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

HANDBOOK ON

IMPROVED AGRONOMIC PRACTICES OF GROUNDNUT PRODUCTION IN NORTH EAST NIGERIA

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Forward and Acknowledgements

This handbook is intended to guide farmers, extension personnel, students of agriculture and researchers in Nigeria to use improved varieties and associated production practices to increase productivity. The guide draws its lessons from the work and experiences of ICRISAT and its partners in Research for Development on crop-based systems in Nigeria. The publication of this handbook is a demonstration of effective collaboration between ICRISAT, Institute for Agricultural Research (IAR), Ahmadu Bello University (ABU) Zaria, National Agricultural Extension Research and Liaison Services (NAERLS), Federal Ministry of Agriculture and Rural Development (FMARD), numerous farmers' groups and Innovation Platform (IPs). The authors are grateful to the Management of these Institutes and organizations and gratefully acknowledge the work of other researchers that have helped immensely in compiling this manual.

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Introduction

Groundnut (*Arachis hypogaea*) is central to the financial and nutritional well-being of millions of farmers and consumers across North East Nigeria. Nutrition experts point out that groundnut provides over 30 essential nutrients and is an excellent source of niacin, fibre, and vitamin E. Rich in anti-oxidants, the crop is naturally free of trans fats and contains about 25% protein, a higher proportion than any other true 'nut'. It is a staple food and valuable cash crop. The nut is high in oil (between 40-50%) and protein (between 25- 32%) content, and also a good source of essential vitamins and minerals. Groundnut has many culinary and industrial uses, and its year-round demand means that farmers can increase production without fear of market glut. Being a labor-intensive crop, it generates employment for the rural poor. Groundnut improves soil fertility through nitrogen fixation, thereby increasing the productivity of other crops when used in rotation or in a cereal-legume cropping system. Nigeria is the largest groundnut producing country in West Africa, accounting for 51% of production in the region and contributing about 10% of total global production and 39% to that of Africa. A large percentage of this is produced in the North East part of the country. Groundnut, is grown by over 57% and 33% of farmers in Adamawa and Borno States, respectively. It is mostly sold or processed for income generating activities. Nigeria's groundnut production has been increasing at 8% per annum, resulting from area expansion of 6% and increased productivity of 2%. Nigerian groundnut farmers have for many decades relied solely on long-duration local varieties that are low yielding and have low resistance to diseases; this affected productivity greatly. Groundnut production is constrained by the combined effects of drought, increasing prevalence of diseases such as rust, leaf spots and groundnut rosette disease (GRD) which have caused a decline in production. ICRISAT and partners have over the years developed improved varieties and accompanying technologies to increase groundnut productivity. Some of these varieties have been disseminated widely with positive impacts on yields and farmers who adopted them. The USAID Feed the Future Integrated Agriculture Activity will disseminate selected improved groundnut varieties accompanied by management technologies for market-oriented farmers in the North eastern states of Nigeria.

Production Requirements

Site Selection and Land Preparation: The field for groundnut production should have soil that is well drained with sandy, loamy, or sandy-loam texture. It is advisable not to grow groundnut repeatedly on the same field for more than two years, as this may lead to build-up of soil-borne diseases and pests and also become nutrient deficient. Groundnut-cereal rotation is ideal as the fertilizer applied to the cereals in the previous season(s) can be effectively used by groundnut, which in turn enriches the soil with nitrogen through biological nitrogen fixation for the subsequent cereal crop, thus requiring a lower dose of fertilizer. Therefore, proper crop rotation can lead to higher yields and substantial reduction in cost of disease control and fertilizer requirements. Prior to sowing, the field should be cleared of all shrubs, stubble, and crop residue from the previous crop. This helps avoid disease attacks and provides a smooth ground for growth and development.

Conventional tillage (harrow and ridge) is encouraged, as this ensures higher yields than conservation tillage (no-tillage, minimum tillage, reduced tillage and strip tillage). The land should be ploughed and harrowed before making ridges to provide a good tilth for seed emergence. Groundnut may be planted on flat land or on ridges. Planting on ridges produces higher yields, allows easy drainage of excess water, avoids compaction of seed beds and facilitates field operations such as weeding.

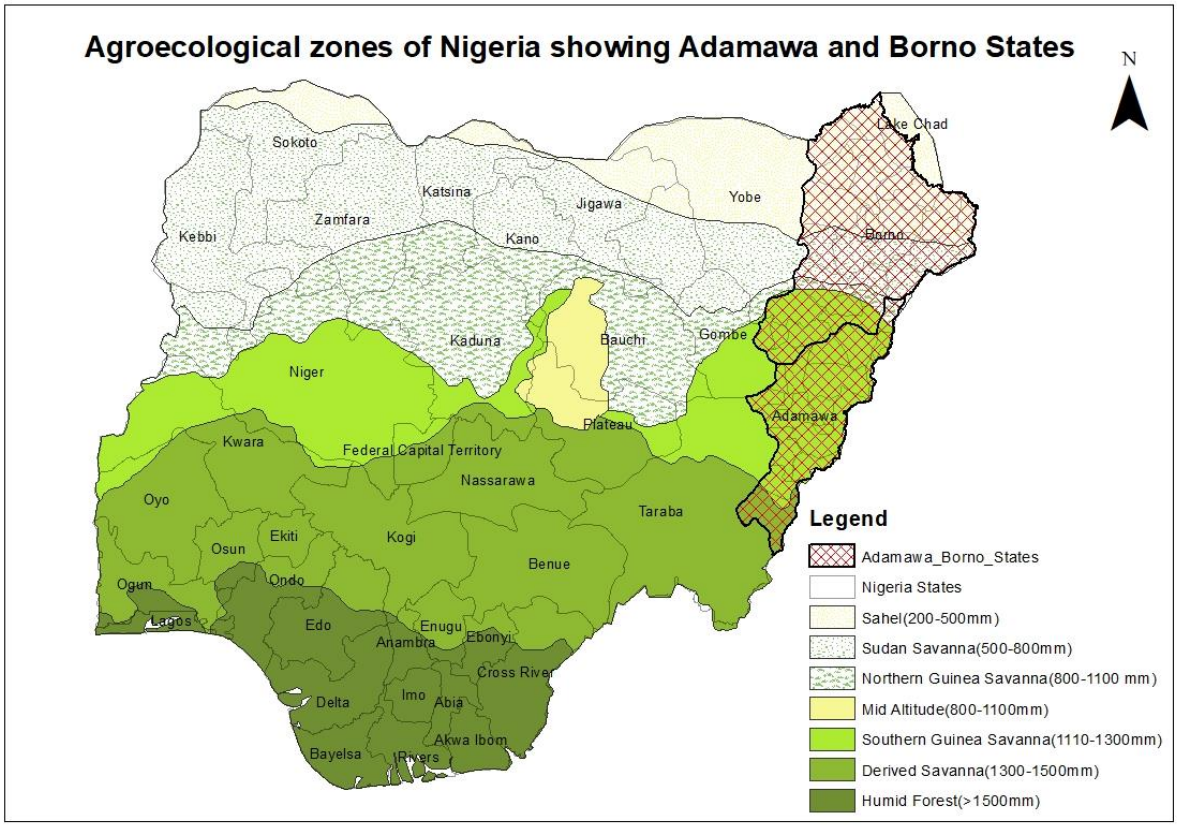
Variety Choice

Some farmers associate large seed with better quality. Others believe that smaller seeds germinate faster and are therefore better. Seed size is a function of the variety. Large seeds need more moisture and therefore take more time to imbibe moisture and germinate. Seeds smaller than the average size of the variety are likely to be immature and should be avoided. Good seeds should be uniform in size, shape and color that conform to the variety in question. The quality of seed used for production will determine the ultimate yield that will be obtained. When selecting seeds of groundnut for cultivation, the three important factors to consider are its source, viability and lifecycle. When good seed is obtained, it is necessary to know how long it takes for the variety to mature so that the prevailing rain pattern in the particular environment suits its production. Early-maturing varieties, for instance, are more suitable for areas with shorter annual rainfall, while late-maturing types will not perform in such environments but rather in areas with longer rainfall duration.

Table 1. Major improved groundnut varieties for North East Nigeria.

S/N	Variety	Features
1.	Samnut 22	Medium maturing (115-120 days), resistant to early and late leaf spots (ELS and LLS), dual purpose (kernel and haulm), high haulm yield (4-5 t/ha), high pod yield (2-2.5 t/ha) and good oil content (48%). Suitable for southern Adamawa State.
2.	Samnut 23	Early maturing (90-100 days), haulm yield of 2 t/ha, good pod yield (2-2.5 t/ha) and high oil content (56%) and quality, resistant to ELS and LLS. Suitable for southern Borno and most part of Adamawa State.
3.	Samnut 24	Early maturing (80-90 days), good haulm yield (2.5-3 t/ha), vigorous plant growth, good yield (2-2.5 t/ha) and high oil content (53%), moderately resistant to ELS and LLS, resistant to rosette disease. Suitable for Borno and northern Adamawa State. Excellent in the dry season.
4.	Samnut 25	Early maturing (80-90 days), good yield potential (2.5-3 t/ha), highly resistant to rosette and moderately resistant to ELS and LLS, and high oil content (51.5%). Suitable for Borno and northern Adamawa State.
5.	Samnut 26	Early maturing (80-90 days), highly resistant to rosette and moderately resistant to ELS and LLS, good yield potential (2-2.5 t/ha) and good oil content (50.9%). Suitable for Borno and northern Adamawa State.
6.	Samnut 27	Extra-early maturity (80-85 days); escapes end-of-season drought, tolerant to Early and Late Leaf Spots, resistant to rosette disease, pod yield of 3.5 t/ha, haulm yield of 3.5 t/ha and good oil content estimated at 45%. Suitable for Borno and northern Adamawa State.
7.	Samnut 28	Medium maturity: 100-105 days, tolerant to Early and Late Leaf Spots, resistant to rosette disease, pod yield of 3.0 t/ha, haulm yield of 3.0 t/ha and good oil content estimated at 47%. Suitable for southern Borno and whole of Adamawa State.
8.	Samnut 29	Early maturity (90-95 days), escapes end-of-season drought, moderately resistant to Early and Late Leaf Spots, resistant to rosette disease, pod yield of 3.3 t/ha, haulm yield of 3.3 t/ha and good oil content estimated at 46%. Suitable for Borno and northern Adamawa State.

The maturity period usually comes from the source of the seed, and information about this may be obtained from seed companies, seed vendors, extension agents and lead farmers. Disease-free, clean, unbroken and physiologically-matured seeds should be used for planting. Some newly released groundnut varieties in Nigeria and their characteristics are listed in Table 1.



Seed Treatment

It is recommended to treat groundnut seeds with fungicides to avoid rot, pre- and/or post emergence damping off of seedlings. Some insects are also known to attack emerging groundnut seedlings. In addition to seeds and seedling protection, seed treatments reduce seedborne infections during germination and allow initial vigorous plant growth. To control the pathogens causing seed and seedling diseases, it is necessary to coat the seed with either Metalaxyl or Dithiocarbamate (Mancozeb) before sowing. Seed treatment before planting ensures the establishment of good plant stand, seedling vigor and subsequently, good yield. Care should be taken while mixing these chemicals as they are poisonous, and the directions for use indicated on the label should be strictly adhered to.

Sowing and Sowing Date

Groundnut should be sown when rain is well established in the rainy season. This varies with the agroecological zone, usually happening towards the end of June in the Sudan Savanna zone but sometimes much earlier in the Northern and Southern Guinea Savannas. With the current fluctuation in weather, it is difficult to give a standard date for planting, but farmers should plant as soon as there is adequate and consistent moisture in the soil for good germination and subsequent plant growth.

The seed rate depends on the variety, seed mass, planting distance and germination rate of the seed lot. The recommended spacing for bunch varieties is 75 cm x 20 cm; 75 cm x 10 cm, or

50 cm x 20 cm, while semi-spreading and spreading varieties can be planted at 75 cm x 20 cm or 75 cm x 25 cm. It is, however, important to find out the required or optimum plant population with inter- and intra-row spacing for any selected variety at one's location from extension agents or the seed source.

Number of seeds per hole during planting

This notwithstanding, two seeds should be sown at a depth of 5 cm. Sowing deeper than this leads to delayed emergence, elongated stems of germinating seedling, poor shoot and root development, poor nodulation and decreased nitrogen fixation, which will consequently lead to reduced yields. Thinning is not normally required in groundnut as this disturbs the seedling and because groundnut seeds are normally expensive. Therefore, farmers should pay attention to the seed sources and quality of seeds to ensure maximum germination and good seedling vigor.

Weeding

Groundnut cannot compete effectively with weeds, especially during the first 3 to 6 weeks after sowing. There is therefore need for early weed control for better yield. The average yield loss due to weeds has been reported to be about 30% and may reach up to 60% under poor management practices. It is thus advantageous to control weeds on groundnut fields using mechanical or chemical means, especially during the initial six weeks of growth. A combination of two or more weed control measures usually provides better results and is therefore more economical. The most effective way is to apply a pre-emergence herbicide like pendimethalin, followed by mechanical or hand weeding once or twice during the cropping season to keep the crop free of weeds.

The choice of weed management method depends on the type of weeds and the level of infestation. Generally, 2 to 3 weeding operations are recommended, the first before flowering and one more during and after pegging. Once pegging begins, soil disturbance near the plant should be avoided or kept to a minimum to avoid interfering with the developing pods. Instead, the tall weeds at this stage can be controlled by manual pulling.

Fertilizer Requirements

Groundnut has been reported to respond better to residual fertility than to direct fertilization. This means that if a well-fertilized crop precedes a groundnut crop, direct fertilization may not increase the yield or quality of the groundnuts. If fertilizer is needed, it is best to broadcast and incorporate it with the soil during land preparation. A soil test is the best way to determine whether fertilizer or lime is required in groundnut cultivation. Liming is necessary only when the soil pH is below 5.8. However, if soil test results are not available, the general fertilizer recommendation is of one bag of NPK 15:15:15 and two bags of Single Super Phosphate (SSP) per ha. Muriate of potash can also be applied if available. If the groundnut crop follows a well-fertilized cereal crop, then two bags of SSP per ha may be sufficient. Alternatively, 3-5 t of organic manure per ha have been found to increase pod and haulm yields significantly. Organic manure also contains micronutrients that may be essential for nodulation. Application of 400 kg/ha gypsum at peak flowering/pegging stage improves seed filling and increases the oil content.

Harvesting

Groundnut is an indeterminate plant, meaning that pod maturity is not continuous or not uniform. Harvesting should therefore be time-bound when most of the pods are mature. This is because waiting for all the pods to mature will result in sprouting (Plate 1) of the already matured ones. Early or premature harvesting, however, lowers the yield, oil quantity and seed

quality. Plants from immaturely harvested seeds germinate slowly and have low vigour and their survival can be difficult under stressful conditions. In addition to sprouting of already mature pods, delayed harvesting leads to loss of over-mature pods during harvest due to weakening of pegs, and increases the possibility of aflatoxin-producing fungi infections. In areas with early rainfall cessation, the crop should be harvested as soon as possible to avoid hardening of the soil, which makes harvesting difficult.

Plate 1: Damaged pods with germinating kernel due to delayed harvesting

A practical way of determining the optimal time for harvest is to look for darkening of the internal surface of the shells and when the seed coat becomes thin and tight on the kernel. Harvesting is also advisable when 70-80% of the pods have matured and pods are plump and show true colour of the variety used.

Groundnut can be harvested either by hand pulling the entire plant (this is possible only when there is enough moisture in the soil) or using a hoe or animal-drawn plough. Animal drawn ploughs (Plate 2) are effective in lifting the entire crop from soils, with low pod loss. The harvested plants should be shaken well to dislodge soil from the pods and kept inverted with the pods facing upward in the field sun drying for 2-3 days. This initial drying is very important because packing of wet pod in bags for as little as 24 hours can lead to considerable damage and rotting as well as aflatoxin build up. However, groundnut pods can also be dry in a mechanical dry under low temperature. This is common under large scale production.

Plate 2: Animal-drawn groundnut digger

Drying and Storage

After harvesting groundnut, plants are stacked in the field for between 3 -5 days for air and sun drying before stripping the pods. Stripping of the pods from the plant is usually done by hand and largely by women and the children (Plate 3). However small-scale stripper is available and can be constructed locally. The pods are continuously dried till the moisture content is between 8-10%. This avoids the development of aflatoxin-producing agents and also preserves seed viability. Increasingly, harvested plants are taken home for drying due to thefts on farm fields, especially if scarce, improved varieties are planted.

After cleaning, the dry pods are stored in bags and stacked to allow free air circulation. The bags should be piled on wooden planks, not directly on the floor, to avoid damage from water and contamination by aflatoxin-producing fungi.

Plate 3: Manual harvesting and stripping of groundnut

Decortication or Shelling

This could be done either by hand-operated or motorized decorticating machines. Whatever the method used; care should be taken to prevent cracking of the kernels. The following steps are important for maximum benefit in groundnut decortication:

- Remove immature pods and those infested by pests and diseases.
- Do not shell by beating or trampling.
- Remove shrivelled, discoloured, mouldy and damaged grains from the lot including groundnuts with damaged testa and discard them.
- Remove dirt and any foreign materials which can be a source of contamination.

Groundnut Diseases and their Control

Groundnut production is adversely affected by a large number of fungal, viral and bacterial diseases. Most of these are widespread, but only a few of them are economically significant. The major diseases in Nigeria are rosette, early leaf spot (ELS), late leaf spot (LLS), rust and aflatoxin.

Plate 4: (L-R) Rosette-resistant and susceptible groundnut varieties.

A. Groundnut Rosette Disease

Groundnut rosette disease (Plate 4) is a viral disease transmitted by aphids. It is the most common and most significant disease of groundnut in all regions where groundnut is grown. It is widespread in sub-Saharan Africa (SSA) and has been a major factor in the decline of groundnut production in Nigeria.

Symptoms: The disease has two types of symptoms: green or yellow (chlorotic). Affected plants are stunted and present a bushy appearance with a marked reduction in leaflet size with visible mottling.

• Yellow (chlorotic) rosette causes plants to 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, while the symptoms in older plants are generally restricted to a few branches or the apical portion of the plant.
• Green rosette disease shows middle mottling on young leaflets with some leaf curling, but leaves are not distorted. Plants infected when young are severely stunted and dark green in colour. Early infected plants produce no yield and there is no control once a plant is infected. A 100% loss in pod yield due to the disease may result if infection occurs before flowering. Control of aphids will prevent further spread of the disease.

Management and Control

1. ***Host plant resistance***

- Improved varieties that are resistant to rosette disease are available and should be preferred. Samnut 24, Samnut 25, Samnut 26, Samnut 27, Samnut 28 and Samnut 29 are resistant to rosette disease and are promoted in the project. The use of a resistant

variety is cheaper and more ecological friendly than any method of disease control. It should therefore be preferred wherever available.

2. ***Chemical control:***

Spray the entire plant with insecticide (cypermethrin, lambda Cyhalothrin, etc.) 14 days after emergence (usually 5 ml/2 l of water, but check the label for instructions) and then at 14-day intervals with a total of three sprayings. This kill or prevents the growth of aphids which are the main vector carrier of the virus on the plant.

3. ***Cultural control:***

- Planting should be done as soon as there is enough moisture in the soil.
- Close planting should be adopted.
- Intercropping with cereals (maize, millet or sorghum) has been found to be effective in reducing disease incidence.

B. Early and Late Leaf Spots

Early leaf spot (ELS) and Late leaf spot (LLS) are the most damaging diseases of groundnut worldwide. Besides adversely affecting yield and quality of pods, they also affect the yield and quality of haulms. Although just one leaf spot pathogen usually predominates in a production region, both leaf spot species are generally found in a single field.

Symptoms: ELS causes small necrotic flecks (spots) to develop which usually have light to dark brown centres and a yellow halo. The spots may range from 1-10 mm in diameter. Sporulation is on the adaxial (upper) surface of leaflets. In LLS, small necrotic flecks develop that then enlarge and become light to dark brown. The yellow halo is either absent or less conspicuous in LLS. Sporulation is common on the abaxial (lower) surface of leaves.
Farmers often confuse leaf spots with harvest indicators, making mitigation measures difficult. The disease(s) may be expressed on both leaves and stems, which results in poor crop stand and yields.

Management

Host plant resistance:

ELS- and LLS-resistant varieties should be used for planting in areas of where they are endemic. Samnut 21, Samnut 22, Samnut 23, Samnut 28 and Samnut 29, have been released in Nigeria and they are resistant to ELS and LLS.

Cultural control

- Crop rotation with cereals has been shown to provide partial management of leaf spots.
- Early sowing has been shown to reduce the severity of leaf spot diseases.
- The date of sowing should be adjusted to avoid conditions favourable for rapid disease development.
- Burying all groundnut crop residues by deep ploughing will reduce initial inoculum.

Chemical control

- Multiple applications of fungicides such as mancozeb or Carbendazim fungicides will control the spread of ELS and LLS.
- Carbendazim (0.05%) has been found to control both leaf spots effectively.
- Therefore, early- and medium-maturing varieties will need two sprays while late-maturing varieties should be sprayed three times.

C. Groundnut Rusts

Rust (*Puccinia arachidis* Speg.) is one of the important foliar diseases that reduces pod quality and causes substantial losses to groundnut production worldwide. If this occurs along with LLS, losses can be as much as 50%.

Symptoms: Rust pustules (spots) are orange coloured and appear on the lower surface of leaflets. On rupturing, they release masses of reddish-brown spots. In contrast to the rapid defoliation associated with leaf spots, leaves infected with rust become necrotic and dry up but tend to remain attached to the plant.

Management

Use of resistant varieties

In places where rust disease is endemic (common), the use of resistant/tolerant varieties in combination with a dose chemical control provides the best results. Samnut 21, Samnut 22, and Samnut 23 are resistant to rust.

Crop Management Practices

- Crop rotation and field sanitation help to reduce their presence in the soil.
- Strict plant quarantine regulations should be enforced to avoid the spread of rust on pods or seeds to disease-free areas.
- Early sowing minimizes disease incidence.
- Intercropping cereal (maize, pearl millet or sorghum) with groundnut is useful in reducing the intensity of rust.
-

Mechanical Control

Destroy volunteer (self-sown) groundnut plants and crop debris to reduce/limit primary source of inoculum.

Chemical Control

The use of 0.25% Mancozeb is effective for the control of rust disease, and should be applied as soon as the symptoms are noticed.

D. Aflatoxins

Aflatoxins are a group of toxic metabolites produced by the fungi *Aspergillus flavus* and *Aspergillus parasiticus*. Aflatoxins are some of the most potent toxic substances found in foods and feeds. Aflatoxin (Plate 5) contamination can occur during pre-harvest and post-production of groundnut. Crop husbandry practices, mechanical damage, insect and bird damage, climatic conditions (drought, stress or excessive rainfall), and soil factors, in addition to host-plant susceptibility, significantly influence aflatoxin contamination.

Plate 5: Aflatoxin contaminated groundnut kernel.

Recommended post-harvest practices to manage aflatoxin infection

Harvesting:

- Do not delay harvest when the crop has reached maturity.
- Immediately after harvesting, pluck the pods off the haulms and place to dry.
- Harvest carefully to avoid mechanical damage. This is particularly important if hand hoes are used to harvest the pods.
- Harvested plants should be shaken well to dislodge soil hanging on the pods and kept inverted with the pods facing upward for 2-3 days.

Drying

- Do not dry produce in contact with soil. Use clean sheets, for example polythene sheets or tarpaulin or mats made of papyrus, cemented grounds or raised structures.
- Dry harvested pods to moisture content level below 8 - 10%.
- Avoid mixing diseased or infected pods with healthy ones.

Shelling

- Separate immature pods from those infested with pests and diseases.
- Do not shell by beating or trampling on groundnut shells.
- Manual or motorized shelling is recommended but care should be taken that the shellers do not damage the pods (the use of appropriate sieves may help). Use hand or motorized shellers specifically designed for groundnuts.
- Do not sprinkle water on dry pods while using mechanical shellers. Instead, adjust (where possible) the space between blades and the sieve according to pod size to reduce breakage.
- Remove shrivelled, discolored, mouldy and damaged grains from the lot including groundnuts with damaged testa and discard them.
- Remove dust and foreign materials which can be a source of aflatoxin contamination.

Storage

- Dry groundnuts well to moisture content of less than 10% for safe storage.
- Place them in packages that will maintain suitable environment and prevent or restrict moisture accumulation and insect/rodent infestation.
- Use new/clean gunny bags or polybags to store groundnut pods.
- Put only clean sorted pods into bags.
- Do not place bags directly on floor.
- Do not heap groundnuts in shells/pods on the floor/ground inside storage structure
- Maintain proper storage facilities (well-ventilated, dry and with low relative humidity) and take care not to expose produce to moisture during transport.
- Control insects and rodents during storage.
- Do not mix new produce with old stock.

Major Pests of Groundnut

The majority of pests that attack groundnut can be grouped as:

- Soil inhabiting insects (e.g. termites, white grubs, earwigs, subterranean ants); foliage feeding insects (leaf miner, caterpillars, armyworm, bollworm);
- Insects that transmit viral diseases (thrips, aphids); and
- Insects that damage flowers and growing parts (blister beetle).

Termites, aphids, thrips and leaf miner are the most important groundnut pests.

A. Aphids: *Aphis craccivora* Koch

These are brownish-grey polyphagous insects feed on other plants. They are vectors of groundnut rosette disease, groundnut mottle virus and peanut stripe virus in Nigeria. Aphids can cause yield losses of up to 40% in groundnut. They can cause serious damage in drought situations when the crop is still young. Aphids are sporadic pests and attack crops at all stages. Both adults and nymphs feed mostly on growing tips and young foliage by sucking sap.

Management

- Groundnut should be sown at the right time after good field sanitation.
- Crop rotation should be practiced with a non-host crop.
- Intercropping with pearl millet has been found to be advantageous.
- Destroy volunteer plants and weeds.
- Use of chemicals: Spray Cypermethrin.

B. Leaf miner

Groundnut leaf miner (*Aproarema modicella* Deventer), a defoliator from the order Lepidoptera, is a very serious pest which attacks both the rainy and dry season crops and is regarded as the most important pest threatening groundnut production whenever outbreaks occur. It is much more damaging during the short rainy cycle when long drought precedes rains, and has been reported to cause total crop loss in some places.

Leaf miner larvae mine the leaves and feed inside the leaflets. Young larvae mine the leaves and later instars exit the mine to web together several leaflets. Damaged leaves become brownish, rolled and desiccated which leads to early defoliation and affects the growth and yield of the plants.

Management

- Groundnut-cereal rotation has been found to reduce leaf miner incidence.
- Manipule planting dates to avoid the pest build-up.
- Use leaf miner-resistant genotypes.
- Use trap crops.
- Botanical pesticides can be used.

C. Thrips:

Groundnut plants are usually attacked by thrips (*Scirtothrips dorsalis* Hood) 6 to 8 weeks after planting. Thrips have a short life cycle and may complete several generations per season under favorable conditions. They feed primarily in terminal leaf clusters between folds of young leaflets by scraping the tender leaf surface and sucking the plant juice. Symptoms of thrips damage include dwarfing and malformation of leaves particularly in crops in the harmattan season**.** Plants can outgrow this injury with no reduction in yield or grade under favorable conditions. However, delay in vine growth from early-season thrips injury may retard maturity.

Thrips can cause serious stunting of crops and yield loss from both direct feeding and virus transmission. They are carried, to a large extent, by wind. Secondary spread occurs when immature thrips develop on virus-infected plants and then mature to the adult stage and feed on other groundnut plants in the same field. The virus can only be acquired by immature thrips feeding on infected plants. As the thrips mature they move to other plants nearby thus spreading the virus from plant to plant.

Symptoms of damage

Yellowish-green patches on the upper surface of tender leaves and brown necrotic areas and silvery sheen on the lower surface are manifestations of infestation. Severe infestations cause stunting in plants.

Management

- Use of chemicals such as Cypermethrin.
- Mixture of chemical and botanicals: 1 ltr neem oil and 1 kg soap powder mixed in 200 l of water per acre, sprayed twice at 10-day intervals.
- Use resistant/tolerant varieties such as the Samnut series.

D. Termites: *Odontotermes* and *Microtermes spp*

Termite damage to groundnut is common when rainfall is low. The *Microtermes* and *Odontotermes* species cause serious damage. Microtermes kill plants directly by destroying the roots. Termite damage groundnut includes wilting of plants in patches, penetration and hollowing out of the tap root and stem thus killing the plant, or holes bored into pods and damage to seed. Termite attack weakens the shells, making them vulnerable to aflatoxin contamination.

Management

- Digging the termataria and destroying the queen is most important in termite management.
- Using well-rotted organic manure.
- Timely harvest of groundnut reduces the likelihood of termite damage on pods.
- Treatment of seed with appropriate chemicals may also reduce termite damage during sowing and the initial crop phase.

Storage Pests of Groundnut

Groundnut is stored both as unshelled pods and as kernels for different uses. Both forms are vulnerable to attack by a number of insect pests after harvest. More than 100 insect species are known to live and feed on stored groundnuts, some of which are of economic importance. Groundnut kernels are more susceptible to insect attack than pods in storage. The amount of damage inflicted by insect pests during processing and storage depends on several factors such as moisture content in the product, the form in which it is stored, stage of maturity at harvest, sanitation of storage space and the quality of the material itself. Following are some important storage pests of groundnut:

A. Groundnut bruchid (*Caryedon serratus* Olivier)

Groundnut bruchid, also known as peanut bruchid beetle, groundnut borer, or seed beetle, is a serious pest of stored groundnut, particularly when still in shells. The damage caused is particularly significant when the groundnuts are destined for processing.

Damage

Bruchid eggs (translucent milky-white) are attached to the pod walls of groundnut. After hatching, the larva burrows straight through the pod wall and starts eating the seed. The first sign of attack is the appearance of 'windows' cut into the pod wall by the larva to allow the adult to leave the pod after emerging from the pupal cocoon. They often live in storage sacks and pupate in large numbers at the bottom of the pile of sacks. By this stage, the groundnut grain/ will be too severely damaged for any use.

Management

- To prevent primary infestation from alternative hosts, avoid drying groundnuts near alternative host trees such as tamarind and acacia.
- When infestation is noticed, remove the infested seeds and follow up with the seed treatment.
- Storing groundnut kernel with dried neem leaves (about 500 g of leaves for 10 kg of kernel) in any sealed container can be effective.

B. Red flour beetle (*Tribolium castaneum* herbst)

Red flour beetle, also known as rust red flour beetle, attacks stored groundnut and other grain products such as flour, cereal grains, meal, beans, and nuts. This beetle causes direct and indirect losses in groundnut which affect both viability and quality.

Damage

The female lays eggs in cracks of the testa or on the damaged portions of the kernels to enable the young grub to feed on the kernel directly. The grub feeds on the kernels, making them unfit for any use. The damage results in powdery appearance in the produce. Infestation by adult beetles can be readily observed by the tunnels they leave when they move through the flour and other granular food products. When infestation is severe, these products turn grayish-yellow and become mouldy, with a pungent odour. Infestation may also be apparent by the appearance of adults on the surface of the seeds.

Treatment/control

- Fumigate the samples with appropriate chemical for 4 hours before storage
- Reject affected samples.

Dry Season Groundnut Production

Plate 6: Dry season groundnut in Northern Nigeria.

Groundnut was not commonly grown in the dry season in Nigeria mainly because of the incidence of aphids and associated rosette disease. However, ICRISAT and partners have successfully demonstrated its cultivation with the dissemination and adoption of early-maturing varieties like Samnut 24. Efforts through different partners and the availability of increased number of early-maturing, heat-tolerant varieties (Samnut 25 and Samnut 26 and Samnut 27) has led to many farmers embracing dry season groundnut production in several states in Nigeria, and this trend continues to grow. Unlike vegetables and fruits grown in the dry season, groundnut produced during this period coincides with the period of high demand for groundnut seeds, grains and fodder, thereby making a market readily available to farmers. In addition, the fodder from groundnut plants in the dry season provides a good source of income to farmers, since its price is highest in the dry season. The problems of post-harvest losses and market congestion as in the case of fruits and vegetables are also not a problem with groundnut production. Dry season groundnut production involves the same cultural practices as those in the rainy season, but with slight modifications. The basic agronomic practices are as follows:

Land Preparation: Land preparation is the same as in the rainy season, though some farmers use basin or beds instead of ridges, which is the usual practice in dry season crops and vegetable production. Old cereal ridges could be used for planting of groundnut in the dry season. This practice reduces the cost of land preparations and other things being equal, it increases profit. If the groundnut is planted early during the cold months of December and January, mulching with black polythene sheet is recommended. This will conserve temperature, moisture and reduce need for weeding.

Planting Date: The best time to plant is between January 15 and February 10, when temperatures are beginning to rise and conditions are conducive to good seed germination and seedling development. Alternatively, groundnut can be planted at the end of the rainy season in mid-October to escape harmattan low temperatures.

Planting Pattern: Planting can be done on ridges or flat beds. Planting on ridges should be done on sides of the ridges to ensure surface irrigation water reaches the seed for uniform germination and proper crop development. Basins can also be used to plant groundnut.

Irrigation: Dry season groundnut production should be done where there is a steady and reliable source of water for irrigation. Depending on soil type and climatic condition, an irrigation interval of 7-10 days can sustain plant growth. Usually, furrow irrigation is practiced, but sprinkler irrigation can also be used to ensure more crop coverage per drop of water.

Constraints: Since dry season groundnut production is usually done in areas where other crops are grown in the dry season, the major problem is that of defoliator and/or sucking insect pests. Insect are likely to migrate from other dry season crops (wheat, tomato and other vegetables) that are planted and harvested earlier to the groundnut field if planted late. Therefore, 2-3 applications of insecticides such as cypermethrin should be undertaken to protect the plants. Rotating the fields between groundnut and these crops is however a good crop rotation practice. Alternatively, if a farmer misses the opportunity of planting wheat and vegetable early in the dry season or due to shortage of fertilizer, groundnut cultivation is an excellent option with equivalent returns and better soil management. Dry season groundnut cultivation must ensure the use of Aphid- and rosette-resistant varieties because aphids are more common in the dry season.

Dry season groundnuts tend to be highly profitable because both the pods and haulms record very high premium prices. Seed production is also very good in the dry season and drying becomes easier especially when the crop is planted early enough.

Reference

Ajeigbe H.A, Waliyar F, Echekwu C A, Ayuba K, Motagi B.N, Eniayeju D and Inuwa A. (2014). A Farmer's Guide to Groundnut Production in Nigeria. Patancheru 502 324, Telangana, International Crops Research Institute for the Semi-Arid Tropics. 36 pp
http://exploreit.icrisat.org/profile/Groundnut

Ousmane, B. and H.A. Ajeigbe, 2009. Cowpea and groundnut seed production practices. In: Ajeigbe, H.A., T. Abdoulaye, and D. Chikoye (Editors) 2009. Legume and cereal seeds production for improved crop yields in Nigeria. Proceedings of the training workshop on production of Legume and Cereal Seeds 24 January–10 February 2008 International Institute of Tropical Agriculture, Kano Station Kano, Nigeria. Funded by Arab Bank for Economic Development and Reconstruction, and Organised by IITA and the National Program for Food Security. 108 pp

Vabi B.M., Mohammed S.G., Echekwu C.A., Mukhtar A.A., Ahmed B., Ajeigbe, H.A. and Eche C.O. (2019). Best Choices for Enhancing Groundnut Productivity in Nigeria. ICRISAT, Patancheru. 29 pp.

ICRISAT HIGHLIGHT

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) is a non-profit, non-political organization that conducts agricultural research for development in the drylands of Asia and sub-Saharan Africa. Covering 6.5 million square kilometers of land in 55 countries, the semi-arid or dryland tropics has over 2 billion people, and 644 million of these are the poorest of the poor. ICRISAT and its partners help empower these poor people to overcome poverty, hunger and a degraded environment through better agriculture. ICRISAT is headquartered in Hyderabad, Telangana State, in India, with two regional hubs (Nairobi, Kenya and Bamako, Mali) and country offices in Niger, Nigeria, Zimbabwe, Malawi, Ethiopia and Mozambique. ICRISAT conducts research on six highly nutritious drought-tolerant crops: chickpea, pigeon pea, pearl millet, finger millet, sorghum and groundnut. ICRISAT envisions prosperous, food-secure and resilient dryland tropics. To achieve this, its mission is to reduce poverty, hunger, malnutrition and environmental degradation in the dryland tropics. It approaches this through partnership-based international agricultural research for development that embodies *Science with a Human Face*. ICRISAT's strategy is anchored on socio-economic process called inclusive market-oriented development (IMOD). ICRISAT has defined six developmental outcomes that it believes will help the poor to move along the IMOD path: food sufficiency, intensification, diversification, resilience and health & nutrition, and women empowerment. Significant reductions in poverty and increases in food security in the dryland tropics are possible through this route. ICRISAT believes this is the way to meet its inspirational targets of halving the incidence of poverty in smallholder farming households, halving the incidence of hunger, halving childhood malnutrition and significantly increasing the resilience of tropical dryland smallholder farming.