Plant Disease and Insect Advisory

Entomology and Plant Pathology
Oklahoma State University
127 Noble Research Center
Stillwater, OK 74078

Vol. 7, No. 41 | http://entoplp.okstate.edu/Pddl/ | Oct 29, 2008

Pierce's Disease of Grape Identified for the First Time in Oklahoma

Damon L. Smith, Turfgrass and Horticulture Crops Extension Pathologist
Lisa Overall, Graduate Research Assistant, Entomology
Eric J. Rebek, Turfgrass and Ornamentals Extension Entomologist
Jennifer Dominiak-Olson, Plant Disease Diagnostician

Recently, a 'Concord' grape sample exhibiting symptoms of disease was submitted to the Oklahoma State University Plant Disease and Insect Diagnostic Laboratory by Casey Sharber, OSU Cooperative Extension horticulture educator for Canadian Co., Oklahoma. The sample was taken from one of four grape vines found in a home gardener's backyard. Leaf symptoms were consistent with those for Pierce's disease of grape, caused by the plant pathogenic bacterium *Xylella fastidiosa*. *Xylella fastidiosa* specific DNA tests were conducted in an effort to detect the pathogen in the diseased tissue. These tests were positive for the pathogen and subsequent genetic tests were performed to verify the strain of bacterium present. These tests confirmed the presence of the Pierce's disease strain of *X. fastidiosa*. Site-visits were then conducted by OSU Extension Specialists and additional samples were collected. Analyses of these samples confirmed that all four 'Concord' grape plants were infected with the Pierce's disease strain of *X. fastidiosa*. Pierce's disease has been found in California, Texas, and Florida in grape, but not in Oklahoma prior to this finding.

Symptoms of Pierce's disease are perennial and will appear late in the summer when weather conditions are predominately hot and dry, or when plants are under drought stress. Plants will exhibit stress, with wilting of shoots, and premature defoliation typically occurring (Fig. 1A). Plants will also yield no fruit or have limited fruit production with poor quality. Chlorosis and green fading colors will develop at the edges of leaves, which dry and turn brown. Some vines will have a 'matchstick' symptom where the leaves have dropped from the plant, but petioles remain attached (Fig. 1B). Marginal browning can take on an undulating appearance as it moves toward the veins of the leaf (Fig. 1C). A yellow to red-brown band may be present between the green and scorched areas of the leaves (Fig. 1C and D). Leaf symptoms of Pierce's disease can look very similar to drought stress symptoms, however, the yellow or red-brown band between green and scorched areas will be absent in vines suffering from drought stress.

Xylella fastidiosa is a gram-negative, fastidious, plant xylem-inhabiting bacterium. Typical of gram-negative bacteria, the cell wall contains endotoxins and, thus, most are pathogenic. Fastidious refers to the bacteria's need for specialized media for survival and growth outside of

plant xylem (Wells et al., 1987). Although various strains do exist, they are grouped as one bacterial species, *Xylella fastidiosa* Wells et al. (Huang and Sherald, 2004).

Xylella fastidiosa is not transmitted from plant to plant without an insect vector (Purcell and Hopkins, 1996). However, recent studies have shown that inoculation of trees by needle injection is possible (Sanderlin, 2005). The bacterium can also be transmitted through use of infected propagation material taken from infected grape vines (Robacker and Chang, 1992).

Xylella fastidiosa is known to cause symptoms in more than 100 plant species in almost 50 plant families yet is considered a "weak" or "opportunistic pathogen" (Schaad et al., 2004). Different strains can cause disease in different plants and in some cases inhabit the plant without causing symptoms. Common leaf scorch symptoms of shade trees are characterized by cell death of the leaves beginning at the leaf margins with a chlorotic band separating the dead from healthy tissue. *Xylella fastidiosa* subsp. multiplex causes disease in peach, plum, almond, elm, pigeon grape, sycamore, and other trees. *Xylella fastidiosa* subsp. *pauca* causes disease in citrus and coffee. *Xylella fastidiosa* subsp. *piercei* causes disease in grape, alfalfa, almond and maples (Schaad et al., 2004). A fourth, subsp. *sandyi*, is known to cause disease in oleander, daylily, Jacaranda, and magnolia (Almeida et al., 2008; Hernendez-Martinez et al., 2007). Researchers may refer to subsp. *piercei* as subsp. *fastidiosa* (Hernendez-Martinez et al., 2007). In Oklahoma, *X. fastidiosa* subsp. *multiplex* has been detected in elm (Olson et al, 2006), sycamore, giant ragweed, mulberry, and oak (Jen Olson, personal communication). Traditionally, the subsp. *piercei* and subsp. *pauca* were considered limited to warmer climates, having little threat to Oklahoma horticulture (Feil and Purcell, 2001). However, Pierce's disease caused by subsp. *piercei* has been detected in Texas (McGaha et al., 2007) and, as of this report, in Oklahoma in grape.

As mentioned previously, *X. fastidiosa* strains are primarily transmitted through xylem-feeding insects; including spittle bugs (Cercopidae), sharpshooters (Cicadellidae: Cicadellinae), cicadas (Cicadidae), and tube-building spittlebugs (Machaerotidae) (Almeida et al., 2005). The major vector of Pierce's disease and citrus variegated chlorosis, two economically important diseases caused by *X. fastidiosa*, is the glassy-winged sharpshooter, *Homalodisca vitripennis* (Germar) (formerly *H. coagulata* Say, Fig. 2). This insect vector, native to the southeastern U.S., possesses traits that allow it to transfer the bacterium at greater rates than sharpshooter and spittlebug species native to the western and southwestern U.S. Specifically, glassy-winged sharpshooter has high mobility, feeds on woody as well as non-woody plant stems, and feeds on 100 plant species in 30 families (Costa et al., 2006). Presently, this sharpshooter has not been found in Oklahoma and ongoing monitoring programs are in place. In general, the bacterium multiplies in and inhabits the foregut of sharpshooter vectors such as *Oncometopia* spp. (Fig. 3), thus after molting the insect loses the ability to transmit the bacterium. Further, the bacterium is not transferred from the female to their eggs (transovarial transmission) and if acquired by adult leafhoppers, is transmitted throughout the life of the vector (Almeida et al., 2005).

The source of the infection of the grape vines in Canadian Co., Oklahoma is not currently known. Contaminated propagation material could be to blame and investigation into the origin of the grape vines is on-going. The extent of spread of the Pierce's disease strain in the area is also not known. Further sampling of the surrounding area is likely. Various insects from the

site have also been collected in an effort to test for the presence of *X. fastidiosa* associated with potential vectors. These analyses will be completed in the near future.

Unfortunately, there is no chemical control or cure for Pierce's disease. If Pierce's disease is identified in a vineyard setting, affected vines should be removed and destroyed to limit spread of the pathogen to healthy plants. The only way to confirm whether a vine is infected by the pathogen that causes Pierce's disease is to submit samples to the Plant Disease and Insect Diagnostic Laboratory (PDIDL). The sample should include a cane with several symptomatic leaves attached. The leaves should be placed within a ziploc bag with no added moisture and mailed to the PDIDL. Be sure to include a completed sample form and check with your sample. Sample forms can be found at http://entoplp.okstate.edu/pddl/pdidl-form.pdf. The cost of the Pierce's disease test is $15 for ELISA (less sensitive) or $50 for PCR and sequencing (highly sensitive). Please specify which test you would like performed on the submission form. Any pertinent digital pictures should be sent to jen.olson@okstate.edu. Results for the Pierce's disease test are generally available in 3-5 business days.

References:

Almeida, R. P. P., F. E. Nascimento, J. Chau, S. S. Prado, C-W. Tsai, S. A. Lopes, and J. R. S. Lopes. 2008. Genetic structure and biology of *Xylella fastidiosa* causing disease in citrus and coffee in Brazil. Applied Environmental Biology. In Press.

Almeida, R. P. P., M. J. Blua, J. R. S. Lopes, and A. H. Purcell. 2005. Vector transmission of *Xylella fastidiosa*: Applying fundamental knowledge to generate disease management strategies. Annals of the Entomological Society of America. 98 (6): 775-786.

Costa, H. S., A. Guzman, R. Hernandez-Martinez, C. Gispert, and D. A. Cooksey. 2006. Detection and differentiation of *Xylella fastidiosa* strains acquired and retained by glassy-winged sharpshooters (Hemiptera: Cicadellidae) using a mixture of strain-specific primer sets. Journal of Economic Entomology 99: 1058-1064.

Feil, H. and A. H. Purcell. 2001. Temperature-dependent growth and survival of *Xylella fastidiosa* in vitro and in potted grapevines. Plant Disease. 85 (12). 1230-1234.

Hernendez-Martinez, R., K. A. de la Cerda, H. S. Costa, D. A. Cooksey, and F. P. Wong. 2007. Phylogenetic relationships of *Xylella fastidiosa* strains isolated from landscape ornamentals in southern California. Phytopathology. 97 (7): 857-864.

Huang, Q., and J. L. Sherald. 2004. Isolation and phylogenetic analysis of *Xylella fastidiosa* from its invasive alternative host, porcelain berry. Current Microbiology. 48: 73-76.

McGaha, L. A., B. Jackson, B. Bextine, D. McCullough, and L. Morano. 2007. Potential plant reservoirs for *Xylella fastidiosa* in South Texas. American Journal of Enology and Viticulture. 58 (3): 398-401.

Olson, B. R., J. Dominiak, S. v. Broembsen, M. Berg, and B. R. Bextine. 2006. First report of *Xylella fastidiosa* in Oklahoma. Plant Disease 90: 108.

Purcell, A. H., and D. L. Hopkins. 1996. Fastidious xylem-limited bacterial plant pathogens. Annual Review of Phytopathology 34: 131-151.

Robacker, C. D., and C. J. Chang. 1992. Shoot-tip culture of muscadine grape to eliminate Pierce's disease bacteria. Horticultural Science 27: 449-450.

Sanderlin, R. S. 2005. Cultivar and seedling susceptibility to pecan bacterial leaf scorch caused by *Xylella fastidiosa* and graft transmission of the pathogen. Plant Disease. 85 (5): 446-449.

Schaad, N. W., E. Postnikova, G. Lacy, F. M'Barek, and C. J. Chang. 2004. *Xylella fastidiosa* subspecies: *X. fastidiosa* subsp. *piercei*, subsp. nov., *X. fastidiosa* subsp. *multiplex* subsp. nov., and *X. fastidiosa* subsp. *pauca* subsp. nov. Systematic and Applied Microbiology 27: 290-300.

Wells, J. M., Raju, B. C., Hung, H-Y, et al. 1987. *Xylella fastidiosa* gen. nov., sp. nov: Gram-negative, xylem-limited, fastidious plant bacteria related to *Xanthomonas* spp. International Journal of Systematic Bacteriology. 37 (2): 136-143.

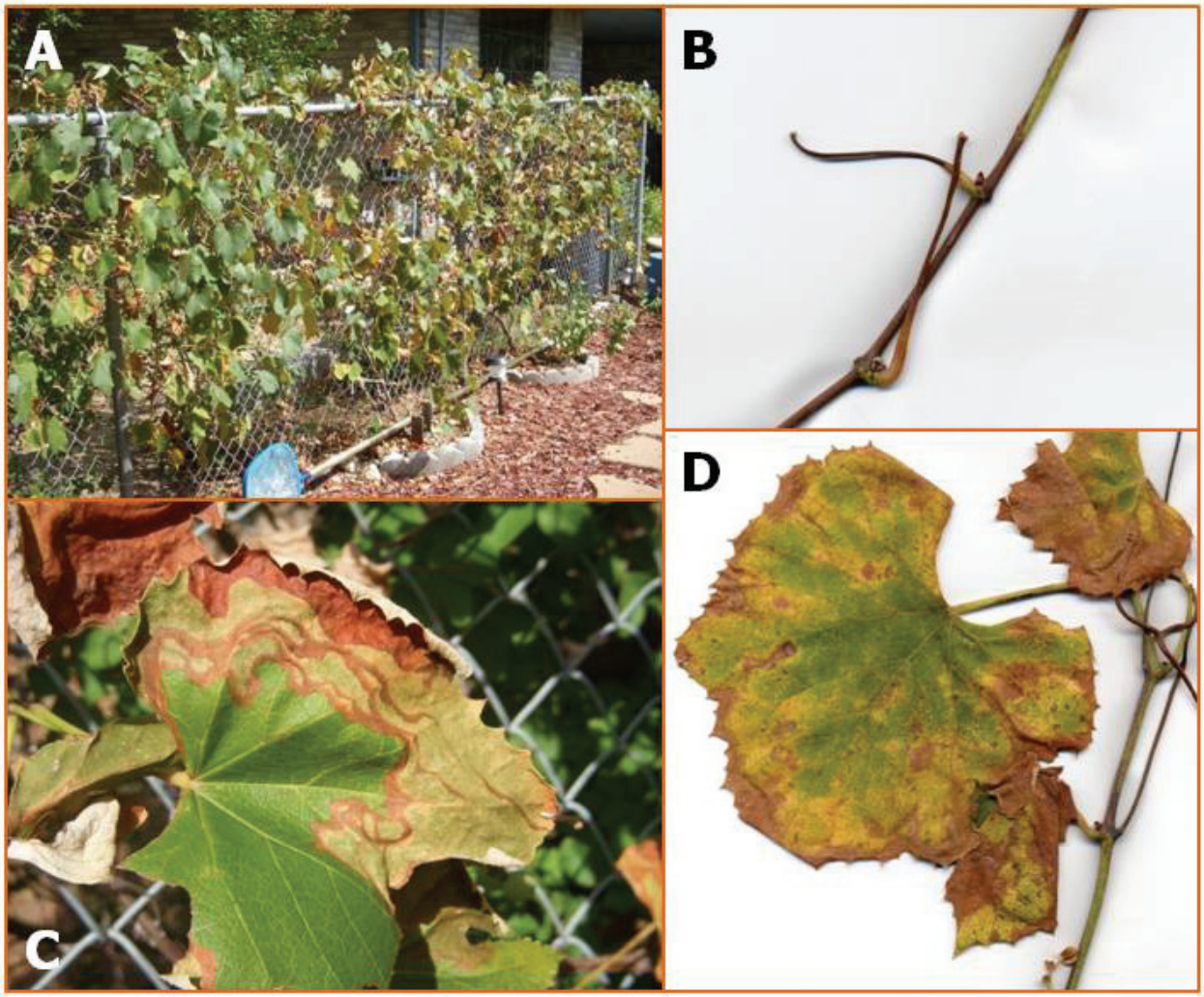

Fig 1. **A**. 'Concord' grape plants in a homeowner's backyard, exhibiting wilt symptoms, characteristic of Pierce's disease, photographed in early August. Photo Credit: Casey Sharber, Canadian Co. OSU Cooperative Extension Service. **B**. 'Matchstick' symptom of Pierce's disease, where the leaves have dropped from the plant and petioles remain attached, photographed in late October. Photo Credit: Rick Grantham, OSU Plant Disease and Insect Diagnostic Laboratory. **C**. 'Concord' grape leaf with characteristic leaf symptoms of Pierce's disease, photographed in early August. Photo Credit: Casey Sharber, Canadian Co. OSU Cooperative Extension Service. **D**. Symptoms of 'Concord' grape leaves with Pierce's disease, photographed in late October. Note green tissue separated from brown tissue by yellow borders. Photo Credit: Rick Grantham, OSU Plant Disease and Insect Diagnostic Laboratory.

Fig. 2. Glassy-winged sharpshooter, *Homalodisca vitripennis.* Photo Credit: Rick Grantham, OSU Plant Disease and Insect Diagnostic Laboratory.

Fig. 3. *Oncometopia orbona.* Photo Credit: Isabelle Lausiére, Texas A&M.

Dr. Richard Grantham, Director, Plant Disease and Insect Diagnostic Laboratory

Issued in furtherance of Cooperative Extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, Robert E. Whitson, VP, Dean, and Director for Agricultural Programs, Oklahoma State University, Stillwater, Oklahoma. This publication is printed and issued by Oklahoma State University as authorized by the Dean of Agricultural Sciences and Natural Resources.