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STUDIES ON BIOCHEMICAL EVALUATION OF LEAF REDDENING IN BT AND NON BT COTTON GENOTYPES

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ABSTRACT:
To ascertain the role of nutrients in leaf reddening, the present field experiment study entitled, "Physiological evaluation of leaf reddening in bt and non bt cotton (gossypium spp l.) genotypes." was conducted at PGI Farm, Mahatma Phule Krishi Vidyapeeth, Rahuri during *kharif* 2010-11 and 2011-12, with the objectives to study the effect of fertilizer levels and foliar sprays of chemicals on reddening of leaves of Bt and non-Bt cotton genotypes. The thirty two treatments consist of application of various levels of fertilizers to the soil and foliar sprays of N, P, K, Mg and S to plants at boll formation and development stage with three replications to Bt and non-Bt cotton hybrids and varieties were tested for the leaf reddening. The results revealed that the incidence of leaf reddening was more in Bt cotton than non-Bt cotton. The minimum intensity of reddening in Bt and non-Bt cotton was observed in the treatments of 125 % RDF + foliar sprays with KNO3/MgSO4/DAP. Among the foliar spray 2 % KNO3 had showed minimum reddening of leaves, which suggest that at boll development stage the application of nitrogen and potassium were helpful for controlling the reddening in Bt and non-Bt cotton. However, the highest yield was recorded in treatment RCH Bt + 125% RDF +KNO_3 2% (V1F2T3) followed by, RCH Bt + 125% RDF +DAP 2% (V1F2T1). This study also suggested that, the nutrients were one of the causes for reddening and Bt cotton had more requirement of nutrients especially at boll development stage, which was fulfilled by the foliar sprays. Application of 125% RDF and the foliar sprays of mineral nutrients (N, P, K and Mg) through 2 % KNO3, 2 % DAP and 2 % MgSO4, had reduced the risk of leaf reddening as well as helped in increasing seed cotton yield in Bt and non-Bt cotton hybrids. The study also provides future guide line of research for various combinations of nutrients for foliar sprays for Bt cotton hybrids at different development stages, which can reduce leaf reddening and their by yield sustainability can be achieved.

Key words: Bt Cotton, leaf reddening, fertilizers, morphology, physiology, yield.

INTRODUCTION:

Cotton is an important fibre crop of global significance and cultivated in tropical and sub-tropical regions of more than seventy countries of the world. Cotton is the major cash crop of India and accounts for 65% of the fibre used in the textile industries. Cotton plays a key role in the national economy in terms of both employment generation and foreign exchange earnings. Cotton impacts the lives of estimated 60 million people in India. By way of exports foreign exchange earnings of cotton amount to about 10 billion dollars which is one third of the total foreign exchange earnings of the country.

India has the largest acreage (9.53 million ha) under cotton at global level and has the productivity of 553 Kg lint/ ha and ranks second in production (310 lakh bales) after China during 2007-08 (Anonymous, 2009).

Maharashtra ranks first in acreage with 3.53 million hectares and second in production yielding 6.7 million bales next to Gujarat (9.5 million bales) with average productivity of 325 kg lint ha^{-1},which is low as compared to national average (494 kg ha^{-1}) (Gawade,2010). There is need to increase the productivity of cotton for economical upliftment of the cotton growers.

Reddening of leaves in cotton is problem observed particularly in irrigated cotton areas. This disorder is not a problem of common occurrence and is an interaction of location, variety, environmental condition and N supply. N deficiency in Punjab and Sindh, long night temperature induced anthocyanin development in Central India, low N and temperature in Deccan canal areas of Maharashtra and desiccating winds at Dharwad are found to be causative factors for leaf reddening (Hebbar, 2005).

Foliar fertilization can be used to improve the efficiency and rapidity of utilization of a nutrient urgently required by cotton crop for maximum growth and yield. However, foliar nutrition should only serve as a supplement to traditional soil applied fertilizer for a sufficient supply of nutrients to the developing cotton crop for optimum yields and fibre quality. In general, foliar application should be done either in the early morning or late evening for maximum efficiency and should not be done to water stressed cotton. There is lot of conflicting information about the benefit of foliar fertilization but scientific evidence to date and the widespread practical use of this phenomenon indicate that it is a viable and useful practice for improved cotton production. foliar application of nutrients viz., macro and micronutrients either alone or in combination has a great effect in improving the efficiency of utilization of nutrients and thereby improves the growth and seed yield and quality characters in cotton and hence, foliar nutrition in cotton can be considered as a useful practice for improved cotton production. (Rajendran, et al, 2010)

MATERIALS AND METHODS :

Present investigation entitled "Physiological evaluation of leaf reddening in Bt and non Bt cotton (*Gossypium spp L.*) Genotypes" was undertaken on the Post Graduate Institute farm, M.P.K.V., Rahuri during the *kharif* 2010-11 and 2011-12 with three replications in FRBD. Main treatment was four cotton varieties including one Bt variety, one non-Bt counter part of the same Bt variety, one hybrid and one variety. In this way main treatment consists of total four treatments (V_1 to V_4). Sub-treatments were two fertilizer doses i.e. F_1, F_2 and four chemical sprays *viz.* T_1, T_2, T_3 and T_4, as mentioned in chapter three earlier in material and methods.

RESULT & DISCUSSION :

Nitrogen concentration of leaves (%)

The data for nitrogen conc. of leaves recorded at 75, 90 and 120 DAS is presented in Table 1 which showed that, nitrogen conc. was more during 75 DAS and gradually decreases thereafter. This reduction in nitrogen conc. was may be due to the incidence of leaf reddening from 75 days onwards. Higher levels of fertilisers and foliar spray of chemicals, results in lowering the rate of nitrogen decrease during crop growth. It was also observed that, the varieties had more nitrogen content in leaves than that, of hybrids.

It is cleared from the data in Table 1 that,, varieties, fertilizers and chemicals had non-significant effect on nitrogen conc. of leaves for all stages, except at 90 DAS, where LRA- 5166 + 125% RDF + DAP 2% (V3F2T1) recorded significantly the highest nitrogen conc. (3.15 and 3.51), while RCH non Bt + 100% RDF + Ascorbic acid 500 ppm (V2F1T4) recorded the lowest nitrogen conc. (1.89 and 2.25) for both the years, respectively.

Therefore it can be concluded that, due to the low status of nitrogen percentage in Bt cotton varieties maximum reddening affected plants were observed in Bt cotton varieties. Similar results were also observed by Dastur and Singh (1947), Ashley (1977), Dhopte and Zade (1979), Bhatt *et al.* (1982) and Akarte *et al.* (1985) and Perumal and Subramanium (1979) also reported that, a decrease in leaf nitrogen caused the leaf reddening.

The results obtained with respect to nitrogen content are in close conformity with the results reported by Pagare (2007) and Masram (2009).

Phosphorus concentration of leaves (%)

The data for phosphorus concentration of leaves recorded at 75, 90 and 120 DAS is presented in Table 2 which showed that, phosphorus concentration was more during

75 DAS and then gradually decreases thereafter. This reduction in phosphorus conc. was may be due to the incidence of leaf reddening from 75 days onwards. Higher levels of fertilisers and foliar sprays of chemicals resulted in lowering the rate of phosphorus decrease during crop growth for both the years.

It is revealed from data in Table 2 that,, varieties had significant effect on phosphorus concentration in leaves at all stages, except during 2011 at 90 and 120 DAS. It was also observed that,, RCH Bt (V1) recorded significantly the highest phosphorus concentration (0.67 and 0.65) at 75 DAS for both the years and (0.53 and 0.44) during 2010 at 90 and 120 DAS respectively. While, Phule–388 recorded significantly the lowest phosphorus concentration at all stages and for both the years respectively. Similar observations were recorded by Masram (2009).

This may explained that, the deficiency of phosphorus was the cause of red leaf occurrence as reported by Chakravorty (1981) and Dhopte (1985).

Potassium concentration of leaves (%)

The data for potassium concentration of leaves recorded at 75, 90 and 120 DAS is presented in Table 3, which showed that, potassium conc. was more during 75 DAS and then gradually decreases thereafter. This reduction in phosphorus conc. was may be due to the incidence of leaf reddening from 75 days onwards. It was also found that,, higher levels of fertilisers recorded higher concentration of potassium per plant. Among the chemicals KNO_3 2% found to increase the concentration of potassium per plant during all stages and during both the years.

The data for three factor interactions is presented in Table 3, which showed that,, varieties, fertilizers and chemicals had non-significant effect on potassium conc. of leaves per plant at all stages, except at 120 DAS. It was also found that,, the treatment RCH Bt + 125% RDF + KNO_3 2% (V1F2T3) recorded significantly the highest potassium conc. (2.88 and 2.96 %) and the treatment LRA- 5166 + 100% RDF + Ascorbic acid 500 ppm (V3F1T4) recorded the lowest potassium conc. (2.17 and 2.25 %) at 120 DAS and for both the years, respectively.

The results are in close conformity with Dhopte (1990), Jadhav *et al.* (2004) and Masram (2009).

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Table 1. Effect of varieties, fertilizer levels and foliar sprays of chemicals on nitrogen content in leaves (%).

Treaments	Nitrogen content in leaves								
	75 DAS			90 DAS			120 DAS		
	2010	2011	Pooled	2010	2011	Pooled	2010	2011	Pooled
Varieties (V)									
V1: RCH Bt	4.21	4.63	4.42	2.48	2.84	2.66	1.48	1.9	1.69
V2: RCH non Bt	4.11	4.49	4.3	1.99	2.35	2.17	1.3	1.72	1.51
V3: LRA 5166	3.86	4.27	4.07	3.07	3.43	3.25	2.44	2.86	2.65
V4: Phule 388	3.95	4.35	4.15	2.75	3.11	2.93	1.69	2.11	1.9
SE(+)	0.14	0.07	0.04	0.02	0.02	0.1	0.04	0.02	0.03
CD at 5%	0.44	0.2	0.12	0.06	0.05	0.27	0.1	0.05	0.95
Fertilizers (F)									
F1: 100% RDF	3.98	4.38	4.18	2.49	2.85	2.67	1.61	2.03	1.82
F2: 125% RDF	4.09	4.49	4.29	2.65	3.01	2.83	1.85	2.27	2.06
SE(+)	0.01	0.01	0.03	0.01	0.01	0.07	0.03	0.01	0.02
CD at 5%	0.03	0.04	0.09	0.04	0.04	0.19	0.07	0.04	0.06
Chemicals (T)									
T1: DAP 2%	4.06	4.46	4.26	2.62	2.98	2.8	1.77	2.18	1.97
T2: MgSO4 2%	4.09	4.49	4.29	2.62	2.98	2.8	1.77	2.19	1.98
T3: KNO3 2%	4.11	4.51	4.31	2.74	2.99	2.87	1.78	2.20	1.99
T4: Asc.acid 500 ppm	3.87	4.29	4.08	2.44	2.8	2.62	1.61	2.03	1.82
T1: DAP 2%	0.01	0.02	0.04	0.02	0.02	0.01	0.04	0.02	0.03
T2: MgSO4 2%	0.04	0.05	0.12	0.06	0.05	0.03	0.1	0.05	0.09
Varieties x Fertilizers (VxF)									
V1 x F1	4.18	4.6	4.39	2.38	2.74	2.56	1.37	1.79	1.58
V1 x F2	4.24	4.66	4.45	2.57	2.93	2.75	1.6	2.02	1.81
V2 x F1	4.05	4.44	4.25	1.92	2.28	2.1	1.19	1.61	1.4
V2 x F2	4.17	4.54	4.35	2.06	2.42	2.24	1.42	1.83	1.62
V3 x F1	3.82	4.22	4.02	3.06	3.42	3.24	2.36	2.78	2.57
V3 x F2	3.91	4.31	4.11	3.08	3.44	3.26	2.53	2.95	2.74
V4 x F1	3.86	4.26	4.06	2.61	2.97	2.79	1.53	1.94	1.74
V4 x F2	4.04	4.44	4.24	2.89	3.25	3.07	1.86	2.27	2.07
SE(+)	0.02	0.27	0.01	0.03	0.03	0.01	0.05	0.03	0.04
CD at 5%	0.05	0.77	0.02	0.08	0.07	0.04	0.01	0.07	0.12

Table 2. Effect of varieties, fertilizer levels and foliar sprays of chemicals on phosphorus content in leaves (%).

Treaments	Phosphorus content in leaves								
	75 DAS			90 DAS			120 DAS		
	2010	2011	Pooled	2010	2011	Pooled	2010	2011	Pooled
Varieties (V)									
V1: RCH Bt	0.67	0.65	0.66	0.53	0.55	0.54	0.44	0.44	0.44
V2: RCH non Bt	0.67	0.6	0.63	0.53	0.5	0.52	0.39	0.42	0.4
V3: LRA 5166	0.61	0.57	0.59	0.47	0.58	0.52	0.44	0.48	0.46
V4: Phule 388	0.6	0.58	0.59	0.46	0.53	0.5	0.43	0.46	0.44
SE(+)	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.03	0.01
CD at 5%	0.03	0.06	0.03	0.03	NS	NS	0.02	NS	0.03
Fertilizers (F)									
F1: 100% RDF	0.6	0.56	0.58	0.45	0.5	0.48	0.39	0.41	0.4
F2: 125% RDF	0.68	0.65	0.66	0.53	0.58	0.56	0.46	0.49	0.48
SE(+)	0.02	0.03	0.01	0.01	0.04	0.01	0.01	0.02	0.02
CD at 5%	0.06	0.09	0.03	0.02	NS	0.02	0.03	0.06	0.05
Chemicals (T)									
T1: DAP 2%	0.67	0.65	0.66	0.53	0.58	0.55	0.45	0.48	0.46
T2: MgSO4 2%	0.65	0.61	0.63	0.51	0.56	0.53	0.43	0.47	0.45
T3: KNO3 2%	0.65	0.62	0.63	0.5	0.56	0.53	0.43	0.46	0.45
T4: Asc.acid 500 ppm	0.58	0.53	0.55	0.44	0.47	0.45	0.38	0.4	0.39
T1: DAP 2%	0.02	0.04	0.03	0.01	0.01	0.01	0.01	0.02	0.01
T2: MgSO4 2%	0.06	0.12	0.09	0.02	0.02	0.03	0.02	0.05	0.03
Varieties x Fertilizers (VxF)									
V1 x F1	0.64	0.62	0.63	0.5	0.52	0.51	0.42	0.4	0.41
V1 x F2	0.7	0.69	0.7	0.56	0.59	0.57	0.46	0.49	0.47
V2 x F1	0.62	0.56	0.59	0.48	0.46	0.47	0.33	0.36	0.34
V2 x F2	0.72	0.64	0.68	0.58	0.55	0.56	0.45	0.48	0.46
V3 x F1	0.56	0.51	0.53	0.42	0.54	0.48	0.41	0.44	0.43
V3 x F2	0.66	0.63	0.64	0.52	0.63	0.57	0.46	0.52	0.49
V4 x F1	0.57	0.54	0.55	0.43	0.5	0.46	0.4	0.43	0.41
V4 x F2	0.63	0.63	0.63	0.49	0.57	0.53	0.46	0.49	0.47
SE(+)	0.01	0.01	0.03	0.01	0.01	0.02	0.06	0.04	0.01
CD at 5%	0.03	0.02	NS	NS	NS	NS	NS	NS	0.03

Table 3. Effect of varieties, fertilizer levels and foliar sprays of chemicals on potassium content in leaves (%).

Treaments	Potassium content in leaves								
	75 DAS			90 DAS			120 DAS		
	2010	2011	Pooled	2010	2011	Pooled	2010	2011	Pooled
Varieties (V)									
V1: RCH Bt	3.12	3.21	3.17	3.01	3.09	3.05	2.7	2.78	2.74
V2: RCH non Bt	3.06	3.18	3.12	2.95	2.98	2.96	2.45	2.53	2.49
V3: LRA 5166	2.92	2.98	2.95	2.8	2.83	2.81	2.27	2.35	2.31
V4: Phule 388	3.04	3.11	3.07	2.92	2.87	2.9	2.36	2.43	2.4
SE(+)	0.11	0.06	0.05	0.33	0.05	0.12	0.02	0.08	0.09
CD at 5%	0.32	0.18	0.15	0.93	0.15	0.35	0.05	0.22	0.24
Fertilizers (F)									
F1: 100% RDF	3	3.07	3.03	2.88	2.91	2.9	2.36	2.44	2.4
F2: 125% RDF	3.07	3.16	3.12	2.96	2.97	2.97	2.52	2.6	2.56
SE(+)	0.08	0.04	0.04	0.02	0.04	0.09	0.01	0.06	0.06
CD at 5%	0.23	0.13	0.1	0.07	0.11	0.24	0.03	0.02	0.02
Chemicals (T)									
T1: DAP 2%	3.06	3.13	3.1	2.95	2.96	2.95	2.45	2.54	2.5
T2: MgSO4 2%	3.06	3.15	3.1	2.95	2.94	2.94	2.48	2.56	2.52
T3: KNO3 2%	3.06	3.16	3.11	2.95	3	2.98	2.49	2.57	2.53
T4: Asc.acid 500 ppm	2.95	3.04	3	2.84	2.87	2.85	2.34	2.42	2.38
T1: DAP 2%	0.01	0.06	0.05	0.01	0.04	0.01	0.02	0.08	0.09
T2: MgSO4 2%	0.03	0.18	0.15	0.03	0.12	0.03	0.05	0.22	0.24
Varieties x Fertilizers (VxF)									
V1 x F1	3.09	3.18	3.14	2.98	3.05	3.01	2.62	2.7	2.66
V1 x F2	3.15	3.25	3.2	3.04	3.14	3.09	2.78	2.85	2.82
V2 x F1	3.03	3.14	3.08	2.92	2.95	2.93	2.33	2.41	2.37
V2 x F2	3.1	3.21	3.16	2.98	3	2.99	2.56	2.64	2.6
V3 x F1	2.86	2.91	2.89	2.75	2.8	2.77	2.2	2.28	2.24
V3 x F2	2.97	3.04	3	2.85	2.85	2.85	2.34	2.42	2.38
V4 x F1	3	3.06	3.03	2.89	2.85	2.87	2.3	2.38	2.34
V4 x F2	3.07	3.15	3.11	2.96	2.89	2.93	2.42	2.49	2.45
SE(+)	0.02	0.09	0.07	0.05	0.08	0.02	0.02	0.01	0.01
CD at 5%	0.05	0.25	0.21	NS	NS	NS	0.07	0.03	0.03