Tempering Beans' Reaction to Heat

Geneticist Timothy Porch is out to beat the heat.

Working from ARS's Tropical Agriculture Research Station at Mayagüez, Puerto Rico, Porch is trying to reduce the impact of heat stress in common beans *(Phaseolus vulgaris)* grown in the continental United States—by breeding for heat tolerance.

He says that average temperatures exceeding 86°F in the day and 68°F at night can impede common beans' reproductive development and that this translates into smaller potential yields during hot summers.

Common beans are a key nutritional and economic crop whose market classes include pinto, kidney, navy, red, black, and snap. U.S. dry beans are grown mostly in the north-central and western regions of the country. North Dakota and Michigan are the biggest producers.

Most common beans are adapted to relatively cool climates. But Porch is trying to equip U.S. beans with high-temperature adaptation and other traits such as drought tolerance and disease resistance.

"An important limitation is the narrow genetic diversity that's available," he says. "U.S. breeding programs use less than 5 percent of available *Phaseolus* germplasm. New diseases, climate change, limited inputs, and market competition are all reasons to diversify the U.S. bean germplasm base."

Porch says that germplasm from the Tropics is the key to introducing the protective traits U.S. producers need. "It harbors the vast majority of beans' genetic diversity," he says. "Tropical beans are often sensitive to the long photoperiods in the continental United States, so conversion must also involve introduction of photoperiod insensitivity through crossing and selection."

Ultimately, Porch says, converting tropical bean germplasm into U.S.-adapted types will lead to increased yields in stressful environments, lower consumer costs, and new genetic material that scientists can use for varietal development.

Vital to Porch's effort has been access to two major germplasm centers: the International Center for Tropical Agriculture (CIAT) in Cali, Colombia; and ARS's Western Regional Plant Introduction Station in Pullman, Washington.

In addition, Porch is using TILLING (Targeted Induced Local Lesions in Genomes), a technique that's based on identifying important genes in a population of mutated beans. "It's a direct and powerful approach to studying the function of important genes," he says. "Down the road, it can lead to development of new varieties with novel characteristics."

PEGGY GREB (D957-1)

Geneticist Tim Porch examines the effects of high-temperature stress on pod development in common bean.

Porch and colleagues at CIAT and the University of Geneva in Switzerland make up a TILLING consortium that has so far produced about 2,000 second-generation families of mutated BAT93, a common bean genotype. BAT93 is known for its broad adaptation and desirable characteristics, such as disease resistance.—By **Luis Pons,** formerly with ARS.

This research is part of Plant Genetic Resources, Genomics, and Genetic Improvement, an ARS National Program (#301) described on the World Wide Web at www.nps.ars.usda.gov.

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