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

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Legume Innovation Lab

Feed the Future Legume Innovation Lab
Advancing the Productivity Frontier

Improving Genetic Yield Potential of Andean Beans with Increased Resistances to Drought, Major Foliar Diseases and Enhanced Biological Nitrogen Fixation (BNF)

The Challenge

Common bean is the most important grain legume consumed in Uganda and Zambia, providing both household income and an affordable source of protein, particularly for women and children; however, production is constrained by several biotic and abiotic stresses (diseases, pests, drought, low soil fertility) that leave annual, nationwide deficits of 5,000 MT in Zambia and undermine the bean's potential as a food security crop in Uganda. Both countries rely predominantly on inferior landraces that are generally low yielding due to their susceptibility to these stresses.

The Project

To avert future food shortages and feed the growing populations as well as improve household incomes, there is critical need for increasing the productivity of beans through the development of improved varieties and germplasm with high yield potential, improved resistance to multiple diseases, healthy root systems, and improved biological nitrogen fixation (BNF) and water use efficiency.

To achieve these goals, researchers need improvements in the current understanding of the physiology of drought and evapotranspiration (the process by which water is transferred from the land surfaces, such as plants, to the atmosphere by evaporation) and the genetics of drought tolerance in common bean along with the development of effective molecular and quantitative methods for the selection of drought tolerance.

The project will apply QTL (quantitative trait loci) analysis and single-nucleotide polymorphism (SNP)-based genome-wide association mapping to uncover regions associated with drought tolerance, disease resistance, enhanced BNF, and faster cooking time.

Results from this project would contribute to improved yield, farm profitability, and human resources in the host countries and indirectly benefit participating U.S. institutions and bean producers.



l. to rt., researchers examine bean plants in a screen house, examining a bean pod in the fields, a bean field in Uganda

Project Objectives

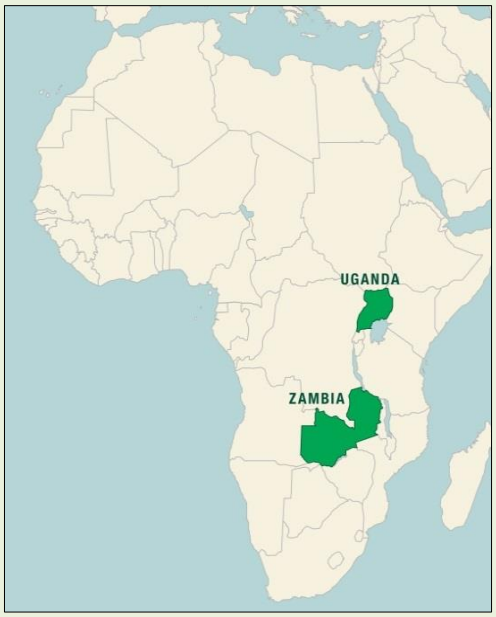
1. Integrate traditional and marker-assisted selection (MAS) methods to combine resistances to foliar diseases, drought, and improved symbiotic nitrogen fixation to assess fast cooking and high mineral content in large-seeded, high yielding red mottled, white, and yellow Andean bean germplasm for Zambia and Uganda.
2. Characterize pathogenic and genetic variability of isolates of foliar pathogens collected in Uganda and Zambia and identify sources of resistance to angular leaf spot, anthracnose, common bacterial blight (CBB), bean common mosaic virus (BCMV), and bean rust in Andean germplasm.
3. Use single nucleotide polymorphism (SNP)-based genome-wide association mapping to uncover regions associated with drought tolerance, disease resistance, cooking time, and BNF to identify QTLs for use in MAS to improve Andean germplasm.
4. Develop phenometric approaches to improving the efficiencies of breeding for abiotic stress tolerance, especially drought.

Projected Outcomes

1. The development and release of locally adapted drought and disease resistant bean cultivars for the major production regions in Uganda, Zambia, and Michigan, resulting in increased and sustainable productivity and profitability of bean production and better nutrition and health among farm families.
2. Increased knowledge of genomic and phenomic research methods on drought stress, foliar diseases, enhanced fixation, and nutritional quality.
3. Identification of germplasm sources to improve selected bean traits.

Major Achievements

1. Collected and evaluated more than 750 germplasm for different traits.
2. Determined the incidence and severity of different bean folia pathogens within major bean growing regions of Uganda.
3. Undertaken inheritance studies to determine modes of inheritance of rust, CBB, and BCMV resistance for preferred Andean bean genotypes in Uganda
4. Identified genomic regions controlling BNF and anthracnose resistance.
5. Made more than 86 different crosses to introgress different diseases' resistances and drought tolerance into Uganda bean varieties.
6. Identified tentative bean sources for rust, CBB, BCMV, and drought resistance, and fast cooking time.
7. Made more than 86 different crosses to introgress different disease resistances and drought tolerance into the susceptible Uganda market class bean varieties.
8. Initiated 36 F1 hybrid combinations to combine multiple disease resistance and drought tolerance into elite African germplasm.



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