

**Strawberry powdery mildew:
epidemiology and the effect of host nutrition on disease**

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Abstract

Knowledge of disease epidemiology and the impact of plant nutrient status on development of disease is fundamental in establishing effective management strategies for crop pathogens such as *Podosphaera aphanis* Br. (Braun *et al.*, 2002), the causal agent of powdery mildew on strawberries. The following study investigated the conditions conducive for powdery mildew in strawberry crops in South Australia, the effect of foliar concentration of potassium and calcium on yield and pathogen development on the strawberry cultivars Aromas (resistant to powdery mildew) and Selva (susceptible), the potential for use of foliar-applied potassium silicate to control disease and identification of genes differentially expressed during disease.

Meteorological conditions associated with establishment of powdery mildew were observed over three consecutive seasons in commercial strawberry crops grown in Woodside, South Australia. Conducive conditions appear to be >28 °C, <55 % relative humidity (RH) with no rain during the day (for conidiation), followed by a night with >10 °C, >90 % RH and no rain (for germination). Colony development was then promoted by days of >15 °C and <70 % RH, with nights of >8 °C, >80 % RH and less than 2 mm rain in every 24 hour period. These are consistent with epidemiological studies of this pathogen (Peries, 1962a; Jhooty and McKeen, 1964; Mukerji, 1968; Perera and Wheeler, 1975; Byrne *et al.*, 2000; Miller *et al.*, 2003; Blanco *et al.*, 2004; Davik and Honne, 2005; Amsalem *et al.*, 2006). This knowledge may facilitate prediction of times considered high risk for establishment of powdery mildew in strawberry crops. Subsequently, this may allow optimisation of fungicide application and improved management of this disease and reduced yield loss and management expenses.

P. aphanis developed at an increased rate on leaves of Selva with low calcium content compared with development on normally fertilised leaves. Increased numbers of conidia germinated successfully on leaves of Aromas with low calcium content compared with development on normally fertilised Aromas leaves, however, the germinated conidia still failed to develop into sporulating colonies. Potassium nutrition had no obvious effect on *P. aphanis* development. Foliar concentration found to be adequate for growth of cultivars, Selva and Aromas were 6.0 mg/g and 4.5 mg/g Calcium, dry weight and 11.0 mg/g and 12.5 mg/g potassium, dry weight (respectively).

Potassium silicate, buffered to pH 7.0 and applied as a foliar fertiliser, reduced the severity of powdery mildew below the economic threshold, though not below the disease severity on plants treated with the fungicide, Systhane[®] (Bayer CropScience). As potassium silicate can be produced organically this compound may provide a useful management tool for both organic and conventional strawberry growers.

Although the cultivar Aromas was not immune to disease under conducive conditions and high inoculum load in the field, inoculation of healthy Aromas plants with *P. aphanis* in the laboratory failed to produce disease. Conidia were seldom found attached to the leaf surface of healthy Aromas leaves. Germination and subsequent colony development were also not observed in inoculated samples. This suggests there is some mechanism of Aromas that inhibits development of this fungus. Preliminary investigation of differential expression in Aromas inoculated with *P. aphanis*, identified sequences with homology to a putative antimicrobial protein and photosynthesis-related genes.

The results of these studies should enable growers to increase both crop yields and control of powdery mildew, one of the major economic diseases in South Australia. The epidemiological knowledge attained will be valuable, and may provide the basis for

future forecast modelling for *P. aphanis* in strawberry crops in South Australia. Recommendations for calcium and potassium leaf content will allow growers to monitor their fertiliser regime for increased yield of these cultivars. Aromas was identified as a powdery mildew resistant cultivar potentially suitable for production in South Australia, and the genes associated with this resistance response may be used in future studies of *Fragaria* species and breeding for powdery mildew resistant cultivars.

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