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Effect of Different Organic Sources on the Productivity of Upland Terraced Rice (*Oryza sativa* L.) under Organic Farming in Nagaland

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Abstract

A field experiment was carried out in the experimental research farm of School of Agricultural Sciences and Rural Development (SASRD), Nagaland University during April to September, 2008 to study the Influence of organic sources of nutrients in enhancing productivity of upland rice (*Oryza sativa* L.). The treatments were vermicompost @ 3 t ha^{-1}, Farmyard manure (FYM) @ 12 t ha^{-1}, Vegetable sea weed manure (VSWM) @ 25 kg ha^{-1} + FYM @ 2 t ha^{-1}, *Azospirillum* + FYM @ 9 t ha^{-1}, Bio-activated algal sea weed manure (BASWM) @ 25 kg ha^{-1} + FYM @ 2 t ha^{-1}, *Azospirillum* + Vermicompost @ 2.25 t ha^{-1} and control replicated thrice laid out in Randomized Block Design. The investigation revealed that application of *Azospirillum* + FYM @ 9 t ha^{-1} recorded Maximum (489.1 g, 146, 275) dry weight m^{-2}, number of panicles m^{-2} and grains panicle^{-1} contributing to highest (28.17 and 56.27 q ha^{-1}, respectively) grain and straw yield. Similarly, the same treatment also yielded highest (34.93, 29.26 and 188.2 kg ha^{-1}, respectively) N uptake by grain and straw as well as available nitrogen

1. Introduction

Rice (*Oryza sativa* L.) plays a vital role in our food as well as nutritional security for millions of livelihood. It is a staple food crop of 60 percent of World population, importantly for more than 90 per cent of the Asians. In India, North-eastern states has 3.369 mha area under rice cultivation, but the average productivity (1761 kg ha^{-1}) is poor even below the national average (2102 kg ha^{-1}) due to inadequate and even lack of resource based management practices (DRR, 2011). Thus a technological breakthrough in agro-techniques especially in nutrient management is an utmost importance for upland rice condition.

In North-east India, indigenous crop husbandry methods particularly in upland rainfed areas are free from external inputs (inorganic fertilizers/pesticides etc). The total NPK use is almost 1% of India's total consumption (104.50 kg ha^{-1}), whereas pesticide is negligible (0.001% out of 80668 t) (Agricultural Statistics at a Glance, 2010). The use of chemicals is neglected because of traditional use of farming as well as encouragement of the Government to grow crops with the help of organic products available. At the same time, availability of approximately 37 mt dung from existing livestock population and 9 mt crop residues and vast reserves of weed biomass, forest litter from 171.08 lakh ha forest lands (Bujarbaruah, 2004) can be utilized for well decomposed FYM to replenish the soil fertility and enhancing yield. Thus this region inherits a great potential for revolutionizing organic production in the country. 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 this respect, Nagaland may be the representative of north-eastern regions where farmers are traditionally growing rice based on locally available organic resources. Hence, the present investigation has been entitled to find out the best organic source/ their combinations on growth and yield attributing characters of rice and nitrogen uptake by rice at harvest.

2. Materials and Methods

The field experiment was conducted in the experimental research farm of School of Agricultural Sciences and Rural Development (SASRD), Nagaland University, situated at 25°45′

43″ N latitude and 93° 53′ 04″ E longitude at an elevation of 310 meters above mean sea level during April to September, 2008. The soil of the experimental field was found well drained and sandy loam in texture, acidic (pH 4.5; Richards, 1954) with high (1.46% C; Walkey and Black method as outlined by Jackson,1967), low available N (176 kg ha^{-1}; by Subbiah and Asija, 1956), medium available P (28.21 kg ha^{-1}; Brays & Kurtz, 1945) and high available K (362.88 kg ha^{-1}; Hanway & Heidal, 1952). The experimental was laid out in Randomised Block Design with seven treatments namely; vermicompost @ 3 t ha^{-1}, Farmyard manure (FYM) @ 12 t ha^{-1}, Vegetable sea weed manure (VSWM) @ 25 kg ha^{-1} + FYM @ 2 t ha^{-1}, *Azospirillum* + FYM @ 9 t ha^{-1}, Bio-activated algal sea weed manure (BASWM) @ 25 kg ha^{-1} + FYM @ 2 t ha^{-1}, *Azospirillum* + Vermicompost @ 2.25 t ha^{-1} and control replicated thrice. Organic manures were applied one month before sowing for well decomposition of organic matter. Biofertilizer (*Azospirillum*) was applied as seed treatment method just before sowing the seed line sown by hand at a 25 x 20 cm^2 at a depth of 2-3 cm. For controlling insect-pests, neem based biopesticides; Max Raze, Max Cannon, *Trichogramma japonicum*, *T. chilonis*, light trap and for blast control, Max Spark were used and found effective. Other agronomic practices were done as per the normal schedule. The data related to each character were analyzed statistically by applying the techniques of ANOVA and the significance was tested by 'F' test (Cochran & Cox, 1957).

3. Results and Discussions

3.1. Growth and yield attributes

Maximum (489.1 g m^{-2}) dry weight m^{-2} was observed with the application of *Azospirillum*+ FYM (9 t ha^{-1}) which was significantly higher than control only (Table 1). This finding was in accordance with Shanmugan and Veeraputhran (2001) who observed that application of green manure or FYM @ 12.5 t ha^{-1} combined with *Azospirillum* (2 kg ha$^{-1)}$ significantly increased the growth attributes of rice. All the yield contributing characters except panicle length, fertility percentage and test weight were significantly influenced by the treatments. Application of *Azospirillum* + FYM (9 t ha^{-1}) had recorded the highest (146) number of panicles m^{-2} which was followed by the application of Bio-activated algal sea weed manure @ 25 kg ha^{-1} + FYM @ 2 t ha^{-1} (143) and Vegetable sea weed manure @ 25 kg ha^{-1} + FYM @ 2 t ha^{-1} (142). Similarly, highest (275) number of grains panicle^{-1} was found with application of *Azospirillum* + FYM (9 t ha^{-1}) which was found at par with all organic manure treatments. Bio-activated algal sea weed manure @ 25 kg ha^{-1} + FYM @ 2 t ha^{-1} produced higher (274) grain panicle^{-1} than Vegetable sea weed manure @ 25 kg ha^{-1} + FYM @ 2 t ha^{-1} (252). Concurrently, longest panicle length (26.6 cm) was produced with Vegetable sea weed manure @ 25 kg ha^{-1} + FYM @ 2 t ha^{-1} followed by Farmyard manure @ 12 t ha^{-1} (26.0 cm), whereas highest fertility percentage (88.7) and test weight (23.9) by *Azospirillum* + FYM @ 9 t ha^{-1}. Tamaki et al. (2002) also recorded similar findings.

The highest (28.17 q ha^{-1}) grain yield was recorded with the combined application of *Azospirillum* and FYM @ 9 t ha^{-1} which was at par with Vegetable sea weed manures @ 25 kg ha^{-1} + FYM 2 t ha^{-1} (26.5 q ha^{-1}) and Bio-activated algal sea weed manure @ 25 kg ha^{-1} + FYM @ 2 t ha^{-1} (26.83 q ha^{-1}) but significantly higher than vermicompost @ 3 t ha^{-1} and FYM @ 12 t ha^{-1} resulting in 8.3% and 19.26% increase in yield, respectively. Bio-activated algal sea weed manure @ 25 kg ha^{-1} + FYM @ 2 t ha^{-1} also significantly produced 14.86%

Table 1: Effect of organic sources on growth and yield of rice

Treatments	Dry weight (g) at harvest	Panicles (m^{-2})	Number of grains (Panicle^{-1})	Panicle length (cm)	Fertility (%)	Test weight (g)	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})
Vermicompost @ 3 t ha^{-1}	449.5	132	226	24.3	86.0	22.4	26.00	50.47
Farmyard manure @ 12 t ha^{-1}	406.3	134	190	26.0	85.7	22.0	23.62	49.13
Vegetable sea weed manure @ 25 kg ha^{-1} + FYM @ 2 t ha^{-1}	462.3	142	252	26.6	87.3	22.9	26.50	53.80
Azospirillum + FYM @ 9 t ha^{-1}	489.1	146	275	24.7	88.7	23.9	28.17	56.27
Bio-activated algal sea weed manure @ 25 kg ha^{-1} + FYM @ 2 t ha^{-1}	472.0	143	274	25.4	88.3	23.2	26.83	54.63
Azospirillum + Vermicompost @ 2.25 t ha^{-1}	450.1	135	233	23.4	87.0	22.9	26.25	52.13
Control	281.4	120	172	23.1	82.0	21.8	23.17	43.25
SEm±	42.73	7.42	17.12	1.54	10.05	1.04	1.37	2.56
CD (p=0.05)	93.11	16.18	37.29	NS	MS	NS	2.98	5.58

higher grain yield (26.83 q ha^{-1}) when compared with FYM @ 12 t ha^{-1} (23.62 q ha^{-1}). However, Vegetable sea weed manures @ 25 kg ha^{-1} + FYM 2 t ha^{-1} only recorded significantly more yield as compared to control. The maximum (56.27 q ha^{-1}) straw yield was recorded from the application of *Azospirillum* + FYM (9 t ha^{-1}) that was significantly higher than Vermicompost @ 3 t ha^{-1} and Farmyard manure @ 12 t ha^{-1} excluding control. This is in accordance with the finding of Singh and Bijayath (2006) in which application of *Azospirillum* and FYM showed superiority in terms of grain yield(5.6 t ha^{-1}) and straw yield (6.7 t ha^{-1}), number of grains panicle^{-1} (135.9), test weight (29.5 g).

3.2. Nitrogen status, soil pH and available organic carbon

The highest (34.93 kg ha^{-1}) N uptake by grain was recorded with the application of *Azospirillum* + FYM (9 t ha^{-1}) which was significantly higher than all except Bio-activated algal sea weed manure @ 25 kg ha^{-1} + FYM @ 2 t ha^{-1} (33.01) (Table 2). This Bio-activated algal sea weed manure @ 25 kg ha^{-1} + FYM @ 2 t ha^{-1} however, resulted significantly higher N uptake by grain than Vermicompost @ 3 t ha^{-1}, Farmyard manure @ 12 t ha^{-1} and control. Likewise, same treatment significantly produced higher (29.26 kg ha^{-1}) N uptake by straw as compared to Vermicompost @ 3 t ha^{-1}, Farmyard manure @ 12 t ha^{-1} and *Azospirillum* + Vermicompost @ 2.25 t ha^{-1} among the organic nutrient source treatments. Bio-activated algal sea weed manure @ 25 kg ha^{-1} + FYM @ 2 t ha^{-1} also recorded 27.86 kg N uptake by straw which was significantly more than Vermicompost @ 3 t ha^{-1}, *Azospirillum* + Vermicompost @ 2.25 t ha^{-1} and control. The increasing level of nitrogen has a direct relationship with that of the nitrogen uptake by grain and straw (Singh et al., 1993). The highest (188.16 kg ha^{-1}) available N content in the soil was also observed with the application of *Azospirillum* + FYM @ 9 t ha^{-1} in which was significantly higher than others. Soil pH and organic carbon percentage were non-significantly affected by different nutrient sources, however highest pH (4.83) was recorded with the application of Vermicompost @ 3 t ha^{-1} whereas maximum organic carbon content (1.21 %) was observed with the application of *Azospirillum* + FYM @ 9 t ha^{-1}. These results are in close conformity with those of Mishra and Sharma (1997) and Mandal and Chettri (1998).

Table 2: Effect of organic sources on nitrogen uptake, available N, soil pH and organic carbon of rice

Treatments	N uptake in rice grain (kg ha^{-1})	N uptake in rice straw (kg ha^{-1})	Available N (kg ha^{-1})	Soil pH	Organic carbon (%)
Vermicompost @ 3 t ha^{-1}	30.94	24.73	175.6	4.83	1.15
Farmyard manure @ 12 t ha^{-1}	28.34	23.58	171.4	4.67	1.15
Vegetable sea weed manure @ 25 kg ha^{-1} + FYM @ 2 t ha^{-1}	32.07	27.44	179.8	4.69	1.20
Azospirillum + FYM @ 9 t ha^{-1}	34.93	29.26	188.2	4.72	1.21
Bio-activated algal sea weed manure @ 25 kg ha^{-1} + FYM @ 2 t ha^{-1}	33.01	27.86	163.1	4.79	1.19
Azospirillum + Vermicompost @ 2.25 t ha^{-1}	31.76	25.02	158.9	4.60	1.12
Control	27.57	20.33	146.4	4.52	1.11
SEm±	0.92	1.29	3.76	0.14	0.04
CD (p=0.05)	2.01	2.80	8.19	NS	NS

4. Conclusion

Application of *Azospirillum* + FYM @ 9 t ha^{-1} was found to be the most effective in influencing yield contributing characters and yield for direct seeded upland rice under the agro-climatic conditions of Nagaland. In relation to sea weed manure, combined application of Bio-activated algal sea weed manure @ 25 kg ha^{-1} + FYM @ 2 t ha^{-1} proved better when compared with Vegetable sea weed manure @ 25 kg ha^{-1} + FYM @ 2 t ha^{-1}.

5. Reference

Agricultural Statistics at a glance, 2010. Department of Agriculture and Cooperation. Ministry of Agriculture, Govt. of India.

Brays, R.H., Kurtz, L.T., 1945. Determination of total, organic and available forms of phosphorus in soil. Soil Science 59, 39-45.

Bujarbaruah, K.M., 2004. Organic Farming; Opportunities and challenges in NE region of India. In: International conference on Organic food held from Feb., 15-17 at ICAR Research Complex for NEH region, Umiam, Meghalaya, 13-23.

Cochran, W.G., Cox, G.M., 1957. Experimental designs. Asia

Publishing House, New Delhi.

Directorate of Rice Research, 2011. www.drricar.org/Rice%20 Statistics.csv. Accessed in November, 2011.

Hanway, J., Heidal, H.S., 1952. Soil testing laboratory procedures. Jowa Agriculture 57, 1-31.

Jackson, M.L., 1967. Soil chemical analysis. Prentice Hall of India Pvt. Ltd., New Delhi.

Mandal, S.S., Chettri, M., 1998. Integrated nutrient management for sustainable productivity and fertility under rice (*Oryza sativa* L.) based cropping system. Indian Journal of Agricultural Sciences 68, 337-340.

Mishra, V.K., Sharma, R.B., 1997. Influence in integrated nutrient management on soil health and energy requirement of rice based cropping system. Oryza 34, 165-70.

Richards, L.A., 1954. Diagnosis and improvement of saline and alkaline soils. U.S.D.A. Handbook, 60.

Singh, G., Singh, O.P., Yadav, R.A., Singh. R.S., Singh, B.B., 1993. Effect of sources and levels of nitrogen on grain yield, yield attributes, nitrogen uptake, recovery and response by rice in deep water condition. Crop Research 6(2), 213-216.

Singh, M.S., Bijayath, 2006. Response of rice (*Oryza sativa* L.) to biofertilizers in combination with FYM and nitrogen. Journal of Ecobiology 18(4), 363-369.

Subbiah, B.V., Asija, G.L., 1956. A rapid procedure for the estimation of available N in soil. Current Science 25, 259-260.

Tamaki, M., Itani, T., Nakano, H., 2002. Effect of continuous organic farming on the growth and yield of rice. Japanese Journal of Crop Sciences 71(4), 439-445.