Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(6): 888-892
Received: 19-09-2019
Accepted: 21-10-2019

Sachin Sharma
Department of Soil Science and Agricultural Chemistry, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India

Ayush Bahuguna
Department of Soil Science and Agricultural Chemistry, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India

Janardan Yadav
Professor, Department of Soil Science and Agricultural Chemistry, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India

Neelam Yadav
Ph. D Soil Science and Agricultural Chemistry, Anand Agriculture University, Gujarat, India

Corresponding Author:
Sachin Sharma
Department of Soil Science and Agricultural Chemistry, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India

Effect of polymer coated urea, neem coated urea and PGPR on growth and yield of rice (*Oryza sativa* L.) in inceptisol of Varanasi

Sachin Sharma, Ayush Bahuguna, Janardan Yadav and Neelam Yadav

Abstract
Rice (*Oryza sativa* L.) is the most important cereal crop of world. India ranks first in area and second in production. Global food requirements have also risen and the expected per capita food requirement is likely to double by 2050. Controlled release fertilizers may be one such solution as they are believed to enhance crop yield while reducing the environmental pollution. Viewing above facts an investigation entitled. Effect of Polymer coated urea, Neem coated urea and PGPR on growth and yield of Rice (*Oryza sativa* L.) in Inceptisol of Varanasi was conducted at the Department of Soil Science and Agricultural Chemistry, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi (U.P.) during the *kharif* season of 2017. Treatments involving split application of polymer coated urea and neem coated urea with nitrogen doses 100%, 80%, (50% + 50%) and (40% + 40%) showed a significant increase in grain and straw yield of rice as well as growth attributes such as plant height, tillers, chlorophyll content etc. Treatment T_{12} (50% of RDN through PCU + 50% by NCU 3 Split) was applied showed a significant increase in biological yield from 112.67 to 200 gm pot^{-1} with chlorophyll content from 31.46 to 51.92 and plant height from 105.09 cm in control to highest 129.94 cm in T_{12} treatment.

Keywords: Polymer coated urea, neem coated urea, rice

Introduction
Rice (*Oryza sativa* L.) is popularly known as of the major staple food crops for more than half of the world population. Rice is the second most substantial crop in the worldwide an area of 161.1 million hectare and production of about of about 751.9 million tonnes (Anonymous 2017) [1]. India claims largest rice area in the world that is 43.4 million hectare and with the production of about 112.9 million tonnes in 2017-2018 and second after china (Anonymous 2018) [2]. Life of human being that can be comprehended by the fact that more that 50% population in Asia consumes rice as staple food while for South Asia this figure is around 70% (Bishwajit *et al* 2013) [3]. Pondering the immense importance of rice for humanity, United Nations Organization has declared the year 2002 as the international year of rice. Over the years with increase in human population the average growth rate of rice yields were declined from 3.68% per year in the early 1980s to 0.74% per year in the late 1990s (Nguyen and Ferrero, 2006) [17].

Nitrogen is one of the most yield-limiting nutrients in lowland rice. Nitrogen improves panicle density, panicle size and reduces spikelet sterility and consequently improves grain yield (Fageria 2007) [4]. Nitrogen recovery efficiency of inorganic fertilizer sources in lowland rice is reported to be about 40% (Fageria 2014; Fageria and Baligar 2005; Fageria, Santos, and Cutrim 2007; Fageria, Slaton and Baligar 2003) [5, 7, 6, 8]. N use efficiency is relatively low in irrigated ricebecause of rapid N losses from ammonia volatilization, denitrification, surface runoff, and leaching in the soil-floodwater system (Peng *et al*. 2006) [14] The most important N sources are ammonium sulfate and urea. Globally, urea comprises more than 50% of the inorganic N fertilizers used for agricultural production (Khalil *et al*.2011). Wild *et al*. (2011) [11, 19] reported that in all crop production systems, improved synchronicity between N supply and crop N demand can lead to increased N use efficiency.

The controlled-release urea (CRU) fertilizers behave somewhat like organic materials in that the rate of release is greatest initially and decreases with time (Kiran *et al*. 2010) [12]. Slow release characteristics permit N uptake by plants according to their demand and reduce N leaching or denitrification losses. Compared to the large amount of fertilizers used throughout the world, the total use of controlled-release fertilizers is still small.

Material Methods
A pot experiment conducted at glass house during kharif season of 2017 on rice crop variety HUR -105 followed by laboratory analysis of the straw, grain and soil samples in the

Department of Soil Science and Agricultural Chemistry. To conduct the pot experiment, bulk surface soil sample (0-15 cm) was collected from the Agricultural Research Farm that was deficient in nitrogen. The soil was air dried and ground to pass through 2 mm sieve. Then processed 10 kg soil was filled in each polythene lined pots. The experimental design was a complete randomized block in 13 treatments. Treatments were replicated 3 times. Treatments T_1 to T_7 having 100% and 80% RDN with neem coated urea and polymer coated urea with 3 split doses. Treatments T_8 to T_{13} comprises with combination of 50%, 40% RDN with polymer coated urea and neem coated urea in split dose mixed with FYM @ 10 t ha^{-1} + PGPR (mixture of *Azotobacter chroococcum, Azospirillum brasilense, Bacillus subtilis, Pseudomonas putida, Pseudomonas aeruginosa, Pseudomonas flurescens, Trichoderma harzianum*).

Soil Analysis

Soil organic carbon content was determined by Rapid Titration Method (Walkley and Black, 1934) [18]. Available nitrogen was determined using alkaline potassium permanganate method (Subbiah and Asija, 1956) [16]. The procedure involves distilling the soil with alkaline potassium permanganate solution and determining the ammonia liberated by titrating against sulphuric acid (0.02N). The Olsen's method (Olsen *et al*., 1954) was used for determination of available-P in soil. In this method soil was extracted with 0.5 M $NaHCO_3$ (pH 8.5). 5 mL of extract was taken and colour was developed by ascorbic acid solution. After waiting for 10 minutes, the intensity of blue colour was measured on spectrophotometer at 760 nm. Available potassium (Hanway and Heidel, 1952) [9] is determined five gram soil was extracted with neutral normal ammonium acetate solution (pH 7.0) by shaking for 30 minutes. Potassium content in the extract was determined flame-photo metrically as given by Muhr *et al*. (1965) [13].

Statistical analysis and interpretation of data

Statistical analysis of the data collected during the study was carried out as outlined by Panse and Sukhatme (1985). Using the' F' (variance ratio) table, the important impact of medicines was assessed. The important variations between the media were evaluated at 5 percent probability level against critical variations.

Variance analysis was carried in Randomized Block Design (RBD) for all treatments. Using the' F' variance ratio test, the importance and non-significant impact of the distinct treatments was evaluated. Calculated ‘F’ value was compared with table value of ‘F’ at 5% levels of significance. If calculated value of ‘F’ exceeds its table value, the effect was considered to be significant. The significant difference between treatment means was tested using critical difference at 5% level of significance.

Result and Discussion

Panicle length, plant height, number of tillers and chlorophyll content

The critical perusal of the data given in the Table number 1 stats that Panicle length, plant height, number of tillers and chlorophyll content (45DAT) in rice were significantly increased by applying different nitrogen sources (polymer coated urea (PCU) and neem coated urea (NCU)) in different doses. Panicle length varies from 16.67cm in control to 23 cm highest in T_{12} treatment (combination of PCU, NCU and PGPR). Plant height varies from 105.09 cm in control to highest 129.94 cm in T_{12} treatment. Improvement in plant height with the addition of N has been reported by Coelho (2011) in lowland rice grown on Brazilian Inceptisol. Plant height is genetically controlled and also influenced by environmental factors such as essential plant nutrients at an adequate level (Fageria 2007) [4]. Chlorophyll SPAD meter reading ranges from 31.46 to 51.92 in control to treatment T_{12}. Number of tillers increased significantly by application of PCU with PGPR and FYM application. Plant height, number of tillers, panicle length and chlorophyll content increased by 23.64%, 88.33%, 37%, 65% with respect to control. It has been observed that the application of PCU, NCU with PGPR increases branching and vegetative growth which ultimately contributes to yield parameters.

pH, EC, Organic carbon %, Available N, P_2O_5, K_2O content in post harvest soil

Changes in pH, EC were insignificant while Organic carbon % increases significantly from 0.39% in control to 0.63 % in treatment T_{12} (50% of RDN through PCU+ 50% of RDN through NCU + FYM @ 10 t ha^{-1} + PGPR). This significant increase due to addition of PGPR and FYM with PCU and NCU.

Available Nitrogen increases in soil due to addition of PCU with NCU in comparision with either only PCU or NCU. Nitrogen in T_{12} treatment is 264.94 kg ha^{-1} while in only PCU treatment T_2 is 260.64 kg ha^{-1} and NCU treatment is 255.41 kg ha^{-1}. An increase is observed in Phosphorous content in soil without PGPR application from17.92 kg ha-1 to 19.4 kg ha-1 with PGPR as it solubilizes phosphorous. K_2O content in post harvest soil is insignificant.

Table 1: Effect of different levels of recommended dose of nitrogen (RDN) through PCU and NCU on no. of tillers $hill^{-1}$ and panicle length (cm), average plant height and chlorophyll content (SPAD value) in rice at different days after transplanting

Treatment		No. of tillers $hill^{-1}$	Panicle length (cm)	Average plant height $hill^{-1}$ (cm)	Chlorophyll content (SPAD value)
		At Harvesting		80 DAT	45 DAT
T_1	Control	6	16.67	105.09	31.46
T_2	100% of RDN through PCU 3 Split	11	22.33	126.10	44.24
T_3	80% of RDN through PCU 3 Split	9.7	20	118.78	37.25
T_4	100% of RDN through NCU 3 Split	11	22	124.50	43.58
T_5	80% of RDN through NCU 3 Split	9.7	18.77	117.76	39.12
T_6	50% of RDN through PCU+ 50% of RDN through NCU 3 Split	10.7	21.5	127.35	46.22
T_7	40% of RDN through PCU+40% of RDN through NCU 3 Split	9.3	18.77	117.62	39.24
T_8	100% of RDN through PCU+ FYM @ 10 t ha^{-1} + PGPR	10	21.5	126.86	49.27
T_9	80% of RDN through PCU+ FYM @ 10 t ha^{-1} + PGPR	9.3	20.1	119.43	43.78
T_{10}	100% of RDN through NCU + FYM @ 10 t ha^{-1} + PGPR	10	21.43	126.60	48.63
T_{11}	80% of RDN through NCU + FYM @ 10 t ha^{-1} + PGPR	9	19.54	118.08	42.33

T_{12}	50% of RDN through PCU+ 50% of RDN through NCU + FYM @ 10 t ha^{-1} + PGPR	11.3	23	129.94	51.92
T_{13}	40% of RDN through PCU+40% of RDN through NCU+ FYM @ 10 t ha^{-1} + PGPR	8.7	20	120.18	43.89
SEm±		0.40	1.609	0.60	2.51
CD at 5%		1.17	15.6	1.89	7.34

*RDN (recommended dose of nitrogen 120kgha^{-1}), PCU (polymer coated urea), NCU (neem coated urea)

Table 2: Effect of different levels of recommended dose of nitrogen (RDN) through PCU, NCU and FYM on EC, pH, Organic Carbon N, P_2O_5 and K_2O of soil after harvesting of rice in kg ha-1 content of post-harvest soil

Treatment		pH	EC	OC (%)	Available nutrient in soil after harvesting		
					N kg ha^{-1}	P_2O_5 kg ha^{-1}	K_2O kg ha^{-1}
T_1	Control	7.25	0.19	0.39	225.70	14.75	218.33
T_2	100% of RDN *through PCU 3 Split	7.18	0.20	0.45	260.64	17.715	254.61
T_3	80% of RDN through PCU 3 Split	7.23	0.19	0.41	246.18	17.84	247.39
T_4	100% of RDN through NCU 3 Split	7.17	0.19	0.44	255.41	18.28	253.82
T_5	80% of RDN through NCU 3 Split	7.64	0.19	0.44	241.16	17.925	245.08
T_6	50% of RDN through PCU+ 50% of RDN through NCU 3 Split	7.17	0.21	0.46	261.16	17.95	256.59
T_7	40% of RDN through PCU+40% of RDN through NCU 3 Split	7.45	0.21	0.45	246.07	17.03	245.83
T_8	100% of RDN through PCU+ FYM @ 10 t ha^{-1} + PGPR	7.53	0.19	0.60	262.94	18.8	255.23
T_9	80% of RDN through PCU+ FYM @ 10 t ha^{-1} + PGPR	7.69	0.20	0.59	247.33	18.825	250.22
T_{10}	100% of RDN through NCU + FYM @ 10 t ha^{-1} + PGPR	7.39	0.21	0.61	257.82	19.385	253.19
T_{11}	80% of RDN through NCU + FYM @ 10 t ha^{-1} + PGPR	8.00	0.22	0.60	247.85	18.635	247.64
T_{12}	50% of RDN through PCU+ 50% of RDN through NCU + FYM @ 10 t ha^{-1} + PGPR.	7.61	0.23	0.63	264.94	19.4	256.36
T_{13}	40% of RDN throughPCU+40% of RDN through NCU+ FYM @ 10 t ha^{-1} + PGPR	7.51	0.21	0.61	248.62	18.985	248.95
SEm±		0.13	0.012	0.02	2.03	1.025	2.58
CD at 5%		0.39	NS	0.06	5.95	N/A	7.55

*RDN (recommended dose of nitrogen 120kgha^{-1}), PCU (polymer coated urea), NCU (neem coated urea)

Grain yield, Straw yield, Biological yield

With different doses of Polymer coated urea (PCU), Neem coated urea (NCU) and with combination of both PCU and NCU with PGPR there is a drastic change in yield of rice is observed. Controlled-release urea fertilizers release N at controlled rates to maintain maximum growth and minimized losses. Crop yields are usually greater, depending on the type and possible rate of fertilizers (Harrison and Webb 2001) [10]. The grain yield ranges from 31 gm pot^{-1} in control to 54.33 gm pot^{-1} in T_{12} (50% of RDN through PCU+ 50% of RDN through NCU + FYM @ 10 t ha^{-1} + PGPR). It increases from 75.25% from controlled one. While only PCU gives grain yield of 44.33 gm pot^{-1} while in combination of PCU, NCU with PGPR it is 54.33 gm pot^{-1}, the increase is 22.5 % recorded. The straw yield ranges from 81.67 gm pot^{-1} in control to 145.67 gm pot^{-1} in T_{12} (50% of RDN through PCU+ 50% of RDN through NCU + FYM @ 10 t ha^{-1} + PGPR). It increases from 78.36% from controlled one. PCU gives straw yield of 130gm pot^{-1} while in combination of PCU, NCU with PGPR it is 145.67 gm pot^{-1}, the increase is 12 % recorded.

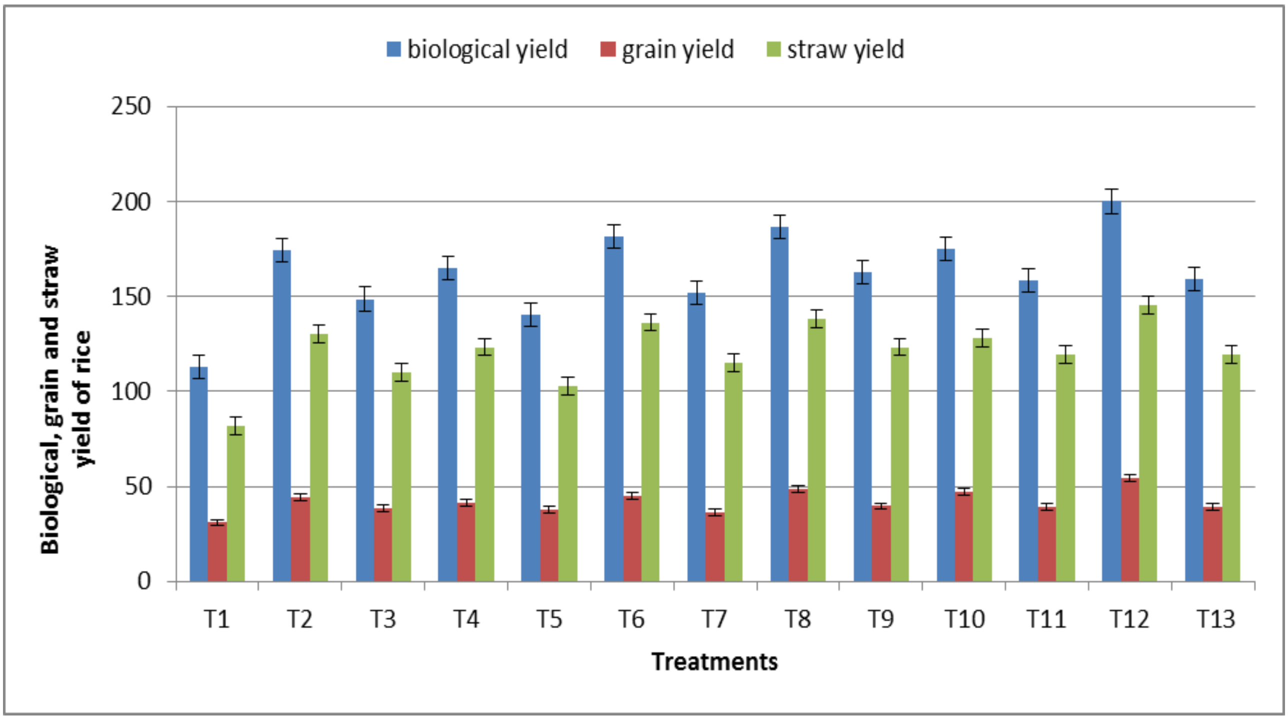
The biological yield of T_{12} (50% of RDN through PCU+ 50% of RDN through NCU + FYM @ 10 t ha^{-1} + PGPR) is 200gm pot^{-1} in comparision with 112.67 gm pot^{-1} of control. Percentage increase in biological yield is 77.50%. PCU gives biological yield of 174.33gm pot^{-1} while in combination of PCU, NCU with PGPR it is 200gm pot^{-1}, the increase is 14.72 % recorded over PCU. CRU with this ability could provide many benefits to rice, such as greater NUE, better plant growth and quality, lower labour costs, and reduced N runoff (Shaviv and Mikkelsen 1993) [15]

Table 3: Effect of different levels of recommended dose of nitrogen (RDN) through PCU and NCU on total yield g pot^{-1}of rice

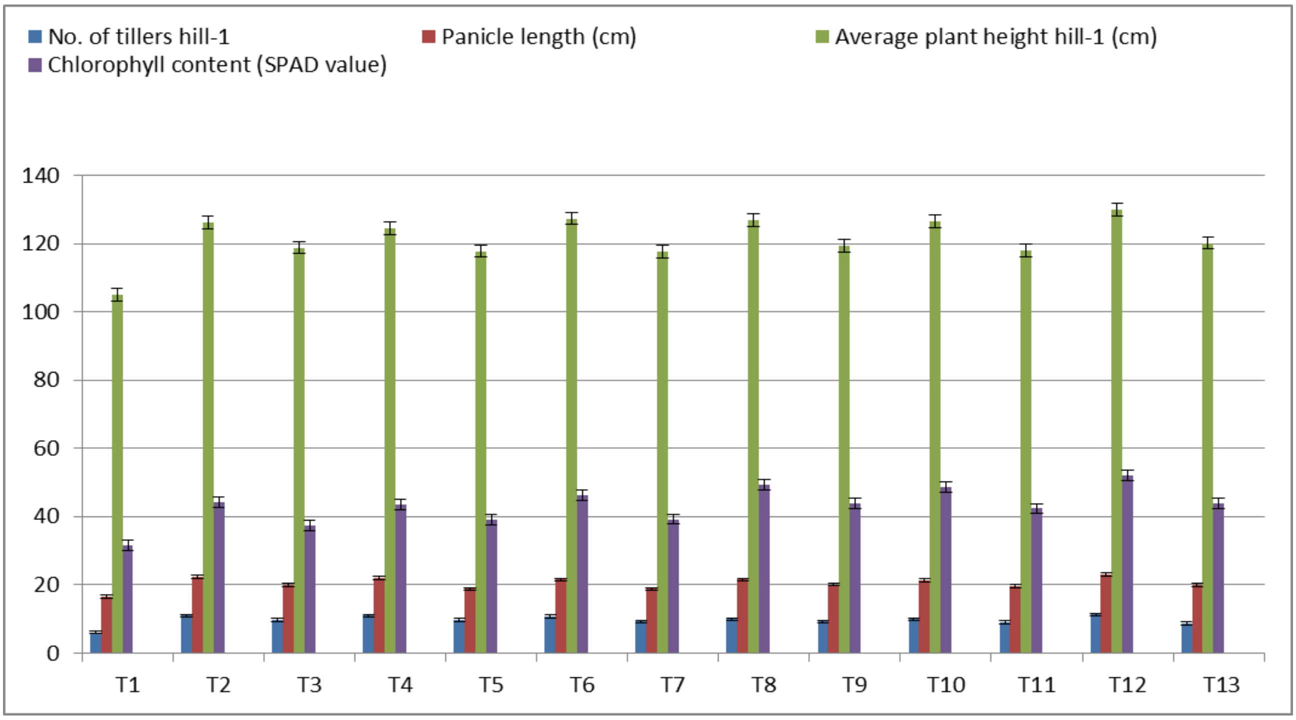
Treatment		Yield		
		Biological gm pot^{-1}	Grain gm pot^{-1}	Straw gm pot^{-1}
T_1	Control	112.67	31.00	81.67
T_2	100% of RDN through PCU 3 Split	174.33	44.33	130.00
T_3	80% of RDN through PCU 3 Split	148.67	38.67	110.00
T_4	100% of RDN through NCU 3 Split	164.67	41.33	123.33
T_5	80% of RDN through NCU 3 Split	140.67	37.67	103.00
T_6	50% of RDN through PCU+ 50% of RDN through NCU 3 Split	181.33	45.00	136.33
T_7	40% of RDN through PCU+40% of RDN through NCU 3 Split	151.67	36.33	115.33
T_8	100% of RDN through PCU+ FYM @ 10 t ha^{-1} + PGPR	186.67	48.67	138.00
T_9	80% of RDN through PCU+ FYM @ 10 t ha^{-1} + PGPR	163.00	39.67	123.33
T_{10}	100% of RDN through NCU + FYM @ 10 t ha^{-1} + PGPR	175.33	47.00	128.33
T_{11}	80% of RDN through NCU + FYM @ 10 t ha^{-1} + PGPR	158.33	39.00	119.33
T_{12}	50% of RDN through PCU+ 50% of RDN through NCU + FYM @ 10 t ha^{-1} + PGPR	200.00	54.33	145.67
T_{13}	40% of RDN throughPCU+40% of RDN through NCU+ FYM @ 10 t ha^{-1} + PGPR	159.00	39.33	119.67
SEm±		3.75	1.50	3.177

CD at 5%	11.01	4.38	9.267

*RDN (recommended dose of nitrogen 120kgha^{-1}), PCU (polymer coated urea), NCU (neem coated urea)



Effect of different levels of recommended dose of nitrogen (RDN) through PCU and NCU on total yield g pot^{-1}of rice



Effect of different levels of recommended dose of nitrogen (RDN) through PCU and NCU on No. of tillers hill^{-1}, Panicle length (cm), Average plant height hill^{-1} (cm), Chlorophyll content (SPAD value)

Conclusion

The given research concludes that the combination of controlled release fertilizer with slow release fertilizer along with microbial consortium (PGPR) gives better result in yield as well as growth attributes than used singly PCU or NCU in different doses for rice crop in Inceptisol of Varanasi.

Acknowledgment

The polymer coated urea was supplied by GSFCL (Gujrat State Fertilizers and Chemicals Limited).

References

1. Anonymous. Central for Advance Trade Research, Trade Promotion Council of India, 2018.
2. Anonymous. Economic Research Report, United States Department of Agriculture. 2017; 237:44-45.
3. Bishwajit G, Sarker S, Kpoghomou MA, Gao H, Jun L, Yin D *et al*. Self-sufficiency in rice and food security: a South Asian perspective. Agriculture & Food Security. 2013; 2(1):10.

4. Fageria NK. Yield physiology of rice. Journal of Plant Nutrition. 2007; 30:843-79.
5. Fageria NK. Mineral nutrition of rice. Boca Raton, Florida: CRC Press, 2014.
6. Fageria NK, Santos AB, Cutrim VA. Yield and nitrogen use efficiency of lowland rice genotypes as influenced by nitrogen fertilization. Pesquisa Agropecuaria Brasileira. 2007; 42:1029-34.
7. Fageria NK, Baligar VC. Enhancing nitrogen use efficiency in crop plants. Advances in Agronomy. 2005; 88:97-185.
8. Fageria NK, Slaton NA, Baligar VC. Nutrient management for improving lowland rice productivity and sustainability. Advances in Agronomy. 2003; 80:63-152
9. Hanway JJ, Heidel H. Soil analysis methods as used in Iowa state college soil testing laboratory. Iowa agriculture, 1952, 57.
10. Harrison R, Webb J. A review of the effect of N fertilizer type on gaseous emissions. Advances in Agronomy. 2001; 73:65-108.
11. Khalil MI, Schmidhalter U, Gutser R, Heuwinkel H. Comprative efficiency of urea fertilization via supergranules versus prills on nitrogen distribution, yield response and nitrogen use efficiency of spring wheat. Journal of Plant Nutrition. 2011; 34:779-97.
12. Kiran JK, Khanif YM, Amminuddin H, Anuar AR. Effects of controlled release urea on the yield and nitrogen nutrition of flooded rice. Communications in Soil Science and Plant Analysis. 2010; 41(7):811-19.
13. Muhr GR, Datta NP, Shankar Subramany N, Dever F, Lecy VK, Donahue RR. Soil testing in India, USDA Publication, 1965, 120p.
14. Peng S, Buresh RJ, Huang J, Yang J, Zou Y, Zhong X *et al*. Strategies for overcoming low agronomic nitrogen use efficiency in irrigated rice systems in China. Field Crops Research. 2006; 96(1):37-47.
15. Shaviv A, Mikkelsen RL. Controlled release fertilizer to increase efficiency of nutrient use and minimize environmental degradation - A review. Fertilizer Research. 1993; 35:1-12
16. Subbiah BV, Asija GL. Alkaline method for determination of mineralizable nitrogen. Current science. 1956; 25:259-260.
17. Van Nguyen N, Ferrero A. Meeting the challenges of global rice production, 2006.
18. Walkley A, Black IA. An examination of the Degtjareff method for determining soil organic matter, and a proposed modification of the chromic acid titration method. Soil science. 1934; 37:29-38.
19. Wild PL, Kessel CV, Lundberg J, Linquist BA. Nitrogen availability from poultry litter and pelletized organic amendments for organic rice production. Agronomy Journal. 2011; 103:1284-91.