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Effect of Different Combination of Nitrogen Sources on the Yield of Direct Seeded Rice (*Oryza sativa*)

Supreet Saajan*, Sumeet Kour, Neetu, Ishita Walia and Arun Kumar

Department of Agronomy, School of Agriculture, Lovely Professional University, Jalandhar-Delhi G.T. Road (NH-1), Phagwara, Punjab, India

**Corresponding author*

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A B S T R A C T

Rice (*Oryza sativa*) is a staple food in many countries especially in the Asian part of the world. Rice (2n=2x=24) serves as main food diet by the majority of people. It is strictly diploid in nature. The demand for rice is increasing day by day due to increase in population pressure in India. A field experiment was conducted during Kharif season in 2015 to check the effect of different nitrogen sources on the yield of Direct Seeded Rice and also to find out the best combination of nitrogen sources for integrated nutrient management. Data was recorded and analyses of data revealed that treatment T7 (azotobacter + 25% vermicompost +50% RDN) gave the significant result in growth and yield attributes with respect to control treatment (inorganic sources only).

Introduction

Rice (*Oryza sativa*) is a major cereal crop in world. It is widely consumed by majority of human population as a staple food. Day by day demand of rice is increasing in India due to increase in the population and change in diet habit of people. More than 90% of total rice production in world is produced and consumed in Asia. India and China are the most important countries of Asia in rice production. Rice play very important role in Indian food production and consumption. It is no wrong to say that rice is life line of India. Due to increase in the population pressure is very important to increase in the agriculture production for maintain food security in India. No doubt use of chemical fertilizer lead to huge increase in the production but from many years continuously along with intensive farming it also impaired the soil fertility and productivity (Vinod Dubey *et al.*, 2012). So, to overcome this problem integrated nutrient management is the best way. In integrated nutrient management we using all the possible ways to provide the nutrient to crops and not depend only on chemical fertilizers. Integrated nutrient management not only supplies the nutrient to crops but also maintains long term soil fertility. It also full fills the theory of sustainable agriculture. Continuous use of inorganic fertilizer causes the deficiency of micro nutrient and create imbalance in soil physicochemical properties of soils. On the other hand, long term use of integrated nutrient management(INM) increase in the organic carbon, macro nutrients [nitrogen (N), phosphate (P), potassium (K)], and micronutrient [iron (Fe), manganese (Mn), zinc (Zn), copper (Cu), and boron (B)] availability and also improved physical properties leading to sustenance of fertility (Maji and Mondal,2004). NPK status of the soil is enhanced by addition of organic sources of the nutrient. Incorporation of organic nutrient sources in soil improves the soil properties and productivity in rice-rice growing system (Sireesha *et al.,* 2017). Use of synthetic fertilizers has increased the productivity of crops, but also have many harmful effects to environmental like soil pollution, air pollution, water pollution, human health's related problem and also making the crop productivity unsustainable (Eid *et al.,* 2006). However, use of the organic and inorganic nutrient sources in combination is very effective way to added nutrients which results increase in production and productivity of crops without causing any harmful effect to environment. Integrated nutrient management INM also helps in managing the biological waste by incorporation into the soil which provides the nutrients to subsequent crops. Keeping all above facts in view the study was conducted to find the best combination of the organic and inorganic nutrient sources in rice without deteriorating the productivity.

Materials and Methods

Location of experimental site

The Experiment was conducted entitled with "Effect of different combinations of Nitrogen Sources on Yield of Direct Seeded Rice" at the farm Department of Agronomy, Lovely Professional University, Phagwara on rice (*Oryza sativa*) during *Kharif* season in year 2016-2017. The farm is situated at 31°22'31.81'' North latitude and 75°23'03.02" East longitude with 252m average elevation above mean sea level. It is comes under sub-tropical region in central plane of state agro climatic zone. Region of experimental site comes under sub tropics with cool weather in winter season, hot weather in summers and distant rainfall period in month of July, August and September. South west monsoon is main source of rainfall in this region.

Experimental detail

A Randomized complete block design was used with nine treatment and three replications has been used in this experiment. Three bio-fertilizers **(**cyanobacteria, azotobacter and Azospirillum), two organic sources (Farm yard manure and Vermicompost) and inorganic fertilizer (urea) were used as source of nitrogen in different combinations. Detailed number of treatment is presented in Table 1.

Agronomic practices

Pusa basmati 1121 variety of rice was used in this experiment. It was released in 2008 and recommended by Punjab Agricultural University (PAU) to grow in Punjab. It is about 120 cm tall. It has extra-long grain with good cooking quality with average maturity time of 137 days (Anonymous, 2017). Seed was sown on 16 June in *Kharif* season. Ten kg seed rate per acre was used for direct seeding rice with recommended row to row spacing of 20 cm. The seed was sown about approximately depth of 2-3 cm. Full dose of phosphorus (P2O5) 30 kg/ha and potassium (K2O) 30 kg/ha along with nitrogen as per treatment was applied as basal dose. Remaining nitrogen from 125 kg/ha (100% RDN) were applied as per treatments in three equal splits at 3, 6 and 9 weeks after sowing.

Data collection

Crop growth parameters (Plant height and number of tillers) and yield parameters (Number of panicle per hill, Grain per panicle, Grain Yield per plot) were observed. Crop growth parameters (Plant height, number of tillers and number of leaves) were measured at 30 DAS, 45 DAS, 60 DAS, 75 DAS and Yield parameters were measured at time of crop harvesting.

Statistical analysis

Data were analyzed by Duncan's Multiple Range Tests (DMRT) for separation of means with a probability $p< 0.05$. Difference between mean values was evaluated by Analysis of Variance (ANOVA) using the software SPSS 16.

Results and Discussion

Plant height

Data found from this experiment at different growth stages treatment number T7 (50% RND + 25% vermicompost + 25% azotobacter) showed significant superior result over the control treatment at all different growth stages(Table 2). Densilin *et al.,* (2011) found similar results in experiment with combine use of vermicompost and bio-fertilizer found significant increase in the growth and yield parameters because bio-fertilizer change the microbial status of the soil which improve the nutrient status and increase soil fertility.

Number of tillers

Data recorded at from this experiment found that treatment T7 (azotobacter + 25% vermicompost + 50 % RDN) and T9 (Azospirillum+25% vermicompost + 50%RDN) gave significant higher number of tillers in comparison to control treatment on the basis of statistical analysis (Table 3). Treatment number T7 shows maximum 24.20 number of tillers per hill and T9 shows second highest 23.53 number of tiller per hill which are statistically similar to each other. Use of combination of vermicompost with inorganic fertilizer reduced the emphasis on chemical fertilizer also with significant increase in the growth and yield characteristic along with quality of rice grain, it is due to different organic sources increase the nutrient status of soil also with increase in cation exchange capacity and increase water holding capacity of soil which increase uptake of nutrients through mass flow. It also supported by Tejada *et al.,* (2009). Bao *et al.,* (2013) also found similar result that combine use of azospirillum bio-fertilizer in combination of organic and inorganic nitrogen sources in rice showed significant increase in tillers growth and shoot length.

Panicle per hill

Data recorded from this experiment indicated that treatment number T7 (azotobacter+25% vermicompost + 50% RDN) showed 23.55% higher number of panicle from control treatment (Table 4). Wani *et al.,* (2016) observed the similar findings while conducting study on use of Azotobacter (*chroococcum spp.*) that *Azotobacteria* genus synthesizes growth promoters which enhance the agricultural production.

Number of grains per panicles

Data found from this experiment from each different treatments, the treatment number T7 (azotobactor + 25% vermicompost + 50% RDN) and T9 (Azospirillum + 25% vermicompost + 50%RDN) showed significantly higher number of grains per panicles (Table 5). Better nourishment gives beneficial effects which increase rate of photosynthesis and assimilation rate. This was also confirmed by findings of Sujatha *et al.,* 2014.

Table.1 Treatment details

S. No	Treatment
T1	Control (100% urea)RDN
T2	50 % RND + 50% FYM
T3	50 %RND + 50% vermicompost
T4	50%RND + 25%FYM + 25 % cyanobacteria
T5	50%RND + 25%vermicompost +25% cyanobacteria
T6	50%RND + 25%FYM + 25% azotobacter
T7	50%RND + 25%vermicompost + 25%azotobacter
T8	50%RND + 25%FYM + 25%Azospirillum
T9	50%RND + 25%vermicompost + 25%Azospirillum

Table.2 Effect of different nitrogen sources on the height of direct seeded rice

Treatment	Height- 30 DAS	Height -45 DAS	Height -60 DAS	Height- 75 DAS
T1	$33.80^{bc} \pm 1.30$	$55^{bcd} \pm 2.00$	$88.6^{b} \pm 1.83$	$109.88^{b} \pm 0.41$
T2	$31.40^{c} \pm 0.2$	$52.26^{d} \pm 1.89$	$86.20^{b} \pm 1.00$	$109.84^{b} \pm 0.32$
T3	$32.93^{bc} \pm 0.9$	$53.26^{cd} \pm 1.39$	$88.26^{b} \pm 1.26$	$111.21^{b} \pm 0.48$
T4	$35.13^{bc} \pm 0.6$	$56.40^{bcd} \pm 0.50$	$88.46^{b} \pm 0.37$	$111.06^{b} \pm 0.48$
T5	$35.06^{b} \pm 0.54$	$57.60^{ab} \pm 0.40$	$88.8^{b} \pm 0.11$	$111.44^{b} \pm 0.68$
T6	$35^{b} \pm 0.83$	$58.53^{ab} \pm 0.74$	$88.53^{b} \pm 0.26$	$111.45^{b} \pm .21$
T7	$38.46^{a} \pm 0.93$	$61.60^{a} \pm 1.33$	$92.33^{a} \pm 1.23$	$115.23^{a} \pm 0.37$
T8	$35.13^{b} \pm 0.24$	$57.40^{abc} \pm 1.38$	$88.26^{b} \pm 0.63$	$111.12^{b} \pm 0.24$
T9	$37.80^{a} \pm 1.11$	$61.00^{a} \pm 1.47$	$91.73^{a} \pm 0.75$	$114.03^{a} \pm 0.32$

The mean followed by different alphabets are significantly different at $P < 0.05$, according to Duncun's multiple range test (DMRT) for separation of means.

Table.3 Effect of different nitrogen sources on the growth of tillers in direct seeded rice

Treatment	Tillers- 30 DAS	Tillers- 45 DAS	Tillers- 60 DAS	Tillers -75 DAS
T1	4.46 ^{cd} ± 0.43	12 ^{a} ± 0.52	15 ^{b} ± 0.23	16.66^{bcd} ±.37
T2	3.93 ^{d} ± 0.54	11.60 ^{a} ± 0.83	14.40 ^{b} ± 0.30	15.90 ^{cd} ±.96
T3	4.40 ^{cd} ± 0.40	11.66 ^{a} ± 0.33	14.80 ^{b} ± 0.11	15.43 ^{d} ± 0.29
T4	4.73 ^{cd} ± 0.26	12.26 ^{a} ± 1.42	15 ^{b} ± 0.30	17.06 ^{bc} ±.12
T5	4.80 ^{cd} ± 0.34	12.26 ^{a} ± 1.18	15.26 ^{b} ± 0.48	17.43 ^{b} ± 0.23
T6	5.53 ^{bc} ± 0.26	11.33 ^{a} ± 0.33	15.20 ^{b} ± 0.30	17.73 ^{b} ± 0.17
T7	6.93 ^{a} ± 0.17	13.73 ^{a} ± 0.93	17.8 ^{a} ± 0.74	24.20 ^{a} ± 0.52
T8	4.86 ^{cd} ± 0.48	11.26 ^{a} ± 0.78	15.26 ^{b} ± 0.26	17.26 ^{bc} ± 0.29
T9	6.40 ^{ab} ± 0.23	13.73 ^{a} ± 0.26	17.73 ^{a} ± 0.29	23.53 ^{a} ± 0.52

The mean followed by different alphabets are significantly different at $P < 0.05$, according to Duncun's multiple range test (DMRT) for separation of means.

Table.4 Effect of different nitrogen sources on panicles in direct seeded rice

Treatment	Panicle / plant
T1	17.20 ^{bc} ± 0.1
T2	16.73 ^{c} ± 0.31
T3	16.70 ^{c} ± 0.35
T4	17.46 ^{b} ± 0.27
T5	17.43 ^{bc} ± 0.20
T6	18.46 ^{b} ± 0.29
T7	22.50 ^{a} ± 0.70
T8	18.40 ^{b} ± 0.27
T9	21.46 ^{a} ± 0.93

Table.5 Effect of different nitrogen sources on grain/panicle in direct seeded rice

Treatment	grain/ panicle
T1	79.70 ^{d} ± 0.23
T2	76.03 ^{f} ± 0.32
T3	77.75 ^{e} ± 0.52
T4	79.77 ^{d} ± 0.16
T5	81.86 ^{c} ± 0.20
T6	84.34 ^{b} ± 0.24
T7	88.98 ^{a} ± 0.12
T8	82.66 ^{c} ± 1.49
T9	88.62 ^{a} ±.12

Table.6 Effect of different nitrogen sources on the grain yield in direct seeded rice

Treatment	Yield per plot
T1	2.67 ^{d} ± 0.03
T2	2.32 ^{e} ± 0.031
T3	2.39 ^{e}± 0.04
T4	2.68 ^{d} ± 0.03
T5	2.93 ^{c} ± 0.08
T6	3.16 ^{b} ± 0.13
T7	3.66 ^{a} ± 0.32
T8	3.23 ^{b} ± 0.03
T9	3.62 ^{a} ± 0.04

The mean followed by different alphabets are significantly different at $P < 0.05$, according to Duncun's multiple range test (DMRT) for separation of means.

Grain yield per plot

Grain is the economic parameter in cereals crops. Application of different nitrogen sources significantly affects the effects grain yield. Treatments number T7 (azotobacter + 25% vermicompost +50% RDN) and T9 (Azospirillum +25% vermicompost + 50%RDN) showed 27.04% and 25.95% higher grain yield with respect to control treatment (Table 6). Pandey and Kumar, (1989) also reported that with the use of azotobacter bio fertilizer shows significant higher grain yield in comparison to control treatment. Inoculation of bio fertilizer shows much beneficial effect to plant growth and development it is because bio fertilizer makes entophyte bacterial relationships with plant help on plant growth through its life cycle. This is supported by Sturz *et al.,* (2000). Sattar *et al.,* (2014) also reported that inoculation of azospirillum bio fertilizer recorded maximum yield 8.43t/ha from among the treatments as compared to where the bio fertilizer was not used.

In Conclusion, application of nitrogen form different sources shows significant higher result in growth characteristics and yield characteristic in comparison to the control treatment. Integrated application of different nutrient sources shows sustainability in soil environment which gives synergetic effect on the growth and yield of different crops. Integrated application of nitrogen from different sources makes a balance in environment at micro level with no adverse effect. Use of Integrated nutrient management also helps in manage agriculture residual waste and other wastes by use as nutrient sources combined with synthetics fertilizers. Integrated nutrient management is a beneficial tool for the sustainable agricultural production.

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