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

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Progress Report
(Sept 1st, 2007 – August 31st 2008)

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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 second year of implementation (1 September 2007- 31 August 2008). Funded through the framework of the 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. 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 Naliendale 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 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. Highlights of the progress made by the Project within the reporting period (Sept 2007 – Aug 2008) are provided below:

- Three additional sources of resistance each for GRD and ELS were identified from core collections and wild germplasm.
- An aflatoxin sick plot has been established at Chitedze Research Station, the use of which is already contributing useful information for classifying resistant varieties.
- Groundnut accessions ICGV-SM 90704, ICG 12991, ICGV-SM 95714 and ICGV 94114 were used for Rosette, Aphid, ELS and Rust resistance introgression respectively. A total of 48 crosses involving these sources and farmer / market preferred locally adapted varieties were made.
- Thirty one (31) nurseries comprising 1074 progeny rows were evaluated under high rosette disease pressure, ranging from F2 through F7 and Check rows. In addition, two wild *Arachis* spp. nurseries were screened for resistance to GRD.
- A total of 379 and 164 single plant selections for GRD and ELS resistance, respectively, were identified for generation advance
- Seed production efforts by the Project led to production of nucleus seed of 83 lines in advanced, elite trials and released varieties in quantities ranging from 3.8 to 71.7kg to maintain germplasm stock for supply to NARS. Various quantities of breeder seed were produced on station in Malawi, which includes 5.43 tons of GRD resistant varieties; ICGV-SM 90704 and ICGV-SM 99568, 2.8 tons of CG7, JL 24 and Baka; 560kgs of Chalimbana and 335 Kgs of Chalimbana 2005.

- A total of 91 lines and varieties were distributed from Chitedze Agricultural Research Station to three country NARS programmes, including Malawi, with support from the Groundnut ESA Project.
- Participatory variety Evaluation and Demonstrations conducted in Farmers fields in Malawi and Tanzania, has revealed 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 in Malawi.
- Research Technicians and Outreach NGO continue to be trained on seed production and groundnut husbandry practices
- Farmer associations / clubs and farmer market research groups are currently in operation in target districts for ease of technology dissemination and farmer / researcher learning.
- Initial farmer seed banks have been developed.
- 1500 groundnut leaflets and one video film on improved groundnut practices have been produced in Tanzania.
- Traders and stakeholders have been engaged on issues of groundnut marketing and NASFAM, one of our project partners is actively involved in buying and export of groundnut.

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 limit crop productivity and 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.

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. 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 (GRD) caused by a viral complex is endemic to the African continent and epidemics occure often with losses approaching 100% in many fields. Early leaf spot (ELS) caused by *Cercospora arachidicola*, late leaf spot (LLS) 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

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 challenges will be the subject of the diagnostic studies. The breeding program is being conducted in two stages. The first was to identify parental lines with desired characteristics for hybridization and/or breeding populations at different stages of development. The second consists of designing and selecting specific breeding products from the segregating population(s) developed/selected in the first stage. The diagnostic stage, conducted simultaneously with the first stage of the breeding work, has been used in designing 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.

Progress to date

The Project, now in its third year of implementation, has made significant progress towards achievement of milestones and targets. The baseline survey has been conducted and used in the design of subsequent activities. Following screening of extensive core, local and wild germplasm, six additional sources of resistance to foliar diseases have been identified. In addition, farmer preferred varieties with local adaptation have been identified in Malawi and Tanzania and introgression for GRD and foliar fungal disease resistances initiated. To complement these efforts, NARS capacity for disease screening has been improved. Over 1707 (633 in 2006/7 and 1074 in year 2007/8) progeny rows (F2 through F7 and checkrows) and 380 have been screened for GRD and ELS respectively. The project has distributed 1005 lines/ varieties to NARS programs and produced over 9 tons of breeder seed of several varieties. Working with partners, the project has also facilitated the production of 34 tons of seed of improved varieties through community based seed schemes.

To improve awareness and promote adoption of improved varieties, 146 trials/ demonstrations focusing on management of aflatoxin, groundnut rosette disease and Participatory Variety Selection (PVS) have been implemented. Through these, the project has shown that an integrated management approach provides an effective and practical disease and aflatoxin management strategy for small farm holders.

Investigators

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- National Smallholder Farmers' Association of Malawi (NASFAM), Malawi
- Agricultural Research Institute (ARI)-Naliendele, Tanzania

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Research Report

At the end of its four year period, this Project expects to deliver three main outputs in Malawi and Tanzania: 1) 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; 2) adoption rates of improved farmer and market-acceptable varieties and production technologies enhanced; and, 3) groundnut productivity increased. This Section, arranged by objective, narrates activities undertaken by the Project during the reporting period (Sept 2007- August 2008). For each objective, a short introduction and rationale is followed by a narrative summary of activities undertaken and related findings prior to brief remarks on implications of these research findings for the next stage of research (including suggested development activities and policy, where appropriate).

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

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Introduction

One of the challenges facing small farm holders in the Semi-Arid Tropics (SAT) of sub-Saharan Africa (SSA) is how to harness limited available resources in harsh environments to enhance incomes and reduce malnutrition and poverty through improved agricultural production. In the project target areas, 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 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 will also be 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[1] with resistances to diseases and drought as initial parents for the development of improved populations. This presents a 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 the reporting period:

- 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

For the second season rains (2007/8), following the first season activities in the last reporting period (2006/7), a groundnut minicore, comprising of 192 groundnut lines, was evaluated under high GRD and ELS disease pressures at Chitedze Agricultural Research Station using the Infector Row technique. The Infector Row technique enables consistently high disease pressures and reduces possibility of 'escapes' (Subramanyam *et al*., 2001). This screening exercise identified potential sources of resistance to both GRD and ELS. For Rosette resistance, the lines identified are ICG 13099, ICG 14705 and ICG 6888 each with mean GRD incidences of less than 25%. These lines also revealed low GRD incidences (<20%) in the previous season confirming their performance. For ELS, good resistance (ELS scores of <5 on a nine point scale)[2] was observed from ICG 6913, ICG 6022 and ICGV-SM 95741. In Tanzania, 25 varieties were evaluated against major foliar diseases (ELS, Rosette and Rust) at Naliendele and Nachingwea Agricultural Research Institutes. Varieties ICGV–SM 03590 and ICGV- SM 05521 gave high and stable yield across sites. Based on the disease scores ICGV-SM 03590 was highly tolerant to major foliar diseases (ELS score <3, Rosette < 1% and rust score <1) while ICGV-SM 05521 showed moderate resistance.

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[1] As of 2007, ICRISAT maintained 15,419 groundnut accessions from 93 countries at its genebanks

[2] ELS Scores (1 = highly resistant, 2 – 3 = resistant, 4 – 5 = moderately resistant, 6 – 7 = susceptible, 8 – 9 = highly susceptible)

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

In Malawi preference ratings for the 2007/08 growing season showed new varieties were preferred to varieties *Chalimbana* and JL 24. ICGV-SM 90704 (*Nsinjiro*) and ICGV-SM 99568 (*Chitala*) were the most preferred high yielding Virginia and Spanish varieties, respectively. Amongst the elite lines under participatory variety selection with farmers, ICGV-SM 01513, an early maturing line, was the farmer-favored variety. In Tanzania, , on the other hand, ICGV-SM 01711, ICGV-SM 01721 and CG-7 were the most preferred Virginia groundnut varieties across sites evaluated. Amongst the early duration materials, ICGV-SM 99557, ICGV-SM 99555 and *Pendo* were most preferred.

Crosses were initiated (December 2007- April 2008) to introgress four specific traits (GRD, aphid, ELS and rust resistance) into farmer-preferred varieties. Since there is unproblematic movement of germplasm between Tanzania and Malawi it was agreed within the Project team that the Chitedze site also be used to undertake the crosses for Tanzania (Tanzanian farmer preferred varieties) as well as those for Malawi. Groundnut accessions ICGV-SM 90704, ICG 12991, ICGV-SM 95714 and ICGV 94114 were used for Rosette, Aphid, ELS and Rust resistance introgression respectively. A total of 48 crosses involving these sources and farmer / market preferred locally adapted varieties were made. In late August, 2008, 24 more crosses were planted under overhead irrigation at Kandiyani, ten kilometers from Chitedze Agricultural Research Station. Kandiyani site characteristics are similar to those at Chitedze, with availability of year round irrigation infrastructure. Farmer preferred varieties (2006/07) include (*Johari* (Robut 33-1), *Pendo* (ICGMS-33), *Nyota* (Spancros) and *Red Mwitunde* from Tanzania and *Chalimbana*, CG 7 and JL24 from Malawi.

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

A one-month training course on use of the Infector Row technique for GRD screening was conducted from December 17, 2007 to January 13 2008. Mrs. Joana Kasuga and Mr. Joseph Nzunda, technicians from NARI, Naliendele in Tanzania attended the training. The training was focused on maintenance of viruliferous and non-viruliferous aphids in the greenhouse, and subsequent activities towards ensuring high GRD disease pressure in the field. They were also trained on improved groundnut production practices. Practical sessions on field screening for GRD using the infector row technique were also conducted. On return to Tanzania, the two technicians immediately began use of the Infector Row technique in Tanzania for GRD screending. Their work, however, has been hampered by slow progress in establishment of a greenhouse at Naliendele, required for rearing viluriferous aphids. To support this initiative, the Project leader (Dr. E. Monyo) and ICRISAT Pathologist (Dr. M. Osiru) traveled to Tanzania to backstop the implementation of this activity.

Work on greenhouse establishment in Tanzania commenced in 2007. To-date, materials have been ordered but delivery is still awaited. In the meantime, stopgap measures (a small room with gauze is being used within NARI) are being undertaken to ensure that GRD field screening activities continue.

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

Screening Breeding Populations for GRD resistance
Thirty one (31) nurseries comprising 1074 progeny rows were evaluated under high rosette disease pressure. The materials, developed to combine two or more traits (grain yield, aphid resistance and GRD resistance), ranged from F2 through F7 to Check rows. In addition, two wild *Arachis* spp. nurseries were also screened for resistance to GRD and ELS. Ten out of 28 Hypogae x Arachis rosette introgression progrenies were selected for generation advance under rosette High Disease Pressure (HDP). In the *Arachis* spp. for GRD screening, the whole nursery succumbed to rosette infestation and none of the plants produced a pod. A total of 379 single plant selections were picked for generation advance: 213 plants derived from F_2-F_6 progeny rows were identified for generation advance through single plant selections; 84 F7 progeny rows were advanced to check rows while 72 check row populations were advanced to preliminary trials. Fifty nine (59) progeny rows from F7 and Check rows had 0% rosette incidence (Table 1).

Table 1: Results of single plant and progeny row selection program for segregating breeding populations in F2-F7 and Check Row in the GRD nursery during 2007-08 season at ICRISAT Chitedze Research Station.

Populations	Populations		
	Evaluated	**Selected**	**With 0 % rosette incidence**
Dormancy and rosette resistance check row	22	11	5
GRD inheritance check row	9	2	2
GRD resistance check row	31	13	4
GRD and dormancy check row	31	8	1
GRD inheritance-aphid x GRD check row	6	5	1
Aphid and GRD resistance check row	15	9	1
Aphid resistance inheritance check row	8	6	0
Aphid resistance check row	27	12	1
Aphid resistance backcross check row	13	6	0
GRD resistance and confectionery F7	37	26	24
Aphid resistance x rosette virus resistance F7	13	8	3
Rosette virus x ELS resistance-F7	35	12	10
Aphid resistance x ELS resistance-F7	64	24	1
GRD and bold seeded-F7	25	14	6
Aphid resistance and confectionery- (VB) F6 SPS	34	15	2
GRD resistance and confectionery- (VB) F6 SPS	33	23	9

Aphid resistance and ELS –F4 SPS	78	40	3
Aphid resistance inheritance-F4 SPS	46	5	0
High oleic acid and rosette resistance-F4 SPS	45	6	0
Dormancy and rosette resistance-F4 SPS	30	0	0
GRD resistance-F4 SPS	15	0	0
GRD resistance (VB) confectionery- F3 SPS	34	0	0
Aphid resistance (VB) confectionery F3 SPS -	50	4	0
Aphid and rosette virus resistance- F3 SPS	13	10	0
Aphid resistance and ELS resistance- F3 SPS	21	10	0
Aphid resistance and rosette virus resistance- F3 SPS	18	12	0
Aphid and GRD resistance- F3 SPS	31	3	0
Aphid and ELS resistance-F3 SPS	87	32	0
F2 crosses	19	9	0
F2 bulk crosses	53	23	0
Aphid resistance-F2 SPS	70	21	0
Hypogaea by Arachis rosette introgression	28	10	0
Arachis species for rosette screening	33	0	0
Total	1074	379	73

Screening Breeding Populations for ELS resistance

Details of the ELS segregating nursery performance for the main season (07/08) are highlighted in Table 2. A total of 331 breeding populations from six nurseries ranging from F_5-F_7 were screened for ELS resistance at Chitedze. These populations were developed to combine ELS resistance and yield. Chitedze, at an altitude of 1149masl, provides an excellent screening location for ELS. From the 331 progeny rows evaluated, 164 single plant selections were made for advance to the next growing season. 51% of the selections were made from the F_7 populations.

Table 2. Results of single plant and progeny row selection program for segregating breeding populations in F5 to F7 in the ELS nursery during 2007-08 season at Chitedze Research Station (Malawi)

Populations	Populations		
	Evaluated	Selected	Remarks
Arachis Hypogaea ELS Introgression	60	36	generation advance
ELS interspecific lines	5	0	Nothing to advance
Groundnut Germplasm Lines for ELS - F5	33	14	Advanced to F6
ELS resistance and confectionery (Virginia) F6SPS	37	21	Advanced to F7
ELS & X Rosette resistance – F7 SPS	10	9	To Check Row
ELS X ELS Resistance – F7 SPS	186	84	To Check Row
Total	**331**	**164**	

1.1.3 Develop and evaluate advanced breeding lines and varieties

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

In Malawi, elite ELS and GRD trials revealed new sources of resistance from the 24 lines evaluated on station at Chitedze. Significant differences were observed for ELS mean scores. Potential lines identified included ICGV-SM 05542, ICGV-SM 05534, ICGV-SM 05521, ICGV-SM 05774 and ICGV-SM 05543. All these lines performed better than the check (JL24), which recorded a score of 8.5 against ≤ 6 for the lines. For GRD, only ICGV-SM 01514 displayed a disease incidence of 0%. ICG 12991 also performed well with a rosette incidence of 2.5% and a kernel yield of 1385 kg/ha. Rust evaluations were undertaken in Nachingwea and Naliendele in Tanzania. 25 lines for both SB and VB were evaluated at Nachingwea and Naliendele respectively. Among the Spanish, ICGV-SM 99554, 99530, and 99543 were the best for yield. (Appendix 1). Varieties ICGV-SM 99530, 01513, 99529, 01504 and 02501 were the best with ELS scores (≤ 3) at Nachingwea. At Naliendele (Appendix 2), significant differences (P>0.05) were observed amongst varieties for pod yield with best performance from variety ICGV-SM 91706 (2.0 t ha^{-1}). Variety ICGV-SM 01711, one of the candidate varieties for release, was among the best yielding varieties (1.5 t ha^{-1}). Other varieties that demonstrated high yield performance and moderate tolerance to diseases at Naliendele were ICGV-SM 01709, 03701, ICGV-SM 91707 and ICGV-SM 88762.

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 on an annual basis

Seed production efforts by the Project led to the following achievements for the year ending August 2008:

- Nucleus seed of 83 lines in advanced, elite trials and released varieties was produced in quantities ranging from 3.8 to 71.7kg to maintain germplasm stock for supply to NARS.
- Various quantities of breeder seed were produced on station in Malawi as follows:
    - 2.37 tons of GRD resistant variety ICGV-SM 90704; 3.06 tons of early maturing GRD resistant variety ICGV-SM 99568;
    - 1.4 tons of CG 7, 380kg of JL 24, 1.02 tons of ICGV 12991;
    - 1.5 tons of *Pendo*, a released cultivar in Tanzania;
    - 335kg of *Chalimbana* 2005, a recently released cultivar; and,
    - 560kg of the local variety *Chalimbana.*

Table 3 below presents the groundnut seed by category distributed to national programmes in the sub-region. A total of 91 lines and varieties were distributed from Chitedze Agricultural Research Station to three country NARS programmes, including Malawi, with support from the Groundnut ESA Project.

Table 3. Seed distribution to National Programs during 2007 - 08 season

Nursery	Malawi	Tanzania	Mozambique	Total
International Trials (sets)	17	17	12	**46**
Advanced Breeding Trials	10	15	11	**36**
Early generation Breeding Material	0	0	0	**0**
Germplasm samples	0	0	0	**0**
Others (varieties/breeder seed)	3	3	3	**9**
Total	**30**	**35**	**36**	**91**

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

Following participatory variety selection, varieties ICGV-SM 01513, ICGV-SM 99568 and ICGV-SM 90704 were amongst the most popular varieties amongst farmers and were identified for evaluation under high GRD and ELS pressure on-station. Results of this evaluation revealed an average score of 3.5 for ELS and 9.9% as Rosette incidence. In Tanzania the project collected five local varieties from farmers in the main groundnut growing areas of Masasi and Dodoma (Red Mwitunde, Dodoma bold, Manguru, Kanyomwa, and Nyota). Each of these varieties was multiplied for maintenance and to avail seed for experimentation. The main objective is to ultimatimately introgress biotic stress resistances to these widely adapted farmer varieties.

Implications of the research findings

a. For the next stage of research

Identification of resistance sources in cultivated groundnuts is an important finding towards solving this important problem. To date, only two short duration varieties have been developed with resistance to GRD. This year's evaluation confirmed the three lines identified for GRD resistance and three lines for ELS resistance in the previous season. In addition, more sources of resistance were also identified. More importantly, farmer participatory varietal selection has revealed more farmer preferred varieties that can be candidates for gene introgression to improve their resistance reaction to the major biotic constraints (rosette and ELS). The logical next steps will be to characterize the sources of the resistance identified followed by candidate gene introgression. This knowledge will enable us develop genotypes combining resistances from different sources eg varieties combining the two different modes of resistance to GRD. Thrusts to improve capacity in Tanzania for screening using the Infector Row technique will be important to strengthen the existing capacity available in the region. This will enable larger number of groundnut germplasm to be screened for important disease constraints.

b. For future development activities

ICRISAT through the project will continue to multiply seed of released and pre-release varieties at Chitedze. Further thrusts to support informal seed production systems will be adopted to ensure better access to seed of improved varieties.

References

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

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Introduction

There is large potential for improving farmer incomes through increasing groundnut production that is yet to be exploited. One known practical approach to this end is to make available high yielding, disease resistant varieties. However, increasing access to improved groundnut varieties (with better disease resistance, yield performance and market acceptability) must be coupled with improved seed systems, 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), it has become apparent that most are not being adequately utilized by small-scale farmers. 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 the improved germplasm. 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. Further, even in areas where improved varieties have been adopted, poor crop husbandry practices still predominate amongst poor farmers; yields remain low, and varietal potentials, even when improved germplasm is available, remain largely untapped. Other constraints include market standards, particularly to international and regional markets, that sanction such produce insisting on higher quality (i.e. aflatoxin) and use of improved crop husbandry practices. This objective will promote wide scale adoption of 'best practices' such as optimum plant populations, optimum planting dates, matching 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 enhance village adoption.

Narrative Summary

The activities below were conducted during the period. Progress for each activity area is detailed in the following section:

- 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 widescale on-farm adaptive testing with farmer participation

During the reporting period, a total of 46 trials were established in Malawi in the two target districts of the Project (Mchinji and Nkhotakota). The districts are representative of the two important growing ecologies of groundnuts - the Lake Shore lowland plains the mid-altitude areas of Malawi. In Tanzania 50 variety trials were conducted in 10 villages. These villages were set as replicates and represented the groundnut growing areas. The trials results are summarized below:

a. Participatory varietal evaluation

In Malawi, the participatory groundnut variety trial involved five Spanish varieties (JL 24, ICGV-SM 99568, ICGV-SM 99541, ICGV-SM 01513 and *Nyanda* and five Virginia varieties (*Chalimbana*, CG7, ICGV-SM 01708, ICGV-SM90704 and 92R/70-4). Sets were planted in a Randomized Complete Block Design in four replicates (4 farmers). Plants were spaced at 75cm between rows and 10cm between plants. At least two weedings were undertaken. Results of the trials indicated significant differences in pod and kernel yield (Appendix 3). Amongst Virginia varieties, ICGV-SM 90704 was the most preferred yielding 1281kg ha^{-1} but ICGV-SM 99568 (*Chitala*), a Spanish variety was the overall preferred genotype across sites with a yield of 1461 kg ha^{-1}. In order to better understand farmer preferences farmers were asked to rank important traits and varietal characteristics. Results of these activities are presented in Appendices 4 and 5. Amongst the elite varieties in the pipeline, ICGV-SM 01513 featured in the top four preferred varieties of the ten tested varieties (Appendix 4). *Chalimbana* was ranked poorly compared to the 2006/07 growing season. This was probably due to drought and its low yield of 819kg ha^{-1} . It however, remained popular amongst farmers for its large kernels and taste. The results of the ranking exercise show that farmers generally prefer Spanish varieties (Appendix 4). The results also imply that yielding ability was the most important reason for farmer varietal preferences (Appendix 5). The short rainy season experienced in these benchmark districts (Appendix 6a) had a significant negative effect on the yield of long duration varieties especially *Chalimbana*. Distribution during the month of February was not equal, with a long spell of two weeks without any rainfall, followed by large amounts of rainfall before and after this period (daily rainfall data not shown).

In Tanzania, poor rainfall (Appendix 6b) contributed significantly to the poor performance of Virginia varieties. Variety ICGV-SM 01721 and ICGV-SM 01711 significantly out-yielded recommended Virginia groundnut variety *Johari* with pod yield of 1018 and 1000 kg ha^{-1}, respectively vs 393 kg ha^{-1} across 7 on-farm sites. Variety ICGV-SM 01711 recorded high pod yield at Nangomba, Mikangaula 2, and Chipuputa in Masasi District and Madangwa in Lindi District. While ICGV-SM 01721 performed better at Mnanje, Mikangaula 1 and Mikangaula 2 in Masasi and Mkwajuni in Tunduru District (Appendix 7a1). ICGV-SM 01711, ICGV-SM 01721 and CG-7 were the most preferred and high yielding groundnut Virginia varieties across sites (Appendix 7a) and as expected, the Spanish varieties under National Performance Trials (NPT) ICGV-SM 99557 and ICGV-SM 99555 were the best for yield performance and farmer preference just like the currently available variety *Pendo* but providing higher yields. (Appendix 7b and 7b1).

Figure 1: Farmers participating on variety selection (left) in Dodoma, Tanzania and (right) in Mchinji, Malawi

b). Demonstrate technologies for the management of Rosette

For the management of GRD, three options were demonstrated to farmers in Malawi. The trials were arranged using a Mother-baby trials approach in Randomized Complete Block Design (RCBD). The three management options were: 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. Results showed significant differences in Rosette incidence (%), pod and kernel yield (Appendix 8). Overall mean yield for early planting was higher than that of late planting, 1015kg ha^{-1} and 728.6kg ha^{-1} respectively (Appendix 8). Rosette incidence for early planting was also lower (8%) than that of late planting (11%). Rosette incidences for high plant population was lower than for for low plant populations (7.6 against 10.9%). Overall resistant genotypes produced a higher mean yield than susceptible ones 991.7 kg ha^{-1} vs 751.8 kg ha^{-1} . Overall yields for high plant population was higher than that of low plant population 1066 kg ha^{-1} against 677.5 kg ha^{-1}.

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 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 2 farmers fields per district with each farmer having all the three treatment combinations. Four baby trials were instituted per Mother trial. A total of twenty farmers were involved in the running of the Aflatoxin trials for the two Districts. Plants were spaced at 75cm between rows and 10cm between planting stations. Plots contained 4 rows each 20m long. Ridges were boxed every 2m. Estimation of aflatoxin B1 was undertaken in the ICRISAT laboratory at Chitedze using an immunoassay method (ELISA).

Overall results for the treatment combinations show no significant differences in Aflatoxin levels, $p \leq 0.05$ except for early planting with ICGV-SM 99568. Use of box ridges however, had lower aflatoxin levels compared to open ridges, 210 ppb and 221.5 ppb respectively (Appendix 9). Similarly, late planting had higher levels of aflatoxin as compared to early planting, 290.5 ppb and 141ppb respectively. Both varieties (JL 24 and ICGV-SM 99568) used in the study are susceptible to Aflatoxin. There is need to repeat this trial with the incorporation of a resistant variety as one of the treatment. This will enable us compare the effects of an integrated approach combining improved management practices with improved genotypes.

Results from Elite Aflatoxin Groundnut Variety Trial conducted on-station demonstrated significant differences for aflatoxin contamination between genotypes under imposed water stress (Appendix 10). The levels of aflatoxin in stressed trial ranged from 0 – 1545.8 ppb compared to 0 – 12.7 ppb for the irrigated trial. These are very significant findings with implications for groundnut improvement for aflatoxin resistance.

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

In Malawi, 18 farmer field days were conducted in the two groundnut growing districts of Mchinji (8) and Nkhotakota (10) in Malawi. These field days attracted participation of 623 persons: 276 Women (44.4%) and 347 men from stakeholders like Ministry of Agriculture, farmers, Traditional leaders and nearby schools. These demonstrations focused on validating and promotion of technologies on three aspects: Participatory Varietal evaluations, options for the management of aflatoxin and options for management of Groundnut Rosette Disease (GRD).

In Tanzania, Farmers' field days were conducted in Masasi and Dodoma districts, which are the areas the project is being implemented. A total of 255 farmers participated in the events. Farmers learned the importance of planting at recommended spacing and timely weeding. Also, the farmers participated in the evaluation of varieties in the Participatory variety selection trials.

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, two (2) major partners- CARE (Cooperative for American Relief Everywhere) Malawi and National Association of Small-holder Farmers in Malawi (NASFAM) were identified and activities agreed to. With support from the EU, CARE, in collaboration with ICRISAT organized 450 farmers in 15 community-based organizations. Each farmer received 4 kgs of breeder seed (var. ICGV-SM 90704) produced by the Groundnut ESA Project.

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

Improved variety, seed and market information platforms have been established at pilot sites in Tanzania and Malawi (incl. farmers' resource shops in Mchinji and Nkhotakhota). The project has also defined market channels (including links between market traits, drought tolerance and risk strategies (per target zone). This activity is currently more established in Malawi, where NASFAM has functional marketing collection points. Efforts are underway for similar platforms in Tanzania using Primary Cooperative Societies in Masasi and Dodoma.

c) Community seed banks established and fully functioning

In the first quarter of 2007/08 growing season, the project initiated a successful seed inspection exercise in the research groups established with NASFAM. This involved the Ministry of Agriculture and Food Security Seed Inspectors. In Mchinji, 93 farmers organized into 19 research groups received a total of 1000kgs breeder seed of variety ICGV-SM 90704. These farmers together produced 17.4873 tons of groundnut seed nuts in pod. The 140 farmers in Nkhotakota in 28 groups who received a total of 675kgs breeder seed of a short duration variety JL 24 managed to produce 3.25 tons of seed in pods.

In Tanzania and through partner NGOs, the program distributed 2000kg breeder seed of the popular variety *Pendo* to farmers in 50 villages or groups in Masasi (25kg per group of 10-15 farmers) and 30 villages or groups in Dodoma under the seed loan system and 20 tonnes of groundnuts seeds (in pods) have been produced. Farmer Field Schools (FFS) and contract growers together produced 140 tonnes of groundnut variety (pods). The project has bought 7 tonnes of groundnuts pods for distribution to the project areas to speed up the diffusion of groundnut variety *Pendo* to more remote areas in the project districts for greater impact. The Diocese of Central Tanzania (DCT) is involved in seed multiplication and distributed 80kgs of seed to four villages in Chakhwa, Makangwa, Mulodha and Chipanga. Approaches to ensure sustainability through farmers are being refined for the coming season. In addition, DCT will participate in varietal evaluations in the next season

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

In Tanzania, training of extension agents and NGO outreach personnel in innovative technology transfer (geared to help the poor) has been scheduled for May, 2009. In Malawi, the exercise was conducted in the 2006/07 growing season where 13 NASFAM Association Field Officers and Lead farmers were trained.

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

In Tanzania, one (1) training course on seed production was conducted from 30 – 31st Dec 2007. 4 research technicians, 20 extension officers and 11 FRG leaders, who are involved in running the contract and community seed production program from Masasi District Council attended the training. In Malawi, two newly appointed Association Field Officers were trained on the management of on farm trials in Mchinji.

Implications of the research findings

a. For the next stage of research

Results of this seasons effort have shown the effectiveness of improved practices on crop yields and disease incidences. For GRD management, results show yield advantages realized through integrated disease management including use of resistant varieties, early planting, high plant population and water harvesting. The results show that these options have the potential for minimizing GRD incidence. Similarly, lower levels of aflatoxin have been demonstrated through use of plot water management and early planting. For the 2008/09 season, combined effects of host genotype plus crop management practices on aflatoxin contamination will be investigated. There will also be need to continue with promotion of integrated disease management trials and demonstrations to promote these technologies to smallholder farmers. In addition, efforts on seed multiplication will be strengthened to ensure availability of seed stock both for breeder and certified seed.

b. For future development activities

In a bid to engage more farmers and stakeholders in the Participatory Breeding Programme in 2008/09 growing season in Malawi, the project intends to out scale activities by identifying more farmers for variety trials as well as conducting seed fairs in the Bench mark Districts. In Tanzania, five varieties are being evaluated in National Performance Trials (NPT), prior to submission to the National Release Committee. The NPTs are being conducted by the Tanzania Official Seed Certification Institute (TOSCI). TOSCI has established trials in five sites (Nachingwea, Naliendele, Masasi, Kilosa and Makutopora). Three sites are required for assessment. Seed will then be tested for Distinctiveness Uniformity and Stability (DUS). In all the trials, variety *Pendo* was used as a check. The Project will follow up this development to support the Tanzania NARS to release a new variety to complement Pendo, the last released groundnut variety in 1999.

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

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Introduction

Technology out-scaling is essential to achieve impact at national level. It is essential that mechanisms are put in place to ensure that project 'islands of success' are sustainably widened to include more target beneficiaries. In this Project, the multi-institutional partnership for technology uptake include farmers, community leaders, researchers and extension agents, and private sector traders and processors. This objective aims to put in place farmer platforms and mechanisms to improve sustainability of the project outputs. Two specific areas of the groundnut that will target two different, yet significant areas of the farm-to fork continuum: farmer groups and market networks. To support this, the project partners noted the need to organize project activities to enable proper monitoring and evaluation of activities.

Narrative Summary

The following were the activities undertaken in the two countries during 2007 – 08:

3.1.1 Organize planning workshop of project stakeholders to agree on project components for promotion, pilot areas and mode of operation.
3.1.3 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.

The Project team members held their Annual Planning and Review Meeting on Monday September 24, 2007 at Cresta Hotel. The meeting reviewed the previous year's experiences, challenges and lessons. Importantly, the meeting agreed that there was no need to make changes to activities planned for Year 2 based on the review. The meeting also discussed the baseline reports from both Tanzania and Malawi where it was agreed that there will be need to ensure that the reports are re-written following a standard format to reflect the fact that this is indeed one study in two countries. The next Internal review meeting will be held in Maputo, together with the annual planning meeting. All project partners will plan to arrive at the meeting venue slightly earlier for this purpose.

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 collaboration with Zonal Communication office in Southern Tanzania organized the production of groundnut leaflets on improved groundnut practices and video film to sensitize stakeholders on groundnut production and marketing. The project has also published a booklet of groundnuts improved production practices in Kiswahili intended for extension officers and farmers interested in the production and promotion of the crop

a). Traders/ Stakeholder Engagement:
Marketing companies including Olam (Tanzania), Abbas Export, Atlas trading and Fida Hussein Company were engaged 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 with exports amounting to more than 2100 tons from smallholder farmers from the target districts this reporting season (ie between July 2007 – August 2008).

b). Leaflets, Fliers and Videos:
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 even where researchers have not been able to reach due to a number of limitations.

The project has produced groundnut leaflets (1000 copies) to enable farmers in Tanzania learn about improved technologies for the crop. A total of 1500 leaflets were reprinted following demand from stakeholders. One Video film on improved groundnuts production technologies was produced in Kiswahili with sub-titles in English. About 4,000 people saw the video during the Nane nane National Farmers' Day celebrations in Mtwara. One Booklet titled "Kanuni za Kilimo Bora cha Karanga" (Improved groundnut production methods) was also produced.

3.1.3 Establish strategy and time frame for impact monitoring and reporting

Project collaborators have developed a monitoring and evaluation strategy for the project. The M&E strategy outlines the need for regular monitoring and evaluation based on project milestones and outputs.

As part of its regular activities for assessing performance of activities, the team agreed to undertake a series of internal monitoring and evaluation activities, one of which took place from April 6, 2008 for a period of 10 days. This is also in fulfillment of the Project's M&E Plan. The objective of the visit was thus to monitor field activities currently underway in Tanzania and provide recommendations for improvement. Three team members from Malawi, Emmanuel Monyo (ICRISAT), Moses Osiru (ICRISAT) and Frank Masankha (NASFAM) traveled to Tanzania to visit the field activities. Travel was initiated at the invitation of Dr. Omari Mponda (NARI, DRT), team leader for the activities in Tanzania. Dates were identified (6-15 April, 2008) based on the optimum period for organising field days and also for observing performance of varieties being evaluated by farmers. On arrival by air in Mtwara, the team initially received a briefing from Dr. Mponda on the activities being implemented by the Project and subsequently visited field trials in nearby on-station fields. The monitoring team then traveled to Masasi and visited farmers' fields at this location, and neighboring districts before travel to Nachingwea and then back to Masasi. A stop was made at the Tanzania Official Seed Certification Institute (TOSCI) in Morogoro to discuss with officials on issues related to the NPT trials currently underway. Later, team members visited partners and trials in Dodoma before a meeting with the leadership at DRT. To finalize the trip, a wrap-up meeting was organized by the host, Dr. Omari Mponda to discuss arising issues and concretize recommendations.

Implications of the research

a. For future development activities

Communication media, farmer field days and seed fairs have increased awareness on the available groundnut technologies like seed from improved varieties and this is projected to put a lot of pressure on the seed production unit. There will be need therefore to intensify seed production through community seed groups who have already shown good potential.

b. For policy

Findings from this project have so far shown that groundnuts have the potential to mitigate income problems faced by resource poor farmers. Efforts must therefore be harnessed from all stakeholders to enable farmers grow groundnuts on commercial basis. The outcome of commercialization will be the need for ready markets and storage facilities. The project should as such intensify on activities that would link potential buyers to farmers as well as develop user-friendly packages for post harvest handling techniques of the crop.

3. Team Report Section

Community of Practice (CoP)

The first meeting of Legumes Community of Practice was successfully held on September 25-28, 2007 in Lilongwe, Malawi. Project team members attended the meeting, delivered a presentation on the ESA Breeding Project and also hosted one of two field days. During the CoP, a number of important challenges were raised for the project team such as:

1. How can farmers benefit nutritionally from increased production of groundnuts? Increased production may not mean increased consumption and increasing incomes often does not improve nutrition
2. How can farmers obtain access to small shelling machines?
3. How can farmers (particularly males) improve knowledge on nutritional components that could impact child feeding
4. Is there need to look into P efficient groundnuts? Is there correlations with root hairs and P uptake; P-screening etc. technical assistance.

Meeting with DRT, Tanzania

A visit was paid to the Ministry of Agriculture, and discussions held with Dr. Musabaha, the Assistant Director for Crops at the Department for Research and Training (DRT, Tanzania), on behalf of the Director. The Directorate welcomed the Groundnut ESA Project to Tanzania, noting that their activities were in line with the Goals of the Government of Tanzania. He urged the Project to continue to focus on linking farmers with markets to improve income generation. He also urged the teams to be prepared for the McKnight CoP meeting in Tanzania, and assured them of his Directorates' support.

Visit to field activities of the McKnight Funded Cowpea Alectra Project as participation in the McKnight CoP activities

As part of the learning activities of the McKnight ESA legumes CoP, four members of the Groundnut Breeding (ESA Africa) Project, Emmanuel Monyo (PI & Groundnut Breeder, ICRISAT, Malawi), Omari Mponda (Collaborator & Groundnut Breeder, Naliendele Agricultural Research Institute, DRT, Tanzania), Moses Osiru (Collaborator & Groundnut Pathologist, ICRISAT, Malawi) and Frank Masankha (Collaborator & Crop Production Specialist, NASFAM) visited the Cowpea Alectra (ESA) Project sites in Dodoma Tanzania to improve cross learning and lesson sharing amongst the two projects. Two field sites of the Cowpea Alectra Project were visited- Bihawana Farmer Training Center (BFTC) and the "Voice of the Farmer" Group in Dodoma, that helped to underscore the objectives and activities of the Cowpea Project, achievements to date, challenges faced, and the Project's attempts to respond to these challenges.

1. The Groundnut Team noted the approaches used by the Cowpea breeding team. In particular, special note was taken of use of the BFTC, in which farmers were able to both participate in the trial and varietal selection while also obtaining relevant training in other aspects of crop production. The Groundnut Team will explore on use of the BFTC for future trials in Dodoma.
2. The Team noted that Alectra is also parasitic to groundnuts. A neighbouring field to the cowpea trials revealed Alectra parasitising groundnut, albeit at lower numbers. Alectra is

a reported parasite of Groundnut. There is need to explore further if this is a significant constraint to groundnut production in the region. It is important to note that if alectra seed banks are created in groundnut fields, the problem might be exacerbated in the future since farmers are not removing the weed from their crops- unaware of the potential danger of the innocent looking parasitic weed.

3. Discussions were held with Dr. Mbwaga on arrangements for the organisation of the forthcoming CoP meeting to be held in Tanzania. Both Projects suggested that this meeting be held in Dodoma since this would enable the team to visit trials of both the Cowpea and the Groundnut ESA Project.
4. Linkages were established with the Diocese of Central Tanzania (DCT) a Church based NGO, for the multiplication of seed in Tanzania.

Other Insights and lessons learnt:

1. The team noted that both rosette incidence and (particularly) rust incidence and severity at Naliendele were significantly higher than that obtained naturally at Chitedze. Thus, Naliendele could provide an excellent site for rust screening in the future.
2. End of season drought is clearly a problem in the project areas of Tanzania. In a number of trials visited, farmers complained about the poor yields from their local varieties due to either mid season or end season drought. In Manchari village, Dodoma, farmers noted that rainfall distribution is a problem and that farmers must continue to plant with the first rains.

Challenges:

1. Mobility within the country remains a challenge due to lack of a project vehicle. This problem will be solved shortly. The Mcknight Foundation has made available funds to purchase two project vehicles, one for Malawi and a second for Tanzania. The vehicle for use in Malawi has already been received while Tanzania awaits their order from Toyota Japan.

Work plan Section:

Detailed Work plan for Year 3 (September, 2008 – August 2009)

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

- 3.1.1. Organize planning workshop of project stakeholders to agree on project components for promotion, pilot areas and mode of operation.
- 3.1.2. 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
- 3.1.3. 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
3 3 3	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)	August 2009 February 2009 April 2009	• List of farmer researcher groups in the two countries • List of sources of resistance for hybridization • List of varieties with farmer / market preferred traits
3	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) • New improved groundnut varieties incorporating local derived genes for quality and adaptation developed by year 4 (2010)	August 2009 May 2009 August 2009	• Training report for GRD, ELS and rust screening • Infector row technique established in Tanzania • List of materials or genotypes with genetic resistance for Rosette, ELS, rust and LLS and combined resistances. • List of promising materials

Year	Quarter	Activity number	Type of milestone	Description of Milestone	Time due*	Means of verification
3	1-4	1.1.4	Activity	• Nucleus seed of elite lines produced annually for NARS testing and for breeder seed production. (2007 – 2010)	August 2009	• Seed requests/ signed MTAs
3	1-4		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 2009	• 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 2009	• No. of lines identified for evaluation
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)	May 2009	• List of on-farm trials conducted.
	1-3			• Three varieties with specific and / or combined resistances identified for wide scale testing	May 2009	• List of varieties
	1-3			• Demonstrate techs for reduction of aflatoxin under smallholder conditions (2007 – 10)	May 2009	• 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 08-Aug 09	• No of field days, number and type and stakeholders

Year	Quarter	Activity number	Type of milestone	Description of Milestone	Time due*	Means of verification
						participating • 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 demonstrated
3	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)	Dec 2009 August 2009	• No. of seed delivery innovations operational • Quantity of seed produced and sold • Publications • No. of community seed banks formed
3	1	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 2009	• Training materials • List of trainees • Progress reports
3	1	3.1.1	Activity	• Annual planning and review meetings	Sept-Nov 08	• No of reports

Year	Quarter	Activity number	Type of milestone	Description of Milestone	Time due*	Means of verification
3	1	3.1.5	Activity	• Project management team for internal monitoring established and functioning (Oct-Nov 2006 - 2010)	Oct – Nov 2008	• M&E plan • Progress reviews and annual work plans

Publications Summary

ICRISAT (International Crops Research Institute for the Semi Arid Tropics) 2008. Proceedings of a Stakeholder Workshop on Groundnut Production in Malawi and Tanzania, 1-2 March, 2007, Lilongwe, Malawi. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Training and Outreach Summary

A one-month training course on use of the Infector Row technique for GRD screening was organized by ICRISAT in Malawi. This was conducted from December 17, 2007 to January 13 2008. Mrs. Joana Kasuga and Mr. Joseph Nzunda, technicians from NARI, Tanzania attended the training. The training was focused on maintenance of viruliferous and non-viruliferous aphids in the greenhouse, in addition to improved groundnut production practices. Practical sessions on field screening for GRD using the infector row technique were also conducted.

Two newly recruited Association Field Officers were trained on the management of on farm trials in Mchinji. Training of extension agents and NGO outreach personnel in innovative technology transfer (geared to help the poor) in Malawi and Tanzania has been scheduled for May, 2009.

In Tanzania, one (1) training course on seed production was conducted. 4 research technicians, 20 extension officers and 11 FRG leaders attended the training. In addition, a groundnut seed production course was organised from 30 – 31st Dec 2007. This attracted of extension field officers from Masasi District Council who are involved in running the contract and community seed production program in the District.

APPENDICES.

Appendix 1. Performance of Elite Rosette resistant Spanish (SB) Varieties at Nachingwea, Tanzania during 2007-08

Cultivar Name	**Pod Yield (kg/ha)**	**ELS Score**	**LLS Score**	**% Rosette incidence**
ICGV-SM 01515	1550	3.5	5.5	0.5
ICGV-SM 99529	1750	3	5	0
ICGV-SM 01501	1400	4.5	6	0.6
ICGV-SM 01514	1950	4	1	0
ICGV-SM 01510	1575	4.5	5.5	0.5
ICGV-SM 01513	**1900**	**3**	**3.5**	**2.8**
ICGV-SM 01506	1725	4	3	0.5
ICGV-SM 01502	2150	4.5	2	0.5
ICGV-SM 99574	2650	4.5	3.3	0
ICGV-SM 99543	2250	5.5	4	0.5
ICGV-SM 99554	1575	3.5	4.5	0.5
ICGV-SM 01504	1550	3	6	0
ICGV-SM 99557	2200	5	2	0
ICGV-SM 02501	**1925**	**3**	**1.5**	**0**
ICGV-SM 99551	1525	4.5	4.5	0
ICGV-SM 99530	2450	2.5	5	0
ICGV-SM 99541	1750	3.5	3.5	0.5
ICGV-SM 99552	1625	3.5	3.5	0
ICGV-SM 99566	1750	5	2.5	0
ICGV-SM 99555	**1950**	**4.5**	**5**	**0**
ICGV-SM 99537 *(Mwenje)*	1725	4.5	3.5	0
ICG 12991	1825	4.5	4.5	0.5
ICGV-SM 99568	2150	4.5	2.5	0
ICGV-SM 93437 (*Nyanda*)	2250	4.5	2.5	0.5
JL 24	2025	4	2.5	0
Mean	**1887**	**4.0**	**3.7**	**0.4**
CV %	**21.5**	**18.2**	**32.1**	**278.7**
LSD 0.05	**847.9**	**1.5**	**2.5**	**2.1**

Appendix 2. Performance of Elite Rosette resistant Virginia (VB) Varieties at Naliendele Research Station Tanzania during 2007-08

Treatment	Pod yield	ELS	LLS	Rust	Rosette %
ICGV-SM 01703	1100	2.5	3	4	0
ICGV-SM 01705	1100	3	3	5	0
ICGV-SM 01706	1300	2.5	1.5	5	0
ICGV-SM 01708	1100	3	2.5	4.5	0
ICGV-SM 01709	1700	2	2.5	5.5	0
ICGV-SM 01710	750	2.5	2.5	4.5	0
ICGV-SM 01711	1500	2	2	5.5	0
ICGV-SM 03701	1700	3	1.5	5	0
ICGV-SM 03702	1100	3.5	2.5	5.5	0
ICGV-SM 03703	1300	1	0.5	2.5	0
ICGV-SM 01731	1450	1	1	6	0
ICGV-SM 03705	1500	4	2.5	4	2.08
ICGV-SM 03706	500	3.5	2	4.5	1.39
ICGV-SM 03707	1500	2	2	5	0
ICGV-SM 03708	1550	1.5	1.5	4.5	0
ICGV-SM 03709	1500	1.5	1.5	5.5	0
ICGV-SM 03710	1700	1.5	1	4.5	0
ICGV-SM 88710	1200	1.5	1.5	6	0.568
ICGV-SM 88762	1900	1.5	1.5	5	0
ICGV-SM 91706	2050	1.5	1	5	0
ICGV-SM 91707	1700	2	1	4.5	0
CG 7	1650	2	3	4	0
RG 1	1350	2	2	5	0
ICGV-SM 90704	1700	2.5	2.5	4.5	1.32
CHALIMBANA	1150	3.5	2.5	3.5	0
Mean	1402	0.21	1.94	4.74	0.21
CV (%)	16.85	0.53	39.62	18.798	398
LSD (0.05%)	482.98	1.48	1.603	1.86	1.77

Appendix 3. Yield (kg/ha) performance, Early Leaf Spot and Groundnut Rosette incidence of ten Groundnut varieties evaluated on farmers fields in Mchinji and Nkhotakota Districts of Malawi

Variety	**Pod weight (kg/ha)**	**Kernel weight (kg/ha**	**Shelling %**	**ELS incidence**	**Rosette incidence (%)**	**Yield gain (%) over JL24**
ICGV-SM99568	2249	1461	64.96	6.75	2.25	57.26
ICGV-SM99541	1933	1185	57.9	4.12	1.81	27.55
ICGV-SM90704	1654	1281	64.3	5.62	1.56	16.36
JL 24	**1389**	**929**	**68.6**	**5.12**	**9**	**0**
CG 7	1943	1322	68.3	4	7.25	42.3
CHALIMBANA	1768	819	53.7	4.12	14.12	- 11.8
ICGV-SM01708	1653	950	57.71	6.88	3.31	2.26
1CGV-SM01513	2440	1357	66.6	7	4.12	46.07
ICGV-SM93547 (NYANDA)	1586	931	58.7	7	3.06	0.21
92R/70-4	1586	631	39.5	6.75	2.13	- 32.07
LSD (0.05)	**827.2**	**500**	**14.7**	**1.503**	**2.47**	
CV %	**47.6**	**45.1**	**21.9**	**26.2**	**50.9**	
Mean	**1740**	**1110**	**60.03**	**5.74**	**4.86**	

Appendix 4. Farmer ranking of the 10 groundnut varieties for Mchinji and Nkhotakota in Malawi –2007/08

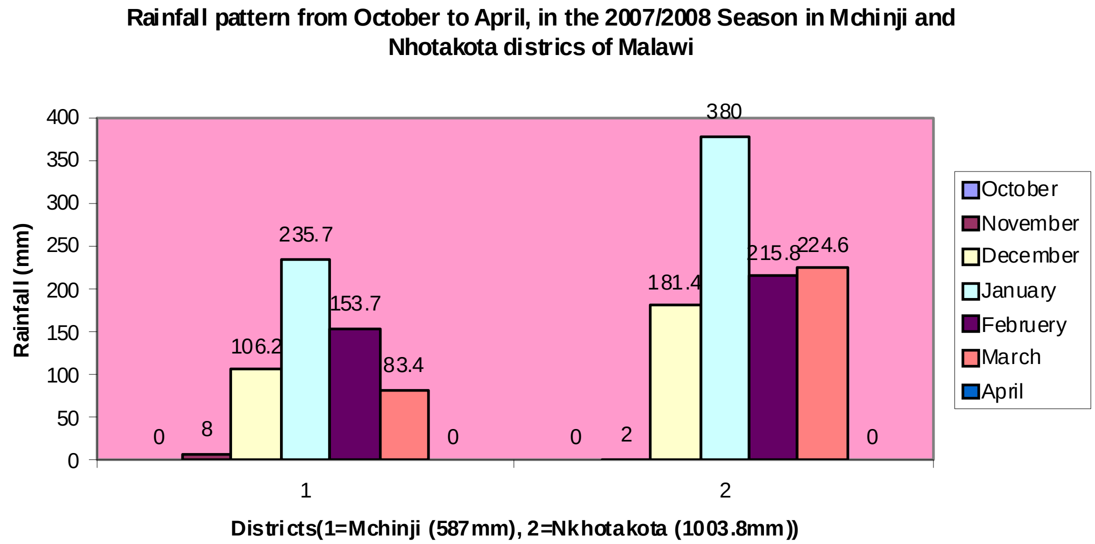
	Variety Characteristics – Mchinji							Variety characteristics – Nkhotakota								
Variety	PS	YD	MA	SH	DS	T	Tot	PS	YD	MA	SH	DS	T	Tot	Overall	Rank
ICGV-SM99568	**2**	**1**	**1**	**2**	**2**	**2**	10	**3**	**2**	**2**	**2**	**2**	**3**	14	24	1
1CGV-SM90704	**2**	**1**	**2**	**2**	**3**	**3**	13	**2**	**1**	**2**	**2**	**2**	**3**	12	25	2
1CGV-SM01513	**3**	**1**	**2**	**2**	**2**	**2**	12	**2**	**1**	**2**	**2**	**3**	**3**	13	25	2
JL 24	**3**	**3**	**1**	**3**	**3**	**1**	14	**3**	**2**	**2**	**3**	**3**	**1**	14	28	3
CG 7	**2**	**1**	**2**	**3**	**3**	**3**	14	**2**	**2**	**2**	**2**	**3**	**2**	14	28	3
1CGV-SM01708	**3**	**2**	**2**	**3**	**3**	**3**	16	**4**	**2**	**2**	**3**	**3**	**3**	17	33	4
ICGV-SM99541	**3**	**3**	**3**	**3**	**2**	**2**	16	**3**	**3**	**3**	**3**	**2**	**2**	16	32	4
Nyanda	**3**	**3**	**2**	**3**	**3**	**3**	17	**3**	**2**	**2**	**3**	**3**	**3**	16	33	4
Chalimbana	**1**	**4**	**4**	**2**	**4**	**3**	18	**1**	**3**	**3**	**2**	**4**	**3**	16	35	5
92R / 70-4	**4**	**3**	**3**	**4**	**3**	**3**	20	**3**	**2**	**2**	**4**	**4**	**3**	18	38	6

Where: PS=pod size, YD= pod yield, MA=maturity duration, SH= ease of shelling, DS=disease incidence, T= taste
Scores are based on 1-4 scale where; 1= Excellent, 2 = very good, 3 = good and 4 = poor

Appendix 5. Proportion of farmers prioritizing varieties and preferred traits for groundnuts in Malawi – 2007/08

CRITERIA	Variety				
	Chalimbana N = 97	ICGV-SM 01513 N = 94	ICGV-SM 99568 N = 160	ICGV-SM 90704 N = 118	TOTALS 469
Big pod size	**41**	**5.7**	**1.6**	**10.5**	**14.7**
High yielding	**2.5**	**33.4**	**56.3**	**61.4**	38.4
Early maturing	**3**	**43.2**	**27.0**	**21.7**	31.8
Ease of shelling	**33.5**	**5.0**	**11.4**	**3.5**	5.3
Disease resistant	**12.5**	**10.2**	**2.1**	**1.2**	6.5
Good taste	**7.5**	**2.5**	**1.6**	**1.7**	**3.3**
TOTAL	100	100	100	100	**100**

Appendix 6a. Rainfall pattern for Mchinji and Nkhotakota in Malawi – 2007/08 season



Appendix 6b. Rainfall distribution for three test sites in Tanzania (Nach=Nachingwea, Hom=Hombolo, Nal=Naliendele)

SITE	DATE	Nov-07	Dec-07	Jan-08	Feb-08	Mar-08	Apr-08	May-08	TOTAL
NACH	**1-10**	0	33.6	80.8	77.1	53.0	0.7	0.0	
	11-20	0	47.5	15.5	29.7	7.9	80.0	5.8	
	21-31	9.3	10.9	101.1	43.8	61.4	9.0	0.0	
	TOTAL	**9.3**	**92**	**197.4**	**150.6**	**122.3**	**89.7**	**5.8**	**667.1**
HOM	**1-10**	0.0	45.7	1.1	29.3	5.8	22.2		
	11-20	37.1	142.6	3.9	102.8	4.6	0.0		
	21-31	0.0	37.9	104.4	7.5	168.6	0.0		
	TOTAL	**37.1**	**226.2**	**109.4**	**139.6**	**179.0**	**22.2**		**713.5**
NAL	**1-10**	4.5	17.2	132.8	67.3	60.2	34.4	0	
	11-20	0	44.9	43.4	126.9	18.8	75.3	72.3	
	21-31	3.4	4.6	121.8	9.4	59.7	35.4	0.5	
	TOTAL	**7.9**	**66.7**	**298**	**203.6**	**138.7**	**145.1**	**72.8**	**932.8**

Appendix 7a. Summary of matrix ranking of Virginia groundnut varieties across six sites in Southern Tanzania 2007-08

VARIETY	CHIPUPUTA	MKWAJUNI	MADANGWA	MNANJE	NANGOMBA	MIKANGAULA	TOTAL	RANK
ICGV-SM 90704	11	13	9	11	15	**18**	**77**	4
CG 7	14	12	11	15	14	**19**	**85**	2
ICGV-SM 0711	14	18	11	13	16	**18**	**90**	1
ICGV-SM 01721	17	12	8	12	16	**19**	**84**	3
ICGV-SM 01731	11	16	9	9	12	**13**	**70**	5
CHIMBUWILA	13	9	11	7	8	**15**	**63**	7
JOHARI	15	13	10	7	9	**12**	**66**	6

Appendix 7a1. Summary Performance of Elite Virginia groundnut varieties across 7 On-farm sites in Tanzania during 2007/08 season

Cultivar	CHIPU	MAD	MKW	MNJ	MIK 1	MIK 2	NANG	Pod yield Kg/ha
ICGV-SM-90704	600	875	750	950	1000	800	1000	854
CG - 7	750	600	650	600	600	750	650	657
ICGV-SM-01711	950	1275	875	950	750	950	1250	1000
ICGV-SM-01721	850	800	1200	1300	1250	950	775	1018
ICGV-SM-01731	500	525	575	625	250	500	500	496
CHIMBUVILA	650	250	475	575	475	650	500	511
JOHARI	350	450	400	300	500	350	400	393
Mean								704
CV%								29
LSD								222

KEY: CHIPU=CHIPUPUTA, MAD=MADANGWA , MKWA=MKWAJUNI MNJ=MNANJE, MIK 1=MIKANGAULA 1, MIK 2=MIKANGAULA 2 NANG=NANGOMBA

Appendix 7b. Summary of the results of the matrix ranking of Spanish groundnut varieties across sites 2007-08

VARIETY	LIKOKONA	MKWAJUNI	SISI	MVUMI	MPETA	MIKANGAULA	TOTAL	RANK
PENDO	18	13	8	8	15	17	79	1
ICGV-SM 99557	18	15	11	9	11	15	79	1
ICGV-SM 99555	16	15	13	8	11	15	78	3
ICGV 12991	20	11	12	6	11	13	73	5
ICGV-SM 01506	12	13	8	8	6	8	55	6
ICGV-SM 99554	20	14	9	5	12	17	77	4
LOCAL	13	12	6	4	5	10	50	7

Appendix 7b1. Summary Performance of Elite Spanish groundnut varieties across 7 On-farm sites in Tanzania during 2007/08 season

Cultivar	LIK	MICH	MIK	MKW	MPT	MVUM	SISI	Pod yield kg/ha
PENDO	675	750	950	875	950	708	950	837
ICGV-SM-99557	1190	1200	1380	820	1380	975	1450	1199
ICGV-SM-99555	1050	1000	1500	675	1300	596	1450	1082
ICG 12991	900	800	1200	870	1200	752	1046	967
ICGV-SM-01506	700	1000	1100	850	1100	790	1150	956
ICGV-SM-99554	1085	875	1200	1000	1200	654	1400	1059
LOCAL	800	250	800	725	1100	629	1450	822
Mean								989
CV%								23
LSD								249

Sites: Masasi district:LIK = Likokona, MICH=Michiga, MIK= Mikangaula, MPT = Mpeta, Dodoma: MVUM = Mvumi –Iringa, Tunduru: SISI= Sisi kwa sisi.

Appendix 8. Effect of time of planting, plant population and host resistance on GRD incidence and yield in Mchinji and Nkhotakota Districts of Malawi

	Time of planting				Plant population			
Variety	Early planting		Late planting		High population		Low population	
	Grain yield-kg/ha	Rosette incidence (%)	Grain yield-kg/ha	Rosette incidence (%)	Grain yield kg/ha	Rosette incidence (%)	Grain yield kg/ha	Rosette incidence (%)
Nsinjiro (Resistant)	1282	2.25	808.5	2.15	1482	1.25	608.5	3.15
Chalimbana (Susceptible)	887.5	6.9	579.5	21.1	896.5	15.1	570.5	12.65
Malimba (Susceptible)	613.5	21.35	927	16.9	706	12.85	834	25.4
Baka (Resistant)	1277	0.75	599.5	2.8	1179.5	1.05	697	2.5
Mean	**1015**	**7.813**	**728.6**	**10.73**	**1066**	**7.56**	**677.4**	**10.92**
CV%	**46.7**	**71.2**	**39.5**	**69.1**	**44.0**	**61.8**	**39.6**	**69.8**
SE	**162.6**	**4.699**	**84.0**	**4.849**	**169.4**	**3.731**	**58.6**	**5.3**

Appendix 9. Effect of water management, time of planting and genotype on aflatoxin contamination (ppb) on farm in Malawi

	Water management		**Time of planting**	
	Open ridges	**Box ridges**	**Early planting**	**Late Planting**
Variety	**Aflatoxin level (ppb)**	**Aflatoxin level (ppb)**	**Aflatoxin level (ppb)**	**Aflatoxin level (ppb)**
JL 24	241.5	180	241.5	180
ICGV-SM 99568	205	240	40.3	401
Mean	**221.5**	**210**	**141**	**290.5**
CV%	**57.0**		**63.2**	
SE	**181.2**		**216.5**	

Appendix 10. Screening Elite Groundnuts Genotypes for Yield and Water Stress Induced Aflatoxin Accumunation

	Irrigated Treatment			**Water Stress Treatment**		
Cultivar name	pod weight (kg/ha)	Kernel yield (kg/ha)	Non-Stress Aflatoxin	pod weight (kg/ha)	Kernel yield (kg/ha)	Stress Aflatoxin
Ah 7223	2484	1841	3.05	743.2	459.7	0
ICGV-SM 01503	2866	1876	2	1240.8	709.1	0
ICGV 91284	2102	1510	0.05	971.9	699.9	0.1
Faizpur	1911	1215	12.7	827.1	343.8	0.2
J 11	2803	2016	4.4	1267.1	874.2	0.7
ICGV 91283	2548	1715	0.35	497.9	330.4	16.7
ICGV 94373	2038	1505	0	783.5	516.4	193.9
ICGV-SM 99537	2675	1758	0.5	1279.9	885.7	539.5
UF 71513-1	1975	1391	3.15	572.8	392.9	1545.8
Mean (25)	**2318**	**1607**	**2.24**	**817**	**531**	**157**
cv%	**30.1**	**30.7**	**181.5**	**50.2**	**53**	**185.6**
L.S.D	**1438.9**	**1016.4**	**8.389**	**844.9**	**579.3**	**602**