

## Success story under RKVY Project Implemented at UAS, Raichur

### SUCCESS STORY- V

#### Leaf Reddening and its management in Bt Cotton

**1. Title:** Leaf Reddening and its management in Bt Cotton

**2. Category : Agriculture**

“Most significant achievement/success story for food grain production,

**3. Challenge :**

Among the production constraints, leaf reddening has become major physiological problem in Bt cotton cultivation. Majority of the cotton farmers throughout the country have opined that Bt cotton is very much prone to leaf reddening disorder. Thousands of acres of cotton crop were found to be affected by this complex in major cotton growing belts of Karnataka, Maharashtra, Andhra Pradesh, Tamil Nadu and Northern states. Leaf reddening incidence in cotton was more pronounced with Bt genotypes than non-Bt genotypes. In Karnataka, cotton occupies an area of 5.49 lakh ha with a production of 13.1 lakh bales and productivity of 406 kg ha<sup>-1</sup> (Anon., 2012). The average seed cotton yield is around 400 kg lint ha<sup>-1</sup>, which is far less than actual potential yields. Hosmath *et al.* (2012) observed that Bt cotton genotypes recorded significantly higher red leaf index (1.82) as compared to non- Bt cotton genotypes (1.63). This is an account of more number of good opened bolls per plant as a result of plant tolerance to bollworm incidence when compared to non-Bt genotypes.

The malady is mostly observed during peak flowering and boll development stages or later but occasionally during squaring to early flowering stage. If the reddening occurs in early squaring and flowering stages, the yield losses may be as high as 60-75%. Usually reddening occurs after boll formation stage where the losses could be 15-25% depending upon severity. The deficiency of nutrients viz., nitrogen, phosphorus, potash and zinc also result in reddening of leaves.

The principle cause of reddening is due to nitrogen, phosphorous and magnesium deficiency. Increase in nitrogen along with phosphorus and potassium increases the supply of nitrogen to leaf and reduces the formation of anthocyanin at the cost of chlorophyll. These points out the importance of plant nutrition and other management practices in controlling leaf reddening in cotton

**Theme:** Management of leaf reddening in *Bt* cotton

## **Objectives**

- i. To survey and document the major factors responsible for leaf reddening and trends of leaf reddening with its severity with seasonal changes in *Bt* cotton growing areas of Karnataka.
- ii. Studies on the morphological, physiological and bio-chemical changes on development of reddening symptoms throughout the crop developmental stages of *Bt* cotton and associated crop yield losses.
- iii. To evolve the integrated management strategies through field studies on screening of suitable genotypes / hybrids, sowing time with balanced and timely application of major and micro nutrients through various means and other related studies with environmental /seasonal interactions.
- iv. On-farm demonstration of the promising technology.

## **4. Initiative**

### **Steps taken to carry out the programme**

To know the extent of damage and probable cause for yield reduction due to leaf reddening in *Bt* cotton a survey was undertaken in different districts of Karnataka during December 2013. The occurrence of leaf reddening was as follows in different districts.

1. Gulbarga and Yadgir districts : 10-50% in irrigated & 25-60 % in rainfed areas
2. Raichur , Koppal & Bellary district : 15-45% in irrigated & 25-50% in rainfed
3. Bagalkot & Dharwad districts : 5-35% in irrigated & 15-55% in rainfed
4. Chitradurga & Davanager districts: 15-35% in irrigated & 35-50% in rainfed areas
5. Chamarajnar & Mysore districts : 5-40 in irrigated & 30-65% in rainfed

### **Reasons for the reddening in *Bt* cotton**

From the survey it was found that occurrence of leaf reddening was more in the winter season and wherever nutrients applied in very less or nil application of N, P, K & magnesium nutrients which are the key elements involved in development of reddening in the leaves. Further, in *Bt* cotton leaf reddening was more at the time of flowering and boll development.

### **Steps taken to fulfill the objectives:**

In *Bt* cotton due to heavy boll load at flowering nutrients applied at the time of sowing are not sufficient to support the development of bolls. Hence, nutrients should be provided through foliar spray at flower initiation stage helps in control of leaf reddening

It was decided to provide the nutrients N, P, K and Mg through water soluble fertilizers like 19:19:19 NPK and Magnesium sulphate for cotton growing farmers of Hyderabad Karnataka region. Demonstrations in 200 ha , 350 ha and 150 ha in *Kharif* 2014 2015 and 2016, respectively with following inputs

- 1) Soil application of  $MgSO_4$  @ 25kg/ha at the time of sowing
- 2) Foliar application of (1%)  $MgSO_4$  @ 7.5kg/ha for three times at 60, 80 & 100 days after sowing.

### Identification of goals

As per the survey conducted in different districts, it was clearly identified that leaf reddening is major problem for *Bt* cotton cultivation. It is required to manage the leaf reddening through supplementing water soluble chemical fertilizers containing Mg, N,P & K foliar spray and soil application and also creating awareness among the farmers about use of water soluble fertilizers as foliar spray through the training programmes.

### Methodology followed

Cotton growing farmers of different districts were identified for the demonstration of leaf reddening management by providing the nutrients N,P K and Mg through water soluble fertilizers 19:19:19 and Magnesium sulfate by adopting recommendations of package of practices. It was suggested to apply  $MgSO_4$  @ 25kg/ha Soil application at sowing and foliar application of (1%)  $MgSO_4$  and 19:19:19 NPK @ 7.5kg/ha for three times at 60, 80 & 100 days after sowing.

**Table 1. The details of demonstrations conducted in different districts is as follows:**

Sl. No.	District	No. of Hectare		
		2014-15	2015-16	2016-17
1	Gulbarga	30	40	00
2	Yadgir	40	100	30
3	Raichur	70	150	70
4	Koppal	20	30	20
5	Ballary	30	30	30
6	Bagalkot	10	00	00
		<b>200</b>	<b>350</b>	<b>150</b>

### 5. Key result/insight/interesting fact

During 2014-15, The effect of nutrients supply on cotton yield was more in irrigated conditions than rainfed areas. Leaf reddening control was also more in irrigated areas as compared to rainfed area. The overall increase in cotton yield ranges from 17.5 to 19.0 percent over the control plots. The leaf reddening incidence was reduced by 44.7 to 45.1 percent over the control plots in different districts of Karnataka.

Similarly during 2015-16, application of nutrients helped in control of leaf reddening. Overall leaf reddening was reduced by 29.2 to 41.6 percent over the control plots and cotton yield was increased by 15.3 to 17.5 percent. Input response was more influenced in irrigated areas as compared to rainfed areas.

**Table 2. Range of cotton yield and leaf reddening occurrence recorded in demonstration fields in different districts of Karnataka region during 2013-14**

Sl. No	District	Situation	Cotton Yield (Q/ha)			Leaf reddening( %)		
			Control	Treated	Percent increase over control	Control	Treated	Percent decrease over control
1	Gulbarga	Rainfed	16.11 to 17.75	18.35 to 20.87	13.9-17.6	26.5 to 59.55	19.67 to 43.96	25.8-26.2
2	Yadgir	Irrigated	25.22 to 32.15	29.62 to 34.80	17.4-21.3	20.00 to 42.0	8.00 to 24.00	42.9-60.0
3	Raichur	Irrigated	22.22 to 29.15	26.57 to 33.75	15.8-19.6	22.51 to 45.21	9.61 to 25.52	43.6-57.3
4	Koppal	Rainfed	14.23 to 18.33	17.25 to 21.89	19.4-21.2	18.31 to 42.31	8.00 to 12.51	56.3-70.4
5	Ballary	Irrigated	24.57 to 31.42	29.89 to 37.96	20.8-21.7	21.25 to 42.43	10.45 to 22.65	46.6-50.8
6	Bagalkot	Rainfed	17.50 to 20.89	21.00 to 23.00	10.0-20.0	22.00 to 47.00	17.50 to 29.00	20.5-38.3
<b>Average range</b>					17.5-19.0			44.7-45.1

**Table 3. Range of cotton yield and leaf reddening occurrence recorded in demonstration fields in different districts of Karnataka region during 2014-15**

Sl. No	District	Situation	CottonYield (Q/ha)			Leaf reddening ( %)		
			Control	Treated	Percent increase over control	Control	Treated	Percent decrease over control
1	Gulbarga	Rainfed	9.68 to 15.65	11.52 to 18.20	19.0-16.3	21.65 to 65.15	14.65 to 50.20	22.9-32.3
2	Yadgir	Irrigated	16.50 to 19.50	19.00 to 22.63	15.2-16.1	22.78 to 60.12	13.52 to 38.25	36.4-40.6
3	Raichur	Irrigated	12.23 to 20.89	14.90 to 24.51	17.3-21.8	25.35 to 53.11	20.14 to 31.11	20.6-41.4
4	Koppal	Rainfed	10.00 to 16.33	11.55 to 19.21	15.5-17.6	24.31 to 58.32	20.98 to 41.50	13.7-28.8
5	Ballary	Irrigated	15.00 to 25.50	17.40 to 30.25	16.0-18.6	27.65 to 55.69	17.08 to 33.98	38.2-78.5
					<b>17.2-17.5</b>			<b>29.1-41.6</b>

## 6. Impact:

In Karnataka the area under cotton was around 6.0 lakh hectares with 535 kg/ha productivity during 2015-16, Due to the intervention of the technology *i.e.*, application of chemical fertilizers containing nutrients N,P K and Mg overall increased the cotton yield was 17.25 percent over the control plots which lead to an increase nearly one quintal/ha and overall leaf reddening in *Bt* cotton was reduced( controlled) by 35 percent.

## 7. Lessons Learned

### 1. What did you learn in this process?

1. Occurrence of leaf reddening in *Bt* cotton was due to shortage of nutrients N,P,K and Mg . Chemical fertilizers supplying nutrients N,P,K and Mg applied at 60, 80 & 100 days after sowing help in controlling development of leaf reddening.

2. What was difficult or challenging?

Leaf reddening in *Bt* cotton is a complex phenomenon and physiological disorder. Different factors are involved in process of leaf reddening development. Difficult to identify the particular reason for the cause.

3. How did you overcome the challenges faced?

Further research was needed and experiment was conducted with different treatments of nutrients and find out the possible remedy.

4. If you were to do it all over again, what would you do differently?

Impact of magnesium sulphate @25 kg/ha soil application and foliar spray of magnesium sulphate and 19:19:19 N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O water soluble fertilizer (each@1%) at 60, 80 & 100 DAS on leaf reddening in *Bt* cotton. With this intervention leaf reddening was controlled only 35 to 40 percent but still it can be controlled with other treatments or interventions for no leaf reddening in *Bt* cotton.

## 1. Supporting Quotes and images



## 9. Additional information

### 1. List of all project partners and/or donors who supported the work .

- 1) Principal Investigator and Director of Research, UAS, Raichur
- 2) Co Principal Investigator , Dr. Satyanarayana Rao, Professor of Agronomy, MARS, Raichur
- 3) Co Principal Investigator , Dr. Amaregouda, Professor of Crop Physiology, College of Agriculture, Raichur
- 4) Co Principal Investigator Dr. J.N. Nidgundhi, Associate Professor , Genetics & Plant Breeding , MARS, Raichur
- 5) Co Principal Investigator , Dr. Ravi, M.V. , Asst. Professor Soil Science, College of Agriculture, Raichur

- 6) Co Principal Investigator ,Dr. M. K. Meena, Assistant Professor, Crop Physiology, DR Office, UAS, Raichur

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## 10. Checklist

Sl. No.	Question to consider	YES	NO
1	Is the story interesting to the target audience of the project/activity report?	Yes	
2	Does the story explain what new insights the project brings? What is the main lesson learned from this story? Does the story describe a key insight on what works and what doesn't and something that future project could build on	Yes	
3	Does the story describe the outcomes the project produced and the people who are benefitting? What changes—in skills, knowledge, attitude, practice, or policy—has the project brought, and who is benefitting from these changes?	Yes	
4	Does the story make a compelling point that people will remember? Does the story show how the project makes a difference to improving livelihoods and lessening poverty?	Yes	
5	Does the story provide an interesting fact that people will remember? For example, how much yields increased, how many hectares of land could become more productive from this innovation or technology?	Yes	
6	Does the story explain what kind of impact this innovation or technology could have if scaled up?	Yes	
7	Does the story show which partners contributed and how?	Yes	
8	Does the story include quotes from Stakeholders or beneficiaries?		No
9	Have I provided links to other media (journal articles, website news, newsletter, blogs, annual reports of other Programme/ project ) that also feature this story?	Yes	
10	Have I provided the contact details of people who can provide more information?	Yes	

## 11. Contact person for this story (name, position, email address)

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