Diseases Caused by Oomycetes

First Report of White Rust Disease Caused by *Albugo koreana* on *Camelina sativa* in China

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Camelina sativa, an herbaceous annual plant in the family Brassicaceae, is especially well known for its oilseed crop that produce camelina oil (Hovsepian et al. 2008). In April 2016, white blister rust disease on *C. sativa* was observed in cultivated farmland with an incidence of ~60% in Xinyuan County (43°33'39.17"N, 83°14'54.04"E), Xinjiang, China. Symptoms appeared as light-yellow chlorotic spots on the upper surface of the leaves and white blister on the corresponding lower surface. Blister sori were white, oval to ellipsoidal, scattered or coalesced, and 1.8 to 4 mm in diameter. Two representative voucher specimens were deposited in the Mycological Herbarium of Tarim University (HMUT 2527 and HMUT 2528), Aral, China. Sporangiophores were hyaline, clavate or cylindrical, straight to slightly curved, (23.7 to) 27.9 to 37.9 (to 42.1) (average 31) × (7.9 to) 9.6 to 13.7 (to 15.1) (average 11.4) μm ($n = 30$), thick-walled on their lower parts, and bearing sporangia in chains. Primary sporangia were globose to subglobose, wall equal thickness, and (9.5 to) 10.6 to 13.2 (to 14.3) (average 11.9) μm in diameter ($n = 50$). Secondary sporangia were mostly subglobose to ovoid, with a subtruncated base, and (12.1 to) 13.2 to 16.9 (to 18) (average 15.1) × (11 to) 12.1 to 15 (to 16.1) (average 13.4) μm in size ($n = 50$). Oogonia were globose to subglobose, (39.7 to) 42.7 to 51.7 (to 54.1) (average 48.3) μm in diameter ($n = 30$), irregular. Oospores were globose to subglobose, brown, (34.5 to) 37 to 42.7 (to 45.2) (average 41.1) μm in diameter ($n = 30$), 3 to 5 μm wall in thickness, with single warts, 1.5 to 4 × 2 to 3.5 μm ($n = 30$). The morphological characteristics of specimens were consistent with those of *Albugo koreana* (Choi et al. 2007). To confirm the identification, genomic DNA was extracted directly from sori on diseased leaves from isolates HMUT 2527 and HMUT 2528, respectively. The internal

transcribed spacer (ITS) rDNA and cytochrome oxidase II (*cox2*) mtDNA were amplified with primers DC6/LR-0 described by Choi et al. (2006) and *cox2*-F/*cox2*-R described by Hudspeth et al. (2000), respectively. A BLASTn search revealed that the ITS rDNA sequences (GenBank MW135444 and MW135445) were 99% (838/844 nucleotides) identical to that of *A. koreana* from *Capsella bursa-pastoris* (AY929829), and the *cox2* sequences (GenBank MW147150 and MW147151) were 100% (567/567 nucleotides) identical to that of *A. koreana* from *C. bursa-pastoris* (AY927048). Based on the concatenated ITS and *cox2* sequences, maximum likelihood (ML) and Bayesian (B) analyses showed that the pathogen from *C. sativa* clustered with the reference isolate of *A. koreana* (ex *C. bursa-pastoris*) with high bootstrap support (BS) values and maximum posterior probability (PP) (100 ML BS and 1.00 BPP, respectively). For pathogenicity, sporangia collected from the infected leaves were suspended in sterile water at 4°C for 2 h to improve zoospore release, and the zoospore suspension obtained from sporangial suspension (1×10^5 sporangia/ml) was inoculated to the lower surface of six healthy potted plants. Three noninoculated plants served as controls. Each plant was kept in a separate plastic humid chamber in a greenhouse at 25°C and 80% humidity for 15 days. Typical symptoms of white rust pustules that developed on the inoculated plants were identical to those observed on the originally infected leaves. Control plants remained symptomless. Based on morphological characteristics, molecular data, and pathogenicity tests, the pathogen on *C. sativa* was identified as *A. koreana*. *A. koreana* also is reported only on *C. bursa-pastoris* in Korea (Choi et al. 2007; Farr and Rossman 2020). To our knowledge, this is the first record of white rust disease caused by *A. koreana* on *C. sativa*, and the species is new to China. This report represents a new host-plant association and a new geographical expansion for this species, presenting a potential threat to camelina production in northwest China.

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