



First report of *Phytophthora nicotianae* causing root and crown rot of strawberry in Turkey

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Approximately 415,000 tonnes of strawberries (*Fragaria × ananassa*) are produced in Turkey annually, making the country one of the leading producers in the world (FAO, 2016). In 2016, symptoms of decline were observed on strawberries grown in greenhouses in the Serik district of Antalya province, Turkey. These included yellowing of foliage, wilting, decaying roots and reddish-brown lesions on crown tissues resulting in plant death. At least 20% of the plants were affected by the disease. A *Phytophthora* sp. was consistently isolated from small necrotic segments taken from the margin of lesions and plated onto potato dextrose agar after surface disinfection in 1% NaOCl for three minutes. Hyphae growing out of the tissue pieces were cut and transferred to carrot agar (CA) to obtain pure cultures.

The *Phytophthora* isolates did not produce oogonia and oospores in CA and V8 agar. Papillate sporangia were usually non-caducous but some were detached. They were ovoid or almost spherical and rarely obpyriform (Fig. 1) with a rounded base. Occasionally double papillae occurred. Lateral attachment was common. Sporangia were 34.2–58.0 µm long (mean 47.0 µm) and 28.4–43.3 µm wide (mean 35.3 µm), with length-to-width ratios of 1.3. Terminal and intercalary chlamydospores were abundant and 24.5–50.7 µm in diameter (mean 33.5 µm) (Fig. 1). The isolates grew at 35°C on CA. The morphological features were consistent with the heterothallic species *Phytophthora nicotianae* (Gallegly & Hong, 2008). The ITS region of the rDNA gene of one isolate was amplified and sequenced to confirm morphological identification. The nucleotide sequence (GenBank Accession No. MF379696) had 100% identity with other *P. nicotianae*

isolates in GenBank (e.g. MG208675, MF115425, KX611371, LT628539 and KU172526).

The pathogenicity of *P. nicotianae* was demonstrated using a soil infestation test. To prepare the inoculum, wheat grains moistened with distilled water were autoclaved and inoculated with mycelial agar plugs. They were then incubated for two weeks at 22°C in the dark. Each of the strawberry seedlings was transplanted to a 3-litre pot containing autoclaved peat/perlite mixture (3:1, v/v) mixed with inoculum at a rate of 4% of the total soil volume. Eight inoculated plants were used in the test as well as eight non-inoculated plants as control. Plants incubated in a greenhouse at 25 ± 1°C were kept constantly wet. After four weeks, symptoms including poor growth of plants, reduced hairy root growth, and necrosis on roots and crowns were observed on inoculated plants, whilst control seedlings remained healthy (Figs. 2–3). The pathogen was re-isolated from symptomatic root and crown tissues.

To our knowledge, this is the first report of *P. nicotianae* causing root and crown rot of strawberry in Turkey.

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Figure 1



Figure 2



Figure 3

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