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Yield and nitrogen uptake by drill sown paddy as affected by different coatings of urea under two row spacings*

Rice (*Oryza sativa* L.) is a staple food for majority of the population in India. The demand for rice will grow in the coming decades due to potential changes in temperature, precipitation and sea level rise, as a result of global warming. According to FAO, the global rice requirement in 2025 will be of the order of 800 mt. At the moment, the production is less than 600 mt and hence an additional 200 mt needed will have to be produced by increasing productivity per unit area against the diminishing resources (Anon., 2010).

Nitrogen is one of the most important and essential nutrient which directly influences the growth, development, yield and quality of rice. Nitrogen is universally deficient in majority of the agricultural soils and successful arable farming is impossible without the use of nitrogenous fertilizers. Moreover, nitrogen fertilization aims at a high economic return of the investment through optimized crop yield and quality.

Although, nitrogen is from a quantitative point of view, the most important nutrient in crop production in comparison with phosphorus and potassium, its efficiency is low for crop production. Fertilizers upon application to soil are subjected to numerous reactions, transformations and N loss mechanisms such as ammonia volatilization, nitrification and subsequent denitrification, leaching, chemical and microbial immobilization and surface runoff. Thus quite a high proportion of the applied N is lost one way or the other. As a result, N use efficiency for crop production is discouragingly low. For upland grain crops, it hardly exceeds 50% (Roy and Chandra, 1979) and for irrigated flooded and lowland rice, it varies between 30-45 per cent (Zia and Waving, 1987). In view of the high cost of nitrogen fertilizer, it is important to improve the N utilization efficiency for crop production with the objective to reduce cost of crop production.

The growth and yield of rice plant is known to be affected quantitatively and qualitatively by plant spacing. There have been some contradictions regarding the adequate spacing for rice crops. For example, Ogbodo *et al.* (2010) reported that wider spacing produced significantly higher rice grain yield and tillers than planting at closer spacing, where as Chandrakar and Khan (1981) indicated that closer spacing for rice was superior to wider spacing in terms of straw yield, effective tillers per unit area.

A field experiment was carried out during *kharif* 2010 at Agricultural Research Station, Mugad, University of Agricultural Sciences, Dharwad. The treatments consisted of two row spacings, 20 cm (S_1) and 30cm (S_2) as main plots and seven different substances coated urea *viz.* T_1- Uncoated urea, T_2- Granulated urea, T_3- Tar coated (1 kg tar + 2 litre kerosene/ 100 kg urea) urea, T_4- Tar coated (1 kg tar + 2litre kerosene/100 kg urea) urea + Neem cake added (30 kg/100 kg urea), T_5- Tar coated (1 kg tar + 2 litre kerosene/100 kg urea) urea + Neem oil (500 ml/ 100 kg urea), T_6- Waste engine oil coated (1 litre /100 kg urea) urea and T_7- Waste engine oil coated (1 litre/100 kg urea) urea+ neem cake added (30 kg/100 kg urea) as sub plots. The experiment was carried out in clay loam soil (31.1% sand, 39.2% silt and 29.7% clay) with pH of 7.09 and 338.4 kg ha^{-1} available nitrogen, using rice variety SIRI-1253. Basal dose of fertilizers at the rate of 50:50:50 kg of N:P_2O_5:K_2O, respectively was applied through complex fertilizer containing 20:20:20 of N:P_2O_5:K_2O, respectively. Remaining 50 kg of nitrogen was applied through urea as two equal split doses one at maximum tillering stage (40 DAS) and another at panicle initiation stage (60 DAS).

The crop was harvested treatment wise at maturity. From the net plot values, the grain yield per hectare was computed. For the estimation of nitrogen in plant samples, 0.5 g of powdered samples were digested with concentrated sulphuric acid in the presence of digestion mixture ($CuSO_4$ + K_2SO_4 + Selenium powder) till it turned colourless. The digested sample was further diluted with distilled water to a known volume. Nitrogen was estimated in a Microkjeldhal unit as described by Black (1965) and nitrogen uptake by rice plant was worked out. The experimental data obtained was subjected to statistical analysis adopting Fischer's method of analysis of variance as outlined by Gomez and Gomez (1984). The results obtained from field experiment are presented in table Table 1.

Data showed that space between the rows and the application of different substances coated urea had significant influence on grain yield. The crop sown with 30 cm row spacing recorded significantly higher grain yield (54.12 q ha^{-1}) over 20 cm row spacing (49.98 q ha^{-1}). Treatment with application of tar coated (1 kg tar + 2litre kerosene/100 kg urea) urea + neem cake added @ 30 kg/100 kg urea recorded significantly higher grain yield of 55.82 q ha^{-1}. This was on par with the treatment that received used engine oil coated (1 litre/100 kg urea) urea+ neem cake added @ 30 kg/100 kg urea (54.95 q ha^{-1}). The treatment that received uncoated urea recorded the lowest grain yield (48.45 q ha^{-1}).

Yield components such as number of panicles per meter length, panicle length, panicle weight, spikelets per panicle and number of filled grains per panicle in 30 cm row spacing eventually resulted in higher grain yield as compared to 20 cm row spacing. This could be due to the wider feeding area offered by sowing with 30 cm row spacing resulting in opportunity for greater root growth, increased availability and accessibility of nutrients. This is because plants grown with wider spacing have more area of land to draw the nutrients from and compensate for the low nutrient level of the soil. The plants also were exposed more to solar radiation which encouraged superior photosynthetic process. This situation definitely increased plants uptake of nutrients and growth. Ogbodo *et al.* (2010) reported that the wider spacing produced plants with more vigorous growth and larger plant size which normally increases photosynthetic efficiency and grain yield.

The availability of required quantity of nitrogen for longer time was probably responsible for higher values for yield components in treatment receiving tar coated (1 kg tar + 2 litre kerosene/100 kg urea) urea + neem cake added @ 30 kg/100 kg urea. Further continued availability of N after panicle initiation

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Table 1. Effect of row spacing and application of urea coated with different substances on grain yield and nitrogen uptake by paddy

Treatments	Grain yield (q ha^{-1})			Nitrogen uptake (kg ha^{-1})		
	S_1- 20 cm row spacing	S_2- 30 cm row spacing	Mean	S_1- 20 cm row	S_2- 30 cm row spacing	Mean spacing
T_1- Uncoated urea	46.21	50.70	48.45	128.36	148.78	138.57
T_2- Granulated urea	49.09	53.23	51.16	141.45	160.48	150.96
T_3- Tar coated (1 kg tar + 2 litre kerosene/100 kg urea) urea	50.48	53.05	51.77	149.30	165.98	157.64
T_4- Tar coated (1 kg tar + 2litre kerosene/100 kg urea) + Neem cake added (30 kg/100 kg urea) urea	53.50	58.14	55.82	172.93	187.30	180.12
T_5- Tar coated (1 kg tar + 2 litre kerosene/100 kg urea) + Neem oil (500 ml/100 kg urea) urea	49.04	54.88	51.96	147.81	168.35	158.08
T_6- Used engine oil coated (1 litre /100 kg urea) urea	47.57	52.96	50.26	134.81	160.59	147.70
T_7- Used engine oil coated (1 litre/100 kg urea) + neem cake added (30 kg/100 kg urea) urea	53.98	55.91	54.95	159.66	179.35	169.50
Mean	49.98	54.12	52.05	147.76	167.26	157.51
For comparing means of	S.Em ±	C.D. (0.05)		S.Em ±	C.D. (0.05)	
Row spacing (S)	0.54	3.06		4.26	17.72	
Urea coatings (T)	1.16	4.44		3.41	12.97	
S X T	2.201	NS		7.79	NS	

stage has contributed to the partitioning of biomass to the reproductive parts.

The crop sown with 30 cm row spacing recorded significantly higher nitrogen uptake (167.26 kg ha^{-1}) over 20 cm row spacing (147.76 kg ha^{-1}). It might be due to favourable soil condition which enhanced nutrient uptake as well as better growth and activity of roots. Ogbodo *et al.*(2010) and Romasany and Babu (1997) reported that plants grown with wider spacing have more area of land to draw the nutrient and were exposed more to solar radiation which encouraged superior photosynthetic process. This situation definitely increased plants uptake of nutrients.

The treatment receiving tar coated urea plus neem cake added urea recorded significantly higher nitrogen uptake (180.12 kg ha^{-1}) than other treatments this could be due to prolonged availability of nitrogen in the treatment. This was on par with treatment that received used engine oil coated urea+ neem cake added (30 kg/100 kg urea) (180.12 kg ha^{-1}). The least value was recorded in the treatment received uncoated urea (138.57 kg ha^{-1}). Application of neem cake coated urea increased the percent nitrogen content and uptake of nitrogen (Jat and Pal 2002, Kumar and Prasad, 2004).

From this study it can be concluded that the crop sown with 30 cm row spacing recorded significantly higher yield as compared to 20 cm row spacing. Significantly higher uptake of nitrogen was also recorded in 30 cm row spacing. Application of tar coated and neem cake blended urea increased the grain yield and nitrogen uptake.

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