ULTRASTRUCTURE OF SOLANUM TUBEROSUM VAR. KATAHDIN INFECTED WITH PHYTOPHTHORA INFESTANS

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Whole leaves and tuber slices of the potato cultivar Katahdin (susceptible) were inoculated with P. infestans (race 0), causative agent of Late Blight. In multiple trials, the fungus was able to infect tuber tissue but not leaves. The reaction with tuber slices gave rise to a fungal mat on the surface. Leaves gave no visible response. The ultrastructure of the tuber infection was observed at various stages.

Methods. Sporangia of P. infestans, race 0, grown on rye-steep agar (1), were collected in 20 ml sterile distilled water and diluted to 40,000 per ml. Leaves were dipped for 3 min in 5% household bleach and rinsed thoroughly with sterile water. Tubers were washed in 20% bleach and cut into slices 1 cm thick. Slices and leaves were inoculated with 1 ml sporangia suspension and incubated at 20 C in the dark for intervals ranging from 6 hr to 5 days. Samples for embedding were fixed 3 hr in 3% glutaraldehyde plus 1% formaldehyde in 0.025M cacodylate buffer, pH 6.2, rinsed in buffer, and post-fixed 1 hr in 1% osmium tetroxide in the same buffer. Specimens were embedded in epoxy resin. Sections were stained in 2.5% aqueous uranyl acetate for 15 min and Reynolds lead citrate for 10 min.

Observations and Discussion. Well-infected tuber tissue 5 days after inoculation had many intercellular hyphae but few haustoria. The best developed haustorium observed (Fig. 1) contained abundant osmiophilic material, presumably lipid, and a lomasome at the tip. A typical extrahaustorial matrix was present but no wall apposition. Several haustoria were small and rounded with extrahaustorial matrix plus a covering of small particles and vesicles, characteristic of wall appositions reported to surround haustoria in resistant tuber cells (2). Fig. 2 shows one of these. Various cytoplasmic organelles were always present in the host near the penetration site.

More common than haustoria were the structures shown in Fig. 3. A lobed projection of the potato cell wall is directly apposed by a large lomasome in the fungus. The fingerlike wall growth resembles the extrahaustorial matrix in Fig. 1. The potato cell wall was darkened. The membrane enclosing the lobed structure is presumably the potato plasma membrane. Similar structures have been suggested to be early stages in haustorial penetration and to result from efforts by the host to bar the fungus (2). In this tissue, we observed (a) no penetration pegs forming at these sites despite the well-developed appearance of the cell wall structure in question, and (b) no intermediate stages in haustorial development. The prevalence of this interfacial structure suggests that it may represent multiple sites of successful barrier activity by the host or, conversely, unsuccessful penetrations by the fungus.

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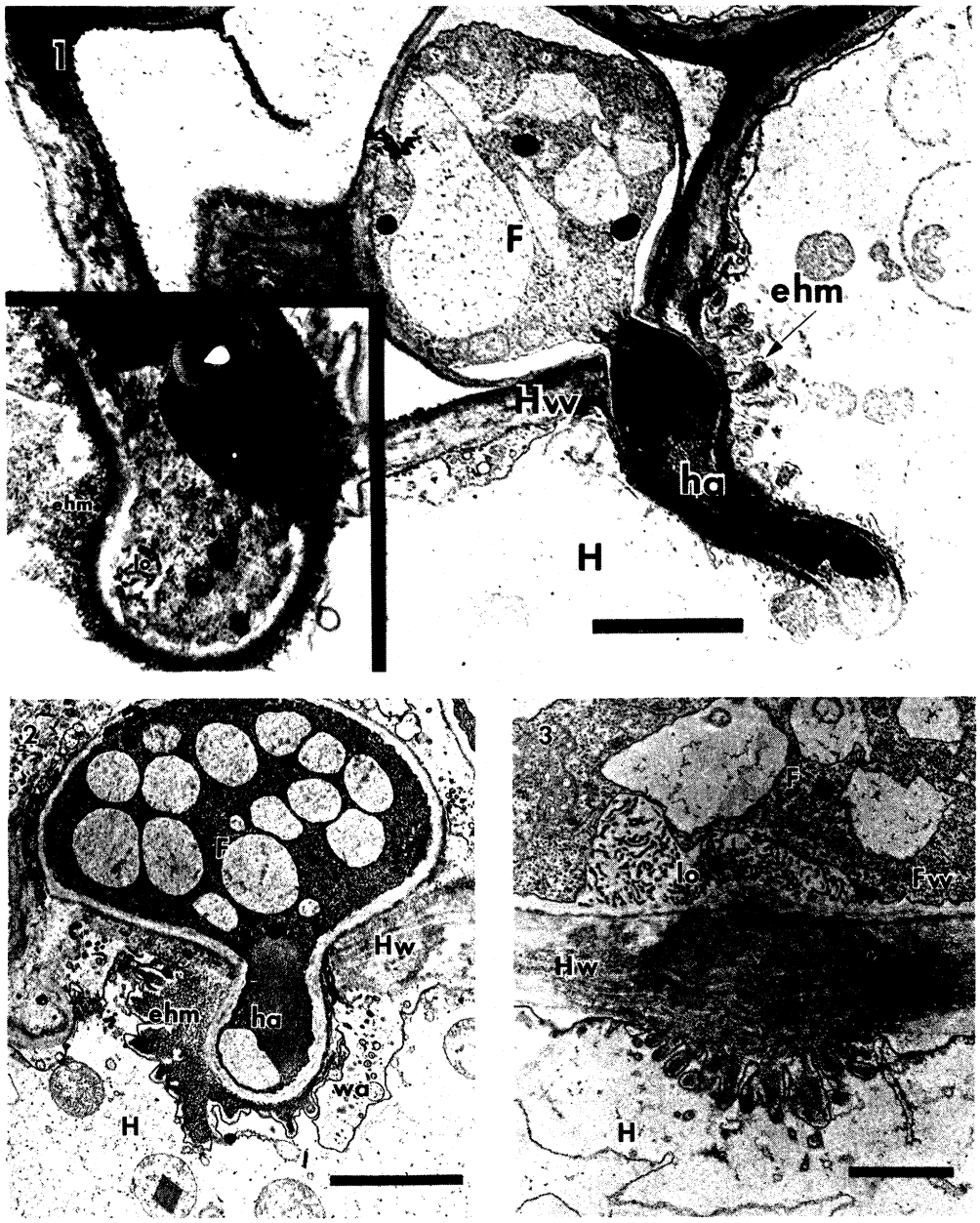
(1) Hodgson, W. A. and P. N. Grainger. 1964. Can. J. Plant Sci., 44, 583.

(2) Hohl, H. R. and P. Stössel. 1976. Can. J. Bot., 54, 900-912.



ehm	extrahaustorial matrix	ha	haustorium
F	fungus	Hw	host wall
Fw	fungal wall	lo	lomasome
H	host	wa	wall apposition

Fig. 1. Well-developed haustorium of Phytophthora infestans invading potato tuber cell. Distal portion of the haustorium is enlarged in inset. Bar equals 6 µm.

Fig. 2. Smaller, rounded haustorium with extrahaustorial matrix plus elements of a wall apposition. Bar equals 3 µm.

Fig. 3. Cell wall interface of fungus and tuber. Lomasome in fungus apposes cell wall elaboration in host. Bar equals 1 µm.