

# *Fusarium solani* f. sp. *cucurbitae*, affecting melon in Almería Province, Spain

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**Abstract** During surveys carried out for assessing the occurrence of cucurbit-infecting soil fungi, melon plants exhibited necrosis on the basal stem, wilt and death. Mycological analysis and experimental inoculations showed the causal agent to be *Fusarium solani* f. sp. *cucurbitae*. This is the first report of *F. solani* f. sp. *cucurbitae* as the causal agent of crown rot of melon in Europe.

**Keywords** *Fusarium solani* f. sp. *cucurbitae* · Melon · Zucchini

Melon (*Cucumis melo*) is a widely cultivated crop in the south of Spain, covering 14,500 ha of which approximately 5,500 ha are grown in plastic-houses in the southeast (Anonymous 2009). In the spring of 2009, melon plants cv. Timon, cultivated in a commercial plastic-house near the village of San Agustín (36°71' N, 2°69' W) in Almería Province, exhibited necrosis on the basal stem, wilt and death (Fig. 1). The incidence of dead plants was 10–15 %. *Fusarium* sp. was consistently isolated on potato dextrose agar (PDA) from the basal stems of symptomatic plants.

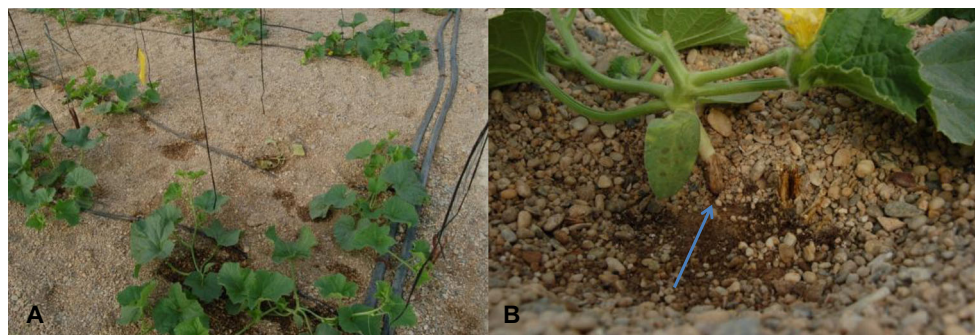
Three single spore isolates (Fsm711, Fsm721 and Fsm731) were identified on PDA, carnation leaf-piece agar medium (CLA) and Spezieller Nährstoffarmer agar medium (SNA) (Leslie and Summerell 2006) as *Fusarium solani* species complex (FSSC) due to their production of long and slightly curved or straight macroconidia, containing between three to six septa (four and five septa more frequent) with distinctly or

barely notched basal cells. Microconidia formed on false heads on long or intermediate, branched and often verticillate monophialides (Fig. 2). Chlamydospores formed in conidia and in hyphae, often in chains. DNA was extracted from three isolates and the identity of these isolates was confirmed by comparing a portion of the elongation translation factor 1- $\alpha$  at the Fusarium-ID database, Pennsylvania State University (Geiser et al. 2004). The pathogenic isolates had a 99.85 % homology with the isolates NRRL 43315 (Elmer et al. 2007) and NRRL22098 (O'Donnell et al. 2008), corresponding to *F. solani* f. sp. *cucurbitae* MPI, isolated from cucurbits in the United States. The sequences of two isolates, Fsm711 and Fsm731, were deposited in GenBank with accession Nos: KC711040 and KC711041, respectively, and the isolate Fsm711 has been deposited with the accession CECT20831 in the Colección Española de Cultivos Tipo (CECT), Parc Científic Universitat de València, Paterna, Spain. The pathogenicity of the three isolates was tested in two experiments conducted in a greenhouse in Almería. Pre-germinated seeds of melon cv. Timon and zucchini cv. Consul were sown in 1L-containers filled with vermiculite in the fall 2010 and spring 2011 (experiments 1 and 2, respectively). Melon plants at the 1–3 true-leaf stage and zucchini plants at the 3–4 true-leaf stage were inoculated by irrigating plants with a suspension (50 ml/plant) obtained by blending and homogenising the colonies when they fully covered each Petri dish of PDA in 600 ml sterile distilled water. Inoculum concentrations for different isolates and experiments ranged  $7.3 \times 10^6$  to  $4.4 \times 10^7$  propagules/ml. A nutrient solution of  $1.9\text{--}2.1 \text{ dS m}^{-1}$  EC was prepared for fertigation using water of  $0.6 \text{ dS m}^{-1}$  EC, and distributed to each plant with a drip irrigation system. An experimental design of two-factor randomised complete blocks with three replicates, each plot comprising six plants (three plants per container) was established. In experiments, 18 uninoculated melon and zucchini plants of the same cultivars were used as controls. The

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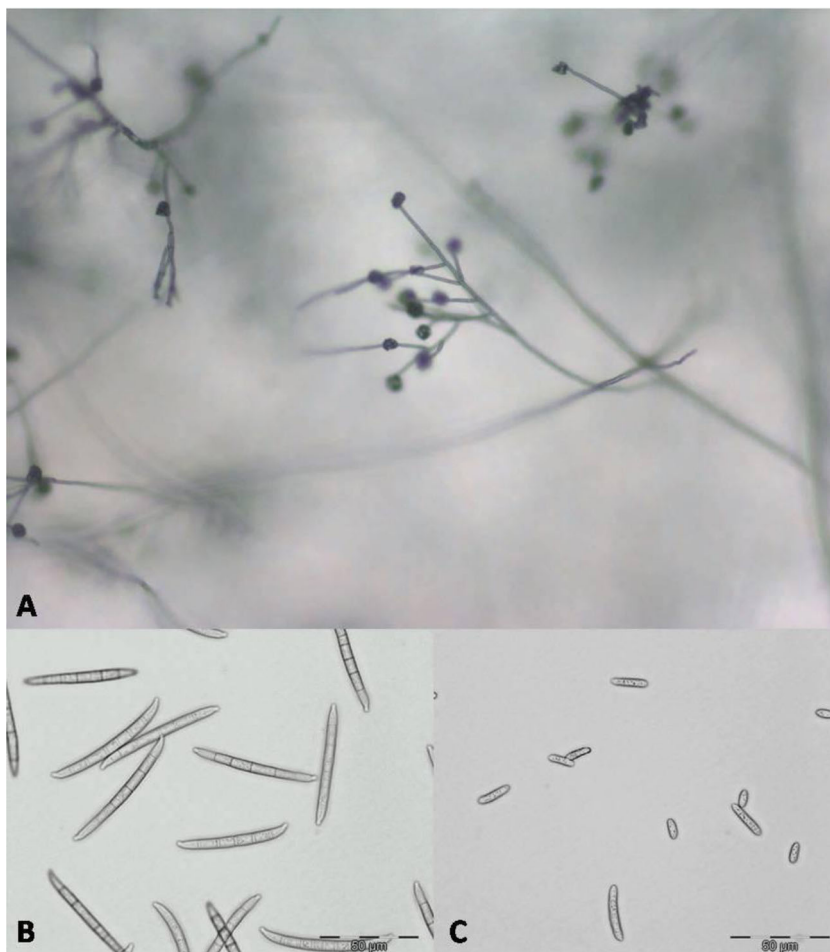
**Fig. 1** Melon plants affected by *Fusarium solani* f. sp. *cucurbitae* causing basal stem necrosis and wilting in a commercial plastic house in Almeria province, Spain. (a) Comparison of diseased and symptomless plants; (b) Basal stem necrosis



plants were maintained along 35 and 43 days following inoculation in the greenhouse, for experiments 1 and 2, respectively. During the experiments, sequential observations of the uninoculated plants were performed for the detection of symptoms development. The mean temperatures ranged from 15.2 to 26.1 °C, maximum ranged from 21.3 to 44.9 °C and minimum ranged from 8.5 to 18.0 °C for experiment 1, and

mean temperatures ranged from 19.0 to 26.0 °C, maximum ranged from 27.9 to 41.1 and minimum ranged from 12.9 to 18.3 for experiment 2. In experiment 1, the first wilting occurred in both species 17 days after inoculation and at the end of the experiment, 83.3 % melon and 61.1 % zucchini plants inoculated with Fsm721 and 100 % of inoculated plants with Fsm711 and Fsm731 died. In experiment 2, the first

**Fig. 2** Morphological characteristics of the pathogen on carnation leaf-piece agar medium: branched monophialides (a), macroconidia (b), microconidia (c)



**Fig. 3** Wilt symptoms in melon plants inoculated with *Fusarium solani* f.sp. *cucurbitae* in pathogenicity test



wilting occurred 7 days after inoculation in zucchini plants, and 36 days later, 100 % of melon and zucchini plants inoculated with the three isolates died. Inoculated plants exhibited lesions in the crown but had no secondary root rot (Fig. 3), while all uninoculated plants remained asymptomatic. The pathogen was recovered from symptomatic plants in both experiments, fulfilling Koch's postulates.

*Fusarium solani* f. sp. *cucurbitae* race 1 was reported in a squash field (*Cucurbita maxima*) in the province of Valencia, east-central Spain (García-Jiménez et al. 1997), and in zucchini greenhouses (Gómez et al. 2008) in Almería. However, this is the first report of *F. solani* f. sp. *cucurbitae* race 1 as the causal agent of crown rot of melon in Europe, specifically in southern Spain, which is one of the world's largest concentrations of plastic-houses. In this area, other susceptible species belonging to the Cucurbitaceae family such as zucchini, melon, cucumber, watermelon and rootstocks for watermelon are cropped on greater than 16,700 ha (Sanjuán 2001). These cucurbits are potential hosts of the pathogen. There is therefore a reasonable risk that once introduced, the pathogen can spread easily in the area and cause significant economic damage.

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