The Andhra Agric. J 70 (2): 147-152, 2023
10.61657/aaj.2023.22

Effect of Nano Urea on Growth and Yield of Direct Seeded Rice in North Coastal Zone of Andhra Pradesh

M Masayya, B Jyothi Basu, S Jaffar Basha and K C Nataraja
Department of Agronomy, Agricultural College, Naira. 532 185

ABSTRACT

The field experiment was conducted in sandy clay loam soils to test the effect of nano urea on the performance of direct seeded rice (*Oryza sativa* L) during *kharif,* 2022 at Agricultural College Farm, Naira, Acharya N.G. Ranga Agricultural University, Andhra Pradesh. The experiment was laid out in randomized block design with seven treatments, which included the use of conventional and nano urea. The results revealed that the application of 1/3 RDN (40 kg N ha) through conventional urea as basal + three foliar sprays of nano urea @ 2.5 ml lit^{-1} of water at 30, 50 & 70 DAS (T_3) recorded significantly higher plant height (134.5 cm), number of total tillers m^{-2} (468.5 No. m^{-2}), dry matter accumulation (14946 kg ha^{-1}) and grain yield (6750 kg ha^{-1}) which was significantly higher compared to other treatments. However it was on par with the application of T_2: (Urea 1/3 RDN (40 kg N ha^{-1}) as basal + two foliar sprays of nano urea @ 2.5 ml lit^{-1} of water at conversion to wet and PI stages). While the lowest response of growth parameters and grain yield was observed in the treatment with the application of only four foliar sprays of nano urea @ 2.5 ml lit^{-1} of water at 10, 30, 50 and 70 DAS (T_6) and found inferior to rest of treatments.

Keywords: *Nano urea, conventional urea, growth parameters and grain yield*

Rice (*Oryza sativa* L.) is preferred as staple food crop for most of the countries. In India it is grown in all the states. After wheat, the rice is most popularly grown due to its wider adoptability and greater demand for consumption. It is estimated that 60% increase in agricultural production needs to be achieved by 2050 to feed the increasing population. The area under rice in India is 45.07 m ha with production and productivity of 122.27 mt & 2713 kg ha^{-1}, respectively (Agricultural at a glance. 2021). Due to scarcity of labour and labour diversion to non-agricultural purposes like for industrial work, there is a severe scarcity of human labour. With the problem of severe labour scarcity, the conventional method of transplanting becomes more difficult to achieve yield and profit in rice cultivation. In this context, to avoid these challenges direct seeded rice cultivation is more adoptable in North Coastal zone of Andhra Pradesh and also in most part of the rice growing regions (Ramulu *et al.,* 2020).

The use of chemical fertilizers needs striking balance between agricultural yield and long-term environmental sustainability. Inorganic fertilizers played a key role in maximization of crop yield especially nitrogenous fertilizers. To get higher yield, more amount of traditional inorganic fertilizers is used, which have lower nutrient use efficiency (30-40 %) and loss of nutrients (60-70%) by various pathways like-denitrification, volatilization, leaching losses and surface runoff (Mohanraj *et al.,* 2019). Further, these causes groundwater pollution, eutrophication and lower nutrient use efficiency. So, practicing nano fertilizers improves nutrient use efficiency and minimize the pollution (Mehta *et al.,* 2019). Application of nano urea at the rate of 2-4 ml per litre of water at critical growth stages of crop stimulates crop responses, meets nutritional requirement and enhances nutrients availability. It is quickly absorbed by the plant leaves due to its nano sized particles (Kumar *et al.,* 2021). Hence, Nano urea enhance and nitrogen efficiency in the rice crop by utilizing the different levels of conventional urea and nano urea. In this scenario, an experiment was conducted to test the efficacy of conventional and nano urea under direct seeded rice in North Coastal zone of Andhra Pradesh.

Materials and Methods

The field experiment was conducted during *kharif,* 2022 at Agriculture College Farm, Naira, Acharya N. G. Ranga Agricultural University located at North Coastal Zone of Andhra Pradesh. The soil of the experimental site was sandy clay loam in texture, with 6.4 pH, 0.80% organic carbon, 303 kg ha^{-1} available nitrogen, P_2O_5 36 kg ha^{-1} available and K_2O 380 kg ha^{-1} available.

The experiment was laid out in randomized block design with seven treatments *viz.,* T_1- 100% RDN (120 kg N ha^{-1}) urea through 3 equal splits at basal, at the time of conversion to wet and PI stages.

T_2- Urea 1/3 RDN (40 kg N ha^{-1}) as basal + two foliar sprays of nano urea @ 2.5 ml lit^{-1} water at conversion to wet and PI stages.

T_3- Urea 1/3 RDN (40 kg N ha) as basal + three foliar sprays of nano urea @ 2.5 ml lit^{-1}water at 30, 50 & 70 Days after sowing.

T_4 - Urea 1/4 RDN (30 kg N ha) as basal and at PI + two foliar sprays of nano urea @ 2.5 ml lit^{-1} water at conversion to wet and PI stages.

T_5- Urea 1/4 RDN (30 kg N ha) as basal and at PI + three foliar sprays of nano urea @ 2.5 ml lit^{-1} water at 30, 50 & 70 DAS.

T_6 -No basal dressing and four foliar sprays of nano urea @ 2.5 ml lit^{-1} water at 10, 30, 50 & 70 DAS.

T_7 - No basal dressing and five foliar sprays of nano urea @ 2.5 ml lit^{-1} water at 10, 30, 50, 70 & 90 DAS.

The rice variety used for the experiment was MTU-1061(Indra). All the data recorded were subjected to statistical analysis using Fisher's method of analysis of variance as outlined by Panse and Sukhatme (1967) for the design adopted in this study.

3. RESULTS AND DISCUSSION

3.1 Plant height (cm)

Plant height of dry direct sown rice was measured at active tillering, panicle initiation and harvesting stages of the rice crop and showed statistically noticeable differences with the application of different combination of conventional urea and nano urea as a source of Nitrogen fertilizer (Table 1).

Among all the treatments, highest plant height was recorded at active tillering, panicle initiation and at harvest *i.e.,* 66.1, 100.5 and 134.5 cm, respectively with the application of urea 1/3 RDN (40 kg N ha^{-1}) as basal + three foliar sprays of nano urea @ 2.5 ml lit^{-1} water at 30, 50 & 70 DAS (T_3), which was significantly higher over all the treatments however, found on parity with treatment T_2 application of urea 1/3 RDN (40 kg N ha^{-1}) as basal + two foliar sprays of nano urea @ 2.5 ml lit^{-1} water at conversion to wet and PI stages at active tillering (64.0 cm) , panicle initiation (99.7 cm) and harvest stage (127.5 cm). Then the decreasing trend was observed in the following treatments $T_1 > T_5 > T_4 > T_7$ respectively. While the shortest plants were observed in the treatment T_6 with basal dressing + four foliar sprays of nano urea @ 2.5 ml lit^{-1} water at 10, 30, 50 & 70 DAS in all the stages of rice crop.

As nitrogen is a most crucial element for the synthesis of the amino acid tryptophan, its presence in the soil has a direct impact on growth attributes of rice crop and exhibits direct influence on increase of plant height in all the stages of the crop as evident in the present findings and the results also supported by the studies of Velmurugan *et al.* (2021), Raheem *et al.* (2019), Saud *et al.* (2022a) and Sahu *et al.* (2022).

3.2 Dry matter production (kg ha^{-1})

The impact of conventional urea and nano urea application on drymatter production (kg ha^{-1}) of rice at various crop growth stages such as active tillering, panicle initiation, flowering and at harvest is presented in the table 1.

Dry matter accumulation increased progressively with the advance in the age of crop. At active tillering stage, panicle initiation, flowering and at harvest the maximum amount of dry matter production (2029, 5357, 9116 and 14946 kg ha^{-1}, respectively) was recorded with the application of urea 1/3 RDN (40 kg N ha^{-1}) as basal + three foliar sprays of nano urea @ 2.5 ml lit^{-1} water at 30, 50 & 70 DAS (T_3) and this treatment was statistically on par with the treatment T_2 at active tillering (1980 kg ha^{-1}), panicle initiation (5254 kg ha^{-1}), flowering (8868 kg ha^{-1}) and harvest stage (14707 kg ha^{-1}) with the substitution of urea 1/3 RDN (40 kg N ha^{-1}) as basal + two foliar sprays of nano urea @ 2.5 ml lit^{-1} water at conversion to wet and PI stages. It was also observed that the dry matter production was in the treatments T_1, T_5, T_4 & T_7 respectively in all the growth stages. Significantly lowest drymatter accumulation of 1163, 3914, 7029 and 11290 kg ha^{-1} was obtained in respective stages of rice crop with the application of no basal dressing + four foliar sprays of nano urea @ 2.5 ml lit^{-1} water at 10, 30, 50 & 70 DAS in T_6. This might be due to increase in height of plants, leaf area and tiller numbers m^{-2} etc., which ultimately enhanced the drymatter accumulation and CGR. Similar line of results was also reported by Benzon *et al.* (2015), Hafeez *et al.* (2015), Rawate *et al.* (2022) and Sharma *et al.* (2022).

3.3 Number of tillers m^{-2} (No. m^{-2})

The data statistically showed measurable difference among all the treatments with the application of nano urea and conventional urea on the number of tillers m^{-2} at active tillering, panicle initiation and flowering stages of rice crop as shown in table 1.

Maximum no. of tillers were obtained with the application of urea at active tillering (623.7), panicle initiation (524.7) and flowering (468.5) with the application of urea 1/3 RDN (40 kg N ha^{-1}) as basal + three foliar sprays of nano urea @ 2.5 ml lit^{-1} water at 30, 50 & 70 DAS (T_3), which was significantly superior over all the treatments except treatment T_2 with the substitution of urea 1/3 RDN (40 kg N ha^{-1}) as basal + two foliar sprays of nano urea @ 2.5 ml lit^{-1} water at conversion to wet and PI *i.e.,* 602.5, 503.2 and 446.7 (No. m^{-2}) in respective stages of rice. While significantly lowest tiller production was noticed in treatment T_6 with no basal dressing and four foliar sprays of nano urea @ 2.5 ml lit^{-1} water at 10, 30, 50 & 70 DAS, however found on par with the treatment T_7.

Application of foliar spray resulted in better absorption of nutrient entering into plant system through the stomata easily resulting in increase in cell division, meristematic activity and stimulation of cell elongation in plants. All these, ultimately helped in increasing number of tillers. These results are corroborating with those reported by Ranjan *et al.* (2023) and Midde *et al.* (2021).

3.4 Grain Yield (kg ha^{-1})

Grain yield of rice was significantly influenced by foliar application of nano urea and conventional urea in direct sown rice (Table 2). The maximum grain yield (6750 kg ha^{-1}) was found in treatment T_3 - Urea 1/3 RDN (40 kg N ha) as basal + three foliar sprays of nano urea @ 2.5 ml lit^{-1}water at 30, 50 & 70 DAS) and this treatment was at par with grain yield (6592 kg ha^{-1}) of treatment T_2- Urea 1/3 RDN (40 kg N ha^{-1}) as basal + two foliar sprays of nano urea @ 2.5 ml lit^{-1} water at conversion to wet and PI stages. Grain yields resulted under the treatments T_1 (5903 kg ha^{-1}), T_5 (5825 kg ha^{-1}), T_4 (5716 kg ha^{-1}) and T_7 (5375 kg ha^{-1}) found significantly on par with each other. The least amount of grain yield (5018 kg ha^{-1}) was registered in the treatment T_6 (no basal dressing + four foliar sprays of nano urea @ 2.5 ml lit^{-1} water at 10, 30, 50 & 70 DAS), however found comparable with the treatment T_7.

Further, the improvement of yield attributes like maximum number of panicles bearing tillers (No. m^{-2}), number of filled grains panicle^{-1} might have resulted in enhanced nutrient uptake by crop with the application of both conventional urea and nano urea and culminated in increasing the grain yield. The results are according to those reported by Lahari *et al.* (2021) and Sahu *et al.* (2022b).

Based on the present study, it was confirmed that application of urea 1/3 RDN (40 kg N ha) as basal + three foliar sprays of nano urea @ 2.5 ml lit^{-1}water at 30, 50 & 70 DAS was significantly found to be the best treatment compared to the other treatments. Based on the present results it is concluded that, substitution of nano urea for conventional urea during the crop growth of rice, increases the growth and grain yield of direct seeded rice. The application of nano nitrogen fertilizer can reduce losses such as leaching and denitrification. Further, enhances nitrogen use efficiency which ultimately helps in attainment of better performance under direct sowing conditions of rice in north coastal zone of Andhra Pradesh.

LITERATURE CITED

Agricultural at a glance. 2021. 29. www.agricoop.nic.in.

Benzon H R L, Rubenecia M R U, Ultra Jr V U and Lee S C (2015). Nanofertilizer affects the growth, development and chemical properties of rice. *International Journal of Agronomy and Agricultural Research.* 7(1): 105-117.

Table 1. Plant height, drymatter production and no. of tillers at different growth stages of direct seeded rice as influenced by nano urea during *kharif* 2022-23

Treatments	Plant height (cm)			Drymatter production (kg ha^{-1})				No. of Tillers m^{-2}		
	Active tiilering	Panicle initiation	Harvest	Active tiilering	Panicle initiation	Flowering	Harvest	Active tiilering	Panicle initiation	Flowering
T_1: 100% RDN (120 kg N ha^{-1}) urea through 3 equal splits at basal, at the time of conversion to wet and PI stages	56.3	91.6	120.4	1637	4608	7953	13280	548.6	450.9	416
T_2: Urea 1/3 RDN (40 kg N ha^{-1}) as basal + two foliar sprays of nano urea @ 2.5 ml lit^{-1} water at conversion to wet and PI stages	64	99.7	127.5	1980	5254	8868	14707	602.5	503.2	446.7
T_3: Urea 1/3 RDN (40 kg N ha^{-1}) as basal + three foliar sprays of nano urea @ 2.5 ml lit^{-1} water at 30, 50 & 70 DAS	66.1	100.5	134.5	2029	5357	9116	14946	623.7	524.7	468.5
T_4: Urea 1/4 RDN (30 kg N ha^{-1}) as basal and at PI + two foliar sprays of nano urea @ 2.5 ml lit^{-1} water at conversion to wet and	54.6	90.9	116.8	1541	4549	7857	12905	530.4	442.8	393.3
T_5: Urea 1/4 RDN (30 kg N ha^{-1}) as basal and at PI + three foliar sprays of nano urea @ 2.5 ml lit^{-1} ater at 30, 50 & 70 DAS	55.7	91.4	120	1634	4560	7911	13168	538.8	446.6	404.1
T_6: No basal dressing and four foliar sprays of nano urea @ 2.5 ml lit^{-1} water at 10, 30, 50 & 70 DAS	45.6	82.2	114.4	1163	3914	7029	11290	476.1	401.6	365.6
T_7: No basal dressing and five foliar sprays of nano urea @ 2.5 ml lit^{-1} water at 10,30,50,70 & 90 DAS	51.8	89.1	115.8	1295	4465	7856	12245	512.3	433	379.2
S.Em ±	**2.8**	**2.7**	**4.4**	**111**	**184**	**245**	**432**	**18.1**	**17.1**	**15.5**
CD (P=0.05)	**8.4**	**8.2**	**13.1**	**330**	**549**	**728**	**1285**	**53.9**	**50.9**	**46.2**

Table 2: Grain Yield (kg ha^{-1}) of direct seeded rice as influenced by nano urea during *kharif,* 2022-23

Treatments	Grain Yield (kg ha^{-1})
T_1: 100% RDN (120 kg N ha^{-1}) urea through 3 equal splits at basal, at the time of conversion to wet and PI stages	5903
T_2: Urea 1/3 RDN (40 kg N ha^{-1}) as basal + two foliar sprays of nano urea @ 2.5 ml lit^{-1} water at conversion to wet and PI stages	6592
T_3: Urea 1/3 RDN (40 kg N ha^{-1}) as basal + three foliar sprays of nano urea @ 2.5 ml lit^{-1} water at 30, 50 & 70 DAS	6750
T_4: Urea 1/4 RDN (30 kg N ha^{-1}) as basal and at PI + two foliar sprays of nano urea @ 2.5 ml lit^{-1} water at conversion to wet and PI stages	5716
T_5: Urea 1/4 RDN (30 kg N ha^{-1}) as basal and at PI + three foliar sprays of nano urea @ 2.5 ml lit^{-1} water at 30, 50 & 70 DAS	5825
T_6: No basal dressing and four foliar sprays of nano urea @ 2.5 ml lit^{-1} water at 10, 30, 50 & 70 DAS	5018
T_7: No basal dressing and five foliar sprays of nano urea @ 2.5 ml lit^{-1} water at 10,30,50,70 & 90 DAS	5375
S.Em ±	**231**
CD (P=0.05)	**686**

Hafeez A, Razzaq A, Mahmood T and Jhanzab H M 2015. Potential of copper nanoparticles to increase growth and yield of wheat. *Journal of Nano science with Advanced Technology.* 1(1): 6-11.

Kumar Yogendra, Tarunendu Singh, Ramesh Raliya, Tiwari K N 2021. Nano fertilizers for sustainable crop production, higher nutrient use efficiency and enhanced profitability. *Indian Journal of Fertilisers*. 17(11):1206-1214.

Lahari S, Hussain S A, Parameswari Y S and Sharma S H K 2021. Grain yield and nutrient uptake of rice as influenced by the nano forms of nitrogen and zinc. *International Journal of Environment and Climate Change*. 11(7): 1-6.

Mehta S and Bharat R 2019. Effect of integrated use of nano and non-nano fertilizers on nutrient use efficiency of wheat (*Triticum aestivum* L.) in irrigated subtropics of Jammu. *Journal of Pharmacognosy and phytochemistry*. 8: 598-606.

Midde S K, Perumal M S, Murugan G, Sudhagar R, Mattepally V S, and Bada M R 2021. Evaluation of Nano urea on growth and yield Attributes of Rice (*Oryza Sativa* L.). *Chemical Science Review and Letters*. 11(42): 211-214.

Mohanraj J, Subramanian K S and Lakshmanan A 2019. Role of nano-fertilizer on greenhouse gas emission in rice soil ecosystem. *Madras Agricultural Journal*. 106(10-12): 657-663.

Panse V G and Sukhatme P V 1967. Statistical methods for agricultural workers. *Indian Concil of Agricultural Research*, New Delhi.

Raheem A H J, Hanoon N K and Ghanim B N 2019 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*. (19): 1279-1283.

Ramulu C, Reddy P R R and Narsaiah E 2020. "Effect of nitrogen levels on yield and nutrient uptake of *kharif* rice (*Oryza sativa* L.) under different establishment methods. *Journal of Crop and Weed*. 16(2):106-112.

Ranjan P, Kumar B, Mala A, Priyadarshi S, Aditya S, Babu L, Narayan A and Kumar B 2023. Effect of foliar spray of nano urea on yield and economics of rice. *The pharma innovation*. 12(1): 3030-3033.

Rawate D, Patel J R, Agrawal A P, Agrawal H P, Pandey D, Patel C R, Verma P, Chandravanshi M, Kumar A and Hetram 2022. Effect of nano urea on productivity of wheat (*Triticum aestivum* L.) under irrigated condition. *The Pharma Innovation Journal*. 11(9): 1279-1282.

Sahu K B, Sharma G, Pandey D, Keshry P K and Chaure N K 2022. Effect of nitrogen management through nano-fertilizer in rice (*Oryza sativa* L.). *International Journal of Chemical Research and Development*. 4(1): 25-27.

Sahu T K, Kumar M, Kumar N, Chandrakar T and Singh D P 2022a. Effect of nano urea application on growth and productivity of rice (*Oryza sativa* L.) under mid land situation of Bastar region. *Pharma Innovation*. 11: 185-187.

Saud M, Joseph M, Hemalatha M, Rajakumar D, Jothimani S and Srinivasan S 2022b. Effect of bio-organic fertilizers (BoF) with nano urea spray on nitrogen economy of rice. *The Pharma Innovation Journal*. 11(7): 4475-4480.

Sharma S K, Sharma P K, Mandeewal R L, Sharma V, Chaudhary R, Pandey R and Gupta Shubham 2022. Effect of foliar application of Nano-Urea under different nitrogen levels on growth and nutrient content of Pearlmillet (*Pennisetum glaucum* L.). *International Journal of Plant and Soil Science*. 34(20): 149-155.

Velmurugan A, Subramani T, Bommayasamy N, Kumar M, Swarnam T P and Ramakrishna 2021. The effect of foliar application of nano urea (liquid) on rice (*Oryza sativa* L.). *Journal of the Andaman Science Association*. 26(2): 76-81.

Received on 02.04.2023 and Accepted on 21.06.2023