The Pharma Innovation Journal 2023; 12(7): 2759-2762

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(7): 2759-2762

www.thepharmajournal.com
Received: 24-04-2023
Accepted: 28-05-2023

Sanjay Kumar
M.Sc. Scholar, Department of Agronomy, DKS College of Agriculture and Research Station, Bhatapara, IGKV Raipur, Chhattisgarh, India

Rajendra Lakpale
Professor, Department of Agronomy, College of Agriculture Raipur, IGKV Raipur, Chhattisgarh, India

Panch Ram Mirjha
Assistant Professor, Department of Section of Agronomy, DKS College of Agriculture and Research Station, Bhatapara, IGKV Raipur, Chhattisgarh, India

Satish Yadav
M.Sc. Scholar, Department of Agronomy, DKS College of Agriculture and Research Station, Bhatapara, IGKV Raipur, Chhattisgarh, India

Prashant Uraon
M.Sc. Scholar, Department of Agronomy, DKS College of Agriculture and Research Station, Bhatapara, IGKV Raipur, Chhattisgarh, India

Corresponding Author:
Sanjay Kumar
M.Sc. Scholar, Department of Agronomy, DKS College of Agriculture and Research Station, Bhatapara, IGKV Raipur, Chhattisgarh, India

Effect of levels and numbers of nano urea application with different fertilizer dose on productivity of rice (*Oryza sativa* L.) in Vertisols of Chhattisgarh

Sanjay Kumar, Rajendra Lakpale, Panch Ram Mirjha, Satish Yadav and Prashant Uraon

Abstract
The present investigation entitled "Effect of levels and numbers of nano urea application with different fertilizer dose on transplanted rice (*Oryza sativa* L.) in Vertisols of Chhattisgarh'' was conducted at Research Cum Instructional Farm, Dau Kalyan Singh College of Agriculture and Research Station, Bhatapara (C.G.) during *Kharif* season 2022, to find out the effect of levels and numbers of nano urea on growth and yield of rice. The treatment comprised of four nano urea application as main plot *viz*., N1: 4 ml 20 DAT, N_2: 8 ml 20 DAT, N_3: 4 ml 20 DAT + 4 ml 40 DAT and N_4: 8 ml 20 DAT + 8 ml 40 DAT with three fertilizers application treatment as sub plot *viz*., F1: Control, F2: 50% RDF and F3: 100% RDF. The experiment was laid out in split plot design with three replications. The yield attributes like number of tillers hill^{-1}, number of panicle hill^{-1}, panicle length (cm), number of grain panicle^{-1}, weight of 1000 grain (g), grain and straw yield (kg ha^{-1}) of rice were found significantly superior under treatment N_4: 8 ml 20 DAT + 8 ml 40 DAT followed by N_3: 4 ml 20 DAT + 4 ml 40 DAT. Among the fertilizer application, parameters cited above were recorded significantly higher in treatment F_3:100% RDF**.** N content in grain and straw, protein content, N-uptake and Nitrogen use efficiency were also recorded maximum in above treatments.

Keywords: Levels, nano urea, fertilizer dose, *Oryza sativa* L.

Introduction
The primary target of nanofertilizers in field of agronomy is to increase the plant yield efficiency and diminish losses of nutrients (Ingale *et al*., 2013) [3]. Nano-fertilizers with nano formulated particles can directely supply essential plant nutrients and can be delivered at the time and dose required by crops to the rhizosphere (Subramanian and Tarafdar, 2011) [10].
In this context, IFFCO introduced its nanotechnology-based product *i.e.*, Liquid Nano-Urea Fertilizer which is currently the best alternative to urea fertilizer. One bottle of nano-urea (500 ml) is equivalent to a bag of urea fertilizer (45 kg), 10% lower than a bag of conventional urea. It can bring down the import of urea fertilizers. One nano urea liquid particle is 30 nano meters in diameter, with 10,000 times higher surface area to volume size than normal granular urea. Subsidy burden to government; reduce transport & storage costs and usage of urea fertilizer subsequently to reduce the cost of nitrogen fertilizer. IFFCO claimed that nano-urea could raise yields by 8%.

Materials and Methods
The experiment was conducted at the Instructional Farm Dau Kalyan Singh College of Agriculture and Research Station Bhatapara (C.G.) during *Kharif* season 2022. The field had an even topography and good drainage system. The Experiment was laid out in Split Plot Design (SPD) with three replications. The treatment comprised of four nano urea application as main plot *viz*., N_1: 4 ml 20 DAT, N_2: 8 ml 20 DAT, N_3: 4 ml 20 DAT + 4 ml 40 DAT and N_4: 8 ml 20 DAT + 8 ml 40 DAT with three fertilizers application treatment as sub plot *viz*., F_1: control, F_2: 50% RDF and F_3: 100% RDF. Rice variety ''IGKVR-1" (Rajeshwari) was transplanted as a test crop on 30th July 2022.

Result and Discussion
Yield attributes
The significant effect of nano urea and fertilizer application was recorded on Number of

panicle hill^{-1}, Panicle length (cm), No. of grains panicle^{-1} and Test weight (g) of rice are presented in Table 1. Among the nano urea application treatments, the highest Number of panicles, Panicle length, No. of grains and Test weight was recorded 11.03 hill^{-1}, 23.49 cm, 152.4 panicle^{-1} and 30.23 g respectively in treatment N_4- 8 ml (20 DAT) + 8 ml (40 DAT), which was at par with treatment N_3- 4 ml (20 DAT) + 4 ml (40 DAT), including Number of panicle hill^{-1} (9.68), Panicle length (cm) (22.23), No. of grains panicle^{-1} (143.6), and Test weight (g) (29.50). On the other hand, the lowest Number of panicles, Panicle length, No. of grains and Test weight was observed in the control treatment N_1- 4 ml (20 DAT). The findings of this study demonstrate the significant influence of nano urea application treatments on rice yield parameters. Treatment N_4, with a higher application rate and two split doses, resulted in the highest values for all the measured parameters. This suggests that a higher dose of nano urea, combined with a split application at different growth stages, can effectively promote rice productivity. Similar results were also observed by Sahu *et al.* (2022) [9] and Gewaily *et al.* (2019) [2]. Among the fertilizer application treatments, treatment F_3- 100% RDF demonstrated the highest values for all measured yield parameters, including the number of panicles, panicle length, number of grains per panicle, and test weight. This indicates that providing the full recommended dose of fertilizer (RDF) significantly enhances rice yield. Still showed significant improvements in all yield parameters compared to the control treatment. The observed increases in yield parameters were statistically significant compared to other fertilizer treatments, underscoring the significance of proper fertilization practices in maximizing rice productivity. Also, similar results were reported by Jassim *et al.* (2019) [5] and Lahari *et al.* (2021) [6]. In conclusion, the study showed that nano urea application and fertilizer application have a significant effect on the Number of panicles, Panicle length, No. of grains and Test weight of rice. The results of the study suggest that the application of N_4- 8 ml (20 DAT) + 8 ml (40 DAT) and F_3- 100% RDF can be effective in increasing the Number of panicles, Panicle length, No. of grains and Test weight of rice.

Yield

Grain yield (Kg ha^{-1})

Among the nano urea application treatments, highest grain yield was recorded in treatment N_4- 8 ml (20 DAT) + 8 ml (40 DAT) (5611 kg ha^{-1}), which was at par with the treatment N_3- 4 ml (20 DAT) + 4 ml (40 DAT) (4867 kg ha^{-1}). On the other hand, the lowest grain yield was observed in the treatment N_1- 4 ml (20 DAT) (3989 kg ha^{-1}). The higher grain yield observed in treatments N_4 and N_3 can be attributed to the effective application of nano urea at specific growth stages. The doses of nano urea in treatments N_4- 8 ml (20 DAT) + 8 ml (40 DAT) and N_3- 4 ml (20 DAT) + 4 ml (40 DAT) likely provided a continuous and balanced supply of nutrients, resulting in increased crop growth and productivity. In contrast, the control treatment lacked the additional nutrient supplementation provided by nano urea, leading to lower yields. The results emphasize the importance of proper nutrient management through nano urea application for maximizing rice yield and optimizing harvest quality. The finding of present study is in accordance with those of Midde and Ferumal (2021) [7] and Valojai *et al.* (2021) [12]. Regarding the fertilizer application (F), in the treatment the highest grain yield index was recorded in treatment F_3- 100% RDF (5668 kg ha^{-1}). And the increase was statistically significant compared to other fertilizer treatments. Treatment F_3- 100% RDF also showed significant increases in yield parameters compared to the control treatment, indicating the importance of providing a substantial amount of fertilizer. The control treatment, lacking fertilizer application, exhibited the lowest yields. These findings highlight the critical role of proper fertilizer application in optimizing rice yield. The interaction effect between nano urea and fertilizer application on grain yield of rice was found significant. The results obtained in the present study are supported by the works of Valojai *et al.* (2021) [12] and Rathore *et al.* (2022) [8].

Straw yield (Kg ha^{-1})

Among the nano urea application treatments, highest straw yield was recorded in treatment N_4- 8 ml (20 DAT) + 8 ml (40 DAT) (7236 kg ha^{-1}) which was at par with the treatment N_3- 4 ml (20 DAT) + 4 ml (40 DAT) (6846 kg ha^{-1}). On the other hand, the lowest straw yield was observed in the treatment N_1- 4 ml (20 DAT) (5644 kg ha^{-1}). The controlled release of nitrogen in these treatments promoted vigorous plant growth, resulting in higher straw yields. Conversely, the lowest straw yield in the control treatment N1- 4 ml (20 DAT) suggests that the absence of nano urea limited nutrient supply, leading to reduced straw production. The finding of present study is in accordance with those of Midde and Ferumal (2021) [7] and Valojai *et al.* (2021) [12]. Regarding the fertilizer application (F), in the treatment the highest straw yield was recorded in treatment F_3- 100% RDF (7492 kg ha^{-1}). On the other hand, the lowest straw yield was observed in the control treatment F_1- Control (5242 kg ha^{-1}). The treatment F_3- 100% provided optimal nutrient supply, promoting vigorous plant growth and resulting in higher straw yields. Conversely, the lowest straw yield in the control treatment F_1- Control suggests that the absence of fertilizer severely limited straw production. The interaction effect between nano urea and fertilizer application on straw yield of rice was found significant. The results obtained in the present study are supported by the works of Valojai *et al.* (2021) [12] and Rathore *et al.* (2022) [8].

Biological Yield (Kg ha^{-1})

Among the nano urea application treatments, highest biological yield was recorded in treatment N_4- 8 ml (20 DAT) + 8 ml (40 DAT) (12847 kg ha^{-1}) which was at par with the treatment N_3- 4 ml (20 DAT) + 4 ml (40 DAT) (11833 kg ha^{-1}). On the other hand, the lowest biological Yield was observed in the treatment N_1- 4 ml (20 DAT) (9633 kg ha^{-1}). The finding of present study is in accordance with those of Midde and ferumal (2021) [7] and Valojai *et al.* (2021) [12].

Regarding the fertilizer application (F), in the treatment the highest biological Yield was recorded in treatment F_3- 100% RDF (13159 kg ha^{-1}). On the other hand, the lowest biological yield was observed in the treatment F_1- Control (8508 kg ha^{-1}). The interaction effect between nano urea and fertilizer application on biological yield of rice was found significant. The results obtained in the present study are supported by the works of Valojai *et al.* (2021) [12] and Rathore *et al.* (2022) [8].

Harvest index (%)

Among the nano urea application treatments, highest harvest index was recorded in treatment N_4- 8 ml (20 DAT) + 8 ml (40 DAT) (43.76%) which was at par with the treatment N_3- 4

ml (20 DAT) + 4 ml (40 DAT) (40.53%). On the other hand, the lowest harvest index was observed in the treatment N_1- 4 ml (20 DAT) (40.95%). The higher harvest index observed in treatments N_4 and N_3 can be attributed to the effective application of nano urea at specific growth stages.

Regarding the fertilizer application (F), in the treatment the highest harvest index was recorded in treatment F_3- 100% RDF (43.15%). On the other hand, the lowest harvest index was observed in the control treatment F_1- Control (38.09%). Treatment F_3- 100% RDF also showed significant increases in yield parameters compared to the control treatment, indicating the importance of providing a substantial amount of fertilizer. The interaction effect between nano urea and fertilizer application on harvest index of rice was found significant. The results obtained in the present study are supported by the works of Valojai *et al.* (2021) [12] and Rathore *et al.* (2022) [8].

Plant Chemical analysis

Nitrogen content in grain and straw

Among the nano urea application treatments, highest nitrogen content in grain and straw was recorded 1.10% and 0.65% respectively in treatment N_4- 8 ml (20 DAT) + 8 ml (40 DAT), which was at par with treatment N_3- 4 ml (20 DAT) + 4 ml (40 DAT), including nitrogen content in grain and straw was recorded 1.07% and 0.62% respectively. While the lowest nitrogen content in grain and straw was observed 1.03 and 0.55 respectively in the treatment N_1- 4 ml (20 DAT). Among the fertilizer application treatments, the highest Nitrogen content in grain and straw was recorded in treatment F_3- 100% RDF, 1.10% and 0.65% respectively, which was at par with the treatments F_2- 50% RDF at Nitrogen content in grain (%) (1.07%). While the lowest Nitrogen content in grain and straw was observed in the control treatment F_1- Control, 1.03 and 0.55 respectively. And the increase was statistically significant compared to other fertilizer treatments.

Protein % in grain

Among the nano urea application treatments, highest protein % in grain was recorded 6.90% respectively in treatment N_4- 8 ml (20 DAT) + 8 ml (40 DAT), which was at par with treatment N_3- 4 ml (20 DAT) + 4 ml (40 DAT) in grain was recorded 6.72% respectively. While the loest protein % in grain observed 6.46 respectively in the treatment N_1- 4 ml (20 DAT). Among the fertilizer application treatments, the highest nitrogen content in protein % in grain was recorded in treatment F_3- 100% RDF (6.87%). Which was at par with the treatments F_2- 50% RDF (6.70%). While the lowest protein % in grain was observed in the control treatment F_1- Control (6.48%).

Total N- uptake in grain and straw

The variations in nitrogen uptake in grain and straw among the different nano urea and fertilizer application treatments can be attributed to the nutrient levels provided to the rice plants. Treatment N_4- 8 ml (20 DAT) + 8 ml (40 DAT) and treatment N_3- 4 ml (20 DAT) + 4 ml (40 DAT) resulted in the highest nitrogen uptake, indicating that the specific application of nano urea at appropriate growth stages enhanced the uptake of nitrogen by the plants. Similarly, treatment F_3- 100% RDF and F_2- 50% RDF provided optimal fertilizer doses, resulting in higher nitrogen uptake. In contrast, the control treatments showed the lowest nitrogen uptake, reflecting the absence or inadequate nitrogen supply. These findings highlight the importance of proper nano urea and fertilizer application for enhancing nutrient uptake and ensuring optimal growth and productivity in rice crops. The finding of present study is in accordance with those of Barkha *et al.* (2019) [1] and Sahu *et al.* (2022) [9].

Nitrogen use efficiency of rice

Among the nano urea application treatments, highest nitrogen use efficiency was recorded 8.04 kg kg^{-1} in treatment N_4- 8 ml (20 DAT) + 8 ml (40 DAT), which was at par with treatment N_3- 4 ml (20 DAT) + 4 ml (40 DAT). While the lowest nitrogen use efficiency was observed 4.20% in the treatment N_1- 4 ml (20 DAT). Among the fertilizer application treatments, the highest nitrogen use efficiency was recorded in treatment F_3- 100% RDF (8.59 Kg kg^{-1}), which was at par with the treatments F_2- 50% RDF at nitrogen use efficiency (kg kg^{-1}) (8.50 kg kg^{-1}). While the lowest nitrogen use efficiency was observed in the control treatment F_1- Control (0%). The study showed that nano urea application and fertilizer application have a significant effect on the Nitrogen content in grain and straw, protein % in grain and nitrogen use efficiency of rice. The results of the study suggest that the application of N_4- 8 ml (20 DAT) + 8 ml (40 DAT) and F_3- 100% RDF can be effective in increasing the Nitrogen content in grain and straw, protein % in grain and nitrogen use efficiency of rice. The results obtained in the present study are supported by the works of Scholar, P.G. and Nagar (2021) [11], Rathore *et al.* (2022) [8], Sahu *et al*. (2022) [9].

Table 1: Number of panicles, Panicle length, No. of grains and Test weight of rice as influenced by nano urea and fertilizer applications.

Treatments	Number of panicle $hill^{-1}$	Panicle length (cm)	No. of Grains $panicle^{-1}$	Test weight (g)
Nano Urea Application				
N1- 4 ml (20 DAT)	7.21	20.78	126.9	28.07
N2- 8 ml (20 DAT)	8.36	21.26	135.2	29.07
N3- 4 ml (20 DAT) + 4 ml (40 DAT)	9.68	22.23	143.6	29.50
N4- 8 ml (20 DAT) + 8 ml (40 DAT)	11.03	23.49	152.4	30.23
SEm±	0.49	0.43	3.2	0.27
CD (0.05)	1.70	1.49	11.2	0.95
Fertilizer Application				
F1- Control	6.37	19.99	126.4	27.92
F2- 50% RDF	9.65	22.36	140.7	29.02
F3- 100% RDF	11.20	23.48	151.4	30.08
SEm±	0.51	0.35	2.3	0.32
CD (0.05)	1.52	1.06	6.9	0.96

Table 2: Grain yield, straw yield, biological yield and harvest index of rice as influenced by nano urea and fertilizer applications

Treatments	Grain yield (Kg ha^{-1})	Straw yield (Kg ha^{-1})	Biological yield (Kg ha^{-1})	Harvest Index (%)
Nano Urea Application				
N1- 4 ml (20 DAT)	3989	5644	9633	40.95
N2- 8 ml (20 DAT)	4348	6289	10636	40.47
N3- 4 ml (20 DAT) + 4 ml (40 DAT)	4867	6846	11833	40.53
N4- 8 ml (20 DAT) + 8 ml (40 DAT)	5611	7236	12847	43.76
SEm±	218	136	299	1.24
CD (0.05)	754	470	1036	NS
Fertilizer Application				
F1- Control	3267	5242	8508	38.09
F2- 50% RDF	5176	6778	12045	41.04
F3- 100% RDF	5668	7492	13159	43.15
SEm±	75	121	159	0.60
CD (0.05)	226	362	477	1.80

Table 3: Nitrogen content in grain and straw, protein % in grain, N-uptake and nitrogen use efficiency of rice as influenced by nano urea and fertilizer applications.

Treatments	N content in grain (%)	N content in straw (%)	Protein content in grain (%)	Total N-uptake kg ha^{-1}		NUE (Kg kg^{-1})
				Grain	Straw	
Nano Urea Application						
N1- 4 ml (20 DAT)	1.03	0.55	6.46	49.13	35.18	4.20
N2- 8 ml (20 DAT)	1.06	0.58	6.65	52.77	38.87	4.13
N3- 4 ml (20 DAT) + 4 ml (40 DAT)	1.07	0.62	6.72	58.71	44.09	6.43
N4- 8 ml (20 DAT) + 8 ml (40 DAT)	1.10	0.65	6.90	62.55	49.33	8.04
SEm±	0.01	0.01	0.06	1.57	1.26	1.71
CD (0.05)	0.03	0.03	0.22	5.44	4.35	NS
Fertilizer Application						
F1- Control	1.03	0.55	6.48	48.46	35.07	0
F2- 50% RDF	1.07	0.60	6.70	55.85	41.49	8.50
F3- 100% RDF	1.10	0.65	6.87	63.06	49.06	8.59
SEm±	0.01	0.01	0.07	1.09	0.96	1.18
CD (0.05)	0.03	0.02	0.21	3.25	2.88	3.54

Conclusion

Yield attributing and yield characters- Number of panicles, Panicle length, No. of grains panicle^{-1}, Test weight, grain yield, straw yield, biological yield was obtained under application of nano urea N_4- 8 ml (20 DAT) + 8 ml (40 DAT) and 100% Fertilizer application (F_3), and N_3 + F_3. N content in grain and straw, protein content, N-uptake and Nitrogen use efficiency were recorded highest in above treatments.

Hence, it can be concluded that application of nano urea @ 8 ml (20 DAT) + 8 ml (40 DAT) or N_3 with 100% fertilizer application is beneficial for higher rice productions.

Reference

1. Barkha R, Zalawadia NM, Buha D, Rushang K. Effect of different levels of chemical and nano nitrogenous fertilizers on content and uptake of N, P, K by sorghum crop cv. Gundari. J Pharmacogn Phytochem. 2019;8(5):454-458.
2. Gewaily EE, Ghoneim AM, Khattab EA. Nano-silicon and nitrogen foliar spray affects the growth, yield and nutrients content of rice. World Journal Agricultural Sciences. 2019;15(6):367-375.
3. Ingale AG, Chaudhari AN. Biogenic synthesis of nanoparticles and potential applications: an eco-friendly approach. J Nanomed Nanotechol. 2013;4(165):1-7.
4. IFFCO. World's 1st nano urea introduced by IFFCO for the farmers across the World. Public Relations Department, IFFCO. Press Release, May 31, 2021. http://iffco.in.IFFCO-Nano_press note-converted.pdf.
5. Jassim RAH, 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.). Plant Archives. 2019;19(1):1279-1283.
6. Lahari S, Hussain SA, Parameswari YS, Sharma KHS. Grain yield and nutrient uptake of rice as influenced by the nano forms of nitrogen and zinc. International Journal of Environment and Climate Change. 2021;11(7):1-6.
7. Midde SK, Ferumal MS. Evaluation of nano urea on growth and yield of rice (*Oryza sativa* L.). Chemical Science Review and Letters. 2021, ISSN:2278-6783.
8. Rathore R, Hasan A, David AA, Thomas T, Reddy IS. Effect of different levels of nano urea and conventional fertilizer on soil health of maize (*Zea mays* L.) Var, P3544 in an Inceptisols of Prayagraj, (UP) India, 2022.
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 baster region. The Pharma Innovation Journal. 2022;11(6):185-187.
10. Subramanian KS, Tarafdar JC. Prospects of nanotechnology in Indian farming. Indian J Agric Sci. 2011;81(10):887-893.
11. Scholar PG, Nagar A. Significance of Nano N, P, K and ZnSo4 fertilizers on soil fertility, nutrient uptake and yield of rice production; c2021.
12. Valojai STS, Niknejad Y, Amoli HF, Tari DB. Response of rice yield and quality to nano fertilizers in comparison with conventional fertilizers. Journal of Plant Nutrition. 2021;44(13):1971-1981.