The Andhra Agric. J 63 (1): 128-131, 2016

Impact of Bt Cotton on Soil Fertility in Cotton Growing Belt of Guntur District, Andhra Pradesh

D K D Deekshitha, P Ravindra Babu, P Madhuvani and K Srinivasulu
Department of Soil Science and Agricultural Chemistry, Agricultural College, Bapatla- 522101, Andhra Pradesh

ABSTRACT

Thirty representative surface soil samples were collected to check from cotton growing belt of Guntur district effect of long term cultivation of Bt cotton on soil properties (12 samples each from *Bt* cotton cultivated areas continuously for 2 to 5 years, 8 to 10 years and 6 samples from areas under non *Bt* cotton). All the 30 soil samples were analysed for physico-chemical properties and available nutrient contents. Results revealed that all the soil samples were slightly alkaline in reaction, low in organic carbon and nitrogen, medium to high in phosphorus, very high in potassium, sufficient in sulphur, manganese, copper but deficient in zinc and iron.

Key words : *Bt* cotton, Macronutrients, Soil fertility.

Cotton (*Gossypium hirsutum L*), the queen of fibres or white gold, enjoys a predominant position amongst cash crops in India and world as well. India continued to maintain the largest area under cotton occupying second position in production next to China The productivity of cotton in India is only 507 kg ha^{-1} against the world productivity of 733 kg ha^{-1} (AICCIP 2012-13). In this situation, the high yielding *Bt* cotton under sustained agricultural practices would result in better increase in yields. Cotton was cultivated in an area of 11.1 m ha in India out of which the area under *Bt* cotton had already crossed 90 per cent (CICR, 2011). Through the products of introduced genes, modified rhizosphere chemistry or altered crop residue quality, genetically modified crops have a potential to significantly change soil biodiversity and essential ecosystem functions like nutrient mineralisation, carbon turnover and plant growth (Dunfield and Germida 2004).There is paucity of information on the effect of transgenic cotton on nutrient availability in soil as an impact of altered rhizosphere activity. As adequate nutrient supply is very important to harness and sustain the potential yields of Bt cotton, obviously there is need to understand the nutrient dynamics in the rhizosphere soil of Bt cotton. Keeping this in view, the present study is conducted to study the effect of transgenic cotton on the soil properties.

MATERIAL AND METHODS

Survey was conducted in the cotton growing belt of Guntur region covering nine mandals viz., Vatticherukuru, Sathenepalli, Acchampeta, Thadikonda, Amaravathi, Kakumanu, Guntur (R), Prathipadu, Krosuru and Mangalagiri (R) during the month of June, 2013 and thirty representative surface soil samples (0-15 cm) were collected from farmer's fields. Soil samples were collected from the fields belonging to three different situations namely

- Fields under *Bt* cotton cultivation continuously for past 2 to 5 years
- Fields under *Bt* cotton cultivation continuously for past 8 to 10 years
- Non *Bt* cotton fields

Soil samples collected upto a depth of 30 cm were shade dried, ground with a wooden hammer, passed through a 2 mm sieve and finally stored in labelled air tight poly bags for laboratory analysis. Processed soil samples were used for analysing various physical (Bulk density, pH and EC), physico-chemical (Organic carbon and Cation exchange capacity) and chemical properties (Available N, P, K and micronutrients).

RESULTS AND DISCUSSION

Physical and physico-chemical properties

The data presented in Table 1 shows slight variation in physical and physico-chemical

Table1. Soil physical and physico-chemical properties under *Bt* and non *Bt* cotton soils.

Soil property	Soils under *Bt* cotton for 2-5 years	Soils under *Bt* cotton for 2-5 years	Soils under non *Bt* cotton
Bulk Density (Mg M^{-3})	1.35 (1.3-1.39)	1.34 (1.31-1.39)	1.37 (1.33-1.39)
Soil pH (1:2 soil water suspension)	8.0 (7.8-8.2)	8.0 (7.8-8.3)	7.8 (7.5-8.3)
Electrical Conductivity (dSm-^{1}) (1:2 soil water suspension)	0.32 (0.22-0.48)	0.31 (0.23-0.56)	0.44 (0.26-0.6)
Organic carbon (per cent)	0.40 (0.15-0.58)	0.42 (0.32-0.69)	0.33 (0.15-0.54)
Cation exchange capacity (cmol (p+) kg^{-1})	48 (31.5-62)	48 (35.3-62.4)	46 (32.4-57.6)

Table 2. Soil nutrient status under *Bt* and non *Bt* cotton soils.

Soil property	Soils under *Bt* cotton for 2-5 years	Soils under *Bt* cotton for 8-10 years	Soils under non *Bt* cotton
Available N (kg ha^{-1})	185 (160-254)	176 (132-254)	190 (163-254)
Available P_2O_5 (kg ha^{-1})	62 (21-106)	67 (17-128)	58 (18-98)
Available K_2O (kg ha^{-1})	918 (672-1277)	877 (672-1344)	1038 (739-1250)
Available S (ppm)	18.08 (18.70-27.98)	18.70 (12.13-28.35)	25.71 (15.90-34.40)
Available Zn (ppm)	0.63 (0.37-1.55)	0.66 (0.39-2.03)	0.81 (0.47-1.05)
Available Fe (ppm)	2.57 (1.65-3.11)	2.21 (0.78-3.18)	4.31 (1.69-7.53)
Available Mn (ppm)	4.17 (2.91-10.02)	4.19 (1.9-10.17)	4.54 (2.21-7.32)
Available Cu (ppm)	1.61 (1.05-2.59)	1.60 (1.08-2.36)	2.11 (0.81-3.47)

Figures in parentheses denote range values

properties of soils between the three groups. The soils under all the three categories were slightly alkaline in nature. The mean EC of soils under *Bt* cotton continuously for 2 to 5 years and 8 to 10 years were 0.32 and 0.31 respectively, where as a mean EC of 0.44 dS m^{-1} was recorded in soils under non *Bt* cotton.

The organic carbon content of soils under *Bt* cotton cultivated areas for 2-5 and 8-10 years was 17.5 and 21.5 per cent high over that under non *Bt* cotton areas. The increasing root length value and root biomass might have resulted in greater root exudates and readily metabolizable carbon. Higher organic carbon in fields under *Bt* cotton was also reported by Beura and Rakshit (2011).

A significant positive correlation (r = 0.839, P=0.01) was recorded between cation exchange capacity and organic carbon indicating the high CEC under *Bt* cotton and less in non *Bt* cotton areas. Gaurishankar *et al.* (2002) stated that considerable build up of organic carbon resulted in increase in cation exchange capacity of the soil.

Available N, P, K and S status

The perusal of data presented in Table 2 suggest that soils under *Bt* cotton areas were relatively less in soil nutrient status than those under non *Bt* cotton areas. The mean available nitrogen content in soils under *Bt* cotton for 2-5 years was 185 kg N ha^{-1} and that in soils under *Bt* cotton for 8-10 years was 176 kg ha^{-1} while the soils under non *Bt* cotton have recorded available nitrogen content of 190 kg ha^{-1}. The decrease in available nitrogen content with continuous cultivation of *Bt* cotton might be due to higher uptake of nitrogen.

Available phosphorus content in soils under *Bt* cotton cultivation continuously for 2-5 years and 8-10 years was 62 and 67 kg P_2O_5 ha^{-1} respectively where as 58 kg P_2O_5 ha^{-1} was observed in soils under non *Bt* cotton areas. The increase in available phosphorus content in soil might be due to application of higher doses of phosphatic fertilizers (Farmers apply nearly 150 per cent of the recommended dose of phosphorus). The similar findings were also obtained by Lal *et al* (1997), Dixit and Gupta (1999) and Ahmad *et al*. (2013).

Soils under all the categories were rich in potassium content and sufficient in sulphur. The mean available potassium content in soils under *Bt* cotton cultivation continuously for 2-5, 8-10 years and under non *Bt* cotton areas were 918, 877 and 1038 kg ha^{-1} respectively. The soils belonging to the *Bt* cotton areas showed lesser values than non *Bt* cotton areas in sulphur content by 30 and 27 per cent respectively. The decrease in potassium content was also supported by Beura and Rakshit (2011), Sujatha and Vijayalakshmi, (2013). The high nutrient requirement of *Bt* cotton might have resulted in depletion of nutrients resulting in lesser N, K and S content in *Bt* cotton soils compared to non-*Bt* cotton areas.

Available micronutrients

The available zinc content in soils under *Bt* cotton was deficient (0.63 and 0.66 ppm respectively in 2-5 years and 8-10 years categories respectively) where as non *Bt* cotton soils were sufficient in available Zn content with 0.81 ppm. The available iron content in majority of soils of the Guntur district was below the critical limit (4.5ppm), 16.6 per cent of the soils under non *Bt* cotton recorded high iron content i.e above critical limit. In case of manganese content, about 75.9 per cent of soils, 100 per cent samples in case of available copper content were above the critical limit (1.0, 0.2 ppm respectively for manganese and copper). The mean iron, manganese, copper contents in non *Bt* cotton soils were 4.31 ppm, 4.54 ppm, 2.11 ppm respectively and those in soils under *Bt* cotton cultivation for 2 to 5 years and 8-10 years were 2.57, 4.17, 1.61 ppm and 2.21, 4.19, 1.60 ppm, respectively.

Senapati *et al*, (2012) reported that the cotton growing soils of Guntur district were deficient in iron, zinc and sufficient in copper and manganese with their mean values above the critical limit. There is progressive depletion in micronutrient status in soils where *Bt* cotton was grown continuously but the refurbishment of nutrients at the same rate is not being done in many farming situations. In contrast to the results of present study Beura and Rakshit (2011) reported a significant increase in available zinc content in soil under *Bt* cotton compared to non *Bt* isoline.

CONCLUSIONS

Continuous cultivation of *Bt* cotton for years together reduced the soil fertility status over non *Bt* cotton areas, but there was no evidence to indicate any adverse effects of *Bt* cotton on soil properties in this study. Further research is required to find out more about availability of nutrients and biological activity under *Bt* cotton.

LITERATURE CITED

AICCIP 2012-2013 Annual report of All India Coordinated Cotton Improvement Project, Coimbatore, Tamil Nadu. 4-5.

Ahmad W, Shah Z, Khan F, Ali S and Malik W 2013 Maize yield and soil properties as influenced by integrated use of organic, inorganic and bio-fertilizers in a low fertility soil. *Soil Environment,* 32 (2): 121-129.

Beura K and Rakshit A 2011 Effect of *Bt* cotton on nutrient dynamics under varied soil type. *Italian Journal of Agronomy*, 6(e35): 25-28.

CICR 2011 Vision-2030. Central Institute for Cotton Research, www.cicr.org.in

Dixit K G and Gupta B R 2000 Effect of FYM, chemical and biofertilizers on yield and quantity of rice and soil properties. *Journal of Indian Society of Soil Science*, 80(4): 773-780.

Dunfield K E and Germida J J 2004 Impact of genetically modified crops on soil and plant associated microbial communities. *Journal of Environment Quality*, 33: 806-815.

Gaurishankar L P, Verma and Singh R 2002 Effect of INM on yield and quality of Indian mustard (*Brassica juncea*) and properties of soil. *Indian Journal of Agricultural Sciences,* 72: 551-552.

Lal K, Deb D L, Sachdev M S and Sachdev P 1997 Residual effect of phosphorus and sulphur applied to soybean on succeeding wheat. *Journal of Nuclear and Agricultural Biology*, 26 (1): 29-38.

Senapati D, Veeraiah K, Lakshmi G V and Srinivasulu K 2012 Organic carbon and micronutrient status in cotton growing soils in different mandals of Guntur division. *The Andhra Agricultural Journal*, 59 (1): 61-63.

Sujatha T and Vijayalakshmi K 2013 Soil Fertility status of *Bt* cotton Cultivated fields and other Soils of Khammam region in relation with available macro, micro nutrients and microbial count. *Journal of Environmental Science, Toxicology and Food Technology,* 6(1): 13-18.

(Received on 31.07.2014 and revised on 16.03.2015)