FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

Feed the Future Legume Innovation Lab
Advancing the Productivity Frontier

Development of Robust Molecular Markers & Genetic Improvement of Common & Tepary Beans to Increase Yield in Central America & Haiti

The Challenge

During the past 30 years, most of the growth in bean production in Central America and the Caribbean has occurred in the lowlands (less than 1000 m), especially in the more humid regions. Unfortunately, several biotic and abiotic constraints are common in these tropical lowlands, including Common Bacterial Blight (CBB), BGYMV (Bean Golden Yellow Mosaic Virus) and BCMNV (Bean Common Mosaic Necrosis Virus), which reduce potential crop yields. Further, bean production in Africa could be expanded if lines with better lowland adaptation were developed. Additionally, there are regions and growing seasons in Central America and Haiti that are too hot and dry to produce common beans.

The Project

This project will address several of the biotic and abiotic constraints often encountered by bean producers in the tropical lowlands that affect yield.

top, a field planted with common bean planted on the left and tepary bean on the right; below, common bean drying at the Damien Experiment Station.

Researcher Consuelo Estevez de Jensen showing biological nitrogen fixation (BNF) in roots of a common bean increase of DPC-40 in Gonaive, Haiti; inset, close-up of plant roots showing nodules indicating BNF.

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The recent arrival of BGYMV and BCMNV in the Caribbean and Central America make the selection for resistance to these viruses priority breeding objectives. Resistance to these diseases would also permit increased production of beans in Central America during the first growing season, when rainfall is more reliably abundant. In Guatemala, breeding efforts will focus on increasing resistance to CBB and web blight in humid lowland tropical regions.

In regions where high heat and drought is a challenge, tepary bean, a sister species of common bean grown 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 species produces seeds similar in shape, color, and taste to common bean and is an alternative crop for these regions. Tepary bean lines will be bred using interspecific crosses with common beans for improved resistance to BCMV and BGYMV, larger seed size, and other agronomic traits to increase their adoption potential.

Bean plants with (left) and without (right) leafhopper resistance.

Seed of unimproved tepary beans (*top l.*) surrounded by improved tepary beans and two groups of common beans (*bot. rt.*)

Collection of nodulation data in Tepary inoculation trial, Juana Diaz, Puerto Rico

Project Objectives

1. Genetic improvement of common and tepary beans for Central America and Haiti
2. Development and implementation of robust molecular markers for disease resistance genes
3. Strengthening the capacity of bean programs in Central America and the Caribbean to conduct research and to develop, release, and disseminate improved bean cultivars

Projected Outcomes

1. In the lowlands of Central America and the Caribbean: release and dissemination of black and small red bean cultivars with resistance to Bean Common Mosaic Virus (BCMV) and Bean Common Yellow Mosaic Virus (BGYMV) and greater tolerance to low soil fertility;
2. In the lowlands of Central America and the Caribbean: release and dissemination of black, white, and Andean bean breeding lines with resistance to bruchids, BGYMV, BCMV, and BCMNV;
3. Release and dissemination of yellow and red mottled bean lines with resistance to BGYMV, BCMNV, and BCMV;
4. Release and dissemination of lowland black and white bean breeding lines with resistance to BGYMV, BCMV, BCMNV, and rust;
5. Release of tepary bean lines with virus resistance and improved agronomic traits.

Major Achievements to Date

1. The BGYMV, BCMV, and BCMNV resistant black bean line MEN2201-64ML was released in Honduras as *Lenca Precoz*.
2. XRAV-40-4, a multiple disease resistant black bean adapted to the humid tropics, was developed and released.
3. White bean lines were released that combine resistance to BGYMV, BCMV, BCMNV, and a range of rust races.
4. An improved tepary bean, called *Tep-22*, that combines resistance to CBB, rust, and seed weevil along with tolerance to heat and drought was developed and released.

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