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Integrated Nutrient Management in Transplanted Rice (*Oryza sativa* L.)

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Abstract

A field experiment was carried out during the *kharif* seasons of 2018-19 and 2019-20 at farmer's field of Village Bisrekhi Block Ghorawal of Sonbhadra UP, India to evaluate the performance of rice (*Oryza sativa L.*) to integrated nutrient management under irrigated condition. There were 10 treatments viz; T_{1}- Control, T_2-50% RDF, T_3 -75% RDF, T_4-100% RDF, T_5-5 t FYM ha^{-1} + 50% RDF, T_6-5 t FYM ha^{-1} +75% RDF, T_7-7 t FYM ha^{-1}+ 50% RDF, T_8-7 t FYM ha^{-1}+75% RDF, T_9-7 t FYM ha^{-1}+ 75 % RDF + *Azospirillum,* T_{10}-7 t FYM ha^{-1} + 75 % RDF + *Azospirillum +PSB*. The significantly highest grain yield of rice was (54.76 q ha^{-1}) recorded under application of 7 t FYM ha^{-1} + 75 % RDF + *Azospirillum +PSB* (T_{10}) followed by (51.68 q ha^{-1}) with application of 7 t FYM ha^{-1}+ 75 % RDF + *Azospirillum* (T_9), however lowest yield of rice grain was obtained (22.33 q ha^{-1}) under control plot (T_1).

Key words : *Rice, FYM, Azospirillum, PSB, INM.*

Introduction

Rice (*Oryza sativa* L.) is a cereal grain which is a staple food for nearly half of the world's population. It is an agricultural commodity which is having the third-highest worldwide production after sugarcane and maize In 2018, global production of rice was 759.6 million tonnes as compared to 2014 with just production capacity of 740 Mt. India is the world's second largest rice producer (177 Mt) after China (211 Mt), with an area of 44 million hectares. India is having an average rice productivity of 2.78 t/ha^{-1} (1). Cultivation of high yielding dwarf varieties responsive to fertilizer and excess use of inorganic fertilizers has depleted the inherent soil fertility. The decline or stagnation in yield has been attributed to nutrient mining and reduced use of organics. Several long-term experiments conducted all over India indicated a decrease in rice productivity due to continuous use of chemical fertilizers. Integrated nutrient management (INM) aims to improve soil health and sustain high level of productivity and production (2, 3). Integrated nutrient management (INM) has an important role, which improves efficiency substantially to maintain a high level of productivity and rice production. Organics supply nutrients at the peak period of absorption, but also provides micro nutrients and modifies soil- physical behavior as well as increase the efficiency of applied nutrients and there by productivity of crops. Farm yard manure (FYM) is being used as major source of organic manure in field crops and role of it in crop production cannot be over looked, in addition to supplying all essential plant nutrients it increases activities of bacteria or microbes in soil (4).

Integrated Nutrient Management is flexible approach to minimize the use of chemical fertilizers but maximize their use efficiencies and farmer's profit. For the nutrient management system to be efficient, it should ensure a balance and optimum supply of essential plant nutrients, synchronizing with the need of the crops grown in given cropping system. Integrated nutrient management holds a promise for excellent soil health. In soil system, the soil micro flora negotiates all the nutrients transformations. Any excessive use and abuse of chemical fertilizers harm this intrinsic biological potential of the system whereas; biological sources help to sustain it. Since soil-organic matter is the source of energy to the soil micro flora, its content is considered to be one of the indices of the soil health. Increasing sustainability concerns for resources, and fears of shortage of fertilizer necessitate a system of nutrient management that ensures optimum use of nutrients from soil resources, promotes recycling of organic wastes as carrier as nutrients, and exploits synergistic and antagonistic effect of nutrition in cropping system, for the purpose of developing appropriate fertilizer plans. In this context, practicing integrated nutrient management system is necessary and we need to put in place (5).

Materials and Methods

A field experiment was carried out during the kharif seasons of 2018-19 and 2019-20 at farmer's field of Village Bisrekhi Block Ghorawal of Sonbhadra UP, India to evaluate the performance of rice (*Oryza sativa L.*) to integrated nutrient management under irrigated condition. The soil of the experimental field was sandy loam with pH 7.4, organic carbon 0.42 %, available N 207.11 Kg ha^{-1}, P_2O_5 17.52 Kg ha^{-1} and K_2O was 252.18 Kg ha^{-1} before starting the experiment. There were 10 treatments viz; T_{1}- Control, T_2-50% RDF, $T_3$75% RDF, T_4-100% RDF, T_5-5 t FYM ha^{-1} + 50% RDF, T_6-5 t FYM ha^{-1} +75% RDF, T_7-7 t FYM ha^{-1}+ 50% RDF, T_8-7 t FYM ha^{-1}+75% RDF, T_9-7 t

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Table-1 : Effect of INM on the yield attributing characters and yield of rice (mean data of 2 years).

Treatments	Effect of INM on the yield attributing characters and yield of Rice						
	Number of Effective Tillers M^2	Number of Filled grains $Panicle^{-1}$	Test Weight (g)	Grain Yield (q ha^{-1})	Straw Yield (q ha^{-1})	Biological Yield (q ha^{-1})	Harvest Index (%)
T_{1-} Control	127.25	79.46	22.09	22.33	45.42	67.75	32.95
T_2-50% RDF	135.46	82.52	22.11	24.71	49.28	73.99	33.39
T_3-75% RDF	153.84	94.65	23.42	34.10	67.42	101.52	33.58
T_4-100% RDF,	172.54	116.11	24.75	49.58	97.19	146.77	33.78
T_5-5 t FYM ha^{-1} + 50% RDF	155.75	95.26	23.46	34.80	68.47	103.27	33.69
T_6-5 t FYM ha^{-1} +75% RDF	158.42	98.45	23.55	36.72	71.75	108.47	33.85
T_7-7 t FYM ha^{-1}+ 50% RDF	162.48	102.42	24.08	40.07	78.25	118.32	33.86
T_8-7 t FYM ha^{-1}+75% RDF	165.75	112.84	24.52	45.86	90.15	136.01	33.71
T_9-7 t FYM ha^{-1}+ 75 % RDF + *Azospirillum*	178.95	116.75	24.74	51.68	101.25	152.93	33.79
T_{10}-7 t FYM ha^{-1}+ 75 % RDF + *Azospirillum* + PSB	185.12	118.25	25.02	54.76	105.18	159.94	34.23
SEM±	5.211	3.625	0.152	4.254	5.682	6.172	0.214
CD at 5%	7.881	5.481	NS	6.432	8.591	9332	NS

FYM ha^{-1}+ 75 % RDF + *Azospirillum,* T_{10}-7 t FYM ha^{-1} + 75 % RDF + *Azospirillum +PSB*. These were tested in randomized block design with 4 replications, keeping the layout undisturbed throughout the field experimentation. The recommended dose of fertilizer for rice crop was @ 120 kg N, 60 kg P_2O_5 and 60 kg K_2O ha^{-1}. Farmyard manure was thoroughly incorporated into the plot soil as per treatments requirement. Total quantities of P_2O_5 and K_2O were applied as basal application in the both years of experimentation. However, 50% N was applied at the time of soil preparation as basal application and remaining 50% N was top-dressed in two splits i.e. at 21 and 45 days after transplanting of crop. *Azospirillum* and PSB were applied as soil inoculation before sowing in the plots as per treatment. Rice seedling of 22 days old cv. N.D.R.-2065 was transplanted on 2^{nd} July 2018 and 7^{th} July 2019 and was harvested on 15^{th} October 2018 and 17^{th} October 2019 in the first and second year of the study, respectively. All improved packages of practices of crop management were followed to raise the crop during field experimentation.

Results and Discussion

Growth and yield components

Number of effective tillers per/m : The significantly highest number of effective tillers per m^2 (185.12) were recorded under the application of 7 t FYM ha^{-1} + 75 % RDF + *Azospirillum +PSB* (T_{10}) at the harvesting stages of crop which was followed by (178.95) with application of 7 t FYM ha^{-1}+ 75 % RDF + *Azospirillum* (T_9), however, lowest number of effective tillers per m^2 (127.25) was noted under control plot (T_1). Increase in the levels of plant Nutrients through Integrated nutrient management in rice crop also found significantly increased in the number of tillers m^2 of rice crop at harvesting stages. In general, tillers production of rice had increased as the plant advanced in age from 30 to 60 days. However, there was greater reduction in number of tillers m^2 as the crop attained to harvesting stage. This may be due to the mortality of secondary and tertiary tillers with the advancement in the age of the crop towards harvesting stage. Similar results were also reported by (6).

Number of Filled grains/Panicle : The number filled grains per panicle of rice crop were significantly influenced due to nutrient supply through integrated nutrient management under various combinations. Maximum number filled grains per panicle of rice crop was recorded (118.25) with application of 7 t FYM ha^{-1} + 75 % RDF + *Azospirillum +PSB* (T_{10}) which was closely followed by (116.75) under the application of 7 t FYM ha^{-1}+ 75 % RDF + *Azospirillum* (T_9) however, minimum number filled grains per panicle of rice crop was noted (79.46) under control plot (T_1). These results are closely confirms with the findings of (7).

Test Weight : There was no significantly influence of integrated nutrient management on the test weight of rice crop under various treatment combinations. However, test weight of rice crop under various treatments ranged from 22.09 g to 25.02 g., Similar results were also reported by (2).

Grain Yield (q/ha) : The grain yield of rice was significantly increased due to increase the supply of plant nutrients through integrated nutrient management system. The highest grain yield of rice was (54.76 q ha^{-1}) recorded when applied of 7 t FYM ha^{-1} + 75 % RDF +

Azospirillum +*PSB* (T_{10}) followed by (51.68 q ha^{-1}) with application of 7 t FYM ha^{-1}+ 75 % RDF + *Azospirillum* (T_9), but lowest grain yield of rice was (22.33 q ha^{-1}) noted under control plot (T_1) during the present study. The grain yield of rice was ranged from 22.33 to 54.76 q ha^{-1} under different treatments. The data on grain yield of rice are presented in Table-1. These results are closely confirms with the findings of (8).

Straw yield (q/ha) : The highest significantly straw yield of rice was (105.18 q ha^{-1}) obtained under the application of 7 t FYM ha^{-1} + 75 % RDF + *Azospirillum* +*PSB* (T_{10}) followed by (101.25 q ha^{-1}) with application of 7 t FYM ha^{-1}+ 75 % RDF + *Azospirillum* (T_9). The lowest straw yield of rice was (45.42 q ha^{-1}) noted under control plot (T_1). The straw yield of rice was ranged from 45.42 to 105.18 q ha^{-1}during the present study (Table 1). The variation in the straw yield of rice was recorded significantly due to different combination of integrated nutrient management in rice crop. (9) were also reported similar results.

Biological yield (q/ha) : The biological yield of rice was significantly influenced by the different combinations of integrated nutrient management during the present study (Table-1). The highest biological yield of rice was recorded (159.94 q ha^{-1}) under the application of 7 t FYM ha^{-1} + 75 % RDF + *Azospirillum* +*PSB* (T_{10}) followed by (152.93 q ha^{-1}) with application of 7 t FYM ha^{-1}+ 75 % RDF + *Azospirillum* (T_9), but lowest biological yield of rice was (67.75 q ha^{-1}) noted under control plot (T_1) during the present of study. The biological yield of rice ranged from 67.75 to 159.94 q ha-1 under various treatments (T_1 to T_{10}) during the present investigation. These results are closely confirms with the findings of (7).

Harvest Index : The data on harvest index value of rice are presented in the Table-1. Harvest index value of rice crop was not significantly influenced by the different combination of integrated nutrient management. The harvest index of rice crop under various treatments (T_1 to T_{10}) was varied from 32.95% to 34.23% during the present study. These results were closely confirms with the findings of (9).

It is concluded that integrated nutrient management improve rice yield, as proper decomposition of organic matter supply available plant nutrient directly to plants and created favorable soil environment, altimetly increased the nutrient capacity of soil for longer time, which resulted in better growth, yield attributes and altimetly grain and straw yield of rice crop.

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