First Report of Phytophthora Fruit Rot on Bitter Gourd (*Mormodica charantia*) and Sponge Gourd (*Luffa cylindrica*) Caused by *Phytophthora capsici*

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Luffa sponge (smooth gourd) and bitter gourds (bitter melon) are specialty cucurbit vegetables cultivated in the United States on a small scale for select markets. Luffa gourds are also grown for the sponge obtained from dried fruit for personal hygiene and skin care (Davis 1994; Molinar 2012). These two cucurbits produce vines and are generally grown on a trellis to allow the fruit to grow straight, but some growers have eliminated the trellis and use raised beds to lower production costs. As part of a project to monitor powdery mildew pathotypes present in South Carolina, we have been growing various cucurbits, including pumpkin, squash, melon, bitter gourd, smooth gourd, squash, and ridge gourds, for the past 5 years on raised plastic mulched beds. During September of 2014, 19 days of rainfall produced over 27 cm of rain that resulted in rot of over 50% of the fruit of bitter gourd variety 'Bitter Green Long' (Fig. 1 A) and over 25% on sponge gourd variety 'Harita' (Fig. 2) in a field with no history of fruit rot. The rotting fruits were in contact with the soil in most cases. Earlier reports from the United States have indicated that Luffa fruit touching or close to the ground can rot, however, the causal organism is generally not specified (Davis 1994; Molinar 2012). Microscopic examination of rotting fruit revealed presence of abundant oomycete sporangia. The pathogen was isolated on V8 juice agar amended with antibiotics (Granke et al. 2012) and identified as *Phytophthora capsici* on the basis of sporangia morphology (Fig. 3) and amplification of the ITS region using specific PCR primers. Further confirmation of the pathogen as *P. capsici* was done by PCR amplification and sequencing of 12 specific regions (Quesada-Ocampo et al. 2011) using four isolates from bitter gourd and three from sponge gourd. We observed 100% similarity to known *P. capsici* sequences in the NCBI data base for the following regions: Cox1 (reference sequence AB688175.1); Cox2 (JN618617.1); Nad1 (DQ361203.1); Nad5 (HQ726266.1); β-tubulin (HQ389125.1 and EU080406.1); EF1 (HQ388948.1); Enolase (KF305195.1); HSP090 (HQ725985.1); TigA (HQ388987.1); Ura3 (HQ389053.1 and EF617414.1); ITS5 (KM369965.1); and ITS6 (KM496492.1 and KM369965.1). The sequences for these regions for *P. capsici* isolated from the two gourds have been submitted to the NCBI GenBank (accession

FIGURE 1

(**A**) Bitter gourd fruit collected from a field in Charleston, SC, September 2014, showing natural infection by *Phytophthora capsici*. (**B**) Bitter gourd fruit inoculated with *P. capsici* agar plug showing typical symptoms of fruit rot as that observed in field.

FIGURE 2

Sponge gourd fruit collected from a field in Charleston, SC, September 2014, showing natural infection by *Phytophthora capsici*.

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numbers KP721776 to KP721799). Four isolates collected from bitter gourd belonged to *P. capsici* A2 mating type. Both A1 and A2 mating types were isolated from sponge gourd fruit (Quesada-Ocampo et al. 2011; Granke et al. 2012). Fruits of bitter gourd and sponge gourd were surface sterilized and arranged randomly in four replications with five fruits per replication in a humid chamber. Fruits were inoculated with V8 juice agar plugs (7 mm) from actively growing colonies of *P. capsici* isolated from the respective rotting fruit. Inoculated fruit were maintained in a humid chamber (RH > 95%, 26 ± 2°C) as described before (Kousik et al. 2014). Five days after inoculation, fruit rot identical to what was observed in the field developed on both cucurbits (Fig. 1B). Microscopic observation of inoculated fruit revealed typical *P. capsici* sporangia. *Phytophthora capsici* was re-isolated from edges of rotting lesions of inoculated fruit. The experiments were repeated two more times with similar results. Sixty-five percent of 4-week-old bitter gourd and 100% of squash (*Cucurbita pepo;* susceptible check, Early Prolific Straight Neck) seedlings grown in a greenhouse (27 ± 2°C) in small square pots (6.4 cm) filled with metro mix (Sun Gro Horticulture, Bellevue, WA) succumbed to crown rot 3 weeks after inoculation with zoospores (10^4 zoospores/ml/seedling) of *P. capsici* isolated from the fruit. Crown rot was not observed on sponge gourd seedlings that were similarly inoculated. *Phytophthora capsici* has been reported to infect crops belonging to 27 families, including several members of Cucurbitaceae (Granke et al. 2012). However, *P. capsici* has not been reported on bitter gourd before. Similarly, *P. capsici* has not been reported as a pathogen of sponge gourd in the United States (Granke et al. 2012). However, *P. capsici* was reportedly isolated post-harvest from a rotting fruit collected from a market in Asia (Fatima et al. 2009). Several fungicides that are effective in managing Phytophthora fruit rot of watermelon (Kousik et al. 2014) are also labelled for application on *Mormodica* spp. and edible gourds. In fields with a history of *P. capsici*, these gourds may need to be sprayed or grown on a trellis for managing Phytophthora fruit rot.

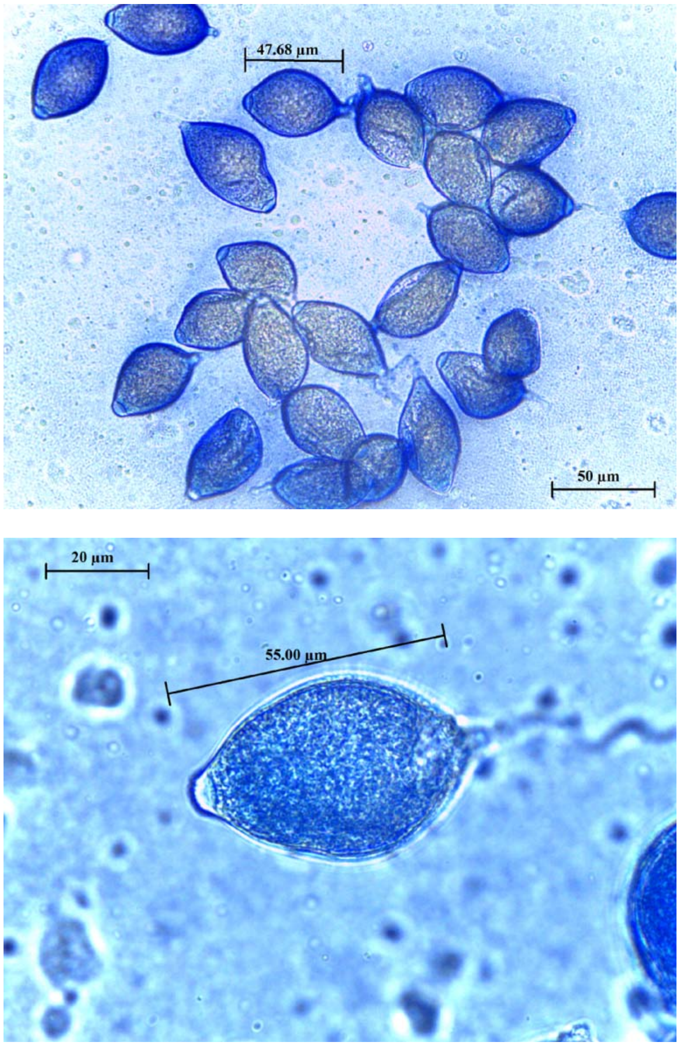

FIGURE 3

Phytophthora capsici sporangium (top). Close up of *P. capsici* sporangia (bottom). Characteristics of the sporangia were used to make the initial identification of the pathogen infecting the two gourds.

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