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Phytophthora Root Rot on Southern Highbush Blueberry in Florida[1]

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Introduction

Roots serve the vital function of water and nutrient uptake for plants. Healthy roots provide the foundation for productive blueberry bushes and require the right horticultural inputs and soil environment to thrive. Less-than-ideal conditions can result in unhealthy, rotten roots, sometimes caused by disease. The most common and destructive root rot disease of southern highbush blueberry (SHB) in Florida is *Phytophthora* root rot (PRR) caused by the oomycete pathogen *Phytophthora cinnamomi* Rands. Oomycetes are also referred to as "water molds" due to their affinity for water-saturated environments. The distinction between oomycetes and fungi is important for disease management, because many fungicides work for one group or the other but not both. Worldwide, *P. cinnamomi* is a devastating pathogen of approximately 5,000 woody plant host species. For blueberry growers in Florida, PRR is a persistent problem that is currently managed through careful site selection, preparation, and routine *Phytophthora*-specific fungicide applications. Information contained in this publication is intended for Florida blueberry growers to use as a guide in the identification and management of *Phytophthora* root rot on SHB.

Disease Cycle and Epidemiology

Phytophthora cinnamomi survives on dead and decaying plant tissues (i.e., saprophytically) in Florida soils throughout the state, and it is a potential problem on all farms with favorable disease conditions. Like all diseases, PRR develops when a susceptible host makes contact with the pathogen during a period of favorable environment for infection and disease development. Environmental factors impact both the host and pathogen. Water-saturated root zones lack oxygen that blueberry roots need, leading to root stress and damage. Saturated soils also provide an ideal environment for the pathogen to produce zoospores (or swimming spores) that infect blueberry roots. The more frequent and increasing duration of root zone saturation, the more likely infection will occur, and the more severe the disease symptoms will become.

One way *P. cinnamomi* survives is by specialized structures called chlamydospores. These spores can survive extreme heat, drought, and freezing conditions. A chlamydospore can germinate, grow, and produce hyphae and other spore types including zoospores. Zoospores have tiny propeller-like appendages they use to swim towards stressed and wounded blueberry roots. If they dry out before finding a host to infect or make contact with an effective fungicide, they die. However, if the spores find wounds or natural

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root openings, they initiate the infection process and move inside the plants' roots where they are protected. Hyphae of the pathogen invade and kill root cells, spreading through the root system into the crown of the plant (i.e., the thick woody stem at the soil line between roots and above ground stems). As the pathogen spreads and multiplies in the field, the population increases, building inoculum and increasing chances of successful infections and additional disease during periods of favorable disease conditions.

Symptoms

The first symptoms of PRR occur on roots, underground, where they are rarely observed. These symptoms include root discoloration (dark brown to black color, instead of the normal cinnamon brown) and rot (Figure 1). As the disease progresses and roots are unable to do their jobs, plants suffer from a lack of nutrients and water. This induces aboveground symptoms, including stunting, yellowing, early fall leaf reddening, wilting (rarely), and eventually plant dieback (Figure 2). Other symptoms of drought stress, including marginal leaf burn and defoliation, can occur with both PRR and other root and vascular diseases, like stem blight, bacterial leaf scorch, bacterial wilt, and others. Symptoms are frequently caused by more than one disease and/or stress, and the physiological drought stress caused by PRR can make plants more susceptible to these other diseases, particularly *Botryosphaeria* stem blight.

Figure 1. A healthy blueberry plant (left) with cinnamon-colored roots, vigorous growth, and green healthy leaves, as compared to a stunted, yellow plant (right) showing leaf reddening, dark brown to black rotten roots, and an overall unthrifty appearance.
Credits: P. Harmon, UF/IFAS

Figure 2. Blueberry plants (top) are stunted as compared to the healthy plants behind them. Leaves show nutrient deficiency symptoms of yellowing and reddening. Another plant with *Phytophthora* root rot (bottom) shows early fall discoloration, its leaves already turning red in late September when the picture was taken.
Credits: P. Harmon, UF/IFAS

The distribution of symptomatic plants within a field can be very helpful in locating PRR hotspots on a farm. PRR tends to affect many plants spanning down and across the rows, resulting in circular to oblong "patches" of stunted and declining bushes. These patches tend to occur first in the lowest, most poorly drained areas of a field, where PRR symptoms also tend to be most severe (Figure 3). In fields that have a slope and use raised beds, PRR can be an issue where surface water pools at the ends of rows that are blocked by elevated end-of-row roads or by mounds that impair surface drainage (Figure 4).

One indicator of possible PRR in plants that show stunting or decline is excessive movement of the crown in the bed when a plant is shaken. Healthy plants will resist rocking back and forth, while plants suffering from PRR will typically appear loose and are easily pulled free from the growing medium. The so-called "tug test" is an indicator of a compromised root system, which may not always be due to PRR.

Figure 3. Saturated soil in the middle of the bed after a heavy rain event. Stunted and yellow plants suffering from phytophthora root rot follow where the soil was saturated, highlighting the importance of good drainage.
Credits: P. Harmon, UF/IFAS

Figure 4. Water collects and stands at the ends of rows in low areas of the field. These are places where the disease is most likely to occur as poor drainage conditions promote phytophthora root rot. Pumping water or increasing drainage by cutting ditches can help reduce the time soil is saturated at row ends.
Credits: P. Harmon, UF/IFAS

Disease Management

The key to PRR management, like many other blueberry diseases, is prevention. Prevention of PRR starts with site selection and field preparation. Given our knowledge of the PRR disease cycle (see previous section), we can limit PRR impacts to production with practical and common-sense considerations involving irrigation management and water drainage. Blueberries planted in deep sands with excellent drainage may never experience PRR; however, where water tables are high or where soils tend to hold water after rain events, growers should use ground contouring and ditching in conjunction with raised bed construction to prevent ponding of surface water. The height of raised beds will vary by the water table level and the effectiveness of surface drainage on the site. For more information about this and other important site selection considerations, see Ask IFAS publication #AC031, the guide on "Florida's Commercial Blueberry Industry."

PRR can also be a problem in nursery production sites; therefore, rooting beds, liner production, and plant finishing beds should be located and constructed to avoid flooding while still providing the necessary water for each step to be successful. In general, potted plants should be grown on an impermeable surface, preferably raised above the ground on benches. Potted plants in production that are flooded by surface water after rain events should be discarded, and pots and contact surfaces should be sanitized prior to reuse. Growers should start with healthy plants free from *Phytophthora*.

Genetic resistance is a desirable trait to control PRR; however, all varieties of SHB currently grown in Florida can succumb to PRR. Although limited information is available, field observations indicate that some varieties are more likely to develop the disease than others. In general, Rabbiteye (*V. ashei* Reade) cultivars are less susceptible to PRR than SHB cultivars.

Fungicide Applications

Two fungicide groups with PRR efficacy are used on blueberry in Florida. The first contains fungicides in the phenylamide group (FRAC group 4) with the active ingredient mefenoxam. Ridomil Gold® SL is one example. Label instructions should be followed carefully to achieve the best results. Specifically, Ridomil is applied directly to the soil/growing medium and NOT sprayed on the leaves and canes of the plant. Ridomil should be sprayed on the bed in a 3-foot-wide band or can be applied through drip or micro-sprinkler irrigation systems. Two applications per season are allowed, with the first recommended in winter before plants bloom. This timing will help prevent root rot through freeze protection events that can leave soils saturated. The second application of Ridomil should be made after harvest, when regular summer rains return, or approximately 6 months after the first application (June to August).

The second group of fungicides labeled for PRR management in blueberry is the phosphonates (FRAC Group P07). Phosphonate products may contain the active ingredients phosphorous acid or salts of phosphorous acid and are sometime referred to as "phites" (e.g., ProPhyt®). Products with the fungicide fosetyl-al are also phosphonates (e.g., Aliette®). These products are systemic and, in contrast to mefenoxam, are recommended as summer foliar sprays to help combat PRR and fungal leaf diseases.

A new fungicide (within the FRAC group 49) is available for use on blueberry. Oxathiapiprolin is available in the product Orondis® Gold 200, or as premix with mefenoxam in the product Orondis® Gold (Premix). These products have not been evaluated on SHB in Florida; thus, look for additional information on these products as data become available. Additional specific information on fungicide products, use rates, reapplication intervals, pre-harvest intervals, and reentry intervals are detailed in EDIS publication #HS1156/HS380, the most current "Florida Blueberry Integrated Pest Management Guide."

In organic production systems where many conventional fungicides cannot be utilized (there is no organic source of phosphorous acid), the aforementioned cultural practices for prevention should be implemented to reduce the likelihood of *Phytophthora* infection and root rot losses. Sanitation measures including proper cleaning of reusable pots, avoiding the re-use of planting substrates, and preventing contact of nursery stock with soil and surface water are also suggested. Efficacy data for mulches, composts, and biological control products are limited.

Summary

Phytophthora root rot is the most common soil borne disease affecting southern highbush blueberry bushes in Florida. Unchecked development can lead to stunting, early fall discoloration, plant dieback, and plant death; however, good cultural and chemical management options exist that can significantly reduce the impact of this important disease when applied preventatively. Submit suspect samples to the UF/IFAS Plant Diagnostic Center for early diagnostic confirmation and consult Extension resources for the most up-to-date management options.

Further Reading

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