Studies on the Host-Parasite Relationships of *Phytophthora cactorum* (Leb. and Cohn) Schroet. and Apple Trees

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** ABSTRACT **
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The present work was undertaken to gain a greater understanding of the nature and location of resistance mechanisms present in apple cultivars to Phytophthora cactorum . Artifical inoculation methods of evaluating resistance to this pathogen were also studied .

The amount and type of sporangial germination in the presence of root exudates was not related to the susceptibility of the apple cultivar involved .

The greatest accumulation of zoospores occurred at root tip regions and wound sites (the sites of maximal root exudation) . The numbers of zoospores which encysted at root tip regions was not related to cultivar resistance and the large variation suggested that the quantity and/or quality of exudation varies considerably from root to root .

The germination of zoospore cysts was markedly enhanced by root exudates of all cultivars tested . Ninety-five percent of the cysts germinated on the root surface while only 80% germinated on cellophane membranes laid over roots . Very few germ tubes formed appressoria upon membranes . More than 95% of the germ tubes grew towards the root and over 98% of them formed appressoria on the root surface . Appressorial formation appeared to be induced by specific surface configurations such as breaks in the outer wall and junctions between cells, on the root surface .

The severity of P. cactorum infection of the seedling unsuberised apple roots (cv. 'COP' and 'GS') was dependent upon the initial inoculum loading, up to a saturation point i.e. extensive infection; a larger inoculum loading was required to reach this point with the more

resistant 'GS' cultivar . The resistant cv. 'M 793' tended to have a lower amount of infection than the susceptible 'MM 106' at corresponding levels of inoculum . However, in general, mechanisms of resistance did not appear to be operating external to apple tissue .

Electron microscopy studies showed that the process of infection was similar in susceptible (MM 106) and resistant (M 793) cultivars . Hyphae grew both intracellularly and intercellularly within root cortical tissue . Penetration through cells appeared to be both mechanical and enzymatic, although penetration by mechanical pressure alone may sometimes occur . Cellular deterioration was frequently obvious 2-4 cells in advance of the mycelium .

The histochemical studies showed that in vivo wall degrading enzymes produced by P. cactorum appeared to have a significant role in assisting fungal growth through host tissue but were relatively insignificant in its destruction .

The lack of apparent structural wound associated responses (e.g. papilla formation) formed in cells of either tested cultivar in response to P. cactorum infection indicates that the mechanisms of resistance of the more resistant cultivars are primarily physiological .

Investigations of internal resistance were hampered by the lack of a fully reliable method of assessing resistance . The most convenient system, inoculation of excised twigs, was further characterised revealing that the type of tissue tested (cortex, phloem-cambium or unlignified xylem) and the basal-distal location of the sampled piece of the shoot needs to be specified for valid comparisons with other workers and correlations with other criteria .

A technique of assessing levels of infection by oospore numbers in unsuberised roots is described and would possibly be a better method for determining a cultivar's resistance to the root rot and perhaps the crown rot forms of the disease .

Endogenous levels of nutritional compounds: total nitrogen, soluble sugars and starch and of phenolic compounds did not appear to determine the rate of apple tissue colonisation by P. cactorum . Phloridzin, the major phenolic of apple tissue, was toxic to P. cactorum in vitro yet mean pathogen growth rates of over 10 mm per day were measured within host tissue indicating that the hyphae are not physically encountering inhibitory amounts of phloridzin in vivo .

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