



Occurrence and distribution of tobacco streak virus (TSV) in the germplasm of ELS cotton *Gossypium barbadense*

P. VALARMATHI* AND K.P.M. DHAMAYANTHI

ICAR-Central Institute for Cotton Research, Regional Station, Coimbatore - 641 003

***E-mail : valarpath@gmail.com**

ABSTRACT : A field survey was conducted during 2017-2018 and 2018-2019 crop season at ICAR-CICR Regional Station, main farm at Coimbatore for the occurrence and distribution of *Tobacco Streak Virus* (TSV) in cotton plants. The presence of TSV disease affecting plants in the germplasm of *Gossypium barbadense* were observed at 60 DAS (Days after sowing). The maximum per cent disease incidence was observed in the germplasm ICB 71 (26.6 %) and mean thrips population was observed as 13.2. The per cent TSV disease incidence in Suvin was observed as 6.7 per cent and mean thrips population was observed as 8.3. In the advance generation of *Gossypium barbadense*, CCB 129 the per cent TSV disease incidence was 20.5 per cent and mean thrips population was observed as 12.4. Per cent disease incidence was maximum in Suvin (32.5%), ICB-25 (26.6%) with disease grade of 3 during 2018-2019. At later stage of the cotton crop due to the abiotic stress like winter period and biotic stress like the viral disease results in the partial withering of the cotton bolls. Maximum disease incidence and thrips population was observed in the advance generation line SXP was 35.8 per cent and 16.6.

Keywords : Cotton, Germplasm, *Gossypium barbadense*, *tobacco streak virus*, thrips

The Indian cotton crop is the most diverse in the world, both in terms of botanical status and fibre quality range. Three of the species of *Gossypium* contributing to the cottons of trade and industrial consumption *viz.*, *hirsutum*, *arboreum* and *herbaceum* are commercially grown in the country. World over, the *G. barbadense* species contributes to the ELS cotton. However, in India, both *G. barbadense* and interspecific hybrids between *G. hirsutum* and *G. barbadense* account for this ELS category. Among the different quality groups, the ELS cotton of 35 mm and above is in great demand world over for the manufacture of high quality ring spun yarns. The common end uses of ELS cotton are sewing threads, loom yarns, blend with

polyester and high quality fabric. As it has high length, strength and micronaire, it generally used to manufacture high quality ring-spun yarns. However, unlike other three cultivated species, *G. barbadense* is highly susceptible to disease and pests.

Various bacterial, fungal, and viral diseases hamper cotton productivity. Among the viral diseases infecting cotton, cotton leaf curl virus and tobacco streak virus are important. Cotton necrosis disease caused by *tobacco streak virus* (TSV) is an emerging threat in India (Rageshwari *et al.*, 2016). *Tobacco streak virus* (TSV) was first identified in tobacco in Brazil (Johnson, 1936; Costa, 1945). In India, TSV was initially identified in sunflower (Prasada Rao *et*

al., 2000) and peanut (Reddy *et al.*, 2002) causing necrosis disease. In Tamil Nadu, Nakkeeran (AICRP report 2010) first reported the association of TSV in cotton. Tobacco streak virus infecting various crops has been reported to be transmitted through mechanical means, infected seeds and through thrips species (Jagtap *et al.*, 2012; Kaiser *et al.*, 1982; Sharman, 2009). Even though, tobacco streak virus is a well exploited pathogen in various host plants, their association with cotton has been sparsely documented (Costa 1945; Prasada Rao *et al.*, 2009; Jagtap *et al.*, 2012; Rageshwari *et al.*, 2016). In cotton, *tobacco streak virus* has been reported to cause a maximum of 62.7 per cent yield loss (Rageshwari *et al.*, 2017). This paper mainly lays emphasis on the disease incidence of TSV in the germplasm of ELS cotton for the period of two years 2017 to 2019 along with the thrips population in infected samples.

MATERIALS AND METHODS

The studies were conducted at ICAR-Central Institute for Cotton Research (CICR), Regional Station, Coimbatore during 2017-2018 and 2018-2019. The experiment consisted of thirty advance generation material which was sown in Randomized block design with three replications with the plot size of 2.5 acres. Three hundred *G. barbadense* germplasm lines were separately sown in duplicate rows for the maintenance breeding. The row length was 45 cm and ten plants were maintained in each row. The diseased plants in each rows were counted. Spacing between rows and plant to plant was 90 x 45 cm. Normal package of practices were followed. Plant protection measures were adopted

to protect the crop from insects as and when required. Tobacco streak virus (TSV) percentage was recorded by the total number of healthy and disease plants in the germplasm after 60 to 75 days after sowing onwards by using the following disease rating scale (Table 1).

Thrips population in the germplasm of *Gossypium barbadense* was observed as mean of three observations. The three observations were taken as first from the population from top two leaves, then from middle two leaves and finally from bottom two leaves. Ten plants were counted for thrips population in each germplasm lines.

RESULTS AND DISCUSSION

i) Occurrence and distribution of TSV in cotton (2017-2018) : Periodical field survey was done during 2017-2018 crop season for the presence of TSV infected plants. The symptoms were necrotic spots dark purple in colour and also drying of squares. The symptom expression in the germplasm of ELS cotton was given in the Fig.1. The presence of disease affected plants in the germplasm of *Gossypium barbadense* were observed at 60 DAS (Days after sowing). The maximum per cent disease incidence was observed in the germplasm ICB 71 (26.6 %) and minimum per cent disease incidence was observed as 3.3 per cent in other ICB germplasm lines. In the germplasm ICB 72 and ICB 73, the disease incidence was 12.5 per cent (Table 2). The disease grade in the germplasm ranged from 2 to 3. The per cent TSV disease incidence in Suvin was observed as 6.7 % and mean thrips population was observed as 8.3. Maximum thrips population was observed in the germplasm of ICB 71 (13.2).

Table 1. Disease rating scale (0-4) for TSV (AICCP)

Scale	Grade	Symptoms
0	Immune	Free from the disease
1	Highly resistant	Few upper leaves showing chlorosis /necrosis
2	Moderately resistant	Moderate square drying and few branches affected
3	Moderately susceptible	Severe burning of squares and more branches affected
4	Highly susceptible	Severe stunting inclusive of above symptoms

Percent TSV incidence was calculated using the formula proposed by Wheeler (1969).

Per cent Disease incidence (PDI) = Number of infected plants / Total number of plants observed * 100

In the advance generation of *Gossypium barbadense*, CCB 129 the per cent TSV disease incidence was 20.5 per cent and mean thrips population was observed as 12.4. In the advance generation of *Gossypium barbadense*, CCB 51 the per cent TSV disease incidence was 13.9 per cent and mean thrips population was observed as 10.6. In the materials CCB 25, CCB 140 and SXP, the per cent TSV disease incidence was minimum 1.6 per cent and mean thrips population was observed as 2.5 (Table 3).

ii) Occurrence and distribution of TSV in cotton (2018-2019) : TSV infected cotton samples were collected at 35 DAS onwards in

the germplasm of *Gossypium barbadense*. The symptoms were very distinct with necrotic spots dark purple in colour and also drying of squares. Per cent disease incidence was maximum in Suvin (32.5%), ICB-25 (26.6%) with disease grade of 3 and observations were taken at period of intervals from sowing till harvesting. Per cent disease incidence in ICB 81 was 20.3 per cent and 13.6 thrips population (Table 4). Wherein in other ICB lines the disease incidence was 12 per cent. At later stage of the cotton crop due to the abiotic stress like winter period and biotic stress like the viral disease results in the partial withering of the cotton bolls. Maximum thrips

Table 2. Disease incidence of TSV in the germplasm of *Gossypium barbadense* (2017-2018)

S. No	Germplasm	Per cent disease incidence (60 DAS)	Disease grade	Mean thrips population/plant
1.	ICB 71	26.6	2.5	13.2
2.	ICB 72 and ICB 73	12.5	2.5	10.9
3.	NDGB 12, NDGB 21	6.6	1.5	8.2
4.	ICB 60, ICB 61, ICB 65, ICB 67, ICB 70, ICB 74, ICB 75, ICB 94, ICB 145, ICB 163, ICB 180, ICB 182, ICB 245, ICB 260 and C 7	5.7	1.5	6.2
5.	ICB 17, ICB 25, ICB 183, ICB 209, ICB 210, ICB 222, ICB 224, ICB 238, ICB 241, ICB 248, ICB 263, ICB 271, ICB 275, ICB 276, ICB 290, NDGB 1, NDGB 23, NBGB 31, NDGB 41, NDGB 62, NDGB 63 and NDGB 64	3.3	1.5	5.2
6.	Suvin (control)	6.7	1.5	8.3



Fig 1. Typical symptoms of necrotic spots with purple colour and drying of squares (ICB 71)

population was observed in the germplasm lines of ICB was 14.4.

Maximum disease incidence and thrips population was observed in the advance generation line SXP was 35.8 per cent and 16.6. Maximum disease incidence and thrips population was observed in the advance generation line SXG was 24.8 per cent and 14.5.

Per cent disease incidence in CCB 11a was 21.8 per cent and thrips population observed was 10.8.

Per cent disease incidence in CCB 143 was 17.4 per cent and thrips population observed was 13.5. Minimum disease incidence and thrips population was observed in the advance generation line CCB 26 was 10.2 per cent and 9.7. Per cent disease incidence in CCB 141 was

Table 3. Per cent disease incidence of TSV in the advance generations of *Gossypium barbadense* (2017-2018)

S. No	Advance generation material	Per cent disease incidence (60 DAS)	Disease grade	Mean thrips population/ plant
1.	CCB 129	20.5	2.5	12.4
2.	CCB 51	13.9	2.5	10.6
3.	CCB 141	12.3	2.5	10.2
4.	CCB 29	6.8	1.5	8.5
5.	CCB 143b	6.6	1.5	8.2
6.	CCB 11, CCB 11a, CCB 30 and CCB 64	3.5	1.5	5.3
7.	CCB 64a	3.3	1.5	5.2
8.	CCB 26, CCB 51- 2, CCB 67 and CCB 143	2.9	0.5	4.2
9.	CCB 25, CCB 140 and SXP	1.6	0.5	2.5

Table 4. Disease incidence of TSV and thrips population in the germplasm of *Gossypium barbadense* (2018-2019)

S. No	Germplasm	Per cent disease incidence (60 DAS)	Disease grade	Mean thrips population/ plant
1.	ICB 25	26.6	2.5	14.4
2.	ICB 49	12.0	2.5	7.6
3.	ICB 81	20.3	2.5	13.6
4.	ICB 173,ICB 207, ICB 222, ICB 231, ICB 276 and ICB 284	17.8	2.5	12.7
5.	ICB 34	10.5	2.5	11.4
6.	ICB 240, ICB 259, ICB 260and ICB 280	11.2	1.5	12.0
7.	ICB 286	11.3	1.5	10.2
8.	ICB 11,ICB 16,ICB 23,ICB 33,ICB 24, ICB 25, ICB 41,ICB 73, ICB 74, ICB 90, ICB 97, ICB 99, ICB 100, ICB 104, ICB 138, ICB 153, ICB 163,ICB 175, ICB 180, ICB 188,ICB 195, ICB 196, ICB 199, ICB 202, ICB 203, ICB 204, ICB 205, ICB 208, ICB 212,ICB 217, ICB 218, ICB 220, ICB 233, ICB 250, ICB 255, ICB 263,ICB 264, ICB 269, ICB 274, ICB 278, ICB 285, ICB 288 and ICB 287	12.1	1.5	8.5
9.	USAGB 1,2,3,4,5,6,7,8,10,11,12,13,14 and 15	10.4	0.5	11.6
10.	NDGB 66,72,85,88,31,49 and 61	8.2	0.5	7.5
11.	EC1,2,3,4,5,6,7,8,9,10,11,12,13, 14, 15,16,17,18,19,20	6.2	0.5	6.5
12.	Suvin (control)	32.5	2.5	14.8

17.1 per cent and thrips population observed was 11.9. Per cent disease incidence in CCB 129 was 16.0 per cent and thrips population observed was 13.6. (Table 5).

Occurrence and distribution of cotton mosaic disease of cotton survey was conducted in September and December in Beed, Parbhani, Nanded and Hingoli districts of marathwada region. The disease was found to occur in early flower development stage of plant, later at maturity and boll development stage. The symptoms disappeared slowly and in December the incidence was difficult to detect. The incidence was found to be 10 to 19 per cent in the month of September but in December it was about 0 to 2 per cent only. TSV causing cotton

mosaic disease in field condition from Marathwada region was first reported by Jagtap *et al.* (2012).

The per cent incidence was found to be maximum in hybrid Ankur 3034 at Anthiyur (50 %) followed by RCH 2 (35.98 %) at Coimbatore. The varieties which were grown only in TNAU, Coimbatore MCU13 and MCU7 recorded 21.27 and 1.65 per cent respectively. But in all the fields which were surveyed, the plants at early flowering stage showed severe symptoms, but recovered from symptoms at maturity. At boll development stage the disease incidence was reported to be only 0 to 7.5 per cent (Rageshwari *et al.*, 2016).

Our survey data pertains particularly to

Table 5. Disease incidence of TSV and thrips populaton in the advance generations of *Gossypium barbadense* (2018-2019)

S. No	Advance generation material	Per cent disease incidence (60 DAS)	Disease grade	Mean thrips population/ plant
1.	CCB 11a	21.8	2.5	10.8
2.	SXP	35.8	2.5	16.6
3.	CCB 143	17.4	1.5	13.5
4.	CCB 141	17.1	2.5	11.9
5.	CCB11	16.8	2.5	12.5
6.	CCB 129	16.0	1.5	13.6
7.	CCB 29	15.5	2.5	14.3
8.	SXG	24.8	1.5	14.5
9.	CCB 143b	14.1	2.5	10.5
10.	CCB 28	13.6	1.5	13.4
11.	CCB 26	10.2	1.5	9.7
12.	CCB 51-2	12.9	1.5	10.1
13.	CCB 64	12.5	0.5	12.7

the distribution of TSV in the germplasm of ELS cotton *Gossypium barbadense* for the period of two years 2017 to 2019. During 2018-2019, the disease incidence was maximum in the germplasm and advance generation lines. Similarly the thrips population observed was maximum during 2018-2019 correlated with the disease incidence. This is the first time of observation of TSV in the germplasm and advance generations of ELS cotton *Gossypium barbadense*.

REFERENCES

- Jagtap, G. P., Jadhav, T. H., and Utpal, D. 2012.** Occurrence, distribution and survey of tobacco streak virus (TSV) of cotton. *Sci. J. Crop Sci.*, **1** : 16-19.
- Johnson, J. 1936.** Tobacco streak, a virus disease. *Phytopathology.*, **26**: 285-92.
- Kaiser, W. J., Wyatt, S. D., and Pesho, G. R. 1982.** Natural hosts and vectors of tobacco streak virus in eastern Washington. *Phytopathology.*, **72** : 1508-12.
- Prasada Rao, R. D. V. J., Jyotsna, M. K., Reddy, A. S., Varaprasad, K. S., Nigam, S. N., and Kumar, P. L. 2009.** Non-systemic infection of tobacco streak virus on cotton in Warangal District, Andhra Pradesh. *Indian J. Plant Prot.*, **37** : 196-98.
- Prasada Rao, R. D. V. J., Reddy, A. S., Chander Rao, S., Varaprasad, K. S., Thirumalaevi, K., Nagaraju Muniyappa, V. and Reddy, D. V. R. 2000.** Tobacco streak ilarvirus as causal agent of sunflower necrosis disease in India. *J. Oilseeds Res.*, **17**: 400-01.
- Rageshwari, S., Renukadevi, P., Malathi, V. G., Amalabalu, P., and Nakkeeran, S. 2017.** DAC-ELISA and RT-PCR based confirmation of systemic and latent infection by tobacco streak virus in cotton and *parthenium*. *J. Plant Pathol.*, **99** : 1-7.

- Rageshwari, S., Renukadevi, P., Malathi, V. G., and Nakkeeran, S. 2016.** Occurrence, biological and serological assay of TSV infecting cotton in Tamil Nadu. *J. Mycol Plant Pathol.*, **46** : 159-68.
- Reddy, A. S., Prasada Rao, R. D. V. J., Thirumala Devi, K. and Reddy, S. V. 2002.** Occurrence of *tobacco streak virus* on peanut (*Arachis hypogaea* L.) in India. *Plant Dis.*, **86**: 173-78.
- Sharman, M. 2009.** Distribution in Australia and seed transmission of *tobacco streak virus* in *Parthenium hysterophorus*. *Plant Dis.*, **93** : 708-12.
- Vinodkumar, S., Nakkeeran, S., Malathi, V.G., Karthikeyan, G., Amala Balu, P., Mohankumar, S. and P. Renukadevi. 2017.** *Tobacco streak virus*: an emerging threat to cotton cultivation in India. *Phytoparasitica*, **45** : 729-43.

Received for publication : September 20, 2019

Accepted for publication : November 16, 2019