Extension Bulletin E-3050 • July 2008

Michigan Blueberry Facts

MICHIGAN STATE UNIVERSITY

Blueberry Aphid and Blueberry Shoestring Virus

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Introduction

Aphids are a sporadic pest in blueberries, but they can sometimes reach high densities. Their abundance should be monitored each year to help prevent outbreaks. The primary species in blueberries in Michigan is the blueberry aphid, *Illinoia pepperi*. The importance of this aphid is magnified by its role as a vector of blueberry shoestring virus (BSSV). Losses due to reduced yield and bush decline are estimated at several million dollars annually in Michigan.

Aphid identification

Adult blueberry aphids are light green, with darker legs and antennae (Fig. 1A, B).

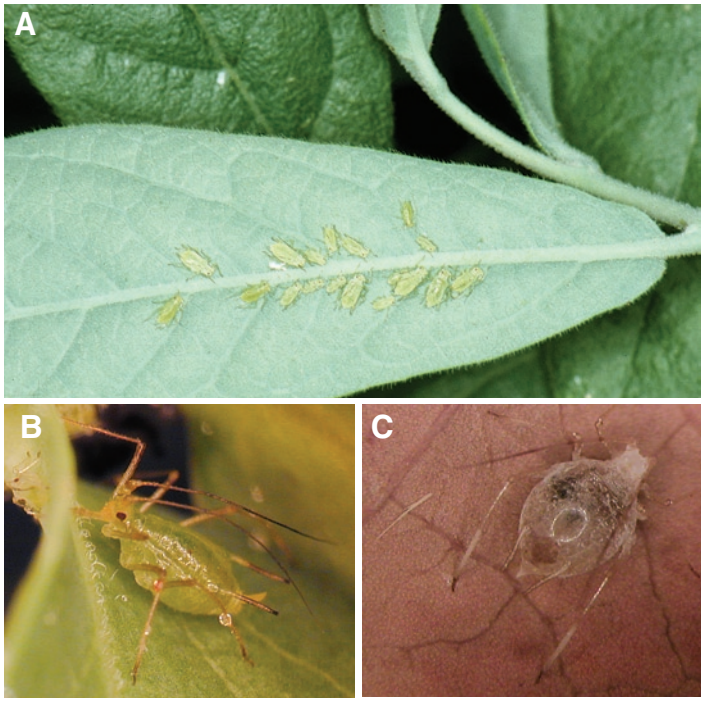

Figure 1. Blueberry aphid (*Illinoia pepperi*): **A**) Colony on underside of blueberry leaf *(photo by Terry Payne, USDA-ARS, Bugwood.org)*; **B**) Close-up of aphid; **C**) Mummy of parasitized aphid with typical tan coloration *(photo by Matt O'Neal)*.

Figure 2. Narrow, strap-like blueberry leaves are a symptom of infection by blueberry shoestring virus.

The siphunculi (two short tubes projecting from the rear of the aphid) have dark brown constricted tips. Young aphid nymphs may be green or yellow and clustered on the underside of the leaf (Fig. 1A, 3). Aphid identification requires a strong hand lens or microscope.

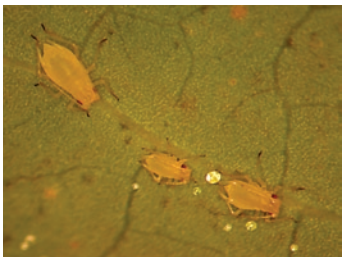

Figure 3. Blueberry aphid nymphs on blueberry leaf.

Aphid life cycle

Blueberry aphids spend the winter as tiny eggs at the bases of bud scales (Fig. 4). Egg hatch starts at around 700 growing degree-days (base 38°F [3.3°C]) in the spring once young foliage has begun to develop, usually during bloom. Young aphids move in search of a place to feed and may move between adjacent plants. Once they are mature, they reproduce asexually (females produce offspring without mating).

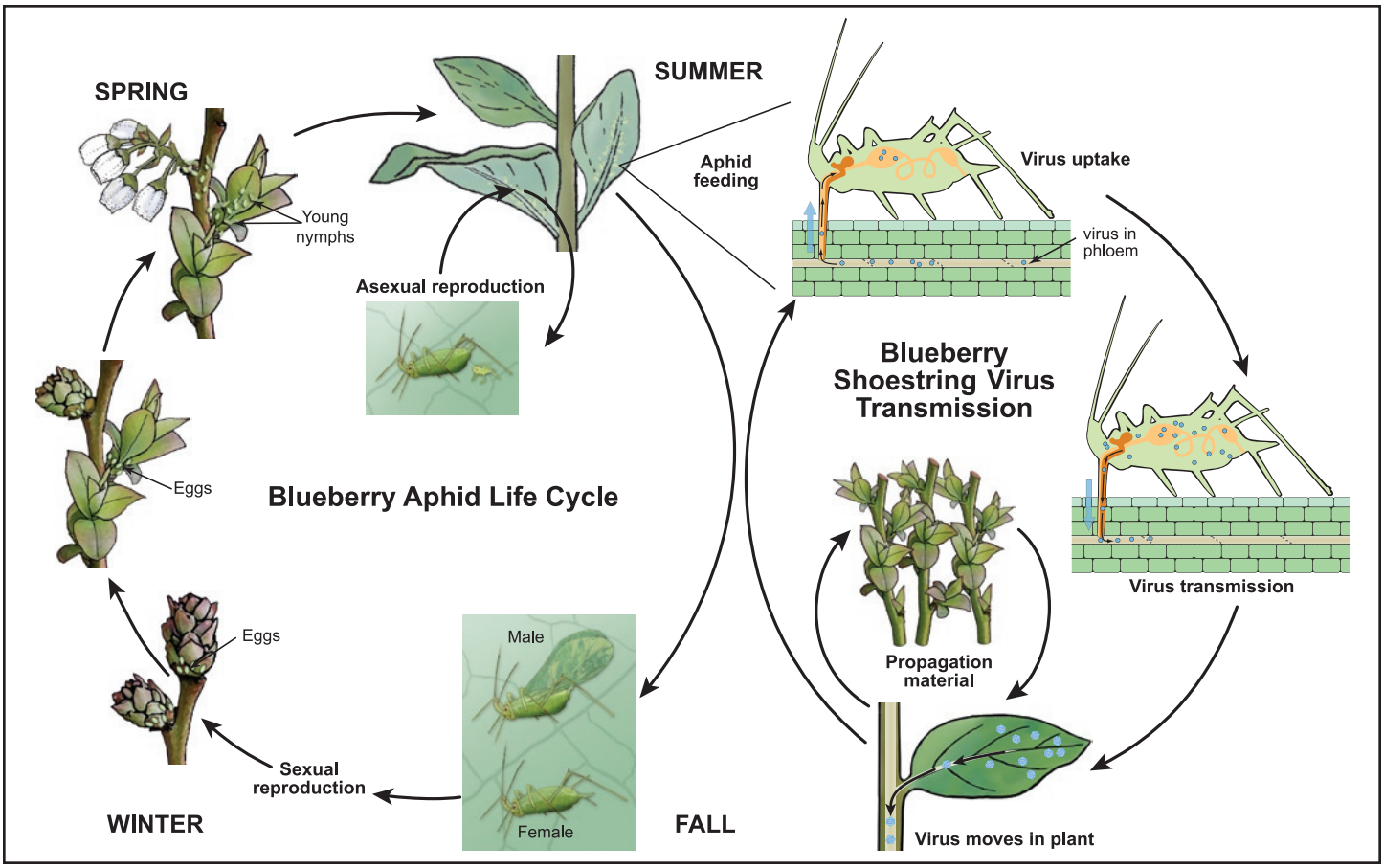

Figure 4. Life cycle of *Illinoia pepperi* and blueberry shoestring virus transmission on highbush blueberries *(illustration by Marlene Cameron).*

As the colonies grow in size, winged forms are produced in response to crowding. Winged aphids can fly between plants, but most aphid movement is within plants. As the period of daylight gets shorter in the fall, aphid colonies produce winged males and females. Males and females mate, and eggs are laid on buds on the new plant growth. Eggs overwinter here until the spring.

Symptoms of virus infection

The symptom that gives blueberry shoestring disease its name is the narrow, strap-like leaves of infected blueberry plants (Fig. 2, 5A). Leaves may have a reddish hue or turn entirely red (Fig. 5B). Reddish purple "oak leaf" patterns along the major veins are also characteristic of this disease (Fig. 5C).

Figure 5. Blueberry shoestring virus symptoms in blueberry: **A**) Reddish purple, strap-like leaves; **B**) Reddening of leaves on entire shoots; **C**) Red oak-leaf patterns along the midribs of blueberry leaves.

Figure 6. Symptoms of blueberry shoestring virus infection in blueberry: **A**) Crescent-shaped leaves; **B**) Pink-tinged blossoms; **C**) Reddish streaks on blossoms.

Sometimes leaves are curved or crescent-shaped (Fig. 6A). Flowers may have a pink tinge or reddish streaks on the corolla (Fig. 6B, C). Fruit remains reddish purple instead of turning blue (Fig. 7A). The most reliable symptom is the presence of reddish streaks on stems (Fig. 7B). Symptoms may be restricted to a few shoots or may be present throughout the bush. Infected bushes eventually become stunted and weak (Fig. 9A, B), which can predispose them to Phomopsis canker and twig blight and winter injury.

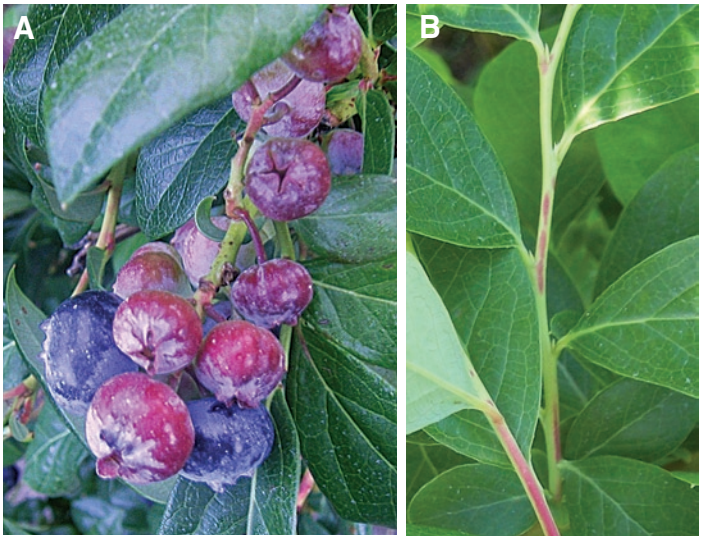

Figure 7. Blueberry shoestring virus symptoms in blueberry: **A**) Reddish berries that do not ripen normally; **B**) Red streaks on green stems.

Virus infection and transmission

Blueberry shoestring virus (BSSV) is a single-stranded RNA virus with isometric particles that are 27 nanometers in diameter (Fig. 8). The virus replicates in plant cells, disrupting normal cell functions. Virus particles move throughout the plant via the phloem and xylem and can be found in all plant tissues as well as in plant sap. This is called "systemic infection." Once a plant is infected, there is no cure. The fact that symptoms may not be visible until 2 to 4 years after initial infection complicates disease detection. The virus is transmitted by cuttings taken from infected plants and by the blueberry aphid. Aphids suck up virus particles while feeding on infected plants and can transmit the virus to healthy plants through their saliva for up to 10 days. Virus particles are also found in the insect hemolymph (blood-like fluid), indicating that the virus circulates within the aphid (Fig. 4).

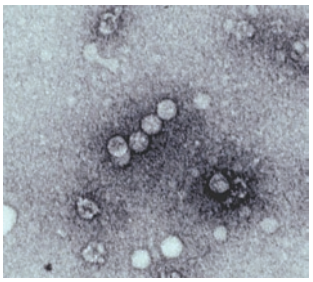

Figure 8. Spherical BSSV particles in plant sap *(electron micrograph by Jerri Gillett).*

Aphid and BSSV Management

Aphid management should be considered to reduce virus infection risk. Through a combination of cultivar selection, regular monitoring, cultural control and accurate timing of effective insecticides, blueberry growers can minimize the spread of BSSV and protect their plantings. Current IPM recommendations include monitoring bushes annually for viral infection and aphid infestation. If virus symptoms are absent, pest management programs should aim to conserve natural enemies, which can prevent outbreaks of blueberry aphids.

Monitoring for aphids

Aphids are typically found on the undersides of leaves on the lower succulent shoots. After bloom, lower shoots on bushes should be inspected weekly in three or more areas in a field. Early in the season, wingless aphids will be found. Later, colonies made up of both winged and wingless aphids may be present. Aphids drop honeydew (a sugary aphid excretion) onto leaves and fruit below, where it can stimulate growth of black sooty mold on plant surfaces.

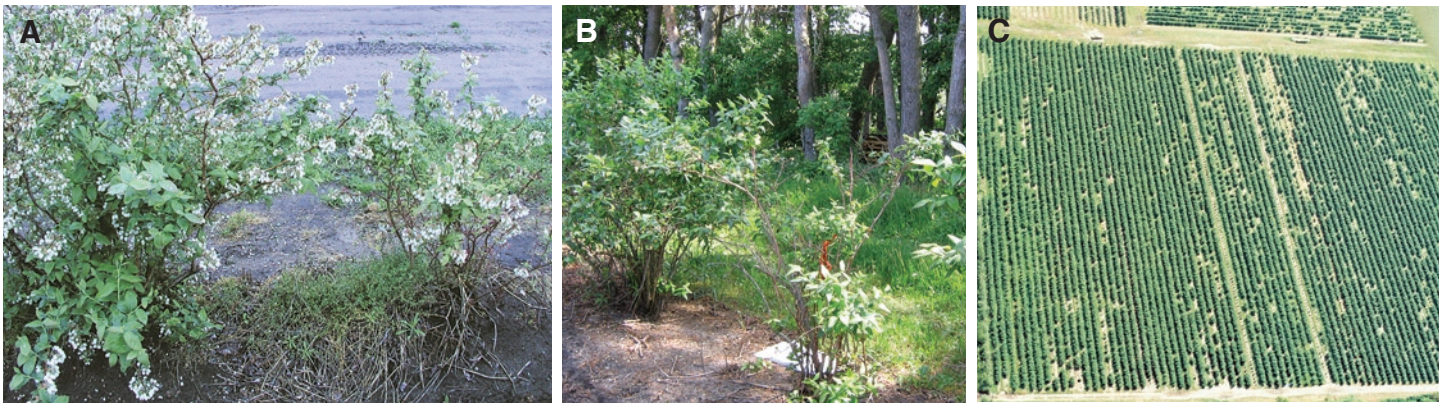

Figure 9. A, B) Decline in blueberry bushes due to infection with BSSV; **C**) Aerial view of blueberry field showing "down-the-row" pattern of BSSV-infected bushes due to movement of virus-carrying aphids by mechanical harvesters. *(Photo by Donald Ramsdell, reprinted from Compendium of Blueberry and Cranberry Diseases, 1995, American Phytopathological Society, St. Paul, Minn.).*

Cultural control

Use only certified virus-free planting material. Infected bushes should be removed and destroyed as soon as possible. Cultivars vary in susceptibility to aphids, but none are immune. The cultivars Jersey, Elliott and Blueray are highly susceptible to BSSV and should be carefully monitored. Bluecrop and Atlantic have field resistance to the virus and are recommended for plantings with high disease pressure. Avoid overfertilization — aphid colonies reproduce most quickly on fast-growing, succulent young shoots. Aphids may be washed off plants by overhead irrigation and heavy rains. Washing harvesters before moving from an infected field to a healthy field removes virus-carrying aphids and prevents virus spread.

Biological control

Several species of parasitic wasps (*Praon* and *Aphidius* species) (Fig. 10A) lay their eggs inside aphids; the larvae then consume them from the inside. Parasitized aphids are light tan and stuck to the leaf. The parasite emerges from the mummified aphid through a small round hole (Fig. 1C). Many predatory insects also attack aphids and their eggs. These include ladybeetle adults and larvae, and larvae of syrphid (hover) flies and lacewings (Fig. 10). Selecting insecticides that have lower toxicity to beneficial insects will enhance the effectiveness of biological control.

Chemical control

If insecticides are necessary, coverage of lower shoots is essential for optimal aphid control. Many broad-spectrum insecticides provide one to two weeks of aphid control and may be used to also target co-occurring insect pests such as fruitworms or blueberry maggot. Newer selective and systemic insecticides in the neonicotinoid class (e.g., Provado, Actara, Assail) provide excellent aphid control because these insecticides spread in the foliage after application, ensuring good coverage. These insecticides are ingested by aphids during feeding, providing long-term control. Organic options for aphid control include neem-based products, insecticidal soaps and dormant oil applications to smother eggs. Consult your local Extension educator and/or regional pest management recommendations for more details on effective pesticide options.

Figure 10. Natural enemies of aphids: **A**) Parasitic wasp (*Aphidius* sp.) *(photo by David Cappaert, Michigan State Univ., Bugwood.org)*; **B**) Seven-spotted lady beetle *(photo by Susan Ellis, Bugwood.org)*; **C**) Green lacewing larva *(photo by Whitney Cranshaw, Colorado State Univ., Bugwood.org).*

We gratefully acknowledge critical review of this fact sheet by James Polashock, Christina DiFonzo, Dave Trinka and Greg Loeb.