Published April 5, 2016

CUBAN BEAN DIVERSITY

Study could lead to new germplam sources, markets

by Madeline Fisher

As once-icy relations between the United States and Cuba continue to thaw, tourists are flocking to the island nation in droves, but Cuba has piqued the interest of scientists for far longer. Among them is Tennessee State University plant geneticist Matthew Blair, a CSSA member whose analysis of Cuban bean diversity appears in the January–February 2016 issue of *Crop Science*.

An expert on legumes and *Phaseolus vulgaris*—the common, or dry, bean—in particular, Blair has performed similar studies in many other countries where beans are a staple food. After doing his master's research with Jim Beaver in the Dominican Republic, he went on to characterize the genetic diversity of beans in Bolivia, Brazil, Chile, Colombia, Ecuador, Mexico, Nicaragua, and Peru, as well as in Asia and Africa.

But his work in the Caribbean always felt incomplete, so when the United States and Cuba began restoring diplomatic ties, Blair thought the time was right to take another look. "We concentrated [during the project with Beaver] on a few beans from everywhere in the Caribbean—mostly from the Dominican Republic and Puerto Rico, with a few Jamaican and Haitian genotypes. But not Cuba," he says. "So I wanted to go back to that initial data and see what's going on in Cuba relative to every other country in the Caribbean."

Many Americans have heard of *Moros y Cristianos*, Cuba's signature black bean and rice dish, and not surprisingly, small black beans composed most of the 200 land races, breeding lines, and commercial varieties that Blair examined in the *Crop Science* study. Black beans are well adapted to the country's lowland and mid-elevation growing conditions, Blair explains. Plus, the climate is similar to the Yucatán Peninsula of Mexico, from which black beans were likely introduced.

At the same time, the collection he assembled with help from Sandra Lorigados at Cuba's National Institute of Agricultural Sciences included red mottled beans—both small and large seeded—along with white- and cream-colored ones, indicating that diversity has been introduced not only from the nearby Yucatán, but also from South America.

Two Distinct Gene Pools with Little Genetic Mixing

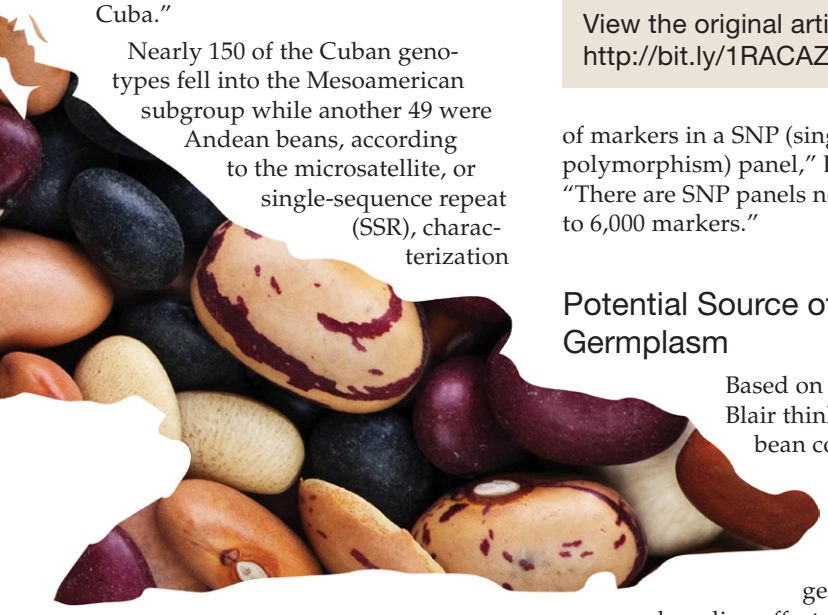
To understand the full story, it's important to know that the common bean is composed of two distinct gene pools, which resulted from the bean's two centers of domestication. Small-seeded "Mesoamerican" beans—including black, pinto, navy, and small red beans—were brought into cultivation in Central America and Mexico. Red kidney beans, cranberry beans, and other large-seeded "Andean" beans, meanwhile, were domesticated in the Andes Mountains of South America.

Both gene pools have existed in Cuba since pre-Columbian times, Blair says, with Mesoamerican beans likely being brought to the island by Taino tribes from the Yucatán—a mere 120 to 130 miles away across the Straits of Yucatán. Andean beans, on the other hand, took a longer, more circuitous route from South America. In this case, Arawak tribes, also known as Caribs, carried the beans up through the Caribbean "Arawak Arc," Blair explains, "an arc of islands, the leeward islands, that goes from Trinidad and Tobago [near Venezuela], through

doi:10.2134/csa2016-61-4-2

Puerto Rico, the Dominican Republic and Haiti, and all the way up to Cuba."

Nearly 150 of the Cuban genotypes fell into the Mesoamerican subgroup while another 49 were Andean beans, according to the microsatellite, or single-sequence repeat (SSR), characterization that Blair performed. Moreover, his analysis suggested that only one race of each genepool is present on the island, with the Andean beans falling into the race Nueva Granada.



This race typically has long, kidney-shaped seeds—exactly the shape of the Andean red mottled and large pink beans that are favored in Cuba today. And Blair suspects they may be descended from the original Andean beans brought to Cuba by Arawak tribesmen, after they stopped in Caribbean islands to the east and south, where these beans are also found.

The clear distinction between the Mesoamerican and Andean genepools agrees well with many previous SSR analyses of common bean worldwide, he adds. However, Blair was somewhat surprised to see how little genetic mixing, or introgression, has occurred between the two genepools in Cuba compared with other Latin American countries. This may indicate that the two subgroups have co-occurred on the island for fewer centuries than in places like Colombia, where hybridization is common. But more work is needed.

"To confirm [the result], it would be interesting to use a large number of markers in a SNP (single nucleotide polymorphism) panel," Blair says. "There are SNP panels now with 3,000 to 6,000 markers."

Dig Deeper

View the original article in *Crop Science* at http://bit.ly/1RACAZK

Potential Source of New Germplasm

Based on his findings, Blair thinks the Cuban bean collection could become a valuable source of new germplasm for breeding efforts around the world, particularly now that Cuba is emerging from its decades-long isolation. Cuban germplasm could, for example, offer new sources of resistance to major diseases and pests across the Caribbean. In addition, because the island's lowland growing conditions are so hot, Cuban beans not only must tolerate heat well, but also reach maturity very early—both of which could be useful traits for adapting bean plants to climate change.

But bean breeders aren't the only ones who could benefit. "Equally important are the plant selectors, who practice participatory varietal selection" in collaboration with Cuban researchers, Blair says. Cooperation among Cuban farmers, plant breeders, agricultural scientists, and "extension" agents is especially well developed in Cuba, he notes, likely because of the tradition of communal farm ownership under communism.

What's more, the exorbitant cost of pesticides and other farm chemicals during the American embargo has forced the country to make do mostly without these inputs. As a result, it's become a leader in organic agriculture, biocontrol, and other low-input practices for growing crops.

Most interesting to Blair, though, is how dietary preferences on the island intersect with his results. It's no accident, for instance, that Mesoamerican black beans dominate the country's current germplasm collections when Cubans prefer these beans so strongly as a food, he says. At the same time, the diversity of Andean beans found in his study could justify more breeding work on these beans. Such work could expand the commercial cultivars available in Cuba and help the nation—the Caribbean's most populous—become more food secure.

"Even though Cuba invests a lot in agriculture, it hasn't been self sufficient in beans. They've been importing beans," he says. "So this is something I really think Cuba could pick up on—understanding the diverse set of beans they work with."

Consumers stand to benefit, as well. "One thing that differentiates local and imported beans is the amount of time since they've been harvested and the amount of time in storage, both of which seriously affect cooking time," Blair adds. "And, of course, Cubans eat beans nearly every day, and they eat them fresh—boiled with rice—so they want fresh beans. That's why I think there's a market for more Cuban-produced beans of varying types and grain colors."

Tell Us What You Think

Rate this article and give us ideas for future articles at www.research.net/r/WTGMTN7