



GROUNDNUT MANUAL FOR UGANDA

Recommended groundnut production
practices for smallholder farmers in Uganda



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INTRODUCTION

Groundnut is the second most widely grown legume in Uganda, after beans. There has been a substantial increase in the growing of groundnut as both a food and cash crop because of increased awareness of its value as a source of protein (23–25% content) and oil (45–52% content). It also has the advantage of generating residual nitrogen in the soil which benefits subsequent crops, especially when groundnut residues are incorporated into the soil during ploughing.

Despite the high local demand for groundnuts, farmers' yields continue to be low, averaging 560 kg/ha of dry seed. Well managed plots, using the right varieties, can yield 2500–3000 kg/ha or more.

This manual provides information on good management practices for groundnut production such as proper timing of activities, proper spacing, use of quality seed, weeding, control of diseases and pests, harvesting, drying and storage. Adopting such practices would help increase groundnut crop production considerably.

Inserted at the back of the manual is a leaflet describing the current varieties available so that up to date choices can be made on which varieties to grow.

LAND SELECTION

Groundnut is not suited to growing in very dry areas or at altitudes above 1500 m (around 5000 ft). Optimum temperatures are 27–30 °C for vegetative growth and 24–27 °C for reproductive growth. Between 450 mm and 1250 mm of evenly distributed rainfall is required annually for good growth and yield.

All soils, other than very heavy, 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. The soils should have a pH (H₂O) between 5.3 and 7.3.

Groundnut requires adequate levels of phosphorus, potassium, magnesium and particularly calcium, which are required for maximizing yield and good quality seed. For farmers who can afford artificial fertilizers, application of Single Super Phosphate (SSP) at the rate of 100–125 kg/ha or Triple Super Phosphate (TSP) at 80–90 kg/ha will boost yield. SSP or TSP should be worked into the soil before planting. In areas where there is a high incidence of empty pods ('pops'), there could well be a shortage of calcium in the soil. To rectify this, a treatment of gypsum at the rate of 200–400 kg/ha (up to 500–1000 kg/ha if the soil is particularly poor) at early flowering will reduce the incidence of pops.

Climate

Soils

Fertilizer

Rotation

To avoid the build-up of pests and diseases, groundnut should not be grown continuously on the same land. A rotation of 3 years or longer can usually reduce disease, pest and weed problems. Because of the incidence of pests and soil-borne diseases, groundnut should not be grown after cotton, although cotton can be used in rotation after groundnut. Other legumes, 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. 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.

Although a number of crops are used as intercrops with groundnut, results from intercropping research have been inconsistent, so any advantages or disadvantages are not known.

Land preparation

Good land preparation provides suitable soil conditions for rapid and uniform germination, good root penetration and growth, and steady pod development. Land should be prepared early, before the rains start, so that sowing can take place early in the rains. All previous crop residues and weeds should be completely removed or buried, and seed beds should be smooth to provide good soil-to-seed contact after sowing. For farmers who use tractors, deep turn the soil to bury residue and weeds, using a disc plough, 3–4 weeks before planting.

Ridges

In wet, low lying areas it may be worth considering using ridges in which to plant groundnuts. The use of ridges can prevent waterlogging, and improve weed control and harvesting. Ridges should be made at, or just before, sowing and they should be flat-topped.

PLANTING

Seed selection

Pods should be shelled 1–2 weeks before sowing and only good quality seed should be selected for sowing. Damaged, small or shrivelled seeds should be discarded. It is good practice to purchase certified seed at regular intervals, preferably every 2–3 years.

Seed dressing

To control seedling blights caused by soil bacteria and fungi, and also other fungal diseases, a fungicide treatment is recommended. Thiram gives good protection and can be applied as a dust at 120 g of thiram/100 kg of seed. The dust must be uniformly mixed with the seed.

Dormancy

It is important to be aware that some varieties of groundnut seed require a period of dormancy between harvesting and sowing and the leaflet on varieties should be consulted before sowing the same seed soon after harvesting.

The planting date is difficult to standardize under Ugandan conditions. However, farmers should plant as soon as there is adequate moisture in the ground to ensure good germination. In general, groundnuts are planted between 15 February and 15 April during the first season and in early August for the second season. Planting early in the season helps to improve yields and seed quality, and reduce the incidence of rosette disease. Long duration varieties should only be planted with the first rains in the first season. Short duration varieties can be planted in either season.

Seeds should be sown at a depth of 5–6 cm. To ensure uniform sowing depth, germination and crop stand, it is suggested that a groove 5–6 cm in depth is made along the rows for planting and, once the seed has been planted at the right depth and spacing, the soil is pressed down to ensure good contact with the seeds, enabling them to extract moisture more effectively. It is important to sow groundnut seed in rows and at the right spacing as this helps to reduce the incidence of rosette disease, ensures a more uniform pod maturity, better quality seed and maximizes yield. Planting groundnut plants closer together results in individual plants setting fewer pods, but over a short period of time. Overall, this will ensure that the pods will be of a similar age and stage of development and, therefore, make it easier to decide when to harvest. Wider spacing will produce less yield per hectare.

The recommended spacing ensures that there is good plant population. The recommended space between rows is 45 cm while the recommended spacing per seed is (see leaflet for variety type):

bunch types:	7.5–10 cm	(e.g. Red Beauty)
semi-erect types:	10–15 cm	(e.g. Igola 1, Serenut 1 and Serenut 2)

Row spacing can be reduced from 45 cm to 30 cm, if desired, and this will allow earlier ground cover and help prevent serious weed problems.

WEEDING

Groundnut cannot compete effectively with weeds, particularly 3–6 weeks after sowing, therefore, early removal of weeds is important. Generally, 2–3 weedings are recommended, the first before flowering and at least one other during pegging. If early weeding is done well, and crop spacing recommendations followed, then the weeds that come up later are smothered with the vigorous growth of the crop.

When weeding, it is very important to avoid covering the bottom of the plants with earth (including earthing up) as this can increase diseases (e.g. white mould), reduce flowering and pod development and, therefore, reduce pod yield. Once flowering and pegging begins it is advisable to weed by hand pulling, rather than by using a hoe, as this is less likely to disturb any developing pods.

Time of planting

Sowing

Spacing

Timing

By hand

Using chemicals

Pre- and post-emergence herbicides may be used to eradicate weeds but they are very expensive for most small-scale farmers. Herbicides such as alachlor (Lasso®) can be used before crop and weed emergence, and bentazone (Basagran®) and fluzafop-p-butyl (Fusilade Super®) following emergence. Follow the manufacturers' instructions with regard to dosage.*

MAIN DISEASES AND PESTS

Groundnut rosette disease

Groundnut rosette disease is caused by a complex of viruses that are transmitted by aphids. It can occur at very high levels and can often produce 100% loss in yield. There are two forms of symptoms seen in the crops: 'chlorotic' (yellow and stunted) and 'green' (green and stunted). Late planted crops and wide spacing can increase the incidence of rosette disease so these should be avoided. Rosette resistant varieties of groundnut are available (e.g. Serenut 2, Igola 1, see also leaflet on varieties) and these eliminate the need for spraying insecticides to control the aphids. If a high yielding non-rosette resistant variety is grown (e.g. Serenut 1) then insecticides will be needed. Systemic insecticides, such as dimethoate (Rogor EC40®) can be sprayed at a dosage of 50 ml in 20 l of water, 14 days after crop emergence and then at 10-day intervals for a total of four sprays.



Plants with chlorotic (yellow) symptoms



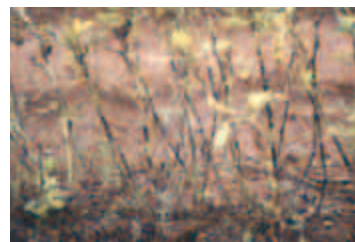
Plants with both chlorotic and green symptoms

Leaf spot

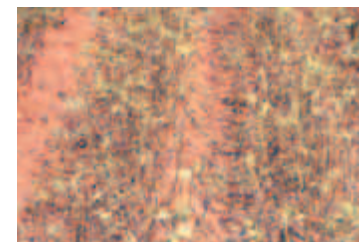
There are two main forms of the leaf spot fungal disease – early and late. Early leaf spot may occur as early as 2 weeks after crop emergence. Lesions produced by this fungus are roughly circular, dark brown on the upper surface with chlorotic (yellow) halos surrounding the darker lesions and a lighter shade of brown on the lower surface of the leaflets. Severe attacks can cause heavy defoliation and result in a large yield loss. Late leaf spot occurs later in the season and has nearly circular lesions which are darker than those of early leaf

* Mention of trade names here and elsewhere in this manual does not indicate a preference for these particular products.

spot. Late leaf spot does not normally affect yield reduction as severely as early leaf spot. On the lower leaf surface where most of the sporulation occurs, the lesions are black. Since the leaf spot pathogens survive mainly in crop debris, cultural practices such as crop rotation, burying crop debris during land preparation and early sowing can significantly reduce the incidence of the diseases. Chemical control may not be economical for rain-fed crops but the fungicides fentin acetate (Brestan®), benomyl (Benlate®) or mancozeb (Dithane M-45®) can be used at the rate of 50 g of the chemical with 20 l water. Apply when lesions are first seen and then at 14-day intervals for 3–4 sprays.



Early leaf spot



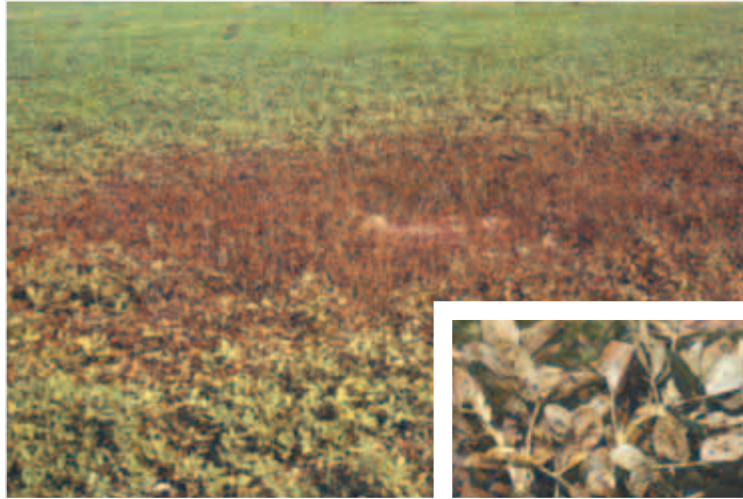
Late leaf spot

Rust occurrence is generally sporadic but sometimes there are severe outbreaks. It can survive in volunteer plants and spores can disperse over long distances to infect other areas. Rust is characterized by orange-red pustules on the leaves which later turn dark brown and cause curling of leaflets and defoliation. The disease is of little consequence if it appears 2–3 weeks before harvesting. The cultural practices and fungicidal control measures recommended for leaf spot should be used.

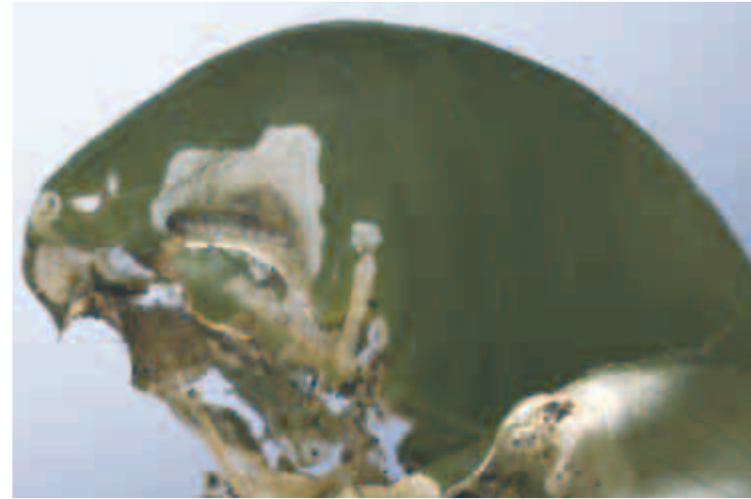
Although the main pest status for aphids on groundnut is as a vector of rosette disease, aphids can, in large numbers, damage the plant tissues when feeding. They can be controlled using insecticides (see rosette disease above). There are also new varieties of groundnut which are aphid resistant and, therefore, do not usually get rosette disease (see variety leaflet). These varieties can be grown without the need to spray insecticides to kill the aphids.

Rust

Aphids



Field with groundnut crop showing leaf rust symptoms



Larva of groundnut leaf miner with damaged leaf



Adult and nymph aphids



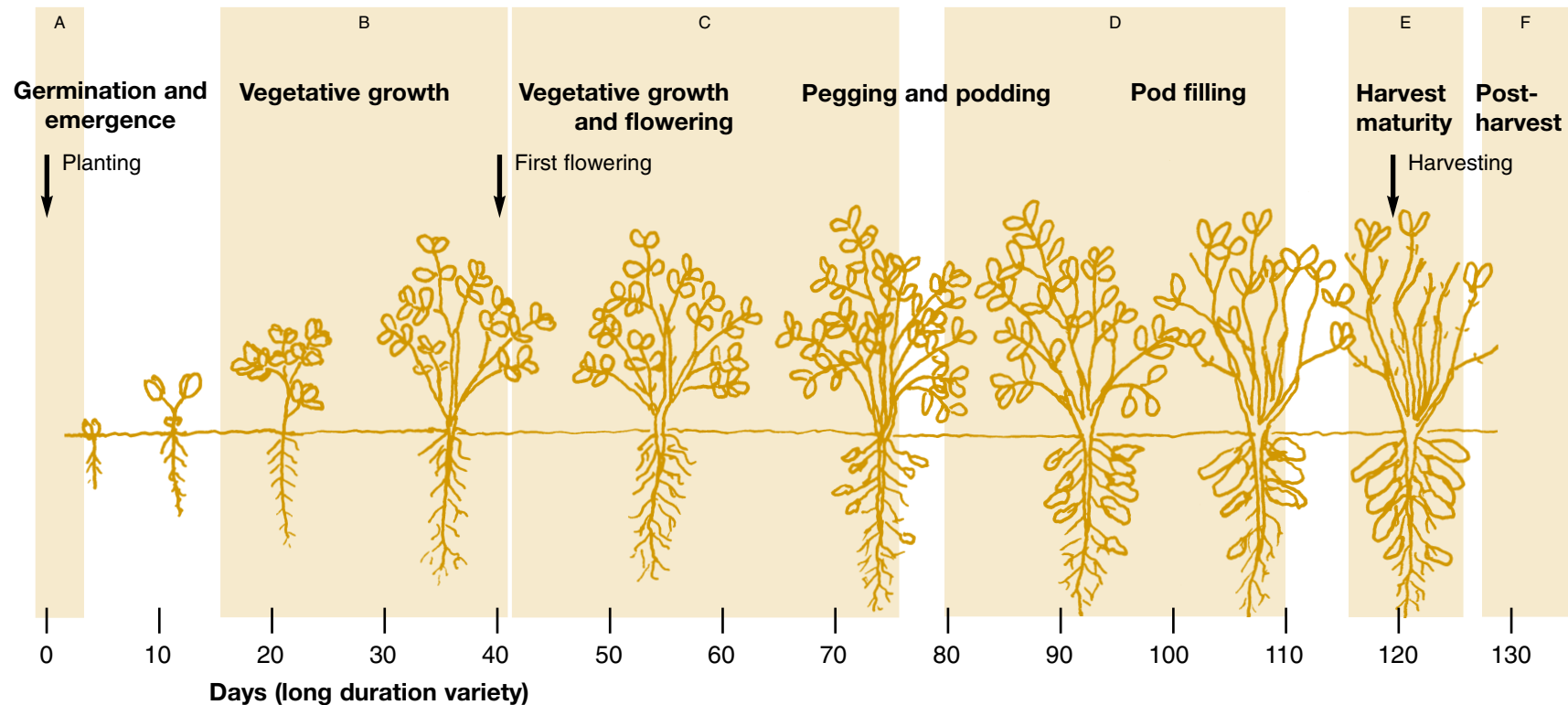
Area of termite damage in a groundnut field

Groundnut leaf miner

Groundnut leaf miner is a comparatively new pest. It is the larva of a small moth which burrows and mines into the leaflets of the plant. When the larvae have grown, they come out of their mines and pull the leaves together with threads.

Severe cases of leaf miner damage make the crop look as if it has been burnt and severe crop losses can occur. It is suggested that systemic insecticides (see rosette disease above) are used as soon as quantities of mines are observed.

STAGES OF DEVELOPMENT OF GROUNDNUT AND RECOMMENDED PRACTICES



A
Prepare land early so that seed can be planted early after first rains.
If possible, fertilize with SSP or TSP before planting.
Choose good quality seed.
Dress seed with thiram to control fungal and bacterial growth.
Sow at 5–6 cm depth.
Space at 45 x 7.5–10 cm for bunch type varieties.
Space at 45 x 10–15 cm for semi-erect type varieties.

B
Ensure good weed control. Avoid earthing up plants when using hoe.
Check for aphids or leaf miners and control if necessary.

C
Ensure good weed control. Weed by hand pulling to avoid earthing up and damage to pegging.
Check for pests and diseases and control where necessary.

D
If weeding is required use hand pulling.
Check for pests and diseases and control where necessary.

E
Harvest when 70% or more pods are mature. Use dark markings on inside of shell.
Seeds should be plump and correct colour for variety.
If crop is severely defoliated (95%) or sprouting has begun, harvest straight away.
Clean excess soil from pods.
Wilt/dry in windrows for 3–5 days.

F
Dry pods on mats for a further 2–5 days.
If A-frames or cocks used, dry for 3–4 weeks and then pick off the pods. Do not dry any further after picking.
Before storing remove poor, damaged, shrivelled, rotten or fungus-infected pods.
Store pods in gunny bags in a cool, dry, well ventilated store. Do not store moist groundnuts. Do not use plastic or poly-weave bags.

Termites

Termite damage can be recognized when plants wither and die. There are no efficient control measures against termites so it is important to avoid growing groundnut in fields that have a history of termites or that have obvious termite mounds. Spot spraying with chlorpyrifos or methyl bromide can be tried.

HARVESTING

Timing

It is very important to harvest groundnuts at the correct time. If harvested too early, the seeds will shrink when drying which lowers the yield, oil content and quality of the seed. Delays in harvesting will result in poor quality seed due to mould infections and subsequent aflatoxin contamination of the seeds/pods. Late harvesting also reduces yield because higher proportions of pods are left in the ground due to the pegs being weak and the pods breaking off. If harvested late, some non-dormant varieties will begin to sprout in the field resulting in yield losses.

Indicators for harvesting time

Leaf fall is not a good indicator of when to harvest. It is recommended that a few plants (3–5) should be pulled up and the pods removed and shelled. The insides of the shells should be examined. If the majority of pods (70% upwards) have dark markings inside the shell and the seeds are plump and the correct colour for that variety, then the groundnuts are mature and ready for harvest. If the crop is severely defoliated as a result of disease (only one or two leaves per branch) or if sprouting has begun, the crop should be harvested regardless of maturity. The estimated period of maturity for each variety can be used as a rough guide.



Figure 8 Shells with dark interior which indicates harvest maturity

Harvesting by hand only is more suitable for the erect groundnut varieties in sandy, loam soils which are well drained. When the soil is wet and heavy or very dry, it is much more difficult to pull up the whole plant without losing pods.

By using a hoe during harvesting it is possible to lift plants out of heavy or dry soil with a reduced pod loss. Spreading varieties can also be more easily lifted. Care should be taken not to damage the pods with the hoe as damage makes the pods susceptible to fungal attack. A hoe fork lessens the likelihood of such damage.

It is important to shake the plant after lifting to remove excess soil from the pods, particularly when the soil is wet or heavy. Soil stuck to the pods will lengthen drying times and produce better conditions for the development of unwanted fungal growth.

DRYING

The correct drying or curing of the harvested groundnuts is very important as poor curing can help induce fungal growth (producing aflatoxin contamination) and reduce seed quality for consumption, marketing and germination for the following season's planting. For good storage and germination, the moisture content of the pods should be reduced to 6–8%. There are different ways of drying the pods, some of which are better than others. It is particularly important to note that if the pods are exposed to the sun for too long the seed quality can deteriorate considerably and germination can be affected.

If the harvested groundnut plants are left to dry on the soil surface where they have been lifted, the pods are likely to be in contact with the soil, which can contain moisture and be at a higher temperature. This method can easily affect the quality of the seed, particularly if there is rain during the drying period. If field drying is used, it is better to use windrows, where plants are laid in rows to catch the wind and dry more quickly. The drying of pods in windrows (3–5 days) should produce the required level of moisture before the pods are picked or stripped. Excessive exposure to the sun can affect the quality of the seed.

The plants can be picked/plucked from the windrows and then laid out in a thin layer in the sun on dry ground, matting or other dry surfaces for a further 2–5 days which would normally dry the pods to the required moisture content for storing. Pods should be covered or taken indoors during wet weather. They can also be picked immediately after lifting and then dried in the sun as above for 6–8 days. Once again excessive exposure to the sun can affect the quality of the seed.

Ideally pods should be dried with plenty of air circulation and in the shade. Two principal methods are used elsewhere in Africa, both of which can produce good quality seed with reduced levels of fungal infection. After 2–3 days of wilting in the field in windrows, the plants should be dried using one of the following methods.

Hand lifting

Hand lifting with a hoe or hoe fork

Cleaning

The importance of drying

Drying in windows

Drying on mats

Drying so that the pods are shaded

(a) *Cock*. Plants are laid, with foliage, directly on the ground in a circle 1–2 m in diameter, the pods placed towards the inner part of the circle. Layers of plants are built up, gradually reducing the diameter of the circle as the cock gets higher, until there is a small opening left at the top of the cock. Foliage (e.g. banana leaves) can be used to cover the top of the cock. The cock should be built on raised ground so that the lower parts do not get waterlogged if it rains during drying. Polythene should not be used for the base of the cock as this reduces drainage in the case of rain, and also should not be used as a cover as a build up of condensation can occur.



Cocks used for plant/pod drying

(b) *A-frame*. The wilted plants are gathered and stacked on an A-frame with the pods facing inwards and away from the soil. A-frames are easy to construct using three thick poles as a base with thin poles attached to either side of the two main poles of the A forming shelves on to which the wilted plants can be placed. The lowest shelf should be about 30 cm above the ground. Excellent air circulation occurs and, if constructed properly, the drying foliage of the plants protects the pods from rainfall.

In both cases the groundnuts should normally be left drying for 3–4 weeks before the pods are picked. After picking do not dry further by putting the pods into the sun as this could result in over-drying or a reduction in seed quality.

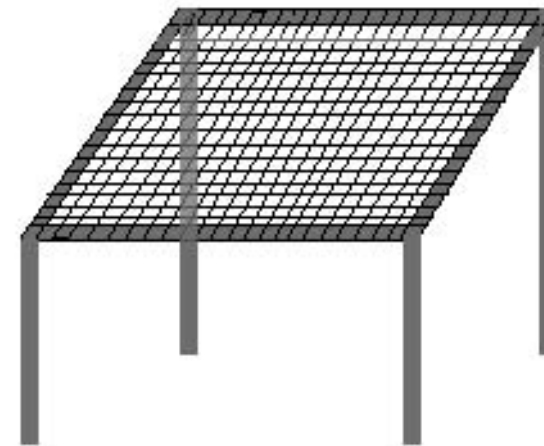
Plucking

The hand removal of pods from the plants (plucking) can be labour intensive. A simple frame of wood, built at a height convenient for plucking, covered with a stretched piece of chicken netting, can speed up the process considerably

and reduce drudgery. The dried/wilted plants are held by the leaves and the roots/pods drawn across the stretched chicken wire. The pods get caught in the wire and are pulled off, dropping below the frame.



A-frame used for plant/pod drying



Construction of a simple plucking machine

STORAGE

Requirements

It is best to store groundnuts in their shell. Good drying of the pods to 7–8% moisture content will help to ensure that the seeds remain in good condition during storage. Never bag groundnuts for storage if the pods are still damp. Before storing, poor, damaged, shrivelled, rotten, or fungus-infected pods should be removed. Whatever the storage container, it is important to ensure that the store is dry and that there is good ventilation so that the pods/seeds do not increase in moisture content, which would encourage fungal growth. Ideally the store should be cool, as this prolongs the storage life of the pods.

In bags

Bags should be made of a material which allows the air to circulate, therefore, gunny bags are recommended. Do not use polythene or polypropylene bags as these restrict air flow and fungal growth could occur. For the same reason, do not cover bags with plastic or tarpaulin (canvas) which may also restrict ventilation and increase condensation. Bags should be stored away from the ground on wooden slats to avoid damage from dampness. If bags are stacked, a gap should be left between stacks to allow ventilation. Do not stack bags more than ten bags high.

Other methods

If bags cannot be used, storage in clay pots, woven baskets, or storing loose may be used. In all cases it is important to ensure good ventilation by keeping the storage vessel off the ground and ensuring that the storage place used is dry. When storing the pods loose, a platform made of local material (e.g. bamboo) should be made to keep the pods off the ground.

Pests

When pests damage the pods/seeds, they create the conditions for the build-up of fungal infection. Insect storage pests can be controlled using pirimiphos-methyl (Actellic Super®) applied as a dust to the pods before bagging.

SHELLING

Shelling should be done as and when groundnut seeds are required for consumption, marketing or for planting as the storage life of the seed outside the shell is short and the quality can reduce rapidly. With both hand and mechanical shelling, the seeds should be checked and any discoloured, mouldy or shrivelled seeds should be thrown away.

By hand

Hand shelling is labour intensive but is effective for small quantities of groundnut. It is particularly good for the selection of seed for planting the following season as there is less damage to the seeds, thus avoiding fungal infections. The practice of putting pods into sacks and beating them to break them up is not recommended as this can produce a high level of damaged seeds.



Mechanical shellers are labour-saving and the rotary design (shown here) produces very little cracking of the seed

There are a number of mechanical hand shellers on the market that can shell groundnuts at a rate of up to six bags an hour. The rotary types have the advantage of continuous operation (rather than shelling in batches) and new designs produce very little wastage in terms of damaged seed.

AFLATOXIN

Aflatoxin is a toxic substance produced by mould fungi (*Aspergillus flavus* and *A. parasiticus*) which can grow on poorly managed agricultural crops, particularly groundnuts. Aflatoxin contamination may happen during pre-harvest and post-harvest handling of the crop. Pre-harvest contamination is severe during periods of drought at the pod filling stage. Post-harvest contamination results mostly from poor drying and curing procedures. If eaten in sufficient quantities aflatoxin can cause sickness, hepatitis and/or liver cancer. It is, therefore, extremely important to ensure good management of groundnut crops and any suspect seed should be destroyed rather than used for human or animal consumption. If groundnuts are to be sold for export no aflatoxin contamination must be present. Although the practices for minimizing mould are mentioned in the different sections above, they are summarized here.

- (a) Harvest the crop as soon as it is mature, any delay will encourage the development of fungus.

Mechanical shellers

- (b) Avoid damaging pods during cropping.
- (c) Remove soil from the pods before leaving to dry.
- (d) Ensure that the correct drying procedures are used and that damaged, shrivelled, or rotten pods are removed before storage.
- (e) Store the pods under dry, well ventilated conditions to ensure the moisture content remains low, thus discouraging fungal growth.
- (f) Avoid damaging the seed during shelling and destroy any discoloured, shrivelled or mouldy seed.
- (g) Avoid pod damage by insects as this can leave the pods/seeds susceptible to fungal infection.
- (h) Pre-harvest contamination is severe during drought and extra care should be taken to clean the seed, especially the smaller seed.



Symptoms of *Aspergillus flavus* which produces aflatoxin contamination

QUALITY AND MARKETING

The quality of groundnut is determined very much at the farm level. Good growing, harvesting, drying and storage on-farm (as set out in this manual) will ensure that the pods/seeds are marketable. A buyer will, in particular, be looking for (ideals shown in brackets): varietal purity (at least 95%), low moisture content (7–8%), high shelling percentage (above 55%), low level of damaged pods/kernels (less than 17%) and no aflatoxin contamination.

ACKNOWLEDGEMENTS

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