	167.43	432.25	860.41	5.58	9.18	13.25
T_7- 75% RDF + 25% N GLM	54.53	67.76	94.00	8.63	14.46	14.73	160.66	413.25	818.12	4.58	8.71	12.44
T_8-Control	41.76	55.13	63.60	3.43	8.83	10.06	72.12	172.28	334.56	2.39	3.59	4.88
S.Em ±	1.74	2.06	2.34	0.41	0.68	0.52	8.69	13.78	20.35	0.16	0.39	0.58
CD at 5%	5.43	6.32	7.18	1.28	2.10	1.60	4.82	42.21	62.33	0.49	1.19	1.79

Table 2: Effect of integrated nutrient management on rice of panicle length (cm), number of grains panicle^{-1}, test weight (g), grains yield (qha^{-1}), straw yield (qha^{-1}) and harvest index (%)

Treatments	Panicle length (cm)	Grains panicle^{-1}	Test weight (g)	Grains yield (q ha^{-1})	Straw yield (q ha^{-1})	Harvest index (%)
T_1 - 100% RDF	26.56	135.76	25.36	44.66	62.05	44.17
T_2 - 50% RDF	18.10	121.06	22.40	24.16	34.57	41.33
T_3 - 75% RDF	20.10	125.73	24.13	29.00	42.67	41.24
T_4 - 50% RDF + 50% N FYM	25.26	133.56	25.23	43.56	61.46	44.18
T_5 - 75% RDF + 25% N FYM	24.56	131.57	25.00	40.20	50.64	42.15
T_6 - 50% RDF + 50% N GLM	27.16	136.26	25.66	44.90	63.37	44.13
T_7 - 75% RDF + 25% N GLM	24.83	132.33	25.16	40.56	52.14	42.13
T_8-Control	17.36	119.80	22.23	9.10	8.41	40.13
S.Em ±	0.76	1.17	0.51	1.92	0.89	16.02
CD at 5%	0.25	3.60	1.58	5.88	2.73	N/S

Conclusion

Integrated nutrient management practices showed positive and favorable effect on improving almost all the growth characters, rice. The crop receiving 50% RDF + 50% N through green leaf manure yielded maximum and it was followed by the crop raised with 100% RDF chemical fertilizer and 50% RDF + 50% N through farm yard manure which achieve higher productivity and sustainability of rice. From the study, it may be concluded that rice requires sufficient nutrient to produce satisfactory yield and application of 100% RDF can be provided to obtain it. But considering the soil health and sustainability in rice production, INM should be adopted with either of 50% RDF + 50% N through GLM or 100% RDF.

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