

Diseases Caused by Fungi and Fungus-Like Organisms

First Report of Powdery Mildew of Blackberry Caused by *Podosphaera aphanis* in Serbia

M. Stevanović,¹ M. Vojvodić,² S. Kovačević,² G. Aleksić,¹ S. Živković,¹ and A. Bulajić^{3,†}

¹ Department of Plant Diseases, Institute for Plant Protection and Environment, 11000 Belgrade, Serbia

² Institute of Phytomedicine, Department of Phytopathology, University of Belgrade – Faculty of Agriculture, 11080 Belgrade, Serbia

³ Institute of Plant Protection, Department of Phytopathology, University of Belgrade – Faculty of Agriculture, 11080 Belgrade, Serbia

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Blackberries (*Rubus* L. subgenus *Rubus* Watson) are popular wild fruits with a high content of antioxidants and thus beneficial effect on human health (Reyes-Carmona et al. 2005). In July 2019 and May 2020, plants with typical powdery mildew symptoms were collected in the blackberry cultivar ‘Triple Crown’ orchard (2 ha) in the vicinity of Pakovrač (Moravica District, Serbia). The symptoms observed in 2019 included mild chlorotic spots on both old and young leaves accompanied by white powdery mildew colonies on the surface of the leaves, visible on both primocanes and floricanes. In 2020, even more intensive symptoms occurred on fruit-bearing shoots, which were covered with dense white fungal growth. Heavily infected leaves turned necrotic along the edges, followed by defoliation. Disease incidence was calculated by randomly counting and rating 100 plants in four replications and estimated to be over 90%, and disease severity was estimated to be over 40%. Morphological characteristics were assessed using bright-field and phase-contrast microscopy (Jankovics et al. 2011) and revealed the presence of unbranched, erect conidiophores ($n = 50, 75$ to $200 \mu\text{m}$) with a cylindrical foot cell and up to five short cells. Conidia were unicellular, hyaline, and ellipsoid-barrel-shaped ($n = 50, 22.5$ to 35.5×12.5 to $15 \mu\text{m}$) containing fibrosin bodies (in 3% KOH). All observed characteristics resembled

Podosphaera spp. (Braun and Takamatsu 2000). The presence of chasmothecia was not recorded. Further molecular identification was conducted using internal transcribed spacer sequence analysis of two isolates, 420G-19 and 30G-20, sampled in 2019 and 2020, respectively. Total DNA was extracted directly from epiphytic mycelium on the leaves using a DNeasy Plant Mini Kit (Qiagen, Hilden, Germany) following the manufacturer’s instructions. Polymerase chain reaction amplification and sequencing were performed with primers ITS1F and ITS4 (Takamatsu et al. 2010). The nucleotide sequence of the representative isolates 420G-19 (530 bp) and 30G-20 (530 bp) (accession nos. MN914995 and MT514661) shared 100% identity, and both shared 99.49 to 99.81% nt identity with 32 *Podosphaera aphanis* strawberry and raspberry isolates in GenBank (the highest 99.81% with GU942455, Harvey and Xu 2010), confirming that powdery mildew of blackberry in Serbia is caused by *P. aphanis*. To fulfill Koch’s postulates, 10 rooted, healthy blackberry plants (cv. Triple Crown) were dusted with conidia of isolate 30G-20 and incubated at 23°C under high relative humidity in the glasshouse. Healthy blackberry plants incubated in the same conditions served as a negative control. Minute white fungal colonies sharing the same microscopic features with the original isolate were visible 7 to 8 days postinoculation on all inoculated plants. No fungal growth was observed in the negative control. Serbia is the fourth largest blackberry producer in the world (Strik et al. 2007), and the occurrence of *P. aphanis* causing powdery mildew as a new pathogen is of utmost importance. *P. aphanis* is described as a strawberry and raspberry powdery mildew pathogen with a population expressing substantial genetic diversity (Harvey and Xu 2010). The molecular data on blackberry-originating isolates of *P. aphanis* are missing. Our study showed that *P. aphanis* could be destructive for blackberry in Serbia, thus representing a threat for the production of these valuable crops.

References:

- Braun, U., and Takamatsu, S. 2000. *Schlechtendalia* (Halle) 4:1.
Harvey, N., and Xu, X. M. 2010. *J. Plant Pathol.* 92:775.
Jankovics, T., et al. 2011. *Plant Dis.* 95:719.
Reyes-Carmona, J., et al. 2005. *J. Food Sci.* 70:s497.
Strik, B. C., et al. 2007. *HortTechnology* 17:205.
Takamatsu, S., et al. 2010. *Persoonia* 24:38.

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[†]Indicates the corresponding author.

E-mail: A. Bulajić; bulajic_aleksandra@yahoo.com