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## Influence of foliar nutrition on leaf chlorophyll, anthocyanin pigment and leaf reddening index of BT cotton under rainfed condition

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### Abstract

A field experiment was conducted on Farmers field at Kautha, Tq. Kandhar, Dist. Nanded, Maharashtra during *Kharif-2018* to find out the effect of foliar nutrition on leaf reddening of Bt (*Gossypium spp.*) cotton under rainfed condition. The experimental result indicated that among the various treatments application of 100 per cent RDF + foliar spray of DAP @ 1% + KNO<sub>3</sub> @ 1% + MgSO<sub>4</sub> @ 1% and micronutrient grade II @ 0.5% followed by 100% RDF + 19:19:19 @ 1% + MgSO<sub>4</sub> @ 1% + Micronutrient grade II @ 0.5% at critical growth stages helps in increase chlorophyll content, decreases anthocyanin accumulation in leaves and reduced the leaf reddening index in Bt cotton under rainfed condition.

**Keywords:** Foliar nutrition, chlorophyll, anthocyanin pigment and leaf reddening index

### Introduction

Cotton is one of the most important commercial crop of India and particularly in Maharashtra. Performance of Bt cotton varies from region to region with changing agroclimatic condition. Cotton is cultivated in more than seventy countries popularly known as 'White Gold' and 'King of Fibre' supplies a major share of raw material for the textile industries. The area under Bt cotton is increasing over the years however, actual yield levels are low due to several constraints. Leaf reddening is one of the major cause of poor yield in Bt cotton. Reduction in yield of Bt cotton based on severity of leaf reddening. Among the plant pigment accumulation of anthocyanin pigment bring red and purple colour to leaf cause degradation of chlorophyll which affects the photosynthesis process and ultimately leads to poor yield of Bt cotton. Considering the above fact, the experiment was conducted to overcome this problem by foliar application of macro and micronutrients at flowering, boll formation and boll development stage.

### Material and Methods

A field experiment was conducted on farmers field at Kautha, Tq. Kandhar, Dist. Nanded during *Kharif-2018* to find out the effect of foliar nutrition on leaf reddening of Bt cotton under rainfed condition in randomized block design with eight treatments each replicated three times. The Bt cotton variety Ajeet-155 was sown 24 plots of size 5x 4 m<sup>2</sup> each. The seeds were dibbled at the spacing of 120 x 45 cm. Foliar application of multi-nutrients carried out at critical growth stages of cotton viz. 70, 90 and 120 DAS respectively. The treatments were T<sub>1</sub>- Control (N<sub>100</sub> P<sub>50</sub> K<sub>50</sub>), T<sub>2</sub> - 100% RDF + water spray, T<sub>3</sub>- 100% RDF + Urea @ 2% foliar spray, T<sub>4</sub>- 100% RDF + 19:19:19 @ 1% foliar spray, T<sub>5</sub>- 100% RDF + KNO<sub>3</sub> @ 2% foliar spray, T<sub>6</sub>- 100% RDF + MgSO<sub>4</sub> @ 1% foliar spray, T<sub>7</sub>- 100% RDF + foliar spray of DAP @ 1% + KNO<sub>3</sub> @ 1% + MgSO<sub>4</sub> @ 1% + Micronutrient grade II @ 0.5%, T<sub>8</sub> - 100% RDF + Foliar spray of 19:19:19 @ 1% + MgSO<sub>4</sub> @ 1% + Micronutrient grade II @ 0.5%. The leaves were collected at flowering, boll formation and boll development stages. DMSO extraction technique (Hiscox and Israelstam, 1979) [7] was used for extraction of chlorophyll and anthocyanin pigment was determined spectrophotometrically following Thimmaiah (2004) [12]. For the quantitative estimation of degree of leaf reddening, an index was worked out, the method outlined by Dastur *et al.* (1952) [4]. The basis of this method is the number of leaves showing the signs of reddening at given time. Leaves turned red partly or wholly, where divided into five categories as follows:

Grade zero - When all the leaves were green or less than three leaves showed sign of reddening. Grade one - When three leaves show sign of reddening. Grade two - When more than three leaves were showing signs of reddening but young leaves were green. Grade three

When all the leaves were showing reddening in patches.  
Grade four – When the whole plant turned red.

## Results and Discussion

### Total chlorophyll content (mg g<sup>-1</sup>)

Data on effect of foliar nutrition on chlorophyll content of cotton at different growth stages tabulated in table 1. From the data it was observed that chlorophyll – ‘a’, chlorophyll – ‘b’ and total chlorophyll found in range of 0.62 to 2.19, 0.53 to 1.88 and 0.86 to 2.90 mg g<sup>-1</sup> at boll development stage of cotton.

The data showed that application of Treatment T<sub>7</sub> contained RDF + foliar spray of DAP @ 1% + KNO<sub>3</sub> @ 1% + MgSO<sub>4</sub> @ 1% + micronutrient grade II @ 0.5% showed maximum chlorophyll content followed by treatment T<sub>8</sub> over control (RDF) at flowering, boll formation and boll development stages of cotton and Chlorophyll -‘a’ content was higher than chlorophyll -‘b’. Treatment T<sub>7</sub> found at par with treatment T<sub>8</sub> at flowering, boll formation and boll development stage and superior over rest of the treatment. This indicated that the

foliar application of macro and micronutrients at critical growth stages of cotton increases the chlorophyll content in plant.

Increase in chlorophyll content in cotton leaf might be due to supply of nitrogen, magnesium, phosphorus, zinc, sulfur and other micronutrients by foliar application because magnesium and nitrogen are main constituent of chlorophyll and other nutrients like Fe, Zn and S play an important role in synthesis of chlorophyll although they are not constituent of chlorophyll.

Similar results were observed by Jadhao *et al.* (2004) [9] reported that the spray of 0.3% MgSO<sub>4</sub> was found to be the best for chlorophyll content in leaves and spray of 1% urea and 1.5% urea statistically superior over control. The results are in line with the finding reported by Patel *et al.* (2011) [10] revealed that the total chlorophyll content was significantly higher with recommended dose of fertilizer based on soil test value with 10 t FYM ha<sup>-1</sup> with one spray of each of 1 per cent and 2 per cent of urea and 1 per cent MgSO<sub>4</sub> during flowering and boll development stage.

**Table 1:** Effect of foliar nutrition on chlorophyll ‘a’, chlorophyll ‘b’ and total chlorophyll pigment (mg g<sup>-1</sup>) at different growth stages of cotton.

Treatment	At flowering			At boll formation			At boll development		
	Chlo-‘a’	Chlo-‘b’	Total chlorophyll	Chlo-‘a’	Chlo-‘b’	Total chlorophyll	Chlo-‘a’	Chlo-‘b’	Total chlorophyll
T <sub>1</sub> - Control (100% RDF)	1.39	0.52	1.32	0.87	0.66	1.15	0.62	0.53	0.86
T <sub>2</sub> - 100% RDF + Water spray	1.11	0.47	1.34	0.92	0.68	1.20	0.71	0.59	1.03
T <sub>3</sub> - 100% RDF + 2% urea	1.52	0.66	1.83	1.62	0.69	1.95	1.76	1.10	2.17
T <sub>4</sub> -100% RDF + 1% 19:19:19	1.38	0.88	1.73	1.46	0.38	1.70	1.45	0.64	1.76
T <sub>5</sub> - 100% RDF + 2% KNO <sub>3</sub>	1.50	0.65	1.81	1.61	0.68	1.94	1.41	1.09	2.12
T <sub>6</sub> - 100% RDF + 1% MgSO <sub>4</sub>	1.57	0.70	1.91	1.91	0.85	1.99	2.03	1.31	2.67
T <sub>7</sub> - 100% RDF + 1% DAP + 1% KNO <sub>3</sub> + 1% MgSO <sub>4</sub> + 0.5% Micronutrient grade II	1.76	1.10	2.16	1.98	1.63	2.62	2.19	1.88	2.90
T <sub>8</sub> - 100% RDF + 1% 19:19:19 + 1% MgSO <sub>4</sub> + 0.5% Micronutrient grade II	1.44	1.82	2.11	1.49	2.05	2.40	1.72	1.65	2.77
General mean	1.45	0.85	1.77	1.48	0.95	1.86	1.48	1.09	2.03
SE(m) ±	0.110	0.257	0.036	0.140	0.281	0.123	0.156	0.219	0.071
CD at 5%	0.334	0.777	0.109	0.423	0.849	0.373	0.471	0.663	0.215

### Anthocyanin content (mg g<sup>-1</sup>)

The data pertaining to the effect of different foliar application of macro and micronutrients on anthocyanin content of cotton

leaves were found to be in range of 2.83 to 3.02 mg g<sup>-1</sup> at flowering, 2.63 to 3.35 mg g<sup>-1</sup> at boll formation and 2.74 to 3.84 mg g<sup>-1</sup> at boll development stage in table 2.

**Table 2:** Effect of foliar nutrition on anthocyanin content (mg g<sup>-1</sup>) at different growth stages of cotton.

Treatment	Anthocyanin content (mg g <sup>-1</sup> )		
	At flowering stage	At boll formation stage	At boll development stage
T <sub>1</sub> - Control (100% RDF)	3.00	3.32	3.84
T <sub>2</sub> - 100% RDF + Water spray	3.02	3.35	3.73
T <sub>3</sub> - 100% RDF + 2% urea	2.90	3.00	2.95
T <sub>4</sub> -100% RDF + 1% 19:19:19	2.94	3.09	3.01
T <sub>5</sub> - 100% RDF + 2% KNO <sub>3</sub>	2.91	3.05	2.95
T <sub>6</sub> - 100% RDF + 1% MgSO <sub>4</sub>	2.85	2.92	2.85
T <sub>7</sub> - 100% RDF + 1% DAP + 1% KNO <sub>3</sub> + 1% MgSO <sub>4</sub> + 0.5% Micronutrient grade II	2.83	2.63	2.74
T <sub>8</sub> - 100% RDF + 1% 19:19:19 + 1% MgSO <sub>4</sub> + 0.5% Micronutrient grade II	2.85	2.69	2.77
General mean	2.91	3.00	3.10
SE(m) ±	0.028	0.096	0.062
CD at 5%	0.085	0.292	0.187

Highest anthocyanin content 3.84 mg g<sup>-1</sup> with treatment T<sub>1</sub>(RDF) observed at boll development stage and it was decreased up to 2.74 mg<sup>-1</sup> due to application of RDF + DAP @ 1% + KNO<sub>3</sub> @ 1% + MgSO<sub>4</sub> @ 1% + micronutrient grade II @ 0.5%. Anthocyanin pigment in cotton leaves were found to be increased with maturity of crop. Result indicated that foliar application of nutrients found to be beneficial for

minimizing the anthocyanin pigment because during boll development stage leaf nutrients translocated toward bolls and deficiency of nutrients occur which reduces the chlorophyll and enhance the anthocyanin accumulation in leaf.

Reduction in anthocyanin content might be due to foliar application of macro and micronutrients at specific growth stages of cotton which increased the supply of nitrogen and

magnesium to leaf and reduce the formation of anthocyanin at the cost of chlorophyll because nitrogen, magnesium are the main constituent of chlorophyll molecule. Above result are in line with Byale *et al.* (2014) [2] they observed that application of primary nutrients along with magnesium, sulfur, zinc, boron (spray) found to be effective for controlling anthocyanin accumulation and maximum anthocyanin found as crop matured. Similar results also observed by Chimmad and Panchal (2000) [3] reported that the chlorophyll content decreased and anthocyanin content increased as crop attained maturity.

### Leaf reddening index

The result regarding effect of foliar nutrition on leaf reddening index of cotton at flowering, boll formation and boll development stage presented in table 3.

Data indicated that leaf reddening index were found to be minimum at flowering stage. Maximum leaf reddening index at boll development stage found in treatment T<sub>1</sub>-100% RDF (1.26). This clearly indicated that due to lack of moisture in

root zone and high amount of calcium carbonate induce the trace of macro and micronutrients in plant which resulted the leaf reddening (Ghode, 2016 and Ingole, 2018) [6, 8]. Minimum leaf reddening index with treatment T<sub>7</sub> followed by treatment T<sub>8</sub>. It is indicated that foliar application of macro and micronutrients at critical growth stages of cotton reduce the intensity of leaf reddening. Foliar spray of DAP + KNO<sub>3</sub> + MgSO<sub>4</sub> and micronutrients along with RDF might be attributed to the development of optimum canopy as a result of lower leaf reddening index which was attributed due to higher leaf nitrogen, magnesium and chlorophyll contents thus leading to higher photosynthetic efficiency. Similar finding was also reported by Santhosh *et al.* (2015) [11].

Ali (2011) [1] reported that use of potassic fertilizer and foliar spray of micronutrient especially zinc, boron and copper with RDF at specific growth stages reduce the intensity of reddening. Similar finding was also reported by Deshpande *et al.* (2015) application of 100% RDF along with three foliar spray of 1% KNO<sub>3</sub> or 1% MgSO<sub>4</sub> or 2% DAP was found minimum intensity of reddening of leaves.

**Table 3:** Effect of foliar nutrition on leaf reddening index (LRI) at different growth stages of cotton.

Treatment	Leaf reddening index		
	At flowering stage	At boll formation stage	At boll development stage
T <sub>1</sub> . Control (100% RDF)	0.80	1.06	1.26
T <sub>2</sub> . 100% RDF + Water spray	0.83	1.00	1.16
T <sub>3</sub> . 100% RDF + 2% urea	0.73	0.80	0.82
T <sub>4</sub> . 100% RDF + 1% 19:19:19	0.73	0.87	0.82
T <sub>5</sub> . 100% RDF + 2% KNO <sub>3</sub>	0.80	0.86	0.73
T <sub>6</sub> . 100% RDF + 1% MgSO <sub>4</sub>	0.73	0.86	0.82
T <sub>7</sub> . 100% RDF + 1% DAP + 1% KNO <sub>3</sub> + 1% MgSO <sub>4</sub> + 0.5% Micronutrient grade II	0.60	0.73	0.69
T <sub>8</sub> . 100% RDF + 1% 19:19:19 + 1% MgSO <sub>4</sub> + 0.5% Micronutrient grade II	0.66	0.81	0.70
General mean	0.73	0.86	0.87
SE(m) ±	0.064	0.077	0.055
CD at 5%	0.194	0.234	0.167

### Conclusion

It is concluded that application of 100 per cent RDF along with foliar spray of DAP @ 1% + KNO<sub>3</sub> @ 1% + MgSO<sub>4</sub> @ 1% and micronutrient grade II @ 0.5% followed by application of 100 per cent RDF + foliar spray of 19:19:19 @ 1% + MgSO<sub>4</sub> @ 1% + Micronutrient grade II @ 0.5%. at flowering, boll formation and boll development stage found to be beneficial for increase chlorophyll content, besides decrease in anthocyanin accumulation in leaves and reduced the leaf reddening index in Bt cotton under rainfed condition.

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