Journal of Applied Horticulture, 16(1): 59-60, 2014

Physical properties and transmission of papaya ringspot virus

Isha Bhoyer, Mina D. Koche*, Santoshi Pudake and N.B. Ninawe

Department of Plant Pathology, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola-444104 (Maharashtra). India.
**E-mail: mdkoche@gmail.com*

Abstract

Experiment was conducted *in vitro* to see the different physical properties and transmission of papaya ring spot virus with different aphid species. The virus was found to be inactivated between temperature 50 to 55°C and between the dilutions of 10^{-3} to 10^{-4}. It remained viable upto 24 hours at temperature 28 to 30°C and 5 days at 6 to 8°C temperature. The virus was transmissible by five aphid species *Aphis gossypii* (Glover)*, Aphis craccivora* (Koch)*, Acyrthosiphon pisum* (Buczacki S. and Harris K.)*, Dactynotus carthami* (Hille Ris Lambers)*, Aphis nerii* (Boyer de Fonscolombe) in non persistent manner.

Key words: Papaya, ringspot virus, physical properties, aphid

Introduction

Papaya ringspot is one of the most economically important diseases of papaya and widely prevalent in all papaya growing states in India including Maharashtra and causes severe losses in papaya cultivation. During the survey of papaya in various locations of Vidarbha region reported that papaya ringspot virus (PRSV) caused 80 to 100 per cent damage to papaya cultivar Honeydew (Lokhande *et al.*, 1992). In Marathwada region, 79 per cent of disease incidence reported due to papaya ringspot virus (Yemewar and Mali, 1980). Papaya ringspot virus P-infection is typically characterized by the production of ringspot symptoms on fruits of infected papaya plant (Jensen, 1949). In addition to ringspot symptoms, PRSV produces a range of other symptoms such as leaf mosaic and chlorosis, water soaked oily streaks on the petiole and upper part of trunk, distortion of young leaves that sometimes results in shoestring like symptoms, stunting of infected plants and flower abortion. Consequently, fruit production can be severely decreased and fruit sugar level reduced by 50 % or more. The fruit size and quality is much affected resulting decrease in market value.

The losses caused due to papaya ringspot virus infection, can be minimized by aquiring knowledge about the vector responsible for viral disease transmission, host range of papaya ringspot virus, physical properties of virus, susceptible/ resistant papaya cultivars to PRSV. Keeping in view the significance of transmission mode of PRSV, its host range, physical properties, response of different available varieties of papaya to PRSV infection, aphid transmissibility of PRSV, the present investigation on PRSV strain prevalent in this area was carried out.

Materials and methods

Source of inoculum: The young leaves of papaya plants showing mosaic, leaf distortion, shoestring symptoms were collected from Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola.

Thermal inactivation point (TIP): Standard leaf extract was prepared in 1:1 ratio of infected leaf tissues of diseased plant to 0.1 M phosphate buffer, pH 7.5 containing sodium sulphite 0.5%. Aliquots of 2 mL standard leaf extract were pipetted into a set of 12 thin walled test tubes of about 1 cm diameter. Each test tube was then individually exposed to temperature starting from 40°C to 95 °C for 10 minutes in a metallic constant temperature water bath. All the treated extracts were then inoculated on the leaves of healthy young papaya plants at six leaves stage by conventional leaf rub method. Similarly, a set of 10 plants of assay host were inoculated with untreated extract which served as control. Numbers of local lesions per leaf were worked out.

Dilution end point (DEP): The standard leaf extract prepared from infected leaves of papaya was diluted in 10 fold series of dilutions *viz.,* 1:10 (10^{-1}), 1:100 (10^{-2}), 1:1000 (10^{-3}), 1:10000 (10^{-4}), 1:100000 (10^{-5}), 1:1000000 (10^{-6}) by adding required quantity of sterilized distilled water. A set of 5 plants were inoculated separately for each dilution treatments. Standard leaf extract without dilution served as control. Observations were recorded periodically for expression of symptoms for each dilution treatment.

Longevity *in vitro* (LIV): In order to know the *in vitro* longevity of the virus, standard leaf extract was kept at room temperature 28 to 30°C and second lot in refrigerator at 6° to 8°C temperature. The plants inoculated with extract immediately after extraction period served as control. Whereas, the sap from test tubes stored at room temperature and refrigerated condition was inoculated at a fixed period intervals *i.e.* 0, 4, 8, 12, 24 h and average number of local lesions were per leaf were recorded on 2, 3, 4, 5, 6 and 7 days.

Aphid transmission: Five aphid species *viz., Aphis gossypii* (Glover), *A. craccivora* (Koch), *Acyrthosiphon pisum* (Buczacki S. and Harris K.), *Dactynotus carthami* (Hille Ris Lambers) and *A. nerii* (Boyer de Fonscolombe) were collected directly from cotton, cowpea, safflower and calatropis respectively. In all the transmission tests, only adult apterous aphids were used. Adult apterous aphids from each species were given a pre-acquisition fasting period of 1 hour under darkness by keeping them in sterilized petridishes. Pre-acquisition fasting period was followed by an acquisition feeding period of 5-10 minutes on young PRSV infected leaves of papaya plant (cv. Honeydew). Then the aphids were gently picked with moistened camel hair brush No. 0 and collected in another sterilized petridish and then transferred to

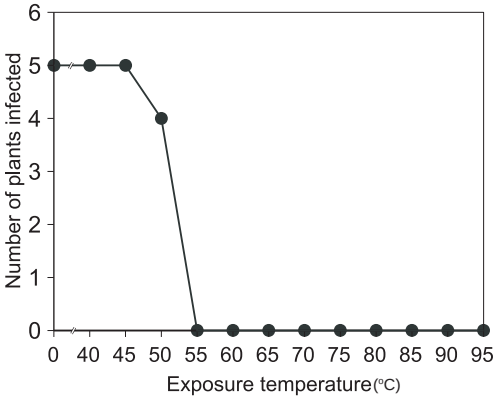

Fig. 1. Thermal inactivation point of papaya ringspot virus (5 plants inoculated in each treatment).

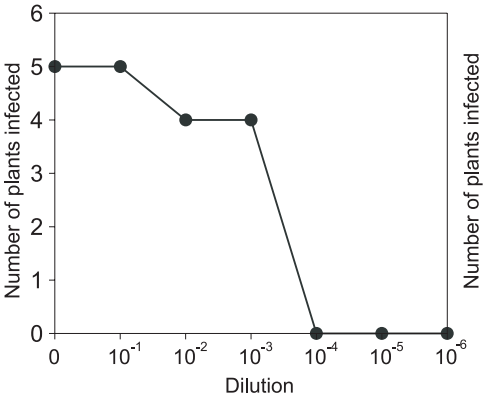

Fig. 2. Dilution end point of papaya ringspot virus (5 plants inoculated in each treatment).

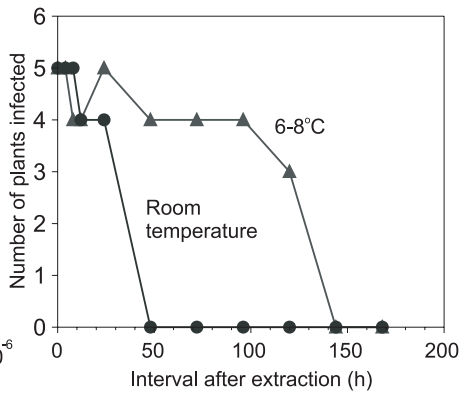

Fig. 3. Longevity *in vitro* of papaya ringspot virus (5 plants inoculated for each treatment).

the young healthy six leaves stage test plants of papaya with the help of another moistened camel hair brush.

For aphid transmission study 10 healthy seedlings of papaya were used. 10 viruliferous aphids were released on each test plant and were allowed to feed overnight and then killed by spraying 0.02 per cent dimethoate insecticide on test plants. All the test plants were maintained in an insect proof cage house and observations were recorded on their transmission ability and types of symptoms developed on the test plants.

Results and discussion

Physical Properties: The result of physical properties revealed that the virus isolate could not withstand to the temperature of 55 °C and the plants inoculated with this treatment failed to produced any symptoms of the disease (Fig. 1). Above this temperature *i.e.* from 60 to 95 °C, no symptoms were observed on test plants. This indicated that thermal inactivation point of the virus under investigation lies between 50 to 55°C temperature. The present virus could retain the infectivity up to 50 °C temperature only. Wu *et al.* (1983) also got similar observations on PRSV and he reported the TIP of PRSV in between 50 to 55°C. However, Rosa and Lastra (1983) reported the TIP in case of PRSV 57°C and 52 to 54°C, respectively. This may be due to strainal variations.

The crude sap diluted to 10^{-1} to 10^{-3} (1:10 to 1:1000) dilution produced mosaic, leaf distortion and shoestring symptoms, the typical symptoms produced by papaya ringspot virus (PRSV), on all the test plants inoculated (Fig. 2). Whereas sap diluted to 10^{-4} (1:10000) dilution or more failed to produce any symptoms of the disease on inoculated test plants. The results thus indicated that the dilution end point of papaya ringspot virus under study was found between 10^{-3} to 10^{-4} dilution. Dethe (2000) reported that dilution end point (DEP) of all the tested strains of PRSV *viz.*, PRSV-S, PRSV-M_1, PRSV-P, PRSV-Y was found between 10^{-3} to 10^{-4}.

Papaya ringspot virus (PRSV) under investigation retained infectivity for 24 hours at room temperature (28 to 30°C) and upto 5 days at 6 to 8°C temperature. Virus lost its infectivity within 2 days at room temperature and after 5 days at 6 to 8°C temperature (Fig. 3). Dethe (2000) reported that the longevity *in vitro* of all tested strains *viz.*, PRSV-S, PRSV-M_1, PRSV-P, PRSV-Y was found upto 28 hours. The results of aphid transmission of the virus causing Papaya ringspot virus (PRSV) are depicted in Table 1. It was found that five aphid species *viz.*, *Aphis gossypii* (Glover), *A. craccivora* (Koch), *Acyrthosiphon pisum* (Buczacki and Harris), *Dactynotus carthami* (Hille Ris Lambers), *A. nerii* (Boyer de Fonscolombe) were able to transmit the virus in non-persistant manner from papaya to papaya. *Dactynotus carthami* was found to be most efficient and showed (100%) transmission of PRSV followed by *A. gossypii* (90%), *Acyrthosiphon pisum* (90%), *A. craccivora* (80%) and *A. nerii* (70%). All test plants used in aphid transmission study showed a typical mosaic, leaf distortion, shoestring symptoms during the incubation period of 13 to 14 days. Mali (1987) reported that PRSV was transmitted by *A. gossypii, A. craccivora, Acyrthosiphon pisum, A. nerii, D. sonchi, MelanoA. sacchari* and *Rhophalosiphum maidis* whereas, *Myzus persicae* was most efficient vector. Dethe (2000) reported that the four strains *viz.*, PRSV-S, PRSV-M_1, PRSV-P and PRSV-Y were found to be transmissible by *Acyrthosiphon pisum, Dactynotus carthami, Myzus persicae, A. gossypi* and *Aulacarthum solani* in non persistent manner.

Table 4. Aphid transmission study of papaya ringspot virus. Test plants showed mosaic, leaf distortion, shoestring symptosm with all aphid speceis

Aphid species	Transmission (%)	Incubation period (days)
Aphis gossypii	90	14
Aphis craccivora	80	13
Acyrthosiphon pisum	90	13
Dactynotus carthami	100	14
Aphis nerii	70	14

References

Dethe, D.W. 2000. *Further Studies on Papaya Ringspot Virus (PRSV) Isolates Occurring on Papaya*. M.Sc. Thesis (Unpub.) MAU, Parbhani, India.

Jensen, D.D. 1949. Papaya virus diseases with special reference to papaya ringspot. *Phytopathol.,* 39: 191-211.

Lokhande, N.M., P.G. Moghe, A.D. Matte and B.J. Hiwase, 1992. Occurrence of papaya ringspot virus (PRSV) in Vidarbha region of Maharashtra. *J. Soils and Crops*, 2(2): 36-39.

Mali, V.R. 1987. *Research Review Report on Plant Pathology (Virology)*. Maharashtra Agric. Univ. Joint Agresco Rept. 1987: 14-16.

Rosa, M.De and L.R. Lastra, 1983. Purification and partial characterization of papaya ringspot virus. *Phytopath. zeitschrift*, 106(4): 329-336.

Wu, F.C., X.X. Peng and S.H. Xu, 1983. Preliminary studies on identification, purification and properties of papaw ringspot virus in South China. *Acta Phytopathologia Sinica*, 13(3): 21-28.

Yemewar, S.I. and V.R. Mali, 1980. On the identity of sap transmissible virus of papaya in Marathwada. *Indian J. Mycol. Plant Pathol*., 10(2): 155-160.

Received: October, 2013; Revised: March, 2014; Accepted: April, 2014