Diseases Caused by Parasitic Plants

First Report of *Cirsium arvense* (Canada Thistle) as a New Host of *Orobancha cumana* in Xinjiang, China

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Cirsium arvense (Canada thistle), a perennial herb native to Eurasia, has been introduced to temperate regions and is a serious weed for arable and pastoral agriculture (Schroeder et al. 1993). *C. arvense* reproduces both clonally and sexually. It is highly competitive, causes yield reductions in crops such as wheat, alfalfa, and sugarbeet, and can reduce forage availability and production (Wilson 1981). It can harbor plant pathogens such as plant-parasitic nematodes (Tenuta et al. 2014). Sunflower broomrape (*Orobancha cumana* Wallr.) is a holoparasitic plant with a restricted range of hosts in the wild (mainly on a few Asteraceae species) and in fields (exclusively on sunflowers) (Fernández-Martínez et al. 2015). *O. cumana* infection can cause up to 80% yield loss in sunflowers, threatening production in Xinjiang and Inner Mongolia, China (Parker 2009). In July 2019, broomrape was observed parasitizing *C. arvense* in a greenhouse used for sunflower resistance identification (Shihezi, 44°18'36"N, 86°39'36"E, 500 m elevation) in Xinjiang. Broomrape parasitized 50% of plants, with an average of one to two broomrape shoots per plant. Total genomic DNA was extracted from the flowers of broomrape, and the *rps2*, *rbcL*, and *trnL-F* genes and rDNA ITS region were amplified by PCR using primer pairs *rps2F/rps2R*, *rbcLF/rbcLR*, *C/F*, and *ITS1/ITS4*, respectively (Anderson et al. 2004; Manen et al. 2004; Park et al. 2007; Taberlet et al. 1991). The ITS (659 bp), *rps2* (451 bp), *trnL-F* (914 bp), and *rbcL* (961 bp) sequences were deposited in GenBank as MT856745, MW809407, MW809408, and MW809409. BLAST analysis showed that the ITS sequence shared 100% similarity with *O. cumana* (659/659 nt, MK567978), the *rps2* sequence shared 99% similarity (449/451 nt, KT387722), the *trnL-F* sequence shared 99% similarity (907/911 nt, MT027325), and the *rbcL* sequence shared 99% similarity (956/964 nt, MK577840). Morphological characteristics (such as stem, inflorescence,

corolla, bracts, calyx, stamens, and gynoecium) are consistent with *O. cumana* (Pujadas-Salvà and Velasco 2000). Morphological and molecular identification strongly support that the broomrape on *C. arvense* was *O. cumana*. Greenhouse pot experiments were carried out to assess the parasitic relationship (Fernández-Martínez et al. 2000). In January 2020, *C. arvense* roots were harvested from an extant field of *C. arvense* in the greenhouse at Shihezi University. The soil was dug to a 30- to 40-cm depth, and *C. arvense* roots were removed and carefully washed in water. The healthy and living *C. arvense* roots were selected and cut into 10- to 11-cm pieces. Four *C. arvense* root pieces were grown (buried at a depth of 10 to 12 cm) in 8-liter pots containing a mixture of sand/vermiculite/compost (1:1:1 v/v/v) and *O. cumana* seeds (50 mg of seeds per 1 kg of substrate) with five replicates. Three noninfected plants were grown and evaluated in parallel. Approximately 80 days after planting, at the flowering stage of the *O. cumana*, *C. arvense* plants were uprooted from the soil. Compared with noninfected plants, the hosts' symptoms included slow growth, leaf wilting, and chlorosis, and they were similar to the broomrape-infected *C. arvense* plants observed in the greenhouse. The roots of *C. arvense* and broomrape were carefully washed in water, and the parasitism of *O. cumana* was observed. The infection was confirmed by observation of the attachment of the *O. cumana* to the *C. arvense* roots. This is the first report of *O. cumana* parasitizing *C. arvense* in Xinjiang, China. *C. arvense* as a new host of *O. cumana* indicates that sunflower broomrape can also propagate and survive in a host such as Canada thistle grown in sunflower fields. This finding suggests it may be more difficult to control sunflower broomrape by rotation. The contaminated area and the degree of parasitism of broomrape on *C. arvense* in the field will be investigated, and better-integrated control methods for controlling *O. cumana* will be designed.

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The author(s) declare no conflict of interest.

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