Fighting Fire (Blight) with...Organic Fire? Organic Orchard Management in the Humid Midwest

A Decision Case Study

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"I could be pushed into a corner if I have to choose between my orchard and organic certification. If National Organic Program-acceptable and effective controls for fire blight are not found, I may not have an orchard left to certify." Deirdre, like many orchardists, is facing difficult choices when fire blight hits their orchard. Fire blight, caused by the bacteria ***Erwinia amylovora****, spreads like wildfire through trees. A major tool to control fire blight is the antibiotic streptomycin that was allowed in organic production only under the strictest of conditions. The National Organic Standards Board signaled it intended to remove antibiotics from use in organic orchards altogether, but organic apple growers had no proven, alternative strategy to control fire blight.*

Deirdre and her husband John Biondi are second-career orchardists. Deirdre grew up in suburban Chicago, but always had an interest in farming. In graduate school, she took leadership roles in the student sustainable agriculture organization. After obtaining her joint Ph.D. degrees in Land Resources and Adult Education, she worked primarily in Africa with nonprofit agricultural organizations. She had many leadership roles, including directing Georgia Organics, serving as board President for the Organic Farming Research Foundation, and chairing the UW-Center for Integrated Agriculture's Citizen Advisory Committee. Still, her heart was in farming, and so in 2002, she and her husband purchased a farmstead in Wisconsin's Driftless Region, with the intent to raise organic apples for hard cider and brandy production.

"I have three degrees in agriculture, but somehow didn't take a single class in horticulture" Deirdre remarked. In 2003, Deirdre began an intensive period of learning the orchard business, with an eye to raising traditional English and French cider apples. These apple varieties are like the wine grapes of apples due to their tannin and acid profiles. They yield a more complex, full body, and aromatic cider. She soon learned that orchardist Dan Bussey lived nearby and shared her interest in unique apple varieties. He taught her to graft, shared scion wood from his trees, and the two split rootstock orders. On her hunt for learning opportunities, Deirdre saw that there was a lack of information specific to organic tree fruit production and so she helped organize a network for organic apple growers. Here Deirdre met and was mentored by farmer-innovator Jim Koan, from Michigan. Deirdre also worked with the University of Wisconsin to establish apple IPM conference calls targeted to organic fruit producers. These weekly calls helped her gain invaluable insight

into pest management specific for her operation.

In 2006, Deirdre planted her first 800 trees in a block, and started a nursery with an additional 300 trees. Her intention was to borrow a tree planter, but when it was unavailable she found herself, with a little help from friends, digging 1,100 holes with shovels. She planted more trees every year, having to replace whole rows of trees wiped out by fire blight. Her goal was to plant 1,500 to 4,000 trees annually to get the orchard to 20,000 trees primarily of true English and French cider apples. To reach this goal, she maintained a hoop house for propagation, using Jim Koan's system of hoophouse tree propagation while also contracting with tree nurseries to custom graft trees for her.

Growing organic apples in the humid Midwest is risky, and a major challenge is disease. The true cider apples are particularly prone to fire blight infection. Early on, Deirdre culled the apple variety most prone to fire blight, and introduced two disease-resistant, tart apples developed in the US and recommended by the former pomologist and cider maker at Cornell University, Ian Merwin. Liberty and Priscilla proved to be excellent acidic apples that blend well with the tannic cider apples.

Finding Fire Blight

With the first blossom comes the first evidence of fire blight (*see EXHIBIT A: Tree Fruit Crops: Fire Blight*). In 2008, two years after initial plantings, a major fire blight infection hit Deirdre's young orchard. The first evidence of disease was flower stamens oozing orange. The disease enters the stamens when weather conditions are right. Warm, rainy, windy spring days during bloom leave the trees wide open to disease. Droopy tender new shoots indicate that the disease is spreading, and if tree trunks start to ooze, it is time for drastic measures. To slow the spread of disease, Deirdre cut and burnt whole trees. After cutting down the first one hundred trees, she stopped counting. Young trees less than ten years old are most susceptible, meaning all her true cider apples were in harm's way.

Apples are a high-value, capital-intensive crop and growing them organically reduces the options for contending with disease. Cutting down trees as a means to protect other trees from disease amounts to losing the capital invested to grow those trees. And Deirdre faced the additional challenge of potentially losing the only disease prevention tool in her tool-box – antibiotics, especially streptomycin.

Fire blight is endemic in the natural environment. That is, it is widely found in soils, and lives on wild hosts, such as apples, hawthorne, plum, and other trees in the rose family. As Deirdre explained, it is "a sleeper disease" that could "wake up" and appear whenever conditions were right. Fire blight is a serious threat to commercial apple production, conventional or organic. Michigan growers have lost millions of dollars to region-wide fire blight infections, to the point where fire blight in Michigan has developed antibiotic resistance to streptomycin. Washington State organic growers also saw fire blight resistance to streptomycin and had switched to another antibiotic –

oxytetracycline. It is precisely this issue of antibiotic resistance that was of concern to the National Organic Standards Board (NOSB).

Alternatives to Antibiotic Use

The NOSB regularly reviews all pest control chemistries used for certified organic production, and in the spirit of continual improvement, will restrict chemicals and eventually phase them out if the Board deems them unnecessarily risky to human or environmental health (*see EXHIBIT B: Fire Blight Control for Organic Orchards: Moving Beyond Antibiotics*). With antibiotics, the concern is that disease-causing pathogens will become resistant and will no longer be controllable with antibiotics. Streptomycin is a restricted use chemical in organic production so farmers wanting to use it must show cause. In Deirdre's case, cause was clear. She could lose the very varieties that distinguish her brandy and ciders if she didn't have access to streptomycin.

As NOSB continued to debate the status of streptomycin as an allowable disease prevention tool, Deirdre started looking for alternatives. Apogee (prohexadione-calcium) is a synthetic product that conventional growers may use. It thickens cell walls so that shoots are less vulnerable to attack, but it is not allowed in organic production. She kept abreast of on-going research at Oregon State University and Washington State University on alternative strategies. Similar research trials in Michigan were not yielding the same results as research in western states, likely due to the more humid weather conditions. Meanwhile, Deirdre had invested a lot of time in weekly examination of each and every tree for infected shoots, and removing infected shoots and whole trees from the orchard.

Deirdre started experimenting with additional copper sprays beyond early spring, including at blossom. She relied on her mentors to improve her use of copper as a disease control tool, but was uncertain if copper would be effective from one disease window to the next. Copper, a heavy metal, was an allowed chemical in organic production, but caused fruit russetting – a discoloration that doesn't affect fruit quality but affects marketability. Because she was processing all her apples, she was not concerned about fruit russetting. Newer products that have lower levels of copper or can complement a disease program including copper and, while expensive, can be sprayed more frequently without accumulating in the soil. Other options that Deirdre considered for her orchard were biologicals that became newly available for organic production. Serenade Optimum (QST 713 strain of *Bacillus subtilis*) showed promise in western orchard research. Blossom Protect (Aureobasidium pullulans) was a yeast that, when used as part of a treatment program of lime sulfur & fish oil, followed by Blossom Protect, followed by a soluble copper was very effective at controlling fire blight in western orchards. The efficacy of such new treatments was unknown in the Upper Midwest and were more expensive to growers than antibiotic treatments.

Should Deirdre build her business as an organic cider company, given her ongoing struggles with fire blight? If she chooses to switch to a conventional growing model to increase her options for disease control, what will she lose? Or should she discontinue growing the true cider varieties that distinguish her products but are prone to fire blight, what are the tradeoffs?

Exhibit A. Tree Fruit Crops: Fire Blight

Disease Identification
Sheet No. D3 (revised)
1994

TREE FRUIT CROPS

IPM Integrated Pest Management

CORNELL COOPERATIVE EXTENSION

Fire Blight

Erwinia amylovora (Burrill) Winslow

Wayne F. Wilcox
Department of Plant Pathology, NYS Agricultural Experiment Station at Geneva, Cornell University

Fire blight is one of the most destructive diseases of apple and pear trees. Outbreaks are sporadic in most parts of the Northeast, but can cause extensive tree damage when they do occur. Therefore, the necessary intensity of control programs will vary considerably for different plantings and in different years, depending on individual orchard factors and weather conditions.

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 7.

Fig. 8.

Exhibit A, cont'd.

The following is an excerpt from the article, Tree Fruit Crops: Fire Blight, *by Wayne F. Wilcox of Cornell Cooperative Extension Disease Identification Sheet No. D3, 1994, found at: https://ecommons.cornell.edu/handle/1813/43095.*

Symptoms

Fire blight produces several different types of symptoms, depending on what plant parts are attacked and when. The first symptom to appear, shortly after bloom, is that of blossom blight. In the early stages of infection, blossoms appear water-soaked and gray-green but quickly turn brown or black; generally, the entire cluster becomes blighted and killed. The most obvious symptom of the disease is the shoot blight phase, which first appears one to several weeks after petal fall. The leaves and stem on young, succulent shoot tips turn brown or black and bend over into a characteristic shape similar to the top of a shepherd's crook or candy cane. Small droplets of sticky bacterial ooze often can be seen on the surface of these blighted shoots when the weather is warm and humid. Under favorable conditions, shoot blight infections will multiply and continue to expand down the stems, causing the tree to appear scorched by fire. Shoot blight infections can expand beyond the current season's growth into the older supporting wood, causing dark sunken cankers to form.

Fruit may appear small, dark, and shriveled if infected when young, or show expanding red, brown, or black lesions when infected later. Infected fruit often exude droplets of sticky bacterial ooze, particularly when the weather is warm and humid. Entire trees on highly susceptible rootstocks or interstems can wilt and die if this portion becomes infected. The original source of such "rootstock blight" infections is not always obvious.

Control

Fire blight is best controlled using an integrated approach that combines (a) horticultural practices designed to minimize tree susceptibility and disease spread; (b) efforts to reduce the amount of inoculum in the orchard; and (c) well-timed sprays of bactericides to protect against infection under specific sets of conditions.

Horticultural practices. The most effective horticultural practice for minimizing fire blight outbreaks is to avoid highly susceptible cultivars and rootstocks. Highly susceptible apple cultivars include Crispin (Mutsu), Fuji, Gala, Idared, Jonathan, Monroe, Paulared, Rhode Island Greening, Rome Beauty, 20-0unce, and Wayne. Such cultivars on highly susceptible rootstocks are particularly dangerous combinations, since one bad outbreak can lead to substantial tree death within the orchard. Most popular pear cultivars are highly susceptible to fire blight, although Seckel is somewhat less so.

Shoot blight is most common on young succulent growth; therefore, pruning systems and nitrogen fertilization practices that avoid excessive and prolonged shoot growth are important for limiting shoot blight severity. Advancement of disease into the supporting framework of the tree can be minimized by pruning out blighted shoots as soon as they appear in the early summer. This practice is particularly important on young or dwarf trees, where infected shoots may be only a short distance from the trunk or major scaffold limbs. Cuts should be made at least 8-12 inches (20-30 cm) below the margin of visible infection. Sterilizing pruning shears with alcohol or household bleach between each cut is commonly recommended, although this practice is often impractical and of limited value. Good control of insects with piercing and sucking mouthparts (aphids, leafhoppers, pear psylla) can be important to slow the spread of shoot blight infections.

Exhibit A, cont'd.

Inoculum reduction. Primary inoculum sources should be reduced by pruning out cankered limbs and branches during the dormant season. Application of a copper-containing fungicide/bactericide at or shortly after green tip will further reduce the number of new fire blight bacteria produced from overwintering cankers. In orchards with a history of fire blight, the yellow-orange shoots characteristic of canker blight infections should be scouted for and pruned out 1-2 weeks after petal fall; this is particularly useful when blossom blight is well-controlled and canker blight infections are thus the main source of inoculum for disease spread during the summer. Pruning out new shoot blight infections as they appear can also help limit disease spread, but will be most effective if practiced rigorously during the first few weeks after bloom; pruning will do little to slow disease spread if delayed until a large number of infections are visible.

Bactericide sprays. Most serious fire blight epidemics begin with infection during bloom. Certain antibiotics can effectively protect against blossom infections when applied shortly before or immediately after they occur; various prediction systems have been developed to help determine when such sprays are most important. Most systems are based on the principle that (a) a certain number of heat units, usually in excess of 65°F (18.3°C), must accumulate during bloom before a threshold level of inoculum has been reached; and (b) rain is necessary after this point, to wash the bacteria to their infection sites. Thus, antibiotics should be applied just before (or after) a rain if the inoculum threshold has been reached. Check for current, local recommendations. Routine use of antibiotics to prevent shoot blight spread during the summer is not effective or recommended. However, applications to protect new wounds immediately following a hail storm can be very beneficial; check current recommendations.

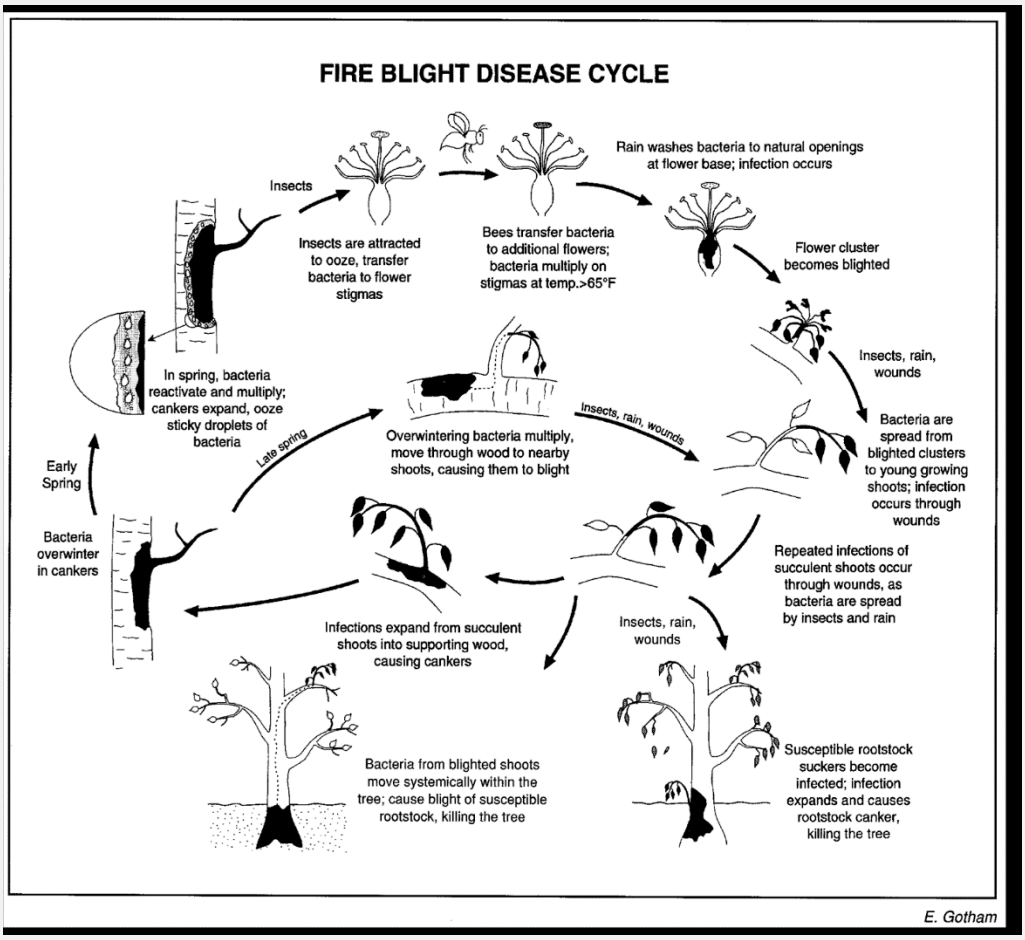

Exhibit B. Fire Blight Control for Organic Orchards: Moving Beyond Antibiotics

The following is an excerpt from an eOrganic article by David Granatstein, of Washington State University, eXtension, 2015, found at: http://articles.extension.org/pages/70541/fire-blight-control-for-organic-orchards:-moving-beyond-antibiotics.

Introduction

Fire Blight is a serious disease of apple and pear caused by the bacterium *Erwinia amylovora*. It originated in the U.S. and is now found in many parts of the world. Most domesticated apple and pear cultivars have some degree of susceptibility to infection. Damage is not cosmetic, but reduces crop yield and may kill entire trees. Prior to implementation of the National Organic Program (NOP), a number of U.S. certifiers allowed the use of the antibiotics oxytetracycline and streptomycin for control of this disease, as they are naturally occurring molecules produced by soil microorganisms. However, the NOP classified them as synthetics but allowed their use for fire blight control only. The National Organic Standards Board has voted to remove these antibiotics from the national list of allowed materials, and their use will be prohibited after October 2014. Due to the potentially devastating damage from this disease, organic apple and pear growers are looking for viable non-antibiotic control measures.

Breeding for Resistance

The ideal solution to fire blight is genetic resistance bred into both the scion (fruit-bearing portion) and rootstock of the tree. The 'Geneva' series apple rootstocks do exhibit a high level of resistance to fire blight, but do not confer resistance to the scion grafted onto them. No highly resistant scion cultivars have been identified that also have the requisite fruit quality characteristics needed for commercialization. Breeding programs are looking at sources of resistance in other wild apple species that have better fruit quality potential, and progress can be expected over the next 10-15 years.

Biological and Chemical Control

Application of antibiotics has been the primary practice used to manage fire blight for more than 50 years. Antibiotics are effective and fast-acting, and can be used in concert with disease prediction models so treatments may only be made when risk of infection is high. Research on biological control practices has been conducted since the 1980s, and several products have been commercialized such as BlightBan®A506. However, until recently, no products exhibited efficacy similar to antibiotics. In 2012, the yeast product Blossom Protect™ debuted in the U.S. market and has performed well for the past two seasons. Other materials such as Serenade® MAX, Double Nickel 55™, and soluble copper are also available and organic-compliant, providing growers with several options to combine into an integrated fire blight management program. In addition, lime sulfur, commonly used by apple growers as a blossom thinner to reduce crop load, has been shown to exert control of fire blight when applied during bloom.

Conclusion

Significant progress has been made in the past several years on non-antibiotic fire blight control methods that would be compliant on organic orchards. Well-vetted recommendations are not yet available, and thus growers need to be testing these new materials and ideas on their own orchards in the meantime. Ultimately, genetic resistance to the disease will provide the most sustainable alternative but this is likely decades away. However, growers can test small plantings of some of the reputedly more resistant cultivars now, observed their resistance, fruit quality, and horticultural needs, and develop their own markets for these new cultivars. The demand for organic apples continues to increase, and growers need well-proven organic fire blight control options.

Discussion Questions:

Below are examples of the kinds of questions the decision case study facilitator can use to stimulate discussion of the issues in this case. Participants may discuss some of these questions in groups of two to four and some questions as a large group. The questions used can vary depending on your time limit and the issues you wish to discuss. Other questions may be added as needed and appropriate to the situation.

1. What was the role of mentors in Deirdre Birmingham starting her orchard? How would you go about learning farming practices from scratch?

2. How does the perennial nature of the orchard change the way disease impacts the farm and is managed by the farmer, compared with annual cropping systems?

3. How do regional differences in conditions affect farmers and crop industries? Do some regions have an inherent advantage? If so, should production of particular crops be confined only to some regions? How do these issues relate to consumer interest in locally grown agricultural products?

4. How should researchers investigating fire blight controls allocate their efforts? Should they focus on resistant genetic material, biological controls, or other organic products to apply?

5. What options does the NOSB have to respond to antibiotic resistance and disease in organic orchards? How should they make this decision for organic orchards?

6. Are there marketing advantages to Deirdre Birmingham, to maintain organic certification for her apples and cider? How should she balance these advantages with the extra work and risk associated with managing fire blight organically?

7. How can the greater community help small, certified organic diversified farm operators succeed?