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Response of applied neem coated urea (NCU) on yield and yield attributing parameters of rice (*Oryza sativa* L) in Vertisol

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Abstract
A field experiment was carried out during the *Kharif* season (June–October) of 2016 at the Research Farm of the Indira Gandhi Agricultural University, Raipur (C.G.), India to study the Response of applied neem coated urea (NCU) on yield and yield attributing parameters of rice (*Oryza sativa* L) in Vertisol. The experiment was laid out in a Randomized block design with three replications and eight treatments namely i.e. 100 % PU (3 splits), 75 % NCU (3 splits), 100 % NCU (3 splits), 125 % NCU (3 splits), 100 %NCU (full basal), 100 % NCU (2 splits 50%+50%), 100 % NCU (2 splits 75%+25%) and Control (N_0 P_{60} K_{40}). The results obtained in this study showed that the T_4-125% Neem coated urea performed significantly better than the other treatments for almost all the agronomic yield attributing characters (number of tillers 323, number of panicle 345, panicle length 23.3cm, filled grain per panicle147, test weight of 1000 seeds of rice 28.6gm, grain 42.5 q ha^{-1} and straw 67 q ha^{-1} yields, nutrient uptake 103 kg ha^{-1} N, 18.8 kg ha^{-1} P and 190 kg ha^{-1} K. The chemical properties of soil viz pH 7.4, Electrical conductivity 0.26dSm^{-2}, Available nitrogen 222 kg ha^{-1}, phosphorus 14.3 kg ha^{-1}, potassium 409 kg ha^{-1} was found higher in T_4–125% Neem coated urea (3 splits) and lowest was found under control treatments at harvest stage of rice.

Keywords: Rice, Nitrogen, Neem coated urea, yield

Introduction
Rice (*Oryza sativa* L.) remains the most important staple food on the planet since it feeds about half the population on a daily basis. About 750 million of the world's poorest people depend on it to survive (Zeigler 2007). In Asia, India has the largest area under rice (43.4 m ha) accounting for 29.4% of the global rice area and recorded in terms of production (104.3 million tons) with an average productivity of 2137 kg ha $^{-1}$ (Ministry of Agriculture and Farmer welfare, 2015) during 2015-16. In Chhattisgarh, rice occupies average of 3.7 million ha area with production of 7.65 million tons with average productivity 1322 kg ha^{-1} productivity 2015-16 (Department of Agriculture, Raipur 2015-16).

N is an essential plant nutrient being a component of amino acids, nucleic acids, nucleotides, chlorophyll, enzymes, and hormones. N promotes rapid plant growth and improves grain yield and grain quality through higher tillering, leaf area development, grain formation, grain filling, and protein synthesis. Nitrogen is needed in large amounts for rice and provision of adequate supply of N throughout the growing season is necessary for realizing potential yields. Fertilizer nitrogen (N) has contributed an estimated 40% to the increase in per capita food production over the past 50 years (Brown, 1999; Smile, 2002) [2, 23]. Presently 50% of human population relies on nitrogen fertilizer for food production (Ladha *et al.*, 2005) [11]. In the past decade total fertilizer nutrients consumption in Chhattisgarh state is increased from a total of 0.602 million MT in 2012-13 to 0.704 million MT during 2013-14. *Kharif: Rabi* share in total consumption changed from 69:31 in 2012-13 to 63:37 during 2013-14. NPK use ratio changed from 8.1:3.9:1 to 5.6:2.6:1 during the period. Neem oil is derived from seeds of neem (*Azadirachta indica*) contains melicians (generally known as neem bitters) of which Epinimbin, Deacetyl, Salanin and Azadirachtin are the active fractions, which showed dose dependent nitrification inhibition action (Devakumar and Goswami 1992) [3]. Neem (*Azadirachta indica*) is a tall perennial tree growing widely in the tropics and subtropics. It sheds fruit during the summer months of May to July. Seeds are collected and used for extracting oil. The cake (5 per-cents N) left after oil extraction is generally used as manure and for making neem cake-coated urea.

Nitrification inhibiting properties of neem and its role in increasing NUE in rice was first reported by Bains *et al*. (1971) [1]. They treated the urea with ethanol extract of neem seeds. Scientists at the Indian Agricultural Research Institute, New Delhi, India reported the nitrification-inhibiting properties of neem (Reddy and Prasad, 1975; Thomas and Prasad, 1983) [19, 28] and neem-cake coated urea.

Methods and Materials

A field experiment was carried out during the *Kharif* season (June–October) of 2016 at the Research Farm of the Indira Gandhi Agricultural University, Raipur (C.G.), India to study the Response of applied neem coated urea (NCU) on yield and yield attributing parameters of rice (*Oryza sativa* L) in Vertisol. The experimental site is situated in plains of Chhattisgarh at Eastern part of Raipur and it is located at $20^0 4'$ North latitude and $81^0 39'$ East longitudes and 293 m above mean sea level. The soil of experimental site is represented as a Typic chromesterts (Vertisols) (Arang-I series). It is locally called *Kanhar*. The soil is characterized by silty clay texture and moderate to slow internal drainage, medium to deep depth, and brownish gray in surface color, sub angular to angular, blocky structure and neutral in reaction. The decennial monthly minimum temperature fluctuates from 6.6 to 26.8 ^{0}C and maximum temperature from 28.5 to 44.8 ^{0}C in this region. The average annual rainfall is 1150 mm, and over 80% of this is received through northwest monsoon during July to September. The characteristics of top-soil (0–15 cm layer) at the start of experiment was neutral in reaction (pH 7.3), electrical conductivity 0.27 dSm^{-1}, soil organic carbon 0.53 %, available N 169 kg/ha (Subbiah and Asija 1956) [24], available P 12.97 kg/ha (Olsen *et al.* 1954) [14] and available K 368 kg/ha (1 N NH_4OAc-extractable K). The experiment was laid out in a Randomized block design with three replications and eight treatments namely i.e. 100 % PU (3 splits), 75 % NCU (3 splits), 100 % NCU (3 splits), 125 % NCU (3 splits), 100 %NCU (full basal), 100 % NCU (2 splits 50%+50%), 100 % NCU (2 splits 75%+25%) and Control (N_o P_{60} K_{40}). The treatment means were compared using least significant differences at 5% level of significance (Gomez and Gomez 1984).

Results and discussion

Effect of neem coated urea on Yields attributing character of rice

The application of increasing dose of N significantly increased the number of tillers in rice presented in table 1. The number of tillers m^{-2} was observed significantly higher in all the treatment over the control. In T_4-125 % NCU applied in 3 splits i.e. basal, maximum tillers and PI recorded maximum number of tillers 323 followed by T_3-100 %NCU (3 splits) 321, T_1-100 % PU (3 splits) 320 and T_6-100 % NCU (2 splits 50%+50%) 317. The lowest number of tillers was obtained from T_8-control (N_o P_{60}, K_{40}) treatment i.e. 233. Similar results were reported by Prasad *et al*. (1998) [15-16] he reported that neem-coated urea increased the total number of tillers per hill. The improvement in the formation of tillers with N application in the present experiment might be due to increase in nitrogen availability which enhanced tillering, Kumar *et al.* (2007) [7-8] and Raj *et al.* (2014) [18] also found similar findings.

The number of panicles per m^{-2} was significantly influenced by different levels of nitrogen application (Table 1). The highest number of panicle per m^{-2} was found in T_4-125 % NCU (345) applied in 3 splits Basal, Max. tiller and PI, treatment which is statistically at par with T_3-100 % NCU(3 splits) 329 followed by T_1-100 % PU (3 splits) 315, T_6-100 % NCU (2 splits 50%+50%) 314 and T_5-100% NCU (full basal) 311 and the lowest panicle per m^{-2} (210) was found in T_8 No nitrogen treated control (N_o P_{60} K_{40}) plot. Similar findings were reported by Kumar *et al.* (2015) [10] he observed that neem coated urea performed best which increased the growth and yield, plant height, number of tillers/m, numbers of panicle/hill, numbers of grains/panicle. Prasad *et al*. (1998) [15-16], Kumar *et al.* (2007) [7-8] also found similar findings. Pushpanathan *et al.* (2005) [17] found coated fertilizers improved the yield components.

There was no significant difference among the treatments in terms of panicle length of rice presented in Table 1. However, maximum panicle length was recorded 24.33cm in T_4-125 % NCU applied in 3 splits treatment followed by 23.6 cm in T_1-100 % PU (3 splits) and T_5-100 % NCU(full basal) and the lowest panicle length was found in 21.27 cm in T_8-control (N_oP_{60},K_{40}). Similar finding reported by Kumar *et al.* (2015) [10] he observed that neem coated urea performed best which increased the growth and yield, plant height, number of tillers/m, numbers of panicle/hill, panicle length, numbers of grains/panicle. Kumar *et al.* (2007) [7-8] and Raj *et al.* (2014) [18] also found similar findings.

It is revealed from the table 1. That the number of filled grains $panicle^{-1}$ was non significant difference among the treatments however higher number of filled grains $panicle^{-1}$ observed under the treatment T_4-125 % NCU applied (3 splits Basal, Max. Tiller and PI) 147 followed T_5-100% NCU (full basal) 141 and T_6-100% NCU (2splits 50%+50%) 141 treatment, and minimum was found under the T_8-control (N_oP_{60}, K_{40}) 128 treatment. Neem coated urea supply the nutrient to the plant and reduced the losses of N in soil. Similar finding was reported by Kumar *et al.* (2015) [10] observed that neem coated urea performed best which increase the growth and yield, plant height, number of tillers/m, numbers of panicle/hill, numbers of grains/panicle similar findings ware also observed by Kumar *et al.* (2007) [7-8].

The 1000 grain weight (gm) (table 1) was maximum with T_4 - 125% NCU 3split (28.6 gm), which is non significantly higher than other treatments and followed by T_5 100 % NCU (full basal) 27.9gm, T_1-100 % PU (3 splits) 27.8 gm and T_3-100% NCU (3 split) 27.7 gm and the lowest was found in T_8-control (N_oP_{60} K_{40}) 26.6 gm. Similar trend was observed for test weight as that of number of total tillers. Similarly, Pushpanathan *et al*. (2005) [17] observed that coated fertilizers improved the yield components like productive tillers, panicle length, fertile spikelet's per panicle and 1000 grain weight when applied at a proper time. These results also corroborate with the findings of Kumar *et al*. (2011) [9].

Effect of neem coated urea on Grain and straw yield of rice

Grain yield was found significantly higher (Table 2) over the control. The maximum grain yield recorded in T_4- 125% NCU (3 splits) 42.5 q ha^{-1} followed by T_3 100% NCU (3 split) 38.7 q ha^{-1}, which was statistically at par with T_2-75% NCU (3 split) and T_6-100% NCU (2 split 50%+50%) 37.7 q ha^{-1} where both treatments recorded similar yield, followed by T_1-100% PU (3 splits) 36.6 q ha^{-1}. All NCU treatments were on par and significantly superior to PU and control. The lowest yield was found 29.1q ha^{-1} in T_8-control (N_oP_{60}, K_{40}). The treatment T_4 -125% NCU (3split) recorded higher yield by 23 & 30% over 100% NCU (3split) and 100% PU (3split),

respectively. Shivay *et al*. (2000) [21] and Suganya *et al*. (2007) [25-26] also others are record more grain and straw yields from NCU application. Mangat and Narang (2004) [12] found higher crop yield obtained in paddy and wheat when NCU was applied at 100% N application and when NCU was applied at 80% level, the yield was reduced significantly. Treatment T_4-125% neem coated urea 3 splits showed the highest response with respect to straw yield ranging from 48.2 q ha^{-1} to 76 q ha^{-1} (table 2) The application of different doses of neem coated urea and prilled urea significantly increased the straw yield of rice. The maximum straw yield was recorded 76 q h^{-1} in T_4- 125% NCU (3 splits) followed by 61.8 q ha^{-1} in T_3 100% NCU (3 split), 59.6 q ha^{-1} in T_2-75% NCU (3 split) and T_6-100% NCU (2 splits 50%+50%) both having similar yield and the lowest (48.2 q h^{-1}) in T_8-control (N_o P_{60} K_{40}) plot. Nitrogen influenced vegetative growth in terms of plant height and number of tillers m^{-2} which increased straw yield. It might be due to the increased nitrogen use efficiency and continuous supply of nitrogen boosting vegetative growth. Singh and Shivay (2003) [22] found significantly higher grain and straw yield as compared to prilled urea. Sarangi *et al*. (2016) [20] also found similar results. Mangat and Narang (2004) [10] found 100% recommended levels of neem coated urea gave significantly higher yield in wheat but when NCU was applied at 80% level, the yield was reduced significantly.

Effect of neem coated urea (NCU) on nutrient uptake in Rice

The total N, P and K uptake (table 3) was significantly higher in T_4-125 % NCU (3 splits). In case of nitrogen, maximum uptake was found in T_4-125 % NCU (3 splits) 103kg ha^{-1} followed by T_3 100%NCU (3 split) 85.4kg ha^{-1},T_6 -100% NCU (2 splits 50%+50%) 83 kg ha^{-1} and T_5-100% NCU (full basal) 78.2 kg ha^{-1} recorded higher total nitrogen uptake and lowest from T_8-control (N_o P_{60},K_{40}) 49.2 kg ha^{-1}.Phosphorus uptake was recorded significantly higher in T_4-125 %NCU (3 splits) 18.8 kg ha^{-1} followed by T_6-100% NCU (2 splits 50%+50%) 14.8 kg ha^{-1} which was statistically at par with T_7-100% NCU (2 splits 75%+25%) 14.5 kg ha^{-1}, T_3-100% NCU (3split) 13.6 kg ha^{-1}, T_6 100% NCU (2splits 50%+50%) 13.5 kg ha^{-1} and T_1 100% PU (3split) 13.2 kg ha^{-1}. The lowest phosphorus uptake was recorded from T_8-control (N_o P_{60}, K_{40}) 10 kg ha^{-1}. The range of total K uptake was from 111.7 kg ha^{-1} to 190 kg ha^{-1}. The total uptake of potassium was seen more in the sites which is significantly higher in the order of T_4 (190 kg ha^{-1}) > T_2 (151.3 kg ha^{-1}) > T_7 (148 kg ha^{-1}) > T_3 (147.2 kg ha^{-1}) > T_6 (139.2 kg ha^{-1}) and the lowest K uptake was found in T_8-control (N_o P_{60} K_{40}) 111.7 kg ha^{-1}. The balanced nutrition led to better uptake of all the nutrients. Raj *et al*. (2014) [18] found that neem cake blended urea maintained high available N status in the soil compared to other slow release forms of urea. Prilled urea maintained lower N status. With regard to different N source, neem cake blended urea recorded the highest uptake and prilled urea recorded the lowest uptake. Upadhyay and Tripathi (2000) [29], Shivay *et al*. (2000) [21] and Thind *et al*. (2010) [27] also found superiority of NCU over ordinary urea in N uptake and nitrogen use efficiencies.

Effect of neem coated urea on Soil chemical properties

A study on soil pH (Table 4) revealed that soil pH was non-significant in all the stages. Maximum pH was found in T_5-100% NCU (full basal) 7.6 followed by T_4–125% NCU (3 split) and T_7-100% NCU (2 split) 7.5 at 30 DAT. At 60 DAT maximum pH was found in T_4-125% NCU (3 split) 7.5 followed by T_6-100 % NCU (2 splits 50%+50%) and after harvest stage maximum pH was found in T_4 125% NCU (3 split) 7.4 followed by T_3-75% NCU 3 split 7.37. The lowest pH was found at all stage under treatment T_8-Control (N_o P_{60} K_{40}) 7.3, 7.2 & 7.2. The total soluble salt content expressed as electrical conductivity (EC) was found significantly higher in T_4-125% NCU (3 split) 0.26 dSm^{-2} followed by T_7-100% NCU (2 split) 0.25 dSm^{-2} at 30 DAT. At 60 DAT T_5–100% NCU (full basal) 0.26 dSm^{-2} found higher EC followed by T_4-125% NCU (3 split) 0.24 dSm^{-2} and after harvest stage EC was found non-significantly higher in T_4-125% NCU (3 split) 0.26 dSm^{-2} followed by T_7-100% NCU (2 splits 75%+25%) and T_2-75 % NCU (3 split) 0.24 dSm^{-2}. The lowest EC was found under treatment T_8-Control (N_o P_{60} K_{40}) at all stage (0.20dSm^{-2}, 0.21dSm^{-2} & 0.23dSm^{-2}). Soil organic carbon was found significantly higher (table 4) in T_4 125% NCU (3 split) 0.58% followed by T_7 0.57%, T_3 & T_6 0.5.6% was found similar percentage of organic carbon at 30 DAT. At 60 DAT organic carbon was found non-significantly higher in T_4 125% NCU (3 split) 0.62 % followed by T_3-100% NCU (3 split) and T_5 0.61% soil organic carbon and after harvest stage maximum organic carbon in T_4-125% NCU (3 split) 0.55 % followed by T_7-100% NCU (2 split 75%+25%) and T_5-100 % NCU (full basal) 0.5.4%. The lowest OC was found treatment T_8-Control (N_o P_{60} K_{40}) at all stage under (0.51%, 0.57% & 0.50%). It is observed from the table 5, that available nitrogen in soil was found significantly higher in treatment T_4-125 % NCU (3 splits) 217 kg ha^{-1} followed by T_3-100 % NCU (3 splits) 197 kg ha^{-1}, T_1-100 % PU (3 splits) 174 kg ha^{-1} and T_7-100% NCU (2splits 75%+25%) 180 kg ha^{-1} at 30 DAT of rice. At 60DAT, the available nitrogen was found significantly higher in T_4 226 kg ha^{-1} followed by T_3 -201 kg ha^{-1}, T_6 197 kg ha^{-1} and T_7 188 kg ha^{-1} and after harvest stage available nitrogen was found non-significantly higher under treatment T_4 222 kg ha^{-1} followed by T_3 192 kg ha^{-1}, T_5 176 kg ha^{-1}, T_1 176 kg ha^{-1} and T_2 171kg ha^{-1}. The lowest available nitrogen was found under treatment T_8-Control (N_o P_{60}, K_{40}) at all stages (155 kg ha^{-1}, 151 kg ha^{-1} and 146 kg ha^{-1}). Similar finding was reported by Murthy *et al.* (2014) [13] resulted post harvest soil nutrient status revealed that, incremental doses of N by 50 % and above only improved the status of organic carbon and available N over initial value. Kashiri *et al.* (2013) [5] resulted essential oil coated urea maintained a higher availability of N for a longer time as also similarly reported by Kumar *et al.* (2015) [10].

It is revealed from the table 5. that available phosphorous in soil was found non-significantly higher in treatment T_4-125 % NCU (3 splits) 17.71 kg ha^{-1} followed by T_5-100 %NCU(full basal) 16.93 kg ha^{-1}, T_3-100 % NCU (3 splits) 16.73 kg ha^{-1} and T_1-100 % PU (3 splits) 16.34 kg ha^{-1} at 30 DAT of rice. At 60 DAT, available phosphorous was found significantly higher in T_4 15.32 kg ha^{-1} followed by T_6- -100 %NCU (2splits 50%+50%) 15.23 kg ha^{-1}, T_3 12.69 kg ha^{-1} and T_1 100% PU (3split) 12.57 kg ha^{-1} and after harvest stage available phosphorus was found non-significantly higher under treatment T_4 14.25 kg ha^{-1} followed by T_6 13.59 kg ha^{-1}, T_5 13.29 kg ha^{-1} and T_1-100 % PU (3 splits) 12.72 kg ha^{-1} and T_3 12.07 kg ha^{-1}. The lowest available phosphorus was found under treatment T_8-Control (N_o P_{60} K_{40}) at all stages (14.78 kg ha^{-1}, 9.98 kg ha^{-1} and 10.57 kg ha^{-1}). Similar finding was reported by Krishnamurthy *et al.* (2010) [6] and he that found at medium P- fertility level (20-30 kg P_2O_5 ha^{-1}) was exhibiting higher grain yield response. Similarly Murthy *et al.* (2014) [13] the status of available P_20_5 was unaffected by

incremental doses of N P and K, also similarly reported by Kumar *et al*. (2015) [10].

Available potassium content in soil was found significantly higher (table 5) in treatment T_4-125 % NCU (3 splits) 439 kg ha^{-1} followed by T_3-100 % NCU (3 splits) 432 kg ha^{-1} and T_7-100 % NCU (2 splits75%+25%) 427 kg ha^{-1} at 30 DAT of rice crop. At 60 DAT of available K was found significantly higher in T_4 410 kg ha^{-1} followed by T_3 405 kg ha^{-1} and T_1 404 kg ha^{-1} and after harvest stage available potassium was found non-significantly higher under treatment T_4-125 % NCU (3splits) 409 kg ha^{-1} followed by T_3 and T_7 both having 406 kg ha^{-1}. The lowest available potassium content was found under treatment T_8-Control (N_o P_{60} K_{40}) at all stage (407kg ha^{-1}, 390 kg ha^{-1} and 388 kg ha^{-1}). Similar finding was reported by Murthy *et al.* (2014) [13] also reported by Kumar *et al*. (2015) [10].

Table 1: Effect of neem coated urea on the yield contributing characters of rice

Treatment	Number of tillers m^{-2}	No. of panicle m^{-2}	Panicle length (cm)	Filled grain/ panicle	Test weight (gm)
T_1 100 % PU (3 splits)	320	315	23.7	129	27.8
T_2 75 % NCU (3 splits)	311	295	22.0	130	27.5
T_3 100 % NCU(3 splits)	321	329	23.0	133	27.7
T_4 125 % NCU(3 splits)	323	345	24.3	147	28.6
T_5 100 % NCU (full basal)	317	311	23.7	141	27.9
T_6.100%NCU (2split 50%+50%)	317	314	22.0	141	27.1
T_7 100%NCU (2split 75%+25%)	309	306	22.7	139	27.3
T_8. Control (N_o P_{60} K_{40})	233	210	21.3	128	26.6
CD (P=0.05%)	8.46	1.13	NS	NS	NS

Table 2: Effect of neem coated urea (NCU) on grain and straw yield of rice

Treatment	Grain Yield (q ha^{-1})	Straw yield (q ha^{-1})
T_1 100 % PU (3 splits)	36.7	58.7
T_2 75 % NCU (3 splits)	37.2	59.6
T_3 100 %NCU(3 splits)	38.6	61.8
T_4 125 % NCU(3 splits)	42.5	76.0
T_5 100 % NCU (full basal)	36.7	58.7
T_6.100%NCU (2split 50%+50%)	37.2	59.6
T_7 100%NCU (2split 75%+25%)	35.6	56.9
T_8. Control (N_o P_{60},K_{40})	29.7	48.2
CD (P=0.05%)	2.28	3.72

Table 3: Effect of Neem coated urea on nutrient uptake in rice

Treatment	Total nutrient uptake (kg h^{-1})		
	Nitrogen	Phosphorus	Potassium
T_1 100 % PU (3 splits)	77.5	13.2	136.5
T_2 75 % NCU (3 splits)	74.3	12.6	151.3
T_3 100 %NCU(3 splits)	85.4	13.6	147.2
T_4 125 % NCU(3 splits)	103.0	18.8	190.0
T_5 100 % NCU (full basal)	78.2	14.8	139.2
T_6.100%NCU (2split 50%+50%)	83.0	13.5	143.2
T_7 100%NCU (2split 75%+25%)	75.4	14.5	148.1
T_8. Control (N_o P_{60} K_{40})	49.2	10.0	111.7
CD (P=0.05%)	7.07	2.46	11.15

Table 4: Effect of neem coated urea (NCU) on the soil pH, Electrical conductivity and organic carbon at different growth stages and after harvest of rice

Treatment	Soil pH			Electrical conductivity (dSm^{-2})			Organic carbon (%)		
	30 DAT	60 DAT	After harvest	30 DAT	60 DAT	After harvest	30 DAT	60 DAT	After harvest
T_1 100 % PU (3 splits)	7.3	7.37	7.3	0.23	0.23	0.23	0.54	0.60	0.52
T_2 75 % NCU (3 splits)	7.3	7.30	7.3	0.21	0.23	0.25	0.52	0.59	0.53
T_3 100 %NCU(3 splits)	7.4	7.4.3	7.3	0.24	0.22	0.24	0.56	0.61	0.52
T_4 125 % NCU(3 splits)	7.5	7.47	7.4	0.26	0.24	0.26	0.58	0.62	0.55
T_5 100 % NCU (full basal)	7.6	7.37	7.3	0.23	0.26	0.23	0.56	0.61	0.54
T_6.100%NCU (2split 50%+50%)	7.4	7.43	7.2	0.24	0.22	0.24	0.55	0.56	0.53
T_7 100%NCU (2split 75%+25%)	7.5	7.27	7.3	0.25	0.23	0.25	0.57	0.59	0.54
T_8. Control (N_o P_{60},K_{40})	7.3	7.2	7.2	0.20	0.21	0.23	0.51	0.57	0.50
CD (P=0.05%)	NS	NS	NS	0.018	0.023	NS	0.043	NS	NS

Table 5: Effect of neem coated urea (NCU) on the available major nutrient at different growth stages and after harvest of **rice**

Treatment	Available Nitrogen (Kg ha^{-1})			Available Phosphorus (Kg ha^{-1})			Available Potassium (Kg ha^{-1})		
	30 DAT	60 DAT	After harvest	30 DAT	60 DAT	After harvest	30 DAT	60 DAT	After Harvest
T_1 100 % PU (3 splits)	184	180	176	16.3	12.6	12.7	421	404	402
T_2 75 % NCU (3 splits)	167	176	171	15.2	11.7	11.2	397	391	393
T_3 100 %NCU(3 splits)	197	204	192	16.7	15.0	12.1	432	405	406
T_4 125 % NCU(3 splits)	217	226	222	17.7	15.3	14.3	439	410	409
T_5 100 % NCU (full basal)	180	178	176	16.9	12.2	13.3	413	401	397
T_6. 100 % NCU (2 splits 50%+50%)	170	197	163	16.1	12.7	13.6	407	390	398
T_7 100 % NCU (2 splits 75%+25%)	172	188	163	16.3	11.4	12.6	427	391	406
T_8. Control (N_o P_{60},K_{40})	154	151	145	14.8	10.0	10.6	407	390	388
CD (P=0.05%)	21.23	22.29	NS	NS	1.37	NS	25.15	9.85	NS

Conclusions

The yield attributing growth parameters i.e. number of tillers m^{-2}, Number of panicle m^{-2}, panicle length (cm) and filled grain per panicle and 1000 grain weight of rice was observed highest under the treatment T_4-Neem coated urea 125 % (3 split).Grain and straw yield of rice was found significantly higher under treatment T_4-125% NCU (3split) Followed by T_3 100 %NCU (3 splits) and minimum was recorded under T_8-(N_0, P_{60} & K_{40}) in control plot.Total uptake of Nitrogen, Phosphorus and Potassium by plant was higher in T_4-125 %NCU (3split), followed by T_3 100 %NCU (3 splits) and minimum was found under control plot. Similar trends were observed in Nitrogen efficiency and agronomic efficiency was found higher under T_4-Neem coated urea 125 % and T_2 75 %NCU (3 splits), respectively. The soil nutrient status was improved by application of neem coated urea. The results indicated that the available nitrogen, Phosphorus, Potassium and micronutrient status was observed higher under T_4-Neem coated urea 125 %.

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