E-ISSN: 2618-0618
P-ISSN: 2618-060X

www.agronomyjournals.com
2024; SP-7(10): 519-522
Received: 09-06-2024
Accepted: 15-07-2024

Kavitha
M.Sc. Scholar, Department of Agronomy, University of Agricultural Sciences, Bangalore, Karnataka, India

Seenappa C
Professor, Department of Agronomy, University of Agricultural Sciences, Bangalore, Karnataka, India

Saralakumari J
Professor, Department of Soil Science and Agricultural Chemistry, University of agricultural sciences Bangalore, Karnataka, India

Sushma HA
Ph.D. Scholar, Department of Agronomy, University of Agricultural Sciences, Bangalore, Karnataka, India

Santosh Araganji
M.Sc. Scholar, Department of Agronomy, University of Agricultural Sciences, Bangalore

Shwetha GV
M.Sc. Scholar, Department of Sericulture, University of Agricultural Sciences, Bangalore, Karnataka, India

Corresponding Author:
Kavitha
M.Sc. Scholar, Department of Agronomy, University of Agricultural Sciences, Bangalore, Karnataka, India

Influence of nano fertilizers on productivity and profitability of aerobic rice in Eastern dry zone of Karnataka

Kavitha, Seenappa C, Saralakumari J, Sushma HA, Santosh Araganji and Shwetha GV

DOI: https://doi.org/10.33545/2618060X.2024.v7.i10Sh.1832

Abstract
A field experiment was conducted at Agronomy Field Unit, Zonal Agricultural Research Station, University of Agricultural Sciences, Gandhi Krishi Vigyan Kendra, Bengaluru, Karnataka, India during *kharif* season 2023 in Randomised Complete Block Design with thirteen treatments and replicated thrice. A field experiment was conducted to assess the effect of foliar application of nano urea, nano DAP and nano potash at tillering and panicle initiation stage on productivity and profitability of aerobic rice. The results revealed that the treatment T_{11} (100% RDF + nano urea, nano DAP and nano potash each @ 6 ml L^{-1}) recorded significantly higher grain yield (5054 kg ha^{-1}), straw yield (5453 kg ha^{-1}), net returns (Rs. 65597 ha^{-1}) and B:C ratio (2.27) followed by treatment T_8 (100% RDF + nano urea, nano DAP and nano potash each @ 4 ml L^{-1}). The nano fertilizers improves growth, yield, soil health and nutritional quality of the produce due to higher absorption rate, utilization efficiency and minimum losses.

Keywords: Aerobic rice, nano urea, DAP, potash, productivity and profitability

Introduction
Rice is the most essential crop for millions of farmers who grown it on 166.20 m ha worldwide. It feeds more than 60 percent population of India. The world's population is predicted to surpass 9.7 billon by 2050, necessitating a 60 percent increase in food production (Anon., 2021) [1]. Several technologies have been in use for decades to boost paddy yield. The aerobic rice is a renowned methodology that has demonstrated and encouraging results in India. To satisfy future food demands, it is necessary to lower production costs while boosting productivity. The aerobic rice is the method of cultivation of rice under aerobic situation which is characterized by aerated soil environment during the entire period of crop growth (Jana *et al.*, 2018) [6]. The aerobic rice production is a revolutionary way of growing rice in well-drained, non-puddled and unsaturated soils without ponded water. This system uses input responsive specialized rice cultivars and complementary management practices to achieve atleast 4 to 6 t ha^{-1} using only 50 to 70 percent of water required for irrigated rice production (Bhattarai *et al.*, 2005) [4]. The aerobic rice is developed by combining drought tolerance upland rice and yield potential of lowland rice so aerobic rice is 'improved upland rice' in terms of yield potential and 'improved low land rice' in terms of drought tolerance. It is a rice growing in aerobic soil, with the use of external inputs such as supplementary irrigation, fertilizers and aiming at higher yield. It is the better remedy for future climate change under drought condition with lesser greenhouse gas (GHG) emission due to unsaturated conditions, aerobic rice emits lesser methane (CH_4) gas into the atmosphere, thus keeping the environment safe besides water saving. The precise nutrient management is important in enhancing the productivity of aerobic rice. The balanced fertilizers application from the beginning of crop growth is utmost important to minimize the nutrient losses of applied fertilizers and achieve a better productivity of the aerobic rice. The new solution is needed to increase productivity and profitability of aerobic rice. The nanotechnology has the ability to manage the release of chemical fertilizers and the ability to govern plant growth and increase the yield target that promotes productivity of the crop while ensuring environmental safety.

The nano fertilizers can improve productivity of the crop by enhancing the rate of seed germination, seedling growth, photosynthetic activity and nitrogen metabolism because of their positive effects on crop nutrition, plant can uptake nutrients rapidly, penetration into cells and transport within plant tissues, nano fertilizers are more efficient than traditional fertilizers. Hence, this research aims to assess the potential of nano fertilizers interms of productivity and profitability of aerobic rice.

Material and Methods

The field experiment was conducted at the Agronomy Field Unit, Zonal Agricultural Research Station, University of Agricultural Sciences, Gandhi Krishi Vigyan Kendra, Bengaluru. The experimental site was situated in the Eastern Dry Zone (Agro Climatic Zone V) of Karnataka which was located between 12º 58' North latitude and 77º 33' East longitude at an altitude of 930 m above mean sea level. The study area received 557 mm of precipitation during the *kharif* 2023. The experiment involved thirteen treatments, replicated thrice in Randomized Complete Block Design and soil was red sandy. The seeds of the KMP-175 aerobic rice variety, developed by the University of Agricultural Sciences, Bangalore, were hand-dibbled at a rate of one seed per hill, maintaining a spacing of 30 cm between and within rows, with a seed rate of 5 kg ha^{-1}. After sowing, the seeds were immediately covered by using a wooden plank. The farmyard manure was applied 15 days prior to sowing at the rate of 10 t ha^{-1} across all treatment plots. The fertilizers were applied according to recommendations (100:50:50 kg of N:P_2O_5:K_2O ha^{-1}), with 50% of nitrogen (N) and the full doses of phosphorus (P_2O_5) and potassium (K_2O) applied as basal, while the remaining 50% of nitrogen was applied at 45 days after sowing (DAS). All plots received an initial irrigation of 5 cm depth immediately after sowing, irrigation was given every 5 days interval throughout the crop growth period and adjusting irrigation based on rainfall as needed.

The treatments included in the experiment were T_1 (100% RDF), T_2 (100% RDF + Nano urea @ 2 ml L^{-1}), T_3 (100% RDF + Nano DAP @ 2 ml L^{-1}), T_4 (100% RDF + Nano potash @ 2 ml L^{-1}), T_5 (100% RDF + Nano urea, Nano DAP and Nano potash each @ 2 ml L^{-1}), T_6 (75% RDF + Nano urea, Nano DAP and Nano potash each @ 2 ml L^{-1}), T_7 (50% RDF + Nano urea, Nano DAP and Nano potash each @ 2 ml L^{-1}), T_8 (100% RDF + Nano urea, Nano DAP and Nano potash each @ 4 ml L^{-1}), T_9 (75% RDF + Nano urea, Nano DAP and Nano potash each @ 4 ml L^{-1}), T_{10} (50% RDF + Nano urea, Nano DAP and Nano potash each @ 4 ml L^{-1}), T_{11} (100% RDF + Nano urea, Nano DAP and Nano potash each @ 6 ml L^{-1}), T_{12} (75% RDF + Nano urea, Nano DAP and Nano potash each @ 6 ml L^{-1}) and T_{13} (50% RDF + Nano urea, Nano DAP and Nano potash each @ 6 ml L^{-1}).

Results and Discussion

Productivity of aerobic rice

The data on grain yield, straw yield and test weight of aerobic rice were presented in the Table 1 and Fig. 1. The signficantly higher grain yield (5054 kg ha^{-1}) and straw yield (5453 kg ha^{-1}) of aerobic rice were recorded with the application of 100% RDF along with two foliar sprays of nano urea, nano DAP and nano potash each at the rate of 6 ml L^{-1} which was on par with the application of 100% RDF + nano urea, nano DAP and nano potash each @ 4 ml L^{-1}. The significantly lower grain yield (4305 kg ha^{-1}) and straw yield (4784 kg ha^{-1}) of aerobic rice were recorded with the application of 100% RDF only. The test weight of aerobic rice was found non significant.

The foliar application of nano fertilizers significantly increased the productivity of aerobic rice. The higher grain yield was attributed to significantly higher growth parameters and yield attributes of aerobic rice and also increase in grain yield might be due to the combined application of normal and nano urea, nano DAP and nano potash which ensured optimum and balanced nutrient availability throughout the crop period. The better NPK status of plant at reproductive stage consequent to increasing availability of nutrients to the crop to maintaine complimentary source sink relationship because of the increasing NPK fertilization improved growth, photosynthesis and yield components of aerobic rice. These findings were supported by Attri *et al.* (2022) [2] and Rathnayaka *et al.* (2018) [8]. The combined application of both normal and nano fertilizers which facilitated greater availability of nutrients for the development of vegetative structures, photosynthetic activity, acceleration of the respiration process, hormonal growth responses and increasing penetration in plant cell membrane division, number of grains, dry matter accumulation, nutrinet uptake, improved translocation of photosynthates from source to sink and partitioning which resulted in higher grain yield and straw yield of aerobic rice. Similar observations were also reported by Benzon *et al.* (2015) [3], Jassim *et al.* (2019) [5] and Sahu *et al.* (2022) [9].

Profitability of aerobic rice

The data on economic analysis of aerobic rice was presented in the Table 2 and Fig. 2. The higher cost of cultivation (Rs. 51391 ha^{-1}), gross returns (Rs. 116988 ha^{-1}), net returns (Rs. 65597 ha^{-1}) and B:C ratio (2.27) were recorded with the application of 100% RDF along with foliar sprays of nano urea, nano DAP and nano potash each at the rate of 6 ml L^{-1}. The analysis of economics factors like cost of cultivation, gross returns, net returns and B:C ratio were important to evaluate the effect of the treatment from practical point of view to the farming community. The grain yield of aerobic rice was major factor which caused differences in net income and net returns per rupees invested. These findings were supported by Kumar *et al.* (2018) [7] and Saud *et al.* (2022) [10].

Numerically higher cost of cultivation (Rs. 51391 ha^{-1}) of aerobic rice was recorded with the application of 100 percent RDF along with foliar sprays of nano urea, nano DAP and nano potash each at the rate of 6 ml L^{-1} due to higher cost of these fertilizers and additional investment on their application. The higher gross returns (Rs. 116988 ha^{-1}) of aerobic rice was attained with the application of 100 percent RDF along with foliar sprays of nano urea, nano DAP and nano potash each at the rate of 6 ml L^{-1} due to higher yield levels of aerobic rice was obtained in this treatment compared to other treatment. However, higher net returns and B:C ratio (Rs. 65597 ha^{-1} and 2.27, respectively) of aerobic rice were observed with the application of 100 percent RDF along with foliar sprays of nano urea, nano DAP and nano potash each at the rate of 6 ml L^{-1} compared to other treatments.

Table 1: Effect of foliar application of nano urea, nano DAP and nano potash on grain yield (kg ha^{-1}), straw yield (kg ha^{-1}) and test weight (g) of aerobic rice at harvest

Treatments	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Test weight (g)
T_1 = 100% RDF	4305	4784	19.57
T_2 = 100% RDF + Nano urea @ 2 ml L^{-1}	4675	4882	20.38
T_3 = 100% RDF + Nano DAP @ 2 ml L^{-1}	4563	4828	20.21
T_4 = 100% RDF + Nano potash @ 2 ml L^{-1}	4523	4802	20.17
T_5 = 100% RDF + Nano urea, Nano DAP and Nano potash each @ 2 ml L^{-1}	4738	4907	20.24
T_6 = 75% RDF + Nano urea, Nano DAP and Nano potash each @ 2 ml L^{-1}	4502	4897	20.07
T_7 = 50% RDF + Nano urea, Nano DAP and Nano potash each @ 2 ml L^{-1}	4406	4876	19.82
T_8 = 100% RDF + Nano urea, Nano DAP and Nano potash each @ 4 ml L^{-1}	4887	4997	20.56
T_9 = 75% RDF + Nano urea, Nano DAP and Nano potash each @ 4 ml L^{-1}	4713	4882	20.45
T_{10} = 50% RDF + Nano urea, Nano DAP and Nano potash each @ 4 ml L^{-1}	4686	4866	19.94
T_{11} = 100% RDF + Nano urea, Nano DAP and Nano potash each @ 6 ml L^{-1}	5054	5453	20.78
T_{12} = 75% RDF + Nano urea, Nano DAP and Nano potash each @ 6 ml L^{-1}	4696	4867	20.49
T_{13} = 50% RDF + Nano urea, Nano DAP and Nano potash each @ 6 ml L^{-1}	4603	4846	20.05
F-test	*	*	NS
SEm±	73.53	158.69	0.56
CD @ 5%	216.61	472.17	-

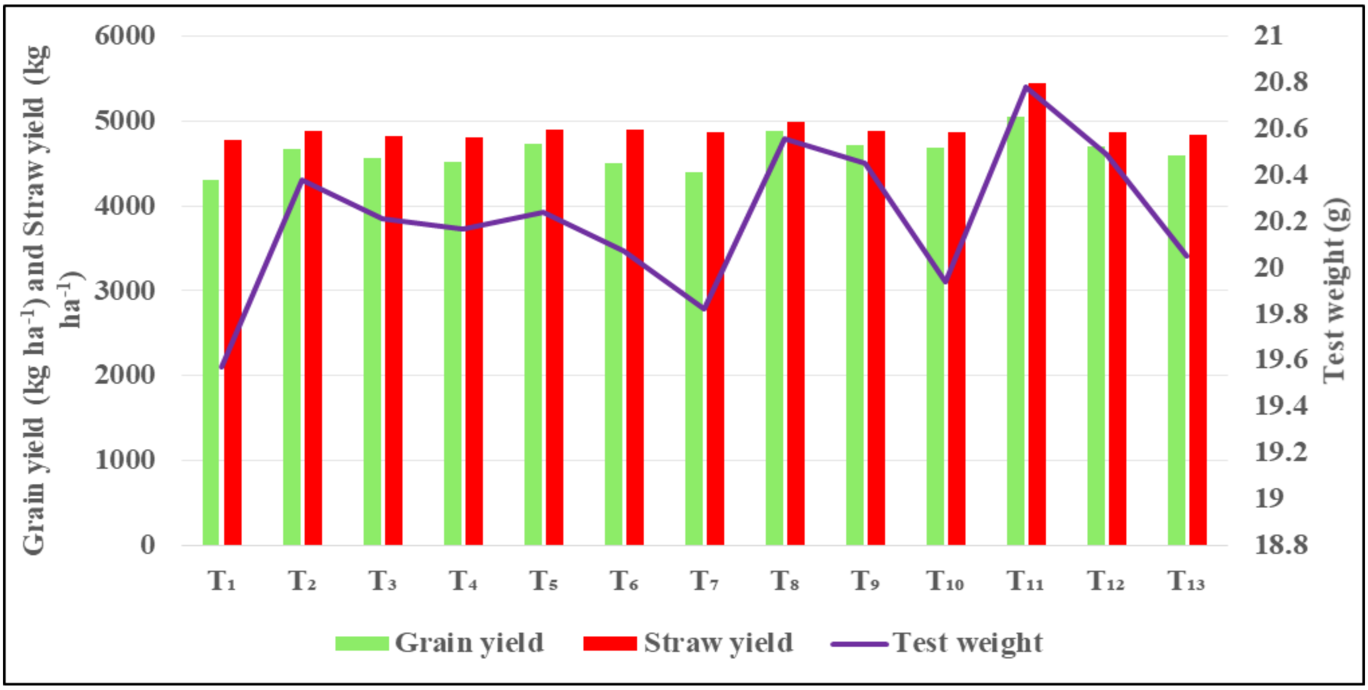

Fig 1: Grain yield (kg ha^{-1}), straw yield (kg ha^{-1}) and test weight (g) of aerobic rice as influenced by foliar application of nano urea, nano DAP and nano potash

Table 2: Effect of foliar application of nano urea, nano DAP and nano potash on profitability of aerobic rice cultivation

Treatments	Cost of cultivation (Rs. ha^{-1})	Gross returns (Rs. ha^{-1})	Net returns (Rs. ha^{-1})	B:C ratio
T_1 = 100% RDF	43741	90010	46269	2.05
T_2 = 100% RDF + Nano urea @ 2 ml L^{-1}	44191	94285	50094	2.13
T_3 = 100% RDF + Nano DAP @ 2 ml L^{-1}	44941	94386	49445	2.10
T_4 = 100% RDF + Nano potash @ 2 ml L^{-1}	44641	93006	48365	2.08
T_5 = 100% RDF + Nano urea, Nano DAP and Nano potash each @ 2 ml L^{-1}	46291	103096	56805	2.22
T_6 = 75% RDF + Nano urea, Nano DAP and Nano potash each @ 2 ml L^{-1}	45018	98044	53026	2.17
T_7 = 50% RDF + Nano urea, Nano DAP and Nano potash each @ 2 ml L^{-1}	43745	93932	50187	2.14
T_8 = 100% RDF + Nano urea, Nano DAP and Nano potash each @ 4 ml L^{-1}	48841	109814	60973	2.25
T_9 = 75% RDF + Nano urea, Nano DAP and Nano potash each @ 4 ml L^{-1}	47568	103986	56418	2.18
T_{10} = 50% RDF + Nano urea, Nano DAP and Nano potash each @ 4 ml L^{-1}	46295	100192	53897	2.15
T_{11} = 100% RDF + Nano urea, Nano DAP and Nano potash each @ 6 ml L^{-1}	51391	116988	65597	2.27
T_{12} = 75% RDF + Nano urea, Nano DAP and Nano potash each @ 6 ml L^{-1}	50118	110312	60194	2.20
T_{13} = 50% RDF + Nano urea, Nano DAP and Nano potash each @ 6 ml L^{-1}	48845	105666	56821	2.16

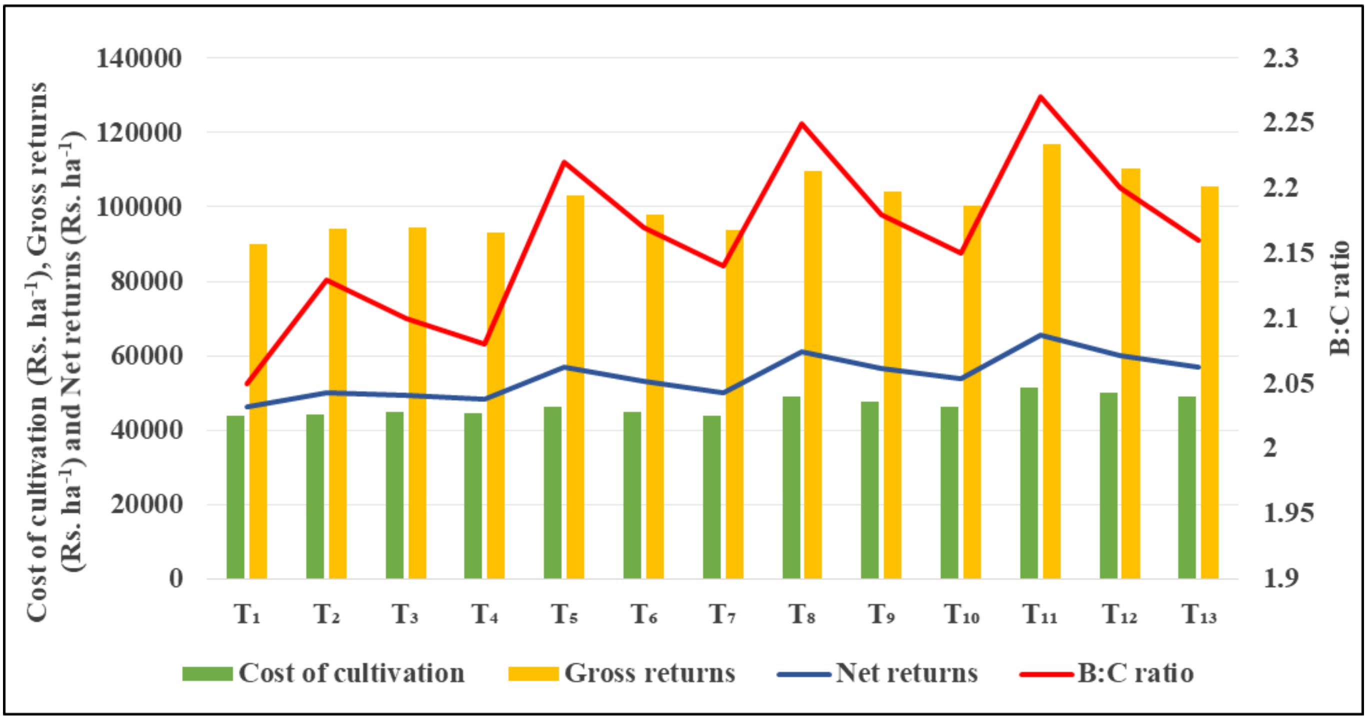

Fig 2: Cost of cultivation (Rs. ha^{-1}), gross returns (Rs. ha^{-1}), net returns (Rs. ha^{-1}) and B:C ratio of aerobic rice as influenced by foliar application of nano urea, nano DAP and nano potash

Conclusion

From this study, it can be concluded that combined application of normal and nano urea, nano DAP and nano potash improved the productiivty and profitability of aerobic rice. The grain yield, straw yield, gross returns, net returns and B:C ratio were higher with the application of 100% RDF along with two foliar sprays of nano urea, nano DAP and nano potash each at the rate of 6 ml L^{-1} at tillering and panicle initiation stage given better productivity and profitability of aerobic rice.

References

1. Anonymous. Area, production and productivity of rice in India and World, c2021. www.faostat.org.
2. Attri M, Sharma N, Sharma BC. Effect of foliar application of nano urea on productivity and profitability of fine rice under irrigated subtropics of Jammu region. Indian Journal of Ecology. 2022;49(5):1935-1938.
3. Benzon HL, Rubenecia MU, Ultra JR, Lee SC. Nano fertilizers affects the growth, development and chemical properties of rice. International Journal of Agronomy and Agricultural Research. 2015;7(1):105-117.
4. Bhattarai SP, Su NH, Midmore, DJ. Oxygation unlocks yield potentials of crops in oxygen-limited soil environment. Advances in Agronomy. 2005;88(1):313-377.
5. Jassim RH, Kadhem HN, Nooni GB. Impact of levels and time of foliar application of nano fertilizer (super micro plus) on some components of growth and yield of rice (*Oryza sativa* L.). The Pharm Innovation Journal. 2019;19(1):1279-1283.
6. Jana K, Karmakar R, Banerjee S, Puste AM. Aerobic rice cultivation system eco-friendly and water saving technology under changed climate. Agricultural Research and Technology Journal. 2018;13(2):1-5.
7. Kumar Y, Tiwari KN, Singh T, Sain NK, Laxmi S, Verma R. Nano fertilizers for enhancing nutrient use efficiency, crop productivity and economic returns in winter season crops of Rajasthan. Annals of Plant and Soil Research. 2020;22(4):324-335.
8. Rathnayaka RM, Iqbal YB, Rifnas LM. Influence of urea and nano nitrogen fertilizers on the growth and yield of rice (*Oryza sativa* L.) cultivar 'Bg 250'. International Journal of Research publications. 2018;5(2):7-7.
9. Sahu TK, Kumar M, Kumar N, Chandrakar T, Singh DP. Effect of nano urea application on growth and productivity of rice (*Oryza sativa* L.) under midland situation of Bastar region. The Pharma Innovation Journal. 2022;11(6):185-187.
10. Saud M, Joseph M, Hemalatha M, Rajakumar D, Jothimani S, Srinivasan S. Effect of bio organic fertilizers (BoF) with nano urea spray on nitrogen economy of rice. The Pharma Innovation Journal. 2022;11(7):4475-4480.