HISTORY

Bacterial blight on blueberry is a severe disease which appears occasionally in Fraser Valley fields. In years when the disease occurs, it can cause significant yield losses for growers, especially in young plantings. Observations suggest that when the disease symptoms appear in early spring (late Feb. to early March),the preceding fall and winter conditions were severe enough to cause damage to buds, blossoms and twigs and promote subsequent infection. For example, the most recent severe outbreaks of disease that occurred in Delta and Cloverdale in spring and summer of 2006 and 2007were preceded by severe winters and cold spring weather prior to bud break. In addition, areas with low elevation can provide favourable conditions for blight in most years as they are more prone to frost injury. This suggests that tissue injury and damage due to cold weather conditions may enhance the severity of bacterial blight. Disease may also be enhanced by late fall/winter injury to tissues before onset of dormancy. The disease incidence has generally been low in the 2009 and 2010 growing seasons as these years had mild weather conditions during periods of hardening and bud growth.

DAMAGE DUE TO BACTERIAL BLIGHT

The causal organism of blight is reported to be the bacterium *Pseudomonas syringae* pv.*syringae* (Pss). In addition to blueberry, this bacterium can also infect members of the *Prunus* family (cherry, peach, plum,) as well as other crops (pear, bean) and ornamental plants, such as lilac, Magnolia, Forsythia, cotoneaster, mock orange, etc. Pss is able to survive as a saprophyte (epiphyte) on the surface of apparently healthy tissues in low numbers, utilizing available nutrients to grow. If wounds (due to frost injury or hail, for example) or natural openings (lenticels) are present on the plant, the bacteria multiply and invade the underlying tissues, where they spread. Cool, wet weather conditions that occur in the fall and spring seasons permit colonization of wounded tissues, and subsequent warm weather in spring provides conditions for further bacterial growth and disease development. Therefore, weather can enhance disease by increasing tissue damage as well as promoting bacterial growth.

DISEASE SYMPTOMS

Tissues that are most susceptible to infection are the buds and tender one-year old canes, especially if frost-damaged. Stem symptoms initially appear as black lesions, ranging in size from several millimeters to more than 10 cm (Figure 1A, 1B). Lesions have clear borders and they may girdle the stem, leading to shoot death and blighting of buds near the infected area. Flower buds and blossoms can also be killed by blight. Symptoms of bacterial blight can be confused with infection by *Phomopsis* or *Botrytis.* Frequently, these fungi can be recovered from diseased tissues together with *Pseudomonas*. From infected tissues, bacteria can spread to adjacent twigs or neighboring plants by wind-blown rain. Any damaged tissue (through physical damage, frost damage, or pruning wounds)is particularly susceptible to infection.

BACTERIAL INFECTION

Research has shown that populations of *Pseudomonas* exist naturally on the surface of blueberry tissues, such as twigs. In the fall season, for example, bacteria can be present which overwinter on or beneath the bark tissues. Bacterial populations may increase if weather conditions become warm, such as in early spring (late Feb.). However, in order for the bacteria to infect, they must produce toxins (syringomycin) or act as " ice-nucleating agents " i.e. they trigger the formation of ice crystals in plant tissues by secreting a protein that allows these crystals to form more readily. Therefore, indirectly, the presence of the bacteria may enhance the appearance of frost-damage symptoms, which in turn, favours the growth of the bacteria since these damaged tissues are more susceptible.

Figure 1. Symptoms of bacterial blight infection in the field. A) Infected twigs and buds. B) Long stem lesion with tip dieback and most of the associated buds killed. C) 1-year old stem tips were wounded with a pin and sprayed in the fall (wounds are indicated by arrows). In the following spring, stems sprayed with water (left) had normal healing of wounds but stems sprayed with *Pseudomonas syringae*pv.*syringae* (right) showed blackening of the wound sites. More bacteria can be recovered from wounded tissues compared to unwounded tissues.

BACTERIAL POPULATIONS AND INFECTION

Through repeated sampling of blueberry plant tissues over a 2-year period, we showed that *Pseudomonas* populations are present in fields sampled in Delta and Cloverdale. Other areas sampled where the bacteria were recovered were Pitt Meadows, Maple Ridge, and Abbotsford. After biochemical characterization, we confirmed that *P. syringae*pv. *syringae* was present. However, it was surprising to find that many other *Pseudomonas* species and pathovars were also present on blueberry plants. Their role in disease is not yet known. This suggests that presence of bacteria is not the limiting factor for disease to develop. Specific strains of the bacteria were able to cause blight on lilac and blueberry tissues in the laboratory. These strains produced syringomycin toxin and were capable of promoting ice-nucleation. Wounding was important, as demonstrated by a high incidence of infection after the bark was scraped with a pin (Figure 1C). More bacteria were recovered from wounded tissue. This suggests that Pss is a weak pathogen. We have now developed a molecular test to detect the presence of specific pathogenic *Pseudomonas syringae* strains. This may improve monitoring studies.

DISEASE MANAGEMENT

At present, fixed copper is the only chemical registered for bacterial blight control on blueberries. Sprays should be timed to coincide with periods of increasing bacterial multiplication and onset of wet weather such as late fall to early spring when temperatures start to increase. The efficacy of spray applications made in the early fall on bacterial infection or survival has not been determined. However, resistance to copper may develop with continued use of the chemical. Some strains of *Pseudomonas* are becoming tolerant to copper as shown by testing in select fields in the Fraser Valley.

With regard to biological control agents, Serenade is currently registered for bacterial blight control on blueberry. Local research has shown it to be effective in reducing blossom infection when applied in the spring, but efficacy of fall applications has not been determined. Bloomtime Biological and BlightBan C9-1 are other biological controls that are used to control bacterial diseases in other crops, such as fireblight (*Erwinia amylovora)* in apple orchards. Our research has shown that Bloomtime is capable of colonizing blueberry leaf tissue under lab conditions and can out-compete *Pseudomonas* when co-inoculated on detached leaves. Therefore, this product is worthy of additional testing in the field.

Diseased tissues can be pruned out and discarded, but pruning wounds may also provide entry sites for the bacteria to infect the plants. Since bacterial blight is sporadic, implementation of control methods should be based on prior knowledge. The past history of bacterial blight occurrence in the field, late season cane growth due to over-fertilization with nitrogen, and years with high levels of frost damage in the fall or early spring, can all increase disease. Many blueberry cultivars are susceptible to bacterial blight, but late blooming varieties such as Elliot may escape bud damage caused by spring frosts.

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