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Effect of foliar feeding of gluconate and EDTA chelated plant nutrients on yield, quality and nutrient concentrationin *Bt* cotton

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ABSTRACT : The field experiments were conducted at Experimental Farm Department of Soil Science and Agricultural Chemistry,Vasantrao Naik Marathwada Krishi Vidyapeeth Parbhani, during 2009-2010 and 2010-2011 experiment was laid out in randomized block design with sixteen treatments replicated twice. The data on yield and quality 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 government 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,Fegluconate and Fe EDTA which were equally effective in quality parameters.

Key words : *Bt* cotton, EDTA, foliar feeding, gluconate, nutrient concentration, quality, yield

Cotton (*Gosspium* spp.) is one of the most important commercial crop 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”.

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.

The soils of the cotton growing area are generally low in organic carbon, nitrogen, available phosphorus, zinc and sulphur. At present, removal of nutrients/ha (NPKS) (179 kg/ha) is in excess of what is being added (117 kg/ha) resulting in a negative nutrient balance in soil (Patil and Zagade, 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. 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 was undertaken with the objectives *i.e.* to study the response of gluconate and EDTA chelated nutrients on growth, yield and quality of *Bt* cotton.

MATERIALS AND METHODS

The field experiments were conducted on TypicHaplusterts at Research Farm Department of Soil Science and Agricultural Chemistry. A research porject was conducted during 2009-2010 and 2010-2011 at Vasantrao Naik 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 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 7^{th} approximation, the soils are classified as TypicHaplusterts 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 TypicHaplusterts. It was slightly alkaline in reaction (8.20 and 8.0), safe in soluble salt concentration (EC 0.117 to 0.113/dSm) and medium in organic carbon content (6.70 and 6.50 g/kg for cotton crop during the year 2009 and 2010). The free calcium carbonate content was 48.00 to 36.00 g/kg. The available nitrogen, phosphorus and potassium content of experimental soil of cotton were 147.00 and 139.00 kg/ha, 8.9 and 10.20 kg/ha, 887.00 and 670.00 kg/ha, 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 and 16.30 and 14.80 C mol (p^+)/kg, 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 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 of 16 treatments replicated 2 times in cotton crop. Recommended dose of fertilizer was applied to the crop (120:60:60 kg NPK/ha). The certified seed of cotton RCH 2 (BG II) were sown in *kharif* season by dibbling one seed/hill at 90 x 60 cm distance.

Nitrogen was given in 2 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 2 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 mortar 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^{o}C for 12 h. 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.

RESULTS AND DISCUSSION

Yield attributes of *Bt* cotton (Table 1)

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 bolls/plant.

In the year 2009-2010, 2010-2011 and pooled, the bolls/plants increased from 56.50 to 81.50 45.50 to 74.50 and 51.00 to 78.00, respectively at harvest. The maximum bolls/ plant were observed with treatment T_2 and minimum in treatment T_1. The result concluded that treatment T_2 gave the highest 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 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. Increasing value of NPK with micronutrients leads to increase bolls/plant might be also due to availability of nutrients for longer period through 2 foliar sprays.

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 2009-2010, 2010-2011 and pooled. The highest boll weight was recorded with T_2 and lowest in control treatment (T_1).The pooled data revealed that treatment T_2 recorded highest boll weight (*i.e.* 3.50), which was on par with treatment T_3, T_2, T_8 (Fe gluconate) and T_9 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 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 2009-2010, the yield were ranged from 1631.41 to 2929.34 kg/ha, while in 2010-2011 yield were ranged between 1364.88 to 2490.00 kg/ha with pooled from 1498.14 to 2709.67 kg/ha, 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. 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 and 2490.67 kg/ha during 2009-2010 and 2010-2011, respectively and was *on par* with T_3 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

Table 1. Effect of foliar feeding of gluconate and EDTA chelated plant nutrient on bolls/plant, boll weight (g) and yield (kg/ha) of *Bt* cotton

Treatment	Bolls/plant			Boll weight (g)			Yield (kg/ha)		
	2009-2010	2010-2011	**Pooled**	2009-2010	2010-2011	**Pooled**	2009-2010	2010-2011	**Pooled**
T_1-Control	56.50	45.50	**51.00**	2.47	2.32	**2.39**	1631.41	1364.88	**1498.14**
T_2-Zn gluconate	81.50	74.50	**78.00**	3.53	3.47	**3.50**	2929.34	2490.00	**2709.67**
T_3-Zn EDTA	80.00	74.00	**77.00**	3.50	3.44	**3.47**	2683.30	2348.60	**2515.95**
T_4-Mn gluconate	69.50	61.50	**65.50**	3.10	3.01	**3.05**	2352.42	1877.50	**2114.96**
T_5-Mn EDTA	71.00	63.50	**67.25**	3.14	3.07	**3.10**	2376.20	1938.07	**2157.13**
T_6-Cu gluconate	64.00	54.50	**59.25**	2.91	2.77	**2.84**	1831.25	1535.50	**1683.37**
T_7-Cu EDTA	61.50	52.00	**56.75**	2.86	2.70	**2.78**	1776.10	1510.92	**1643.51**
T_8-Fe gluconate	76.50	68.00	**72.25**	3.34	3.25	**3.29**	2562.68	2085.18	**2323.93**
T_9-Fe EDTA	76.00	67.50	**71.75**	3.29	3.18	**3.23**	2462.86	2056.29	**2259.57**
T_{10}-Ca gluconate	60.00	49.50	**54.75**	2.59	2.51	**2.55**	1769.21	1451.74	**1610.47**
T_{11}-Ca EDTA	59.50	47.50	**53.50**	2.56	2.41	**2.48**	1695.64	1409.88	**1552.76**
T_{12}-Mg gluconate	73.50	65.50	**69.50**	3.18	3.09	**3.13**	2421.00	1962.67	**2191.83**
T_{13}-Mg EDTA	75.50	67.00	**71.25**	3.20	3.13	**3.16**	2422.53	2035.06	**2228.79**
T_{14}-Zn, Mn, Cu, Fe, Ca and Mg gluconate	69.00	61.00	**65.00**	3.03	2.97	**3.00**	2206.71	1632.48	**1919.59**
T_{15}- Zn, Mn, Cu, Fe, Ca and Mg EDTA	68.50	59.00	**63.75**	2.95	2.81	**2.88**	1972.46	1547.55	**1760.00**
T_{16}-Government grade	269.00	62.50	**65.75**	2.77	3.00	**2.89**	2330.91	1825.00	**2077.95**
SE +	3.73	3.64	**2.61**	0.11	0.11	**0.08**	108.52	155.17	**94.91**
CD (p=0.05)	11.23	10.97	**9.15**	0.35	0.34	**0.29**	326.55	466.91	**332.84**
Grand mean	**69.47**	**60.81**	**65.14**	**3.03**	**2.95**	**2.98**	**2214.00**	**1816.96**	**2015.48**

micronutrients in increasing the yield through their effect on various morpho physiological traits. Foliar micronutrients in known to increase the yield of cotton crop (Sasthri *et al.*, 2000).

It is found 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. It has been observed that foliar application of Zn (0.5%) on 50 and 65 DAS gave seed cotton yield of 14.69/ ha as compared to 11.82 q/ha 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 *et al.*, (2010) also concluded that foliar application of nutrient 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 (Table 2)

Lint index : In 2009-2010 and 2010-2011 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. 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 significance by giving higher lint index over control. Whereas, treatment T_6, T_7, T_{10}, T_{11}, T_{12}

Table 2. Effect of foliar feeding of gluconate and EDTA chelated plant nutrient on lint index and ginning percentage (%)

Treatment	Lint index			Ginning percentage			Test weight (g)		
	2009-2010	2010-2011	**Pooled**	2009-2010	2010-2011	**Pooled**	2009-2010	2010-2011	**Pooled**
T_1-Control	2.75	2.53	**2.64**	30.57	30.37	**30.47**	6.17	5.94	**6.05**
T_2-Zn gluconate	4.11	4.01	**4.06**	34.32	34.37	**34.34**	8.27	8.09	**8.18**
T_3-Zn EDTA	4.09	3.97	**4.03**	34.02	33.70	**33.86**	8.19	7.92	**8.05**
T_4-Mn gluconate	3.79	3.53	**3.66**	32.50	32.31	**32.40**	7.58	7.18	**7.38**
T_5-Mn EDTA	3.94	3.75	**3.84**	32.95	32.80	**32.87**	7.72	7.38	**7.55**
T_6-Cu gluconate	3.36	3.12	**3.24**	31.50	31.46	**31.48**	6.86	6.53	**6.69**
T_7-Cu EDTA	3.47	3.26	**3.36**	31.94	31.71	**31.82**	6.93	6.62	**6.77**
T_8-Fe gluconate	4.06	3.93	**3.99**	33.77	33.94	**33.85**	8.22	7.79	**8.00**
T_9-Fe EDTA	4.01	3.84	**3.92**	33.55	33.49	**33.52**	7.88	7.53	**7.70**
T_{10}-Ca gluconate	2.93	3.08	**3.00**	31.17	31.00	**31.08**	6.53	6.27	**6.40**
T_{11}-Ca EDTA	2.81	2.93	**2.87**	30.92	30.72	**30.82**	6.48	6.13	**6.30**
T_{12}-Mg gluconate	3.82	3.78	**3.80**	33.10	32.93	**33.01**	7.79	7.31	**7.55**
T_{13}-Mg EDTA	3.99	3.80	**3.89**	33.25	33.20	**33.22**	6.83	7.47	**7.65**
T_{14}-Zn, Mn, Cu, Fe, Ca and Mg gluconate	3.64	3.41	**3.52**	32.12	32.00	**32.06**	7.27	6.93	**7.17**
T_{15}- Zn, Mn, Cu, Fe, Ca and Mg EDTA	3.55	3.43	**3.49**	32.07	31.85	**31.96**	7.11	6.85	**6.98**
T_{16}-Government grade	23.83	3.58	**3.70**	32.30	32.25	**32.27**	7.34	7.00	**7.17**
SE +	0.30	0.41	**0.26**	1.94	1.30	**1.17**	0.83	0.70	**0.30**
CD (p=0.05)	NS	NS	**0.90**	NS	NS	**4.11**	NS	NS	**1.05**
Grand mean	**3.63**	**3.50**	**3.56**	**32.50**	**32.38**	**32.44**	**7.32**	**7.06**	**7.22**

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 outturn in Table 2. Foliar application of Zn, Mn, Fe, and Mg either through gluconate of EDTA improved the ginning outturn. However, it could not reach to the level of significance.

The ginning outturn 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/100 seed, respectively. In pooled, it ranged from 6.05 to 8.18/g/100 seed and the results were significant. The treatment T_2 was superior over the control and was *at par* with rest of the treatments except Cu gluconate and Cagluconate foliar spray and treatment T_{14}.

Plant nutrient concentration (Table 3)

Plant nitrogen concentration : Data (pooled) on effect of foliar feeding of Gluconate and EDTA chelated plant nutrient on N concentration are presented in Table 3. The pooled grand mean varied from 2.04 to 2.21 per cent at 40 to 60 DAS, respectively. The highest N concentration was noticed at 60 DAS and thereafter declined towards maturity. Among the treatments at 40 DAS, application of Zn gluconate proved to be superior in increasing the N concentration of cotton plant and was significantly superior over the control and all other treatments except Zn EDTA.

At 60 DAS, in both years the pooled data revealed that cotton receiving Zn gluconate sprays showed improvement in N concentration. The N concentration at 60 DAS was ranged from 1.82 to 2.48 . The treatment Zn gluconate spraying of 0.5 per cent resulted into highest N concentration and was significantly superior over rest of the treatments and treatment Zn EDTA spraying closely followed the gluconate and EDTA . The same trend was observed at 100 and 120 DAS. At harvest stage the data inferred that application of Zn gluconate showed significantly higher rate of N concentration over the control and other treatments and was *at par* with Zn EDTA. The decrease in concentration of nutrients at final stage of cotton might be due to dilution effect caused by higher dry matter production.

Phosphorus concentration : The phosphorus concentration ranged from 0.46 to 0.64 per cent at an increasing rate from 40 to 80 DAS and started declining from 100 DAS to at harvest (Table 3). 40 and 60 DAS the P concentration was increased from 0.35 to 0.59 per cent and 0.40 to 0.67 per cent. Higher P concentration was recorded in Zn gluconate 0.59 and 0.65 per cent. It was *at par* with Zn EDTA (0.58 and 0.64%), Fe EDTA (0.57 and 0.62%), Fe gluconate (0.56 and 0.60%), Mg gluconate (0.53 and 0.58%) and Mg EDTA (0.53 and 0.57%), respectively, which were *on par* with superior treatment.

Highest rate and amount of concentration of phosphorus was noted, due to application of treatment Zn gluconate 0.81 and 0.74 in both the years. At 100 and 120 DAS and at harvest the P concentration rate started declining toward the maturity of crop.In this situation also, the treatment Zn gluconate

Table 2. Effect of foliar feeding of gluconate and EDTA chelated plant nutrient on N, P, K concentration of *Bt* cotton.

Treatment	N concentration (%) (DAS)					At	P concentration (%) (DAS)					At	K concentration (%) (DAS)					At
	40	60	80	100	120	harvest	40	60	80	100	120	harvest	40	60	80	100	120	harvest
T_1-Control	1.70	1.82	1.72	1.65	1.59	1.52	0.35	0.40	0.45	0.41	0.31	0.27	1.38	1.52	1.55	1.75	1.65	1.54
T_2-Zn gluconate	2.29	2.48	2.31	2.22	2.15	2.04	0.59	0.67	0.77	0.59	0.47	0.4	1.94	2.17	2.53	2.44	2.31	2.15
T_3-Zn EDTA	2.25	2.47	2.3	2.2	2.1	2.01	0.58	0.64	0.76	0.58	0.46	0.39	1.9	2.15	2.46	2.4	2.26	2.13
T_4-Mn gluconate	2.16	2.31	2.24	2.08	2.02	1.87	0.5	0.55	0.7	0.55	0.4	0.35	1.83	2.05	2.09	2.28	2.1	2.03
T_5-Mn EDTA	2.14	2.27	2.21	2.05	1.99	1.84	0.48	0.54	0.68	0.53	0.39	0.34	1.79	1.95	1.99	2.24	2.08	1.96
T_6-Cu gluconate	1.92	2.09	1.97	1.84	1.77	1.68	0.40	0.46	0.58	0.48	0.35	0.31	1.57	1.72	1.74	1.99	1.84	1.76
T_7-Cu EDTA	1.85	2.00	1.91	1.78	1.73	1.65	0.40	0.45	0.54	0.47	0.34	0.3	1.54	1.69	1.71	1.93	1.79	1.7
T_8-Fe gluconate	2.19	2.43	2.28	2.16	2.11	1.93	0.56	0.59	0.73	0.56	0.43	0.37	1.87	2.11	2.35	2.33	2.18	2.08
T_9-Fe EDTA	2.22	2.44	2.29	2.19	2.13	1.99	0.57	0.62	0.75	0.58	0.45	0.38	1.89	2.14	2.4	2.35	2.2	2.11
T_{10}-Ca gluconate	1.78	1.94	1.86	1.74	1.68	1.6	0.39	0.43	0.52	0.45	0.33	0.29	1.48	1.61	1.64	1.89	1.74	1.65
T_{11}-Ca EDTA	1.77	1.88	1.8	1.7	1.64	1.56	0.37	0.42	0.49	0.43	0.32	0.28	1.45	1.58	1.6	1.83	1.7	1.61
T_{12}-Mg gluconate	2.21	2.4	2.26	2.17	2.1	1.93	0.53	0.58	0.74	0.57	0.42	0.37	1.87	2.13	2.27	2.34	2.18	2.09
T_{13}-Mg EDTA	2.18	2.36	2.25	2.13	2.06	1.9	0.53	0.57	0.72	0.55	0.41	0.35	1.86	2.09	2.17	2.31	2.14	2.06
T_{14}-Zn, Mn, Cu, Fe, Ca and Mg gluconate	2.03	2.16	2.14	1.93	1.86	1.77	0.42	0.5	0.63	0.5	0.37	0.32	1.68	1.81	1.87	2.11	1.95	1.86
T_{15}- Zn, Mn, Cu, Fe, Ca and Mg EDTA	1.96	2.13	2.09	1.88	1.82	1.73	0.41	0.48	0.6	0.5	0.36	0.32	1.63	1.76	1.81	2.06	1.9	1.82
T_{16}-Government grade 2	2.11	2.21	2.18	1.96	1.92	1.81	0.46	0.52	0.65	0.52	0.38	0.35	1.75	1.89	1.92	2.19	1.98	1.9
SE+	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.03	0.04	0.02	0.02	0.03	0.13	0.11	0.05	0.03	0.01	0.06
CD at 5 %	0.08	0.09	0.09	0.13	0.08	0.08	0.07	0.12	0.16	0.1	0.09	0.07	NS	NS	0.2	NS	0.49	0.23
Grand mean	**2**	**2.2**	**2.1**	**2**	**1.8**	**1.8**	**0.5**	**0.5**	**0.6**	**0.5**	**0.4**	**0.3**	**1.8**	**1.9**	**2**	**2.3**	**2**	**1.9**

showed significantly superior over control and with rest of treatments.

Potassium concentration : The data pertaining to potassium concentration in cotton at different growth stagesare presented in Table 3. At 40 and 60 DAS, the critically analyzed pooled data revealed the non significant results. Potassium concentration in *Bt* cotton at 80 DAS ranged from 1.55 to 2.53 per cent. It was found that treatment T_2 with 2.53 per cent K, emerged to be distinctly superior treatment over control and all other treatment. At 100 DAS the pooled data revealed the higher level of significance recorded in potassium concentration (*i.e.* 2.44%) was with application of zinc gluconate to *Bt* cotton crop. It proved to be significantly superior over control and rest of treatments. The treatment T_3 Zn EDTA (2.40%) was *on par* with superior treatment. The data recorded at 120 DAS the potassium concentration doesn't reach up to the level of significance. At harvest stage pooled data resulted maximum K concentration in *Bt* cotton was observed in the plants, treated with Fe gluconate T_2 (2.13) foliar feeding followed treatment T_3 (2.13%), T_9 (2.11%), T_8 (2.10%), T_{12} (2.09 per cent) and T_{13} (2.06%).

CONCLUSION

The treatment T_2 showed more bolls/ plant followed by treatment T_3. The maximum bolls were observed after 120-135 days and thereafter there was a decline in the boll formation. The maximum boll weight was observed with treatment Zn gluconate. Spraying of Zn gluconate, Zn EDTA and Fe and Mg nutrients have produced more seed cotton yield. The quality parameters *viz.*, staple length and ginning percentage found to be improved due chelated nutrients sprays. But, could not reach to the level of significance. Among the treatments Zn gluconate spray found to be distinctly superior over the control (T_1), T_{10} and T_{11} and *at par* with remaining treatments spraying of Zn, Fe and Mg gluconate and EDTA found to significantly superior over control and was *at par* with rest of treatments in test weight.The foliar feeding of gluconate and EDTA chelated plant nutrients found to be effective in increasing the macronutrient concentration in plant at various growth stages. Among the chelated nutrient sprays gluconatecomplexed nutrients found superior over EDTA chelated nutrients and government grade 2.

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