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Research article

First record of the fungus *Setomelanomma holmii* (Pleosporales, Phaeosphaeriaceae) on *Picea abies* in Bulgaria

Maria Dobreva[1], Margarita Georgieva[2], Pencho Dermendzhiev[3], Vasil Velinov[4], Rumen Nachev[5], Georgi Georgiev[6]

(1) Forest Protection Station – Plovdiv, 82 Slavyanska Street, 4023 Plovdiv, Bulgaria, mr_dobreva@abv.bg
(2) [Corresponding author] Forest Research Institute, Bulgarian Academy of Sciences, 132 St Kliment Ohridski Blvd, 1756 Sofia, Bulgaria, margaritageorgiev@gmail.com; https://orcid.org/0000-0003-3165-1992
(3) Forest Protection Station – Plovdiv, 82 Slavyanska Street, 4023 Plovdiv, Bulgaria, p.t.dermendzhiev@gmail.com
(4) Forest Protection Station – Plovdiv, 82 Slavyanska Street, 4023 Plovdiv, Bulgaria
(5) Forest Protection Station – Plovdiv, 82 Slavyanska Street, 4023 Plovdiv, Bulgaria, rnachev@lzsplovdiv.iag.bg
(6) Forest Research Institute, Bulgarian Academy of Sciences, 132 St Kliment Ohridski Blvd, 1756 Sofia, Bulgaria, ggeorgiev.fri@gmail.com; https://orcid.org/0000-0001-5703-2597

Abstract: Spruce needle drop disease of Norway spruce (*Picea abies*) associated with a fungal pathogen *Setomelanomma holmii* (Pleosporales, Phaeosphaeriaceae) was established for the first time in Bulgaria in 2023. Severe symptoms of the disease were observed in 12.4% of 6-year old Norway spruce saplings planted in the nursery of Training and Experimental Forest Range, Yundola village (Southwest Bulgaria). Fruiting structures of the fungus were found on the branches and twigs of *P. abies*. Only current year needles remained on severely affected samplings. Symptoms of the disease were not detected on the Colorado blue spruce (*Picea pungens*) young trees planted in the same nursery.

Keywords: pathogen, *Picea abies, Setomelanomma holmii,* spruce needle drop

Introduction

Spruce needle drop disease caused by the fungus *Setomelanomma holmii* M. Morelet, 1980 (Pleosporales, Phaeosphaeriaceae) was first reported on *Picea pungens* Engelm. in France in 1980 (Morelet, 1980). The genus *Setomelanomma* M. Morelet is a monotypic, containing the sole species *S. holmii* that is pathogenic on branches and twigs of *Picea* species. The fungus causes chlorosis, brown discoloration and needle drop of older spruce needles in the autumn. Rossman et al. (2002) reported the presence of the fungus in North America and conducted detailed studies including both morphology and phylogeny (Zhang et al., 2012). Subsequently, *S. holmii* was reported on *P. glauca* (Moench) Voss in North America (Canada and the United States) (Rossman et al., 2002), *P. abies* (L.) Karst in the United States (Plewa et al., 2012), *P. crassifolia* Kom. in China (Wu et al., 2014). In Europe (Lithuania), the fungus was observed on *P. abies* shoots in a study for assessment of the diversity and composition of fungal communities following the invasion of spruce bud scale (*Physokermes piceae* Schrank) (Menkis et al., 2015). According to the GBIF Secretariat (2023), *S. holmii* was found in the Europe (France, Estonia, Denmark and Finland), in North America (the United States and Canada), and in Asia (China and Russian Federation). While the pathogenicity of this fungus is still under investigation, it has been reported to cause disease on white spruce (*P. glauca*) and Colorado blue spruce (*P. pungens*) in Canada (Rossman et al., 2002).

The purpose of this note is to report the presence of *Setomelanomma holmii* on Norway spruce (*P. abies*) saplings that appeared for the first time in Bulgaria.

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Material and methods

In November 2023, severe symptoms of needle drop disease were observed on 6-year old Norway spruce (*P. abies*) saplings planted in the nursery of Training and Experimental Forest Range, Yundola Village (in the pass between Rila and the Western Rhodopes mountains, 42°03′37.63″N; 23°51′01.82″E; 1375 m a.s.l.). Symptomatic saplings were eradicated and transported to the Forest Protection Station in Plovdiv and to the Laboratory of phytopathology at Forest Research Institute in Sofia. Parts of dead shoots with and without needles were surface washed with tap water for 5 min, surface sterilised for 1 min in 96% ethanol, and placed in Petri dishes on moistened filter paper. The samples were incubated at 22 °C under artificial light in a Thermo Heraeus BK 6160 testing chamber. The shape and size of 100 fruiting bodies were examined with Zeiss GSZ stereo microscope. A number of 100 asci and ascospores were measured at magnification 125× using Olympus CH20 stereo microscope. Both stereomicroscopes were equipped with a digital camera DinoEye AM-423X.

Results

A total number of 485 Norway spruce (*P. abies*) seedlings was planted in the nursery of Training and Experimental Forest Range in Yundola Village in 2020. In November 2023, symptoms of spruce needle drop disease were observed on 60 young trees (12.4%). Forty young symptomatic saplings (66.7%) were completely defoliated and dead, and the rest ones (33.3%) were partially affected. On the severely affected saplings dry needles were left only on the tips of twigs that were hanging down (Fig. 1A, B). Symptoms of the disease were not detected on the Colorado blue spruce (*Picea pungens*) trees planted in the same nursery.

Abundant small black dots were visible in November on the Norway spruce twig surface. Fruiting bodies (ascomata) were found on current and second year old host twigs. The observed perithecia were 100–275(187) μm in diameter, black, globose to subglobose, with black setae (Fig. 1 C, D). Asci were with broadly cylindrical shape, 8-spored, 66.9–83.5(75.3) × 12.1–13.4(12.8) μm in size (Fig. 1E). The size of measured ascospores was 17.5–21.1(19.0) × 6.4–7.9(7.3) μm, ellipsoidal, hyaline to pale yellowish, transversely septate with three-septate, slightly constricted at the septa (Fig. 1F).

Discussion

The size, shape and colour of fruiting bodies, asci and ascospores of *Setomelanomma holmii* were consistent with descriptions of the fungus made by Rossman et al. (2002).

In our study the fungus was identified on the basis of morphological characteristics as the causal agent of Spruce needle drop disease on *Picea abies* saplings in Southwest Bulgaria. Black flask-shaped fruiting bodies were found on the surface of the branches and twigs (Fig. 1C, D). According to Rossman et al. (2002), the ascomata of *S. holmii* develop in late May and early June, while needles are still present. O'Brien (2013) noticed that all of the needles on the affected branches drop off by the end of the summer, except the current needles on the tips of the branches. In our study symptoms of the disease were observed in November when gradual loss of needles were detected on 12.4% of severely affected trees.

Spruce needle drop disease is consistently associated with the fungus *Setomelanomma holmii*. Its fruiting structures on the twigs were often associated with spruce decline (needle browning and drop off) (Rossman et al., 2002; Wu et al., 2014; Jayasiri et al., 2015). Spruce needle drop disease affects stressed trees (Eilers et al., 2021). It is thought that the environmental stress (long period of drought and high temperatures) can trigger the pathogen growth and subsequently loss of needles. In 2019 the fungal species was listed in the EPPO Plant Quarantine Data Retrieval System (EPPO, 2019).

Since the spruce needle drop disease is a relatively new problem, not many details are known about its life cycle. It is known that the fungus overwinters in infected branches (Eilers et al., 2021). Kosawang et al. (2018) revealed that fungal endophytic communities of tolerant ash species including *Setomelanomma holmii* may protect them from ash dieback. The selected endophytes have the potential to act as biocontrol agents with high antagonistic activity against *Hymenoscyphus fraxineus* causing ash dieback that threatened ash trees in Europe for more than two decades (Pacia et al., 2023).

The fungus *S. holmii* was first reported in North America in 1998 caused discolouration and needle

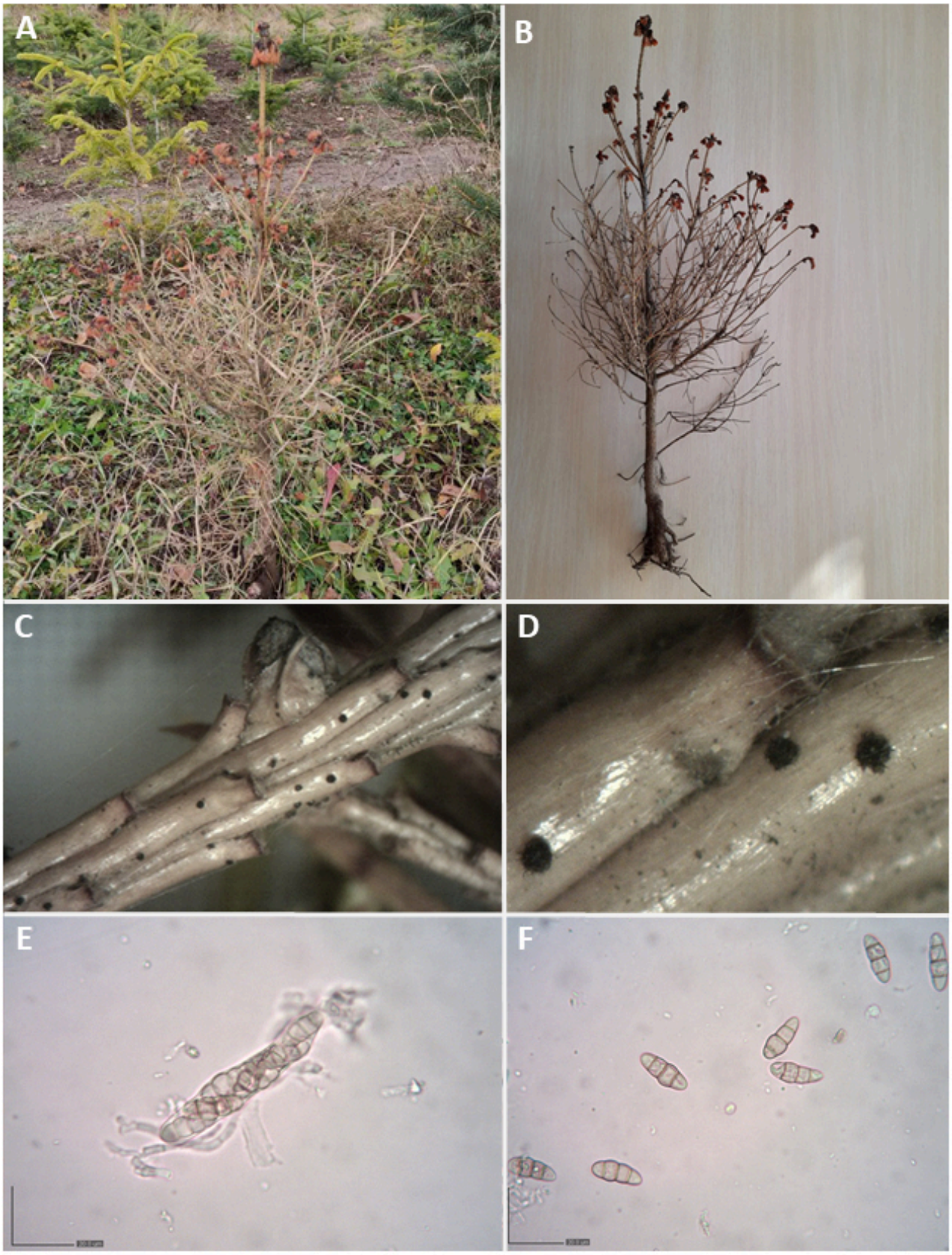


Fig. 1. *Setomelanomma holmii* on *Picea abies* saplings: A and B – infected saplings of *Picea abies;* C and D – ascomata on twigs; E – asci; F – ascospores. Scale bars: E and F = 20 μm.

drop of older needles on *Picea glauca* and *P. pungens* (Rossman et al., 2002). On the herbarium material examined of *P. pungens* branches from the United States (Kansas, Shawnee County, collected in May 1959), black fruiting bodies of *S. holmii* were found (Jayasiri et al., 2015), which is an indication that the pathogen most likely has a North American origin. No anamorph is known for *S. holmii* on natural substrata or in culture on agar (Rossman et al., 2002).

The current study of pathogen *S. holmii* on Norway spruce saplings is the first report for presence of the fungus in Bulgaria. It probably has the potential to cause intense problems on stressed and physiologically weakened young spruce plants of different species planted in the nurseries and plantations. In 2016, the fungal pathogen *Sirococcus conigenus* (Pers.) P.F. Cannon & Minter was identified for the first time on Norway spruce in the same nursery (Dobreva et al., 2017). It is necessary to monitor for the presence of the pathogens not only in the studied area, but also where spruce species are planted in forests or as an ornamental trees in urban green ecosystems.

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