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Sangh Ravikiran
M. Sc. (Agri.) in Agronomy, Department of Agronomy, College of Agriculture, University of Agricultural Sciences, Raichur, Karnataka, India

AS Halepyati
Professor of Agronomy, Department of Agronomy, College of Agriculture, University of Agricultural Sciences, Raichur, Karnataka, India

Correspondence
Sangh Ravikiran
M. Sc. (Agri.) in Agronomy, Department of Agronomy, College of Agriculture, University of Agricultural Sciences, Raichur, Karnataka, India

Response of *Bt*-cotton (*Gossypium hirsutum* L.) to nutrient management practices under supplemental irrigations

Sangh Ravikiran and AS Halepyati

Abstract

Field experiment was conducted at Agricultural College Farm, Raichur on vertisol during 2010-11. Experiment was laid out in split plot design with three fertilizer levels in main plot and six foliar applications of nutrients in sub plots with three replications. Effect of nutrient management practices differed significantly on growth and yield parameters of cotton. Fertilizer levels through 125 per cent of recommended dose of fertilizers (RDF) recorded significantly higher leaf area index (1.35) and seed cotton yield (17.1 q ha^{-1}) over other fertilizer levels. Besides, foliar application of 0.5 per cent tracel (Zn, Fe, Mn and B) recorded significantly higher leaf area index (1.36) and seed cotton yield (17.5 q ha^{-1}) against other treatments. In addition, interaction effect of fertilizer levels of 125 per cent RDF with foliar application of 0.5 per cent tracel recorded significantly higher leaf area index (1.40) and seed cotton yield (19.9 q ha^{-1}) when compared to other treatment combinations.

Keywords: fertilizer levels, foliar application of nutrients and seed cotton yield

Introduction

Nutrient supply is the most important limiting factor in cotton production. Most often soils in rainfed areas are not only thirsty but also hungry. It is a well established fact that adequate quantities of nutrients are needed for achieving high yields. The nutrient management in cotton is a complex phenomenon due to its simultaneous production of vegetative and reproductive structures during the active growth phase. Cotton plant being a heavy feeder, needs proper supply of plant nutrients for its successful cultivation as the crop matures in about 160 to 170 days after sowing (Tayade and Dhoble, 2010) [5]. Besides, crop is harvested in different picking as on boll matures during reproductive stage. Hence, adequate amount of nutrients *i.e*., nitrogen, phosphorus and potassium is necessary during vegetative as well as reproductive stages for higher photosynthetic area, maximizing root volume and better boll development. Besides, secondary nutrient, micronutrient and growth regulator which are required in small quantities needs to be supplied through foliage rather than soil application for immediate effect. Furthermore, combined effect of primary nutrients with foliar application of secondary nutrients, micronutrients and growth regulator at various growth stages is necessary for maximizing seed cotton yield by reducing physiological disorders and increasing reproductive sinks. In this direction the present study was undertaken.

Material and Methods

The field experiment was conducted during *Kharif*, 2010-11 at Agricultural College Farm, Raichur situated in North Eastern Dry Zone (Zone-2) of Karnataka at 16º 12' N latitude and 77º 20' E longitude with an altitude of 389 meters above the mean sea level. The experiment was laid out in split plot design with fertilizer levels (75, 100 and 125 % of recommended dose of fertilizer) in main plot and water soluble micronutrients {control, 0.5 % mahazinc ($ZnSO_4$), 10 ppm planofix (NAA), 0.5 % nutriment ($FeSO_4$), 1 % mangala $MgSO_4$ ($MgSO_4$) and 0.5 % tracel (Zn, Fe, Mn and B)} as sub plot with three replications. Recommended dose of fertilizers (RDF) includes 125:75:75 kg $N:P_2O_5:K_2O$ ha^{-1} plus farm yard manure (5 to 10 t ha^{-1}). The experimental soil was clayey (53.5 % clay) in texture with available nitrogen (218.0 kg ha^{-1}), phosphorus (35.0 kg ha^{-1}), potassium (345.0 kg ha^{-1}) and organic carbon (0.70 %). Fertilizer dose *i.e.*, half of the nitrogen dose, entire dose of phosphorus and potassium in the form of urea, diammonium phosphate (DAP) and murate of potash (MOP) were applied as basal dose and remaining half of the nitrogen in the form of urea was top dressed in three equal splits at 50, 80 and 110 days after sowing in the ring formed 5 cm away from the plant. Whereas, foliar application of nutrients was imposed at flowering (90 DAS) and boll formation stage (110 DAS). Crop was managed as per package of practices recommended for Zone 2. Fisher's method of analysis of variance was applied for analysis and interpretation of the data as given by Panse and Sukhatme (1967) [2].

Results and Discussion

Effect of fertilizer levels on growth and yield parameters of cotton differed significantly (Table 1, 2 and 3). Application of fertilizer through 125 per cent of RDF recorded significantly higher seed cotton yield (17.1 q ha^{-1}) when compared to other RDF and increase in yield was to the tune of 27.6 per cent over 75 per cent of RDF. Higher yield is due to higher nutrients with higher levels of fertilizer *i.e*., nitrogen, phosphorus and potassium increased accumulation of dry matter in vegetative parts and economic parts during respective growth stages which further resulted in higher harvest index (0.20). Higher source is due to higher sinks as reflected from leaf area index (1.35) as a result of higher leaf area during vegetative stages with available nutrient content in the soil. Besides, plant height, days to 50 per cent flowering, chlorophyll content, carotenoid content and seed index were found to be non significant. Similar findings were reported by Narayana *et al.* (2008) [1].

Effect of foliar application of nutrients on growth and yield parameters of cotton differed significantly (Table 1, 2 and 3). Foliar application of B, Fe, Mn and B in the form of tracel at flowering (90 DAS) and boll formation stage (110 DAS) recorded significantly higher seed cotton yield (17.5 q ha^{-1}) over other treatment combinations and increase in yield was 40 per cent over control, besides this further reflected in higher harvest index (0.21). This is due to micronutrient application through foliage reduced dropping of bolls with higher assimilation of dry matter in vegetative and reproductive parts. Higher reproductive parts are due to higher vegetative structure as seen from higher leaf area index (1.36) and plant height (143.4 cm). Micronutrient application during vegetative stages increased cell division which reflected in higher leaf area and other vegetative parts. Besides, days to 50 per cent flowering, chlorophyll and carotenoid content and seed index were found to be non significant. Similar results were recorded by Shasthri *et al.* (2000) [3].

Interaction effect of fertilizer levels and foliar application of nutrients on growth and yield parameters of cotton differed significantly (Table 1, 2 and 3). Fertilizer levels with respect to 125 per cent of RDF with foliar application of 0.5 per cent tracel recorded significantly higher seed cotton yield (19.9 q ha^{-1}) when compared to other treatment combinations and increase in yield was upto 61.8 per cent over fertilizer level of 75 per cent of RDF and control. Besides, this was on par with fertilizer levels with respect to 125 per cent of RDF with foliar application of 10 ppm planofix. Higher yield is due to adequate and balanced fertilization *i.e*., both macro and micronutrient increased dry matter assimilation in vegetative and reproductive parts during respective stages. Besides, higher yield might be due to higher growth parameters as reflected from higher leaf area index (1.40) and higher index is due to higher leaf area as a result of higher chlorophyll content (2.21 mg g of fresh $weight^{-1}$). Besides, plant height, days to 50 per cent flowering, seed index, carotenoid content, seed index and harvest index were found to be non significant. Similar research findings were obtained by Sisodia and Khamparia (2007) [4].

Table 1: Plant height, leaf area index and days to 50 per cent flowering of cotton at harvest as influenced by nutrient management practices

Treatments	Plant height (cm)							Leaf area index							Days to 50 per cent flowering						
	S_1	S_2	S_3	S_4	S_5	S_6	Mean	S_1	S_2	S_3	S_4	S_5	S_6	Mean	S_1	S_2	S_3	S_4	S_5	S_6	Mean
F_1	115.9	133.0	135.6	135.1	135.5	140.5	132.7	1.24	1.26	1.29	1.29	1.31	1.32	1.29	88.0	87.3	87.7	88.3	88.0	88.0	87.9
F_2	116.6	136.9	140.1	137.3	139.1	143.5	135.6	1.24	1.31	1.33	1.33	1.33	1.36	1.32	89.3	88.0	87.7	87.3	88.7	88.0	88.2
F_3	119.3	142.2	143.7	142.4	145.4	146.1	139.9	1.22	1.34	1.36	1.38	1.38	1.40	1.35	88.7	88.0	89.7	87.3	87.7	89.0	88.4
Mean	117.3	137.6	139.8	138.3	140.0	143.4		1.24	1.30	1.33	1.33	1.34	1.36		88.7	87.8	88.3	87.7	88.1	88.3	
	S.Em.±			C.D. at 5%				S.Em.±			C.D. at 5%				S.Em.±			C.D. at 5%			
F	1.7			NS				0.007			0.027				0.1			NS			
S	2.3			6.6				0.006			0.018				0.4			NS			
F at the same or different S	4.0			NS				0.012			0.038				0.7			NS			

Table 2: Chlorophyll 'a', Chlorophyll 'b' and Carotenoid content of cotton at harvest as influenced by nutrient management practices

Treatments	Chlorophyll 'a' (mg/g of fresh weight)							Chlorophyll 'b' (mg/g of fresh weight)							Carotenoid (mg/g of fresh weight)						
	S_1	S_2	S_3	S_4	S_5	S_6	Mean	S_1	S_2	S_3	S_4	S_5	S_6	Mean	S_1	S_2	S_3	S_4	S_5	S_6	Mean
F_1	2.56	2.44	2.40	2.27	2.60	2.42	2.45	1.94	2.29	2.38	2.01	2.01	2.06	2.11	0.91	0.76	0.70	0.80	0.70	0.72	0.77
F_2	2.70	2.42	2.38	2.35	2.18	2.60	2.44	2.21	1.81	1.93	2.35	2.13	1.59	2.00	0.72	0.99	0.80	0.65	0.76	0.92	0.81
F_3	2.55	2.82	2.77	2.47	2.15	2.22	2.50	1.74	1.58	1.89	2.00	2.06	2.21	1.91	0.83	0.75	0.65	0.64	0.84	0.74	0.74
Mean	2.60	2.56	2.51	2.36	2.31	2.41		1.97	1.89	2.07	2.12	2.06	1.95	2.01	0.82	0.83	0.72	0.69	0.77	0.79	
	S.Em.±			C.D. at 5%				S.Em.±			C.D. at 5%				S.Em.±			C.D. at 5%			
F	0.12			NS				0.18			NS				0.06			NS			
S	0.10			NS				0.09			NS				0.06			NS			
F at the same or different S	0.20			NS				0.24			0.83				0.12			NS			

Table 3: Seed index, seed cotton yield and harvest index of cotton at harvest as influenced by nutrient management practices

Treatments	Seed index (g)							Seed cotton yield (q ha^{-1})							Harvest index						
	S_1	S_2	S_3	S_4	S_5	S_6	Mean	S_1	S_2	S_3	S_4	S_5	S_6	Mean	S_1	S_2	S_3	S_4	S_5	S_6	Mean
F_1	9.7	9.7	10.1	9.7	9.6	10.0	9.8	12.3	12.4	14.3	12.9	13.6	15.0	13.4	0.18	0.17	0.19	0.18	0.18	0.19	0.18
F_2	9.7	9.5	9.7	10.0	9.9	9.8	9.8	12.1	13.2	15.5	14.3	15.4	17.7	14.7	0.18	0.17	0.19	0.18	0.19	0.21	0.19
F_3	9.8	9.8	9.8	10.0	9.7	9.7	9.8	13.2	15.7	19.6	16.1	17.9	19.9	17.1	0.19	0.19	0.22	0.19	0.20	0.22	0.20

<table>
<tr><td>Mean</td><td>9.7</td><td>9.7</td><td>9.9</td><td>9.9</td><td>9.7</td><td>9.8</td><td></td><td>12.5</td><td>13.8</td><td>16.4</td><td>14.4</td><td>15.6</td><td>17.5</td><td></td><td>0.18</td><td>0.18</td><td>0.20</td><td>0.18</td><td>0.19</td><td>0.21</td><td></td></tr>
<tr><td></td><td colspan="3">S.Em.±</td><td colspan="4">C.D. at 5%</td><td colspan="3">S.Em.±</td><td colspan="4">C.D. at 5%</td><td colspan="3">S.Em.±</td><td colspan="4">C.D. at 5%</td></tr>
<tr><td>F</td><td colspan="3">0.03</td><td colspan="4">NS</td><td colspan="3">0.26</td><td colspan="4">1.01</td><td colspan="3">0.002</td><td colspan="4">0.0079</td></tr>
<tr><td>S</td><td colspan="3">0.09</td><td colspan="4">NS</td><td colspan="3">0.31</td><td colspan="4">0.89</td><td colspan="3">0.003</td><td colspan="4">0.0083</td></tr>
<tr><td>F at the same or different S</td><td colspan="3">0.14</td><td colspan="4">NS</td><td colspan="3">0.55</td><td colspan="4">1.72</td><td colspan="3">0.005</td><td colspan="4">NS</td></tr>
</table>

Treatment Details

Main plots: F_1 - 75 % RDF
F_2 - 100 % RDF
F_3 - 125 % RDF

Sub plots: S_1 : control
S_2 : foliar spray of 0.5 % mahazinc ($ZnSO_4$)
S_3 : foliar spray of 10 ppm planofix (NAA)
S_4 : foliar spray of 0.5 % nutriment ($FeSO_4$)
S_5 : foliar spray of 1 % mangala $MgSO_4$ ($MgSO_4$)
S_6 : foliar spray of 0.5 % tracel (Zn, Fe, Mn and B)

Conclusion

From the present investigation it may concluded that fertilizer levels with respect to 125 per cent of RDF, foliar application of 0.5 per cent tracel and their interaction performed better when compared to other treatment combinations.

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