

Verticillium dahliae



Fig. 1. *Verticillium dahliae*: conidiophores (a) and microsclerotia (b). *Verticillium wilt symptoms*: wilting of eggplant (c) and artichoke (d) leaves; defoliation of olive twigs; vascular browning in stem cross sections of artichoke (f) and olive (g); and plugging of xylem vessels in olive trunk (h).

Disease: Verticillium wilt

Classification: K: Fungi, P: Ascomycota, C: Sordariomycetes, O: Glomerellales, F: Plectosphaerellaceae

Verticillium wilt is caused primarily by *Verticillium dahliae*, although *V. albo-atrum* Reinke & Berth and other *Verticillium* species can also induce the disease. *V. longisporum* infects Brassicaceae species. *Verticillium* spp. are soil-borne vascular pathogens characterized by high polyphagy, ubiquity and long survival.

Biology and Ecology:

The reproduction is strictly asexual via hyaline conidia (2.5-8.0 × 1.4-3.2 μm), born on verticillate conidiophores, and melanized microsclerotia (15-50 μm, occasionally up to 100 μm). Microsclerotia persist in soil for many years, even in the absence of plant hosts. Stimulated by plant root exudates, microsclerotia germinate and hyphae infect young roots to invade the xylem, where the infection becomes systemic. Wilting of shoots and vascular browning are typical symptoms of Verticillium wilt. Microsclerotia produced in senescent tissues renew the inoculum in the soil.

V. dahliae populations are conceived host-adapted rather than host-specific. They may display cross pathogenicity among different plant species, though they are more aggressive on the original host. There are six main vegetative compatibility groups in *V. dahliae*. Two pathotypes, namely defoliating and non-defoliating, affect cotton and olive, whereas race 1 and 2 occur in tomato and lettuce.

Distribution:

V. dahliae is an ubiquitous plant pathogen. It is present between 60°N and 50°S latitude. Increasing spread of the pathogen, and especially of its defoliating pathotype, is a major concern for olive orchards.

Host Range:

Plant hosts of *V. dahliae* include more than 400 species of trees, shrubs, vegetables, ornamentals, weeds and other herbaceous plants belonging to 76 botanical families. Significant economic impact of Verticillium wilt occurs on crops such as olive, cotton, lettuce, potato, artichoke, strawberry, etc.

Impact:

In olive, recent estimates refers disease prevalence of 6-36% in Italy, 35% in Turkey, 10-50% in Greece, 71% in Andalusia, Spain, 60% in Morocco and 90% in Algeria, with a mean disease incidence of 5-30% in the affected orchards. In artichoke, 80% disease prevalence and 54% incidence have been reported from Spain. Yield losses are in the range of 10-15% (up to 50%) in potato, and may reach 100% in lettuce.

Management options:

Management of Verticillium wilt in many crops relies on an integrated approach. Soil fumigants provided the best results in the past, while fungicides were mostly ineffective. Soil solarization, especially in warm climate areas, contributes to reduce the soil inoculum. Pre- and post-planting cultural practices should be adopted to avoid the contamination of *V. dahliae*-free soils, as the pathogen cannot be eradicated.

The host genetic resistance is the best control strategy. Several cotton, potato and olive varieties possess levels of resistance. Most tomato varieties carry the *Ve1* gene, which confers dominant resistance to race 1, but no sources of resistance against race 2 have been identified so far. Some olive varieties are variably resistant against *V. dahliae* and, among them, 'Frantoio', 'Empeltre', 'Oblonga' and 'Changlot Real' are partially resistant even to the defoliating pathotype. Grafting on resistant rootstocks is also a feasible control measure.

Further Reading:

1. Bubici, G. and Cirulli, M. (2008) Integrated management of Verticillium wilt of tomato, In: Ciancio, A., Mukerji, K.G. (Eds.), Integrated management of diseases caused by fungi, phytoplasma and bacteria. Springer, pp. 225-242.
2. Cirulli, M., et al. (2010) Verticillium wilt: a threat to artichoke production. Plant Dis. 94, 1176-1187.
3. Jiménez-Díaz, R.M., et al. (2012) Verticillium wilt: a major threat to olive production. Current status and future prospects for its management. Plant Dis. 96, 304-329.
4. Klosterman, S.J., et al. (2009) Diversity, Pathogenicity, and Management of Verticillium Species. Annu Rev Phytopathol 47, 39-62.
5. Pegg, G.F. and Brady, B.L. (2002) Verticillium Wilts. CABI Publishing, New York

Key Contacts: Giovanni Bubici, e-mail: giovannicola.bubici@cnr.it