
**ISSN Print:** 2664-6552
**ISSN Online:** 2664-6560
**Impact Factor:** RJIF 5.5
IJCRD 2022; 4(1): 25-27
https://www.chemicaljournal.in/
Received: 23-05-2022
Accepted: 08-06-2022

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# Effect of nitrogen management through nano-fertilizer in rice (*Oryza sativa* L.)

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**DOI:** https://doi.org/10.33545/26646552.2022.v4.i1a.29

**Abstract**
The present investigation entitled "Effect of Nitrogen Management through Nano-fertilizer in Rice (*Oryza sativa* L.)" was conducted during *Kharif* season of 2021 at instructional farm of Barrister Thakur Chhedilal College of Agriculture and Research Station Bilaspur (Chhattisgarh). Resulted that all the growth parameters and yield attributes which were significantly superior under the treatment 50% RDN as basal + foliar spray of nano urea at tillering stage + foliar spray of nano urea at PI stage. Application of 50% RDN as basal + foliar spray of nano urea at tillering stage + foliar spray of nano urea at PI stage resulted higher gross income Rs. 146896.76 ha$^{-1}$, Net income Rs. 97394.70 ha$^{-1}$, B:C ratio 1.97 which was significantly superior over rest of the treatments. In the treatment 50% RDN as basal + foliar spray of nano urea at tillering stage + foliar spray of nano urea at PI stage was observed as the best treatment in increasing the grain yield (55.18 q ha$^{-1}$) and straw yield (59.70 q ha$^{-1}$) of rice crop. Availability of N, $P_2O_5$ and $K_2O$ in soil after harvest of rice crop were estimated higher with treatment 50% RDN as basal + foliar spray of nano urea at tillering stage + foliar spray of nano urea at PI stage. Content and uptake of Nitrogen, Phosphorus and Potassium by rice crop were estimated higher under the treatment 50% RDN as basal + foliar spray of nano urea at tillering stage + foliar spray of nano urea at PI stage.

**Keywords:** IFFCO nano urea fertilizer, transplanted rice, growth and yield

## Introduction
Rice (*Oryza sativa* L.) belong to family Poaceae and rice was believed to have originated from South-East Asia. It is one of the most important cereal crops in tropics as well as parts of temperate region of the globe. Rice is being cultivated under diverse agro ecologies varying from irrigated uplands and rain fed lowlands to flood- prone rice ecosystems. India comes second to China in terms of area and production among the world's major rice producing nations. Out of 782 million tonnes of global rice production from 167.1 million hectares, India produced 116.42 m t in 44.5 m ha (rainy season: 102.13 m t from 39.27 m ha) Rice production in Chhattisgarh, the total area of production was reported to about 3.87 million hectares with production accounting to be 11.63 million tonnes and a productivity of 3.0 t ha$^{-1}$.

Rice plants require a specific amount of nutrients in a specific form to be added in a time for their growth and development. Nitrogen plays an important role in the cultivation of rice. Nitrogen is an essential plant nutrient being a component of amino acids, nucleic acids, nucleotides, chlorophyll, enzymes, and hormones. N promotes rapid plant growth and improves grain yield and grain quality through higher tillering, leaf area development, grain formation, grain filling, and protein synthesis. N is highly mobile within the plant and soil. Nitrogen is the most limiting element in almost all Indian soils. Thus, proper application of N fertilizers is vital to improve crop growth and grain yields, especially in intensive agricultural systems. Nitrogen is mostly supplied by urea fertilizer which is highly mobile in soil and causes volatilization and surface runoff problem. Urea releases harmful pollutants in the air and soil water. It exerts higher concentrations of ammonia in the soil making it even more acidic and thus retards the soil of its fertility. The consumption of urea in the country has reached about 35 million tonnes, with 70% manufactured in India. Thus use of urea causes water and soil pollution and puts financial burden to the farmers.

In comparison to urea the uptake efficiency of nano urea is more than 80%. It is thus, required in lesser measure compared to the conventional urea fertilizer to fulfill plant's nitrogen requirement. 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 fertilizer. One nano urea liquid particle is 30 nano meters in diameter, with 10,000 time's higher surface area to volume size than normal granular urea. Foliar application of nano urea liquid at critical crop growth stages of a plant effectively fulfils its nitrogen requirement and leads to higher crop productivity and quality in comparison to conventional urea.

However, published literatures regarding appropriate quantity and the use of Nano-fertilizer (Nano-urea) on growth and yield of rice are rare. For that reason, this study aimed to elucidate the study of effect of Nano- urea fertilizer on rice crop.

## Materials and Methods

A field experiment was conducted during *Kharif* season of 2021 at instructional farm, Barrister Thakur Chhedilal College of Agriculture and Research Station, Bilaspur (Chhattisgarh) to investigate the "Effect of Nano DAP fertilizer on Growth and Yield of Rice (*Oryza sativa* L.)". The experiment field is geographically situated located in the central part of Chhattisgarh state at latitude 22.0796 °N, and longitude 82.1391 °E and an altitude of 262.0 meters above the MSL. The geographical region comes under the Eastern Plateau and Hills region (Agro-climatic zone 7) of India. Chhattisgarh has three Agro-climatic zones, in which Bilaspur comes under the Chhattisgarh plain zones. The experiment farm is characterized by a hot, moist and sub-humid region, receives an average of 1250 mm annual rainfall every year. The soil condition of experimental field was neutral in pH (6.8), Electrical Conductivity 0.25 $dSm^{-1}$, bulk density 1.32 g $cc^{-1}$ and particle density 2.62 g $cc^{-1}$, clay loam in texture, low in available N (218.5 kg $ha^{-1}$), medium in available P (13.88 kg $ha^{-1}$) and medium in available K (275.96 kg $ha^{-1}$). Zinco rice (MS) variety of rice was selected for the experimental crop with spacing of row to row 20 cm and plant to plant 15 cm in distance. The experiment was laid out in Randomized Block Design (RBD) with three replications and 7 treatments combination and experimental plots were laid out with dimensions as Gross plot area (5 m × 4.50 m) and Net plot area (4.60 m × 4.20 m). The treatments *viz.*, $T_1$ – 50% of RDN as basal, $T_2$ – 50% of RDN as basal + 25% of RDN at tillering, $T_3$ – 75% of RDN as basal, $T_4$ – 50% of RDN as basal + 25% of RDN at tillering stage + 25% of RDN PI stage, $T_5$ – 50% of RDN as basal + foliar spray of nano urea at tillering stage, $T_6$ – 50% RDN as basal + foliar spray of nano urea at tillering stage + foliar spray of nano urea at PI stage and $T_7$ – 75% of RDN as basal + foliar spray of nano urea at tillering stage. The recommended dose of nutrients are 100:60:40 N, $P_2O_5$, $K_2O$ kg $ha^{-1}$ was applied through urea, SSP and MOP for the experiment under transplanted rice condition.Recommended dose of $P_2O_5$ and $K_2O$ are common for all the treatment. Foliar spray of nano urea @4 ml $litre^{-1}$ of water is applied where @ 500 liters water is required for one ha.

The soil samples collected at 15 cm depth after harvest were analyzed to assess the available nutrients viz., N, $P_2O_5$ and $K_2O$. The plant samples were analyzed for their nutrient contents (N, P and K) by following the standard procedures and the nutrient uptake was calculated. The mean values were used for statistical analysis as suggested by Panse and Sukhatme (1978).

Data recorded on various parameters of the experiment was subjected to analysis by using Fisher's method of analysis of variance (ANOVA) and interpreted as outlined by Gomez and Gomez (1984). The level of significance used in F and t test was p = 0.05. Critical difference values were calculated where F test was found significant.

## Results and Discussion

### Growth and yield attributes

The data on yield attributes *viz.* number of effective tillers $m^{-2}$, panicle length (cm), total number of grains $panicle^{-1}$ and number of filled grains $panicle^{-1}$ was recorded significantly higher under treatment $T_6$ (50% RDN as basal + foliar spray of nano urea at tillering stage + foliar spray of nano urea at the PI stage). However, it was at par with treatment $T_7$ (75% of RDN as basal + foliar spray of nano urea at the tillering stage) and $T_4$ (50% of RDN as basal + 25% of RDN at tillering stage + 25% of the PI stage). This may be due the foliar application of nano urea at their critical stage (tillering and PI), this may lead to supply sufficient amount of nitrogen. Nitrogen enhance the cell elongation, activity of merismatic cells and also increase grain formation, The results obtained are same as that obtained by Swati Mehta and Rajiv Bharat (2019) [11].

### Yield

Application of nano urea fertilizers had a significant effect on the grain (q $ha^{-1}$) and straw yield (q $ha^{-1}$). Data pertaining to yield is recorded and presented in table 3. Among the applied treatments, $T_6$ (50% RDN as basal + foliar spray of nano urea at tillering stage + foliar spray of nano urea at the PI stage) observed significantly higher grain yield 55.18 q $ha^{-1}$ and straw yield 59.70 q $ha^{-1}$. Foliar application of nano urea fertilizer increase rice grain yield and straw yield because it increases rate of photosynthesis, higher dry matter produce, photosynthate accumulate and translocation to the economic part of the plant. A similar result was observed by Apoorva *et al*., (2017), Swati Mehta and Rajiv Bharat (2019) [11] and Mehta *et al*., (2019) [11].

### Nutrient content and uptake

The data about nutrient content (%) and uptake (kg $ha^{-1}$) at the harvest stage of rice were presented in Table 4 and Table 5, respectively. Significantly highest content of N in grain (1.250%) and straw (0.410%) was recorded in the treatment $T_6$ (50% RDN as basal + foliar spray of nano urea at tillering stage + foliar spray of nano urea at PI stage) and highest uptake of N, P and K in grain was recorded respectively 69.08 kg $ha^{-1}$, 19.34 kg $ha^{-1}$, 13.82 kg $ha^{-1}$ and straw was recorded respectively 24.51 kg $ha^{-1}$, 5.38 kg $ha^{-1}$, 99.25 kg $ha^{-1}$ in the treatment $T_6$.

Nano-fertilizers provide more surface area for different metabolic reactions in the plant. The nutrient uptake by grain and straw was found to be increased with the foliar application of nano urea because nano urea have large surface area and particle size is minute which is less than leaves and root pore size, this may cause higher penetration of nutrient into the plant. Because of that treatment $T_6$ (50% RDN as basal + foliar spray of nano urea at tillering stage + foliar spray of nano urea at PI stage) resulted higher nutrient

content and uptake by grain and straw. Also a similar result was found by Bora and Pandey (2018) [5].

## Conclusion

The highest number of panicles $m^{-2}$, total number of grains $panicle^{-1}$, number of filled grains panicle-1, test weight (g), grain, straw yield and nutrient uptake was recorded under treatment $T_6$ (50% RDN as basal + foliar spray of nano urea at tillering stage + foliar spray of nano urea at PI stage) which was significantly at par with the treatment $T_7$ (75% of RDN as basal + foliar spray of nano urea at the tillering stage) and $T_4$ (50% of RDN as basal + 25% of RDN at tillering stage + 25% of RDN at PI stage).

**Table 1:** Effect of Nano urea application on Yield attributes of Rice

| Treatments | Effective tillers $m^{-2}$ | Panicle length (cm) | Total number of grains $panicle^{-1}$ | Chaffy grains $panicle^{-1}$ | Filled grains $panicle^{-1}$ | Test weight (g) |
|---|---|---|---|---|---|---|
| $T_1$ | 172.66 | 11.20 | 131.10 | 9.49 | 124.28 | 20.23 |
| $T_2$ | 177.89 | 17.45 | 139.60 | 8.36 | 133.25 | 21.20 |
| $T_3$ | 175.44 | 15.03 | 135.77 | 9.02 | 129.86 | 20.88 |
| $T_4$ | 189.97 | 20.45 | 151.08 | 7.95 | 143.39 | 22.97 |
| $T_5$ | 179.43 | 18.84 | 145.99 | 8.05 | 138.81 | 21.34 |
| $T_6$ | 198.53 | 23.76 | 163.81 | 7.35 | 157.39 | 23.25 |
| $T_7$ | 194.33 | 21.97 | 157.79 | 7.76 | 151.44 | 23.13 |
| S.E.M (±) | 3.17 | 1.17 | 4.81 | 0.74 | 4.72 | 0.82 |
| CD (5%) | 9.76 | 3.59 | 14.83 | NS | 14.54 | NS |

**Table 2:** Effect of nano urea application on grain yield (q $ha^{-1}$), straw yield (q/ha), harvest index (%)

| Treatments | Grain yield (q $ha^{-1}$) | Straw yield (q $ha^{-1}$) | Harvest index (%) |
|---|---|---|---|
| $T_1$ | 37.05 | 47.31 | 43.91 |
| $T_2$ | 41.22 | 51.04 | 44.67 |
| $T_3$ | 38.31 | 49.22 | 43.76 |
| $T_4$ | 50.21 | 55.81 | 47.35 |
| $T_5$ | 45.13 | 53.61 | 45.70 |
| $T_6$ | 55.18 | 59.70 | 48.03 |
| $T_7$ | 52.93 | 58.33 | 47.57 |
| S.E.M (±) | 1.79 | 2.09 | 0.06 |
| CD (5%) | 5.51 | 6.43 | NS |

**Table 3:** Physico-chemical properties of soil after harvest of crop

| Treatments | Bulk Density (g $cc^{-1}$) | Particle Density (g $cc^{-1}$) | pH | EC ($dSm^{-1}$) | OC (%) |
|---|---|---|---|---|---|
| $T_1$ | 1.320 | 2.58 | 6.60 | 0.250 | 0.440 |
| $T_2$ | 1.329 | 2.61 | 6.67 | 0.259 | 0.449 |
| $T_3$ | 1.324 | 2.60 | 6.68 | 0.255 | 0.447 |
| $T_4$ | 1.335 | 2.61 | 6.75 | 0.264 | 0.455 |
| $T_5$ | 1.332 | 2.60 | 6.72 | 0.261 | 0.451 |
| $T_6$ | 1.340 | 2.63 | 6.80 | 0.27 | 0.548 |
| $T_7$ | 1.338 | 2.62 | 6.78 | 0.27 | 0.460 |
| S.E.M (±) | 0.05 | 0.10 | 0.23 | 0.01 | 0.02 |
| CD (%) | NS | NS | NS | NS | NS |

**Table 4:** Available N, $P_2O_5$ and $k_2O$ content in soil after harvest of crop

| Treatments | N (kg $ha^{-1}$) | $P_2O_5$ (kg $ha^{-1}$) | $K_2O$ (kg $ha^{-1}$) |
|---|---|---|---|
| $T_1$ | 214.33 | 10.80 | 273.26 |
| $T_2$ | 218.30 | 11.51 | 274.33 |
| $T_3$ | 212.89 | 11.39 | 269.98 |
| $T_4$ | 221.21 | 12.42 | 282.55 |
| $T_5$ | 218.42 | 11.76 | 278.44 |
| $T_6$ | 231.33 | 12.23 | 289.20 |
| $T_7$ | 227.41 | 12.16 | 286.96 |
| S.E.M (±) | 4.0 | 0.68 | 4.64 |
| CD (5%) | 12.35 | NS | NS |

## References


1. Abdo W *et al.* Effect of different nitrogen fertilizer rates on yield and yield related traits for seven durum wheat (*Triticum turgidum* L. var Durum) Cultivars Grown at Sinana South Eastern Ethiopia. 2012;12(3):6079-6094.
2. Adhikari T, Kundu S, Rao AS. Zinc delivery to plants through seed coating with nano-zinc oxide particles. Journal of Plant Nutrition. 2016 Jan 2;39(1):136-146.
3. Wakuma Biratu, Derbew Belew, Edossa Ettissa. Evaluation of hot pepper (*Capsicum annuum* L.) cultivars for growth and dry pod yields against different blended fertilizer and nitrogen rates in raya Azebo, Southern Tigray. Int. J Res. Agron. 2021;4(2):15-22.
4. Alhasan AS. Effect of different NPK nano-fertilizer rates on agronomic traits, essential oil, and seed yield of basil (*Ocimum basilicum* L. cv dolly) grown under field conditions. Plant Archives. 2020;20(Supplement 2):2959-2962.
5. Bora R, Chilwal A, Pandey PC, Bhaskar R. Nutrient content and uptake in rice (*Oryza sativa* L.) under the Influence of long term balance fertilizer Application. Int. J. Curr. Microbiol. App. Sci. 2018;7:2011-2017.
6. Jyothi TV, Hebsur NS. Effect of nanofertilizers on growth and yield of selected cereals-A review. Agricultural reviews. 2017 Jun 1;38:2.
7. Tehulie NS, Misgan T. Review on the effects of nitrogen fertilizer rates on growth, yield components and yield of potato (*Solanum tuberosum* L.). Int. J Res Agron. 2019;2(2):51-56. DOI: 10.33545/2618060X.2019.v2.i2a.68
8. Sanmugum M. Review on the Use of Nano technology in Fertilizers University of Sri Jayewardenepura Article; c2021.
9. Tarafdar JC, *et al.* Esther. Enhancing Nutrient Use Efficiency through Nano Technological Interventions. Indian J Fert. 2015 Dec;11(12):46-51.
10. Agricultural Statistics Directorate. The production of paddy and sunflower for the year 2019. Report of the Central Bureau of Statistics - Ministry of Planning, Republic of Iraq, 13 p, (in Arabic); c2020.
11. Mehta S, Bharat R. Effect of integrated use of nano and non-nano fertilizers on yield and yield attributes of wheat (*Triticum aestivum* L.). Int. J Curr. Microbiol. App. Sci. 2019;8(12):598-606.