Trees That Talk

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When trees talk to each other, they apparently don't just stand around idly shooting the breeze. There is growing scientific evidence that, far from being helpless giants, trees engage in active, organized warfare against ravenous insects and microorganisms. When they communicate, their conversations invariably center on defensive strategy.

Such recent findings refute the deep-rooted belief that trees and other plants are passing beings. For centuries, man assumed that plants were at the mercy of Mother Nature and subject to the whims of the weather, predatory birds and parasites that served to limit the pest population. Although it is true that trees can't run away from their enemies, they aren't helpless victims of insects and other creatures that can freely munch away at them, either.

Field studies conducted at several universities reveal that trees have a kind of neighborhood alert system to warn each other of impending danger. **Dr. David Rhoades**, an organic chemist, and zoologist at the University of Washington in Seattle, was the first to present documented evidence that trees "talk."

"Plant communication was somewhat of a serendipitous discovery," Rhoades admits. "In the last 10 years or so, evidence has been building to support the observation that plants produce defensive chemicals in their leaves that increase in direct response to an insect infestation. In 1979, I was studying what happens to willow trees when attacked by tent caterpillars. What we started to find was that not only were attacked trees responding defensively, so were unattacked trees. We got the idea that some sort of communication was going on here and did additional experiments."

In the initial study, Rhoades paired willow trees into two groups, one for experiment and another control group situated nearby. He infested the experimental trees with tent caterpillars and left the other willows alone. Two week later, he removed leaves from both the experimental and control trees and fed them to caterpillar larvae in the laboratory. As suspected, the larvae eating leaves from the test trees showed slower growth, indicating the leaves were emitting unappetizing chemicals. But to Rhoades' surprise, larvae dining on the unattacked control leaves developed more slowly, too.

Since the study was conducted with strictest controls, Rhoades wondered whether the attacked trees were somehow warning the neighboring willows to arm themselves by broadcasting monoterpenes, organic chemicals in a vapor state. Either that, Rhoades concluded, or the control trees were detecting pheromones, chemicals secreted by the caterpillars to attract other insects.

To confirm his theory, Rhoades repeated the study, only this time adding a third control group located several miles away from the test site. Again the larvae feeding on the leaves from both the test and nearby control trees grew at a retarded rate, while those fed leaves from the distant controls grew normally. It was obvious that the neighboring trees had mobilized their defenses.

Meanwhile scientists elsewhere were producing evidence that corroborated Rhoades' earlier findings.

At Dartmouth College in Hanover, New Hampshire, **Jack Schultz**, an entomologist, and **Ian Baldwin**, a biologist, have been working with sugar maple and poplar in a controlled, indoor environment. Instead of subjecting the trees to an insect attack, they mechanically ripped the leaves of test trees, leaving the control group in the same chamber and another control in another chamber unharmed. A later analysis of the leaves showed that the test group, along with the nearby controls, developed phenolics, noxious compounds disliked by insects. Leaves from the trees in the other room showed no change. Whatever communication went on appeared to be trunk-to-trunk and not through telepathy.

In an article in *Mosaic*, a journal of the National Science Foundation (March/April 1983), Schultz speculates that trees not only signal each other, but leaves on a single tree play a cunning strategy game with predators. Schultz says that by varying chemical compounds from leaf to leaf, trees engage the feeding insect in a deadly "shell game." The catepillar is forced to roam about the tree trying to guess which leaves are nourishing and which are noxious, and in doing so, it becomes more conspicuous to hungry birds. The tactic also serves to hamper the development of the caterpillar since it can't comfortably browse in one spot.

Schultz also notes that catepillars rarely eat a leaf entirely and wonders whether this half-finished meal is the result of a swift and unsavory chemical change in the leaf. Schultz has been conducting tests on these theories.

All these experiments are leading to the conclusion that trees aren't as defenseless as they appear. They have developed a sophisticated chemical arsenal that could make any worm buggy. Some trees give insects indigestion by clogging their systems with gluey tannins, lignins and phenols. At other times, trees concoct phoney amino acids to trick insects into eating defective protein that will stunt their growth. And hypersensitive plant cells have been shown to commit "sacrificial suicide" to set off the chain reaction that starts production of defensive chemicals.

This coordinated activity does not seem farfetched to Rhoades. "There's lots of visible synchronized behavior in plants," he says. "Plants often flower and fruit together. It makes sense that this synchronization involves some communication. It's possible they communicate about other things as well."

Rhoades also points out that synchronized fruiting may be a protective act, whereby the plants saturate the predator with goodies. While a few plants may succumb to the insect banquet, the group itself is able to survive.

One may ask, however, if plants are so smart, why do they fall prey to insect outbreaks? "It takes a while for plants to get it together to defend themselves," Rhoades explains. "Once they get organized, the insects usually move on." Rhoades speculates that trees appear to acquire short-term immunity from insect predators, such as spruce budworms and larch budmoths. Once the immunity wears off, the trees become vulnerable again to insect invasions. This possibly explains why regional insect outbreaks happen at regular intervals.

This research hold intriguing possibilities for forest management. "One practical application would be to turn the trees on before the outbreak so we can prevent damage," Rhoades says. "One way would be to release these defensive gases in trace quantities to mobilize trees into action."