International Journal of Advanced Biochemistry Research 2025; SP-9(10): 1534-1538

International Journal of Advanced Biochemistry Research

ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating (2025): 5.29
IJABR 2025; SP-9(10): 1534-1538
www.biochemjournal.com
Received: 04-07-2025
Accepted: 07-08-2025

Harsh Jaiswal
M.Sc. Scholar, Department of Soil Science, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

LK Srivastava
Principal Scientist, Department of Soil Science, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Gourav Kumar Jatav
Scientist, Department of Soil Science, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Neha Nishad
M.Sc. Scholar, Department of Soil Science, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Corresponding Author:
Harsh Jaiswal
M.Sc. Scholar, Department of Soil Science, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Validation of fertilizer prescription equation evolved for Chhattisgarh dhan-1919 in a Vertisol

Harsh Jaiswal, LK Srivastava, Gourav Kumar Jatav and Neha Nishad

DOI: https://www.doi.org/10.33545/26174693.2025.v9.i10Ss.6051

Abstract
An experiment was conducted on “Validation of fertilizer prescription equation evolved for Chhattisgarh dhan-1919 in a Vertisol” at research cum instructional farm IGKV, Raipur (C.G.) during Kharif season, 2024 with the three objectives: (1). To test the validity of fertilizer prescription equation evolved for rice var. Chhattisgarh dhan - 1919. (2). To estimate the nutrients uptake and use efficiency. (3). To calculate the benefit cost ratio under various treatments. The fertilizer prescription equation previously developed for rice (variety - Chhattisgarh dhan-1919) in Vertisol as FN = 4.72Y-0.70SN - 0.25ON, FP = 1.22Y-2.72SP-0.20OP and FK = 1.37Y-0.09SK 0.06OK were validated on research cum instructional farm IGKV, Raipur. The experimental field was laid out in randomized block design with four replications, consisting of six treatments as control ($N_0P_0K_0$), RDF (($N_{100}P_{60}K_{40}$), STCR based dose for TY 55 q/ha ($N_{127}P_{18}K_{36}$), STCR based dose for TY 55q/ha with FYM ($N_{120}P_{16}K_{34}$+5 t/ha FYM), STCR based dose for TY 65q/ha ($N_{174}P_{30}K_{49}$) and STCR based dose for TY 65 q/ha with FYM ($N_{168}P_{28}K_{48}$+5 t/ha FYM). Treatment with STCR based dose for target yield 65 q/ha with 5 ton/ha FYM and treatment with STCR based dose for target yield 65 q/ha were recorded significantly higher grain and straw yield and also found statistically at par with each other’s. Treatment with STCR based dose for target yield 55 q/ha with 5 ton/ha FYM, treatment with STCR based dose for target yield 55 q/ha and RDF gave almost similar grain and straw yield and significantly higher than control. The grain yield received under treatments based on targeted yield 55 q/ha and targeted yield 65 q/ha were achieved with + 10% variations due to fertilizer application alone and along with 5 ton/ha FYM as per yield target, so its proved that the fertilizer prescription equations developed previously were valid for rice variety Chhattisgarh dhan - 1919 in a Vertisol.

Keywords: STCR, FYM, RDF, soil test, Vertisol

1. Introduction

The Green Revolution played a key role in making India self-reliant in food production. However, it also led to the excessive and unbalanced application of chemical fertilizers, which has negatively impacted soil health. This issue is especially concerning in areas of intensive farming, where crops extract large amounts of nutrients from the soil, yet replenishment through fertilizers remains both inadequate and disproportionately focused on nitrogen as a result, the productivity of major crops has either stagnated or begun to decline. At current levels of agricultural output and fertilizer application, it is estimated that there is a nutrient deficit of around 10 million tones, the difference between the nutrients taken up by crops and those added through fertilizers, organic sources of nutrients such as compost, crop residues, and bio-fertilizers have the potential to fill this gap. However, only about one-third of these available organic resources are currently being utilized in farming. This underuse is accelerating the depletion of the soil’s nutrient reserves. Consequently, soil fertility is deteriorating rapidly, posing a serious risk to both agricultural productivity and long-term sustainability.

Multiple approaches have been developed to recommend fertilizer use based on chemical soil testing, with the goal of maximizing crop yield per unit of fertilizer applied. Among these, the Soil Test Crop Response (STCR) method has proven particularly effective tools for fertilizer recommendations. This approach helps in formulating fertilizer adjustment equations and developing calibration charts, which guide fertilizer recommendations based on soil test results to achieve targeted crop yields (Ramamoorthy *et al*., 1967; Singh and Biswas, 2000) [8, 11].

The Soil Test Crop Response (STCR) approach plays a crucial role in maintaining sustainable crop yields while reducing both fertilizer inputs and overall cultivation costs (Saxena *et al*., 2008; Chatterjee *et al*., 2010) [10, 3].

Fertilizer decisions should consider the crop's nutrient demands, the natural nutrient supply from the soil, and the short- and long-term effects of applied nutrients. One major factor contributing to reduced agricultural productivity is the inconsistent use of fertilizers by farmers. This often stems from a lack of knowledge about soil fertility and crop nutrient needs, leading to both nutrient toxicity and deficiencies, as noted by Ray *et al*. (2000) [9]. To address this, the AICRP center under the STCR (Soil Test Crop Response) project developed fertilizer prescription equations tailored for various crops and agro-ecological zones across different states. By inputting soil test results and target yield values into these equations, precise fertilizer nutrient recommendations can be generated. These values can then be converted into actual fertilizer application amounts. Using such a targeted approach not only helps conserve fertilizer and improve farm profitability but also promotes better soil health. Srinivasan and Angayarkanni (2008) [13] observed that applying fertilizers based on STCR equations can lead to nutrient buildup in the soil, which enhances its fertility over time. Additionally, applying nutrients as per soil test results tends to produce higher crop response ratios and better benefit-cost outcomes.

Our national food security mission, rice crop plays an important role and is a means of livelihood for Millions of rural households. Rice is grown in Chhattisgarh in an area of 37.88 lakh hectares with a Production of 74.86 lakh tones and productivity of 2.15 tones/ha in 2023-24.

2. Materials and Methods

2.1 Experimental site and soil characteristics

The experimental site is located at the research field of IGKV, Raipur. Which is located near Zora village at eastern part of the state of Chhattisgarh, central India. The site lies at 21.250 N latitude and 81.620 E longitudes with an average elevation of 298.15 meters from above mean sea level. The experimental site belongs to the soil order of Vertisol, which is also locally known as Kanhar. Vertisol is neutral to alkaline in soil reactions due to presence of lime concretion in lower horizon, clayey in texture and dark brown to black in color. The initial soil test values were as pH 7.55, EC 0.21 ds/m, organic carbon 0.55%, available nitrogen 170 kg/ha, available phosphorus 16.42 kg/ha and available potassium 372 kg/ha.

2.2 Treatments

Using six different combination of fertilizer application along with Control ($N_0P_0K_0$), RDF ($N_{120}P_{60}K_{40}$), STCR based dose for YT 55q/ha without FYM ($N_{127}P_{18}K_{36}$), STCR based dose for TY 55q/ha with 5-ton FYM ($N_{120}P_{16}K_{34}$), STCR based dose for TY 65q/ha without FYM ($N_{174}P_{30}K_{49}$), STCR based dose for TY 65q/ha with 5-ton FYM ($N_{168}P_{28}K_{48}$). The study carried out on soil test based fertilizer prescription in a Vertisol. Before conducting the trial, the field divide in to four equal long strips denoted as R_1, R_2, R_3 and R_4. The experiment was laid out in RBD design. For validation of fertilizer prescription equation evolved for Chhattisgarh dhan - 1919 in a Vertisol was here FN= 4.72Y-0.70SN-0.25ON FP= 1.22Y-2.72SP-0.20OP FK=1.37Y-0.09SK-0.06OK Where FN, FP and FK are fertilizer N, P_2O_5 and K_2O in kg/ha, respectively. SN, SP and SK are soil test values for available N, P and K in kg/ha, respectively. ON, OP and OK are organic nutrients of N, P and K in kg/ha, respectively. Y is targeted yield of rice q/ha. The fertilizer N, P_2O_5 and K_2O were calculated on basis of soil test for the targeted yield treatments by using these equations. The following doses of fertilizer N, P_2O_5 and K_2O were applied to achieving the yield targets of 55 and 65 q/ha based on the soil test values with FYM @ 5 t/ha (treatments T4 and T6) and chemical fertilizer alone (treatments T3 and T5).

3. Result and Discussion

3.1 Crop yield and yield attributes of Chhattisgarh dhan-1919 rice crop

3.1.1 Plant height (cm)

Effect of different fertilizer treatments on plant height was found to be significant and has been presented in Table 1 and Fig 1. The variation in plant height of rice was influenced by the application of different fertilizer doses. The maximum plant height (99.50 cm) was observed under the treatment with STCR based dose for target yield 65 q/ha with 5 ton/ha FYM. Treatment STCR based dose for target yield 65 q/ha (97.00 cm) followed by RDF (96.00 cm) and STCR based dose for target yield 55 q/ha with 5 ton/ha FYM (95.50 cm) gave significantly higher plant height than control (80.5 cm) and these treatments were statistically at par with STCR based dose for target yield 55 q/ha (94.75 cm) and each other's. The control plot recorded minimum plant height(80.50cm). The variation in plant height of rice was influenced by the application of different fertilizer doses. This may be because fertilizers play a role in promoting rapid leaf, stem and other vegetative part's growth and development. Similar results reported by Parihar *et al*. (2015) [6] and Choudhary *et al*. (2022) [4].

3.1.2 Numbers of total tillers/m^2 and effective tillers/m^2

The numbers of total tillers/m^2 and effective tillers/m^2 have been represented in Table 1 and Fig 1. Maximum number of total tillers/m^2 were observed in STCR based dose for target yield 65 q/ha with 5 ton/ha FYM (466.34) followed by STCR based dose for target yield 65 q/ha (463.03) and RDF (458.91). These treatments are statistically at par with each other. STCR based dose for target yield 55 q/ha have more tillers/m^2 (441.72) than control (295.97) and also at par with STCR based dose for target yield 55 q/ha with 5 ton/ha FYM (453.75). The maximum numbers of effective tillers/m^2 were found in STCR based dose for target yield 65 q/ha with 5 ton/ha FYM (358.26) followed by STCR based dose for target yield 65 q/ha (356.40) and RDF (345.00). These treatments were at par with each other. Similarly STCR based dose for target yield 55 q/ha with 5 ton/ha FYM (334.50) followed by STCR based dose for target yield 55 q/ha (330.00) and RDF (345.00) were also found at par with each other's and these treatments were found more effective tillers/m^2 than control (212.10).The increase in number of total tillers and effective tillers by application of NPK fertilizers and FYM can be attributed to soil condition with more availability and nutrients uptake, water and growth promoting substances to promote more tillers. Similarly result reported by Uddin *et al*. (2013) [14] and Bhavya *et al*. (2021) [2].

3.1.3 Panicle length of rice (cm)

Table 1 and Fig 1 show the result of panicle length of rice. The highest panicle length was observed in STCR based dose for target yield 65 q/ha with 5 ton/ha FYM (23.48cm) followed by STCR based dose for target yield 65 q/ha (22.95cm). STCR based dose for target yield 55 q/ha with 5 ton/ha FYM (22.53cm), STCR based dose for target yield 65 q/ha and RDF (21.95cm) were found statistically at par with each other. The smallest panicle length was observed in control (18.95cm). The panicle length was increased with the level of nitrogen dose. Increasing panicle length might be because nitrogen and balance fertilization contributes in stimulating cell division in the reproductive stage of crop growth. Similar findings reported by Bhavya *et al*. (2021) [2] and Choudhary *et al*. (2022) [4].

3.1.4 Filled and unfilled grains per panicle of rice.

The result of filled and unfilled grains per panicle have been represented in Table 1 and Fig 1. The maximum filled grains were recorded in STCR based dose for target yield 65 q/ha with 5 ton/ha FYM (182.94) followed by STCR based dose for target yield 65 q/ha (180.45). STCR based dose for target yield 55 q/ha with 5 ton/ha FYM (166.95), RDF (163.58) and STCR based dose for target yield 55 q/ha (150.75) have more filled grains than control (123.53) and also have at par with each other. Unfilled grains showed non-significant difference due to various fertilizations and maximum unfilled grains recorded in STCR based dose for target yield 65 q/ha (13.75) followed by STCR based dose for target yield 65 q/ha with 5 ton/ha FYM (12.50), STCR based dose for target yield 55 q/ha (12.25) and control (12.00). The minimum unfilled grains were found in RDF (10.50) and STCR based dose for target yield 55 q/ha with 5 ton/ha FYM (10.50). This is due to adequate supply of photosynthates from the source to the sink (grain). Accumulation of photosynthates to sink depends on the availability of nutrients and genetic potentiality of the crops. The similar results were obtained by Uddin *et al*. (2013) [14] and Aparna *et al*. (2017) [1].

3.1.5 Test weight of rice grains

The Effect of different fertilizer treatments on test weight of rice grains showed in Table 1 and Fig 1. The highest test weight was recorded in STCR based dose for target yield 65 q/ha with 5 ton/ha FYM (18.49 gm) and RDF (18.46 gm). The lowest test weight was recorded in control (18.25 gm). STCR based dose for target yield 55 q/ha with 5 ton/ha FYM (18.36 gm) and STCR based dose for target yield 55 q/ha (18.31 gm) were found almost equal test weight. STCR based dose for target yield 65 q/ha (18.41 gm) was also found almost equal test weight with RDF. Fertilizer application had non-significant impact on test weight of grains because test weight of a variety is genetically inherent character.

3.1.6 Grain and Straw yield of rice

Table 1 and Fig 1 were represented that grain and straw yield have been affected by the application of different fertilizer treatments. The highest grain yield was recorded in STCR based dose for target yield 65 q/ha with 5 ton/ha FYM (66.32 q/ha), which was also statistically at par with STCR based dose for target yield 65 q/ha (64.00 q/ha). Treatments RDF (58.58 q/ha), STCR based dose for target yield 55 q/ha with 5 ton/ha FYM (57.79 q/ha) and STCR based dose for target yield 55 q/ha (55.77 q/ha) were found statistically at par with each other. The lowest grain yield was recorded in control (31.06 q/ha). The grain yield was found +10 % variation from targeted yield under the application of different treatments 55 q/ha and 65 q/ha alone and along with 5 ton ha 1 FYM. So, it's proved that the fertilizer prescription equation developed previously was valid for Chhattisgarh dhan- 1919 in a Vertisol. Significantly highest straw yield was recorded in STCR based dose for target yield 65 q/ha with 5 ton/ha FYM (83.23 q/ha), which was also statistically at par with STCR based dose for target yield 65 q/ha (79.30 q/ha). STCR based dose for target yield 65 q/ha, RDF (75.21 q/ha), STCR based dose for target yield 55 q/ha with 5 ton/ha FYM (73.99 q/ha) and STCR based dose for target yield 55 q/ha (69.24 q/ha) were also found statistically at par with each other. The lowest straw yield was recorded in control (37.65 q/ha). Results showed that the yield of rice was increased by addition of FYM. Similar results were observed by Rai *et al*. (2016) [7] and Kumar *et al*. (2023) [5].

Table 1: Effect of different fertilizer treatments on yield and yield attributes of rice crop.

S.N.	Treatments	Plant height (cm)	Total tillers/m^2	Effective tillers/m^2	Panicle length (cm)	Filled grains/panicle	Unfilled grains/ panicle	Test weight (gm)	Grain yield (q/ha)	Straw yield (q/ha)
1.	Control (0-0-0)	80.50 c	295.97 c	212.10 c	18.95 d	125.53 d	12.00	18.25	31.06 c	37.65 c
2.	RDF (100-60-40)	96.00 ab	458.91 a	345.00 ab	21.95 b	163.58 bc	10.50	18.46	58.58 b	75.21 b
3.	STCR based dose for YT 55 q/ha (127-18-36)	94.75 b	441.72 b	330.00 b	20.95 c	150.75 c	12.25	18.31	55.77 b	69.24 b
4.	STCR based dose for YT 55 q/ha (120-16-34) with 5 ton/ha FYM	95.50 ab	453.75 ab	334.50 b	22.53 b	166.95 b	10.50	18.36	57.79 b	73.99 b
5.	STCR based dose for YT 65 q/ha (174-30-49)	97.00 ab	463.03 a	356.40 a	22.95 ab	180.45 ab	13.75	18.41	64.00 a	79.30 ab
6.	STCR based dose for YT 65 q/ha (168-28-48) with 5 ton/ha FYM	99.50 a	466.34 a	358.26 a	23.48 a	182.94 a	12.50	18.49	66.32 a	83.23 a
	S Em±	1.524	4.724	5.024	0.243	5.210	0.756	0.110	1.596	1.989
	CD	4.593	14.239	15.143	0.733	15.706	NS	NS	4.812	5.996

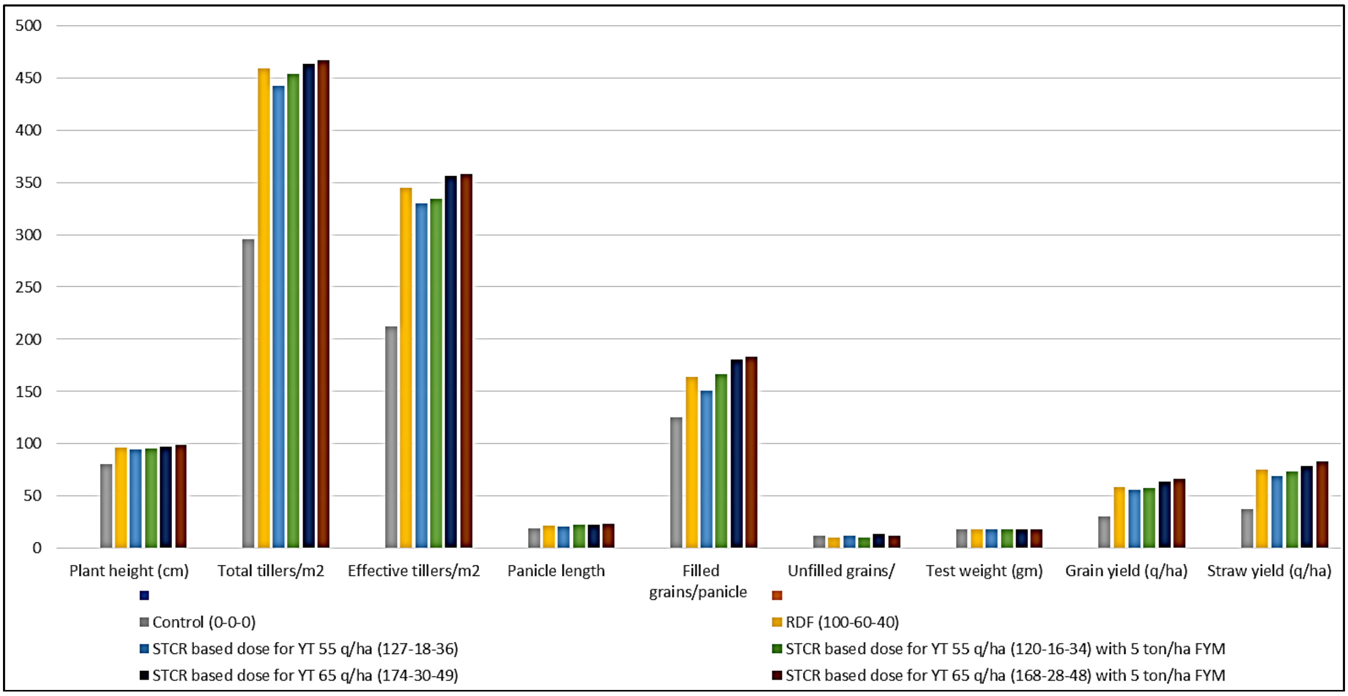

Fig 1: Effect of different fertilizer treatments on yield and yield attributes of rice crop.

4. Conclusion

The maximum plant height was recorded in the treatment with STCR based dose for target yield 65 q/ha with 5 ton/ha FYM (99.50cm), which was statistically at par with other treatments except STCR based dose for target yield 55 q/ha and control. Significantly lowest plant height was recorded in control (80.50cm). The maximum number of total (466.34) and effective (358.26) tillers were found in the treatment with STCR based dose for target yield 65 q/ha with 5 ton/ha FYM, which was statistically at par with other treatments except STCR based dose for target yield 55 q/ha and control. The minimum number of tillers was found in control. The highest panicle length observed in treatment with STCR based dose for target yield 65 q/ha with 5 ton/ha FYM (23.48 cm), which was found statistically at par with treatment with STCR based dose for target yield 65 q/ha (22.95 cm). Significantly lowest panicle length observed in control (18.95cm). The maximum filled grains were observed significantly highest in treatment with STCR based dose for target yield 65 q/ha with 5 ton/ha FYM (182.94) followed by treatment with STCR based dose for target yield 65 q/ha (180.45). Control (123.53) was found significantly minimum filled grains. The unfilled grains found non-significant in treatments. The test weight of grains showed non-significant difference due to various application of fertilizers. The highest test weight recorded in treatment with STCR based dose for target yield 65 q/ha with 5 ton/ha FYM (18.49 gm) and lowest in control plot (18.25 gm).Significantly highest grain yield observed in treatment with STCR based dose for target yield 65 q/ha with 5 ton/ha FYM (66.32q/ha), which was found statistically at par with treatment with STCR based dose for target yield 65 q/ha (64.00 q/ha). The lowest grain yield observed in control (31.06q/ha). The highest straw yield was observed in treatment with STCR based dose for target yield 65 q/ha with 5 ton/ha FYM (83.23q/ha) and significantly lowest straw yield was observed in control plot (37.65q/ha). The grain yield received under targeted yield treatments YT 55 q/ha and YT 65 q/ha were achieved with ± 10% variations due to fertilizer application alone or along with 5 ton/ha FYM as per yield target, so, its proved that the previously developed fertilizer prescription equations were valid for rice crop.

References

1. Aparna V. Studies on physiological characteristics influencing nitrogen use efficiency in rice genotypes (*Oryza sativa* L.) [dissertation]. Hyderabad: Professor Jayashankar Telangana State Agricultural University; 2017.
2. Bhavya N. Assessment of soil test crop response-based fertilization on nutrient requirement, nutrient uptake and nutrient use efficiency of aerobic rice. Chem Sci Rev Lett. 2021;9(1):1-5.
3. Chatterjee A, Tanoue S, Houl JH, Hardin PE. Regulation of gustatory physiology and appetitive behaviour by the *Drosophila* circadian clock. Curr Biol. 2010;20(4):300-309.
4. Choudhary L, Singh KN, Gangwar K, Sachan R. Effect of FYM and inorganic fertilizers on growth performance, yield components and yield of wheat (*Triticum aestivum* L.) under Indo-Gangetic plain of Uttar Pradesh. Pharma Innov J. 2022;11(4):1476-1479.
5. Kumar A, Singh AK, Rai A, Gangwar A, Kumar M, Pareek N, *et al*. Productivity and economics of wheat under STCR-based nutrient management in alluvial soil. J AgriSearch. 2023;10(4):217-220.
6. Parihar M, Meena RK, Jat LK, Suryakant HS. Effect of inorganic fertilizers with and without FYM on yield, nutrient uptake and quality parameters of rice (*Oryza sativa* L.). Environ Ecol. 2015;33(4):1480-1484.
7. Rai HK, Sachidanand B, Baghel SS, Dey P. Evaluation of productivity and economics of wheat under STCR-based nutrient application with and without FYM in a Vertisol. Ecol Environ Conserv. 2016;22(6):107-111.
8. Ramamoorthy B, Narasimhan RL, Dinesh RS. Fertilizer application for specific yield targets of Sonara-64. Indian Farming. 1967;17(5):43-45.

9. Ray PK, Jana AK, Maitra DN, Saha MN, Chaudhury J, Saha S, *et al*. Fertilizer prescriptions on soil test basis for jute, rice and wheat in a *Typic Ustochrept*. J Indian Soc Soil Sci. 2000;48(1):79-84.
10. Saxena AK, Singh S, Srivastava A, Gautam P. Yield target approach under integrated nutrient management for assessing fertilizer requirements of onion in Mollisols of Uttarakhand. Indian J Hortic. 2008;65(3):302-306.
11. Singh GB, Biswas PP. Balanced and integrated nutrient management for sustainable crop production: limitations and future strategies. Fertiliser News. 2000;45(9):55-60.
12. Singh M, Jat LK, Ram RL. Validation of soil test and yield target-based fertilizer prescription model for rice on Inceptisol of eastern zone of Uttar Pradesh, India. Int J Curr Microbiol Appl Sci. 2017;6(2):406-415.
13. Srinivasan S, Angayarkanni S. Fertilizer potassium doses based on STCR for a yield target of 70 q ha^{-1} on rice cv. ADT-36. Asian J Soil Sci. 2008;3(2):246-248.
14. Uddin S, Sarkar MAR, Rahman MM. Effect of nitrogen and potassium on yield of dry direct seeded rice cv. NERICA I in Aus season. Int J Agron Plant Prod. 2013;4(1):69-75.
15. Ruog E. Transactions of the Seventh International Congress of Soil Science. Trans Int Congr Soil Sci. 1960;4(7):46-52.