Bark beetle carries devastating Dutch elm disease fungus among elm trees.

SAVE THE ELMS

New strategies for fighting fungus and beetles finally may counter Dutch elm disease

BY JULIE ANN MILLER

Like the tiny mouse in the fable who saved a mighty lion from a net trap, so a lowly bacterium may come to the rescue of the stately American elm tree. During the past 60 years Dutch elm disease has ravaged the foliage of many U.S. cities, and disease-resistant varieties of elm are being sought to replace the fallen trees. But millions of elm trees still shade our cities, and scientists remain hopeful that we can save many of those beautiful old trees.

A promising discovery in the search for a defense against Dutch elm disease centers on a bacterium normally found on leaves of wheat, barley and oats. This microorganism can defeat the fungus responsible for Dutch elm disease and thereby may both prevent the disease in healthy trees and in those trees already infected.

"We need to find an organism that could be put in a tree and allowed to colonize it and change the microflora of the tree," explains Gary Strobel, a plant pathologist at Montana State University. Although not many organisms can kill fungi, one group of plant-associated bacteria were known to be antagonistic, Strobel says. He and Don F. Myers screened a large number of those bacteria — called pseudomonads — in the search for a strong opponent to the Dutch elm disease fungus. They found several worthy antagonists, which produce fungus-killing antibiotics when grown on an extract of elm.

Once the biologists found bacteria that oppose the fungus in laboratory dishes, they moved on to greenhouse-grown trees and found that the bacteria, after being injected, take up residence in the trees without doing any damage. The bacteria are still residing in the trees three seasons later.

But many things that work in the greenhouse do not work in free-living trees, Strobel cautions. So the next step was to take the bacteria out to the field — the streets, parks and forests. Across the country a thousand trees — some free of Dutch elm disease and some already infected with the fungus — are being treated experimentally with the bacteria.

Preliminary data on thirty infected trees injected with bacteria last season are encouraging, Strobel says. In 70 percent of the trees treated, the progress of Dutch elm disease was halted. But in each untreated control tree the disease spread unrelentingly.

The fungus (*Ceratocystis ulmi*) does its damage by triggering an elm's antitoxin response, which blocks water movement in the vascular system and eventually kills the tree. The bacteria seem to work therapeutically by halting the spread of fungus and allowing the tree to grow around its wound. "The elm in most cases is given a chance to outgrow the fungus," Stroble says.

Marketing of the bacteria is already being considered by the Ortho garden products company, according to Strobel. Bacteria grown in large vats would be freeze-dried, and the customer would add water before injecting the bacteria into a tree.

An advantage over fungicides now in use would be that one injection might protect indefinitely. Repeated injections, which are necessary with the benamyl salt derivatives now used, weaken a tree. In addition, current fungicides can only limit fungus growth; they do not kill the fungus when used at a concentration safe for the tree.

Bark beetles are the target of other elm protection research. The pinhead-size beetles, *Scolytus multistriatus,* carry the fungus from tree to tree. Massive use of DDT to kill the beetles was an early form of protection, but it had adverse effects on the bird populations. A less hazardous insecticide, methoxychlor, is currently in use but more subtle weapons against the beetles are now being sought, such as use of synthetic sex attractants.

Courtship behavior of the beetles has been recorded extensively by University of California entomologist Pavel Svihra and photographer Jack Kelly Clark, who have observed 200 samples of beetle breeding. In half the cases the male courted a female ensconced in a feeding cavity dug into the crotch of an elm twig. In the other cases the female courted a male who was in the cavity, pushing him out and taking his place before they mate.

Previously scientists believed that bark beetle copulation occurs only in dead elm wood, where females excavate egg galleries. Svihra and Clark, however, now have shown that beetle mating is also associated with feeding in living elm tissue. They say, "These observations may influence further studies to identify the chemical messages used by *S. multistriatus* in feeding, mating and egg-laying and may lead to new control strategies." □