Plum Pox Virus In Ornamentals

Plum pox is a serious disease of Prunus species caused by a virus.

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This disease, also known as Sharka, was first reported occurring in plums in Bulgaria in 1915 and spread rather slowly northward through eastern Europe reaching the former Yugoslavia in 1935 and Hungary about 1941. After about 1950 the disease spread more rapidly reaching Germany in 1956, Poland and Russia in 1961, and France in 1970. The disease appeared in England in 1965, but was quickly eradicated successfully. However, from about 1970 onward the disease reappeared in English nurseries in imported rootstocks and now occurs throughout England. Spain was the most recent western European country to be invaded by Plum pox in 1984. Throughout Europe Plum Pox is considered the most devastating disease of stone fruits and it has been estimated that over 100 million European trees are infected. Unfortunately for the nursery industry, PPV can also infect many ornamental Prunus species. In 1992, plum pox symptoms were first detected in the western hemisphere in Chile. In October 1999, PPV (D-strain; see strain information below.) was positively identified for the first time in North America in peaches growing in Latimore and Huntington townships, Adams County, Pennsylvania ; and in 2000, PPV-D was detected in peaches growing in the Niagara area of Ontario, Canada. In the summer of 2007, one PPV infected tree was identified in Michigan and at two sites in western New York near Lake Ontario. The spread of PPV has been contained and the virus eradicated from Pennsylvania. Because of the serious threat PPV poses to

fruit production, all susceptible species including ornamentals will be subject to quarantines, stop-sales, and shipping restrictions imposed by domestic and foreign government agencies.

The following summarizes information from the scientific literature on PPV with the intention of informing the general reader about what PPV is, the symptoms it causes, host plants, how it spreads, and about control strategies.

Symptoms

Symptoms vary considerably with the host plant species, cultivar, age and nutrient status of the plant, and environmental conditions. In addition, different strains of PPV may cause different degrees of disease severity. Unfortunately, many trees fail to show symptoms for the first few years following the initial infection of the tree. In addition, trees are not uniformly infected in all branches, making detection difficult. Therefore, the lack of symptoms is not proof that a plant does not have the disease. When symptoms do occur, however, they are frequently very diagnostic and easily recognized.

Diagnostic Leaf Symptoms

- mild light green discoloration bordering the leaf veins (vein yellowing)
- chlorotic light green or yellowed rings.

These symptoms may be barely visible to the eye or obvious depending on factors described above.

Diagnostic Fruit Symptoms On Peach And Apricot

- lightly pigmented chlorotic rings or line patterns
- deformed fruit
- necrotic areas on fruit (apricot)
- the internal stone may have white rings on its surface (apricot)

Diagnostic Symptoms On Plums

- infected fruits drop prematurely in some cultivars
- fruits develop darker rings or spots on the skin
- fruits are severely deformed
- reddish discoloration of the flesh

Host Range

Plant viruses are named according to the plant host in which they are first identified and the common symptom, hence the name plum pox virus or PPV. The name, however, does not indicate its complete plant host range. PPV infects plums, peach, nectarines, apricot, almond, cherry, and wild Prunus species. European scientists have reported that privet (*Ligustrum vulgare*), walnut (*Juglans regia*) and euonymus (*Euonymus europea*), are susceptible. Under laboratory conditions, scientists have also been able to infect a very large number of wild native and introduced weed species, including herbaceous plants, but it is not known what role any of those plants play in PPV survival. *P. serotina* (black cherry) could serve as a wild host in Pennsylvania (see below).

The following plants have been found to be susceptible to Pennsylvania strains (See Damsteegt et al. 2007):

Graft and aphid inoculated	**Aphid inoculated**	**Graft inoculated**
P. angustifolia Chickasaw plum	*P. cerasifera* Cherry plum	*P. blireana*
P. armeniaca Apricot	*P. domestica* subsp. *insititia* Bullace plum	*P. cerasifera* 'Myrobalana' and 'Thundercloud' plum
P. avium 'Mazzard'	*P. dulcis* 'Butte' and 'Mission' Almond	*P. fruticosa* European dwarf cherry
P. cistena Purple leaf sand cherry	*P. humilis* Humble bush cherry	*P. glandulosa* 'Rosea Plena' Dwarf flowering almond
P. davidiana David's peach	*P. laurocerasus* 'Schipkaensis' cherry laurel	*P. hortulana* Wild goose plum
P. domestica 'Brompton' Garden plum	*P. mume* Japanese apricot	*P. ilicifolia* Holly leaf cherry
P. emarginata Bitter cherry	*P. salicina* Japanese plum	*P. incam* 'Okame' Flowering cherry
P. incam 'Okame' Flowering cherry	*P. serrulata* Japanese flowering cherry	*P. incisa*
P. mahaleb Mahaleb cherry	*P. spinosa* Blackthorn, sloe	*P. laurocerasus* 'Otto Luyken' cherry laurel
P. maritima Beach plum		*P. lyonii* Catalina Isl. Cherry
P. nigra Canadian plum		*P. maackii* Manchurian cherry
P. padus European bird cherry		*P. mexicana* Mexican plum

P. pensylvanica Pin cherry		*P. sargentii* Sargent's cherry
P. pumila var. *besseyi* Western sand cherry		*P. subhirtella* 'Pendula' Equinox cherry
P. pumila var. *depressa* Eastern sand cherry		*P. tenella* Dwarf Russian almond
P. serotina Black cherry		*P. yedoensis Yoshino* flowering cherry
P. serrulata 'Kwansan' cherry		
P. triloba Flowering almond		
P. virginiana Chokecherry		
P. virginiana var. *demissa* Western chokecherry		

P. cerasus Sour (tart) cherry and P. x 'Snofozam' (Snow Fountains) Snow Fountain cherry were not susceptible, despite repeated inoculations.

Characteristics and Mechanisms for Spread

Plum Pox Virus is considered a virus species in the genus Potyvirus in the family Potyviridae. Some well known relatives of PPV are potato virus Y, bean common mosaic virus, maize dwarf mosaic virus, and watermelon mosaic virus. These are all transmitted by aphids. In Europe, plum pox virus is known to occur in different forms or strains (PPV-D, PPV-M, PPV-C, and PPV-EA). At this point in time, all PPV isolates occurring in North and South America are related to the PPV-D strain.

Short Distance Spread Within Orchards And Nurseries

In natural settings such as orchards, PPV is spread only by aphids. About 12-15 species of aphids reported to transmit PPV occur in the fruit growing region of southeastern Pennsylvania. One of the most efficient vectors, the green peach aphid (*Myzus persicae*) colonizes peaches and other stone fruits; and the second most efficient vector, the spirea aphid (*Aphis spiraecola*), is a common migrant into stone fruit orchards in Pennsylvania (Wallis, et al. 2005) Therefore, the potential exists for aphid spread of PPV.

The mechanism by which aphids transmit PPV is called non-persistent transmission. Once the aphid

probes into an infected plant and acquires the virus, the virus can only be transmitted by the aphid for a short time (minutes). Aphids make two kinds of probes on leaf surfaces, test probes and feeding probes. To determine whether the plant is a good food source, the aphid will make a test probe for only a few seconds (Feeding probes may last for hours.). Immediately following a short test probe the aphid may withdraw the stylet, fly to another plant, and test probe that plant. Rapid transmission of non-persistently transmitted potyviruses, including PPV, occurs during aphid test probes and not during the longer feeding probes. Aphids probing in an infected cell can transmit the acquired virus only to the next cell they feed on. The aphid cannot feed a single time on an infected plant and then transmit virus to several other healthy plants. Each aphid must feed directly on an infected plant, acquire sufficient virus, and then fly immediately to the next plant in order to effect a transmission. Because of this, aphids are thought to spread PPV from leaf to leaf or branch to branch while test probing a single tree resulting in multiple infection sites on one tree.

Long distance spread

Long distance spread of PPV is by movement of infected plants or plant parts by humans. Movement of infected nursery stock, seedlings, root stocks, or budding material are all implicated. Buds taken from infected trees will carry the virus and transfer the virus when grafted to healthy trees. Aphids can also acquire PPV after feeding and probing on fruit harvested from infected trees and transmit the virus to healthy *Prunus* seedlings (Gildow, et al. 2004). Therefore, strategies to prevent PPV spread must also consider movement of infected fruit. Although long distance spread by flying aphids is possible, it is thought to be unlikely because aphids lose non-persistently transmitted viruses when they probe on any non-*Prunus* species; and other potyviruses, like PPV, become non-infectious in the aphid usually within an hour after acquisition.

Control

Strategies for controlling PPV in Pennsylvania involves detecting and destroying infected plants in order to eliminate the virus.

Exclusion

APHIS (Animal and Plant Health Inspection Service of the USDA) is responsible for testing all imported nursery stock for a range of pathogens and especially for those that are not known to occur in the United States. Only pathogen-free material is released for commercial use. The occurrence of PPV in Pennsylvania highlights the importance of testing imported nursery materials and not bringing

plant material into the U.S. without having it first tested.

If the disease is localized to a small area, it may be contained by quarantines preventing movement of infected plants out of that area. A quarantine was implemented October 21, 1999 for Huntington and Latimore townships in Adams County, Pennsylvania, by the Pennsylvania Department of Agriculture. Virus testing of Prunus nursery stock is necessary to prevent the long-range spread of PPV.

Eradication

Eliminating virus infected materials as quickly as possible, before it spreads, is the next objective. Virus diseased trees cannot be cured and the virus cannot be eliminated from individual trees. Therefore, it is necessary to destroy PPV-infected trees once identified because an infected tree will serve as a virus source for all surrounding susceptible species. Because PPV does not induce easily recognized symptoms for the first few years of infection, serological tests, such as enzyme-linked immuosorbent assay (ELISA), or even more sensitive tests involving nucleic acid probes for specific viral RNA sequences must be employed. Tissue from trees to be tested can be collected by growers or scouts. PPV is generally not evenly distributed throughout the tree. Some branches, leaves, flowers, or fruits of infected trees may contain detectable levels of virus while other parts of the same tree appear uninfected. Therefore when sampling individual trees for serological tests, several samples must be taken from each tree.

Once infected trees are identified, they must be destroyed. Because of the danger of undetected latent infections and the probability of aphid spread, all *Prunus* species within 500 meters of PPV infected trees are also removed. PPV can survive in all living parts of infected trees, even infected roots. Sucker shoots developing from infected root stocks are good sources of PPV. Therefore, once infected trees are removed it is important to kill shoots that emerge from infected roots left in the ground. Once trees are removed, they should be destroyed promptly so that aphids on them do not have the opportunity to move to neighboring trees. Fruit harvested from areas with known infected trees should be disposed of in landfills and not deposited in cull piles exposed to aphids.

Protection

Although, insecticides can reducing total aphid populations on trees, insecticides do not completely protect trees from aphid inoculation with PPV because it may only take one or a few aphids migrating from a source outside the orchard to test probe and inoculate a tree.

Because aphids lose the virus if they test probe a non-host plant, decreased infection rates may occur when susceptible plants are surrounded by a barrier crop of a non-host species in which the virus does

not multiply. In theory, Prunus species surrounded by several rows of a non-Prunus species might be protected from aphid spread from an adjacent wild or ornamental Prunus species

Current status of control successes

In Pennsylvania, PPV has been eradicated. No PPV was detected in wild indigenous *Prunus* species or weeds.

Testing for the Virus in New Plants

Sampling and testing should be done so that infected trees can be found and destroyed before they serve as a source of PPV for other trees. If a nursery specializes in or relies on the sale of Prunus species as an important part of business, it is suggested that 4-5 cuttings be taken during the winter as soon as it is possible to force growth from them. It is thought that 90 days of chilling in the field is sufficient dormancy to then be able to force growth. Force bud-break and send the samples in for testing. If sampling is done during the growing season, four to five twigs and attached leaves should be removed from a tree and placed together in a plastic bag with a **dry** paper towel. **Do not add water to the samples.** Use a separate bag for samples from each tree. Assign a label or code to each tree sampled. Keep a list of that information for later reference. Label the bags carefully so that when you receive the results, you will know exactly which result goes with each tree. While collecting samples, place them in a cooler, out of the sun. It is best to put some ice in the bottom of the cooler. Send the samples to the testing laboratory the fastest way possible.

Tree samples are being tested for PPV by the laboratories listed below. It is best to call the lab before sending samples so that they know samples are coming and also to obtain any additional guidelines for collecting and shipping samples.

Dr. Ruth Welliver
Pennsylvania Department of Agriculture
Bureau of Plant Industry
2301 N. Cameron St.
Harrisburg, PA 17110-9408
717-787-4843

Agdia, Inc.
30380 County Road 6
Elkhart, IN 46514
Phone: 1-800-622-4342

Email: testing@agdia.com

Further information, including photos of PPV symptoms .

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