Diseases Caused by Fungi and Fungus-Like Organisms

First Report of *Golovinomyces cichoracearum* Causing Powdery Mildew on *Zinnia elegans* in China

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Zinnia elegans, common zinnia, is an annual plant with high ornamental value. It is widely planted in many nurseries, city parks, universities, and home gardens in China. From August to October 2020, powdery mildew-like signs and symptoms were observed on leaves of *Z. elegans* growing on the campus of Henan Normal University, Henan Province, China. White powdery colonies in circular or irregularly shaped lesions were abundant on both surfaces of leaves and covered up to 95% of the leaf area. Any infected leaves were chlorotic, deformed, or senescent. More than 70% of the monitored *Z. elegans* plants showed these signs and symptoms. Conidiophores ($n = 20$) were 100 to 200 $\times$ 9 to 13 μ m and composed of foot cells, followed by straight cells and conidia. Mycelial appressoria were single and nipple-shaped. The oval-shaped conidia ($n = 30$) were 22 to 36 $\times$ 12 to 18 μ m, with a length/width ratio of 1.4 to 2.7, and produced germ tubes from the polar ends of the spore. No chasmothecia were found. Based on these morphological characteristics, the pathogen was initially identified morphologically as *Golovinomyces cichoracearum* (Braun and Cook 2012). Structures of the pathogen were scraped from infected leaves, and total genomic DNA was isolated using the method previously described by

Zhu et al. (2019). The internal transcribed spacer (ITS) region of rDNA was amplified by PCR using the primers ITS1/ITS4 (White et al. 1990), and the amplicon was sequenced by Invitrogen (Shanghai, China). The sequence for the fungus was deposited into GenBank under accession number MW029904 and was 99.83% identical (595/596 bp) to *G. cichoracearum* on *Symphytichum novi-belgii* (HM769725) (Mørk et al. 2011). To perform pathogenicity analysis, leaf surfaces of five healthy plants were fixed in a settling tower and then inoculated by blowing fungal conidia from mildew-infested leaves using pressurized air. Five noninoculated plants served as a control. The inoculated and noninoculated plants were separately maintained in two growth chambers (humidity, 60%; light/dark, 16 h/8 h; temperature, 18°C). Eleven to 12 days postinoculation, powdery mildew signs were conspicuous on inoculated plants, whereas control plants remained healthy. Similar results were obtained by conducting two repeated pathogenicity assays. Thus, based on the morphological characteristics and molecular analysis, the pathogen was identified and confirmed as *G. cichoracearum*. This pathogen has been reported on *Z. elegans* in India, Israel, Jordan, Korea, Nepal, Sri Lanka, Switzerland, and Turkey (Farr and Rossman 2020). To our best knowledge, this is the first report of *G. cichoracearum* on *Z. elegans* in China. The sudden outbreak of powdery mildew caused by *G. cichoracearum* on *Z. elegans* may adversely impact the plant health and ornamental value in China. Therefore, the confirmation of *G. cichoracearum* infecting *Z. elegans* expands the understanding of this pathogen and provides the fundamental knowledge for future powdery mildew control.

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