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Site specific nutrient management in rice crop (MTU-1010) with special reference to nitrogen, phosphorus and Potassium in *Inceptisols* of Bemetara district of Chhattisgarh

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Abstract
Nitrogen is an integral part of all proteins and is one of the main chemical elements required for plant growth and photosynthesis. It is one of the most yield limiting major nutrients among N, P and K required for optimum crop production. In most agricultural conditions, availability of usable Nitrogen is the most limiting factor of high growth. The right amount of phosphorus can help crops yield more fruits and create healthier stocks and root systems. K does not become a part of the chemical structure of plants, it plays many important regulatory roles in increases crop yield and improves quality. Our objective were to identify role of important nutrients N, P and K and there deficiency symptoms. The omission plot technique is used to identify limiting nutrient. In a omission plot adequate amount of all nutrients are applied except for the one omitted nutrient. Total 11 treatments were tested with rice (MTU-1010) as a test crop, laid out in CRD with three replications. Status of N and P is deficient in *Inceptisols* of Bematara district of Chhattisgarh.

Keywords: SSNM, Omission plot technique

Introduction
Rice is the most important and extensively cultivated food crop, which provides half of the daily food for one of every three persons on the earth. In our country, more than 40 million hectares area is covered under rice cultivation and total production has crossed 100 million tones. Rice production in India is an important factor for food security. However, little is known about the sustainability of the current production systems, particularly systems with triple cropping under minimum practice. Among the various cropping systems, rice based cropping systems are the predominant systems in India. Managing the variability in soil nutrient supply that has resulted from intensive rice cropping is one of the challenges for sustaining and increasing rice yield in India.
Rice requires adequate supply of nutrients to achieve the high yields necessary to feed growing populations. Many of these nutrients come from soil and organic inputs, such as crop residues and manures; but high yields still require supplemental nutrients from fertilizer. Existing fertilizer recommendations for rice often advise fixed rates and timings of N, P and K for vast areas of rice production. Such recommendations assume the need of a rice crop for nutrients is constant among years and over large areas. But crop-growth and crop-need for supplemental nutrients can be strongly influenced by crop-growing conditions, crop and soil management, and climate - which can vary greatly among fields, villages, seasons, and years.
Adequate supply of plant nutrients decides optimum productivity of any cropping system. Even if, all other factors of crop production are in the optimum, the fertility of a soil largely determines the ultimate yield (Sekhon and Velayutham 2002) [8]. Application of supplemental nutrients is required if the soil does not supply sufficient nutrients for normal plant development and optimum productivity. Fertilizer is one of the most important sources to meet this requirement. Indiscriminate use of fertilizers, however, may cause adverse effect on soils and crops both regarding nutrient toxicity and deficiency either by over use or inadequate use (Ray *et al*., 2000) [7]. Diagnostic techniques including identification of deficiency symptoms, soil and plant analysis and biological tests are helpful in determining specific nutrient stresses and quantity of nutrients needed to optimize the yield (Havlin *et al*., 2007) [4].

Soil fertility evaluation, thus, is the key for adequate and balanced fertilization in crop production.

The SSNM approach advocates sufficient use of fertilizer P and K to overcome P and K deficiencies, to avoid the mining of soil P and K and to allow best N management. Fertilizer P and K requirements, sufficient to overcome deficiencies and maintain soil fertility, are determined with a nutrient decision support system (Witt and Dobermann, 2002) [14], SSNM considers indigenous nutrient supply of the soil and productivity targets capable of sustaining higher yields on one hand, and assured restoration of soil fertility on the other. Gill *et al* (2008) [3] felt that with implementation of SSNM, the present food grain production could be achieved from half of the current irrigated area and rest could be better utilized in crop diversification efforts.

Similarly, Srivastava *et al* (2009) [10] reported that SSNM increased the yield and improved the quality of sweet orange when compared with state nutrient recommendations and farmer fertiliser practice. Thus, high net economic returns realized with implementation of SSNM calls for large scale adoption of this technology to help reduce the gap between actual and potential yields

Materials and methods

A pot culture study was undertaken in the green house of the Department of Soil Science and Agricultural Chemistry, College of Agriculture, IGKV, Raipur during kharif season 2015 to study Site specific nutrient management in rice crop (MTU-1010) with reference to Nitrogen, Potassium and Phosphorus in *Inceptisols* of Bemetara district of Chhattisgarh. For this purpose, representative *Inceptisol* field of farmer from Deori village of the Berala block, district Bemetara was selected based on intensive cropping followed since last 20 years.

Bulk **s**oil samples was collected from the farmer's fields from a depth of 15 cm using spade, composited and brought to the green house. Bulk **s**oil samples collected from the farmer's fields from a Soil samples were thoroughly mixed, made free from plant residues and filled in cemented pots as 10 kg/pot. The optimum doses of nutrients were fixed in kg/ha as N - 150, P_2O_5 - 44, K_2O - 66, S - 45, Fe - 20, Mn - 15, Cu - 7.5, Zn -7.5, B - 3 and Mo - 0.75 for SSNM dose.

Results and discussion

The mean total N uptake by rice was significantly affected with application of different treatments. Highest N uptake (556 mg/pot) was observed in treatment associated with B omitted pot followed by the treatment receiving all nutrients (522 mg/pot) whereas the least N uptake (305 mg/pot) was associated with N omission. Omission of P resulted in significantly higher N uptake (383 mg/pot) than N omission but was lower than the N uptake in other nutrient omission treatments. N uptake in S omitted pots was 445 mg/pot which was at par with P omitted pot. N uptake by rice in K, B, Zn, Ca, Mg, Cu, K omitted pots and treatment with all nutrients applied were statistically at par with each other.

Deficiency of nutrients and depletion of organic matter are the main limitations of soil series (Wickramasinghe, 2006) [13]. the supply of all the nutrients including N in SSNM treatment increased the grain and straw yields causing more uptake of N (Syed *et al.* 2006) [11]. Minimum nitrogen uptake was observed with nitrogen omission because nitrogen was the most yield limiting nutrient which resulted in lower yields and lower nitrogen uptake. The similar findings were also reported by Bhuiyan *et al*. (1986) [2] and Mishra *et al*. (2007) [6]. Essential nutrient N, P and K are required in large proportions and also the most yield limiting nutrient in the soil.

Average P uptake by rice was significantly affected with application of different treatments (Table 1). Highest P uptake (132 mg/pot) was observed in treatment receiving B omitted pot whereas the least P uptake (75 mg/pot) was associated with N omission. Omission of P resulted in higher P uptake (81 mg/pot) than N omission and showed non-significant difference. P uptake in S omitted pot was significantly lower than the treatment receiving all nutrients. P uptake by rice in B, Zn, K, Ca, Mg, Cu and Mo omitted pots and treatment with all nutrients applied were statistically at par with each other.

Total P uptakes were found more in the treatments which received all the nutrients (All), omitted with K, Ca, Fe, Mg, Mn, Cu, Zn, B and Mo whereas the omission of N, P and S reduced the uptakes of P by rice. Supply of all the nutrients including P in „All" treatment increased the soil solution P causing higher absorption of P resulting in higher grain and straw yields as well more uptake of P (Venkatesh *et al*., 2002) [12]. Lower P uptakes were observed with P omission because P was the next most yield limiting nutrient after N, which resulted in lower yields and lower P uptake.

The data presented in Table 1: clearly indicated that the mean total K uptake by rice was significantly affected with application of different treatments. Omission of N, P and S caused lower uptake of K in different pots. Highest K uptake (656 mg/pot) was associated with the treatment receiving all the nutrients except B. whereas the least K uptake (402 mg/pot) was observed with N omission. Omission of P resulted in higher K uptake (489 mg/pot) than N omission but was significantly lower than K uptake in other nutrient omission treatments. K uptake in S omitted pot was 516 mg/pot and varied significantly with all treatments except N and P omitted pots. P uptake by rice in B, Zn, Ca, Mg, K, Cu and Mo omitted pots and treatment with all nutrients applied were statistically at par with each other.

Potassium exerts a positive role on photosynthesis and production of dry matter (Senthivel and Palaniappan, 1985) [9] causing higher uptake of K in the treatments receiving all the nutrients. Omission of K reduced the K uptakes in comparison to the treatments receiving all the nutrients; however, the reductions were less in comparison to omission of N, P, S and Zn. This indicates that N, P, S and Zn were the more limiting nutrients than those of other nutrients.

Conclusion

N is the most yield limiting nutrient followed by P. Soils of *Inceptisols* of Bematara district is show low status of N and P. N, P and K are required in large proportions in soil to maximize the yield because uptake of these elements is higher as campare to secondary and micronutrients.

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Table 1: Total uptake of N, P and K (mg/pot) by rice (MTU-1010) in relation to different treatments in *Inceptisol*

S. No.	Treatments	N	P	K
1	All	522 a	124 a	612 a
2	All – N	305 d	75 c	402 d
3	All – P	383 c	81 c	489 c
4	All – K	503 ab	118 ab	579 ab
5	All – S	445 bc	104 b	516 bc
6	All – Ca	524 a	123 a	614 a
7	All – Mg	509 ab	119 ab	600 a
8	All – Cu	504 ab	118 ab	599 a
9	All – Zn	515 ab	121 ab	606 a
10	All – B	556 a	132 a	656 a
11	All – Mo	508 ab	123 a	600 a
C.D. at 5%		**70**	**17**	**77**

Fig 1: View of response of rice to nitrogen omission plot in *Inceptisol*

Fig 2: View of response of rice to phosphorus omission plot in *Inceptisol*

Fig 3: View of response of rice to potassium omission plot in *Inceptisol*

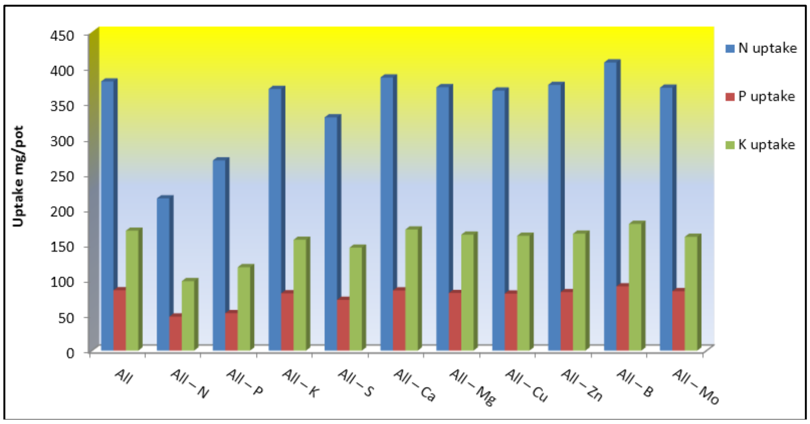

Fig 4: grain uptake of N, P and K (mg/pot) by rice (MTU-1010) in relation to different treatments in *Inceptisol*

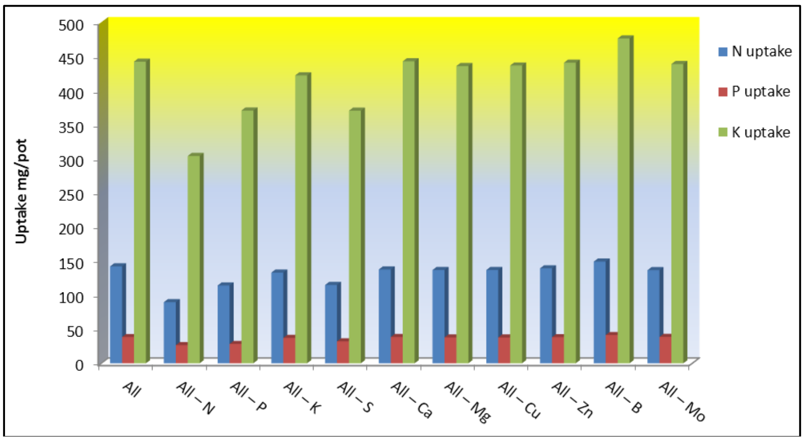

Fig 5: straw uptake of N, P and K (mg/pot) by rice (MTU-1010) in relation to different treatments in *Inceptisol*

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