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Lecanosticta acicola (Ascomycota) causing brown spot needle blight on Atlas cedar (*Cedrus atlantica*) in Germany

Lecanosticta-Nadelbräune (*Lecanosticta acicola* (Ascomycota)) an Atlas-Zeder (*Cedrus atlantica*) in Deutschland

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Abstract

The fungus *Lecanosticta acicola* (Thüm.) Sydow causes needle blight on trees of the genera *Pinus* and *Cedrus*. On pines, it has been known in Germany since 1994. Here, its first detection on Atlas cedar in Germany is reported.

Keywords

Lecanosticta acicola, brown spot needle blight, *Cedrus atlantica*, Atlas cedar

Zusammenfassung

Der Pilz *Lecanosticta acicola* (Thüm.) Sydow verursacht die Nadelbräune an Bäumen aus der Gattung *Pinus* und *Cedrus*. An Kiefern ist er in Deutschland bereits seit 1994 bekannt. Hier wird über seinen ersten Nachweis an Atlas-Zeder in Deutschland berichtet.

Stichwörter

Lecanosticta acicola, Lecanosticta-Nadelbräune, *Cedrus atlantica*, Atlaszeder

Introduction

The Atlas cedar (*Cedrus atlantica*) is on the Red List of Threatened Species (Thomas, 2013) and is considered an alternative tree species in Europe in the wake of climate change (Luciano de Avila & Albrecht, 2018; Courbet et al., 2012). In this respect, diseases observed on this tree species are of particular interest. Therefore, the cause of a premature needle fall on two Atlas cedars in a park in Konstanz was investigated in more detail.

Methods

Twigs and fallen needles of the cedar trees were examined for fungal organs present on the sample as it is received in the laboratory or after moist chamber incubation by a dissecting microscope (Leica M125; Leica, Wetzlar, Germany) and a compound microscope (Leica DM2000). Conidia mounted in water were measured with a light microscope at a magnification of $\times 400$ or $\times 1000$.

For DNA extraction one single typical well-developed conidoma from each sample was transferred into 2.0 mL reaction tube containing grinding beads and homogenized using the MP FastPrep24 homogenizer (MP Biomedicals LLC, Solon, Ohio, USA). DNA was extracted using the Qiagen DNeasy Plant Pro Kit (Qiagen, Venlo, Netherlands) and the ITS region was amplified by PCR using the ITS4/ITS5 primers (White et al., 1990). Sequencing was performed on the Applied Biosystems SeqStudio Genetic Analyzer (Thermo Fischer Scientific, Waltham, Massachusetts, USA). ITS-sequences were processed using the DNASTAR Lasergene software (DNASTAR, Madison, WI, USA) and compared to the sequences of NCBI Genbank using the BLAST function.

Results and Discussion

In a public park in the city of Konstanz (Baden-Württemberg, Germany) two old Atlas cedar (*Cedrus atlantica*) trees showing needle cast and their crowns were almost completely defoliated (Fig. 1). Brown, pre-maturely abscised needles laid on the lower twigs (Fig. 2) and on the ground. Only the current-year needles remained attached to the lower twigs giving them a “paintbrush” appearance (Fig. 3). On dead needles black acervuli developed and broke through the epidermis by one or two slits creating a bridge of epidermal tissue over the fruiting bodies (Fig. 4). Under moist conditions, brown to olive, straight to curved thick-walled conidia with 1 to 5 septa (most 2-3 septa) were released. They differ clearly in size depending on condition of the specimens. Spores from herbari-



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Fig. 1. Defoliation of Atlas cedar infected by *Lecanosticta acicola*



Fig. 2. Browning of needles and needle cast

um specimens measure (21)-29-(38) × (3)-4.4-(6) μm vs. (30)-44-(68) × (3)-4.5-(6) μm measured for living conidia obtained from incubation experiments in a moist chamber (Fig. 5). A sexual stage (Ascomata) of the fungus was not detected.

According to the morphology of the acervuli and the conidia the fungus was identified as a species of the genus *Lecanosticta* (Ascomycota). The rDNA (ITS) sequences from two isolates were more than 99.8 % identical to the epitype of a *Lecanosticta acicola* (Thümen) H. Sydow (isolate CBS 133791,

GenBank Accession No. NR_120239.1). The generated sequences were submitted to GenBank (accession numbers ON416900, ON416901) and herbarium samples were deposited in the fungal collections of the State Museum of Natural History Karlsruhe (KR), Germany (accession numbers: KR-M-0047823, KR-M-0047824).

The genus *Lecanosticta* includes nine species with *L. acicola* being the type species. *L. pharomachri* and *L. acicola* are the only species known to be significant plant pathogens (Theron et al., 2022; van der Nest et al., 2019a). They cause brown spot needle blight that is a serious disease of pines worldwide with more than 40 *Pinus* species becoming infected (Farr & Rossman, 2022). However, *L. acicola* is not limited to the genus *Pinus*, since Oskay et al. (2020) and Schenck et al. (2022) report an infection of *C. libani* and *C. atlantica* under natural conditions. *Cedrus* is a member of the family Pinaceae as are



Fig. 3. "Paintbrush" appearance of a twig



Fig. 4. Fructifications (acervuli) rupturing the needle epidermis

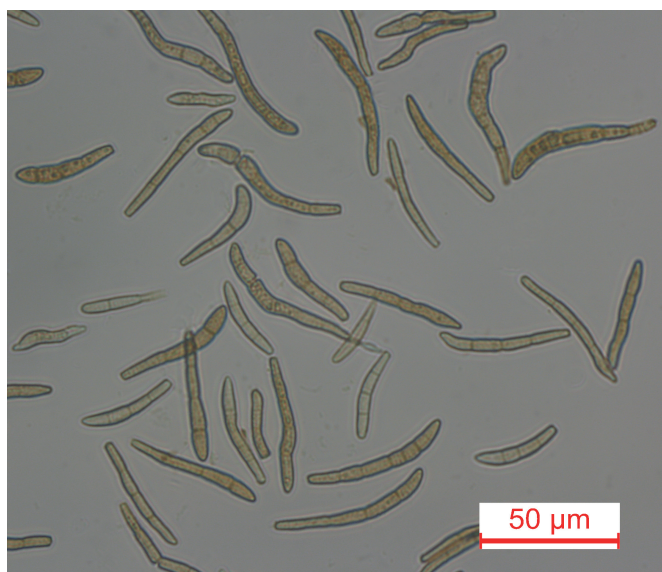


Fig. 5. Fresh living conidia

all other hosts known so far. Although *L. acicola* is already known as needle parasite on *Pinus* in Germany since 1994 (Pehl, 1995), to our knowledge, this is the first report of *L. acicola* on *C. atlantica* in Germany. The defoliation on Atlas cedar was considerable (Fig. 1) compared to the low disease severity reported from *C. libani* in Turkey (Oskay et al., 2020). The drought of 2018 to 2020 may have favoured the outbreak of the disease and the wet summer of 2021 ensured the spread of conidia within the trees. The source of inoculum could not be identified.

L. acicola is becoming a pathogen of great concern in Europe. Its introduction to and spread within Europe is probably due to the effects of climate change, increasing international trade of infected plant material and the emergence of additional aggressive strains (van der Nest et al., 2019b). More surveys are needed to closely monitor the spread of the pathogen to other hosts.

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Conflicts of interest

The authors declare that they do not have any conflicts of interest.

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