Research Paper :

Cassava mosaic virus induced physio-biochemical changes in the leaves of tapioca (*Manihot utilissima* Pohl.)

TOMY PHILIP

International Journal of Plant Protection **(April, 2010), Vol. 3 No. 1 : 31-33**

Correspondence to :
TOMY PHILIP
Central Sericulture Research and Training Institute, Srirampura, MYSORE (KARNATAKA) INDIA

SUMMARY

Tapioca (*Manihot utilissima* Pohl.), one of the main food plants of eri silkworm, is severely affected by cassava mosaic disease caused by cassava mosaic geminivirus of the genus Begomovirus and family Geminiviridae. The disease makes the leaf highly chlorotic, distorted and curled with reduced leaf area. The disease reduces the leaf yield and its quality drastically and makes it less suitable for eri silkworm rearing. The virus was found to caused significant reduction in almost all physiological and biochemical parameters of tapioca leaf. Total leaf protein content was reduced by about 16.2%, while there was an increase of total sugar content by 12.8%.

Key words : Cassava mosaic virus, Physiological and biochemical changes, Tapioca

Accepted : December, 2009

Nutritional quality of leaves play vital role in the robust growth of silkworm larvae and improving the commercial characters of cocoon as well as in their reproductive performance (Li and Sano, 1987). All the nutrients in balanced proportion are necessary for the healthy growth of silkworm larvae and production of robust cocoons. Diseases play an important role in reducing the nutritional quality of leaf. Diseases interfere with plant biochemical processes occurring in the leaves and in one or more ways with the physiological functions of the plant resulting in severe loss in yield and quality (Philip, 1991). Several reports are available on the post infectional physiological and biochemical changes in various plants in response to the attack of various diseases (Philip *et al*., 2009). No such reports are available on the tapioca leaves infected by cassava mosaic virus.

MATERIALS AND METHODS

Physiological and biochemical parameters of healthy and infected leaves were studied on H-177 variety of tapioca raised at the Central Sericultural Research and Training Institute, Mysore during the month September-October of the year 2006-07. Leaf area of healthy and CMV infected leaf was determined with the help of leaf area meter, LICOR model 3100. Leaf pigment content was determined by the SPAD-502 chlorophyll meter (Minolta cc Japan). Leaf temperature, stomatal diffusive resistance and transpiration rate were recorded using the steady state porometer (model –LI-1600-LICOR). Healthy and infected leaves were collected and brought to the lab. for estimating chlorophyll and carotenoid contents (Arnon,1949), total soluble protein (Lowry *et al.*,1951), total sugars (Morris, 1948), moisture content (AOAC,1985) and relative water content (Ritchie *et al.*,1990). For recording all data minimum 25 leaves each of healthy and diseased leaves were used. Data were statistically analyzed and important results are presented in Table 1.

RESULTS AND DISCUSSION

The results obtained from the present investigation are summarized below :

Physiological changes

Studies on physiological characters revealed reduction in almost all parameters in virus-infected leaves. Leaf pigment value (SPAD value) was reduced by 30.02%, transpiration rate by 53.44 mg cm^{-2} S^{-1} and relative water content by 6.18%. Stomatal diffusive resistance, which is an important parameter indicating the gas exchanges was 1.63 and 3.31 S cm^{1}, respectively in healthy and infected leaves.

Biochemical changes :

There was also substantial decrease in all biochemical parameters as a result of viral infection in healthy tapioca leaves. Moisture percentage was 77.51 %, which was reduced to 73.46% in infected leaves, showing a reduction of 5.23%. Chlorophyll 'a' and 'b' were 0.47 and 0.74-mg/g fresh wt, respectively in healthy leaves, whereas in infected leaves it was 0.24 and 0.35 mg/g fresh weight, respectively. Carotenoid content was 1.08 and 0.60 mg/g fresh weight, respectively in healthy and virus infected leaves (Table 1).

Total soluble protein content in healthy leaf was 122.97mg/g dry weight. Virus infection has reduced the total soluble protein content to 105.86 mg/g dw. There was a reduction of 16.2 % in protein content in CMV infected leaves. However, the total sugar content was increased in virus-infected leaves. Total sugar was 82.03 and 92.55 mg/g dw, respectively in healthy and CMV leaves, showing an increase of 12.8 % (Table 1).

During pathogenesis, various physiological activities of the host are known to undergo deviations from the normal course (Mahadevan and Sridhar, 1986). Several studies have shown changes in the biochemical constituents of food plants of silkworm due to various pathogens (Philip *et al.*, 2009).

Plant pathogens are reported to imbalance the chlorophyll contents and their ratio (Tungawat, 1977). The reduction may be due to the disintegration of or inhibition of their synthesis by the growing pathogen inside the leaf tissues. As the disease severity increases, the percentage of reduction also increases. In the present study, there was reduction in all the physiological activities and in total protein content. The reduction in physiological activities could probably be due to the interference of the virus. The reduction in photosynthetic pigments, moisture content and total protein could probably be due to their utilization by the proliferating virus. The virus might have utilized the leaf protein for its own multiplication resulting in reduction in leaf protein.

There was an increase of 12.8 % in total sugar content in infected leaves. Increase in total sugar content and decease in protein content has also been reported in castor leaves affected by rust, spot and blight diseases (Shree *et al.*, 2000). The increase in total sugar content could be due to the increased activity of invertase and reduced activity of sucrose synthetase and sucrose –p-synthetase as observed by Mitchell (1982) in wheat stem rust.

The importance of nutritionally rich leaves of food plants for successful eri silkworm rearing needs no emphasis. Pathogenic microorganisms are known to cause alterations in many physiological functions of plant and its biochemistry. The productivity and quality will be deteriorated as the physiological functions are adversely affected.

The silkworm cocoons are made up of proteins secreted by the silk glands. The protein derived from leaf is used for the production of eri cocoons. For quality silkworm cocoon production protein level in the range of 20-25% is required (Hirano, 1980). Any reduction in protein content in tapioca leaf will adversely affect the cocoon formation and its quality. This is also substantiated by the findings of Philip *et al.* (2008), who have reported

Table 1 : Changes caused due to infection of cassava mosaic virus in tapioca leaf

Parameters	Type of leaf		% increase/ decrease	T test
	Healthy	Infected		
Physiological changes				
Stomatal diffusive resistance (S cm^{-1})	1.63	3.31	+103.1	**
Transpiration rate (µg cm^{-2} S^{-1})	31.21	14.53	-53.44	**
Leaf temperature (^{0}C)	33.30	33.50	+. 60	NS
Relative water content (%)	82.78	77.66	-6.18	**
Leaf pigment value (SPAD value)	37.30	26.10	-30.02	**
Biochemical changes				
Moisture %	77.51	73.46	-5.23	**
Moisture retention capacity (%)	76.61	73.56	-3.98	*
Chlorophyll 'a' (mg/g fresh wt.)	0.47	0.24	-48.94	**
Chlorofphyll'b'(mg/g fresh wt.)	0.74	0.35	-52.70	**
Total chlorophyll (mg/g fresh wt.)	1.20	0.59	-50.83	**
Carotenoid (mg/g fresh wt.)	1.08	0.60	-44.44	**
Total protein (mg/g dry wt.)	122.97	105.86	-13.91	**
Total sugar (mg/g dry wt.)	82.03	92.55	+12.82	*

* and ** indicate of significance of values at P = 0.05 and 0.01, respectively, NS-Non significant

prolonged larval duration, reduced larval weight, cocoon weight and silk percentage when eri larvae were fed with CMV infected tapioca leaves.

REFERENCES

A.O.A.C. (1985). *Official Methods Of Analysis*. Association Of Analytical Chemists (12th Ed.) AOAC, Benjamin Franklin Station, Washington DC, USA. pp 490- 510

Arnon, D.I.(1949).Copper enzymes in isolated chloroplasts. *Plant Physiol*., **24** : 1-15.

Hirano, H. (1980). Thermatological studies of protein variation in mulberry, *Bull. Seric. Exp.Sta. Japan*, **28**(2): 67-186

Li, R. and Sano, X. (1987). The relationship between quality of mulberry leaves and some economic characters during the later larval stage. *Acta Sericologia Sinica*, **10**: 197-201.

Lowry, O.H., Rosenbrough, N.J., Fan, A.L and Randall, R.J.(1951). Protein measurement with folin- phenol reagent. *J .Biol.Chem*.,**193**: 266-275

Mahadevan, A. and Sridhar, R.(1986)**.** *Methods in Physiological Plant Pathology*. Sivakami Publications, Madras, India.

Mithell, D.T. (1982). Invertase ativity in leaf tissue susceptible and resistant to wheat stem rust. *Trans. British Mycol. Sci.*, **78**(1): 173-176.

Morris, D.L.(1948). Quantitative determination of carbohydrates with dreywoods anthrone reagent. *Science*, **107** : 254-255.

Philip, T. (1991). Cultural methods of pest and disease control in mulberry. *Indian Silk*, **30**:36-38.

Philip, T., Qadri, S.M.H., Somaprkash, D.S., Shekhar, M.A. and Kamble, C.K.(2008). Effect of feeding CMV infected tapioca leaves on the cocoon and grainage parameters of eri silkworm, *Samia cynthia ricini***.** *Indian J. Seric*., **47**(2): 161-164.

Philip,T., Mala V. Rajan, Qadri, S.M.H. and Kamble, C.K. (2009). Post infectional physio-biochemical changes in food plants of silkworm and the effect of feeding diseased leaves on silkworm. *Indian J. Seric*., **48**(1): 1-9.

Ritchie, S.W., Houyen, H.T. and Holaday, A.C.(1990). Leaf water content and gas exchange parameters of two wheat genotypes differing in drought resistance. *Crop Sci*., **30**(1) : 105-111.

Shree, M.P., Chandra, M. and Ravi Kumar, K.(2000). Nutritional content of healthy and diseased leaves of castor and papaya, the food plants of eri silk moth. *Bull. Indian Acad. Seric*., **4**: 82-90.

Tungawat, R. (1977). Chlorophyll a/b ratio as influenced by plant pathogens. *Sci. Cult*., **43** (10): 436.

****