Diseases Caused by Fungi and Fungus-Like Organisms

First Report of Powdery Mildew Caused by *Golovinomyces ambrosiae* on Industrial Hemp in New Jersey

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In December 2019, New Jersey became one of the first states to have its industrial hemp (*Cannabis sativa* L.) plan approved by the U.S. Department of Agriculture (USDA) following enactment of the 2018 Farm Bill that authorized the production of hemp. Following this approval, hemp was legally grown for the first time in 2020. During the growing seasons of 2020 and 2021, powdery mildew-like symptoms were observed during the summer months (Jun to Aug) in greenhouse hemp research and fall months (Aug to Oct) in field production plots on Rutgers Agricultural Experiment Station farms in southern and northern New Jersey. Symptoms were observed on leaves and stems of hemp cultivars ‘CB Genius’, ‘Cherry Wine’, and ‘Bay Mist’. Symptoms initially appeared as small white patches of mycelia and conidia on the adaxial surface of leaves that gradually spread to entire leaves and stems. Leaf discoloration (e.g., chlorosis) and premature leaf drop were observed. More severe symptoms and damage were observed in the greenhouse than outdoor cultivation. A voucher specimen was deposited in the U.S. National Fungus Collections, USDA-ARS, Beltsville, MD (accession number 929187). Morphological examination of the white colonies from the cultivar Baymist was carried out using light microscopy and further characterized by sequencing. This isolate was labeled PMH2. Hyphae were septate, conidiophores were hyaline, unbranched, 130 to 240 µm in length, and produced one to four conidia in chains. Conidia were hyaline, ellipsoid to ovoid in shape, and 20 to 36 × 10 to 18 µm ($n = 30$). Oil-like drops were present within conidia, although no distinct fibrosin bodies were observed. Chasmothecia were not

observed. Morphological observations were consistent with those of *Golovinomyces* spp. as described by Braun and Cook (2012). Morphological observations (conidiophore and conidial measurements) were also similar to the description of *G. ambrosiae* on hemp in Wiseman et al. (2021). Sequencing of the internal transcribed spacer (ITS), large ribosomal subunit (28S), intergenic spacer (IGS), beta-tubulin (TUB2), and chitin synthase 1 (CHS1) regions was carried out with the primer sets ITS5/ITS4, LSU1/LSU2, IGS-12a/NS1R, TubF1/TubR1, and gCS1a1/gCS1b, respectively, as shown by Qiu et al. (2020). Maximum-likelihood phylogenetic analysis confirmed the grouping of the PMH2 isolate within the *G. ambrosiae* accessions. Each individual gene alignment was treated as a separate partition. Sequences were not concatenated for maximum-likelihood phylogenetic analysis. Sequence data were deposited in GenBank under the accessions OK626453 (ITS), OK626454 (28S), OL456201 (IGS), OL415512 (TUB2), and OL415513 (CHS1). To fulfill Koch’s postulates, two mature, potted plants of *C. sativa* cv. ‘Alpha Explorer’ were inoculated by gently pressing symptomatic hemp leaves onto their leaf surface. They were incubated in an indoor grow room at 23°C and relative humidity of 50%. Non-inoculated healthy plants of Alpha Explorer served as a control. Inoculated plants developed powdery mildew symptoms within 10 to 12 days, while all control plants were asymptomatic. The powdery mildew on inoculated plants was found to be morphologically similar to the original. *G. ambrosiae* has been reported on *C. sativa* in Oregon (Wiseman et al. 2021) and *G. ambrosiae* (as *G. spadiceus*) has been reported on *Cannabis* in Kentucky (Szarka et al. 2019), Ohio (Farinas and Hand 2020), and New York (Weldon et al. 2020). This is the first known report of *Golovinomyces ambrosiae* causing powdery mildew on hemp in New Jersey. With the December 15, 2021, opening of cultivation licensing and retailing of recreational marijuana, the acreage of hemp production in New Jersey is expected to significantly increase, particularly for greenhouse production. It is important to document the species to develop management strategies to control this disease.

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