

Phytophthora nicotianae

Overview

Phytophthora nicotianae Breda de Haan (= *Phytophthora parasitica* Dastur) has a long history as a pathogen of plants. It was first described in 1896, and has a broad host range (Erwin and Ribeiro 1996). In black wattle (*Acacia mearnsii* De Wild.), it causes a disease called gummosis. It was reported in 1971 in South Africa (Zeiljemaker 1971) and in 2005 in Brazil (Santos et al. (2005)). In Brazil, gummosis of black wattle is also caused by *P. boehmeriae* Sawada (Santos et al., 2006) and *P. frigida* Maseko, Coutinho & Wingfield (Alves et al., 2016). In South Africa, other agents are *P. boehmeriae* and *P. meadii* McRae (Roux and Wingfield, 1997). Gummosis disease is characterized by necrotic bark lesions of varying sizes, with or without exudation of gum. Lesions are located in the collar and in the basal region of the trunk (Santos et al., 2001). In Brazil, evaluation of commercial plantations showed the incidence of gummosis to be over 20% (Santos and Luz, 2007).

Morphology

Sporangia formed in 10% nonsterile soil extract are papillate, persistent, and predominately ovoid, measuring 56.0 x 35.0 to 33.3 x 24.5 μm (average: 42x 29 μm) with a length-breadth

ratio of 1.4:1 (Fig. 1). Chlamydospores are terminal or intercalary in the mycelium, with a diameter of 25.4 to 40.3 μm (average of 33.0 μm) (Fig. 2). *P. nicotianae* is heterothallic and isolates from both the A1 and A2 compatibility groups are recovered. Oospores measure 23-38 μm in diameter (average: 29 μm). The antheridia are amphigynous (Fig.3) (Santos et al., 2005).

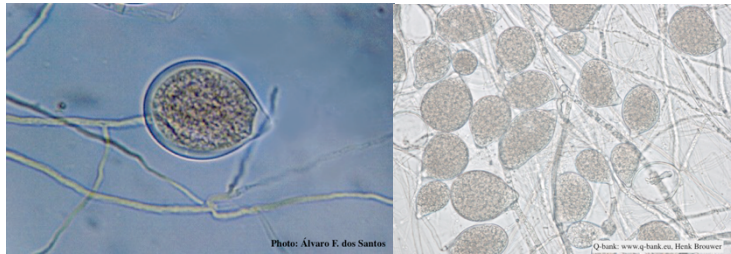


Figure 1. Noncaducous sporangia showing ovoid shape and papillate condition. (Upper photo from Fitopatol. bras. 2005, lower photo from Q-bank: www.q-bank.eu, Henk Brouwer, CBS-KNAW, Utrecht, The Netherlands).

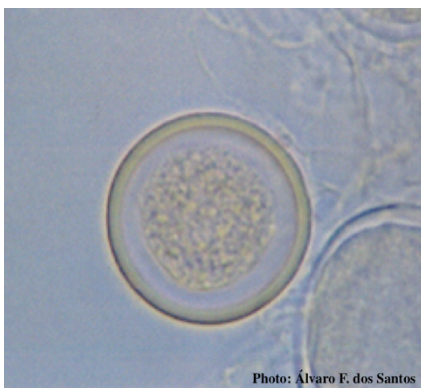


Figure 2. Globose chlamydospore (Fitopatol. bras. 2005).

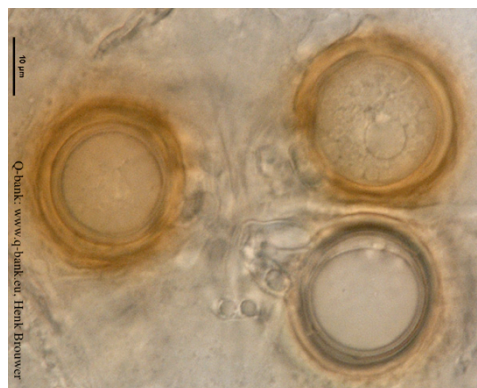


Figure 3. Oogonia. Photo from Q-bank: www.q-bank.eu, Henk Brouwer (CBS-KNAW, Utrecht, The Netherlands).

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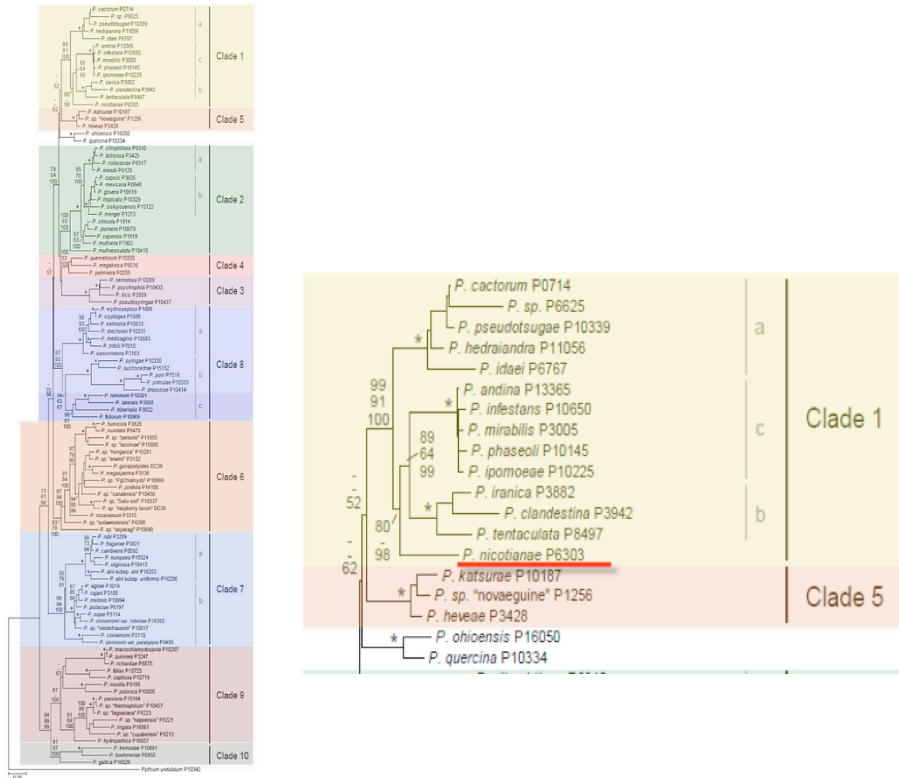


Figure 4. Genus-wide phylogeny for *Phytophthora* using four mitochondrial loci (cox2, nad9, rps10 and secY; 2,373 nucleotides) (Martin, Blair and Coffey, unpublished)

Genetics:

Phytophthora nicotianae is placed in Clade 1 (Kroon et al., 2012) (see also Fig. 4).

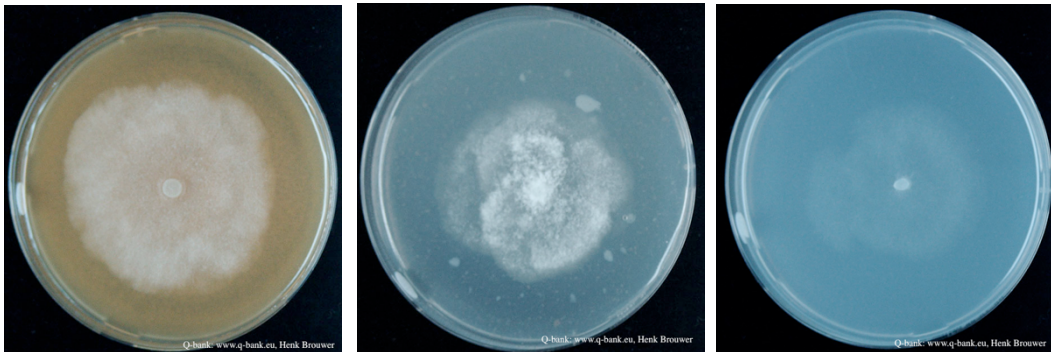


Figure 5. *P. nicotianae* after 7 days at 24° C on V8 (left), PDA (center), and CMA (right). From Q-bank: www.q-bank.eu, Henk Brouwer (CBS-KNAW, Utrecht, The Netherlands)

Growth in culture:

Cultures of *P. nicotianae* on carrot agar medium (CA) are petaloid, with dense and cottony aerial mycelium; colonies have diffuse edges (Fig. 5). The optimum temperature for mycelial growth is between 24 and 32°C, and no growth occurs at 36°C (Santos et al., 2005).

Distinguishing characteristics for identification

P. nicotianae is similar to *P. frigidia* in various morphological characteristics, including persistent, papillate and ovoid sporangia, amphigynous antheridia, and heterothallism. Isolates of both species do not sporulate on solid medium (Santos et al. 2005, Alves et al. 2016). However, they can be separated by molecular analysis, as *P. frigidia* is in Clade 2 and *P. nicotianae* is in Clade 1 (Kroon et al. 2012). *P. nicotianae* can be differentiated morphologically from *P. boehmeriae* and *P. meadii*. *P. boehmeriae* is homothallic, produces caducous sporangia with short pedicels (<5 μ m), and does not grow at 32°C (Santos et al., 2006). *P. meadii* also produces deciduous sporangia, on medium-length pedicels (18 μ m) (Gallegly and Hong 2008).

Disease History

Phytophthora nicotianae was the first species associated with gummosis of black wattle in 1971 in South Africa (Zeiljemaker 1971). Other species associated with gummosis are: in Brazil, *P. boehmeriae* (Santos et al., 2006) and *P. frigidia* (Alves et al, 2016); and in South Africa, *P. boehmeriae* and *P. meadii* (Roux and Wingfield 1997). Symptoms of gummosis occur on the trunk and are characterized by



Figure 6. Symptoms of gummosis on black wattle (Fitopatol. bras. 2005).

necrotic lesions in the bark (Fig. 6). The abundant gummy exudation is the most characteristic symptom of the disease but is easily confused with other problems, since gum exudes from the trunk of the black wattle when injured by both biotic and abiotic agents. The amount of gum produced depends on the genetic characteristic of the tree and environmental factors, such as temperature and moisture availability. As a result, there is little gum in the dry season, but much gum can be exuded in the wet season (Zeiljemaker, 1968).

Impacts in the forest

Black wattle is a forest species from Australia, planted in South Africa and in southern Brazil, both for the production of tannin from the bark and for the wood used in energy production, pulp and paper. In Brazil, it is planted mainly for the production of tannin. Gummosis is the main disease problem of black wattle. The pathogen damages the bark, especially in the basal and middle portions of the trunk, causing economic losses in production of bark and, in extreme cases, death of trees (Santos et al. 2007).

Forest and Wildland Hosts and Symptoms

P. nicotianae is found worldwide. It causes root rot, collar rot, seedling blight, leaf blight, or fruit rot on 255 host genera representing 90 plant families (Erwin and Ribeiro 1996). In Brazil, *P. nicotianae* has a broad geographic distribution and numerous hosts, having been found in 34 hosts representing 22 plant families (Santos et al., 2014). *P. nicotianae* is the main *Phytophthora* species found in Brazil, attacking both agricultural and forestry crops (Santos et al., 2014) including black wattle (*Acacia mearnsii* De Wild.)(Table 1). In black wattle plantations, it is not possible to differentiate the symptoms of gummosis caused by *P. frigida* and *P. nicotianae*. The two pathogens cause similar symptoms which are characterized by necrotic lesions, with or without exudation, localized in the basal region of the trunk. Lesions do not reach heights greater than 1.5 m (Alves et al. 2016; Santos et al. 2005, Santos et al. 2007).

Table 1. *Phytophthora nicotianae* main forest host, symptoms, and locations.

Host Latin name	Host common name	Symptoms	Habitat	Region
<i>Acacia mearnsii</i>	Black wattle; Acácia-negra (Portugese)	Canker, gummosis	Plantations	South Africa, Brazil

Management and education resources

Forest Phytophthoras – a hidden threat to take a serious note of:

http://www.fabinet.up.ac.za/newsitem/240-forest_Phytophthoras.pdf

Gomose de *Phytophthora* da acácia-negra:

http://forestphytophthoras.org/sites/default/files/educational_materials/com_tec101.pdf

O complexo gomose da acácia-negra:

http://forestphytophthoras.org/sites/default/files/educational_materials/circ-tec44.pdf

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