I J T A © Serials Publications

National Academy of Agricultural Science (NAAS) Rating : 3.03

Effect of Foliar Feeding of Gluconate and EDTA Chelated Plant Nutrients on Yield,Quality and Nutrient Concentration of Bt-Cotton

*Gourkhede. P. H., *Patil. V. D. and *Narale S. H.

ABSTRACT: *The field experiments were conducted on experimental farm of Department of soil science and Agricultural Chemistry Vansantrao Naik Marathawada Krishi Vidyapeeth parbhani , during 2009-10 and 2011-12.To "study the effect of foliar feeding of gluconate and EDTA chelated plants nutrients on yield ,quality and nutrient concentration of Bt cotton". The experiment was laid out in randomized block design with sixteen treatments replicated two times. The data on yield, quality and nutrient concentration were collected at various growth stages of Bt cotton. The results indicated that the foliar feeding of gluconate and EDTA chelated plant nutrients found to be effective in increasing the yield attributes viz. number of bolls ,boll weight and seed cotton yield . Among the chelated nutrient sprays gluconate complexed nutrients found superior over EDTA chelated nutrients. Further, gluconate and EDTA complexed nutrient were superior over control and goverment grade 2 foliar spray. The quality parameters like lint index, ginning percentage, test weight and oil content were improved by application of Zn gluconate over all the treatments expects Zn EDTA ,Fe gluconate and Fe EDTA which were equally effective in quality parameters. The relatively higher nutrient concentration (N, P, K, Ca, Mg, Zn, Fe, Mn and Cu) of macro and micronutrients was observed in treatment T_2 (Zn gluconate) at 40 to 80 DAS growth stages. The numerical data also revealed that from 100 DAS to at harvest the concentration of all nutrients started declining as crop progressed towards, its physiological maturity. Treatment T_3 (Zn EDTA), T_8 (Fe gluconate), T_9 (Fe gluconate), T_{12} (Mg gluconate) and T_{13} (Mg EDTA) were found to be at par with spray of Zn through gluconate salt.*

Key words: *Foliar feeding,Gluconate,EDTA,Yield,Quality,Nutrient concentration,Bt-cotton.*

Cotton (*Gosspium* spp.) is one of the most important commercial crops playing a key role in economical, political and social status of the world and so has retained its unique fame and name as the "King of fibres" and "White gold" because of its higher economical value among cultivable crops for quite a long period. It was the superiority of Indian cotton fabrics famed as "Web of woven mind" which attracted European countries to seek new trade routes to India. Indian economy continued to receive great support from the cotton industry, is one of the major industries in India contributing 12 per cent to the export basket with improved cotton productivity and other innovations. In the production line, India will be in a position to get more foreign exchange and earned Rs. 10270.21 crores from export of 83.00 lakh bales in 2009-10 (Cotton Advisory Board).

The soils of the cotton growing area are generally low in organic carbon, nitrogen, available phosphorus, zinc and sulphur. At present, removal of nutrients per hectare (NPKS) (179 kg ha^{-1}) is in excess of what is being added (117 kg ha^{-1}) resulting in a negative nutrient balance in soil (Patil, 2011). The nutrient supply is the second most important limiting factor in cotton production only after water. Most often soils in the rainfed area are not only thirsty but also hungry for the nutrients. Basically, soils sickness vis-a-vis nutritional stress is the result of deficiency of macro and micronutrients in soil. Deficiency, disorder and demand are internally related with each other in balanced plant diet. Macronutrient deficiency in soil is one of the major causes for yield reduction for wide array of crops. Hence, for significant improvement in production and productivity of cotton, these constraints, in fact need to be managed with top priority in the research agenda. Foliar feeding is a reliable method of feeding plants when soil feeding is inefficient. Almost everything a plant

* Department of Soil Science and agriculture chemistry,Vasantrao Naik Marathwada Krishi Vidyapeth, Parbhani, 431401, Maharashtra.

requires to grow and develop is manufactured in the leaves. Hormones, metabolites, proteins, amino-acids the list goes on and they are all manufactured in specialized cells contained within the plants leaves. Most leaves have stomata either only on the underside or on both sides of the leaf. Foliar absorption is through the stomatas which are microscopic pores in the epidermis of the leaf. The leaf with its epidermis can also function as an organ that absorbs and exerts water and substance which may be dissolved in it, when the stomatas are open, foliar absorption is easier. So, the foliar application assumes greater importance, as the nutrients are brought in the immediate vicinity of the metabolizing area i.e. foliage. Information regarding the effect of foliar feeding of cotton is inadequate, moreover use of chelated nutrients e.g. EDTA chalets and newly developed gluconate chalets required to be tested for their performance. Therefore, the present investigation entitled "Studies on effect of foliar feeding of gluconate and EDTA chelated plant nutrients on growth and yield of Bt cotton under rainfed condition" was undertaken with the objectives.To study the response of gluconate and EDTA chelated nutrients on growth, yield and quality of Bt cotton,To study the plant nutrients concentration at various growth stages of Bt cotton.

MATERIAL AND METHODS

A research project "effect of foliar feeding of gluconate and EDTA chelated plant nutrients on yield quality and nutient concentration of Bt-cotton under rainfed condition" was conducted during 2009-10 and 2010-2011 at Marathwada Krishi Vidyapeeth, Parbhani. It was aimed to find out the influence of foliar feeding of micronutrient through gluconate and EDTA. Gluconate is a salt of gluconic acid, which helps to increase the efficiency of micronutrients and EDTA (Ethylene diamine tetra acetic acid) which has property of forming stable soluble complexes. The foliar application assumes greater importance as the nutrient are brought in the immediate vicinity of the metabolizing area i.e. foliage and also these nutrients are fast acting nutrients.

A research project "Studies on effect of foliar feeding of gluconate and EDTA chelated plant nutrients on growth, yield and quality of Bt-cotton under rainfed condition" was conducted during 2009-10 and 2010-2011 at Marathwada Krishi Vidyapeeth, Parbhani. It was aimed to find out the influence of foliar feeding of micronutrient through gluconate and EDTA. Gluconate is a salt of gluconic acid, which helps to increase the efficiency of micronutrients and EDTA (Ethylene diamine tetra acetic acid) which has property of forming stable soluble complexes. The foliar application assumes greater importance as the nutrient are brought in the immediate vicinity of the metabolizing area i.e. foliage and also these nutrients are fast acting nutrients.

The field experiment were conducted on Typic Haplusterts at Research Farm of Department of Soil Science and Agricultural Chemistry. The soil is characterized by black colour dominated by montmorillonite clay with high coefficient of expansion and shrinkage leads to deep cracking. The soils are formed from basaltic material. According to 7th approximation, the soils are classified as Typic Haplusterts (Malewar, 1977) and are included in Parbhani series. The topography of experimental plot was fairly level. In order to determine the soil properties of experimental soil before sowing the surface (0-22.5 cm depth) soil sample were collected from randomly selected spots covering experimental area. A composite soil sample was prepared and analysed for its various physico-chemical properties. The experimental soil was fine, Smectitic (Calcarious), Iso-hyperthermic Typic Haplusters. It was slightly alkaline in reaction (8.20 and 8.0), safe in soluble salt concentration (EC 0.117 to 0.113 dSm^{-1}) and medium in organic carbon content (6.70 and 6.50 g kg^{-1} for cotton crop during the year 2009 and 2010). The free calcium carbonate content was 48.00 to 36.00 g kg^{-1}. The available nitrogen, phosphorus and potassium content of experimental soil of cotton were 147.00 and 139.00 kg ha^{-1}, 8.9 and 10.20 kg ha^{-1}, 887.00 and 670.00 kg ha^{-1}, during 2009 and 2010, respectively and can be categorized as low in available N, medium in P_2O_5 and high in K_2O. Exchangeable Ca and Mg status were 27.30 and 24.48 C mol (p^+) kg^{-1} and 16.30 and 14.80 C mol (p^+) kg^{-1}, respectively. While, the micronutrient status like zinc, iron, manganese and copper content before administration of treatments were 0.56 and 0.53, 2.62 and 2.60, 15.17 and 13.08, 4.39 and 3.57 mg kg^{-1} during 2009 and 2010, respectively and rated as low in Zn and Fe and high in Mn and Cu. the experiment was laid out in Randomized Block Design comprising sixteen (16) treatments replicated two (2) times in cotton crop. Recommended dose of fertilizer was applied to the crop (120:60:60 kg NPK ha^{-1}). The certified seed of cotton RCH-2 (BG-II) were sown in kharif season by dibbling one seed per hill at 90 x 60 cm distance.

Nitrogen was given in two splits. Fifty per cent nitrogen was applied at the time of sowing and remaining 50 per cent was applied one month after sowing. Entire dose of phosphorus and potassium was applied at the time of sowing.

Micronutrient sprays of gluconate and EDTA chelated plant nutrients were applied to the crop at the time of flowering i.e. at 55 DAS and second spray was applied at the time of boll development stage i.e. at 75 days after sowing. Two plants were randomly selected from two observation line of each plot, tagged and all biometric observations were recorded. Initial and periodical soil samples were collected at 40, 60, 80, 100, 120 DAS and at harvest stage of crop from surface layer (0.15 cm) of each treated plots of the layout. Soils were air dried, ground with wooden morter and pestle and passed through 2 mm sieve. The sieved samples were stored in polythene bags with proper labeling for further analysis. Nutrient content in cotton plant as influenced by treatment combinations were determined periodically at 20 days interval and after harvest of crop. The samples were washed with the tap water and in detergent solution followed by distilled water. After cleaning, plants were dried in shade and subsequently in oven at 70°C for 12 hrs. The oven dried sample were ground in electrically operated grinder with stainless steel blade to maximum fineness. The powdered samples were stored in polythene packets with proper labeling and utilized for nutrient content studies. The data emerged out from the field experiment were analysed by analysis of variance and degree of freedom were partitioned into different variance, due to replication and treatments combinations. Results were statistically analysed as per the method given in statistical method for agricultural workers by Panse and Sukhatme (1987).

RESULT AND DISCUSSION

Yield attributes of Bt-cotton

Number of bolls: The results revealed that treatment difference due to foliar feeding of gluconate and EDTA chelated plant nutrients were significant throughout the growth stages of Bt cotton crop in production of number of bolls plant^{-1}.

In the year 2009-10, 2010-11 and pooled, the number of bolls plants^{-1} increased from 56.50 to 81.50 45.50 to 74.50 and 51.00 to 78.00, respectively at harvest. The maximum number of bolls plant^{-1} were observed with treatment T_2 (Zn gluconate) and minimum in treatment T_1 (control). The result concluded that treatment T_2 (Zn gluconate) gave the highest number of bolls, followed treatment T_3, T_8, T_9, T_{13} and T_{12} and these treatments were also found at par with each other. The increase in number of bolls may be due to micronutrient applications which are involved in greater diversion of the metabolites to the fruiting parts, culminating in more boll production. This finding is in conformation with earlier reported by Venkatkrishna and Pothiraj (1994). Increasing value of NPK with micronutrients leads to increase number bolls plant^{-1} might be also due to availability of nutrients for longer period through two foliar sprays. The above findings are in agreement with the finding of Bhaskar (1993) and Malewar *et al*. (1999).

Boll weight: The data on effect on foliar feeding of gluconate and EDTA chelated plants nutrients on boll weight .The boll weight of Bt cotton varied between 2.47 to 3.53, 2.32 to 3.47 and 2.39 to 3.50 g in 2009-10, 2010-11 and pooled. The highest boll weight was recorded with T_2 (Zn gluconate) and lowest in control treatment (T_1). The pooled data revealed that treatment T_2 (Zn gluconate) recorded highest boll weight (i.e. 3.50), which was on par with treatment T_3 (Zn EDTA), T_2 (Zn gluconate), T_8 (Fe gluconate) and T_9 (Fe EDTA) and significantly superior over the control. This might be due to accelerated mobility of photosynthates from source to sink as influenced by the application of zinc and iron. Similar observations were also made by Ahalawat (1974), Namdeo *et al*. (1992), Wankhede *et al*. (1994), Anonymous (1995), Hanumanthareddy (1999) and Sasthri *et al*. (2000).

Cotton yield: The data regarding effect foliar feeding of gluconate and EDTA chelated plant nutrients on yield of cotton .

The application of varied levels of foliar feeding of micronutrients significantly influenced the cotton yield in both the years of experiment and in pooled. In the year 2009-10, the yield were ranged from 1631.41 to 2929.34 kg ha^{-1}, while in 2010-11 yield were ranged between 1364.88 to 2490.00 kg ha^{-1} with pooled from 1498.14 to 2709.67 kg ha^{-1}, respectively.

The application of Zn gluconate tended to increase the cotton yield significantly during both the experimental years and in pooled data. The pooled data showed that application of Zn gluconate increase the cotton yield which was to the tune of 2709.67 kg ha^{-1}. However, it was on par with application of treatment T_3 (Zn EDTA) however, significantly superior over control (T_1).

The foliar feeding of Zn gluconate produced statistically superior cotton yield 2929.34 kg ha^{-1} and 2490.67 kg ha^{-1} during 2009-10 and 2010-11, respectively and was on par with T_3 (Zn EDTA) and found to be significantly superior over control (T_1).

From the above results, it can be concluded that due to foliar application of micronutrient there was increase in cotton yield.

In cotton, the yield depends on the accumulation of photoassimilates and its partitioning in different parts of the plant. The yield is strongly influenced by the application of foliar micronutrient indicating the role of these micronutrients in increasing the yield through their effect on various morpho-physiological traits. Foliar micronutrients in known to increase the yield of cotton crop (Wankhade *et al.*, 1994 and Sasthri *et al.*, 2000).

Sharma *et al.* (1990) obtained the foliar spray of multi-micronutrient proved highly beneficial for increase yield and yield attributes. It may be due to the sufficient availability of micronutrients by foliar feeding, which was not only an additional channel of nutrition but also means of regulating root uptake. Sharma *et al.* (1998) observed that foliar application of Zn (0.5 per cent) on 50 and 65 DAS gave seed cotton yield of 14.69 ha^{-1} compared with 11.82 q ha^{-1} without Zn.

Application of zinc and iron enhanced seed cotton yield. This might be due to improved growth and yield attributing characters. Similar results were recorded by Chhabra *et al.* (2004) in cotton. Rajendran (2010) also concluded that foliar application of nutrient in alone or in combination has a great effect in improving the efficiency of utilization of nutrients and thereby improves the growth and seed cotton yield.

Quality parameter of Bt-cotton

Lint Index: In 2009-10 and 2010-11 the lint index ranged from 2.75 to 4.11 and 2.53 to 4.01, respectively while in pooled the lint index ranged from 2.64 to 4.06 (Table 4.9). During both the years, the results were non significant, but in pooled the result were found to be significant and the treatment T_2 was found distinctly superior over control (T_1). Further, treatments T_4, T_5, T_8, T_9, T_{12}, T_{13} and T_{16} also showed their significantly by giving higher lint index over control. Whereas, treatment T_6, T_7, T_{10}, T_{11}, T_{12} and T_{15} were at par with control. These results clearly showed that addition of the zinc, manganese, iron and magnesium in fertilizer application schedule are important.

Ginning percentage (%): The pooled value of ginning percentage ranged from 30.47 to 34.34 per cent with an average 32.44 per cent ginning out turn in Table 4.9. Foliar application of Zn, Mn, Fe, and Mg either through gluconate of EDTA improved the ginning out turn. However, it could not reach to the level of significance.

The ginning out turn parameter was governed mostly by genetic factors and hence remained more or less constant. These results were on the similar lines as that of Gaddime (2003) in cotton.

Test weight: The test weight on both year of experiment was ranged from 6.17 to 8.27 and 5.94 to 8.09 g^{-1} 100 seed, respectively. In pooled, it ranged from 6.05 to 8.18 g^{-1} 100 seed and the results were significant. The treatment T_2 (Zn gluconate) was superior over the control and was at par with rest of the treatments except Cu gluconate and Ca gluconate foliar spray and treatment T_{14} (all nutrient EDTA).

Nutrient concentration in cotton

N concentration in Bt cotton (%)

Data on effect of foliar feeding of gluconate and EDTA chelated plant nutrient on N concentration during two consecutive years i.e. 2009-10, 2010-11. The pooled grand mean varied from 2.04 to 2.21 per cent at 40 to 60 DAS, respectively. It clearly indicated that highest N concentration was noticed at 60 DAS and thereafter started declining toward maturity. In the year 2009-10, 2010-11 and pooled, application of Zn gluconate (T_2) proved to be superior in increasing the N concentration at 40 DAS.In pooled analysed data the treatment T_2 (2.29) was found to be significantly superior over the control and all other treatments and were on par with treatment T_3 (Zn EDTA).At 60 DAS, in both years and pooled data revealed that the treatment T_2 (Zn gluconate) showed distinct results in improving N concentration. The N concentration at 60 DAS was ranged from 1.82 (T_1) to 2.48 (T_2). The treatment T_2 (Zn gluconate) resulted the highest N concentration and was significantly superior over control and rest of the treatments and was closely followed on par with treatment T_3 (Zn EDTA).The same trend was observed at 100 and 120 DAS. At harvest stage the treatment T_2 in both consecutive years and pooled data interfered that application of T_2 (Zn gluconate) treatment showed significantly higher rate of N concentration over the control (T_1) and other treatments and was with treatment T_3 (Zn EDTA).The decrease in concentration of nutrients at final stage of cotton this might be due to dilution effect caused by higher dry matter production.

REFERENCES

Anonymous, (2010), Cotton advisory board, Cotton Corporation of India 2010. *www.cotcorp.gov.in.*

Patil V.D. and Zagade T. R. (2011), Spectral behavior of maize under varying fertility conditions. *Abstracts and souvenier* of state level seminar on soil health, sustainability and food security.

Malewar, G.U. (1977), Micronutrient status, their distribution and availability in soils of Marathwada region of Maharashtra State in relation to soil types and cropping patterns. A thesis submitted to M.A.U., Parbhani for Ph.D.

Panse, V.G. and P.V. Sukhatme (1988), Statistical methods of Agricultural Workers, ICAR Publication, New Delhi.

Bhaskar, K.S., Gaikwad, S.T. and Ananthakumar. (1993), Response of upland cotton (*Gossypium hirsutum* L.) to the levels of fertilizers in shallow soils. *Indian J. Agron*. **38**(1): 89-92.

Venkatakrsihan, A.S. and P. Pothiraj. (1991), Nutrient management in irrigated cotton (*Gossypium hirsutum*). *Indian J. Agron.,* **36**(4):622-624.

Malewar, G.V., S.B. Badole, C.V. Mali, and M.B. Siddiqui, (1999), Yield, NPK concentration and their uptake by sunflower and cotton as influenced by fly ash with and without FYM and fertilizer. *J. Soils and Crops*, **9**(1): 18-22.

Ahlawat, P.S. and V.M. Sahani (1974), Studies on fertility levels on cotton. *Indian J. Agron*., **24**(2): 231-233.

Namdeo, K.N., J.N. Sharma and K.C. Mandloi (1992), Effect of foliar feeding of micronutrient on production of rainfed hybrid cotton. *Crop Res., Hisar*, **5**(3): 451-455.

Wankhade, ST., L.D. Meshram and H.K. Kene (1994), Impact of foliar feeding of nutrients on hybrid seed production. *P.K.V. Res. J.*, 18:127-28.

Hanumanthareddy, L.P. (1999), Impact of nutrients on growth regulators on trying of reproductive structures in cotton (*Gossypium barbadense*). M.Sc. (Agri.), Thesis University of Agricultural Sciences, Dharwad.

Sashtri, G.; C.P. Thagarajan, P. Srimathi, K. Malarkodi, and E.P. Venkatasalam, (2000), Foliar application of nutrient on the seed yield and quality characters of non aged and aged seeds of cotton cv. MCUS. *Madras Agricultural J.*, 87: 202-208.

Sharma, U.C., Gangwar, M.S. and Srivastava, P.C. (1990), Effect of zinc and sulphur on nutrient uptake and yield of mustard. *J. Indian Soc. Soil Sci.,* **38**: 696-701.

Chhabra, K.L.; L.K. Bishnio and M.S. Bhattoo (2004), Effect of macro and micro-nutrients on the productivity of cotton genotypes. *Univ. of Agril. Sci., Dharwad, Karnataka*. pp : 161-162.

Rajendran, K., Mohamed, M.A. and Vaijyapuri K. (2010), Foliar nutrition in cotton – A review. *Agric. Rev*., **31**(2): 120-126.

Gaddime (2003), Effect of sources and levels of boron on growth, yield and nutrient uptake by rainfed cotton. A Thesis submitted to MAU, Parbhani.