"Niagara Rhodo"

Newsletter of the Niagara Chapter,
Rhododendron Society of Canada,
District 12, American Rhododendron Society

Living with Phytophthora Root Rot Disease

Our Purpose: We are a non-profit organization whose aim is to promote, encourage and support interest in the genus *rhododendron.* Our goal is to encourage gardeners to grow and appreciate these plants, by providing educational meetings with knowledgeable speakers, access to topical publications and hosting joint meetings with other chapters'

Content

Living with Phytophthora Root Rot Disease
by Dixie and Martin Taylor.

A report on a talk given by Dr. Steve Krebs, Director of the Leach Research Station, Holden Arboretum, Madison, Ohio, to the membership of the Niagara Region Chapter, at the Vineland Innovation and Research Centre, Vineland Station, ON. March 5, 2017.

Word of Caution

By becoming a successful grower, the reader will be exposed to a contagion for which there is no cure. Once infected with an appreciation of rhododendrons and azaleas most gardeners spend a lifetime collecting these most beautiful of all plants.

H. Edward Reiley

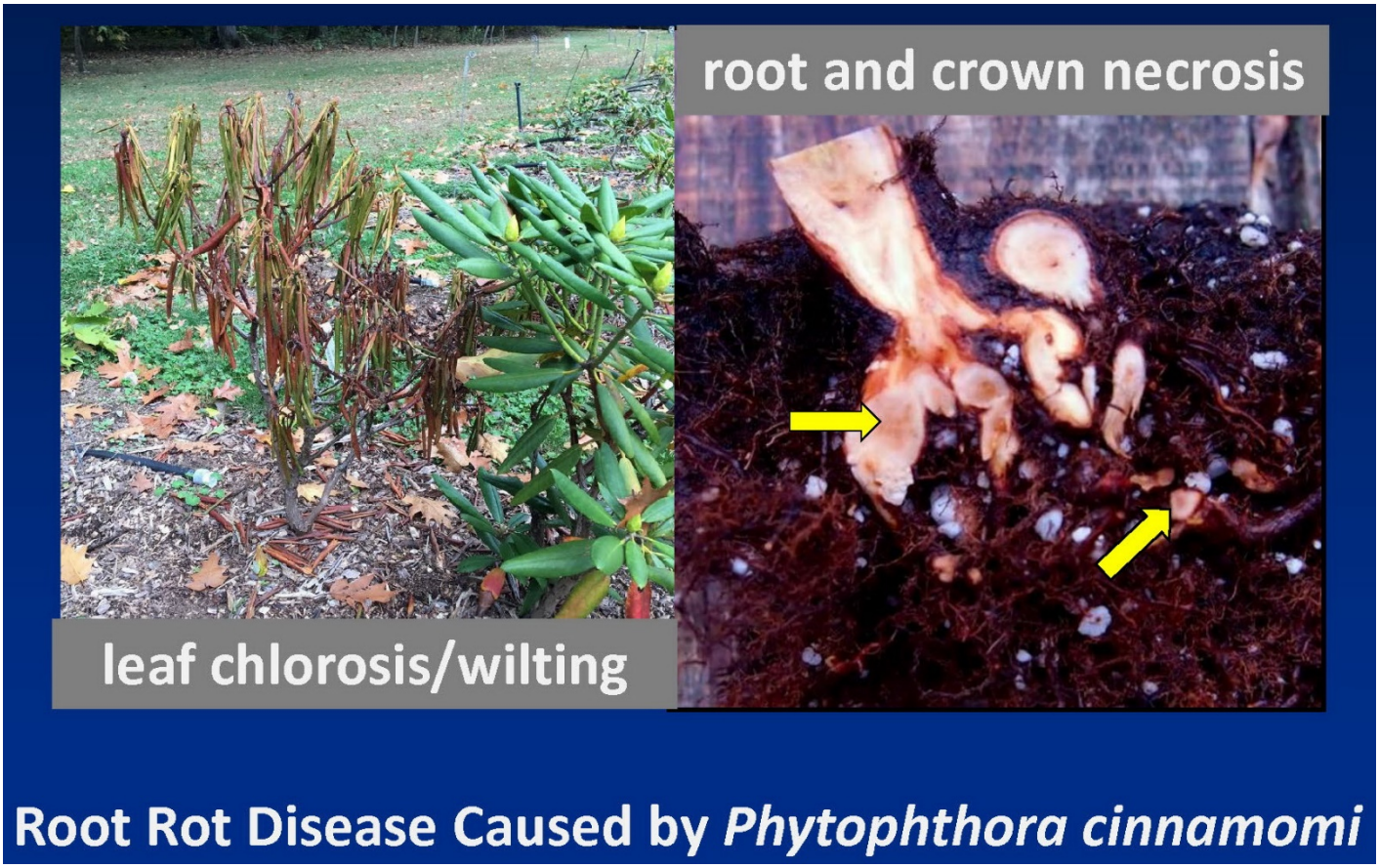
Living with Phytophthora Root Rot Disease

Presentation: Dr. Steve Krebs, Director, David G. Leach Research Station, Holden Arboretum, Madison, Ohio; Eastern Vice President, American Rhododendron Society, March 5, 2017
Review: Dixie & Martin Taylor, Niagara Region Chapter, Rhododendron Society of Canada.

Dear reader. In view of the complex nature of this devastating plant pathogen and its global distribution, a few basic issues above and beyond Dr. Steve Krebs' talk have been examined in more detail: 1. What do we know about this pathogen? 2. If the pathogen is in southern Ontario, how should homeowners deal with it? 3. And taking into consideration climate change, what are the implications for the spread of the pathogen in the future?

Presentation. On March 05, 2017, Steve Krebs, well-known plant breeder and geneticist from the David G. Leach Research Station in Madison, Ohio, gave a fascinating presentation on the highly invasive, global soil pathogen, *P. cinnamomi* and its devastating impact on a wide range of plants including rhododendrons and azaleas. It was a wake-up call for most of us, but also a privilege to learn about his ground-breaking research which spans almost two decades, developing heat tolerant, cold hardy and *Phytophthora*-resistant hybrid rhododendrons. The good news for rhodie lovers was that at least one of these super-hardy, resistant, lovely cultivars, trade name, Splendor™ will be commercially available by 2018. Holden Arboretum and the David G. Leach Research Station are located on the south shore of L. Erie and as such have an ideal, well-drained sandy loam soil for rhododendrons.

Starting in the 1950s, the late influential rhododendron breeder, David G. Leach began breeding cold hardy hybrid rhododendrons (USDA zone 5b, -26c/ -15F) and is famous for introducing gorgeous cultivars such as yellow 'Capistrano', and the bi-coloured 'Red River', not to mention his pivotal book on **Rhododendrons of the World**, 1962. Steve also inherited 2000 of his former mentor's cold hardy rhododendron selections and cultivars which form the core collection at the Leach Research Station.
During the talk we learned some interesting, if disturbing facts about the root rot pathogen *P. cinnamomi (Pc), a* common and fatal disease of rhododendrons and azaleas, as well as over 3000 plant species worldwide. *Pc* is thought to have originated in South East Asia, in the uplands on the west coast of Sumatra where it was first described in 1922 as the causal agent for bark canker of cinnamon trees, *Cinnamonum burmannii*. Trade between Asia and the rest of the world has been ongoing for over 400 years, including perennial fruit, spice and nut crops, and Pc has been transported globally through the distribution of living plants and associated root pathogens (Burgess et al, 2016).
A fungus-like, eukaryotic microorganism in the water mold family, *P. cinnamomi* prefers Mediterranean-like climates including mild, moist winters and springs, and hot summers. The pathogen attacks the fibrous root systems of susceptible plants leading to drought-like symptoms of leaf wilting and chlorosis, progressing to the terminal rusty or cinnamon discolouration stage of root and crown necrosis.
Although less than 5% of rhododendrons tested to date are considered resistant, Steve mentioned that most semi-evergreen azaleas and a few lepidotes may be less susceptible, possibly due to their origins in South East Asia where the pathogen is also endemic. Resistance does not mean immunity to the disease, however.



P. cinnamomi is unique for being a highly invasive oomycetes which can live in soil, water and on flowering or dead plants, reproduces both sexually and asexually, and has a persistent chlamydospore for survival during unfavorable conditions, e.g too cold, hot, dry, or alkaline environments. Under saturated, wet conditions, the spores germinate and microscopic swimming zoospores are released which then

encyst and feed on their plant hosts. After infection the microorganisms spread mainly through the inner bark cambium of the roots and stems. Chlamydospores can persist in soil and water and on dead plants for years.

Other *Phytophthora* pathogens attacking rhododendrons include *P. cactorum* dieback and *P. citricola.* These soil pathogens also have a wide host range including azalea, mugo pine, yew, and heather to name a few. Typically, poorly drained, water-logged soil or media, and plastic ground covers favor these water mold microorganisms. Long distance movement of infected plants or soil can spread the pathogens, as well as contaminated plant debris, potting media, or water (Pscheidt and Ocamb, 2017). Plants infected with *P. cactorum* 'dieback' manifest differential dieback of stems with wilting leaves similar to *Botryosphaeria dothidea*. Steve recommends pruning back the diseased stems into healthy white, moist wood, and burning the debris.

In addition, *Phytophthora ramorum*, discovered in Europe and North America in the 1990s, and best known for 'sudden oak death', also has a widely diverse host range including many oaks, shade trees, conifers and woody ornamentals such as rhododendrons and viburnums. 'Ramorum blight' and 'shoot dieback' in ornamental nursery crops are also often confused with *Botryosphaeria dothidea*, or *Phomopsis* in azaleas (Fry & Grunwald, 2010). Massive tree removal programs are currently underway in California forests to contain the spread of this pathogen.

An impressive map from the Australian paper by Burgess et al, March 2016: **Current and projected global distribution of *Phytophthora cinnamomi*, one of the world's worst plant pathogens**, was revealed and is worth closer inspection. The current global niche for Pc is derived from the pathogen's response to temperature and moisture, the CLIMEX model, and includes a projection to 2080 of its potential distribution with predicted climate change. Extensive soil sampling and records from around the world were used to validate the presence or absence of the pathogen (0 = positive records, X = negative records).

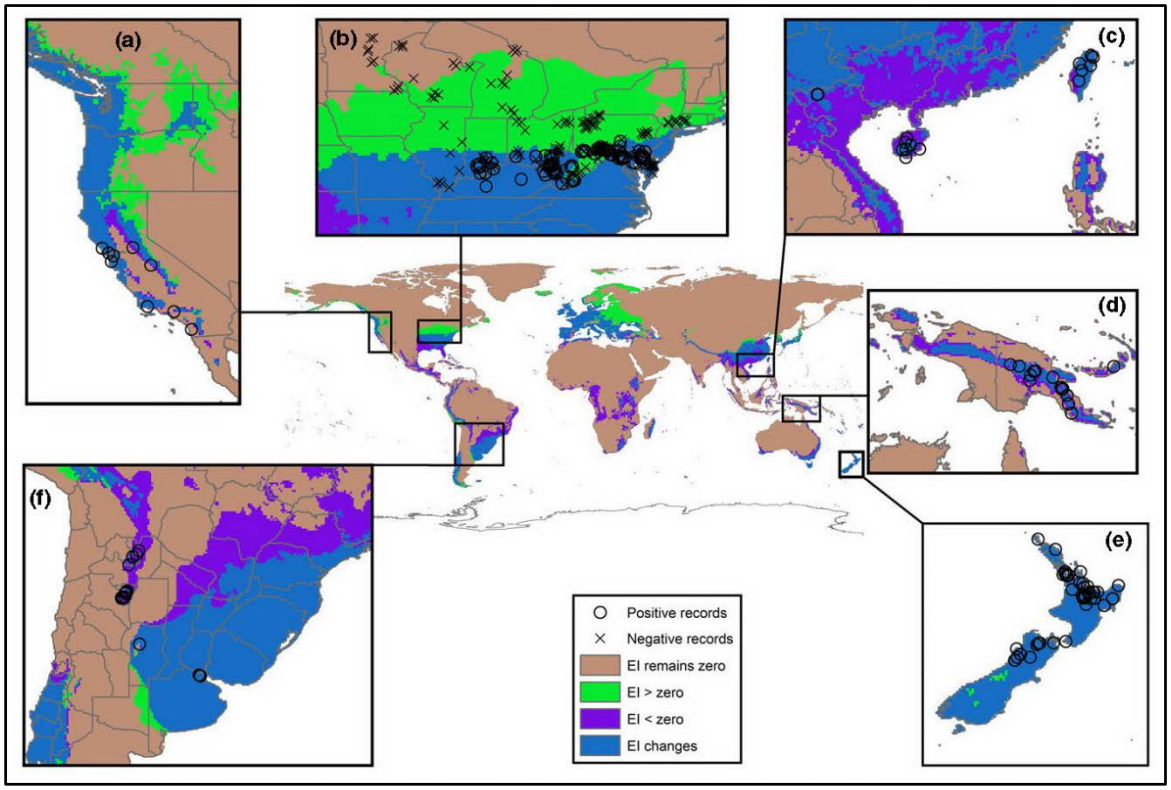
Not surprising, coming from Australia where the pathogen is well-established, Pc is labelled as 'one of the 100 worst invasive, alien species on the planet'. The authors urge active management from governments and relevant environmental managers, using the CLIMEX model to assess regions at greatest risk, to coordinate targeted sampling strategies and to implement hygiene and quarantine procedures to contain its spread (Burgess et al, 2016).

But there may be other important explanations for why plant communities or natural ecosystems do not succumb despite the presence of Pc. For example, because the pathogen is a poor saprotroph (an organism that feeds on or derives nourishment from decaying organic matter) and competitor in the soil, disease may not be observed where there are disease-suppressive soils, such as soils that are well-aerated and rich in carbon and beneficial microbes, or soils with high pH, or simply in the absence of susceptible hosts. As well, most natural grassland species are not known to be susceptible (Burgess et al, 2016).

Note the four CLIMEX Ecoclimatic Indexes **(EI**) in the middle which represent current and projected distribution of the pathogen to 2080. Although areas where **EI remains 0 (brown**) represent unsuitable climate conditions for persistence of Pc in natural ecosystems, the pathogen can still exist locally in microclimates created by adequate water, such as irrigated gardens, orchards, plantations, and in potted plants, regardless of general climate (Burgess et al, 2016). In addition, **EI < 0 (purple**) are areas projected to become unsuitable for the survival of Pc by 2080*;* **EI > 0 (green**) represents expansion into areas of suitable climate by 2080, and **EI changes (blue**) represents areas that are currently suitable, but will either expand or contract by 2080.

With climate change expected to bring warmer temperatures and higher precipitation to many parts of the world by 2080, the CLIMEX model (**EI > 0, green**) predicts that Pc could potentially expand eastward from the Pacific West Coast, north of the 40th Parallel into eastern Canada, north into Scandinavia and Iceland, and into Eastern Europe. In these areas at least, current cold winter temperatures effectively keep Pc confined to managed horticultural environments.

The importance of Steve's outstanding work breeding resistant, hardy rhododendron hybrids therefore can't be underestimated. Resistance breeding adds a powerful new tool to integrated pest management *of P. cinnamomi* and requires about 10 years from seed to selection of superior individuals that have been tested at multiple locations. Other important new tools being developed include rootstock propagation on hardy, resistant host stock, and antimicrobial biological controls, including beneficial microbes in the soil.



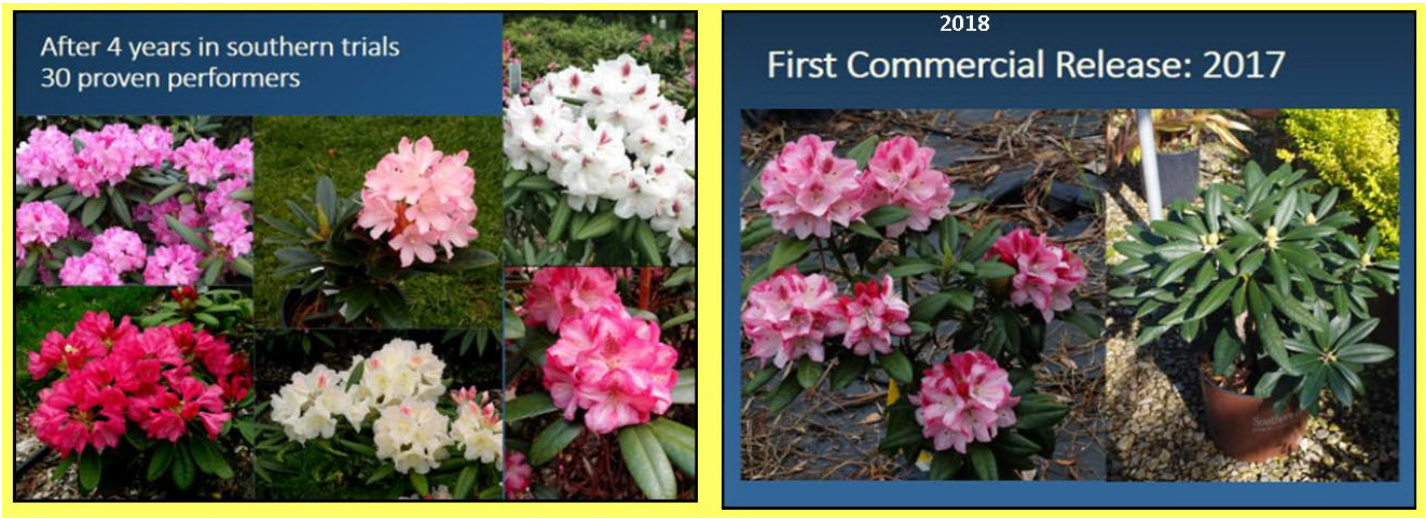
Considering the persistent nature of water molds like *Phytophthora*, the importance of excellent drainage, including rigorous nursery hygiene can't be emphasized enough. Avoidance of 'wet feet' includes strategies such as not planting rhododendrons in front of downspouts or at the bottom of slopes, planting above grade in poorly drained or heavy soils (raised beds), and using high quality (hot) compost to create well-aerated, carbon and microbe- rich, disease-suppressive soils (Brownbridge, pers. com., 2017). Open, well-aerated ground covers of organic or inorganic mulches ranging from pine to hardwood bark, to coarse stone or gravel of granite composition are also essential for maintaining healthy, well-aerated soils and good drainage.

Steve also surprised us by strongly advising against using peat in soil or soil-less mixes for two main reasons: peat is a non-renewable resource, and because of superior moisture retention may increase the risk of microclimates favorable to the survival of *Phytophthora.* As an alternative, Steve mentioned heat-expanded shale (haydite) for use in raised beds (DiGeronimo in Ohio makes a product called

Bioblend), which provides good open porosity in a coarse to fine, gravel and sand mix of pH 5, includes 5% organics, looks attractive and is good for the plants.

Steve has been most successful breeding highly disease resistant *R. hyperythrum* with many cold hardy cultivars. A species from Taiwan, *R. hyperythrum* also provides good ornamental traits such as vigorous growth, dense, glossy foliage and abundant, if floppy, white flower trusses. Buds in hybrid plants are cold hardy to at least zone 6 (some a bit more cold hardy), and heat tolerant to zone 9, the Gulf South. Tests indicate that 50% *R.* h*yperythrum* in the hybrid results in the best performance for warm climates, eg. a cross of hardy susceptible cultivar with the more cold-sensitive but resistant *R. hyperythrum*.
After growing 2500 *R. hyperythrum* F1 hybrids from seed in Madison and Kirtland, Ohio, 165 selections were clonally propagated (4 to 5 rooted cuttings from each selection) and sent down to Louisiana, USDA hardiness zone 9, to be field tested over 4 years for heat tolerance and disease resistance with some shocking results. Compared to Madison, Ohio, hardiness zone 5, Louisiana has much higher average daily temperatures and almost double the amount of rainfall. Not surprising, by year 3, 75% of the plants had perished!

Among the 30 or so individuals that performed well in the southern trials (examples in left picture), three to date have been put into tissue culture at Briggs Nursery (WA) for eventual introduction. Apparently it takes 4 to 5 years to get plants established in tissue culture and grown on to the saleable size of 1-2 gal (Krebs, pers. com., 2017). The first commercial release will be sold in 2018 under the tradename Splendor™ shown in picture on the right.



Early screening for resistance in breeding populations, including *R. hyperythrum* hybrids takes place after being inoculated with the *Phytophthora* pathogen under flooded conditions. Other cold hardy cultivars also being used for resistance breeding include *R. 'Ingrid Mehlquist', R. 'Caroline', R. 'Rocket', R. 'Vernus'* with some dazzling flower shapes and colours produced by Rocket x Caroline, Vernus X Rio, Ingrid Mehlquist X Rio and Ingrid Mehlquist X Pride's Early Red.

Less than twenty years ago, testing for plant resistance to *Phytophthora* was unnecessary because of our cold winters, and possibly because inoculum levels in most garden soils would have been minimal - good drainage, non-conducive, well-aerated soils, and resistant or less-susceptible plants being key. But due to repeated introduction of inoculum into horticultural environments over the years and favourable microclimates, this balance has changed.

Now breeding hardy, resistant plants is of paramount importance and a major strategy in effective management of *Phytophthora.* As it takes at least 10 years between seed and field performance before commercial release, ongoing offsite plant trials are of critical value including: candidate cultivar trials, rootstock pH trials, disease resistance trials, and not least, trials of **Brueckner** rhododendrons.

In summary… from any perspective, there is no quick fix. Be cautious when purchasing any nursery plants today, and as conscientious gardeners consider hot composting , as well as testing garden soils and compost for fertility and *Phytophthora* at **A & L Biologicals** in London, Ontario, or at the **Agriculture and Food Lab** (A.F.L), at Guelph University.

Special thanks to Steve Krebs for contributing two of the above papers, and for so generously taking the time to edit this review, and to answer our many questions.

Further Reading:

Benson, D.M., and Cochran, F.D., 1980. Resistance of Evergreen Azaleas to Root Rot caused by *Phytophthora cinnamomi*, North Carolina State University. Plant Disease 64: 214 - 215

Burgess, T.I. et al, 2016. Current and projected global distribution of *Phytophthora cinnamomi*, one of the world's worst pathogens. Global Change Biology (2016).

Fry, W.E., and Grunwald, N.J., 2010. Introduction to Oomycetes. The Plant Health Instructor. American Phytopathological Society (APS).

Krebs, S.L. and Wilson, M.D., 2002. Resistance to *Phytophthora* Root Rot in Contemporary Rhododendron Cultivars. HortScience 37(5): 790-792.

Pscheidt, J.W., and Ocamb, C.M. (Senior Eds.), 2017. Rhododendron-Phytophthora Root Rot. Pacific Northwest Plant Disease Management Handbook, Oregon State University.

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