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Effect of neem coated urea under different nitrogen application schedule on physio chemical properties of soil in transplanted rice (*Oryza sativa* L.)

Shriman Kumar Patel, Sneha and Yogesh Kumar

Abstract

Nitrogen is an important macronutrient for plant function and key component of amino acids, which form the building blocks of plant proteins and enzymes. The field experiment to determine "Effect of neem coated urea under different nitrogen application schedule on physio chemical properties of soil in transplanted rice" was conducted at the Crop Research Centre of Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut (U.P.) the Kharif season of 2016. The experiment was carried out with eleven treatments and three replication comprising T_1-control (No N), T_2-50:25:25 N, T_3-33:33:33 N, T_4-25:25:50 N, T_5-25:50:25 N, T_6-00:50:50 N, T_7-00:75:25 N, T_8-00:25:75 N, T_9-50:50:00 N, T_{10}-50:00:50 N through neem coated urea as basal, at maximum tillering and panicle initiation stage and T_{11}-LCC based (≤ 4 critical value) and estimated in a randomized block design. The result revealed that the application of nitrogen through neem coated urea under different nitrogen application schedule did not show significant effect on soil physical (bulk density, moisture content, water holding capacity and infiltration rate) properties. The application of nitrogen through neem coated urea 25% at basal, 50% at tillering stage and 25% at panicle initial stage, respectively improve soil nutrient status like available nitrogen, phosphorus and potassium in soil.

Keywords: Bulk density, moisture content, water holding capacity

Introduction

Rice as a staple food crop plays important role in food as well as nutritional security in particularly in India. The slogan "Rice is life" is most proper where it plays a pivotal role in food security and is a means of livelihood for millions of rural households. In India, the national food security system mostly depends on the productivity of the rice ecosystem. The effect of nitrogen (N) on crops is profound, however, most understanding of crop growth responses to this element is empirical. An appropriate amount of nitrogen fertilizer encourages photosynthesis in rice (Hussain *et al*., 2016) [6]. Nitrogen is an essential element to sustain the normal life activities of plants. Nitrogen is not only the basic element of plants but also the nutrient needed for plant growth. Adequate nitrogen is an essential condition for cell division, and whether the nitrogen supply is sufficient or not is directly related to organ differentiation, formation, and tree structure formation. When urea is applied to the soil, a cascade of chemical and biological reactions transforms urea-N into several other N forms, of which some are susceptible to lose and therefore lead to reduced availability of N to crop plants. The most notable two broad categories of transformations are (i) hydrolysis of urea by urease enzyme which rapidly converts urea-N to ammonium-N and (ii) nitrification brought about by a group of nitrifying bacteria that leads to conversion of ammonium N to nitrate-N. Based on the performance of NCU in studies carried out with several crops in different parts of the country, the Government of India allowed urea manufacturers to coat granular urea with neem oil to produce NOCU up to 35 percent of the total capacity of their plants. Nitrogen is an essential element to sustain the normal life activities of plants. Nitrogen is not only the basic element of plants but also the nutrient needed for plant growth. Adequate nitrogen is an essential condition for cell division, and whether the nitrogen supply is sufficient or not is directly related to organ differentiation, formation, and tree structure formation. Recently with the decision of the government of India in 2015 to produce the entire amount of urea produced in the country as NCU, there is a need to quantify its rate of application in transplanted rice. In addition, altering the split doses according to the crop growth stages may synchronize the supply of nitrogen with that of the plant demand, and help augment yield, P, and K uptake.

But there is a lack of information regarding the dose and split schedule of neem coated urea under different nitrogen application schedules in transplanted rice. Hence, the present study was undertaken with the objective to study the different nitrogen application schedules on physiochemical properties of soil in transplanted rice.

Material and Methods

Experimental site

The experiment was conducted with eleven treatments and replicated three times with a randomized block design. Each plot size was of 5 m × 3 m. The crop was grown during kharif seasons of 2016. The experimental site is located at latitude of 290 40′ North and longitude of 770 42′ East and at an altitude of 237 metre above mean sea level (MSL) of the crop research centre Chirauri of Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut (U.P.), India.

Treatments details

The eleven treatments were as follows: T_1 control (No N), T_2 (50:25:25 N), T_3 (33:33:33 N), T_4 (25:25:50 N), T_5 (25:50:25 N), T_6 (00:50:50 N), T_7 (00:75:25 N), T_8 (00:25:75 N), T_9 (50:50:00 N), T_{10} (50:00:50N) through neem coated urea as basal, at maximum tillering and panicle initiation stage and T_{11}LCC based (≤ 4 critical value). Nitrogen was applied through neem coated urea purchases from market.

Cultivation methods

The rice variety used in this experiment was Pusa Bashmati-1, which is an indica variety. The required quantities of NP and K were applied in the different treatments by neem coated urea, Single super phosphate and Muriate of potash. Half dose of nitrogen and full dose of other nutrients (as per treatments) was applied as basal and rest nitrogen was applied in two equal splits at tillering and panicle initiation stages.

Data collection and analysis

Soil samples from a depth of 0-15 cm were collected from each plot of the experimental field prior to transplanting and a composite sample was drawn for determining its physical and chemical properties. The characteristics of top soil (0-15 cm soil layer) at the start of experiment was neutral in reaction (pH 7.8), electrical conductivity (0.20 dSm^{-1}), soil organic carbon (0.43%), available N (203.37 kg/ha), available P (10.87 kg/ha) and available (K 231.43 kg/ha) were estimated by combined glass electrode pH meter method, Walkley and Black's rapid titration method, Alkaline potassium permanganate method (Subbiah and Asija 1956) [4], Olsen's method (Olsen *et al*. 1954) [2] and 1 N NH_4OAc (Hanway and Heidal, 1952) [5], respectively. The treatment means were compared using least significant differences at 5% level of significance (Gomez and Gomez 1984) [1].

Results and discussion

Physical properties of soil

The physical properties of soil (bulk density, moisture content, water holding capacity and infiltration rate) of the soil at harvest stage of experimental field are presented in table 1. The result showed the soil of experimental is mean value bulk density (1.45), water holding capacity (41.30), infiltration rate (3.31) and moisture content (16.50) of soil did not vary at harvesting stage of transplanted rice due to the application of different nitrogen application schedule through neem coated urea.

Table 1: Effect of different nitrogen application schedule on physical properties of soil

Treatments	Bulk density g cm^{-3}	Moisture content (%)	Water holding capacity (%)	Infiltration rate (cm hr^{-1})
T_1 Control (No N)	1.43	16.23	41.45	3.21
T_2 50:25:25 N	1.44	16.43	41.85	3.32
T_3 33:33:33 N	1.45	16.62	40.64	3.43
T_4 25:25:50 N	1.42	16.86	41.54	3.27
T_5 25:50:25 N	1.44	16.53	40.43	3.28
T_6 00:50:50 N	1.49	16.32	41.79	3.37
T_7 00:75:25 N	1.46	16.53	41.54	3.32
T_8 00:25:75 N	1.43	16.31	41.09	3.34
T_9 50:50:00 N	1.44	16.62	41.27	3.29
T_{10} 50:00:50 N	1.47	16.87	41.85	3.32
T_{11} LCC Based (4 ≤ Critical value)	1.45	16.21	40.89	3.31
Mean	1.45	16.50	41.30	3.31
CD at 5%	NS	NS	NS	NS

Chemical properties of soil

The data presented in fig.-1. The application of different nitrogen application schedule through neem coated urea on soil pH did not significant effect at harvest stage of rice transplanted soil. Highest soil pH was recorded in soil sample with the application of 25:50:25 N through neem coated urea as basal, at maximum tillering and panicle initiation, respectively (T_5). Minimum soil pH 7.18 was found in control. At harvesting stage of rice crop, organic carbon in soil under different treatments varied from 3.84 to 4.41 g kg^{-1}. The maximum organic carbon of 4.41 g kg^{-1}, statistically *at par* to T_4 and T_{11} and significantly higher than the remaining treatments was found in T_5 where the 25:50:25 N through neem coated urea as basal, at maximum tillering and panicle initiation was applied. The minimum organic carbon (3.84 g kg^{-1}) found under control was statistically *at par* to T_{10}, T_7 and significantly lower than all the remaining treatments. The organic carbon content in soil with the recommended N application schedule (T_2) and 50% N as basal and rest through LCC (≤ 4) also differed significantly. Organic carbon in soil was also comparatively higher in T_3 and T_4.

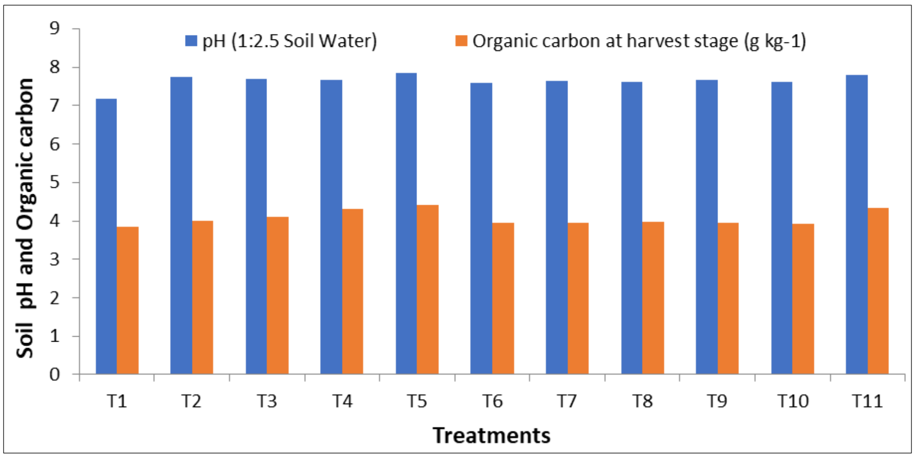

Fig 1: Effect of different treatments on pH and organic carbon at harvesting stage in surface soil

Available N (kg ha^{-1})

The data related to available nitrogen as affected by different nitrogen levels treatments at different stage were presented in Fig. 2. The available nitrogen in soil decreases gradually with the advancement of crop growth in all the treatments. Fig. 2. Shows that the available nitrogen recorded significantly highest (140.53 kg ha^{-1}) at tillering stage in comparison to (138.45 kg ha^{-1}) at panicle initiation and (133.38 kg ha^{-1}) at harvest stage of rice crop, respectively. The treatment (T_5) received the application of N application schedule 25% N as basal, 50% at maximum tillering and 25% N at panicle initiation stage found the maximum available nitrogen followed by T_3 (nitrogen through neem coated urea 33% N as basal, 33% at maximum tillering and 33% N at panicle initiation stage), T_{11} (LCC based (4 critical value), T_2 (50:25:25 N), T_4 (25:25:50 N), T_9 (50:50:0 N), T_{10} (50:0:50 N) and T_7 over control respectively. The use of 50% N as basal and rest through LCC (≤ 4) also recorded significantly maximum available nitrogen as compared to the existing recommendation (T_2). At panicles initiation and harvesting stage the application of 25% N through neem coated urea as basal, 50% at maximum tillering and 25% panicle initiation stage (T5) resulted into maximum available nitrogen in soil. It might be due to delayed N application through NCU. Higher nitrogen availability can also be described due to slightly higher organic carbon content which is an index of nitrogen availability.

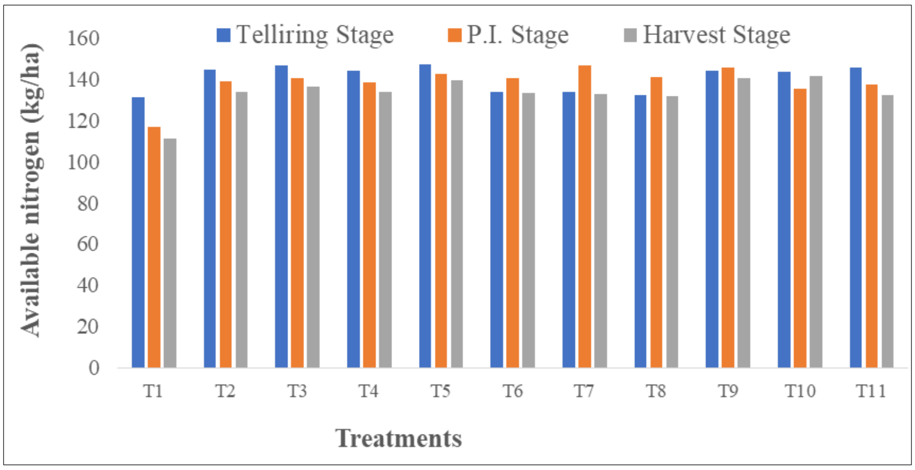

Fig 2: Effect of different treatments on available nitrogen (kg ha^{-1}) at various stages

Available P (kg ha^{-1})

The available phosphorus in soil declines gradually with the advancement of crop growth in all the treatments at harvest stage depicted in Fig. 3. At tillering stage, available phosphorus in soil under different treatments diverse from 10.21 to 13.96 kg ha^{-1}. The highest available phosphorus 13.96 kg ha^{-1} statistically *at par* to T_2, T_4, T_{11} and significantly higher than the remaining treatments was found in T_5 (25:50:25 N through neem coated urea as basal, at maximum tillering and panicle initiation. respectively). Phosphorus availability improve significantly over (T_2) due to application of 50% N as basal through neem coated urea and rest through LCC (≤ 4). At harvesting stage, available phosphorus in soil under different nitrogen level treatments varied from 9.85 to 12.21 kg ha^{-1}. The maximum available phosphorus (12.21 kg ha^{-1}) found with 25:50:25 N through neem coated urea as basal, at maximum tillering and panicle initiation. Respectively (T_5) was followed by T_3 (33:33:33 N through neem coated urea as basal, at maximum tillering and panicle initiation stage) over control respectively. Available phosphorus in soil increased initially and reached to maximum at PI stage, thereafter reduced to lowest value at harvesting in all the treatments. Higher availability of phosphorus at panicle initiation stage may be supposed due to reduction process owing to submergence. Highest available phosphorus at maximum tillering and PI stage could be ascribed to higher organic matter content in this treatment, which may reduce the fixation of phosphate by providing protective cover on sesquioxide and chelating cations responsible for fixation (Singh *et al*., 2008) [3]. Treatment T_5 recorded maximum available phosphorus at harvesting, it may be attributed to the effect of organic acids released due to mineralization of crop residues.

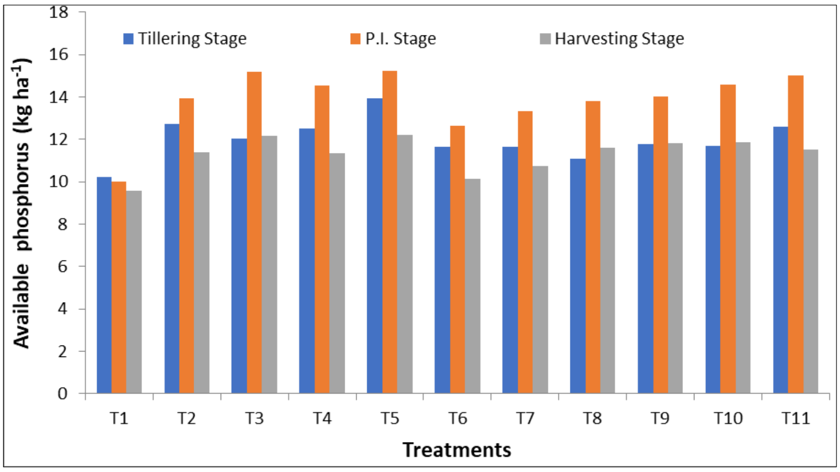

Fig 3: Effect of different treatments on available phosphorous (kg ha^{-1}) at various stages

Available K (kg ha^{-1})

Perusal of the data presented in fig. 4. The available potassium in soil decreases gradually the advancement of crop growth in all the treatments with the application of different nitrogen levels treatments. The highest available potassium was found (230.95kg ha^{-1}) under the treatments T_{11} (50% N as basal and rest through LCC) followed by $T_5>T_3>T_4>T_9>T_{10}>T_2>T_7>T_8$ and over control respectively.

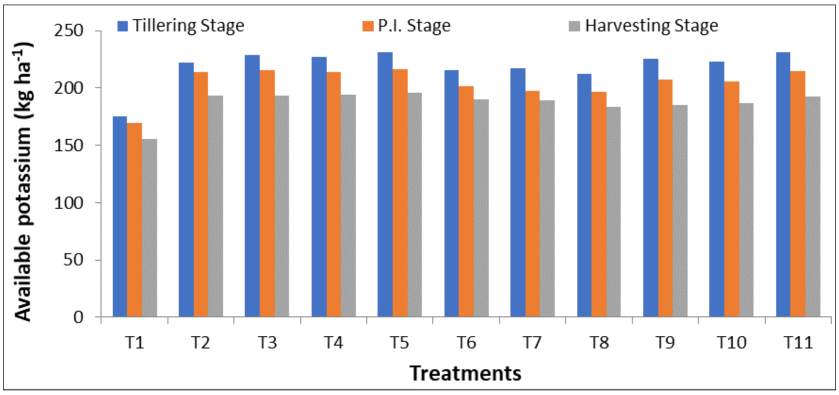

Fig 4: Effect of different treatments on available potassium (kg ha^{-1}) at various stage

Thereafter at panicle and at harvest stage of rice potassium availability decreases in all treatment. The available potassium in soil at all the stages of crop growth varied significantly with the application of different levels of nitrogen and significantly higher available potassium in soil as compared to control at all the stages of crop growth. The improvement in K was might be due to slow and steady supply of K due to solubilization effect of organic acid produced during decomposition processes (Singh *et al*., 2008) [3].

Conclusion

The application of nitrogen through neem coated urea of different schedule application did not significant effect on physical properties soil in transplanted rice as well as chemical properties like pH and organic carbon. While, the application of nitrogen through neem coated urea 25% at basal, 50% at tillering stage and 25% at panicle initial stage, respectively improve soil nutrient status like available nitrogen, phosphorus and potassium in soil.

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