© 2023, Centre for Advanced Research in Agricultural Sciences
Research Journal of Agricultural Sciences
Volume 14; Issue 05 (Sep-Oct 2023); pp 1214–1217

Open Access
ISSN: 0976-1675 (P)
ISSN: 2249-4538 (E)

Full Length Research Article

Effect of Different Organic Inputs on Growth and Yield of Rice under Upland Rainfed Condition of Nagaland

Kalibo V. Yeptho[1], T. Gohain[2], Khrawbor Dkhar*[3] and Lowrence Kithan[4]

[1-4] Department of Agronomy, School of Agricultural Sciences and Rural Development, Nagaland University: Campus Medziphema - 797 106

Abstract

A field experiment entitled "Effect of different organic inputs on growth, yield and quality of rice (*Oryza sativa* L.) under upland rainfed condition of Nagaland" was conducted at SASRD, Nagaland University during *kharif* 2018-19. The study was conducted to evaluate the effect of different organic inputs on growth and yield responses of rice and to determine the suitable organic inputs. The experiment consisted of seven treatments viz., T_1: Control, T_2: FYM @10 t ha^{-1}, T_3: Enriched compost @ 2.5 t ha^{-1}, T_4: Poultry manures @ 5 t ha^{-1}, T_5: Pig manures @ 5 t ha^{-1}, T_6: Vermicompost @ 2.5 t ha^{-1}, T_7: Green manures (in situ) which laid out in RBD with three replications. The results revealed that the tallest plant (49.67, 62.44, 115.99 cm) and highest number of plant population of 220.67, 283.33 and 273.33 plants m^{-2} was recorded from T_6 and treatment T_1 produced the lowest plant height and plant population. The treatment T_6: Vermicompost recorded maximum number of panicles (250) and the number of grains panicle^{-1} (127.13). Application of T_6: Vermicompost @ 2.5 t ha^{-1} recorded the maximum filled grain percentage (78.59), highest grain yield (38.44 kg ha^{-1}), straw yield (53.87 kg ha^{-1}) and harvest index (41.64) whereas the lowest was observed in T_1. The gross return showed highest in T_6 (₹ 66948.0), and T_7 with green manuring was found to be highest with net return (₹ 33663.2) and benefit cost ratio (2.31) which may be due to low cost of inputs.

***Key words*: **Enriched compost, Vermicompost, Green manure, Benefit cost ratio

Rice (*Oryza sativa* L.) is a cereal grain which belongs to the grass family of *Poaceae*. It is one of the most cultivated grain crops in India as well as in Asian countries. It is a primary food source for more than one-third of world's population [1]. Rice is one of the world's largest cereal crops providing the caloric need for millions of people. India has the largest area under rice cultivation (44.3 million ha) accounting for 29.40 of the global rice area [2]. It is the principal cereal crop of Asia, which ensures food and nutritional security to the major population. It accounts for about 43% of total food grain production and 46% of total cereal production in the country [3]. In India, 433.88 lakh hectares of land is under rice cultivation producing 104.32 million tonnes of rice with an average yield of 2404 kg ha^{-1} during 2016-2017 [4]. The total global production of rice was 480.04 MT in 2017 and the production has been raised up to 486.3 MT in the year 2018 [5]. After China, India ranks second with an area of 43.39 million hectare [4] producing 108.86 million tonnes of rice [6] giving an average productivity of 2.40 tonnes ha^{-1} [4].

India's Northeast is mostly based on an agrarian economy with more than 70% of the population engaged in the agriculture sector. Household food and nutritional security of North-eastern states of India predominantly depends on rice. Rice is the main crop in the Northeastern states occupying 3.51 million hectares which accounts for more than 80% of the total cultivated area of the region and 7.8 per cent of the total rice area in India while its share in national rice production is only 5.9%. The total rice production of NE region is estimated to be around 5.50 million tones with average productivity of 1.57 t ha^{-1}, which is much below the national average of 2.08 t ha^{-1} [7].

Rice is staple food of Nagaland with about 86% of the cultivable area in the state under *jhum* and terrace rice cultivation systems. In Nagaland area under *jhum* is about 56.50% and contributes 49.26% to total rice production. Traditional rice varieties are grown in altitude ranging from 300 to 2500 meters. Rice is the most important food grain crop of the State of Nagaland and grown throughout the state under upland conditions, direct seeded on hill slopes and irrigated lowland conditions. The total area under Rice cultivation in Nagaland is 1,81,400 hectares with the production of 318 thousand tones [8]. Rice in Nagaland is cultivated under different ecosystems because of its diverse climate and physiographic condition.

The agriculture in Nagaland have adopted a system of agricultural practices without the use of external inputs, and is

Received: 08 Jun 2023; Revised accepted: 16 Aug 2023; Published online: 12 Sep 2023

Correspondence to: Khrawbor Dkhar, Department of Agronomy, School of Agricultural Sciences and Rural Development, Nagaland University: Campus Medziphema - 797 106, Tel: +91 8259019777; E-mail: khrawbdkhar2007@gmail.com

Citation: Yeptho KV, Gohain T, Dkhar K, Kithan L. 2023. Effect of different organic inputs on growth and yield of rice under upland rainfed condition of Nagaland. *Res. Jr. Agril. Sci.* 14(5): 1214-1217.

one of the lowest consumers of chemical fertilizers in the country @ 1.5 kg ha^{-1} which is negligible by any standards. Presently organic agriculture has come out to be the viable alternative for quality food production, eco sustainability, soil and human health issues along with other social and cultural issues. Organic farming is gaining momentum during recent times due to awareness of people towards environment and food safety [9]. Organic manures not only act as the source of nutrients, but also provide micronutrients and modify soil-physical behavior as well as increase the efficiency of applied nutrients [10].

MATERIALS AND METHODS

A field experiment was conducted during the *kharif s*eason, 2018-19 to study the effect of different organic inputs on growth, yield and quality of rice (*Oryza sativa* L.) under upland rainfed condition of Nagaland in the experimental research farm of School of Agricultural Sciences and Rural Development (SASRD), Nagaland University, Medziphema Campus. The farm is located in the foothill of Nagaland at an altitude of 310 meters above sea level with the geographical location at 25º 45’43’’ North latitude and 95º 53’04’’East longitude. The climatic condition of the experimental field was categorized as sub-humid tropical zone with an average rainfall ranging from 2000-2500 mm. The soil of the experimental field is sandy loam belonging to the taxonomical order Inceptisol. Soil samples were drawn from 0-15 cm depth to determine the fertility status of the soil. The samples were grinded and sieved and were analyzed by methods of chemical analysis. The experiment was laid out in randomized block design (RBD) with three replications. The treatment consisted of 7 treatments viz. T_1: Control (No sources), T_2: FYM @10 t ha^{-1}, T_3: Enriched compost @ 2.5 t ha^{-1}, T_4: Poultry manures @ 5 t ha^{-1}, T_5: Pig manures @ 5 t ha^{-1}, T_6: Vermicompost @ 2.5 t ha^{-1}, T_7: Green manures (in situ).

RESULTS AND DISCUSSION

The data pertaining to the plant height showed that the plant height increased as the duration of days increased. At the growing stage of 30 DAS, treatment T_6 - Vermicompost @ 2.5 t ha^{-1} produced the tallest plant height (49.67cm) and was at par with all the treatments except T_1 and $T_{5.}$ The treatment T_1 produced the shortest plants of 39.31cm. At 60 DAS, T_6 (62.44 cm) registered the maximum value for plant height and the shortest plant height was obtained from treatment T_1 - control (46.78 cm). At 90 DAS, the tallest plant was observed in treatment T_6 - Vermicompost (115.99 cm). Relatively better performance of vermicompost might be due to the presence of plant growth substances identified as indole compounds which could be secreted into cast and in turn increased plant growth [11-12]. Similar findings were reported by Thirunavukkarasu and Vinot [13] in which highest plant height of 38.8 and 74.3 cm was produced by application of vermicompost @ 2.5 t ha$^{-1.}$ According to them, the increase in plant height ascribed to applied vermicompost might have accelerated the metabolic and physiological activity of the plant and put more growth by assimilating more amounts of major nutrients and ultimately increased the plant height [14].

Table 1 Effect of different organic inputs on plant height (cm), plant population (m^{-2}), crop growth

Treatments	Plant height (cm)	Plant population (m^2)	Crop growth rate (g m^2 day^1)	Relative growth rate (g g^{-1}day^{-1})
	90 DAS	90 DAS	45-60 DAS	45-60 DAS
T_1: Control	95.67	201.33	1.58	0.03
T_2: FYM @ 10 t ha^{-1}	109.83	224.00	1.41	0.04
T_3: Enriched compost @ 2.5 t ha^{-1}	108.51	222.00	2.54	0.06
T_4: Poultry manure @ 5 t ha^{-1}	109.55	208.00	1.46	0.05
T_5: Pig manure @ 5 t ha^{-1}	103.44	213.67	2.27	0.04
T_6: Vermicompost @ 2.5 t ha^{-1}	114.37	273.33	3.05	0.07
T_7: Green manure (In situ)	103.02	209.33	1.58	0.06
SEm±	1.00	4.68	0.4603	0.0002
CD (P = 0.05)	3.08	14.41	NS	NS

Table 2 Effect of different organic inputs on number of panicles (m^{-2}), panicle length (cm), panicle weight (g) and number of grains panicle^{-1}

Treatments	Number of panicles (m^{-2})	Panicle length (cm)	Panicle weight (g)	Number of grains panicle^{-1}
T_1: Control	195.33	23.82	3.00	98.67
T_2: FYM @ 10 t ha^{-1}	210.67	25.15	3.36	121.93
T_3: Enriched compost @ 2.5 t ha^{-1}	212.00	25.31	3.50	115.67
T_4: Poultry manure @ 5 t ha^{-1}	202.00	25.39	3.53	110.00
T_5: Pig manure @ 5 t ha^{-1}	207.00	25.01	3.83	118.87
T_6: Vermicompost @ 2.5 t ha^{-1}	250.00	25.64	3.51	127.13
T_7: Green manure (In situ)	204.00	26.50	3.59	116.87
SEm±	3.97	0.35	0.03	2.83
CD (P = 0.05)	12.24	NS	NS	8.74

On plant population the data revealed that Application of vermicompost @ 2.5t ha^{-1} showed the highest plant population of 220.67, 283.33 and 273.33 plants m^{-2} in all the stages of growth viz. 30, 60 and 90 DAS. Similar findings were also observed by Asadipour and Hadi [15] where application of vermicompost @10t ha^{-1} resulted in increase in plant density in growth and yield attributed of mung bean. On crop growth rate (CGR) the various treatments showed no significant variation in all the stages. However, at the growing stage of 45 DAS the highest CGR was recorded in application of vermicompost @ 2.5 t ha^{-1} (3.05) whereas the treatment T_1 (1.58) obtained the lowest crop growth rate. Nainawatt [16] also found that application of @ 2.5 t ha^{-1} vermicompost resulted in higher dry matter production. The data on relative growth rate revealed that the effect of various sources of organic inputs was found to be non- significant in all the stages. The highest RGR was recorded in T_6. Vegetative growth of paddy like shoot weight, root weight, dry matter production influenced significantly by the addition of vermicompost in comparison with sole application of chemical fertilizers [17].

Table 3 Effect of different organic inputs on filled grain percentage (%), test weight (g), grain yield (q ha^{-1}) and straw yield (q ha^{-1}) and harvest index (%)

Treatments	Filled grain percentage (%)	Test weight (g)	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Harvest index (%)
T_1: Control	69.36	32.36	12.43	34.25	26.61
T_2: FYM @ 10 t ha^{-1}	70.43	33.18	35.77	53.43	40.09
T_3: Enriched compost @ 2.5 t ha^{-1}	71.09	33.64	32.67	47.32	40.84
T_4: Poultry manure @ 5 t ha^{-1}	77.62	33.12	30.41	49.66	38.38
T_5: Pig manure @ 5 t ha^{-1}	72.64	32.66	31.28	50.64	38.16
T_6: Vermicompost @ 2.5 t ha^{-1}	78.59	34.3	38.44	53.87	41.64
T_7: Green manure (In situ)	71.95	33.18	27.32	50.64	35.04
SEm±	2.39	1.96	0.11	0.04	0.13
CD (P = 0.05)	7.35	NS	0.32	0.14	0.40

The data indicated that the number of panicles (m^{-2}) significantly increased by the different sources of organic inputs. It was recorded that the maximum number of panicles m^{-2} (250) was obtained with the application of vermicompost @ 2.5 t ha^{-1} and the lowest panicle number (195.33) was recorded by the treatment T_1. This is due to greater availability of nutrients from applied vermicompost and N fertilizer and microbial stimulation effects of vermicompost and gradual mineralization of N [18]. The data on panicle length showed that the different treatments showed no significant variation. However, with the application of vermicompost @ 2.5t ha^{-1} (25.64) showed the tallest panicle length which was at par with all the treatment except treatment T_1. The treatment T_1 (23.82) obtained the lowest panicle length. The data on panicle weight revealed that there were no significant differences observed between the treatments, the highest panicle weight (3.59) was observed with application of vermicompost @ 2.5t ha^{-1}. The lowest panicle weight was observed in treatment T_1 (3.00). The data on the number of grains $panicle^{-1}$ recorded that the treatment exhibited significant variation under different organic inputs.

Application of vermicompost @ 2.5t ha^{-1} (127.13) produced maximum number of grains $panicle^{-1}$ which was at par with treatment T_2 (121.93). The treatment T_1 (98.67) obtained minimum number of grains [19]. The data on filled grain percentage showed significant variation under the influence of different organic inputs. Application of vermicompost @ 2.5t ha^{-1} (78.59) showed the highest filled grain which was at par with T_4 (77.62) and T_5 (72.64). Treatment T_1 (69.09) obtained the lowest filled grain percentage. This is also due to increased uptake of nutrients as a result of enhanced availability in the soil [18]. Highest number of filled grains was registered by vermicompost @ 2.5 t ha^{-1} of 99 followed by vermicompost @ 2 t ha^{-1} of 96. This may be due to microbial stimulation effect of vermicompost and N supplied through gradual mineralization [13]. The data on test weight of grain was found to be non-significant under the effect of different sources of organic inputs.

Table 4 Economics cost of cultivation

Treatments	Total cost of cultivation (₹ ha^{-1})	Gross returns (₹ ha^{-1})	Net returns (₹ ha^{-1})	B:C Ratio
T_1: Control	12600.0	22158.5	9558.5	0.79
T_2: FYM @ 10 t ha^{-1}	33600.0	62292.6	28692.6	0.85
T_3: Enriched compost @ 2.5 t ha^{-1}	38600.0	56958.6	18358.6	0.70
T_4: Poultry manure @ 5 t ha^{-1}	26100.0	53188.0	27088.0	1.04
T_5: Pig manure @ 5 t ha^{-1}	26100.0	54677.0	28577.0	1.10
T_6: Vermicompost @ 2.5 t ha^{-1}	38600.0	66948.0	28348.0	0.73
T_7: Green manure (In situ)	14300.0	47963.2	33663.2	2.31

The grain yield on the effect of different sources of organic inputs exhibited significant variation. The maximum grain yield of 38.44 was recorded with the application of vermicompost @ 2.5 t ha^{-1}. The lowest grain yield of 12.43 was recorded by T_1. The increase in grain yield with vermicompost was attributed to the significantly higher yield attributes due to increased availability of nutrients from vermicompost, presence of biologically active metabolites like gibberlins, cytokinins, auxins and group B vitamins [20]. Vermicompost application @ 2.5t ha^{-1} ha increased grain and straw yield of rice significantly and saved up to 50% of recommended NPK fertilizer rates in upland rice [21]. The data on straw yield showed significant difference among the treatments and application of vermicompost @ 2.5 t ha^{-1} (53.87) produced the maximum straw yield. The treatment T_1 (34.25) recorded the lowest straw yield [22]. Jeyabal and Kuppuswamy [23] also reported that application of vermicompost with higher grain and straw yield of rice in rice - legume cropping system and improved the soil fertility. The harvest index under the effect of different sources of organic inputs showed a significant variation among different treatments. The highest harvest index of 41.64 was obtained with the application of vermicompost @ 2.5 t ha^{-1}. The lowest harvest index was produced by treatment T_1 (26.61). This finding can be efficiently supported by the research work of Murali and Setty [22] who reported a significant increase in higher yield with the application of vermicompost. Net income was recorded maximum in treatment T_7 (₹ 33663.2). While the highest B:C ratio (2.31) was obtained under treatment T_7 [24].

CONCLUSION

Application of vermicompost @ 2.5 t ha^{-1} (T_6) was found to be the most effective in influencing the growth and yield under the effect of different organic inputs of rice (*Oryza sativa* L.) under upland rainfed condition of Nagaland. Among the sources of organic inputs, green manuring in situ (T_7) was found to be the most suitable organic inputs. Among the different organic inputs highest net return (₹ 33663.2) and benefit cost ratio (2.31) was found in green manuring in situ (T_7) due to the low cost of inputs.

Acknowledgement

The authors are thankful to the School of Agricultural Sciences and Rural Development (SASRD), Nagaland University, Medziphema Campus, India for providing necessary facilities and financial support to conduct the field and laboratory studies.

LITERATURE CITED

1. Prasad R, Prasad LC, Agrawal RK. 2010. Genetic diversity in Indian germplasm of aromatic rice. *Oryza* 46: 197-201.
2. Baishya LK, Rathore SS, Singh D, Sarkar D, Deka BC. 2015. Effect of integrated nutrient management on rice productivity, profitability and soil fertility. *Annals of Plant and Soil Research* 17(1): 86-90.
3. Abraham T, Kumar PP, Pattanaik SSC, Kumar R, Kumar U, Kumar A. 2018. Effect of customized leaf colour chart based real time N management on agronomic attributes and protein content of rice. *Oryza* 55(1): 165-173.
4. Anonymous. 2017. Annual Report. Department of Agriculture, Cooperation & Farmers Welfare, Ministry of Agriculture & Farmers Welfare, Government of India. pp 157.
5. Anonymous. 2018. United States Department of Agriculture, estimates record global rice production, capital market, Mumbai, pp 21.
6. Anonymous. 2017. Agricultural Statistics Division, Directorate of Economics and Statistics, Department of Agriculture, Cooperation and Farmers Welfare.
7. Pattanayak A, Ngachan SV, Mohanty AK. 2011. Status Paper on Rice in North East India. Rice Knowledge Management Portal (RKMP), Directorate of Rice Research, Rajendranagar, Hyderabad-500 030.
8. Anonymous. 2012. FAO. FAOSTAT. Database collection of primary crops.
9. Singh DK, Gupta S, Nanda G, Sharma Y, Singh VV, Bisarya D. 2017. Evaluation of rice varieties for yield under organic farming in tarai region of Uttarakhand, India. *International Journal of Current Microbiology and Applied Sciences* 6(4): 734-738.
10. Pillai SP, Geethakumari VL, Sheeba RI. 2007. Balance-sheet of soil nitrogen in rice (*Oryza sativa*)-based cropping systems under integrated nutrient management. *Indian Journal of Agronomy* 52(1): 16-20.
11. Atiyeh RM, Lee S, Edwards CA, Arancon NQ, Metzger JD. 2002. The influence of humic acids derived from earthworms-processed organic wastes on plant growth. *Bioresource Technology* 84: 7-14.
12. Chaoui I, Zibiliske M, Ohno T. 2003. Effects of earthworm casts and compost on soil microbial activity and plant nutrient availability. *Soil Biology and Biochemistry* 35: 295-302.
13. Thirunavukkarasu M, Vinoth R. 2013. Influence of vermicompost application along with nitrogen on growth, nutrients uptake, yield attributes and economics of rice (*Oryza sativa* L.). *International Journal of Agriculture, Environment and Biotechnology* 6(4): 599-604.
14. Hiradeve PN, Deotale RD, Deogirkar MS, Gaikwad B. 2011. Effectivity of foliar sprays of vermicompost wash on chemical, biochemical, yield and yield contributing parameters of groundnut (*Arachis hypogeae* L.). *Journal of Soils and Crops* 21(2): 266-272.
15. Asadipour M, Haidi MRHS. 2013. Influence of vermicompost and plant density on some morphological traits and biological yield of mungbean (*Vigna radiata*). *International Research Journal of Applied and Basic Sciences* 5(3): 319-323
16. Nainawatt. 1997. Vermitechnological studies on organic studies on solid waste management. *Ph. D. Thesis*, Rajasthan University, India.
17. Kale RD, Bano K. 1986. *Proceedings of National Seminar on Organic waste Utilization*. pp 151-160.
18. Roy DK, Singh BP. 2006. Effect of level and time of N application with and without vermicompost on yield, yield attributes and quality malt barley. *Indian Journal of Agronomy* 51(1): 40-42.
19. Sudha B, Chandini S. 2003. Vermicompost - a potential organic manure for rice. *Intensive Agriculture* 40: 1-2.
20. Tomati U, Grappelli A, Galli E, Rossi W. 1991. Fertilizers from vermiculture as an option for organic waste recovery. *Agrochemical* 27: 244-251.
21. Angadi VV, Radder GD. 1996. Organic Farming and Sustainable Agriculture. National Seminar, G.B. Pant University of Agriculture and Technology, Pantnagar. pp 34.
22. Murali MK, Setty RA. 2000. Effect of levels of NPK, vermicompost and growth regulator (Triacontanol) on growth and yield of scented rice. (*Oryza sativa* L.). *Mysore Journal of Agricultural Sciences* 34: 335-339.
23. Jeyabal A, Kuppuswamy G. 2001. Recycling of organic wastes for the production of vermicompost and its response in rice–legume cropping system and soil fertility. *European Journal of Agronomy* 15(3): 153-170.
24. Bora D, Goswami J, Saud RK, Begum M. 2014. Effect of organic inputs on production and quality of scented rice variety *Keteki joha* in Assam and its economic aspect *Agricultural Science Digest* 34(2): 115-118.