Virus and Viruslike Diseases of Blueberries
Michigan State University Extension Service
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Issued December 2008
6 pages

Extension Bulletin E-3048 • December 2008

Michigan Blueberry Facts

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Virus and Viruslike Diseases of Blueberries

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Blueberries are affected by various virus and viruslike diseases. Viruses consist of minute infectious particles. They depend on the plant for multiplication and interfere with normal functioning of plant cells. They are spread via infected planting material and/or vectors such as insects and nematodes. Symptoms caused by phytoplasmas (specialized bacteria that colonize plant phloem) may resemble those of virus diseases. Diagnostic tests are available for pathogen detection.

Shoestring (Blueberry shoestring virus)

Shoestring is a widespread disease of blueberry in Michigan and New Jersey and has also been detected in Washington, Oregon and New Brunswick, Canada. It is caused by blueberry shoestring virus (BSSV). In Michigan, shoestring is common in old blueberry (cv. Jersey) fields.

Symptoms

Affected leaves are reddened and straplike (Fig. 1A) or crescent-shaped. Red oak-leaf patterns may also occur on the foliage (Fig. 1B). The most reliable symptom is red streaks on current or 1-year-old stems (Fig. 2A). Flowers may have a pink tinge or reddish streaks (Fig. 2B). Fruit remains reddish instead of turning blue (Fig. 2C). Yields are reduced, and bushes slowly decline over time.

Disease cycle

Blueberry shoestring virus may be introduced in a field with infected planting stock. The virus is spread by the blueberry aphid (*Illinoia pepperi*) (Fig. 3), which is common in the eastern United States but has not been found in the Pacific Northwest. Aphids pick up virus particles by feeding on infected plants and then transmit them while feeding on healthy plants. Transmission starts in the spring when aphids emerge and ends in the fall just before leaf drop. Aphids can move from infected bushes to neighboring healthy ones and may also be transported down rows by mechanical harvesters.

Figure 2. Symptoms caused by blueberry shoestring virus: **A)** red streaking on stems of blueberries; **B)** red-tinged flowers *(photo by Mark Longstroth)*; **C)** red-tinted berries that do not ripen normally.

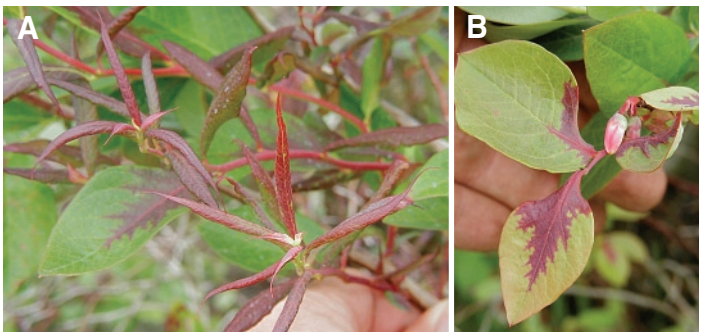

Figure 1. A) Reddish, straplike leaves caused by blueberry shoestring virus; **B)** leaf distortion and red oak-leaf pattern on leaves of blueberry shoestring virus-infected bush *(photos by Mark Longstroth).*

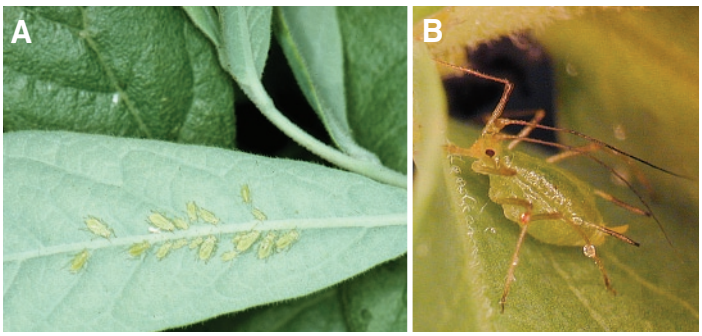

Figure 3. Blueberry aphid *(Illinoia pepperi)*: **A)** colony on underside of blueberry leaf *(photo by Jerry Payne, USDA-ARS, Bugwood.org)*; **B)** closeup of an aphid *(photo by Rufus Isaacs).*

Management

Plant certified virus-tested planting stock and choose resistant cultivars (e.g., Bluecrop). Remove and destroy infected bushes where possible. Monitor aphid populations and reduce spread of the disease with well-timed insecticide applications. Wash the harvester between fields to rid the equipment of virus-carrying aphids.

Tomato ringspot (Tomato ringspot virus)

Tomato ringspot is caused by tomato ringspot virus (ToRSV). It is a problem in the Northwestern blueberry-growing regions of the United States and has also been found in Michigan, New York, Canada and Chile.

Symptoms

Infected leaves are often malformed with numerous circular, chlorotic or necrotic spots that range from 2 to 5 millimeters (~1/16 to 3/16 inch) in diameter (Fig. 4A). These spots can also occur on canes. Other symptoms are shoot dieback, stunting and a slow decline leading to plant death (Fig. 4B). Flower clusters may develop abnormally (Fig. 5). This disease spreads slowly, about 1 meter (3 feet) per year.

Disease cycle

ToRSV is transmitted by dagger nematodes *(Xiphinema americanum)*, which feed on blueberry roots in the soil. The virus has a wide host range, including apples, grapes and raspberries. Weeds (e.g., dandelion, chickweed and narrow-leaved plantain) can act as reservoir hosts for the virus. The virus can also be seed-borne.

Management

If ToRSV has been confirmed, remove infected bushes. Before replanting, test soil for the presence of dagger nematodes, and fumigate if the test is positive. Buy certified virus-tested planting stock. Other important control approaches include maintaining good weed control and planting resistant cultivars (e.g., Bluecrop).

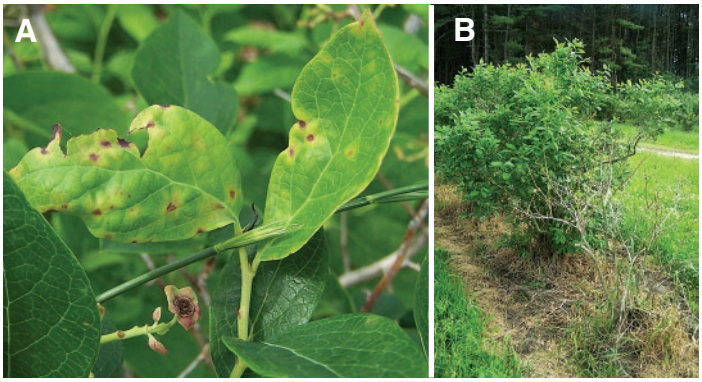

Figure 4. A) Foliar symptoms of tomato ringspot virus showing necrotic circular spots and leaf distortion on blueberry cv. Berkeley; **B)** dying plant (foreground) because of infection with tomato ringspot virus.

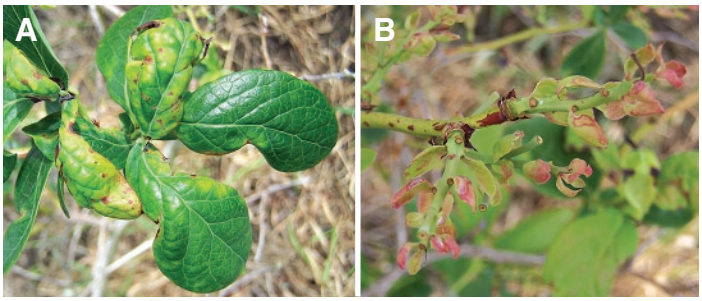

Figure 5. A) Curled, distorted blueberry leaves with reddish and necrotic spots; **B)** Abnormal flower cluster due to infection by tomato ringspot virus.

Necrotic ringspot (Tobacco ringspot virus)

Necrotic ringspot is caused by tobacco ringspot virus (TRSV). It occurs sporadically in the northern United States, Canada and Chile.

Symptoms

Leaves are deformed, curled or crinkled and covered with small reddish or necrotic spots (Figs. 6A and 7). Spots may fall out, giving a shot-hole appearance. Some cultivars show rosetting of terminal leaves or stem dieback. Infected bushes show a steady decline in growth and productivity over several years (Fig. 6B). Dying bushes may be found in patches in fields. The disease spreads slowly in a roughly circular fashion. Most cultivars are susceptible, but Jersey is resistant to the most common strain of the virus.

Disease cycle

The disease can be introduced into a field with infected planting stock and is transmitted by the dagger nematode *(Xiphinema americanum)*. The virus is acquired by the

Figure 6. A) Tobacco ringspot virus-infected blueberry leaves showing necrotic spots and crinkling; **B)** decline in blueberry bushes due to infection by tobacco ringspot virus.

nematode within 24 hours and is transmitted by both adult and larval stages. Weeds such as dandelion, chickweed and common plantain serve as reservoir hosts for the virus.

Figure 7. Leaf curling and spotting due to tobacco ringspot virus.

Management

Plant certified virus-tested planting stock. Maintain good weed control. If TRSV has been confirmed, remove and destroy symptomatic bushes. Before replanting, have soil tested for dagger nematodes, and fumigate if the test is positive.

Red ringspot (Blueberry red ringspot virus)

Red ringspot is caused by blueberry red ringspot virus (BRRV) and primarily occurs in the eastern United States. It has also been found in Michigan.

Symptoms

In early summer, small, red blotches (Fig. 8A) or ringlike spots (Fig. 8B) appear on green stems. In mid- to late summer, red to purple circular spots appear on older leaves first, then progress to younger leaves (Figs. 8C and 9). These spots are only visible on the upper leaf surfaces. In addition, light-colored blotches can develop on infected fruit.

Disease cycle

Infected cuttings are the likely source of infection in most cases. The disease does not appear to spread naturally in the field in the Pacific Northwest. In Michigan, where the disease spreads slowly, mealybug is thought to be the vector of BRRV. Cultivars Bluetta, Blueray, Burlington, Coville, Darrow, Earliblue and Rubel are susceptible, whereas Bluecrop and Jersey are considered resistant.

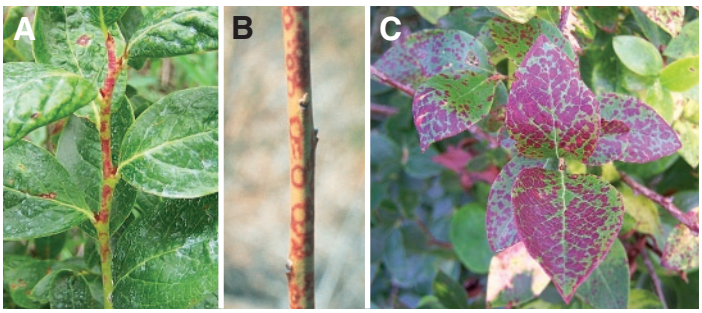

Figure 8. Symptoms caused by blueberry red ringspot virus: **A)** reddish blotches on blueberry stem; **B)** red ringlike lesions on blueberry stem; **C)** Purplish red spots on upper surfaces of leaves.

(Fig. 8B photo by Donald Ramsdell. Reprinted from Compendium of Blueberry and Cranberry Diseases, 1995, American Phytopathological Society, St. Paul, Minn.)

Management

Plant certified virus-free planting stock. Remove and destroy infected bushes. Planting moderately resistant cultivars can be effective at limiting the occurrence and spread of blueberry red ringspot virus.

Leaf mottle (Blueberry leaf mottle virus)

Leaf mottle is caused by blueberry leaf mottle virus (BLMV). It has been reported only in Michigan and New Brunswick, Canada.

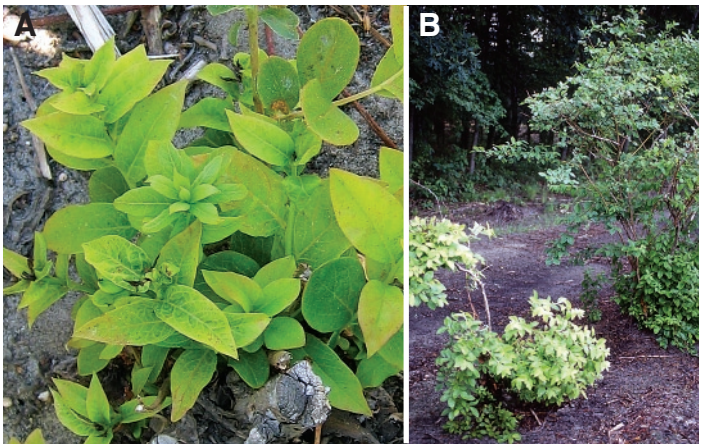

Figure 9. Symptoms of blueberry leaf mottle virus infection: **A)** small, pale green, rosetted and narrow leaves; **B)** pale green, stunted Jersey bush (on left).

Symptoms

Leaves show a mottling pattern and may be malformed or straplike (Fig. 9A). Jersey and Blueray plants have small, pale green, rosetted leaves (Figs. 9A and 10). Bushes may be stunted (Fig. 9B). Severely infected Rubel bushes show extensive dieback of stems with a small amount of regrowth at the base and produce little or no crop (Fig. 11A).

Disease cycle

The virus is transmitted via infected cuttings and infected pollen carried by honeybees (Fig. 11B). Bees can spread the virus, in infected pollen, from diseased to healthy bushes up to 1.6 kilometer (1 mile) away. Symptoms do not become apparent until 3 to 4 years after infection.

Figure 10. Yellowish, misshapen blueberry leaves are indicative of infection by blueberry leaf mottle virus.

Figure 11. A) Severe dieback of stems and leaf regrowth on blueberry (cv. Rubel) infected with blueberry leaf mottle virus; **B)** honeybee with pollen baskets on legs *(photo by Rufus Isaacs).*

(Fig. 11A photo by Donald Ramsdell. Reprinted from Compendium of Blueberry and Cranberry Diseases, 1995, American Phytopathological Society, St. Paul, Minn.)

Management

Plant certified virus-free planting stock. Remove and destroy infected bushes. If a field is known to have leaf mottle virus, do not move beehives from that area to other fields. Place beehives as far as possible from infected areas.

Mosaic (causal agent unknown)

Mosaic has been observed in most blueberry-growing regions. The cause is unknown, but the presence of double-stranded RNA in infected bushes suggests that a virus is involved. Diseased planting material is mainly responsible for introducing mosaic into commercial plantings. The disease is of relatively little concern.

Symptoms

Leaves exhibit a mottle or mosaic pattern that varies from light green to yellow or pink (Fig. 12). Symptoms may be irregularly distributed on infected plants and may not be apparent every year. Fruit on diseased bushes ripens late and is of poor quality. No resistant cultivars are known.

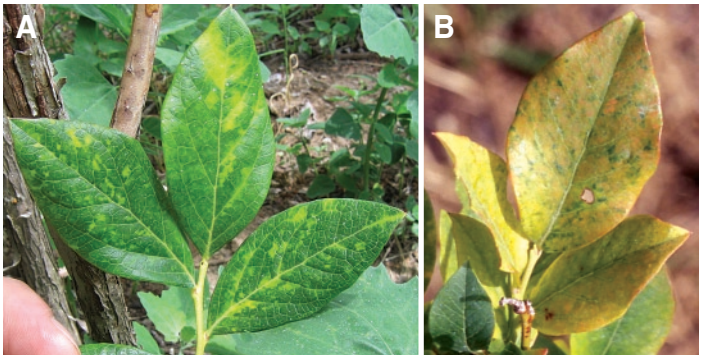

Figure 12. Mosaic symptoms on blueberry leaves: **A)** light green mosaic pattern; **B)** mostly yellow mosaic pattern.

Disease cycle

Mosaic spreads slowly in the field by unknown means. Because no causal organism has been identified, little is known about its biology.

Management

Plant certified virus-tested planting stock.

Stunt (Blueberry stunt phytoplasma)

Stunt is a serious and widespread disease of blueberry caused by the blueberry stunt phytoplasma, a bacterial pathogen. The disease occurs in Michigan, New Jersey, North Carolina, Massachusetts, New York and Canada.

Figure 13. Stunting of blueberry bush (left) because of blueberry stunt disease.

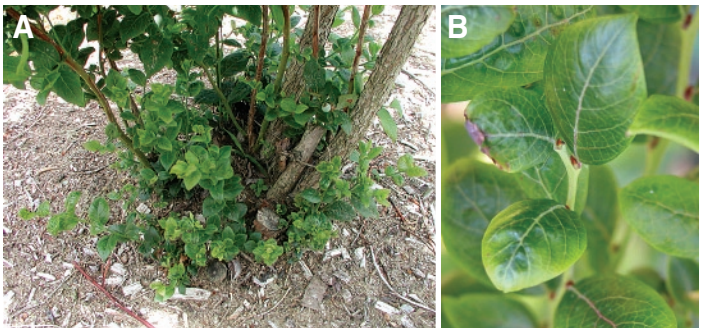

Figure 14. A) Bushy, stunted blueberry shoots because of infection by blueberry stunt phytoplasma; **B)** downwardly cupped leaves with chlorotic edges.

Symptoms

Infected plants are stunted with bushy branches at the base because of a shortening of the internodes (Figs. 13 and 14A). Leaves are cupped downward and have chlorotic edges and interveinal areas (Fig. 14B). Fruit on infected plants ripens late or not at all. In fall, chlorotic areas on leaves turn a brilliant red. Bushes decline in growth and productivity over time.

Disease cycle

Blueberry stunt phytoplasma is transmitted in the field by sharpnosed leafhoppers *(Scaphytopius* spp.*)* (Fig. 15) and by cuttings taken from infected plants. The causal agent overwinters in roots and vascular tissues of infected stems and roots. Infections usually coincide with peaks in leafhopper activity.

Figure 15. Sharpnosed leafhopper *(photo by Jerry Payne, USDA-ARS, Bugwood.org).*

Management

Use disease-free planting material. Remove and destroy infected plants. Monitor leafhopper activity and apply well-timed insecticides to limit spread of the pathogen. Spray insecticide before removing bushes to prevent leafhoppers from flying off and spreading the disease to adjacent bushes.

Scorch (Blueberry scorch virus)

Scorch, caused by blueberry scorch virus (BlScV), does not occur in Michigan. However, it is a serious disease on both coasts of North America and has also been detected in Europe. In New Jersey, it is also known as Sheep Pen Hill disease.

Symptoms

Sudden death and complete necrosis of flowers and leaves occur during bloom (Figs. 16A and B). Twigs may die back up to 10 centimeters (4 inches). Scorched blossoms are often retained throughout the summer and may resemble spring frost injury or Botrytis blight. Some cultivars (e.g., Stanley) also show marginal leaf chlorosis (Fig. 17A). In Sheep Pen Hill disease, leaves may show a red line pattern in the fall (Fig. 17B). A severe infection can kill the bush. The New Jersey strain causes symptoms in all cultivars except Jersey, whereas the West Coast strain is symptomless in many cultivars including Bluecrop, Bluetta, Duke and Nelson.

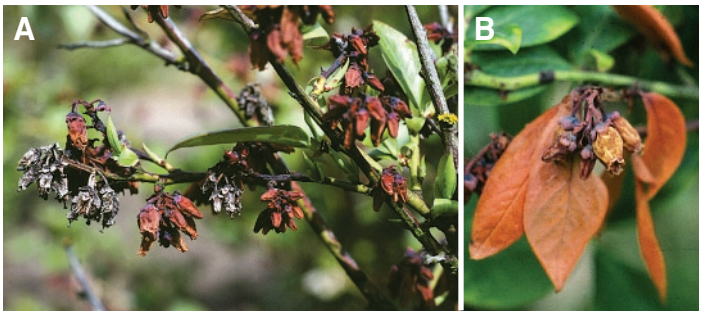

Figure 16. A) Blighting of blueberry flowers; **B)** blighted leaves due to infection by blueberry scorch virus *(photos by Peter Bristow).*

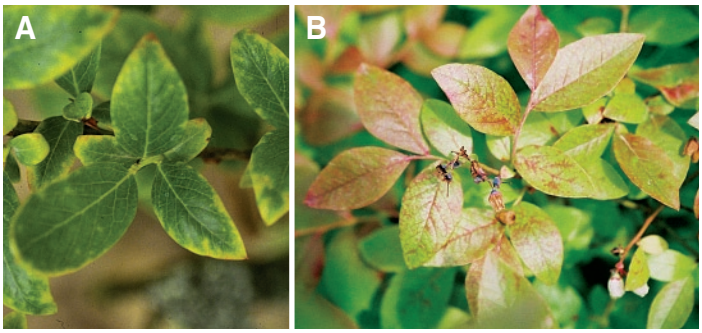

Figure 17. A) Marginal leaf chlorosis due to blueberry scorch virus *(photo by Peter Bristow)*; **B)** red line patterns on blueberry leaves in the fall due to infection with the Sheep Pen Hill strain of BlScV *(photo by Peter Oudemans).*

Disease cycle

Blueberry scorch virus is transmitted by infected plant material and aphids. Once a plant is infected, symptoms may take 1 to 2 years to develop. The disease spreads quickly in a radial pattern, and eventually all bushes in a field may become infected. The virus spreads readily to neighboring fields but usually not more than 1 kilometer (0.6 mile). Infected, symptomless plants do carry the virus and remain a source of inoculation for infection of surrounding bushes.

Management

Plant certified virus-tested planting stock. Have symptomatic bushes tested to confirm the disease. Remove and burn infected bushes, and plant tolerant cultivars. Apply insecticides to control aphids, and clean harvesting equipment to remove infective aphids.

Shock (Blueberry shock virus)

Blueberry shock is caused by blueberry shock virus (BlShV). It occurs only in the Pacific Northwest and has not been found in Michigan.

Symptoms

Symptoms are very similar to those of scorch — i.e., sudden, complete flower and leaf necrosis during the bloom period (Figs. 18 and 19). However, unlike scorch, a second flush of foliage occurs and the plants appear quite normal later in the season except for the lack of fruit. Infected bushes often exhibit symptoms for 1 to 4 years and then become symptomless. Eventually the bushes recover, and a good crop is possible in well-managed fields.

Figure 18. Sudden necrosis of blueberry leaves due to blueberry shock virus *(photo by Robert Martin).*

Disease cycle

The virus is dispersed by infected pollen carried by bees and spreads rapidly in a radial pattern. Infection occurs only during the bloom period. Symptomless infected plants remain a source of virus. All tested cultivars are susceptible.

Figure 19. Shock-infected blueberry bush showing necrotic blossoms on the left; healthy bush on the right *(photo by Robert Martin).*

Management

Plant certified virus-tested planting stock. Do not establish new plantings adjacent to infected fields or use planting stock from a field that is in remission. Remove and destroy infected bushes before bloom or let disease run its course.

Fruit drop (causal agent unknown)

This disease does not occur in Michigan. However, premature fruit drop has been observed in Oregon, Washington and British Columbia. Plants flower normally, but the young flowers and fruit show a transient red coloration that is absent in healthy plants (Fig. 20). The fruit develops to about pea size and then falls off, leaving virtually no fruit at harvest. A virus is suspected because of the pattern of disease spread in affected fields.

Figure 20. Transient red coloration of flowers in blueberry bush with fruit drop symptoms.

Virus-tested certification programs

Virus-tested certification programs are credited with lowering the incidence of viruses in blueberry fields nationwide. Buying virus-tested planting stock is the primary preventive measure for virus disease control. Several nurseries in Michigan submit voluntarily to a testing program administered by the Michigan Department of Agriculture. Mother blocks in these nurseries are inspected annually for virus symptoms, and serological tests are conducted on random samples for all blueberry viruses. Cuttings are taken only from mother plants that are deemed free from viruses.

Sending in samples for diagnosis

Plant samples suspected of having a virus disease can be sent to the Michigan State University Plant Diagnostic Laboratory or to Agdia, Inc. (30380 Co. Road 6, Elkhart, IN 46514; phone: 1-800-62-AGDIA) for testing. Late spring to early summer is the best time to test plant material. Collect symptomatic plant tissues (e.g., leaves and flowers) and place them in a plastic bag. Refrigerate samples to keep them fresh, and send them by overnight mail as soon as possible.

Michigan virus quarantine regulations

In 2002, the Michigan Department of Agriculture (MDA) established a quarantine for blueberry planting material to prevent the introduction into Michigan of blueberry scorch virus (BlScV), blueberry shock virus (BlShV) and Sheep Pen Hill virus (a strain of blueberry scorch virus designated as BlScV-NJ). Blueberry scorch virus is known to occur in Oregon, Washington, New Jersey, Massachusetts, Connecticut and British Columbia; whereas blueberry shock virus has been confirmed in Oregon, Washington, and British Columbia. To date, these viruses have not been found in Michigan. It is very important that they are kept out because they can wreak havoc on the Michigan blueberry industry. Blueberry scorch is particularly destructive. MDA quarantine regulations stipulate that no plants, buds, vegetative cuttings or any other blueberry planting material should be brought into Michigan from regulated areas (British Columbia, Washington, Oregon, New Jersey, Massachusetts, Connecticut) unless they have been certified by a virus-tested certification program recognized by the MDA. Planting material shipped into Michigan must be accompanied by a State Phytosanitary Certificate or Certificate of Quarantine Compliance, indicating its point of propagation or production and labeled or stamped to show compliance with the terms of this quarantine. Violations of the quarantine regulations can lead to fines and destruction of uncertified or virus-infected plant material as well as revocation of the special permit to ship to Michigan.

We thank Dave Trinka and Richard Kaitany for critical review of this fact sheet.