Crop Advisory Team
Alert
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Initial sampling underway this summer in southwestern Michigan detected one tree with the virus.

Plum pox virus and what it means for Michigan

Contents

In July 2006, the plum pox virus was detected in a plum tree in southwestern Michigan during a routine sampling by the Michigan Department of Agriculture (MDA). This special newsletter contains information about this plant disease and efforts to stop its spread.

Michigan's plum pox virus survey and restrictions

Robin Rosenbaum and Mike Hansen

The Michigan Department of Agriculture has been surveying for plum pox virus (PPV) since 2000 as part of the Cooperative Agricultural Pest Survey (CAPS) program. CAPS is a combined effort by federal and state agricultural organizations to survey, detect and monitor agricultural crop pests and biological control agents. Survey for PPV was initiated in response to the identification of PPV in Pennsylvania in October 1999. Since 2000, the MDA has conducted PPV surveys every summer including a CAPS-funded survey in 2006.

In July 2006, PPV was detected in a plum tree sampled at the Southwest Michigan Research and Extension Center (SWMREC) in Benton Harbor, Michigan. On August 11, the USDA laboratory in Beltsville, Maryland confirmed that the sample was positive for the "D" strain of the plum pox virus. MDA staff immediately began to sample 100 percent of the non-cherry Prunus trees at SWMREC and will continue to identify and survey all non-cherry Prunus trees within a radius of 5 miles of the positive tree. The survey will include commercial orchards, homeowner orchards, abandoned trees and landscape plants known to be susceptible to this strain of PPV.

MDA's sampling effort will be supported by the USDA, Animal and Plant Health Inspection Service (APHIS) staff from the USDA's Plum Pox Survey Office as well as USDA inspectors from throughout the United States. It's estimated that 150,000 trees will need to be sampled as part of this delimiting survey. If an additional positive tree is found, the survey will be adjusted accordingly to provide a 5-mile buffer around each infected tree.

The USDA has issued Emergency Action Notifications (EAN's) to all landowners with commercial orchards identified within one mile of the infected tree. Additional EAN's will be issued to landowners with PPV-susceptible plants. The EAN provides notice that a landowner may not move propagative materials from PPV susceptible plants off of their properties. The MDA will soon initiate a quarantine of the same geographical area in accordance with Michigan's laws. The restrictions in the quarantine will parallel those issued in the EAN's.

Neither the EAN nor the MDA quarantine will hinder the harvest and sale of fruit in this area since PPV is not transmitted through the fruit or the seed. The plum pox virus poses no human health risk. ❐

History, biology and management of the plum pox virus

Mira Bulatovic-Danilovich, Bill Shane and Ray Hammerschmidt

The stone fruit disease plum pox was confirmed for the first time in Michigan in July 2006. Plum pox was first found in North America in Pennsylvania in September 1999. The Michigan Department of Agriculture (MDA) has participated in a national surveillance program for plum pox virus (PPV) since 2000. The discovery of PPV in southwestern Michigan was the result of this ongoing survey. The USDA's Animal Plant Health Inspection Service (APHIS) is also involved in the detection effort and determining the spread of plum pox in the United States.

Symptoms

The virus causes chlorotic rings on the fruit and leaves of infected plants. Fruit of infected plants may be of poorer quality and distorted. Symptoms vary depending on the plant type, variety, condition of the plant, time of year and the length of time the plant has been infected. Many trees may not show symptoms for the first few years following first infection. Symptoms on mature peach fruit consist of chlorotic rings or line patterns. Apricot and plum fruit will often be bumpy. European plum varieties can develop red discolored areas and drop prematurely whereas Japanese plums show ring spot symptoms. The D strain can cause severe necrotic spots on leaves of some plum varieties; peaches may have chlorotic spots and streaks, and apricot leaves typically show only mild symptoms. Leaf symptoms are more easily seen in spring.

PPV symptoms are sometimes difficult to distinguish from other diseases and may be confused with rusty spot of peaches and nectarine as well as insect-related problems such as damage from thrips, white apple leafhopper and San Jose scale. (See color images of "look alikes" and PPV symptoms on the next two pages of this newsletter.)

Peaches are susceptible to plum pox and are worth about ten million dollars in annual income to Michigan growers.

History

Plum pox, also called Sharka, is considered one of the most serious virus diseases of stone fruit in Europe. The cradle of the disease is southeastern Europe. Early reports indicate Macedonia (part of former Yugoslavia) as the place where the first disease symptoms were observed as early as 1910. Growers in Bulgaria started reporting seeing pox on the plums during 1915-18. Bulgarian researcher Atanasoff was the first to write about the disease and its virology in his report 'Sarka po slivite' (Pox of Plums) in 1932. Since then, the disease spread slowly until after World War II. By the mid-1980's, it had spread to most of Europe with the exception of Netherlands, Belgium and Switzerland where it was presumably eradicated. By the late 1980s it had spread to Cyprus, Egypt, Syria and India. In Europe, there are some 100 million trees infected presenting a serious economic problem. Susceptible varieties can have up to 100 percent crop loss due to diminished quality or massive fruit drop about 10 days prior to harvest. In 1992, it was found in Chile in the Western Hemisphere.

Plum pox was first found in North America in Pennsylvania in October 1999. The USDA launched an extensive survey and eradication effort that eventually stretched over three counties. Plum pox was discovered in eastern Ontario and Nova Scotia in 2000 and western New York in early July 2006. PPV has apparently been eradicated from Nova Scotia. The USDA has pursued a vigorous policy of detection and eradication in the United States.

What is plum pox?

Plum pox is caused by a virus from the genus *Potyvirus*, one of the largest groups of plant viruses. It is the only known potyvirus infecting stone fruit *Prunus sp.* Four strains of PPV have been identified in the world. These strains are: PPV-M, PPV-EA, PPV-C and PPV-D. The most prevalent strain in central, eastern and southern Europe is strain M that infects peaches, plums and apricots. It is easily transmitted by aphids and, in certain varieties, by seed as well. It is considered to be the epidemic strain of the virus.

Strain EA is known to exist only in northern Africa. It will infect apricots. Strain C is probably the most devastating strain due to the wide range of species that can be infected. It is known as "cherry strain" since the natural host range includes sweet and sour cherries. It was isolated from the sour cherry trees in Moldova. It could be very easily

Color images for
History, biology and management of the plum pox virus

Premature fruit drop off PPV-infected plum tree cv. Cacanska rana (Cacak's Early).

Plum pox virus symptoms

At left, typical plum pox virus (PPV) symptoms on plum leaves - concentric circular discoloration and mottling.

PPV symptoms on the plum fruit cv. Cacanska rana (Cacak's Early).

Plum pox look alikes: Dieases and insects creating similar symptoms or damage

Rusty spot symptoms of powdery mildew (*Podosphera* sp.) on peaches and nectarines can be confused with PPV.

At far right, feeding damage from thrips on plum fruit also looks similar to PPV.

Color images for
History, biology and management of the plum pox virus

Plum pox look alikes

Several symptomps of bacterial canker (*Pseudomonas* sp.) resemble PPV as shown in these photos of infected plum fruit and leaves.

Images provided by Mirjana Bulatovic- Danilovich and William Shane, Michigan State University.

transmitted onto other *Prunus sp.* by inoculation. It was wide spread in central and eastern Europe.

PPV-D strain is widely spread throughout western Europe. This is the only strain found in the Western Hemisphere, first in Chile, then in Pennsylvania and consequently in Canada, New York and Michigan. This Dideron or "D" strain of the virus infects peaches, nectarines, plums and apricots **but not cherries**. Research has shown that it is not seed-transmitted. The D strain is less aggressive than the M and EA strains. Numerous cultivated and weed annual plants can become artificially infected with PPV, but never have been shown to be a risk to stone fruit. Extensive surveys in Pennsylvania in areas adjacent to PPV-infected orchards provided no evidence that PPV has moved into wild species.

Biology

Infected peach, nectarine, plum and apricot trees are the primary source of PPV inoculum. The virus is spread to new areas by moving uncertified infected plant material through budding, grafting and transplanting, and by migrating aphids. Aphids are effective for spreading PPV within a tree and to adjacent trees. Aphids have several generations per year and have winged forms for movement from tree-to-tree.

Spread by aphids over long distances is less common. Natural barriers such as hills and woods help to restrict spread. Several aphid species can serve as carriers for PPV. Among the most important species are the green peach aphid (*Myzus persicae*), leaf curling plum aphid *(Brachycaudus helichrysi)*, peach leafroll aphid *(Myzus varians)*, damson-hop aphid *(Myzus humili)*, thistle aphid that overwinters on plums *(Brachycaudus cardui)* and the spirea aphid (*Aphis spiraecola*) as well as many less commonly found in commercial stone fruit orchards.

Aphids common in stone fruit orchards generally have two to three generations per year and tend to be most abundant on lush foliage shortly after shuck split, especially during cool and wet springs. It is important to realize that some aphids such as cherry aphid *(Myzus cerasi)*, mealy plum aphid *(Hyalapterus pruni)* and non-aphid arthropods such as leafhoppers *(Edwardsonia plebei)*, lecanium scale *(Lecanium corni)* and plant bug *(Lygus pratensis)* **are not capable of transmitting the virus**.

Aphids obtain the virus while probing and feeding on infected plant tissue with a straw-like stylet for sucking up plant sap. The highest concentration of the virus is found in the cell sap of the leaf epidermal cells. When the aphid penetrates with its stylet into one of those cells, the virus is pulled into the stylet where it remains. Plum pox is a non-persistent virus, meaning that the aphid retains the virus in its mouthparts and foregut until its next feeding probe, usually less than one hour, and rarely as long as several hours. The virus is transmitted as soon as the aphid spears the cell with its stylet containing sufficient amount of virus obtained by the previous probing. An important point is that the virus does not circulate within the aphid, and it does not replicate itself while in the aphid's body. Infections spread slowly cell-to-cell within plant tissue from the point of initial aphid feeding. Gradually, the infection spreads throughout the entire tree, especially if

Several species of aphids, like this green peach aphid, are an important vector of plum pox virus.

List of known hosts of plum pox

Main hosts of concern	Other hosts	Artificially infected hosts (Plants artificially infected in a lab that may be less susceptible in nature.)
Apricots (*P. armeniaca*)	Wild plum (*P. americana*)	Flowering plum (*P. triloba*)
Common plum (*P. domestica*)	Cherry plum (*P. cerasifera*)	Manchu or Nanking cherry (*P. tomentosa*)
Japanese plum (*P. salicina*)	Dwarf flowering almond (*P. glandulosa*)	Purple leaf sand cherry (*P. x cistena*)
Peach (*P. persica*)	Black thorn (*P. spinosa*)	Sand cherry (*P. pumila*)
Nectarine (*P. persica* var. *nucipersica*)	Japanese flowering cherry (*Prunus serrulata*)	

Thus far, the only ornamental plant found to be infected naturally is *P. glandulosa* from one homeowner site in Pennsylvania.

aphids continue to feed on the tree.

When the disease is first introduced to an orchard, the spread from tree-to-tree is slow, because of the low probability that a feeding aphid will encounter the virus. The speed of PPV spread in an orchard increases greatly as the number of aphids and number of infected trees increases.

Management

Management strategies of plum pox are aimed primarily at preventing introduction by use of virus-tested clean nursery stock. Once detected, strict quarantine, eradication and ongoing surveys are the only useful strategies because a tree, once infected, will never be free of the disease.

Insecticide management strategies that keep aphid populations low may help to slow PPV movement in areas where PPV is rare, but may not be a good idea in some situations. Insecticide treatment can sometimes cause winged forms of the aphids to leave treated areas, taking the virus with them to infect new hosts. ❐

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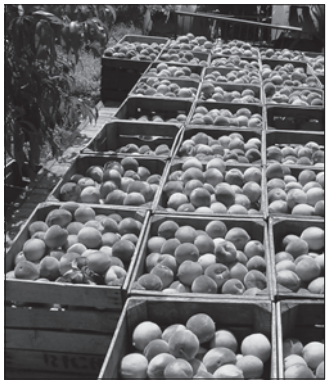
Potential impacts on Michigan's peach and plum industries

Mark Longstroth



Plum pox is a significant threat to the stone fruit industry in the United States. This plant virus does not affect people, only plants. Peach and plum trees are most at risk from the strain of the plum pox found in North America. This virus is considered the most serious virus disease of peaches and plums in Europe. Infected plants are typically destroyed to prevent the spread of the disease.

The Michigan peach industry is worth about ten million dollars in income to growers. Production is centered in Berrien and Oceana counties with almost 2,000 acres in each county. In these counties, peach production is an import part of the local economy. In Berrien County most of the fruit is sold as fresh fruit in Michigan and across the Midwest. Many Oceana County peaches are processed into frozen peach slices. Across Michigan, peaches are sold locally at farm markets. There are over 5,000 acres throughout Michigan on 470 fruit farms. Peaches represent an important crop on these farms, increasing the diversity of fruit crops planted, reducing the risk of total crop loss and spreading income over several sources.

The Michigan plum industry has declined about 50 percent in the last several decades with the decline of demand for both fresh and processed plums and prunes. Plums generate about one million dollars of income each year. About 180 growers farm an estimated 900 acres of plums. ❐

Questions and answers regarding plum pox

Robin Rosenbaum, Mike Hansen, Bob Tritten, Bill Shane and Mira Danilovich

The following questions were asked on August 16 at a public information session on plum pox held at the Southwest Michigan Research and Extension Center near Benton Harbor.

Q. What is the incubation period between injection by an aphid and when it can be detected in a laboratory? (How soon can the disease be detected in a laboratory after injection by an aphid?) There is no simple answer to this question. Certainly it would depend on the proximity of the infected source, aphid activity and the number of aphids infected and capable of vectoring the virus, weather conditions, etc. High temperatures will diminish the potency or concentration of the virus in the tissue, thus making it harder to detect. This particular strain D is not an epidemic strain. Once transmitted, it does not move rapidly through the plant's tissue and stays contained to the limb or two at the point of infection. Consequently, at the early stages of infection it would be quite possible to miss the virus' presence.

It may take considerable time before the virus is systemic and in reasonable high concentration to be detectable.

Q. What is the long-term reservoir for the disease? Infected trees harbor the virus over the winter. Aphids must continually go back to an infected tree as the virus persists in the insect only an hour or two.

Q. What's the threshold for positive in the 5-mile radius? Because of the nature of this virus, any positive find would trigger additional survey and evaluation. One positive tree is the threshold for identifying PPV and is used as a basis for regulatory decisions in the future.

Q. Is there a strategy for addressing homeowner and abandoned orchards in the survey process? Yes, MDA staff will drive the roads in the survey area to look for homeowner and abandoned orchards and will include them in the survey and any subsequent regulatory restrictions. There are also concerns about Prunus landscape plants other than fruit trees susceptible to PPV. Flowering almond is one example.

Q. What's the immediate future for the affected tree and trees in the area? MDA needs to complete the survey of the area before decisions can be made. The positive tree will be removed as soon as MDA determines that it no longer serves a useful purpose in the survey effort.

Q. Are there any PPV resistant varieties of stone fruit trees? Research has shown that there are some resistant varieties (See list on this page.).The USDA has developed a plum that is immune to plum pox virus, meaning that not only does it show no symptoms, but also the virus is unable to multiply in it. Researchers in several countries are developing immune varieties and root-stock. There are varieties that show little or no symptoms, but continue to harbor the virus. True immunity is needed.

Q. Can the Prosser facility in Washington State eliminate PPV with their processes? Prosser's charter is to take wood from desirable trees and clean it up using known methods for removing virus from stock. If there is a commercial quality fruit tree, Prosser can clean up the wood prior to moving the wood into a Virus Free or certified nursery.

Q. I've heard the Castleton variety mentioned in the New York PPV situation. What can you tell me about this variety? In the New York PPV situation, one tree of Castleton variety tested positive to the presence of virus. This is a European-type plum variety developed by Cornell University. It has no special susceptibility to PPV—this happened to be one of the varieties infected. Nurseries maintain a strict test for PPV in their plant material. There should be no concern about planting this or any other plum coming from a nursery with a certified testing program for PPV.

Q. Is there any threat to the breeding program at SWMREC? Will there be research lost? The current survey underway will reveal what research material must be eliminated to remove any risk. The Prosser facility will be used to test and verify the clean status of valuable advanced new perspective varieties from the peach breeding program.

Q. Can or should I propagate my trees this year? If you are propagating your own trees, you need to carefully consider the risk of using wood that has not been sampled and found to be negative for PPV. If you plan to send wood from your farm to a commercial nursery, remember that scionwood must be inspected prior to shipment. Commercial nurseries should be very careful not to accept uninspected wood into their nurseries as they could be inviting problems. Scionwood is regulated as nursery stock in Michigan. Contact the Michigan Department of Agriculture for their guidance. In some situations, they can test the material. ❒

PPV resistant varieties

Plums – Bluefre, Anna Späth, Burbank, Èaèanska lepotica, Èaèanska najbolja, Ersinger, Althans and Green Reneklode, Midora, DeMontford, Kirkes Pflaume, Mirabelle de Nancy, Opal, Oullins, pitestean, President, Ruth Gerstetter, Stanley, Sugar plum, Tuleu Gras, Valor, Valjevka, Vengerka Obileynaà.

Peaches – Andros, Coronado, June Berta, Ranger, Rio Oso Gem.

Nectarines – Crimson Gold, Fantasia and May Grand. Apricots: Badami, Early Orange, Harcot, Nanno, Stella.

Keeping up with plum pox

Print publications can quickly become out-of-date. MSU Extension will maintain links and updates related to plum pox on the Internet at: http://ipm.msu.edu/plumpox.htm

If you find something suspicious on a susceptible host plant, please contact your county MSU Extension office, regional Michigan Department of Agriculture office, or MSU Diagnostic Services (517-355-4536).

Seasonal crop and pest updates and alerts are published each growing season by the Fruit Crop Advisory Team (CAT) Alert at: http://www.ipm.msu.edu/fruit-cat.htm

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