Diseases Caused by Fungi and Fungus-Like Organisms

First Report of *Fusarium solani* Associated with the Bulb Rot of Tulip (*Tulipa* spp.) in India

Qadrul Nisa,¹ Efath Shahnaz,^{1,†} Saba Banday,¹ Ali Anwar,¹ Khalid Z. Masoodi,² Aflaq Hamid,¹ Imtiyaz T. Nazki,³ Mudasar A. Mir,² Khair ul Nisa,⁴ Mohammad Saleem Dar,¹ and Safina Kosser⁵

¹ Biocontrol Laboratory, Division of Plant Pathology, SKUAST-K, Shalimar, Srinagar, 190025, India

² Division of Plant Biotechnology, SKUAST-K, Shalimar, Srinagar, 190025, India

³ Division of Floriculture and land scape Architecture, SKUAST-K, Shalimar, Srinagar, 190025, India

⁴ Department of Environmental Science, University of Kashmir, Srinagar, 190006, India

⁵ Division of Fruit Science, SKUAST-K, Shalimar, Srinagar, 190025, India

Plant Dis. 106:759, 2022; published online as <https://doi.org/10.1094/PDIS-05-21-0916-PDN>. Accepted for publication 19 July 2021.

Tulip is an ornamental bulbous flowering crop belonging to the genus *Tulipa* and family Liliaceae. It is the first ranking bulbous ornamental plant in the world (Nayeem and Qayoom 2015). They are often the first flowers to bloom in the spring. Kashmir valley is located in the northern Himalayas in the northwestern region of the Indian subcontinent. It is an alluring and fascinating place known all over India and the home of the famous “Indira Gandhi Memorial Tulip Garden”, the largest tulip garden in Asia. However, there are a number of constraints in tulip cultivation, among which bulb rot occupies a prominent place (Piwoni 2000). Bulb rot is posing problem to all the tulip growers throughout the world (De Hertogh et al. 1983). Rot symptoms were observed on tulip bulbs in the field as well as in storage conditions (20 to 22°C temperature with a relative humidity of 65%) in the summers of 2018 and 2019 in Shalimar fields of Kashmir. The main disease symptoms are yellow sunken spots on bulbs and purple-yellow coloration of leaves. The causal agent was isolated using a tissue bit technique (Pathak 1972) on potato dextrose agar plates, which were incubated at 24 ± 2°C. The single-spore technique was used to obtain the pure isolate (Johnston and Booth 1983). The isolate covered the full plate (90 mm) in 10 days. The colony was dull whitish in color, flat and smooth, with concentric ring formation in the culture plate with the inner ring having a creamy exudation. The mycelium was septate, branched, and hyaline in color and measured 3.50 to 5.20 µm in width with an average of 4.4 µm. Microconidia were hyaline, cylindrical to oval, zero to one septum, and measuring 7.50 to 11.00 × 2.80 to 3.75 µm in size. Macro conidia were hyaline with three to four septa, fusiform, moderately curved, and measuring 21.15 to 32.00 × 3.80 to 4.75 µm in size with an average of

28.50 ± 0.21 × 4.30 ± 0.2 µm. On the basis of these morphological and cultural characteristics of the fungus, it was identified as *Fusarium solani*. To confirm the identity, PCR amplification was carried out for two genes: internal transcribed spacer (ITS 1, ITS 4) and translation elongation factor1-alpha gene (tef1-alpha) (O'Donnell et al. 1998; White et al. 1990) BLAST analysis of the sequence obtained for both the genes showed 99% homology with *F. solani* sequences in GenBank and *Fusarium*-ID databases. The sequences were deposited in GenBank (accession nos. MN611433 and MW995477). A pathogenicity test was conducted on variety Orange Emperor in both the laboratory and polyhouse. Bulbs were divided into three sets (three bulbs per set); one set was given injury and dipped in conidial suspension (10⁶ conidia/ml) for 30 min, another set was kept uninjured and dipped in spore suspension of the same concentration, and the third set served as a control and was dipped in sterilized distilled water. All the respective sets were incubated in a moist chamber maintained at a temperature of 22°C to observe symptoms. The injured ones showed symptoms after 7 to 8 days of inoculation, whereas the uninjured bulbs showed symptoms after 11 to 12 days. No symptoms were observed in the control set. A pot experiment was also conducted to carry out the pathogenicity tests. Bulbs were injured with the help of a sterile needle and were dipped in conidial suspension (10⁶ conidia/ml) for 30 min (Pastrana et al. 2014). The bulbs kept for the control were dipped in sterilized distilled water. Bulbs were then planted in pots maintained at 18°C. The above-ground parts of the inoculated bulbs showed symptoms like stunted growth, which gradually turned yellow and did not produce flowers. The bulbs after harvesting were rotten. No symptoms were observed in the control plants. To fulfill Koch's postulates, the fungal pathogen was reisolated, which was identified as *F. solani*. The pathogen is reported to cause disease in other crops (Gupta et al. 2012), but to our knowledge and on the basis of literature, this is the first report of *F. solani* causing bulb rot of tulip in India.

References:

- De Hertogh, A. A., et al. 1983. Hortic. Rev. (Am. Soc. Hortic. Sci.) 5:45.
- Gupta, V., et al. 2012. Plant Dis. 96:1067.
- Johnston, A., and Booth, C. 1983. Page 439 in: Plant Pathologist's Pocket Book. Oxford and IBH Publishing, New Delhi, India.
- Nayeem, M., and Qayoom, A. 2015. J. Appl. Eng. 3:202.
- O'Donnell, K., et al. 1998. Proc. Natl. Acad. Sci. U.S.A. 95:2044.
- Pastrana, A., et al. 2014. Plant Dis. 98:161.
- Pathak, V. N. 1972. Page 448 in: Essentials of Plant Pathology. Prakash Publishers, Jaipur, India.
- Piwoni, A. 2000. Prog. Plant Prot. 40:653.
- White, T. J., et al. 1990. Page 315 in: PCR Protocols: A Guide to Methods and Applications. Academic Press, San Diego, CA.

The author(s) declare no conflict of interest.

e-Xtra

Keywords: tulip, bulb rot, *Fusarium solani*, India, first report

[†]Indicates the corresponding author.
E. Shahnaz; efaths@gmail.com