Botany

Nature's remedy for stressed-out plants

Studies of the wispy little field plant *Arabidopsis* reveal that many organisms may have found a common way to cope with stress, beginning eons ago with their earliest ancestors.

Stresses such as heat, drying, and even exposure to alcohol can damage cells by interfering with essential proteins that catalyze reactions or give cells structure. The proteins may get distorted, or they may aggregate in useless clumps.

For almost a decade, scientists have known how animal and bacterial cells cope. They generate hardy molecules called heat shock proteins that not only resist stress but also can rescue their susceptible protein brethren. At the first sign of high temperature, for example, the genes for heat shock proteins turn on, churning out the protective molecules until the stress subsides.

Heat shock proteins appear to work by binding to distorted proteins, straining chemical bonds until they break. The bonds then form correctly.

Until recently, no one knew whether plants had heat shock proteins. But a University of Chicago research team studying a heat shock protein in yeast also found such a protein in *Arabidopsis*. "We've found heat shock proteins in every plant type we've tested," says lead researcher Susan Lindquist.

"Organisms often have to cope quickly with changes in their environment," she says. "It looks like this solution arose early in evolution." Today, both primitive and recently evolved organisms use heat shock proteins.

The team found that *Arabidopsis* produces the helpful proteins in large amounts in seeds during their maturation, with peak production in the older, dry seeds. The proteins disappear, the researchers say, when the plant germinates.

In work presented this month at the annual meeting of the American Society for Cell Biology in Washington, D.C., Lindquist speculated that "dryness could cause seed proteins to aggregate." Heat shock proteins could insulate seeds against such effects, she says.

Because the team has found that heat shock proteins generated in too-warm leaves differ from those in drying seeds or in watered roots, Lindquist concludes that "different types of protein may appear for different types of stress."

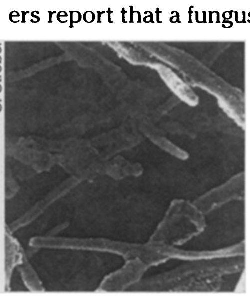
Rarest U. S. tree under fungus attack

The stinking yew, or, as it's more gracefully named, the Florida torreya, is the rarest tree species in North America. The conifer grows only in ravines along a short stretch of the Apalachicola River between Florida and Georgia.

The torreya is in trouble, however, for reasons that have nothing to do with the evil odor that its needles release. Since the late 1950s, the trees have been dying in large numbers, but until recently, the cause of death puzzled researchers. The 1,500 or so trees that remain qualify as an endangered species.

As one of the few close relatives of the Pacific yew, which produces the potent anticancer drug taxol, "the torreya's extinction would be especially regrettable," writes plant biologist Jon Clardy of Cornell University.

In the November 1995 CHEMISTRY AND BIOLOGY, Clardy and others report that a fungus, *Pestalotiopsis microspora,* is probably destroying the tree. Though virtually all plants contain fungi, the usually harmless or even beneficial relationship can sometimes become parasitic. The authors speculate that changes in forestry practices may have made this rarest tree vulnerable to attack.


S. Strobel

Spores of the fungus P. microspora, *which invades torreya trees.*

Technology

A walk on the wild side

In the wilds of Central America, laced with rivers and streams, the agile, whip-shaped basilisk shows why it has earned the nickname Jesus Christ lizard.

It runs on water.

Upright on two legs, the 90-gram lizard can skip briskly on fringed toes across the surface of a river. Until now, scientists had not understood how these creatures support their body weight on the water, says Thomas A. McMahon, a biomechanist at Harvard University.

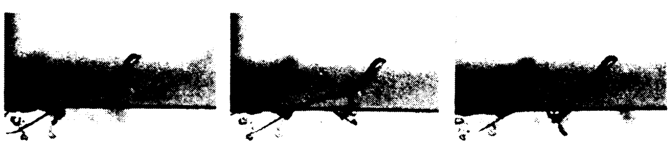
Motivated by a long-standing interest in running, McMahon and James W. Glasheen, also of Harvard, propose in an upcoming issue of NATURE a hydrodynamic model to explain how the basilisk accomplishes this feat.

After studying *Basiliscus basiliscus* plucked from the jungles of Costa Rica, the researchers found that most of the lizard's support comes from a well-timed foot stroke. With each step, the basilisk slaps the water and strokes its foot down, creating an air-filled cavity, then moves into the next step.

"I've been interested for many years in the mechanics of walking and running, in four-legged animals as well as two-legged ones," says McMahon. "We want to know how the basic physics of walking and running shapes performance. If you change a physical parameter, such as an animal's size or the length of its leg, or the strength of gravity, how do those changes affect performance?"

"It sounds strange to ask these questions about animals," he adds, "even though engineers ask them all the time about machines."

McMahon's team has devised mathematical models to integrate various parameters of walking and running, enabling them to predict how motion changes when, for example, a runner carries extra weight, chugs up an incline, or traverses an unusual surface.


Glasheen

B. basiliscus, *the Jesus Christ lizard.*

The models have helped the engineers grasp the biomechanics of legged locomotion in a wide range of animals, "improving our engineering sense of how animals work," he says. For instance, the models show that animal legs work like springs, maintaining a uniform response to applied forces, no matter how fast the animal runs.

"This came as a surprise," he says. "Neurophysiologists now want to understand how muscles and nerves collaborate to produce springlike legs."

To test the models, the team had people run on treadmills while suspended from the ceiling to simulate low gravity—and even to run on their hands while lying prone on a horizontal support. The latter, for instance, showed that jogging on one's hands eats up four to five times as much energy as equivalent motion via legs.

In low-gravity experiments, McMahon and his colleagues Rodger Kram and Claire Farley of the University of California, Berkeley found that the rate of energy consumption changes in proportion to apparent body weight during both running and walking but changes less during walking. A simulated gravity reduction of 75 percent caused energy consumption to drop 72 percent during running but only 33 percent during walking.

"Because reducing gravity decreases the energetic cost much more for running than for walking," the team concluded, "walking is not the cheapest way to travel a mile at low gravity."