Germplasm

Insurance for the Future That Pays Current Dividends

During the Irish potato famine of the mid-1800s, late blight—caused by the fungus *Phytophthora infestans*—led to the deaths of about 1 million people, and a further million emigrated as a result of the famine. The potato, a food staple in Ireland, simply had no resistance to the disease.

In 1992, when new, more virulent strains of *P. infestans* appeared in the United States, potatoes were still just as vulnerable.

The best defense to late blight has come from a wild potato relative, *Solanum pinnatisectum,* collected in central Mexico, which has genetic resistance to the disease. ARS scientists bred *S. pinnatisectum's* resistance into a new commercial potato named "Defender," the first processing variety with both foliar and tuber resistance to late blight, including resistance to the newer isolates of the fungus. Defender was released in 2005.

That wild potato relative originated from a sample, or accession, in ARS's National Plant Germplasm System (NPGS), which includes germplasm collections of agronomically important plants and their relatives.

The NPGS comprises working collections around the country, each of which concentrates on specific types of plants, plus the National Center for Genetic Resources Preservation (NCGRP) in Fort Collins, Colorado, where plant germplasm is kept in long-term cryogenic storage.

"The National Plant Germplasm System is our stockroom for tools to deal with problems like a pathogen mutating or when a new pest makes it into the United States," says David Ellis, a curator and plant physiologist at NCGRP. "Then researchers from all over turn to our germplasm collections to find the building blocks—the genes they need to breed a solution to the new problem."

When the Russian wheat aphid spread to the United States in 1986, all commercial wheat was susceptible to it. More than 30,000 wheat and 24,000 barley accessions, mostly from the ARS National Small Grains Collection in Aberdeen, Idaho, were screened for resistance to this insect that has cost American wheat and barley farmers billions of dollars in losses.

ARS researchers identified more than 300 resistant wheat germplasm accessions and 40 promising barley lines as potential sources of resistance genes. Breeders began a crash program using this germplasm to develop new varieties, and the crisis was averted.

PEGGY BAIN (D132-1)

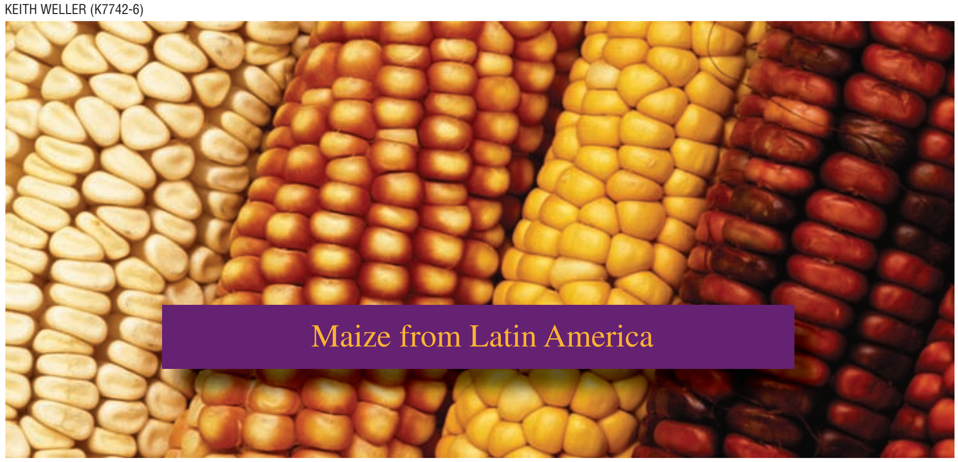
Defender is the only U.S. commercial potato with late-blight-resistant leaves and tubers.

"You never know what problem we will have to face at any time. The staggering increase in global commerce alone means more spread of diseases, weeds, and pests. Having a resource like the germplasm collections already in place is our security that we will be able to react quickly when we are confronted with a new problem," says Ellis.

Germplasm collection and preservation are not actions that can wait until new genes are needed. Global climate change, loss of habitats, the spread of monoculture cropping, and even war and political instability threaten genetic variation in agriculture and in the wild. Pathogens and pests continue to evolve. So protecting as wide an array of crop varieties and their wild relatives as possible is the best insurance policy for the present and for the future. It is impossible to tell ahead of time just what genes a plant may offer that may one day be needed.

There is, for example, the scraggily wheat that USDA plant explorer Jack R. Harlan and his Turkish colleague Osman Tosun collected from a field in Fakiyan Semdinli, Turkey, in 1948. At the time the sample was taken, the wheat looked terrible—it lodged, had no winter hardi-

KEITH WELLER (K7742-6)



Unusually colored and shaped maize from Latin America. Exotic corn, like this, and domestic corn are preserved in ARS's National Plant Germplasm System, providing a reservoir of genetic diversity on which breeders can call if a pathogen, pest, or other problem threatens a crop.

ness, and was susceptible to leaf rust. By itself, "it was a hopelessly useless wheat but was dutifully conserved," Harlan wrote of the wheat that was placed in the National Small Grains Collection simply as plant introduction (PI) number 178383.

But 15 years later, when U.S. wheat breeders were looking for a way to breed resistance to a new stripe rust outbreak, PI 178383 was found to have resistance to 4 races of stripe rust, 35 races of common bunt, and 10 races of dwarf bunt—as well as tolerance to flag smut and snow mold. Today, PI 178383 appears in the pedigree of virtually all wheat grown in the Pacific Northwest.

Breeders turn to the germplasm collections not just to solve disease and pest problems, but also to expand drought and temperature tolerance, adapt plants to new growing conditions, and make them more productive, nutritious, durable, or simply better tasting.

Nor does ARS maintain its germplasm collections just for the United States's agricultural security and progress.

"The NPGS distributed more than 172,000 plant samples worldwide in 2007," says Ellis. "They went to breeders and researchers and will contribute to development of crops we will need or want. Genetic resources like those from ARS's National Plant Germplasm System are simply the foundation of our agricultural future."—By **J. Kim Kaplan,** ARS.

The National Plant Germplasm System plays a role in many of ARS's national research programs, described on the World Wide Web at www.nps.ars.usda.gov.

David Ellis is with the USDA-ARS National Center for Genetic Resources Preservation, 1111 S. Mason St., Fort Collins, CO 80523-4500; phone (970) 495-3227, fax (970) 221-1427, e-mail david.ellis@ars.usda.gov. ✷

STEPHEN AUSMUS (K10189-9)

At the National Center for Genetic Resources Preservation in Fort Collins, Colorado, plant physiologist Loren Wiesner (right) and technician Bill Prange retrieve seed samples from a –18°C (0°F) storage vault for distribution to sites for cultivar development or study.

Safeguarding Our Crops

In Griffin, Georgia, the Agricultural Research Service houses the Plant Genetic Resources Conservation Research Unit, led by Gary Pederson. The unit, part of the National Plant Germplasm System (NPGS), is a gold mine of plant species with more than 88,000 plant accessions in stock. It also serves as an invaluable resource for researchers who are developing new cultivars for farmers facing tough growing conditions. More than 30,000 free samples are sent out each year.

Alterations in climate, insect pests, and water supply, among other factors, affect viability and profitability of crops. But ARS safeguards the continued abundance of crops by taking a long-range view of crop production. Scientists at Griffin and other ARS locations are the keepers of plant germplasm. They are tasked with safeguarding samples of all crops of agricultural importance in the southeastern United States and providing seed stock to researchers and educators anywhere in the world.

Trips are also conducted to find new varieties to add to the collection. For instance, watermelon accessions previously collected from Egypt, India, Iran, Serbia, and Zambia were reported in 2007 that have resistance to broad mite. This pest is not currently found in the United States, but it could become a problem in the future.

Even samples collected decades ago may be sources of disease resistance. One such peanut accession, known as PI 203396, was collected in a Brazilian market in 1952 and is currently the source of resistance to tomato spotted wilt virus (TSWV) in most of the peanut cultivars grown in the southeastern United States. TSWV is a major peanut disease.

The unit boasts one of the most varied collections of any ARS laboratory in the NPGS. It includes peanuts, legumes, sweetpotatoes, peppers, squash, annual clover, eggplant, and sorghum, to name a few.—By **Sharon Durham,** ARS.

PEGGY GREB (K10460-1)

Genetic variability in seed color and size in cultivated peanut accessions maintained at Griffin, Georgia.