Diseases Caused by Fungi and Fungus-Like Organisms

First Report of Powdery Mildew Caused by *Golovinomyces ambrosiae* on *Cannabis sativa* in Oregon

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Oregon is one of the largest producers of hemp in the United States with 25,900 ha of hemp licensed to growers in 2019, a five-fold increase over the previous year. Industrial hemp has a wide range of uses including textiles to nutritional supplements; in Oregon, hemp has become one of the most economically promising crops and is mainly cultivated for cannabidiol (CBD) production. Between 2018 and 2019, multiple independent greenhouse growers in western Oregon reported powdery mildew-like signs and symptoms on leaves and buds of several *Cannabis sativa* cultivars, including ‘Cherry Wine’. Signs of the disease started as small, white, powdery patches, typically on the adaxial sides of leaves, and progressed to coalescent colonies on leaves, stems, and buds. Fungi present on diseased tissues had unbranched hyaline conidiophores that measured 140 to 250 µm and grew erect from cauliculous and amphigenous mycelium ($n = 15$). Foot cells were cylindrical, often tapered at one or both ends, and measured 80 to 117 × 9.5 to 11.9 µm ($n = 15$). Conidia were catenulent, hyaline, ellipsoidal to barrel-shaped, lacked fibrosin bodies, and measured 24 to 34 × 12 to 18 µm ($n = 50$). No chasmothecia were observed. Morphological observations overlapped with several *Golovinomyces* spp., including *G. ambrosiae*, *G. cichoracearum*, and *G. spadicus* (Braun and Cook 2012). Identification was confirmed by bidirectional sequencing and phylogenetic analysis of 1,457 nucleotides from the concatenated internal transcribed spacer (ITS), 28S large ribosomal subunit, and beta-tubulin (TUB2) regions of two isolates using primer pairs ITS1/ITS4, NL1/LR5, and TubF1/TubR1, respectively (Mori et al. 2000; Qiu et al. 2020; Vilgalys and Hester 1990; White et al. 1990; GenBank nos. MW248121 to MW248124,

MW265971 to MW265972). The Oregon hemp isolates grouped (bootstrap value = 100) in a monophyletic clade with *G. ambrosiae* accessions from Qiu et al. (2020). Pathogenicity was confirmed by transferring conidia by leaf rub inoculation onto 2- to 4-week-old Cherry Wine potted plants and incubated outdoors at 12 to 22°C. Control plants were mock inoculated using healthy leaves. Powdery mildew symptoms developed on inoculated plants approximately 14 to 21 days later; control plants were asymptomatic. Identification was confirmed by morphological characterization and sequencing using the aforementioned primers. The hemp isolates were also able to infect detached leaves of *Humulus lupulus* ‘Symphony’ via similar inoculations; however, colony development on Symphony was slow and sporulation sparse, as was reported by Weldon et al. (2020). *Golovinomyces* spp. have also been reported on hemp in Kentucky (Szarka et al. 2019), Ohio (Farinas and Peduto Hand 2020), and New York (Weldon et al. 2020). Although reported as *G. spadicus*, these reports are also likely *G. ambrosiae* according to new taxonomic revision of the genus (Qiu et al. 2020). This is the first known report of *G. ambrosiae* causing powdery mildew on hemp in Oregon (OSC 171893). Although powdery mildew on hemp currently appears most severe in protected cultivation, rapid expansion of hemp cultivation and introduction of new CBD varieties throughout Oregon could lead to increased powdery mildew risk in outdoor cultivation.

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