Alder Decline - *Phytophthora alni*
PEST RISK ASSESSMENT

This risk assessment follows the format used by the Exotic Forest Pest Information System for North America. Guidelines are listed at http://spfnic.fs.fed.us/exfor/download.cfm.

IDENTITY

Name: *Phytophthora alni* (Brasier and S. A. Kirk)
Etymology: *Phytophthora* from Greek meaning plant destroyer, *alni* from *Alnus* meaning Alder.
Taxonomic Position: Chromalveolata: Heterokontophyta: Oomycota: Peronosporales: Pythiaceae.
Common Names: *Phytophthora alni*-Induced Alder Decline, also, Lethal Root and Collar Rot in Alder.

RISK RATING SUMMARY

Relative Risk Rating: HIGH
Degree of Uncertainty: Moderate
Uncertainty in this assessment results from: The more virulent sub species *P. alni* ssp. *alni* has not been detected in North America.

RISK RATING DETAILS

Establishment Potential Is: HIGH
- Suitable climatic conditions and suitable host material coincide with ports of entry or major destination in North America.
- Organism has active, directed host searching capability or is vectored by an organism with directed host searching capability.
- Organism has high inoculum potential or high likelihood of reproducing after entry.

Justification: *P. alni* ssp. *uniformis* has already been isolated from an Oregon forest and its presence in the USA increases the chances of it becoming an established pathogen. *P. alni* ssp. *alni* is of greater concern due to higher virulence. Since one *P. alni* sub species has already been introduced the chances of another being introduced are good. *P. alni* produces many motile zoospores that can spread long distances in water. The climate in the Pacific Northwest is favorable to this pathogen and susceptible hosts are present.

Spread Potential is: HIGH
- Organism is capable of dispersing more than several km per year through its own movement or by other factors such as wind, water or vectors.
- Organism has demonstrated ability for redistribution through human assisted transport
- Organism has high reproductive potential
- Potential hosts have contiguous distribution
- Newly established populations may go undetected for many years due to cryptic nature, concealed activity, slow development of damage symptoms or misdiagnosis.

Justification: *P. alni* spreads in water and *Alnus* spp. are naturally present in riparian zones.

Phytophthora spp. have been documented to spread through human assisted transport in the nursery industry through the importation of infested plant material and within forest ecosystems on foot wear or the wheels of vehicles. If *P. alni* infection occurs in a remote natural ecosystem the potential for it to remain undetected for some time is high.

Economic Impact Potential Is: HIGH

- Organism attacks hosts or products with significant commercial value (such as for timber, pulp, wood products, wooden structures, Christmas trees, fruit or nut production, syrup production, etc.).
- Organism directly causes tree mortality or predisposes host to mortality by other organisms.
- Damage by organism causes a decrease in value of the host affected, for instance, by lowering its market price; increasing cost of production, maintenance, or mitigation; or reducing value of property where it is located.
- Organism may cause loss of markets (foreign or domestic) due to presence and quarantine-significant status.

Justification: *A. rubra* (red alder) is one of the few commercial hardwood species in the Western United States and is susceptible to *P. alni*. Alder accounts for 90% of all hardwood species harvested in Western Oregon. The USDA APHIS issued a Federal Order for *Phytophthora alni* in 2009.

Environmental Impact Potential Is: HIGH

- Organism is expected to have direct impacts on species listed by Federal, Provincial or State agencies as endangered, threatened, or candidate. An example would be feeding on a listed plant species.
- Organism is expected to have indirect impacts on species listed by Federal, Provincial or State agencies as endangered, threatened, or candidate. This may include disruption of sensitive or critical habitat.
- Introduction of the organism would likely result in control/eradication programs that may have potential adverse environmental effects.

Justification: Some *Alnus* spp. are listed as 'endangered' or 'threatened' in the USDA plant profile, but not in Oregon. *A. incana* is protected in Illinois, and *A. viridis* is protected in Massachusetts, Pennsylvania, and Tennessee. The death of *Alnus* spp. due to the introduction of *P. alni* would be deleterious to wetland conservation. Loss of Alder in the riparian zone could have an impact on soil composition, species composition, stream flow and water quality.

HOST(S)

Alnus spp. – Alder (Betulaceae) including *A. cordata* (Italian alder), *A. glutinosa* (European common alder), *A. incana* (grey alder) *A. rubra* (red alder) and *A. viridis* (green alder) (reference). North American red alder (*A. rubra*) has been shown to be susceptible to *P. alni* in inoculation experiments, but is more resistant to infection than the European common alder (*A. glutinosa*).

Prunus avium – wild cherry has been shown to be susceptible in wound inoculation experiments.

GEOGRAPHICAL DISTRIBUTION

Europe – Widespread: Austria, Belgium, Czech Republic, Denmark, France, Germany, Hungary, Ireland, Italy, Lithuania, Netherlands, Poland, Slovenia, Sweden, United Kingdom. All three sub species of *P. alni* have been found in Europe; *P. alni* subsp. *alni*, *P. alni* subsp. *uniformis* and *P. alni* subsp. *multivora*.

North America – Isolated: Alaska, Minnesota, and Oregon. Two isolations from leaves under Alder in Alaska and a single isolation of *P. alni* subsp. *uniformis* causing root rot on *Alnus rubra* (red alder) in a forest in Oregon. An isolate was tentatively referred to as *P. alni* in a nursery survey in Minnesota.

BIOLOGY

Three subspecies have been identified; *P. alni* subsp. *alni*, *P. alni* subsp. *uniformis*, and *P. alni* subsp. *multivora*. *P. alni* sub sp. *alni* appears to be the most aggressive pathogen of three sub species. So far *P. alni* subsp. *uniformis* is the only sub species to have been isolated in North America. *Phytophthora alni* subsp. *alni* was initially thought to be an interspecific hybrid between *P. cambivora* and another species closely related to *P. fragariae*. However *P. alni* subsp. *alni* has more recently been shown to be a genuine hybrid of *P. alni* subsp. *uniformis*, and *P. alni* subsp. *multivora.*

Infection is most likely effected by motile zoospores, which are released from the asexual sporangia. These spores can be spread in water and soil. Trees are often infected around the collar through the bark. Although *Phytophthora alni* is similar in morphology to *P. cambivora* it is homothallic unlike *P. cambivora,* which is heterothallic. Optimal temperatures for growth in culture range from 23 to 25°C and the upper limit for growth is 29°C on carrot agar.

PEST SIGNIFICANCE

Economic impacts

Nine hundred forty-nine thousand acres of Red Alder and 5 thousand acres of White Alder were grown in Oregon in 1999. In 2010, 12,819,000 board feet of alder was harvested in Western Oregon. Two percent of all timber harvested that year was from hardwood species, with alder accounting for 90% of all hardwood species harvested.

Environmental impacts

P. alni has had an impact on water courses in Europe due to the widespread death of alders along water courses. *Alnus* spp. are an indicator of wetlands and are considered 'facultative wetland' trees because they usually occur in wetlands but are occasionally found in non

wetland areas. The importance of Alder trees to wildlife (mammals and terrestrial birds), as a source of food is minor, and as a source of cover is moderate.

Alder trees are present throughout Oregon. There are four native *Alnus* species present in Oregon, *A. incana* (gray alder), *A. rhombifolia* (white alder), *A. rubra* (red alder) and *A. viridis* (green alder) all of which have been shown to be susceptible to *P. alni* in Europe. European alder (*A. glutinosa*) is the most susceptible species of Alder to *P. alni* induced alder decline but this species of Alder is not present in Oregon, but it is native and widespread throughout Midwestern and North Eastern United States.

CONTROL MEASURES

The most effective control measure is to prevent the introduction of this invasive pathogen into the ecosystem or the nursery industry. Aggressive disease management techniques will likely achieve little more than to slow the spread of this pathogen. Movement of plants should be minimized and when plants are being shipped they should go through a quarantine period to allow for the detection of any diseased plants before they enter the environment.

Once a plant is infected with *P. alni* it cannot be cured. Infected plants must be destroyed. *P. alni* spread can be mitigated by regular inspections for early detection. Vehicles and footwear passing through high-risk areas should be cleaned and disinfected to avoid spreading infested soil around. Nurseries should use sterilized soil and clean pots to reduce the risk of infection of vulnerable seedlings. Irrigation should be from a clean source of water that has been treated to minimize the risk of spreading zoospores onto clean plant material. Protectant fungicides may be appropriate in a nursery setting to reduce the chance of infection.

DETECTION & IDENTIFICATION

Symptoms

P. alni usually infects the host through the roots and collar and causes root rot, collar rot and bleeding cankers. Bark dies around the collar and roots. Canopy dieback may be observed, leaves tend to be small, yellow and sparse. The tree declines in vigor and may eventually die.

Morphology

Oogonia are variably ornamented and have amphigynous (occasionally paragynous) antheridia. They vary in size from 37 to 55µm in diameter. Sporangia are borne singly on long sporangiophores, they are ellipsoid, non-papillate and non caducous with a broad exit pore. They vary in size from 35 to 70µm in length and 27.5 to 50µm in diameter. Chlamydospores have not been observed.

Identification tests

ELISA field test kits are available for quick detection of *Phytophthora* species. Lab culture or PCR would be necessary to determine the species or sub species.

MOVEMENT & DISPERSAL

Phytophthora spp. reproduce asexually through the production of sporangia, which release motile zoospores that can, potentially, be transmitted long distances in water. Oospores are sexual spores that can survive for long periods of time in soil.

P. alni is soil and waterborne pathogen of Alder. As such it is particularly rampant in riparian areas and has spread rapidly across Europe. *P. alni* can be spread through the movement of infected plants, and infested soil or water. As such it is problematic in nurseries as well as natural riparian zones.

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