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Growth of Transplanted Rice as Influenced by Enriched Nitrogen Sources at Different Levels

N. Prathap Reddy[1*], CH. Bharat Bhushan Rao[2], K. Surekha[3] and SA. Hussain[4]

[1]Department of Agronomy, College of Agriculture, PJTSAU, Rajendranagar, Hyderabad, Telangana- 500030, India.
[2]Department of Agronomy, Student Farm, PJTSAU, Rajendranagar, Hyderabad, Telangana-500030, India.
[3]Department of Soil Science, ICAR-Indian Institute of Rice Research, Hyderabad, Telangana-500030, India.
[4]Department of Agronomy, College Farm, PJTSAU, Rajendranagar, Hyderabad, Telangana-500030, India.

Authors' contributions

This work was carried out in collaboration among all authors. Author NPR performed the statistical analysis, wrote the protocol, wrote the first draft of the manuscript and managed the analyses of the study. Authors CHBBR and KS designed the study. Author SAH managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

The field experiment was carried out during *kharif*, 2018 at the research farm of the ICAR, Indian Institute of Rice Research (IIRR), Hyderabad (TS) to study the growth of transplanted rice as influenced by the enriched nitrogen sources at different levels. The experiment was laid out in randomized block design with eleven treatments viz., T_1 Control (0:60:40 kg N:P:K ha^{-1}), T_2 (75% Recommended Dose of Nitrogen (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

**Corresponding author: E-mail: prathapreddynaide@gmail.com;*

neem coated urea + nitrification inhibitor). From this study it can be concluded that application of 100% RDN through neem coated urea resulted in highest plant height at 90 Days after transplanting (DAT) and at harvest, tillers m^{-2} at 60 DAT and at harvest, dry matter production at 90 DAT and at harvest, SPAD meter readings at 60 DAT and 90 DAT. Similarly, lowest plant height, tillers m^{-2}, dry matter production and SPAD meter readings were recorded for control.

Keywords: Dry matter production; enriched nitrogen sources; plant height; SPAD meter readings; tillers m^{-2} and transplanted rice.

1. INTRODUCTION

Rice is the most important food crop which stands second in the world after wheat in area and production. About 91 per cent of the world's rice is grown and consumed in Asia [1]. Rice is the major cultivated crop in India with 44.1 M ha area and the production of 116.47 million tons with an average productivity of 26.38 q ha^{-1} (India stat, 2020) [2]. Recovery of applied fertilizer N in flooded rice soils is very poor due to leaching, volatilization and denitrification losses. Mismanagement of nitrogen fertilizer have impact on economic and environmental aspects of crop production [3]. Addition of nitrification inhibitors with N fertilizers helps to maintain the Nitrogen in NH_4^+ form which reduces the losses. Slow release nitrogen fertilizers reduce the losses of nitrogen by releasing small amounts of nitrogen coinciding with the crop need. Composting helps in conversion of agricultural waste into biofertilizer. Rice straw is the immediate source of organic waste available in the field. It can be degraded by *Trichoderma* spp. [4]. Keeping this in view an research was conducted on growth of transplanted rice as influenced by enriched nitrogen sources at different levels.

2. MATERIALS AND METHODS

A research trail was conducted during *kharif*, 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, low in available N (239 kg ha^{-1}), medium in available P_2O_5 (36 kg ha^{-1}) and high in available K_2O (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.

2.1 Treatment Details

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).

2.2 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.* ($15x10^3$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.

2.3 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 [5]. 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.

2.4 Weather Conditions

The weather data was recorded from the meteorological observatory located at Agricultural Research Institute, Rajendranagar, Hyderabad. The mean weekly maximum temperature during the crop growth period ranged from 27.4°C to 33.4°C while the weekly minimum temperature varied from 12.7°C to 21.6°C. The mean weekly maximum relative humidity (RH-I) during the crop growth period ranged from 78.7% to 95% while the weekly minimum relative humidity (RH-II) ranged from 31.5% to 83%. The total rainfall recorded during the crop growth period was 333.8 mm distribution over 21 rainy days. The mean weekly sun shine hours ranged from 0.6 hrs to 8.86 hrs day^{-1} and the mean pan evaporation varied from 3.3 to 6.7 mm day^{-1} and the mean wind velocity ranged from 0.9 to 13.0 km hour^{-1}.

2.5 Nitrogen Content and Quantity of Organic Manures Added

Vermicompost and rice straw compost are the organic manures used. Nitrogen content in vermicompost is 1.1% and in rice straw compost is 1.2%. The quantity of organic manure added to substitute 100% RDN is 11000 kg ha^{-1} of vermicompost and 10000 kg ha^{-1} of rice straw compost. The observations were recorded on plant height, dry matter accumulation (kg ha^{-1}), tillers m^{-2} and SPAD meter readings. The data was analysed statistically.

3. RESULTS AND DISCUSSION

3.1 Plant Height (cm)

At 90 DAT, highest plant height was recorded with (T_7) (94.9 cm). Lowest plant height (74.5 cm) was recorded for control treatment (Table 1). There was 27.3% increase in the plant height was observed with the application of 100% RDN through neem coated urea (T_7) compared to without application of nitrogen.

At harvest, highest plant height was recorded with (T_7) (98.1 cm). Lowest plant height was (76.8 cm) was recorded for control treatment (Table 1). There was 27.7% increase in the plant height was observed with the application of 100% RDN through neem coated urea (T_7) compared to without application of nitrogen. The difference in the plant height might be due to the gradual release of nitrogen through neem coated urea and maintenance of higher available nitrogen in soil throughout the crop growth period and also due to increased metabolic process and better mobilization of synthesized carbohydrates into amino acid and protein which in turn stimulated the rapid cell division and cell elongation which allowed the plant to grow faster. Suresh et al. [6] reported that application of neem coated urea in three splits recorded highest plant height. Similar findings were reported by Shivay et al. [7] and Joshna et al. [8].

Table 1. Plant height (cm) and Tillers (m^{-2}) of transplanted rice as influenced by different enriched nitrogen sources

Treatment	Plant height (cm)		Tillers (m^{-2})	
	90 DAT	At Harvest	60 DAT	At Harvest
T_1- Control (0:60:40 kg N:P:K ha^{-1})	74.5	76.8	258.8	272.0
T_2- 75% RDN through neem coated urea	88.2	91.0	325.2	340.1
T_3- 75% RDN through enriched rice straw compost with *Trichoderma*	81.5	84.4	305.8	317.4
T_4- 75% RDN through vermicompost	80.7	82.5	290.4	301.4
T_5- 75% RDN through neem coated urea + nitrification inhibitor	87.1	90.8	323.1	338.6
T_6- 75% RDN (50% RDN through vermicompost+25% RDN through neem coated urea +nitrification inhibitor)	86.6	89.8	320.3	336.1
T_7-100% RDN through neem coated urea	94.9	98.1	369.9	388.2
T_8-100% RDN through enriched rice straw compost with *Trichoderma*	82.9	85.6	312.0	325.0
T_9-100% RDN through vermicompost	82.2	84.6	297.0	312.3
T_{10}-100% RDN through neem coated urea + nitrification inhibitor	91.6	94.8	343.3	360.3
T_{11}-(100% RDN [50% RDN through vermicompost + 50% RDN through neem coated urea +nitrification inhibitor])	90.7	93.7	329.6	342.6
SE(m) ±	3.2	3.1	10.6	13.7
CD(p=0.05)	9.6	9.3	31.3	40.4

SEm: Standard Error of Mean, CD: Critical Difference

3.2 Tillers m^{-2}

Tillers are very important because the final yield is mainly a function of number of panicle bearing tillers per unit area. At 60 DAT, highest tillers m^{-2} was recorded with the (T_7) (369.9) and (T_{10}) (343.3) respectively. Lowest tiller m^{-2} (258.8) was recorded for control treatment (Table 1). There was 42.9% increase in the tillers m^{-2} with 100% RDN through neem coated urea (T_7) compared to without application of nitrogen.

At harvest, highest tillers m^{-2} was recorded for T_7 (388.2) and T_{10} (360.3) respectively. Lowest tillers m^{-2} (272) was recorded for control treatment. There was 42.7% increase in the tillers m^{-2} with 100% RDN through neem coated urea (T_7) compared to without application of nitrogen. Number of tillers at 60 DAT and at harvest was highest for (T_7) (Table 1). This might be due to adequate supply of nitrogen which resulted in better partitioning of photosynthates to the mother culm which supplies carbohydrates and their nutrient developing tillers. Similar findings were reported by Rahman et al. [9] and Saha et al. [10]

3.3 Dry Matter Production (kg ha^{-1})

At 90 DAT, highest dry matter production was recorded with T_7 (14468 kg ha^{-1}) and T_{10} (13990 kg ha^{-1}). Lowest dry matter production (7032 kg ha^{-1}) was recorded for control treatment (Table 2). There was 105% increase in the dry matter production was observed with the application of 100% RDN through neem coated urea (T_7) compared to control.

At harvest, highest dry matter production was recorded with (T_7) (14489 kg ha^{-1}) and (T_{10}) (14025 kg ha^{-1}). Lowest dry matter production (7080 kg ha^{-1}) was recorded for control treatment (Table 2). There was 104% increase in the dry matter production with 100% RDN through neem coated urea (T_7) compared to control.

Highest dry matter production at 90 DAT and harvest was resulted with (T_7). This might be due to slow rate supply of nitrogen boosting dry matter content through production of photoassimilates through leaves which is the center of plant growth during vegetative stage and later distribution of assimilates to the reproductive organs. The photosynthetic activity in plants are well reflected

Table 2. Dry matter production (kg ha^{-1}) and SPAD meter readings of transplanted rice as influenced by different enriched nitrogen sources

Treatment	Dry Matter Production (Kg Ha^{-1})		SPAD Meter Readings	
	90 DAT	AT HARVEST	60 DAT	90 DAT
T_1- Control (0:60:40 kg N:P:K ha^{-1})	7032	7080	33.5	30.2
T_2- 75% RDN through neem coated urea	11829	11881	38.4	35.4
T_3- 75% RDN through enriched rice straw compost with *Trichoderma*	8745	8764	36.7	34.1
T_4- 75% RDN through vermicompost	8467	8502	35.6	33.4
T_5- 75% RDN through neem coated urea + nitrification inhibitor	11385	11398	38.2	34.9
T_6- 75% RDN (50% RDN through vermicompost+25% RDN through neem coated urea +nitrification inhibitor)	10058	10158	37.9	34.2
T_7-100% RDN through neem coated urea	14468	14489	43.3	38.7
T_8-100% RDN through enriched rice straw compost with *Trichoderma*	9720	9788	37.1	33.8
T_9-100% RDN through vermicompost	9506	9531	36.2	33.2
T_{10}-100% RDN through neem coated urea + nitrification inhibitor	13990	14025	39.8	37.1
T_{11}-(100% RDN [50% RDN through vermicompost + 50% RDN through neem coated urea +nitrification inhibitor])	12558	12676	39.4	36.7
SE(m) ±	335.9	370.1	1.6	1.2
CD(p=0.05)	990.9	1091.7	4.7	3.7

SEm : Standard Error of Mean, CD : Critical Difference in the dry matter production. Similar findings were reported by Amrutha et al. [11], Ronanki et al. [12] and Kumari et al. [13].

3.4 SPAD Meter Readings

At 60 DAT, highest SPAD meter readings was recorded with T_7 (43.3), T_{10} (39.8) and T_{11} (39.4). Lowest SPAD meter readings (33.5) was recorded for control treatment (Table 2). There was 29.2% increase in the SPAD meter readings was observed with 100% RDN through neem coated urea(T_7) compared to control.

At 90 DAT, highest SPAD meter readings was recorded with T_7 (38.7), T_{10} (37.1) and T_{11} (36.7). Lowest SPAD meter reading (30.2) was recorded for control treatment (Table 2). The increase in SPAD meter readings was 28.1% with application of neem coated urea (T7) compared with control.

SPAD meter readings were significantly increased with the application of 100% RDN through neem coated urea. This might be due to the fact that nitrogen helps to maintain better auxin levels and presumably chlorophyll content of leaves. The results corroborate with findings of Joshi et al. [14] and Yang et al. [15].

4. CONCLUSION

The research was conducted on growth of transplanted rice as influenced by enriched nitrogen sources at different levels. It can be concluded that growth parameters like plant height, tillers m^{-2}, dry matter production kg ha^{-1}, SPAD meter readings showed significant difference when different enriched nitrogen sources were used. Application of 100% RDN through neem coated urea significantly improved the growth of transplanted rice as compared to other enriched nitrogen sources.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Dobermann A, Witt C, Abdulrachman S, Gines HC, Nagarajan R, Son TT, et al. Estimating indigenous nutrient supplies for site specific nutrient management in Irrigated Rice. Agronomy Journal. 2003; 95(4):924-935.
2. Indiastat. Available:https://www.indiastat.com/agriculture-data/2/ agricultural production/225/ stats.aspx.. 2020
3. Tubana BS, Harrell D, Walker T, Phillips S. Midseason nitrogen fertilization rate decision tool for rice using remote sensing technology. Better Crops. 2011;95(1):22-24.
4. Sannathimmappa HG, Gurumurthy BR, Jayadeva HM, Rajanna D, Shivanna MB. Effective recycling of paddy straw through microbial degradation for enhancing grain and straw yield in rice. Journal of Agriculture and Veterinary Science 2015; 8(1):70-73.
5. Deepanjan M, Pandya B, Arora A, Dhara S. 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.
6. Suresh S, Swarnapriya R. Studies on bioefficacy of neem coated urea. Asian journal of soil science. 2008;3(2):333-335.
7. Shivay YS, Prasad R, Singh S and Sharma SN. Coating of prilled urea with neem (*Azadirachta indica*) for efficient nitrogen use in lowland transplanted rice (*Oryza sativa* L.). Indian Journal of Agronomy. 2001;46(3):453-457.
8. Joshna CD, Anurag, Surekha K, Bajpai RK, Kumar R. Studies on nitrogen use efficiency in irrigated rice as influenced by various sources of nitrogen. International Journal of Chemical Studies. 2017;5(4):1278-1288.
9. Rahman MH, Ali MH, Ali MM, Khatun MM. Effect of different level of nitrogen on growth and yield of transplant aman rice CV BRRI dhan 32. International Journal of Sustainable Crop Production. 2007; 2(1):28-34.
10. Saha B, Panda P, Sarathi PP, Panda R, Kundu A, Roy S and Mahato N. Effect of different levels of nitrogen on growth and yield of rice (*Oryza sativa* L.) cultivars under terai-agro climatic situation. International Journal of Current Microbiology and Applied Sciences. 2017; 6(7):2408-2418
11. Amrutha TG, Jayadeva HM, Shilpa HD, Sunil CM. Growth and yield of aerobic rice as influenced by levels and time of application of nitrogen. Research on

Environment Life Science. 2016;9(6):655-657.
12. Ronanki S, Leela Rani P, Madhavi A, Sreenivas G, Raji Reddy D. Dry matter accumulation, partitioning and nitrogen uptake of transplanted rice under varied plant densities and nitrogen levels. Chemical Science Review and Letters. 2017;6(23):1975-1979.
13. Kumari G, Chaudhary SK. Influence of neem coated urea and micronutrients on performance of rice under aerobic condition. International Journal of Current Microbiology and Applied Sciences. 2018;7(5):2024-2035.
14. Joshi AJK, Gupta JK, Choudhary SK, Paliwal DK. Efficiency of different nitrogen source, doses and split application on growth and yield of maize (*Zea mays L.*) in the Malwa region of Madhya Pradesh. Journal of Agriculture and Veterinary Science. 2014;7(2):39-42.
15. Yang Hu, Yang J, Yamin LV, Junjun H. SPAD Values and nitrogen nutrition index for the evaluation of rice nitrogen status. Plant Production Science. 2014;7(1):81-92.

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