Etiology and Real-Time Polymerase Chain Reaction-Based Detection of Gremmeniella- and Phomopsis-Associated Disease in Norway Spruce Seedlings

Isabella Baja, Halvor Solheim, Ari M. Hietala, and Carl Gunnar Fossdal

Norwegian Forest and Landscape Institute, P.O. Box 115. 1431 As, Norway.
Accepted for publication 7 July 2006.

ABSTRACT


In spring 2002, an unusual disease outburst was recorded on Norway spruce seedlings in southeast Norway. Extensive damage was recorded on 1- and 2-year-old Norway spruce seedlings that either had wintered in nursery cold storage or had been planted out in autumn 2001. The damage was characterized by leader shoot dieback and stem necroses on the upper or lower part of the shoot from 2001. Gremmeniella abietina and a Phomopsis sp. frequently were isolated from the diseased seedlings. Internal transcribed spacer (ITS) ribosomal (r)DNA sequence analysis and random amplified microsatellites profiling indicated that the G. abietina strains associated with diseased nursery seedlings belonged to the large-tree type (LTT) ecotype of the European race of G. abietina var. abietina, and inoculation tests confirmed their pathogenicity on Norway spruce. Based on ITS rDNA sequence analysis, the Phomopsis strains associated with diseased seedlings did not represent any characterized Phomopsis spp. associated with conifers. The Phomopsis sp. was not pathogenic in inoculation tests, indicating that it may be a secondary colonizer. ITS-based real-time polymerase chain reaction assays were developed in order to detect and quantify G. abietina and Phomopsis in the nursery stock. We describe here the G. abietina-associated shoot dieback symptoms on Norway spruce seedlings and conclude that the unusual disease outburst likely was related to the G. abietina var. abietina epidemic caused by the LTT on large Scots pines in 2001.

Additional keywords: Picea abies.

Gremmeniella abietina (Lagerb.) M. Morelet is one of the most serious pathogens on pines in the Northern hemisphere. It causes a range of symptoms known as the Brunchorstia dieback or Scleroderris canker. G. abietina comprises two described varieties: var. abietina associated with a number of conifers and with a large geographic distribution area, and var. balsamea known only from Quebec, Canada, where it is associated with Abies balsamea, Picea glauca, and P mariana (25). As reviewed by Hamelin and Raill (12), G. abietina var. abietina, based on morphological, serological, and genetic studies, has been divided into North American, Asian, and European races. The European race of G. abietina var. abietina consists of two ecotypes named the "small-tree type" (STT) and the "large-tree type" (LIT) (16), also previously described as biotypes A and B, respectively (30). Based on pairing tests, STT and LTT are regarded as genetically isolated (32). The LTT is most common in 15- to 40-year-old Scots pine (Pinus sylvestris L.) trees in southern Scandinavia and Finland (15.31), where it causes dieback of current-year shoots in the entire crown. The STT occurs on young Scots pine trees in northern Scandinavia and at higher elevations in the south, where it causes perennial cankers on the parts of the tree covered by a lasting snow layer during the winter (19).

Besides pines, G. abietina also may attack Norway spruce (Picea abies (L.) Karst.) where the infection occurs mainly on the previous year’s leader shoot and results in stem girdling and top dying (20.28). During the outbreaks in the southernmost part of Norway in the early 1980s, G. abietina damaged Norway spruce trees and saplings grown as the understorey below Scots pine (2,28).

The symptoms of Gremmeniella spp. damage on trees (here defined as having a diameter >10 cm at breast height) differ from those on saplings (>1 m tall) and seedlings (<1 m tall). On Scots pine seedlings, damage caused by G. abietina can be identified readily due to the characteristic umbrella-like folding of needles on the infected leader shoot (4,22). Regarding Norway spruce seedlings, there are no reports describing Gremmeniella infection on seedlings while still in nursery production (<2 years old). Barklund and Hellgren (1) explained this by a long latent period after the infection and reported that shoot dieback symptoms on seedlings usually develop after they have been planted out. The symptoms at this stage are described as being similar to shoot dieback caused by Sirococcus conigenus (DC) P.F. Cannon & Minter (5).

We are unable to supply this entire article because the publisher requires payment of a copyright fee. You may be able to obtain a copy from your local library, or from various commercial document delivery services.