



Fig. 1 Nordmann fir (*Abies nordmanniana*) with symptoms of current season needle necrosis (CSNN). Photo: V. Talgø

Fungi found in Norway and Austria in association with *Abies*-needles developing current season needle necrosis (CSNN)

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Current season needle necrosis (CSNN) (Fig. 1) is common on *Abies* spp. both in the USA (Chastagner et al. 1997) and Europe (Lyhr 1994, Perny et al. 2004). To our knowledge, the main focus on seeking an explanation to the problem has been on noninfectious/abiotic factors like nutrition (Hendrick 2002) and effect of shading. The fact that diseased needles occur between perfectly healthy looking needles (Fig.1), may indicate that a pathogen is causing the problem. Nutrient deficiency symptoms are, according to our experience, more uniformly distributed (Talgø et al. 2007).

From Germany, *Kabatina abietis* Butin & Pehl sp. nov. was identified from grand fir (*Abies grandis*) needles with symptoms resembling CSNN (Butin and Pehl 1993). They described

the symptoms as spotty discoloration (browning) of fir needles. Also in Austria *K. abietis* was associated with CSNN symptoms on grand fir (Fig 2), nordmann fir (*Abies nordmanniana*) for Christmas trees, and noble fir (*Abies procera*) (Perny et al. 2004). In Norway *Kabatina* sp. was found on spotted noble fir needles in 2002 (Talgø et al. 2003).

In 2004, we decided to look into possible fungal infection on symptomatic needles on nordmann fir from south-western Norway. In early October, we collected six needle samples (Fig. 3) from five different farms in Rogaland county. Small needle sections were surface sterilized before they were placed on potato dextrose agar (PDA). Parallel samples were incubated (100 % RH and 20 °C).



Fig. 2 Current season needle necrosis (CSNN) due to *Kabatina abietis* on grand fir (*Abies grandis*) in Austria. Photo: T. Cech



Fig. 3 Needles of nordmann fir (*Abies nordmanniana*) with symptoms of current season needle necrosis (CSNN). The needles were collected from five farms (six samples) in Rogaland county in early October 2004. Photo: V. Talgø



Fig. 4 *Petalotiopsis* sp. on growth medium (PDA) (left) and incubated needles of nordmann fir (*Abies nordmanniana*) with current season needle necrosis (CSNN) symptoms (right). Photo: V. Talgø

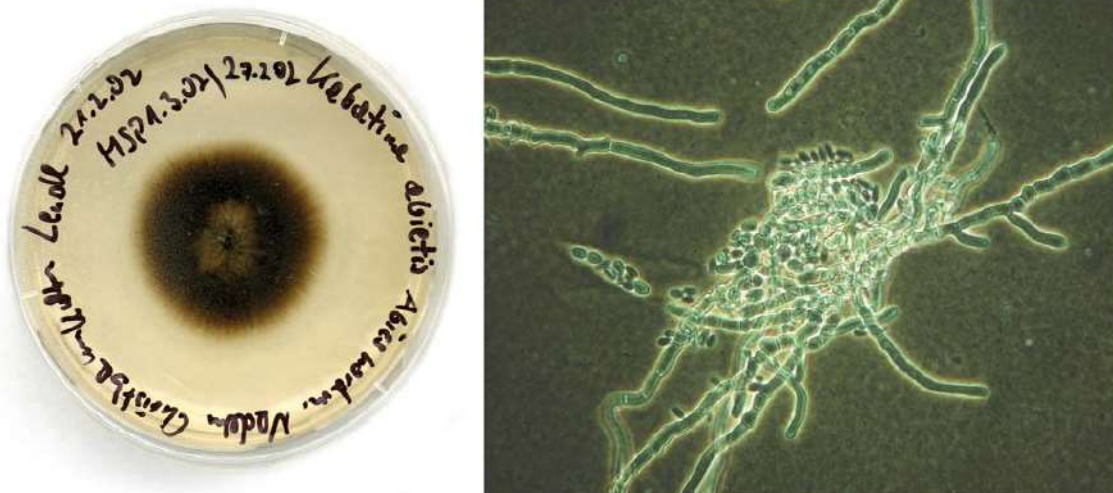


Fig. 5 Culture of *Kabatina abietis* isolated from nordmann fir (*Abies nordmanniana*) in Austria (left). The photo to the right shows hyphae with conidial glomeration. Photo: T. Cech

Pestalotiopsis sp. dominated both on PDA and on incubated samples (Fig. 4). *Pestalotiopsis* spp. are considered weak pathogens or saprophytes. Interestingly though, a dark culture with morphological characters resembling *K. abietis* (Fig. 5), was present on six out of six samples.

Since the samples in Norway were collected late in the season in 2004, we could not eliminate that the fungi we found were secondary invaders, and therefore new samples were collected in July 2005, at the time when the first symptoms developed (Fig. 6). Isolations on PDA and water agar (WA) resulted also at this time of the year in cultures resembling *K. abietis* (Fig. 5). Isolates are stored and will

be used for inoculation tests to fulfil Koch's postulates. Sequencing will be performed, including a culture we obtained from a CSNN sample of nordmann fir sent to us from Denmark in 2005.

CSNN has thus far not been problematic in Norwegian Christmas tree fields, but we have received samples occasionally during 2004 to 2007. On the upper side of the needles from a majority of these samples, there were densely situated acervuli (Fig. 7). Occasionally greyish spore masses oozed out from the acervuli after incubation. Isolation on PDA directly from the spore masses yielded a culture identical to the culture in Fig. 5. The acervuli had *textura angularis* as described for *K. abietis* by



Fig. 6 Initial symptoms of current season needle necrosis (CSNN) on nordmann fir (*Abies nordmanniana*). Symptoms developed earlier in 2007 (photo to the right, June 28) than in 2006 (photo to the left, July 10). Both samples came from the same location in Rogaland county. Photo: V. Talgø



Fig. 7 Acervuli (black spots) on the upper surface of needles from nordmann fir (*Abies nordmanniana*) with symptoms of current season needle necrosis (CSNN). The samples were collected in Rogaland county in January 2007 (left) and in April 2007 (right). Photo: V. Talgø

Butin and Pehl (1993), and the morphology of the spores corresponded well with their description. Butin and Pehl (1993) reported that *K. abietis* mainly form on the lower side of the needles (hypophyllous). As far as we observed, acervuli did not appear on the upper surface (epiphyllous) until the necrotic areas changed from brown to more greyish. Thus, acervuli seemed to form later on the upper side of the needles than on the lower side.

On three samples collected in January 2007 from three different locations in Rogaland county, we found a discomycete (Fig. 8) among the acervuli mentioned above. The same type of apothecia were found on several samples from a new location in Rogaland county in late April 2007. Apothecia grew on both the upper and lower side of the needles. We were wondering if it could be the tele-

omorph state of *Kabatina abietis*, but sequencing revealed that it was a *Mollisia* sp., *M. fusca* had the closest match (99,64 %). *Mollisia* spp. are common on rotting wood (Ellis and Ellis 1997).

Reports from the extension service indicate that there is more CSNN in Norway in 2007 than in previous years. From Austria, on the other hand, the opposite seems to be the case. We have isolated from new samples in 2007 (to the right in Fig. 6), and done chemical analyses of nutrient content in needles from both symptomatic and healthy trees. Results are not yet available.

It may be concluded from our investigations in Norway and Austria that we have clear indications that CSNN is caused by *K. abietis*.



Fig. 8 *Mollisia* sp. on a nordmann fir (*Abies nordmanniana*) needle collected in Rogaland county in January 2007. Photo: V. Talgø

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