DEVELOPING SHORT-AND MEDIUM-DURATION GROUNDNUT VARIETIES WITH IMPROVED YIELD PERFORMANCE, ACCEPTABLE MARKET TRAITS AND RESISTANCE TO FOLIAR DISEASES

Supported by
The McKnight Foundation, USA

Principal Investigator
Emmanuel S Monyo (ICRISAT – Breeder)

ICRISAT, Chitedze Research Station, 16 km Peg Mchinji Rd
P O Box 1096, Lilongwe, Malawi. Tel: +265 1 707057/67/71, Mobile: +265 8203858
Email: e.monyo@cgiar.org

Progress Report
(Sept 1st, 2008– August 31st 2009)

Collaborating Scientists

ICRISAT	MALAWI	TANZANIA
Moses Osiru – Collaborator Pathology	Betty Chinyamunyamu – Principal Collaborator Economics	Omari Mponda – Principal Collaborator Breeding
Moses Siambi – Collaborator Agronomy	Candida Nakhumwa – Collaborator Economics	Elly Kafiriti – Collaborator Agronomy
		Mark Sijaona – Collaborator Pathology

PARTICIPATING ORGANISATIONS:

1. International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)
2. National Smallholder Farmers' Association of Malawi (NASFAM) - Malawi
3. Department of Research and Training (DRT) of the Ministry of Agriculture and Food Security – Tanzania

Table of Contents **Page**

Executive Summary

The McKnight Foundation supported Project 'Developing short and medium duration groundnut varieties with improved yield performance, market traits and resistance to foliar diseases' is currently coming to the end of its third year of implementation (1 September 2008- 31 August 2009). Funded through the framework of the Collaborative Crop Research Program, the overall goal of the four year (2006/07 to 2009/10) Project is 'poverty reduction and improvement in food and nutrition security among smallholder farm families in mid- altitude and lowland areas of Malawi and Tanzania through development of short and medium duration groundnut varieties with improved yield performance, acceptable market traits and resistance to foliar diseases. Project rationale is to provide resource-poor farmers with practical low cost options for disease control and drought management based on plant host resistances. Various farmer-participatory strategies are adopted to ensure sustainable access to the technologies, including improving formal and informal seed systems, strengthening capacity of smallholder farmers and agricultural advisors, and improving awareness of the technologies. The project, led by International Crops Research Institute for the Semi Arid Tropics (ICRISAT), is being implemented in partnership with the Naliendele Agricultural Research Institute (NARI) in Tanzania and the National Smallholder Farmers' Association of Malawi (NASFAM).

The project will deliver three main outputs: a) high yielding farmer and market-acceptable short- and medium-duration groundnut varieties with resistance to foliar diseases; b) Increase adoption rates of improved farmer and market-acceptable varieties and production technologies; and, c) Increase groundnut. Highlights of the progress made by the Project within the reporting period (Sept 2008 – Aug 2009) are provided below:

- Additional sources of resistance for Groundnut Rosette Disease (GRD) and Early Leaf Spots (ELS) continue to be identified from core collections. Accessions ICG 14705, ICG 13099, ICGV-SM 05701, ICGV-SM 08523 and ICGV-SM 08527 have shown potential for Rosette resistance while ICGV-SM 07502, ICGV-SM 07505, and ICGV-SM 07508 are promising materials for ELS resistance.
- Groundnut accessions ICGV-SM 90704, ICG 12991, ICGV-SM 95714 and ICGV 94114 continue to be used for Rosette, Aphid, ELS and Rust resistance introgression respectively. An additional 74 crosses involving these sources and farmer / market preferred locally adapted varieties were made. A backcross nursery comprising 200 BC2F1 has also been developed. F2 progenies from crosses to introgress rosette resistance into farmer preferred varieties are now available for advancing into F3s in both countries.
- All currently released varieties in Tanzania have been confirmed as susceptible to the Groundnut Rosette Virus (GRV) through grafting trials.
- Construction of facilities for aphid rearing in Tanzania has been completed.
- A special course on design of experiments and statistical data analysis using GenStat was conducted for 7 NARS Technicians and 3 Scientists.
- Fourteen (14) nurseries comprising two hundred twenty seven (227) progeny rows ranging from F4 to check rows were evaluated under high rosette disease pressure. A total of 123 single plant selections were chosen for generation advance.

- A total of 277 breeding populations from five (5) nurseries ranging from F_6 to check rows were screened for ELS resistance. A total of 118 single plant selections were chosen for generation advance.
- Seed production efforts by the Project in collaboration with other projects led to production of nuclear seed of 69 lines in advanced, elite trials and released varieties in quantities ranging from 5 to 25kg to maintain germplasm stock for supply to NARS.
- Various quantities of breeder seed were produced on station in Malawi, with additional support from the Tropical Legumes 2 (TL2) project. These include: 12,096kg of ICGV-SM 90704; 720kg of ICG 12991, 11,448kg of ICGV-SM 99568, 2,772kg of JL 24 (Kakoma), 764kg of CG 7 and 594kg of MGV 5.
- A total of 182 lines and varieties (trials, breeding populations and breeder seed) were distributed from Chitedze Agricultural Research Station to three country NARS programs, including Malawi, Tanzania and Mozambique with additional support from the TL2 funded Groundnut Project for Eastern and Southern Africa (ESA).
- Seventy-eight (78) trials and demonstrations were conducted in Malawi. Participatory Variety Evaluation conducted in Farmers fields in Malawi and Tanzania, continue to reveal new farmer preferred varieties.
- Effectiveness of improved practices on crop yields and disease incidences like options for Management of Groundnut Rosette Disease and Aflatoxin Contamination has been demonstrated on Farmers fields and farmers are already adopting the technology.
- A total of 46 lead farmers, 10 extension workers and 3 Association Field Officer were trained in post harvest groundnut handling practices.
- Eighty-one (81) Farmer associations / clubs and farmer market research groups (51 in Malawi and 30 in Tanzania) are operational in target districts for ease of technology dissemination and farmer / researcher learning. These have formed a basis for seed banks as well. 418 farmers in Malawi are currently involved in seed production.
- A total of 16 Farmers Field Days were conducted in the two countries.
- 16,000 Groundnut leaflets, 2000 booklets and 14 documentaries highlighting project activities and technologies on improved groundnut practices have been produced.
- NASFAM, one of our project collaborators continues to buy and export groundnuts. Additionally, NASFAM has added Mzimba district as its second farmer association accredited for Fair Trade privileges.

1. Web Page Update

Project information

The problem

Low agricultural productivity, malnutrition and poverty affect the majority of rural households in Malawi and Tanzania. Poor soil fertility and unreliable rainfall are major factors limiting crop productivity. Consequently, most households do not produce enough food to feed themselves for more than nine months of the year. More than 49% (Malawi) and 40% (Tanzania) of children under five in the rural areas are malnourished to such a degree that their development is retarded. Food shortfalls play a major role in malnutrition but a lack of protein, oil and vitamins in a largely cereal-based diet is also of major importance. More than half of the populations in the two countries live below the poverty line. Thus, the purchase of additional food to supplement the family diet, or of external inputs to improve crop productivity, is not possible for the average household.

Groundnut (also known as peanut) is an important legume crop in the region. Increasing groundnut production has the potential to help mitigate these serious problems for the more than 300,000 rural households in the two countries who live in areas where groundnuts are commonly grown. The crop grows ranging from latitude 40ºN to 40ºS. In most countries in ESA, smallholder farmers with no irrigation and almost no inputs other than land and labor grow the crop in semi-subsistence. It is grown under a wide range of agro ecological conditions (altitude: from sea level to over 1500 m, rainfall 300-1000 mm) but production is concentrated in low and highly variable rainfall.
Because they fix atmospheric nitrogen, groundnuts can thrive under low nitrogen conditions. They also improve soil fertility for the subsequent crop. Increased groundnut consumption will help families reduce problems of malnutrition, since they are nutritious (high protein [12 - 36%], high oil content [36-54%]), thrive under low rainfall and can be grown with low capital investment. Being a popular commodity that is widely traded in local regional and international markets, groundnuts can also be an important source of income, especially for women farmers, who are the main cultivators of groundnuts and who have tended to be excluded from growing traditional cash crops, such as tobacco.

Foliar diseases are generally considered the major constraint to increased groundnut production. Groundnut Rosette Disease, caused by a viral complex, is endemic to the African continent and epidemics occur often, with losses approaching 100% in many fields. Early leaf spot caused by *Cercospora arachidicola*, late leaf spot caused by *Phaeoisariopsis personata*, and rust caused by *Puccinia arachidis*, are other key fungal diseases that cause considerable damage to groundnut production. Leaf diseases can be controlled by timely applications of fungicidal sprays. However, the cost of fungicidal application is prohibitive for smallholder farmers. Therefore, the use of resistant crop cultivars provides the most appropriate means of disease control, being easily incorporated into farmers' operations at little extra cost.

The approach

Project work plan

The overall strategy being pursued consists of four main components: diagnosis, breeding, variety testing and dissemination, and capacity building. Breeding and variety testing involves full participation of smallholder farmers, whose growing conditions, priorities, preferences and seed delivery system practices are the subject of the diagnostic studies. The breeding program is being conducted in two stages. The first has been identification of parental lines with desired characteristics for hybridization and/or breeding populations at different stages of development. The second and currently in effect consist of designing and selecting specific breeding products from the segregating population(s) developed/selected in the first stage. The diagnostic stage is being conducted simultaneously with the first stage of the breeding work. The results of the diagnostics have been used to design the second stage of breeding. Training programs have been designed to strengthen the research and development capacities of collaborating partners and to enhance the innovative capability of farmer groups at participating locations.

Goals

The project goal is reduction of poverty by improving income level, food and nutrition security through investments in short- and medium-duration high yielding groundnut varieties with acceptable market traits and resistance to foliar diseases.

Investigators

Partner institutions

- International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Malawi
- National Smallholder Farmers' Association of Malawi (NASFAM), Malawi
- Agricultural Research Institute (ARI)-Naliendele, Tanzania

Investigators at ICRISAT(*****=project leader)

Emmanuel S. Monyo*
Moses Siambi
Moses Osiru

Investigators at NASFAM

Betty Chinyamunyamu
Candida Nakhumwa

Investigators at ARI

Omari Mponda
Elly Kafiriti
Mark Sijaona

2. Research Report

The Project is currently in its third year of implementation and by the end of its four-year period, three main outputs are expected to be delivered in Malawi and Tanzania:

a) High yielding farmer and market-acceptable short and medium-duration groundnut varieties with resistance to foliar diseases developed through conventional and farmer-participatory breeding approaches;
b) Enhanced adoption rates of improved farmer and market-acceptable varieties and production technologies;
c) Increased groundnut productivity.

In the Research Report section, activities undertaken during the reporting period between Sept 2008 and August 2009 have been compiled by objective. For each, a brief introduction is followed by a narrative summary of activities undertaken preceding short comments on implications of the research findings for the next stage of research, for suggested development activities and for policy where applicable.

Objective 1. Develop high-yielding farmer and market-acceptable short- and medium-duration groundnut varieties with resistance to foliar diseases

Authors

Malawi
Emmanuel Monyo, Principal Investigator - Breeder, ICRISAT
Moses Siambi, Collaborator - Agronomist, ICRISAT
Moses Osiru, Collaborator - Pathologist, ICRISAT
Wills Munthali, Project Officer - Breeder, ICRISAT
Betty Chinyamunyamu, Principal Collaborator - Economist, NASFAM
Candida Nakhumwa, Collaborator - Economist, NASFAM
Samu Phiri, Project Research Technician, NASFAM

Tanzania
Omari K. Mponda, Principal Collaborator - Breeder, NARI
Elly M. Kafiriti, Collaborator - Agronomist, NARI
Mark Sijaona, Collaborator - Pathologist, NARI
Mashamba Philipo, Collaborator-Breeder
Charles Mkandawire, Collaborator-Technician
Joan Kasuga, Collaborator-Technician

Introduction

Small farm holders in the Semi-Arid Tropics (SAT) of sub-Saharan Africa (SSA) continue facing a lot of challenges on how to harness limited available resources in harsh environments (biotic and abiotic stress) to improve their incomes and reduce malnutrition and poverty through improved agricultural production. These farmers also have limited capacity to deal with new and emerging challenges. The project currently running in four benchmark districts; Mchinji and

Nkhotakota in Malawi and Dodoma and Masasi in Tanzania has developed and implemented a number of interventions aimed at mitigating the challenges these resource poor are facing. In these target areas like the rest of SAT, groundnut production is severely constrained by diseases, including the Groundnut rosette disease (GRD), Leaf spot diseases (Early and Late leaf spot-ELS & LLS, caused by *Cercospora arachidicola* and *Phaesariopsis personata*, respectively, and Rust (*Puccinia arachidis*), aflatoxin (*Aspergillus flavus*) contamination as well as drought. This objective seeks to investigate the adequacy of available germplasm base in the region as a source of high yielding varieties with farmer and market preferred traits and ability to overcome existing biotic and abiotic constraints in the region. To complement this, actions have been taken to improve available germplasm through introductions and breeding work. Breeding efforts by the project are aimed at developing groundnut-breeding lines with combined resistances to GRD and foliar diseases and acceptable farmer and market quality traits using a farmer participatory approach. Based on prior testing and experience, ICRISAT and the NARS from Tanzania have identified germplasm from ICRISAT's extensive groundnut collection with resistances to diseases and drought as initial parents for the development of improved populations. Through introgression of desired traits into farmer-preferred varieties, the project has so far produced F2 progenies and BC2F1 materials ready for exploitation by the two countries. Confirmatory tests for resistance to GRD and the aphid vector in the released varieties in Tanzania have been conducted in the green house at Chitedze Research Station.

Climate update

During the reporting period, a long and severe drought was experienced in the central zone of Tanzania (Dodoma), which resulted into total crop failure in most of the project sites. In Southern Tanzania rainfall was poorly distributed and prolonged dry spells encouraged outbreak of rosette leading to reduction in yield. The normal planting period for Naliendele is late December – mid January. During this period, prolonged dry spells experienced disrupted planting of seed plots and trials. Most of the trials were planted in February, which received about 50% of the total rainfall, which resulted to good plant establishment. However, prolonged dry spells at podding stage in March and April resulted to poor pod filling and hence reduction in yield.

In Dodoma (Makutopora, Hombolo and Bihawana) and at Ilonga Research Station (Kilosa district) seedling emergence and plant establishment was good until early March; however, total crop failure occurred due to drought that followed. Therefore, yield data and other parameters from these sites are not reported.

Narrative summary

The following activities were undertaken in the two countries during 2008-2009

- 1.1.1 Identify through PPB and introgress germplasm for yield components farmer/market preferences and adaptation
- 1.1.2 Develop diverse groundnut breeding lines and populations and capacity to screen for GRD and foliar disease resistance in Tanzania
- 1.1.3 Develop & evaluate advanced breeding lines and varieties
- 1.1.4 Germplasm exchange between Malawi, Tanzania, Mozambique and others

Progress of Outputs

1.1.1 Identify through PPB and introgress germplasm for yield components farmer/market preferences and adaptation

a) Additional sources of resistance to foliar diseases identified from core collections, local and wild germplasm

During the reporting period (2008/09), a reference set comprising 289 groundnut lines was evaluated under high GRD and ELS disease pressure at Chitedze Research Station using the infector row technique. The screening exercise continues to identify potential sources of resistance to both GRD and ELS. Additional to the three lines identified in the 2007/08 season, ICG 14705, ICG 13099, ICGV-SM 05701, ICGV-SM 01514 have also been identified as potential sources of Rosette resistance with GRD incidences of less than 5%. For ELS, good resistance (ELS scores of <5 on a nine point scale) was observed from ICG 14118, ICG 8517, ICGV-SM 95741 and ICGV-SM 06394. It was also observed that lines; ICGV-SM 07531, ICGV-SM 06661 and ICGV-SM 01711 showed combined resistance for both GRD (0% Rosette incidence) and ELS (ELS scores < 4).

As a result of screening activities at Naliendele, Nachingwea and Makutopora in Tanzania, varieties ICGV-SM 02501, ICGV-SM99568, ICGV-SM 03701 and ICGV-SM 90704 were identified as tolerant to foliar diseases (ELS, rosette and Rust). ICGV-SM 03590 combined resistance to Rosette (4%) and ELS (<4) while ICGV-SM 02501 combined resistance to Rust (score of 3) and Rosette (4%).

Responding to the need for characterizing rosette reaction or confirming the resistance/susceptibility status of improved varieties (*Pendo, Johari* and *Nyota*) released in Tanzania, the Project embarked on grafting experiments with a susceptible variety carrying Groundnut Rosette Virus (GRV) after infestation. This was a confirmatory test. Grafting trials were conducted by ICRISAT in the glass house at Chitedze Research Station where the three varieties were used both as rootstocks as well as scions onto the known GRV susceptible line JL 24. Data collected included disease scoring. GRD was observed on *Pendo*, *Johari* and *Nyota* whether used as scion or rootstock. Results show that the three varieties released in Tanzania are susceptible to GRD and presents an additional challenge, as the project must prioritize identification of rosette resistant varieties for Tanzania since none is available. Significant progress for this has already been made and currently the project has nurseries of the farmer preferred varieties incorporating GRD resistance source at BC2F1.

b) Farmer preferred varieties with local adaptation identified and hybridization initiated for introgression of GRD and foliar fungal disease resistance

The project continues to build a wide genetic pool for purposes of introgression of GRD, Aphid, Early Leaf Spot and Rust disease resistance for utilization by breeding programs for both Malawi and Tanzania. A nursery comprising 74 crosses for the introgression of the afore mentioned traits into farmer preferred varieties [*Johari* (Robut 33-1), *Pendo* (ICGMS-33), *Nyota* (Spancros) and *Red Mwitunde* from Tanzania and *Chalimbana*, CG 7, JL 24 (Kakoma) and *Nyanda* from Malawi] was re-established at Chitedze Research Station in Malawi to build on the 2007/08

activities. Groundnut accessions ICGV-SM 90704, ICG 12991, ICGV-SM 95714, and ICGV-SM 94114 were used as sources of resistance to Rosette, Aphid, ELS and Rust respectively. Since the on set, the activity has generated about 1,500 F3 segregating progenies each for the three (3) major biotic constraints; Rosette, ELS and Rust in short duration background and are available for exploitation by Malawi and Tanzania and other ESA countries..
The project has in this reporting period finalized the construction of Aphid rearing facilities at Naliendele Research Station in Tanzania. This is a huge boost for tangible screening activities in Tanzania. In support of the activity, ICRISAT dispatched a set of 12 nurseries ranging from 3 to 25 entries for on station as well as a nursery of 38 rosette disease segregating F2/F3 populations for Tanzania to identify resistant progenies for generation advance. Out of this, 46 F3 single plant progenies have been selected. Materials were selected on the basis of their superiority for resistance to major foliar diseases and acceptable grain size (a farmer preferred trait). Currently screening activities using the infector row technique are fully implemented in Tanzania.

Additional to introgression of resistance traits into farmer-preferred varieties, the project is also focusing on the mode of gene action for ELS. This will create a more focused ELS breeding program. A *p (p-1)* diallel mating design was initiated at the hybridization block at Chitedze Research Station. Six varieties; 3 resistant varieties including ICGV-SM 95714, ICGV-SM 95741 and ICGV-SM 93555 identified through the germplasm screening process in the preceding years and 3 susceptible varieties JL 24 (Kakoma), *Pendo* and *Nyanda* from the farmer preferred varieties were used. Crosses were made in all possible combinations. The F1 materials from these crosses are currently being advance into F2. The first round of field test is expected to take place in the 2009/10 season.

1.1.2 Develop diverse groundnut breeding lines and populations and capacity to screen for GRD and foliar disease resistance

a) Disease screening capacity strengthened in the NARS on the use of the infector row technique

For the third year running, the project continues to build capacity in the NARS through staff training. In the reporting period, three training courses on three modules (hybridization, infector row technique and experimental design) were conducted at Chitedze Research Station –Malawi. First, was a two-week training course on hybridization techniques and introduction to disease screening conducted from 19th October to 2nd November 2008 for Technicians from Malawi, Tanzania and Mozambique. The training aimed at enhancing effective breeding programs for NARS by improving skills in hybridization, disease identification and screening for staff. A total of seven (7) NARS Technicians one (1) female and six (6) males of which two were from Tanzania, two from Mozambique and three from Malawi attended the training. As a result of the training, the Malawi National program has started carrying out its own training activities for hybridization, a positive indicator of enhanced capacity. For Tanzania the training that project staff has received through support from McKnight Foundation has already started making a difference in the whole Oilseeds Research Program in Tanzania through implementation of various breeding activities.

This was followed by another two-week training course split into two modules. The first module involved NARS Technicians who went through the first course in October 2008. The training built on the theoretical aspects of the infector row technique from the first course and took advantage of the established fields at Chitedze Research Station. This endeavors to develop strong foundation for disease screening programs for NARS. The second module on experimental design and data analysis using GenStat was facilitated by Prof. Roger Stern from the University of Reading –UK and involved both NARS Technicians and Scientists. Three NARS Scientists from Malawi, Tanzania and Mozambique participated in the training. The training on statistics hopes to generate good and meaningful reporting, which emanates from good data organization and analyses. It is also hoped that the training offered by the project is going to stimulate further learning by enabling each location and or partner analyze their own data and draw lessons from their projects.

b) Diversified groundnut populations/ breeding lines with genetic resistance to Rosette, ELS, rust and LLS and combined resistances

Screening Breeding Populations for Rosette resistance

In Malawi, the McKnight project in collaboration with the TL 2 project established Fourteen (14) nurseries comprising two hundred twenty seven (227) progeny rows. These were evaluated under high Rosette and ELS disease pressure. The materials combine two or more traits (grain yield, aphid resistance and GRD resistance) and ranged from F4 through F7 to check rows. A total of one hundred and twenty three (123) single plant selections were made for generation advance; Twenty-nine (29) of these plants were derived from F4 –F5 progeny rows and identified for generation advance, Twenty-six (26) progeny rows from F7 were advanced to check rows and Sixty-eight (68) progeny rows from check rows were advanced to preliminary trials. 68 % of materials from the check rows had 0% rosette incidence (Table 1).

Table 1: Selection program for segregating breeding populations in F4-F7 and Check Row in the GRD nursery during 2008-09 season at ICRISAT- Chitedze Research Station.

POPULATIONS			
POPULATIONS	EVALUATED	SELECTED	Entries with 0 % rosette incidence
Rosette resistance and ELS resistance check row	12	11	11
Aphid resistance and ELS resistance check row	24	24	17
Aphid and GRD resistance F4 SPS	3	1	1
Aphid resistance and rosette resistance check row	8	6	3
Aphid resistance x rosette virus resistance F4	12	5	3
Aphid resistance x ELS resistance-F4	32	9	6
GRD and bold seeded-Check row	14	6	5
Rosette virus resistance and confectionery check row	26	21	21
Aphid resistance and confectionery-F7	21	11	10
GRD resistance and confectionery-F4	4	1	1
Aphid resistance and ELS –F4 SPS	10	2	2
High oleic acid and rosette resistance-F5 SPS	6	2	0
Aphid resistance (VB) confectionery F7 SPS -	15	15	9
Aphid resistance and ELS resistance- F5 SPS	40	9	7
TOTAL	**227**	**123**	**93**

Screening Breeding Populations for ELS resistance

A summary of the ELS segregating nursery performance for the main season is highlighted in Table 2. A total of 277 breeding populations from five (5) nurseries ranging from F6 to check rows were screened for ELS resistance at Chitedze Agriculture Research Station. These populations were developed to combine ELS resistance and yield. Chitedze Research Station at an altitude of 1149masl provides an excellent screening location for ELS. Out of the 277 progreny rows evaluated, one hundred and eighteen (118) single plant selections were chosen (disease score ≤ 4 on a scale of 1 -9) for advance..

Table 2. Selection program for segregating breeding populations in F6 to check row in the ELS nursery during 2008-09 season at ICRISAT Chitedze Research Station

POPULATIONS			
POPULATIOPNS	EVALUATED	SELECTED	REMARKS
Arachis Hypogaea ELS Introgression	152	41	To be advanced for further screening
Evaluation of Groundnut Germplasm Lines To ELS - F6	14	14	Advanced to F7
ELS resistance and confectionery (Virginia) F7SPS	18	5	Advanced to Check row
ELS & X Rosette resistance – Check row	9	9	Advanced to Preliminary Trials
ELS X ELS Resistance – Check row	84	49	Advanced to Preliminary Trials
Total	**277**	**118**	

1.1.3 Develop and evaluate advanced breeding lines and varieties

c) New improved groundnut varieties incorporating local derived genes for quality and adaptation developed by Year 4

For on station trials in Tanzania a number of positive strides in terms of identification of traits for various breeding needs have been made. Varieties ICGV-SM 02724, ICGV-SM 01721, ICGV-SM-01711 and CG-7 demonstrated to have large seed size compared to recommended variety Johari. This provides a window of opportunity to have Johari replaced or improved with large seeded varieties for the market needs. Results also showed that ICGV-SM-01711, ICGV SM 90704 and Local variety Kanyomwa were tolerant to rosette. ICGV SM 90704 is currently being used as source of rosette resistant into farmer preferred varieties. ICGV-SM 03590 was identified as resistant to rosette but recorded a relatively low pod yield across sites probably due to poor establishment and low final plant stand as a result of drought. Variety, ICGV SM 03521 combined resistance to foliar diseases and high yielding ability. It also out yielded the two recommended varieties Nyota and Pendo by about 10 percent. Due to drought, pod yields were low for the tested varieties and ranged from 300 -950 kg/ha. The highest yielding variety (ICGV-SM-03701) with an average pod yield of 897 kg/ha across sites had high yields but late onset of rosette incidence (average of 13%) compared to ICGV SM 99568 that had low rosette incidence (5.7%) and low pod yield of 647 kg/ha (Appendix 1a).

1.1.4 Germplasm exchange between Malawi, Tanzania, Mozambique and others

a). Nucleus seed of elite lines produced annually for NARS testing and for breeder seed production

Seed production efforts by the Project with additional resources from the TL2 project have led to the following achievements for the year ending August 2009:

- Nuclear seed of 69 lines in advanced testing in the National Programs in Eastern and Southern Africa was produced in quantities ranging from 5kg -25kg by ICRISAT at Chitedze Research Station for sharing with NARS. In Tanzania, 230 Kgs nuclear seed of seven (7) varieties namely; *Pendo, Mnanje,* ICGV-SM 99568, ICGV-SM 90704, *Red Mwitunde, Nachingwea* and *Nyota* has been produced at Naliendele Research Station and Nachingwea Sub station for on-farm research.

b) Advanced breeding lines and breeder seed of improved groundnut varieties available to NARS and NGOs in ESA on an annual basis

- Various quantities of breeder seed were produced on station in Malawi and Tanzania as follows:

  In Malawi, 12,096kg of GRD resistant variety ICGV-SM 90704; 720kg of Aphid resistant variety ICG 12991, 11,448kg of early maturing GRD resistant variety ICGV-SM 99568, 2,772kg of early maturing variety JL 24 (Kakoma), 764kg of high yielding variety CG 7 and 594kg of variety MGV 5. Tanzania has produced 2 tonnes of breeder seed of variety Pendo. Severe drought, contributed to low production of breeder seed in Tanzania.

- Table 3 below presents the groundnut seed by category distributed to national programmes in the sub-region. A total of 182 lines and varieties were distributed from Chitedze Agricultural Research Station to three country NARS programmes, including Malawi.

Table 3. Seed distribution to National Programs during 2008 - 09 season

Nursery	**Malawi**	**Tanzania**	**Mozambique**	**Total**
International Trials (sets)	12	12	12	**36**
Advanced Breeding Trials	57	3	36	**96**
Early generation Breeding Material	0	38	0	**38**
Germplasm samples	0	0	0	**0**
Others (varieties/breeder seed)	0	5	7	**12**
Total	**69**	**58**	**55**	**182**

c) Early high yielding, farmer preferred lines identified for evaluation under high GRD and ELS disease pressure using the infector row technique

The use of the infector row technique has significantly increased the likelihood to identify lines that are possible candidates as sources of resistance to GRD and ELS. In Malawi, A total of 20 Spanish and 20 Virginia varieties in the Regional Elite Variety Trials were evaluated under high GRD and ELS disease pressure using the infector row technique at Chitedze Research Station. Significant differences, p = 0.05 were observed in Spanish varieties for pod yield and reaction to GRD and ELS while for Virginia varieties, significant differences were only shown in reaction to GRD (Appendix 1b). High yielding Spanish varieties included ICGV-SM 03590, ICGV-SM 99566 and ICGV-SM 99551 giving a pod yield of 3228 kg ha^{-1}, 3139 kg ha^{-1} and 3094 kg ha^{-1}respectively. These varieties also showed a reasonable resistant to both GRD (< 5.6%) and ELS (<4). For Virginia, ICGV-SM 02712 and ICGV-SM 01711 were the highest yielding varieties with a pod yield of 4344 kg $ha^{-1}$and 3039 kg ha^{-1} respectively. These varieties also yielded above CG7 (2217 kg ha^{-1}), which was used as a check . ICGV-SM 01711 is resistant to both ELS (score ≤3) and rosette (incidence 0%). ICGV-SM 02712 have good levels of resistance to ELS but moderately resistant to GRD (late onset of incidence – 31%), compared to CG7 (incidence 47) and early onset of symptoms.

Implications of the research findings

a. For the next stage of research

Intensification of screening activities in Tanzania and Malawi has revealed a number of promising materials as candidate lines for addressing both biotic and abiotic stresses. There will be need to introgress new sources of resistance into favorable farmer/market preferred varieties. Additionally biotic stress resistant lines identified through on-station trials will also have to be promoted to on-farm testing to quickly identify varieties for Tanzania. The project will also have to focus on identifying materials that will combine both drought and disease resistance, in short to medium duration background.

b. For future development activities

Efforts to introgress Rosette (GRD) resistance into Pendo (Tanzania) JL 24 (Kakoma) (Malawi) should continue. ICRISAT through the project will also continue to multiply seed of released and pre-release varieties at Chitedze. Informal seed production systems have proved very effective as such effort will be required to ensure better access to seed of improved varieties. Increased seed production of new released varieties is anticipated in Tanzania.

Objective 2. Promote adoption of improved high-yielding farmer and market-acceptable short- and medium-duration groundnut varieties

Authors

Malawi
Emmanuel S. Monyo, Principal Investigator- Breeder, ICRISAT
Moses Siambi, Collaborator - Agronomist, ICRISAT
Moses Osiru, Collaborator - Pathologist, ICRISAT
Wills Munthali, Project Officer – Breeder, ICRISAT
Betty Chinyamunyamu, Principal Collaborator – Economist, NASFAM
Candida Nakhumwa, Collaborator – Economist, NASFAM
Samu Phiri, Project Research Technician, NASFAM

Tanzania
Omari K. Mponda, Principal Collaborator - Breeder, NARI
Elly M. Kafiriti, Collaborator - Agronomist, NARI
Mark Sijaona, Collaborator - Pathologist, NARI
Mashamba Philipo, Collaborator-Breeder
Charles Mkandawire, Collaborator-Technician
Joan Kasuga, Collaborator-Technician

Introduction

Groundnut production if appropriately exploited can help mitigate the numerous challenges faced by small-scale farmers in ESA. The crop is well traded within and across the region and has potential to minimize poverty and malnutrition. To effectively achieve significant strides in exploiting benefits from groundnuts, high adoption levels as well as efficient and effective market linkages should accompany improved production technologies. In spite of a wide range of available groundnut technologies (including varieties), it has become apparent that small-scale farmers are not adequately utilizing them. Thus, rates of adoption remain generally low, partly because farmers are either not aware of the availability of the technology, but also due to inaccessibility of quality seed of improved varieties. The latter is related to the under-development of the seed supply systems for groundnuts and lack of NARS and farmer capacity to multiply quality seed. Groundnut being a self-pollinated crop has attracted less interest from seed companies and as such it is not available on the market. Further, even in areas where improved varieties have been adopted, poor crop husbandry practices predominate amongst poor farmers; yields remain low, and varietal potential, remain largely untapped. For the benchmark districts, the project has observed a significant change in the rate of adoption of improved technologies such as varieties, management of GRD, and Aflatoxin.

The main strategy underpinning this objective is promotion to achieve wide scale adoption of ‘best practices’ such as optimum plant populations, optimum planting dates, linking cultivars with length of growing periods and the use of host plant resistance utilizing both existing (released varieties) and new ‘Project’ developed varieties in a bid to sustainably increase groundnut production in Malawi and Tanzania. Conducting demonstrations of improved technologies on-farm, will enable farmers to experientially learn through comparison with farmer practices and will stimulate adoption of on-farm proven technologies.

Narrative Summary

2.1.1 Conduct participatory adaptive trials and demonstrations including promotion of systems for control and management of aflatoxin

2.1.2 Conduct field days, agricultural shows & rural seed fairs with farmers, researchers & market players

2.1.3 Enhance institutional innovations to improve access of the poor to good quality seeds of improved high yielding adapted varieties

2.1.4 Conduct training-of-trainers program on seed and crop production techniques for extension and NGO partners

Progress of Outputs:

2.1.1 Conducting participatory adaptive trials and demonstrations including promotion of systems for control and management of aflatoxin

Varieties for wide scale on-farm adaptive testing with farmer participation

A total of Seventy-eight (78) trials were established in Malawi in the two target districts of the Project (Mchinji and Nkhotakota) spanning forty-three (43) villages. Thirty -five (35) of these trials were female led and Forty-three (43) trials handled by males. The districts represent two important growing ecologies of groundnut- the Lake Shore areas and the mid altitude plains. In Malawi, 2008/09 season has been characterized with good rainfall distribution and excellent enthusiasm from farmers across the project sites. Trials and demonstrations were well laid and managed. In Tanzania, the project conducted variety trials to elicit farmer's choice and preferences on groundnut varieties. A total of 30 Farmer Research Groups/Farmer Field Schools (FRG/FFS) were involved in Participatory Variety Selection (PVS); twenty groups in Masasi, Nanyumbu, Lindi, Ruangwa, Tunduru and Mtwara and 10 in Dodoma. However serious drought and incidences of Groundnut Rosette Disease especially in Dodoma led to total crop failure in Dodoma and significant losses in the other districts. This is a clear testimony to the value of short duration disease resistant varieties which this project is attempting to develop.

Fig 1. Combined effects of drought and groundnut rosette disease at Muungano village in Dodoma-Tanzania during 2008/09 season

a. Participatory varietal evaluation

In order to elicit more views and engage more farmers and the communities on variety selection, the project conducted forty (40) variety trials in Mchinji and Nkhotakota Districts. The activity aims at comparing (and demonstrate) improved groundnut varieties with the varieties commonly used by farmers, giving farmers opportunity to see the range of elite varieties available and potentially new materials in the pipeline and collect outstanding information from farmers that may strengthen the case for release.

The participatory groundnut variety trial involved five Spanish varieties (JL 24 (Kakoma), ICGV-SM 99568, ICGV-SM 99541, ICGV-SM 01513 and *Nyanda* and five Virginia varieties (*Chalimbana*, ICGV-SM 01711, ICGV-SM 01708, ICGV-SM 90704 and ICGV-SM 01731). Three of the Virginia varieties used were new lines that have shown potential and identified through the screening process. Sets were planted in a Randomized Complete Block Design using farmers as replicates. Trials were spaced at 75cm between rows and 10cm between plants. Plots contained 4 ridges each 6m long. At least two weedings were undertaken. Data collected included; stand count, disease severity, farmers' preferences, pod weight and number of pods per plant. Criteria for selection included yield, seed size, taste, grain filling, ease of shelling, disease resistance and level of dormancy.

Results show significant differences $p = 0.05$ in pod and kernel yield over the two sites (Appendix 2). For Virginia varieties, ICGV-SM 01711 gave the highest pod and kernel yield, 2626 kg $ha^{-1}$and 1585kg ha^{-1} respectively followed by ICGV-SM 01708 (1546kg ha^{-1}) and ICGV-SM 90704 (1543 kg ha^{-1}). For Spanish varieties, ICGV-SM 01513 one of the promising lines in its third year of on farm testing performed relatively well giving 2041kg ha^{-1} and 1407kg ha^{-1} (32% kernel yield gain over JL 24 (Kakoma) - a local check) for pod and kernel yield respectively. These varieties also gave a kernel yield above that of the site mean (1342 kg ha^{-1}) and recorded a relatively low rosette incidence ($< 4.8\%$) and very high mean pod number per plant (>27 pods/plant) as compared to Chalimbana with 21 pods/plant and JL 24 (Kakoma) with 24.36 pods/plant. Results show a high and positive correlation (+ 0.734) between pod number and kernel yield.

The Participatory Variety Selection (PVS), has revealed seed size as a priority trait for farmers followed by disease resistance, yield, easiness of shelling and taste in that order. A direct matrix for ranking by traits showed *Chalimbana*, a local long duration variety as the overall preferred irrespective of its relatively low yield (991kg ha^{-1}) and susceptibility to diseases. Chalimbana is preferred specifically for its large seed size, ease of shelling, taste and pre-harvest dormancy. This was followed by ICGV-SM 90704 (*Nsinjiro*) and ICGV-SM 99568 (*Chitala*) yielding 1543kg $ha^{-1}$and 1252kg ha^{-1} respectively (Appendix 3). In addition to high yielding ability, ICGV-SM 90704 (*Nsinjiro*) was selected chiefly for its disease (GRD and ELS) resistance attributes. A pair wise ranking system however showed ICGV-SM 90704 (*Nsinjiro*) being ranked ahead of Chalimbana, the two though being the most preferred (App. 4). There was variation however with regards to preferences for individual districts. Three most preferred varieties in Mchinji were *ICGV-SM 99568 (Chitala), Chalimbana* and ICGV-SM 90704 (*Nsinjiro*) in order of preferences while JL 24 (*Kakoma*) was the most preferred variety in Nkhotakota followed by *Nsinjiro* and *Chalimbana* (Appendices 5 and 6). A pair-wise variety ranking for Nkhotakota shows the pattern as follows: ICGV-SM 90704 (*Nsinjiro*), JL 24 (Kakoma) and ICGV-SM 99568 (*Chitala*) being the most preferred varieties (Appendices 7). Farmers however registered a concern with ICGV-SM 90704 (*Nsinjiro*) for shelling difficulties.

New introductions ICGV-SM 01731 and ICGV-SM 01708 were consistently in the top four preferred varieties confirming their potential. The preference pattern for this season favored a lot of medium duration varieties and this could be attributed to the good rainfall distribution the season had as opposed to the 2007/08 season which experienced end season droughts in both districts that led to poor pod filling in most varieties especially *Chalimbana*. The variation in the nature of seasons also offered an opportunity for farmers to visualize that short duration varieties fit very well in either situations. One challenge though has been the existence of sprouting in all short duration varieties due to lack of dormancy.

In Tanzania, the local evaluative criteria, which farmers used prior to harvest were drought resistance, disease resistance, pod size, pod filling and kernel size. The farmers also included criteria such as marketability, easiness to pluck at harvesting and post-harvest stages. Appendices 8 and 9 present the results of a matrix ranking of the 7 Virginia groundnut varieties in four sites and 7 Spanish varieties for 2 sites in Southern Tanzania. The methods used to elicit farmers' preferences with regard to the 7 Virginia varieties indicated that ICGV-SM-01711 (963 kg ha^{-1}), ICGV-SM-01721 (725 kg ha^{-1}) and ICGV SM 90704 (729 kg ha^{-1}) were the best three varieties preferred by farmers than Johari, which is the current recommended Virginia variety. Variety CG-7 that has been adopted by farmers in Masasi as "Mnanje" ranked fourth. For Spanish types, varieties ICGV 99557 and ICGV 99555 were the most preferred varieties. Variety Pendo was fourth in the ranking. The Monitoring and Evaluation visit conducted by national NARS Tanzania reported good performance and farmer preference of variety "Mnanje" (CG-7) in the Western Zone in Nzega District. Generally, the incidence of drought and rosette that prevailed during the season, on a research point of view provided farmers opportunity to identify varieties tolerant to drought and rosette disease. On farm trials for Spanish varieties in the central and Southern Tanzania identified ICGV 99557, Pendo and ICGV 99555 as the highest yielding varieties with pod yields of 742 kg ha^{-1}, 697 kg ha^{-1} and 694 kg ha^{-1} respectively (App.10). Figures 2 and 3 show participatory variety selection in Mlonyeni – Malawi and Nanyumbu – Tanzania.

Fig 2. A variety trial in Msitu –Mchinji (Malawi) *Fig 3. PVS –Nanyumbu (Tanzania)*

b). Demonstrate technologies for the management of Rosette

This trial hopes to popularize some of the common disease management technologies amongst small-scale farmers, validate recommended cultural practices with specific released varieties and enable small-holder farmers in project areas to increase food security through reduction in GRD incidence.

Three options demonstrated to farmers were arranged in Mother-baby trials in Randomized Complete Block Design (RCBD) and included: time of planting (early vs late (3 wks later), genotype (resistant vs susceptible) and plant population (high (10cm) vs low (30cm) plant population). Two Virginia (*Chalimbana* and *Nsinjiro*) and two Spanish (*Malimba* and *Baka*) varieties were tested. Baka and Nsinjiro are resistant to GRD while *Chalimbana* and Malimba are susceptible to GRD. A total of twenty-two farmers were involved in the running of the rosette trials for the two Districts. Ridges were spaced at 75cm apart with either 10cm or 30cm between plants in their respective treatments. Plots contained 4 rows each 20m long. Important data for this activity included stand count, rosette scores, pod weight and technology assessment (based on plant growth)

In Malawi, relatively low rosette incidences were experienced in the 2008/09 season as a result there were no significant differences, p= 0.05 between treatments for rosette incidence. However, variations between treatments still carrying sufficient message for farmers to visualize the merits and demerits from the treatments were observed. The overall mean for the genotype-time of planting and genotype-plant population interactions showed a higher rosette incidence for late planting (19.6%) than early planting (6%) and11.6% for high plant population (10cm) compared to 14.1% for low (30cm) plant population (Appendix 11). Similarly for genotype, time of planting and plant population interaction, the rosette incidence was higher at low plant population (30cm) than high plant population (10cm), 7.3% and 4.8% respectively and high for late planting compared to early planting, 20.9% and 18.4% respectively (Appendix 12). Resistant varieties also performed much better at early planting than late planting for rosette resistance, 1.3% compared to 5.9% respectively. Similar trend has been shown for resistant varieties at low and high plant population, 5% and 2.2% respectively. It has also been demonstrated on farmers fields that there were substantial yield gains through early planting compared to late planting, 865kg ha^{-1} and 427 kg ha^{-1} respectively and that use of high population (10cm) adds more to the food basket than low population (30cm), 743 kg ha^{-1} and 549 kg ha^{-1} respectively (App. 13). The project team also shared the previous (2007/08) results with farmers who have shown clear conviction that these interventions (early planting, high plant population and use of resistant varieties) have the potential to mitigate yield losses resulting from incidences of Groundnut Rosette Disease.

c) Demonstrate technologies for reduction of aflatoxin under smallholder conditions

The main objective of this trial was to validate and promote options for management of Aflatoxin contamination of Groundnut through use of varieties (resistant, J11 versus susceptible, ICGV-SM 99568), time of planting (early versus late) and water management (box versus open ridges). A mother-baby trial design was used. Mother trials were planted at 4 farmers fields per district with each farmer having all the three treatment combinations. Each mother trial was flanked by two Baby Trials. A total of twenty two (22) farmers were involved in the running of the Aflatoxin trials for the two Districts. Ridges were spaced at 75cm between rows and 10cm between planting stations. Plots contained 4 rows each 20m long. Ridges were boxed every 2m. Important data collected included stand count, technology assessment (based on plant growth) and pod weight. Groundnut samples were taken to Chitedze Research Station and after drying; a 300g random sample was subjected to aflatoxin analysis using the Enzyme Linked Immuno-Sorbent Assay (ELISA).

Overall results for the treatment combinations show no significant differences in Aflatoxin levels, p =0.05. Use of box ridges however, had lower aflatoxin levels compared to open ridges, 121 ppb and 129 ppb respectively in the susceptible variety (ICGV-SM 99568) and 3ppb compared to 4ppb for box and open ridges respectively in the resistant variety, J 11 (App. 14). The difference in levels between the two treatments is relatively lower compared to that of 2007/08 season. This is attributed to sufficient rainfall received in the 2008/09 rainy season. Results of the two seasons are however consistent. In the absence of moisture stress, use of box ridges in overall performance did not show much impact (66ppb for open ridges and 62 for box ridges) in terms aflatoxin concentration. For time of planting: late planting had higher levels of aflatoxin as compared to early planting, 85 ppb and 43 ppb respectively. ICGV-SM 99568, a susceptible variety had a higher level of aflatoxin than J11, 125 ppb vs 3.75ppb respectively. These differences provide enough evidence for farmers that planting early and use of resistant varieties is key towards reducing levels of aflatoxin in groundnuts at farm level. Results from on farm trials are also consistent with those conducted on station under irrigation and water stress conditions. Twenty-five (25) test lines were planted in pots subjected to the two water treatments (stressed and non-stressed). There were significant differences, p=0.05, in the levels of aflatoxin in the test materials. Under water stress, aflatoxin levels were higher ranging from 0.0 to 299 ppb than the irrigated treatment, 0.264 to 31 ppb. J11, a known source of aflatoxin resistance recorded low aflatoxin levels (<5.394ppb) in both treatments consistent with on-farm findings.

The rainfall data for Malawi and Tanzania for 2008/09 season is shown in appendices 15 and 16.

2.1.2 Conduct field days, agricultural shows & rural seed fairs with farmers, researchers & market players

Field Days (FD) have increasingly played a pivotal role in showcasing project activities (groundnut technologies) to farmers, traders and communities at large and have continued attracting large numbers of participants. FDs have also provided an excellent forum for increasing scientific reasoning with farmers. In Malawi, 12 successful farmer field days were conducted in the two districts of Mchinji (5) and Nkhotakota (7). These field days attracted seven hundred and seventy six (776) participants (268 Women and 508 males) from stakeholders like Ministry of Agriculture, local traders, farmers, Traditional leaders and nearby schools. The focus was on validating and promotion of technologies on three aspects: Participatory Varietal Selection, options for the management of aflatoxin, options for management of Groundnut Rosette Disease (GRD) as well as quality seed production. For Nkhotakota, a community radio Station that reaches 6 districts covered the activity.

The Project in Tanzania organised four (4) Farmer Field Days (FFD) in the districts of *Tunduru, Masasi, Nanyumbu* and *Mtwara*. This was done in collaboration with SADC- ICART sesame project and TL 2. A total of 300 (100 females and 200 males) attended. These field days provided an opportunity for collaborating and non-collaborating farmers within and neighboring villages to interact which in turn helped in the spread of technological information regarding groundnut varieties and production techniques. The high prevalence of drought and rosette in Tanzania, from a research point of view also provided an opportunity for both researchers and farmers to test and identify groundnut varieties that can yield well under such stress. Varieties: ICGV-SM 99568, ICGV-SM 90704 and ICGV-SM 01711 were proposed by farmers to combine both rosette and drought tolerance while ICGV-SM 99551, ICGV-SM 99557, ICGV-SM 86737 and CG 7 as drought tolerant. This however remains a major challenge requiring re-directed effort to mitigate the existing constraint. The project also organized two rural seed fairs in Nanyumbu and Dodoma districts, which attracted 2000 farmers and facilitated exchange of seed production through community seed banks.

2.1.3 Enhance institutional innovations to improve access of the poor to good quality seeds of improved high yielding adapted varieties

a) Agreements established with at least two non-governmental organizations to establish community seed production for at least two different varieties in each country

In Malawi, 5.3 tons of breeder seed variety ICGV-SM 90704 (*Nsinjiro*) was delivered to CARE (Cooperative for American Relief Everywhere) Malawi. With support from the EU, CARE, in collaboration with ICRISAT organized 450 farmers in 15 community-based organizations. Each farmer received 10 Kgs of breeder seed ICGV-SM 90704 produced through the McKnight Project for further multiplication.

As a result of project intervention in Masasi and Nanyumbu districts in Tanzania, the regional authorities in Mtwara are actively involved in promoting the production of groundnut as an alternative cash crop. Nanyumbu District harvested about 9,000 tonnes. The harvest would have been much higher had it not been for drought experienced throughout the season.

b) Monitoring system established to assess seed demand from demonstration trials, and link this to basic seed production

In May 2009, the Project's monitoring team visited all sites where trials were planted in Nkhotakota and Mchinji (Malawi). From the trial sites, farmers were able to visibly see the characteristics of different varieties of groundnuts, which were grown and indicated their preferences and reasons for their preference, which is then used to guide seed multiplication initiatives. Variety trials and Seed multiplication activities mounted in the project sites have exposed farmers and communities at large to many new promising lines and newly released varieties. ICGV-SM 99568 (*Chitala*) and ICGV-SM 90704 (*Nsinjiro*) have attracted special attention from farmers for their diseases resistance (GRD) and high yielding abilities. ICGV-SM 90704 was the overall preferred. There is a lot of pressure for seed for these varieties not only from project sites. The Project as of now does not have enough capacity to multiply seed to meet such requirements. Additionally, multiplication of ICGV-SM 99568 (Chitala) has not yet been commissioned. The team will however continue working with communities through development of seed banks to increase access of variety ICGV-SM 90704 to farmers.

c) Community seed banks established and fully functioning

From the initial 233 farmers and 47 seed banks producing seed in 2007/08 season, the number has grown to 418 farmers and 51 seed banks with the area increasing by more than 4 fold per farmer. In the second quarter of 2008/09, the project initiated a seed inspection exercise in the research groups established with NASFAM. The activity was successful and involved the

Ministry of Agriculture and Food Security Seed Inspectors. It was encouraging to note that some farmers especially the first beneficiaries had not only followed recommended practices but also increased cultivation from the initial 0.2 to about 1½ acres of ICGV-SM 90704 (*Nsinjiro*) per farmer. In Mchinji, farmers in the community seed production produced about 6.5 tonnes (shelled) seed of variety ICGV-SM 90704. Two hundred and forty three (243) Farmers in Nkhotakota who received 5kgs each of JL 24 (Kakoma) have produced about 16 tonnes unshelled groundnuts. Farmers in Nkhotakota have often sold their groundnuts to local traders without an appropriate price framework. There is urgent need to develop proper market links for these farmers.

For the first time in Tanzania, the project facilitated Farmer Research Groups of Mpeta (Mapambano group), Mnanje (Umoja group) and Likokona (Tupendanne) getting into official seed production contract with Agricultural Seed Agency (ASA) to produce certified groundnuts seed of variety *Pendo.* In addition, about 30 community seed banks each comprising 8-25 members have been established in the project areas for on-farm seed production. Each of these groups received between 10 to 20 kg of seed depending on the amount of land available. The project purchased 7 tonnes of groundnut seed for distribution to the project areas to speed up the diffusion of groundnut variety Pendo in the project districts for greater impact.

2.1.4. Conduct training-of-trainers program on seed and crop production techniques for extension and NGO partners

a) *Training and information needs of partners identified*

One of the challenges the project has noted is limited know how for farmers and partners at large on interventions against aflatoxin management after harvest. In this regard, the project continues to engage more cooperating partners on issues of aflatoxin awareness. Additional to field demonstration on the management of aflatoxin, in Malawi, three (3) Extension workers from Ministry of Agriculture, three (3) Association Field officers and eighteen (18) lead farmers from NASFAM from the bench mark districts were trained on post harvest crop handling especially the formation of ventilated stacks. Similar training was provided to twenty-eight (28) facilitators from CARE (the NGOs that received breeder seed for community seed banks) and seven (7) Extension workers from the Ministry of Agriculture in Kasungu

b) Informal short and formal/long term training initiated during year 1 and continuing

In Tanzania, the project organized a joint training in collaboration with ICART Sesame project and Tropical Legume 2 to equip Extension workers and farmers with techniques on quality seed production as well as layout of on-farm trials and data collection. This training attracted a total of sixty (60) participants, which included twenty-four (24) farmers and thirty six (36) extension workers. Chamwino District Council – District Agricultural and Livestock Development Officer (DALDO) Office also trained farmers from sixteen (16) villages in Dodoma. The training, which focused on seed production techniques for the groundnut variety Pendo, drew two farmers from each village

Implications of the research findings

a. *For the next stage of research*

. Following outcomes from trials and demonstrations, there will be need for development of integrated disease management (IDM) and their introduction to the community through organized structures like Farmer Field Schools. These have proved effective for farmers in Kasungu under a joint project implemented by CARE and ICRISAT. Realising the complex nature of aflatoxin contamination, the project will need to develop integrated management tactics aiming at tackling the problem both at pre-harvest and post-harvest. There will also be need to put more effort on identifying GRD resistant varieties for Tanzania as the current released varieties are all susceptible. Additionally there will be need for speedy release of technology by combining testing with on-farm promotion. This is vital for farmers to quickly realize benefits and move out of the poverty trap. Efforts on seed multiplication will have to be strengthened to ensure availability of seed stock both for breeder and certified seed as Informal seed systems have proven effective in increasing availability of seed and also in promotion of improved varieties.

b. *For future development activities*

There is a window of opportunity for the project to reach out and build on the lessons learnt from the benchmark districts as NASFAM has of late added Mzimba District to the Fair Trade group. The district however lies outside the two agro-ecological zones, which are the current focus of the project – it is in the high altitude but interestingly with many pockets of high groundnut production. This however is viewed, as new proposition in the project as the current breeding scope would require expansion.

In the present scenario the project will continue to out scale by engaging more farmers and stakeholders in the Participatory Breeding Program for 2009/10 growing season in Malawi and Tanzania. This emanates from the demand farmers and villages placed in the 2008/09 season to handle more demonstrations and trials in the 2009/10 season to be accorded sufficient opportunity for participation.

Objective 3. Increase groundnut productivity by development and implementation of a sound and practical technology dissemination program

Authors

Malawi
Emmanuel S. Monyo, Principal Investigator - Breeder, ICRISAT
Moses Siambi, Collaborator - Agronomist, ICRISAT
Moses Osiru, Collaborator - Pathologist, ICRISAT
Wills Munthali, Project Officer - Breeder, ICRISAT
Betty Chinyamunyamu, Principal Collaborator – Economist, NASFAM

Candida Nakhumwa, Collaborator – Economist, NASFAM
Samu Phiri, Project Research Technician, NASFAM

Tanzania
Omari K. Mponda, Principal Collaborator - Breeder, NARI
Elly M. Kafiriti, Collaborator - Agronomist, NARI
Mark Sijaona, Collaborator - Pathologist, NARI
Mashamba Philipo, Collaborator-Breeder
Charles Mkandawire, Collaborator-Technician
Joan Kasuga, Collaborator-Technician

Introduction
The development of an effective and efficient technology dissemination program is a foundation for the rate at which farmers willingly adopt them. This is an essential component of the project given the fact that there is already some improved technologies but relatively low level of uptake. The problem is multifaceted as such, the need to approach it holistically can not be over emphasized., In this Project, the multi-disciplinary partnership for technology uptake have included farmers, community leaders, researchers, extension agents, and private sector, (traders and processors). The aims is to put in place platforms and mechanisms to improve sustainability of the project outputs and in the process expose project's main features and successes.

Narrative Summary

3.1.1. Organize planning workshop of project stakeholders to agree on project components for promotion, pilot areas and mode of operation.
3.1.2. Promote/encourage development of farmer associations/clubs and producer marketing groups and community collection points from village to district levels
3.1.3. Disseminate (scale-up and scale-out) both methodologies for technology promotion and the proven technologies from benchmark testing sites (target communities) to communities in the district and at the national level
3.1.4. Establish strategy and time frame for impact monitoring and reporting

Progress of outputs

3.1.1 Organize planning workshop of project stakeholders to agree on project components for promotion, pilot areas and mode of operation.

On 29th October 2008, the Project team in Malawi held its Annual Planning and Review Meeting at Chitedze Research Station –ICRISAT conference room. The objective of the meeting was to review the preceding season, share experiences, challenges and lessons. Importantly, the meeting agreed on timely allocation of resources to facilitate speedy operations. The meeting grouped together all collaborating Scientists, Scientific officers and Technicians from ICRISAT-Malawi and NASFAM, and built on an earlier meeting for the whole team that was held just before the CoP2 workshop in Maputo. The Malawi meeting ratified the project plans for 2008/09 season.

3.1.2 Dissemination (scale-up and scale-out) methodologies for technology promotion and the proven technologies from benchmark testing sites (target communities) to communities in the district and at the national level

The project in Tanzania in collaboration with communication media experts from the National Television Channels, TVT, Star TV has produced fourteen (14) documentaries of which seven (7) have been broadcast to the general public to sensitize stakeholders on project activities in specific and groundnut production and marketing in general. The project has also published booklets and fliers of groundnuts improved production practices in Chichewa for Malawi and Kiswahili for Tanzania intended for farmers (collaborating and non-collaborating) and extension officers. Although a lot of proven technologies have been developed, most of them are still not known by farmers, which have led to low adoption. Communication media was employed to complement conventional interventions to scale up and out technologies that have been developed. By using the communication media it is anticipated that technologies will be spread to cover a wider area than could be reached by researchers alone.

a). Traders/ Stakeholder Engagement:

The Business community continues to be engaged and sensitized on the existence of groundnut technologies through seed fairs. Two seed fairs one in Dodoma Central Tanzania and the other in Nanyumbu Southern Tanzania were organized to create awareness and accessibility of seeds of improved varieties. The seed fair in Dodoma attracted 500 people while that of Nanyumbu brought together about 2000 people. During the events, live radio coverage and TV broadcast were made by both local and National radios. Channel 10 and Tanzania Broadcasting Corporation were also engaged.

b). Leaflets, Fliers, Videos and radio programs:

In order to enhance groundnut productivity, production and incomes of poor farmers, in Malawi, the project has produced and distributed 15,000 flyers of three different types in Chichewa to communities and extension workers in Mchinji and Nkhotakota districts. These flyers depict improved groundnut varieties released in Malawi, production technologies for the management of rosette and aflatoxin. The project also produced a poster presented at several forums including the NASFAM Annual General Meeting held from 25-26th of November 2008. The poster aimed at highlighting projects activities and islands of success. The meeting attracted NASFAM farmers throughout the country, Officials from the ministry of Agriculture and Food Security including the Deputy Minister, Marketing Organizations and Extension workers from various districts. The project team from ICRISAT also recorded a radio program through NASFAM communications Unit sensitizing the communities on the dangers of aflatoxins and approaches to managing it. A similar program was recorded with Nkhotakota Community Radio Station which also covers Salima, Likoma, Kasungu, Nkhatabay and Ntchisi districts.

In Tanzania, 1000 leaflets 2000 groundnut booklets on improved groundnut crop husbandry in Kiswahili (*Kanuni Bora za kilimo cha karanga*) have been distributed to farmer groups, students, Ministry of Agriculture Training Institute (MATI-Mtwara) and other interested stakeholders during seed fairs. The project also invited communication media experts from the National

Television Channels, TVT, Star TV and Newspaper Journalists to visit the project areas to document the impact of project activities. Star TV have produced 6 documentaries of which 3 have been broadcast while Tanzania Broadcasting Corporation (TBC) through TVT have produced 8 documentaries of which 4 have been broadcast to the general public

In a bid to link farmers to markets, the Principal collaborator for Tanzania (Dr Mponda) attended and participated in the 6th Tanzania National Business Council Kilimo Kwanza Meeting and exhibited some of the projects outputs: booklets, leaflets and candidate varieties for release. 500 participants including The President of Tanzania Hon Jakaya Kikwete, Prime Minister Mizengo Pinda, President of Zanzibar Hon Amani Karume, Ministers, Permanent Secretaries and The Business Community were in attendance.

3.1.3 Establish strategy and time frame for impact monitoring and reporting

In fulfillment of the Project's M&E plan, in July 2009, Team members from Malawi, Emanuel Monyo (ICRISAT) and Harvey Charlie (ICRISAT) undertook a two-week visit to Tanzania to monitor field activities and backstop operations under the invitation of Dr Omari Mponda. The team visited both on-station and on-farm trials. The team noticed successful implementation of project activities however most sites experienced serious drought and high rosette incidences. The majority of farmers experienced total crop losses. Losses were serious in Dodoma than was the case in Masasi and Nanyumbu Districts. The team also noted that fresh seed would have to be supplied for farmers through their community seed banks.

Implications of the research

a. For future development activities

Communication media, increased number of trials /demonstrations, farmer field days and seed fairs contribute to increased awareness on the available groundnut technologies such as improved varieties (ICGV-SM 90704 and ICGV-SM 99568 for Malawi and Pendo for Tanzania) and IDM packages. This has in turn put pressure on the need for increased seed production. The project will have to fully utilize and enhance the capacities of existing and new community seed groups and collaborating NGOs.

b. For policy

Trials and demonstrations mounted in the benchmark districts have increased adoption of technologies in these target areas. Deliberate policies need therefore to be put in place to extend lessons learnt in these areas to other districts to enable a good proportion of farmers in Malawi and Tanzania access such technologies.

3. Team Report Section

ICRISAT-Team visitation to Tanzania.

The team from ICRISAT-Malawi comprising Dr. Emmanuel Monyo and Harvey Charlie visited project activities in Tanzania to monitor, backstop and as part of learning of the Project activities in Tanzania. The Team observed successful implementation of both on-station and on farm activities in Tanzania despite setbacks as a result of extensive drought and incidence of Groundnut Rosette Disease. The intensity of damage however provided an opportunity to select materials that could combine resistance to both GRD and drought or each separately.

Community of Practice (CoP)

The second annual meeting of the Southern Africa CCRP community of practice (CoP2-SAf) was held between October 6th-9th in Maputo, Mozambique. Representatives of the six CCRP projects in Malawi, Mozambique and Tanzania shared strategies and plan for their projects; gave presentations about their project's progress, mounted project displays, which included posters, leaflets, and products. Dr. Manual Amane of IIAM, the national agricultural research program of Mozambique hosted the meeting and organized a field day at Umbeluzi Research Station. The featured topic of the CoP2-SAf was climate variability and change, for which Dr. Roger Stern served as resource person. The meeting was coordinated by Regional Representative Joseph Mpagalile and facilitated by Jurgen Hagmann.

The third annual Southern Africa CoP meeting is expected to be held from September 21-25, 2009, in Bagamoyo Town, Tanzania. Representatives of the six CCRP projects in Malawi, Mozambique and Tanzania will share strategies and plans for their projects and explore topics of mutual interest, and participate in a field day.

Visits by members of the External Program Management and Review (EPMR) of ICRISAT, Regional Coordinator and the Scientific liaison Officer for Southern Africa

The EPMR of ICRISAT team visited ICRISAT program in Malawi and met members implementing the McKnight Project ('*Developing short and medium duration groundnut varieties with improved yield performance, market traits and resistance to foliar diseases'*) as part of their evaluation of ICRISAT research in Eastern and Southern Africa region. The team visited *Kalulu* one of the chapters in Mchinji District where project activities are taking place to interact with farmers. Farmers outlined benefits accrued since the project's inception. Amongst others, farmers noted increased incomes and a reduction in cases of malnutrition at least for collaborating farmers as a result of interventions by the project. Improved varieties and use of improved production technologies were cited as catalysts. Farmers proposed continuation of the project to a point where commercialization would be in sight and requested for existence of strong market linkages.

Dr Charlie Riches – CCRP Scientific liaison for Southern Africa visited the projet in April 2009 and was given full overview of the project's on-station research activities including hybridization, disease screening and breeder seed production.

Finally, The Regional coordinator, Dr Joseph Mpagalile visited Mlonyeni and Kalulu, two of the Chapters in Mchinji District in May 2009. Being an off-season period, Dr. Mpagalile could only interact with farmers about project activities . Seed banks from the community seed multiplication were the main visible aspect of the project. Farmers displayed seed of variety ICGV-SM 90704 (*Nsinjiro*) and other new varieties under on-farm testing in these communities while they held discussions with Dr Mpagalile on their perception of the project's focus. Similar sentiments as were echoed to the EPMR team were expressed to the coordinator.

Acquisition of project vehicles, Technical and logistical backstopping to Tanzania

The project acquired two vehicles (Toyota Hillux Double Cabin) one each for project operations in Malawi and Tanzania through a special grant from the Foundation. The availability of the vehicles has greatly improved timely implementation of project activities in both countries. The Tanzanian team has also acknowledged in several ways ICRISAT's timely fund disbursement, technical backstopping (including organizing training for project staff); and for sharing improved groundnut germplasm. The training to staff received through support by McKnight Foundation is making a difference in the whole Oilseeds Research Program in Tanzania where active breeding activities are now being implemented at Naliendele Research Station including aphid rearing, hybridization and disease screening using the infector row technique.

Other Insights and lessons learnt:

1. Severe drought and incidence of GRD in Tanzania have stalled project activities. In a number of trials visited, there was complete crop loss especially in Dodoma. This highlights the importance of finding and releasing rosette resistant varieties for Tanzania.

Immediate actions required

1. The project needs to supply fresh improved seed of variety Pendo to communities that experienced serious cases of drought and rosette during 2008/09 season
2. The project must fast track activities to identify rosette resistant varieties while increasing efforts to introgress resistance in the already preferred and popular *Pendo*.
3. There is need to increase efforts towards development of strong farmer organizations for purposes of marketing especially in Tanzania.

A look into phase II. Lessons to carry forward

1) The project has realized faster progress through working with organized farmers. It makes sense for project activities in phase II to include Mzimba district the only second Fair Trade accredited NASFAM farmer association. Lessons learnt from Mchinji will be out scaled
2) Farmer participatory varietal selection has been an effective tool for identification of farmer-preferred varieties and therefore need to be widely adopted in all project areas.
3) Even though project activities center around a research group, specific farmers within the group run the trials and demonstration. To improve learning, the concept of Farmer Field Schools (FFS) will be introduced to foster greater interaction among group members to enhance knowledge sharing.

4) Infector row technique has enabled a large number of ICRISAT groundnut germplasm to be screened for important disease constraints. Naliendele Research Station in Tanzania has been identified as a hotspot screening site for rust disease. This capability will be established in Tanzania.
5) A a number of the early maturing released varieties, such as JL 24 (Kakoma), ICGV-SM 99568 (Chitala), Nyanda and promising lines such as ICGV-SM 99541 and ICGV-SM 01513 have pre-harvest sprouting problems due to lack of dormancy. Seed dormancy in early maturing varieties is an important constraint to address in phase II.
6) Community seed banks through organized farmers have proved effective in disseminating seed of self pollinated crops like groundnuts. Successful farmer organization models learned in phase I will be out scaled to more farmers and districts.

Based on experience drawn from an ICRISAT/CARE project in Kasungu district, Farmer Field Schools have proved to be an effective tool for technology dissemination to farmers. Most activities in the area have been farmer driven and has had positive impact on the adoption of the technologies (improved varieties and production packages). It is in this regard that extending such an approach to new project sites has the potential for yielding quick results. Districts like Mzimba in the Northern Malawi are strategically positioned to rip benefits from an expanded McKnight Project in Malawi.

Mzimba is the largest district in Malawi covering an area of 10,430km^2 with a population of 610,944. Most people are involved in subsistence farming of maize supplemented by groundnuts and sweet potatoes for food and cash and tobacco for cash. The district lies at 11^{o}30 S and 33^{o}30 E. Most of the area lies in the rain shadows of the Viphya highlands, Nyika plateau and Njakwa hills with an altitude of over 1400m above sea level. Twenty-five (25%) percent of the households are female headed. Land holding size per household is about 0.9 hectares with 35% of the household cultivating on less than 0.5 hectares per household. Chronic malnutrition is a big problem affecting about 53% of children under 5 years of age.
Since land shortage is one of the underlying factors contributing to food and nutrition insecurity in the district, improved food production technologies including legumes should be promoted. According to a survey conducted in Mzimba by EveryChild (an NGO) in 2002, long-term strategies need to be put in place in the district in order to ensure increased food productivity, crop diversification as well as dietary diversification. The survey also recommended proper food storage and utilization as part of the strategy and that these be promoted and strengthened at village and household level. This confirms the current view in the project that establishment of Farmer Field Schools is the most effective and efficient tool to foster and promote improved technologies to farming families and in turn achieve increased adoption.

Mzimba also offers a window of opportunity for farmers, as it has become the only second district in Malawi under NASFAM to be accredited for *Fair Trade* after Mchinji. It is also believed that lessons drawn from Mchinji will provide an excellent basis for success in Mzimba

Work plan Section:

Detailed Work plan for Year 4 (September, 2009 – August 2010)

Project Outputs and Activities

Objective 1: High yielding farmer and market-acceptable varieties developed

1.1.1. Continued identification through PPB and introgress germplasm for yield components farmer/market preferences and adaptation

1.1.2. Develop diverse groundnuts breeding lines and populations and capacity to screen for GRD and foliar disease resistance in Tanzania

1.1.3. Develop & evaluate advanced breeding lines and varieties

1.1.4. Germplasm exchange between Malawi, Tanzania, Mozambique and others

Objective 2: Adoption rates of improved farmer and market-acceptable varieties and production technologies enhanced

2.1.1. Conduct participatory adaptive trials and demonstrations including promotion of systems for control and management of aflatoxin

2.1.2. Conduct field days, agricultural shows & rural seed fairs with farmers, researchers & market players

2.1.3. Enhance institutional innovations to improve access of the poor to good quality seeds of improved high yielding adapted varieties

2.1.4. Conduct training-of-trainers program on seed and crop production techniques for extension and NGO partners

Objective 3: Groundnut productivity increased. A practical and implement able technology dissemination program developed

3.1.4. Organize planning workshop of project stakeholders to agree on project components for promotion, pilot areas and mode of operation.

3.1.5. Promote/encourage development of farmer associations/clubs and producer marketing groups and community collection points from village to district levels

3.1.6. Disseminate (scale-up and scale-out) both methodologies for technology promotion and the proven technologies from benchmark testing sites (target communities) to communities in the district and at the national level

3.1.7. Establish strategy and time frame for impact monitoring and reporting

Year	Quarter	Activity number	Type of milestone	Description of Milestone	Time due*	Workplan for 2009/10 season
4 4 4	1-4 2 2-3	1.1.1	Activity	• Knowledge and skills of rural men and women specialized in germplasm management and maintenance incorporated into modern breeding strategies from year 1 (2006) • Additional sources of resistance to foliar diseases identified from core collections, local and wild germplasm (2007 – 2010) • Farmer preferred varieties with local adaptation identified and hybridization initiated for introgression of GRD and foliar fungal disease resistances (2007-2010)	August 2010 April 2010 April 2010	• Form at least 50 more Research groups in the two countries (ICRISAT, DRD & NASFAM) • Advance F3 progenies (from introgression activity) and initiate progeny selection for biotic constraints in progeny rows (ICRISAT) • Continue introgression of desired traits into farmer-preferred varieties (ICRISAT and DRD).
4	1-4 3 1-4	1.1.2 1.1.2 1.1.3	Activity	• Disease screening capacity developed in Tanzania and NARS scientists trained on the use of the infector row technique from year 1 (2007 – 2010) • Diversified groundnut populations /breeding lines with genetic resistance for Rosette, ELS, rust and LLS and combined resistances. (2007 – 2010)	August 2010 May 2010	• Organize at least two Training courses to provide support to Tanzania NARS on various aspects of disease screening (ICRISAT) • Advance selected breeding materials and evaluate them under high rosette, ELS and rust disease pressure using the infector row technique in Malawi and Tanzania (ICRISAT & DRT). • Develop Breeding populations (ICRISAT and DRD)

Year	Quarter	Activity number	Type of milestone	Description of Milestone	Time due*	Workplan for 2009/10 season
				• New improved groundnut varieties incorporating local derived genes for quality and adaptation developed by year 4 (2010)	Nov/ Dec 2009	• Supply new sets of trials incorporating elite lines for evaluation in Tanzania (ICRISAT)
4 4	1-4 1-4 2-3	1.1.4	Activity Activity Activity	• Nucleus seed of elite lines produced annually for NARS testing and for breeder seed production. (2007 – 2010) • Advanced breeding lines and breeder seed of improved groundnut varieties available to NARS and NGOs in ESA in an annual basis (2007 – 2010) • Early high yielding, farmer preferred lines identified for evaluation under high GRD and ELS disease pressure using the infector row technique (2007-2010)	August 2010 August 2010 Nov/ Dec 2009	• Produce nucleus seed of lines in advanced testing for sharing with NARS in the region (ICRISAT) • Produce breeder seed of released / or pre-released varieties to support sustainable seed delivery of improved varieties (ICRISAT and DRD) • Supply specialized nurseries for screening under high, and low disease pressure at hotspot screening sites (ICRISAT).
4	1-3 1-3	2.1.1	Activity	• Eight varieties identified for wide scale on-farm adaptive testing with farmer participation for each country (2007 – 2010) • Three varieties with specific and / or combined resistances identified for wide scale testing	May 2010 May 2010	• Implement on-farm trials and Demos in Malawi and Tanzania (ICRISAT, DRD, and NASFAM) • Analyze results of PVS and identify candidate varieties for wide scale testing in Malawi and

Year	Quarter	Activity number	Type of milestone	Description of Milestone	Time due*	Workplan for 2009/10 season
	1-3 2	2.1.2		• Demonstrate techs for reduction of aflatoxin under smallholder conditions (2007 – 10) • Field days, demonstrations, agricultural shows and seed fairs conducted at select farmer field school sites annually (2007 – 2010)	May 2010 March/ April/ Oct/ Nov 2010	Tanzania (ICRISAT, NASFAM & DRT). • Implement Demonstrations for integrated management of Aflatoxin on farmers fields in Malawi and Tanzania (ICRISAT DRD & NASFAM). . • Conduct field days (ICRISAT DRD & NASFAM) • Conduct seed fairs (ICRISAT DRD & NASFAM)
4	1 1-4	2.1.3	Activity	• Agreements established with at least two non-governmental organizations to establish community seed production for at least two different varieties in each country (2006 - 10) • Community seed banks established and fully functioning (2006 – 2010)	May 2010 August 2010	• Implement joint seed production with NGOs operating in target sites eg CARE Malawi and Dutch Connections in Tanzania (ICRISAT, DRD, NASFAM). • Strengthen existing (81) community seed banks and establish new groups to meet increasing numbers of participants (ICRISAT, DRD & NASFAM).
4	1	2.1.4	Activity	• Training and information needs of partners identified (2007– 2010)	Feb 2010	• Continue liaising with partners to identify training needs (ICRISAT).

Year	Quarter	Activity number	Type of milestone	Description of Milestone	Time due*	Workplan for 2009/10 season
				• Informal short and formal /long term training initiated during year 1 and continuing (2007 – 2010)		• Develop programs (TV and Radio) to facilitate the activity (ICRISAT). • Develop and offer training support to stakeholders on pertinent areas pertaining to g/nut technologies (ICRISAT).
4	1	3.1.1	Activity	• Annual planning and review meetings	Sept-Nov 2009	• Conduct a review of 2008/09 activities and plan activities for 2009/10 season with collaborators (ICRISAT, DRT & NASFAM).
4	1	3.1.5	Activity	• Project management team for internal monitoring established and functioning (Oct-Nov 2006 - 2010)	May/ June Oct/ Nov 2010	• End of project survey to gauge progress/project related changes. • Monitoring visitation to ascertain implementation of 2009/10 activities in both countries (ICRISAT, DRT &NASFAM).

Publications Summary

1. Monyo ES, Osiru MO, Kadyampakeni D, Mponda O and Chinyamunyamu B. (eds.). 2009. Improving Food Security and Nutrition in Malawi and Tanzania through Research on Edible Legumes. Proceedings of Stakeholder Workshops on Groundnut Production in Malawi and Tanzania held 1-2 March and 13 April 2007, Lilongwe (Malawi) and Mtwara (Tanzania). Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 96 pp. ISBN: 978-92-9066-515-1

2. **Monyo ES**, Osiru M, Mponda O, Harvey C and Munthali W., 2008. Rosette and Early Leaf spots resistant groundnut varieties for Eastern and Southern Africa. Third International Conference of the Peanut Research Community on Advances in Arachis through Genomics and Biotechnology (AAGB-2008). ICRISAT, Hyderabad (AP), India 4-8 November, 2008. Abstracts – pg 20.

3. Vadez V, Varshney RK, Bertioli D, Leal-Bertioli S, Patterson A, **Monyo E**, Mponda O, Kapewa T, Ntare B, Hamidou F, Moutari A and Ndoye O. 2008. The long journey towards molecular breeding to improve groundnut productivity for marginal environments in sub-Saharan Africa. Presented at the 2008 Annual Research Meeting of the Generation Challenge Program, 16-20 September 2008, Bangkok, Thailand

4. **Monyo ES**., Osiru MO., Siambi M., Munthali W., Chinyamunyamu B., Mponda O., Nakhumwa C., Kafiriti E., Phiri SD and Sijaona M. 2008. Developing Short-And Medium-Duration Groundnut Varieties With Improved Yield Performance, Acceptable Market Traits And Resistance to Foliar Diseases. Annual General Meeting of the National Smallholder Farmers Associations of Malawi (NASFAM) – 25th November, 2008. ICRISAT. Lilongwe, Malawi

5. **Monyo, E.S**., Osiru M.O., Mponda, O., Chinyamunyamu, B., Kafiriti, Warren D., and Nakhumwa, C. 2008.. Developing Short and medium duration groundnut varieties with improved yield performance, acceptable market traits and resistant to foliar diseases. Paper presented at the Second meeting of the McKnight Legumes Community of Practice Meeting, 6 – 10 Oct 2008, Maputo, Mozambique

6. Osiru, M.O. and **Monyo, E.S**. 2008. Life-saving nuts. Satrends Issue 86.

7. **UHURU:** Wakulima nchini hupoteza shs. Bilioni 14 kutokana na kutotumia mbegu bora. (Farmers in Tanzania lose US$14 million annually from lack of good quality groundnut seed). Emmanuel S Monyo (ICRISAT) http://www.uhuruinfo.co.tz. ISSN 0876-3896 Na. 20126 Jumatatu Desemba 22, 2008 pg5.

8. **HabariLEO:** Utafiti wabainisha tatizo kilimo cha karanga. (Research reveals huge loses from use of inappropriate groundnut seed) Emmanuel S Monyo (ICRISAT) http://www.habarileo.co.tz ISSN 1821-570X Na. 00734 Jumanne Desemba 23, 2008 pg4.

9. Fliers (Chichewa and English versions): (a). Enhancing grain legumes' productivity and production and incomes of poor farmers in drought prone areas of Sub-Saharan Africa – groundnut Breeding for E/S Africa. E .S. Monyo, M. Siambi, W.M. Munthali, H. Charlie, C. Mukhala and S. Phiri

Training and Outreach Summary

The following training outreach activities were implemented

1. Training in post harvest crop handling for the management of aflatoxin contamination in groundnuts – beneficiaries 3 extension officers, 3 NASFAM association field officers and 18 lead farmers in Mchinji, 28 CARE Malawi community facilitators, and 7 extension officers from Kasungu
2. Training on techniques for good quality seed production – 24 farmers, 36 extension officers from 16 villages in Dodoma, Tanzania

APPENDICES.

App. 1a. Summary Performance of Groundnut Variety Trials across sites in Tanzania

Cultivar	NALIENDELE			NACHINGWEA			MAKUTOPORA
	Pod yield (kg ha^{-1})	Rosette incidence %	ELS	Pod yield (Kg ha^{-1})	Rosette incidence %	ELS	Pod yield (kg ha^{-1})
CG 7	640	5	2.7	1427	11.3	4	386.6
ICGV 90092	732.7	12	3	1133	7	3	115.8
ICGV-SM 02501	744	4	2.3	1520	3.4	3	172
ICGV-SM 03590	726	4	3	973	16.8	4	245.3
ICGV-SM 03701	953.3	11	3.3	1613	15	4	125.5
ICGV-SM 05521	509.3	6	3.3	1187	4.9	4	146.2
ICGV-SM 90704	643.3	4	3	1373	13.9	3	171.5
ICGV-SM 99537	863.3	13	3.3	1560	16.8	3	243.1
ICGV-SM 99568	428.7	7	4.3	1200	4.4	4	312.4
ICGV-SM 99574	301.3	12	4.3	973	10.4	3	168.1
Mean	654	7.8	3	1296	10	3.5	209
CV %	29	44.4	19.6	16.4	42	21.5	29.8
LSD	325	5.9	1.1	364.7	6.8	1.3	106.7
P=0.05		*	*	*	*	ns	**

App. 1b. Summary Performance of the Regional Elite Groundnut Variety Trial for Spanish and Virginia (Malawi)

Genotype	Pod yield	ELS score	Rosette Incidence (%)	Genotype	Pod yield	ELS score	Rosette Incidence (%)
ICGV 94139	3028	4	0	CG 7	2217	2	47.01
ICGV-SM 00537	3028	4	5.684	ICGV-SM 01709	2600	3.5	0.69
ICGV-SM 01501	1606	7	0.435	ICGV-SM 01711	3039	3	0
ICGV-SM 01502	2628	5.5	1.579	ICGV-SM 01721	2833	2	18.11
ICGV-SM 01504	2333	7.5	0.532	ICGV-SM 01731	2372	2	0
ICGV-SM 01510	2672	7	0.952	ICGV-SM 02701	2222	1.5	27.8
ICGV-SM 01514	3094	3.5	0.476	ICGV-SM 02707	2450	3	39.74
ICGV-SM 01515	2311	4	2.08	ICGV-SM 02710	2400	2	26.06
ICGV-SM 03590	3228	3	0.515	ICGV-SM 02712	4344	2	31.73
ICGV-SM 98543	1289	3	23.262	ICGV-SM 02715	2039	2	40.45
ICGV-SM 99529	2628	4	2.161	ICGV-SM 02724	2328	3	4.89
ICGV-SM 99530	2728	4.5	1.304	ICGV-SM 02725	2317	2	24.06
ICGV-SM 99537	2856	4.5	1.339	ICGV-SM 03707	2339	4.5	0
ICGV-SM 99551	3106	4	0.972	ICGV-SM 03708	2628	4.5	0
ICGV-SM 99552	2772	4.5	1.485	ICGV-SM 03709	2278	4	0
ICGV-SM 99554	1211	4.5	1.982	ICGV-SM 03710	2611	3	0
ICGV-SM 99555	2217	6	1.415	ICGV-SM 05693	2733	1.5	31.2
ICGV-SM 99557	1922	6.5	1.601	ICGV-SM 05696	1922	1	29.8
ICGV-SM 99566	3139	6	1.339	ICGV-SM 88762	2317	2.5	0.76
ICGV-SM 99568	2778	6.5	3	ICGV-SM 90704	2689	4	1.34
F.Pr	**0.008**	**<.001**	**0.001**	**F.Pr**	**<.001**	**0.006**	**<.001**
Grand mean	**1776**	**4.97**	**2.61**	**Grand mean**	**2534**	**2.65**	**16.2**
S.E	**242.6**	**0.461**	**2.456**	**S.E**	**206.4**	**0.57**	**5.35**
L.S.D	**715.6**	**1.36**	**7.245**	**L.S.D**	**608.8**	**1.682**	**15.79**
CV %	**19.3**	**13.1**	**133.3**	**CV %**	**11.5**	**30.4**	**46.8**

App. 2. **Performance data for on farm variety trials in Mchinji and Nkhotakota. (Malawi)**

	Pod Yield (kg/ha)	Grain Yield (kg/ha)	Rosette incidence (%)	No of pods/plant
Genotype				
Chalimbana	1958	991	4.273	21
ICGV-SM01513	2041	1407	4.818	31.09
ICGV-SM01708	2609	1546	3.545	32
ICGV-SM01711	2626	1585	3.909	27.27
ICGV-SM01731	2581	1519	3.545	27.45
ICGV-SM90704	2575	1543	2.818	34.91
ICGV-SM99541	1912	1283	5.273	26.82
ICGV-SM99568	1844	1252	5.545	27.45
JL 24 (KAKOMA)	1794	1268	5.455	24.36
Nyanda	1428	1025	6.182	25.82
Mean	2137	1342	1.45	27.82
Fpr	**<0.001**	**0.015**	**0.003**	**<0.001**
SE	219.9	137.2	0.743	2.064
Lsd	617.9	385.6	2.089	5.798
CV	34.1	33.9	170.6	24.6

App. 3. Direct matrix ranking (average) for varieties by trait for Mchinji and Nkhotakota districts.

Variety	Diseases	Yield	Filling	Dormancy	Shelling	Seed size	Taste	Total	Rank
Chalimbana	3.7	3.2	3.3	1	1.3	1	2	15.5	1
ICGV-SM90704	1.3	1.7	2.3	1	3.7	3.3	2.5	15.8	2
ICGV-SM99568	3.3	2.7	2.7	2.8	1.5	1	2.2	16.2	3
ICGV-SM01731	3	2.2	2.7	1	3	2.5	2.5	16.8	4
JL 24 (KAKOMA)	4	2.2	1.8	3.8	1.7	2.5	1.3	17.3	5
ICGV-SM01711	3.3	2.7	2.5	1.2	3.3	3.2	3	19.2	6
ICGV-SM01513	3	2.2	2.7	2.8	3.5	3.5	3	20.7	7
ICGV-SM01708	3	3	2.8	1.2	3.3	4	3.7	21	9
ICGV-SM99541	3.7	2.8	3.2	3.3	2.7	2.5	3	21.2	8
Nyanda	3.8	3.8	3	3.2	3.8	4	3.3	25	10

1=Excellent, 2=very good, 3=good, 4=poor

App. 4. PAIR-WISE RANKING FOR MCHINJI

	JL 24 (KAKOMA)	**ICGV-SM90704**	**Chalimbana**	**ICGV-SM01731**	**ICGV-SM99568**	**ICGV-SM01711**	**ICGV-SM01708**	**ICGV-SM01513**	**ICGV-SM99541**	**Nyanda**
JL 24 (KAKOMA)	X									
ICGV-SM90704	ICGV-SM90704	X								
Chalimbana	Chalimbana	Chalimbana	X							
ICGV-SM01731	ICGV-SM01731	ICGV-SM90704	Chalimbana	X						
ICGV-SM99568	JL 24 (KAKOMA)	ICGV-SM90704	ICGV-SM99568	ICGV-SM99568	X					
ICGV-SM01711	ICGV-SM01711	ICGV-SM90704	Chalimbana	ICGV-SM01731	ICGV-SM99568	X				
ICGV-SM01708	ICGV-SM01708	ICGV-SM90704	ICGV-SM01708	ICGV-SM01731	ICGV-SM01708	ICGV-SM01708	X			
ICGV-SM01513	JL 24 (KAKOMA)	ICGV-SM90704	Chalimbana	ICGV-SM01731	ICGV-SM99568	ICGV-SM01711	ICGV-SM01708	X		
ICGV-SM99541	JL 24 (KAKOMA)	ICGV-SM90704	Chalimbana	ICGV-SM01731	ICGV-SM99568	ICGV-SM01711	ICGV-SM99541	ICGV-SM01513	X	
Nyanda	JL 24 (KAKOMA)	ICGV-SM90704	Chalimbana	ICGV-SM01731	ICGV-SM99568	ICGV-SM01711	ICGV-SM01708	ICGV-SM01513	ICGV-SM99541	X
TOTAL SCORE	4	8	7	6	6	4	6	2	2	0
RANK	4	1	2	3	3	4	3	5	5	6

App. 5. Direct matrix ranking for varieties by trait for Mchinji district.

Variety	Yield	Taste	Shelling	Filling	Seed size	Dormancy	Disease	Total	Rank
ICGV-SM99568	2.3	2	1.7	2.3	1	2.7	3.3	15.3	1
Chalimbana	3.3	2.3	1.3	3	1	1	3.7	15.7	2
ICGV-SM90704	2	2.3	3.7	2.3	3.7	1	1.7	16.7	3
ICGV-SM01731	2	2.7	3	3.3	2	1	3.3	17.3	4
ICGV-SM01513	2.7	2.3	3	2.3	3	3	3	19.3	5
ICGV-SM01711	2.3	2.7	3.7	2.7	3.3	1.3	3.3	19.3	6
ICGV-SM99541	2.3	2.3	2.3	3.3	2.3	3.7	3.3	19.7	7
JL 24 (KAKOMA)	3.3	1.7	1.7	2.7	2.7	4	4	20	8
ICGV-SM01708	3	3.3	3.7	2.7	4	1.3	3.3	21.3	9
Nyanda	3.7	3.3	3.7	2	4	3.3	4	24	10

1=Excellent, 2=very good, 3=good, 4=poor

App. 6. Direct matrix ranking for varieties by trait for Nkhotakota district.

Variety	Yield	Taste	Shelling	Grain Filling	Seed size	Dormancy	Disease	Total	Rank
JL 24 (KAKOMA)	1	1	1.7	2.3	1	3.7	4	14.7	1
ICGV-SM90704	1.3	2.7	3.7	3	2.3	1	1	15	2
Chalimbana	3	1.7	1.3	1	3.7	1	3.7	15.3	3
ICGV-SM01731	2.3	2.3	3	3	2	1	2.7	16.3	4
ICGV-SM99568	3	2.3	1.3	1	3	3	3.3	17	5
ICGV-SM01711	3	3.3	3	3	2.3	1	3.3	19	6
ICGV-SM01708	3	4	3	4	3	1	2.7	20.7	7
ICGV-SM01513	1.7	3.7	4	4	3	2.7	3	22	8
ICGV-SM99541	3.3	3.7	3	2.7	3	3	4	22.7	9
Nyanda	4	3.3	4	4	4	3	3.7	26	10

1=Excellent, 2=very good, 3=good, 4=poor

App. 7. PAIR-WISE RANKING OF VARIETIES BY FARMERS IN NKOHTAKOTA

	JL 24 (KAKOMA)	ICGV-SM90704	Chalimbana	ICGV-SM01731	ICGV-SM99568	ICGV-SM01711	ICGV-SM01708	ICGV-SM01513	ICGV-SM99541	Nyanda
JL 24 (KAKOMA)										
ICGV-SM90704	ICGV-SM90704	X								
Chalimbana	JL 24 (KAKOMA)	ICGV-SM90704	X							
ICGV-SM01731	JL 24 (KAKOMA)	ICGV-SM90704	ICGV-SM01731	X						
ICGV-SM99568	JL 24 (KAKOMA)	ICGV-SM90704	ICGV-SM99568	ICGV-SM99568	X					
ICGV-SM01711	JL 24 (KAKOMA)	ICGV-SM90704	Chalimbana	ICGV-SM01731	ICGV-SM99568	X				
ICGV-SM01708	JL 24 (KAKOMA)	ICGV-SM90704	ICGV-SM01708	ICGV-SM01731	ICGV-SM01708	ICGV-SM01708	X			
ICGV-SM01513	JL 24 (KAKOMA)	ICGV-SM90704	Chalimbana	ICGV-SM01731	ICGV-SM99568	ICGV-SM01513	ICGV-SM01708	X		
ICGV-SM99541	JL 24 (KAKOMA)	ICGV-SM90704	Chalimbana	ICGV-SM99541	ICGV-SM99568	ICGV-SM99541	ICGV-SM99541	ICGV-SM01513	X	
Nyanda	JL 24 (KAKOMA)	ICGV-SM90704	Chalimbana	ICGV-SM01731	ICGV-SM99568	ICGV-SM01711	ICGV-SM01708	ICGV-SM01513	ICGV-SM99541	X
TOTAL SCORE	8	9	4	5	6	1	5	3	4	0
RANK	2	1	5	4	3	7	4	6	5	8

App. 8. Matrix ranking of groundnut Virginia varieties by farmers at four sites in southern Tanzania.

	Ngalinje	Namatumbusi	Makulani	Mkangala	Total	Mean	Rank
ICVG-SM 90704	2	2	2	3	9	2.25	3
CG 7	4	5	5	2	16	4	4
ICGV-SM 01711	1	3	3	1	8	2	2
ICGV-SM 01721	2	1	1	3	7	1.75	1
ICGV-SM 01731	5	3			8	4	4
JOHARI	6	-	4	-	10	5	6
LOCAL	-	-	-	-	-	-	7

App. 9. Results of Matrix ranking of Spanish varieties at 2 sites in southern Tanzania.

Variety	Drought resistance	Yielding	Pod size	Disease tolerance	Total	Rank
PENDO	2	4	3	2	11	4
ICGV 99557	2	4	4	3	13	1
ICGV 99555	3	2	4	3	12	2
ICGV 12991	3	3	2	4	12	2
ICGV 01506	-	-	-	-	-	-
ICGV 99554	-	-	-	-	-	-
LOCAL						

1=Excellent, 2=very good, 3=good, 4=poor

App. 10. Groundnut on-farm Spanish variety preference trials at 7 sites in southern and central Tanzania

Variety	Mpeta-MASASI	Mkwajuni-TUNDURU	Mnanje-NANYUMBU	Mean
PENDO	700	690.5	700	697
ICGV 99557	600	875	750	742
ICGV 99555	500	882.4	700	694
ICG 12991	500	714.3	480	565
ICGV 01506	-	648.6	460	554
ICGV 99554	500	596.2	520	539
LOCAL	-	395.8	400	398
Mean				611
CV %				16
LSD				177
P=0.05				*

App. 11. Integrated management of Rosette: Genotype-Time of planting and Genotype – plant population interactions

	Rosette incidence (%)			
	Time of planting		Plant population	
Genotype	T1 (early)	T2 (late)	P1 (10cm)	P2 (30cm)
Chalimbana	7.5	26.4	14.3	19.6
ICGV-SM90704	0.3	2	1	1.3
Malimba	15.4	46.1	29.8	31.7
Baka	1	3.9	1.2	3.7
Mean	6	19.6	11.6	14.1
Fpr		**0.152**		**0.989**
SE		7.25		7.25
Lsd		20.52		20.52

App. 12. Integrated management of Rosette: Genotype/Time of planting and plant population interaction.

		Rosette incidence (%)			
	Time of planting	T1(early)		T2(late)	
	Plant population	P1(10)	P2(30cm)	P1(10)	P2(30cm)
Genotype					
Chalimbana		5.8	9.2	22.8	30
ICGV-SM90704		0.4	0.2	1.6	2.4
Malimba		12.4	18.4	47.2	45
Baka		0.6	1.4	1.8	6
Mean		4.8	7.3	18.4	20.9
Fpr					**0.973**
SE					10.26
Lsd					29.02

App. 13. Genotype effect on yield under different rosette management practices

	Grain yield				Pod yield			
	Time of planting		Plant population		Time of planting		Plant population	
Genotype	T1 (early)	T2 (late)	P1 (10)	P2 (30cm)	T1 (early)	T2 (late)	P1 (10)	P2 (30cm)
Chalimbana	1116	442	922	636	1518	740	1270	988
ICGV-SM90704	1078	487	869	696	1666	845	1416	1095
Malimba	651	375	614	411	952	549	901	600
Baka	616	404	567	453	869	597	809	657
Mean	865	427	743	549	1251	683	1099	835
Fpr		**0.068**		**0.867**		**0.031**		**0.863**
SE		102.1		102.1		108.4		108.4
Lsd		288.8		288.8		306.7		306.7

App. 14. Integrated management of aflatoxin contamination on-farm - genotype time of planting and genotype water management interaction

	Aflatoxin contamination (ppb)				
Time	Early planting	Late planting	Boxed ridges	Open ridges	Mean
Genotype					
ICGV-SM 99568 (Chitala))	84	166	121	129	125
J 11	3	5	3	4	3.75
Mean	43	85	62	66	64
Fpr		0.544		0.954	
SE		65		65	
Lsd		186.6		186.6	

App. 15. Cumulative rainfall distribution for Nkhotakota and Mchinji (Malawi)

Month	**Nkhotakota (mm)**	**Mchinji (mm)**
November	16.5	26
December	248.1	200
January	169.1	213
February	501.2	542
March	431.1	424
April	247.9	270
Totals	**1613.9**	**1675**

App. 15. Cumulative rainfall distribution for Naliendele, Nachingwea and Hombolo (Tanzania)

Month	**Naliendele (mm)**	**Nachingwea (mm)**	**Hombolo (mm)**
November	60.8	2.5	142.7
December	123.9	126.0	64.7
January	16.8	88.7	51.0
February	324.9	25.7	180.2
March	84.1	140.7	90.7
April	93.8	78.7	75.0
Totals	**704.3**	**462.3**	**604.3**