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Site specific nutrient management for crop yield maximization using two soil types of Bilaspur District of C.G. on grain and straw yield

Yushma Sao, Gajendra Singh and Madan Kumar Jha

Abstract
The field experiment was conducted A pot experiment was carried out at the Department of Soil Science and Agricultural Chemistry, BTC College of Agriculture and research Station, Bilaspur, during *Kharif* season 2015-16. 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 2015-16. The soils used for pot experiment were two type i. e. *Inceptisol* and *Vertisol*. Both the soils were collected from two different locations of Bilaspur 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 (MTU-1010) was transplanted in three hills/pot with 2-3 seedlings in each hill. In eleven treatments. Grain and straw yields of rice in *Vertisol* were significantly reduced with the omission of N, P and S in comparison to the treatment T_1 that received all the nutrients. The yield reductions were more pronounced with N and P omission pots (43.2 %, 41.7 % and.34.1 %, 31.8 % respectively). Reductions in grain and straw yields in S omitted pots were 11.3 % and 10.6 %, respectively. And Grain and straw yields of rice in *Inceptisol* were significantly reduced with the omission of N, P, and S in comparison to the treatment (T_1) that received all the nutrients. The yield reductions were more pronounced with N and P omission (42.8 %, 38.9 % and.32.8 %, 31.5 % respectively). Reductions in grain and straw yields in S omitted pots were 13.9 % and 12.5 %, respectively.

Keywords: Inceptisol, Vertisol, Nutrients, Straw

Introduction
Agriculture plays a vital role in India's economy. Over 58 per cent of the rural households depend on agriculture as their principal means of livelihood. Agriculture, along with fisheries and forestry, is one of the largest contributors to the Gross Domestic Product (GDP). Fertilizers nutrients played a stellar role in improving crop productivity and production, Food grains production rose from 52 million tonnes in 1951-52 to 265 million tonnes in 2013-14 (Anon., 2014).

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. Continuous use of high analysis fertilizer, multiple nutrient deficiencies are likely. High crop yields can only be achieved by correcting such deficiencies. Other micronutrients like Fe, Mn, Cu, B and Mo may be sufficient for low to medium level of crop production but may not be sufficient for high level of crop production. High crop yields can only be achieved when high yielding crop varieties are properly nutritioned in a correct amount and proper ratios. 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.

The response of rice and wheat to fertilizer applications is often far below the potential yields due to low fertilizer efficiency, inadequacy of current fertilizer recommendations, and the ignorance of nutrients other than N, P, and K may that limit crop production. Takkar (1996) has reported based on the studies from several places that normal yield of crops could not be achieved despite balanced use of NPK due to micronutrient deficiency in soils.

Deficiency of micronutrients may either be primary, due to their low total content of elements or secondary, caused by soil factors reducing their availability to plants. The emergence of micronutrients deficiency has generally been considered as secondary.

Material and methods

The observations of the grain and straw yields of each treatment were recorded after harvesting of rice crop. The bundles were sun dried, weighted, threshed and finally seeds were cleaned and yields were recorded.

Results and discussion

Grain and straw yields

The results pertaining to grain and straw yields of rice grown in *Vertisols* and *Inceptisols* as influenced by different treatments are illustrated in table 1.

The rice grain and straw yields were significantly affected with application of different treatments in both *Vertisol* and *Inceptisol*. Omission of N (T_2) and P (T_3) significantly reduced the grain yield in *Vertisols*. While, in case of *Inceptisol*, omission of N (T_2) and P (T_3) as well as S (T_5) significantly reduced the rice grain yield. The highest grain yield was recorded in the treatment T_{11} (27.91 g pot^{-1}) and T_1 (32.46 g pot^{-1}) in *Vertisols* and *Inceptisols*, respectively. Omission of N reduced the yield by 43.19 % and 42.82%, while P omission caused a yield reduction of 34.18 % and 32.87 % in *Vertisols* and *Inceptisols*, respectively (Table 4.3). The per cent reductions in rice yield under different omitted pots were in order of N>P>S>Zn. The results of the present investigation are also corroborated by Bhuiyan *et al.* (1986) [2], Haefele and Wopereis (2005) [4] Segda *et al*. (2005) [8], Amin *et al.* (2013) [1] and Islam *et al.* (2013) [5].

Table 1: Grain and straw yield of rice as affected by different treatments in *Vertisol* and *Inceptisol.*

Treatments		Grain yield (gm pot^{-1})		Straw yield (gm pot^{-1})	
		Vertisols	***Inceptisols***	***Vertisols***	***Inceptisols***
T_1	All	27.45	32.46	29.65	35.20
T_2	All – N	15.59	18.56	17.26	21.50
T_3	All – P	18.07	21.79	20.20	24.08
T_4	All – K	26.58	30.98	28.83	33.91
T_5	All – S	24.34	27.93	26.50	30.79
T_6	All-Fe/Ca	26.98	31.53	29.93	34.27
T_7	All-Mn/Mg	26.87	30.62	28.76	33.93
T_8	All – Cu	26.64	31.59	29.35	34.21
T_9	All – Zn	25.52	29.83	28.02	32.32
T_{10}	All – B	27.74	30.46	30.53	33.81
T_{11}	All – Mo	27.91	31.61	30.57	34.37
CD at 5%		3.79	2.68	3.907	2.522
C.V.		8.533	5.194	8.418	4.672

Similarly, the highest straw yield was recorded in treatment T_{11} (30.57 g pot^{-1}) and treatment T_1 (35.20 g pot^{-1}) in *Vertisol*s and *Inceptisols* respectively. Omission of N (T_2) and P (T_3) significantly reduced the straw yield in *Vertisols*. While in *Inceptisol*s, Omission of N (T_2) and P (T_3) as well as S (T_5) significantly reduced the straw yield of rice. Omission of N reduced the straw yield by 43.54 % and 38.92 %, while P omission caused a yield reduction of 33.92 % and 31.59 % in *Vertisols* and *Inceptisols*, respectively (Table 4.3). The per cent reductions in rice straw yield under different omitted pots were in order of N>P>S>Zn. Similar results have also been reported by Bhuiyan *et al.* (1986) [2]. Mishra *et al*. (2007) [6] reported a decrease in straw yield of rice with omission of N, P and S.

Large reductions in the grain and straw yield of rice were observed with the omission of Nitrogen and phosphorus as compared to the other nutrient omission treatments. The yield reductions were more pronounced with N omission. This indicates that N was the most yield limiting nutrients in all the soils followed by P. Under tropical climatic conditions, oxidation loss of organic matter results in low organic carbon (Singh *et al.* 2000) [7]. 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 and hence the omission of P caused more reduction in yields. On the basis of yield performance the next element which limited the yields in both the soils was zinc (Zn) followed by sulphur (S). Reduction in yields in 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) [10]. Yield reductions with 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. Continuous use of diammonium phosphate and other S free fertilizers in place of single superphosphate and other S containing fertilizers might be attributed in lower S contents in the soil (Biswas *et al*. 2004) [3]. Higher adsorption and immobilization of S by heavy textured black soil (Tiwari *et al*. 2006) [9] might have resulted in lower yields in *Vertisols* soil.

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