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NEW DISEASE REPORT

Pucciniastrum verruculosum causing rust disease on *Aster tataricus* in Korea

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Aster tataricus (Tatarian aster, Asteraceae) is a perennial herb native to East Asia. The plant is used as a traditional herbal medicine for the treatment of coughs and asthma. In Korea the plant is cultivated as an ornamental, but its young leaves are also edible when cooked like spinach. In September 2016, symptoms of rust disease were found on *A. tataricus* in a public garden (c. 0.5 ha) in Goseong and on Taegi mountain in Hoengseong, Korea, with a disease incidence of 85% and 55%, respectively (Figure 1). Symptoms appeared as yellowish, vein-limited, polyangular, chlorotic spots on the upper surface of infected leaves, and yellow to orange-coloured pustules of the uredinial stages were revealed on the corresponding lower surfaces (Figure 2). During subsequent surveillance in 2020, two additional samples of the rust were collected in Gapyeong, and four samples from all three areas were deposited in the Korea University herbarium (Accession Nos. KUS-F29482, F29504, F31844, and F32016).

The infected leaves were examined under a light microscope. Uredinia were hypophyllous, subepidermal, scattered or grouped, bright yellow to orange, round, and 100–200 μm in diameter (Figure 3). Urediniospores were initially hyaline, later yellowish, ovate to ellipsoid and (17.5–)19.3–22.1(–24.3) × (14.7–)15.3–17.5(–20.6) μm (av. 20.7 × 16.4 μm) (Figure 4), echinulate with a thin wall of 0.8–1.5 μm (av. 1.1 μm) (Figure 5). The telial stage was not observed. The morphological characteristics were consistent with those of *Pucciniastrum verruculosum* Jing X. Ji & Kakish. (Ji *et al*., 2019).

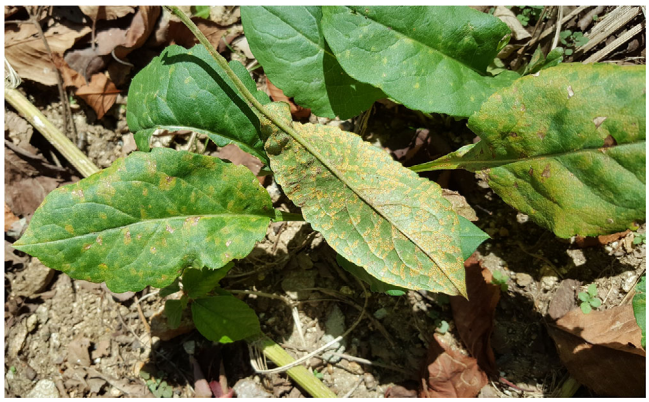


FIGURE 1 Rust disease symptom caused by *Pucciniastrum verruculosum* on *Aster tataricus* in the field

To confirm the morphological identification, genomic DNA was extracted from four representative specimens (KUS-F29482, F29504, F31844, and F32016). Two ribosomal DNA regions were amplified; the internal transcribed spacer (ITS) with primers ITS5u and ITS4rust (Pfunder *et al*., 2001) and large subunit (LSU) rDNA with primers LRust1R and LRust3 (Beenken *et al*., 2012). The resulting sequences were deposited in GenBank (Accession Nos. MZ725011-MZ725014 for ITS and MZ724682-MZ724685 for LSU) and compared with

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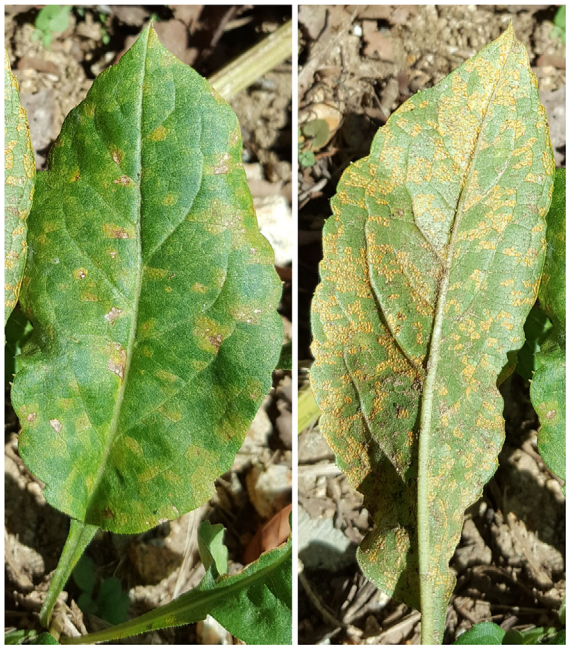


FIGURE 2 Vein-limited chlorosis caused by *Pucciniastrum verruculosum* on the upper leaf of *Aster tataricus* (left) and urediniа on the corresponding lower leaf surface (right)

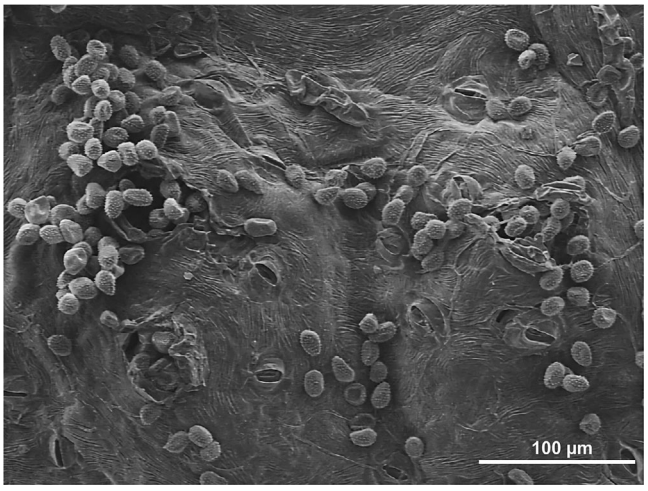


FIGURE 3 Uredinia and urediniospores of *Pucciniastrum verruculosum* observed under a scanning electron microscope

other reference sequences using BLASTn. The ITS sequences of the Korean specimens were identical to *P. verruculosum* on *Kalimeris* spp. (MG787108 and MG787110) and differ at two nucleotides with *P. verruculosum* on *Aster tataricus* (MG787109, MH780995, MH780994). The LSU sequences were identical to those on *A. tataricus* (MG787134, MH781001-MH781003). In maximum-likelihood phylogenetic trees for ITS (Figure 6A) and LSU (Figure 6B) sequences, the Korean samples were grouped with the reference sequences of *P. verruculosum* with high bootstrap supporting values of 100 in ITS and 99% in LSU.

Until *Pucciniastrum verruculosum* was described as a rust on *Aster tataricus*, *Kalimeris integrifolia*, and *K. lautureana* in China (Ji *et al*., 2019),

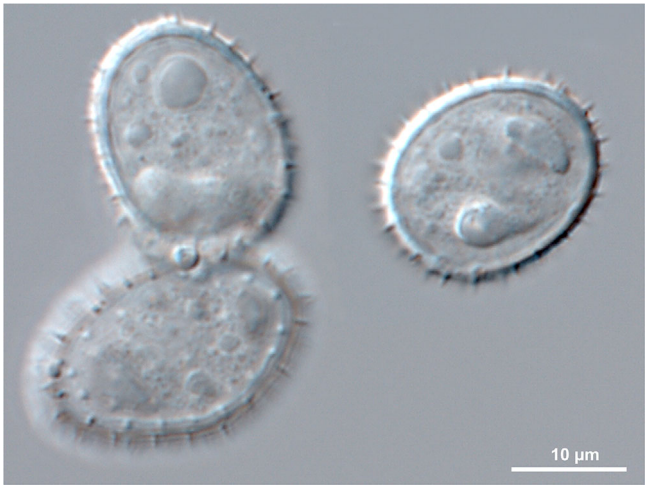


FIGURE 4 Urediniospores of *Pucciniastrum verruculosum* observed under a differential interference contrast microscope

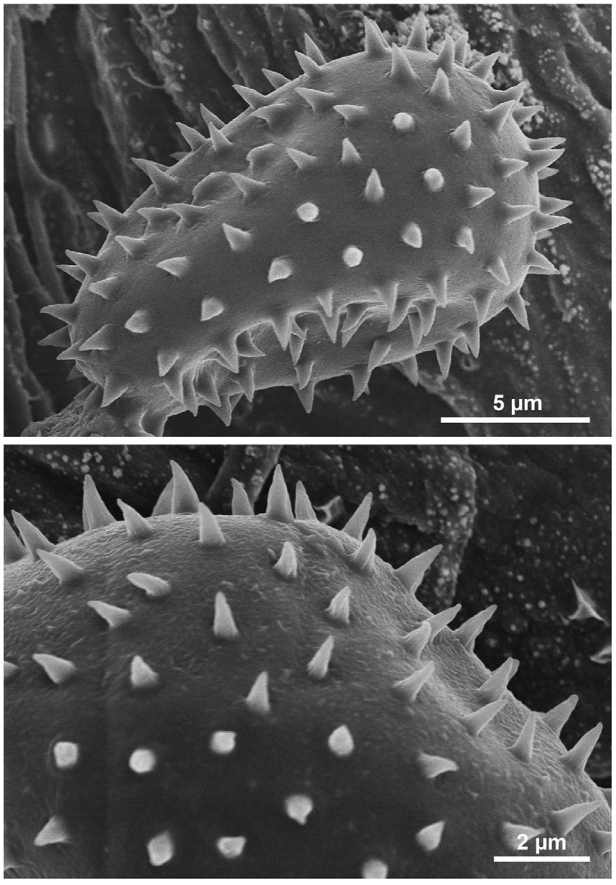


FIGURE 5 Wall ornamentation of urediniospore of *Pucciniastrum verruculosum* observed under a scanning electron microscope

four rust fungi had been recorded on *A. tataricus* worldwide, namely, *Coleosporium asterum*, *C. solidaginis*, *Puccinia dioicae*, and *P. extensicola* (Farr & Rossman, 2021). In Korea, *Coleosporium asterum* has previously been recorded on *A. tataricus* in North Korea (Hiratsuka, 1942) and in South Korea (Kim, 1963), but the present Korean samples were easily

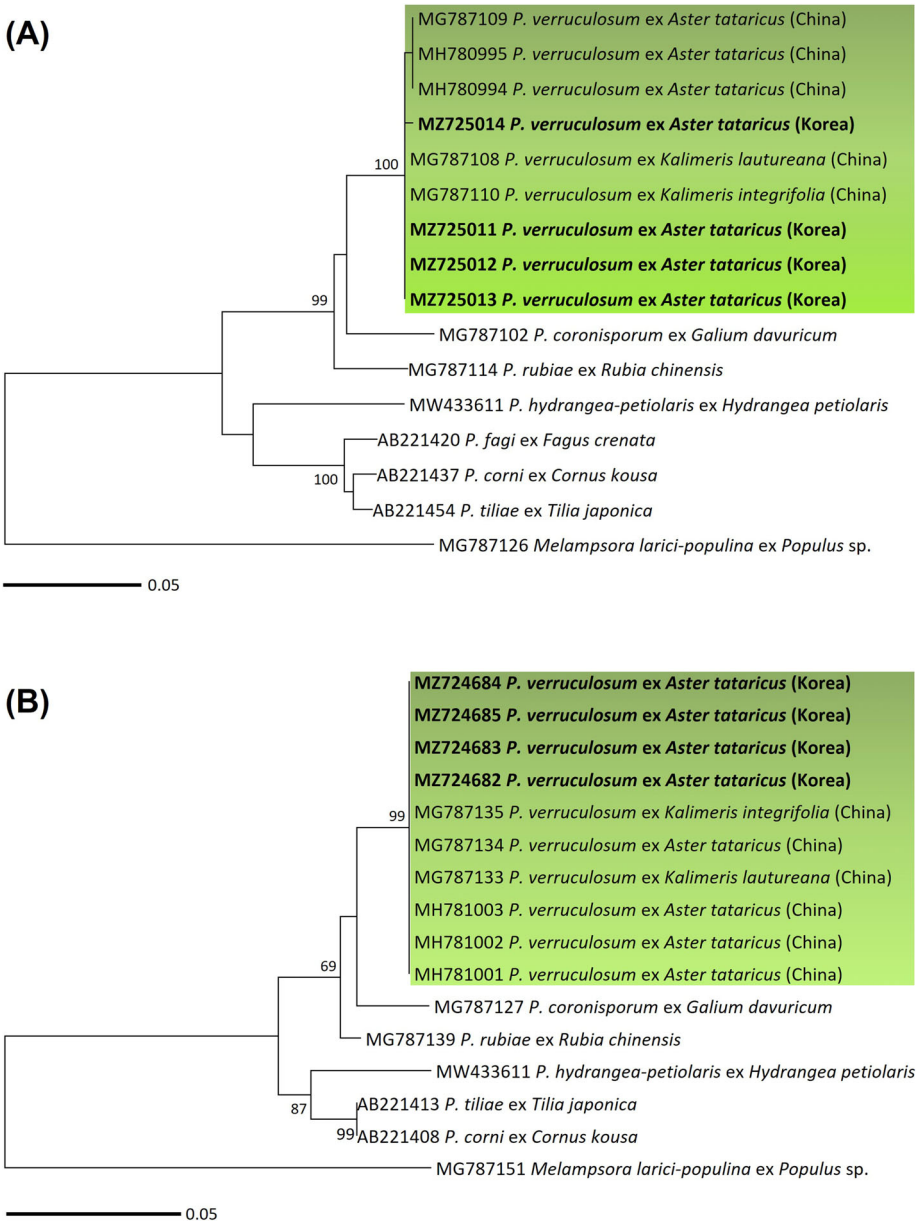


FIGURE 6 Phylogenetic trees between *Pucciniastrum verruculosum* and related rust fungi retrieved from GenBank, inferred by the maximum-likelihood method with the ITS (A) and LSU (B) rDNA sequences. Bootstrap values based on 1,000 replications are indicated at the branches. The Korean isolates described in this study are shown in bold

distinguishable from *C. asterum* both morphologically and phylogenetically. To our knowledge, this is the first report of *P. verruculosum* on *A. tataricus* in Korea. As only the uredinial stage was found on *A. tataricus* in our field work, but also in China (Ji *et al*., 2019), the prerequisite for effective control of *P. verruculosum* is to find its potential alternative host.

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