

Development of the Wheat Powdery Mildew Pathogen under Oxidative Stress

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Plants are often exposed to stress conditions that adversely affect their growth, development, or productivity (Vranová *et al* 2002). Reactive oxygen species, as ubiquitous messengers of stress responses, play a signaling role in adaptive processes. In the infected plant cell, the accumulation of reactive oxygen species can cause rapid death of plant cells, blocking the development of the pathogen (Trujillo *et al* 2006). It is known that hydrogen peroxide accumulates at the sites of contact of the host plant and pathogen between epidermal cells undergoing a hypersensitive response and the subjacent mesophyll cells (Vanacker *et al* 2000).

The characteristic feature of the pathogenesis of *Blumeria graminis* f. sp. *tritici* on the leaves of wheat is the formation of a halo at the penetration site. The halo can be observed on the surface of the epidermis of wheat in form of an area of structural changes in the cell wall. Halos occur at the contact points of primary and secondary germ tubes of powdery mildews fungus with epidermal cells of wheat leaves as a paired structure (small and large halo).

In this work we used *Triticum aestivum* L. (wheat) plants infected by the powdery mildew fungus *Blumeria graminis* f. sp. *tritici*. To model oxidative stress, wheat leaves of the plants were detached and their cut ends immersed in the hydrogen peroxide solution after inoculation,

Unfixed samples were examined in a LEO-1430 VP scanning electron microscope (Carl Zeiss, Germany) at -30 ° C using freezing consoles Deben UK (United Kingdom).

B. graminis f. sp. *tritici* conidia germinated on the surfaces of leaves to produce a primary germ tube and a germ tube that developed an appressorium (Fig. 1). Some conidia germinated abnormally and form appressoria with elongated germ tube or multiple germ tubes partially lost their orientation. Haloes showed concentric circles 60–120 µm in diameter. Haloes occurred at the contact points of primary and secondary germ tubes as paired structures (small and large haloes). Sometimes only a single halo was visible at the contacted sites of a secondary germ tube with the cuticle. Treatment with hydrogen peroxide inhibited development of pathogen colonies, increased the number of abnormal appressoria, and the average diameter of the haloes. Some haloes formed on treated leaves changed the morphology and had internal rings.

Hydrogen peroxide treatment increased the average size of paired and single haloes. After treatment with 1mM hydrogen peroxide abnormal large haloes of up to 250–300 mkm were observed.

These observations suggest that increase of abnormal appressoria, and the changes in halo morphology and size is a result of oxidative stress. Well-known formation of elongated appressoria in resistant plants was similar to abnormal development of the mildew pathogen at hydrogen peroxide treatment and, thus, may be associated with appearance of active oxygen species during plant resistance responses. Apparently, the reason for variability of haloes may be local features of the interaction of a pathogen with some plant cells, including local differences in metabolism of active oxygen species.

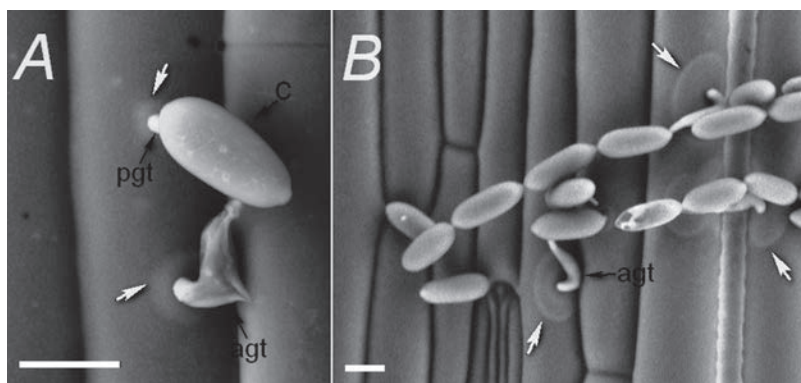


Figure 1 A - a fungal conidium (c) germinated to form a primary germ tube (pgt) and appressorial germ tube (agt) under which developed a circular halo (white arrow). B - an ungerminated conidium and germinated conidium with germ tubes. 48 h after infection, SEM, intact leaves at -30°C . Scale bar = 20 mkm.

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