

Tepary Beans Offer Hope for Hot, Drought Prone Areas Affected by Climate Change

Smallholder bean farmers living in hot, dry agroecological zones in Central America and Haiti have difficulty growing common bean, a staple crop critical for household food security and livelihoods. The *tepany* bean (*Phaseolus acutifolius*), a sister species of common bean grown by Native Americans for more than 5,000 years in semi-arid production systems in Mexico and the Southwest United States, has naturally evolved with resistances to drought and high temperature conditions. This underutilized bean species, which produces seeds similar in shape, color, and taste to common bean, is an alternative crop that can be grown in semi-arid areas and agricultural systems with increased prevalence of drought and high temperatures resulting from climate change.

Dr. Timothy Porch, a USDA-ARS Research Geneticist and Co-PI in a Legume Innovation Lab project led by the University of Puerto Rico (Dr. James Beaver, Lead PI) and the Escuela Agricola Panamericana–Zamorano in Honduras, is seeking to increase bean productivity in lowland (< 1000 m) bean production regions of Central America and Haiti. The strategy for addressing climate change adopted by this project is to genetically improve tepary bean for agronomic traits and yield potential

rather than to breed common bean for increased tolerances to drought and high temperatures.

Common bean is a species best adapted to agroecological zones with moderate rainfall and temperatures. By exploiting the tepary bean's natural heat and drought tolerance characteristics, Legume Innovation Lab scientists believe that this new crop will provide countless smallholder farmers in regions adversely affected by climate change with a viable means to produce bean grain.

A major constraint to bean production in Central America is viruses. *Bean common mosaic virus* (BCMV) and *bean common mosaic necrosis virus* (BCMNV) can cause up to 90% yield loss in susceptible varieties.

Dr. Porch has identified BCMV- and BCMNV-resistant tepary bean lines in the USDA-GRIN and CIAT tepary germplasm collections. New high yielding varieties of tepary bean with acceptable seed quality traits, along with virus, common bacterial blight, and weevil resistances are currently being bred.



Seed of improved tepary versus unimproved tepary (top left)

In 2013, the first improved tepary bean line was released by the Legume Innovation Lab project in collaboration with Feed the Future's USDA-ARS project, the University of Puerto Rico, and Colorado State University. This variety has larger seeds, improved disease resistances, and upright plant architecture for easier harvest, characteristics that are important to bean farmers.

"We breed beans—common and tepary—by selecting for specific traits to achieve two very different but equally important objectives," said Porch. "The first is to breed lines with increased vigor and disease-



A field planted with common bean (l) and tepary bean (rt.)

and pest-resistances, traits that contribute to high grain yield. The second is to breed for seed traits—color, size, taste, cooking time—that are important to consumers. If we don't pay attention to the seed traits, advances made in improving agronomic traits may be irrelevant. Consumers purchase and eat beans that look, cook up, and taste good. Market demand for a new bean variety is essential for a new variety to

be adopted. Plant breeders have to focus on both objectives—and we do."

As a result of USAID investments under Feed the Future, systematic breeding of tepary bean is being conducted for the first time. Advanced lines of tepary beans are currently being evaluated under field conditions in Honduras, Burkina Faso, and Puerto Rico. Future breeding efforts will utilize marker-assisted selection to accelerate the combining of genes for expanded disease resistance and desired agronomic traits.

Tepary bean provides hope to smallholder bean farmers affected by climate change both in the Americas and in Africa. Within the savanna regions of West Africa, tepary is already grown on a limited scale but sought by consumers for its flavor as a compliment to cowpea. Unfortunately, smallholder farmers in both continents don't have access yet to improved, high yielding varieties of tepary bean. With projections of expanding and more frequent drought in many regions, the tepary bean has the potential of being a game-changing technology, providing farmers with an alternative but similar and equally nutritious bean crop that will enhance their resilience to pending climate change.