

First report of downy mildew on *Plantago major* caused by *Peronospora alta* in Brazil

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Abstract. *Peronospora alta* is recorded for the first time causing downy mildew on *Plantago major* (Plantaginaceae) in Brazil.

Plantago major, common plantain (local name in Brazil: tanchagem), is a small biennial herb that belongs to the plantain family (Plantaginaceae) and is native to Europe. In Brazil it is widely cultivated as a medicinal plant and used as a diuretic, cicatrizer and expectorant among others (Lorenzi and Matos 2002). However, despite such uses it is generally regarded as a noxious agricultural and garden weed (Heywood *et al.* 2007). There are relatively few studies of diseases occurring on members of the plantain family in Brazil and only three fungal species have been recorded on *P. major* (Mendes *et al.* 1998).

Since November 2000, a downy mildew disease has been observed attacking *P. major* cultivated in plots in a small medicinal garden of the campus of the Universidade Federal de Viçosa (state of Minas Gerais, Brazil). The disease was particularly intense during wet periods of the year. Samples of diseased material were collected, dried in a plant press and deposited at the herbarium of the Universidade Federal de Viçosa (Herbarium VIC 30560) for later studies. Only recently (January 2008) this disease was studied in more detail for a full elucidation of its aetiology. Both dried specimen and freshly collected fresh material were examined.

Symptoms on living leaves started as chlorotic areas on the lamina with well defined borders adaxially. Abaxially such yellowed tissues were covered with a grayish fungal growth. As the disease advanced, the tissue became necrotic and brown and leaves blighted and died (Figs 1–3).

Slides containing the fungal structures were mounted in lactophenol and observed with a light microscope (Olympus BX 51). The fungus had the following morphology: sporangiophores 325.5–869.0 × 6.0–9.5 μm, base slightly swollen, 9.5–12.5 μm wide, main trunk cylindrical, 268–452 μm high, branching dichotomously 5–8 times, terminal branches 6.0–28.5 μm long, tapering and curved; sporangia deciduous, mostly ovoid, sometimes globose to ellipsoid, 22.0–30.0 × 16.0–25.0 μm, pale-brown (Figs 4 and 5). No oospores were observed in sections of leaf tissues.

This fungus clearly belongs to the oomycete genus *Peronospora*. The status of *Peronospora* species described on the *Plantago* is somewhat confused. There are six published

names, but apparently only four are accepted (Francis 1981; Dick 1998), and at least three of those species have been recorded on *P. major*. These are: *P. alta*, *P. plantaginis* and *P. akatsukae* (Francis 1981). There is little distinction between these three species. *Peronospora akatsukae* was only recorded once from Japan (Ito and Murayama 1943) and has a similar



Fig. 1. General view of a plot of *Plantago major* plants attacked by downy mildew.



Fig. 2. Leaves of *Plantago major* attacked by *Peronospora alta*.



Fig. 3. Close-up of adaxial surface of *Plantago major* attacked by *Peronospora alta* with sporulating fungal colonies.

morphology to *P. alta*. Distinction between these two species should be verified with modern molecular tools. *Peronospora plantaginis* is recorded from Bulgaria, India, Korea, Poland and North America (Farr *et al.* 2008) and can be easily distinguished from other *Peronospora* on *P. major* by its larger conidia that are distinctly pointed basally and also somewhat pointed apically (Shaw 1949). *Peronospora alta* is the most frequently recorded species and most widespread species, with many records in Asia, Europe and North America (Farr *et al.* 2008). It has also been recorded from South America, in Argentina (Francis 1981). The fungus morphology, from the Brazilian specimen, was compared with that described for the three species previously recorded on *P. major*. It can be easily separated from *P. plantaginis* based on conidial/sporangial morphology. At present the Brazilian specimen is better placed under *P. alta*. *Peronospora alta* and *P. akatsukae* are similar morphologically and it is possible that *P. akatsukae* is conspecific with *P. alta*. If such synonymy becomes recognised, then the name *P. alta* has priority over *P. akatsukae*. *Peronospora alta* has



Fig. 4. Sporangiophore and sporangia of *Peronospora alta* (bar = 100 μ m).



Fig. 5. Close-up of terminal branches of sporangiophore and sporangia of *Peronospora alta* (bar = 50 μ m).

already been recorded from a neighbouring country from Brazil (Argentina) and is the most widespread species of the three recorded on this host. This is the first record of *Peronospora alta* from Brazil.

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