Diseases Caused by Oomycetes

First Report of *Phytophthora parsiana* Causing Crown and Root Rot on Guayule in the United States

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Guayule (*Parthenium argentatum* A. Gray) is a perennial shrub (approximately 50 cm in height) cultivated in the southwestern United States. It produces natural low-allergenic latex, resins, and high-energy biofuel feedstock. During August 2021, a crown and root rot disease was observed on 2-year-old plants of direct-seeded guayule cultivar Az 2 in research plots in Pinal County, Arizona, where a record 36 cm of rainfall had fallen during monsoon season. Symptoms included yellowing of leaves, wilting, and plant death. Average disease incidence was 16%. Isolation from necrotic crown and root tissues on 10% clarified V8-PARP (Jeffers and Martin 1986) yielded *Phytophthora*-like colonies. Three isolates were subcultured on V8 agar and chlamydospores and hyphal swellings were abundant in 2-week-old cultures. All three isolates produced abundant noncaducous and nonpapillate sporangia ranging from 33 to 54 × 20 to 39 μm (average 45.5 × 28.5 μm, $n=20$) in soil water extract solution. Isolates did not produce oospores after 2 weeks on carrot agar at 20°C in the dark. Isolates had optimum vegetative growth at 30°C and grew well at 35°C. There was no growth at 5 or 40°C. Genomic DNA was extracted from the mycelia of three isolates using DNeasy Plant Pro Kit (Qiagen, Valencia, CA) according to the manufacturer's instructions. The internal transcribed spacer (ITS) region of rDNA, mitochondrially encoded cytochrome c oxidase 1 (cox 1) gene, and beta-tubulin (β-tub) gene were amplified with primers ITS1/ITS4 (White et al. 1990), COXF4N/COXR4N, and TUBUF2/TUBUR1 (Kroon et al. 2004), respectively, and the resulting three amplicons were sequenced (GenBank Accession Nos. OK438221, OK484426, and OK484427). A BLASTn search of the 811-bp amplicon (OK438221) revealed 99% match (762/766) with ITS sequences

MG865562, which was *Phytophthora parsiana* Ex-type CPHST BL 47 from Iran. BLAST analysis of the 867-bp amplicon (OK484427) showed 99% identity (866/867) with the COX 1 sequence of *P. parsiana* (KC733455) from Virginia. BLAST analysis of the 941-bp amplicon (OK484426) showed 99% identity (928/938) with the β-tub sequence of *P. parsiana* (AY659746). To fulfill Koch's postulates, pathogenicity tests were conducted twice on 2-week-old Az 2 guayule seedlings grown in 10 plants per 1.9-liter pot filled with a steam-disinfested potting mix. Pots were placed in a plastic container and watered three times a week by flooding to create waterlogged conditions. Plants were maintained in a greenhouse with 12 h day/12 h night (15 to 28°C) and fertilized weekly with a 20-20-20 fertilizer at 1 mg/ml. Fifty plants in five pots were challenged with a *P. parsiana* isolate by drenching each pot with 50 ml of a 1×10^5 zoospore/ml suspension. Fifty plants in five pots, serving as a control, each received 50 ml of distilled water. Symptoms of wilting, root rot, and plant death were observed after 1 week in inoculated plants, and control plants remained asymptomatic. *P. parsiana* was reisolated from necrotic roots of inoculated plants but not from control plants. To our knowledge, this is the first report of crown and root rot in guayule caused by *P. parsiana* in Arizona. *P. parsiana* is a species known for causing root rot on woody plants such as pistachio in California (Fichtner et al. 2016) and Iran (Mostowfizadeh-Ghalamfarsa et al. 2008). Arizona is home to the desert woody guayule plant. *P. parsiana* may represent a significant barrier to commercialization of guayule for rubber in low desert areas of Arizona. The origin, distribution, and virulence of the pathogen on Arizona guayule is currently unknown. Disease resistance evaluation may help identify resistance in guayule germplasm that is useful in breeding for resistant cultivars.

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