



First report of *Globisporangium heterothallicum* causing root and crown rot of pepper in Turkey

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Turkey is the world's third-largest producer of pepper (*Capsicum annuum*), annually cultivating over 90,000 ha and producing over half a million tonnes of fruit. In 2019, wilting and death of c. 20% of plants were observed in pepper fields in Şanlıurfa province, Turkey (Fig. 1). Severe root and crown rot symptoms with discoloration were observed on affected plants, and necrotic lesions expanded rapidly into the stems which killed the plant (Fig. 2).

To isolate the putative pathogen, small pieces of symptomatic root (5-10 mm) were surface sterilised in 70% ethanol for 30 seconds then transferred onto grated apple cornmeal agar amended with antimicrobial agents. Twelve oomycete isolates with abundant hyphal swellings were purified by subbing single hypha onto new plates and incubating at 20°C for one week in the dark. Sporangia were formed, terminal or intercalary, (sub-)globose or lemon-shaped, and grew up to 20 µm in diameter (Fig. 3). A sexual stage was not observed. The internal transcribed spacer (ITS) and the large subunit (LSU) of the nuclear rDNA and mitochondrial cytochrome oxidase II gene (*cox II*) of two representative isolates were sequenced using primer pairs ITS4/ITS6, NL1/NL4, and FM66/FM58 and deposited in GenBank under Accession Nos. MT039879-MT039880, MT039885-MT039886, and MT038359-MT038360, respectively. Comparisons with sequences of *Globisporangium heterothallicum* Uzuhashi, Tojo & Kakish (Basionym: *Pythium heterothallicum* W. A. Campb. & F. F. Hendrix) isolates showed 97.5-100% nucleotide identity for ITS (MN541110, KU209920), LSU (AY598654, HQ665235) and *cox II* (AB512908, AB512913). This genetic identification is consistent with morphological identification as described by Uzuhashi *et al.* (2010). Whilst the isolate currently warrants the name *G. heterothallicum* it should be noted that it is significantly distinct from the sequence of the type strain and this lineage may warrant further characterisation.

Pathogenicity tests were done in a growth chamber on pepper seedlings (*C. annuum* cv. Acuka). The inoculum was produced on moistened (25 ml of deionised water/20 g of grains and allowed to soak overnight) and autoclaved (two times on two consecutive days for 30 min) wheat grains. 5-mm-diameter plugs of a *G. heterothallicum* isolate were added to the seeds and incubated at 25°C for 15 days. Peat-based potting soil and finely ground wheat grain inoculum were mixed at 2 g of infested grain per kg of soil and added to each of the ten 20-cm-diameter pots, and subsequently planted with 3-week-old seedlings. Six control plants were inoculated with ground sterile wheat grains. All seedlings were incubated at 20°C and 80%

relative humidity on 16/8-hr light/dark photoperiod for a month. All ten inoculated plants wilted within one week and within three weeks all inoculated plants had root and crown rot, and had dropped many leaves (Fig. 4). *G. heterothallicum* was recovered from the roots of all inoculated plants. None of the control plants displayed symptoms and the pathogen could not be isolated from these plants.

Globisporangium heterothallicum was reported as a pathogen on a number of hosts including spinach in Sweden (Larsson, 1994), corn in China (Gan *et al.*, 2010), soybean in Pennsylvania, USA (Coffua *et al.*, 2016), alfalfa in Minnesota, USA (Berg *et al.*, 2017), and grapevine in South Africa (Langenhoven *et al.*, 2018). To our knowledge, this is the first report of *G. heterothallicum* causing root and crown rot of pepper in Turkey.

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Figure 1



Figure 2

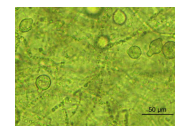


Figure 3



Figure 4

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