Research Proposal: Breeding Peanut for Disease Resistance Valuable to Latin America, the Caribbean, and the United States.

Principal Investigator

Barry Tillman
University of Florida
North Florida Research and Education Center
3925 Highway 71
Marianna, FL USA 32446-7906
Phone: +1 (850) 394-9124 x109
Fax: +1 (850) 482-9917
Email: btillman@ufl.edu

Co-Project Investigator(s)

Albert Culbreath
University of Georgia
Department of Plant Pathology
UGA-CPES
P.O. Box 748
Rainwater Road
Tifton, GA 28637
Phone: (229) 386-7285
Email: spotwilt@uga.edu

Amanda Gevens
University of Florida
1421 Fifield Hall
PO Box 110680
Gainesville, Florida 32611
Phone: (352) 392-3631
Email: gevens@ufl.edu

Roy Pittman
USDA-ARS
1109 Experiment St. Griffin, GA 30223
Phone: (770) 2293252
Email: roy.pittman@ars.usda.gov

Partner Scientist(s)

Diego Baldelomar
Asociación de Productores de Oleaginosas y Trigo (ANAPO)

Ione Betti
Asociación de Productores de Oleaginosas y Trigo (ANAPO)

Alessandra Favero
Embrapa Genetic Resources and Biotechnology (EMBRAPA)

Judy Hendrix
United States Department of Agriculture - Agriculture Research Service (USDA-ARS)

Jaime Hernandez
Asociación de Productores de Oleaginosas y Trigo (ANAPO)

Rolando Moreno
Asociación de Productores de Oleaginosas y Trigo (ANAPO)

Ruben Mostacedo
Asociación de Productores de Oleaginosas y Trigo (ANAPO)

Geographical Location

Bolivia

Submitted

09/28/2007

Focus

Domain - Production Values Region - Latin America

Background

Foliar diseases negatively impact yield and profits of peanut producers worldwide. In developed countries like the USA, control of leaf spot accounts for 10-15% of total variable costs associated with peanut production. Cultivars with resistance could significantly reduce this cost and reduce crop losses from disease. In developing countries where producers grow peanut for subsistence, fungicides may not be available or affordable. Deployment of disease resistant cultivars could significantly reduce disease and prevent excessive yield losses when conditions are conducive to disease development.

Several countries previously supported by the CRSP could benefit from a

project that assists in development of germplasm that can be selected for local adaptation. Those countries could also benefit from training in basic plant selection and disease identification and evaluation. Our preferred host country of Bolivia has been involved in the CRSP and has the ability to assist in this project because its climate is suited to screening leaf spot and rust and because of the potential of its genetic resources to provide novel sources of disease resistance. Several advanced lines from a previous Bolivia CRSP project have excellent resistance to the leaf spot pathogens. However, most of those have not been evaluated for resistance to rust, and most have been evaluated in only one country.

This project will address several of the USAID Mandated Programming and Technical Elements. Increasing the peanut yield per unit area will help to reduce poverty and hunger, raise rural incomes and improve health. Development of disease resistant peanut cultivars will directly address the area of Integrated Pest Management. Such cultivars will provide benefits to CRPS host countries and within the USA by reducing production risk and/or cost and increasing yield.

Technical Review

Early leaf spot and late leaf spot are a worldwide and potentially devastating pair of peanut diseases. Resistance has been identified and cultivars with partial resistance are available, but not widely employed.

In the case of rust, cultivar resistance has received little attention in the USA because the disease is usually not problematic in most of the peanut production area. However, as peanut production has moved into coastal areas of Alabama and Florida, rust can be problematic. Rust can be a major constraint to peanut production in much of the tropical and sub-tropical areas of the Americas and can be severe even in "dry season" production whereas the leaf spot typically is a problem in wetter seasons. There is germplasm known to have partial resistance to rust that can be exploited.

Wild peanut relatives hold promise as a source of resistance to both leaf spot and rust, but very little of that potential has been exploited in commercial scale breeding programs. Two possibilities exist for using this wild germplasm. First, scientists in Brazil have developed amphiploids with apparently excellent resistance to late leaf spot and rust; we could optimize these amphiploids in the US, Bolivia, and other CRSP host countries. Second, our preferred host country of Bolivia is rich in peanut wild species. We could develop amphiploids from those that could contain valuable disease resistance genes.

Problem Statement

Peanut cultivars with disease resistance are important worldwide. In developed countries like the USA, rising production costs are pushing the industry to find ways to produce peanuts with less expense. In developing countries, many producers cannot afford fungicides to control diseases, so cultivar resistance is a primary control measure. We propose to develop cultivars with resistance to early and late leaf spot and peanut rust aimed primarily for use in the Caribbean and the Americas.

Deployment of germplasm will be in cooperation with other CRSP projects based in the Caribbean and Latin America. We will also seek partnerships with breeding and research programs in Argentina and Brazil to assist in identifying germplasm with rust and leaf spot resistance. There are significant opportunities to use wild peanut relatives to improve rust and leaf spot resistance of cultivated peanut. Access to these wild relatives is limited, but through a cooperative program, we may have access to advanced amphiploids from Brazil and diploids from Bolivia.

In addition to providing new cultivars for peanut production, we propose to train host country participants in breeding techniques (especially breeding for disease resistance), and in integrated disease management incorporating resistant cultivars with chemical and cultural practices that help in disease management. This development will ideally include training graduate students from the host country at the University of Florida and/or the University of Georgia.

Vision and Approach

Goals

1. Develop rust and leaf spot resistant germplasm and cultivars.
2. Deploy the germplasm and cultivars throughout the Caribbean and the Americas where peanut is grown as is practically feasible. (primarily through other CRSP programs)
3. Train graduate students from the host country in plant breeding and/or plant pathology.
4. Assist the host country and other CRSP host countries in developing breeding and/or testing capabilities by training their personnel in disease evaluation and basic breeding techniques needed to select and advance promising lines.
5. Develop integrated disease management programs utilizing resistant cultivars

Objectives

1. Develop rust and leaf spot resistant germplasm for the region - based on parallel activities in the USA and Bolivia.
2. Train graduate students from the host country, or other Caribbean or Latin American countries.
3. Train host country collaborators to evaluate peanut plants for rust and leaf spot resistance and to select and propagate those plants that show promise.

Research Approach

Breeding for rust and leaf spot resistance.

A literature search revealed germplasm with partial resistance to rust. We will access that germplasm from the National Plant Germplasm System. The University of Florida peanut breeding program has a long history of developing leaf spot resistant germplasm so we have access to a deep pool of material. One of our testing locations near Citra, Florida at the UF Plant Science Research and Education Unit routinely has a climate conducive to both rust and leafspot. We will utilize that location to screen germplasm and breeding populations for rust and leaf spot resistance.

This project will be a regional breeding program for CRSP host countries in the Caribbean and Latin America. As such, we will coordinate with other CRSP projects to deploy and evaluate germplasm for local adaptation and eventual development into cultivars.

Training & Capacity Development Approach

Formal training will be accomplished by identifying at least one or two students from the host country or from the target area (Americas) to enroll in graduate school in either the University of Florida or the University of Georgia.

Capacity building in the host country will be accomplished by visits to review programs and by providing short-term training for host country scientists at the University of Florida and/or the University of Georgia.

Intended Benefits & Impact Responsiveness

Development Benefits

This project will be a germplasm and cultivar development program for all CRSP projects operating in the Caribbean, Central America and South America. Therefore the beneficiaries of the program will include not only the host country of this specific project, but the host countries of other CRSP

projects as well. Entities that will benefit include 1) farmers by way of improved cultivars, 2) consumers by way of new, or more plentiful peanut products, 3) the peanut industry as a result of training scientists, and 4) breeding programs that will have new germplasm to work with.

The specific benefits are:

1. A germplasm pool that can be evaluated under local conditions
2. Improved cultivars developed from that germplasm pool
3. Scientists trained to identify peanut diseases and to select germplasm best suited for their growing conditions.

US Benefits

A large part of this project will aim to bring novel germplasm into the US breeding programs. The genetic base of peanut is narrow, especially in the area of disease resistance. The peanut industry in the US could benefit by the development of cultivars with higher levels of leaf spot and rust resistance than is currently available.

Potential Impacts

Early in the breeding process, impact can be measured by identification of peanut lines with resistance to rust and/or leaf spot pathogens. These lines will likely come from previous work and will be evaluated for suitability for production or use as parents in subsequent phases. The final impact will be realized when commercial cultivars are available with improved disease resistance. Success in this project has the potential to significantly reduce the cost of production in the US. Additionally, broadening the genetic base of peanut with wild relatives should allow for improvement in traits other than disease resistance. In the developing countries being targeted, incorporation of foliar disease resistance into commercial cultivars should help to stabilize production. In those countries, improved cultivars should allow peanuts to be grown more profitably and in areas or at times that are currently too risky for successful production.

Equipment

Equipment needed for field research for the U.S. portion of this project is available at Georgia and Florida research facilities. If funding is available, a precision planter will aid significantly in the breeding work in Florida and would be needed beginning in 2009. The cost of the planter is $25,000.

Project Timeline

WINTER 2008

1. Identify graduate student candidates from the host country
2. Identify potential rust resistant germplasm
3. Select potential leaf spot resistant material from the Florida breeding program

SPRING - SUMMER 2008

1. Develop a graduate student project and move toward enrolling the student in the Fall semester of 2008. Potential graduate student programs include:
    a. Evaluating germplasm for rust and leaf spot resistance in the Caribbean and Latin America.
    b. Identification of wild peanut relatives with resistance to leaf spot and rust.
2. Evaluate putative rust and leaf spot resistant germplasm on the Plant Science REU near Citra Florida.
3. Invite leaders of the other CRSP projects in the target area (both host country leaders and US University leaders) to view the first plots in Citra and train host country participants to evaluate peanut for leaf spot and rust resistance.

FALL - WINTER 2008-2009

1. Begin graduate student program.
2. Harvest first round of test plots and send seed of the best lines to target countries for local evaluation.
3. Begin making crosses between rust resistant germplasm and leaf spot resistant germplasm in Griffin, GA.

SPRING 2009 – 2012

During the last three years of the project, we will continue a traditional breeding program to develop leaf spot and rust resistant peanut cultivars. Whenever possible, we will utilize the host country, or Puerto Rico winter nurseries to speed the breeding process. During the summer of 2009, we will again invite host country collaborators and US University participants to Florida to be trained in evaluation of rust and leaf spot resistance and to be trained in selection and further propagation of potential cultivars.

USAID Mandate Responsiveness

MDGs

Poverty/Hunger: Improved Health: Raised Rural Incomes: Sustainable Development

Foreign Assistance Framework

Governance: Human Capacity: Economic Structure: Persistent Dire Poverty: Global Issues (HIV and Infectious Diseases, climate change, biodiversity)

IEHA

Science and Tech Applications: Increased demand for peanuts: Market Access: Increased Trade

USAID Focal Areas

Greater incomes: Greater value and market demand: Public Health: Food Security: Sustainable Value Chain: Improved Human Capacity