Bacterial Fruit Blotch

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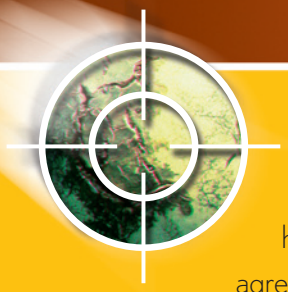
A COMMERCIAL GROWERS GUIDE

Bacterial Fruit Blotch



First observed in U.S. commercial watermelon fields in 1989, bacterial fruit blotch (BFB) can be devastating for commercial watermelon, cantaloupe and honeydew growers with losses reaching 100%. Over the last 20 years, academia and industry have come together to study the disease and have made considerable gains in the areas of BFB epidemiology and management. There is general agreement that while there is no cure, all parts of the production chain including seed producers, transplant growers and commercial growers can take preventative steps to avoid losses from BFB.

This educational pamphlet is designed to provide commercial cucurbit (watermelon, melon, cucumber, pumpkin, squash, etc.) growers with information about BFB and to provide recommendations on how to reduce the occurrence of the disease in production fields and greenhouses. This information was compiled with contributions from academic and industry BFB experts and distributed by industry sponsors. This brochure is the most current educational material on BFB to date (June, 2009).

Causes and Sources

Bacterial fruit blotch is caused by the bacterium, *Acidovorax avenae subsp. citrulli* (Aac). Aac can be introduced into cucurbit fields through a variety of sources including contaminated seed, infected transplants or by natural spread from alternate hosts such as wild cucurbits (e.g. citron, bur gherkin, etc.) or volunteer watermelons. The disease can survive and spread through other methods including:

- Aac may over-winter on infected wild cucurbits, volunteer plants, or infected plant debris.
- In the greenhouse – structures, equipment, and greenhouse supplies may be contaminated with the pathogen.
- The dense plant populations and high relative humidity often present in greenhouse production facilities favor the spread of BFB.
- Overhead irrigation easily spreads the pathogen between plants and can rapidly cause a large section of a greenhouse to become infected with BFB. Note: there is a lag period between infection and symptom development, so plants may remain symptomless for several days or more after infection.
- Machinery, workers, and wind-driven rain can spread Aac in the field.
- Seed harvested from infected fruit may carry Aac.
- Hot and wet conditions (excessive watering or rainfall) in a field or greenhouse are critical environmental factors that facilitate the spread of Aac and disease development.
- The practice of grafting significantly increases the risk of transmitting BFB.

Figure 1. Production practices play a big role in the spread of the bacteria causing BFB. **A)** Overhead irrigation is a key factor in the spread of bacteria in the greenhouse. **B)** Equipment can spread the problem from field to field.

BFB Control

For successful management of BFB everyone in the production chain must do their part. Follow these practices to reduce your chances of losses from BFB.

Seed Use

- Use seed from a reputable seed producer.
- Prior to planting, all sources of seed (commercial, experimental or trial varieties, or if grafting, the seed of the rootstock and scion) should be tested and found to be "Negative" or "No evidence" of Aac using an appropriate seed sample (at least 30,000 seed or 10% of the total for smaller size lots).
- Tests should be conducted by a reputable testing service or company using an appropriate seed health assay. There are several tests that can be used to detect BFB associated with seed and examples are provided at the NSHS website (http://www.seedhealth.org/index.html).

Figure 2. A) Foliage of healthy watermelon seedlings. **B)** Root system of a healthy watermelon seedling.

- A "Negative" or "No Evidence" test result does not guarantee the seedlot is free of Aac.
- Any seed sources (commercial or experimental) that have not been tested for Aac should not be grown in greenhouses and fields with commercial cultivars.

Transplant Production

- Use seed from a reputable producer that has been adequately tested for Aac (see Seed Use).
- Inspect seedlings often - beginning when the cotyledons start to expand. If seedlings with BFB are found, the most prudent course of action is to destroy all seedlings in the greenhouse and sterilize all flats, greenhouse surfaces, and soil.
  - If this is economically unfeasible, destroy the flats with symptomatic plants and all surrounding flats within a minimum of 5 feet beyond the outermost symptomatic seedling. Inspect the seedlings in this greenhouse on a daily basis and implement chemical control (e.g. copper-based bactericides) to protect exposed plants. This secondary approach, although economically feasible, may not eliminate all seedlings that harbor the bacterium.
  - Prior to reuse, sterilize the flats that contained the infected or exposed plants by using steam or chemical disinfectants (e.g. 0.53% NaOCl - sodium hypochlorite, the active ingredient in household bleach - mix 1 part bleach with 9 parts water or quaternary ammonium salts as appropriate).
  - Inspect areas surrounding greenhouses and growing facilities for cucurbit weeds that can harbor Aac. Destroy all host weeds (all cucurbits) that are found.
- Practice good sanitation in the greenhouse.
  - Ensure that workers wash hands and use a shoe bath each time they enter and exit a greenhouse.
  - Use steam or chemicals (0.53% NaOCl, quaternary ammonium salts or other appropriate disinfectants) to sterilize all plant containers and tools before and after each use.
  - Avoid unnecessary handling of plants to limit the spread of Aac.
  - Destroy discarded plant material by burning or burying because any infected plant materials remaining within or near transplant houses can serve as a source of inoculum for subsequent infection.
- When grafting, ensure that tools are sterilized by dipping in 70% ethanol or 0.53% NaOCl between each plant. Keep the tools in the suspension long enough to ensure disinfection and periodically replace the disinfectant to ensure it is effective. Rinse tools and hands so that residual disinfectant does not harm the transplants.
- Grafting methods normally employ high humidity. BFB prevention requires low humidity. You must manage humidity conditions for these circumstances to ensure grafts take and to avoid BFB. Make certain seedlings are inspected prior to and are kept dry during grafting. Inspect grafted seedlings often for the presence of the disease.
- Maintain low humidity and eliminate free water using sub-irrigation of flats to control spread of the bacterium.
- Overhead irrigation is not recommended. However, if you use this method, use low pressure and minimize the time leaves are wet.
- Close greenhouse side flaps during windy periods.
- Do not handle plants while the foliage is wet.
- Segregate seedlots to reduce the chance of lot-to-lot cross-contamination.
  - Use barriers between seedlots to further improve isolation and reduce splash-dispersal of Aac.

Commercial Production Growers

- Use seed from a reputable producer that has been adequately tested for Aac as described above.
- Use transplants from a reputable producer who has appropriately inspected transplants for BFB prior to delivery.

- Inspect all seedlings visually for BFB prior to accepting them from transplant producers.
- Include BFB inspection in regular field scouting procedures.
- Scout for and destroy all volunteer cucurbit weed hosts (e.g. citron, bur gherkins, etc.) in the field, and in immediately surrounding areas and field borders.
- Avoid overhead irrigation and do not work in fields when foliage is wet.
- Apply copper-based bactericide sprays using updated recommend-ations from local extension services or crop protection specialists.
- Plow-down or thoroughly compost field debris and cull piles after each growing cycle.
- Rotate out of BFB susceptible crops (all cucurbits) for 2 – 3 years to avoid contamination of future crops, especially if BFB occurred in the crop.

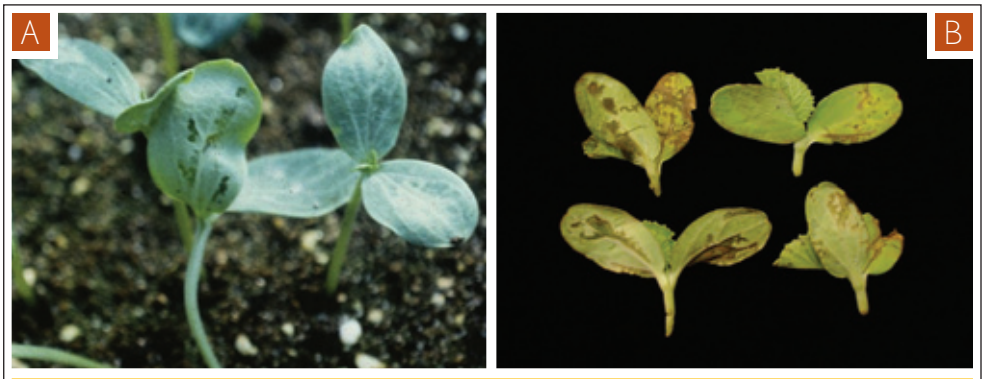


Figure 3. Typical BFB lesions on **A)** watermelon cotyledons and **B)** melon cotyledons.

How to Diagnose BFB

Seedlings: Initial BFB symptoms on seedlings include dark water-soaking on the lower surface of the cotyledon. These water-soaked lesions become necrotic and are often adjacent to the veins of the cotyledon. Lesions can occur on the stems as seedlings emerge resulting in collapse and death of the seedling.

Leaf: BFB is very difficult to diagnose based on leaf symptoms. Often, leaf symptoms may be inconspicuous or very similar to symptoms caused by other pathogens that are more prevalent on the foliage. When they occur, leaf lesions are light to reddish-brown on cantaloupe and honeydew but dark-brown to black on watermelon. Leaf lesions can spread along the midrib and main veins. At times, water-soaking may appear on stems.

Fruit: Aac enters the plant and fruit through the stomata (natural openings that occur on leaves and on fruit surfaces) or wounds from mechanical or other injury. Fruit infection occurs most commonly during early fruit development (1-3 weeks after fruit set); however, symptoms are usually most apparent during the last two weeks of fruit development. On watermelon fruit, symptoms begin as small, greasy-looking, water-soaked areas less than an inch in diameter with irregular margins. Initially, these lesions do not extend into the flesh of the watermelon, but later the lesions turn brown and crack. White,

Figure 4. A) BFB symptoms on mature watermelon leaves. **B)** BFB lesions on cantaloupe leaves. Note the tan to white appearance.

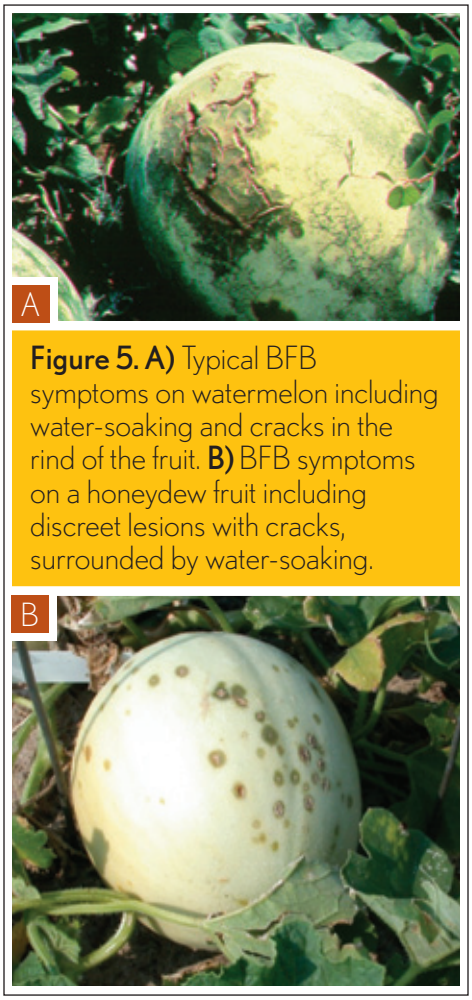


Figure 5. A) Typical BFB symptoms on watermelon including water-soaking and cracks in the rind of the fruit. **B)** BFB symptoms on a honeydew fruit including discreet lesions with cracks, surrounded by water-soaking.

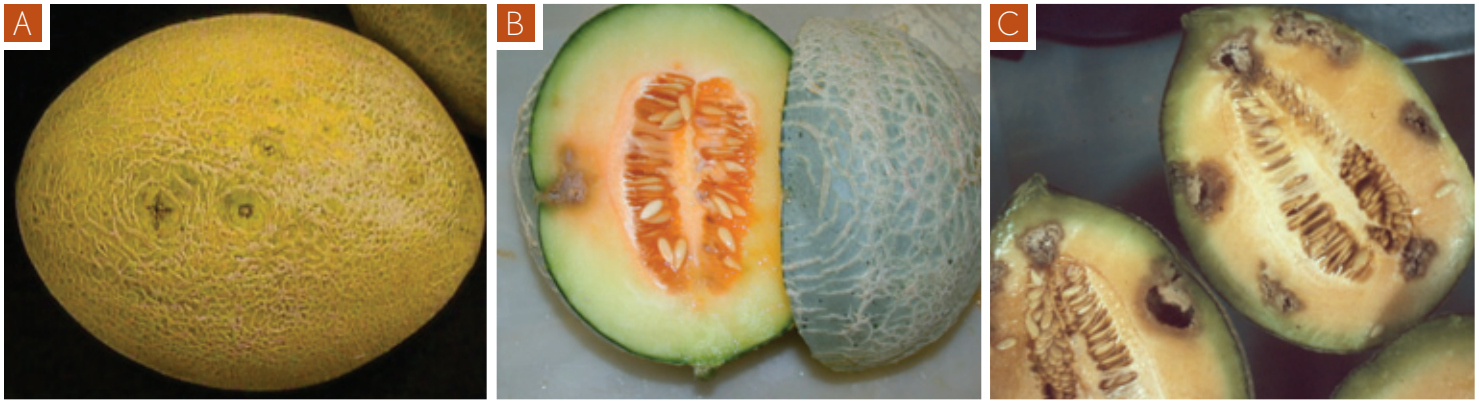


Figure 6. A) External BFB symptoms on a cantaloupe fruit. These symptoms include small depressed pin-point lesions and cracks. These may be misinterpreted as insect damage. **B)** Early external and internal symptoms of BFB on cantaloupe fruits. Netting fails to form over the pin-point depressed surface lesion but the rot penetrates from the rind into the flesh of the fruit. **C)** Advanced internal BFB symptoms on cantaloupe fruits including pits and rotten cavities that penetrate from the rind into the flesh of the fruit.

foamy ooze often can be seen on the fruit surface and fruit decay often follows. On melon and cantaloupe fruit, BFB symptoms include small pinpoint lesions that do not expand on the surface of the fruit, however, extensive internal fruit decay can occur. Cantaloupe and melon fruit symptoms may be difficult to detect visually because they often appear as small sunken lesions, easily mistaken for insect injury. However, BFB can result in complete internal fruit rot.

What to do if you suspect BFB

If BFB is suspected in fields or greenhouse, take a sample of the symptomatic tissue to the local extension office, state university laboratory, or a private diagnostic laboratory for an accurate diagnosis.

Rapid diagnostic kits are also available and easy to use. These are recommended for transplant growers and growers with large acreage. These tests can be useful for establishing a preliminary diagnosis but samples for a final diagnosis should be sent to a reliable diagnostic laboratory for confirmation.

Question and Answers:

Q1: Why do the symptoms seem to 'suddenly appear' on the fruit about 2 weeks before market maturity?

A1: Aac can invade the stomata of very young cucurbit fruit, but the lesions may be small and restricted in size. About 2-3 weeks after fruit set (anthesis), the progress of the disease and maturing fruit allows for multiplication of the bacteria; which promotes visible BFB lesions and fruit decay. The exact reason for this latent symptom development is unknown but it may be influenced by fruit physiology e.g. maturation of fruit tissues.

Q2: Will watermelon or melon fruit become infected after harvest, or show symptoms if they did not show them before harvest?

A2: Current knowledge indicates that fruit cannot become infected after harvest. However, for fruit that are infected prior to harvest, symptoms may continue to develop and may progress from a surface lesion to fruit rot. This can be a problem if it occurs in transit to markets.

Q3: How susceptible are other cucurbits to BFB?

A3: Watermelon, cantaloupe and several other types of melons including honeydew appear to be highly susceptible to Aac, and natural outbreaks have been observed frequently in these hosts. A wide range of other cucurbits has also been found to be susceptible to Aac including cucumber, squash, gourds and pumpkin. The foliage of other cucurbits, such as summer and winter squash and cucumbers, may harbor the bacterium and may express symptoms. However, wide spread outbreaks of BFB in these cucurbits have not been observed. This might be due to the production strategy used for these crops (no transplanting) and/or that the prevalent Aac strains are only weakly pathogenic on these hosts.

Q4: What environmental conditions are critical for disease development?

A4: BFB is promoted by hot and wet conditions. Disease development and spread is most rapid in the summer when weather conditions are hot and sunny with frequent afternoon thundershowers that includes blowing rains.

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Photos: Special thanks to the American Phytopathological Society for the photos provided.

Websites: The American Phytopathological Society at http://www.apsnet.org/education/LessonsPlantPath/BacterialBlotch/default.htm

Additional sources of information on bacterial fruit blotch:

Compendium of Cucurbit Diseases,
by The American Phytopathological Society,
3340 Pilot Knob Road,
St. Paul Minnesota, 55121-2997.

2001 Guidelines for Managing
Bacterial Fruit Blotch Disease,
by the National Watermelon Association, Inc.,
P.O. Box. 38, Morven Georgia, 31638.

Watermelons, Characteristics,
Production and Marketing. by ASHS Press.
113 South West Street, Suite 200,
Alexandria,VA. 22314