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 , 2006 – August 31st 2007)

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

Executive Summary

This report details activities implemented and resulting outputs to date from the project 'Developing short and medium duration groundnut varieties with improved yield performance, market traits and resistance to foliar diseases' during the period 1 September 2006 to 31 August 2007. Funding from the project was provided through the framework of the McKnight Foundation's Collaborative Crop Research Programme. 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. The project, led by ICRISAT, is being implemented in partnership with the Naliendale Agricultural Research Institute in Tanzania, and NASFAM.

The project expects to deliver three outputs 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). Adoption rates of improved farmer and market-acceptable varieties and production technologies enhanced and c). Groundnut productivity increased. A practical and implement able technology dissemination program developed. Highlights of the progress made by the Project within the reporting period (Sept 2006 – Aug 2007) are provided below:

- A hybridization block for introgression of resistance to Groundnut rosette disease (GRD) and foliar fungal diseases was initiated at Chitedze Research Station.
- Genotypes resistant to foliar diseases and GRD diseases have been identified in Tanzania through farmer participatory variety selection and in Malawi through use of the infector row technique
- New sources of resistance to GRD have been identified from the Groundnut mininicore collection
- Populations exhibiting multiple disease resistances identified and promoted for generation advance
- NARS in Eastern and Southern Africa supplied with International Trials / Nurseries, Advanced breeding lines and improved varieties for use
- Participatory variety Evaluation Nurseries and Demonstrations established in Farmers fields in Malawi and Tanzania
- Options for Management of Groundnut Rosette Disease and Aflatoxin Contamination Demonstrated on Farmers fields in Malawi and Tanzania
- Baseline surveys conducted in target districts in Malawi and Tanzania to map farming systems, and socio-economic factors leading to identification of entry points for technological interventions
- Farmer associations / clubs and farmer market research groups established in target districts for ease of technology dissemination and farmer / researcher leaning.

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. 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 workplan

The overall strategy to be pursued will consist of four main components: diagnosis, breeding, variety testing and dissemination, and capacity building. Breeding and variety testing will involve full participation of smallholder farmers, whose growing conditions, priorities, preferences and seed delivery system practices will be the subject of the diagnostic studies. The breeding program will be conducted in two stages. The first will consist of identification of parental lines with desired characteristics for hybridization and/or breeding populations at

different stages of development. The second stage will consist of designing and selecting specific breeding products from the segregating population(s) developed/selected in the first stage. The diagnostic stage will be conducted simultaneously with the first stage of the breeding work. The results of the diagnostics will be used to design the second stage of breeding. Training programs will be designed to strengthen the research and development capacities of collaborating partners and to enhance the innovative capability of farmer groups at participating locations.

The 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

Research Report

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

Authors

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

Tanzania
Omari K. Mponda, Breeder, Principal Collaborator – Breeder, NARI
Elly M. Kafiriti, Agronomist , Collaborator – Agronomist, NARI
Mark Sijaona, Pathologist , Collaborator – Pathologist, NARI
Charles Mkandawire, Agricultural Field Officer, NARI
Joan Kasuga, Agricultural Field Officer, NARI

Introduction

One of the key challenges of the small farm holder in sub-Saharan Africa is how to harness limited available resources and harsh environments for the improvement of agricultural production to enhance incomes and reduce malnutrition and poverty. In the project target areas of the mid- and low altitude regions of Tanzania and Malawi, Groundnut production is severely constrained by both biotic and abiotic stress factors. The most important constraints in this regard are generally considered to be diseases, including the Groundnut Rosette Disease, Leaf spot diseases (Early and Late Leaf Spot caused by *Cercospora arachidicola* and *Phaesariopsis personata*, respectively and Rust (*Puccinia arachidis*), aflatoxin contamination as well as drought. The research question that is being investigated through this objective is therefore the adequacy of available germplasm as a source of high yielding varieties encompassing farmer and market preferred traits and adaptation to existing biotic and abiotic constraints in the region. Breeding efforts by the project have been aimed at developing groundnut-breeding lines with combined resistances to rosette 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 collection1 with resistances to diseases and drought as initial parents for the development of improved populations. The rationale for this objective is to provide resource-poor farmers with practical low cost options for disease control and drought management based on plant host resistances. Access to these technologies will be ensured through adopted strategies that foster

[1] ICRISAT maintains over 15,000 groundnut accessions from more than 90 countries at its genebanks

farmer participation at all stages. In addition, other outputs as discussed in this report, are also geared to improving access to developed technologies. This presents the bold step in combating the myriad challenges posed by two of the major constraints (diseases and drought) that lower groundnut yields in the ESA region.

Narrative Summary
The following activities were undertaken in the two countries during 2006 - 07:

1.1.1 Identification and introgression of germplasm for yield components, farmer/market preferences and adaptation to biotic and abiotic (drought) traits
1.1.2 Develop diverse groundnuts breeding lines and populations and capacity to screen for GRD and foliar disease resistance
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 disease identified from core collections, local and wild germplasm

A groundnut minicore comprising 192 lines representing the full range of trait variability in the groundnut collections was evaluated under high rosette disease pressure at Chitedze Research Station. This evaluation revealed three potential new sources of resistance to GRD. These are ICG 6888, ICG 13099, and ICG 14705. Further confirmation of the value for these lines will be done through greenhouse experimentation. Two different modes of resistance to GRD have been confirmed. The first is resistance to the groundnut rosette virus (available in ICGV-SM 90704) and the second is resistance to the aphid vector (available in ICG 12991). Greenhouse experimentation with the new lines above will confirm their nature of resistance.

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

In Tanzania, preference ratings indicated farmer's preference for ICGV 99555 and ICGV SM 99557. The two varieties showed high yield compared to Pendo the currently released variety. Other farmer preferred varieties in Tanzania are Nyota, Johari,and Sawia. In Malawi, the most farmer / market preferred varieties are Chalimbana, CG7 and JL24. Unfortunately all these varieties are susceptible to all major diseases; rosette, ELS and rust.

A hybridization block for introgression of resistance to GRD and foliar fungal diseases was initiated at Chitedze Research Station. Groundnuts accessions ICGV-SM 90704, ICGV-SM 94584, and ICGV-SM 01501 were used for rosette resistance introgression; ICGV-SM 93555 and ICGV-SM 95714 for ELS resistance introgression while, ICGV-SM 94114 and ICGV-SM

95342 were sources of rust resistance. A total of 56 crosses involving these sources and the Malawi farmer / market preferred locally adapted varieties were made. Hybridization with Tanzanian varieties is targeted for next season.

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

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

The infector row technique is currently in use in Eastern and Southern Africa at the ICRISAT Chitedze Research Centre with Malawi NARS . Efforts to use this technique in Tanzania this season were hampared by lack of a greenhouse. Using resources from the McKnight Foundation program the NARS in Tanzania initiated work on their new greenhouse which should be available next season.

Screening Breeding Populations for Rosette resistance
At Chitedze in Malawi, sixteen rosette disease segregating nurseries from F5 – F7 were established under high disease pressure. The rosette disease pressure was very good resulting in over 90% infection in the spreader rows and susceptible checks. Observed resistant progenies were to a great extent reflective of genetic resistance in the populations.

From the 16 nurseries ranging from F5 – F6 in 394 progeny rows, a total of 242 plants were identified for generation advance through single plant selection (61%) of the total number. Out of these we identified 73 single plant selections from 7 of the nurseries with 0% rosette incidence (18% of the progenies) and an additional 68 plants with rosette incidence ranging 1 - ≤ 20%. From among 239 F7 progeny rows, 163 lines were identified for promotion to check-row yield performance trials (68%). Details of the GRD segregating nursery performance for main season 2007 is highlighted in the table below.

Results of single plant and progeny row selection program for segregating breeding populations in F5 – F7 in the rosette disease nursery during 2006 – 07 season at the ICRISAT Chitedze Research Station (Malawi):

Nursery	Progeny Rows planted	No. of Single Plants Selected	Entries with 0% rosette incidence	Entries with 1 - ≤ 20% rosette incidence
Rosette resistant & conf (virg)-F5SPS	38	33	6	6
Aphid res &conf (virg)- F5SPS	50	34	5	9
Rosette GRV & bold seeded-F6SPS	49	25	12	5
Aphid resistance x ELS resistance-F6SPS	129	65	6	33
Rosette virus x ELS resistance-F6SPS	53	35	20	6
Aphid resistance x ros virus res-F6SPS	30	13	2	5
Rosette virus res&conf-F6SPS	45	37	22	4
Aphid resistance backcrosses-F7SPS	29	13	0	4
Aphid resistance-F7 SPS	44	27	0	5
Aphid resistance inheritance-F7SPS	17	8	0	0
Aphid & GRV res-F7SPS	27	15	0	3
GRV inheritance-aphid x GRV-F7SPS	8	6	2	1
GRV&dormancy-F7SPS	36	31	2	8
GRV resistance-F7SPS	46	31	3	6
GRV inheritance-F7SPS	9	9	8	0
Dormancy & rosette res-F7SPS	23	23	0	2

Screening breeding populations for Early Leaf Spots resistance
Six ELS nurseries ranging from F4 – F7 comprising 591 progeny rows were evaluated at Chitedze Research Station in Malawi for the purpose of identifying superior plants segregating for ELS resistance. There are excellent progenies in the nurseries that combined ELS and rosette resistance. Good progress is also being realized from utilization of the ELS hot spot screening nursery in Malawi to identify ELS resistant progenies from segregating populations sourced from Hyderabad India. Shuttle breeding between the two programs hastens the rate of genetic advance. Hot spot screening nurseries helps breeders from both programs identify useful materials for particular constraints that would have otherwise not be noticed. Out of 79 progenies in F4 selected from an initial nursery of 443 we have identified 33 with very good levels of resistance to ELS for promotion to F5.

In pyramiding ELS resistance genes, 186 superior progenies combining ELS resistance from various sources have been selected for generation advance from this seasons' nursery of 240 F5 progeny rows. Further progress has been achieved in selection of 37 single plants for generation

advance from 49 progeny rows (in F5 nursery) combining ELS resistance and confectionary market traits - essentially ELS resistance in large seeded germplasm.

Results of single plant and progeny row selection program for segregating breeding populations in F4 – F7 in the ELS Nursery during 2006 – 07 season at the ICRISAT Chitedze Research Station (Malawi)

Nursery	Progeny Rows planted	No. of Single Plants or progeny rows Selected
ELS Interspecific Lines from Embryo Rescue	13	6
ELS X Rosette Resistance – Checkrow Trial	200	200
ELS & X Rosette Resistance – F7	10	10
Evaluation Of Germplasm Segregating Populations - F4 (from India)	79	33
ELS & X ELS Resistance – F6 SPS	240	186
ELS Resistance And Confectionery (VB) F5 SPS	49	37

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
b) Advanced breeding lines and breeder seed of improved groundnut varieties available to NARS and NGOs in ESA in an annual basis
Seed production efforts by the project led to the following achievements for the year ending August 2007;

- 995 kg breeder seed of the newly released rosette resistant variety ICGV-SM 99568 for Malawi. This variety is also early maturing, Spanish type with confectionary market traits
- 1000 kg breeder seed of the rosette virus resistant, market preferred medium season Virginia type variety ICGV-SM 90704.
- 200 kg breeder seed of the farmer / market preferred groundnut variety Pendo for Tanzania
- Nuclear seed of 295 lines in the advanced and elite trials was produced in quantities ranging from 2kg – 20kg to maintain germplasm stock for supply to NARS

Besides released varieties, pre-released varieties such as ICGV-SM 99541, ICGV-SM 01513, ICGV-SM 99537, and ICGV 93437 were multiplied in quantities ranging from 100kg – 500kgs. ICGV-SM 99541, and ICGV-SM 01513 are under on-farm testing in Mozambique and Zimbabwe, where as ICGV-SM 99537, and ICGV 93437 are released in Zimbabwe and South Africa but also under evaluation in Mozambique National Trials. For seed distribution to various NARS during the past season please refer to the table below:

Seed distribution to National Programs during 2006 - 07 season:

Nursery	Malawi	D.R. Congo	Mali	Moz[a]	Kenya	Tanz[a]	Les[a]	Zam	Zim	**Totals**
International Trials/ Nurseries (No. of sets)	1	1	0	2	0	6	2		0	**12**
Advanced Breeding lines	19	10	0	2	4	75	50		0	**160**
Early generation Breeding Material	0	0	711	0	0	0	0	0	0	**711**
Germplasm samples	0	0	0	0	0	0	0		0	**0**
Others (Varieties/ breeder Seed, etc.)	0	0	0	3	0	0	0	25	3	**31**
Total	**20**	**11**	**711**	**7**	**4**	**81**	**52**	**25**	**3**	**914**

[a] Moz = Mozambique, Tanz = Tanzania, Les = Lesotho

Implications of the research findings

a. For the next stage of research

Two different modes of resistance to groundnut rosette disease have already been identified. Resistance to the rosette virus (GRV Resistance) and resistance to the aphid vector. Whereas several sources of resistance to GRD are known, for many of them we still do not know whether we have GRV resistance or vector resistance. It is important to properly characterize these sources. After this has been done then the next step will be to combine these two different resistances into a single genotype to improve the stability of resistance.

Many of the genotypes identified as resistant to GRD remain susceptible to ELS and vice versa. Since these diseases are equally important this project is striving to pyramid multiple disease resistances thereby combining ELS and Rosette resistance into one genotype. We have segregating populations combining ELS and Rosette resistance currently at F7 generation.

The Groundnut Breeding Programme based at Naliendele in Tanzania is maintaining a total of 150 lines obtained from ICRISAT from previous collaboration on breeding for yield, drought tolerance and disease resistance. It is to the national interest to expand the groundnut gene pool and increase availability of genetic materials for the breeding programme inorder to create and increase genetic variation for exploitation. Increased access of Tanzania NARS to the ICRISAT groundnut germplasm have enabled the national team to identify candidate varieties for release to the groundnut growers in Tanzania with high yielding, acceptable market attributes and farmer preferred varieties.

b. For future development activities

Increased access of Tanzania NARS to the ICRISAT groundnut germplasm have enabled the national team to identify candidate varieties for release to the groundnut growers in Tanzania with high yielding, acceptable market attributes and farmer preferred varieties. Based on previous collaboration with ICRISAT and this years' evaluation through the McKnight Foundation Project, Naliendele Research Station has identified two candidate varieties for release: 2 Spanish (ICGV 99555 and ICGV SM 99557) and 2 Virginia varieties (ICGV – SM 01711 and CG-7). The identified varieties will be evaluated further under high GRD and ELS conditions in Tanzania while submitting them for Distinct Uniformity and Stability (DUS) tests and National Performance Test (NPT) simultaneously so that time is not wasted.

In Malawi CG 7 and ICGV-SM 90704 are the fast moving groundnut varieties on the market. Despite enjoying popularity among farmers in Malawi, CG 7 is very susceptible to rosette disease and the yields are drastically reduced during epidemic years. The project has identified other high yielding varieties with high resistance to rosette and will give farmers a wider choice in terms of variety selection once the varieties are released. The next candidate variety is ICGV-SM 01731 (medium maturity, large seeded Virginia type). For the first time, adequate seed volumes (1 ton) of the newly released short duration rosette resistant variety ICGV-SM 99568 will be available for basic seed production – to enable this variety released in 2005 reach farmers during 2008 – 09 season.

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
Davie Kadyampakeni,Project Scientific Officer, ICRISAT
Betty Chinyamunyamu, Principal Collaborator – Economist, NASFAM
Candida Nakhumwa, Collaborator – Economist, NASFAM
Samu Phiri, Project Research Technician, NASFAM

Tanzania

Omari K. Mponda, Breeder, Principal Collaborator – Breeder, NARI
Elly M. Kafiriti, Agronomist , Collaborator – Agronomist, NARI
Mark Sijaona, Pathologist , Collaborator – Pathologist, NARI
Charles Mkandawire, Agricultural Field Officer, NARI
Joan Kasuga, Agricultural Field Officer, NARI

Introduction

There is large potential for improving farmer incomes through increasing groundnut production that is yet to be exploited. However, increasing access to improved groundnut varieties (with better disease resistance, yield performance and market acceptability) must be coupled with adoption of improved crop husbandry techniques and accompanying market sinks for significant strides to be made. In spite of a wide range of available groundnut technologies (including varieties), most are not being utilized by small scale farmers and rates of adoption remain generally low, partly because farmers are either not aware of their existence and inaccessibility of quality seed of improved germplasm. The latter is related both to the underdevelopment of the seed supply systems for groundnuts and lack of NARS and farmer capacity to multiply quality seed. Further, even in areas where improved varieties have been adopted, poor crop husbandry practices still predominate; yields remain low, and varietal potentials remain untapped. In addition, high market standards, particularly international and regional markets, sanction such produce insisting on higher quality and use of improved crop husbandry practices. This project will promote 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.

The main strategy underpinning this objective is the enhancement of adoption rates of improved farmer and market-acceptable varieties and production technologies. Conducting demonstrations of improved technologies on-farm will enable farmers to experientially learn through comparison with farmer practices and will enhance village adoption.

Narrative Summary

The activities conducted during the period included:

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

2.1.2 Conducting field days, agricultural shows & rural seed fairs with farmers, researchers and market players;

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

2.1.4 Conducting 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

a) Varieties for widescale on-farm adaptive testing with farmer participation

In Malawi, Thirty six trials/ demonstrations were conducted in two groundnut growing districts (Mchinji and Nkhotakota). The districts are representative of the two important growing ecologies for groundnut- the lake shore areas and the lowland plains. The demonstrations

focused on promotion of 'best bet' technologies on three aspects: Options for the management of Groundnut Rosette Disease (GRD); Options for management of Aflatoxin contamination and participatory varietal evaluations. Each of the three is briefly discussed below;

Participatory varietal evaluation: The experimental demonstration was set up to a) compare (and demonstrate) improved groundnut varieties with the varieties commonly used by farmers; b) provide opportunity for farmers to observe first hand range of elite varieties available and potentially new materials in the pipeline; and c) collect outstanding information from farmers and industry that may strengthen the case for release. The participatory groundnut variety trial involved five Virginia (Chalimbana, ICGV – SM 90704 (Nsinjiro), CG 7, ICGV-SM 01708 and ICGV-SM 88710) and five Spanish (JL24 (released in Malawi as Kakoma), ICGV-SM 99568, ICGV-SM 99541, ICGV-SM 01513, and ICGV-SM 93437 (commonly known as Nyanda)) varieties. Varieties were planted in a randomised block design in plots of $60m^2$ with eight replications in each of the two districts. Planting was done as soon as possible with first effective rains. Plants were spaced at 75cm between rows and 10cm between plants. At least two weedings were undertaken. Studies revealed significant differences in Kernel and pod yield amongst varieties tested. However, although variety Chalimbana revealed the highest pod yield (2801 kg ha-^{1}), accession ICGV SM01513 produced the highest kernel yield of 1146 kg ha^{-1}. Of specific interest were promising Virginia materials ICGV-SMs 01708 and 88710 and Spanish materials ICGV-SMs 01513 and 99541 which yielded significantly higher than JL 24 (57 to 63% increase in yield over JL 24). The low shelling percentages of Virginia types could be attributed to the early harvesting (before the physiological maturity) by farmers. Tasting evaluations revealed that farmers still have a liking for variety Chalimbana. Farmer ranking also revealed that farmers in Malawi prefer varieties with tan colored kernels (Appendix 2.2).

Management of GRD: Three options were demonstrated to farmers; that is use of resistant genotypes (susceptible vs. resistant), time of planting (early vs. late) and plant population (high vs. low plant population). The purpose of the demonstrations were to validate, on-farm, a basket of farmer-friendly options for the management of Groundnut Rosette Disease and also importantly to reduce incidence of GRD in farmer fields in project sites through improved technology dissemination and adoption. A randomised complete block design, with farmers as replicates was used. Result showed that early planting gave higher pod yield of 1771.3 kg ha-1 than late planting 1359.9 kg ha-1, high plant population gave superior yield of 1627.1 kg ha^{-1} over low plant population, 1501.7 kg ha^{-1} (Appendix 2.3). However, incidence of GRD was not adequate to enable assessment of the effect of the treatments (plant population and time of planting) on kernel yield. Nonetheless, higher pod yields were obtained in the resistant than the susceptible varieties for both early and late planting, high and low plant populations.

Management of the aflatoxin problem: The demonstrations hoped to validate options for management of aflatoxin contamination of groundnut and to promote available technologies. Use of tolerant genotypes, time of planting (early vs. late) and water management (box versus open ridges) were all demonstrated. The results presented in this report are preliminary, as testing for aflatoxin contamination levels are to be done in the next reporting period. Preliminary results showed that accession J 11 yielded 17%, 25%, 19% and 23% lower than the mean for the two sites in early and late planting, high and low plant population, respectively (Appendix 2.3). JL 24 gave 16%, 10%, 15% and 14% higher pod yields than the mean for the two sites in early and

late planting, high and low plant population, respectively. ICGV-SM 99568 showed comparative pod yield increases of 15%, 4% and 9% in late planting, high and low plant population, respectively. Overall, mean pod yield was higher in early planting, 2221.3 kg ha^{-1} than late planting 1904.5 kg ha^{-1}. Pod yield was superior in box ridges than open ridges as 2119 and 2031.3 kg ha^{-1}, respectively. This might be ascribed to the presence of ample moisture regimes in box ridges that serve as tools for rainwater harvesting compared to open ridges that let the rainwater drain away easily from the furrows. The farmers noted that they were not able to visualize aflatoxin contamination during field days. They however understood from the demonstrations that aflatoxin contamination could be mitigated by use of the box ridges as opposed to use of the open ridges.

In Tanzania, 17 groundnut demonstrations were established. Improved varieties Nyota, Johari, Sawia and Pendo were planted in 10 villages representing the groundnut growing areas of Masasi in single unreplicated plots in a RCBD. Plots sizes were 10x10m with 50cm between rows and 10cm between plants.

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

Field days: Nine (9) Farmer Field Days were conducted in Malawi to popularize and disseminate promising groundnut production technologies to farmers and collaborating stakeholders. Three hundred and ninety-three farmers and stakeholders including Government and Non-governmental organization (NGO) extension workers, researchers, local leaders such as chiefs and village headmen, attended the field days.

In Tanzania, two field days were organized at 46 days after sowing and at harvesting with total participation of 171 farmers, 83 were men and the rest were women. The field days were organized such that one was held at 46 days after sowing and the other prior to harvest-maturity stage. From 1-6, July 2007 the project organized groundnut seed fairs in Masasi district in Tanzania.

Seed Fairs: The two seed fairs slated to be held in Malawi during the reporting period will be held during the next reporting period. Seed fairs in Malawi will be implemented in October / Novermber 2007 to give farmers opportunity to procure seed for planting (the season begins end of November). In Tanzania, seed fairs were organized from July 1-6 of 2007 in Mpeta and Mangaka villages in Masasi district. . About 2000 people in total attended the seed fairs. Farmers were provided with extension materials including leaflets, video films and interacted with exhibitors. NGOs are currently being encouraged to participate in the seed production process

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

Community Seed Multiplication: In Malawi, ten farmers were involved in groundnut seed multiplication activities in Mchinji and Nkhotakota. The seed production plots were established on farmer fields. All farmers were provided with 10-20 kg of Variety Nsinjiro (ICGV-SM 90704), a high yielding rosette resistant variety, with high market potential in the region and beyond. During the third quarter of this reporting period, the Project facilitated inspection of seed fields by the Ministry of Agriculture and Food Security Seed Inspectors in Mchinji district. The role of the inspectors was to officially inspect and certify the seed multiplication programs ensuring that they are in compliance with Malawi Government standards on production of certified seed. The 10 farmers involved in the seed multiplication produced about 1.7 tons of quality groundnut seed. The farmers involved in seed multiplication will be supported during the next reporting period through seed fairs to be organized by the project.

In Tanzania, Farmers participating in the 17 farmer field schools and 12 farmer research groups were provided with 10-20 kg of Variety Pendo (ICGMS 33). A total of 32 tons of improved groundnut variety Pendo were produced by individual farmers and the Farmer Research Groups (FRGs) that attended the seed fairs. NARI has purchased about 2 tons for the project use during the 2007/08. A second set of seed fairs will be organized by the project to provide farmers a forum to sell seeds. The government is supporting the promotion of variety Pendo throughout Tanzania.

Traders/ Stakeholder Engagement: Prior to preparation of seed fairs in Tanzania, marketing companies including Olam (Tanzania), Abbas Export, Atlas trading and Fida Hussein Company were visited to discuss issues pertaining to groundnut marketing and were also invited to attend the seed fairs. In addition, primary cooperative societies and agricultural marketing and cooperative societies also participated. In Malawi, NASFAM, one of the project collaborators is actively involved in buying and export of groundnut.

Leaflets/ Fliers: The project has produced groundnut leaflets (1000 copies) to enable farmers to learn about improved technologies of the crop.

2.1.4 Conduct training of trainers programme on seed and crop production techniques for extension and NGO partners:

Training of trainers: Two one-day training workshops were organized by ICRISAT and NASFAM in Malawi with the objective to (i) strengthen capacity of NASFAM Association Field Officers (AFOs) in groundnut production through improved knowledge of available technologies; (ii) improve efficiency of the AFOs to manage on-farm field experiments particularly the ICRISAT-NASFAM McKnight Project; and (iii) provide a forum for discussion on constraints and challenges in the Malawi groundnut sector. Thirteen (13) AFOs participated in the training workshops, six in Mchinji and seven in Nkhotakota. Training focused on strengthening capacity for improved groundnut production technologies, improved crop management, important diseases and pests in groundnuts and their control strategies, aflatoxin contamination and management, post-harvest management of groundnuts and on-farm demonstration of data collection techniques. Training materials developed for the courses are available for future use.

In Tanzania, due to late disbursement of funds training of extension officers' and Farmers on seed and crop production was not undertaken. This will be conducted in November 2007. Twenty-four (24) extension officers and 50 farmers who are members of Farmer Research Groups in 20 established Farmer Field Schools centers will be trained. The training will cover all aspects of quality seed production and crop production techniques.

Implications of the research findings

b. For the next stage of research

The findings of this research demonstrate that farmers are able to effectively participate in plant breeding programmes. Farmer identification of susceptible genotypes correlated well with researcher results for disease attributes. The findings also indicate that use of on-farm demonstrations can be an important tool in the evaluation process to ensure that input from farmers is obtained. The screening of genotypes on-farm further facilitates identification of possible parents that combine disease resistance, acceptability and adaptability to the local growing conditions. It is hoped that this will increase the adoption of improved groundnut production technologies, as farmers' preferred traits would be incorporated in current and future breeding programs. Promotion of integrated disease management strategies such as early planting, use of resistant varieties, correct plant spacing should be intensified, promoted and popularized among smallholders through field days and demonstrations to increase awareness among the smallholder farmers. The seed fairs provided farmers a forum to share the results of groundnut testing and demonstrations, created awareness and accessibility of the produced seeds as well creation of working contacts between groundnut producers, seed producers and traders. The findings from this work underscore the importance of farmers in PPB. The project will continue to provide opportunity for farmer education through increased interaction on-farm.

b. For future development activities

In the coming stages, it will be important to ensure that other stakeholders involved in the entire production to consumption continuum for groundnuts are also involved in the selection process. For example, although traders have been widely involved in Tanzania, feedback from this sector should be increased to ensure quality and other concerns are captured and redressed. It will be important in this regard to also obtain the quality traits of various markets, national, regional and international. Further, in the absence of formal seed production initiatives, the current efforts involving the informal sector (NGOs, Farmers' Groups, Individual farmers, etc) should be enhanced. There will be need to scale-up and out Project 'islands of success'. Outcomes of these activities have already shown that when farmers are provided with the right support services, including information they are able produce quality seed. The on-farm demonstration plots established can be used for training farmers in community based seed production. As more new varieties are released, farmers will be trained in basic seed production techniques such as rouging off-types using phenotypic characters at both vegetative and reproductive phases, scouting for pests, seed cleaning and storage. It is important for the Malawi and Tanzania Governments, therefore, to provide necessary policy support to facilitate, sustainably, farmer production of high quality seed.

Objective 3. Increasing 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
Davie Kadyampakeni,Project Scientific Officer, ICRISAT
Betty Chinyamunyamu, Principal Collaborator – Economist, NASFAM
Candida Nakhumwa, Collaborator – Economist, NASFAM
Samu Phiri, Project Research Technician, NASFAM

Tanzania
Omari K. Mponda, Breeder, Principal Collaborator – Breeder, NARI
Elly M. Kafiriti, Agronomist , Collaborator – Agronomist, NARI
Mark Sijaona, Pathologist , Collaborator – Pathologist, NARI
Charles Mkandawire, Agricultural Field Officer, NARI
Joan Kasuga, Agricultural Field Officer, NARI
Jackline Shayo, Agricultural Field Officer, NARI

Introduction
The multi-institutional partnership for technology uptake included farmers, community leaders, researchers and extension agents, and private sector traders and processors. Activities included organizing two planning workshops of project stakeholders to agree on project components for promotion, pilot areas and mode of operation in Tanzania and Malawi; Conducting baseline surveys, mapping farming systems and socioeconomic factors, and identifying technological intervention points and strategies that respond to the needs of each district including market opportunities and constraints; Promoting/encouraging development of farmer associations/ clubs, and Producer marketing groups and commodity collection points from village to district levels; 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; and Establish strategy and time frame for impact monitoring and reporting.

Narrative Summary
The following were the activities undertaken in the two countries during 2006 – 07:

3.1.1 Organization of a planning workshop of project stakeholders to agree on project components for promotion, pilot areas and mode of operation
3.1.2 Conducting baseline surveys, mapping farming systems and socioeconomic factors, and identification of technological intervention points and strategies that respond to the needs of each district including market opportunities and constraints

3.1.3 Promotion of farmer associations/ clubs, and Producer marketing groups and commodity collection points from village to district levels
3.1.4 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
3.1.5 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

a) Project launching workshops for linkages, partnerships establishment and stakeholders familiarization

Two Project Launching and Stakeholders' workshops were held March 1 - 2, 2007 (Malawi) and April 13, 2007 (Tanzania). In Malawi, the workshop involved participants from ICRISAT, Ministry of Agriculture and Food Security (MOAFS), Department of Agricultural Research (DAR), National Smallholder Farmers' Association of Malawi (NASFAM) and the Private Sector. There were exchange visits during the course of conducting the planning and stakeholder workshops. During the stakeholder workshop in Malawi, a delegation comprising researchers and a representative of traders from Tanzania attended the project launch. They also contributed immensely to the planning of the project in Malawi and shared experiences from Tanzania for the benefit of the team from Malawi. The McKnight Project team from ICRISAT MALAWI and NASFAM attended the Tanzania workshop and contributed to the deliberations related to the workplan for the country. The stakeholder workshops focused on two sub-themes: researchable challenges and opportunities in groundnut production and marketing for smallholder farmers in Malawi and Tanzania; and tools, methods and approaches for improved project implementation. An overview of the Groundnut Breeding Project was presented coupled with a discussion for input by the various stakeholders on the project budget and workplan. Compilations of proceedings has been completed – the document will be printed by second quarter of year 2.

3.1.2 Conduct baseline surveys, map farming systems and socioeconomic factors, and identify technological intervention points and strategies that respond to the needs of each district including market opportunities and constraints

a) Benchmark sites identified

The sites were identified in Malawi (Nkhotakota and Mchinji districts) and in Tanzania (Dodoma and Masasi districts) for which baseline data has been collected.

b) Baseline / benchmarks on technology, socio economic-health nutrition, and markets completed

Baseline Surveys: Two baseline surveys were conducted in benchmark areas in Malawi (613 respondents) from March 12 – 24, 2007 and Tanzania (395 respondents) from 6 – 13 March and 23 – 30 March 2007 to facilitate impact assessment. Data were collected on household assets, livestock production, crop production and groundnut production in particular (focusing on post-harvest technologies, markets and marketing), food and nutrition security, and institutional support. A multi-stage and purposive sampling process was used to select survey areas and farmers. The main objective was to obtain a wide range of representative areas and farmer situations in each of the research agro-ecological zones. The process comprised of three stages, which included selection of farming systems, selection of villages and selection of farmers. For each sampling stage some guiding criteria were used to ensure adequate representation of survey areas and sample farmers. Several data collection methods were employed; however, the primary method followed was use of questionnaire survey (semi-structured) which can be categorized as quantitative research. A standard questionnaire and a checklist for focus group discussions were adopted after conducting a pre-test in one of the villages. Data were analysed using SPSS statistical package. Descriptive, means comparison, correlation and test of functional relationships between variables dominated the data analysis. In baseline survey preliminary findings in Malawi, respondents cited inadequate finances for inputs and unfavourable climate as the key crop production constraints. Others cited unavailability of seed for crops, lack of management skills and unfavourable soil for crops as the key constraints. Groundnut marketing constraints were low prices, unassized or tampered-with weighing scales, and buying on credit from farmers. Respondents suggested key interventions as seed supply, marketing services, and extension services. In Malawi, the respondents grow Chalimbana, CG 7, Chalimbana 2000 (ICGV-SM 90704), Malimba, Kandodo and Gambia, in order of decreasing importance. Farmers however prefer CG7, Chalimbana, Chalimbana 2000 (ICGV-SM 90704) and Malimba for their cultivation. Important reasons for their choices were mainly high yields, early maturity, high prices, the only available variety, disease resistance, large seed size in order of decreasing importance. In Malawi, average size of the household field under local groundnut is estimated at 1.11 acres while under improved groundnut is 1.24 acres grown by 16.4% and 17.3% of the respondents, respectively. Amount of groundnut sold per household was 514kg, 406kg and 395kg in 2005/6, 2004/5 and 2003/4, respectively. Groundnuts consumed per household in 2005/6, 2004/5 and 2003/4 were 109kg, 149kg and 120kg. The results show that there has been a general increase in groundnut production over the past three years possibly as a result of farmer awareness and introduction of high yielding improved varieties.

In Tanzania, farmers considered prevalence of pests and diseases to be the major limitations in groundnut production. The second in importance was poor management whereby farmers indicated that they had not been trained on improved management skills for groundnuts. Seed availability was also highlighted as an important constraint in groundnut production. Analysis of groundnut variety preferences indicated high preference ratings for variety Pendo followed by Nyota, Johari and Sawia. Varieties Pendo and Nyota are both Spanish types whereas Johari and Sawia belong to the Virginia type. Variety Pendo was preferred due to its marketability and seed size; high yield performances, early maturity, ease to harvest and plucking. According to this study, at least 30% of the total households cultivated area was under groundnuts. Average farm area of groundnuts per household was about 1.5 acres. At least 50 percent of the household groundnut farms in the studied villages in Masasi were under improved varieties. Varieties that

were often to be grown by farmers in the district were Pendo, Johari, Nyota*, Karanga njugu, Kanyomwa,* Sawia*, Manguru, Chimbuvila* and *Nachingwea.* Nachingwea was an old Virginia variety that was obtained from the late Groundnut scheme in Nachingwea that was officially recommended as Red Mwitunde. *Kanyomwa, Manguru* and *Chimbuvila* are local Virginia type varieties. Kanyomwa is characterized by having 2-3 kernels per pod while *Manguru* and *Chimbuvila* have predominantly 2 big kernels per pod. Pendo, Johari, Nyota and Sawia are improved varieties. Karanga njugu is just a nick name given to all groundnut varieties that are characterized having erect bunch that resembles bambara groundnuts bunches. In Dodoma district, groundnut varieties that were reported to be commonly grown included Nyota, *Ndulima* and *Mahobe*. Varieties Nyota and *Ndulima* were the most common. Whereas Nyota is an improved variety, *Ndulima* and *Mahobe* are local varieties belonging to the Spanish and Virginia types, respectively.

3.1.3 Promote/encourage development of farmer associations/ clubs, and Producer marketing groups and commodity collection points from village to district levels

a) Farmer / researcher market networks established

NASFAM has already put in place Mchinji Farmers Association for buying groundnuts. In Nkhotakota, NASFAM has 6 Associations namely Nkhunga South and North, Zidyana, Mwansambo, Linga North and South Association for buying various crop enterprises including groundnuts. These associations buy groundnut produce from the 10 chapters across the two districts. NASFAM has a total of 964 farmer clubs in Mchinji with a total membership of 16,409 and 531 clubs in Nkhotakhota with a membership of 7,581. Our project is currently working with 82 groundnut clubs in Mchinji and 37 clubs in Nkhotakota. Total membership of the clubs we are working with across the two districts is 1095. Under the project, the NASFAM clubs have been key in the formation of 47 Farmer Research Groups (FRGs) and 47 Community Seed Banks. The FRGs participate in farmer and site selection for on-farm trial and/or demonstrations, planting, assessing and identification of desirable traits and participatory variety selection and as a vehicle for improved seed introduction on-farm.

At least 17 Farmer Field Schools in Tanzania have been established of which 10 were located in Masasi district and the remaining in Ruangwa, Nachingwea, Tunduru, Lindi and Mtwara Districts. Farmer Field Schools in Malawi were not yet initiated in the first year of the project but they will come in early in the 2007/8 growing season in order to use the existing crop in the field for the on-farm learning process.

Technology promotion in benchmark testing sites and target countries: The project in collaboration with Zonal Communication office organized the production of groundnut leaflets on improved groundnut practices, radio and TV programmes to sensitize stakeholders on groundnut production and marketing in Tanzania. A total of 1000 leaflets were produced and 400 were distributed. Five (5) radio bulletins: 3 by Radio Tanzania Dar es Salaam (RTD) and 2 by Radio Free Africa were produced. With respect to TV/Film shows 1 Documentary program produced, 3,000 people shown during groundnut seed fairs and 4,000 people shown during Nane nane National Farmers' Day celebrations in Mtwara. These fairs were also covered by Uhuru and

Mzalendo Newspapers and The Daily News (Tanzania). One hundred fifty (150) posters for improved varieties were printed and distributed during groundnut seed fairs. In Malawi, groundnut field day programs were aired on Radio Nkhotakota for dissemination of groundnut production technologies.

Media promotion was done on aflatoxin management in Malawi on 24-25 July 2007, and this involved broadcasters from 35 media houses including national radio and television broadcasting stations in Malawi; daily national newspapers in Malawi, Television Kenya and Tanzania; British Broadcasting Corporation and Newspaper houses from Reuters (Africa and UK), other African countries, Asia and Europe. This afforded farmers, researchers and journalists an opportunity to exchange ideas on aflatoxin contamination and management.

Monitoring and evaluation: Monitoring and evaluation has been built into the project design, and progress in all activities will be regularly monitored using the NASFAM Monitoring and Evaluation Unit, in comparison with pre-determined milestones. This will enable the Project Management Team (PMT) to re-think the assumptions made at the onset of the project for both countries. Following the baseline, a comprehensive M&E plan is going to be developed during the first quarter of year 2.

Implications of research findings

a. For future development activities

The awareness of groundnuts technologies significantly increased and many farmers are expected to start commercializing the crop, which may demand increased use of improved technologies, e.g. seeds and demand for more leaflets. Workable technology dissemination models identified through this project can now be widely disseminated with confidence throughout Tanzania and Malawi.

b. For policy

Groundnuts have demonstrated to have potential in increasing household income in the groundnut growing areas characterized by poor soils and drought. Efforts need be put in place to encourage farmers to grow the crop on commercial basis for income and food security. From observations and discussions with farmers it appeared harvesting and shelling to be the most laborious activities; the project should consider introducing smallholder shellers to reduce drudgery. The level of crop husbandry used in groundnuts is still low and the potential yield of improved varieties is not being realized. The project should put emphasis on training farmers and extension officers on improved agronomic practices. In the absence of well-defined groundnut markets the crop is being stored for a long time by farmers increasing chances of deterioration and loss of quality including aflatoxin contamination. The project should stimulate official marketing of groundnuts through primary societies and the linking of producers to groundnut marketing companies. Although groundnuts are an oilseed crop there was no indication in the study areas of local processing to extract oil or peanut butter processing. Along with the

development of new varieties, post harvest technologies need to be promoted in the project area for value addition.

Team Report Section.

Team activities: The team had two formal exchange visit programs. The first one was during the stakeholder launching workshops which also provided a venue for joint planning of year 1 activities. The Malawi based team (ICRISAT and NASFAM) participated in the launching workshop in Tanzania, and the Tanzania based team also participated in the launching workshop in Malawi. The teams contributed to the deliberations related to the workplan for each country and included people with varying experiences. For example, the Tanzania team brought a private groundnut trader to the Workshop in Malawi.

The Tanzania team organized a seed fair at Mpeta and Mangaka villages in Masasi which was attended by close to 2000 farmers. One representative of the team from Malawi was in attendance. Groundnut technologies including new seed varieties, displays of farmer variety selection results, and village value addition methods were displayed. Farmers took the opportunity to purchase seed from one another. It is estimated that more that half of the farmers were able to exchange germplasm and learn various value addition techniques like oil expression.

Insights and lessons learned. The planning workshops afforded the opportunity for exchange of ideas among the stakeholders and agreements on the workplans. This was key to the successful implementation of the project in the two countries and project annual planning and review meetings are now a feature of the project.

The seed fairs are a very effective way of disseminating new farmer preferred varieties in rural areas. Tanzania has a long track record of implementing successful seed fairs and there is opportunity for the team in Malawi to benefit from this experience.

We noted that efforts to produce with smallholder farmers Government Certified Seed may not be sustainable because of prohibitive costs and the small farmers plots. The project will ensure through training of field extension officers and lead farmers that quality seed is indeed produced on-farm but reduce the costs of carrying government inspectors long distances to certify small farmers plots.

Introduction of short duration Spanish varieties into the traditional medium duration environments in Malawi during the first year presented a challenge. Whereas farmers were appreciative of new early maturing varieties as an early source of nutrition and household income, they are not used to the Spanish plant type and some went ahead harvesting the trials in fear that the crop was mature before the technicians collected all the data. Enhanced farmer education is necessary.

In both Malawi and Tanzania, timely execution of field activites were hampared by mobidity problems. It was not always possible to have reliable transportation at critical times of trial

evaluation and some important data may have been missed. The team brought already brought this concern to McKnight to request for a project vehicle for both Malawi and Tanzania.

Workplan Section:

Detailed Workplan for Year 2 (Sept 2007 – Aug 2008)

Project Outputs and Activities

1 High yielding farmer and market-acceptable varieties developed

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

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

4 Groundnut productivity increased. A practical and implement able technology dissemination program developed

4.1.1 Organize planning workshop of project stakeholders to agree on project components for promotion, pilot areas and mode of operation
4.1.2 Conduct baseline surveys, map farming systems and socioeconomic factors, and identify technological intervention points and strategies that respond to the needs of each district including market opportunities and constraints
4.1.3 Promote/encourage development of farmer associations/ clubs, and Producer marketing groups and commodity collection points from village to district levels
4.1.4 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
4.1.5 Establish strategy and time frame for impact monitoring and reporting

Year	Quarter	Activity number	Type of milestone	Description of Milestone	Time due*	Means of verification
2	4	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)	August 2008	• List of farmer researcher groups in the two countries
2	2			• Additional sources of resistance to foliar diseases identified from core collections, local and wild germplasm (2007 – 2010)	Februa ry 2008	• List of sources of resistance for hybridization
2	2-3			• Farmer preferred varieties with local adaptation identified and hybridization initiated for introgression of GRD and foliar fungal disease resistances (2007)	April 2008	• List of varieties with farmer / market preferred traits
2	4	1.1.2	Activity	• Disease screening capacity developed in Tanzania and NARS scientists trained on the use of the infector row technique from year 1 (2007 – 2010)	August 2008	• Training report for GRD, ELS and rust screening • Infector row technique established in Tanzania
	3	1.1.2		• Diversified groundnut populations /breeding lines with genetic resistance for rosette, ELS, rust and LLS and combined resistances. (2007 – 2010)	May 2008	• List of materials or genotypes with genetic resistance for rosette, ELS, rust and LLS and combined resistances.
	1-4	1.1.3		• New improved groundnut varieties incorporating local derived genes for quality and adaptation developed by year 4 (2010)	August 2008	• List of promising materials

Year	Quarter	Activity number	Type of milestone	Description of Milestone	Time due*	Means of verification
2	3	1.1.4	Activity	• Nucleus seed of elite lines produced annually for NARS testing and for breeder seed production. (2007 – 2010)	August 2008	• Seed requests/ signed MTAs
2	4		Activity	• Advanced breeding lines and breeder seed of improved groundnut varieties available to NARS and NGOs in ESA in an annual basis (2007 – 2010)	Aug 2008	• Seed requests/ signed MTAs • List and quantities of germplasm distribution by country
	2-3		Activity	• Early high yielding, farmer preferred lines identified for evaluation under high GRD and ELS disease pressure using the infector row technique (2007-2010)	May 2008	• No. of lines identified for evaluation
2	1	2.1.1	Activity	• Eight varieties identified for wide scale on-farm adaptive testing with farmer participation for each country (2007 – 2010)	May 2008	• List of on-farm trials conducted.
	1			• Three varieties with specific and / or combined resistances identified for wide scale testing	May 2008	• List of varieties
	1			• Demonstrate techs for reduction of aflatoxin under smallholder conditions (2007 – 10)	May 2008	• List of on-farm demonstrations and trials
	2	2.1.2		• Field days, demonstrations, agricultural shows and seed fairs conducted at select farmer field school sites annually (2007 – 2010)	Oct 07-Aug 08	• No of field days, number and type and stakeholders participating

Year	Quarter	Activity number	Type of milestone	Description of Milestone	Time due*	Means of verification
						• No of demonstrations mounted • List of traders and others involved in g/nut trading • No of farmers demonstrating at seed fairs and list of varieties preferred by farmers & market
2	1	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)	Dec 2007	• No of seed delivery innovations operational • Quantity of seed produced and sold • Publications
	3			• Monitoring system established to assess seed demand from demonstration trials, and link this to basic seed production (2008)	Nov-Dec 2007	• No of field visits made.
	1			• Community seed banks established and fully functioning (2006 – 2010)	August 2008	• No of community seed banks formed
2	2	2.1.4	Activity	• Training and information needs of partners identified (2007– 2010) • Informal short and formal /long term training initiated during year 1 and continuing (2007 – 2010)	Feb 2008	• Training materials • List of trainees • Progress reports
2	1	3.1.1	Activity	• Annual planning and review meetings	Sept-	• No of reports

Year	Quarter	Activity number	Type of milestone	Description of Milestone	Time due*	Means of verification
					Nov 2007	
2	1	3.1.3	Activity	• Farmer, researcher and market network established (2006 – 2008)	Dec 2007	• No of clubs/ associations operating in target communities • No of collection points • Report on production and annual targets for participating clubs • List of traders and others involved in g/nut trading
2	1	3.1.5	Activity	• Project management team for internal monitoring established and functioning (Oct-Nov 2006 - 2010)	Oct – Nov 2007	• M&E plan • Progress reviews and annual workplans

Budget

The team is requesting USD 89,435.00 for implementation of the detailed workplan above. Please see excel sheet attachment

Publications Summary

1. **Osiru, M., Monyo, E., Waliyar, F., and Harvey, C., 2007.** Strategies for Management of the groundnut rosette disease in Sub-Saharan Africa. Fourth Annual General Meeting of the Forum for Agricultural Research in Africa. 10 – 17 June, 2007. Sandton. South Africa.

Training and outreach summary

Two one-day training workshops were organized by ICRISAT and NASFAM in Malawi with the objective to (i) strengthen capacity of NASFAM Association Field Officers (AFOs) in groundnut production through improved knowledge of available technologies; (ii) improve efficiency of the AFOs to manage on-farm field experiments particularly the ICRISAT-NASFAM McKnight Project; and (iii) provide a forum for discussion on constraints and challenges in the Malawi groundnut sector. Thirteen (13) AFOs participated in the training workshops, six and seven in Mchinji and Nkhotakota, respectively. Training focused on strengthening capacity for improved groundnut production technologies, improved crop management, important diseases and pests in groundnuts and their control strategies, aflatoxin contamination and management, post-harvest management of groundnuts and on-farm demonstration of data collection techniques.

In Tanzania, Extension officers' and Farmers' Training course on seed and crop production training workshop will be organized to increase the knowledge of extension officers and farmer research groups members on quality seed production and improved agronomic packages for groundnuts and to increase farmers' access to seeds of improved groundnut variety Pendo. Twenty-four (24) extension officers and 50 farmers who are members of Farmer Research Groups in 20 established Farmer Field Schools centers will be trained. The training will cover all aspects of quality seed production and crop production techniques. The training was postponed until October-November because of late disbursement of funds. When funds were disbursed it was time for establishing trials on-station and on-farm.

In April 2007, a Pathologist (Dr Farid Waliyar) from ICRISAT Headquarters gave a training staff to Project scientists in Malawi on modern groundnut disease scoring and management techniques. That same week, Tanzanian scientists were also visited so they benefited from the knowledge of Dr Waliyar on Aflatoxin management in groundnuts.

APPENDICES.

Appendix 2.1. Yield (Kg ha^{-1}) performance and GRD incidence (%) of ten Groundnut varieties evaluated on-farm in the districts of Mchinji and Nkhotakota, Malawi

Variety	Shelling Percentage	Pod weight (kg ha$^{-1)}$	Kernel yield (Kg ha^{-1})	GRD incidence (%)
Chalimbana	27.6	2801	773.076	44
ICGVSM88710	31.8	2468	784.824	13
ICGVSM099541	36.8	2437	896.816	33
ICGVSM01513	48.3	2373	1146.159	3
CG7	31.1	2244	697.884	62
ICGVSM01708	33.2	2051	680.932	15
ICGVSM90704	45.1	2043	921.393	3
ICGVSM99568	49.9	1795	895.705	0
NYANDA	54.5	1727	941.215	2
JL24	55.2	1513	835.176	8
Mean	**40.6**	**2160**	**857.318**	**18**
CV(%)	**30.7**	**57.26**	**59.8**	**257**
LSD (0.05)	**11.67**	**1027**	**445**	**47**

Appendix 2.2: Farmer ranking of 10 groundnut varieties based on kernel visual and taste characteristics using the direct matrix ranking technique

Variety	Variety Characteristics-Nkhotakota						Variety Characteristics-Mchinji (less taste for boiled groundnuts						
	Pod size	Grain size	Grain color	Taste (boiled)	Taste (raw)	Variety score	Pod size	Grain size	Grain color	Taste (raw)	Variety score	Overall score	Rank
Chalimbana	5	5	4	5	5	**24**	5	5	5	3	**18**	42	1
ICGV-SM 99568	3	3	5	4	5	**20**	5	5	5	4	**19**	39	2
CG 7	5	5	2	5	5	**22**	4	5	2	5	**16**	38	2
ICGV-SM 88710	5	5	5	4	5	**24**	4	5	2	3	**14**	38	2
ICGV-SM 01708	3	4	4	5	5	**21**	4	5	5	2	**16**	37	3
ICGV-SM 90704	5	5	5	2	5	**22**	5	5	2	3	**15**	37	3
Kakoma	3	3	3	5	1	**15**	5	3	2	5	**15**	30	4
ICGV-SM 99541	3	3	5	4	5	**20**	2	1	2	5	**10**	30	4
Nyanda	2	5	5	5	1	**18**	2	3	2	2	**9**	27	5
ICGV-SM 01513	2	2	5	4	0	**13**	2	3	2	2	**9**	22	6

Scores: 0 – Poor, 1 - Below average, 2 - Average, 3 - Above average, 4 - Good, 5 - Very Good/Excellent

Appendix 2.3: Effect of time of planting, plant population and host resistance on GRD incidence and yield in Mchinji and Nkhotakota districts of Malawi

Variety	Shelling (%)				Kernel yield (kg ha^{-1})			
	Early planting	Late planting	High PP	Low PP	Early planting	Late planting	High PP	Low PP
Baka (Resistant)	59.0	57.8	59.1	58.0	953	1009	1088	916
Malimba (Susceptible)	58.1	58.1	58.2	58.1	823	646	770	736
Nsinjiro (Resistant)	57.8	50.4	53.3	55.5	1167	967	1162	1010
Chalimbana (Susceptible)	48.2	44.5	46.4	46.7	920	518	717	755
Mean	**55.8**	**52.7**	**54.2**	**54.6**	966	**785**	**935**	**854**
S.E.	**7.8**		**8.0**		**597**		**609**	
CV (%)	**14.4**		**14.9**		**69.2**		**70.6**	

Pp= Plant population;

Appendix 2.4: Effect of time of planting, water management and host resistance on GRD incidence and yield in Mchinji and Nkhotakota districts of Malawi

Variety	Shelling (%)				GRD Incidence (%)				Kernel yield (kg ha^{-1})			
	Early planting	Late planting	Box ridges	Open ridges	Early planting	Late plantin g	Box ridges	Open ridges	Early planting	Late planting	Box ridges	Open ridges
J 11 (Resistant)	52.6	50.0	48.0	54.6	17.67	46.75	26.33	40.25	950	729	836	843
JL 24 (Susceptible)	56.6	42.1	51.3	49.8	16.33	21	21.4	17.25	1342	1034	1339	1131
ICGV-SM 99568 (Susceptible)	56.4	37.3	40.2	53.4	0	0	0	0	1151	971	1354	846
Mean	**55.2**	**43.1**	**46.5**	**52.6**	**11.3**	**22.6**	**15.9**	**19.2**	**1148**	**911**	**1176**	**940**
S.E.	**14.2**		**15.6**		**15.63**		**17.53**		**565**		**563**	
CV (%)	**28.5**		**31.3**		**77.3**		**86.8**		**51.2**		**51.0**	

J-11- Aflatoxin tolerant; JL24 susceptible to aflatoxin contamination; ICGV-SM 99568 susceptible to aflatoxin contamination resistant to GRD
GRD Incidence (%) = no of infected plants/total number of plants per plot x100

Appendix 3.1: Trend in groundnut production in Malawi

Type of the respondent	Trend in groundnut production			
	2003/04 (N=304)	**2004/05 (N=503)**	**2005/06 (N=646)**	**Total (1453)**
Member	65.8%	68.8%	68.0%	67.8%
Non Member	34.2%	31.2%	32.0%	32.2%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Appendix 3.2. Groundnut production constraints (% respondents) in Tanzania

Constraints	Masasi	Dodoma	Total Mean
Unfavourable weather	12.6	13.8	13.3
Poor soils	8.2	6.7	7.4
Seed availability	30.8	27.6	29.1
Low cash price	17	14.8	15.8
Poor management	39.64	38.67	39
Lack of capital	34.6	31.4	32.9
Labour	13.7	12.4	13
Pests and Diseases	53.8	54.8	54.3

Appendix 3.3. Distribution of farmers according to key crop production constraints in Malawi

Constraints	Frequency	Percent (%)
Inadequate finances for inputs	199	32.5
Climate unfavourable for the crops	168	27.4
Unavailability of seed for the crops	79	12.9
Lack of management skills	47	7.7
Low food/cash value for the crops	34	5.5
Unavailability of labour	32	5.2
Soil unfavourable for the crops	28	4.6
Don't know	26	4.2
Pests and diseases	18	2.9
Lack of market	17	2.8
Lack of fertilizer/unavailability of fertilizer	6	1
Unavailability of land	2	0.3
Lack of extension services	2	0.3
Low yielding varieties	1	0.2
Late planting	1	0.2
Total of respondents	**613**	**100**

Appendix 3.4. Groundnut variety preference ratings in Tanzania

	Groundnut Varieties			
Criteria	Pendo*	Sawia*	Nyota	Johari*
Pest tolerance	4	2	4	3
Disease tolerance	4	2	3	4
Yield	5	3	5	4
Maturity	5	3	5	4
Drought tolerance	4	3	4	3
Easy of harvesting	5		5	4
Easy of plucking	5		5	3
Pod size	4		3	4
Easy of shelling	4		3	4
Kernel/pod	4		2	2
Seed size	5		2	4
Price	5		5	4
Total	54	13	46	43
Mean score	4.5	2.6	4	3.6
RANK	1	4	2	3

Appendix 3.5. Percent distribution according to reason for choosing a variety in Malawi

	Variety preferred and reasons					
Criteria	**Chalimbana (N=120)**	**Chalimbana 2000 (N=92)**	**CG 7 (N=325)**	**Malimba (N=8)**	**Other (N=2)**	**Total (N=583)**
High yield	23.30%	62.00%	66.50%	12.50%		55.20%
Early maturity	5.00%	4.30%	6.50%		100.00%	6.00%
High prices	12.50%	6.50%	2.80%	12.50%		5.70%
More weight	3.30%	6.50%	5.20%	25.00%		5.30%
Disease resistant	3.30%	2.20%	4.00%	25.00%		3.80%
Large size	14.20%	2.20%	0.30%			3.70%
Marketable	5.80%	2.20%	1.50%	12.50%		2.70%
Good for consumption	5.00%	3.30%	0.90%			2.20%
Easy to harvest	0.80%	3.30%	2.50%			2.20%
Drought tolerant	1.70%	1.10%	1.80%			1.60%
According to soil type	3.30%		1.50%			1.60%
Nutritious	2.50%	1.10%	0.90%			1.30%
Easy to shell	3.30%		0.90%			1.30%
Oil content			1.10%			1.10%
Favored because of color	0.80%	1.10%	0.60%			0.70%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Appendix 3.6. Farmer responses of the most preferred groundnut varieties in Tanzania

Variety preferred	% Farmers		Total
	Masasi (N=155)	Dodoma (N=56)	(N=211)
Pendo	31.8	0	31.8
Nyota	7.6	0	7.6
Johari	10.9	0	10.9
Kanyomwa	4.8	0	4.8
Karanga njugu	6	0.9	7
Nachingwea	1.9	0	1.9
Local	10.9	16.1	27
Ndulima	0	9	9

Appendix 3.7. Farmer responses of the most preferred groundnut varieties in Malawi

Variety preferred	Type of the respondent		Total (N=583)
	Member (N=393)	Non Member (N=190)	
CG 7	57.50%	58.90%	58.00%
Chalimbana	20.60%	28.40%	23.20%
Chalimbana 2000 (Nsinjiro)	19.80%	11.10%	17.00%
Malimba	1.50%	1.10%	1.40%
Other	0.50%	0.50%	0.50%
Total	100.0%	100.0%	100.0%