Diseases Caused by Fungi and Fungus-Like Organisms

First Report of *Fusarium fujikuroi* Causing Bulb Rot on *Lilium lancifolium* in China

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Lilium lancifolium Thunb. (Juandan lily [JL]) is widely cultivated in China. Bulb rot is increasingly common, impacting quantity and quality. Typically, pathogens invade through wounds in the root or ends of the bulb, causing them to brown and rot, which can lead to stem wilt and plant death. Infected bulbs often develop sunken lesions and with scales flaking off. Plants grown from infected bulbs are short, with discolored leaves, wilting, and early death. Bulb rot is commonly observed in fields with excess water and a history of continuous JL cultivation. Here, wilted plants with rotted bulbs were collected from Longshan in Hunan, Enshi in Hubei, Yixing in Jiangsu, and Lu'an in Anhui in 2018 and 2019. Bulbs were surface sterilized with 75% ethanol for 30 s and 2% NaOCl for 5 min and were rinsed with sterile water (SW) thrice. Tissue was divided into 0.5 × 0.5-cm pieces, placed on PDA containing 50 mg/liter of streptomycin sulfate, and incubated at 25°C. Mycelia growing from tissues were subcultured onto fresh PDA to obtain a pure culture, which formed dense white hyphae after a few days, no chlamydospore but abundant conidia ~15 days later. Microconidia were abundant, solitary, thin walled, hyaline, ovoid, 0 to 1 septate, and 6.1 × 2.6 µm (average, $n = 50$). Macroconidia had a curved apical cell, a foot-like basal cell with 3 to 5 septa, and 35.4 × 4.3 µm ($n = 30$). These characteristics matched *Fusarium* spp. (Choi et al. 2018; Leslie and Summerell 2006). To identify the species, DNA fragments of the ITS, *TEF1-α*, and *RPB2* genes were amplified using primers ITS1/ITS4, EF1/EF2, and 7cF/11aR, respectively, and sequenced (Jiang et al. 2018). BLAST analyses showed that the ITS (MT549849), *TEF1-α* (MT553348), and *RPB2* (MW201686) sequences shared 98 to 100% identity with *Fusarium fujikuroi* reference strains in

GenBank. Phylogenetic analysis of our strain S106 and species in the *F. fujikuroi* species complex indicated the strains were *F. fujikuroi* s.s. An ex vivo assay using JL bulb scales and an in vivo assay using potted JL plants were conducted to confirm pathogenicity for four strains, one from each of the four locations, to fulfill Koch's postulates (Bian et al. 2016; Zeng et al. 2020). Healthy fresh JL scales were surface sterilized using 75% alcohol for 30 s and 2% NaOCl for 5 min and were rinsed with SW thrice. Actively growing mycelia on PDA plates were cut into 5-mm blocks as inocula. Scales were punctured with sterilized needles and PDA blocks inoculated on the wound. Sterile PDA without mycelia was a negative control. Scales were placed in sterile culture dishes with two layers of sterilized filter paper and 5 ml of SW. The dishes were incubated in the dark at 25°C. After 10 days, *F. fujikuroi*-inoculated scales showed disease symptoms (brownish lesion) similar to the original infected samples. No symptoms were observed in the control. To test potted plants, fungal cultures were incubated in PD broth for 3 days in a shaker-incubator at 25°C and 180 rpm. Asexual conidia were harvested and adjusted to 1 × 10⁷ conidia/ml. One healthy bulb was planted in each pot in sterilized soil and inoculated with 1 ml of conidia suspension. Pots were placed in a growth chamber at 25°C with 12-h light/12-h dark. Inoculated plants showed stunted growth, and at 30 days after inoculation most of the roots, bulb plate, and scale tissues were rotten and black. Uninoculated plants showed no symptoms. Fungi were reisolated from both pathogenicity assays and showed morphology and DNA sequences identical to the inoculated strains. Several *Fusarium* species have been reported on lily, including *F. tricinatum* in China (Li et al. 2013) and *F. redolens* in Ukraine (Zerova 1940). The originally defined *F. fujikuroi* s.l. is a large complex with >60 species, including *F. fujikuroi* s.s. (Moussa et al. 2017). There are >100 *Lilium* species and many other species whose common names include "lily." This is the first report of bulb rot of JL caused by *F. fujikuroi* s.s. in China. Our result should help with future monitoring and control of JL diseases.

References:

- Bian, X. R., et al. 2016. J Gansu Agric. Univ. 4:58.
- Choi, J. H., et al. 2018. Int. J. Food Microbiol. 267:62.
- Jiang, S. B., et al. 2018. Plant Dis. 102:1177.
- Leslie, J. F., and Summerell, B. A. 2006. The *Fusarium* Laboratory Manual. Blackwell Publishing, Ames, IA.
- Li, Y. Y., et al. 2013. Plant Dis. 97:993.
- Moussa, T. A. A., et al. 2017. Antonie van Leeuwenhoek 110:819.
- Zeng, H. L., et al. 2020. Plant Dis. 104:291.
- Zerova, M. M. Y. 1940. Botanichnii Zh. 1:143.

The author(s) declare no conflict of interest.

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