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Precision nitrogen management in rice through Nano-urea by calibrating the leaf colour chart (LCC) in Konkan Region

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Abstract
Present era, Synthetic fertilizers used extensively in agriculture typically have low Nutrient Use Efficiency (NUE) values. In order to boost nutrient use efficiency, decrease fertilizer waste and lower cultivation costs, hence nano fertilizers are key instruments in agriculture. In order to achieve high rice output with effective N management, a tool that can quickly detect leaf N status and then direct the application of fertilizer N to maintain an appropriate leaf N content can be essential. Keeping this view, the present investigation is plan to study the Precision nitrogen management in rice through Nano-urea by calibrating the leaf colour chart (LCC) in Konkan Region. The experiment was conducted at Agronomy farm, College of Agriculture, Dapoli, Dist. Ratnagiri (M.S.) during *kharif*, 2022. LCC based application of nano urea has positive effect on growth, yield attributes and yield and uptake of nutrients in rice crop. The treatment RDN 50% Basal + LCC < 4 35 Kg N through nano urea (T_9) significantly shows the higher uptake and yield as compare to other treatments. It showed 67.24% and 66.36% higher grain and straw yield, respectively over control. While treatment RDN 50% Basal + LCC < 4 35 Kg N through nano urea (T_9) showed higher net return (Rs 31425.36 ha^{-1}) and B:C ratio (1.38) over all the other treatments.

Keywords: Rice, leaf colour chart, nano urea, growth, yield, economics

1. Introduction
The production of rice is essential to India's economy. One of the main food crops and a staple in the eastern and southern regions of the nation is rice. It is essential to the country of India's food security. In India, rice accounts for 46% of all cereal production and 43% of all food grain production. Almost 50 million households receive their income and jobs on the production of rice. India is the world's second largest producer and consumer after china. In India the area under Rice cultivation is about 45.07 million hectares and production 122.3 million tons with an average productivity of 2713 kg per ha (Anonymous, 2022a) [1]. In Maharashtra, where it contributes 2.8% of national production and 3.6% of land, rice is the second most important crop for the population. In Maharashtra, rice is cultivated on an area of 15.61 lakh acres, producing 32.91 lakh tons of rice annually. Statewide productivity is 2109 kg ha^{-1} on average (Anonymous, 2022b) [2]. Maharashtra is the 13th largest producer of rice in the nation. Maharashtra's average productivity was poor particularly compared to other states that grow rice, such as Punjab, Tamil Nadu, Haryana, and Andhra Pradesh.
The word "nano" is a translation of the Greek word for dwarf. The concept of "nano" is a billionth of a meter. "Nanoparticles" are defined as particles with at least one dimension smaller than 100 nanometers. At the Indian Farmers Fertilizer Co-operative Limited (IFFCO) - Nano Biotechnology Research Centre (NBRC), Kalol, Gujarat, created nano fertilizer domestically for the first time ever using a patented process; in its liquid state, nano-urea has a nitrogen content of 4% by weight. Nano-urea uses nitrogen more effectively than regular urea (Kumar *et al.*, 2021) [7]. In particular, the use of nanomaterials for agricultural purposes was necessary to enhance the fertilization process, raise yields through nutrient optimization and reduce the need for plant protection agents (Huang *et al.*, 2015) [5].
The finest method available for assisting farmers in making an instant judgement regarding the requirement for top dressings of in-season fertilizer nitrogen was the use of the spectral characteristics of rice leaves (Singh and Singh, 2017) [17]. The Leaf Colour Chart (LCC) was a unique and useful way to manage crop-need-based N in wheat, maize, and rice.

The LCC was a less expensive, easier to use, and more precise visual and subjective assessment of plant nitrogen deficit when compared to a chlorophyll meter or a SPAD meter. It regulates the leaf's Colouration's intensity, which is connected to the leaf's nitrogen level (Rostami *et al.* 2017) [14].

2. Materials and Methods

The present investigation was carried out on "precision nitrogen management in rice through Nano-urea by calibrating the leaf colour chart (LCC) in Konkan region" was conducted at Agronomy farm, College of Agriculture, Dapoli, Dist. Ratnagiri (M.S.) during *kharif*, 2022. The analytical work was done at research laboratory of department of Agronomy. Geographically, experimental plot no. (21) at Agronomy farm, College of Agriculture, Dapoli is situated in the subtropical region at 17°45'55" N latitude and 73°10'26" E longitude having elevation of about 157.8 m above mean sea level. The climate is sub-tropical which is characterized by warm and humid atmosphere which is very much favourable for a crop like rice during *kharif* season.

The soil of experimental plot was analysed initially to study various physico-chemical properties, which showed that it was sandy clay loam in texture, with high organic carbon (11.30 g kg^{-1}) and slightly acidic in reaction (pH 5.14) and was low in available nitrogen (251.78 kg ha^{-1}) and potassium (234.60 kg ha^{-1}) and medium in available phosphorous (11.70 kg ha^{-1}). The experiment was designed according to randomized block design with nine treatments and three replications. Rice variety Ratnagiri 1 was transplanted at the spacing of 20 cm × 15 cm. The gross plot size was 4.50 m × 3.60 m while the net plot size was 4.20 m × 3.20 m. Nano urea were foliar applied twice at different concentrations, each at 30 days after transplanting, panicle initiation stage. All the recommended agronomic practices were carried out uniformly for all the treatments as and when required. All together the experiment consist of 36 plots and the treatment details are given in Table 1.

Yield parameters [number of panicles hill^{-1}, panicle length (cm), weight of panicle (g), number of grains panicle^{-1}, number of filled grains panicle^{-1}, weight of filled grains panicle^{-1} and 1000 grain weight] were recorded at harvest from randomly selected five sample hills in each plot. The grain and straw yields and harvest index (HI) was recorded from each net plot area. Plant samples were oven dried, ground, sieved and analysed for total N by micro-Kjeldahl method (Tandon, 1993) [18], P by ammonium molybdate method (Tandon, 1993) [18] K by flame photometry (Tandon, 1993) [18]. Nutrient uptake was estimated by multiplying the N, P and K concentrations of grains and straw with their respective yield (kg ha^{-1}) and summing up the two values. The significance of the treatment difference was tested by variance ratio test (f value), critical difference (C.D.) at 5 percent level of probability and was worked out for comparison and statistical interpretation of significance between treatments mean (Panse and Sukhatme, 1967) [11]. On the basis of the experimental findings the economics of different treatments was worked out. Gross returns (₹ ha^{-1}), net returns (₹ ha^{-1}) and B: C ratio was calculated for each treatment. For that the prevailing market prices of grain and straw were considered. Similarly, the cost of cultivation of the crop under the individual treatment was worked out by taking into account the cost of all inputs and the cost incurred for all the operations up to harvest. The net income was worked out by deducting the cost of cultivation from the gross returns and the B: C ratio for each treatment was worked out by dividing gross returns by cost of cultivation.

Table 1: Treatments details along with symbols used

Treatments	Symbols
Control	T_1
RDF 100:50:50 N: P_2O_5: K_2O kg/ha	T_2
RDN 50% Basal + 50% N through Nano-urea	T_3
RDN 50% Basal + LCC < 3 25 kg N through Nano-urea	T_4
RDN 50% Basal + LCC < 3 30 kg N through Nano-urea	T_5
RDN 50% Basal + LCC < 3 35 kg N through Nano-urea	T_6
RDN 50% Basal + LCC < 4 25 kg N through Nano-urea	T_7
RDN 50% Basal + LCC < 4 30 kg N through Nano-urea	T_8
RDN 50% Basal + LCC < 4 35 kg N through Nano-urea	T_9

3. Results and Discussion

3.1 Yield attributes and yield

Experimental results (Table 2) expressed that the number of panicles hill^{-1}, panicle length, panicle weight, number of grains panicle^{-1}, number of filled grains panicle^{-1}, weight of grains panicle^{-1}, weight of filled grains panicle^{-1} and 1000 grain weight were all significantly influenced by nitrogen management strategies with PAU-LCC. The number of viable grains per panicle is influenced by panicle length, which is a genetic trait of the crop. In the present study, the treatment T_9 (RDN 50% Basal + LCC < 4 35 kg N through nano urea) recorded significantly higher yield attributes *viz*. number of panicles hill^{-1} (10.00), length of panicle (22.64 cm), weight of panicle (2.92 g), number of grains panicle^{-1} (144.66), number of filled grains panicle^{-1} (134.77) and weight of filled grains panicle^{-1} (2.83 g) excluding 1000 grain weight. However, the control treatment T_1, reported the lowest values of the yield-attributing characteristics. This might be due to higher production of photosynthesis because of a greater number of leaves and leaf area plant^{-1} of rice and adequate availability of moisture and nutrient throughout the growing season may be the reason behind this. Lone *et al*. (2017) [8] reported that panicle length, panicle weight, grain and straw yield in LCC 4 @ 20 kg N ha^{-1} were significantly higher than remaining LCC and fixed time N management treatments as well as control. A similar result recorded by Krishnakumar *et al.* (2013) [6] and Balaji and Jawahar (2007) [3].

In the present investigation, grain, straw and ultimately biological yields of rice varied similarly as a reflection of the yield attributes (Fig. 1). As a result, grain yield, straw yield, biological yield and harvest index were all significantly higher with treatment RDN 50% Basal + LCC < 4 35 kg N through nano urea (T_9). However, the treatment T_1 *i.e.*, control observed low yield (grain, straw and biological yield) and harvest index as compared to other treatments. RDN 50% Basal + LCC < 4 35 kg N through nano urea observed 67.24 percent higher grain yield (4824.43 kg ha^{-1}) and 66.36 percent higher straw yield (6016.17 kg ha^{-1}) as compared to control with 1580.07 kg ha^{-1} and 2023.41 kg ha^{-1} grain and straw yield, respectively. The use of nano urea had considerably impact on grain and straw yield it may be caused due to combined application of conventional fertilizer as a basal dose and split dosage application of nano urea has been sprayed on plant surface leads to storage remaining nitrogen in plant cell that may release slowly that can prevent the plant biotic and abiotic stress produces the high grain yield. The considerable increase in straw production caused by the application of a larger dose of N is again attributable to the higher number of tillers and higher N uptake at the active tillering stage (Ravi *et al*., 2007) [12]. Moharana *et al.* 2017 [10] reported that variety Gobinda under application of nitrogen based on LCC threshold value 4 produced significantly the highest straw yield (64.3 q ha^{-1}) than control (36.8 q ha^{-1}). A similar result recorded by Satpute *et al.* (2015) [15] and Lone *et al.* (2017) [8].

Table 2: Yield contributing characters of rice as influenced by different treatments

Treatment	Number of panicles hill^{-1}	Length of panicle (cm)	Weight of panicle (g)	Number of grains panicle^{-1}	Number of filled grains panicle^{-1}	Weight of filled grains panicle^{-1} (g)	1000 grain weight (g)
T_1: Control	5.06	10.48	1.90	64.62	54.81	1.70	26.53
T_2: RDF 100:50:50 N: P_2O_5: K_2O kg/ha	7.22	19.79	2.39	115.53	110.91	2.30	26.61
T_3: RDN 50% Basal + 50% N through nano urea	7.95	20.61	2.41	120.00	106.76	2.33	26.68
T_4: RDN 50% Basal + LCC < 3 25 kg N through nano urea	8.60	20.85	2.50	121.33	107.54	2.40	26.74
T_5: RDN 50% Basal + LCC < 3 30 kg N through nano urea	8.60	20.90	2.59	124.48	113.87	2.44	26.77
T_6: RDN 50% Basal + LCC < 3 35 kg N through nano urea	9.30	21.93	2.64	131.00	119.28	2.50	26.78
T_7: RDN 50% Basal + LCC < 4 25 kg N through nano urea	9.57	22.39	2.77	137.99	130.29	2.57	26.80
T_8: RDN 50% Basal + LCC < 4 30 kg N through nano urea	9.68	22.48	2.87	138.33	131.26	2.76	26.81
T_9: RDN 50% Basal + LCC < 4 35 kg N through nano urea	10.00	22.64	2.92	144.66	134.77	2.83	26.87
S.Em. (±)	0.14	0.14	0.06	2.51	3.48	0.09	0.07
C.D. at 5%	0.43	0.42	0.17	7.53	10.43	0.27	NS
General Mean	8.44	20.23	2.55	121.99	112.17	2.43	26.73

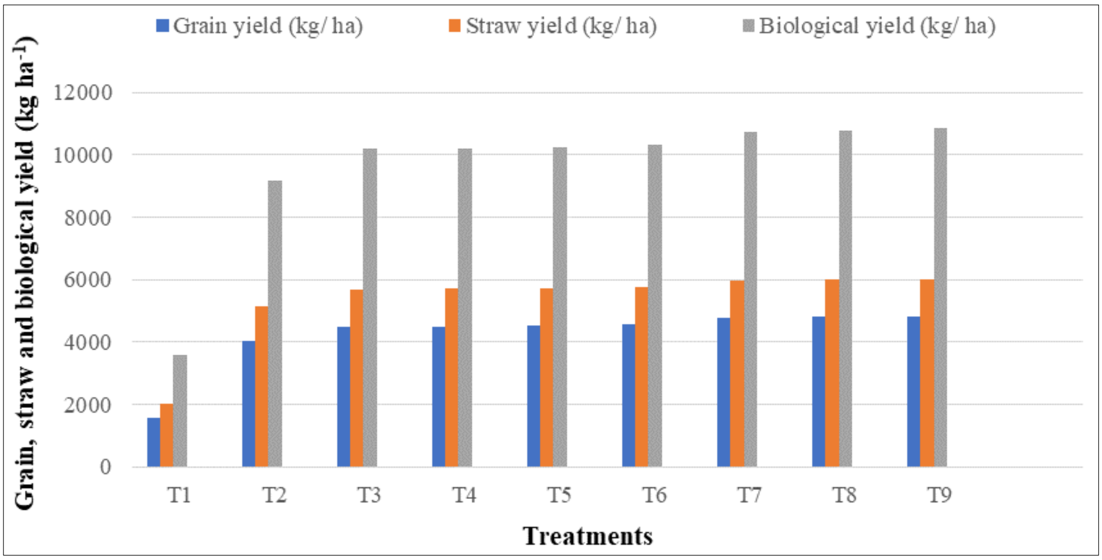

Fig 1: Grain yield, straw yield, biological yield (kg ha^{-1}) and harvest index (%) of rice as influenced by different treatments

3.2 Nutrient content and uptake

In the present investigation concentration of N, P and K in rice grain and straw differed significantly amongst treatments (Table 3). Significantly higher N (1.17% and 0.61% in grain and straw, respectively), P (0.32% and 0.20% in grain and straw, respectively) and K (0.38% and 1.16% in grain and straw, respectively) was observed in treatment RDN 50% Basal + LCC < 4 35 kg N through nano urea (T_9) which was followed by treatments T_7 (RDN 50% + LCC < 4 25 kg through nano urea).

Total N, P and K uptake was in linear association with grain yield and straw yield as shown in Table 3. Total nitrogen (93.71 kg ha^{-1}), phosphorus (28.69 kg ha^{-1}) and potassium (88.50 kg ha^{-1}) uptake in rice was higher with the treatment RDN 50% Basal + LCC < 4 35 kg N through nano urea (T_9) as compared to other treatments. Treatments T_7 (RDN 50% + LCC < 4 25 kg through nano urea) were statistically at par with treatment T_9 with regard to total N, P and K uptake. However, treatment T_1: control (no foliar application) showed lowest values of nutrient uptake. In the present study, with increase in N, P and K content in grain and straw, the uptake of these nutrients was also found to be higher in grain, straw as well as total biological produce; as uptake of a nutrient is a function of concentration of nutrient and yield per hectare.

According to N management using the Leaf Colour Chart at threshold value 4 resulted in a higher total N uptake than LCC 3 and recommended practice. When compared to other treatments, the application of N at LCC < 4 recorded considerably higher N, P, and K content as well as total uptake of N. According to Mangare (2002) [3], the rice straw is the area where potassium accumulates the most since its content potassium at higher rate than the grain.In comparison to other treatments, the LCC < 4 (T_9) with 120 kg N ha^{-1} observed greater N, P, and K content and absorption. Because nutrient uptake by plants depends on both dry matter and nutrients, the larger yields of grains and straw and higher N content led to a greater uptake of nitrogen, phosphorus, and potassium. This is supported by the enhanced nutrient content and their absorption with nitrogen according to Shukla *et al.* (2004) [16] studies.

Table 3: N, P and K content (%) in grain and straw and its total uptake (kg ha^{-1}) by rice crop as influenced by different treatments

Treatment	N content (%)		Total N uptake (kg ha^{-1})	P content (%)		Total P uptake (kg ha^{-1})	K content (%)		Total K uptake (kg ha^{-1})
	Grain	Straw		Grain	Straw		Grain	Straw	
T1	1.109	0.44	26.438	0.207	0.143	6.155	0.276	1.066	25.959
T2	1.121	0.5	70.903	0.229	0.165	17.727	0.314	1.107	69.468
T3	1.127	0.515	79.934	0.237	0.182	21.046	0.333	1.119	78.68
T4	1.138	0.527	81.312	0.257	0.19	22.415	0.333	1.125	79.199
T5	1.142	0.535	82.324	0.268	0.192	23.087	0.343	1.131	80.221
T6	1.157	0.573	85.904	0.304	0.197	25.24	0.349	1.142	81.549
T7	1.173	0.599	91.811	0.327	0.204	27.774	0.375	1.15	86.551
T8	1.176	0.607	92.843	0.33	0.204	28.085	0.376	1.156	87.314
T9	1.179	0.612	93.715	0.338	0.206	28.699	0.382	1.165	88.501
S.Em. (±)	0.002	0.011	0.679	0.005	0.0018	0.343	0.008	0.0073	0.848
C.D. at 5%	0.007	0.032	2.036	0.015	0.005	1.029	0.025	0.022	2.543

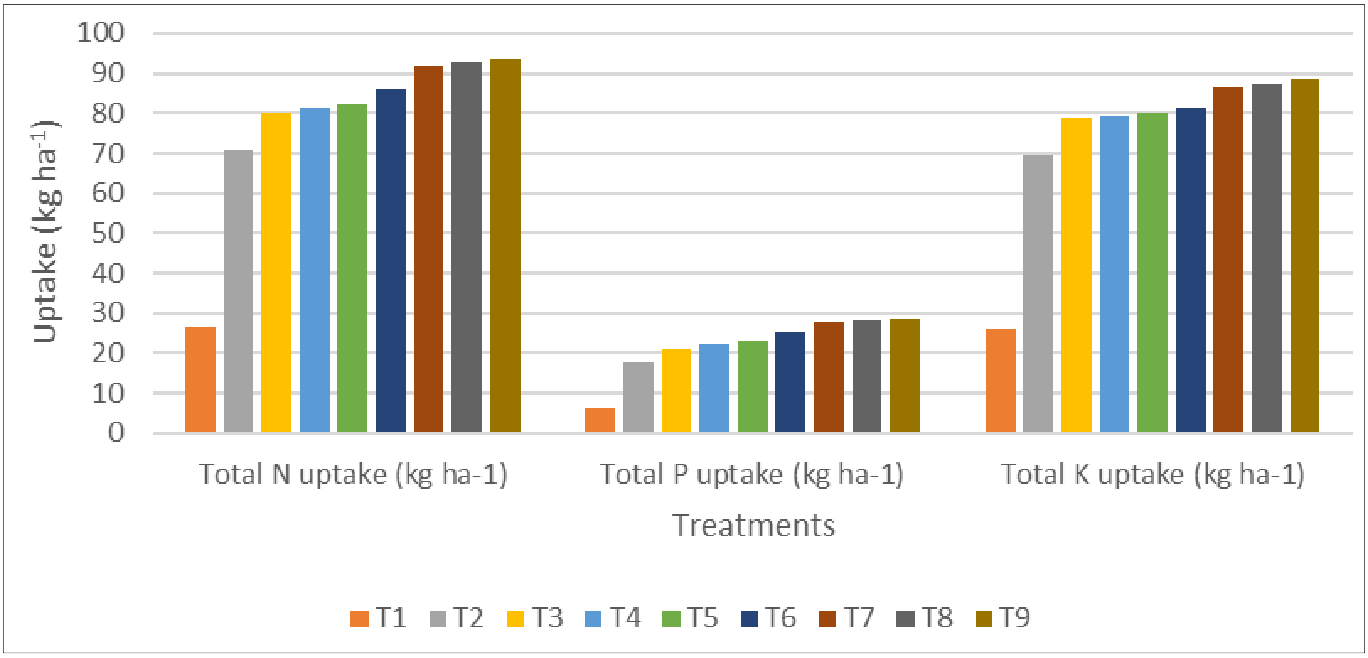

Fig 2: Total N, P and K uptake (kg ha^{-1}) by rice crop as influenced by different treatments

3.3 Economics

The economic evaluation of this current study (Table 4.) showed that, T_9 (RDN 50% Basal + LCC < 4 35 kg N through nano urea) gave higher gross returns (D 1,14,408 ha^{-1}) and net returns (D 31,425 ha^{-1}) and B: C ratio (1.38) which was subsequently followed by treatment T_8 (RDN 50% Basal + LCC < 4 30 kg N through nano urea) and T_7 (RDN 50% Basal + LCC < 4 25 kg N through nano urea). The control treatment (T_1), however, had the lowest gross returns (D 37598.6 ha^{-1}). Debnath and Bandyopadhyay (2008) [4] reported that nitrogen management in transplanted rice through LCC values, recorded highest B:C ratio with 30 kg N ha^{-1} with LCC value of 4 applied in 4 splits as compared to farmers practice. Also, these outcomes are consistent with those of Reddy *et al*. (2014) [13].

Table 4: Economics of rice cultivation as influenced by different treatments based on input cost

Treatments	Cost of cultivation (D ha^{-1})	Gross returns (D ha^{-1})	Net returns (D ha^{-1})	B: C ratio (Input Cost)
T_1: Control	89609.31	37598.6	-30669.87	0.55
T_2: RDF 100:50:50 N: P_2O_5: K_2O kg/ha	114077.32	96163.6	13476.33	1.17
T_3: RDN 50% Basal + 50% N through nano urea	115470.31	106754	24431.2	1.3
T_4: RDN 50% Basal + LCC < 3 25 kg N through nano urea	115793.97	107037	24443.63	1.3
T_5: RDN 50% Basal + LCC < 3 30 kg N through nano urea	115816.33	107572	25043.43	1.31
T_7: RDN 50% Basal + LCC < 4 25 kg N through nano urea	117240.3	113304	30316.37	1.36
T_8: RDN 50% Basal + LCC < 4 30 kg N through nano urea	117265.55	113856	30933.46	1.37
T_9: RDN 50% Basal + LCC < 4 35 kg N through nano urea	117418.73	114408	31425.36	1.38
S.Em. (±)	-	-	661.95	-
C.D. at 5%	-	-	1984.53	-

4. Conclusion
On the basis of experimental findings, it may be concluded that treatment RDN 50% Basal + LCC < 4 35 kg N through nano urea resulted in higher yield attributes and yield. Also, it positively influences nutrient content in rice grain and straw and recorded higher total nutrient uptake by rice crop. However, economic analysis showed that treatment RDN 50% Basal + LCC < 4 35 kg N through nano urea achieved higher gross returns, net returns and B: C ratio.

5. References

1. Anonymous. Agricultural Statistics at a Glance 2022-23. Ministry of Directorate of Economics and Statistics, Ministry of Agriculture and Farmers Welfare, Govt. of India. [Internet]; c2022a. Available from: https//www.agricoop.nic.in
2. Anonymous. Economic survey of Maharashtra 2022-23. Department of Agriculture, Maharashtra State final estimate. krishi.maharashtra.gov.in 2022-23; c2022b.
3. Balaji T, Jawahar D. Comparison of LCC and SPAD methods for assessing nitrogen requirement of rice. Crop Res. 2007;33(1, 2 & 3):30-34.
4. Debnath J, Bandyopadhyay P. Judicious nitrogen management in transplanted rice, through LCC (Leaf Color Chart) values. J Crop Weed. 2008;4(1):52-53.
5. Huang S, Wang L, Liu L. Nanotechnology in agriculture, livestock, and aquaculture in China. A review. Agron Sustain Dev. 2015;35:369-400. http://dx.doi.org/10.1007/s13593-014-0274-x.
6. Krishnakumar S, Haefele S. Integrated nutrient management and LCC based nitrogen management on soil fertility and yield of rice (*Oryza sativa* L.). Sci Res Essays. 2013;8(41):2059-2067.
7. Kumar R, Singh RK, Panda A, Singh SK. Nano Urea: An Efficient Tool for Precision Agriculture and Sustainability. Vigyan Varta. 2021;2(9):72-74.
8. Lone AH, Ganie MA. Nitrogen Management in Rice through Leaf Colour Chart under Kashmir Conditions. Int J Eng Res Technol; c2017, 6(6).
9. Mangare PN. Evaluation of soil and plant testing kits and their efficacy in comparison to standard laboratory analysis under experimental condition with rice as a test crop. M.Sc. (Agri.) thesis submitted to Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli. (M.S.) India; c2002.
10. Moharana S, Gulati JML, Jena SN. Effect of LCC-based nitrogen application on growth and yield of rice (*Oryza sativa* L.) varieties during dry season. Indian J Agric Res. 2017;5(1):49-53.
11. Panse VG, Sukhatme PV. Statistical methods for agricultural workers. I.C.A.R. New Delhi; c1967.
12. Ravi S, Ramesh S, Chandrasekaran B. Exploitation of hybrid vigour in rice hybrid (*Oryza sativa* L.) through green manure and leaf colour chart (LCC) based N application. Asian J Plant Sci. 2007;6(2):282-287.
13. Reddy. Need Based Nitrogen Management in Rice (*Oryza sativa* L.) using Diagnostic Tools. M.Sc. (Agri.) thesis submitted to Kerala Agricultural University; c2014.
14. Rostami M, Movahedi Z, Davari MR, Siahpoosh S. Effect of foliar application of biofertilizer and nano-fertilizers on morpho-physiological characteristics of peppermint (*Mentha piperita* L.). Tropentag 2017-Future Agriculture: Socioecological Transitions and Bio-cultural shifts; c2017.
15. Satpute SB, Das T, Surje DT, Maity SK. Nitrogen management using Leaf Colour Chart (LCC) and nitrogen level in Kharif rice. Indian J Appl Res. 2015;5:2249-555.
16. Shukla AK, Ladha JK, Singh VK, Dwivedi BS, Balasubramanian V, Gupta RK, *et al*. Calibrating the leaf color chart for nitrogen management in different genotypes of rice and wheat in a systems perspective. Agron J. 2004;96(6):1606-1621.
17. Singh B, Singh VK. Advances in nutrient management in rice cultivation. In: Sasaki T, editor. Achieving Sustainable Cultivation of Rice. 2. Burleigh Dodds Science Publishing Limited, Cambridge, U.K.; c2017. p. 25-68.
18. Tandon HLS. Methods of analysis of soils, plants, water and fertilizers. FDCO, New Delhi, India; c1993.