



# First formal identification of *Erysiphe heraclei* causing powdery mildew on dill (*Anethum graveolens*) in Italy

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From 2010 to 2014, typical symptoms of powdery mildew were observed on dill crops (*Anethum graveolens*, Apiaceae) in several greenhouses in Apulia (southern Italy). The disease appeared at all stages of growth, from transplanted seedlings to harvest. If not controlled promptly, a white fungal efflorescence spread progressively from the basal leaves and petioles to the whole plant with disease incidence and severity often reaching 100%. Applications of sulphur sprays to severely diseased plants were often ineffective, rendering the plants unsuitable for harvest. Light microscope observations revealed the presence of an epiphytic mycelium and conidiophores bearing conidia in short chains. The dimensions of the conidia were similar to those reported for *Erysiphe heraclei* on dill by several other authors (Table 1). A 605 bp PCR product amplified from fungal DNA using the ITS1/ITS4 primer pair was sequenced (BMR Genomics, Italy) and the nucleotide sequence deposited in GenBank (Accession No. KP890653, isolate AGR-PUG1). Based on BLAST alignment, the nucleotide sequence shared 99% homology with comparable sequences from accessions of *E. heraclei* found on species in the Apiaceae including dill (JN603995) and carrot (*Daucus carota*, KC480605). The genomic region sequenced shares the same homology with accessions of *Erysiphe betae* (e.g. DQ164432), a pathogen that only infects the genus *Beta* (Amaranthaceae) (Francis, 2002). Based on the morphology of the conidia and sequence homology, the isolated fungus was identified as the anamorph of *E. heraclei*. The teleomorph was not found.

Koch's postulates were fulfilled using a detached-leaf assay. Dill leaves cut from healthy plants were placed on wet filter paper in plastic boxes, and inoculated by spraying a conidial suspension ( $1 \times 10^5$  conidia/ml in water) prepared from diseased leaves. Boxes were incubated in a growth chamber at 20°C in the dark. Disease symptoms appeared on inoculated leaves after 7-10 days, and both the disease and the fungus were similar in appearance

to those observed in the greenhouse (without conidial measurements being made). The control leaves, inoculated with water and incubated in the same way, remained healthy. In the Albenga area (Liguria region, northern Italy), powdery mildew on dill was first reported in 1967, and the causal agent was inferred to be *E. heraclei*, but no details of the method of species identification was reported (FAO, 1969). Although powdery mildew of dill is commonly found on the few dill crops grown in greenhouses in Italy, to the best of my knowledge, this is the first report of *E. heraclei* on dill in Italy confirmed using conidial morphology, ITS sequencing, and Koch's postulates.

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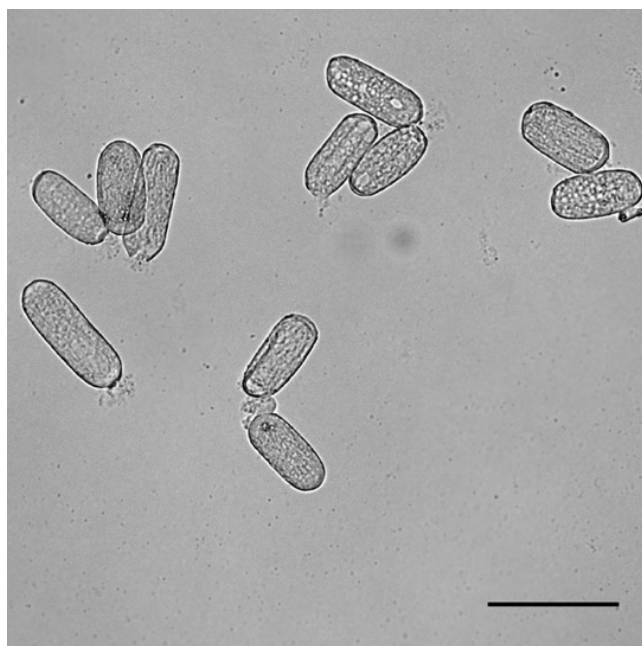


Figure 1

Table 1. Dimensions ( $\mu\text{m}$ ) of conidia of *Erysiphe heraclei* found on dill (*Anethum graveolens*) in Italy.

Length (min.-max.)	Mean length $\pm$ s.d.	Width (min.-max.)	Mean width $\pm$ s.d.	Number of conidia measured	Reference
25.3-50.4	38.3 $\pm$ 4.8	12.3-21.2	15.9 $\pm$ 2.0	100	This paper
30-38	n/a	12-15	n/a	n/a	Soylu & Soylu, 2003
26-42	33.7 $\pm$ 4.33	12-18	14.4 $\pm$ 1.46	55	Torés <i>et al.</i> , 2004
28-50	n/a	14-18	n/a	n/a	Cho & Park, 2012

s.d. = standard deviation where presented  
n/a = not available

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