The Pharma Innovation Journal 2023; SP-12(12): 528-532

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; SP-12(12): 528-532

www.thepharmajournal.com
Received: 15-09-2023
Accepted: 18-10-2023

Dr. Ganesh K Gaikwad
Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India

Subham Kumar
Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India

Dr. Mahesh S Waghmare
Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India

Corresponding Author:
Dr. Ganesh K Gaikwad
Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India

Assessment of foliar application of nano urea with reduced RDF to paddy (*Oryza sativa* L.) crop grown on Ultisols of Jeypore of Odisha

Dr. Ganesh K Gaikwad, Subham Kumar and Dr. Mahesh S Waghmare

Abstract
Besides quantity and source, the method of nitrogen application is critical for maximizing the returns from applied fertilizer. Foliar application of nutrients improves nutrient use efficiency and reduces pollution in the environment. To evaluate the performance of foliar application of nano urea on rice growth and yield during *Kharif* 2021 experiment was laid out in Randomized Block Design with three replications. It consist total ten treatments *viz*. T_1-Control, T_2-100% RDF, T_3- 80% RDF with one foliar application of nano urea @ 3 ml/liter every 7 days, T_4- 70% RDF with one foliar application of nano urea @ 3 ml/liter every 7 days, T_5- 60% RDF with one foliar application of nano urea @ 3 ml/liter every 7 days, T_6- 50% RDF with one foliar application of nano urea @ 3 ml/liter every 7 days, T_7-80% RDF with one foliar application of nano urea @ 3 ml/liter every 14 days, T_8- 70% RDF with one foliar application of nano urea @ 3 ml/liter every 14 days, T_9- 60% RDF with one foliar application of nano urea @ 3 ml/liter every 14 days and T_{10}- 50% RDF with one foliar application of nano urea @ 3 ml/liter every 14 days. Data indicated that application of treatment T_3 (80% RDF + nano-urea @ 3 ml L^{-1} at every 7 days) significantly increases growth parameters such as plant height and number of tillers $hill^{-1}$. The foliar application of nano urea helps in easy absorption of nutrients which increases the maximum vegetative growth due to optimized nutrition of the plant. The treatment T_7 significantly increases the yield and yield parameters such as number of panicles $hill^{-1}$, panicles m^2, number of grains $panicle^{-1}$, grain yield and straw yield of paddy crop.

Keywords: Foliar application, nano urea, Nanofertilizer and rice

Introduction
The natural resources (soil, climate features and water) profoundly influence the cropping pattern, crop and crop productivity in specified region. Literally the lands for agriculture are under a threat due to multi-sectoral demand. There is a remote possibility of expanding agriculture to new areas in the country, contradictory observed that the per capita land availability decreased from 0.48 ha in 1951 to 0.26 ha in 1981 and has further decreased to 0.12 ha during 2019. It is therefore imperative that the land resources need to be interpreted in terms of their suitability for different agricultural uses with a view to maximize production of food, fuel and fiber. Rice (*Oryza sativa* L.) is the main staple food for over half the population worldwide. Worldwide, rice is the agricultural commodity with the second-highest worldwide production, with about 520.5 mt produced in 2022 (Anonymous-2022) [4]. Rice is produced in about 120 countries worldwide, but China (about 149.0 Mmt) and India (about 122.3 Mmt) together account for more than 50% of both rice production globally. In India rice is grown in 45.07Mha, the overall production is 122.27 Mt and the productivity is about 2713 kg ha^{-1} (Anonymous-2021) [3]. The highest productivity is 6710 kg ha^{-1} of China followed by Vietnam (5573 kg ha^{-1}), Indonesia (5152 kg ha^{-1}) and Bangladesh (4375 kg ha^{-1}) (Food and agriculture organization-2022). Rice is grown under diverse soil and climatic conditions the productivity level of rice is low compared to the productivity levels of many countries in the world. It is, therefore, there is ample scope to increase the productivity of rice in the country. There are improved technologies and various interventions which could be adapted to increase the productivity in the country.

Rice yield mostly relies on soil conditions and furthermore on the supply of the accessible nutrients like nitrogen, phosphorus, potassium, sulphur and zinc (Masum *et al.,* 2013) [15]. After carbon, hydrogen and oxygen, nitrogen (N) is one of the important elements in plants because of its key part in chlorophyll production, which is basic for the photosynthesis process. Also, nitrogen is part of different enzymatic proteins that catalyze and regulate plant-development processes (Shaygany *et al.*, 2012) [23]. Besides, nitrogen contributes to the generation of chemical components that secure against parasites and plant diseases (Datta, 1978) [8]. Among the nutrients, nitrogen is the kingpin in rice farming (Alam *et al.*, 2010) [1] for crop growth and development. Nitrogen is an essential constituent of chlorophyll and well-supplied nitrogen which enhanced crop growth vigorously (Dobermann and Fairhurst, 2000) [9]. On the contrary, nitrogen deficiency results reduced tillering (Peng *et al.*, 2007) [19]. At last, crop yield and biomass are profoundly affected by N fertilization (Alexander, 1985) [2]. The absorption patterns of applied nitrogen vary with growth stages. Unfortunately, N use efficiency in the wetland rice culture is very low, rarely exceeding 30-40% and more than 50% of the applied nitrogen is lost through denitrification, volatilization, leaching and runoff (Rana *et al.*, 1989) [20]. Nonetheless, soil N supply is often limited (Kumar *et al.*, 2017) [12], which forces farmers to increase the amount of N fertilizers in order to accomplish better crop yield. However, farmers may provoke nitrogen over fertilization, which effect optimum plant productivity (Shrestha *et al.*, 2020) [24], as plants are not able to absorb the excess of N-fertilizer.

Foliar application can improve nutrient utilization and lowers environment pollution through reducing the amount of fertilizers added to soil (Miah *et al.*, 2017) [16]. In many cases aerial spray of nutrients is preferred and gives quicker and better results than the soil application, which minimizes N losses (Hashem, 2019) [11]. Most plants absorb foliar applied urea rapidly and hydrolyze the urea in the cytosol (Nicoulaud and Bloom, 1996) [17]. In case of foliar feeding, nutrients are absorbed directly where they are needed, the rate of the photosynthesis in the leaves is increased, nutrient absorption by plant roots is stimulated and foliar nutrition applied at critical times.

Nanotechnology is the promising field with its extensive applications in biotechnology, pharmaceutical science, nano-medication and other research territories (Chandana *et al.*, 2021) [7]. Nanotechnology is the new innovation during late years and is working in all fields of agriculture. Nanofertilizers stand apart as one of the most helpful tools, because of their high productivity, functionalities, advantageous and simple applications. Nanofertilizer improve growth parameters of plants such as height of plants, leaf area, number of leaves per plant, increase in dry matter and chlorophyll, photosynthesis rate which outcome more translocation of photosynthates and production to various parts of the plant contrast to chemical fertilizers. Indian Farmers Fertiliser Cooperative Limited i.e. IFFCO is manufacturer of the worlds first revolutionary, innovative Nano-urea fertilizer production in the world, approved by the Government of India and included in the Fertilizer Control Order (FCO) also. A product with organic polymers and developed, patented by IFFCO i.e. Indian Farmers Fertilizer Cooperative Limited. Average physical size of Nano urea particles is in the range of 20-50 nm. Nano urea contains 4% nitrogen by weight in its nano form. Nitrogen present in Nano Urea effectively meets the crop nitrogen requirement. It has better use efficiency than conventional urea. Nano-urea is very effective for precise nutrient management in precision agriculture with matching the crop growth stage for nutrient and may provide nutrient throughout the crop growth period. Nano-Urea provide more surface area for different metabolic reactions in the plant which increase rate of photosynthesis and produce more dry matter and yield of the crop. Keeping all these efficient properties of innovative nitrogenous Indian fertilizer, research project was executed to increase rice productivity in the traditional rice growing belt of Orissa state of India.

Materials and Methods

The present field experiment was conducted during kharif season (25th July to 15th December 2021) in the farmers field at Jeypore, Orissa state of India. Geographically, Jeypore is located at 18°51′N 82°35′E / 18.85°N 82.58°E / 18.85; 82.58 with an average elevation of 659 m (2165 feet). The monsoon season in Jeypore brings about moderate rainfall and is mainly during the months of July, August, September and october months of year. The soils at Jeypore were slightly acidic in nature with pH from 4.5 to 6.0. The topography of experimental plot was leveled and soil was medium black in color with clayey fairly deep and well drained, well suited for paddy cultivation. The land was ploughed deep and was subsequently harrowed twice to achieve fine tilth. Soil was medium in organic carbon, poor in nitrogen, medium in available phosphorus, low in potassium and acidic in reaction. Paddy variety VNR 2318 was sown on 2nd August 2021. The seeds were sown in the nursery bed for further transplanting after 20 days after sowing. The total rainfall received during crop season was 1121.6 mm. The field experiment was laid out in Randomized Block Design with three replications. The ten treatments *viz*. T_1-control, T_2-100% RDF, T_3-80% RDF + nano-urea @ 3 ml L^{-1} at every 7 days, T_4-70% RDF + nano-urea @ 3 ml L^{-1} at every 7 days, T_5-60% RDF + nano-urea @ 3 ml L^{-1} at every 7 days, T_6-50% RDF + nano-urea @ 3 ml L^{-1} at every 7 days, T_7-80% RDF + nano-urea @ 3 ml L^{-1} at every 14 days, T_8-70% RDF + nano-urea @ 3 ml L^{-1} at every 14 days, T_9-60% RDF + nano-urea @ 3 ml L^{-1} at every 14 days and T_{10}-50% RDF + nano-urea @ 3 ml L^{-1} at every 14 days were allotted randomly to each replication as per the plot size. In order to record the observation on various growth characters at different growth stages, 5 plants were selected at random from each net plot. These selected plants were labeled for recording growth observations and harvested separately for assessing per plant yield attributes.

Results and Discussion

Effect of foliar application of nano nitrogen on plant height

The data on plant height of paddy crop influenced by foliar application of nano nitrogen are presented in Table 01. It shows that plant height of paddy was significantly influenced due to foliar application of nano urea at 30 DAS. The plant height varied from 30.95 cm to 34.79 cm. The significantly highest plant height (34.79 cm) was observed due to treatment T_3 (80% RDF + nano-urea @ 3 ml L-1 at every 7 days). Similar trend of results were recorded at 60, 90 and 120 DAS also. At harvest stage, plant height of paddy crop was significantly increased due to foliar application of nano urea, varied from 98.32 cm to 112.41 cm. The significantly highest plant height (112.41 cm) was observed due to treatment T_3 (80% RDF + nano-urea @ 3 ml L^{-1} at every 7 days). The effect of treatment T_3 was found significantly superior over the treatments T_1 Control (98.32 cm), T_2 100% RDF (104.16 cm), T_{10} 50% RDF + nano-urea @ 3 ml L^{-1} at every 14 days (106.89 cm), T_9 60% RDF + nano-urea @ 3 ml L^{-1} at every 14 days (107.20 cm), T_8 70% RDF + nano-urea @ 3 ml L^{-1} at every 7 days (107.58 cm), T_7 80% RDF + nano-urea @ 3 ml L^{-1} at every 14 days (108.08 cm), T_6 50% RDF + nano-urea @ 3 ml L^{-1} at every 7 days (108.51 cm), T_5 60% RDF + nano-urea @ 3 ml L^{-1} at every 7 days (109.27 cm) and treatment T_4 70% RDF + nano-urea @ 3 ml L-1 at every 7 days (110.03 cm). The minimum plant height was recorded with T_1 Control (98.32 cm).

Table 1: Effect of foliar application of nano nitrogen on plant height

Plant Height (in cm)						
Tr. no.	**Treatments**	**30 DAS**	**60 DAS**	**90 DAS**	**120 DAS**	**Harvest**
T_1	Control	30.95	46.45	69.81	90.72	98.32
T_2	100% RDF	32.30	49.62	74.13	98.51	104.16
T_3	80% RDF + nano-urea @ 3 ml L^{-1} at every 7 days	34.79	54.37	80.75	105.08	112.41
T_4	70% RDF + nano-urea @ 3 ml L^{-1} at every 7 days	34.02	53.41	79.35	104.17	110.03
T_5	60% RDF + nano-urea @ 3 ml L^{-1} at every 7 days	33.47	52.37	78.55	103.20	109.27
T_6	50% RDF + nano-urea @ 3 ml L^{-1} at every 7 days	33.64	53.31	78.31	103.59	108.51
T_7	80% RDF + nano-urea @ 3 ml L^{-1} at every 14 days	33.28	51.87	77.85	102.57	108.08
T_8	70% RDF + nano-urea @ 3 ml L^{-1} at every 14 days	33.67	51.57	77.95	102.09	107.58
T_9	60% RDF + nano-urea @ 3 ml L^{-1} at every 14 days	32.85	52.85	77.54	101.37	107.20
T_{10}	50% RDF + nano-urea @ 3 ml L^{-1} at every 14 days	33.12	51.79	77.29	101.35	106.89
SEm±		0.11	0.20	0.14	0.17	0.31
CD at 5%		0.34	0.60	0.429	0.50	0.93

From the data it was clearly observed that application of nano urea @ 3 ml lit-1 along with recommended dose of fertilizer showed significant increase in plant height than control and RDF alone. Significantly increase in paddy crop height was observed with reduced recommended dose of fertilizer (up to 20% reduction of RDF) with the application of nano urea @ 3 ml L^{-1} after every 7 days than control (no fertilizer application) and only RDF application treatment. It was also observed that the effect of nano urea application on paddy crop was slightly noticed till 35 days i.e., early vegetative stage. The strongly visible effect was noticed during 60 and 90 days after transplanting i.e., vegetative phase and reproductive stage. Comparatively, less effect was noticed at ripening stage i.e., after ripening stage. This effect of foliar application of nano urea on increased plant height might be due to the readily absorption of nutrients and its nano sized nitrogen particle, which has more surface area than that of a 1mm urea prills. Nano urea may easily enter through the stomata and other openings and is assimilated by the plant cells. It is easily distributed through phloem from source to sink inside the plant as per its requirement. Unutilized nitrogen is stored in the plant vacuole and is slowly released for proper growth and development of plant. Similar findings were reported by Manik *et al.* (2016) [14] who concluded that application of 50% of prilled urea along with 5 foliar spray of nitrogen @ 5.5 kg produced highest plant height. Miah *et al.* (2017) [16] reported that foliar application of urea can minimize nitrogen requirement of rice through better nitrogen use efficiency compared to urea top dressing. Ratnayaka *et al.* (2018) [21] found that plants treated with 100% Nano-N fertilizer produced maximum plant height as compared to no fertilizer treatment. Mahmoodi *et al.* (2020) [13] concluded that foliar application of nutrients at 75 and 90 days after transplanting recorded highest crop growth rate of 23% than control. Similarly, Hashem *et al.* (2019) [11] also reported that foliar application of NPK at different growth stages might have increased the plant height due to the fact that excess nutrient to rice might help for cell elongation and increase photosynthetic rate.

Table 2: Effect of foliar application of nano nitrogen on tillers and panicles

Tr. no.	Treatments	Average Number of tillers hill^{-1}	Average Number of panicles hill^{-1}	Panicle length (in cm)
T_1	Control	8.33	6.00	18.41
T_2	100% RDF	11.00	8.33	21.51
T_3	80% RDF + nano-urea @ 3 ml L^{-1} at every 7 days	17.00	11.67	23.77
T_4	70% RDF + nano-urea @ 3 ml L^{-1} at every 7 days	16.00	10.33	24.18
T_5	60% RDF + nano-urea @ 3 ml L^{-1} at every 7 days	15.67	10.00	24.19
T_6	50% RDF + nano-urea @ 3 ml L^{-1} at every 7 days	15.33	11.00	28.23
T_7	80% RDF + nano-urea @ 3 ml L^{-1} at every 14 days	16.00	12.33	30.53
T_8	70% RDF + nano-urea @ 3 ml L^{-1} at every 14 days	15.00	11.00	28.17
T_9	60% RDF + nano-urea @ 3 ml L^{-1} at every 14 days	14.67	10.67	27.18
T_{10}	50% RDF + nano-urea @ 3 ml L^{-1} at every 14 days	14.00	10.33	25.96
SEm±		0.50	063	0.19
CD at 5%		1.47	1.88	0.58

Effect of foliar application of nano nitrogen on Average Number of tillers and panicles

From the recorded data, it was concluded that foliar application of nano urea has significantly increased the number of tillers hill^{-1}. The significant increase in the paddy tillers hill^{-1} was observed with reduced recommended dose of fertilizer (up to 30% reduction of RDF) with the application of nano urea @ 3 ml L^{-1} after every 7 days than control (no fertilizer application) and only RDF application. It was also observed that application of reduced RDF (up to 20% reduced RDF with nano urea spray @ 3 ml L^{-1} after every 14 days also resulted in increase in the number tillers hill^{-1} than control and RDF alone. These increased tillers are positively chordate with increase in yield as compared to control and RDF alone.

This positive effect on increase in the number of tillers^{-1} might be due to the readily availability of nitrogen source through nano urea. Foliar application of nano technology is based on nano nitrogen which supply more amount of nutrients as compared with RDF alone. Its small size (20-50 nm) increases its availability to the crop by more than 80% which increased the number of tillers hill^{-1}. Similar findings were also reported by Alam *et al.* (2010) [1] who suggested that application of 94 kg of urea ha^{-1} along with foliar application of 3% urea can significantly increase the numbers of effective tillers hill^{-1}. Similarly, Pravin *et al.* (2013) [18] also reported that foliar application of nano nitrogen has enhanced the growth of number of tillers hill^{-1}. Ratnayaka *et al.* (2018) [21] reported that addition of fertilizer (Chemical or Nano or coordination of both) has increased the number of tillers of rice plants.

Increase in the number of panicles hill^{-1} was recorded with application of nano urea as nitrogen source/ replacement for recommended dose of fertilizer (RDF) through soil application. These increase in the number of tillers was significantly superior as compared with control and only RDF application. Significantly, highest panicle hill^{-1} was recorded with 20% reduction in the RDF with foliar application nano urea @ 3 ml L^{-1} at every 14 days interval. Similarly, with 70% RDF i.e., 30% saving of RDF and 60% RDF i.e., 40% savings of RDF with nano urea @ 3 ml L^{-1} at every 14 days interval also provide significantly higher panicles hill^{-1}. Application of 80% RDF i.e., saving of 20% RDF with foliar application of nano urea as nitrogen source @ 3 ml L^{-1} at every 7 days interval was also recorded significantly higher panicle hill^{-1}. Treatment T_3 i.e., 80% RDF + nano urea application at 7 days interval produced significantly highest tillers when it compared with panicles hill^{-1} production by same treatment was not significantly effective. As treatment T_4 and T_5 i.e., reduced 30% and 40% RDF respectively with foliar nano urea application was not able to produce significantly higher panicles hill^{-1}. Overall data indicates that application of nano urea at 14 days interval was beneficial as compared with 7 days interval application of nano urea as nitrogen source. This increased number of panicles hill^{-1} might be due to increased frequency and dosage of application of nano urea, the plants achieved vigorous vegetative growth due to increase in the photosynthetic activity of the plant. As foliar application of nano urea increased source and sink relation in paddy which enhanced uptake of easily available nutrients through stomata by plants might be the reason for more no of panicles hill^{-1}. Similar findings were also reported by Benzon *et al.* (2015) [6] who found that combination of nano fertilizer along with conventional fertilizer produced maximum number of reproductive tillers of rice plant. Similarly, Sahu *et al.* (2022) [22] also reported that application of 75% of RDN + two foliar spray of nano urea (AT and PI) produced maximum number of tillers as compared to other treatments.

Conclusion
From the data recorded conclusion can be drawn that foliar application of nano nitrogen improves growth parameters like plant height, leaf area and yield attributes parameters like number of tillers, number of panicles and panicle length of paddy crop. Foliar application of nano-urea @ 3 ml L^{-1} at every 7 days with 80% recommended dose of fertilizers (RDF) significantly increases growth parameters such as plant height and number of tillers hill^{-1}. The foliar application of nano urea helps in easy absorption of nitrogen which increases the maximum vegetative growth due to optimized nutrition of the paddy crop.

References

1. Alam SS, Moslehuddin AZM, Islam MR, Kamal AM. Soil and foliar application of nitrogen for boro rice (BRRIdhan 29). Journal of Bangladesh Agriculture University. 2010;8(2):199-202.
2. Alexander A. Foliar fertilization developments in plant and soil science. Martinus Nijhof Publishers. 1985;22:214-216.
3. Anonymous. Agricultural statistics at a glance, Government of India, Ministry of Agriculture & Farmers Welfare, Department of Agriculture & Farmers Welfare, © Government of India, PDES-265-(E); c2021. http://www.agricoop.nic.in/https://eands.dacnet.nic.in/PDF/Agricultural%20Statistics%20at%20a%20Glance%20-%202021%20(English%20version).pdf
4. Anonymous. Koraput district; c2022. (https://koraput.nic.in)
5. Anonymous. World Food and Agriculture-Statistical Yearbook, FAO. 2022. World Food and Agriculture – Statistical Yearbook 2022. Rome; c2022. https://doi.org/10.4060/cc2211en
6. Benzon HRL, Rubenecia MRU, Jr VUU, Lee SC. Nano-Fertilizer Affects the Growth, Development and Chemical Properties of Rice. International Journal of Agronomy and Agricultural Research. 2015;7:105-117.
7. Chandana P, Latha KR, Chinnamuthu CR, Malarvizhi P, Lakshmanan A. Impact of foliar application of nano nitrogen, zinc and copper on yield and nutrient uptake of rice. International Journal of Plant & Soil Science. 2021;33(24):276-282,
8. De Datta SK. Fertilizer Management for Efficient Use in Wetland Rice Soils. International Rice Research Institute Los Banos, Philippines. 1978;2(1):671-670.
9. Dobermann A, Fairhurst T. Rice; Nutrient Disorders and Nutrient Management. and book Series; c2000. p. 41-47, 155-157.
10. FAO; c2022. https://www.fao.org/publications/home/fao-flagship-publications/the-state-of-food-and-agriculture/en dt.02.11.2022.
11. Hashem IM. Studies on the Effect of foliar fertilizer application in combination with conventional fertilizers on rice production. J plant production, Mansoura Univ. 2019;10(6):447-452.
12. Kumar R, Singh A, Yadav RB, Kumar A, Kumar S, Shahi UP, *et al*. Growth, development and yield response of rice (*Oryza sativa* L.) as influenced by efficient nitrogen management under subtropical climatic condition. Journal Pharmacognosy and Phytochemistry. 2017;1:791-797.
13. Mahmoodi B, Morteza M, Eftekhari A, Mogadam NM. Effects of foliar application of liquid fertilizer on agronomical and physiological traits of rice (*Oryza sativa* L.). Acta Agrobotanica. 2020;73(3):2935-1491.
14. Manik IH, Abedin MA, Rahman MR, Chakrobarty T, Jaman SB, Noor MA, *et al*. Reducing urea demand for rice crop through foliar application of urea in boro season.Res. Agric. Livest. Fish. 2016;3(1):79-85.
15. Masum SM, Ali MH, Mandal MS, Chowdhury IF, Parveen K. The effect of nitrogen and zinc application on yield and some agronomic characters of rice cv. BRRI dhan 33. International Research Journal of Applied and

Basic Sciences. 2013;4:2256-2263.
16. Miah H, Anwar MP, Rahman MR, Hoshain S, Hossen K. Minimizing nitrogen requirement of rice through foliar spray of urea. Imperial journal of interdisciplinary research. 2017;3(12):2454-1362.
17. Nicoulaud BAL, Bloom AJ. Absorption and assimilation of foliarly applied urea in tomato. J Am. Soc. Hortic. Sci. 1996;121:1117.
18. Parvin S, Uddin S, Khanum S, Bhuiya MSU. Effect of Weeding and Foliar Urea Spray on the Yield and Yield Components of Boro Rice. International Journal of Sustainable Agriculture. 2013;5(2):44-49
19. Peng XL, Liu YY, Luo SG, Fan LC, Song TX, Guo Y, *et al*. Effects of site-specific nitrogen management on yield and dry matter accumulation of rice from cold areas of Northeastern China. Agricultural Sciences in China. 2007;6:715-723.
20. Rana S, Reddy G, Reddy K. Effect of levels and sources of nitrogen on rice. Indian Journal of agronomy. 1989;34:435-436.
21. Rathnayaka R, Mahendran, Iqbal S, Yudistira LM, Rifnas. 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):235-238.
22. 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.
23. Shaygany J, Peivandy N, Ghasemi S. Increased yield of direct seeded rice (*Oryza sativa* L.) by foliar fertilization through multi-component fertilizers. Archives of Agronomy and Soil Science. 2012;58(10):1091-1098.
24. Shrestha J, Kandel M, Subedi S, Shah KK. Role of Nutrients in Rice (*Oryza sativa* L.): A Review. Agrica. 2020;9:53-62.