Diseases Caused by Fungi and Fungus-Like Organisms

First Report of the Rust Disease Caused by *Puccinia crepidis-japonicae* on New Host *Sonchus arvensis* from Pakistan

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Sonchus arvensis (Asteraceae) is a traditional medicinal herb. The aerial parts are a rich source of vitamins, essential amino acids, and minerals, and it may help in treatment of fever, inflammation, detoxication, and blood circulation (Li and Yang 2018). In October 2018, typical rust symptoms were observed on *S. arvensis* leaves and stems in Buner district, Malakand division, Khyber Pakhtunkhwa Province, Pakistan (34.39° N; 72.61° E). The specimens were examined microscopically and compared with type specimen descriptions in published literature (Dietel 1908; Hiratsuka et al. 1992). The fungus was identified as *Puccinia crepidis-japonicae* based on the characteristic of spore morphology and phylogenetic study based on internal transcribed spacer (ITS) and large subunit (28S, LSU) sequence data. The uredinia were amphigenous, rounded or somewhat elliptical, naked, small patches, equally spread, and brown. Urediniospores ($n = 30$) were globose to ellipsoid, brownish yellow, and measured 22.4 to 24.7×20.2 to $22.1 \mu\text{m}$. The urediniospore walls were brownish orange and finely echinulate and 1.7 to $2.1 \mu\text{m}$ thick with two to three germ pores. The telia were amphigenous, rounded or elliptic, scattered, and dark brown to blackish. Teliospores ($n = 30$) were ellipsoid, subglobose or long ellipsoid, rounded at both ends, not thickened at the apex, warted, reddish brown, and measured 31.3 to 39×24.6 to $26.8 \mu\text{m}$. The teliospore walls were reddish-black and about 1.5 to $2.5 \mu\text{m}$ thick. The pedicels were short, hyaline, fragile, became tapered toward the apex, and

measured 14.4 to 18.7×4.7 to $9 \mu\text{m}$. DNA was extracted from rust spores, and the combined region of ITS and LSU were amplified using Rust2Inv (forward primer) and LR6 (reverse primer) according to the protocol outlined by Aime (2006). A BLASTn search (<https://www.ncbi.nlm.nih.gov>) showed that the combined ITS and LSU region shared 99% identity (792/804 bp) to a directly deposited *P. crepidis-japonicae* accession (KY798395 from Hawaii, U.S.A.), with 100% query cover. The resulting sequence was deposited in GenBank (accession no. MN093335). Both morphological and molecular characteristics indicated that this species was *P. crepidis-japonicae*. To test pathogenicity and fulfill Koch's postulates, a spore suspension (1×10^4 spores/ml) was sprayed on three 6-week-old plants of *S. arvensis* (and one as a negative control) and incubated at 22 to 24°C . Uredinia were observed on the leaves after 10 days of inoculation, whereas the control plants remained symptomless. Microscopic examination confirmed that the symptoms on plants obtained from field and greenhouse inoculations were morphologically identical. This fungus has been observed previously on *Crepis japonica* in China, Hong Kong, Japan, Korea, and Taiwan, on *Prenanthes* sp. and on *Youngia tenuifolia* and *Y. fusca* in China (Farr and Rossman 2021). Pereira et al. (2002) suggested that *P. crepidis-japonicae* may play a significant role as a biocontrol agent against its weed host. To the best of our knowledge, there are no other reports of this fungus on any other hosts within the country. The specimen has been vouchered in LAH Herbarium, Department of Botany, University of the Punjab, Lahore, Pakistan (LAH36343). Both the morphological and molecular identifications confirmed that the pathogen was *P. crepidis-japonicae*. This is the first report of *P. crepidis-japonicae* on *S. arvensis* as a new host from Pakistan.

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