An Asian Journal of Soil Science
Volume **10** | Issue 1 | June, 2015 | 63-67 | e ISSN–0976–7231 ■ Visit us : www.researchjournal.co.in

Research Article

DOI : 10.15740/HAS/AJSS/10.1/63-67

Effect of sulphur and micronutrients (zinc and iron) on nutrient uptake, availability, yield and quality of cotton

■ N. MAMATHA AND H.S. RAMESH

Received : 12.08.2014; **Revised :** 18.04.2015; **Accepted :** 27.04.2015

MEMBERS OF RESEARCH FORUM:

Corresponding author :
H.S. RAMESH, Department of Veterinary Physiology and Biochemistry, Veterinary College, Vinobhanagar, SHIMOGA (KARNATAKA) INDIA
Email: ramamabhi@gmail.com

Co-authors :
N. MAMATHA, Office of Assistant Registrar of Co-operative Societies, Sahakara Bhavan, SHIMOGA (KARNATAKA) INDIA
Email: mamathadavanagere@gmail.com

Summary

In a field experiment conducted on a Typic Chromustert at Main Agricultural Research Station, University of Agricultural Sciences, Dharwad, the yield of cotton was significantly influenced by the different levels and combined application of sulphur, iron and zinc. The treatment that received combined application of sulphur, iron and zinc each at 50 kg per ha recorded the highest seed cotton yield (25.12 q/ha) and the higher nutrient uptake S (21.30 kg/ha), Fe (1303 g/ha), Zn (252.3 g/ha), higher ginning percentage (43.00) and seed index (9.81 g) and lower available S (29.5 kg/ha), Fe (3.20 g/kg) and Zn (0.60 mg/kg) were noticed with the combined application of sulphur, iron and zinc each at 50 kg per ha.

Key words : Cotton, Micronutrients, Seed index, Lint, Ginning

How to cite this article : Mamatha, N. and Ramesh, H.S. (2015). Effect of sulphur and micronutrients (zinc and iron) on nutrient uptake, availability, yield and quality of cotton. *Asian J. Soil Sci.,* **10**(1) : 63-67.

Introduction

In India cotton is being cultivated on an area of 9.0 m.ha with production of 17.0 m bales. However, India needs to produce about 23 m bales of cotton by 2010 AD to meet the anticipated domestic and export demands. Due to population pressure and pressure from food crops expansion, the area beyond the present level of 9.0 m.ha is not possible. This huge deficit necessitates for increased productivity of cotton. The targetted level of fibre production can be achieved through increasing the productivity per unit area per unit time by identifying the constraints and adopting suitable management practices. Among crop management practices, undoubtedly optimal fertilization prescription plays a decisive role in increasing the productivity. It is a quicker, cheaper and economical methodology to over come the various deficiency symptoms (Eibner, 1985). The present investigation was therefore,undertaken to find out the effect of sulphur and micronutrients (Zinc and Iron) on nutrient uptake, availability, yield and quality of cotton.

Resource and Research Methods

A field experiment was conducted on Typic Chromustert at Main Agricultural Research Station, University of Agricultural Sciences, Dharwad during *Kharif*, 2006 to study the effect of sulphur, and micronutrients (zinc and iron) on yield and nutrient uptake by cotton. The initial properties of soil are given in Table A. The experiment was laid out in Randomized Block Design with replications and 9 treatment combinations.

Treatments include 2 levels of sulphur, iron, zinc and their combinations FYM (10 tonnes/ha) and RDF were common for all the treatments. All nutrients were applied as basal, except nitrogen which was applied in three equal splits, one at sowing the remaining two at 60 and 120 DAS. Seeds of cotton (RAHB-87) were dibbled in the field of 120 x 60 cm spacing with 2-3 seeds per spot. Only one plant per spot was retained after uprooting remaining plants. The total seed cotton harvested from the net plot area in each treatment was used for working out seed cotton yield per hectare. Two plants were collected randomly from each treatment at 120 Days and at final picking stage analyzed for N, P, K, S, Fe and Zn content and nutrient uptake was computed. N was estimated by Kjeldahl's digestion and distillation method and S by turbidimetric method, Fe and Zn by feeding diacid extract of plants to AAS as outlined by Jackson (1973).

Seed index is the weight of 100 seeds, which were randomly collected after ginning and their weight was recorded and expressed in gram. Seed cotton obtained from all the pickings in each net plot was mixed thoroughly and 300 g of sample was ginned with mechanical ginner. Ginning percentage was calculated by the following formula :

$$\text{Ginning percentage} = \frac{\text{weight of lint}}{\text{weight of seed}} \times 100$$

The analysis of variance was worked out as per the procedure given by Gomez and Gomez (1984).

Statistical analysis :

Fisher's method of analysis of variance was followed for analysis and interpretation of the data as suggested by Panse and Sukhatme (1967). The level of significance used in 'F' test and't' test was P=0.05. Critical difference was calculated whenever 'F' test was significant.

Research Findings and Discussion

Sulphur uptake differed significantly due to the application of sulphur, iron and zinc and their combinations. At 120 DAS highest uptake of sulphur was recorded in the treatment (T_9) receiving sulphur, iron and zinc each at 50 kg per ha (23.80 kg/ha) and was on par with the treatment (T_8) receiving sulphur, iron and zinc each at 25 kg per ha (22.00 kg/ha) which were significantly superior over control (10.43 kg/ha). This might be attributed to increase in growth and growth components and total dry matter production. The present

Table A : Physical and chemical properties of the soil of experimental area

Sr. No.	Properties	Value obtained	Method employed	References
Physical properties				
1.	Particle size analysis			
2.	Coarse sand (%)	7.10	International pipette method	Piper (1966)
3.	Fine sand (%)	12.30		
4.	Silt (%)	28.60		
5.	Clay (%)	51.95		
6.	Texture	Clay		
Chemical properties				
1.	pH (1:2.5 soil water suspension)	7.80	Potentiometry	Jackson (1973)
2.	EC (dS/m) (1:2.5 soil water extract)	0.31	Conductometery	Jackson (1973)
3.	Organic carbon (g/kg)	5.80	Walkley and Black's wet oxidation method	Jackson (1973)
4.	CEC (cmol (p+)/kg)	49.80	Sodium acetate	Jackson (1973)
5.	Available N (kg/ha)	315.00	Alkaline permanganate method	Subbiah and Asija (1956)
6.	Available P (kg/ha)	22.00	Olsen's method	Jackson (1973)
7.	Available K (kg/ha)	390.00	Flame photometer method	Jackson (1973)
8.	Available S (kg/ha)	22.50	Turbidimetric method	Black (1965)
DTPA extractable micronutrients (mg/kg)				
9.	Iron	3.10	AAS method	Lindsay and Norvell (1978)
10.	Zinc	0.55		
11.	Manganese	2.40		
12.	Copper	0.64		

findings are in line with the findings of Basavarajappa (1992).

Among the different levels of sulphur, iron and zinc, application of these nutrients at higher level (50 kg/ha) recorded higher uptake of iron (1237, 1267, 1274 g/ha) which were on par with the treatments receiving sulphur, iron and zinc each at 25 kg per ha (1223, 1232, 1241 g/ ha), respectively, and significantly superior over control (993 g/ha). Combined application of sulphur, iron and zinc each at 50 kg per ha, recorded the highest uptake of iron (1405 g/ha) which was on par with the treatment (T_8) receiving sulphur, iron and zinc each at 25 kg per ha (1396 g/ha). These two treatments were significantly superior over rest of the treatments. At 120 DAS among the different levels of sulphur, iron and zinc, application of these nutrients at higher level (50 kg/ha) recorded the highest uptake of zinc (209.8, 205.1, 229.8 g/ha), which were on par with the treatments receiving 25 kg sulphur, iron and zinc (198.7, 201.7, 206.7 g/ha) and significantly superior over control (164.2 g/ha). Combined application of sulphur, iron and zinc each at 50 kg per ha recorded the highest uptake of zinc (268.6 g/ha) which was on par with the sulphur, iron, zinc each at 25 kg per ha (261.9 g/ha) and significantly superior over rest of the treatments. This might be attributed to increased dry matter production, growth components and yield components. These results are supported by the findings of Basavarajappa (1992). They noticed combined application of sulphur and micronutrients had marked influence on micronutrient (zinc and iron) uptake which could be due to positive interaction between sulphur, iron and zinc. These results are further supported by the findings of Khandagave *et al.* (1996).

Application of sulphur alone or in combination with iron and zinc had profound influence on available sulphur in soil. At harvest, highest available sulphur (29.5 kg/ha) was recorded in T_9 (RDF + S + Fe +Zn each at 50 kg/ ha) which was on par with T_8 (RDF + S + Fe +Zn each at 25 kg/ha) and significantly superior over rest of the treatments. The lowest value was registered in control (20.3 kg/ha). With the application of sulphur, there was more vegetative as well as root growth which further oxidized the reduced sulphur to sulphate by enhanced microbial activity in association with the roots in the rhizosphere and in the oxidized layer of the soil. The results of present investigation are in conformity with the findings of Chatterjee *et al*. (2000).

The effect of sulphur, iron and zinc on available iron in soil samples of experimental site at harvest indicated that, highest available iron was recorded in the treatment (T_9) receiving combined application of sulphur, iron and zinc each at 50 kg per ha (3.20 mg/kg) which was on par with treatment (T_8) receiving sulphur, iron and zinc each at 25 kg per ha (3.10 mg/kg) and also treatment (T_5) receiving iron 50 kg per ha (3.03 mg/kg) (Table 1). These treatments were significantly superior over rest of the treatments.

The data recorded with respect to zinc status in soil at harvest indicated that, application of zinc profound had influence on the available zinc status. Treatment (T_9) receiving sulphur, iron and zinc each at 50 kg per ha recorded highest available zinc in the soil (0.60 mg/kg) which was on par with the treatment (T_8) receiving sulphur, iron and zinc each at 25 kg per ha T_6 and T_7 treatments receiving zinc of 25 and 50 kg per ha, respectively were significantly superior over rest of the

Table 1 : Effect of different levels of sulphur, iron, zinc and their combinations on uptake, availability, yield and quality of cotton

Treatments	Uptake			Availability			Seed cotton yield (q/ha)	Ginning percentage	Seed index (g)
	Sulphur (kg/ha)	Iron (g/ha)	Zinc (g/ha)	Sulphur (kg/ha)	Iron (mg/kg)	Zinc (mg/kg)			
T_1-RDF (control)	10.43	993	164.2	20.3	2.79	0.49	14.23	34.90	8.11
T_2-RDF + sulphur 25 kg/ha	17.30	1223	198.7	24.5	2.90	0.50	18.00	38.95	9.01
T_3-RDF + sulphur 50 kg/ha	18.90	1237	209.8	25.0	3.00	0.51	19.50	39.20	9.10
T_4-RDF + iron 25 kg/ha	13.50	1232	201.7	22.3	3.00	0.51	17.50	38.90	8.91
T_5-RDF + iron 50 kg/ha	13.85	1267	205.1	22.6	3.03	0.52	18.50	39.10	9.00
T_6-RDF +zinc 25 kg/ha	13.53	1241	206.7	23.0	2.94	0.52	19.80	39.00	9.00
T_7-RDF + zinc 50 kg/ha	14.12	1274	229.8	23.2	2.98	0.56	20.50	39.50	9.10
T_8-RDF + S + Zn + Fe 25 kg/ha	22.00	1396	261.9	27.0	3.10	0.59	23.60	42.30	9.70
T_9-RDF + S + Zn + Fe 50 kg/ha	23.80	1405	268.6	29.5	3.20	0.60	25.12	43.00	9.81
S.E. ±	1.03	49.8	11.0	1.03	0.19	0.03	1.015	1.3	0.2
C.D. (P=0.05)	3.09	150.4	33.0	3.09	0.30	0.09	3.04	3.9	0.6

treatments (Table 1).

Seed cotton yield was significantly influenced by the application sulphur, iron and zinc and their combination. The highest seed cotton yield (25.12 q/ha) was recorded with the application of sulphur, iron and zinc each at 50 kg per ha (T_9). It was on par with the application of sulphur, iron and zinc each (T_8) at 25 kg per ha (23.60 q/ha) and were significantly superior over rest of the treatments.

Among the levels of sulphur, application of 25 kg sulphur per ha recorded significantly higher yield (18.00 q/ha). With increase in sulphur dose to 50 kg per ha, there was further increase in yield (19.50 q/ha), but was on par with 25 kg sulphur per ha.

Application of 25 kg iron (as $FeSO_4$) per ha registered significantly higher yield (17.50 q/ha) over control. With increase in iron dose to 50 kg per ha, there was further increase in yield (18.50 q/ha) but was at par with 25 kg iron per ha.

Application of 25 kg zinc (as $ZnSO_4$) per ha recorded significantly higher seed cotton yield (19.80 q/ha) over control. With increase in zinc dose to 50 kg per ha, there was further increase in yield (20.50 q/ha) but was at par with 25 kg zinc per ha. Yields registered due to application of sulphur, iron and zinc individually were on par with each other. This might be due to increased yield attributing characters such as number of sympodia, number of squares, number of bolls, seed index and mean boll weight per plant. Similar results were reported by Chhabra *et al.* (2004) in cotton and Imayavaramban *et al.* (2006).

Application of sulphur, iron and zinc individually and their combinations had profound influence on ginning percentage. Among the different levels of sulphur, iron and zinc applied individually, application of higher level (50 kg/ha), recorded higher ginning percentage (39.20, 39.10, 39.50) which were at par with sulphur, iron and zinc applied each at 25 kg per ha (38.95, 38.90, 39.00). These were significantly superior over control.

Combined application of sulphur, iron and zinc each at 50 kg per ha recorded highest ginning percentage (43.00) which was at par with treatment (T_8) receiving 25 kg sulphur, iron and zinc (42.30) and significantly superior over rest of the treatments. This might be due to application of these nutrients that have improved percentage of mature and healthy seeds that has improved ginning percentage as compared to control. Similar results were recorded by Singaravel *et al.* (2006).

Significant differences were recorded in the seed index data due to the application of sulphur, iron and zinc. Among different levels of sulphur, iron and zinc, individual application of 50 kg sulphur, iron and zinc recorded higher seed index (9.10, 9.00 and 9.10 g) which were on par with 25 kg sulphur, iron and zinc (9.01, 8.91 and 9.00) but significantly superior over control (8.11 g).

Combined application of sulphur, iron and zinc each at 50 kg per ha, recorded highest seed index (9.81 g) which was on par with treatment (T_8) receiving sulphur, iron and zinc (9.70 g) each at 25 kg per ha and significantly superior over rest of the treatments. This might be due to the three nutrients that help in increased rate of photosynthesis along with greater translocation of photosynthates to site of storage organ. The present data are in consonance with the findings of Mariemuthu and Subbian (2012); Arunvenkatesh and Rajendran (2013) and Pawar *et al.* (2005).

Acknowledgement :

The authors thank Dr. Channal H.T., Professor and HOD Department of Soil Science and Agricultural Chemistry, College of Agriculture, Dharwad, University of Agricultural Sciences, Dharwad for providing the necessary facilities for carrying out this work.

Literature Cited

Arunvenkatesh, S. and Rajendran, K. (2013). Evaluation of plant density and cotton genotypes (*Gossypium hirsutum* L.) on cotton yield and fibre quality. *Internat. J. Forestry & Crop Improv.,* **4** (1) : 1-5.

Basavarajappa, R. (1992). Response of cotton cv. ABADITHA (*Gossipium hirsutum* L.) to soil and foliar application of micronutrients under rainfed conditions. M.Sc. (Ag.) Thesis, University of Agricultural Sciences, Dharwad (KARNATAKA) INDIA.

Black, C.A. (ed). (1965). *Methods of soil analysis* Vol. 1. Am. Soc Agron. Madison, Wisconsin. U.S.A.

Chatterjee, C., Dube, B.K. and Gupta, Jyoti (2000). Influence of variable sulphur application on cotton. *Indian J. Pl. Physiol.,* **5** (1) : 64-67.

Chhabra, K.L., Bishoni, L.K. and Bhattoo, M.S. (2004). Effect of macro and micronutrients on the productivity of cotton genotypes. *International Symposium on Strategies of Sustainable Cotton Production A G. Vis.*" *2 Crop Production,* 23-25 pp.

Eibner, R. (1985). Foliar fertilization-importance and prospects in crop production. In: *Proceedings of 1st International Symposium On Foliar Fertilization,* Berlin, March.

Gomez, K.A. and Gomez, A.A. (1984). *Statistical Procedure For Agricultural Research* - An International Rice Research Institute Book, A Wiley Interscience, John Wiley And Sons Inc., New York, USA.

Imayavaramban, V., Sundaravel Rajan, G., Murugan and **Thanunathan, K. (2006).** Effect of micronutrients on yield and economics of LRA 5166 cotton. *Research on Crops*, **7** (2): 384-385.

Jackson, M.L. (1973). *Soil Chemical Analysis*, Prentice Hall of India Pvt. Ltd. New Delhi, 187pp.

Khandagave, R.B., Koraddi, V.R. and Chandranath, H.T. (1996). Effect of sulphur and zinc on growth and yield of rainfed cotton. *Farming System,* **12** (3/4): 6-10.

Lindsay, W.L. and Norvell, W.A. (1978). Development of DTPA Soil test for Zinc, Iron, manganese and Copper. *Soil Soc. American J.*, **42** : 421-428.

Mariemuthu, S. and Subbian, P. (2012). Response of cotton based cropping systems and nutrient management practices with bioinoculants on growth and yield of cotton in South India, *Internat. J. Forestry & Crop Improv.,* **3** (1) : 34-38.

Panse, V.C. and Sukhatme, P.V. (1967). *Statistical method for Agric workers*. Second Enlarged Edn. ICAR, NEW DELHI, INDIA.

Pawar, G.S., Waybase, T.K., Bhatade, S.S. and More, S.S. (2005). Influence of supplementary foliar spray of micronutrients on seed and seed quality characters of cotton. *J. Cotton Res. Develop.*, **19**(2): 211-212.

Piper, C.S. (1966). *Soil and plant analysis*. Hans Publishers, Bombay pp. 135-136.

Singaravel, R., Radhika, K., Imayavaramban, V. and Elayaraja, D. (2006). Response of cotton to foliar application of micronutrients. *Res. Crops*, **7**(2): 381-383.

Subbiah, B.V. and Asija, G.L. (1956). A rapid procedure for the estimation of available nitrogen in soils. *Curr. Sci.*, **25**: 259-260.