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Effect of Organic Manures and Chemical Fertilizers on the Yield of Rice Seed "Lalat"

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A B S T R A C T

The study was carried out to investigate the effect of organic manures and chemical fertilizers on the yield of rice seed (*Oryza sativa)* during kharif 2015 at the Central Research Station in Farming System Research, OUAT, Bhubaneswar in a Randomised Block Design with 3 replications and 8 treatments having rice variety "Lalat ". From the experiment result, it was observed that the application of 100% NPK+25 Kg $ZnSO_4$ (T_7) produced the highest number of grain/panicle, 1000 grain wt., straw yield, grain yield with chaff, grain yield without chaff and harvest index whereas highest panicle and sterile grain/ panicle was recorded in T_8 (T_7 + residue recycling).

Introduction

Rice (*Oryza sativa*) is one of the most important food crops of India in term of area, production and consumer preference. It provides over 21% of the calorific needs of the world's population and upto 76% of the calorific intake of the population of South East Asia. It is one of the main sources of carbohydrate and also contains considerable amount of protein, minerals and vitamins. India is the second largest producer and consumer of rice in the world.

In Orissa rice is synonymous with food; agriculture in Orissa to considerable extent means growing rice. Rice covers about 69 percent of cultivated area and is the major crop covering about 63 percent of total area under food grains. It is the staple food of almost entire population of Orissa and therefore, the state economy is directly linked with the improvement in production and productivity of rice in the state.

Today, global agriculture is at crossroads as a consequence of climatic change, increased population pressure and detrimental environmental impacts. Increased population needs more food to live on the Earth. India is an agricultural country. Indian population has already crossed 125 crores and it ranks second position in the world. The food production should be increased with the geometrically growing population. In India, there is a constant pressure on crop production from

available cultivable land with limited water resources in order to keep pace with the food requirements for an ever-increasing population. Application of suitable fertilizers is one of the ways to attain maximum crop yield. Chemical fertilizer is the major supplier of nutrients besides organic and green manures. The use of chemical fertilizers has been kingpin of modern agriculture. This undoubtedly boosted the food production but at the same time, it shows the negative effects on physio-chemical properties of soil, nitrogen transformation, macro and micronutrient uptake and nutritional composition (Mahesh and Hosmani, 2004). Application of suitable fertilizers is one of the ways to attain maximum crop yield. Chemical fertilizer is the major supplier of nutrients besides organic and green manures. The production of rice is however, facing a sustainability problem due to practices of modern production system with indiscriminate use of chemical fertilizers and pesticides (Duxbury *et al.*, 2000; Ladha *et al.*, 2000). Hence, the present study was planned with an objective to investigate the effect of selected organic manures and chemical fertilizer on the yield of Rice seed "Lalat".

Materials and Methods

Experimental design

The experimental site was selected in Central Research Station, OUAT, Bhubaneswar. The experiment was designed with Randomised Block Design having 8 treatments and 3 replication. The treatments were as follows involving both chemical, biofertilizer, FYM, non-edible oil.

T_1: Different organic sources equivalent to 1/3 of recommended N (1/3N as FYM@ 5.5t/ha; 1/3N as Dhaincha, 1/3N as NEO).

T_2: T_1 + agronomic practice for weed and pest control (without chemical pesticides)

T_3: 50% N as FYM+ 50% N as Azospirillum + RP + PSB

T_4: T_1 + Azospirillum + PSB

T_5: 50% RDF + 50% N as FYM (8t/ha)

T_6: 100% NPK

T_7: 100% NPK + 25 Kg $ZnSO_4$

T_8: T_7 + residue recycling

Plot size

4.5m × 5m

Incorporation of green manure Dhainca (*Sesbania aculeta)*

Dhaincha at the rate of 25 kg/ ha was sown 1 month before transplanting of rice crop in T_1, T_2 and T_3. Prior to transplanting the dhaincha crop was incorporated into the soil.

Raising of seedlings

Seedlings were raised in wet nursery bed. Prior to sowing in the nursery beds, the seeds were soaked for 24 hours in water. After draining out the water, seeds were incubated for sprouting.

The seed rate used was 30 kg/ha. After 4^{th} day, 1-2 cm standing water was allowed in the nursery bed.

Preparation of plot

The field was thoroughly ploughed to make the soil well pulverized. Laddering was done for proper leveling of the plot.

Two drainage- cum- irrigation channels were prepared between the strips and bunds were raised around the main plot and each sub-plot.

Fertilizer application

The major nutrients applied viz. nitrogen, phosphorus and potassium were applied as per recommendation (80 kg N + 40 kg P_2O_5 + 40 kg K_2O/ha). FYM 20t/ha applied 15 days in advance to avoid immobilization of nitrogen.

10 packets (2 kg/ha) each of Azospirillum and Phosphobacteria were mixed with 25 kg FYM and 25 kg of soil and mixture broadcasted uniformly in the main field before transplanting. Non edible neem seed cake @ 250-400 Kg per hectare was applied as soil application.

Transplanting

21 days old seedlings were transplanted in the main field at a spacing of 20 cm × 10 cm with 2-3 seedlings per hill.

Irrigation

After transplanting of seeds, flood irrigation was given to facilitate availability of enough moisture to the seeds to initiate the process of growth of the crop. Irrigation was given as and when required.

Weeding and plant protection measures

In order to keep the crop weed free, hand weeding was done. Prophylatic plant protection measures were adopted to protect the crop from diseases and pest attack.

Harvesting

When the crop approached harvestable maturity stage, the plants belonging to each treatment and replication were harvested separately. The harvested plants are threshed; seeds were cleaned, dried and graded. The graded seeds were weighed to compare the seed yield.

Biometric observation

Panicle length

The length of the effective panicles in the sample hills was measured from neck node to tip and was expressed in centimeter and the mean value was computed.

Number of grains per panicle

Total number of seeds formed in each panicle in sample hills was counted and the mean was computed.

Fertile grains per panicle

Number of filled seeds in each panicle in sample hills was counted and the mean computed.

Sterile grains per panicle

Number of chaffy/ empty seed in each panicle in sample hills was counted and the mean value computed.

Seed yield per hectare

The total seed yield in each replication on each treatment was determined. From the observation data, the seed yield per hectare was computed and expressed in kg/ha.

Straw yield per hectare

The total straw yield in each plot was recorded and the straw yield per hectare was computed and expressed in kg/ha.

1000 seed weight

After harvest of the seed crops and completion of post-harvest operation, 1000 seeds were counted from each replication under each treatment. The weight of 1000 seeds was taken

by an electronic balance and expressed in gram.

Harvest index (HI)

Harvest index is defined as the ratio of economic yield to the biological yield and it was calculated by using the formula given by Donald (1962)

Harvest index (%) = Grain yield / Biological yield × 100.

Results and Discussion

The data (Table 1 and 2) indicated that the Maximum panicle length of 27.82 was obtained in T_8 Similar results have been obtained by Muhammad *et al.*, 2014 in rice. Highest grain/panicle was observed in T_7 (145.67).The findings were agreement with Yadav *et al.*, 2010 in hybrid rice. Maximum number of fertile grain/panicle was obtained from T_7 (78.10). This confirms the study of Tabar Y.S 2012 and Mahajan *et al.*, 2012 in rice whereas maximum sterile grain/panicle was observed in T_5 (26.33).

The highest test weight was 26.17 g per 1000 seeds in T_7 and lowest was 22.63 g per 1000 seeds in T_5. The present result is also in conformity with Muhammad *et al.*, (2014) but contradicts the findings of Singh *et al.*, (2000), Singh *et al.*, (2009), Yadav *et al.*, (2009), Kumari *et al.*, (2010) in rice with organic source of nutrient management.

Table.1 Effect of organic crop management practices on yield attributing characters

Treatments	Panicle length (cm)	Grain /panicle	Fertile grain /panicle	Sterile grain /panicle	1000 grain wt.(gm)
T_1- (Different organic sources equivalent to 1/3 of recommended N(1/3 as FYM @ 5.5 t/ha,1/3 N as Dhaincha,1/3 N as NEO)	25.61	110.53	74.83	23.47	23.00
T_2 - T_1+ Agronomic practices for weed and pest control (Without chemical)	26.02	125.93	77.20	22.57	24.67
T_3- 50% N as FYM + 50% N as *Azospirillum* + RP + PSB	23.43	110.53	73.93	25.62	22.86
T_4- T_1+ *Azospirillum* + PSB	25.64	110.87	75.63	22.83	23.98
T_5-50% RDF + 50% N as FYM (8t/ha)	24.41	107.87	73.67	26.33	22.63
T_6-100% NPK	26.15	126.20	77.23	22.40	24.98
T_7-100% NPK + 25 Kg ZnSO4	26.56	145.67	78.10	20.15	26.17
T_8-T_7+ residue recycling	27.82	138.27	78.03	20.60	25.94
S.Em±	0.672	6.303	1.520	1.275	0.513
CD(0.05)	2.039	19.120	NS	3.869	1.557
CV	4.529	8.948	3.460	9.606	3.661

Table.2 Contd….

Treatments	Straw Yield (t/ha)	Grain Yield with chaff (t/ha)	Grain Yield without chaff (t/ha)	Harvest Index	Lodging (%)
T_1(Different organic sources equivalent to 1/3 of recommended N(1/3 as FYM@ 5.5 t/ha,1/3 N as Dhaincha, 1/3 N as NEO	5.61	6.5	5.1	0.476	13.33
T_2-T_1+Agronomicpractices for weed and pest control (without chemical)	5.67	6.5	5.4	0.487	16.67
T_3- 50% N as FYM +50% N as *Azospirillum* + RP + PSB	4.95	5.8	4.4	0.470	15.00
T_4-T_1+ *Azospirillum* + PSB	5.23	5.9	4.9	0.483	10.00
T_5-50% RDF +50% N as FYM (8t/ha)	5.5	5.9	5.0	0.476	43.33
T_6-100% NPK	5.01	5.8	4.9	0.494	68.33
T_7-100% NPK+25Kg $ZnSO_4$	5.78	7.5	6.1	0.513	86.67
T_8-T_7+Residue recycling	5.72	6.7	5.9	0.507	78.33
S.Em±	0.004	0.120	0.048	0.001	6.474
CD(0.05)	0.012	0.363	0.146	0.004	19.637
CV	0.131	3.273	1.599	0.438	27.048

The highest straw yield of 5.78 t/ha was obtained from T_7 this is in agreement with Feng 2010 and Yagoub S.O. *et al.*, 2012 in soybean. Highest grain yield with chaff was recorded in T_7 (7.5 t/ha) followed by T_8 (6.7 t/ha). Similarly, Grain yield without chaff was highest in T_7 (6.1 t/ha) followed by T_8 (5.9 t/ha). Judicious and proper use of fertilizers can markedly increase the yield and improve the quality of rice. Results of the present investigation are in agreement with Gupta *et al.*, (2006) and Rehman *et al.*, (2010) in rice.

The highest harvest index was observed in T_7 (0.513) followed by T_8 (1.77). This confirmed the report of several earlier workers in seeds of different crop (Muhammad *et al.*, 2014 in rice and Yagoub *et al.*, (2012) in soybean. The highest lodging % occur in T_7 (86.67%) followed by T_8 (78.33) and least in T_4 (10 %). This may be higher translocation of nutrients from the source to sink. Since rice is widely used as a staple food in most of the Indian states and majority of the studies on rice is mainly based on the use of inorganic chemical fertilizers to increase its productivity. However the use of such chemical fertilizers hampers the eco-system in general and soil quality in particular. As such there is an urgent need to focus more on the cultivation of rice organically and judicious use of recommended chemical fertilizers to increase its yield and to keep the eco-system intact. The present study focuses on the effect of organic manures and chemical fertilizers on the yield of rice seed (*Oryza sativa).* For the present study the rice variety 'lalat' has been chosen because of its widely used rice variety in Orissa as well its nutritional values.

From the study it has been found that seed yield of rice c.v. Lalat were enhanced due to various nutrient management practices. Between the organic sources of nutrients and inorganic fertilizers, the highest yield as well as other parameter were obtained from T_7 (100% NPK along with 25 kg $ZnSO_4$).

In the present contest organic management practices of nutrient is considered to be suitable for maintaining a healthy ecosystem with a sustainable productivity. For quality seed production in rice due emphasis should be given on application of N in form of FYM and Dhaincha.

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