Diseases Caused by Fungi and Fungus-Like Organisms

First Report of *Coleosporium helianthi* Infecting *Helianthus verticillatus* (Whorled Sunflower) in the United States

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Helianthus verticillatus, the whorled sunflower, is an endangered species found only in the southern United States (Trigiano et al. 2021) that is being developed for ornamental uses. This sunflower species requires little to no maintenance, produces spectacular floral displays from September into October, and attracts numerous potential pollinators, including many native bees (Strange et al. 2020). In June and July of 2021, chlorotic, irregularly shaped spots were observed on the adaxial surface of mature leaves of two vegetatively produced clones of *H. verticillatus* (Trigiano et al. 2021) at three locations in Knoxville, TN. In September, Yellow 4A (Royal Horticultural Society 2001) sori were abundant on abaxial surfaces and more rarely on the adaxial leaf surfaces of both clones at all locations. Globose-to-cylindrical, yellow urediniospores were 23.7 (20 to 32) × 18.9 (16 to 22) μm (*n* = 30) with irregular, verrucose ornamentation. The morphology and dimensions of the urediniospores were similar to other *Coleosporium* species (e.g., *C. asterum*, Back et al. 2014). Telia were waxy, red brown (167A; B), and developed in October with colder temperatures. Cylindrical teliospores were sessile, one-celled, thin walled, and with basidia ca. 93 (70 to 117) × 25 (19 to 29) μm, which was consistent with spores of *C. helianthi* (Cummins 1978). DNA was obtained from urediniospores using a Phire kit (ThermoFisher Scientific, Waltham, MA), and the 28S rDNA region was amplified using the NL1 and NL4 primers (Back et al. 2014) (GenBank accession no. OL364847) as well as ITS 1 to 4 primers (White et al. 1990) (GenBank accession no. OL364848). For comparison, DNA sequences were also obtained from authentic *C. helianthi* on *H. divaricatus* in the Arthur Fungarium at Purdue University (#PURN11678; GenBank accession no. OL364846) using the protocols of

Aime et al. (2018). The 28S sequences shared 99.65% (568/570 bp) identity. To test Koch's postulates, seven healthy detached leaves were lightly brushed on both leaf surfaces with leaves with uredia producing urediniospores. The leaves were incubated adaxial side up in 9-cm-diameter Petri dishes on moistened filter paper at ambient laboratory conditions. A similar number of healthy leaves were brushed with healthy leaves, incubated in the laboratory, and served as the control treatment. After 7 to 10 days, uredia with urediniospores formed primarily on the abaxial leaf surface, but a few were present on the adaxial surface of leaves treated with urediniospores, whereas the leaves in the control remained healthy. Molecular, morphological, and infectivity studies identified *C. helianthi* as the pathogen. *C. helianthi* occurs on the commercial sunflower *H. annuus* and several wild sunflower species, including *H. tuberosum* (Jerusalem artichoke) and *H. microcephalus* (small-headed sunflower), among others in the southern United States (Farr and Rossman 2021). *Coleosporium* species are heteroecious and mostly macrocyclic rusts (McTaggart and Aime 2018) with aecia and aeciospores typically found on pines (*Pinus* spp.). Although *H. verticillatus* is very susceptible to rust infection and it probably reduces photosynthetic capability, it does not appear to adversely affect flowering in the fall. The disease primarily degrades the aesthetic appeal of the plant but does not require control measures. To our knowledge, this is the first report of *C. helianthi* infecting *H. verticillatus*. Voucher material is deposited in the Arthur Herbarium (#PURN23470).

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