International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(1): 1543-1546

Received: 01-11-2018
Accepted: 05-12-2018

Sushma
Department of Soil Science, IGKV, Raipur, Krishk Nagar, Chhattisgarh, India

Yushma Sao
Department of Soil Science, IGKV, Raipur, Krishk Nagar, Chhattisgarh, India

Seru Kumar
Department of Soil Science, IGKV, Raipur, Krishk Nagar, Chhattisgarh, India

Rinky Roy
Department of Soil Science, IGKV, Raipur, Krishk Nagar, Chhattisgarh, India

Anmita Tirky
Department of Soil Science, IGKV, Raipur, Krishk Nagar, Chhattisgarh, India

Geeteshwar Verma
Department of Soil Science, IGKV, Raipur, Krishk Nagar, Chhattisgarh, India

Stanley Samuel
Department of Soil Science, IGKV, Raipur, Krishk Nagar, Chhattisgarh, India

Amina Anisha Ekka
Department of Soil Science, IGKV, Raipur, Krishk Nagar, Chhattisgarh, India

Sanju Gilhare
Department of Soil Science, IGKV, Raipur, Krishk Nagar, Chhattisgarh, India

Sushmita Kanwar
Department of Soil Science, IGKV, Raipur, Krishk Nagar, Chhattisgarh, India

Correspondence
Sushma
Department of Soil Science, IGKV, Raipur, Krishk Nagar, Chhattisgarh, India

Macro nutrient content under site specific nutrient management, use in two soil type vertisol and inceptisol on rice grain and straw

Sushma, Yushma Sao, Seru Kumar, Rinky Roy, Anmita Tirky, Geeteshwar Verma, Stanley Samuel, Amina Anisha Ekka, Sanju Gilhare and Sushmita Kanwar

Abstract
A pot culture experiment was conducted in the Department of Soil Science and Agricultural Chemistry, BTC College of Agriculture and research Station, Bilaspur, during *Kharif* season 2017-18. using two representative soils (*Vertisol* and *Inceptisol)* collected from village Mungeli (*Vertisol)* and Jhajh (*Inceptisol)* of the mungeli district.

The objectives of the study were to identify the specific nutrients which limit the crop yield through rice - response using nutrient omission technique during *kharif* season, 2017 and to demonstrate the optimum use of identified limiting nutrients and it's comparison with farmer's fertilizer practice with wheat crop during *rabi* season. 2017-18. On the basis of 1st season results farmer's field demonstration was also carried out at field of farmer's (from where bulk of soils were collected for pot experiment) during *Rabi* season 2017-18. The soils used for pot experiment were two type i. e. *Inceptisol* and *Vertisol*. Both the soils were collected from two different locations of Mungeli district. Collected soils were air dried and filled in cemented pots. The treatments constituted with application of all nutrients applied at optimum level known as All (SSNM dose) while in others, one of the nutrient elements from all the nutrient treatments (All) was omitted. There were eleven treatments for each type of soil and three replications with completely randomized design. All treatments were common for both the soils except omission of Fe and Mn in case of *Vertisol* and omission of Ca and Mg in case of *Inceptisol* were kept keeping the concept of soil reaction. After addition of all treatments, rice (IGKV-1 "rajesh wari") was transplanted in three hills/pot with 2-3 seedlings in each hill. The treatments constituted with application of all nutrients applied at optimum level known as SSNM dose while in others, one of the nutrient elements from all the nutrient treatments was omitted. Total 11 treatments were tested with rice (IGKV-1 "rajeshwari") as a test crop, laid out in CRD (Completely Randomized Block Design) with three replications.

In eleven treatments, first treatment was application of all nutrients (N, P, K, S, Fe/Ca, Mn/Mg, Cu, Zn, B and Mo) and sequentially each nutrient was omitted from all nutrients applied (SSNM). The yield reductions were more pronounced with N and P omission. The P, Ca, Mg, S, Mn, Zn and B content in rice grain were recorded with the treatment (T_1) which received all the nutrients. While, treatment T_{11} had recorded significantly the highest value of N content in rice straw. In case of *Inceptisol*, significantly, the highest P, K, Ca, Mg and S content were recorded in treatment T_1 which received all nutrients. The highest value of P, Mg content in rice straw were recorded in treatment T_1 received all nutrients. Treatment T_{11} had showed the maximum content of N in rice straw.

The overall study indicated that N, P, S nutrients in *Vertisols* and N, P, S nutrients in *Inceptisols* of Bilaspur district were traced as limiting nutrients which should be applied for optimum crop production.

Keywords: inceptisol, vertisol, nutrients, straw

Introduction
Site-specific nutrient management (SSNM) is a plant-based approach, which enables rice farmers to optimally supply their crop with essential nutrients. The optimal supply of nutrients for rice can vary from field-to-field depending on crop and soil management, historical use of fertilizers, management of crop residues and organic materials, and crop cultivar. Optimally supplying rice with essential nutrients as and when needed to achieve high yield and high efficiency of input use involves three steps.

a. The first step is to establish an attainable yield target, which is location and season-specific depending upon climate, rice cultivar, and crop management. This yield target or goal reflects the total amount of nutrients that must be taken up by the crop.

b. The second step is to ensure effective use of existing indigenous nutrients such as from soil, organic amendments, crop residue, manure, and irrigation water.
c. The third step is to apply fertilizer to dynamically fill the deficit between crop needs and indigenous supply and to maintain soil fertility.

The nutrient omission plot technique is a tool for determining crop requirements for fertilizers in rice field. (Buresh, 2007) [3]. Site-specific nutrient management is a set of nutrient management principles combined with good crop management practices that will help farmers attain high yield and achieve high profitability both in the short- and medium-term. SSNM provides an approach for the timely application of fertilizers at optimal rates to fill the deficit between the nutrient needs of a high-yielding crop and the nutrient supply from naturally occurring indigenous sources, including soil, crop residues, manures, and irrigation water. SSNM strives to enable farmers to dynamically adjust fertilizer use to optimally fill the deficit between the nutrient needs of a high-yielding crop and the nutrient supply of naturally occurring indigenous sources such as soil, crop residues, manures and irrigation water (Dobermann *et al*. 2002; Buresh *et al.* 2010) [4]. The SSNM approach has shown the potential to improve productivity and profitability in intensive rice cropping systems of Asia and Africa. (Jinger *et al*. 2017) [12].

Rice (*Oryza sativa* L.) is cultivated in more than hundred countries and undoubtedly a dominant staple food of world and 91 per cent of the world's area and production of rice grown and consumed in Asia (Dobermann and Witt, 2003) [9]. Rice is the most rapidly growing food source in Africa and it is of significant importance to food security in an increasing number of low-income, food-deficit countries (FAO, 2004) [10].

Material and Methods

1. Experimental design: Treatments were laid out in Completely Randomized Design. Treatments were replicated thrice. There was 11 treatments in *Vertisol* and also in *Inceptisol.* All treatments were applied in pots, the treatments for both the soils were same, only two treatments were different.

2. Management of the pots: During *kharif* season the pots were maintained with 3 cm standing water. Remaining doses of nitrogen was applied at tillering and panicle initiation stage. Crop was grown till maturity and harvested on 2th November, 2017.

3. Treatment Details

Vertisols		***Inceptisols***	
Treatment -1 (T_1)	**All (N, P, K, S, Fe, Mn, Cu, Zn, B, Mo)**	**Treatment -1 (T_1)**	**All (N, P, K, S, Ca, Mg, Cu, Zn, B, Mo)**
Treatment -2 (T_2)	All – N	Treatment -2 (T_2)	All – N
Treatment -3 (T_3)	All – P	Treatment -3 (T_3)	All – P
Treatment- 4 (T_4)	All – K	Treatment- 4 (T_4)	All – K
Treatment- 5 (T_5)	All – S	Treatment- 5 (T_5)	All – S
Treatment- 6 (T_6)	All – Fe	Treatment- 6 (T_6)	All – Ca
Treatment- 7 (T_7)	All – Mn	Treatment- 7 (T_7)	All – Mg
Treatment- 8 (T_8)	All – Cu	Treatment- 8 (T_8)	All – Cu
Treatment- 9 (T_9)	All – Zn	Treatment- 9 (T_9)	All – Zn
Treatment- 10 (T_{10})	All – B	Treatment- 10 (T_{10})	All – B
Treatment- 11 (T_{11})	All – Mo	Treatment- 11 (T_{11})	All – Mo

4. Statistical analysis

Statistical analyses of the data in Completely Randomized Design were computed with standard methods of experimental design.

Results and Discussions

In order to accomplish the objectives of the present study, the experiment was conducted on rice crop during the *Kharif* season of 2017 at the College of Agriculture and research Station, IGKV, Mungeli district and in *Rabi* season, wheat crop was grown on Farmers field and compared with SSNM dose formulated based on kharif season's experiment.

Plant nutrient content

1. Nutrient content in rice grain grown in *Vertisol*

Experimental results showed that, P, Ca, Mg and S content in rice grain were significantly affected with application of different treatments (Table 1). But experimental treatments were failed to exert any significant effect on N and K content in rice grain. The highest P (0.24%), Ca (0.21%), Mg (0.16%) and S (0.16%) contents in rice grain were recorded in the treatment that received all the nutrients (T_1) which was statistically at par with treatmentT_2, T_4 andT_{11} in case of P; T_2 in case of Ca and T_8 andT_{10} in case of S content. Similar as macronutrient,

Table 1: Macro nutrient content (%) of rice grain as affected by different treatments in *Vertiso*

Treatments		Nitrogen	Phosphorus	Potassium	Calcium	Magnesium	Sulphur
T_1	All	1.23	0.24	0.55	0.21	0.16	0.16
T_2	All – N	1.21	0.23	0.53	0.20	0.10	0.15
T_3	All – P	1.19	0.20	0.53	0.19	0.15	0.14
T_4	All – K	1.20	0.22	0.50	0.18	0.14	0.14
T_5	All – S	1.18	0.21	0.51	0.19	0.14	0.13
T_6	All – Fe	1.27	0.21	0.48	0.15	0.15	0.14
T_7	All – Mn	1.17	0.20	0.49	0.16	0.15	0.15
T_8	All – Cu	1.18	0.19	0.51	0.15	0.13	0.16
T_9	All – Zn	1.19	0.20	0.50	0.17	0.12	0.15
T_{10}	All – B	1.20	0.19	0.49	0.18	0.14	0.16
T_{11}	All – Mo	1.16	0.22	0.47	0.18	0.12	0.15
SE(m)		0.04	0.007	0.017	0.006	0.005	0.006
C.D.at 5%		NS	0.021	NS	0.017	0.015	0.016

2 Nutrient content in rice straw grown in *Vertisol*

The results pertaining to nutrient content in rice straw grown in *Vertisols* as influenced by different treatments are illustrated in table 1 and table 2.

Experimental results showed that application of different treatments were failed to exert any significant effect on K, Ca, Mg and S content in rice straw while, N and P content were significantly varied under study (Table 1). Treatment T_{11} had recorded significantly higher value of N content (0.43%) and was at par with treatments $T_{1,}$ $T_{6,}$ $T_{7,}$ T_{11} and $T_{10.}$ Significantly higher P content (0.11%) was recorded in treatment that received all nutrients (T_1).

Table 2: Macro nutrient content (%) of rice straw as affected by different treatments in *Vertisol*

Treatments		Nitrogen	Phosphorus	Potassium	Calcium	Magnesium	Sulphur
T_1	All	0.42	0.11	1.32	0.72	0.39	0.084
T_2	All – N	0.39	0.08	1.31	0.70	0.38	0.082
T_3	All – P	0.37	0.08	1.30	0.71	0.37	0.081
T_4	All – K	0.39	0.09	1.28	0.69	0.36	0.079
T_5	All – S	0.38	0.07	1.27	0.68	0.37	0.077
T_6	All – Fe	0.41	0.08	1.29	0.66	0.35	0.081
T_7	All – Mn	0.42	0.09	1.30	0.69	0.34	0.081
T_8	All – Cu	0.37	0.09	1.31	0.71	0.35	0.078
T_9	All – Zn	0.39	0.08	1.32	0.71	0.36	0.077
T_{10}	All – B	0.41	0.09	1.26	0.70	0.37	0.079
T_{11}	All – Mo	0.43	0.08	1.27	0.68	0.36	0.080
SE(m)		0.013	0.004	0.042	0.024	0.012	0.005
C.D. at 5%		0.038	0.013	NS	NS	NS	NS

3. Nutrient content in rice grain grown in *Inceptisol*

Data presented in fig 1 showed that **a**pplications of different treatments were significantly affected the macro nutrient content (P, K, Ca, Mg and S) except N content in rice grain. Significantly, the highest P (0.22%), K (0.53%), Ca (0.20%), Mg (0.13%) and S (0.15%) contents were recorded in treatment received all nutrients (T_1) which was at par with treatments T_2 and T_{11} in case of P content; $T_{2,}$ $T_{3,}$ T_4 andT_{10} in case of K content; T_2 in case of Ca content; $T_{2,}$ T_3 and T_{11} in case of Mg content; $T_{2,}$ $T_{3,}$ T_6 andT_{10} in case of S content.

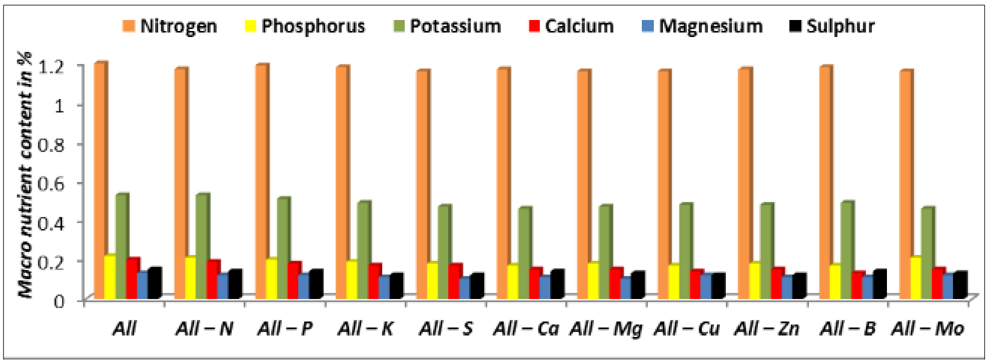

Fig 1: Macro nutrient content (%) of rice grain as affected by different treatments in *in ceptisol*

4. Nutrient content in rice straw grown in *in ceptisols*

Application of different treatments were significantly altered the N, P and Mg content in rice straw (Fig: 2). K, Ca and S contents were not affected in present experiment. The highest value of P (0.10%) and Mg (0.37%) content were recorded in treatment that received all nutrients (T_1). Treatment T_{11} (Omission of Mo) showed the maximum value of N content (0.41%) in rice straw which was at par with treatments $T_{1,}$ $T_{2,}$ T_6 and $T_{7.}$

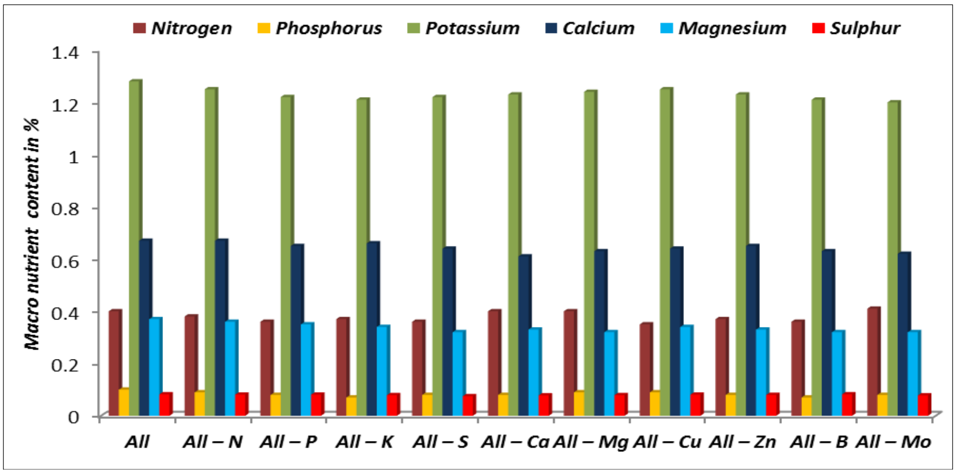

Fig 2: Macro nutrient content (%) of rice straw as affected by different treatments in*Inceptisol.*

References

1. Amin MF, Nath D, Islam MS, Saleque MA. Site specific nutrient management in Ganges tidal floodplain soil of barisal for rice (*Oryza sativa*). Eco-Friendly Agriculture Journal. 2013; 6(02):21-24.
2. Black CA. Method of soil analysis. American Soc. Agro. Medison, Wis. USA, 1965.
3. Buresh. Site-specific nutrient management (SSNM) in rice. Workshop on Balanced Fertilization for Optimizing Plant Nutrition sponsored by the Arab Fertilizer Association (AFA), International Potash Institute (IPI), and World Phosphate Institute (IMPHOS), 2007, 1-8.
4. Buresh RJ, Pampolino MF, Witt C. Field-specific potassium and phosphorus balances and fertilizer requirements for irrigated rice-based cropping systems. Plant Soil. 2010; 335:35-64.
5. Cheng AC, Bray RH. Determination of calcium and magnesium in soil and plant material. Soil Science. 1951; 72:449-458.
6. Chesnin L, Yien CH. Turbidimetric determination of available sulphates. Proc. Soil Sci. Soc. Am. 1950; 14:149-151.
7. Dobermann A, Witt C, Dawe D, Abdulrachman S, Gines HC, Nagarajan R *et al*. Site-specific nutrient management for intensive rice cropping systems in Asia. Field Crops Res. 2002; 74:37-66.
8. Dobermann A, Fairhurst T. Rice: Nutrient Disorders and Nutrient Management. Potash & Phosphate Institute, Potash & Phosphate Institute of Canada, and International Rice Research Institute, Singapore and Los Baños, 2000, 191.
9. Dobermann A, Witt C. Introduction In: Doberman, A., C. Witt and D. Dawe (Eds.) Increasing Productivity of Intensive Rice Systems through Site Specific Nutrient Management. Science Publishers and International Rice Research Institute (IRRI), New Delhi, India and Makati City, Philippines, 2003.
10. FAO. International Year of Rice Concept Paper. Food and Agricultural Organisation of the United Nations (FAO), Rome, Italy, 2004.
11. Gupta UC. A simplified method for determining hot-water soluble boron in podzol soils. Soil Sci. 1967; 103:424-428.
12. Jinger D, Bamboriya SD, Kumawat A, Devi D, Bamboriya SD. Efficient Nutrient and Water Management in Rice-Based Systems. Popular Kheti. 2017; 5(2):64-71.
13. Kumar A, Srivastava LK, Mishra VN, Sharma G. Soils of Chhattisgarh: a study. Global Journal of Multidisciplinary Studies. 2015; 4(10):83-89.
14. Lindsay WL, Norvell WA. Development of DTPA soil test for zinc, iron, manganese and copper. Soil Sci. Soc. Am. J. 1978; 42:421-448.
15. Mathur BS, Sinha H, Rana NK, Lall S. Use of calcium as a nutrient for legume crops in acidic red loam soils of Ranchi. Journal of the Indian Society of Soil Science. 1983; 31:334-336.
16. Mauriya AK, Maurya VK, Tripathi HP, Verma RK, Shyam R. Effect of site specific nutrient management on productivity and economics of rice (*Oryza sativa*) wheat (Triticumastivum) system. Indian Journal of Agronomy. 2013; 58(3):282-287.
17. Mishra VN, Patil SK, Das RO, Shrivastava LK, Samadhiya VK, Sengar SS. Site-specific nutrient management for maximum yield of rice in Vertisol and Inceptisol of Chhattisgarh. A paper presented in South Asian Conference on Water in Agriculture: management options for increasing crop productivity per drop of water, during November, 15-17, 2007 held at IGKV, Raipur (C.G.), India, 2007, 136.
18. Olsen SR, Cole CV, Watanabe FS, Dean L. A. 1954.Estimation of available phosphorus in soils by extraction with sodium bicarbonate. Circ. U.S. Dep. Agric., 2007, 939.
19. Qureshi A, Singh DK, Pandey PC. Site specific nutrient management for enhancing nutrient – use efficiency in rice and wheat. Acadmicagournal of ag. Research. 2016; 4(8):518-524.
20. Rajeswar M, Rao CS, Balaguravaiah D, Khan MAA. Distribution of available macro and micronutrients in soils Garikapadu of Krishna district of Andhra Pradesh. Journal of the Indian society of soil science. 2009; 57(2):210-213.
21. Sahu N, Mishra VN, Srivastava LK, Jata G. Crop Response based Assessment of Limiting Nutrients using Site Specific Nutrient Management for Yield Maximization in Vertisols of Bemetara District of Chhattisgarh, India. International Journal of Current Microbiology and Applied Sciences. 2017; 6(6):1784-1791.
22. Sao Y, Singh G, Jha MK. Site specific nutrient management for crop yield maximization using two soil types of Bilaspur District of Chhattisgarh. Journal of Pharmacognosy and Phytochemistry. 2018; 7(1):08-10.
23. Subbiah BV, Asija GL. A rapid procedure for estimation of available nitrogen in soils. Current Science. 1956; 25:259-263.