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Research Article

Influence of Different Organic Sources of Nutrient on the Productivity of Upland Rice (*Oryza sativa* L.)

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Abstract

A field experiment was conducted during at the Experimental Research Farm, Department of Agronomy, School of Agriculture Sciences and Rural Development (SASRD), Nagaland University, Medziphema, during *kharif* season of 2009 to study the influence of different sources of organic nutrients and bio-nutrient on the productivity of upland rice. The experiment was laid out in RBD with seven treatments including control and replicated thrice. The treatments consisted of control, seed inoculation with biofertilizer (*Azotobactor*) and three sources of organic manures i.e. pig manure, vegetable sea weed manure and vermicompost at the rate of 3.2 t ha^{-1}, 25 kg ha^{-1} and 2.25 t ha^{-1} respectively, along with seed treatment with biofungicide (*Trichoderma*). The experiment results indicated that the application of Biofertilizer+pig manure @ 3.2 t ha^{-1}+*Trichoderma* significantly increased the growth, yield, yield attributes and nutrient uptake of rice over the other treatments. The maximum plant height (135.37 cm), number of tillers $hill^{-1}$ (9), dry weight (404.63 g), number of panicle m^{-2} (122), number of grains $panicle^{-1}$ (151), grain yield (25.18 q ha^{-1}), straw yield (54.83 q ha^{-1}) were obtained. The maximum uptakes of N (23.86%), P (27.47%) and K (21.83%) in the grain were recorded in the treatment, which was significantly higher over the Biofertilizer+vegetable sea weed manure @ 25 kg ha^{-1}.

1. Introduction

Rice (*Oryza sativa* L.) is one of the most important food crops of India and is also the hub of food security of global population. At global level rice is grown on an area is about 155.62 m ha with production and productivity of 461 mt and 4.09 t ha^{-1}, respectively. India ranks first in respect of area 42.75 mha second in production 105.24 mt, only after China, but the average productivity of rice is very low only 2462 kg ha^{-1} (DES, 2014). It is found that, presently threatening the sustainability of Indian agriculture as a serious concern about national food security include: stagnation or even decline in production and productivity growth rates of crops, deterioration of soil fertility, decline in factor productivity and increasing production costs, leaving agriculture as an economically non-viable enterprise. The hazardous environmental consequences and high cost of inorganic fertilizers make them not only undesirable but also uneconomical and out of reach of the poor farmers (Oyedeji et al., 2014). Recently, the use of organic materials as fertilizers for crop production has received attention for sustainable crop productivity (Dong et al., 2012; Arif et al., 2014). Organic material should great promise as a source of multiple nutrients and ability to improve soil characteristics (Orrell and Bennett, 2013). The excessive use of pesticides also resulted in residues much above the safety levels and this brought to the attention of ill-effects of modern agriculture and paved the way for organic based farming which will not only give rich nutrients produce but also quality food devoid of any chemical residue. Among the sources of organic manures, vermicompost is a potential source due to the presence of readily available plant nutrients, growth enhancing substances, and a number of beneficial micro-organisms. In plant nutrition, organic matter level of a soil is a key property that decides the availability status of essential nutrients. Organic sources like farm yard manure (FYM), poultry manure (PM), green manuring and compost etc not only supply the organic matters but also increase the fertility status of soil (Mohammadi et al., 2011). They provide organic acids that help dissolve soil nutrients and make them available for the plants (Husson, 2013). In recent times, attention has been directed towards organic manure because of the rising

cost of inorganic fertilizers coupled with their inability to give the soil the desired sound health (Oyedeji et al., 2014).

Organic farming helps to prevent environmental degradation and can be used to regenerate degraded areas. Thus, considering the growing importance over higher fetch value of organic food and concerns on adverse effects of chemical led modern agriculture on soil productivity, health and environmental quality, there is a need to adopt the concept of sustainable organic based farming, aimed at meeting the needs of the present generation without endangering the resource for future generation. In today context, a handful researches have been taken place on this aspect to the means for sustaining the productivity and introduction of vermicompost, biofertilizers and their suitable combinations are outcome of them. Therefore present investigation was keep in view with objectives of to assess the effect of different sources of organic nutrients and Bio-nutrient on the growth and yield of rice and nutrient uptake by plant.

2. Materials and Methods

The experiment was carried out during *kharif* season 2009 at Experimental Research Farm, Department of Agronomy, School of Agriculture Sciences and Rural Development (SASRD), Nagaland University, Medziphema, Nagaland, India situated at 25°45´43´´ N latitude and 93°53´04´´ E longitude at an elevation of 310 m amsl. The soil was sandy loam texture. The experiment was laid out in randomized block design with three replications. Treatments consisting of control, biofertilizer (*Azotobactor*), three organic manures viz., pig manure @ 3.2 t ha^{-1}, vegetable sea weed manure @ 25 kg ha^{-1}, vermicompost @ 2.25 t ha^{-1} and *Trichoderma*. There were total seven treatment combinations at all. The net plot size was 4.2 × 1.8 m^2. The seeds were sown directly to the plots in the upland condition by dibbling method of sowing at a depth of 2–3 cm with spacing 30×20 cm^2 during May 26th, 2009 and the crop was harvested during the 3rd October, 2009. Organic manures were applied at the time of ploughing according to the pre-planned doses made in each plot. Biofertilizer (*Azotobacter*) and *Trichoderma* was applied as seed treatment method just before sowing the seed. All other agronomic practices i.e. thinning, gap filling eradication of weeds and irrigation was kept same for all treatments. Data on plant height (cm), number of tillers hill^{-1}, dry weight (g), number of panicles m^{-2}, number of grains panicle^{-1}, panicle length (cm), fertility percentage, grain yield (q ha^{-1}), straw yield (q ha^{-1}), harvest index, test weight and NPK uptake kg ha^{-1} were recorded. The data were collected to each character and analyzed statistically by applying the techniques of analysis of variance and the significant of different source of variations was tested by '*F*' test (Cochran and Cox, 1957).

3. Results and Discussion

3.1. Growth characters

The growth parameters of rice viz., Plant height, number of tillers hill^{-1} and dry weight were influenced by the combination of different sources of organic nutrients and bio-nutrient as indicated in Table 1. Biofertilizer+pig manure @ 3.2 t ha^{-1}+*Trichoderma* (T_3) was recorded significantly increased in the plant height (135.37 cm), highest number of tillers hill^{-1} (9) and highest dry matter accumulation (404.63 g) recorded. Where, plant height significantly produced 3.31% higher than Biofertilizer+vegetable sea weed manure @ 25 kg ha^{-1} (T_4), number of tillers significantly higher than all treatments except

Table 1: Effect of combination of different sources of organic nutrients and bio-nutrient on growth, yield and yield attributes of upland rice

Treatment	Plant height (cm)	No. of tillers hill^{-1}	Plant dry weight (g)	No. of panicles m^{-2}	No. of grains panicle^{-1}	Panicle length (cm)	Fertility percentage (%)	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Harvest index (%)	Test weight (g)
T_1	129.07	6	391.2	116	141	22.43	67.08	20.43	48.17	29.83	21.27
T_2	134.5	8	403.83	121	150	25.03	69.63	24	53.6	30.97	22.43
T_3	135.37	9	404.63	122	151	26.67	70.67	25.18	54.83	31.47	23.50
T_4	131.03	7	399.67	117	146	23.30	68.17	22.44	50.33	30.54	22.73
T_5	132.4	7	400.90	118	147	23.40	68.83	23.17	52.67	30.58	22.90
T_6	132.9	7	402.02	119	148	24.50	69.33	23.77	53.23	30.77	23.10
T_7	133.10	8	403.16	120	150	26.07	70.00	24.27	54.33	31.37	23.13
SEm±	1.69	0.48	3.12	0.93	1.59	1.42	5.41	0.76	1.93	0.88	0.74
CD (*p*=0.05)	3.69	1.04	6.80	2.02	3.46	NS	NS	1.67	4.20	NS	NS

T_1= Control, T_2= Biofertilizer+Pig manure @ 3.2 t ha^{-1}, T_3= Biofertilizer +Pig manure @ 3.2 t ha^{-1}+*Trichoderma*, T_4=Biofertilizer + vegetable sea weed manure @ 25 kg ha^{-1}, T_5= Biofertilizer+vegetable sea weed manure @ 25 kg ha^{-1}+*Trichoderma*, T_6=Biofertilizer +vermicompost @ 2.25 t ha^{-1}, T_7= Biofertilizer+vermicompost @ 2.25 t ha^{-1}+*Trichoderma*

with (T_2) and (T_7) and dry matter also significantly increased with 1.24%, 0.93%, 0.65%, 0.37% and 0.2% as compared to (T_4), (T_5), (T_6), (T_7) and (T_2) respectively. Plant height was significantly increased in combination of biofertilizer+pig manure@ 3.2 t ha^{-1}+*Trichoderma* this finding was conformity with (Kwon et al., 2010). They were found that increased stem height on application of pig manures. This may be due to organic manure has been shown to be useful in providing a stable end product without much loss to the nutrients *per se* (Amanullah et al., 2010). This finding was in accordance with (Singh et al., 2002; Bhagwati, 2005). The significant increase in growth may also be due to the effect of biofertilizer and *Trichoderma*. This was also in line with Singh and Bijayath (2006). The increased in number of tillers might be due to favourable uptake of nutrients under the above treatments when compared to other treatment. This was in accordance with Ovung and Sarkar, (2013). *Trichoderma* may also affect the number of tillers, as reported by (Mathivan et al., 2006). Dry matter accumulation (404.63 g) is due to maximum nutrient uptake from *Azotobacter* and pig manures which is accordance with (Haq et al., 2005; Ovung and Sarkar, 2013).

3.2. Productivity

The data pertaining to the effect of combination of different sources of organic nutrients and bio-nutrient on number of panicles m^{-2}, grains panicle^{-1} panicle length, fertility percentage, grain yield, straw yield, harvest index and test weight presented in Table 1. Among the Biofertilizer+pig manure @ 3.2 t ha^{-1}+*Trichoderma* has recorded highest number of panicle m^{-2} (122), higher number of grains (151) panicle^{-1}, grain yield (25.18 q ha^{-1}) and straw yield (54.83 q ha^{-1}). Where, number of panicles m^{-2} statically at par with (T_2) and (T_7) and significantly produced 4.27%, 3.39% and 2.52% higher numbers of panicles m^{-2} than the treatment (T_4), (T_5) and (T_6), respectively. Number of grains panicle^{-1} significantly higher as compared to biofertilizer+vegetable sea weed manure @ 25 kg ha^{-1} (T_4), biofertilizer+vegetable sea weed manure @ 25 kg ha^{-1}+*Trichoderma* (T_5) and biofertilizer+vermicompost @ 2.25 t ha^{-1} (T_6) and significantly produced 3.42%, 2.72% and 2.03% higher number of grains panicle^{-1}, respectively. However, it (T_3) was found at par with (T_2) and (T_7). The findings were in accordance with (Mathivanan et al., 2006) in which the application of *Trichoderma* gave significant increase in grains panicle^{-1} as compared to control. It was observed that there was no significant difference between the treatment on the length of panicle and fertility percentage.

Grain yield significantly 8.68% higher as compared to biofertilizer+vegetable sea weed manure @ 25 kg ha^{-1} (T_4) and 11.01% higher than biofertilizer+vegetable sea weed manure @ 25 kg ha^{-1}+*Trichoderma* (T_5). However, (T_3) was statistically at par with (T_7), (T_6) and (T_2). Straw yield only significant higher than biofertilizer+vegetable sea weed manure @ 25 kg ha^{-1} (T_4) among the organic treatments. Highest fertility (70.67%) was recorded with the combined application of biofertilizer+pig manure @ 3.2 t ha^{-1}+*Trichoderma* (T_3) followed by the treatment (T_7) (70%). The panicle length, harvest index and test weight are found that there was no significant difference between the treatments. However, longest panicle (26.67 cm), highest harvest index (31.47%) and test weight (23.50 g) were recorded with the combined application of biofertilizer+pig manure @ 3.2 t ha^{-1}+*Trichoderma* (T_3). This might be due to the more availability of nutrients from the given treatment and source-sink relationship. Higher grain yield could also attribute to higher dry matter partitioning into grains and better uptake of nutrients. This was in accordance with the findings of (Singh et al., 2003) in which application of pig manure+inorganic fertilizer showed superiority over plant height (106 cm), flag leaf area (27.6 cm) and grain (45.2 q ha^{-1}) and straw yield (50.6 q ha^{-1}). This was also in line with (Haq et al., 2005). It was also observed that harvest index and test weight were statistically non-significant.

3.3. Nutrient uptake by rice crop

The results pertaining to the influence of different sources of organic nutrients on NPK uptake by the rice grains and straw was depicted in Table 2. From the data it was apparent that all the treatment had conspicuous influence on NPK uptake. The highest uptake by grain N (45.58 kg ha^{-1}), P (10.58 kg ha^{-1}) and K (19.14 kg ha^{-1}) were obtained with biofertilizer+pig manure @ 3.2 t ha^{-1}+*Trichoderma* (T_3) which was significantly higher as compared to biofertilizer+vegetable

Table 2: Effect of combination of different sources of organic nutrients and bio-nutrient on NPK uptake in grain and straw of upland rice

Treatment	N uptake in rice grain (kg ha^{-1})	N uptake in rice straw (kg ha^{-1})	P uptake in rice grain (kg ha^{-1})	P uptake in rice straw (kg ha^{-1})	K uptake in rice grain (kg ha^{-1})	K uptake in rice straw (kg ha^{-1})
T_1	30.65	34.68	7.15	6.26	13.69	25.53
T_2	42.72	48.78	9.84	12.33	17.76	36.45
T_3	45.58	50.99	10.58	13.16	19.14	37.83
T_4	36.80	38.75	8.30	8.56	15.71	30.70
T_5	38.93	41.61	8.80	9.48	16.45	32.13
T_6	41.12	45.25	9.27	10.65	17.35	34.59
T_7	42.23	47.28	9.71	11.41	18.20	35.86
SEm±	3.74	4.23	0.91	1.73	1.31	3.15
CD (p=0.05)	8.15	9.21	1.98	3.77	2.85	6.87

sea weed manure @ 25 kg ha^{-1} (T_4) and significantly produced 23.86%, 27.47% and 21.83% higher NPK uptake in rice grain. However, (T_3) was statistically at par with biofertilizer+pig manure @ 3.2 t ha^{-1} (T_2), biofertilizer+vermicompost @ 2.25 t ha^{-1}+*Trichoderma* (T_7), biofertilizer+vermicompost @ 2.25 t ha^{-1} (T_6) and biofertilizer+vegetable sea weed manure @ 25 kg ha^{-1}+*Trichoderma* (T_5). The highest uptake in rice straw N (50.99 kg ha^{-1}), P (13.16 kg ha^{-1}) and K (37.83 kg ha^{-1}) were obtained with biofertilizer+pig manure @ 3.2 t ha^{-1}+*Trichoderma* (T_3) which was significantly higher as compared to biofertilizer+vegetable sea weed manure @ 25 kg ha^{-1} (T_4). The N uptake by rice grain and straw increased significantly with the combine application of different sources of organic nutrients. Similar results were also obtained by (Dinesh et al., 2000; Laxminarayana and Patiram, 2006; and (Singh et al., 2006). P uptake by the rice plant showed significant increased with the application of different sources of organic nutrients. The positive effect of organic manure uptake of P by the crop may be attributed to the chelation of Fe, Al, Mn, Zn, Ca and Mg preventing them from fixing P into insoluble compound. Significant increase in K uptake due to the combine application of organic nutrients were obtained. (Majumdar et al., 2007; Dutta and Sangtam, 2014) reported that NPK uptake by paddy and various forms of N in soil increased significantly with applied N, FYM and nitrogen fixing bacteria (*Azotobacter chroecococum* and *Azospirillum brasilense*).

4. Conclusion

Application of biofertilizer+pig manure @ 3.2 t ha^{-1} +*Trichoderma* was found to be the most effective in influencing yield, yield component characters and also observed the highest NPK uptake by grain and straw.

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