Diseases Caused by Fungi and Fungus-Like Organisms

First Report of Races TKTTP and TKKTP of *Puccinia graminis* f. sp. *tritici* with Virulence to Wheat Stem Rust Resistance Gene *Sr24* in Turkey and Tunisia

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Funding: Funding was provided by Bill and Melinda Gates Foundation (OPP1133199). Plant Dis. 106:757, 2022; published online as <https://doi.org/10.1094/PDIS-03-21-0450-PDN>. Accepted for publication 25 August 2021.

Severe wheat stem rust caused by *Puccinia graminis* Pers.:Pers. f. sp. *tritici* Erikss. can result in complete crop failure. In recent years, the increasing frequency and the early onset of stem rust in Central West Asia and North Africa (CWANA) has become a big concern. The *Sr24* resistance gene, one of the most effective stem rust resistance genes effective against most *P. graminis* f. sp. *tritici* races worldwide, has been widely deployed. Until the recent establishment of virulence to *Sr24* within the Ug99 lineage of the pathogen in Africa (Hei et al. 2020; Jin et al. 2008; Patpour et al. 2016) and Iraq (Nazari et al. 2021), occasional detections of races virulent to *Sr24* were reported in South Africa (Le Roux and Rijkenberg 1987), India (Bhardwaj et al. 1990), Germany (Olivera Firpo et al. 2017), Georgia (Olivera et al. 2019), and western Siberia (Skolotneva et al. 2020). During the rust surveys conducted in Sinops, Samsun, and Kastamonu in the Black Sea region in northern Turkey in 2018, 19 isolates were collected. Single pustule (SP) isolates were developed and used in race analysis in the Biosafety Rust Laboratory, Regional Cereal Rust Research Center (RCRRC), Izmir, Turkey. Sample recovery, experimental procedures for preinoculation, inoculation, incubation, and race typing were conducted as previously described (Nazari

et al. 2021). Among the tested SP isolates, two isolates showed a high infection type (IT) of 33+ on the *Sr24* tester line (Little Club/Agent) and a low infection type of 11+ for the source of *Sr31* (Benno/6*LMPG-6). Eight SP isolates were further developed from the high IT 33+ pustules collected from the *Sr24* tester line. After spore multiplications, they were used in inoculation of the 20 North American stem rust single-gene lines used to differentiate races of *P. graminis* f. sp. *tritici*, plus Trident (*Sr38+*), Siouxland (*Sr24+Sr31*), and Sisson (*Sr31+Sr36*). Five SP-derived isolates with IT 33+ on the *Sr24* single-gene line collected from Samsun (Alacam – Etyemez; location: 41.61889°N, 35.55722°E) and Sinop (Merkez-Sanlıoglu; location: 41.85556°N, 35.04889°E) were identified as race TKKTP and the remaining three SP isolates as race TKTTP. In 2020, we detected two isolates of TKKTP among the stem rust samples from Tunisia submitted to RCRRC. These two isolates were collected from bread wheat cultivars Heydna and Tahmet at a trial site near Bou Salem in western Tunisia (location: 36.5351°N, 8.95486°E). Based on the negative results of the stage 1 test using a suite of four real-time PCR assays diagnostic for the Ug99 race group developed by Szabo (2012), these two races should not belong to the Ug99 race group when compared with the reference Ug99 race TTKTT from Kenya. These races were virulent to *Sr5*, *Sr21*, *Sr9e*, *Sr7b*, *Sr6*, *Sr8a*, *Sr9g*, *Sr9b*, *Sr30*, *Sr17*, *Sr9a*, *Sr9d*, *Sr10*, *SrTmp*, *Sr24*, *Sr38*, and *SrMcN*. In addition to these genes, race TKTTP was virulent to *Sr36*. Both races were avirulent to *Sr11* and *Sr31*. To our knowledge, this is the first report of *P. graminis* f. sp. *tritici* races with the *Sr24* virulence in Turkey and Tunisia. The results reflect an increasing trend of virulence to *Sr24* in the pathogen populations, and raise a great concern given the deployment of the *Sr24* resistance gene in widely grown wheat cultivars worldwide.

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The author(s) declare no conflict of interest.

Keywords: stem rust, *Sr24*, wheat, race analysis, pathogen detection

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