Frontline EXPRESS
Canadian Forest Service, Great Lakes Forestry Centre

Bulletin No. 18

MOLECULAR FOREST PATHOLOGY

INTRODUCTION:

Research under this study is presently focused on developing the use of hydrolytic enzymes as a method to improve tree resistance to fungal and insect pests. The initial focus will be on chitinolytic enzymes produced in vitro by mycoparasitic fungi and actinomycetes. Fundamental research will be carried out to determine the efficacy of these chitinases to inhibit the growth and development of important pests of our major tree species and to determine if these chitinase genes can be incorporated into the tree genome and expressed in vivo.

Three unstable forms (units, rods, and fibrils) of cerato-ulmin in cell-free culture filtrates of *O. ulmi* as observed under the microscope

Former research includes: 1) the isolation and characterization of the toxin (cerato-ulmin) produced by Dutch elm disease (*Ophiostoma ulmi* (Buisman) Nannf.); 2) the isolation and characterization of a novel spore-deficient mutant that causes no Dutch elm disease; 3) characterization of cytoplasmic polyhedrosis virus, a double stranded-RNA virus that infects major forest pests such as spruce budworm *Choristoneura fumiferana*, whitemarked tussock moth *Orgyia leucostigma*, and forest tent catepillar, *Malacosoma disstria*, through the development of innovative techniques for a) purifying both free and occluded virus particles, b) separating virus specific single stranded-RNA from viral double stranded-RNA, c) determining the synthesis of double stranded-RNA in infected cells; and, 4) monitoring very low levels of cytoplasmic polyhedrosis virus infection within populations of naturally infected insects using radiotracer
technology.

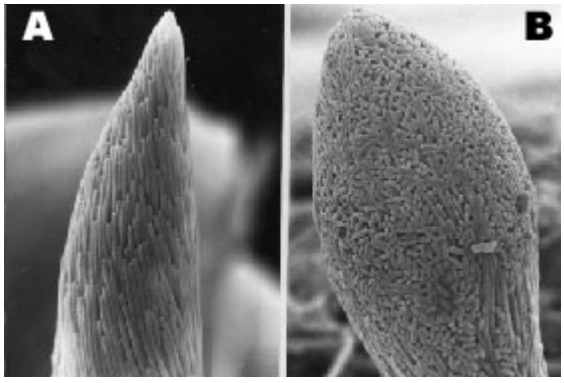
LOCATION/SITE:

Research under this study has mainly been carried out in the laboratory.

RESULTS AND CONCLUSIONS:

Mycoparasitic and antagonistic fungi have been studied to develop a biological alternative or complement to pesticides for the control of fungal pathogens. The plant defence system against microbial pathogens may be modified to produce high constitutive levels of antimicrobial compounds. Chitinases from biocontrol fungi such as *Trichoderma harzianum* and from actinomycetes such as *Streptomyces albidoflavus* are clearly an improvement over plant chitinases. The transgenic use of these chitinase genes should produce a high level of resistance in plants against a variety of forest pests (fungi and insects).

Cerato-ulmin is indisputably involved in the early stages of the development of Dutch elm disease, and findings indicate pathotoxic features that suggest that the toxin is a metabolite specific to *O. ulmi*. For many of our forest pathogens, such as Dutch elm disease, the spore stage accounts for the rapid spread of the disease. The genetics responsible for conidiospore deficiency have been elucidated and have linked



Scanning electron micrographs of synnema formed on white elm wood chips. Displayed are the nonsporulating isolate WBR2-1 (A) and the sporulating isolate A1 (B)

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this unique characteristic to the control of a single nuclear gene, thereby providing methods to control the spread of major disease(s) by blocking a pathogen's ability to produce spores. The radiotracer monitoring technique developed has been implemented into the insect quarantine rearing procedures as an early diagnostic tool to monitor larvae for potential cytoplasmic polyhedrosis virus contamination/carryover from egg masses.

MANAGEMENT INTERPRETATIONS:

With regards to current work under this study, characterizing chitinases produced by microbes will open up new areas upon which to focus our strategies for pest control, whether fungal or insect. This approach has the potential to lead to the development of target specific and environmentally safe biological control methods.

SOURCES OF RELEVANT INFORMATION:

Richards W.C. 1997. Novel spore deficient mutants of the dimorphic fungal plant pathogen, *Ophiostoma ulmi*. Crop Health Unlimited Horizons. CPS/APS joint meeting, July 6-7/97. Winnipeg Manitoba. Phytopathology, Vol. 88 No. 9(supplement) S113.

Richards, W.C. 1994. Cerato-Ulmin: A wilt toxin of Dutch Elm disease. Natural Resources Canada, Canadian Forest Service - Great Lakes Forestry Centre, Information Report 0-X-432.

Richards, W.C. 1994. Nonsporulation in the Dutch Elm Disease fungus *Ophiostoma ulmi*: Evidence for control by a single nuclear gene. Can. J. Botany 72: 461-467.

Richards, W.C. 1994. An enzyme system for liberating viable protoplasts from the yeast (spore) and mycelial states of the dimorphic fungus, *Ophiostoma ulmi*, (Buism) Nannf. Physiological and Molecular Plant Pathology 44: 311-319.

Richards, W.C. 1993. Cerato-Ulmin: A unique wilt toxin of instrumental significance in the development of Dutch Elm disease. pp. 89-151 In: M. Sticklen and J. Sherald, eds. Dutch Elm Disease Research: Molecular and Cellular Approaches. Springer Verlag, New York.

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