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Original Research Article

Study on Host Range of *Cucumber mosaic virus* Infecting Banana

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Keywords

Banana, Cucumber, Sap transmission, Aphid transmission, Non-persistent manner, Per cent transmission, and *Cucumber mosaic virus*

A B S T R A C T

The host range study was conducted on selected plant species of cucumber (*Cucurbitaceae*), chilli, tomato (*Solanaceae*) and cowpea (*Fabaceae*) in greenhouse by adopting sap inoculation and aphid transmission method. The purpose of this study was to know the transmission of CMV infecting banana into different hosts plants either by aphid or mechanically. Out of twenty plants were sap inoculated, only eleven plants expressed the CMV symptoms, cucumber and chilli showed 100 per cent and banana showed 75 per cent transmission. Viruliferous aphid species such as *Aphis craccivora* and *A. gossypii* efficiently transmitted the virus with 20 min of acquisition and 10 to 15 min inoculation feeding period. Ten plants showed the symptoms of CMV after 30 days. Banana and chilli showed 100 per cent and cucumber showed 50 per cent transmission. CMV is easily transmitted by sap inoculation and by aphids in a non- persistent manner.

Introduction

Banana (*Musa* spp.) is the premier fruit of the Asia and Pacific region. It is a globally important fruit crop grown in more than 125 countries with a production of 97.4 million mt (Hu *et al.*, 2007). It is the fourth most important global agricultural commodity in terms of gross value of the produce after rice, wheat and maize. India is the largest producer of banana with a total annual production of 29.72 million tonnes from 0.77 million ha (Anon., 2014).

Biotic factors caused by pests and diseases present constant threats to banana farmers. Biotic stresses like fungi, bacteria, nematodes, viruses and insect pests limit the production and productivity of banana. Among all biotic constraints, viruses cause huge economic loss to the crop.

Banana is affected by four known, relatively well-characterized viruses namely *Banana bunchy top virus* (BBTV) genus *Babuvirus*, *Banana streak virus* (BSV) genus *Badnavirus*; *Cucumber mosaic virus* (CMV) genus *Cucumovirus* and *Banana bract mosaic virus* (BBrMV) genus *Potyvirus* (Diekmann and Putter, 1996). Recently, a filamentous virus, *Banana mild mosaic virus* (BanMMV) has been shown to be widespread in banana and also been noted in banana from Africa and Australia (Thomas *et al.*, 2000).

Cucumber mosaic virus causing yellow mosaic and stripes on leaves, besides causing leaf distortion along with stunting of banana plant, contribute as a major serious threat for banana cultivation (Niblett *et al.*,

1994). In recent years the disease is also known by the name infectious chlorosis disease of banana (Zora Singh *et al.,* 1995).

CMV is a linear positive-sense, single-stranded RNA virus. It's total genome size is 8.621 kb and is broken into three parts. The largest part is 3.389 kb; the second is 3.035 kb; the third is 2.197 kb. The RNA is surrounded by a protein coat consisting of 32 copies of a single structural protein which forms isometric particles. It can be transmitted from plant to plant both mechanically by sap and by aphids in a stylet-borne fashion. It can also be transmitted in seeds and by the parasitic weeds, *Cuscuta* sp. (Dodder) (Zora Singh *et al.,* 1995). And CMV virus concentration in host (Musa) tissue is very less so it is necessary to transfer this virus to good propagation host such as *Nicotiana* sp. (Dheepa and Paranjothi, 2010).

The purpose of the study to know the transmission of CMV infecting banana into different hosts plants either by aphid or mechanically.

Materials and Methods

The host range study was conducted on selected plant species of cucumber (*Cucurbitaceae*), chilli, tomato (*Solanaceae*) and cowpea (*Fabaceae*) in greenhouse by adopting sap inoculation and aphid transmission method.

Maintenance of virus source

The banana suckers infected with CMV planted in earthen pots containing standard pot mixture in the insect proof glasshouse at Department of Plant Pathology, UAS Dharwad. Healthy plants were also maintained separately in the same glasshouse.

Maintenance of test plants

All the test plant used under the study raised And maintained in earthen pots containing standard pot mixture in insect proof glasshouse Cucumber (*Cucurbitaceae*), chilli, tomato (*Solanaceae*) and cowpea (*Fabaceae*) were raised from seeds whereas banana plants from by vegetative means by using suckers.

Maintenance of aphids

Individuals of the aphids *Aphis gossypii* collected from cotton plants and *A. craccivora* collected from cowpea plants were multiplied on healthy cotton and cowpea seedlings respectively. New generation of aphids were transferred to other healthy plants of cotton and cowpea, growing in insect proof cages and were used for aphid transmission study

Methods of transmission

Sap transmission

For host range studies, sap inoculations were carried out by extracting banana leaf tissues infected with CMV in 0.1 M phosphate buffer, pH 7.0 containing 1.0 per cent sodium sulphite. The infectious sap was applied to healthy cucumber (*Cucurbitaceae*), chilli, tomato (*Solanaceae*) and cowpea (*Fabaceae*) in addition to banana plants. Leaves of the inoculated plants were previously dusted with 400 mesh carborandum. For control treatment carborundum dusted leaves were inoculated with phosphate buffer alone. Inoculated plants were maintained in the greenhouse for 30 days and the plants were inspected daily for symptom development. Observation were recorded as per cent transmission, type of symptoms and time taken for symptom development.

Aphid transmission

Several virus free adults of each of the abovementioned aphids were starved for two hours. They were allowed to feed for 20 min on CMV infected plant (acquisition period). Than the aphids were transferred to healthy cucumber (*Cucurbitaceae*), chilli, tomato (*Solanaceae*) and cowpea (*Fabaceae*) hosts in addition to banana, allowed to feed for 10-15 min (inoculation period), and then the insects were killed by insecticide (Malathion). After inoculation the plants were maintained in insect proof cage for 30 days and were inspected daily for symptoms development. Observations were recorded as per cent transmission, type of symptoms and time taken for symptom development.

Results and Discussion

Sap transmission of CMV

Twenty plants of cucumber (*Cucurbitaceae*), chilli and tomato (*Solanaceae*) and cowpea (*Fabaceae*) in addition to banana were sap inoculated. The results revealed that only eleven plants expressed the CMV symptom. Cucumber and chilli showed 100 per cent banana showed 75 per cent, transmission (Table 1) after one month of inoculation. But, there was no transmission to tomato and cowpea plants. Inoculated plants developed severe mosaic and leaf deformation symptoms.

Aphid transmission of CMV

Twenty plants of cucumber (*Cucurbitaceae*), chilli and tomato (*Solanaceae*) and cowpea (*Fabaceae*) in addition to banana were inoculated with viruliferous aphid species *Aphis craccivora* and *A. gossypii.* Both species efficiently transmitted the virus with 20 min of acquisition and 10 to 15 min inoculation feeding period. Ten plants showed the symptoms of CMV after 30 days of inoculation. Banana and chilli showed 100 per cent and cucumber showed 50 per cent transmission and there was no transmission to tomato and cowpea plants (Table 2). Inoculated plants showed typical mosaic symptoms.

Table.1 Host range of CMV infecting banana tested through sap inoculation

Sl. No.	Host plant	No. of plants		Per cent transmission	First symptoms observed (days)	Symptoms observed duration (days)	Symptoms observed
		Inoculated	Infected				
1	Tomato (*Solanum lycopersicum*)	4	0	0	-	30	-
2	Cucumber (*Cucumis sativus*)	4	4	100	09	30	Mosaic
3	Cowpea (*Vigna unguiculata*)	4	0	0	-	30	-
4	Chilli (*Capsicum annum*)	4	4	100	07	30	Mosaic
5	Banana (*Musa* spp.)	4	3	75	14	30	Mosaic

Table.2 Host range of CMV infecting banana tested through aphid transmission

Sl. No.	Host plant	No. of plants		Per cent transmission	First symptoms observed (days)	Symptoms observed duration (days)	Symptoms observed
		Inoculated	Infected				
1	Tomato (*Solanum lycopersicum*)	4	0	0	-	30	-
2	Cucumber (*Cucumis sativus*)	4	2	50	10	30	Mosaic
3	Cowpea (*Vigna unguiculata*)	4	0	0	-	30	-
4	Chilli (*Capsicum annum*)	4	4	100	08	30	Mosaic
5	Banana (*Musa* spp.)	4	4	100	12	30	Mosaic

The virus was found mechanically transmissible to the plant tested in this study. CMV transmitted through the infected sap as a result plant manifested yellowing, stunted growth, mosaic and narrowing of the leaves.

Inoculation at cotyledon stage provides better results than inoculation on to the older leaves. Inoculation was successful when phosphate buffer was used. Sodium sulphite was added to the buffer which helps in preventing oxidation and inactivates CMV infectivity in sap. The virus was readily transmitted mechanically onto the chilli, cucumber and banana plants and produced characteristic systemic and local symptoms of CMV (Madhubala *et al.*, 2005).

The aphid transmitting CMV was identified as *Aphis gossypii* and *A. craccivora.* The plants inoculated through aphid showing yellowing, chlorosis and mosaic symptoms of CMV. Aphid inoculated plants produced systemic mosaic symptoms and similar results regarding aphid transmission of CMV have also been previously reported by Palukaitis *et al.*, (1992)

Out of twenty plants eleven plants showed symptoms like systemic mosaics when healthy plants inoculated by infected sap. Only ten plants showed symptoms when virus transmitted through aphids. These finding showed that insect vectors play an important role in the transmission of CMV within a plant population.

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