

Pepper Mild Mottle Virus

Elizabeth M. Lamb, Assistant Professor, Horticultural Sciences Department, Indian River Research and Education Center, University of Florida, Fort Pierce, FL 34945, Scott Adkins, Research Plant Pathologist, USDA-ARS/United States Horticultural Research Laboratory, Fort Pierce, FL 34945, Kenneth D. Shuler, Vegetable Extension Agent IV, Palm Beach County West Palm Beach, FL 33415, and Pamela D. Roberts, Assistant Professor, Plant Pathology Department, Southwest Florida Research and Education Center, University of Florida, Immokalee, FL 34142

Florida Cooperative Extension Service/ Institute of Food and Agricultural Sciences/ University of Florida/ Christine Waddill, Dean

Pepper mild mottle virus (PMMoV) occurs worldwide in field-grown bell, hot and ornamental pepper species. It has also been found in greenhouses in pepper cultivars in Canada and Spain where greenhouse production practices are ideal for rapid spread of the disease. PMMoV has been identified in commercial bell pepper fields in Florida, in Southwest Florida in January 2000 and then in Southeast Florida in December 2000. Disease incidence (the percentage of plants infected) of up to 30% was estimated in the Florida outbreaks. Because foliar symptoms can be mild, infected plants may not be noticed until the fruit symptoms are evident, resulting in spread to neighboring plants and higher yield losses.

Causal agent and symptoms

PMMoV is in the tobacco mosaic virus (tobamovirus) family. It is spread by mechanical transmission and by infected seed but cannot be transmitted by insects. The virus is identified by the symptoms it causes on indicator host plants, serological methods such as ELISA and the morphology of inclusion bodies induced by the virus in host plant cells. A reputable laboratory should be used to ensure accurate identification of the virus.

Symptoms caused by PMMoV on pepper plants may vary between cultivars. Infected leaves are frequently puckered and mottled yellow or light green (Figure 1). Leaf symptoms are more evident on younger leaves. Plants can be stunted, especially when the infection occurs early in the plant's development (Figure 2). Although infected fruit can be somewhat reduced in size and show variations in color (mottling and color changes at maturity), the most obvious symptom is the distorted or lumpy appearance of the fruit (Figure 3). Older fruit may develop brown streaks or splotches.

Most cultivars and species of pepper (genus *Capsicum*) are susceptible to PMMoV. However, this virus does not affect tomato, eggplant or tobacco, which are in the same family (Solanaceae).

Control

Avoidance is the best means of control. Only seed tested and determined to be free of virus should be planted. Infected seed can be treated with heat, acid, or trisodium phosphate but virus both on the seed surface and inside the seed must be removed to ensure freedom from disease. Seed treatments can reduce seed germination even if done correctly. Although a gene for resistance has been identified, there are very few resistant field cultivars available in the US.

The virus enters the plant through microscopic abrasions or wounds. There are no chemical or biological control methods that can be used to control the disease once the plant is infected. The virus in association with plant sap can be present on skin, clothing, tools and equipment so infected plants should be handled as little as possible and infected fields should be staked, tied, harvested, sprayed, last to avoid spreading the virus to uninfected areas. Infected plants should be removed if elimination can be done without contact with healthy plants. A symptomless plant on either side of those removed should also be rogued, as it is likely that they are also infected. Some viruses can be spread through smoke so diseased plants should be disposed of by composting or burying rather than by burning.

Viruses in the tobacco mosaic virus family are notoriously easy to spread and difficult to eliminate. To reduce spread of the disease, anyone working with the plants should wash their hands with 70% alcohol or strong soap, also cleaning under the nails. Clothing should be washed as frequently as possible. Equipment should be washed then cleaned with 3% trisodium phosphate and not rinsed. Stakes from infected areas of the field should be discarded or soaked in 3% trisodium phosphate before being reused. Household bleach can also be used to clean equipment or stakes.

Diseased plant material will remain infectious until completely broken down. Tillage, increased irrigation and high temperatures encourage the breakdown of plant material in the soil. Any infected plant material in the soil can serve as a source of inoculum for subsequent crops so crop rotation should be prac-

ticed, if possible. Volunteer peppers and weeds, particularly those in the Solanaceae family (such as nightshades), should be removed to reduce possible sources of infections.

Accurate identification is important to avoid yield loss. Other pepper viruses can have similar symptoms but may be spread and controlled through different means. For example, pepper mottle virus, which has somewhat similar symptoms and is also found in Florida, is transmitted by aphids and not by mechanical means. Check with a laboratory that does virus testing, or with your local Cooperative Extension office for identification.



Figure 1. Symptoms of PMMoV in mature pepper leaves, showing puckering with mottled yellow or light green leaves



Figure 2. PMMoV symptoms in young pepper leaves. Plants can also be stunted.



Figure 3a. Fruit infected with PMMoV showing showing mottling and lumpy appearance on fruit.



Figure 3b. Fruit infected with PMMoV showing showing mottling and lumpy appearance on fruit.