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Effect of enriched nitrogen sources at different levels on nutrient uptake of transplanted rice

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Abstract

An experiment was conducted at the research farm of the ICAR- Indian Institute of Rice Research (IIRR), Hyderabad, Telangana during *kharif* season of 2018 to know the effect of enriched nitrogen sources at different levels on nutrient uptake of transplanted rice. The treatments comprised were T₁ Control (0:60:40 kg N:P:K ha⁻¹), T₂ (75% RDN through neem coated urea), T₃ (75% RDN through enriched rice straw compost with *trichoderma*), T₄ (75% RDN through vermicompost), T₅ (75% RDN through neem coated urea + nitrification inhibitor), T₆ (75% RDN (50% RDN through vermicompost + 25% RDN through neem coated urea + nitrification inhibitor), T₇ (100% RDN through neem coated urea), T₈ (100% RDN through enriched rice straw compost with *trichoderma*), T₉ (100% RDN through vermicompost), T₁₀ (100% RDN through neem coated urea + nitrification inhibitor) and T₁₁ (100% RDN (50% RDN through vermicompost + 50% RDN through neem coated urea + nitrification inhibitor). The result showed that highest total nitrogen uptake (117 kg ha⁻¹), total phosphorus uptake (29.4 kg ha⁻¹) and total potassium uptake (97.8 kg ha⁻¹) at harvest was achieved with the application of 100% RDN through neem coated urea (T₇).

Keywords: Enriched nitrogen sources, transplanted rice, nitrogen uptake, phosphorus uptake, potassium uptake

Introduction

Rice (*Oryza sativa* L.) is an important cereal crop and a major staple food that is widely consumed all over the world. India has the largest area under rice with an average productivity of 2638 kg ha⁻¹ (India stat, 2020) [4]. Nitrogen plays a key role in crop production. It is the most limiting nutrient in non-legume cropping systems and also the least predictable one (Sarangi *et al.*, 2016) [9]. An appropriate amount of nitrogen fertilizer improves dry matter accumulation and nutrient uptake (Barlog and Grzebisz, 2004) [1]. Nitrogen in soil is lost through leaching, volatilization, surface runoff and denitrification as a result the efficiency of applied nitrogen fertilizer is only 20-50% (Shivay *et al.*, 2005) [10]. Slow release nitrogen fertilizers reduce the losses of fertilizer application, cause reduction in stress, specific toxicity and environmental pollution. (Nagabhushanam and Spandana Bhatt, 2020) [7]. Slow release nitrogenous fertilizers typically cost more than conventional formulations. Low cost alternatives to slow release fertilizers include addition of plant derived organic substances such as neem cake, neem leaf and *pongamia* extract. Many of these also inhibit denitrifying bacterial activity. (Bhalla and Devi Prasad, 2008) [2]. Application of organic manure with chemical fertilizer accelerates the microbial activity, increases nutrient use efficiency (Narwal and Chaudhary, 2006) [8] and enhances the availability of the native nutrients to the plants resulting in higher nutrient uptake. Keeping this in view, an experiment was conducted to study the effect of enriched nitrogen sources at different levels on nutrient uptake of transplanted rice.

Materials and Methods

The field experiment was conducted during *kharif* season of 2018 at the research farm of the ICAR- Indian Institute of Rice Research (IIRR), Hyderabad, Telangana. The soil of the experimental field was clay loam in texture with pH 8.2, EC 0.59 ds m⁻¹, OC 0.62%, low in available N (239 kg ha⁻¹), medium in available P₂O₅ (36 kg ha⁻¹) and high in available K₂O (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.

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Treatment details

The treatments comprised were T₁ Control (0:60:40 kg N:P:K ha⁻¹), T₂ (75% RDN through neem coated urea), T₃ (75% RDN through enriched rice straw compost with *trichoderma*), T₄ (75% RDN through vermicompost), T₅ (75% RDN through neem coated urea + nitrification inhibitor), T₆ (75% RDN (50% RDN through vermicompost + 25% RDN through neem coated urea + nitrification inhibitor), T₇ (100% RDN through neem coated urea), T₈ (100% RDN through enriched rice straw compost with *trichoderma*), T₉ (100% RDN through vermicompost), T₁₀ (100% RDN through neem coated urea + nitrification inhibitor) and T₁₁ (100% RDN (50% RDN through vermicompost + 50% RDN through neem coated urea + nitrification inhibitor).

Preparation of rice straw compost

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.* (15x10³ 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.

Nitrification inhibitor

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) [3]. The neem coated urea has been treated with karanj oil. 1 ml of karanj oil has been applied to 1 kg of neem coated urea.

Methods adopted for chemical analysis of plant samples

The method adopted for analysis of total nitrogen content, total phosphorus content and total potassium content in plant samples are Modified micro kjeldhal method, Vanado-molybdo phosphoric acid method and Flame photometer method. The nutrient uptake of nitrogen, phosphorus and potassium were computed by multiplying nutrient content of the sample with dry weight of plant samples and expressed in kg ha⁻¹. The recorded data was analysed statistically.

$$\text{Nutrient uptake} = \frac{\text{Percentage of nutrient} \times \text{Total dry matter production (kg ha}^{-1}\text{)}}{100}$$

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 Discussion

Nitrogen uptake (kg ha⁻¹)

At tillering, highest nitrogen uptake (46.2 kg ha⁻¹) was recorded with the application of 100% RDN through neem coated urea (T₇) which was on par with 100% RDN through neem coated urea + nitrification inhibitor (T₁₀) (42.8 kg ha⁻¹). Lowest nitrogen uptake (23.8 kg ha⁻¹) was recorded without application of nitrogen (Table 2). There is 94.1% increase in the nitrogen uptake was observed with the application of 100% RDN through neem coated urea compared to without application of nitrogen.

At panicle initiation, highest nitrogen uptake (84.4 kg ha⁻¹) was recorded with the application of 100% RDN through neem coated urea (T₇) which was on par with 100% RDN through neem coated urea + nitrification inhibitor (T₁₀) (79.4 kg ha⁻¹). Lowest nitrogen uptake (42.0 kg ha⁻¹) was recorded without application of nitrogen (Table 2). There is 101% increase in the nitrogen uptake was observed with the application of 100% RDN through neem coated urea compared to without application of nitrogen.

At harvest, grain and straw uptake were computed separately. Highest grain N uptake (80.3 kg ha⁻¹) was recorded with application of 100% RDN through neem coated urea (T₇) which was on par with 100% RDN through neem coated urea + nitrification inhibitor (T₁₀) (73.8 kg ha⁻¹). Lowest grain N uptake (31.8 kg ha⁻¹) was recorded without application of nitrogen (Table 2). There is 152.5% increase in the grain N uptake was observed with the application of 100% RDN through neem coated urea compared to without application of nitrogen. Highest straw N uptake (36.7 kg ha⁻¹) was noticed with application of 100% RDN through neem coated urea (T₇) which was on par with 100% RDN through neem coated urea + nitrification inhibitor (T₁₀) (33.8 kg ha⁻¹). Lowest straw N uptake (14.1 kg ha⁻¹) was recorded without application of nitrogen (Table 2). There is 160.2% increase in the straw N uptake was observed with 100% RDN through neem coated urea compared to without application of nitrogen. The total

nitrogen uptake at harvest was highest (117 kg ha⁻¹) with the application of 100% RDN through neem coated urea (T₇). Lowest nitrogen uptake (45.9 kg ha⁻¹) was recorded without the application of nitrogen (Table 2). There is 155% increase in the total N uptake was observed with 100% RDN through neem coated urea compared to without application of nitrogen. The higher nitrogen uptake might be due to slow and steady release of nitrogen from neem coated urea. Similar findings were reported by Suresh *et al.* (2008) [11] and Thind *et al.* (2010) [12]

Phosphorus uptake (kg ha⁻¹)

At tillering, highest phosphorus uptake (17.7 kg ha⁻¹) was recorded with the application of 100% RDN through neem coated urea (T₇) which was on par with 100% RDN through neem coated urea + nitrification inhibitor (T₁₀) (16.2 kg ha⁻¹). Lowest phosphorus uptake (7.9 kg ha⁻¹) was recorded without application of nitrogen (Table 3). There is 124% increase in the phosphorus uptake was observed with the application of 100% RDN through neem coated urea compared to without application of nitrogen.

At panicle initiation, highest phosphorus uptake (26.6 kg ha⁻¹) was recorded with the application of 100% RDN through neem coated urea (T₇) which was on par with 100% RDN through neem coated urea + nitrification inhibitor (T₁₀) (24.9 kg ha⁻¹). Lowest phosphorus uptake (11.4 kg ha⁻¹) was recorded without application of nitrogen (Table 3). There is 133% increase in the phosphorus uptake was observed with the application of 100% RDN through neem coated urea compared to without application of nitrogen.

At harvest, grain and straw uptake were computed separately. Highest grain P uptake (22.0 kg ha⁻¹) was noticed with application of 100% RDN through neem coated urea (T₇) which was on par with 100% RDN through neem coated urea + nitrification inhibitor (T₁₀) (21.2 kg ha⁻¹). Lowest grain P uptake (9.0 kg ha⁻¹) was recorded without application of nitrogen (Table 3). There is 144% increase in the grain P

uptake was observed with the application of 100% RDN through neem coated urea compared to without application of nitrogen. Highest straw P uptake (7.4 kg ha^{-1}) was noticed with 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}) (6.9 kg ha^{-1}). Lowest straw P uptake (3.3 kg ha^{-1}) was recorded without application of nitrogen (Table 3). There is 124% increase in the straw P uptake was observed with 100% RDN through neem coated urea compared to without application of nitrogen.

The total phosphorus uptake at harvest was highest (29.4 kg ha^{-1}) 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}) (28.1 kg ha^{-1}). Lowest phosphorus uptake (12.3 kg ha^{-1}) was recorded without the application of nitrogen (Table 3). There is 139% increase in the total P uptake was observed with 100 % RDN through neem coated urea compared to without application of nitrogen. Higher dry matter accumulation at various crop growth stages might be the reason for higher phosphorus uptake because uptake is the result of nutrient content and dry matter accumulation. Similar findings were reported by Mounika *et al.* (2017) ^[6].

Potassium uptake (kg ha^{-1})

At tillering, highest potassium uptake (32.8 kg ha^{-1}) was recorded with the application of 100 % RDN through neem coated urea (T_7). Lowest potassium uptake (15.7 kg ha^{-1}) was recorded without application of nitrogen (Table 4). There is 109% increase in the potassium uptake was observed with 100% RDN through neem coated urea compared to without application of nitrogen.

At panicle initiation, highest potassium uptake (81.0 kg ha^{-1}) 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}) (80.3 kg ha^{-1}). Lowest potassium uptake (41.1 kg ha^{-1}) was recorded

without application of nitrogen (Table 4). There is 97% increase in the potassium uptake was observed with 100% RDN through neem coated urea compared to without application of nitrogen.

At harvest, grain and straw uptake were computed separately. Highest grain K uptake (23.5 kg ha^{-1}) was noticed with 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}) (22.5 kg ha^{-1}). Lowest grain K uptake (9.8 kg ha^{-1}) was recorded without application of nitrogen (Table 4). There is 140% increase in the grain K uptake was observed with 100% RDN through neem coated urea compared to without application of nitrogen. Highest straw K uptake (74.3 kg ha^{-1}) was noticed with application of 100% RDN through neem coated urea (T_7) which was on par with 75% RDN through neem coated urea (T_2), 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}) ($65.2, 73.2$ and 66.6 kg ha^{-1}). Lowest straw K uptake (37.7 kg ha^{-1}) was recorded without application of nitrogen (Table 4). There is 97% increase in the straw K uptake was observed with 100 % RDN through neem coated urea compared to without application of nitrogen.

The total potassium uptake at harvest was highest (97.8 kg ha^{-1}) 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}) (95.7 kg ha^{-1}). Lowest potassium uptake (47.5 kg ha^{-1}) was recorded without the application of nitrogen (Table 4). There is 106% increase in the total K uptake was observed with 100% RDN through neem coated urea compared to without application of nitrogen. The higher potassium uptake might be due to synergistic effect between nitrogen and potassium which is because of higher nitrogen availability that has ultimately resulted in higher potassium uptake. Similar findings were reported by Meena *et al.* (2019) ^[5].

Table 2: Nitrogen uptake (kg ha^{-1}) of transplanted rice as influenced by different enriched nitrogen sources

Treatment	N Uptake (kg ha^{-1})				
	Tillering	Panicle initiation	Harvest		
			Grain	Straw	Total
T ₁ - Control (0:60:40 kg N:P:K ha^{-1})	23.8	42.0	31.8	14.1	45.9
T ₂ - 75% RDN through neem coated urea	36.7	72.0	65.1	32.0	97.1
T ₃ - 75% RDN through enriched rice straw compost with <i>Trichoderma</i>	33.9	56.5	45.5	22.8	68.3
T ₄ - 75% RDN through vermicompost	31.5	55.1	41.7	22.6	64.3
T ₅ - 75% RDN through neem coated urea + nitrification inhibitor	34.9	70.2	60.4	30.0	90.4
T ₆ - 75% RDN (50% RDN through vermicompost + 25% RDN through neem coated urea + nitrification inhibitor)	34.8	65.5	51.8	26.9	78.7
T ₇ -100% RDN through neem coated urea	46.2	84.4	80.3	36.7	117.0
T ₈ -100% RDN through enriched rice straw compost with <i>Trichoderma</i>	33.7	63.1	50.7	23.8	74.5
T ₉ -100% RDN through vermicompost	32.8	62.7	47.9	23.6	71.5
T ₁₀ -100% RDN through neem coated urea + nitrification inhibitor	42.8	79.4	73.8	33.8	107.6
T ₁₁ -(100% RDN [50% RDN through vermicompost + 50% RDN through neem coated urea + nitrification inhibitor])	38.5	75.2	66.5	30.3	96.8
SE(m) $\pm$	2.1	2.9	2.2	1.1	2.7
CD (p=0.05)	6.3	8.8	6.5	3.4	8.0

Table 3: Phosphorus uptake (kg ha^{-1}) of transplanted rice as influenced by different enriched nitrogen sources

Treatment	P Uptake (kg ha^{-1})				
	Tillering	Panicle initiation	Harvest		
			Grain	Straw	Total
T ₁ - Control (0:60:40 kg N:P:K ha^{-1})	7.9	11.4	9.0	3.3	12.3
T ₂ - 75% RDN through neem coated urea	13.5	17.2	15.0	5.5	20.5
T ₃ - 75% RDN through enriched rice straw compost with <i>Trichoderma</i>	9.7	13.2	11.5	4.1	15.6
T ₄ - 75% RDN through vermicompost	9.4	13.0	10.8	3.4	14.2
T ₅ - 75% RDN through neem coated urea + nitrification inhibitor	13.0	16.3	13.8	5.3	19.1

T ₆ - 75% RDN (50% RDN through vermicompost +25% RDN through neem coated urea + nitrification inhibitor)	12.8	15.2	12.7	4.7	17.4
T ₇ -100% RDN through neem coated urea	17.7	26.6	22.0	7.4	29.4
T ₈ -100% RDN through enriched rice straw compost with <i>Trichoderma</i>	11.2	16.6	14.2	5.1	19.3
T ₉ -100% RDN through vermicompost	10.8	15.1	11.9	4.8	16.7
T ₁₀ -100% RDN through neem coated urea + nitrification inhibitor	16.2	24.9	21.2	6.9	28.1
T ₁₁ -(100% RDN [50% RDN through vermicompost+ 50% RDN through neem coated urea +nitrification inhibitor])	13.4	22.8	19.0	6.0	25.0
SE(m) ±	0.7	0.8	0.6	0.2	0.6
CD (p=0.05)	2.1	2.5	1.9	0.7	1.9

Table 4: Potassium uptake (kg ha⁻¹) of transplanted rice as influenced by different enriched nitrogen sources

Treatment	K Uptake (kg ha ⁻¹)				
	Tillering	Panicle initiation	Harvest		
			Grain	Straw	Total
T ₁ - Control (0:60:40 kg N:P:K ha ⁻¹)	15.7	41.1	9.8	37.7	47.5
T ₂ - 75% RDN through neem coated urea	25.8	67.1	21.0	65.2	86.2
T ₃ - 75% RDN through enriched rice straw compost with <i>Trichoderma</i>	21.8	53.4	13.4	47.5	60.9
T ₄ - 75% RDN through vermicompost	20.4	52.8	12.5	46.7	59.2
T ₅ - 75% RDN through neem coated urea + nitrification inhibitor	24.9	63.6	18.6	64.0	82.6
T ₆ - 75% RDN (50% RDN through vermicompost+25% RDN through neem coated urea + nitrification inhibitor)	23.5	62.1	15.8	57.2	73.0
T ₇ -100% RDN through neem coated urea	32.8	81.0	23.5	74.3	97.8
T ₈ -100% RDN through enriched rice straw compost with <i>Trichoderma</i>	24.3	63.7	14.3	53.4	67.7
T ₉ -100% RDN through vermicompost	22.3	60.1	14.1	51.2	65.3
T ₁₀ -100% RDN through neem coated urea + nitrification inhibitor	30.2	80.3	22.5	73.2	95.7
T ₁₁ -(100% RDN [50% RDN through vermicompost + 50% RDN through neem coated urea + nitrification inhibitor])	25.1	73.9	20.2	66.6	86.8
SE(m) ±	0.8	2.2	0.7	3.3	3.5
CD (p=0.05)	2.5	6.6	2.3	9.9	10.5

Conclusion

From the above findings, it can be concluded that application of 100 % RDN through neem coated urea (T₇) results in highest nitrogen, phosphorus and potassium uptake. There is 155%, 139% and 106% increase in the total N, P and K uptake, respectively at harvest was observed with the application of 100% RDN through neem coated urea compared to without application of nitrogen.

References

- Barlog P, Grzebisz W. Effect of timing and nitrogen fertilizer application on winter oilseed rape (*Brassica napus* L.). Journal of Agronomy Crop Science. 2004; 190(5):314-323.
- Bhalla RS, Devi Prasad KV. Neem cake-urea mixed applications increase growth in paddy. Current Science. 2008; 94(8):1066-1070.
- Deepanjan M, Bhavesh P, Anu A, Soni D. Potential use of karanjin (3-methoxy furano-2', 3', 7, 8-flavone) as a nitrification inhibitor in different soil types. Archives of Agronomy and Soil Science. 2004; 50(4-5):455-465.
- India stat. <https://www.indiastat.com/agriculture-data/2/agricultural production/225/stats.aspx...2020>.
- Meena AK, Singh DK, Pandey PC, Nanda G. Effects of neem coated urea on yield, P and K uptake in transplanted rice (*Oryza sativa* L.) and soil chemical properties. Journal of Pharmacognosy and Phytochemistry. 2019; 8(2):999-1003.
- Mounika B, Pullarao CH, Martin LM, Prasad PRK, Ashok RY. Nutrient uptake of rice as influenced by integrated nutrient management practices. Journal of Research. ANGRAU. 2017; 45(4):16-23.
- Nagabhushanam U, Spandana PB. Effect of neem coated urea on yield attributes, yield, nutrient uptake and economics of rice (*Oryza sativa* L.) International Journal of Chemical Studies. 2020; 8(3):123-128.
- Narwal RP, Chaudhary M. Effect of long-term application of FYM and fertilizer N on available P, K and S content of soil. 18th World Congress of Soil Science, Philadelphia, from 9-15 July. Pennsylvania, USA, 2006.
- Sarangi SK, Maji B, Singh S, Srivastava AK, Singh US, Sharma DK. Nitrogen management through neem coated urea and application method further improve rice productivity in coastal flood-prone rainfed lowland. 4th International Agronomy Congress. New Delhi. 2016; 2(4):22-26.
- Shivay YS, Kumar D, Prasad R. Iron pyrites for reducing ammonia volatilization losses from fertilizer urea applied to a sandy clay loam soil. Current Science. 2005; 89(5):742-743.
- Suresh S, Swarnapriya R. Studies on bioefficacy of neem coated urea. Asian Journal of Soil Science. 2008; 3(2):333-335.
- Thind HS, Bijay S, Pannu RPS, Yadvinder S, Varinderpal S, Gupta RK *et al.* Relative performance of neem (*Azadirachta indica*) coated urea vis-a-vis ordinary urea applied to rice on the basis of soil test or following need based nitrogen management using leaf colour chart. Nutrient Cycling in Agroecosystems. 2010; 87(1):1-8.