



plant disease

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DISEASE NOTES

Diseases Caused by Bacteria and Phytoplasmas

Powdery Mildew Caused by *Erysiphe heraclei*: A Novel Field Disease of Carrot (*Daucus carota*) in Brazil

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Carrot is a major vegetable crop in Brazil, being cultivated year-round in all regions. Carrot powdery mildew was first detected in seed production fields of the cultivar Brasília in Brasília-DF in 2008. White cottony growth was observed on leaves, petioles, and floral stalks. In 2014 to 2016, powdery mildew outbreaks were observed (100% incidence) in carrot fields in Brasília-DF, São Gotardo-MG, São Miguel Arcaño-SP, and Cristalina-GO, affecting all available hybrids. Morphological analyses of the conidiophores ($n = 50$) revealed straight and hyaline (25 to $63 \mu\text{m} \times 7$ to $10 \mu\text{m}$) with cylindrical foot cells. Singly borne, hyaline conidia ($n = 50$) displayed barrel to cylindrical shape (24 to $42 \mu\text{m} \times 14$ to $19 \mu\text{m}$). Germ tubes were produced in apical portion of the conidia. Appressoria were lobed. The perfect stage was not found. Pathogenicity assays were performed under greenhouse by inoculating via leaf-to-leaf contact seedlings of the carrot cv. Fortonantes and parsley [*Petroselinum crispum* (Mill.) cv. Portuguesa]. Symptoms and fungal morphology identical to those observed under field conditions were induced on carrot seedlings 10 to 15 days after inoculation, but not in parsley. Based upon this set of characteristics, the isolates were identified as *Erysiphe heraclei* DC ([Braun and Cook, 2012](#)). To confirm this identification, total genomic DNA of four isolates was extracted from conidial suspensions using a modified CTAB protocol ([Boiteux et al. 1999](#)). Purified DNA was used as template in PCR assays with prime pair ITS1 (5'-TCCGTAGGTGAACCTGCGG-3') and ITS4 (5'-TCCTCCGCTTATTGATATGC-3'), targeting the ITS rDNA region ([Cunnington et al. 2003](#)). Gel-purified amplicons were

directly sequenced using the same primer pair. BLASTn alignments of the four carrot isolates (gb\KY513703 to gb\KY513706) showed 98.2 to 99.2% identity among them and 97.7 to 100% identity with a subset of *E. heraclei* isolates previously reported on a wide range of Apiaceae hosts (e.g., KP729443; [Choi et al. 2015](#)). *E. heraclei* was previously reported affecting fennel (*Foeniculum vulgare* Mill.) and parsley in Brazil ([Rosa et al. 2008](#)); however, the carrot isolates were not pathogenic on parsley, indicating either a differential response to infection of parsley varieties or fungal host specialization. According to the USDA Fungal Databases, it is the first report of *E. heraclei* on carrots in Brazil. The introduction of this biotroph pathogen into Brazil remains elusive, but contaminated seeds and/or propagative material could be the possible vehicles. Powdery mildew is a potential threat for the carrot crop in the Cerrado area in central Brazil, especially during the dry season when large crop acreage is cultivated in this region. No fungicide is registered to control this disease in this crop. In this scenario, the incorporation of genetic resistance into elite carrot germplasm would be the best control strategy.

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