First report of brown rot caused by *Rhizopus arrhizus* on tomato in Pakistan

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In a field survey of tomato (*Solanum lycopersicum* L.) in Islamabad, Pakistan, a severe fruit rot (72% incidence) with symptoms of brown spots was observed in 12 randomly selected fields. Symptomatic fruits were superficially disinfected and infected tissues (2–3 mm) were placed on Sabouraud Dextrose Agar (SDA) at 25 °C. After 6 to 7 days, whitish and later grayish black mycelia with a net like structure were observed. Microscopic observations revealed various sub-globose or oval sporangiospores of 5–8 µm diameter. Straight and non-septate sporangiophores of 1–2.1 mm length were observed. Chlamydospores were not observed. Globose sporangia of 150–210 µm diameter were observed. Initially the sporangia were white and then turned black with a distinct collar. Columellae were sub-globose, pale brown, and mostly 70–100 µm. These morphological characteristics were similar to those of *Rhizopus arrhizus* A. Fisch (syn. *Rhizopus oryzae* Went & Prins. Geerl.) (Zheng et al. 2007). To confirm the morphological identification, the Internal Transcribed Spacer (ITS) region of DNA was amplified and sequenced by using the primer pair ITS1-ITS4 (White et al. 1990). Resultant sequence was deposited in NCBI database (MK445256). The resultant sequence showed 100% similarity with *R. oryzae* (syn. *R. arrhizus*) (KM225290.1). A pathogenicity test

was performed following Koch's postulates. Mycelial plugs (5-mm diameter) were placed on wounded tomato fruits at 25–28 °C for one week. All inoculated fruits developed typical brown spots after 5–6 days. No symptoms were observed on wounded but non-inoculated tomato fruits. The pathogen was re-isolated from symptomatic tissues and found similar to the inoculated one. A reference isolate of fungus was deposited in a culture collection of Molecular Plant Pathology Laboratory, Department of Plant Sciences, Quaid-i-Azam University, Islamabad, Pakistan as isolate R-2 with accession no. 212.

Although *R. arrhizus* has been reported on other crops (Farr and Rossman 2018), to our knowledge this is the first report of tomato brown rot caused by this pathogen in Pakistan and worldwide.

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