A focus at Ames

Helping Corn Face Tomorrow's Challenges

KEITH WELLER (K7746-15)

ARS plant pathologist Marty Carson (right) and maize geneticist/ breeder Major Goodman (NCSU) inspect different maize varieties for resistance to southern leaf blight infection.

The future of U.S. corn has been long in the making at Agricultural Research Service units in Ames, Iowa.

The past quarter century has seen scientists there drive two landmark programs aimed at preparing corn—maize—for a tomorrow that now seems destined to involve energy as well as food production.

These programs—the Latin American Maize Project (LAMP) and the Germplasm Enhancement of Maize Project (GEM)—have helped produce scores of unique corn varieties that can be bred to help farmers maintain profits as they combat blights and pests.

Plant geneticist Linda Pollak of ARS's Corn Insects and Crop Genetics Research Unit has been involved with both programs, serving as GEM's first and founding coordinator during the 1990s. Now she's spearheading another initiative: Breeding High-Quality Corn for Sustainable, Low-Input Farming Systems, or HQ-LIFS.

Low Nutrient Input

"My focus now is on providing smaller scale maize producers with plants containing specific traits that will soon be in high demand," she says. "Crucial are varieties for feed and specialty markets that can be grown using small amounts of fertilizers. Varieties that meet these market needs will allow small family farms and seed producers to remain independent and profitable."

Pollak says programs such as these are important because consolidation in the seed industry has decreased diversity and stock choice for small seed companies.

Pollak explains that HQ-LIFS is novel because of its goal: boosting corn's nutritional content while making it more compatible with sustainable farming systems. "Specifically, we're selecting for responses to two factors: slowly available forms of nitrogen and weed pressure."

Because some states regulate use of nitrogen fertilizers, all growers could benefit from corn varieties that yield well with slowly available nitrogen sources, such as organic manures, or with lower amounts of applied fertilizer. "It's time to start selecting corn that yields well under such environments," says Pollak.

Also, she says, recent hybrid breeding efforts have not focused much on nutrient content, such as high levels of carotenoids and vitamin E or enhanced protein quality. "We also need more corn varieties that depend less on herbicides. Especially helpful would be corn that naturally establishes an early competitive edge over weeds."

Pollak says new varieties from the 3-year-old program can also contribute traits required for reliable production under alternative farming systems, such as organic farming. "We're breeding specialty varieties, too—blue corn, white corn, high-methionine corn for organic poultry producers, and corn with slowly digestible starch for native and ethnic foods—that will provide new market possibilities."

Collaborating with ARS in HQ-LIFS are Iowa State University's Corn Breeding Project in Ames; the Michael Fields Agricultural Institute in East Troy, Wisconsin; and the Practical Farmers of Iowa, for on-farm testing.

Pollak wants to form groups involving farmers, seed companies, and processors to grow, test, and evaluate varieties resulting from the program.

A GEM of a Project

Meanwhile, GEM remains a significant force in research and development of corn's genetic resources, or germplasm. Launched in 1994—with support from plant pathologist Marty Carson at ARS's Plant Science Research Unit in Raleigh, North Carolina, and other collaborators—GEM has released 135 lines to cooperators over the past 5 years.

The project is currently administered by ARS's North Central Regional Plant Introduction Research Unit in Ames and by the Raleigh unit, now led by plant pathologist David Marshall.

"GEM's mission is to increase the diversity of U.S. maize germplasm by providing an array of useful genetic material that contains superior traits for human and animal consumption, crop protection, and bioenergy and industrial uses," says Michael Blanco, the plant geneticist who now directs the Ames part of the project.

"It's a collaboration involving universities, private industry, and international and nongovernmental organizations."

The germplasm collection—gained from exotic sources—holds key characteristics such as agronomic adaptability; abiotic stress tolerance; resistance to mycotoxins, diseases, and insects; value-added traits; and superior silage yield and quality.

The most recent releases, which are all publicly available, represent about 20 races of maize, Blanco adds. "Within them, you'll see resistance to threats such as *Fusarium* ear rot, anthracnose stalk rot, and corn rootworm."

He explains that Ames's GEM studies focus on germplasm adapted for the Midwest, while Raleigh scientists concentrate on later-maturing germplasm adapted for the southern Corn Belt and Southeast.

Built on Past Success

The germplasm initially used in GEM was identified during LAMP, an ARS-administered, multinational program financed by Pioneer Hi-Bred International of Des Moines, Iowa, and launched during the 1980s.

LAMP focused on Central America and South America because modern corn was originally domesticated there, and the region still contains wild relatives of U.S. corn with potentially useful genetic traits. Of more than 12,000 Latin American and U.S. corn varieties evaluated under LAMP, 260 accessions were chosen for development.

"GEM's original focus included breeding crosses made with the top 51 picks from LAMP," says Blanco. "But we've expanded the germplasm base significantly with additions from Thailand, Mexico, and Brazil, and improved exotic lines and superior tropical hybrids donated by public and private cooperators."

NUO SHEN (D818-1)

Geneticist Mike Blanco pollinates tropical exotic maize as a first step in breeding corn with improved disease resistance, nutritional quality, and bioenergy potential.

The germplasm GEM uses at Ames is about 25 percent exotic tropical and 75 percent temperate, while Raleigh's is about 50 percent tropical, Blanco says. "Materials from tropical breeding crosses have been excellent sources of resistance to *Fusarium,* gray leaf spot, and southern rust and of value-added traits such as unique starch properties, high protein and oil content, and silage quality. The diversity of these materials may enhance our abilities to support bioenergy and other biobased products."

Since its inception, GEM has spurred release of more than 1,000 sources of germplasm to cooperators who develop them further within their own breeding programs.—By **Luis Pons,** formerly with ARS.

This research is part of Plant Genetic Resources, Genomics, and Genetic Improvement (#301) and Agricultural System Competitiveness and Sustainability (#216), two ARS national programs described on the World Wide Web at www.nps.ars.usda.gov.

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