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# Influence of enriched nitrogen sources at different levels on yield attributes and yield of transplanted rice

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## Abstract
An experiment was conducted under field conditions during *kharif* season of 2018 at the research farm of the ICAR-Indian Institute of Rice Research (IIRR), Hyderabad, Telangana state to know the effect of enriched nitrogen sources at different levels on yield attributes and yield of transplanted rice. Yield attributes like number of panicles (324 $m^{-2}$), total number of grains $panicle^{-1}$ (116), number of filled grains $panicle^{-1}$ (105) and panicle length (23.7 cm) were found to be highest with the application of 100% RDN through neem coated urea ($T_7$). Highest grain yield (6694 kg $ha^{-1}$) and straw yield (7812 kg $ha^{-1}$) was recorded with the application of 100% RDN through neem coated urea ($T_7$). This was found to be on par with 100% RDN through neem coated urea + nitrification inhibitor ($T_{10}$). Lowest grain yield (3120 kg $ha^{-1}$) and straw yield (4009 kg $ha^{-1}$) was recorded with ($T_1$) Control (0:60:40 kg N:P:K $ha^{-1}$).

**Keywords:** Enriched nitrogen sources, transplanted rice, yield attributes, grain yield, straw yield

## Introduction
Rice (*Oryza sativa* L.) is one of the most important cereal crops of the world, grown in wide range of climatic zones, to nourish the mankind. More than 90 per cent of the World's rice is grown and consumed in Asia. India has the largest area under rice (43.7 m ha) accounting for 112.75 million tons in terms of production with an average productivity of 2576 kg $ha^{-1}$ (Ministry of Agriculture and Farmer welfare, 2018) [1].
Nitrogen is the key nutrient element required in large amounts for rice and provision of adequate supply of N throughout the growing period is necessary for realizing potential yields. Nitrogen promotes rapid plant growth and improves grain yield. Improving efficiency of fertilizer N use is vital to achieve and sustain high crop yields and reduce losses of N that can potentially deteriorate environmental quality. (Thind *et al*., 2010) [2]. Slow-release fertilizers (SRF) are often used to increase nitrogen-use efficiency. SRFs are designed to release N over an extended period of time, rather than all at once, in an attempt to better match plant N needs throughout the growing season and to reduce time of exposure for N losses to the environment. Combining organic manures and chemical fertilizers has the potential to provide greater stability in crop production, maintain improvements in soil fertility and enhance the efficiency of growth and yield generation. Vermicompost is considered as a soil additive to reduce the use of mineral fertilizers because it provides required nutrient amounts, increases cation exchange capacity and improves water holding capacity (Tejada and Gonzaler, 2009) [3].

## Material and Methods
The experiment was conducted under field conditions during *kharif* season of 2018 at the research farm of the ICAR- Indian Institute of Rice Research (IIRR), Hyderabad, Telangana state. The soil of the experimental field was clay loam in texture, low in available nitrogen (239 kg $ha^{-1}$) high in phosphorus (36 kg $ha^{-1}$) and potassium content (407 kg $ha^{-1}$). Varadhan, a mid early duration variety was used. The experiment was laid out in randomized block design with eleven treatments and each one replicated thrice. The treatments comprised were $T_1$ Control (0:60:40 kg N:P:K $ha^{-1}$), $T_2$ (75% RDN through neem coated urea), $T_3$ (75% RDN through enriched rice straw compost with *trichoderma*), $T_4$ (75% RDN through vermicompost), $T_5$ (75% RDN through neem coated urea + nitrification inhibitor), $T_6$ (75% RDN (50% RDN through vermicompost + 25% RDN through neem coated urea + nitrification inhibitor ), $T_7$ (100% RDN through neem coated urea), $T_8$ (100% RDN through enriched rice straw compost with *trichoderma*), $T_9$ (100% RDN through vermicompost), $T_{10}$ (100% RDN through neem coated urea + nitrification inhibitor) and $T_{11}$ (100% RDN (50% RDN through vermicompost + 50% RDN through neem coated urea + nitrification inhibitor).

Rice straw has been chopped into small pieces of 3-6 cm by using shredding machine and composting piles were constructed by laying several layers of shred rice straw, inoculated with *Trichoderma sp.* ($15x10^3$cfu $ml^{-1}$) at 10 days interval and moisture was maintained at 50-60% during the compost period. The fermentation was allowed to continue for 6-8 weeks. The piles were turned up for proper mycelia growth and aeration at 5 days interval. The compost was ready within 8 weeks. Karanj oil has been used as nitrification inhibitor. Karanj oil has been obtained from the seeds of karanja tree (*Pongamia glabra* Vent.), which is reported to have nitrification inhibitory properties (Deepanjan *et al*., 2004) [4]. The neem coated urea has been treated with karanj oil. One ml of karanj oil has been applied to one kg of neem coated urea.

**Table 1:** Nitrogen content and quantity of organic manures added

| Organic manures | N (%) | Quantity added to substitute 100% recommended nitrogen for rice (120 kg $ha^{-1}$) |
|---|---|---|
| Vermicompost | 1.1 | 11000 kg $ha^{-1}$ |
| Rice straw compost | 1.2 | 10000 kg $ha^{-1}$ |

## Results and Discussions

### Yield Attributes

### Number of panicles $m^{-2}$

Highest number of panicles $m^{-2}$ (324) was recorded with the application of 100% RDN through neem coated urea ($T_7$) which was on par with 100% RDN through neem coated urea + nitrification inhibitor ($T_{10}$) (304). Lowest number of panicles $m^{-2}$ (205) was recorded without the application of nitrogen ($T_1$) Control (0:60:40 kg NPK $ha^{-1}$) which was on par with 75% RDN through enriched rice straw compost with *Trichoderma* ($T_3$), 75% RDN through vermicompost ($T_4$), 100% RDN through vermicompost ($T_9$) (232, 220 and 227). (Table 2). There was 58% increase in the number of panicles $m^{-2}$ with 100% RDN through neem coated urea compared to without application of nitrogen. This might be attributed to reduced losses associated with sufficient amount of nitrogen through neem coated urea at critical stages which would have maintained continuous supply of nitrogen into the soil solution to match the requisite absorption pattern of crop especially at later stages crop to meet the physiological processes. Similar findings were reported by Ashvin Kumar *et al*. (2018) [5].

### Panicle length (cm)

Highest panicle length (23.7 cm) was recorded with the application of 100% RDN through neem coated urea ($T_7$) which was on par with 100% RDN through neem coated urea + nitrification inhibitor ($T_{10}$) (22.6 cm). Lowest panicle length (19.3 cm) was recorded without the application of nitrogen ($T_1$) Control (0:60:40 kg NPK $ha^{-1}$) which was on par with 75% RDN through neem coated urea ($T_2$ ), 75% RDN through enriched rice straw compost with *Trichoderma* ($T_3$), 75% RDN through vermicompost ($T_4$), 75% RDN through neem coated urea + nitrification inhibitor ($T_5$), 75% RDN (50% RDN through vermicompost + 25% RDN through neem coated urea + nitrification inhibitor ($T_6$ ), 100% RDN through enriched rice straw compost with *Trichoderma* ($T_8$),100% RDN through vermicompost ($T_9$) (21.3, 20.2, 20.0, 21.2, 20.9, 20.7 and 20.6). (Table 2). There was 22.7% increase in the panicle length (cm) was observed with 100% RDN through neem coated urea ($T_7$) compared to without application of nitrogen. This might be due to reduced losses associated with sufficient amount of nitrogen through neem coated urea at critical stages which would have maintained continuous supply of nitrogen into the soil solution to match the requisite absorption pattern of crop. Similar findings was reported by Pramanik *et al.* (2013) [6].

### Total grains panicle$^{-1}$

Highest number of total grains panicles$^{-1}$ (116) was recorded with the application of 100% RDN through neem coated urea ($T_7$) which was on par with 75% RDN through neem coated urea ($T_2$), 75% RDN through neem coated urea + nitrification inhibitor ($T_5$), 100% RDN through enriched rice straw compost ($T_8$), 100% RDN through neem coated urea + nitrification inhibitor ($T_{10}$) and 100% RDN [50% RDN through vermicompost + 50% RDN through neem coated urea + nitrification inhibitor]) ($T_{11}$) (107, 106, 104,111 and 108). Lowest number of total grains panicle-$^1$ (88) was recorded without the application of nitrogen ($T_1$) Control (0:60:40 kg NPK $ha^{-1}$) which was on par with 75% RDN through enriched rice straw compost with *Trichoderma* (T3), 75% RDN through vermicompost ($T_4$), 75% RDN (50% RDN through vermicompost + 25% RDN through neem coated urea + nitrification inhibitor ($T_6$), 100% RDN through vermicompost ($T_9$) (96, 94, 100 and 100). (Table 2). There was 31.8% increase in the number of total grains panicle$^{-1}$ was observed with 100% RDN through neem coated urea compared to without application of nitrogen. Similar findings were reported by Saha *et al*. (2017) [7].

### Number of filled grains panicle$^{-1}$

Highest number of filled grains panicle$^{-1}$ (105) was recorded with the application of 100% RDN through neem coated urea which was on par with 75% RDN through neem coated urea ($T_2$ ), 75% RDN through neem coated urea + nitrification inhibitor ($T_5$), 100% RDN through enriched rice straw compost ($T_8$),100% RDN through neem coated urea + nitrification inhibitor ($T_{10}$) and 100% RDN [50% RDN through vermicompost + 50% RDN through neem coated urea + nitrification inhibitor]) ($T_{11}$) (96, 93, 92, 99 and 97). Lowest number of filled grains panicle$^{-1}$ (77) was recorded without the application of nitrogen ($T_1$) Control (0:60:40 kg N:P:K $ha^{-1}$). (Table 2). There is 36.3% increase in the number of filled grains panicles$^{-1}$ was observed with 100% RDN through neem coated urea compared to without application of nitrogen. This might be due to higher uptake of applied nitrogen and greater availability of soil nutrients. Similar findings were reported by Shukla *et al*. (2015) [8].

**Table 2:** Yield attributes of transplanted rice as influenced by different enriched nitrogen **sources**

| Treatment | Yield attributes | | | | |
|---|---|---|---|---|---|
| | Panicles $m^{-2}$ | Panicle length (cm) | Total grains $panicle^{-1}$ | Filled grains $panicle^{-1}$ | Test weight(g) |
| $T_1$- Control (0:60:40 kg N:P:K $ha^{-1}$) | 205 | 19.3 | 88 | 77 | 24.1 |
| $T_2$- 75% RDN through neem coated urea | 283 | 21.3 | 107 | 96 | 24.5 |
| $T_3$- 75% RDN through enriched rice straw compost with *Trichoderma* | 232 | 20.2 | 96 | 85 | 24.3 |
| $T_4$- 75% RDN through vermicompost | 220 | 20.0 | 94 | 82 | 24.3 |
| $T_5$- 75% RDN through neem coated urea + nitrification inhibitor | 277 | 21.2 | 106 | 93 | 24.4 |
| $T_6$- 75% RDN (50% RDN through vermicompost +25% RDN through neem coated urea + nitrification inhibitor) | 257 | 20.9 | 100 | 88 | 24.6 |
| $T_7$-100% RDN through neem coated urea | 324 | 23.7 | 116 | 105 | 24.7 |
| $T_8$-100% RDN through enriched rice straw compost with *Trichoderma* | 238 | 20.7 | 104 | 92 | 24.5 |
| $T_9$-100% RDN through vermicompost | 227 | 20.6 | 100 | 88 | 24.5 |
| $T_{10}$-100% RDN through neem coated urea + nitrification inhibitor | 304 | 22.6 | 111 | 99 | 24.6 |
| $T_{11}$-(100% RDN [50% RDN through vermicompost + 50% RDN through neem coated urea +nitrification inhibitor]) | 290 | 21.5 | 108 | 97 | 24.5 |
| SE(m) ± | 9.6 | 0.7 | 4.5 | 5.2 | 0.1 |
| CD (p=0.05) | 28.3 | 2.1 | 13.3 | 15.4 | NS |

**Test weight (g)**

Test weight has not shown any significant difference due to different enriched nitrogen sources. However maximum test weight (24.7 g) was recorded with the application of 100% RDN through neem coated urea ($T_7$). Lowest test weight (24.1 g) was recorded without the application of nitrogen ($T_1$) Control (0:60:40 kg NPK $ha^{-1}$). (Table 2). Test weight a genetic character specific to the variety, was not found to be not influenced by application of different enriched nitrogen sources to the crop.

**Yield**

**Grain yield (kg $ha^{-1}$)**

Highest grain yield (6694 kg $ha^{-1}$) was recorded with the application of 100% neem coated urea ($T_7$) which was on par with 100% RDN through neem coated urea + nitrification inhibitor ($T_{10}$) (6204 kg $ha^{-1}$). Lowest grain yield (3120 kg $ha^{-1}$) was recorded without the application of nitrogen ($T_1$) Control (0:60:40 kg NPK $ha^{-1}$) which was on par 75% RDN through vermicompost ($T_4$) (3651 kg $ha^{-1}$). (Table 3 and Fig 1). There is 114.5% increase in the grain yield was observed with 100% RDN through neem coated urea compared to without application of nitrogen. This might be due to the slow nitrogen releasing property of neem coated urea, which made the nitrogen available for plants for a longer time and it was utilized by plants even during the reproductive phase and thus, helped the plants to produce the higher number of productive tillers that resulted in higher grain yield. Similar findings were reported by Mohapatra *et al.* (2015) [9] and Sarangi *et al.* (2016) [10].

**Straw yield (kg $ha^{-1}$)**

Highest straw yield (7812 kg $ha^{-1}$) was recorded with the application of 100% neem coated urea ($T_7$) which was on par with 100% RDN through neem coated urea + nitrification inhibitor ($T_{10}$) (7340 kg $ha^{-1}$). Lowest straw yield (4009 kg $ha^{-1}$) was recorded without the application of nitrogen ($T_1$) Control (0:60:40 kg NPK $ha^{-1}$). (Table 3 and Fig 1). There was 98% increase in the straw yield was observed with 100% RDN through neem coated urea compared to without application of nitrogen. Nitrogen influenced vegetative growth in terms of plant height and tillers $m^{-2}$ which increased straw yield. This might be due to increased nitrogen use efficiency and continuous supply of nitrogen boosting vegetative growth. Similar findings were reported by Naik *et al.* (2015) [11].

**Table 3:** Yield (kg $ha^{-1}$) and Harvest index (%) of transplanted rice as influenced by different enriched nitrogen sources

| Treatment | Yield (kg $ha^{-1}$) | | Harvest index (%) |
|---|---|---|---|
| | Grain | Straw | |
| $T_1$- Control (0:60:40 kg N:P:K $ha^{-1}$) | 3120 | 4009 | 43.7 |
| $T_2$- 75% RDN through neem coated urea | 5489 | 6371 | 46.3 |
| $T_3$- 75% RDN through enriched rice straw compost with *Trichoderma* | 3933 | 4729 | 45.3 |
| $T_4$- 75% RDN through vermicompost | 3651 | 4710 | 43.6 |
| $T_5$- 75% RDN through neem coated urea + nitrification inhibitor | 5139 | 6241 | 45.2 |
| $T_6$- 75% RDN (50% RDN through vermicompost + 25% RDN through neem coated urea + nitrification inhibitor) | 4439 | 5610 | 44.1 |
| $T_7$-100% RDN through neem coated urea | 6694 | 7812 | 46.2 |
| $T_8$-100% RDN through enriched rice straw compost with *Trichoderma* | 4345 | 5421 | 44.5 |
| $T_9$-100% RDN through vermicompost | 4117 | 5220 | 44.1 |
| $T_{10}$-100% RDN through neem coated urea + nitrification inhibitor | 6204 | 7340 | 45.8 |
| $T_{11}$-(100% RDN [50% RDN through vermicompost + 50% RDN through neem coated urea + nitrification inhibitor] ) | 5618 | 6728 | 45.5 |
| SE(m) ± | 188.9 | 206.7 | 1.25 |
| CD (p=0.05) | 557.2 | 609.7 | NS |

**Harvest index (%)**

Harvest index has not shown any significant difference due to different enriched nitrogen sources. However the harvest index ranged from 43.7% in ($T_1$) Control (0:60:40 kg NPK $ha^{-1}$) to 46.3% in 75% RDN through neem coated urea ($T_2$). (Table 3). All the treatments were found to be on par with each other with different enriched nitrogen sources. Similar findings were reported by Luna *et al.* (2017) [12].

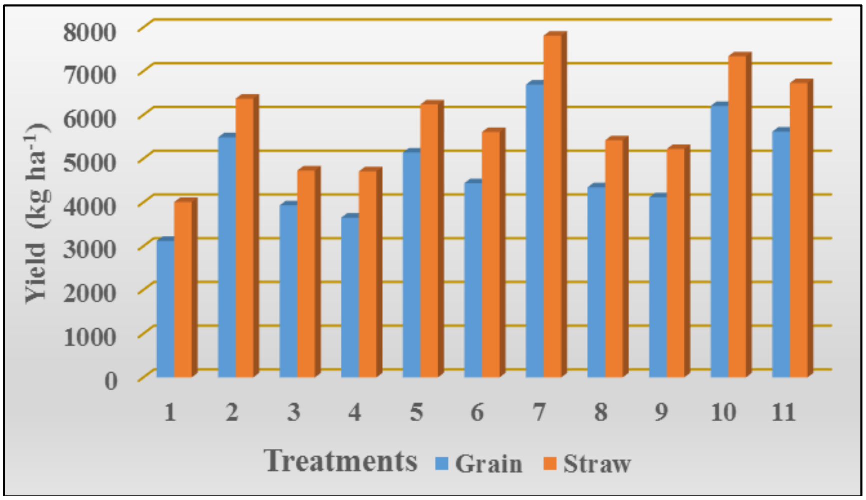


**Fig 1:** Grain and straw yield (kg ha$^{-1}$) of transplanted rice as influenced by different enriched nitrogen sources

## Conclusion

From the above results it can be concluded that application of 100% RDN through neem coated urea ($T_7$) resulted in higher number of panicle m$^{-2}$, number of filled grains panicle$^{-1}$, total number of grains panicle$^{-1}$, panicle length, grain yield and straw yield.

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