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Total nutrient uptake and grain yield of rice (*Oryza sativa*) as influenced by neem coated urea fertilizer

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Abstract
Rice is the world's single most important food crop, being the primary food source for more than a third of the world's population and grown on 11% of the world's cultivated area. Agronomical trial on Paddy and Wheat crops with Neem coated Urea as source of Nitrogen has produced significantly higher yield. The experiment was laid out in randomized block design with ten treatments in three replications. The application of 100% RDN as NCU in 3 splits (Basal + Max Tillering + Panicle Initiation) recorded significantly higher number of filled grains (173.0) as compared to other treatments. The unfilled grains panicle^{-1} (16.03) was recorded non-significantly highest under the treatment of 100% RDN as PU as 3 splits (Basal + Max tillering + Panicle Initiation) (T_1) as compared to all other treatments. Test weight, grain yield t ha^{-1}, total uptake were recorded non-significantly highest under the treatment of 100% RDN as NCU in 3 splits (Basal + Max Tillering + Panicle Initiation).

Keywords: RND, NCU, Basal and PI

Introduction
Rice is the world's single most important food crop, being the primary food source for more than a third of the world's population and grown on 11% of the world's cultivated area. Specially, it is important in case of Asians, Africans, and Latin Americans living in the tropics and subtropics. In these areas, population growth is high and will likely remain high at least for the next few decades and rice will continue to be their primary source of food. For India, it is estimated that the rice consumption in 2015-16 was 99.5 million tonnes and in 2025, the demand will be around 140 million tonnes and the world demand for rice is projected to increase by as much as 70% over the next 30 years. The International Rice Research Institute (IRRI, 2000) studied the food problem in relation to world population, and they predict that 800 million tons of rice will be required in 2025.

With consumption of fertilizer-nitrogen increasing from 0.6 million tonnes in 1965-66 to 16.95 million tonnes in 2014-15, India has emerged as the second largest consumer of N in the world. Since 1970s, urea is the major source of fertilizer-N; 83.1% fertilizer-N was consumed as urea in 2014-15 (Anonymous, 2015) [2]. With record urea production of 24.5 million tonnes in 2015-16, its dominance as source of fertilizer N in India is likely to continue. While urea provides the most N at the lowest cost, has no storage risks and can be used for all types of crops and soils with little or no harm to the soil, use efficiency of urea-N by different crops can be as low as 20% and it rarely exceeds 50%.

Material and Method
The study was under taken with a view to find out the Evaluation of neem coated urea fertilizer for their efficiency and its effect on increase in grain yield of rice (*Oryza sativa*)'' was conducted at the ICAR-Indian Institute of Rice Research (IIRR) Farm, Rajendranagar, Hyderabad during *kharif* season (2016-17). The experiment was laid out in randomized block design with ten treatments in three replications. The treatments comprised of T_1: 100% RDN as PU in 3 Splits (Basal + Max Tillering + Panicle Initiation); T_2:100% RDN as NCU in 3 Splits (Basal + Max Tillering + Panicle Initiation); T_3: 100% RDN as NCU in 2 Splits (Basal + Max Tillering); T_4: 100% RDN as NCU as Basal; T_5: 75% RDN as NCU in 3 Splits (Basal + Max Tillering + Panicle Initiation); T_6: 75% RDN as NCU in 2 Splits (Basal + Max Tillering); T_7: 75% RDN as NCU as Basal; T_8: NCU application based LCC readings; T_9: PU application

based LCC readings and T_{10}: Control. Filled and unfilled number of grains panicle^{-1} was determined by counting the grains in five panicles of randomly selected plants and meant heir was calculated. Sterility percentage is the proportion of number of unfilled grains per panicle to the total number of grains per panicle represented by percentage. Thousand grains were counted from the grains obtained from five randomly selected hills and the weight was recorded as test weight in grams (g). Plants in the net plot area were harvested separately in each plot threshed and grains were separated, dried under sun and the grain yield per plot was recorded after cleaning. From this yield per plot was computed and expressed as t ha^{-1}. The N, P and K uptake was also worked out multiplying concentration with respective dry weight of rice grain and straw on oven dry basis *i.e.* Nutrient uptake (kg ha^{-1}) = Concentration (%) × Dry matter yield (q ha^{-1}).

Result and Discussion

The application of 100% RDN as NCU in 3 splits (Basal + Max Tillering + Panicle Initiation) (T_2) recorded significantly higher number of filled grains (173.0) as compared to other treatments. However, it was also found at par with the treatment of 100% RDN as NCU in 2 splits (Basal+ Max Tillering) (T_3) (166.8), 75% RDN as NCU in 2 splits (Basal + Max Tillering) (T_5) (166.1), NCU based on LCC (T8) (152.2), 100% RDN as PU as 3 splits (Basal + Max tillering + Max tillering) (T_1) (147.2) and PU based on LCC (T9) (143.8). The unfilled grains panicle^{-1} (16.03) was recorded non-significantly highest under the treatment of 100% RDN as PU as 3 splits (Basal + Max tillering + Panicle Initiation) (T_1) as compared to all other treatments. Sterility percentage (10.36%) was recorded non-significantly highest under the treatment of control (T_{10}) as compared to all other treatments. The application of NCU as basal and three splits might have helped in improving the nutrient availability for prolonged period during crop growth and development stages, ultimately influenced the reproductive stages and resulted more number of grains and filled grains panicle^{-1} and test weight. The NCU supply of N as required might be the cause in for the nutrient availability for a prolonged period during crop growth and development stages ultimately it influenced the reproductive stage and resulted in more number of grain and filled grains panicle^{-1}and test weight. These findings are in agreement with Mutanal *et al.* (1997) [4], Abraham *et al*. (1975) [1] and Kumar *et al.* (2010) [3]. Test weight (23.1 g) was recorded non-significantly highest under the treatment of 100% RDN as NCU in 3 splits (Basal + Max Tillering + Panicle Initiation) (T_2) as compared to all other treatments. Grain yield (6.21 t ha^{-1}) of rice was recorded by the application of NCU applied 100% RDN as NCU in 3 splits (Basal + Max Tillering + Panicle Initiation) (T2) which was about 106% increases over control (T_{10}). However, it was at par to those of 100% RDN as NCU in 2 splits (Basal + Max Tillering) (T_3) (6.08 t ha^{-1}) and NCU based on LCC (T_8) (5.84 t ha^{-1}). Grain yield of rice in control (T_{10}) was 3.0 t ha^{-1} and the yield increased significantly in all treatments over control indicating N application has significant effect in increasing yield of rice.

The total nutrient uptake, N was significantly higher under (86.23 kg ha^{-1}) 100% RDN as NCU in 3 splits (Basal + Max Tillering + Panicle Initiation) (T_2) which was found to be at par with NCU based on LCC (T_8) (85.59 kg ha^{-1}), 100% RDN as PU in 3 splits (Basal + Max Tillering + Panicle Initiation) (T_1) (84.94 kg ha^{-1}), 75% RDN as NCU in 3 splits (Basal + Max Tillering+ Panicle Initiation) (T_5) (84.27 kg ha^{-1}) and 100% RDN as NCU in 2 splits (Basal + Max Tillering) (T_3) (80.41 kg ha^{-1}). The lowest uptake (39.35 kg ha^{-1}) was recorded under control (T_{10}). The total nutrient uptake, P was significantly higher under (39.93 kg ha^{-1}) 100% RDN as NCU in 3 splits (Basal + Max Tillering + Panicle Initiation) (T_2) which was found to be at par with NCU based on LCC (T_8) (38.13 kg ha^{-1}), 100% RDN as NCU in 2 splits (Basal + Max Tillering) (T_3) (37.32kg ha^{-1}), 75% RDN as NCU in 3 splits (Basal + Max Tillering+ Panicle Initiation) (T_5) (35.19 kg ha^{-1}) and 100% RDN as PU in 3 splits (Basal + Max Tillering + Panicle Initiation) (T_1) (34.44 kg ha^{-1}). The lowest uptake (17.88 kg ha^{-1}) was recorded under control (T_{10}). The total nutrient uptake, K was significantly highest under (149.80 kg ha^{-1}) 100% RDN as NCU in 3 splits (Basal + Max Tillering + Panicle Initiation) (T_2). The lowest uptake (68.78 kg ha^{-1}) was recorded under control (T_{10}).

Table 1: Number of filled and unfilled grain, sterility percentage, test weight, grain yield and total nutrient uptake of rice as influenced by neem coated urea fertilizer

Treatment	Number of filled grain panicle^{-1}	Number of unfilled grain panicle^{-1}	Sterility percentage (%)	Test weight (g)	Grain yield t ha^{-1}	Total nutrient uptake Kg ha^{-1}		
						N	P	K
T_1: 100% PU-(Basal+ Max. till.+PI)	147.2	16.03	6.57	22.8	5.55	84.94	34.44	132.25
T_2: 100% NCU-(Basal+ Max. till.+PI)	173.0	11.40	6.14	23.1	6.21	86.23	39.93	149.80
T_3: 100% NCU-(Basal+ Max. till.)	166.8	12.00	6.68	22.9	6.08	80.41	37.32	136.94
T_4: 100% NCU-Basal	136.3	11.50	7.91	22.3	4.47	59.71	28.69	106.76
T_5: 75%NCU-(Basal+ Max. till.+PI	166.1	12.73	7.32	22.7	5.66	84.27	35.19	134.65
T_6: 75%NCU-(Basal+ Max. till.)	144.1	11.47	7.43	22.6	4.90	68.06	30.73	113.51
T_7: 75% NCU-Basal	122.8	12.17	8.57	21.8	4.21	60.48	23.96	99.47
T_8: NCU-Basal on LCC	152.2	11.47	7.17	22.9	5.84	85.59	38.13	134.47
T_9: PU-Basal on LCC	143.8	12.70	8.82	21.2	5.47	75.84	36.06	126.27
T_{10}: Control	122.8	8.87	10.36	20.6	3.00	39.35	17.88	68.78
SEM±	10.0	1.26	0.89	1.6	0.13	2.6	1.63	4.26
CD (P=0.05)	29.8	NS	NS	NS	0.39	7.9	4.83	12.66

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