GAU Research Journal **44** (2) : 107-111 (April 2019) **Short communication**

Effect of soil and foliar application of nutrients on growth and yield of *Bt* cotton (G*ossypium hirsutum* L.)

NANDKISHOR I. PATEL[1*], D. B. MODI[2], R. N. SINGH[3], C. K. PATEL[4] AND B.S.DEORA[5]

AICRPDA, Centre for Natural Resources Management, S. D. Agricultural University, Sardarkrushinagar -385 506, Gujarat

Received: 09 July, 2018 Accepted: 10 August, 2018

Key words: Foliar application, *Gossypium hirsutum*, Nutrients, yield and Fertility

Cotton (*Gossypium hirsutum* L.) is considered as an important fibre crop of India. Gujarat is leading cotton growing state which grows cotton on about 2.69 million ha producing 11.60 million bales of lint with the productivity of 733 kg lint per hectare. It is the backbone of textile industries providing 85 % of raw material to textile industry and it earns about 33 per cent of total foreign exchange (Anon., 2014). Most of the *Bt* cotton hybrids bear fruiting parts by 20 to 25 days and also mature early in comparison to the erstwhile inter specific hybrids and hence need for optimum nutrition begins from the beginning in cotton otherwise there would be flower and/or boll drop, *etc.* which greatly affect overall crop production. However, certain physiological problems have also mushroomed with *Bt* cotton cultivation leading to decline in productivity. Of these reddening of leaves also called "*LALYA*" is prime malady. Besides that, square drying, premature floral abscission and failure to set the bolls are among some other abiotic disorders associated with poor productivity in the era of *Bt* cotton cultivation. K nutrition has pronounced effects on carbohydrate partitioning by affecting either phloem export of photosynthates (sucrose) or growth rate of sink and/or source organs (Cakmak *et al.,*1994).

Furthermore, K has an important role in the translocation of photosynthates from sources to sinks (Cakmak *et al*. 1994). Pettigrew (1999) stated that the elevated carbohydrate concentrations remaining in source tissue, such as leaves, appear to be a part of the overall effect of K deficiency in reducing the amount of photosynthate available for reproductive sinks, which produced changes in lint yield and fiber quality seen in cotton. Potassium plays a particularly important role in cotton fiber development and a shortage will result in poorer fiber quality and lowered yields (Cassman *et al*., 1990).

For cotton crop yielding about 1800 kg/ha, 70% of the Zn and P taken up was removed in the seed, apart from 17% of Fe and 12% of B (Rochester, 2007). Soil application of Zn, B, Fe, Mn, Cu and Mn on calcareous soils is less efficient, as these nutrients remain inaccessible to plant roots due to the higher soil pH (Rashid and Ryan, 2004, Sajid *et al.,* 2008). However, an alternative approach under such circumstances is foliar application of nutrients (Rab and Haq, 2012) primarily for two reasons. First, it eliminates the effects of soil pH on the availability of these nutrients (Ali, 2012). For reasons mentioned above, it has gained significant attention in agriculture worldwide (Liew *et al*., 2012). External supplementation of plant nutrients needs to be therefore emphasized keeping in view their role in improving yield. Since little information is available on soil application of Mg and aforesaid nutrients through foliar sprays and consequently their effect on yield and fertility of *Bt* cotton, hence, the present investigation was carried out for two years to draw conclusive inferences.

MATERIALS AND METHODS

The experiment was conducted during *Kharif* season of the years 2015 and 2016 at Agriculture Research Station, Sardarkrushinagar Dantiwada Agriculture University, Talod, North Gujarat. The soil was normal in EC (0.12 mmhos/cm), low in O.C (0.23%), medium in available P_2O_5 (48.6 kg/ha) and available K_2O (226

[1&4]Associate Research Scientist, [2]Assistant Research Scientist, and [5]Research Scientist, AICRPDA, Centre for Natural Resources Management [3]Assoc. Director of Research (Farm), Directorate of Research, S. D. Agricultural University, Sardarkrushinagar

*Email: nip111967@gmail.com

kg/ha). The experiment was comprised of 12 treatments of foliar and soil application of $MgSO_4$ i.e T_1:control(three water sprays), T_2: three foliar sprays of KNO_3 @ 1.5 % ,T_3: three foliar sprays of KNO_3 @ 3.0 %, T_4: soil application of $MgSO_4$ @ 15 kg/ha, T_5: soil application of $MgSO_4$ @ 30 kg/ha, T_6: soil application of $MgSO_4$ @ 15 kg/ha +three foliar sprays of KNO_3 @ 1.5 %, T_7: soil application of $MgSO_4$ @ 15 kg/ha +three foliar sprays of KNO_3 @ 3.0 %, T_8: Soil application of $MgSO_4$ @ 30 kg/ha +three foliar sprays of KNO_3 @ 1.5 %, T_9: soil application of $MgSO_4$ @ 30 kg/ha +three foliar sprays of KNO_3 @ 3.0 %, T_{10}: foliar application of $ZnSO_4$ @ 0.5 % +$FeSO_4$ @ 1.0 %, T_{11}: T_7 +T_{10} and T_{12}: T_9+T_{10} at square formation, flowering and boll development stages arranged in randomized block design with three replications. The *Bt* cotton hybrid GCH-8(B.G. II) was selected for the studies because of its popularity among cotton growers. Sowing was performed at onset of monsoon by dibbling 2-3 seeds/hill which were later thinned to one seedling per hill. The recommended fertilizer dose (i.e 120 kg N, 00 kg P_2O_5 and 00 kg K_2O/ha) was applied as per package of practices. The rain received during the crop season was 751.0 and 571.0 mm spread over 17 and 29 days for year 2015 and 2016, respectively. Data on yield and soil fertility were recorded. All other recommended production and protection practices were uniformly applied. The pooled analysis was made from 2 years data as per the standard procedure proposed by Thimmaian (1999). Economics were also calculated on the basis of prevailing market price of inputs and seed cotton.

RESULTS AND DISCUSSION

The data clearly indicated that different treatments had significant influence on seed cotton yield. Soil application of $MgSO_4$ @ 15 kg/ha + three foliar sprays of KNO_3 @ 3.0 % (T_7) significantly increased seed cotton yield during both the years and in pooled analysis, but it was found at par with soil application of $MgSO_4$ @ 30 kg/ha +three foliar sprays of KNO_3 @ 3.0 % (T_9) as well as T_{12} i.e. T_9 + foliar application of $ZnSO_4$ @ 0.5 % +FeSO4 @ 1.0 % during 2015, 2016 and in pooled results. Soil application of $MgSO_4$ @ 15 kg/ha + three foliar sprays of KNO_3 @ 3.0 % recorded significantly the highest seed cotton yield of 1569 kg/ha in pooled dat. There were no significant interactions among K, Fe, Zn and Mg with respect to yield (Table 1). Similar findings of application of magnesium sulphate which significantly increased seed cotton yield(SCY) per plant as compared with the untreated control were also reported by Zakaria *et al*. (2008). Foliar sprays of KNO_3 @ 1.0 % also raised the SCY as compared to control was also observed by Basavaraj *et al*. (2017).

Soil available magnesium was significantly increased due to soil application of $MgSO_4$ @ 30 kg/ha + three foliar sprays of KNO_3 @ 3.0 %, but it was found at par with the treatment combined with the soil application of $MgSO_4$ @ 15 and 30 kg/ha during individual years and in pooled results. Application of different treatments failed to exert their significant effect on available Fe and Zn contents in soil (Table 2). Similar findings were also recorded by Uday Badugu (2012).

The results showed that the maximum gross income (Rs. 67467/ha) and net income (Rs. 31767/ha) were recorded due to soil application of $MgSO_4$ @ 15 kg/ha + three foliar sprays of KNO_3 @ 3.0 % (Table 1). This is on the expected line as higher the nutrition to the crops higher will be the cotton yield and it ultimately lead to higher gross and net returns. The results are in conformity with those of Uday Badugu(2012) and Hosamani *et al* (20l3) who also obtained higher net returns.

CONCLUSION

In short, it can be concluded that the maximum seed cotton yield and monetary returns as well as soil fertility status were recorded with application of 15 kg $MgSO_4$ /ha as basal and three foliar sprays of KNO_3 @ 3.0 % at square formation, flowering and boll development stages with recommended dose of fertilizers(120+00+00 kg N, P_2O_5, K_2O /ha).

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Table 1 Effect of different treatments on yield & economics (Pooled)

Treatment details	Seed cotton yield(kg/ha)			Total Cost of Culti.	Gross income (Rs/ha)	Net Income (Rs/ha)	B: C ratio
	2015	2016	Pooled				
T1:Control(Three water sprays)	1290	981	1136 (cd)	27600	48848	21248	1.77
T2: Three foliar sprays of KNO3 @ 1.5 %	1171	969	1070(d)	31200	46010	14810	1.47
T3: Three foliar sprays of KNO3 @ 3.0 %	1533	1063	1298(bc)	34800	55814	21014	1.60
T4:Soil application of MgSO4 @ 15 kg/ha	1290	820	1055(d)	27900	45365	17465	1.63
T5:Soil application of MgSO4 @ 30 kg/ha	1416	926	1171(cd)	28650	50353	21703	1.76
T6:Soil application of MgSO4 @ 15 kg/ha +Three foliar sprays of KNO3 @ 1.5 %	1233	1051	1142(cd)	32100	49106	17006	1.53
T7:Soil application of MgSO4 @ 15kg/ha +Three foliar sprays of KNO3 @ 3.0 %	1788	1349	1569(a)	35700	67467	31767	1.89
T8:Soil application of MgSO4 @ 30 kg/ha +Three foliar sprays of KNO3 @ 1.5 %	1554	1020	1287(bc)	32850	55341	22491	1.68
T9:Soil application of MgSO4 @30 kg/ha +Three foliar sprays of KNO3 @ 3.0 %	1712	1282	1497(a)	36450	64371	27921	1.77
T10: Foliar application of ZnSO4 @ 0.5 % +FeSO4 @ 1.0 %	1543	1027	1285(bc)	28160	55255	27095	1.96
T11: T7 +T10	1420	1034	1227(cd)	36860	52761	15901	1.43
T12: T9+T10	1689	1183	1436(ab)	37610	61748	24138	1.64
SEm±	69.7	89.7	56.8				
C.D. at 5 %	205.6	263.1	161.8				
C.V. %	8.2	14.7	11		Seed cotton	43	

Table 2 Effect of different treatment on soil fertility at harvest (Pooled)

Treatments details	Soil fertility (ppm)								
	Mg			Fe			Zn		
	2015	2016	Pooled	2015	2016	Pooled	2015	2016	Pooled
T1:Control(Three water sprays)	26.90	29.87	28.38	4.13	3.81	3.97	0.40	0.31	0.36
T2: Three foliar sprays of KNO_3 @ 1.5 %	26.20	28.57	27.38	4.50	4.17	4.34	0.41	0.31	0.36
T3: Three foliar sprays of KNO_3 @ 3.0 %	26.40	28.80	27.60	4.43	4.10	4.27	0.41	0.33	0.37
T4: Soil application of $MgSO_4$ @ 15 kg/ha	31.50	33.97	32.73	4.70	4.38	4.54	0.44	0.35	0.39
T5: Soil application of $MgSO_4$ @ 30 kg/ha	35.50	38.27	36.88	4.87	4.54	4.70	0.44	0.35	0.39
T6: Soil application of $MgSO_4$ @ 15 kg/ha +Three foliar sprays of KNO_3 @ 1.5 %	32.50	35.37	33.93	4.77	4.45	4.61	0.44	0.35	0.40
T7: Soil application of $MgSO_4$ @ 15kg/ha +Three foliar sprays of KNO_3 @ 3.0 %	32.17	34.80	33.48	4.88	4.58	4.73	0.46	0.37	0.41
T8: Soil application of $MgSO_4$ @ 30 kg/ha +Three foliar sprays of KNO_3 @ 1.5 %	35.60	38.17	36.88	4.88	4.57	4.73	0.45	0.37	0.41
T9: Soil application of $MgSO_4$ @30 kg/ha +Three foliar sprays of KNO_3 @ 3.0 %	35.80	37.97	36.88	4.90	4.62	4.76	0.46	0.37	0.41
T10: Foliar application of $ZnSO_4$ @ 0.5 % +FeSO4 @ 1.0 %	26.00	28.57	27.28	5.25	4.94	5.10	0.48	0.39	0.44
T11: T_7 +T_{10}	33.30	36.17	34.73	5.06	4.76	4.91	0.47	0.39	0.43
T12: T_9+T_{10}	35.00	37.90	36.45	5.31	5.04	5.18	0.50	0.42	0.46
SEm±	2.19	2.19	1.56	0.72	0.23	0.17	0.03	0.33	0.02
C.D. at 5 %	6.46	6.42	4.45	NS	NS	NS	NS	NS	NS
C.V. %	12.07	12.07	11.68	8.79	9.00	8.89	10.32	12.44	11.26