

Modelling the epidemic of oak decline in the Iberian forests

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Abstract

Since the 1980s an epidemic of oak decline is severely affecting the two main species of trees in the Iberian forests: the holm oaks (*Quercus ilex*) and cork oaks (*Quercus suber*). In 1996 the origin of this epidemic was clarified by the isolation of the pathogen *Phytophthora cinnamomi* by the phytopathologist C. M. Brasier [1]. This pseudofungi behaves in a similar way to true fungi creating a mycelium around the roots of its host and, finally, causing the necrosis of the radicular system, incapacitating them to absorb water and nutrients. This epidemic is now a very serious issue to be taken into account in environmental policies as it is destroying one of the most emblematic ecosystems of our country.

In this work, we discuss a network mathematical model to analyze the propagation of the *P. cinnamomi* pathogen in a ‘dehesa’ up to some thousands of hectares in extension. This model includes the terrain elevation as a parameter that correlates with the likelihood of the pathogen transmission (as lower areas are flooded more easily and zoospores require water to navigate to the roots and infect the next plant). A kernel that determines the force of infection depending on the distance between the two trees is also considered [2].

The model is fitted to epidemiological data obtained from surveys in the estate ‘Haza de la Concepción’, an experimental estate of the Cáceres council. By using a particle swarm optimization method we show that the preferred scenario corresponds to a very fast propagation of the disease (some months to one year in a hectare) followed by a slow death of the oaks (who still can survive an average of 50 years to the *P. cinnamomi* infection).

Our model illustrates the use of network modelling techniques in forest pathology and can have important consequences for the management and treatment of this disease as well as reforestation plans.

References

- [1] Brasier, C. M. *Ann. For. Sci.* 1996, 53, DOI: 10.1051/forest:19960217.
- [2] Cardillo, E.; Abad, E.; S., M. *Forest pathology* 2021, 51, DOI: 10.1111/efp.12667.

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