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Farmer's fertilizer practice and utilizing omission plot techniques to yield maximization in *Inceptisols* of Bemetara District of Chhattisgarh, India

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Abstract
A omission plot technique was conducted in the green house of the Department of Soil Science and Agricultural Chemistry, College of Agriculture, IGKV, Raipur during *kharif* season 2015 to study the Farmer's fertilizer practice and utilizing omission plot techniques to yield maximization of rice and wheat crops in *Inceptisols* of Bemetara District of Chhattisgarh. The nutrient omission plot technique is most usuable technique for determining the nutrient deficiency, deficiency symptoms and amount of fertilizers required for attaining a yield target. In omission plot technique applied all nutrients in adequate amounts except for the nutrient of interest (the omitted nutrient).Total 11 treatments were tested with rice (MTU-1010) as a test crop, laid out in CRD with three replications. Grain and straw yields of rice was significantly reduced with the omission of N, P, and S in comparison to the treatment receiving all the nutrients (SSNM). Higher grain and straw yields were observed in the treatment which received all the nutrients (All).The yield reductions were more pronounced with N and P omission as 42, and 29.97 %, respectively. The percentage yield reduction of S omission is 13.60%. This indicates that S status in *Inceptisol* was at marginal level which might have not sufficient to increase the grain yield at optimum level. Based on the performance of rice crop during *Kharif* season, the yield limiting nutrients identified were in the order of N > P > S. These limiting nutrients were tested on farmer's fields with wheat crop during R*abi* season, 2015-16 where bulk soil samples were collected for pot culture study. The limiting nutrients applied in optimum doses (SSNM) as N - 150, P_2O_5 - 100, K_2O - 80, S – 45. The wheat yield was recorded 25% higher as compared to the farmer's fertilizer practice (80:58:38 kg N:P_2O_5:K_2O).

Keywords: SSNM, *Inceptisols*, Farmer's fertilizer practice, omission plot techniques.

Introduction

Site specific crop and soil management is really a repacking of management concepts that have been promoted for many years. It is basically taking a systematic approach to applying sound agronomic management to small area of a field that can be identified as needing special treatment.

The component of site specific management may not be new but we have the capability with new technology to use them more effectively. Site specific management include practices that have been previously associated with maximum economic yield management, best management practices as well as general agronomic principles. The systematic implementation of these practices in to site specific systems is probably our best opportunity to develop a truly sustainable agriculture system.

To provide balance nutrition to rice plant, SSNM has the potential to increase fertilizer use efficiency as well as grain yield in the farmers' fields (Khurana *et. al.* 2007) [3] It is one of the important ways to increase rice yield in farmers' field as well as to minimize soil fertility degradation. Plant nutrients such as N, P and K are often applied to plants to ensure economically viable grain- yields in large-scale cropping systems (Swanson 1982) [2]. The use of site-specific nutrient management has been shown to be a simple and effective way to increase nitrogen use efficiency (Khosla *et. al*. 2002) [4] Soil native fertility may effectively be determined by the nutrient omission plot technique.

Chhattisgarh State has four major soils type *i.e.* Entisols, Inceptisols, Alfisols and Vertisols. Almost all soils are deficient in nitrogen and phosphorus and medium to high in potassium. Zinc deficiency is also reported in some patches of Alfisols and Vertisols of this region. In view of continuous use of sulfur free complex fertilizers, chances of increase in S deficiency are likely. In addition to this limitation, low fertilizer efficiency, inadequacy of current fertilizer recommendations and the ignorance of nutrients other than N, P, and K may limit crop production. In view of continuous use of high analysis fertilizer, multiple nutrient deficiencies are likely. High crop yields can only be achieved by correcting such deficiencies.

Site specific nutrient management is of utmost importance for obtaining high yields on sustainable basis.
At present the site specific nutrient management for rice crop is developed and adopted by the farmer all over the world.

Materials and Methods

Pot culture experiment using nutrient omission technique

The present study was under taken as nutrient omission trial to assess the fertility status of *Inceptisols* representative soil group of Bemetara district. The details of the omission trials are presented in the following section

Location of the study area

Inceptisols soil group was taken in bulk from the farmer's fields of village Deori, block - Berla, district Bemetara, to assess the fertility status. Pot culture nutrient omission experiment was carried out in the green house in the Department of Soil Science and Agricultural Chemistry, College of Agriculture, Indira Gandhi Krishi Vishwavidyala, Raipur, CG during *Kharif* season, 2015 with rice as test crop and based on the results of *Kharif* season, frontline demonstrations on farmer's field were taken during *Rabi* season, 2015-16 with wheat as a test crop.

Preparation of treatments for pot study

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 in the Department of Soil Science and Agricultural Chemistry, College of Agriculture, Raipur. Soil samples were thoroughly mixed, made free from plant residues and filled in cemented pots as 10 kg/pot.
The treatments constituted with application of all nutrients applied at optimum level and called as SSNM dose/All nutrients applied, omission of each nutrient from SSNM dose using nutrient omission technique to identify the limiting nutrients. Total 11 treatments were formulated with application of nutrients (N, P, K, S, Ca, Mg, Cu, Zn, B, Mo) in optimum level and sequentially each nutrient was omitted from all nutrients applied (SSNM).
The optimum doses of nutrients were fixed in kg/ha as N - 150, P2O5 - 44, K2O - 66, S - 45, Ca - 110, Mg - 55, Cu - 7.5, Zn -7.5, B - 3 and Mo - 0.75 for SSNM dose. Rice (MTU-1010) was taken as test crop laid out under CRD (Completely Randomized Block Design) with three replications.

Test Crops

For evaluating the fertility status of soils, rice (MTU-1010) during *Kharif* season, 2015 was taken and based on the *Kharif* season's results frontline demonstration were taken on farmer's fields during *Rabi* season 2015-16 with wheat (GW-273) crops.

Table 1: Physico-chemical properties of experimental soil

S.No.	Properties	*Inceptisol*
1	Mechanical analysis	
	Sand %	38.45
	Silt%	32.44
	Clay %	29.11
	Textural class	Clay loam
2	pH (1:2.5) soil :water suspension	6.6
3	Electrical conductance dSm^{-1}	0.15
4	Organic C (g kg^{-1})	4.8
5	Cation Exchange Capacity Cmol(p) kg^{-1}	26.43
6	Alkaline KMnO4- N (kg/ha)	179
7	Olsen P (kg/ha)	14.33
8	Neutral normal Amm Acetate extractable-K (kg/ha)	394
9	Available Ca (kg/ha)	2165
10	Available Mg (kg/ha)	706
11	$CaCl_2$ extractable S (kg/ha)	21.45
12	Hot water extractable B (ppm)	0.83
13	DTPA extractable micronutrients (ppm)	
	Fe	17.71
	Mn	21.14
	Zn	1.04
	Cu	1.89

Results and Discussion

The mean grain and straw yields of rice in *Inceptisol* were significantly affected with different treatments applied. Omission of N and P reduced grain yields of rice significantly over all other the treatments including application of all nutrients (SSNM). Highest yield (34.90 g/pot) was recorded in the B omission pot and lowest yield with omission of N (18.99 g/pot). Omission
of N from all nutrients reduced the grain yield by 42.10 %, Phosphorus omission caused a yield reduction of 29.97 % and S omitted pot reduced the grain yield by 13.60% (Fig.4.2 and Table 1.2). Mean grain yields of rice in B, Ca, Zn, Mo, Mg, K, and Cu omitted pots did not vary significantly and were statistically at par.
Straw yields of rice also showed significantly reduced yields with omission of N and P as observed with grain yield. However, S omitted pot also showed statistically reduced straw yield.
Higher grain and straw yields were observed in the treatment which received all the nutrients (All) and omission of K, S, Fe, Mn, Ca, Mg, Cu, B, Zn and Mo in both the soils under study. Large reductions in the grain and straw yield of rice were observed with the omission of Nitrogen (N) and phosphorus (P) as compared to the other nutrient omission treatments (). The yield reductions were more pronounced with N omission (42.10 %) than P (29.97%). This indicates that N was the most yield limiting nutrients in both the soils under study followed by P. Omission of all other nutrients did not indicate yield reduction significantly. However, omission of S nutrient reduced the grain yield by 13.60 % over the treatment receiving all nutrients (All). This indicates that S status in *Inceptisol* was at marginal level which might have not sufficient to increase the grain yield at optimum level.
Oxidation loss of organic matter under tropical climatic

conditions results in low organic carbon (Singh *et al.*, 2000) [5]. Since organic matter content is an indicator of available nitrogen status of soils, the soils of the area are also dominantly low in respect of available nitrogen. The soils were inherently low in available P (Table 1.1) and hence the omission of P caused more reduction in yields. On the basis of yield performance, the next elements which limited the yields in *Vertisol* were S followed by Zn and B whereas Zn and B did not show the yield limiting factor in *Inceptisol*. Yield reduction due to S omission may be attributed to less supply of S, since the available S in these soils were in the lower margin of medium category (Table 1.1). Continuous use of S free fertilizers like DAP and others may also be one of the possible reasons for lowering the S status in soils and caused yield reduction (Biswas *et al*., 2004) [1]. Similarly, Zn omitted pots may be attributed to low availability of Zn upon flooding because of formation of sparingly soluble sulphides and carbonates under anaerobic conditions (Yoshida *et al*., 1971) [7]. The marginal level of Zn in *Vertisol* due to continuous crop removal may also be a reason for lowering the yield in *Vertisol.*

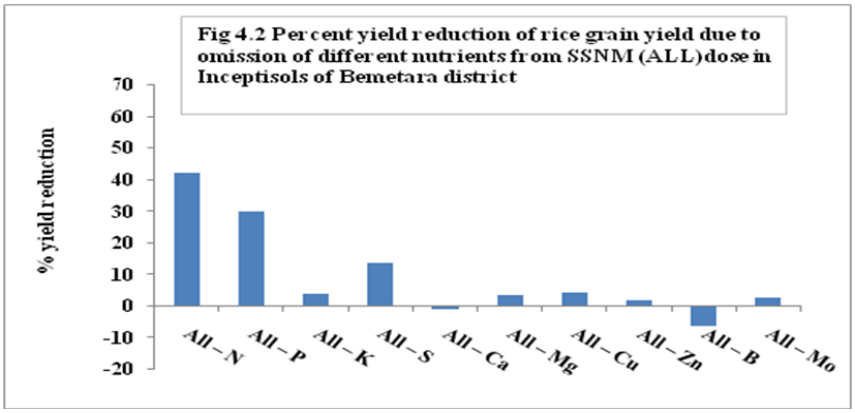
Higher adsorption and immobilization of S (Tiwari *et al.*, 2006) [6] might have resulted in lower yields in both the soil. The yield reductions were observed more in the *Inceptisol than the Vertisol.* With respect to B omission treatment, yield reductions in *Vertisol* may be attributed to reduced availability of B due to formation of Ca-borate and B-silicate (Sharma *et al*., 2003) [8] and low soil status. On the basis of yield performance the yield limiting nutrients in *Vertisol* may be put in the order of N > P > S > Zn > B whereas that in *Inceptisol*, the limiting nutrients may be in the order of N > P > S.

Based on the performance of rice crop during *Kharif* season, the nutrients identified as limiting nutrients were N, P and S. These nutrients were applied as per the following doses which are known as SSNM dose (as used in rice crop) and tested with wheat crop (GW-273). The SSNM doses were as N - 150, P2O5 -100 and S – 45. The farmer's fertilizer doses were applied at the rate of 80:58:38 (N: P2O5: K2O) kg/ha. The wheat grain yields of farmer's fields were higher in SSNM dose applied based on the yield limiting nutrients as compared to that of farmer's practice dose (Fig. 6). There was 27 % increase in the wheat grain yield over farmer's practice dose. This testing confirmed that application of identified limiting nutrients as N, P and S nutrients in *Inceptisol* were identified and must be applied for maximum crop yield.

Table 2: Grain and straw yields of rice (MTU-1010) in relation to different treatments in *Inceptisol*.

S. No.	Treatments	Grain yield (g/pot)	Straw yield (g/pot)
1	All	32.80 ab	34.94 a
2	All – N	18.99 c	24.20 c
3	All – P	22.97 c	29.26 b
4	All – K	31.52 ab	33.79 a
5	All – S	28.34 b	29.24 b
6	All – Ca	33.09 ab	34.96 a
7	All – Mg	31.72 ab	34.51 a
8	All – Cu	31.40 ab	34.48 a
9	All – Zn	32.18 ab	34.80 a
10	All – B	34.90 a	37.62 a
11	All – Mo	31.92 ab	34.96 a
CD at 5%		4.45	4.48

The values in a column with a common letter are not significantly different.



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