What is damaging my sweetpotato?

A field guide for farmers on pests and diseases of sweetpotato in sub-Saharan Africa

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Participants of the sweetpotato integrated production and pest management (IPPM) farmer field schools (FFS) asked for a guide on pests and diseases of sweetpotato that would help them remember what they had learnt in the FFS and support their continued experimentation with different pest and disease management options. Together we assembled a draft guide, which was field tested by the participants of 37 sweetpotato FFS run during the 2005/06 season in Uganda, Kenya and Tanzania. Initially many stakeholders thought we should simplify the guide. However, the farmers who field tested it wanted even more in depth information to be included along with the details of more of their traditional pest and disease management practices. The guide is available in Swahili and English, several vernacular terms are included in the English version to facilitate understanding, particularly in N. Uganda.

Other farmer guides on: sweetpotato processing and recipes, and vine multiplication are being developed. These farmer guides complement the comprehensive manual previously developed for facilitators 'Manual for sweetpotato integrated production and pest management farmer field schools in sub-Saharan Africa'.

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Contents

- *Insect life cycles* – collect a weevil infested root from the field, cut it open and look at the living creatures you see inside. Keep the root with the creatures in it in a well ventilated jar in a cool safe place. Keep checking on it regularly and see what the adults that emerge look like. You could also add adult weevils to a fresh root in a jar, leave them for about 10 days and then remove them and wait to see how long it takes for their offspring to emerge from the root.

- *Insect zoos* – collect a range of insects and other animals from around the sweetpotato field, try to observe what they are eating. Keep the different insects and animals in containers with different food sources, insects, plant parts etc and see which one eats what. Do any of them eat sweetpotato pests?

- *Planting sites and pest and disease incidence* – Try establishing a new sweetpotato crop right next to an old sweetpotato crop, and then also establish a new sweetpotato crop far away from any old sweetpotato crops. Keep a record of the pest and disease incidence in the two fields.

- *Sources of disease* – put a storage root with root rot symptoms together with a healthy root in a clean sack, gently shake the roots for a minute. Take the roots out and keep them separately in clear plastic bags label them ‘sick’ root and ‘healthy 1’ root respectively. Then add another clean root to the original sack and gently shake it for one minute, remove it and place in a clean bag labelled ‘healthy 2’. Then wash the sack carefully with water till it is clean and then dry it. Then put another clean root into it, gently shake it for a minute and then take the root and place it in a clean bag labelled ‘healthy 3’. Observe the roots daily and record when they start to show disease symptoms. What does this tell us about how diseases spread and how we can reduce the risk of spreading them?

- *The effect of leaf damage on yield* – design an experiment with several sweetpotato plots, pick the leaves in the different plots in different ways, e.g. picking only 50% of the leaves in some plots and 100% in other plots, the frequency with which leaves can be picked can be varied between plots as well. Keep careful records of what you have done in each plot. Then at harvest time compare the effect of the different defoliation patterns on yield. Can sweetpotato plants recover from and compensate for leaf damage? Does this mean we shouldn’t worry too much about those insects which feed on the leaves only?

Example of a disease management experiment:

Objective: *To test to what extent the use of clean planting material and roguing of infected plants can increase sweetpotato yield*
Research topic: *Effect of disease management techniques on yield*
Treatments:
- *Farmers normal practice*
- *Use of clean planting material*
- *Farmers normal practice and fortnightly roguing of any plants showing virus symptoms*
- *Use of clean planting material and fortnightly roguing of any plants showing virus symptoms*

Replications: *2 (A and B)*

Example of the field layout of the above disease management experiment

Treatment	*Farmers normal practice*	*Use of clean planting material*	*Farmers normal practice and roguing*	*Use of clean planting material and roguing*
Replication	*A*	*A*	*A*	*A*
Treatment	*Use of clean planting material*	*Use of clean planting material and roguing*	*Farmers normal practice*	*Farmers normal practice and roguing*
Replication	*B*	*B*	*B*	*B*

5 m

5 m

Other ideas for pest and/or disease management activities and experiments

The following are suggestions for other pest and disease management activities and experiments you might like to adapt to fit your specific needs.

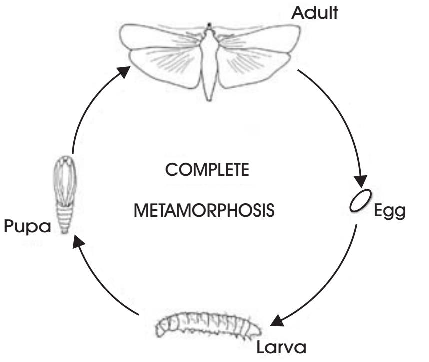
- *Local knowledge on pest and disease control* – collect information from other farmers on methods they use or have heard about to manage various sweetpotato pest and disease problems, then test and compare some of the different methods in an experiment to find out which work best in your local area.

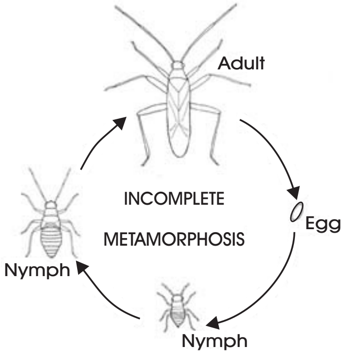
Where do these pests and diseases come from?

Sometimes it seems like these pest and disease problems appear out of nowhere, but they don't. All pests and diseases always come from somewhere, but they have lifecycles with some stages that are often not easy to see.

If you think about insects, the adult stage (*mdudu kamili, ekurut lo etionit*) is always responsible for reproduction and often for dispersal: it sometimes doesn't even actually feed. The male and female adult insects mate and then the female lays eggs (*mayai, abeei*). The eggs are often not easy to see, they can be very small and may be hidden in places, such as underneath the leaves, in the sweetpotato roots or in the soil. After hatching from the eggs, the immature insects feed and grow to become adults.

In the case of many insects, the appearance of the immature stage differs greatly from that of the adult and is called a larva (*funza, ekurut lo eliata*), this is the case for example in butterflies and beetle species. As the larva feeds, it grows and sheds its skin (moults/ *aibutu*) as it gets bigger. When it is fully-grown it moults into a pupa (*buu, ekurut lo eburiara*). Although the pupa can't move, inside it there are lots of changes taking place so that when it emerges as an adult it looks completely different. We call this process of change 'metamorphosis' (*aijulanakineta*).





In other types of insects, the immature stage that hatches from the egg looks like a smaller version of the adult, and is called a nymph, not a larva. Although nymphs look like the adult insects, they are missing wings and sexual organs, which develop as they grow.

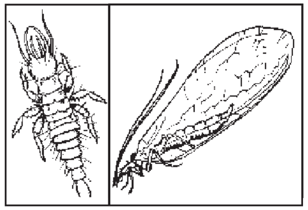
The time taken for an insect to complete its lifecycle (from egg to adult) varies between different insect species. Environmental conditions such as temperature, food sources etc also affect the speed of development. Some insects can feed on several different plants during their development we call these alternative host plants.

Insects can spread from one place to another by: flying; walking; being blown in the wind; through movement of infested soil, plant materials, tools, shoes; and on livestock etc.

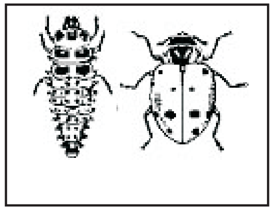
Because insects have relatively short lifecycles, high populations can build up over very short periods of time. For example, suppose one female sweetpotato weevil lays 100 eggs that all hatch and develop into adults within a month. This will mean that one month later there are 50 female sweetpotato weevils, if they mate and each lay 100 eggs, one month later there will be 2500 female sweetpotato weevil adults to feed and lays eggs on your crop, plus 2500 male ones too! Of course, this sort of disaster (*engeso*) does not happen very often, but why not?

This is because, not all the creatures we find on sweetpotato are pests, some are beneficial insects or natural enemies. Natural enemies are living organisms that kill, injure or cause disease in other living organisms. There are three kinds of natural enemies:

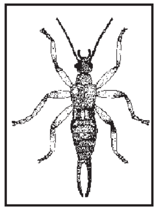
- Predators (*Lu'opapero*)– hunt and kill other creatures



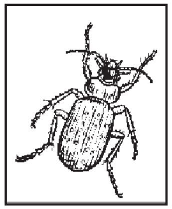
Lacewing nymph and adult – the nymph is predacious



Ladybird larvae & adult (Agero*) are predacious*



Earwig *(*Esiara*)*



Ground beetle *(*Ekonyelet*)*

- Parasites – consume other creatures but first enter the bodies of their victims (hosts) and feed off them. The parasites that attack insects are usually wasps (*ituturo*) or flies, they lay their eggs on the host and when the eggs hatch the larvae start to feed on the host, weakening it.

- Pathogens *(Iboro lu eyaunet adeka)*– organisms that cause disease. They enter the body of their host and live and multiply within in it, weakening and finally killing the host. Insects attacked by pathogens are usually swollen, may change colour, move very slowly and stop eating.

Experimenting

Experiments are great tools for testing and adjusting practices in order to develop technologies that suit the specific conditions of ones own farm. In the sweetpotato farmer field school you will have been involved in designing and evaluating several experiments, these notes are just to serve as a reminder of the key issues. Experimenting often begins by identifying the constraint and thinking about possible solutions.

One experiment should only test one topic at a time otherwise the results become difficult to understand, e.g., crop variety, planting method, dose of manure, pest or disease management practice.

We need to clearly define the **objective** of the experiment, making it as detailed as possible. What is to be tested and what result do we expect?

We need to determine the **treatments** to test. Too many or too few treatments will not result in useful information. The optimum number of treatments is usually 3-5 per experiment. First, we should determine a control treatment, which could be a standard practice with known results, such as farmers' normal practice, or the standard recommendations of the agricultural extension service. The other treatments contain variations from the control.

To ensure reliability of the experiment, each treatment should be replicated at least twice. Replications help reduce the effect of variable factors in the field, e.g. soil, water availability and shade. A replicate plot is an exact copy of the original plot (e.g. a photocopy) but just placed in a different part of the field.

For the experiment each plot should be at least 10 m^2. The shape of each plot should be similar, preferably square. In a sweetpotato field, for instance, we could make plots of three ridges wide and 4 m long. The different treatments should be placed in the field in such an order that the two replications of each treatment are not adjacent.

Plots need to be labelled clearly with the name of the treatment and which replicate it is. It is also wise to keep a map of the field layout in case the labels get damaged.

We need to have thought about what we will measure in our experiment in order to determine which treatment is better than the others, do we just want to measure yield at harvest, or do we want to assess the level of damage in a field over time, or the number of diseased plants, or the number of insects etc. We also need to have thought about how we will use the data we collect from our experiment.

affects a wide range of crops, making crop rotation difficult for management of the nematodes.

Above-ground, there are no obvious, specific diagnostic symptoms. Nematode infected plants may exhibit general symptoms of malaise or poor growth associated with poor root growth, including stunting, chlorosis and a tendency to wilt early.

Root-knot nematode causing distortion and necrosis

Internal necrosis of sweetpotato edible root caused by root-knot nematode

Necrotic lesions and cracks caused by Scutellonema bradys *(top) compared with unaffected root (bottom)*

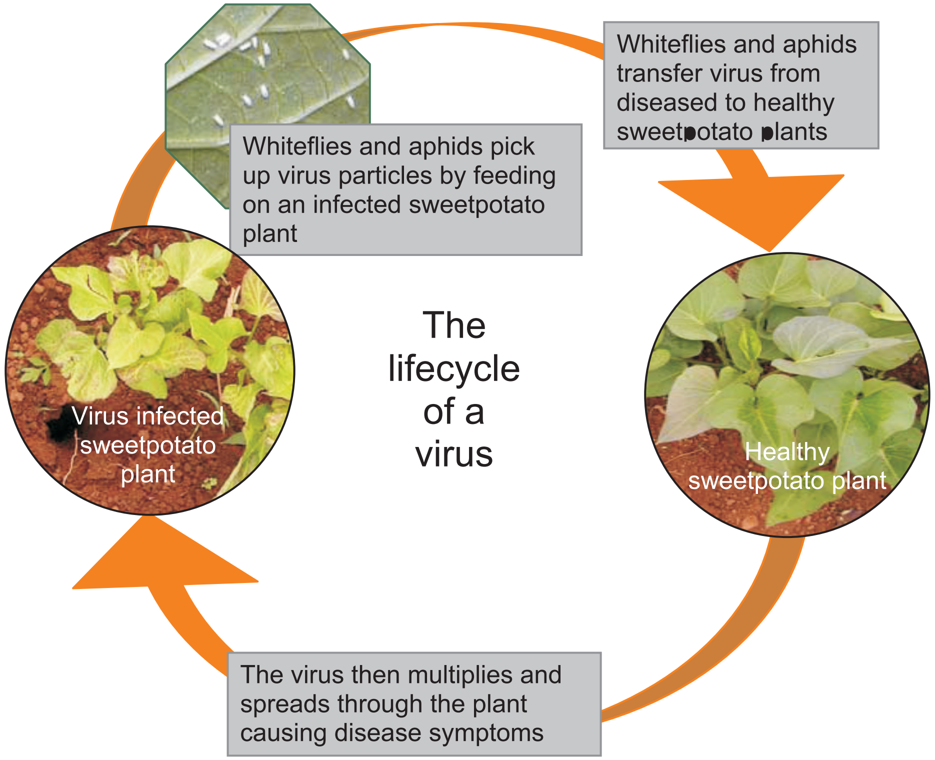
Below-ground, obvious swellings (galls) may be present on roots of plants affected by root-knot nematodes, although not all cultivars react in this way. Otherwise, symptoms on roots consist of necrosis, stunting, reduced mass and terminated root tips resulting in stubby, highly branched roots. On the edible roots nematodes typically cause cracking, which is also complicated (and mis-diagnosed) with drought effects, necrotic patches and blister-like swellings.

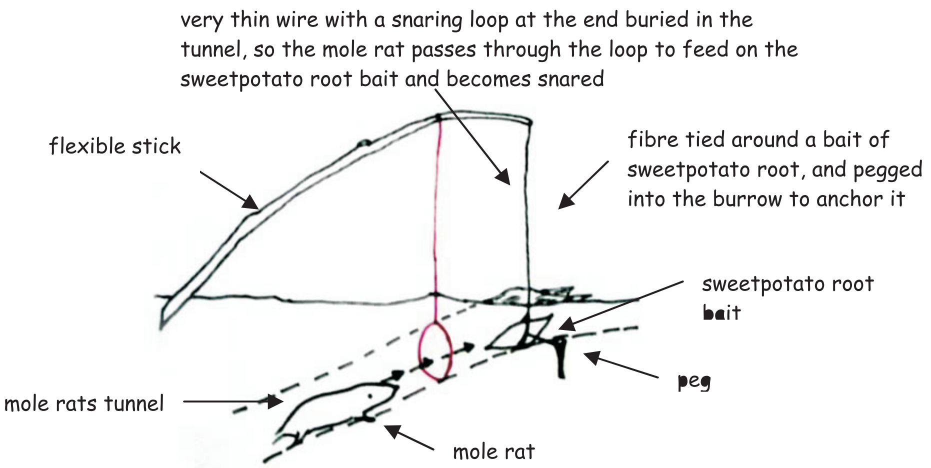
Nematodes can survive in the soil between crops on decomposing plant material, on alternative crop or weed roots, or in some cases they may survive in a state of desiccation until favourable conditions return. Nematodes can also be spread between fields when soil is moved, for example, on farming tools, shoes, through infested planting material and irrigation water. Hygiene and field sanitation are very important for reducing nematode damage.

Diseases also have lifecycles and these may be quite varied and complex. However, the key factor is that plant diseases, just like insects, always derive from a previous infection of the same disease. So a previous infection of *Alternaria* can only generate a new *Alternaria* infection. Fungal and bacterial diseases usually have special resting stages in which the disease organism can survive for long periods of time, often in dead leaves, and may be blown in the wind onto young, previously unaffected crops. These resting stages, when they arrive on a new host plant, can germinate and penetrate into the new host. With fungal diseases, you can often see their resting stages or spores as a fine dot at the tips of fine hairs often sticking out as a mat from the surface of a diseased leaf. Occasionally, as with smuts, these fruiting bodies can be quite massive and the spores form a very obvious fine dust. Common ways by which plants get infected by fungal and bacterial diseases are:

- by spores blown about in the wind from older diseased crops;
- by spores splashed up by heavy rain from leaf litter;
- from diseased planting material, especially if the crop is propagated vegetatively as sweetpotato is.

Virus diseases are unusual in that they do not have a form that by itself can penetrate the skin of a new host so as to infect it. Instead, they rely on another organism, often a plant-sucking insect that feeds on the crop such as a whitefly *(ekwanga)*, leafhopper (*iberei*) or aphid *(eiliana)*, to carry the virus from one plant and to insert it into another plant. Thus, just as the mosquito has first to feed on a human with malaria in order to transmit the disease to another healthy human, so the aphid or whitefly has first to feed on a diseased plant in order to transmit the disease to a healthy plant. In this way, the insect acts in much the same way as mosquitoes act in transmitting malaria in humans. So, if we can stop such insects feeding and moving from an old diseased crop to a new crop, this can prevent plants in the new crop becoming diseased. Also, just as only Anopheline mosquito species can transmit malaria, so only one type of insect can transmit a particular virus. Thus, only whiteflies can transmit cassava mosaic disease or *Sweet potato chlorotic stunt virus* whereas only aphids can transmit *Sweet potato feathery mottle virus*. Once the plant is infected by the virus, the virus then multiplies and spreads through the plant so every part is infected with millions of virus particles (which are so tiny you need a special electron microscope to see them). In this way, the whole plant becomes diseased, an aphid or whitefly can pick up virus from any part of the plant and cuttings taken from even a healthy-looking part of a newly-diseased plant are probably infected.





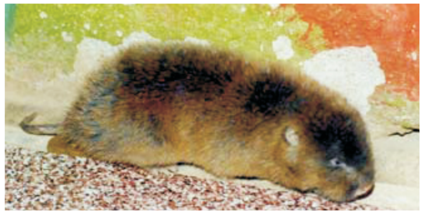
Wild pigs, porcupines, baboons, monkeys, elephants, hippos, guinea fowl and domestic animals such as pigs, cows and goats are often reported as serious pests of sweetpotato by farmers. The presence of hedges or thorn fences may act as deterrents against some of these pests. Domestic animals can be tethered to help reduce damage: this is particularly important during the planting material production time.

Nematodes

Nematodes (*ikuru lu cicika noi*) are microscopic worms, some of which can damage sweetpotato and other crops by feeding on them, others are beneficial to crops by feeding on or killing insect pests. Some nematode species infect sweetpotato roots by either entering the roots and feeding on tissue from within the root, while others migrate through the soil and feed externally on tissue from the soil. They feed by piercing cells with their needle-like stylets, damaging roots by injuring the cells they feed on, stealing nutrients, distorting root growth and by enabling other pathogens and pests to enter root tissues.

The most destructive nematodes affecting sweetpotato are root-knot nematodes (Meloidogyne spp.) and reniform nematodes (Rotylenchulus spp.). Root-knot nematodes commonly cause gall-like swellings on roots and tubers of a wide range of crops. Reniform nematode damage is less obvious, but still

Vertebrate pests



Rats and mole/ root rats (*enfuko, efutto, enyuru*) occasionally feed on sweetpotato storage roots either by digging through the ridges and mounds or accessing the exposed roots. They often spoil more roots than they actually eat. Signs of their damage and presence include: small mounds of freshly dug soil, sweetpotato vines being pulled back down into the soil, holes in the sides of ridges or mounds.

Rodent damage can be reduced by:

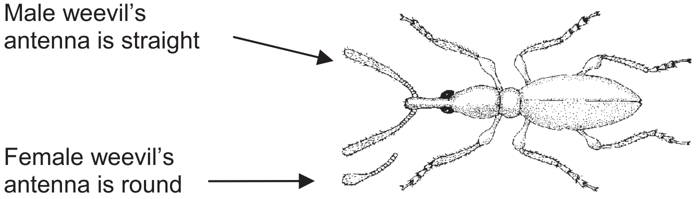
- Destroying rodent burrows.
- Keeping the field and surrounding areas clean of vegetation and rubbish to help reduce rodent populations.
- Digging a deep ditch around the perimeter of their field to prevent rodents from digging tunnels straight into the fields.
- Use of repellent materials inside their unblocked burrows – some traditional control practices include
  - spreading the leaves of repellent plants such as *intwinti*.
  - placing a mixture of cow dung and pepper in the burrows and burning it to smoke the rodents out, or pumping the smoke into the tunnel to try and suffocate it.
  - planting the deep-rooted, poisonous shrub *Tephrosia vogelii* in the field to repel mole rats.
  - placing human faeces in the rodents burrow
- Drowning the rodent by pouring water into the hole/ burrow, mixtures of hot water and pounded hot chilli pepper are reported to kill them.
- Traps can be set in locations where livestock and children will not interfere or get hurt by them. The Mutoto mole rat trap design that is popular in E. Uganda and W. Kenya is shown in the diagram.
- Poisoning. As rodents are mammals, any poisons that kill them will also seriously harm humans and livestock so poisoning is not recommended unless closely supervised, as baits may be eaten by livestock or children.

Rodent control works best if done on a large scale, so it is worth trying to interest one's neighbours.

Most serious insect pest of sweetpotato:

Sweetpotato weevils *(Amijimiji na acok)*, ***Cylas puncticollis*** *(oriono)* and ***Cylas brunneus*** *(arengan)*

The sweetpotato weevil is a type of beetle; the adult stage is a black or brown beetle that looks like a large ant. When an adult weevil is disturbed, it often plays dead. It is the most important pest of sweetpotato in most of sub-Saharan Africa. As well as destroying large parts of the roots and causing unsightly damage, the 'undamaged' part of the root also becomes bitter and unmarketable. The weevil larvae also feed in the stems, causing large lumps to appear and damaging the connection to the roots.



Sweetpotato weevil egg, found in a hole in a vine or easily accessible root

Sweetpotato weevil larva, tunnel while feeding and damage the vine or root,

Sweetpotato weevil pupa, pupation occurs within the feeding tunnels

The most effective way to control the weevil is through cultivation practices aimed at preventing infestation, including:

- Field sanitation
  - removal and destruction (through burning or feeding to livestock) of infested vine and root remains. If vines are left in the field to maintain soil fertility, care should be taken to ensure they are dead/dry and not able to sprout and then provide food for weevils. If piecemeal harvesting of

the crop is practised, care should be taken to remove and destroy any infested roots that are found.
  - removal of volunteer sweetpotato plants *(ailibos)* and wild morning glories as these may be alternative hosts,
  - crop rotation with other crops for 2-3 seasons if possible

- Use of clean (uninfested) planting materials, especially vine tips. Weevils tend to lay eggs in the older woodier parts of the vine, so if the vine tips are used for planting they are less likely to be infested by weevils.
- Planting away from weevil-infested fields, and/or using a barrier crop such as cassava, maize, bananas or sorghum (planted in advance so that the vegetation is high enough) around the perimeter in strips at least 3-5 m wide to restrict sweetpotato weevil migration.
- Timely planting and prompt harvesting once the crop is mature to avoid the dry period when weevil populations can multiply rapidly.
- Flooding the field for 48 hours after harvest to drown weevils in the soil.
- Hilling up of soil around the base of plants to prevent or fill soil cracks. This practice not only protects the plants from weevil attack but can also result in increased crop yields.
- Mulching to keep the soil moist and prevent cracks, and provide a more favourable place for natural enemies. Care should be taken to make sure the weevils can not feed or develop on the mulching material.
- Piecemeal harvesting to remove the largest storage roots most at risk from weevil attack and subsequent hilling up of the soil around the remaining roots to prevent weevils from accessing the roots through cracks in the soil.
- Botanical 'tea' solutions (*Omusasie*) are traditionally used as insecticides. Mayoya FFS in Kenya crush hot pepper and bitter leaves, mix them with soapy water and soot, then leave it for 3 days just stirring occasionally before sieving it, diluting the liquid 1:1 with water and then sprinkling or spraying on the infested sweetpotato plants.
- Ash can be sprinkled onto the sweetpotato plants and surrounding soil to help kill crawling insects


Sweetpotato weevil damage to roots

Because sweetpotato weevils are so good at hiding under the leaves and in the soil, handpicking and use of commercial insecticides are generally not effective.

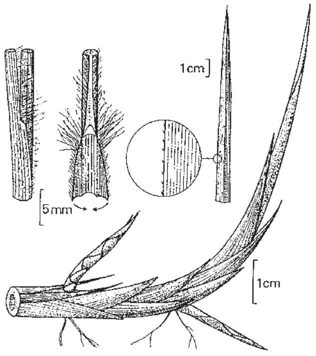
Weed management methods include:

- Careful removal of perennial weeds, especially the roots, rhizomes and tubers of species including Imperata (spear grass; *Ebiata=Ateso*), Cynodon (star grass), Cyperus (nut grass; *Eriau=Ateso*) and Digitaraia (couch grass; *Esirike=Ateso*), and burial of annual weeds during ridging and mounding.
- Early weeding during the first four to six weeks after planting so that the weeds don't compete with the young sweetpotato planting materials. Weeding is easiest when there is no crop to avoid.
- Careful cleaning of equipment before moving it from one field to another.
- Use of clean planting material.
- Composting any manure that contains weed seeds before applying it to the field.
- Mulching to reduce weed emergence.
- Crop rotations limit the build-up of weed populations. Weeds tend to prosper in crops that have requirements similar to the weeds.
- Intercropping (growing two or more different crops together) can be used as an effective weed control strategy by increasing shade and crop competition with weeds through tighter crop spacing.
- Young geese (*itudoi*) work well at removing weeds between plants in rows that cannot be reached by cultivators or hoes. They are particularly useful on grass weeds.
- Tillage and cultivation are the most traditional means of weed management in agriculture. Both expose bare ground, which is an invitation for weeds to grow and encourages soil erosion, speeds organic matter decomposition, disturbs soil biology, increases water runoff, decreases water infiltration, damages soil structure, and costs money to maintain.
- Herbicides such as Round-up (glyphosphate) can provide control of most of the problem weeds encountered in sweetpotato fields. However, their cost, and the challenges of accurate and timely application mean they have little appeal for small-scale farmers. A good practice is to dig planting ridges or mounds two to three weeks prior to planting. Then spray any weeds that emerge the day before planting vines.

Weeds

Weeds are unwanted plants that may reduce the yield or value of the crop harvested. Weeds can be divided into three categories: grasses; sedges; and broad-leaved plants. Examples from each category are given below:

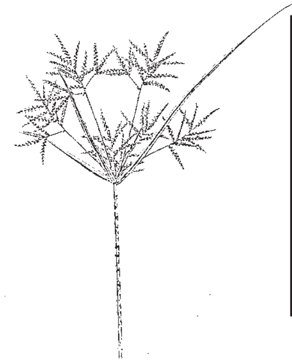
Grass



Imperata cylindrica

Mtimbi (Kiswahili),
Ebiata (Ateso),
Lalang, Lusenke (Luganda)

Sedge



Cyperus esculentus

Eriau (Ateso)

Broad-leaved plant

Lantana camara

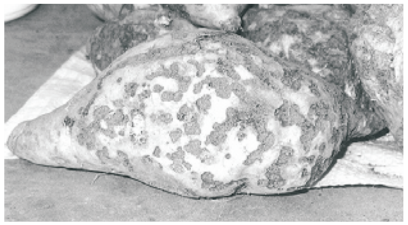
Elatana (Ateso),
Akayuukiyuuki
(Luganda), Magwagwa
(Luo),

Weeds can cause losses when:

- they compete with the sweetpotato crop for nutrients, light, water and growing space, resulting in smaller and fewer roots.
- their removal is time consuming or costly when labour is hired, and children may miss school to help their parents to weed.
- they provide shelter for insect pests, helping them survive when there is no crop growing in the field. Sweetpotato weevils can feed and survive on weeds from the same family (Convolvulaceae, morning glory) as sweetpotato such as *Ipomoea cairica* (sweet mile a minute vine) and *Convolvulus* spp (bindweeds).
- the roots of certain spear grasses penetrate and damage the sweetpotato root.

Other insects damaging sweetpotato roots in the field

Rough sweetpotato weevil (*Blosyrus* species) *(Abokoro)*

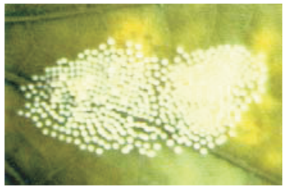


Yellow eggs are laid in groups around the edge of sweetpotato leaves, the leaf edge is often folded over the eggs. The C-shaped, whitish larvae roll the leaves and drill themselves into the soil, head first searching for food, if they find sweetpotato roots they make deep grooves/furrows (*emukule lo kwatar/ bokor*) on the surface. This damage is often wrongly thought to be due to millipedes (*agolu*) and/ or white grubs. The damage can reduce the market value of sweetpotato roots, and the deep peeling necessary to remove the damage can result in some yield loss. The use of clean planting material, sanitation, timely planting, and crop rotation can help to reduce the incidence of this pest.

Other insect pests damaging sweetpotato leaves and vines in the field

Sweetpotato butterfly (*Acraea acerata*) *(Epelepelet)*

The larvae feed on the leaves. Complete defoliation may result from severe attacks. Outbreaks usually occur at the start of the dry season.



Eggs of the sweetpotato butterfly

Larva of the sweetpotato butterfly

Adult sweetpotato butterfly

Clean uninfested planting material should always be used. Handpicking the larvae off the leaves and destroying their webbed nests is effective if labour is easily available. Early planting and harvesting enable the crop to escape severe attacks. Ants prey on the larvae, and there are several larval and pupal parasites. Intercropping sweetpotato with onion/ or the silver leaf *Desmodium uncinatum* might reduce the number of eggs laid. Severe outbreaks might warrant the use of contact insecticides.

Sweetpotato hornworm (*Agrius convolvuli*) *(Omumwarat)*
One large larva can defoliate a plant on its own, and a large population of older larvae can defoliate a field overnight. The larvae feed on the leaf blades, causing irregular holes, and may eat the entire blade, leaving only the petiole. Yield losses can occur if heavy defoliation takes place when the crop is young. The sweetpotato hornworm larvae also attack egg plant, legumes, pepper, tomato and taro.


Sweetpotato hornworm larva


Sweetpotato hornworm pupa


Adult sweetpotato hornworm (hawkmoth; eporiporit)

Handpicking the larvae from leaves is usually sufficient in small areas. Turning the soil over between crops exposes the pupae. Light traps can be used to monitor the population of adults, when an increase occurs manual removal of larvae can prevent the build-up of a large population. Egg and larval parasites help to reduce outbreaks. Severe outbreaks might warrant the use of 'tea' solution or contact insecticides.

Tortoiseshell beetles (*Aspidomorpha* spp., *Laccoptera* spp.) *(Akolodong)*
The young larvae scrape the upper surface of the leaves, while older larvae and adults eat large round holes in the leaves. Severe attacks can sometimes skeletonise the leaves and peel the stems. Alternative host plants include coffee, round potato and various flowers. Control is rarely necessary, but planting away from alternative host plants can reduce populations. The beetles are often confused with ladybird beetles.


Eggs inside papery case


Tortoiseshell beetle larva


Tortoiseshell beetle adult


Damage caused by tortoiseshell beetles

Other forms of crop hygiene such as ensuring that the vines and leaves from harvested crops are completely destroyed (they can be fed to livestock) and that all the roots (especially the small ones which may come from diseased plants), are destroyed.

However, often the best and certainly the most convenient means of controlling SPVD is to plant varieties of sweetpotato which have resistance to virus diseases.

All these management practices work better if they are done on areas as large as possible, so if communities can work together to manage SPVD they will all benefit. The crop hygiene you do to control sweetpotato viruses probably also helps control other pests and diseases.

Fungal pathogens causing diseases of the leaves and vines

Alternaria

The fungus survives in the soil and in plant remains. The airborne spores are spread through: infected planting material; wind; splashing rain and water. During the rains the increased humidity often leads to high levels of infection. The disease incidence and lesion (*iboconoreta*) size increase in wetter, high altitude areas.


Alternaria infected sweetpotato vine

The disease is first observed as small, brown/grey/black oval lesions with a typical bulls' eye appearance of concentric rings, on leaves, stems and petioles. On the lower side of the leaf, blackened veins are observed. As the disease progresses, the lesions become necrotic usually surrounded by a wide yellow halo; soon after the whole blade turns chlorotic and drops. Vine bases and middle sections are more affected than tips. Death of vines can occur. The ground under affected vines is often covered with blackened leaf debris.

Sweet potato feathery mottle virus (SPFMV) and *sweet potato chlorotic stunt virus* (SPCSV) are together the most important viruses affecting sweetpotato in Africa. By themselves, sweetpotato viruses may cause only mild or no obvious symptoms. However, plants can be infected by more than one type of virus and, when this happens, the viruses may help each other to multiply with the result that the disease is more severe than expected. The combination of SPCSV + SPFMV is known as *sweet potato virus disease* (SPVD) and is the most important disease of sweetpotato in Africa. SPFMV is transmitted by a wide range of aphid species *(eiliana)* and is spread mainly by winged adults, even of species that do not colonise sweetpotato, flying from plant to plant. SPCSV is transmitted by the mobile adult form of whiteflies *(ekwanga)*, especially *Bemisia tabaci*, as they fly from plant to plant. Since it is the spread of SPCSV by whiteflies that synergises SPFMV, whiteflies are also usually the driving force behind the spread of SPVD. Neither disease is spread by insects over very long distances.

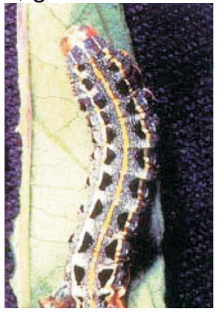
Because viruses spread quickly through the vascular system of a plant to infect the whole plant, any portions of an infected plant that are used as planting materials (vines or roots), are almost always diseased themselves. This then carries the disease to the next generation of plants.

So:

- **Make sure cuttings are collected for planting new sweetpotato crops from healthy plants** and, if possible, from healthy plants in crops in which few other plants have the disease. Then there is also less chance of taking cuttings from plants that have just been infected. It may be better to avoid collecting cuttings from very old crops both because SPVD may have built up in these crops and because SPVD is less easy to see in old plants than in vigorously-growing crops.
- **Remove and burn or feed to livestock any diseased plants as soon as they appear in young crops** (plants infected when young wouldn't have yielded much anyway, the neighbouring plants will soon fill up the space and you can replant cuttings if you wish in young crops).
- **Avoid planting new crops where you grew sweetpotato last season** because roots and cuttings from old diseased plants surviving in the soil will produce diseased plants from which infection will easily spread to your new crop.
- **Plant your new crop away from old crops** so it is difficult for whiteflies and aphids to reach your new crop.

Armyworms (*Spodoptera exigua* and *Spodoptera eridania*) *(Ekutelek)*
The young larvae often scrape *(aikis)* sweetpotato leaves, while the older larvae feed producing large irregular holes and may leave only the veins. Apart from sweetpotato, armyworms attack asparagus, banana, cocoa, corn, citrus, garlic, jute, kenaf, mulberry, onion, passion fruit, sesame, sorghum, soybean, tobacco, rice, tomato, sugarcane, cotton, beans, peanuts, castor oil plants, taro, wheat, round potato, cabbages, kales, cucumbers, melons, squashes, pumpkins, grasses and some broad leaf weeds.


Eggs of the armyworm Spodoptera exigua


Armyworm larva, Spodoptera exigua


Armyworm larva, Spodoptera eridania


Adult armyworm moth Spodoptera eridania

To reduce damage from armyworm, weed hosts should be eliminated, leaves containing eggs and larvae should be destroyed, and light traps can be hung over basins of water in the field to trap the adults at night. Predatory bugs, carabid beetles, spiders and vespid wasps attack the larvae, many parasite species are also known. The botanical 'tea' solution, the biopesticide Bt, and formulations of nuclear polyhedrosis viruses can be used for spot application.

Clearwing moth (*Synanthedon* spp.) *(Eporiporit lo ecaete abebenoka)*
The larvae bore into the vines and occasionally the storage roots. The vine base becomes swollen and full of feeding tunnels. If infestation is heavy the vines can break off at the base. This vine damage can lead to a reduction in the storage root yield.

It is not often necessary to control this insect. Cultural methods similar to those used against the sweetpotato weevil should be effective in reducing the incidence of this pest, e.g. use of clean planting materials, hilling up of earth around base of plant, field sanitation and timely harvesting.

Damage caused by larvae of the clearwing moth

Pupal cases of the clearwing moth on a sweetpotato vine

Adult clearwing moth

Hairiness and eriophyid mites *(aijuloikit ka ebulolo lo acok)*

The shoot on the right shows typical symptoms (dense white felt of hairs on the stem, bud and leaf petiole plus stem and petiole thickening) of hairiness. The shoot on the left is unaffected and of the same variety.

It is quite common that the stems, leaf petioles, buds and undersides of sweetpotato leaves become covered with a dense layer of white hairs. The leaves and plants are also generally slightly stunted, the leaves and stems thickened, and the plants yield poorly. Occasionally, whole crops are affected but often the symptoms affect just one or a patch of plants, and often only particular varieties. This hairiness is caused by eriophyid mites. The mites feed in the bud and on young foliage of the sweetpotato plant, injecting growth substances into it at the same time so as to make the plant produce the dense mat of hairs (probably providing protection for the mites). The adult mites are tiny and look like a speck of dust. The mites invade crops by being blown like dust particles in the wind. Little is known about them or how to control them. Some varieties of sweetpotato seem more prone to infestation than others.

Most serious disease of sweetpotato

Viruses

Viruses are the most damaging group of disease organisms affecting sweetpotato in Africa. Viruses are amongst the smallest organisms known and can be seen only using a very powerful electron microscope. They are very simple organisms and can only survive and multiply inside their hosts/ victims. Most also need to be carried from plant to plant, usually by an insect which feeds on plant sap, such as aphids or whiteflies. Once a virus enters a cell in the body of its host, it will take over part of the management of the cell's processes, and force the cell to produce more viruses identical to itself – rather than the crop yield we want! These new virus particles then spread through the plant to infect more cells.

Common symptoms of virus infection in plants, including sweetpotato, are:

- diminished growth so the plants and leaves remain small (stunted).
- chlorosis (paleness, even whitening; *aidosoikit*) of the leaf tissue. This chlorosis may be general or in a pattern, often either between the leaf veins in a mosaic or less well defined mottle, or along the veins to form a chlorotic network.
- mishapen leaves with an uneven or curled appearance.
- pigmented leaves, often purple or yellow generally or in spots or rings.
- reduced production of sweetpotato storage roots.

Viruses affecting sweetpotato can be spread by the use of foliar cuttings taken from infected plants. They are also transmitted from plant to plant by sap-sucking aphid and whitefly insects.

Sweet potato virus disease (SPVD) affected plant (bottom left)