FEED THE FUTURE

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

Peanut Innovation Lab Annual Report Fiscal Year 2024

Feed the Future
Innovation Lab for Peanut

(Peanut Innovation Lab)

Annual Report – Fiscal Year 2024

(1 October 2023 – 30 September 2024)

Peanut Innovation Lab Management Entity
University of Georgia, Athens, Georgia
December 2024

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Director's Greeting

In FY24, the Peanut Innovation Lab finalized its project portfolio for the second five-year phase. The 22 projects, many of which are led by African scientists, focus on bringing innovative solutions to critical problems along the peanut (groundnut) value chain.

Improved varieties are under development through the Groundnut Improvement Network for Africa (GINA), a pan-Africa network of national programs that are using modern phenotyping approaches such as drone imaging, portable NIR spectrometers, and genomic selection with diverse germplasm from across Africa including wild species. Partners are identifying the best varieties through annual multi-location variety trials and using a new citizen-science approach called TRICOT (triadic comparison of technologies) trials in which hundreds of farmers are evaluating sets of varieties under their own farm conditions.

Seed of these new varieties are delivered more effectively to farmers through linkages that allow the private sector to play a stronger role in early generation seed production. The program is identifying market demands early to drive the seed system.

In addition to work with genetics, the program is conducting GREAT (Groundnut Research Extension and Adoption of Technology) trials on farmers' fields to determine the optimal combination of agronomic practices required for maximum quality and profit. Research involves additional inputs to deal with poor soil fertility, pests, diseases and more frequent erratic rainfall across Africa. Farmers experience these improved approaches through demonstration trials combined with virtual and in-person training.

In work to mechanize, partners are designing and testing appropriately scaled machines, while identifying local manufacturers. Shelling and grading equipment is in use while a farm-size thresher is in testing. Experts from the US peanut industry are advising local partners in the adoption and use of small- to large-scale equipment.

Gender researchers are studying the best approaches to improve gender equity and impact at the household level, including a large-scale evalution of the Gender Action Learning System (GALS) through controlled trials involving thousands of households.

In this phase, the Peanut Innovation Lab has made significant efforts to scale activities and to focus the efforts on a common set of 21 SMART objectives. Given this focus, we have organized the Annual Report by country, highlighting the activities and achievements the collective projects are making in that country. Individual projects are presented as short descriptions to acknowledge the contributions each is making in achieving the collective goals within a country and across the Peanut Innovation Lab.

We hope you will enjoy the FY24 Annual Report. There is still a lot to be accomplished, but we believe that through a focused partnership approach, we will reach our goals.

Dave Hoisington, PIL Director

Research Program Overview and Structure

The Peanut Innovation Lab contributes to the Global Food Security Strategy by increasing the production, sustainability, profitability and use of peanut in targeted developing countries and the US. This is achieved through research linkages between US and developing country scientists in four Areas of Inquiry: 1) varietal development and seed systems, 2) production packages and mechanization, 3) quality, and 4) gender and youth.

Area of Inquiry 1 (Varieties and Seed) fosters a network of groundnut breeders across Africa working together to use diverse germplasm coupled with modern genomic and information technologies in the breeding programs. The objective is to enhance the capacity of peanut breeding programs in each country to develop new varieties using modern efficient approaches, and to test and release varieties that increase yields and address the local, national and regional demands of the country. Attention is also given to enhancing the seed system within the country by linking public and private partners in a demand-driven production process.

Area of Inquiry 2 (Production and Mechanization) builds partnerships between the public and private sector and establishes new partnerships in groundnut production and local processing. Research focuses on the best management practices to optimize quantity and quality of the crop by smallholder and commercial farmers, and effective practices including mechanization for harvesting, drying, storage and shelling.

Area of Inquiry 3 (Quality) works to assess benefits of peanut-based foods for school feeding programs and addresses requirements for chemical composition and mycotoxin contamination through control practices and monitoring.

Area of Inquiry 4 (Gender and Youth) seeks to improve our understanding of the roles that gender and youth play in mediating interactions with peanut value chains in target countries. Research and training efforts seek to improve equitable access to innovation for women, men, youth and the rural poor to improve peanut productivity and quality by leveraging knowledge about their engagement in peanut production and use.

SMART Objectives

The Peanut Innovation Lab drafted 21 SMART Objectives as goals for the five-year second phase. These set Specific, Measurable, Achievable, Realistic and Time-bound objectives that projects work collectively together to achieve. Progress made towards each objective's goal achieved since the start of this phase in FY23 is presented under the four Areas of Enquiry.

Varieties and Seed

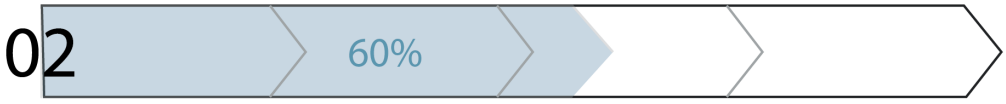
Much of the lab's variety development work is done through the Groundnut Improvement Network for Africa (GINA), a continent-wide collaborative group of peanut breeders who share germplasm and knowledge. Improving seed production is a common goal in all GINA countries.

New varieties

Release at least 20 varieties in GINA countries that improve yield, seed size, duration and other traits.

2024 *Released 6 varieties (1 in Zambia, 2 in Niger and 3 in Uganda), 2 varieties will be registered in Senegal and 4 varieties released in Togo in 2025. Thirty-five varieties from the GINA core collection are under evaluation in Malawi and 28 lines in advanced yield trials in Uganda.*

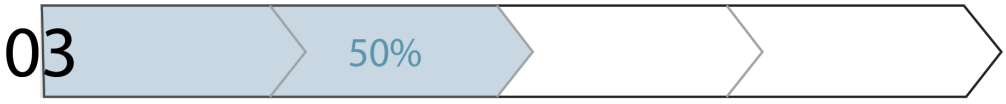
High-oleic varieties



Release 5 high-oleic (75% oleic acid content) varieties in GINA countries.

2024 *Three high-oleic varieties (SARINUT 6, 7, 8) released in Ghana. High-oleic lines identified in GINA core, crosses made and populations under development in several countries.*

TRICOT variety trials



Conduct TRICOT trials with at least 200 farmers in four countries in 2024 & 2025.

2024 *TRICOT trials conducted in 3 countries involving 734 farmers: Ghana (15 varieties, 284 farmers), Togo (13 varieties, 200 farmers), and Senegal (15 varieties, 250 farmers). Trials are planned for next season in Malawi (11 varieties, 315 farmers) and Uganda (13 varieties, 100 farmers).*

Seed production

Produce breeder, pre-basic/foundation and certified seed for at least 3 flagship varieties in at least 4 GINA countries.

2024 *3.8 MT of breeder seed produced for 6 flagship varieties in Malawi, 5 MT of breeder seed of flagship varieties in Ghana, 2 ha of breeder seed of 3 varieties in Togo, 1.2 ha of breeder seed of 4 varieties in Burkina Faso, 0.2 MT of breeder seed of 3 flagship varieties in Senegal during off-season.*

Breeding management

05 — 75%

Facilitate GINA partners using the Breeding Management System for design and data storage in at least 90% of their groundnut trials.

2024 *All trials in Malawi, Ghana and Senegal, 20% of trials in Burkina Faso, 60% in Togo, 95+% in Uganda conducted using BMS. Genotyping data for the GINA collection is stored in a Gigwa instance linked to BMS. A common instance of BMS for all breeders in GINA is under development.*

Efficiency in breeding

06 — 50%

Improve the efficiency of national programs' research trials by decreasing the cost, labor and time by at least 10%, through digitizing breeding, and the use of mechanization and high-throughput phenotyping.

2024 *Optimized groundnut sheller/grading table used in Senegal, Ghana, Uganda and Malawi. A small-plot thresher has been tested by the breeding program in Malawi, where additional units may be produced and tested next season. The Senegal breeding program is using a portable NIR spectrometer to screen segregating populations for high oleic, saving up to 75% of genotyping costs.*

Production & Mechanization

Through on-station and on-farm trials, as well as developing appropriately scaled equipment for groundnut, the lab improves agronomic efficiency at the smallholder level.

TRICOT agronomy trials

07 — 33%

Conduct simplified multivariate input/agronomic practice trials with 500 farmers following the TRICOT approach in Ghana, Malawi and Senegal for 2 years.

2024 *GREAT trials that include 4 levels of inputs conducted by 144 farmers in Malawi. Trials under design for implementing next season in Ghana.*

Production packages

08 — 33%

Develop 3 production packages (optimal low, medium and high inputs) specific for at least 5 GINA countries.

2024 *GREAT trials designed with 4 input levels tested on-farm and on-station in Malawi. Design is underway for packages in Ghana and will be tested in the next planting cycle.*

Local machinery

2024 *Discussions underway with two potential manufacturers in Malawi.*

Train at least 1 local manufacturer in at least 4 GINA countries in the manufacture and maintenance of the mechanized sheller and sizing tables.

Groundnut thresher

2024 *Thresher designed and prototype sent to Malawi for demos at Groundnut Tour in Malawi 2024. Discussions underway with two potential manufacturers in Malawi to provide additional units for further testing next season.*

Produce a prototype of a peanut thresher scaled to be used by smallholders. If the prototype is successful, train 1 local manufacturer in at least 4 GINA countries in the manufacture and maintenance of the thresher.

Quality

Aflatoxin remains a challenge for production, storage and consumption of peanuts across the globe, despite some simple practices to reduce the risk. The Peanut Innovation Lab works to reduce aflatoxin through improved and effective monitoring to ensure the implemented protocols are resulting in low-alfatoxin peanuts for consumers. Nutritional research assesses the impact of a peanut-based school meal on cognitive learning in school children.

Buying points

2024 *Under discussion in Malawi with Pyxus, a company that worked with 10,000 farmers and bought 4900 MT of groundnuts last year.*

Implement 10 buying points (sheller/aspirator, sizing table, moisture meter, aflatoxin testing) that use empirical quality measures to determine peanut grade and reduce aflatoxin risk by 25%.

Local procurement

2024 *School food meal project underway and initial procurement completed.*

Link 1,500 trained smallholder farmers in northern Ghana producing high-quality peanuts to sell to the manufacturer of a school food program for 10,000 students in rural schools in northern Ghana by 2027.

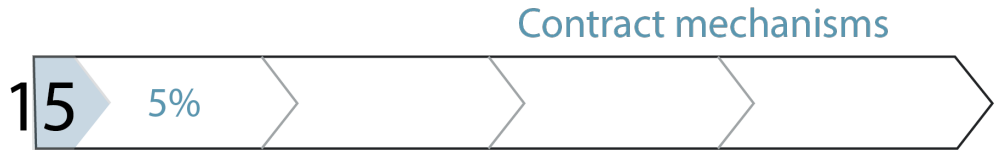
Train 5,000 high-risk peanut product processors (e.g., kuli kuli) on aflatoxin risk management by 2025 to reduce aflatoxin levels in their produce by 25% by 2028.

One AI NIR methodology developed by ImagoAI considered, but not yet validated to work with peanuts.

Develop at least 1 non-destructive, low-cost aflatoxin testing method for peanut.

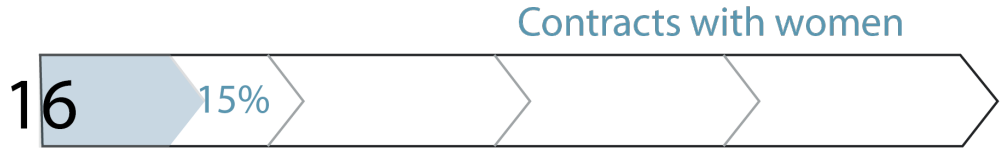
Gender & Youth

Gender is a cross-cutting theme in all Peanut Innovation Lab research, but also as stand-alone projects that seek to understand better the roles, responsibilities and expectations of men and women in order to improve quality of life and effectiveness of agricultural innovations.



Evaluation tool developed and tested in a pilot survey with 200 households/400 individuals. The initial baseline study with ~10,000 farmers will be conducted in early 2025.

Evaluate gender-responsiveness of contracting mechanisms through trials with 2,000 farmers. Scale effective approaches to 30,000 in partnership with private companies to support USAID Mission goal of 120,000 farmers in formal market in Malawi.



Household studies as part of SMART objective #14 will be used to enable Pyxus to increase the number of contracts signed by underrepresented groups and to support them in delivering on those contracts.

In support of the Malawi Mission's goals, increase the number of contracts signed by underrepresented groups, e.g. women, female-headed and poor households, by 10% by 2028.

Time-use tracker

Develop a shelf-ready time use tracking methodology innovation by 2028.

2024 *Protocols under development, time-use tools developed, and data collection to commence in late 2024/early 2025.*

Labor-saving technology

Identify and evaluate 3-5 labor-saving technologies to reduce time-related barriers that block women's economic gains. By 2028, scale proven technologies to 30,000 farmers through development partners and the private sector, and in support of the Ghana Mission's goal to increase commercialization and profitability for African farmers, including women.

2024 *Project under discussion.*

School snacks

Generate evidence on the social impacts (including reductions in women's childcare responsibilities) of peanut-based school snacks by 2026 through trials in 10 schools (1,500 households); develop partnerships with public and private actors (including MSR) to scale to 30,000 households by 2028 in Ghana.

2024 *Project awarded to conduct a study of school snack's social impacts involving 20 schools/5,000+ students and their households; trial design underway and activities to start in Ghana in early 2025. Meanwhile, snack manufacturer Project Peanut Butter in discussion with local partners to scale to 30,000 households by 2028.*

Seed production

Identify opportunities to support youth engagement in groundnut production by 2026; work with public, private and NGO actors to scale to 20,000 households across PIL target countries by 2028.

2024 *A partnership with RESOPP and SCL in Senegal developed that has planted 20 ha for certified seed production of 2 improved varieties.*

Adoption of new varieties

Increase young adult adoption of new varieties and BMPs by 100% over baseline across PIL target countries by 2028.

2024 *Sample frame for distribution of improved groundnut seed to households with young adults developed for implementation in 2025.*

Reports by Country

The Peanut Innovation Lab works primarily in five countries – Ghana, Madagascar, Malawi, Senegal and Uganda – and has increased activities in Zambia. The lab provides logistical and financial support for research in other countries that are members of the Groundnut Improvement Network for Africa (GINA).

Groundnut Improvement Network for Africa

The Groundnut Improvement Network for Africa is a pan-Africa group of national peanut breeders who work together to access and assess the genetic diversity of peanut, use modern genomic, phenotypic and data management tools to predict trait performance, and use the diversity and tools to develop and release improved varieties in their respective countries.

National programs in Senegal (for West Africa) and Uganda (for East and Southern Africa) provide regional coordination and support by managing Peanut Innovation Lab projects in each region, supplying germplasm, organizing workshops and providing continual support and guidance.

The current countries involved include, in West Africa: Senegal, Ghana, Niger, Mali, Burkina Faso, The Gambia, Guinea and Togo; and in Eastern and Southern Africa: Uganda, Malawi, Madagascar, Mozambique, Tanzania and Zambia.

GINA countries benefit the network by:

- Evaluating lines from the GINA collection and using them in crosses, and
- Sharing knowledge and experience.

GINA countries receive from the network:

- Peanut germplasm including a core set of 200 diverse lines from across Africa, improved varieties released in other African countries, and new lines derived from wild species,
- Access to the latest genomic technology for peanut and advanced phenotyping tools including the use of drone imagery,
- Support in using an advanced digital breeding platform to facilitate better management of trial design, data collection and analysis, and seed inventory,

- Access to all data generated on the GINA lines via a central data management system, and
- A network of peanut researchers and breeders in Africa and the USA to help advise and support their breeding and research efforts.

In FY24, breeders continued to screen the GINA Core Set of 200 diverse lines under a variety of environmental and disease conditions. Collective analysis of these results identified several lines that perform well across a wide range of agro-ecologies, indicating lines with more resilience to the changing environmental conditions. Several programs have been able to release improved varieties in their respective countries from the core set and use many in crosses to develop new lines in their programs.

Four countries (Ghana, Malawi, Senegal and Uganda) initiated a project to use drone imaging and machine learning to better predict the performance of peanut lines in the field. These efforts aim to provide more rapid and precise methods to screen materials and compare results across GINA.

By accessing services from Intertek and HudsonAlpha, many breeders are now using genomic approaches to confirm hybridity in crosses and make genomic selections in their programs. As all GINA core lines have been genotyped and many sequenced, the materials are excellent resources ready to be used with the latest genomic tools.

New diverse materials are being developed by crossing wild species together to create novel peanut lines. These are then crossed into existing peanut varieties and provided to GINA breeders to use as novel sources of disease resistance, drought tolerance and nutritional quality.

TRICOT trials were designed by many programs for next crop cycle and implemented by two programs (Ghana and Senegal) in FY24. These trials allow hundreds of farmers to evaluate sets of three varieties under their own conditions and provided simple feedback on the varieties' performance. The data both within a country and across the GINA countries will provide critical information on what lines farmers prefer.

Good progress was made to provide training and support for all GINA programs to use the Breeding Management System, a cloud-based digital data management system designed to support breeding programs. Each GINA country now has the necessary hardware and software to use BMS, staff trained in its use, and access to central support. A central database of BMS was installed that now provides all GINA breeders access to all data from the GINA trials.

The annual GINA workshop conducted in Lilongwe, Malawi in April allowed the breeders to present their latest data on the GINA lines, receive updates on the latest tools available and make plans for future efforts. The group agreed that GINA has been a success and allowed breeders to significantly improve their programs.

Partners

Centre de Coopération Internationale en Recherche Agronomique pour le Développement-CIRAD (France)

Centre National de Recherche Appliquee au Developpement Rural-FOFIFA (Madagascar)
Council for Scientific and Industrial Research-CSIR/Savannah Agricultural Research Institute-SARI (Ghana)
Department of Agricultural Research Services-DARS (Malawi)
HudsonAlpha Institute for Biotechnology (USA)
Institut de Recherche Agronomique de Guinée -IRAG (Guinea)
Institut National pour l'Etude et la Recherche Agronomiques-INERA (Burkina Faso)
Institut Sénégalais de Recherches Agricoles-ISRA (Senegal)
Institut Togolais de Recherche Agronomique-ITRA-CRASS (Togo)
Institute of Rural Economy-IER/Centre Régionale de la Recherche Agronomique-CRRA (Mali)
Integrated Breeding Platform-IBP (Mexico)
L'Institut National de la Recherche Agronomique du Niger-INRAN (Niger)
Mozambique Institute of Agricultural Research-IIAM (Mozambique)
National Agricultural Research Institute-NARI (The Gambia)
National Agricultural Research Organization-NARO/National Semi-Arid Resources Research Institute-NaSARRI (Uganda)
New Mexico State University (USA)
Tanzania Agricultural Research Institute-TARI (Tanzania)
Texas A&M (USA)
Texas Tech (USA)
University of Georgia (USA)
Virginia Tech (USA)
Zambia Agricultural Research Institute-ZARI (Zambia)

Projects

Breeding germplasm for quality & drought, Mark Burow, Texas A&M University
Breeding Management System & GINA coordination, Daniel Fonceka, CIRAD
Coordination of variety trials & early-generation seed in Malawi, Naveen Puppala, New Mexico State University
Enhancing genetic potential in Eastern and Southern Africa, David Okello Kalule, NARO-NaSARRI
Enhancing genetic potential in West Africa, Aissatou Sambou, ISRA-CERAAS
Genomics support for GINA and Groundnut Rosette Disease, Josh Clevenger, HudsonAlpha Institute for Biotechnology
Groundnut Rosette Disease in West Africa, Richard Oteng-Frimpong, CSIR-SARI
High-throughput phenotyping, Maria Balota, Virginia Tech
Novel diversity to improve peanut in Africa, David & Soraya Bertioli, University of Georgia
Seed coat biochemical markers, Mark Burow, Texas Tech University
Varieties & EGS for Malawi, Justus Chintu, DARS-Chitedze

Look Ahead

Diverse lines will be developed and evaluated under diverse conditions. Drone imaging will be used to better predict performance. Greenhouse and field studies will optimize the chemical control of *Aspergillus flavus* infection, growth and aflatoxin contamination. Variety development research will select the best lines under drought and disease pressure and release improved lines for farmers.

Ghana

The Peanut Innovation Lab works with public and private partners in Ghana to improve groundnut production through variety development, improved production practices and mechanization, with a particular eye to promoting gender equity, improving nutritional outcomes and supporting markets.

Ghana is part of the Groundnut Improvement Network for Africa, a pan-Africa group of plant breeders who compiled lines from across the continent and work together to access the genetic diversity in that core collection of lines. Along with other GINA countries, Ghana's Council for Scientific and Industrial Research (CSIR) has continued to expand their use of an advanced digital breeding platform called the Breeding Management System (BMS) to facilitate better management of trial design, data collection and analysis, and seed inventory.

Three Ghanaian scientists completed PhDs with support from the Peanut Innovation Lab in 2024. Stephen Arthur and Ahmed Seidu each completed doctorates at the University for Development Studies in Tamale, while Leslie Commey (not pictured) completed a PhD at Texas Tech University.

New groundnut varieties that will help farmers to adapt to climate change and disease are making it through the development pipeline faster through new drone-based imaging that more quickly predicts performance. To build local capacity to use drone imaging, a peanut breeder and PhD graduate student travelled to Virginia Tech in Suffolk, Virginia from 25 March to 30 April to train in how to fly drones, capture images and analyze the images to develop predictive models. The student will conduct research to develop predictive models for disease traits, performance under drought and maturity as part of their thesis research under the supervision of the peanut breeder and project PI.

In efforts to create and release of new varieties, especially varieties with high oleic content and resistance to groundnut rosette disease (GRD), the SARI breeding team selected 18 lines and evaluated these in yield trials in four environments (Njankpala, Wa, Silbelle and Manga). In addition, the team made crosses among six lines from the GINA core collection that offer high yield, high oleic acid content, good nutritional qualities and GRD resistance. Finally, partners planted a total of 182 early-maturity and 90 medium-maturity GINA core lines in replicated trials to screen for GRD resistant lines that can be released as-is in Ghana or used in crosses.

SARI produced fresh breeder seed of two recently released varieties, SARINUT 1 and SARINUT 2, and will make it available for certified seed production.

A new type of trial promises to give insight into farmer preferences and help seed producers strategically grow volumes and varieties that farmers want. TRICOT (triadic comparisons of technologies) trials, a citizen-science approach, provides a large number of farmers random sets of three varieties which they grow under their usual practices and then rank the varieties based on how they perform. To gather this data, the lab began TRICOT trials in 2024 across northern Ghana that involved 15 varieties and 284 farmers (96 females age 24-72 and 188 males age 22-67).

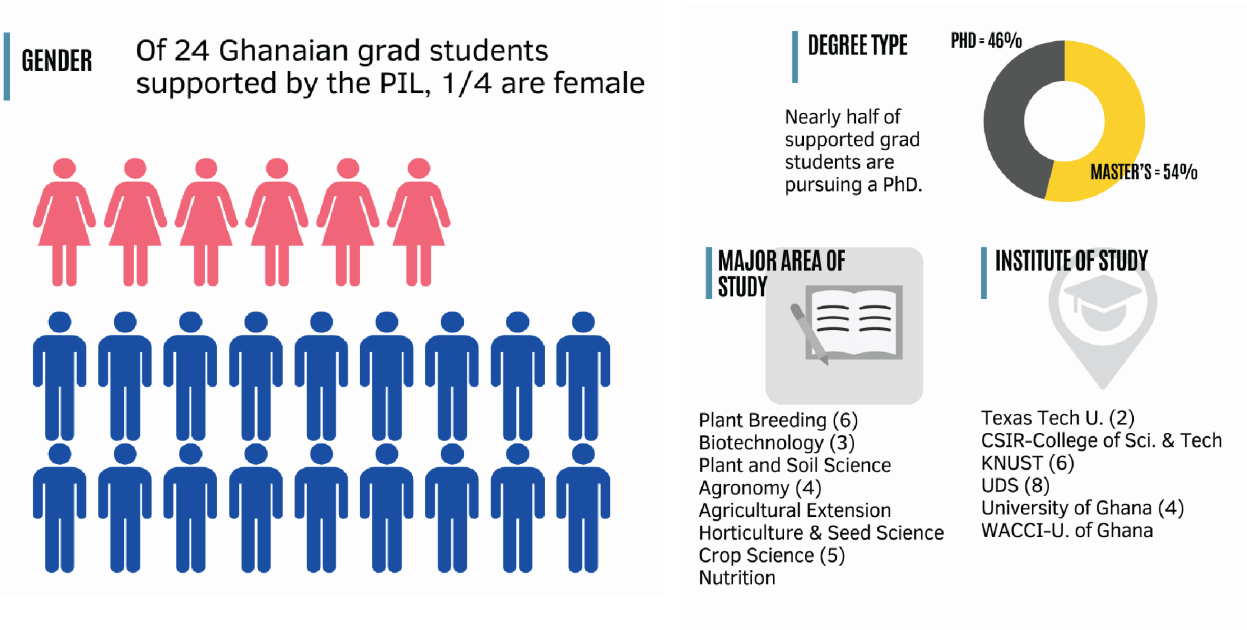
Agronomic trials used as demonstration plots show lead farmers (who then pass the info on to others) how improved practices combine with soil fertility, seed quality, weed and disease management, maturity, drying and storage to impact yield. The demo plots were planted at four locations and used to provide season-long training starting in June to a total of 65 lead farmers (32 female, 33 male) across the four locations (17 at Nyankpala, 16 at Yendi, 15 at Karaga, 17 at Manga).

Linkages along the groundnut value chain were improved through the annual Ghana Groundnut Working Group (GGWG) meeting, which brings together scientists, aggregators, seed suppliers, manufacturers and farmers to discuss latest advances and identify challenges to advance groundnut in Ghana. The May 2024 meeting was postponed after the untimely death of an important partner but was rescheduled to October 2024.

The Ghana Groundnut Working Group, a group of scientists working along the peanut value chain in Ghana, postponed a summer 2024 meeting after the sudden death of a prominent member. The group, which the Peanut IL helped to establish in 2019, met in fall instead.

School meals provide a way to get healthy peanuts to students while boosting local consumption of a locally grown crop. A scaled-up version of research in the Mion district seeks to find out how school meals affect attendance and cognition in more than 5000 students at 20 schools. The Ghana team met with local authorities including village chiefs to introduce and test a new biometric fingerprint attendance tracking system, trained collaborators at each school to use the system and met with parents/caregivers to introduce the study. The trials launched in May involving 5,017 participants across 20 primary and secondary schools. To measure the impact at the household level, a new project involving Michigan State University and the Institute of Statistical, Social and Economic Research at the University of Ghana will conduct household surveys starting in the FY25 to assess nutritional and time use impacts in households that are part of the school feeding program compared with schools not participating. While earlier research with school meals focused on cognitive gains, researchers noted student attendance increased, particularly for girls and through older age groups. Anecdotally, parents said they had less pressure to care for children and prepare food during the day, which increased time for women. Future research will flesh out these anecdotal findings.

Students



Partners

Crop Research Institute (CRI)
Kwame Nkrumah University of Science and Technology (KNUST)
Project Peanut Butter (PPB)
Savanna Agriculture Research Institute (SARI)
University for Development Studies (UDS)
University of Ghana

Projects

Breeding germplasm for quality & drought, Mark Burow, Texas A&M University
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Ghana school meal household impacts, Mywish Maredia, Michigan State University
Groundnut Rosette Disease in West Africa, Richard Oteng-Frimpong, CSIR-SARI
High-throughput phenotyping, Maria Balota, Virginia Tech
Novel diversity to improve peanut in Africa, David & Soraya Bertioli, University of Georgia
Peanut-based school meals, Mark Manary, Washington University-St. Louis
Production packages for Ghana, David Jordan, North Carolina State University
Seed coat biochemical markers, Mark Burow, Texas Tech University

Look Ahead

Variety development will select the best lines under drought and disease pressure. Drone imaging will be used to better predict performance. Greenhouse and field studies will optimize the chemical control of *Aspergillus flavus* infection, growth and aflatoxin contamination. Agronomic demonstration trials will be expanded to more areas where Outgrower Businesses (input and aggregation groups that are part of FtF's Market System and Resilience activity) are located. The school meal program will continue across all schools adding two all-female junior high schools. Household surveys to measure the impacts of the school meal program at the household level will start.

Madagascar

The USAID Madagascar mission initiated a buy-in with the Peanut Innovation Lab in October 2023 for the lab to work to improve the peanut value chain in the country, while Kansas State University's Global Collaboration on Sorghum and Millets (GCSM) leads a related activity on those crops. Based on previous work of GCSM, the Peanut IL developed a partnership with FOFIFA (the Malagasy national agriculture research institute) under a project called APEMBA (Agricultural Project for Enhancing sorghum Millet and peanuts Business Activity in Madagascar) that was launched in January 2024 with USAID and the Malagasy government.

USAID and mission representatives visited sorghum and groundnut trials and a seed multiplication site in June to learn about the work located on 500ha of agricultural land (200ha are under canal irrigation).

The Peanut Innovation Lab began work with public and private partners in Madagascar to improve groundnut production through variety development, improved production practices and mechanization, with a particular eye to promoting gender equity, improving nutritional outcomes and supporting markets.

Madagascar joined the Groundnut Improvement Network for Africa (GINA), a pan-Africa group of plant breeders who compiled lines from across the continent and work together to access the genetic diversity in that core collection of lines. Through GINA, the Peanut IL was able to obtain 15 improved lines most adapted to the local environments across the country (6 short duration from Senegal and a mix of nine short- and long-term duration lines from Uganda). Local varieties included Fleur 11, a short duration, drought tolerant line from Senegal and Donga, a higher yielding, red-seeded Virginia grown primarily in high-rainfall areas.

By the end of 2023, 12 research sites including FOFIFA research stations, private company properties, Ministry of Ag facilities and farmer fields were selected to host variety

adaptation trials. The sites stretch from the far northeast to the deep south and cover all relevant agro-ecologies from the central highlands to dry coastal regions.

Because the amount of seed was limited, not all varieties were testing in all locations. However, results pointed toward a need to focus on short-duration, drought-tolerant lines in the lowland regions (Menabe, Southwest and Deep South) and potential for disease-resistant (including Groundnut Rosette Disease), high-yielding, longer-duration Virginia-types in the central and northern regions.

To expand human capacity and prepare for the 2024-25 cropping season, the program sent eight interns (four to work with peanut, four to work with sorghum) to Senegal for intensive, hands-on training with the scientists at the Peanut IL partner ISRA-CERAAS. Over a cropping season, the interns worked with leading global experts in the field who also are Francophone and familiar with working in limited-resource settings.

Interns traveled from Madagascar to Senegal for a months-long immersion in conducting peanut and sorghum trials. Here, groundnut interns score the health of plants in trials in Senegal.

The program facilitated GINA sending more seed of 15 varieties from Senegal and Uganda, as well as additional varieties for the 2024-25 cropping season. This included nine varieties that have been released in multiple SADC countries. If these lines perform well, they might be released quickly in Madagascar under the seed harmonization treaty in the region. Commercial partners in Malawi, Senegal and Uganda would also be able to send larger volumes of these varieties to prime the seed system in Madagascar.

FOFIFA arranged for off-season seed production at two sites in Madagascar (near Ihosy and Toliara) to have more seed available and evaluate the potential for irrigated production in dry months. Initial data suggests that the Toliara site was well suited for peanut, producing decent yields and quality seed that was available for November planting. The crop in Ihosy matured later due to the higher elevation and cooler temperatures and may not be harvested in time for the next season. To assure better execution during the 2024-25 campaign, an experienced agronomist who has worked with CERAAS and helped train the interns in Senegal, was sent to Madagascar to work with FOFIFA during preparing and planting.

In addition to the work on variety evaluation, seed production and agronomy, the program has worked to find and bring together key stakeholders in the market to coordinate future efforts. From the private sector, Tozzi Green, an Italian-led agribusiness located near

Ihosy, has expressed interest in seed production and processing and participated in the Georgia Peanut Tour in September. From the market perspective, Groupe Basan, is a large Malagasy corporation that owns an RUTF producer and snack company. The donor community has shown interest in the peanut value chain as one of few viable commercial commodities in the vulnerable dryland areas of the country that have experienced frequent cyclones and drought. To define these opportunities, the Peanut IL will be conducting a value-chain assessment, focusing on evaluating market opportunities.

Finally, to help value chain actors explore opportunities available in peanuts, the Peanut IL has supported several people from Madagascar to attend the Groundnut Tour in Malawi in April and Georgia Peanut Tour in September. These tours have emphasized teamwork that led to initiatives in those countries and how integration of public and private sectors with research partners achieved growth and investment in the peanut/groundnut sector.

Students

The program is supporting many interns and students to strengthen capacity of in-country institutes involved in groundnut research and production. Eight students were sent to Senegal (CERAAS) for 3-month training on sorghum and groundnut research and systems.

Partners

FOFIFA
Tozzi Green
Group Basan

Projects

Breeding Management System & GINA coordination, Daniel Fonceka, CIRAD
Enhancing genetic potential in Eastern and Southern Africa, David Okello Kalule, NARO-NaSARRI
Enhancing genetic potential in West Africa, Aissatou Sambou, ISRA-CERAAS
Strengthening the groundnut value chain in Madagascar, Dave Hoisington, University of Georgia
Strengthening the sorghum and millet value chains in Madagascar, Nat Bascom, Kansas State University

Look Ahead

Groundnut and sorghum variety trials that will include additional varieties will be conducted for a second year in multiple sites including with private sector partners. A groundnut value chain assessment will be completed and disseminated to define market opportunities for groundnut. Local partners will be supported to participate in various sorghum and groundnut-related activities and opportunities. A groundnut workshop will be conducted mid-year to disseminate the latest findings and recommendations, as well as set priorities and goals for the future efforts.

Malawi

The Peanut Innovation Lab works with public and private partners in Malawi to improve groundnut production through variety development, improved production practices and mechanization, with a particular eye to promoting gender equity, improving nutritional outcomes and supporting markets.

Under the USAID Growth Poles Activity, the Peanut Innovation Lab has continued its strong focus on private sector engagement, particularly to reinforce the efforts of tobacco companies in diversification for their contracted farmers. These partnerships involve joint evaluations of improved varieties and agronomic practices, including evaluating these on-farm. Efforts to study the impact of gender training via the Gender Action Learning System (GALS) is in progress in partnership with Pyxus Agriculture Ltd. These activities have greatly impacted the whole groundnut sector, including demand for research and extension to scale varieties and production practices to smallholder farmers.

Malawi is part of the Groundnut Improvement Network for Africa (GINA), a pan-Africa group of plant breeders who compiled lines from across the continent and work together to access the genetic diversity in that core collection of lines. Along with other GINA countries, the Malawi Department of Agricultural Research Services has continued to expand their use of an advanced digital breeding platform to facilitate better management of trial design, data collection and analysis, and seed inventory.

Malawi is part of the Groundnut Improvement Network for Africa and is testing varieties from across the continent to find genetic resilience (left row) and vulnerability (right row) to diseases.

In work to develop new varieties, trials were conducted at DARS-Chitedze and Pyxus Mpale research farms to assess about 200 lines of the GINA Core Set and select those that performed well to incorporate into the Malawi Groundnut Advanced Line Trials (MGALTs) in the 2024/25 season. MGALTs involving 20 Virginia and 15 Spanish advanced lines also were conducted at eight sites across four agroecological zones in Malawi. Some lines performed well despite difficult drought and GRD conditions; partners will conduct a second year of trials in the 2024/25 season.

To evaluate varieties under various production practices, partners also conducted Malawi Groundnut Variety Trials (MGVTs) on 12 released varieties at eight sites across the four

agroecological zones. At the DARS-Chitedze and Pyxus Mpale, the trials were conducted under both low (good seed, high planting density) and high (good, seed, inoculant, legume fertilizer) input conditions. While only the first year, a few lines (e.g., CG 11) performed well across several sites. The trials will be continued over multiple years and locations to create a reliable estimate of how the varieties perform under different conditions.

New drone-based imaging promises to help new groundnut varieties travel through the development pipeline faster. To build local capacity to use drone imaging a DARS research technician, who also is pursuing a master's degree, was trained in how to fly drones, capture images and analyze the images to develop predictive models at a five-week (25 March-30 April) training program at Virginia Tech in Suffolk, Virginia. The student will conduct research to develop predictive models for disease traits, performance under drought and maturity as part of their thesis research under the project and supervision of the peanut breeder and project PI.

DARS planted five hectares of breeder seed during the main 2023-24 rainy season – two Virginia (CG 9 and CG 11) and four Spanish (CG 13, CG 14, CG 15, and CG 17) but the yield was only about half of expected volume, due to mid-season drought and high GRD pressure. DARS opted to make up for this shortfall by planting three hectares of off-season breeder seed production plots at Masenjere in Chikwawa and Bwanje in Dedza under irrigation. Harvest is expected in late October-early November and was projected to add an additional 4,720 kgs of seed, nearly doubling the yield over 2022-23.

Hundreds of people from across Africa and the US attended the three-day Groundnut Tour in Malawi in April to highlight advances in commercializing the groundnut sector there.

GREAT (Groundnut Research Extension and Adoption of Technology) trials are honing recommendations for production practices and helping farmers to weigh their own return on investment. The trials are held on-station and on-farm to test agronomic inputs and practices to improve groundnut yield and quality. In FY 2024, researchers and farmers evaluated four sequentially increasing input packages – base (improved seed & high planting density), base + lime, and base + lime + fungicide, base + lime + fungicide + fertilizer – in replicated trials at research farms owned by Pyxus and Horizon Farms and as single replicates in 144 Pyxus farmers' fields. Other replicated trials at Pyxus and Horizon Farms included fertility (16 treatments), herbicide (16 treatments), disease (16

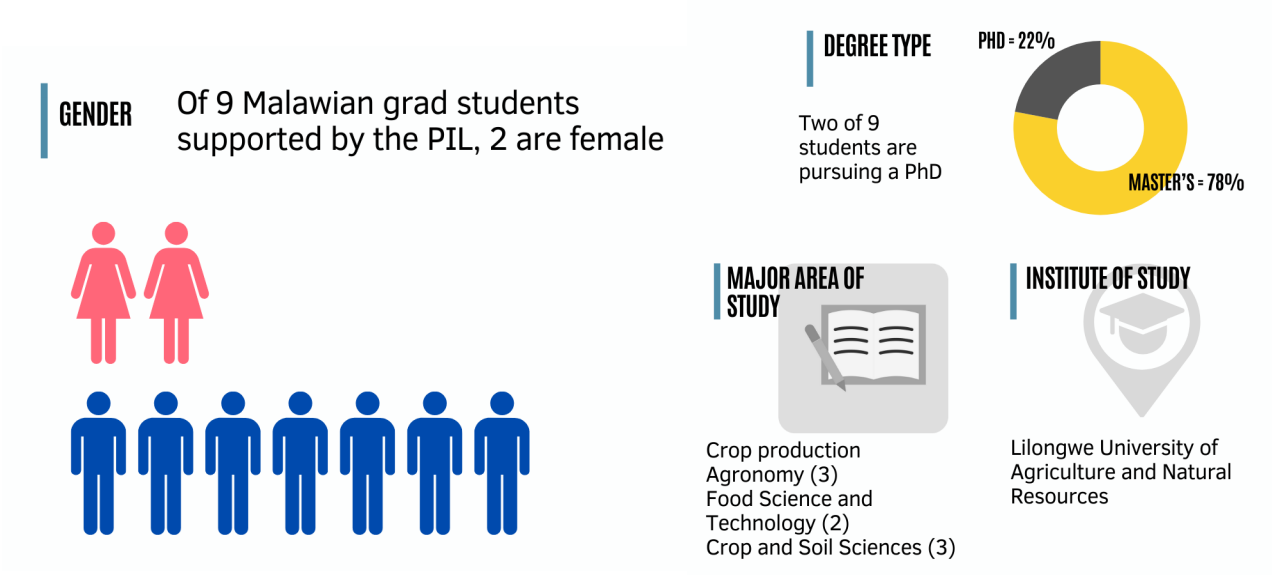
treatments), tillage and crop rotation (9 treatments) and tillage and fertility (12 treatments). Most input packages increased yield and quality, but the improvements were not statistically significant, likely due to the severe drought and heavy groundnut rosette disease pressure across both research locations.

Much of this work was celebrated in April at the Groundnut Tour in Malawi, when more than 200 people from 15 countries came to tour groundnut research and production facilities, many of which have been developed over the past few years. The Peanut Innovation Lab along with Pyxus Agriculture and USAID Growth Poles organized the first iteration of the tour on 16-18 April. Over the course of the three days, attendees visited research trials, seed production and buying point demos at DARS, Horizon Farms and Pyxus; visited the Pyxus shelling plant; and attended a final day of presentations on the future of groundnut in Malawi which included booths set up by various local stakeholders.

The program designed and built a portable thresher that can quickly and efficiently strip pods from harvested vines. A small US company, Frank's Designs for Peanuts, built and shipped a thresher to Malawi in February and demonstrated it during the Groundnut Tour in April. Following the tour, staff at Pyxus and DARS evaluated on their respective stations and found that the machine can thresh 10 bags or approximately 500 kg per hour. The lab is talking with local manufacturers and will evaluate the machines in the next season.

In preparation for assessing the impacts of GALS (Gender Action Learning System) training in improving household equality and impact of agricultural-led growth, approximately 200 households (400 individuals) in Mchinji and Lilongwe districts participated in a pilot study to evaluate the household survey to be used in the project. The survey is being conducted in collaboration with LUANAR-Bunda and WOLREC.

Students



Partners

Lilongwe University of Agriculture and Natural Resources (LUANAR)
Department of Agricultural Research Services (DARS)
Horizon Farms, Ltd.
Pyxus Agriculture Ltd.
Universal/Limbe Leaf
Malawi Growth Poles Activity
WOLREC
Malawi Mangoes
Agricane

Projects

Breeding Management System & GINA coordination, Daniel Fonceka, CIRAD
Coordination of production packages for Malawi, Greg MacDonald, University of Florida
Coordination of variety trials & early-generation seed in Malawi, Naveen Puppala, New Mexico State University
Enhancing genetic potential in Eastern and Southern Africa, David Okello Kalule, NARO-NaSARRI
Gender Action Learning System impact in Malawi, Stuart Sweeney, University of California-Santa Barbara
Genomics support for GINA and Groundnut Rosette Disease, Josh Clevenger, HudsonAlpha Institute for Biotechnology
High-throughput phenotyping, Maria Balota, Virginia Tech
Malawi household impact assessments, Jessica Marter-Kenyon, University of Georgia
Production packages for Malawi, Rick Brandenburg, North Carolina State University
Strengthening the groundnut value chain in Malawi, Dave Hoisington, University of Georgia
Varieties & EGS for Malawi, Justus Chintu, DARS-Chitedze

Look Ahead

All variety and agronomy trials will be repeated to gain a second year of data. TRICOT trials will evaluate varieties with 315 farmers. Drone images will be collected and predictive models developed. Options to manufacture the thresher locally will be explored and additional units built to further assess the throughput and identify possible improvements in design. A Groundnut Research conference will be organized with LUANAR and DARS to provide updates on the latest research findings to a wide range of stakeholders. Approximately 10,000 households will receive GALS training as part of work to analyze the effectiveness of this system.

Senegal

Senegal is the West Africa hub for the Groundnut Improvement Network for Africa (GINA), a pan-Africa group of plant breeders who compiled lines from across the continent and work together to access the genetic diversity in that core collection. Along with other GINA countries, Senegal's Institut Sénégalais de Recherches Agricoles (ISRA) has adopted the advanced digital breeding platform, Breeding Management System, to facilitate better management of trial design, data collection and analysis, and seed inventory.

As the regional coordinator for the network, ISRA-CERAAS has continued to share germplasm across Africa. In FY24, 10 lines from the GINA core-collection that showed high pod yield and stability across environments in West Africa as well as six recently registered varieties in Senegal were shared with IRAG peanut breeding program in the Republic of Guinea. In addition, seven varieties from Senegal, nine from Uganda and eight from Malawi have been shared with FOFIFA peanut breeding program in Madagascar.

At CERAAS, Aissatou Sambou leads GINA work in West Africa, supporting colleagues in the region with germplasm from the collection and expert advice.

In Senegal, new groundnut varieties that will help farmers to adapt to climate change and disease are making it through the development pipeline faster through new drone-based imaging that more quickly predicts performance. To build local capacity to use drone imaging, a scientist from ISRA-CERAAS participated in a training in how to fly drones, capture images and analyze the images to develop predictive models at a five-week (25 March-30 April) training program at Virginia Tech in Suffolk, Virginia. A total of 240 varieties from the GINA core set were planted on July 31 at a site in Nioro. Two flight missions were already performed at Nioro, imaging 240 varieties grown under drought conditions. A PhD graduate student with the Cheikh Anta Diop University will join the project in late 2024.

The staff at ISRA also has been working with a portable NIR spectrometer provided by the PIL (along with training in how to use the equipment) to predict fatty acid values in groundnut.

Towards the release of new varieties, especially ones that combine high oleic content with resistance to *Aspergillus flavus* and rust, over 100 lines are in trials at the ISRA stations in Nioro, Kolda and Djibelor, 19 lines out of a total of 109 short- and medium-duration high oleic (>75% oleic acid content) lines are being evaluated in multilocation trials, and over

250 extra-early maturity lines are being developed to target the highly variable rainfall environments. Additional crosses are being advanced to produce improved varieties meeting market demands and that have tolerance to drought and diseases required for future climate scenarios.

A farmer in the Groundnut Basin of Senegal shows his TRICOT field to visitors. The citizen-science methodology allows farmers to assess varieties and advise seed producers on which they prefer.

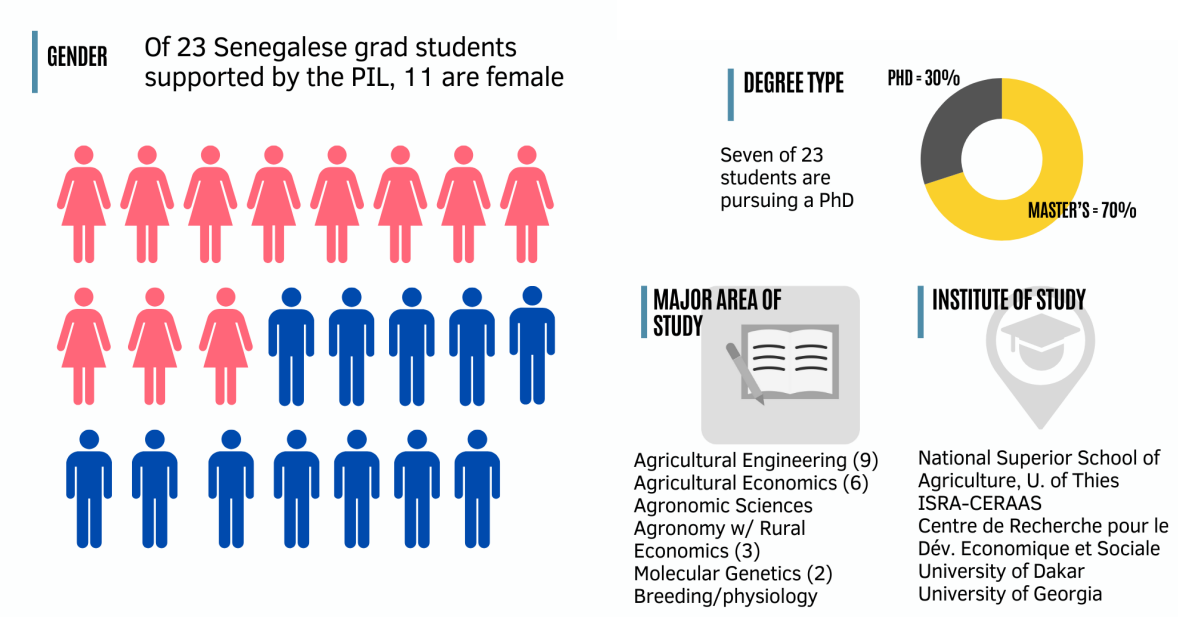
Data revealing that extreme heat days have already reduced yields has reoriented efforts in the breeding program to evaluate germplasm for heat tolerance. Senegal offers an excellent opportunity for this due to the quality of the research programs and the natural gradient of heat that increases the further you travel away from the coast. The research station in Tambacounda will now focus on variety evaluations for heat.

A new type of trial promises to give insight into farmer preferences and help seed producers strategically grow volumes and varieties that farmers want. TRICOT (triadic comparisons of technologies) trials provide farmers random sets of three varieties which they grow under their usual practices and rank based on how they perform. To gather this data, the lab began TRICOT trials in Senegal in 2024 involving 10 top lines identified from the GINA collection, including one line that is in the registration process in Senegal and four that have recently been registered. The trials are being conducted with the Caritas NGO and involve 250 farmers in the groundnut basin. Ten students and ten Caritas staff are handling 25 farmers each in three major peanut producing regions in the groundnut basin (Fatick, Kaolack and Kaffrine). Data collection is in progress.

A groundnut seed sector review was conducted with ENSA, RESOPP, ISRA, CIRAD, DISEM and SCKA partners to identify strengths, opportunities and bottlenecks in improved groundnut seed production. RESOPP and other seed producers are refining a draft report of these findings, which include specific recommendations building capacity in the groundnut seed sector and creating a more enabling environment to generate and disseminate improved seed. In partnership with RESOPP, ISRA and SCKA, SCL is producing approximately 12 metric tons of improved groundnut seed for 450 households in 30 treated survey sample villages to trial in 2025.

The lab established a partnership with private seed producers SCL and RESOPP to generate high quality groundnut seed for farmers to evaluate and to improve groundnut seed markets in Senegal. Ten to 60 kg of early generation seed were provided to SCL for producing pre-basic seed. Two staff of SCL attended the Georgia Peanut Tour to learn about seed production and mechanization and network with other private companies working in the US and in Africa. SECPA, a small private seed producer, is receiving pre-basic seeds of five recently registered varieties.

Students



Partners

Institut Sénégalais de Recherches Agricoles (ISRA)
Centre d'Etudes Régional pour l'Amélioration de l'Adaptation à la Sécheresse (CERAAS)
Centre de Recherche Pour le Developpement Economique et Social (CRDES)
Centre National de Recherche Agronomique (CNRA)
Ecole Nationale Superieure Agricole (ENSA)
Societe de Cultures Legumieres (SCL)
Senegal Farmers' and Pastoral Organizations Network (RESOPP)

Projects

Breeding Management System & GINA coordination, Daniel Fonceka, CIRAD
Breeding germplasm for quality & drought, Mark Burow, Texas A&M University
Enhancing genetic potential in West Africa, Aissatou Sambou, ISRA-CERAAS
Genomics support for GINA, Josh Clevenger, HudsonAlpha Institute for Biotechnology
High-throughput phenotyping, Maria Balota, Virginia Tech
Novel diversity to improve peanut in Africa, David & Soraya Bertioli, University of Georgia
Senegal seed adoption, Brad Mills, Virginia Tech

Look Ahead

Variety development efforts will continue to select the best lines under drought and disease pressure. Drone imaging will be used to better predict performance under drought and disease pressure. On-farm TRICOT trials will be completed and analyzed to determine preferred varieties, and plans made for next season's trials. Certified quality seed of the improved varieties will be distributed to farmers in a selected samples of 30 villages and household surveys and farmer interviews will be conducted across 1,125 households.

Uganda

Uganda is the Eastern and Southern Africa hub for the Groundnut Improvement Network for Africa, a pan-Africa group of plant breeders who compiled lines from across the continent and work together to access the genetic diversity in that core collection of lines. Along with other GINA countries, Uganda's National Agricultural Research Organisation (NARO) has adopted the advanced digital breeding platform, Breeding Management System, to facilitate better management of trial design, data collection and analysis, and seed inventory.

As the regional coordinator for the network, NARO has continued to share germplasm across Africa, supporting the development of trials in Madagascar with germplasm and expert advice. Researchers hosted colleagues from Madagascar to tour Ugandan breeding facilities and trial sites.

Uganda released three new varieties in 2024, which farmers welcomed enthusiastically. NARO Nut 5R, 4R and 3R promise improved yields and resilience for farmers in semi-arid regions.

In work to bring new varieties to Ugandan farmers, good progress was made to enrich the groundnut variety development pipeline with new lines for evaluation and new drone-based imagining for more rapid prediction of performance. To build the required local capacity for using drone imaging, a graduate student was trained in how to fly drones, capture images and analyze the images to develop predictive models at a six-week (25 March-30 April) training program at Virginia Tech in Suffolk, Virginia. The student will conduct research to develop predictive models for disease traits, performance under drought and maturity as part of their thesis research under the project and supervision of the peanut breeder and project PI.

A total of 206 lines derived from crosses between Serenut 9T (a leading Ugandan variety) and B7-30-9-3 (a line with good groundnut rosette resistance) were characterized for disease resistance and yield at the National Semi-Arid Resources Research Institute (NaSARRI), in Serere District, Eastern Uganda. Three new groundnut varieties were released in February. Breeders are screening high oleic lines from the GINA core and ICRISAT to identify final lines to evaluate in national performance trails in 2025 to release as high oleic varieties.

TRICOT trials targeting 100 farmers have been designed and are ready to implement next season. A total of 6 MT of early generation seed (EGS) of flagship varieties was produced and is ready to share with partners via NARO Holdings. A total of 40 demonstration plots were planted nationwide and used for training of 4,225 farmers and other stakeholders.

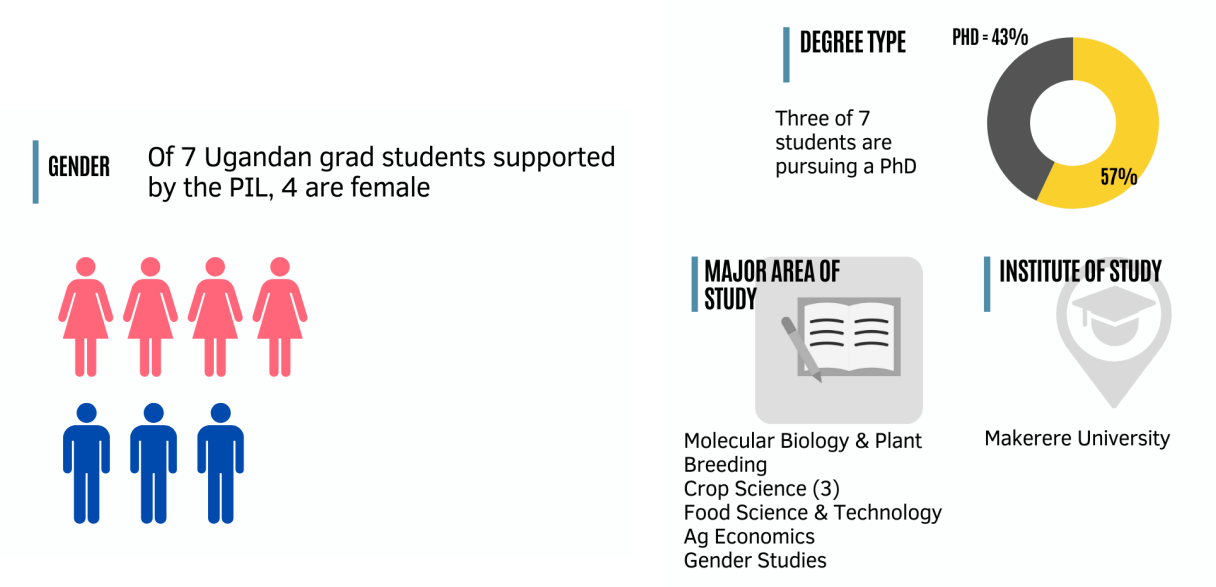
Together with the Uganda National Academy of Sciences, the book titled "Owning our Futures: Approaches to Realize Community Action for Climate Change Adaptation in Uganda. Report of the Committee on Community Action for Climate Change Adaptation" was published presenting recommendations for addressing climate change in the country. The achievements of the groundnut team were featured in four newspaper articles, six TV appearances, over 40 radio talk shows and a 15-week radio show.

Palwo women groups in the Pader district of northern Uganda are producing seed of released groundnut varieties at two locations (Pajule and Kiteny). Nwoya Youth Local Seed Businesses (Ma Icayo Aye Konyi LSB) are multiplying seed of two released varieties and have hosted awareness and commercialization demonstrations for these flagship groundnut varieties to local communities.

Two groundnut demonstrations for refugee settlements and host communities were planted in Palabek and Lokung districts in Lamwo district Northern Uganda. Two local community genebanks in Soroti (Katine) and Amuria (Orungo) were involved in the conservation of landraces, hosting demonstration plots, variety selection plots and multiplication of the flagship varieties.

SUMZ Foods, IVORY Organics, and McDough Foods have been involved in testing various released varieties for their enterprises/market segments.

Students



Partners

National Agricultural Research Organization-National Semi-Arid Resources Research Institute (NARO-NaSARRI)
Makerere University

Projects

Breeding Management System & GINA coordination, Daniel Fonceka, CIRAD
Enhancing genetic potential in Eastern and Southern Africa, David Okello Kalule, NARO-NaSARRI
Genomics support for GINA and Groundnut Rosette Disease, Josh Clevenger, HudsonAlpha Institute for Biotechnology
Groundnut Rosette Disease in West Africa, Richard Oteng-Frimpong, CSIR-SARI
High-throughput phenotyping, Maria Balota, Virginia Tech
Novel diversity to improve peanut in Africa, David & Soraya Bertioli, University of Georgia

Look Ahead

Drone images of 200 GINA core lines will be used to identify the best lines. More than 50 lines will be evaluated for inclusion in national performance trials next year, and 292 Uganda landraces and high oleic lines screened for disease resistance. TRICOT trials involving at least 100 farmers will be implemented. Breeder and EGS plots will be planted to produce demanded seed of flagship varieties. At least 3,000 farmers (youth, women, men), processors, students (graduate, undergrad, diplomas and certificates) will be trained in groundnut production practices.

Zambia

Good progress was made to enrich the groundnut variety development pipeline with new lines for evaluation. From the GINA Core Set, eight lines have been evaluated in five multi-location trials and 10 on-farm trials in Zambia with the second set of trials completed in FY24. From these trials, two lines have been identified with excellent performance and will be submitted into the variety release process next year. Especially exciting is the identification of the GRD resistant Spanish variety from the GINA Core Set.

The Peanut IL promotes collaboration with private sector wherever possible, recognizing the value of shared investment to create demand for improved technologies. Discussions with Good Nature Agro in Chipata have taken place to develop a partnership for evaluating released varieties, conducting GREAT (Groundnut Research Extension and Adoption of Technology) trials to assess impacts of production practices, and to develop a more sustainable seed system for groundnut. The Good Nature Agro CEO and operations director participated in the Georgia Peanut Tour in September.

The local and regional GINA collaborators are all engaging in digital management of their breeding programs through the Breeding Management System platform. They are also engaging in the evaluation of modern phenotyping tools, including the use of modern drone imaging to predict performance in the field.

The GINA collaborators are sharing diverse germplasm across the continent to give farmers access to the best available varieties, while continuing to address challenges of heat, drought and disease through modern breeding approaches.

Partners

Zambia Agricultural Research Institute, Msekera Research Station
Good Nature Agro

Students

The PIL supports one PhD student, a man, who specializes in plant breeding.

Projects

Breeding Management System & GINA coordination, Daniel Fonceka, CIRAD
Enhancing genetic potential in Eastern and Southern Africa, David Okello Kalule, NARO-NaSARRI
Genomics support for GINA and Groundnut Rosette Disease, Josh Clevenger, HudsonAlpha Institute for Biotechnology

Look Ahead

The selected lines will be submitted for ultimate release as new varieties. Additional diverse materials will be screened and crosses made to develop high oleic varieties.

Projects

Most projects in the previous phase were continued through 2028, with new activities and goals to scale up the innovations from in the first five-year phase.

Funding for PIL projects comes from various sources, including Cooperative Agreement No. 7200AA 18CA00003 to the University of Georgia as management entity for U.S. Feed the Future Innovation Lab for Peanut. The lab also receives funding through a buy-in with the USAID Mission in Madagascar and through a contract with the Malawi Mission's Growth Poles activity in Malawi. Funding from Irish Aid facilitates gender research in Malawi.

Breeding Management System & GINA coordination

PI: Daniel Fonceka, CIRAD, Montpellier, France
Budget: $500,000 *(Jan 2023-Jan 2028, funded through PIL Cooperative Agreement)*
Countries: GINA
Description: This project supports the Groundnut Improvement Network for Africa (GINA) in project coordination and using the Breeding Management System, a platform that organizes and standardizes data collection. Making breeding programs more efficient improves variety development, germplasm management and sharing, in seed multiplication and diffusion across the GINA national programs. The work involves coordinating GINA efforts at the regional level and supporting the implementation of modern breeding schemes, population development and variety testing. The project is expected to significantly strengthen the GINA network, to contribute to the development and dissemination of new, improved peanut varieties of higher yield and better quality that are adapted to the realities of climate change and that contribute to food security across countries in Africa.
Partners: Jean-Marcel Ribaut, IBP, El Batán, Mexico; Alioune Mbow, SKCA, Dakar, Senegal; David Okello, NARO-NaSARRI, Soroti, Uganda; Jean-Francois Rami, BIOS_AGAP CIRAD, Montpellier, France

Breeding germplasm for quality & drought

PI: Mark Burow, Texas A&M University, Lubbock, TX USA
Budget: $249,903 *(Jan 2023-Jan 2028, funded through PIL Cooperative Agreement)*
Countries: GINA, Senegal, Ghana
Description: This project works to develop and release improved groundnut varieties with traits that meet market demands. While initially these efforts focus on demands in Senegal and Ghana, the traits are considered critical for most all GINA countries. Varieties to be released are Spanish market types (a major market type in Africa) that possess good tolerance to drought/water stress; resistance to leafspot, groundnut rosette disease (GRD) and *Aspergillus flavus* infection/low aflatoxin contamination; early to medium maturity; normal and high oleic acid content; medium to large seed size; and fresh seed dormancy (if possible). The project also aims to develop high-throughput screening techniques for *A.*

flavus resistance/aflatoxin contamination, assist in the use of UAV-based imaging, and identify genes/QTLs associated with drought tolerance, *A. flavus* resistance/aflatoxin contamination and GRD resistance.
Partners: Issa Faye, ISRA-CNRA, Bambey, Senegal; Richard Oteng-Frimpong, Theophilus Tengey, CSIR-SARI, Nyankpala, Ghana; John Cason, Charles Simpson, Texas A&M AgriLife Research, Stephenville, TX, USA; Venugopal Mendu, Texas A&M University, Kingsville, TX, USA; Haydee Laza, Texas Tech University, Lubbock, TX, USA

Coordination of production packages for Malawi

PI: Greg MacDonald, University of Florida, Gainesville, FL, USA
Budget: $127,539 *(Jan 2023-Jan 2028, funded through PIL Cooperative Agreement)*
Countries: Malawi
Description: One of two projects aimed at improving production practices in Malawi, this project involves on-station and on-farm trials of groundnut production inputs and packages. The trials conducted with local partners across the target agro-ecological zones (Mid/High-Altitude, Lakeshore, and Shire Valley) involve varieties and production practices appropriate for smallholder (low inputs) to mega-farm/commercial (high inputs) farmers.
Partners: Rick Brandenburg, David Jordan, NCSU, Raleigh, NC, USA; Wezi Mhango, LUANAR-Bunda, Lilongwe, Malawi; Limbikani Matumba, LUANAR-NRC, Lilongwe, Malawi; Justus Chintu, DARS-Chitedze, Lilongwe, Malawi; Andrew Goodman, Precious Mtengezo, Horizon Farms, Lilongwe, Malawi; Yaona Mtonga, Pyxus Agriculture, Lilongwe, Malawi; Charlie Leaper, Malawi Mangoes, Matumba, Malawi; Callum Saunders, Agricane/Growth Poles, Lilongwe, Malawi; Naveen Puppala, NMSU, Las Cruces, NM, USA

Coordination of variety trials & early-generation seed in Malawi

PI: Naveen Puppala, New Mexico State University, Las Cruces, NM, USA
Budget: $246,600 *(Jan 2023-Jan 2028, funded through PIL Cooperative Agreement)*
Countries: Malawi
Description: This project provides expert advice to in-country partners as they design, implement and analyze trials for advanced lines and released varieties. The trials are conducted across agro-ecological zones (Mid/High-Altitude, Lakeshore, and Shire Valley) and involve varieties and production practices appropriate for smallholder (low input) to mega-farm/commercial (high input) farmers. Work also supports the production of early-generation seed through the establishment of demand-based quantities and seed production practices that allow public and private partners to deliver the required quantity and quality of seed each year. Finally, the project will develop and test new versions of selected released varieties that are improved for nematode resistance and high oleic composition.
Partners: Justus Chintu, DARS-Chitedze, Lilongwe, Malawi; Andrew Goodman, Precious Mtengezo, Horizon Farms, Lilongwe, Malawi; Yaona Mtonga, Pyxus Agriculture, Lilongwe, Malawi; Charlie Leaper, Malawi Mangoes, Matumba, Malawi; Callum Saunders, Agricane/Growth Poles, Lilongwe, Malawi

Enhancing genetic potential in Eastern and Southern Africa

PI: David Okello Kalule, NARO-NaSARRI, Soroti, Uganda
Budget: $501,969 *(Jan 2023-Jan 2028, funded through PIL Cooperative Agreement)*
Countries: GINA, Malawi, Mozambique, Tanzania, Uganda, Zambia
Description: Uganda is a hub for GINA in East and Southern Africa, creating benefits for Ugandan farmers and supporting breeding efforts in other countries. Partners specifically are working to optimize breeding pipelines to develop varieties with resistance to GRD and high-oleic content.
Partners: Lutangu Makweti, ZARI, Chipata, Zambia; Amade Muitia, IIAM, Nampula Research Station, Nampula Mozambique; Justus Chintu, DARS, Chitedze, Lilongwe, Malawi; Jean-Marcel Ribaut, IBP, El Batán, Mexico; Josh Clevenger, HudsonAlpha Institute for Biotechnology, Huntsville, AL, USA; Daniel Fonceka, CIRAD, Montpellier, France

Enhancing genetic potential in West Africa

PI: Aissatou Sambou, ISRA-CERAAS, Thies, Senegal
Budget: $387,470 *(Jan 2023-Jan 2028, funded through PIL Cooperative Agreement)*
Countries: GINA, Burkina Faso, Gambia, Ghana, Guinea, Mali, Niger, Senegal, Togo
Description: As a regional center for research in West Africa, Senegal is a hub for GINA, creating benefits for Senegalese farmers and supporting breeding efforts in other countries. Partners specifically are working to optimize breeding pipelines to develop varieties with resistance to leafspot, high oleic, high protein, zinc and iron content; enlarge the diversity of the GINA core collection with germplasm from USDA and breeding lines from new GINA partnering breeding programs; use TRICOT trials to test for the most adapted elite lines; and produce breeder seed for the most demanded varieties.
Partners: Daniel Fonceka, CIRAD, Montpellier, France; Issa Faye, ISRA-CNRA, Bambey, Senegal; Joel-Romaric Nguepjop, CIRAD, UMR-AGAP, ISRA-CERAAS, Thies, Senegal; Richard Oteng-Frimpong, CSIR-SARI, Nyankpala, Ghana; Dramane Sako, CRRA/IER, Kayes, Mali; Moumouni Konaté, INERA, Farakoba, Burkina Faso; Essohouna Modom Banla, CRASS/ITRA, Kara, Togo; Sulayman Fofana, NARI, The Gambia; Jean François Rami, CIRAD, Montpellier, France; Jean-Marcel Ribaut, IBP, El Batán, Mexico; Peggy Ozias-Akins, UGA, Tifton, GA, USA; Josh Clevenger, HudsonAlpha Institute for Biotechnology, Huntsville, AL, USA

Gender Action Learning System impact in Malawi

PI: Stuart Sweeney, University of California-Santa Barbara, Santa Barbara, CA, USA
Budget: $1,181,919 *(Jan 2023-Jan 2028, funded through PIL Cooperative Agreement)*
Countries: Malawi
Description: As groundnut – which is often grown by women – grows in importance in Malawi, women could lose an important source of income if men take over. Researchers are studying the training programs that are meant to empower women to see if they are effective in helping both men and women communicate and achieve their goals. The project evaluates the efficacy of training programs (Gender Action Learning System,

Financial Literacy, and Business Development) crossed with market interventions (groundnut contracts, market purchases, unconditional cash transfers).
Partners: Kathy Baylis, University of California-Santa Barbara, CA, USA; Donald Makoka, LUANAR, Lilongwe, Malawi; Sekanawo Kasiya, LUANAR, Lilongwe, Malawi; Maggie Banda, WOLREC, Blantyre, Malawi; Erin Lentz, University of Texas, Austin, TX, USA; Sari Blakeley, Columbia University, New York, NY, USA

Genomics support for GINA and Groundnut Rosette Disease

PI: Josh Clevenger, HudsonAlpha Institute for Biotechnology, Huntsville, AL, USA
Budget: $271,587 *(Jan 2023-Jan 2028, funded through PIL Cooperative Agreement)*
Countries: GINA
***Description*:** This project provides genetic mapping and selection services to help breeders throughout the GINA network to choose lines that carry specific traits. HudsonAlpha developed Khufu, a set of software tools that analyzes the entire genome quickly, producing genotyping information fast, within the time needed to make real time selections in breeding programs. The project aims to finalize development of genomic markers for groundnut rosette virus disease (GRD) and to support the objectives of the broader peanut innovation lab projects and the breeding goals of the GINA partners. These objectives include mapping wild species introgressions that are linked to key traits and efficiently selecting for those introgressions within selection programs, further characterizing GINA diversity, determining varietal purity using genome-wide markers to understand allelic frequency within breeding populations, and integrating known and newly discovered variation linked to important diseases into selection programs.
Partners: GINA, Daniel Fonceka, CIRAD, Montpelier, France; David Okello, NARO-NaSARRI, Soroti, Uganda

Ghana school meal household impacts

PI: Mywish Maredia, Michigan State University, East Lansing, MI, USA
Budget: $350,000 *(Oct 2024-Jan 2028, funded through PIL Cooperative Agreement)*
Countries: Ghana
Description: Researchers are surveying 1500 households (750 where kids are getting a peanut-based meal at school and 750 where there is no school meal) in two waves to gauge the social impacts (including reductions in women's childcare responsibilities) of a peanut-based meal served at school. At the same time, researchers are identifying and evaluating three to five labor-saving technologies with the potential to reduce time-related barriers to economic upgrading for women.
Partners: Andrew Agyei-Holmes, University of Ghana, Accra, Ghana; Ayala Wineman, Michigan State University, East Lansing, MI, USA; Nana-Amma Asante-Poku, University of Ghana, Accra, Ghana; Richmond Atta-Ankomah, University of Ghana, Accra, Ghana

Groundnut Rosette Disease in West Africa

PI: Richard Oteng-Frimpong, CSIR-SARI, Nyankpala, Ghana
Budget: $350,000 *(Jan 2023-Jan 2028, funded through PIL Cooperative Agreement)*
Countries: GINA, Ghana, Togo, Uganda
Description: Groundnut Rosette Disease (GRD) is a growing problem in Western Africa, where local varieties have no genetic resistance. The project involves growing GINA varieties in GRD hotspots in Ghana to identify resistant lines that can be deployed immediately to farmers' fields. Following that, breeders will introgress the sources of resistance into elite or well-adapted peanut varieties in Ghana. The TRICOT approach will be employed to speed up dissemination of promising varieties while gathering the required data for varietal release. Early-generation seed will be produced for the varieties developed to produce certified seed. These varieties will help farmers to overcome low yields from GRD infection and improve their productivity and livelihoods.
Partners: Jerry Asalma Nboyine, CSIR-SARI, Tamale, Ghana; Essohouna Modom Banla, CRASS/ITRA, Kara, Togo; David Okello, NARO-NaSARRI, Soroti, Uganda; Peggy Ozias-Akins, Department of Horticulture, University of Georgia, Tifton, GA, USA; Josh Clevenger, HudsonAlpha Institute for Biotechnology, Huntsville, AL, USA

High-throughput phenotyping

PI: Maria Balota, Virginia Tech, Suffolk, VA, USA
Budget: $522,226 *(Jan 2023-Jan 2028, funded through PIL Cooperative Agreement)*
Countries: GINA, Ghana, Malawi, Senegal, Uganda
Description: This work aims to speed up the process of breeding new varieties by making phenotyping more efficient, accurate and uniform with digital tools and analysis methods involving remote sensors and drone images. These high throughput phenotyping methods (HTP) provide better breeding and allow integrated data collection, management, and analysis across the Groundnut Improvement Network for Africa (GINA). The work builds on expertise and capacity developed from the initial five years of the project (2018-2023), including data collected from lines of the 300-line African set using proximal sensors purchased through this grant, and the developed vegetation indices (VIs) with superior prediction power over the traditional methods that are currently being deployed for use in selection for disease resistance, water stress tolerance, and yield.
Partners: David Kalule Okello, NARO-NaSARRI, Soroti, Uganda; Richard Oteng-Frimpong, CSIR-SARI, Nyankpala, Ghana; Daniel Fonceka, CIRAD, Montpelier, France; Issa Faye, ISRA-CNRA, Bambey, Senegal

Malawi household impact assessments

PI: Jessica Marter-Kenyon, University of Georgia, Athens, GA, USA
Budget: $1,115,651 *(Feb 2023-Jan 2028, contract with Malawi Mission Growth Poles Activity)*
Countries: Malawi
Description: The project supports activities by LUANAR and WOLREC in Malawi to conduct household surveys under the Peanut IL UCSB project.
Partners: Donald Makoka, Sekanawo Kasiva, LUANAR, Lilongwe, Malawi; Maggie Banda, WOLREC, Blantyre, Malawi; Stuart Sweeney, Kathy Baylis, University of California-Santa Barbara; Erin Lentz, University of Texas at Austin; Sari Blakeley, Columbia University; Pyxus Agriculture, Malawi; Liz Venable, Growth Poles Activity, Malawi

Novel diversity to improve peanut in Africa

PI: David & Soraya Bertioli, University of Georgia, Athens, GA, USA
Budget: $500,000 *(Jan 2023-Jan 2028, funded through PIL Cooperative Agreement)*
Countries: GINA, Senegal, Uganda
Description: This work introduces genetic diversity from peanut's wild relatives into African peanut cultivars to convey disease resistance and climate resilience. This is done by creating crosses of wild species that have identified genes for desirable traits (such as yield, disease resistance, heat and drought tolerance) and incorporating them through traditional breeding into elite farmer-preferred varieties. This work focuses on some of the most challenging problems for peanut production in Africa: groundnut rosette disease, late leaf spot and stress from drought and heat. National programs in Senegal, Uganda and other GINA countries are able to produce peanut cultivars with superior resistance to serious pests and diseases and with longer shelf-life through the wilds' genes.
Partners: David Okello, NARO-NaSARRI, Soroti, Uganda; Daniel Fonceka, CIRAD, Montpellier, France; Peggy Ozias-Akins, UGA, Tifton, GA, USA

Peanut-based school meals

PI: Mark Manary, Washington University-St. Louis, St. Louis, MO, USA
Budget: $750,000 *(Jan 2023-Jan 2028, funded through PIL Cooperative Agreement)*
Countries: Ghana
Description: Around 3,000 students ages 5 to 15 years old will be given a traditional meal of porridge or a peanut-based meal over a school year to see how the peanut-based meal improves cognition and attendance, particularly for adolescent girls. Since the peanuts are grown and processed in northern Ghana, the project seeks to create market pull for clean, healthy groundnuts. A related project is evaluating the household impacts of the school meals.
Partners: Issah Shani, Matilda Steiner-Asiedu, Firibu Saalia, University of Ghana, Accra, Ghana; Kevin Stephenson, Donna Wegner, Washington University School of Medicine, St. Louis, MO, USA

Production packages for Ghana

PI: David Jordan, North Carolina State University, Raleigh, NC, USA
Budget: $499,810 *(Jan 2023-Jan 2028, funded through PIL Cooperative Agreement)*
Countries: Ghana
Description: The project demonstrates how certain production packages can reduce the negative impact of pests, improve soil fertility, reduce the risk of aflatoxin contamination and, in some cases, make farmers more money. Farmers experience the impacts of a range of production packages using the Outgrower Business network, a system of lead farmers and aggregators in northern Ghana. Through demonstration plots at three stations and TRICOT trials, farmers can see and express their preferences about production packages.
Partners: Jerry Nboyine, Richard Oteng-Frimpong, Ahmed Seidu, CSIR-SARI, Nyankpala, Ghana; Rick Brandenburg, NCSU, Raleigh, NC; USA; Greg MacDonald, UF, Gainesville, FL; USA; Richard Akromah, William Ofori Appaw, KNUST, Kumasi, Ghana

Production packages for Malawi

PI: Rick Brandenburg, North Carolina State University, Raleigh, NC, USA
Budget: $562,111 *(Jan 2023-Jan 2028, funded through PIL Cooperative Agreement)*
Countries: Malawi
Description: One of two projects aimed at improving groundnut production practices in Malawi, this project involves research into specific agronomic inputs and building local capacity by supporting PhD and MSc students' research.
Partners: David Jordan, NCSU, Raleigh, NC, USA; Greg MacDonald, UF, Gainesville, FL, USA; Wezi Mhango, LUANAR-Bunda, Malawi; Limbikani Matumba, LUANAR-NRC, Malawi; Justus Chintu, DARS-Chitedze, Lilongwe, Malawi; Andrew Goodman, Horizon Farms, Malawi; Precious Mtengezo, Horizon Farms, Malawi; Yaona Mtonga, Pyxus, Malawi; Charlie Leaper, Malawi Mangoes, Matumba, Malawi; Callum Saunders, Agricane/Growth Poles, Malawi; Naveen Puppala, NMSU, Las Cruces, New Mexico, USA

Seed coat biochemical markers

PI: Mark Burow, Texas Tech University, Lubbock, TX, USA
Budget: $109,390 *(Jan 2023-Jan 2028, funded through PIL Cooperative Agreement)*
Countries: GINA, Ghana
Description: Researchers are testing under field conditions whether certain seed coat compounds control *Aspergillus flavus* infection in peanuts resulting in lower aflatoxin levels. The trials are being conducted in the greenhouse and field in northern Ghana to characterize the environmental behavior of all three compounds in soil and water; identify the appropriate time, means of application and concentration of all three compounds in managing pre-harvest aflatoxin contamination; evaluate the efficacy of different application methods and optimal timing of all three compounds for managing aflatoxin contamination; and develop a possible biochemical NIR spectrum to screen for

concentration of the three compounds in peanut seed coat as a means of identifying *A. flavus* resistant varieties**.**
Partners: Theophilus Tengey, Leslie Commey, CSIR-SARI, Nyankpala, Ghana; Venugopal Mendu, Texas A&M University, Kingsville, TX, USA

Senegal seed adoption

PI: Brad Mills, Virginia Tech, Blacksburg, VA, USA
Budget: $597,250 *(Jan 2023-Jan 2028, funded through PIL Cooperative Agreement)*
Countries: Senegal
Description: Earlier surveys of more than 1000 groundnut farmers in Senegal found that they weren't planting improved seed, because they didn't have access to it and even when they did find seed to buy, it was low quality. This work aims to generate a sustainable market for improved seed in the Groundnut Basin by addressing demand-side access and seed quality problems that farmers face, while also helping seed producers estimate the demand for different varieties each year. Researchers will conduct focus group interviews in villages to identify farmer demand for, and constraints to, the potential uptake of improved groundnut seed, then work with special software to identify stocks of seed and collaborate with producers to distribute approximately 15 metric tons of improved groundnut seed. That seed will be distributed to farmers who will evaluate its return on investment and express whether they would pay for the seed in the future. Through three seasons, the project aims to build trust in improved seed, while building a reliable seed production system for in-demand, high-quality varieties.
Partners: Katim Toure, ENSA, Iba der Thiam University of Thies, Thies, Senegal; Pierre Maurice Diatta, Ziguinchor, Senegal; Tamsir Mbaye, ISRA, Dakar, Senegal; Anubhab Gupta, Virginia Tech, Blacksburg, VA, USA; Daniel Fonceka, CIRAD, Montpellier, France; Issa Faye, ISRA-CNRA, Bambey, Senegal; Alioune Mbow, SCKA, Dakar, Senegal; Genti Kostandini, UGA, Griffin, GA, USA

Strengthening the groundnut value chain in Madagascar

Buy-in from the USAID Mission in Madagascar
PI: Dave Hoisington, University of Georgia, Athens, GA, USA
Budget: $1,250,000 *(Oct 2023-Sep 2025, buy-in from USAID Madagascar Mission)*
Description: The project aims to enhance the peanut value chain in Madagascar by introducing new peanut varieties, mechanizing agricultural practices, increasing the research capacity of the national partners and reinforcing gender inclusion and equity and youth empowerment. The project leverages international collaboration, the Groundnut Improvement Network for Africa (GINA) and other institutions in the Peanut Innovation Lab's network to fast track the project's activities and meet the underlined objectives.
Countries: Madagascar
Partners: Mina Randrianarisoa, Allain Ranivomanana, FOFIFA, Madagascar; Sandra Ramarolahy, Tozzi Green, Madagascar; Pierre-Yves Bouchaud, Group Basan, Madagascar

Strengthening the groundnut value chain in Malawi

Contract with USAID's Malawi Mission Growth Poles activity
PI: Dave Hoisington, University of Georgia, Athens, GA, USA
Budget: $790,886 *(Feb 2023-Jan 2028, contract with Malawi Mission Growth Poles Activity)*
Description: The project supports US and international peanut experts visits to Malawi to advise on on-going activities. In addition, the project is identifying and designing peanut mechanization options for farmers, researchers and small-scale enterprises.
Countries: Malawi
Partners: Justus Chintu, DARS-Chitedze, Lilongwe, Malawi; Andrew Goodman, Precious Mtengezo, Horizon Farms, Lilongwe, Malawi; Yaona Mtonga, Pyxus Agricuilture, Lilongwe, Malawi; Charlie Leaper, Malawi Mangoes, Matumba, Malawi; Callum Saunders, Agricane/Growth Poles, Lilongwe, Malawi

Strengthening the sorghum and millet value chains in Madagascar

PI: Nat Bascom, Kansas State University, Manhattan, KS, USA
Budget: $1,250,000 *(Oct 2023-Sep 2025, buy-in from USAID Madagascar Mission)*
Countries: Madagascar
Description: The project aims to enhance the sorghum and millet value chains in Madagascar by introducing new sorghum and millet varieties, improving seed producing, increasing the research capacity of the national partners, and reinforcing gender inclusion and equity and youth empowerment.
Partners: Mina Randrianarisoa, Allain Ranivomanana, FOFIFA, Madagascar; Sandra Ramarolahy, Tozzi Green, Madagascar

Varieties & EGS for Malawi

PI: Justus Chintu, DARS, Lilongwe, Malawi
Budget: $231,000 *(Jan 2023-Jan 2028, funded through PIL Cooperative Agreement)*
Countries: Malawi
Description: Partners conduct on-station and on-farm trials of groundnut germplasm, advanced lines and released varieties across agro-ecological zones (Mid/High-Altitude, Lakeshore, and Shire Valley) and test production practices appropriate for smallholder (low inputs) to mega-farm/commercial (high inputs) farmers. The project also produces early-generation seed from public and private partners by establishing systems to estimate demand and meet that demand through production practices that deliver the required quantity and quality of seed each year.
Partners: Naveen Puppala, NMSU, Las Cruces, New Mexico, USA; Andrew Goodman, Precious Mtengezo, Horizon Farms, Lilongwe, Malawi; Yaona Mtonga, Pyxus Agriculture, Lilongwe, Malawi; Charlie Leaper, Malawi Mangoes, Matumba, Malawi; Callum Saunders, Agricane/Growth Poles, Lilongwe, Malawi

Success Stories

Malawi shows off progress through groundnut tour

Visitors from across Africa and the U.S. spent three days at the Groundnut Tour in Malawi in April touring the peanut value chain, learning about the innovations (such as this thresher) that are part of the commercialization of the crop in the face of declining tobacco.

Ten years ago, the Georgia Peanut Tour welcomed its first visitor from Malawi, where peanuts are part of the local cuisine but are mostly grown in small gardens or bought in informal markets. Over the next decade, demand for the country's main cash crop – tobacco – declined and farmers turned to peanut.

That shift made the Georgia Peanut Tour a valuable resource for agricultural leaders in Malawi looking to organize peanut production, improve extension systems and scale up shelling and storage. With support from the Peanut Innovation Lab, visitors from Malawi attended the Georgia tour every year, traveling halfway around the world to see how farmers, shellers, researchers and others work together to get a large crop of peanuts to consumers every year.

In April, Malawi debuted its own 2024 Groundnut Tour, attracting visitors from across the continent to learn how the industry has developed in the country.

“Each year, we look forward to the Georgia Peanut Tour as a week when peanut people from across the U.S. and Malawi can get together and talk about different aspects of peanut production and marketing, including how we plant and harvest the crop, control pests, manage seed systems, test for aflatoxin and other topics,” said Peanut Innovation Lab Assistant Director Jamie Rhoads. “To be able to replicate a tour in Malawi fulfilled a dream for a lot of people, and it is great to be part of it.”

The production scale in Malawi is very different than in the U.S., with most farmers working only 1 or 2 acres. Most of the labor – from planting to harvesting to shelling — is done by hand.

Despite these challenges, Malawi’s government has declared a goal to produce 1 million metric tons of groundnuts by 2030, an ambitious campaign that would more than double the current production.

Because Africa’s population is growing, improving peanut production practices will allow its farmers to create the supply to feed more people, said Bob Parker, the former president and CEO of the National Peanut Board, the organization that represents U.S. peanut farmers.

Parker gave the keynote speech on the third day of the tour, urging decision-makers in Malawi to look within Africa for a market. While population growth in the U.S. and Europe is mostly stagnant, Africa will see a population boom over the next 20 years that will lead to increased food demand.

“It’s hard to grow an industry that is already mature. When you look at growing the peanut industry in Malawi, I think you have a great opportunity, considering the population growth here, in the countries around you and in this part of the world,” Parker told the crowd. “I encourage you to consider how you can harness that growth and increase demand.”

Much like its Georgia progenitor, the Malawi tour included two days of visits to research stations, farms, a buying point and a shelling plant, plus a day of hot-topic discussions. The event attracted visitors from across Africa, USAID representatives, Ireland's ambassador to Malawi, and the diplomatic representative for the U.S. Embassy.

“This week, we are hosting people from across the world who are in the groundnut industry to see what we are doing to improve the production of groundnuts in Malawi. After that, we expect to see an increase in the number of farmers who will be producing different types of groundnuts for products within the region, but also outside of the continent,” said Sam Kawale, Malawi’s minister of agriculture.

Tadala Rambiki, groundnut production manager for the international agricultural company Pyxus Agriculture Ltd., participated in the Georgia Peanut Tour in 2019. He was particularly interested in stops at buying points operated by Birdsong Peanuts and Sasser 520 and at JLA Laboratories, which tests for contaminants like aflatoxin.

“The visit was indeed helpful in envisaging how we can scale up production and processing,” he said. “For instance, from the tour, we embarked on research to determine risky components for aflatoxin in groundnuts in partnership with the Peanut Innovation Lab

and LUANAR (Lilongwe University of Agriculture and Natural Resources)," he said. "After the brief and discussion at the JLA lab, having understood the various test procedures and methodologies, we also sought to develop and validate a testing procedure for peanuts at Pyxus."

At the time, Pyxus was brainstorming a grading system to evaluate the size and quality of peanuts at buying points and looking to build a shelling factory in Malawi's capital city, Lilongwe.

Today, Pyxus buys and shells more than 5,000 metric tons of peanuts a year through 10,000 contracted farmers who receive inputs and extension advice from the company. The company also runs its own aflatoxin testing lab and turns peanut shells into pellets for fuel, a value-added product.

Pyxus' farmers, on average, grow only 1 hectare (about 2.5 acres) of groundnuts. To help those farmers adopt new technologies and increase their productivity, the Peanut Innovation Lab is working with 147 of Pyxus' lead farmers to run demonstration trials. Known as Groundnut Research Extension and Adoption of Technology (GREAT) trials, the idea is to start with a control plot that includes no improved practices, then incrementally increase inputs such as double-row planting, inoculant, fungicide and legume fertilizer, into a bundle. By evaluating individual and packaged inputs, these trials help farmers find the best production packages for their fields.

"This first tour in Malawi has been a resounding success in bringing people from all sectors in the groundnut space in Malawi and its partners together to exchange ideas celebrate achievements and set targets," said Ron Ngwira, managing director of Pyxus Agriculture Malawi. "It has been a concerted effort of many sponsors, organizers and teams of people making it a well-executed event all around."

The 2024 Groundnut Tour in Malawi was organized by the USAID-funded Growth Poles activity with organizational support from Pyxus, the Peanut Innovation Lab, the national Department of Agricultural Research, and others. Organizers hope to host a similar event in the future, perhaps every other year, with a research meeting held in alternating years.

Handheld device helping plant breeders see oil quality in seeds

Dave Hoisington works with Rachelle Djiboune at CERAAS, where Djiboune is characterizing groundnut seed as high-oleic or not. The handheld NIR device validated by Hoisington has made her work many times faster.

Wouldn't it be nice if you could look inside a peanut kernel and see the nutritional content hiding there? It's possible.

A device calibrated and deployed by the Peanut Innovation Lab is allowing partners to test peanut seed where they are – avoiding time-consuming and expensive off-site lab tests – to see which plants have the desired oil content. The technology is saving money and speeding up the process to develop new high-oleic lines where people need them the most.

High-oleic peanut varieties are a priority in many places because that oil content is healthier and makes the nut itself even more shelf-stable.

"High oleic content is an important trait for the future, and these devices can be a game-changer for plant breeders with limited time and resources," said Dave Hoisington, who directs the Peanut Innovation Lab and worked with JLA Laboratories to validate the device for use with peanuts. "By validating the device and equipping partners with this technology, we've allowed them to make quicker selections that will get nutritious new peanut varieties in farmers' fields sooner and at less expense."

Standard peanut varieties contain about 50% oleic acid and about 35% linoleic acid. High-oleic nuts shift that ratio to 80% oleic and about 4 % linoleic – similar to olive oil.

The first high oleic acid peanut cultivar was developed in Florida in the 1980s through a spontaneous mutation. Since then, breeders have been working to cross the trait into varieties grown in their countries.

High oleic content is a tricky asset because it involves both the genes of the variety and the maturity of the harvested nuts. Given the indeterminate nature of peanuts (each peanut is a different age like on a tomato plant) each kernel on a plant can have a different oil content. In addition, since the trait is invisible to the naked eye, it's very easy to lose the genes required through seed mix-ups.

Breeders can test using gas chromatography and near-infrared spectrometry, but those technologies can be expensive. Knowing that a new handheld portable NIR spectrometer might cut the cost and expense considerably, the Peanut Innovation Lab validated that the device for peanuts, established testing protocols, deployed units to partners in Africa and trained those partners to use the device.

"As a team, we like the device because it streamlines our work by saving time and costs, improving accuracy, and providing more data at both individual and family levels. It also enhances efficiency by integrating seamlessly into our workflow," said Aissatou Sambou, the peanut breeder for Senegal.

Before breeders in Senegal had the NIR device, they checked for the high-oleic genes using a molecular marker assay. When the device arrived, they re-tested and found 100% correspondence. The NIR found high-oleic content in every seed that they previously found to carry the genetic trait for high-oleic content.

Now, technicians can screen seeds much faster and at no cost, avoiding cumbersome genetic tests that required them to chip each seed and send them away for genetic analysis. By screening larger numbers of seed, breeders can progress quicker in selecting the best individuals.

"It also allows them to screen for high oleic lines so any mistakes in the process can be rectified before they invest in advancing materials, and for checking that what they think they have is really correct," Hoisington said.

The lab deployed four units in Africa: two in Senegal (CERAAS and CNRA), one in Ghana (CSIR-SARI) and one to Malawi.

The device can also be calibrated to detect other content, such as total protein, moisture and carbohydrates. The instrument provides a quick, easy-to-use, non-destructive method that can be performed almost anywhere, and has already been used to evaluate lines in Malawi, Ghana and Uganda.

Looking from the sky to speed plant breeding, predict performance

Scientists from Ghana, Senegal, Uganda and Malawi work with experts at the Virginia Tech's Tidewater Agricultural Research and Extension Center, where they studied for six weeks at the start of a project to create high throughput phenotyping tools that will speed up the selection process in plant breeding.

Plant breeders can't speed up how fast a plant grows, which limits how quickly they can develop new varieties. But knowing sooner how a plant is responding to its environment can speed up the process of selecting plants with certain traits and make that work more reliable.

In earlier research, the Peanut Innovation Lab used hand-held sensors to evaluate peanut plants in the field, and developed vegetation indices that could predict disease resistance, water stress tolerance, and yield better than traditional methods of evaluating plants.

Now, researchers are working with drones in four African countries, using similar technology to make selections with less time and manpower, and more accuracy, and can be used in connection with digitized methods of analysis and selection decision tools.

At the end of four years, researchers in Ghana, Senegal, Malawi and Uganda hope to have a ready-to-use, relatively easy, standardized toolbox for high-throughput phenotyping that can be used by colleagues across the continent to predict disease resistance, water stress, yield and other yield-related traits in groundnut.

The researchers working on the project – some of them graduate students – spent six weeks in 2024 at Virginia Tech's Tidewater Agricultural Research and Extension Center (AREC) attending a drone school. Organized by crop physiologist Maria Balota, who leads the HTP project of the Peanut Innovation Lab, the program also involved precision agriculture specialist Abhilash Chandel. "The idea came from the earlier Peanut Innovation Lab project that I led to help farmers in Africa improve peanut varieties and yields," said Balota. "We needed to make sure that all participating countries in the project would have at least one researcher who knows how to fly a drone, collect images, and process and analyze them. With this school, we accomplished that."

Modou Mbaye, a physicist with ISRA in Senegal sets up a drone to fly over a groundnut field. Mbaye plans to use AI to develop predictive models for crop performance based on historic data collected with drones.

From different regions and with different levels of experience with remote sensors, the researchers had the same overall goal, so working together over several weeks gave them a time to explore drone applications and aerial imaging together.

"Agriculture in Africa is more than just a profession, it's a way of life," said Ugandan doctoral student Ivan Chapu. "Meeting people from various parts of Africa working toward improving people's livelihoods and sharing experiences was very insightful, and I believe these networks formed will foster collaborations in the future."

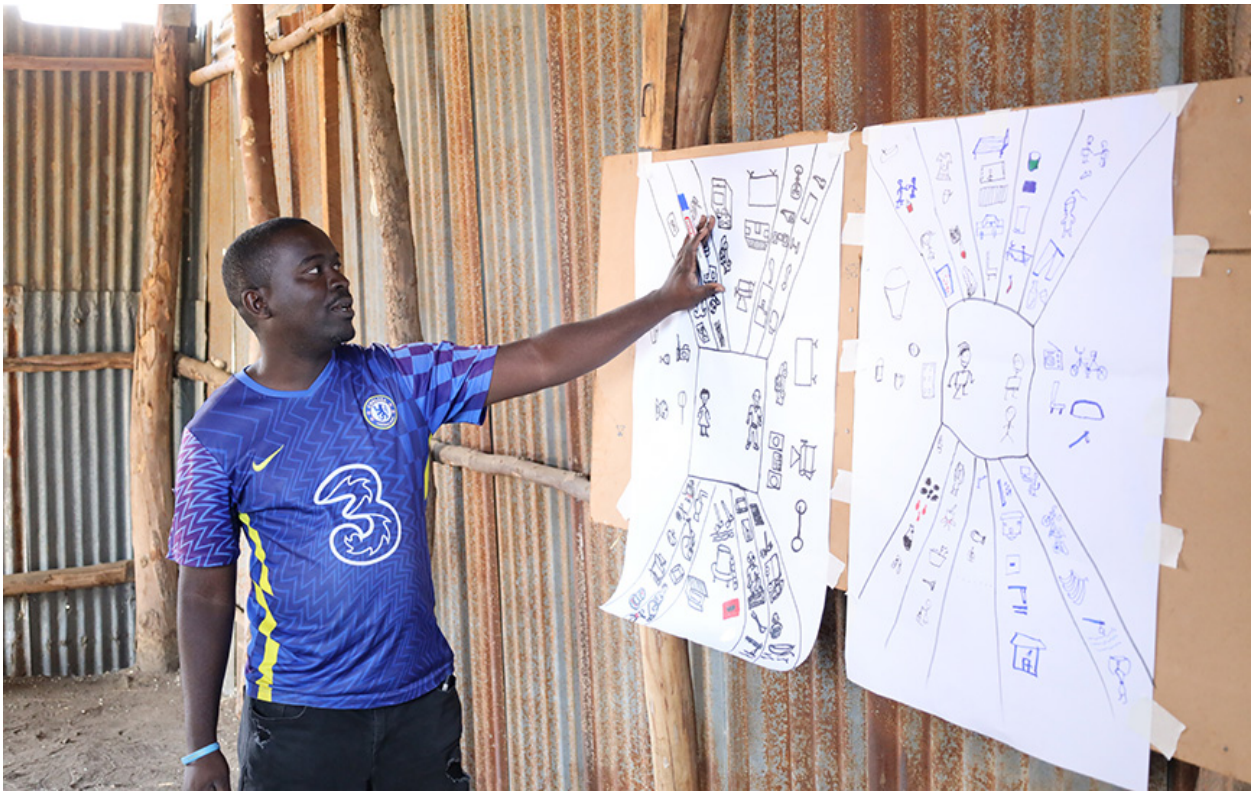
The program included flight instruction, image acquisition and classroom training in data analysis using AI machine learning. They also made several site visits to see firsthand the growing, shelling, processing, packaging, and retail aspects of peanuts in the region.

"Remote sensors excel at assessing the current state of plants, while AI enhances this capability by predicting future performance," said Modou Mbaye, a physicist who is the AI and precision agriculture specialist for ISRA in Senegal. "By integrating data from historical crop records, weather patterns, soil conditions, and management practices and genomic information, AI enables more accurate and actionable insights."

By using AI with drones, Mbaye will help diagnose which plants are performing well, but also predict how plants will perform in the future based on conditions.

With similar activities in four different countries and regions of Africa, the project team will be able to analyze extensive datasets from the field and use AI to find trends and patterns beyond human perception, allowing for models that forecast crop performance under various conditions. When scaled, this will help researchers develop better varieties faster, and farmers make smarter decisions on managing their crop resulting in bigger yields.

Evaluating gender empowerment to help farmers in Malawi



A participant in GALS training explains the vision chart showing the contributions that he and his fiancée make to their farm. The training is widely used in international development to help men and women reach shared aspirations, but research is needed to show whether the training achieves the goals that NGOs and private businesses want.

Understanding gender dynamics is important to help farmers be productive and to prevent women from losing an important source of income, decision-making, household economic management, and independence.

Malawi is undergoing an agricultural transformation as farmers and agricultural companies turn from tobacco to other commodities. Farmers grow about 420,000 tons of groundnut per year, but the Malawi government has set a goal to more than double that production to 1 million metric tons per year by 2030. As commercialization efforts ramp up, a major Peanut Innovation Lab project is helping partners to find the best way to empower women and deploy technology that will help the agricultural sector reach its productivity goals.

This work evaluates one of the most promising interventions – the Gender Action Learning System (GALS) – a training method designed to improve cooperation between men and women and empower women in household decision-making. In GALS training, participants use visual diagrams to imagine the futures they want and take action against any barriers that inhibit it, including those societal norms that drive gender inequality and injustice.

Private companies, NGOs and large funding agencies like USAID use GALS, but also need information about how the intervention works best, particularly in the context of groundnut in Malawi. Different iterations of the program (for example, one-day, five-day or 14-day) are

often paired with financial literacy or other training, and research can assure donors that they are getting the result they want. The research is answering questions specific to Malawi, but also will be applicable elsewhere.

Work began in 2024, when researchers interviewed 100 farmers in focus groups asking about their lives, family structure and labor division to inform the design of a pilot survey.

These conversations also explored local perceptions of gender empowerment, asking directly what it means to be empowered, whether participants have marital harmony, whether relationships are changing over generations, and what participants want for their children.

Interviews included people who have received gender-empowerment training, as well as people who have not. Groups also included farmers who sell their crop under contract to Pyxus Agriculture Ltd. – a private agriculture company and Peanut Innovation Lab partner that is a main player in groundnut commercialization in Malawi – farmers who have sold to Pyxus, but not under contract, and farmers who have no contact with Pyxus.

Some of the highlights of these conversations include:

- Men and women have a concept of empowerment and healthy relationships but also reported a lot of problems with domestic violence, alcoholism and gambling.
- Participants agreed that agronomic decisions (what variety to plant, whether to hire outside labor, when to sell the crop) should be discussed within couples.
- Some participants find that gender roles and expectations are changing. One example involved carrying the hoe. In the past, a woman might be expected to carry her husband's tools, but today, they carry their own hoes and do their own work

Work continues to finish the survey instrument and define geographical areas. In 2025, the team will conduct the full baseline survey and implement different types of GALS training.

Enumerators working for the project will return at one year and again at two years after the training to survey families and find out whether participants saw changes in their lives.

Using a randomized controlled trial design the team will evaluate the efficacy of training programs (Gender Action Learning System, Financial Literacy, and Business Development) crossed with market interventions (groundnut contracts, market purchases, unconditional cash transfers) against an untreated control group.

This work will include an evaluation of women's time use to see whether commercialization and GALS (separately and in combination) affect gendered time use in the home.

Partners include the USAID Malawi Mission; Malawi Growth Poles Activity, a USAID project managed by Palladium; Irish Aid; Pyxus Agriculture Ltd.; WOLREC (Women's Legal Resources Centre in Malawi); and universities including LUANAR of Malawi, University of California Santa Barbara, University of Texas-Austin, Columbia University, and University of Georgia.

Appendices

Management Entity

The Peanut Innovation Lab Management Entity is hosted by the University of Georgia's College of Agricultural and Environmental Sciences in Athens, GA. Current staff includes:

- Dave Hoisington (director)
- Jamie Rhoads (assistant director)
- Allen Stripling (business manager)
- Allison Floyd (communications coordinator)
- Kristen McHugh (operations specialist)
- Jessica Marter-Kenyon (Gender and Youth specialist)
- Mamadou Thiam, project manager for Madagascar
- Linda Chinangwa, project manager for social science in Malawi
- Norah Machinjiri Kaula, project manager for bioscience in Malawi
- Wills Munthali, project manager for bioscience in Malawi

External Advisory Panel

The External Advisory Panel (EAP) continues to provide feedback on the research progress by participating in project launch meetings and events in-country, as well as reviewing annual reports. Current External Advisory Panel members are:

- Cynthia Donovan, retired associate professor, Agricultural Food and Resource Economics, Michigan State University, US
- Jeff Ehlers, program officer, Bill & Melinda Gates Foundation, US
- Isaac Minde, deputy director, Innovative Agricultural Research Initiative (iAGRI), Tanzania, and Professor of International Development, Michigan State University, US
- Shyam Nigam, expert consultant in agriculture for development, India
- Helga Recke, visiting fellow-CALS-AWARE, Cornell University, US
- Samara Sterling, research director, The Peanut Institute, US
- Farid Waliyar, independent consultant, retired from ICRISAT in 2014, France

The Peanut Innovation Lab director and assistant director, and the USAID agreement officer's representative (Jim Gaffney) are *ex officio* members of the External Advisory Panel.

Human & Institutional Capacity Development

Short-term training workshops

Date of Training	Country of Training	Brief Purpose of Training	Number Trained		
			M	F	Total
3 Jun-29 Nov 2024	Ghana	*Season long training in groundnut production practices at Nyankpala, Wa, Manga, Yendi and Karaga* – provided hands-on training to out-grower businesses and farmers in northern Ghana on the best practices for growing groundnut.	32	33	65
24 Jan 2024	Madagascar	*Peanut Innovation Lab Madagascar Project Meeting* – multi-day meeting provided the opportunity to discuss with partners the plans for activities focused on improving groundnut production in the country.	38	31	69
22-25 Apr 2024	Malawi	*2024 Groundnut Improvement Network for Africa (GINA) Meeting* – four-day meeting provided updates of the latest genotyping and phenotyping results, discussed future priorities, inclusion of new diversity, and efforts in varietal development and release including planned TRICOT trials.	33	15	48
5-6 Aug 2024	Malawi	*Review of Groundnut Trial Results and Planning for Next Season Workshop* – presented the results of the trial data from the 2023-24 crop season to cooperators and in-country partners. Initial plans for next season trials discussed.	11	9	20
25 Jun 2024	Senegal	*TRICOT trial concept and use of ODK training for TRICOT experiments* – training introduced students, Caritas field agents and technicians to the TRICOT methodology, and provided them hands-on experience in using the ODK Collect tool.	7	8	15
12 Jul 2024-11 Oct 2024	Senegal	*Basic Peanut Production Research and Agronomy* – training supported Malagasy researchers to enhance their capacity to conduct variety trial management and hands on training on basic peanut research and agronomy.	2	2	4
11-23 Jul 2024	Uganda	*Design TRICOT trial for Uganda* – Designing TRICOT trial for Uganda for popularizing released varieties	6	2	8
15 Mar - 30 Apr 2024	USA	*Drone School* – training taught the African collaborators how to fly a drone and remotely collect and analysis plant disease and stress response data, how to process the images and extract vegetation indices.	4	1	5
17-19 Sep 2024	USA	*The 2024 Georgia Peanut Tour* – 2 ½ day tour staged in the central region of Georgia's production area provided the opportunity to learn more about peanut production, research, processing, and more. Field visits provided a glimpse of peanut production, digging and harvest.	27	12	39

Long-term degree training

ID	Gender	Home Country	Degree	Discipline	Institution	Institution Country	Completion Date	Degree Granted
1	Female	Ghana	Master's	Plant Breeding & Genetics	Makerere Regional Center for Crop Improvement (MaRCCI), Makerere University	Uganda	May-21	Y
6	Male	Ghana	Master's	Biotechnology	University for Development Studies	Ghana	Jun-21	N
8	Male	Ghana	Ph.D.	Plant and Soil Science	Texas Tech University	USA	Aug-24	Y
24	Male	Ghana	Master's	MPhil, Plant Breeding and Biotechnology	CSIR-College of Science and Technology	Ghana	Oct-22	Y
26	Female	Ghana	Master's	Agronomy	Kwame Nkrumah University of Science and Technology	Ghana	Nov-21	Y
27	Male	Ghana	Master's	Biotechnology	University for Development Studies	Ghana	Nov-22	Y
28	Male	Ghana	Ph.D.	Agronomy and Pest Management	Kwame Nkumah University of Science and Technology	Ghana	Mar-24	Y
33	Male	Ghana	Master's	Plant Breeding	University of Ghana	Ghana	Jul-22	Y
40	Female	Ghana	Master's	Plant Breeding & Genetics	Makerere Regional Center for Crop Improvement (MaRCCI), Makerere University	Uganda	Feb-23	Y
43	Male	Ghana	Master's	Plant Breeding	Kwame Nkrumah University of Science and Technology	Ghana	Dec-20	N
48	Male	Ghana	Ph.D.	Agronomy and Pest Management	University for Development Studies	Ghana	Apr-24	Y
56	Male	Ghana	Ph.D.	Agricultural Extension	University of Ghana	Ghana	Aug-25	N
57	Female	Ghana	Ph.D.	Horticulture and Seed Science and Technology	Kwame Nkrumah University of Science and Technology	Ghana	Mar-25	N
60	Male	Ghana	Master's	Biotechnology	University for Development Studies	Ghana	Nov-23	N
61	Male	Ghana	Ph.D.	Plant Breeding	West Africa Centre for Crop Improvement, University of Ghana	Ghana	Dec-19	Y
62	Male	Ghana	Ph.D.	Plant breeding	University of Ghana	Ghana	Jul-22	Y
65	Male	Ghana	Master's	Crop Science	University for Development Studies	Ghana	May-22	Y
75	Male	Ghana	Ph.D.	Nutrition	University of Ghana	Ghana	Jul-25	N
76	Male	Ghana	Ph.D.	Crop Physiology	Kwame Nkrumah University of Science and Technology	Ghana	Nov-27	N

ID	Gender	Home Country	Degree	Discipline	Institution	Institution Country	Completion Date	Degree Granted
77	Male	Ghana	Ph.D.	Plant Breeding	Kwame Nkrumah University of Science and Technology	Ghana	Nov-27	N
78	Female	Ghana	Master's	MPhil Agronomy	University for Development Studies	Ghana	Jul-25	N
79	Male	Ghana	Master's	Crop Science	University for Development Studies	Ghana	Apr-26	N
80	Female	Ghana	Ph.D.	Crop Science	University for Development Studies	Ghana	Apr-28	N
84	Male	Ghana	Master's	Plant and Soil Science with a concentration in Crop Science	Texas Tech University	USA	Dec-26	N
49	Male	India	Master's	Genetics and Plant Breeding	ICRISAT	India	Aug-20	Y
7	Female	Kenya	Master's	Plant Breeding & Genetics	Makerere Regional Center for Crop Improvement (MaRCCI), Makerere University	Uganda	Mar-23	Y
31	Female	Kenya	Ph.D.	Agronomy	Makerere University	Uganda	Dec-25	N
3	Male	Malawi	Master's	Crop production	Lilongwe University of Agriculture and Natural Resources	Malawi	Jul-24	Y
25	Male	Malawi	Master's	Master of Science in Agronomy	Lilongwe University of Agriculture and Natural Resources	Malawi	Aug-23	Y
36	Female	Malawi	Master's	Agronomy	Lilongwe University of Agriculture and Natural Resources	Malawi	Feb-25	N
54	Male	Malawi	Master's	Impact of agronomic practices on groundnut seed quality	Lilongwe University of Agriculture and Natural Resources	Malawi	Nov-24	Y
71	Male	Malawi	Master's	Food Science and Technology	Lilongwe University of Agriculture and Natural Resources	Malawi	Jul-24	Y
72	Male	Malawi	Master's	Food Science and Technology	Lilongwe University of Agriculture and Natural Resources	Malawi	Dec-24	N
81	Female	Malawi	Master's	Crop and Soil Sciences	Lilongwe University of Agriculture and Natural Resources	Malawi	Aug-26	N
82	Male	Malawi	Ph.D.	Crops and Sol Sciences	Lilongwe University of Agriculture and Natural Resources	Malawi	Aug-27	N
83	Male	Malawi	Ph.D.	Crop and Soils Sciences	Lilongwe University of Agriculture and Natural Resources	Malawi	Aug-27	N
10	Male	Niger	Ph.D.	Agrophysiology	ICRISAT	Niger	Dec-24	N
15	Female	Niger	Ph.D.	Agronomy	ICRISAT	Niger	Jun-23	Y

ID	Gender	Home Country	Degree	Discipline	Institution	Institution Country	Completion Date	Degree Granted
5	Male	Senegal	Master's	Agricultural Engineering	National Superior School of Agriculture (ENSA), University of Thies	Senegal	Sep-21	Y
9	Male	Senegal	Master's	Agricultural Engineering	National Superior School of Agriculture (ENSA), University of Thies	Senegal	Dec-20	Y
16	Female	Senegal	Master's	Agricultural Engineering	National Superior School of Agriculture (ENSA), University of Thies	Senegal	Mar-21	Y
17	Male	Senegal	Master's	Agricultural Economics	National Superior School of Agriculture (ENSA), University of Thies	Senegal	Sep-22	Y
19	Male	Senegal	Ph.D.	Agronomic Sciences	National Superior School of Agriculture (ENSA), University of Thies	Senegal	Dec-19	N
20	Male	Senegal	Master's	Agronomy with Rural Economics specialization	National Superior School of Agriculture (ENSA), University of Thies	Senegal	Dec-20	Y
21	Male	Senegal	Master's	Agronomy with Rural Economics specialization	National Superior School of Agriculture (ENSA), University of Thies	Senegal	Jan-21	Y
22	Male	Senegal	Ph.D.	Molecular Genetics	ISRA-CERAAS	Senegal	May-25	N
23	Female	Senegal	Ph.D.	Molecular Genetics	ISRA/CERAAS	Senegal	Mar-25	N
32	Female	Senegal	Ph.D.	Agronomy with Rural Economics specialization	National Superior School of Agriculture (ENSA), University of Thies	Senegal	Feb-25	N
38	Female	Senegal	Ph.D.	Agricultural Economics	Centre de Recherche pour le Dévelopement Economique et Sociale	Senegal	Dec-25	N
39	Female	Senegal	Master's	Agricultural Engineering	National Superior School of Agriculture (ENSA), University of Thies	Senegal	Jul-20	Y
42	Male	Senegal	Master's	Agricultural Economics	National Superior School of Agriculture (ENSA), University of Thies	Senegal	Nov-21	Y
45	Male	Senegal	Master's	Agricultural Engineering	National Superior School of Agriculture (ENSA), University of Thies	Senegal	Oct-21	Y

ID	Gender	Home Country	Degree	Discipline	Institution	Institution Country	Completion Date	Degree Granted
51	Female	Senegal	Ph.D.	Agricultural Economics	Centre de Recherche pour le Dévelopement Economique et Sociale	Senegal	Dec-25	N
52	Male	Senegal	Master's	Agricultural Engineering	National Superior School of Agriculture (ENSA), University of Thies	Senegal	Mar-21	Y
63	Female	Senegal	Master's	Breeding/physiology	University of Dakar	Senegal	Dec-25	N
64	Male	Senegal	Ph.D.	PhD in Agricultural and Applied Economics	University of Georgia	USA	Aug-23	N
66	Female	Senegal	Master's	Agricultural Engineering	National Superior School of Agriculture (ENSA), University of Thies	Senegal	Oct-22	Y
67	Female	Senegal	Master's	Agricultural Engineering - Value Chain	National Superior School of Agriculture (ENSA), University of Thies	Senegal	Dec-24	N
68	Female	Senegal	Master's	Agricultural Engineer with specialty in economics	National Superior School of Agriculture (ENSA), University of Thies	Senegal	Sep-23	Y
69	Male	Senegal	Master's	Agricultural Economics	National Superior School of Agriculture (ENSA), University of Thies	Senegal	Dec-22	Y
70	Female	Senegal	Master's	Agricultural Economics	National Superior School of Agriculture (ENSA), University of Thies	Senegal	Dec-22	Y
34	Female	Tanzania	Master's	Plant Breeding and Seed Systems	Makerere University	Uganda	Feb-25	N
12	Female	Uganda	Ph.D.	Molecular biology and Plant Breeding	Makerere University	Uganda	Jan-25	N
13	Male	Uganda	Master's	Crop Science (Crop Protection)	Makerere Regional Center for Crop Improvement (MaRCCI), Makerere University	Uganda	Nov-23	Y
35	Male	Uganda	Master's	Crop Science	Makerere Regional Center for Crop Improvement (MaRCCI), Makerere University	Uganda	Sep-21	Y
41	Female	Uganda	Master's	Food Science and Technology	Makerere University	Uganda	Sep-22	Y
46	Female	Uganda	Master's	Agricultural and Applied Economics	Makerere University	Uganda	Jan-24	Y

ID	Gender	Home Country	Degree	Discipline	Institution	Institution Country	Completion Date	Degree Granted
50	Female	Uganda	Post-doctoral Studies	Gender Studies and Development including Agriculture	School of Women and Gender Studies, Makerere University	Uganda	Dec-20	N
74	Male	Uganda	Ph.D.	Crop Science	Makerere University	Uganda	Nov-26	N
2	Female	USA	Post-doctoral Studies	Nutrition and Health	University of Georgia	USA	May-22	Y
4	Female	USA	Post-doctoral Studies	Gender and Youth	University of Georgia	USA	Sep-21	Y
11	Male	USA	Ph.D.	Agricultural and Applied Economics	University of Georgia	USA	May-23	Y
14	Female	USA	Ph.D.	Geography	University of California, Santa Barbara	USA	Jun-24	Y
18	Female	USA	Master's	Agricultural Leadership, Education and Communications	University of Tennessee	USA	Dec-20	Y
29	Female	USA	Post-doctoral Studies	Demography	University of Minnesota	USA	Dec-21	Y
30	Female	USA	Post-doctoral Studies	Demography	University of California, Santa Barbara	USA	Dec-22	Y
37	Female	USA	Ph.D.	Rural Sociology	Pennsylvania State University	USA	May-24	Y
44	Male	USA	Ph.D.	Agricultural and Applied Economics	University of Georgia	USA	Dec-20	N
47	Female	USA	Ph.D.	Agricultural and Applied Economics	Virginia Tech	USA	Aug-27	N
53	Male	USA	Bachelor's	Anthropology	University of California, Santa Barbara	USA	Jun-22	Y
55	Female	USA	Bachelor's	Statistics and Geography	University of California, Santa Barbara	USA	Jun-23	Y
59	Female	USA	Master's	Agricultural Leadership, Education and Communications	University of Tennessee	USA	May-23	Y
73	Male	USA	Ph.D.	Environmental Health Sciences	University of Georgia	USA	Feb-24	N
58	Male	Zambia	Ph.D.	Plant Breeding	African Center for Crop Improvement	South Africa	Apr-25	N

List of Awards to Partners

US Partners (by State)

Institution	Project Name	Start Date (mm/dd/yy)	End Date (mm/dd/yy)	FY 2024 Budget	Total Budget
Alabama				**$70,596**	**$271.587**
HudsonAlpha Institute for Biotechnology	Mapping Groundnut Rosette Virus resistance and GINA genomics support *(sub-award from UGA)*	10/1/2023	9/30/2027	$70,596	$271,587
California				**$226,617**	**$1,737,256**
Stanford University	Examining the Utility of Satellite-based Assessment in a Maize/Peanut Agroecosystem for Estimated Crop Response in Malawi *(sub-award from NCSU)*	10/1/2018	9/30/2021	-0-	$65,000
University of California, Santa Barbara (UCSB)	Gender, Fertility, and Intra-household Dynamics and resilience in the Senegalese Peanut Farmers in Ghana *(sub-award from UGA)*	7/1/2019	12/31/2024	-0-	$490,337
	Evaluation of the GALS training program, and provide insights about which type of contracting mechanism is most effective for households, and not disempowering of youth and women, while also meeting the needs of the commercial *(sub-award from UGA)*	7/15/2024	9/30/2027	$226,617	$1,181,919
District of Columbia				**$0**	**$108,176**
International Food Policy Research Institute (IFPRI)	Connecting Male and Female Smallholder Farmers to Premium Groundnut Markets and Aflatoxin-mitigating Technologies through Innovation Aggregator Contracts *(sub-award from UGA)*	8/1/2018	7/31/2022	-0-	$108,176
Florida				**$40,576**	**$142,659**
University of Florida (UFL)	Development and Delivery of Improved Production and Pest Management Packages to Peanut Farmers in Ghana *(sub-award from NCSU)*	10/1/2018	9/30/2022	-0-	$15,120
	Evaluation of Production packages for groundnut production by Malawi farmers *(sub-award from UGA)*	2/15/2024	9/30/2027	$40,576	127.539
Georgia				**$48,462**	**$1,755,844**
University of Georgia (UGA)	Leveraging Genetics Resources to Enhance Peanut/Groundnut Breeding in Africa and the United States	10/1/2018	9/30/2022	-0-	$21,700
	Use if Novel Genetic Diversity for Peanut Varietal Development in East Africa	9/1/2018	9/30/2027	$48,462	$325,166
	Incorporating New Wild Alleles to Improve Elite African Peanut Cultivars	10/1/2018	9/30/2021	-0-	$110,000
	Mapping Groundnut Rosette Virus (GRV) Resistance to Marker-assisted Selection	10/1/2018	9/30/2021	-0-	$67,610
	Connecting Male and Female Smallholder Farmers to Premium Groundnut Markets and Aflatoxin-Mitigating Technologies through innovation Aggregator Contracts	8/1/2018	7/31/2022	-0-	$244,172

Institution	Project Name	Start Date (mm/dd/yy)	End Date (mm/dd/yy)	FY 2024 Budget	Total Budget
	Identifying the Alternative Host for Groundnut Rosette Disease Virus Complex	8/1/2018	2/1/2021	-0-	$47,800
	Regulation of Gut Microbiome by Peanut Supplement in Youth with both Genders	4/1/2019	12/31/2024	-0-	$553,375
	Enhancing the Genetics Potential of Peanut Production in Eastern/Southern Africa *(sub-award from NASARRI)*	2/1/2019	7/31/2022	-0-	$15,400
	Enhancing the Genetics Potential of Peanut Production in West Africa *(sub-award from ISRA)*	2/1/2019	7/31/2022	-0-	$15,400
	Genotypic Analysis of Peanut using Axiom_Arachis2 SNP Array	5/1/2018	4/30/2019	-0-	$106,670
	Retaining Next Generation Farmers in the Senegalese Groundnut Basin *(sub-award from Virginia Tech)*	3/1/2019	2/28/2022	-0-	$154,391
USDA-ARS National Peanut Research Laboratory (NPRL)	Technical Evaluation of PICs Bags for use with Shelled Peanuts	5/1/2018	6/30/2024	-0-	$94,200
Kansas				**$626,103**	**$1,250,000**
Kansas State University (KSU)	Climate adapted Cropping Systems and Value Chains Development Sorghum, Pearl Millet & Groundnut	9/15/2023	9/14/2025	$626,103	$1,250,000
Michigan				**$0**	**$350,000**
Michigan State University (MSU)	Impact evaluation of peanut-based school meals on household welfare in Mion District, Northern Ghana	10/1/2024	9/30/2027	$0	$350,000
Mississippi				**$0**	**$86,711**
Alcorn State University	Modern Peanut Technologies Adoption and Smallholder Farmers Welfare	9/1/2021	11/31/2023	-0-	$86,711
Missouri				**$174,826**	**$975,800**
Washington University (WU)	Integrating the Power of Peanuts into School Feeding	1/1/2019	9/30/2027	$174,826	$975,800
New Mexico				**$33,435**	**$246,600**
New Mexico State University (NMSU)	Development, evaluation and early-generation seed production of groundnut varieties for Malawi farmers	2/15/2024	9/30/2027	$33,435	$246,600
North Carolina				**$133,046**	**$724,351**
North Carolina State University (NCSU)	Examining the Utility of Satellite-based Assessment in a Maize/Peanut Agroecosystem for Estimated Crop response in Malawi	10/1/2018	9/30/2022	-0-	$86,604
	Development of Efficient Agronomic Peanut Production Packages for Malawian Farmers	10/1/2019	9/30/2027	$73,356	$364,512
	Development and Delivery of Improved Production and Pest Management Packages to Peanut Farmers in Ghana	10/1/2018	9/30/2027	$59,690	$273,235
Ohio				**$0**	**$131,585**
Ohio State University (OSU)	Optimized Shrub System (OSS): an Innovation for Landscape Regeneration and Improved Resilience for the Peanut-Basin on Senegal	9/1/2018	12/31/2024	-0-	$131,585

Institution	Project Name	Start Date (mm/dd/yy)	End Date (mm/dd/yy)	FY 2024 Budget	Total Budget
Pennsylvania				**$0**	**$371,329**
Pennsylvania State University (Penn State)	Time Poverty among Women Smallholder in Ghana: implications for Gender Priorities in the Peanut Value Chain	3/1/2019	12/31/2023	-0-	$371,329
Tennessee				**$0**	**$184,228**
University of Tennessee (UT)	Photovoice for Youth Empowerment in Peanut Value Chain	3/1/2019	7/31/2023	-0-	$184,228
Texas				**$89,099**	**$566,534**
Texas Agriculture and Mechanical College (Texas A&M)	Breeding and Enhancement of Tolerance to Water Deficit, Resistance to leaf Spot and Improved Oil Composition on Peanut	10/1/2018	9/30/2027	$38,385	$169,174
Texas Tech University (TTU)	Developing *Aspergillus flavus* Resistance Peanut using Seed Coat biochemical marker(s)	10/1/2018	12/31/2024	-0-	$335,800
	Breeding and drought. Leafspot & oil content *(sub-award from Texas A&M)*	5/1/2024	9/30/2027	$50,114	$61,560
Virginia				**$287,353**	**$881,769**
Virginia Tech (VT)	Integration of High Throughput Phenotyping (HTP) for Enhancing Breeding Programs in Senegal, Ghana, Uganda, and Regional Cooperation	9/1/2018	9/30/2027	$99,195	$287,949
	Development and Delivery of improved Production and Pest Management Packages to Peanut Farmers in Ghana *(sub-award from NCSU)*	10/1/2018	9/30/2022	-0-	$15,120
	Retaining Next Generation Farmers in the Senegalese Groundnut Basin	3/1/2019	09/30/2027	$188,158	$578,700

International Partners (by Country)

Institution	Project Name	Start Date (mm/dd/yy)	End Date (mm/dd/yy)	FY2024 Budget	Total Budget
France				**$231,975**	**$500,000**
Center for International Research Agricultural Development (CIRAD)	Regional coordination, data management and analytics support for GINA	11/13/2023	9/30/2027	$231,975	$500,000
Ghana				**$312,455**	**$2,100,759**
Crop Research Institute (CRI)	Development and Delivery of Improved Production and Pest Management Packages to Peanut Farmers in Ghana *(sub-award from NCSU)*	10/1/2018	9/30/2027	$2,000	$90,940
Kwame Nkrumah University of Science and Technology (KNUST)	Development and Delivery of Improved Production and Pest Management Packages to Peanut Farmers in Ghana *(sub-award from NCSU)*	10/1/2018	9/30/2027	$2,000	$95,833
Project Peanut Butter	Integrating the Power of Peanuts into School Feeding	1/1/2019	9/30/2027	$103,455	$400,214
Savanna Agriculture Research Institute (SARI)	Integration of High Throughput Phenotyping (HTP) for Enhancing Breeding Programs in Senegal, Ghana, Uganda and Regional Cooperation *(sub-award from VT)*	9/1/2018	11/30/2027	$31,460	$149,057

Institution	Project Name	Start Date (mm/dd/yy)	End Date (mm/dd/yy)	FY2024 Budget	Total Budget
	Breeding and Enhancement of Tolerance to Water Deficit, Resistance to Leaf spot and Improved Oil Composition on Peanut *(sub-award from Texas A&M)*	10/1/2018	9/30/2027	$14,300	$89,970
	Development and Delivery of Improved Production and Pest Management Packages to Peanut Farmers in Ghana *(sub-award from NCSU)*	10/11/2018	9/30/2027	$79,750	$508,750
	Securing groundnut's future in West Africa through the deployment of GRD-resistant varieties *(sub-award from UGA)*	11/1/2023	9/30/2027	$68,390	$350,000
	Time Poverty among women Smallholders in Ghana: Implications for Gender Priorities in the Peanut Value Chain *(sub-award from Penn State)*	3/1/2019	10/31/2022	-0-	$65,630
	Breeder Seed Production and Assessment of Breeding Programs Capacity building in targeted African Countries *(sub-award from NARO/NASARRI)*	5/1/2018	4/30/2021	-0-	$24,000
	Enhancing the Genetic Potential on Peanut Production in West Africa *(sub-award from ISRA)*	2/1/2019	7/31/2027	$11,000	$42,900
University for Development Studies (UDS)	Connecting male and female smallholder farmers to premium groundnut markets and aflatoxin-mitigating technologies through innovation aggregator contracts *(sub-award from UGA)*	8/1/2018	7/31/2022	-0-	$248,244
University of Ghana	Integrating the Power of Peanuts into School Feeding *(sub-award from WU)*	1/1/2019	9/30/2027	$0	$35,221
India				**$0**	**$25,000**
International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)	Developing Aspergillus flavus resistant Peanut using Seed Coat biochemical marker(s) *(sub-award from TTU)*	10/1/2018	12/31/2024	-0-	$25,000
Kenya				**$0**	**$174,900**
International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)	Mapping Groundnut Rosette Virus (GRV) resistance for marker-assisted selection *(sub-award from UGA)*	10/1/2018	9/30/2021	-0-	$174,900
Malawi				**$196,498**	**$1,004,542**
Lilongwe University of Agriculture and Natural Resources (LUANAR)	Development of Efficient Agronomic Peanut Production Packages for Malawian Farmers *(sub-award from NCSU)*	10/1/2019	7/31/2027	$46,806	$295,035
Department of Agriculture Research Service (DARS)-Chitedze	Development of Efficient Agronomic Peanut Production Packages for Malawian Farmers *(sub-award from NCSU)*	2/1/2019	7/31/2022	-0-	$26,400
	Development, evaluation and early-generation seed production of groundnut varieties for Malawi Farmers	3/11/2024	9/30/2027	$57,750	$271,587
	High-throughput phenotyping *(sub-award from VT)*	11/2/2023	9/30/2027	$25,300	$80,520

Institution	Project Name	Start Date (mm/dd/yy)	End Date (mm/dd/yy)	FY2024 Budget	Total Budget
	Enhancing the Genetic Potential of Peanut Production in Eastern/Southern Africa *(sub-award from NARO/NaSARRI)*	2/1/2019	7/31/2027	$27,142	$134,420
	Breeder Seed Production and Assessment of Breeding Programs Capacity building in targeted African Countries *(sub-award from NARO/NaSARRI)*	5/1/2018	4/30/2019	$12,000	$12,000
Horizon Farms Ltd.	Examining the Utility of Satellite-based Assessment in a Maiz/Peanut Agroecosystem for Estimated Crop response in Malawi *(sub-award from NCSU)*	10/1/2018	9/30/2022	-0-	$23,430
	Development of Efficient Agronomic Peanut Production Packages for Malawian Farmers *(sub-award from NCSU)*	10/1/2019	7/31/2027	$27,500	$161,150
Mali				**$0**	**$30,800**
Centres Régionaux de Recherche Agronomique/ Institut d'Economie Rurale (CRRA/IER)	Enhancing the Genetic Potential of Peanut Production in West Africa *(sub-award from ISRA)*	2/1/2019	7/31/2027	$0	$30,800
Mozambique				**$25,410**	**$146,420**
Mozambique Agricultural Research Institute (IIAM)	Enhancing the Genetic Potential of Peanut Production in Eastern/Southern Africa *(sub-award from NARO/NaSARRI)*	2/1/2019	7/31/2027	$25,410	$134,420
	Breeder Seed Production and Assessment of Breeding Programs capacity building in targeted African Countries *(sub-award from NARO/NaSARRI)*	5/1/2018	4/30/2019	-0-	$12,000
Niger				**$0**	**$126,650**
International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)	Developing Aspergillus-flavus resistant Peanut using seed coat biochemical marker(s) *(sub-award from TTU)*	10/1/2018	12/31/2024	-0-	$95,850
Centre Regional de la Recherche Agronomique (INRA)	Enhancing the Genetic Potential of Peanut Productions in West Africa *(sub-award from ISRA)*	2/1/2019	7/31/2022	-0-	$30,800
Senegal				**$197,722**	**$1,578,183**
Centre de Recherche Pour le Developpement Economique et Social (CRDES)	Gender, Fertility, and Intra-household dynamics and resilience in the Senegalese Peanut Production Chain *(sub-award from UCSB)*	7/1/2019	12/31/2024	-0-	$122,972
Ecole Nationale Superieure d'Agriculture de Thies (ENSA)	Retaining Next Generation Farmers in the Senegalese Groundnut Basin *(sub-award from VT)*	3/1/2019	2/28/2027	$76,450	$333,550
Institut Senegalais de Recherches Agricoles (ISRA)	Integration of High Throughput Phenotyping (HTP) for enhancing Breeding Programs in Senegal, Ghana, Uganda and regional Cooperation *(sub-award from VT)*	9/1/2018	9/30/2027	$28,622	$143,843

Institution	Project Name	Start Date (mm/dd/yy)	End Date (mm/dd/yy)	FY2024 Budget	Total Budget
	Breeding and Enhancement of Tolerance to water deficit, resistance to leaf spot and improved oil composition on Peanut *(sub-award from Texas A&M)*	10/1/2018	9/30/2027	$14,300	$79,200
	Enhancing the Genetic Potential of Peanut Production in West Africa *(sub-award from ISRA)*	2/1/2019	7/31/2027	$50,275	$385,270
	Breeder Seed Production and Assessment of Breeding programs capacity building in targeted African Countries *(sub-award from NARO/NaSARRI)*	5/1/2018	4/30/2019	-0-	$12,000
	Genotypic analysis of Peanut Germplasm using Axiom-Arachis2 SNP array *(sub-award from UGA)*	5/1/2018	4/30/2019	-0-	$53,350
	Incorporating new wild alleles to improve elite West African Peanut Cultivars *(sub-award from UGA)*	10/1/2018	9/30/2021	-0-	$90,000
	Use of novel genetic diversity for peanut varietal development in Africa *(sub-award from UGA)*	10/1/2023	9/30/2027	$27,775	$139,645
University of Thies	Optimized Shrub System (OSS): an Innovation for Landscape Regeneration and Improved Resilience for the Peanut-basin of Senegal *(sub-award from OSU)*	9/1/2018	12/31/2024	-0-	$218,353
Uganda				**$163,025**	**$1,146,305**
Makerere University	Photovoice for Youth Empowerment in Peanut Value chains in Uganda *(sub-award from UT)*	3/1/2019	2/28/2022	-0-	$124,277
	Regulation of Gut Microbiome by Peanut Consumption in Youth with both Gender *(sub-award from UGA)*	4/1/2019	9/30/2022	-0-	$46,446
National Agriculture Research Organization /National Semi Arid Resources Research Institute (NARO/NaSARRI)	Integration of High Throughput Phenotyping (HTP) for enhancing Breeding Programs in Senegal, Ghana, Uganda, and Regional Cooperation *(sub-award from VT)*	9/1/2018	11/30/2027	$36,410	$173,871
	Use of Novel Genetic diversity for peanut development in East Africa *(sub-award from UGA)*	9/1/2018	9/1/2027	$52,485	$235,188
	Mapping Groundnut Rosette Virus (GRV) resistance for marker-assisted selection *(sub-award from UGA)*	10/1/2018	9/30/2021	-0-	$55,000
	Identifying the Alternative Host for Groundnut Rosette Disease Virus Complex *(sub-award from UGA)*	8/1/2018	2/1/2021	-0-	$102,200
	Photovoice for Youth Empowerment in peanut value Chains in Uganda	3.1.2019	2/28/2022	-0-	$33,440
	Enhancing the Genetic Potential of Peanut Production in Eastern/Southern Africa	2/1/2019	7/31/2027	$74,130	$382,549
	Adoption and implementation of digital management systems and analytical pipeline by groundnut breeding programs in Malawi, Mozambique, and Zambia	5/1/2018	4/30/2019	-0-	$140,625

Institution	Project Name	Start Date (mm/dd/yy)	End Date (mm/dd/yy)	FY2024 Budget	Total Budget
	Breeder Seed Production and assessment of Breeding Programs capacity building in targeted African countries	5/1/2018	4/30/2019	-0-	$35,415
Zambia				**$24,972**	**$146,420**
Zambia Agriculture Research Institute	Enhancing the Genetic Potential of Peanut Production in eastern/southern Africa *(sub-award from NARO/NaSARRI)*	2/1/2019	7/31/2027	$24,972	$134,420
	Breeder Seed Program and assessment of breeding program capacity building in targeted African countries *(sub-award from NARO/NaSARRI)*	5/1/2018	4/30/2019	-0-	$12,000

Acronyms

BMS	Breeding Management System
CERAAS	Centre d'Etude Régional pour l'Amélioration de l'Adaptation á la Sécheresse, Senegal
CIRAD	Centre de Coopération Internationale en Recherche Agronomique pour le Développement, France
CNRA	Centre National de Recherches Agronomiques, Senegal
CRI	Crops Research Institute, Ghana
CRRA	Centres Régionaux de Recherche Agronomique, Mali
CSIR	Council for Scientific and Industrial Research, Ghana
DARS	Department of Agricultural Research Services, Malawi
EAP	External Advisory Panel
ENSA	École Nationale Supériere d'Agriculture
FY24	Fiscal Year 2024
GGWG	Ghana Groundnut Working Group
GRD	Groundnut rosette disease
GREAT	Groundnut Research Extension and Adoption of Technology
GRV	groundnut rosette virus
HTP	high-throughput phenotyping
IBP	Integrated Breeding Platform
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics, India
IER	Institut d'Economie Rurale, Mali
IFPRI	International Food Policy Research Institute, USA
IIAM	Instituto de Investigação Agrária de Moçambique, Mozambique
INRA	Institut National de la Recherche Agronomique, Mali
ISRA	Institut Sénégalais de Researches Agricoles, Senegal
ITRA	Institut Togolais de Recherche Agronomique, Togo
KNUST	Kwame Nkrumah University of Science and Technology, Ghana
LLS	late leaf spot
LUANAR	Lilongwe University of Agricultural and Natural Resources, Malawi
NARO	National Agricultural Research Organization, Uganda
NaSARRI	National Semi-Arid Resources Research Institute, Uganda
NCSU	North Carolina State University, NC
NPRL	National Peanut Research Lab, GA
QTL	quantitative trait loci
SARI	Savannah Agricultural Research Institute, Ghana
SNP	single-nucleotide polymorphism
UGA	University of Georgia, GA
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
ZARI	Zambian Agricultural Research Institute, Zambia

Glossary

Aflatoxin: [aflə'täksən] a class of toxic compounds that are produced by the fungi *Aspergillus flavus* and *A. parasiticus* after infecting various plant species, and can cause liver damage, cancer, stunting and even death in humans and other animals.

Aggregator: [ˈagrəˌgādər] an individual or business entity that collects and distributes product from multiple sources. Some examples of aggregators of farmers' produce: a farmers' market, a food hub, a distributor, or an individual farmer who does the product marketing for several other farmers.

Breeder seed: in peanut or groundnut, the nuts of plants grown by breeders to specifically increase the stock of a certain type of seed available in the future.

Groundnut rosette virus: a pathogenic virus complex found in sub-Saharan Africa that is transmitted between plants by insect vectors such as the groundnut aphid (*Aphis craccivora*) and can cause significant yield loss.

Gut microbiome: the totality of microorganisms, bacteria, viruses, protozoa, and fungi, and their collective genetic material present in the gastrointestinal tract.

High-throughput phenotyping (HTP): the use of modern sensors, such as light- and color monitors, to record data on traits like plant development, architecture, plant photosynthesis, growth or biomass productivity to accelerate the in-field measurements of plant traits needed by plant breeders to determine which plant features and genomic characteristics are most critical to new plant development.

Introgression: [ĭn'trə-grĕsh'ən] in genetics, the movement of a gene from one species into the gene pool of another by the repeated backcrossing of an interspecific hybrid with one of its parent species.

Late leaf spot (LLS): a major foliar disease caused by the fungus *Nothopassalora personata* that leads to circular dark brown to black spots without a halo on the lower surface of the leaves and also on stems and pegs resulting in severe yield loss to the groundnut growers.

Marker assisted selection or marker aided selection (MAS): an indirect selection process where a trait of interest is selected based on a marker (morphological, biochemical or DNA/RNA variation) linked to a trait of interest (e.g. productivity, disease resistance, abiotic stress tolerance, and quality), rather than on the trait itself.

Mycotoxin: [mī'kō-tŏk'sĭn] a toxic secondary metabolite produced by organisms of the fungus kingdom that is capable of causing disease and death in both humans and other animals.

Nematodes: [nem-uh-tohd] multicellular insects that live in soil and feed on plant roots.

Oleic acid: [ō-lē'ik as'id] a monounsaturated fatty acid with good resistance to rancidity which may reduce the risk of coronary heart disease when substituted for saturated fats in cooking.

Polymorphism: a discontinuous genetic variation resulting in the occurrence of several different forms or types of individuals among the members of a single species.

Quantitative trait locus (QTL): a region of DNA which is associated with a particular phenotypic trait, which varies in degree and which can be attributed to polygenic effects, i.e., the product of two or more genes, and their environment.

Resilience: [rĭ-zĭl'yəns] the ability to absorb and recover from shocks and stresses. In plants, these stresses or shocks may be related to drought or disease.

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