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RESPONSE OF GROWTH AND YIELD OF RICE (*Oriza Sativa* L.) TO POLYMER COATED UREA

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ABSTRACT

A pot experiment was conducted during 2014-15 in open field condition to evaluate the effect of polymer coated urea on plant growth and yield of lowland puddled rice. The result indicated highest grain and straw yield (34.33g hill^{-1}&42.75g hill^{-1}) with the application of polymer coated urea. Polymer coated urea application improved plant height, number of tillers and green leaves per hill by 8.75, 20 and 27%, respectively over urea supergranule.

KEY WORDS
Chlorophyll content
Plant growth
Polymer coated urea
Straw yield

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INTRODUCTION

Rice plays a vital role in our national food security and a means of livelihood for millions of rural household. India is largest producer, consumer and exporter of rice in the world. In India, rice is grown in 43.85 million hectare of land with total annual production of 104.8 million tonnes with an average annual productivity of 23.90 q ha^{-1} (Anonymous, 2015). However the productivity of rice is much lesser than the average world productivity of 4.6 tonnes per hectare. In general, it is recognized that availability of nitrogen and water are main plant growth limiting factors. According to Sahu and Samant (2006) hardly 30-40% of applied nitrogen is utilized by rice plant, rest of amount get lost through leaching, denitrification, volatilization and runoff. The occurrence of nitrogen deficiency has been identified as the key to the low productivity of rice in rainfed lowland ecosystem, particularly in Indo-Gangatic region. Proper and scientific method of fertilization is required to ensure maximum utilization of nitrogen applied for better crop growth and higher yield. Hence, it is essential to induce improved nitrogenous fertilizer in place of urea in rice cultivation to improve plant growth, grain yield and nitrogen use efficiency.

An ideal fertilizer supplies the nutrient required for optimum plant growth during the entire growing season (Gandeza *et al.,* 1991). Controlled Released Fertilizer is the newest and advance technique supplying adequate amount of nutrient at right time/stage and right place to sustain crop yield. Effective nitrogen management such as rate and synchronized N application with the crop requirement in real time plays an important role in increasing response to added fertilizers and thereby, improving the grain yield of rice varieties including hybrids (Ashwini *et al.* ,2015). Keeping these in view, the present investigation was carried out to evaluate the effect of polymer coated urea on plant growth and yield of lowland puddled rice.

MATERIALS AND METHODS

The present pot experiment was conducted during *kharif season* of 2014-15 at Agricultural Research Farm of Banaras Hindu University, Varanasi which lies in Indo-Gangatic plain zone. The soil of experiment site was classified in sandy clay loam texture, normal in EC (0.29 dSm^{-1}, Jackson 1973), low in organic carbon (0.38%, Walkey & Black's method 1934), low in N (179 kg ha^{-1}, Alkaline permanganate method (Subbiah and Asija, 1956)) and medium in P_2O_5 (18 kg ha^{-1}, 0.5 N $NaHCO_3$ extractable (Olsen *et al.*, 1995)), but high in K_2O (199 kg ha^{-1}, Ammonium acetate Method). The rice cultivar NDR-97 was selected for study. The experiment was conducted in Randomized Complete Block Design (RBD) comprising five treatments *i.e.* polymer coated urea (double layer and single layer), Neem Coated Urea (NCU), Sulfur Coated Urea (SCU) and urea supergranule (USG) replicated four times.

The PLA (Polylactic acid) coated urea; a biodegradable polymer was used for research. It was prepared by dipping urea granules (2g) in polylactic acid solution as it completely adhered round the granules then it was dried. Similarly sulfur coated urea was prepared by adhering sulfur powder round the urea granule in 3:1(urea: Sulfur) ratio. Open bottom cemented pots of 60 cm diameter were partially buried in soil and thereafter 25 days old healthy seedlings were planted at the spacing of 15×15cm (R×P) after mixing recommended dose of fertilizers (DAP,2.5g & MOP,2.0g per pot) and puddled the soil within the buried pots. The uncoated and coated ureas were deep placed in the center of four hills after a week of transplanting. Plants were harvested, dried in forced oven and weighted. All the parameters were taken and analyzed for individual plant using SAS statistical software.

RESULTS AND DISCUSSION

Plant growth and yield was significantly influenced by application of polymer coated urea, because of the positive correlation between temperature, release of nutrients, plant nutrient demand and plant growth (Shoji, 2005). The data on various growth parameters indicated significant difference for plant height, number of tillers and leaves per hill (Table 1).

Plant height was significantly increased in polymer coated urea double and single layer (79.89cm & 77.82cm respectively), whereas application of urea supergranule exhibited the minimum plant height (73.41cm). Significantly higher numbers of tillers (19) were recorded with application of polymer coated urea than that of the uncoated urea (16). As adequate availability of nutrient at active tillering stage results in maximum tiller production. These findings support the findings of Nash *et al.* (2013) and Yi *et al.* (2011).

The data indicated significant effect of coated urea on green leaves and its chlorophyll content (Table 2).Coated urea significantly affected the green leaves at later stage of crop growth as compared to uncoated urea i.e. 28.67, 20.03, 17.47 and 6.09% increase with PCU (double layer), PCU (single layer), NCU and SCU, respectively over USGs. Chlorophyll content (SPAD) recorded during maturity of crop was significantly higher with application of coated urea. However, the values among treatments were found to be non-significant at 30 DAT.

Coated urea controls the release of N and delays N availability to the crop continuously produces green leaves upto maturity and also improves the chlorophyll content in leaves. A study conducted by Upadhyay *et al.*, 2015 observed higher chlorophyll content in rice leaves showing higher SPAD readings.These findings are in agreement with the findings of Hatfield and Parkin (2014) and Cambouris *et al.* (2014).The data on grain and straw yield were significantly affected by polymer coated urea (Fig:1).The highest grain and straw yield (54.39g & 69.93g) per hill was observed in polymer coated urea treatment, though neem coated urea (NCU) was at par with sulfur coated urea (SCU).These findings are in close conformity with those of Ma *et al.* (2012); Nash *et al.* (2013);

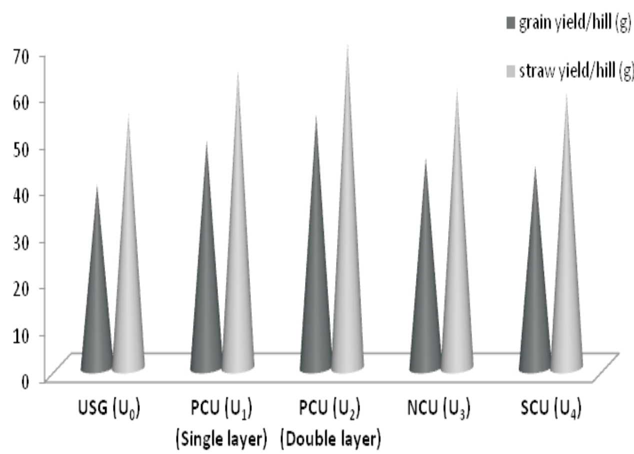

Figure 1: Effect of Polymer coated urea on Grain and Straw Yield of paddy (g hill^{-1}) in lowland cultivation

Table 1: Effect of polymer coated urea on plant height, number of tillers per hill of rice under lowland cultivation

Treatments	Source of Nitrogen	Plant Height (Cm)	No. of Tillers Per hill
U_0	Urea Supergranules (USG)	73.41	16.04
U_1	Polymer coated urea (single layer)	77.82	18.28
U_2	Polymer coated urea (double layer)	79.89	19.29
U_3	Neem coated urea (NCU)	76.21	17.00
U_4	Sulfur coated urea (SCU)	75.69	16.53
	LSD (0.05)	1.33	1.2

Table 2: Effect of polymer coated urea on number of green leaves per hill and chlorophyll content of rice under lowland cultivation

Treatments	Source of Nitrogen	Chlorophyll Content 30 DAT	At Harvesting	No. of Leaves per hill
U_0	Urea Supergranules (USG)	42.88	29.45	50.38
U_1	Polymer coated urea (double layer)	43.10	31.45	60.44
U_2	Polymer coated urea (single layer)	44.05	34.80	64.29
U_3	Neem coated urea (NCU)	43.03	30.63	59.15
U_4	Sulfur coated urea (SCU)	42.10	30.23	53.42
	LSD (0.05)	NS	2.63	3.26

Golden *et al.* (2009); Farmaha& Sim (2013). According to Fageria *et al.* (2011b), nitrogen is one of the yield limiting nutrients in rice production and it is responsible for increasing straw yield and grain yield.

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