

ACTION FOR LIVELIHOOD ENHANCEMENT IN NORTHERN UGANDA (ALENU)

GROUNDNUTS PRODUCTION TRAINING MANUAL



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ACKNOWLEDGEMENTS AND DISCLAIMER

This manual was developed by Pascale Waelti of Bern University of Applied Sciences, School of Agricultural, Forest and Food Sciences HAFL and Robert Bakyalire of AFARD for a consortium consisting of four NGOs (Caritas Switzerland, Advance Afri-ka, Agency for Accelerated Regional Development, and Gulu Women Economic De-velopment and Globalization) for the implementation of the Action for Livelihood En-hancement in Northern Uganda (ALENU) Project that is funded under the Develop-ment Initiative for Northern Uganda (DINU), a government of Uganda programme supported by the European Union (EU) and supervised by Office of the Prime Minister.

The manual formulation process included a review of a number of manuals for which we are indebted, namely:

Kefa, O. H. (n.d.). Groundnut Production Guide for Uganda : GROUNDNUT PRODUCTION GUIDE FOR UGANDA : Recommended practices for farmers.

Okello, D. K., Okori, P., Puppala, N., Bravo-Ureta, B., Deom, C. M., Ininda, J., ... Asekenye, C. (2014). Groundnut seed production manual for Uganda. Retrieved from <http://ec2-50-19-248-237.compute-1.amazonaws.com/420/>

Infonet Biovision website: <https://infonet-biovision.org/>

Pictures and text extract of these sources have been used in this manual.

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ABOUT ALENU PROJECT

Under the Development Initiative for Northern Uganda (DINU), a Government of Uganda programme supported by the European Union (EU) and supervised by Office of the Prime Minister, Caritas Switzerland has received a grant to implement the Action for Livelihood Enhancement in Northern Uganda (ALENU). ALENU is implemented by a consortium consisting of four NGOs (Caritas Switzerland, Advance Afrika, Agency for Accelerated Regional Development, and Gulu Women Economic Development and Globalization).

Objectives and Results

ALENU is a 40-month action that focuses on improving livelihoods through increased and diversified food production, enhanced market opportunities and better maternal and child nutrition in six districts of the West Nile and Acholi sub-regions. Its **overall objective** is, “to consolidate stability in Northern Uganda, eradicate poverty and under-nutrition and strengthen the foundations for sustainable and inclusive socio-economic development.” And the **specific objective** is, “to increase food security, improve maternal and child nutrition, and enhance household incomes through support to diversified food production and commercial agriculture and through improving household resilience (notably to climate change) and women empowerment. The three main result areas are: **Result 1.1:** Increased production of diversified food; **Result 1.2:** Increased market accessibility; and **Result 1.3:** Improved nutritional status

Districts and Sub Counties

Agago (Wol and Lokole); Amuru (Amuru and Lamogi); Omoro (Odek and Lakwana); Nebbi (Erussi and Atego); Pakwach (Pakwach and Panyimur); Zombo (Kango and Athuma)

Main Activities

Result 1.1: Increased production of diversified food

Select HHs; develop Family Development Plans; develop seasonal Production and Marketing Plans; set up group demonstration gardens; conduct farmer field school sessions; facilitate outreaches by local government extension staff; organize seasonal agro-input fairs; build capacity of agro-input suppliers; form commodity-based cooperatives; train VSLA Mentor; train Farmer Group (FG) members in VSLA; link SACCOs/ progressive FGs with formal banks.

Result 1.2: Increased market accessibility

Provide FGs with Business Development Services; organize/ promote sub-county farmer markets; facilitate learning visits to model farmers/private sector actors; create added value for commodities; organize a multi-stakeholder platform and annual cross-sector dialogues; achieve progress in certification, quality control, branding and contracting.

Result 1.3: Improved nutritional status

Train VHTs/Health Workers on good nutrition practices, child health, family planning and WASH; empower cultural and religious leaders to sensitise community; increase access to prevention and curative health services; improve nutrition and sanitation practices at HH level; train VHTs on family planning, provide family planning services; conduct annual couples conference and community dialogues on family planning/GBV; conduct community dialogues for out-of-school adolescents on sexuality/ family planning, provide health services; advocate for supplies of FP commodities; facilitate debating clubs and youth peer groups in schools; collaborate with faith-based medical bureau.

Approaches

- **Holistic Family-Centered Approach:** All household members will benefit from a combination of bundled services customized to meet their specific needs, address their vulnerabilities and strengthen their capacities at the collective and the individual level and in view of reducing poverty and malnutrition.
- **Village Savings and Loan Association (VSLA) and Linkage Banking:** Provide simple savings and loan facilities in a community that does not have easy access to formal financial services. Strong VSLAs will be registered at district level and linked to formal financial institutions or federated into SACCOs for better financial inclusion.
- **Farmer Field School (FFS) with Peer-to-Peer Demonstration-based Extension Approach:** Promote practical knowledge among smallholders on improved technologies through participatory, experimental, problem solving and discovery-based learning and hence increase yields, food adequacy and

collective marketing for better market positioning.

- **Market Systems Development (MSD) and Value Chain Approach (VCA):** Make markets work for the benefit of the poor by tackling the underlying causes of market failure and strengthening the functions of market actors as well as the rules and norms that govern the market system.
- **Agro-ecology:** Apply ecological and social concepts and principles to the design and management of food and agricultural systems to optimize the interactions between plants, animals, humans and the environment while taking into consideration the social aspects that need to be addressed for a sustainable and fair food system (FAO).

Key stakeholders

Stakeholder	Role
Target farmers and their households	Main beneficiaries, participate in selection of market commodities and peer-extension agents (CBTs, Poultry Paravets, Agroecology Champions, VSLA Mentor and Market Committee Members), various capacity building activities and monitoring and learning meetings
Local Governments	Oversee implementation of activities and align the Action with the district priorities, involved from planning stage and play a major role throughout the implementation as advisors, extension workers, or beneficiaries of capacity building
Community members	(VHTs, cultural and religious leaders, senior women and male teachers, youth Mentors), contribute to changing attitudes and practices, involved at all project cycle stages.
Private sector	Expand market system and offer production inputs (seeds, tools, etc.), loans, services (market information, advisory service, quality control, vet services etc.), transport and, as traders and processors, purchase the products of target farmers and farmer groups
Advance Afrika, AFARD, Gwed-G	Local implementing partners, in charge of implementation based on a mix of geographical and technical division of responsibilities
Caritas Switzerland	Consortium coordinator and donor, ensures independent project supervision, in charge of MEL and quality assurance including capacity building of co-applicants, and the development of a network of strategic contacts with development partners
Ugandan Government	Supervising (OPM) and contracting authorities (National Authorizing Officer/ Ministry of Finance, Planning and Economic Development)
EU	Main donor

Beneficiaries total 35'900 individuals (farmers and their household members, local government officers, community and private sector members, and the staff of implementing partners).

O. Training concept

The training is based on elements of the FFS approach and adult learning theories. The following elements are important:

- The training should be conducted in a participatory and highly interactive way because involvement and learning are enhanced when participants contribute to the discussion. It is therefore essential that participants are encouraged to share their own experiences before the theoretical material is brought to them.
- Similarly, practical exercises, where participants apply what they learn directly in a demonstration field, will enhance learning.
- The demonstration field should be located on the farm of one of the participants (host farm). All training sessions will take place in this field. The host farmer must look after the field between training sessions.
- The training plan must follow the cropping calendar for the product concerned, so that the farmer can apply what he has learned directly at home (see the proposed training calendar below). Ideally, the participants should meet every week or second week on a learning cycle comprising 8-10 meetings.
- Where appropriate, encourage participants to try different things and make small “experiments”, either at home or on the demonstration field (for example, applying different types of fertilizer) and observe the effect these treatments can have on the crop.
- If possible, the facilitator should visit farmers in their fields to give them feedback on how they implement their crop at home and help them find solutions to the problems they face.

The participatory method and learning-by-doing will create a direct link between the training and the challenges farmers face when implementing new techniques at home. This will enable them to develop their observation and innovation skills and to find solutions on their own to the problems they may face. It is recommended to start each training session with the practical part, before the facilitator gives technical advice at the end of the training sessions.

Recommended structure of a training session:

1. Welcome

(a). A look back at what has happened since the last meeting. (10-20 minutes)

In the participant fields: Take a few minutes to ask participants what they have been able to apply at home since the last session and with what results. Allow participants to share their experiences with each other, highlight their successes and ask questions if they have any.

In the demonstration field: Also take a few minutes to observe with the participants

what has happened in the demonstration field since the last session. What has changed, how have the plants grown? What disease problems can be seen? Do they find insects, other organisms? How is the soil, the humidity, etc.? Facilitators can ask the participants to focus on aspects related to the topic of the day.

2. Introduction of the topic of the day and short brainstorming to identify what the participants know already about this topic. (10-20 minutes)

For each chapter, some guiding questions are proposed to stimulate the discussion.

(a). Exercises in the field (2 hours). Practical aspects of the topic of the day are directly applied in the field by the participants, with the support of the facilitator. The participants shall then apply these techniques at home as well.

(b). Summary (20-30 minutes): the facilitator summarizes important aspects of what has been learned during the sessions and give some more technical advice if necessary.

Recommended training program

It is important that the training units are delivered at a time that is appropriate to the crop production schedule, so that participants are then able to apply the new knowledge gained directly at home.

Where appropriate, some training units may be combined (e.g., common varieties (Unit 1) and nursery establishment (Unit 3). Other units may also be offered in two separate sessions to address or deepen different aspects (e.g., pest and disease management (Unit 6)).

Topic	Duration	Timing
1. Introduction to the principles and practices of Agro-ecology	1.5 hours	At all stages of establishment and management
2. Importance of groundnut cultivation and common varieties in Uganda	1.5 hours	4 weeks before planting time
3. Land selection, Land preparation and other Ecological requirements (Climatic conditions, Soils, Altitude)	2.5 hours	4 weeks before planting time
4. Seed Selection and Planting	3 hours	Day of planting
5. Weeding	3 hours	3-4 weeks after planting
6. Pests and diseases management	2 sessions of 3 hours	5-10 weeks after planting
7. Harvesting	3 hours	Week 11-20 after planting
8. Post harvesting operations	4 hours	Week 11-20 after planting

What is agroecological farming?

Agro-ecology was defined as “an applied science that studies ecological processes applied to agricultural production system”. Therefore, Agro-ecology is farming that aims at feeding a growing population while conserving and nurturing the natural resource base. Agroecological farmers want to improve food yields for balanced nutrition, strengthen fair markets for their production, enhance healthy ecosystems, and build on traditional knowledge and customs. Their objective is to create stable food production systems that are resilient to environmental perturbations such as climate change and disease.

Agroecology views farmland as an ecosystem – a complex network in which every living and nonliving component of the system is important and affects every other component, either directly or indirectly. Since farmland provides many services to us humans (such as food production, clean water or biodiversity) we have to take care of it. Key principles of agroecological farming therefore include:

- Protect the environment and use natural resources efficiently and sustainably;
- Reduce the use of chemicals as far as possible;
- Make use of organic/biological measures and resources, and try to recycle what you can;
- Rather prevent problems (such as pests and diseases) than having to treat them;
- Let nature help you;
- Practice agriculture for the good of people and the environment.

Topics in which agroecological farming differs particularly from conventional farming are especially soil fertility management and pest and disease management¹.

Soil fertility management

Instead of simply using chemical fertilizers to boost crop growth, agroecological soil fertility management considers crop rotations or intercropping with legumes (that can fix nitrogen from the air, the use of manure and compost, and beneficial organic matter management to keep soils healthy and fertile. Reducing tillage operations and protecting the soil with a permanent cover helps maintain the soil fertile and healthy. Some practical guidelines on how to prepare and use soil fertility amendments are given in a separate leaflet.

Pest and disease management

To reduce the use of chemicals as far as possible, agroecological pest and disease management applies many practices to prevent pests and diseases from building up and creating losses:

- » Cropping patterns such as crop rotations, intercropping, or trap/catch/push crops can break pest and disease cycles (and provide numerous other benefits), while anti-parasite crops may scare away (repel) or trap certain

¹ and efficient irrigation, sustainable water use

pests;

- » Use resistant and tolerant varieties (quality seed, seed treatments, ...);
- » Strong plants are less susceptible to pests and diseases (soil fertility, micro-climate, weeding, nurseries, effective micro-organisms and the like, ...);
- » Introduce and nurture beneficial organisms (habitat, e.g. agroforestry, to enhance diversity);
- » Adequate fertilization and irrigation (not too much N or humidity);
- » Physical control: traps, enclosures/netting, by hand, scaring away, removing diseased plants, ...;
- » Organic pesticides: produced by farmers, small businesses;
- » Go regularly to the field and observe thoroughly.

Some recipes and guidelines to produce and use such measures are explained further-on or in a separate leaflet.

1

Importance of groundnut cultivation and different varieties

A. Learning objectives

After the training, participants are able to:

- Be aware of the conditions required for groundnut production
- Understand the benefits of groundnut cultivation for income and nutrition
- Have reflected on the reasons why they would like to grow groundnut
- Know the characteristics of different varieties of groundnut commonly grown in Uganda and be able to choose varieties adapted to the growing conditions of their farm and production objectives
- Know that the groundnut can be used as ruminant fodder

B. Duration

1.5 hours

C. Learning aids

- Flip charts
- Marker pens
- Masking tape
- Training manual
- Different varieties of groundnuts (if available) or pictures of these varieties

D. Activities

Introduction (20 minutes)

The trainer will introduce the topic of the day. He may discuss the following questions with the participants:

- Why is it important for you to grow groundnuts? How will groundnut cultivation fit within your farms? For which purpose do you want to grow groundnuts (self-consumption, as a source of in-come)?
- What could be the benefit to grow groundnuts?

- What could be the main problems for you to grow groundnuts? How to overcome these problems?

Discussion (30 min)

Discuss in small groups why you would like to produce groundnuts and what are the pros and cons of your objectives. How does the reason of groundnut production influence the way of production?

Exercise choosing the right variety (30 minutes)

The facilitator gathers on a table a sample of the groundnut varieties available in Uganda (or pictures of them, if groundnuts are not available).

The facilitator asks the participants to discuss (either in groups first, or directly in plenum) the following questions:

- Which of these varieties / plant types do you know, how do you call them?
- Which one have you already grown, eaten? Which one do you prefer and why?
- What advantages and disadvantages do you know from these varieties / plant types?
- Which variety would you choose to grow for which purpose?

The exercise can be closed by a degustation of the different varieties!

Summary by the facilitator (30-60 minutes)

The facilitator summarizes the discussion by explaining the importance of growing groundnuts and presenting the information concerning the different varieties and their characteristics.

E. Content

2.1 Reasons for growing groundnut

Groundnut (*Arachis hypogaea* L.), also known as peanut, is cultivated in the semi-arid tropical and subtropical regions of nearly 100 countries in six continents between 40° N and S of the equator. In Southern and Eastern Africa, peanut is grown at an altitude of over 1500 m, with a rainfall of 300-1000 mm. In Western and Central Africa, peanut is cultivated in semi-arid areas. There, a growing season of 75-150 days with an annual rainfall of 300-1200 mm is required.

Groundnuts are grown for different reasons including:

- Most of the world production of groundnuts is crushed for oil that is used mainly for cooking. The press cake from oil extraction is a feed rich in protein but is also used to produce groundnut flour, which is used in many human foods.
- Groundnut is an important legume grown and consumed locally, and the principle source of digestible protein (25-34%), cooking oil (44-56%), and vitamins. These qualities make groundnut an important nutritional

supplement to mainly cereal diets of maize, millet and sorghum of many Ugandans.

- The seeds or kernels are eaten raw, boiled or roasted, made into confectionery and snack foods, and are used in soups or made into sauces to use on meat and rice dishes.
- Groundnut requires little input, and therefore it is appropriate for cultivation in low input agriculture by smallholding farmers.
- Even though grown mainly as a subsistence crop, groundnut is also a significant source of cash income.
- However, if you want to grow groundnuts for sale, you must first find out if there is a market for your groundnuts and what varieties are in demand for that market.
- In many countries, groundnut cake and haulms (foliage, straw/stems) are used as livestock feed. On top of using the grain, peanut crop residues present a good fodder for ruminants and can be fed fresh, dried or ensiled. It consists of leaves, stalks/vines and remaining pods left in the field after the peanut harvest.
- Depending on the livestock production system, peanut crop residues can be used as a supplement or as a sole feed. It is a good quality forage and sometimes major provider of fodder wherever it is grown. However, like other legume hays, peanut forage is subject to leaf shattering, which increases the proportion of stems and diminishes its nutritional value.
- Dual-purpose peanut varieties capable of producing appreciable quantities of both grain (peanuts) and good quality hay are being developed and disseminated in Africa and Asia.
- Improves on the soil fertility status through the fixed nitrogen, this then benefits subsequent crop in the rotation and has been observed to create a yield increase of up to 20%

2.2 Types of groundnut plants

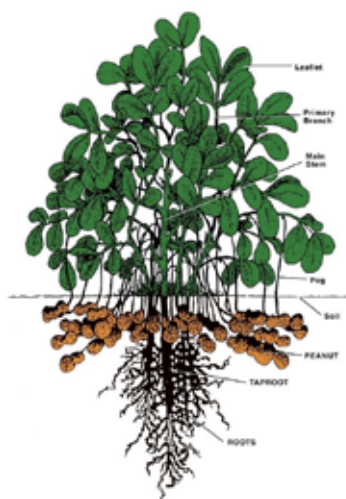


Figure 1 Different parts of groundnut plant (Source: Berkeley)

Peanut is an annual herbaceous plant growing 30 to 50 cm tall. As a legume, it belongs to the botanical family Fabaceae (also known as Leguminosae, and commonly known as the bean or pea family). Like most other legumes, peanuts nurture symbiotic nitrogen-fixing bacteria in their root nodules. There are two different types of groundnut plants:

- Bunch type (eg. Serenut 4T, 5R, 6T), mature in 90 to 100 days
- Semi erect or runner type (f.eg. Serenut 1R, Serenut 2, Serenut 7T, Serenut 8R), mature in 120 to 150 days

Runner peanuts have long branches with nuts growing or “running” all along their length. Bunch peanut plants, on the other hand, produce all their nuts at the end of these branches, in a bunch. Bunch type peanuts do not yield as highly as runners, and because of this they are not grown as frequently on a worldwide scale.

2.3 Selected varieties of groundnut commonly cultivated in Uganda

- It is important for growers to plant high quality seed of varieties adapted to their farm situation.
- Which variety to choose depends on local conditions and the purpose of growing and intended use (self-consumption, selling in the local market, in supermarket, for hotels, processing into oil, meal or other products, growing for animal fodder). Therefore, it is important to think about the intended use of the groundnut you will cultivate, the market preferences, and to choose the varieties accordingly.
- For the crop to thrive, it needs to be adapted to the area. The performance of groundnut shows regional differences: western, central and southern region prefer red types whereas northern and eastern regions prefer tan/white varieties. Taking the farm situation into consideration, it sets the decision for the different varieties.
- Certainly, yield and grade attributes must be given priority, but disease tolerance, growth habit, maturity, and seed quality and availability should also be considered.
- Remember: The “perfect variety” possessing all the necessary traits for diverse environments does not exist. Therefore, it makes good sense to plant a couple of different varieties to reduce the production risk.

Constraints to groundnut production

- Diseases like Leaf spot, groundnut rosette and leaf rust are the main cause of reduced yield and as well compromise quality in groundnut.
- Drought that sets in before plants reaching physiological maturity affects mainly the farmers that plant late
- Pests like aphids, leafminer, termites, rodents among others and Nematodes reduce economic yield of groundnuts.
- Lack of proper drying facilities like tarpaulins encourages development of mould and aflatoxin development
- No access to better Markets of groundnuts.

Table 1 presents the comparative characteristics of varieties currently grown in Uganda

Variety	Year Released	Maturity days	Negative attribute	Positive attribute	Special trait
Serenut 1R	1998	100-110	Susceptible to leaf miner, leaf spot & aflatoxin	Big bold red seeds Resistant to leaf spot Drought tolerant	Confectionery type Soft shell Stay green
Serenut 2	1998	100-110	Susceptible to leaf miner Difficult to shell	Big bold tan seeds Resistant to leaf spot & rosette Good for condiments	Highly drought tolerant Tolerant to aspergillus colonization & aflatoxins
Serenut 3R	2002	90-100	Long dormancy (45 days) Weak pegs at harvest Bitter taste when raw Susceptible to aflatoxins	Resistant to leaf spot & rosette Drought tolerant	High oil content Good for butter
Serenut 4T	2002	90-100	Susceptible to leaf miner, leaf spot, rosette & aflatoxin	Good for confectionery type & butter Early maturing	High shelling return Tolerant to aspergillus colonization & aflatoxins
Serenut 5R	2010	100-110	Susceptible to leaf miner & aflatoxin	Tolerant to drought Resistant to rosette Resistant to leaf spot	Confectionery type Good attractive red colour
Serenut 6T	2010	90-100	Susceptible to leaf miner, leaf spot & aflatoxin	Rosette resistant Easy to shell Early maturing	Very tall bunchy groundnuts Easy to harvest Confectionery type

Variety	Year Released	Maturity days	Negative attribute	Positive attribute	Special trait
Serenut 7T	2011	100-110	Susceptible to leaf miner & aflatoxin	Drought tolerant Rosette & leaf spot resistant Big pods & seed Stay green	Easy to shell Confectionery type Good for condiment
Serenut 8R	2011	100-110	Susceptible to leaf miner & aflatoxin	Drought tolerant Rosette & leaf spot resistant Stay green	Deep red with faint dark stripes Easy to harvest
Serenut 9T	2011	100-110	Susceptible to leaf miner	Very sweet drought tolerant Uniform mat type growth Rosette & leafspot resistance Easy to shell Stay green	Tolerant to aspergillus colonization & aflatoxins Tolerant to thrips attack Best tan confectionery
Serenut 10R	2011	100-110	Susceptible to aflatoxins Premium market prefers red seed coat Colour intermediate tan & red	Drought tolerant Rosette & leaf spot resistance Stay green	Tolerant to leaf miner
Serenut 11T	2011	100-110	Susceptible to leaf miner & aflatoxins	Drought tolerant Rosette & leaf spot resistance Easy to shell	Giant pod & seed Confectionery type

Serenut 12R	2011	100-110	Susceptible to leaf miner & aflatoxins Medium seed size	Drought tolerant Rosette & leaf spot resistance Stay green	Very tall bunchy G-nuts Easy to harvest Deep red colour Confectionery type
Serenut 13T	2011	100-110	Susceptible to leaf miner & aflatoxin	Drought tolerant Rosette resistant Stay green Easy to shell Good for butter & condiments	Uniform light tan attractive seeds
Serenut 14 R	2011	100-110	Susceptible to leaf miner & aflatoxin	Drought tolerant Rosette & leaf spot resistance Stay green	Confectionery type
Red beauty	1966	90-100	Susceptible to all disease	Excellent marketability Good for sauce	Red seeded
NARONUT 1R (DOK 1R)	2019	75		Resistant to rosette virus, drought and heat tolerant, Extra early maturity.	Deep red in colour
NARONUT 2T (DOK 2T)	2019	80-85	N/A	Early maturing, resistant to rosette virus, resistant to leaf spot, tolerant to drought and heat.	Tan seeded

2

Land selection and Land preparation (Ecological requirements)

A. Learning objectives

After completing this module, participants will:

- Understand the factors to consider in selecting a suitable site for groundnuts production.
- Learn the best practices of land preparation for groundnuts production.
- Know the conditions necessary for proper growth of groundnuts.

B. Duration

3 hours

C. Learning aids

- Land where the groundnut plot will be implemented
- Tools for land preparation such as Hoes, Pangas, Slashers, Axes

D. Activities and exercises

Look back at what has happened since the last meeting. (10-20 minutes)

Take a few minutes to ask participants what they have been able to apply at home since the last session and with what results. Allow participants to share their experiences with each other, highlight their successes and ask questions if they have any.

Introduction and practical selection of the land for the groundnut plot (1 hour)
This activity should take place directly at the groundnut production area.

The trainer introduces the topic of the day. He then asks the participants and discusses with them the following questions, possibly directly in the area where the groundnut plot will be implemented:

- Why is it important to select a suitable site for groundnut production?
- In which soil conditions do groundnuts perform best?
- Which common mistakes do farmers make when they select a site and prepare their land?

- What factors determine the suitability of a site for groundnuts production?
 - What are the best practices when preparing the land?
1. Based on the discussion, the participants are asked to list the criteria on a flip chart.
 2. The facilitator asks then the participants to choose the right location to implement the groundnut plot and justify their choice. Alternatively, they can assess the plot that has already been selected using the criteria that have been discussed.

Exercise: preparing the land for groundnut plantation (1-2 hours)

The participants, together with the facilitator, will practically prepare the land for groundnut plantation.

Facilitator's summary (30 minutes)

The facilitator sums up important points of land selection and proper land for groundnut production based on the aspects presented in the sub-chapter E. Content below.

E. Content

3.1. Land selection for groundnut cultivation

The previous cropping history of the land and the type of soils are to be taken as key considerations in considering selecting land for groundnut production. Otherwise, the land selected should fulfill the growing (Ecological) requirements of groundnut and shows the following characteristics:

Climatic conditions

- Groundnuts grow well in most parts of Uganda. They require evenly distributed rains, but dry weather is necessary at ripening and harvest to reduce post-harvest losses when harvesting is done during the wet season.
- Optimum temperatures are 27 – 30°C for vegetative growth and 24 – 27 °C for reproductive growth. Between 450 mm and 1250 mm or evenly distributed rainfall is required annually for good growth and yield. Early maturing small seeded varieties require 300 - 500 mm while medium to late maturing large seeded varieties need 1000 - 1200 mm rainfall.

Soils

- All soils, other than very heavy ones are suitable for growing groundnut, but the best are deep, well-drained sandy, sandy loam or loamy sand soils. The latter facilitate the forcing of the developing fruit into the soil (pegging). Groundnut will not grow well or fix nitrogen in acidic or infertile soils. Groundnuts grow best on soils limed to a pH of 5.8 to 6.2, provided other essential elements are in balance and available to the plant.
- Heavy clay soil has surface crusting that tends to resist peg penetration and

pod expansion this may result into loss of pods into the soil during harvest. Also pods harvested from clay soil tend to carry a lot of soil resulting into lengthy period of drying, thus predispose kernels to mould and aflatoxin contamination.

- Soils rich in organic matter most especially residual fertilization will give good yields even without additional fertilizers.
- The site should show physical signs of soil fertility such as organic matter, vigorous growth of grasses (e.g. guinea grass) and dark colour among others.

Altitude

- Groundnut is not suited to growing in very dry areas or at altitudes higher than 1500 meters above sea level (around 5000). Generally, higher altitudes with cooler climates are not suitable for groundnut production.

3.2. Land preparation for groundnut cultivation

After selecting the site, it is important for a farmer to prepare land prior to onset of rain for sowing to take place in the early rains.

- A well-prepared seedbed ensures good germination and reduces weed infestation. This should be done twice using hand hoe or ox plough.
- After the 1st digging where most of the vegetation is buried, a period of 3 - 4 weeks is allowed for organic matter to decompose before secondary tillage and harrowing is done.
- Groundnuts require a well pulverized seed bed with sufficient planting depth to provide good soil to seed contact for good germination and proper root establishment.
- In wet/low lying areas it is advisable to plant groundnuts on ridges to prevent waterlogging and improve harvesting.
- After ploughing and harrowing to a fairly good tilth, ridges, which are 80 cm apart with flattish tops, should be made so that two rows of nuts can be planted on each ridge.



Fig. 1: Fine seed bed ready for planting

3

Seed Selection and Planting

A. Learning objectives

At the end of the session, participants will:

- Be able to conduct a simple germination test
- Know when is the best time to plant groundnuts
- Know the correct spacing and planting depth of groundnuts
- Know the possible sources of quality seed for planting
- Understand the recommended planting practices for groundnuts

B. Duration

3 hours

C. Learning aids

- Tools for the germination test: Seed, Watering can, Spray pump
- Tools for soil preparation like Panga, Hoes, Poles, Dry grass, Tying materials
- Tape measure (50 meter), Marker pens
- Two pieces of sisal string
- Seed in different forms (broken, immature, discolored)

D. Activities and exercises

Look back at what has happened since the last meeting. (10-20 minutes)

In the participant fields: Take a few minutes to ask participants what they have been able to apply at home since the last session and with what results. Allow participants to share their experiences with each other, highlight their successes and ask questions if they have any.

In the demonstration field: Also take a few minutes to observe with the participants what has happened in the demonstration field since the last session. What has changed, how have the plants grown?

Introduction (15 minutes)

The trainer will introduce the session of the day. At this point the trainer should also make it clear to the participants that the session will involve practical work and will take some time. To stimulate the discussion, the trainer can ask the following questions:

- Where do you procure your seeds?
- How do you select quality seeds?
- When do you plant your groundnuts?
- How do you plant the groundnuts in your field?
- How readily do you access metrological information?
- Do you factor in metrological information in production calendar?
- What are the benefits of a well-planned planting?

Demonstration germination test (optional)

The facilitator show the participants how to conduct a germination test. The participants can then do it at home.

Demonstration sowing groundnut (2 hours)

The trainees, together with the facilitator will practically sow the groundnut in the demonstration field of the group. The facilitator must explain all the different activities involved step by step. The knowledge got from the demonstration plot will be used by the trainees in their fields at household level.

Summary (20 minutes)

The facilitator summarizes the main points of the topic of the day

E. Content

- Timely planting should be the practice as it helps take advantage of the rains and helps to avoid end of season drought effect.
- Planting should be done as soon as there is adequate and stable moisture in the soil to ensure optimal germination and the subsequent plant growth.
- It is recommended that farmers should acquire seeds from credible source or seed harvested from previous season to avoid poor germination. Avoid planting seed that has lasted more than one season in the store.
- Before planting, a farmer should carry out germination test to determine the viability and the germination percentage (should be 85 and above to obtain a good plant stand in the field).

4.1 Seed selection:

- A uniform stand of healthy, vigorous plants is essential if growers are to achieve the yields and quality needed for profitable groundnut production. It is important for growers to plant high quality seed of varieties adapted to

their farm situations, management styles, and intended market uses. Yield and quality are two major factors that influence variety selection.

- Growers with significant disease history may need to choose a variety with disease tolerance or resistance.
- Use high quality seed or a recommended variety. Several factors must be considered when deciding on variety. First, it is extremely important to evaluate varieties based on regional performance (western, central and southern region prefer red types whereas northern and eastern regions prefer tan/white varieties).
- Certainly, yield and grade attributes must be given top priority, but disease tolerance, growth habit, maturity, and seed quality and availability should be considered. The perfect variety possessing all the necessary traits for diverse environments does not exist, so it makes good sense to plant a couple of different varieties to reduce the production risk.
- Pods should be shelled 1-2 weeks before sowing and only good quality seed should be selected for sowing.
- Damaged, small or shriveled seeds should be discarded. It is good practice to purchase certified groundnut seed at regular intervals, preferably every 2-3 years. The seeds must be free from contamination, irrespective of the sources of supply.
- It is always recommended to test the germination capacity of the seed prior to planting. Planting two or more varieties with different maturity dates permits efficient use of limited harvesting and curing equipments.
- Additionally, planting varieties with different genetic pedigrees reduces the risk of crop failure because of adverse weather or unexpected disease epidemics.

4.2 Procedure on how to conduct a simple germination test.

- The farmer should select a moist area around homestead to conduct this experiment.
- Randomly select 10 groundnut seeds.
- Sow seeds in the prepared area, 10 cm apart.
- 1 week after planting, count and record the number of germinated seeds to determine the germination percentage.
- Repeat counting after another 3 to 4 days. A viable legume seed should be able to emerge within 10 days and certified seeds are expected to have a germination percentage of over 90%. (Hence 8-9 seeds out of ten should germinate).

4.3 Seed dressing

- Groundnut seed is susceptible to blights and rot in the soil.

- A fungicidal seed treatment will limit this decay and increase the stand in the field.
- Two seed coating agents are currently registered for use on groundnuts, namely Mancozeb and Thiram.
- Comprehensive directions for the use of these agents are indicated on the label. Complete coating of the seed is essential and the use of a mechanical mixing apparatus is strongly recommended. This will reduce seed borne infections during seedlings germination and allow initial vigorous growth.
- However, the use of dressed seed is not recommended in agroecological production.

4.4 Dormancy

- This is the period after maturity/harvesting that is required for the seed of certain varieties to continue developing before it can germinate even though the normal environmental factors conducive for germination are available.
- For instance Serenut 3R has a dormancy of at least 45 days; Serenut 5R has a dormancy period of at least 30 days. The other commercial varieties (see table 1) have no dormancy period and sprout in the field when harvesting is delayed.

4.5 Time of planting

- With the current weather changes globally, the planting date is difficult to standardize.
- Adherence to meteorological information localized for your area gives you a gesture on when planting can be scheduled.
- However, farmers should plant as soon as there is adequate and consistent moisture in the ground to ensure good germination and the subsequent plant growth.
- Timely planting dates should take advantage of periods of higher rainfall and avoiding end of the season drought effects.

4.6 Sowing

- Mark the planting strings to required spacing in order to obtain the optimum plant population depending on the variety.
- Calibrate farmers to dig to a required depth using a hand hoe.
- Sow groundnut seed in rows and at the right spacing (figure 2).
- Sowing at 5 - 6 cm depth ensures that the plant develops and produces optimally.
- Seed that germinates slowly as a result of deep planting, takes longer to emerge and a sub-standard plant will be produced.
- Shallow planting of seed (less than 5cm) can only be considered when

enough moisture is available, and the climate is moist.

- In situations where moisture is not limiting, 5 cm to 6 cm is the ideal planting depth.
- Seeds must not be sown immediately after heavy rains since they imbibe too much water, which causes rotting. This also results in excessive soil compaction which may hinder germination.
- Long duration varieties (120 days and above e.g. Igola) should only be planted with the first rains in the first season.
- Short to medium duration varieties can be planted in either season. Early planting generally improves yields and seed quality.
- Seeds for planting should be well selected: they should be clean, well filled and without any blemishes.
- Seeds for planting should be kept in their pods and shelled a few days before planting.
- Depending on the varieties you chose, maturation will take within 90 to 100 days (bunch varieties), while runner types mature in 120 to 150 days.

4.7 Plant density and spacing

Planting groundnuts is done using a seed rate of 30-40kgs/acre spacing may vary according to seed size & growth habits;

- 45cmx10 - 15cm for Semi erect type: (Igola 1, Serenut 1 and Serenut 2)
- 45cmx7.5 - 10 cm for bunchy types: (Red Beauty, Serenut 4T, Serenut 6T)

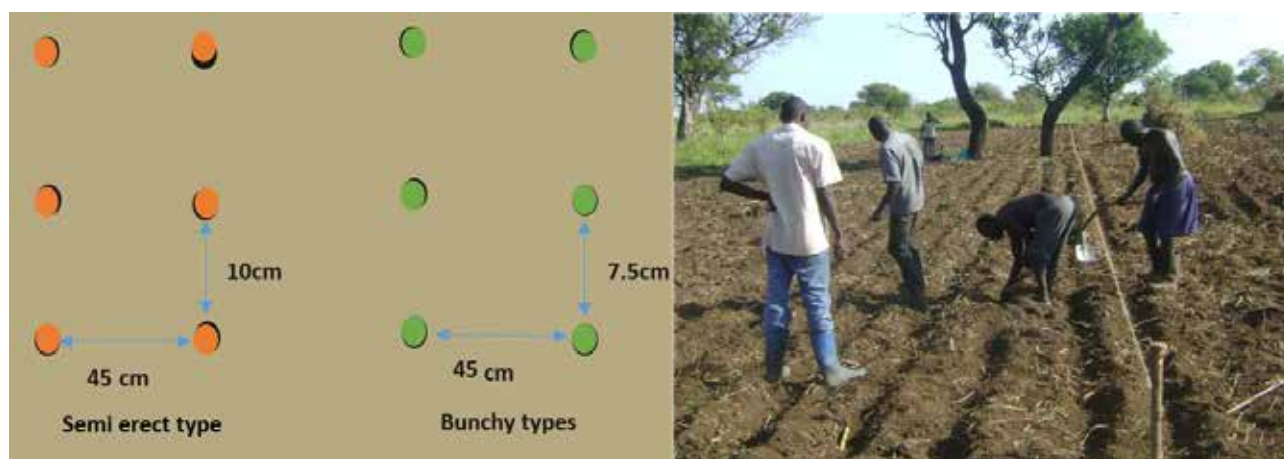


Figure 2 (left) recommended planting distances, (right) Farmers in Pajule planting groundnuts in rows

- Row spacing can be reduced to 30 cm for a good fertile soil to allow early ground cover to suppress weeds and also create a microclimate unfavorable for aphids known to be transmitters of groundnut rosette.

4

Weed management in groundnuts

A. Learning objectives

After completing this module, Participants will:

- Understand the effects of weeds on the yields of Groundnut crop
- Learn the different methods of weed control in Groundnuts.
- Understand the importance of timing of weed control in Groundnut crop.

B. Duration

2- 3 hours

C. Learning aids

- Hand hoes

D. Activities and exercises

Look back at what has happened since the last meeting. (10-20 minutes)

- **In the participant fields:** Take a few minutes to ask participants what they have been able to apply at home since the last session and with what results. Allow participants to share their experiences with each other, highlight their successes and ask questions if they have any.
- **In the demonstration field:** Also take a few minutes to observe with the participants what has happened in the demonstration field since the last session. What has changed, how have the plants grown?

Introduction (20 minutes)

The trainer will introduce the topic of the day. He can stimulate discussion by asking the following questions:

- From time of planting, when do often do the first weeding?
- How generally do you do weeding in groundnuts?
- Do you weed at home? How and why? If not, why?
- What is the effect of too much weeds on the groundnut plants?

Demonstration (2-3 hours)

This training should be practically done in the group demonstration field.

In a first step, the facilitator can walk through the plot with the participants and ask them to identify the weeds that can be found there.

In a second step, the participants, together with the facilitator, will do the weeding. They may not finish weeding their demo plot during this session but will do follow up weeding until the group demo is completed.

The knowledge got from the demonstration plot will be used by the trainees in their fields at household level.

Facilitator's summary (15 minutes)

The facilitator should really remind the trainees about the important of weeding since majority of the farmers tend to ignore this.

E. Content

Weeds are defined as any unwanted crop or plant in the garden. This includes volunteer crops that farmers tend to leave in the field and may be potential of pests and diseases.

Effects of weeds on groundnuts;

- Reduction of crop yields
- Competition with crops for nutrients, sunshine, space.
- Harboring pests and disease-causing organisms.
- Lowering the quality of harvest and its market value.
- Increasing the cost of production.
- Making harvesting difficult.

Attributes which make weeds out compete crops;

- They are hardy and therefore, adapted to the wild or harsh conditions.
- They can survive even in poor soils
- They are attacked by few pests and diseases and also possess tolerance to pests and diseases attack.
- They have short maturity period hence they can reach reproductive stages before crops.
- They are prolific as they produce very many seeds.
- Some of them are parasitic to crops e.g. striga, dodder.
- Their seeds have a long dormancy period hence can stay in the soil for long without losing viability

- Weeds contribute to a greater reduction in yield by competing with plants for moisture, nutrition, light, and space during growth. Farmers should note that effective early weed management through the growing season translates into higher yields.
- Weeding therefore should be done 2-3 times using cultural, mechanical and physical means. Farmers often prefer hand weeding because of its effectiveness, this is done by digging while exposing the roots of weed so that they dry up.
- Timing should be when weeds have not reached reproductive stage.



- The first weeding is done before flowering of groundnuts and at least one other during pegging.
- Once pegging begins, there should be minimum soil disturbance near the base of plant to avoid interference during pod development.
- Instead weeds at this stage can be controlled by hand-pulling to avoid earthing up and damaging the pegs.
- Weeding sometimes may depend on the species and the level of infestation. However, a combination approaches provide the most successful results.

Considerations for cultural and mechanical weed management.

- Practice crop rotation.
- Use high quality weed-free seed.
- Remove spotty infestations by hand hoeing or spot spraying to prevent spreading weed seed, rhizomes, tubers or roots. This is particularly important for perennial weed species.
- Clean all tillage and harvesting equipment before moving to the next field, or from weedy to clean areas within a field.
- Keep the boundaries areas adjacent to fields clean.

Summary of recommended practices

Table 1: Recommended practices in cultivation of groundnuts (Source: Biovision Infonet 2020)

Agronomy aspect	Recommended practice
Climate	Rainfall: 450-1250 mm per year Temp: 24-30°C
Region in Uganda	Low to mid-altitude
Soils	Sandy or sandy loam, or loamy sands
Fertilizer	60 kg ha ⁻¹ NPK
Rotation	With cereals or cassava, sweet potato, sunflower
Land preparation	Before on-set of rains
Planting	When moisture is adequate and stable in soil
Sow	5-6 cm deep
Seed dressing	With fungicide
Spacing	- Semi-erect types: 45 X 10-15 cm e.g Serenut 1R, Serenut 2, Serenuts 7T, Serenut 8R - Bunch types: 45cm X 7.5-10 cm e.g Serenut 4T, 5R, 6T
Weeding	2-3 times
Irrigation	Where possible and necessary

5

Pest and disease management in groundnuts

Groundnuts are susceptible to a wide range of diseases. A number of these diseases are seed-borne. It is therefore recommended that farmers should use certified seed from reliable sources to reduce seed borne infections and allow initial vigorous growth.

A. Learning objectives

After completing this module, participants will:

- Identify the common pests and diseases affecting groundnuts and their effects.
- Know the signs and symptoms of different pests and disease that attack groundnuts
- Learn the Integrated Pest and Disease management approaches in groundnuts production.
- Understand the critical stages of growth of different pests to target control

B. Duration

2 sessions of 4 hours

C. Learning aids

- Photo cards
- Demonstration garden
- Insect bottle
- Stationery
- Knapsack sprayer
- Jerry can
- Basin soap
- Neem seed oil 0.3ec (or photo graph)
- Cow dung, 2 fingers of ripe bananas, brewer's yeast, one litre of honey and water.
- Trap bottles.
- Pesticides (turfgor, select plus)

D. Activities and exercises

Look back at what has happened since the last meeting. (10-20 minutes)

- **In the participant fields:** Take a few minutes to ask participants what they have been able to apply at home since the last session and with what results. Allow participants to share their experiences with each other, highlight their successes and ask questions if they have any.
- **In the demonstration field:** Also take a few minutes to observe with the participants what has happened in the demonstration field since the last session. What has changed, how have the plants grown? Do they see any weeds on their fields?

Introduction (20 minutes)

The trainer will introduce the topic of the day pointing out what is to be learnt, including the different pests and diseases affecting groundnuts and their control. The trainer should inform trainees that training will be a practical one where the trainees will be taken to the group demonstration for different pest and diseases scouting and identification.

The following questions can be used to stimulate the discussion:

- What main pest and diseases affecting groundnuts do you encounter in your field?
- What symptoms of pest attack and diseases have you seen on your groundnut plants?
- Which prevention measure do you know to avoid pest and disease attacks?
- Which organic treatment against pest and diseases do you know?

Practical exercise (2 hours)

How to observe the groundnut field and plant to detect pest attack and diseases?

The facilitator discusses with the participant how the field should be visited to monitor pest and diseases. Then, he discusses with them how single plant should be observed, which aspects should be looked at. An observation format could be developed by the group.

Practical observation of the field in subgroups

Each subgroup of 4-5 participants will observe one or two plants taking into consideration the criteria identified in the previous exercise. Parts of sick plants and insects can be collected. In-sects can be collected and placed in bottles. The groups summarize their observations on a flip chart and try to formulate recommendations.

Presentation by the subgroups in plenum and discussion

The findings of each subgroup are presented and discussed with the help of the flip chart and insect glasses. At the end of the discussion, the main pests and diseases

found in the field should have been identified and possibilities for prevention or treatments discussed.

Summary

The facilitator summarizes the main findings of the group works and discussions. He presents other important pest and diseases that may affect groundnut.

In the next weeks, the groups may be doing scouting on their own and will be using the insect bottle to keep the insects and present to the Agricultural officers on the days they visit the groups. The knowledge got from the demonstration plot will be used by the trainees in their fields at household level.

A diary on pests and diseases and control mechanisms can be written to share the experience with peers.

E. Content

6.1. Major Pests of Groundnuts

Groundnuts suffer from many pests and some of them are:


Aphids


(*Aphis craccivora*)





Figure 3 Groundnut aphid colony on cowpea. (Source: James Litsinger, Infonet Biovision)

- Aphids are brownish-gray insects responsible for the spread of groundnut rosette, a viral disease.
- Aphid damage is more severe during drought situations and when the crop is still young.
- They are sporadic and damage is at all stages during feeding, especially on growing tips and young foliage.
- They suck the sap causing flowers to abort, leaves to curl, stunted growth and instant dieback. Their major threat is the transmission of viruses in groundnuts gardens.

<p>Signs, symptoms and damages</p>  <p>Figure 4 Groundnut plant suffering from chlorotic rosette (Source: ICRISAT)</p>	<ul style="list-style-type: none"> ▪ Groundnut plants take on a bushy appearance due to attack by <i>A. craccivora</i> and infection with rosette virus. Rosette may take two forms, chlorotic rosette (white patches with green veins on young leaves and short internodes) and green rosette (darker appearance with stunting of leaflets and branches).
<p>Prevention and treatments</p>	<ul style="list-style-type: none"> ▪ Timely sowing of the crop and dense spacing. Early planting allows plants to start flowering before aphids appear while dense planting provides a barrier to aphids penetrating in from field edges. ▪ Crop rotation with non-host crops. ▪ Intercropping with pearl millet. ▪ Destroy volunteer groundnut plants and weeds. ▪ Conserve natural enemies. Ladybird beetles are reported as important natural enemies in groundnuts. ▪ Use neem seed or leaf extracts if necessary. ▪ Do not cultivate groundnut or other legumes continuously on the same ground. ▪ Use tolerant or resistant varieties. The groundnut variety SERENUT 2T and other serenut varieties are reported to be tolerant to aphids. ▪ Set insect traps as early as possible. ▪ Spray the field with dimethoate (not recommended in agroecological production)

<p>Leaf miner (<i>Aproaerema modicella</i>)</p>  <p>Figure 6 Damage caused by Groundnut leafminer. Leaflets became deep brown, rolled, and dried up prematurely due to enlarged leaf mines. (Source: ICRISAT)</p>	<ul style="list-style-type: none"> ▪ Groundnut leaf miner is a very serious pest threatening groundnut production. The pest attacks groundnuts both in rainy and post rainy season but the damage is more severe during the short rainy cycle when long drought precedes rains. ▪ The attack happens when leaf miner larvae mines into the leaves and feed inside causing blister mines. This damage cuts water and nutrient flow thereby turning the leaves brownish and eventually dry up leading to early defoliation and reduction in food making by the plants.
<p>Signs, symptoms and damages</p>	<ul style="list-style-type: none"> ▪ Three or four mines per groundnut leaflet can cause so much distortion that a leaf exposes as little as 30% of the potential photosynthetic area to the sun. ▪ Later, when the caterpillar becomes too large to occupy the mine, they emerge to the leaf surface and either fold over a single leaf and hold it down with silk, or web together two or more leaflets. They live and feed in the shelter they have constructed. ▪ Pupation takes place inside the webbed leaflets. ▪ Damaged leaves become brownish, rolled and dry, which results in early defoliation and affects the growth and yield of the plants.
<p>Prevention and treatments</p>	<ul style="list-style-type: none"> ▪ Following a groundnut - cereal rotation reduces the leaf miner incidence ▪ Plant during the first short rains when normally the miner population is low. ▪ Growing resistant varieties like Serenut 10R gives good yields even under heavy leaf miner infestation, it has also been reported that variety Egola-1 showed signs of relative resistance. ▪ Avoid drought stress by irrigating or early sowing so as to avoid periods when drought is likely. Plants that are drought stressed are much more susceptible to leafminer attack than irrigated plants. ▪ Spraying with Dimethoate starting from 20 days after emergence and repeating 4 times at 10 days interval.

<p>Thrips</p>  <p>(<i>Megalurothrips sjostedti</i> and <i>Frankliniella schultzei</i>)</p>	<ul style="list-style-type: none"> ▪ Thrips attack groundnut plants 6 - 8 weeks after planting. ▪ Thrips feeds primarily on terminal leaf clusters by rasping on the tender leaf surface and sucking plant juices, turning tender leaves into yellowish green patches on the upper surface and brown necrotic areas and silvery sheen on the lower surface of the leaves. ▪ This leads to dwarfing and malformation of leaves.
<p>Signs, symptoms and damages</p>  <p>Figure 7 Thrips damage on groundnut (Source: Steve L. Brown, University of Georgia)</p>	<ul style="list-style-type: none"> ▪ Several species of thrips attack groundnuts. ▪ The flower thrips infest mainly buds and flowers. Attacked flowers are discoloured and scarred; terminal leaf buds are blackened and distorted after unfolding. ▪ Other species of thrips infest foliage. ▪ Thrips feeding causes yellowish-green patches on the upper leaf surface and brown necrotic areas and silvery sheen on the lower surface of the leaf; leaves become thickened and some curling occurs. In severe infestations, young leaves are severely deformed, plants are stunted and leaves are blighted.
<p>Prevention and treatments</p>	<ul style="list-style-type: none"> ▪ Grow resistant/tolerant varieties e.g Serenut 7-14 series. ▪ Conserve natural enemies. Thrips are attacked by predatory thrips, lacewings and predatory bugs. ▪ Whenever necessary spray the crop with botanicals, such as plant extracts (e.g. garlic, rotenone, neem, pyrethrum, etc.). A mixture of garlic and pepper has been recommended for organic growers in USA. ▪ Plough and harrow before transplanting. This can be useful in reducing thrips attacks by killing pupae in the soil.

Termites

(*Coptotermes formosanus*)



Figure 8 Termites (Source: Biovision Infonet)

Groundnut damage by termites is common in light (red and sandy) soil when rainfall is moderate. They attack groundnuts and kill the plants directly through feeding on the roots cutting off the supply of water and soil nutrient to the plant. Termite damage manifest through:

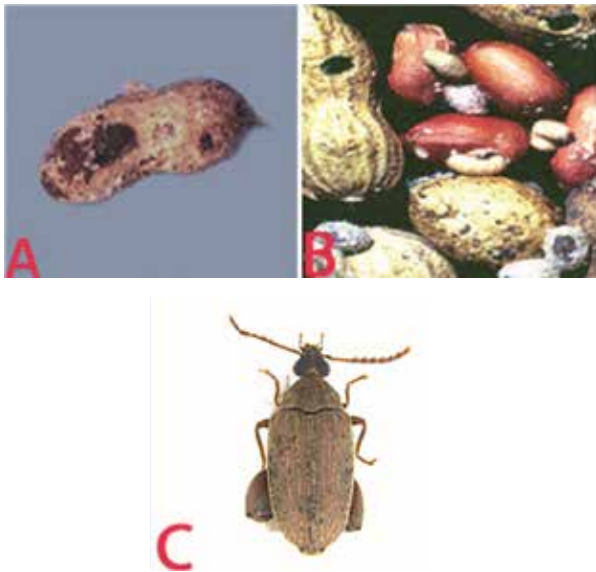
- Wilting of plants in patches.
- Hollow penetration out of the tap root and stem thus killing the plant.
- Bore holes into pods and seed damage.



Signs, symptoms and damages

Figure 9 Hollow pods: Damage of termites in groundnuts

- Roots damaged by other soil pests, such as white grubs, are prone to attack by termites. Some termite species (*Macrotermes* spp., *Hodotermes mossambicus*) cut off stem bases, and may cause 25-100% of plant losses. As the crop ripens the outer layers of the pods are scarified (removal of soft corky tissue between the veins of the pod) by termites allowing contamination of the seed with soil fungi, such as *Aspergillus flavus*, which produce lethal "aflatoxins".
- Scarification of pods is by far the most common type of termite damage at plant maturity, a factor often aggravated by late harvest. Scarification as high as 30% has been reported. Infested plants are not obviously diseased and are frequently harvested and contaminate the rest of the crop. Species such as *Microtermes* spp. also penetrate the pod to feed off the soft inner lining, filling the pod with soil. This form of attack leads to additional loss through premature germination of kernels. Stacks of plants left drying in the fields are also frequently attacked by species such as *Odontotermes* spp. with farmers losing between 30-40% of their crop at this stage.
- Termite damage is generally most serious towards the end of the growing season just prior to harvesting, and it is particularly serious during periods of drought.

<p>Prevention and treatments</p>	<ul style="list-style-type: none"> ▪ Digging the anthills and destruction of the queen is most important in termite management. ▪ Use well rotten organic manure. ▪ Harvest the groundnuts as soon as they are mature, early removal of the plant residues from the field (food for termites!) will reduce the chances of termite damage to pods. ▪ Planting should be carried out early enough to avoid drought periods. Moisture deficiency may stress a crop and lead to attack by termites due to low vigour. ▪ It has been reported that close spacing in groundnut helps to deter termite infestation, although the reason for this was not given. However, high density sowing, followed by thinning of surviving plants where necessary to reduce competition, offsets anticipated losses due to termites. ▪ Apply chlorpyrifos 20 EC or lindane 1.3% to control termites. (not recommended in agroecological production)
<p>Peanut bruchid beetle. (Caryedon serratus)</p>	<ul style="list-style-type: none"> ▪ Most post-harvest groundnut pests are unable to penetrate intact pods, but bruchids are an exception and damage full pods. ▪ This is a serious storage pest particularly for unshelled groundnuts. <div data-bbox="724 1509 1323 2078">  <p>The image block contains three photographs. Photograph A (top left) shows a single groundnut pod with a dark, irregular hole on its surface. Photograph B (top right) shows a cluster of groundnut pods, some of which are red and some yellow, with several small holes visible. Photograph C (bottom center) shows the adult Peanut bruchid beetle, which is a brown, oval-shaped insect with a textured surface and long antennae.</p> </div>

Signs, symptoms and damages	<ul style="list-style-type: none"> ▪ Damage occurs when hatched eggs change to larva stage. The larva burrows straight through the egg shell and the pod wall, and start eating the seed. ▪ The larva will continue to live in storage sacks until they pupate in large numbers at the bottom of the pile of sacks ▪ They make the groundnut seeds unfit for human consumption.
Prevention and treatments	<ul style="list-style-type: none"> ▪ As most post-harvest groundnut pests except bruchids are unable to penetrate intact pods, leaving the crop in the shell for as long as possible during storage is an effective method of limiting damage. ▪ To prevent primary infestation from alternate hosts (Tamarind or Acacia), avoid drying groundnuts near these host trees. ▪ Storing groundnut kernel with dried neem leaves in a sealed container is effective ▪ Research into low cost technology to protect stored groundnut showed that Samadaka (<i>Swartzia madagascariensis</i>), 2 kg of powdered fruits to treat 100 kg groundnuts, was very effective against bruchids and moths for the groundnuts stored in granaries. ▪ Addition of sand as an abrasive material at the farm level was very effective (INPhO Compendium)

Biological control measures

Generally for control of pests in ground nuts, a combination of integrated management approaches help. These stem from adherence to cultural management practices use of biological agents and their products and least use of chemicals.

Under biological measures;

1. Formulation of insect pest trap

Mixture of 0.5kg of detergent(OMO) with 2 ripe bananas+ 0.25 litres of honey+ 0.25kg of cowdung+2kgs of brewer's yeast+20 litres of water.

2. Use of bio-pesticides formulations

Use of Nimbecidin (neem seed oil extracts) in combination with Bio catch effective for most pests

This goes hand in hand with conservation of useful insects that feed on these pests like lady bird beetle.

3. Microorganisms (fungi) that are effective to management of fungal diseases.

These include Metarhizium, Beauveria and Trichoderma. These control a range of groundnuts pests when mixed with charcoal dust. This can be availed from NaSARRI bio-pesticide lab.

6.2. Diseases of Groundnuts

Groundnut rosette disease

Groundnut rosette disease is a serious viral disease of groundnuts, wide spread in all groundnut growing areas. It is transmitted by aphids feeding on the crop.



Symptoms

- Green and yellow or (chlorotic) leaves.
- The plants affected by this disease look stunted and presents a bushy appearance.
- There is a marked reduction in the size of the leaflets and mottling.

- Yellow (chlorotic) rosette symptoms initially develop a faint mottling on young leaves.
- Subsequently, leaflets are yellow with green veins.
- Plants infected when young produce progressively smaller distorted, curled and yellow leaflets. When older plants are infected the symptoms are generally restricted to a few branches or the apical portion. Control of aphids will prevent further spread of the disease.

Management

- Timely planting as soon as there is enough moisture in the soil
- Early sowing and close spacing of rows reduce disease
- Intercropping with beans or sorghum is effective in reducing the disease incidence
- Plant resistant varieties such as Serenut 2-14 series or Igola 1.
- Spray whole plant with insecticides, such as dimethoate 14 days after emergence (usually 5mls per 2 litres of water, and then at 10-day intervals for a total of four sprays).



Early and late leaf spots

Early leaf spot and late leaf spot are the most damaging diseases of groundnuts. They affect the yield and quality. They affect the leaves, causing dark brown spots on the leaves and affecting stand and yields. A farmer may confuse leaf spots with harvest indicators making mitigation measures difficult.

Management

- Crop rotation with cereals has shown less damage by the disease
- Early sowing has been shown to reduce the severity of leaf spot diseases.



Groundnut rusts

Rust is an important foliar diseases that causes substantial losses to groundnut production and reduction in seed quality. Brown to dark reddish-brown pustules appear on the lower surface with the upper surface developing yellow, chlorotic spots with necrotic brown areas in the center. Severely infected leaves turn necrotic and dry but remain attached to the plant.

Management

- Crop rotation and field sanitation.
- Early sowing to avoid disease incidence.
- Intercropping pearl millet or sorghum with groundnut (1:3) is useful in reducing the intensity of rust.
- Use resistant/tolerant varieties
- Selected Cultural practices of Pest and Disease management

Crop rotation

- Groundnut is a legume crop and belongs to the Fabacea botanical family with the ability to fix Nitrogen. This Nitrogen is partly immediately used by the groundnut crop. However, most of the Nitrogen fixed will be available for the following crops.
- A crop rotation of 3 years and longer reduces risks in the farming system by minimizing disease, pest and weed problems. One of the best crops to follow groundnuts is a grass fallow or a grass crop. Cereals, such as maize, sorghum and millet are good rotational crops, and other clean-weeded

crops such as cassava, sweet potato and sunflower can also be used.

- On the other hand, crops such as soybean, tobacco, tomatoes and certain other vegetables may cause a build-up of nematodes and soil-borne diseases and therefore should be avoided in rotation with groundnuts.
- To avoid build-up of pests and diseases, groundnuts should not be grown on the same land continuously.
- Also AVOID growing ground nuts after cotton to reduce on the pest build-up.

Intercropping

- Groundnuts are grown as a sole crop and also intercropped with maize, soybean and cassava. It is also a good intercrop for upland rice, sorghum, okra, sugarcane, and sunflower. To get a good yield however, proper planting distance should be observed along with the other recommended cultural practices.
- In some areas, they are grown under perennial tree crops such as coconut, oil palm or rubber.
- Groundnuts when used as intercrop for upland maize and planted along the contour reduce soil runoff. The plant also reduces population of African bollworm because it serves as a hiding place for beneficial insects.
- There is an increase in the yield of groundnuts when intercropped with early maturing pigeon pea.
- Organic control of pests and diseases in groundnuts (attach as a leaflet since it is not limited to groundnuts)

A) PLANT EXTRACTS

Ginger rhizome extract

- Grind 50 g of ginger and make into paste.
- Mix with 3 litres of water.
- Strain.
- Add 12 ml of soap.
- Mix well
- This spray controls aphids, plant hoppers and thrips.
- ***Ten (10) kg of ginger is needed for 1 ha.



Milk spray

Method of preparation

- Mix 1/2 litre of milk to 4.5 litres of water
- (Milk and water ratio is 1 part milk to 9 parts water).
- Spray at weekly interval as a preventive control measure.
- Pests controlled
- Spider mites
- Mildews
- Mosaic virus
- Leaf blights
- Fungal diseases



Garlic bulb spray

Method of preparation

- Finely chop 85 g (about 2 bulbs) of garlic.
- Soak chopped garlic in 50 ml of mineral oil
- or 1-2L of water for 1 day.
- Add 10 ml of soap to the soaked garlic.
- Dilute with water to make a spray solution in the ratio of 1 part to 9 parts of water.
- Stir well.



Pests controlled

- Thrips
- Aphids
- Whiteflies
- Tomato fruitworm

***This spray also controls bacterial and fungal diseases like black spots, blights, fruit rots and mildews

Neem leaf extract

Method of preparation

- Pound gently 1-2 kg of neem leaves. Place in a pot.
- Add 2-4 litres of water.
- Cover the mouth of the pot securely with the cloth and leave it as such for 3 days.
- Strain to get clear extract.
- Dilute 1 litre of neem leaf extract with 9 litres of water.
- Add 100 ml of soap. Stir well

Pests controlled

- Aphids,
- Colorado potato beetles,
- Grasshoppers,
- Grubs,
- Japanese beetles,
- Leafhoppers,
- Locusts,
- Plant hoppers,
- Scales,
- Snails,



- Thrips,
- Weevils,
- Whiteflies

Onion Bulb Extract

Method of preparation

- Finely chop 50g of bulb-onion
- Add to 1litre of rain water
- Shake well and strain

Diseases controlled

- Alternaria
- Anthracnose
- Fusarium wilt
- Fungal leaf blight



Control Of Specific Pests.

Cutworms

A) Plant extracts

Finger euphorbia plant extract

- Cut a branch and collect the oozing sap.
- Add 1 litre of water to every 10 drops of the sap.

Another method is to cut a mature branch and pound it finely to make it into a paste. Add this to 10 litres of water. Leave it for some time then strain.

B) Use of organic pheromone traps

- Mixture of 0.5kg of detergent(OMO) with 2 ripe bananas+ 0.25 litres of honey+ 0.25kg of cowdung+2kgs of brewer's yeast+20 litres of water.



Physical/Mechanical Organic Pest Control Methods

Sticky board trap

To use, place 1-4 sticky cards per 300 sq m field area. Replace traps at least once a week. To make your own sticky trap, spread petroleum jelly or used motor oil on painted plywood of desired color, 6 cm x 15 cm in size or up. Place traps near the plants but faraway enough to prevent the leaves from sticking to the board. Traps when hung should be positioned 61 cm zone above the plants.

Pests monitored/controlled

Blue sticky cards Thrips

White sticky cards Flea beetles, tarnished plant bugs

Yellow sticky cards Aphids, cabbage root maggots, carrot rust flies, cabbage white butterflies, gnats and whiteflies



7. Rogueing of groundnuts

This activity is paramount in

1. Reducing possible sources of pests and disease infestations in the groundnut field
2. Ensuring purity of the variety is maintained for farmers who may want to participate in Local Seed Business as well as producing for seed to be used in the subsequent season.

This activity has four different stages of the groundnut growth namely;

At seedling stage

- Target volunteer plants, perennial weeds which are larger than the crop seedling
- Weak, distorted variegated, diseased and out of the row aligned seedlings

At flowering stage

- Other varieties, off types- having different flower colour, branching pattern and growth habits

At maturity stage

- Other varieties, off types with different colour, height and maturity

At harvest stage

- Target to remove plants which differ in appearance from seed crop variety; diseased pods and pods and seed characteristics.

6

Harvesting of Groundnuts

A. Learning objectives

After completing this module, participants will:

- Identify signs of maturity in groundnuts.
- Understand the correct stage of harvesting groundnuts.
- Learn the different methods and practices involved in groundnut harvest.

B. Duration

3 hours

C. Learning aids

- Forked hoes.
- Tarpaulins.
- Gunny bags.
- Mature ground nut seed in kernel
- Immature groundnut seed in kernel

D. Activities and exercises

Look back at what has happened since the last meeting. (10-20 minutes)

- **In the participant fields:** Take a few minutes to ask participants what they have been able to apply at home since the last session and with what results. Allow participants to share their experiences with each other, highlight their successes and ask questions if they have any.
- **In the demonstration field:** Also take a few minutes to observe with the participants what has happened in the demonstration field since the last session. What has changed, how have the plants grown?

Introduction (20 minutes)

The trainer will introduce the topic and ask the following questions to stimulate the discussion:

- What are signs of maturity (harvest indices) in the groundnut crop?

- What is the correct stage of harvesting? When do you harvest your groundnut?
- What are the common mistakes made by farmers during harvesting of groundnut?

This can be directly in the field, so that participants can look at sign of maturities directly on the crop.

Demonstration (2 hours)

The participants, together with the facilitator, will harvest the groundnut. This training should be done at the demonstration sites so that the farmers learn good harvesting practices and replicate in their fields at household levels.

E. Content

7.1. Maturity determination

- Harvesting is a very critical operation in groundnut production and if not handled carefully can lead to great loss.
- Mature Groundnut pods possess a skin (testa) that does not easily rub off, and which has a thin papery texture with the characteristic colour of the variety.
- An immature seed has a thick, fleshy skin with a pale colour which rubs off easily.
- Harvesting should be when over 75% of the seeds are mature.
- The different maturity indicators, include;
 - Colour changes especially inside portion of kernel from brown to black.
 - Kernels produces sound when shaken
 - Number of days a particular variety takes to mature after planting (Gestation period)

Harvest indices

a. Hull scrape method

In this method we look at the saddle area, the colour it displays has the following implications;

In this method we look at the saddle area, the colour it displays has the following implications;

Colour	Implication
Black	Mature to over mature
Dark black	Mature
Orange/light brown	Close to mature
Yellow	Immature
White	Immature to underdeveloped

b. Shell interior method

If it is black, it's mature. If it's dark black then it's over mature and if it is white then, immature.

c. Days after planting

This depends on the period a particular variety has been observed to take till maturity.

7.2. Harvesting techniques

Two major harvesting techniques are used during groundnut harvesting; hand pulling and the use of hand hoe/ox drawn plough. Whichever method used, the farmer has to harvest with care to avoid injury to the seeds and pod.

- **Hand pulling** Mostly done for erect/semi erect type in well drained sandy loam. This can be done only during rainy season and is suitable when the soil is moist and soft. This technique involves the farmer holding the entire group of branches of plant and applying force while uplifting the base.
- **Hoe/Ox - drawn plough:** This technique is mostly used for spreading groundnut varieties (Serenut 3R), on heavy soils and during dry conditions. This method is effective in lifting the entire crop from soils with a reduced pod loss. The farmer needs to be careful for the blade not to injure pods and seeds during harvest. A forked hoe/plough is preferred for use because it causes less pod/seed damage than unforked ones. When pods are damaged during harvesting, mould will enter and produce aflatoxin contamination. The situation becomes worse when drying takes place on bare ground. The freshly harvested groundnuts should be cleaned and sorted to remove damaged nuts and other foreign matter to observe quality. It is important to shake the plant well after lifting to remove soil. Damaged pods should be avoided because they are easily attacked by aflatoxin.



7

Post-harvest handling

A. Learning objectives

After completing this module, Participants will:

- Learn the different stages of post-harvest handling in groundnuts.
- Identify common mistakes during post-harvest handling that affect quality and quantity.
- Learn how to minimize aflatoxin development
- Learn basic technologies in during post-harvest handling.

B. Duration

1.5 hours

C. Learning aids

- Tarpaulins.
- Gunny bags.
- Containers.
- Pallets.
- Fact sheets on control of aflatoxin
- Groundnut seeds at least on bag.

D. Activities and exercises

Introduction (20 minutes)

The trainer will start the topic of the day. The following questions can be used to stimulate the discussion:

- How do you handle groundnuts after harvesting, how do you dry them?
- To key aspects do you pay maximum attention after harvesting?
- What problem can you encounter during storage?

Demonstration (2 hours)

This training should be at the time the farmers are harvesting so that the knowledge the farm-ers will get they will use at their household level. Participants, together

with the facilitators, will apply post-harvest operations. This should be at the group demo site and demo host's home. The group members will practically participate in drying their groundnut demo crop. This session should also be used to start drying the groundnuts harvested from the group demo plot and knowledge acquired will be used by the trainees in their individual household fields.

Summary (30 minutes)

The facilitator will summarize important aspects of post-harvest handling of tomatoes.

E. Content

8.1. Drying

Proper harvest and drying have the greatest influence on groundnuts quality and marketing. It is therefore recommended that drying must begin immediately after lifting to prevent mould and spoilage. It is important to shake the pods well during harvest to remove soil particles that might delay drying. Drying should not be on bare ground and special care must be taken when drying in bad weather to avoid pod loss, splitting shell discolouration, mould attack and afla-toxin contamination. Recommended drying practices

- Do not dry groundnuts in contact with soil.
- Use clean sheets, for example polythene sheets, or tarpaulin or mats made of papyrus, ce-mented grounds or raised structures
- Dry groundnuts as soon as possible.
- Sundry grain to bring down its moisture for proper storage of groundnuts



8.2. Storage

The fundamental reason for proper drying of groundnuts pods is to increase storability and prevent growth of storage fungi. Therefore groundnuts must properly dry before placing in a storehouse. The storehouse must be dry, cool and well ventilated. It is best to store groundnuts in their shells at optimum moisture content of 9%. Farmers with large quantities of groundnuts should avoid using

plastic or canvas covers that may cause increased moisture/condensation leading to hotspot formation. Discard diseased, sprouted or insect-damaged pods and only store healthy dry pods.

Storage requires good sanitation, ventilation and pest control. If groundnuts are to be stored for a length of time, storage in unshelled form or in shells is recommended.

Methods of storage

- Use of bags.
- Use of granary.
- Ensure there are pallets on which the packed groundnuts are placed, but not on the floor



8.3 Shelling

Mechanical damage to foodstuff during shelling, threshing and winnowing makes them much more vulnerable to invasion by storage moulds, including *A. flavus*. Under any given environmental conditions fungal growth may be much more rapid in damaged compared to intact nuts. Cracks and breaks in groundnut pods and testa are caused mainly during shelling by trampling or use of machines. There are two types of groundnut shellers now. The hand operated and the motorized shellers. The latter normally uses electricity and can be a simple type of sheller that only handles small volumes of groundnuts or a big type that handles several bags of groundnut per hour.

8

Record keeping

Activity 1: Introduction to record keeping

A. Learning objectives

After this session participants will:

- Be aware of the importance of record keeping and be able to record costs and income of the target crop.
- Know how to calculate the gross margin in order to assess the profitability of a crop and find out ways of potential improvements.

B. Duration

2-3 hours

C. Learning aids

- Flip charts,
- markers,
- calculator.

D. Activities and exercises

Introduction

The trainer will introduce the topic of the day. He will stimulate the discussion by asking the following questions:

- Do you know how much profit you generate with the target crop the last season?
- Do you know which expenditures are most important in the production?
- Do you know if your costs were higher or lower than your income?

Practical exercise

1. The facilitator asks the group to list all the expenses and costs (means of production and la-bour) they had for the target crop during the last crop year (or other crop). Producers are invit-ed to mention them from memory. Do not

forget the value of family labour and the costs of paid labour. The facilitator records the costs mentioned by the producers in the table below (on a flip chart).

2. Once the production costs are listed, the facilitator asks the group about the income: What have you done with the harvest product? Did you sell the entire production or only part of it? How much did you earn from the sales? Do you still have a remaining stock, how many bags/kg? The facilitator writes the cash income or the value of the production (in case of no cash value) in the table under part B. Income. (**see page 54**)
3. The facilitator explains how to compute the **gross margin, which is total income minus the total costs**. Then he asks the group whether the production of this crop is profitable or not (see if the gross margin is positive or negative).
4. The facilitator asks who wants to try to keep a record for the target crop during this season. The facilitator distributes the above table to the participants. The latter should write down their expenses (materials and labor). At each session, the host farmer could present his data (or in turn). It could serve as starting point for a group discussion on the similarities and differences in the record keeping among the participants. And report on the difficulties faced in filling the table.

Activity 2: Gross margin analysis

A. Learning objectives

By the end of the training the participants are able to:

- analyze the record keeping and the gross margin, and identify how to improve the profitability of the target crop

B. Duration

2-3 hours

C. Learning aids

- Flip charts,
- markers,
- calculator.

D. Activities and exercises

- The host farmer and each participant who recorded his costs and income present them to the group. Before the session, the facilitator can help the producers to copy the table on a flipchart to make it easier to read during the session.

Table for the calculation of the costs and income for a crop

Name of farmer:		Village/district:	
Date of calculation:			
Time period (season from/to):			
Crop:			
Total field area (ha):			
Total yield (kg):			
	Quantity	Unit cost (Ushs)	Total (Ushs)
A. Production costs (input)			
Materials			
Seed	3 bags	600	1800
Organic fertilizers:			
- Manure			
- Compost			
Mineral fertilizers:			
- NPK			
Pesticides:			
Packaging bags			
Labor (Person-days)			
Soil preparation	2 man days	2000	4000
Manure application			
Planting			
Weeding/ Hilling up 1			
Weeding/ Hilling up 2			
Dehaulming			
Harvesting			
Threshing			
Transport			
Total production costs (a)			
B. Income (output)			
Sales			
Home consumption*			
Remaining (storage)*			
Others*			
Total income (b)			
Gross margin (b - a)			
Profit per acre (Gross margin divided by field area)			

**Convert in monetary: kg multiplied by market price.*

- The facilitator initiates the discussion on the analysis of the results by asking the following questions. What are the reasons for the different figures/results between the producers? What does a positive or negative gross margin mean? What are the factors that influence expenditures and income? If the gross margin is low or negative, which expenditures could be reduced and how? Which price should you sell your products to make a profit?

