

From 17 to 23 August, 17,250 biologists from 25 countries gathered in Halifax, Nova Scotia, to talk about plant, animal, and microbial partnerships.

## Fungi Shield New Host Plants From Heat and Drought

Could watermelons grow in the steamy environs of the geyser Old Faithful? Or wheat thrive in the hot, dry desert? These crops don't usually survive such hostile conditions, but with help from some microscopic sidekicks, they just might one day. By transplanting symbiotic fungi from drought-tolerant or heat-tolerant plants into crops, researchers have turned wimpy species into hardy ones. The find could expand the range of valuable food crops into currently uncultivable areas.

Researchers typically think poorly of endophytes, fungi that live their entire lives within plants. Many are pathogens, and plant pathologists are working out how to prevent or get rid of infections. But geneticist Regina Redman and microbiologist Russell Rodriguez of the U.S. Geological Survey in Seattle, Wash-

isolated fungi are also overcome by the heat, suggesting that it takes two—the fungi and the host—to deal with the stressful environment, Rodriguez said at the meeting. Other research has indicated that fungi help these plants ward off invading pathogens. With fungi, plants mount a defense response within 24 hours; plants not harboring the endophytes take 3 days longer.

Now Redman, Rodriguez, and Joan Henson, a microbiologist at Montana State University, Bozeman, have demonstrated that these same fungi can protect other plants as well. They put fungal spores on watermelon, tomato, wheat, and other seedlings. The researchers then compared the stamina of infected and uninfected individuals in places with high heat or no water—environments where they wouldn't typically survive.

The food plants became much more tolerant of harsh conditions, the researchers reported at the meeting. Watermelon and tomatoes whose roots would barely



**Hot stuff.** Fungi living inside this grass make life near thermal springs, where soils can be 60°C, tolerable.

ington, have gotten fungi to take up residence in new plant hosts. They now show that fungi “can have big impacts in adapting the plant to particular environments,” says James White, a plant pathologist at Rutgers University in New Brunswick, New Jersey. Furthermore, the researchers are “demonstrating that these [fungi] can be quite useful.”

Redman and Rodriguez and their colleagues first reported benefits from fungi-plant alliances last year. They studied a perennial grass that grows in hot soils around geysers. In the lab, they grew some grass that lacked the normal complement of fungi and others that had it, then exposed both groups to hot soils. Only the plants with fungi survived (*Science*, 22 November 2002, p. 1581).

Their subsequent work has shown that

withstand 38°C did fine at 50°C. And if the researchers let them cool off at night, some of the plants survived in up to 70°C in the day. The results “blew me away,” comments David Garbary, a plant evolutionary biologist at St. Francis Xavier University in Antigonish, Nova Scotia.

Wheat still suffered in the heat but improved its ability to make it through a drought. Uninfected wheat succumbed within 10 dry days; wheat carrying the fungi lasted 18 without water, Rodriguez reported. And the improvement in the plants' disease resistance was equally promising. “The degree of stress tolerance [endophytes] could confer was a surprise,” says Daniel Panaccione, a plant pathologist at West Virginia University in Morgantown.

White, Panaccione, and others hope that these experiments will eventually improve agriculture. “It would be very interesting if one

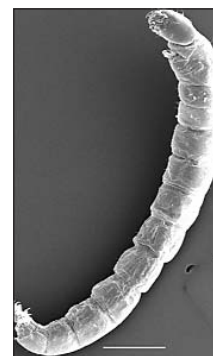
could put thermotolerance into crops,” says White. But he and others caution that the work needs to be repeated and extended to field studies. At the very least, Panaccione says, the new find shows that interactions between fungi and plants have “greater ecological significance than [we] previously thought.”

## Scurrying Larvae Join Seaweed Society

Walk almost anywhere along a North Atlantic rocky shore at low tide, and you may trip over a clump of brown seaweed called *Ascophyllum*, or knotted wrack. The plants host an unusual partnership. Larvae of a tiny insect populate the plant's inner sanctums, David Garbary, a plant evolutionary biologist at St. Francis Xavier University in Antigonish, Nova Scotia, reported at the meeting. He and his colleagues calculate that in terms of biomass, this is likely one of the most abundant marine insects ever described. Yet it's “essentially unknown,” he pointed out: Only two previous reports from Canada are on file.

Knotted wrack plants live a half-century, and their fronds can last 20 years. That's plenty of time to build up a large community. A small brown alga called *Elachista fucicola* and a red seaweed typically grow on *Ascophyllum* fronds. A fungus whose threads are tightly entwined with *Ascophyllum* cells seems to promote the seaweed's growth, at least in the lab. And diatoms munch their way up and down *Elachista*.

Garbary's newfound insect sits atop the chain of command: It eats the diatoms. Upon finding the first specimens 2 years ago, “we were shocked” by their existence, Garbary recalls. Zoology colleagues at St. Francis informed him he had insect larvae. Collaborator Peter Cranston, an entomologist at the University of California, Davis, determined that the larvae belonged to a mosquito-sized marine fly called *Halocladius variabilis*.



**Seaweed stowaway.** The marine fly larva creeps along seaweed munching on diatoms.