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Delineation of Nutrient Status in Bt Cotton Growing Soils of Kurnool District in Andhra Pradesh

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ABSTRACT

TA survey was undertaken to delineate the nutrient status in Bt cotton growing soils in Kurnool district of Andhra Pradesh. The analysis of the soils revealed that the texture of the soils varied from sandy clay loam to clay, neutral to strongly alkaline in reaction, non-saline, medium to high in organic carbon, medium in available nitrogen and high in available P and K. The available Ca, Mg, S, Fe, Mn, Zn and Cu were found to be above their respective critical limits in all the soils. However, 53.33 per cent samples were deficient in available B in Alfisols .

Key words : Bt cotton soils, Macronutrients, Micronutrients, Soil orders.

Transgenic cotton was introduced for commercial cultivation in 1996 in the USA, Australia, China, Mexico and Argentina.The global adoption of transgenic cotton has risen dramatically from 0.8 (1996) to 15.5 m ha in 2008 (James, 2008). Commercial cultivation of Bt cotton in India began in 2002-03 with 3 hybrids *viz.,* MECH 12Bt, MECH 162Bt and MECH 18Bt (APCoAB, 2006). Transegenic cotton contains bollworm resistant gene from soil bacterium *Bacillus thuringiensis*. In India, it is grown to an extent of 69.0 lakh ha^{-1} with a production of 290 lakh bales in the year of 2008-2009, (Narayanan and Phundan singh, 2009) while in Andhra Pradesh, 91 per cent of area is under Bt cotton. According to Ramamurthy and Venugopalan, (2009) Vertic Haplustepts (deep Inceptisols) were better than Typic Haplusterts (Vertisols) for rainfed Bt , as well as conventional cotton (Mandal *et al.,* 2005).

Soil test based fertilizer application is still a rare practice in this area. Hence, there is a wide variation in fertilizer application by farmers. This leads to either excess or deficiency of the nutrient which might result in nutrient imbalances in the soil. As a consequence, the seed cotton yield would be lower than their yield potential. To stabilise the yields of cotton and economy of cotton production, balanced nutrition is essential. Keeping the above aspects in view, the present survey was taken up to delineate the nutrient status in Bt cotton growing soils in Kurnool district of Andhra Pradesh.

MATERIAL AND METHODS

The survey area in Kurnool district of Andhra Pradesh is located at the East longitude of 76°.58' and 79°.34 ,' North latitude of 14°.54' and 16°.18' on eastern side of peninsular India.

About 90 soil samples were collected from the cultivator's fields at flowering stage (60 DAS). The main aim of collecting soil samples at flowering period is with a view that the crop absorbed most of the applied nutrients by that time. Soil samples were collected at two different depths *i.e.* 0-15 cm and 15-30 cm, by covering six locations in the field and mixed thoroughly and pooled as one sample (0-30 cm). The samples were air dried and pounded with a wooden hammer and passed through 2 mm sieve and used for particle size distribution. Based on the status report 1986, scarce rainfall zone, the soils were identified in to three predominant orders *viz.,* Alfisols, Inceptisols and Vertisols. From each of the three orders, 30 holdings were selected from which the soil samples were collected at flowering stage (60 DAS). All the 90 soil samples were analysed for pH, EC, organic carbon and available K as per the standard procedures (Jackson, 1973). Available N was determined by alkaline permanganate method. The available P was extracted with 0.5M $NaHCO_3$ extractant and was determined by using ascorbic acid as reducing agent and the available K in the soils was extracted by employing neutral normal ammonium acetate and determined by aspirating the extract into the flame photometer (Jackson, 1973). Available Ca and Mg were determined by Versenate method (Chopra and Kanwar, 1991) whereas available S was determined turbidimetrically using 0.15% $CaCl_2$ extractant (Cottenie *et al.,* 1979). DTPA exctractable Fe, Mn, Zn, Cu and B were determined as per Lindsay and Norvell (1978).

Soil samples were rated as low, medium and high categories as per the limit suggested by Muhr *et al.* (1965) for organic carbon, available N, P and

Table 1. Soil test summary for soil texture, pH, E. C and organic carbon (mean values) in Bt cotton grown soils

Sl. No.	Soil orders	Number of samples	Soil texture	pH (1:2.5)	E.C (dSm^{-1})	Organic carbon(%)
1.	Alfisols	30	scl-sc	7.16	0.30	0.64
2.	Inceptisols	30	sc-cl	7.78	0.35	0.81
3.	Vertisols	30	cl-c	8.26	0.31	0.70
4.	Overall	30	scl-c	7.73	0.32	0.71

scl: sandy clay loam, sc: sandy clay, cl: clay loam, c: clay.

Table 2. Soil test summary for available N, P and K in Bt cotton grown soils

Sl. No.	Soil orders	Number of samples	Available N			Available P			Available K		
			Mean ($kg\ ha^{-1}$)	Nutrient index	Fertility status	Mean ($kg\ ha^{-1}$)	Nutrient Index	Fertility status	Mean ($kg\ ha^{-1}$)	Nutrient Index	Fertility status
1.	Alfisols	30	401.17	2.00	M	39.92	3.00	H	438.99	2.96	H
2.	Inceptisols	30	379.86	1.93	M	36.24	2.96	H	516.87	3.00	H
3.	Vertisols	30	488.62	2.03	M	38.31	2.96	H	700.39	3.00	H

L: Low, M: Medium, H: High

Table 3. Soil test summary for available Ca, Mg, S, Fe, Mn, Zn, Cu and B in Bt cotton grown soils

Sl. No.	Soil orders	Number of samples	Available secondary nutrients			Available micronutrients ($mg\ kg^{-1}$)				
			Ca (cmol (p+) kg^{-1})	Mg (cmol (p+) kg^{-1})	S ($mg\ kg^{-1}$)	Fe	Mn	Zn	Cu	B
1.	Alfisols	30	8.34	3.81	26.89	6.98	5.08	1.39	0.78	0.49
2.	Inceptisols	30	8.18	3.15	26.48	6.50	5.27	1.30	0.72	0.60
3.	Vertisols	30	12.94	5.16	26.40	6.98	5.40	1.43	0.69	0.89

K. Available Ca and Mg were classified based on the critical limits proposed by Tandon (1989) while available S was rated as per the critical limits established by Tandon (1991). In respect of available Fe, Mn, Zn, Cu and B the ratings given by Lindsay and Norvell (1978) were followed. Nutrient Indices (N.I) for available N, P and K were worked out as per the formula given by Parkar *et al.* (1951). Simple correlation analysis was also carried out between soil physical and physico-chemical characteristics and available soil nutrients by adopting standard procedures.

RESULTS AND DISCUSSION

The soil texture in the Bt cotton growing soils varied from sandy clay loam to clay. Further, the texture in Alfisols, Inceptisols and Vertisols varied from sandy clay loam to sandy clay, sandy clay to clay and clay loam to clay (Table 1). This variation in soil texture might be due to the variation in topographic position, nature of parent material, *in situ* weathering of clay and age of soils. Similar results were reported by Srinivas *et al.,*(1998) in cotton grown soils of Guntur district. The mean values of pH in Alfisols, Inceptisols and Vertisols were 7.16, 7.78 and 8.26, respectively. The variation in pH in different soil orders might be attributed to the variation in nature of parent material and degree of weathering. Similar findings were reported by Narayana *et al.,* (2009). The soils were non-saline with EC values varying between 0.13 and 0.63 dSm^{-1} in different soil orders. The organic carbon content in these soil orders ranged from 0.35 to 1.00 per cent. The medium to high organic carbon content in these soils might be due to application of farmyard manure and incorporation of crop residues by farmers. These findings were in good agreement with the findings of Ramesh Kumar (1992).

Available N, P, K, Ca, Mg and S

The Bt cotton growing soils were medium in available N with overall nutrient index values ranging from 1.93 to 2.03 while available P and K were high with overall nutrient index values varying from 2.96 to 3.00 (Table2). The medium available nitrogen status in these soils might be attributed to medium to high organic carbon content. Further, the semi-arid conditions of the area might have favoured the rapid oxidation and less accumulation of organic matter releasing more NO_3-N which could have been last by leaching (Finck and Venkateswarlu, 1982). High availability of P in these soils may be due to the continuous use of phosphatic fertilizers like single super phosphate by the farmers in these areas. Further, high organic matter status also favoured the solubilization of fixed phosphorus releasing more quantity to available pool. The higher values of K could be attributed to more intense weathering, release of K from organic residues, application of K fertilizers and upward translocation of potassium from lower depth along the capillary raise of ground water. These findings were in agreement with the findings of Vara Prasad *et al.,* (2008).

The mean available Ca in Alfisols, Inceptisols and Vertisols was 8.34, 8.18 and 12.94 cmol (p+) kg^{-1}, respectively. The mean available Mg content in Alfisols, was 3.81 cmol (p+) kg^{-1}, in Inceptisols it was 3.15 cmol (p+) kg^{-1} and in Vertisols it was 5.16 cmol (p+) kg^{-1}. The mean available S in Alfisols, Inceptisols and Vertisols was 26.89, 26.48 and 26.40 mg kg^{-1}, respectively. However the available Ca, Mg and S all in these Bt cotton growing soils were found to be above their respective critical limits (Table 3). The higher sulphur content in these soils might be due to the continuous application of fertilizers like single super phosphate. Similar findings were reported by Sannigrahi *et al.,* (1992) and Sreenivasulu Reddy, (1997) .

Available Fe, Mn, Zn, Cu and B

The mean values of DTPA extractable Fe, Mn, Zn, Cu, and B in Bt cotton grown in Alfisols were 6.98, 5.08, 1.39, 0.78 and 0.49 mg kg^{-1}, respectively while in Inceptisols were 6.50, 5.27, 1.31,0.72 0.78 and 0.60 mg kg^{-1}, respectively and in the Vertisols were 6.98, 5.40, 1.43,0.69 and 0.89 mg kg^{-1}, respectively (Table 3). All the available micronutrients except boron were above their respective critical limits but, 53.33 percent of the samples were found to be deficient in available boron in Alfisols. These observations were in agreement with findings of Giridhar *et al.,* (1998) in Alfisols, Inceptisols and Vertisols of Komarole region of Andhra Pradesh.

Conclusion

In general the nutrients concentration does not differ much among the orders. Further all the nutrients are medium to high in all the three orders. The organic carbon is low in Alfisols as compared to other orders. Hence, judicious application of organic manures along with recommended doses of nutrients not only sustains the productivity of Bt cottons growing soils but also increases the Bt cotton yields.

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