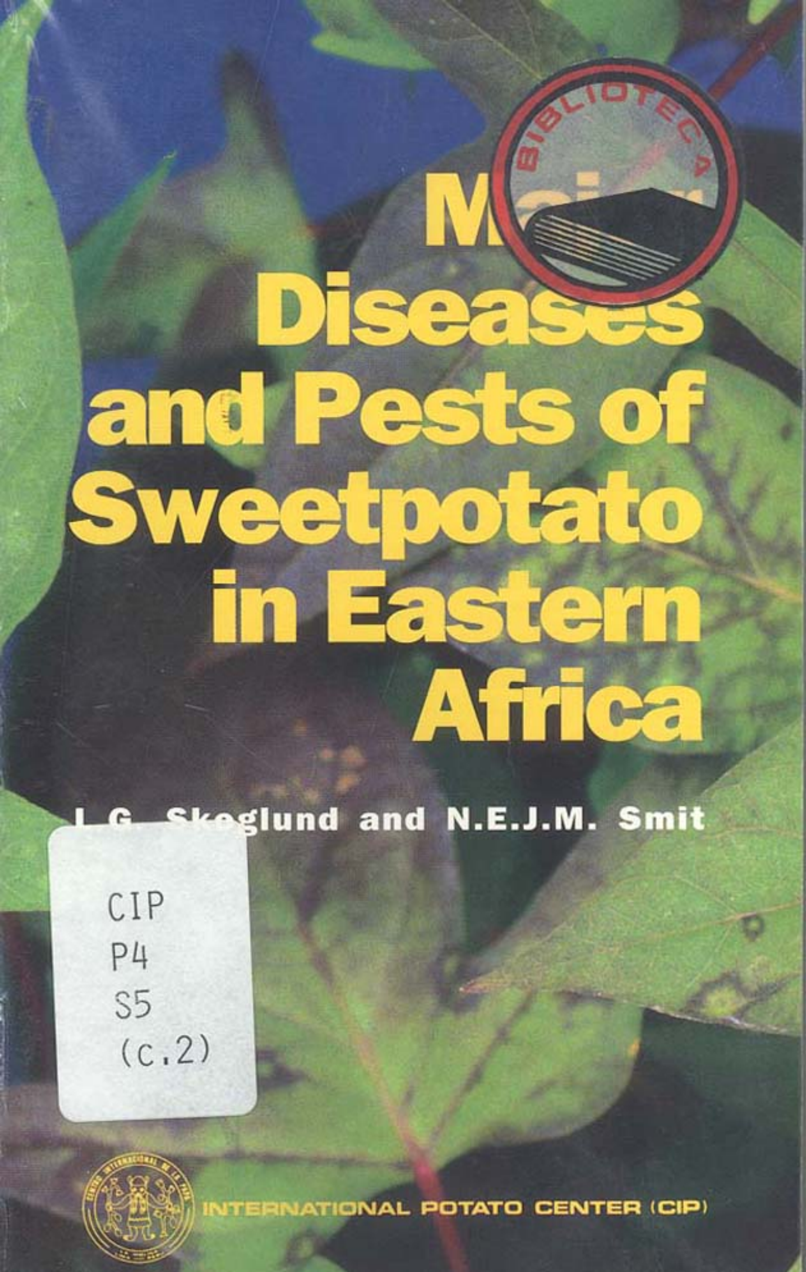

Major Diseases and Pests of Sweetpotato in Eastern Africa

L.G. Skoglund and N.E.J.M. Smit

INTERNATIONAL POTATO CENTER (CIP)

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L.G. Skoglund and N.E.J.M. Smit

International Potato Center (CIP)
P.O. Box 25171
Nairobi, Kenya

The International Potato Center (CIP) is a not-for-profit, autonomous scientific institution established in 1971 by agreement with the government of Peru. The Center develops and disseminates knowledge to facilitate use of the potato, sweetpotato, and Andean roots and tubers as basic foods in the developing world. CIP is one of 18 international research and training centers supported by the Consultative Group on International Agricultural Research (CGIAR). The CGIAR is sponsored by the Food and Agriculture Organization (FAO) of the United Nations, the United Nations Development Programme (UNDP), and the International Bank for Reconstruction and Development (World Bank), and comprises more than 45 countries, international and regional organizations, and private foundations.

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Cover: Photo of chlorotic spots with and without purple margins induced by SPFMV (taken by S. Fuentes).

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Contents

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Introduction

This publication is meant to be used as a field guide so that researchers, extensionists, and farmers growing sweetpotato throughout Eastern and Central Africa can identify common diseases and pests. It is not meant to be comprehensive but is based on the authors' experiences in those regions as well as surveys conducted in Kenya during the period 1990-1992. In general, of all the constraints mentioned, sweetpotato weevils (*Cylas* spp.) and virus diseases contribute the most to yield losses. Leaf- feeding insects, especially the sweetpotato butterfly, cause significant losses during outbreaks.

We have made general comments about control measures. In most cases (except for sweetpotato weevils), little is known about control under tropical conditions. Though chemical controls may exist and be in use in developed countries, we do not recommend them for Eastern and Central Africa.

Photographs in this publication were assembled from collections of different authors, who are acknowledged.

PART I

Diseases and Pathogens of Sweetpotato and Their Control

A number of pathogenic organisms affect sweetpotato in Eastern Africa. Most appear to be widespread, but damage levels vary. Diseases become a limiting factor, especially in the dry season. Up to now, no bacteria or mycoplasma-like organisms have been reported.

In this guide, we separate fungal pathogens according to the type of disease: foliar and stem diseases, storage root and postharvest diseases, and viral diseases. In general, foliar and stem diseases occur at low levels and cause little damage. Indirectly, they contribute to lower yields by reducing photosynthetic area and transport of nutrients and products to the storage roots. In Eastern Africa, storage rots do not cause much damage because sweetpotatoes are consumed shortly after harvest. However, tuber-rotting pathogens are present in the field and are capable of causing significant losses.

Viral diseases have been placed in a separate section, even though they also cause foliage symptoms. Viruses appear to cause the greatest damage in the field and contribute the most to yield losses.

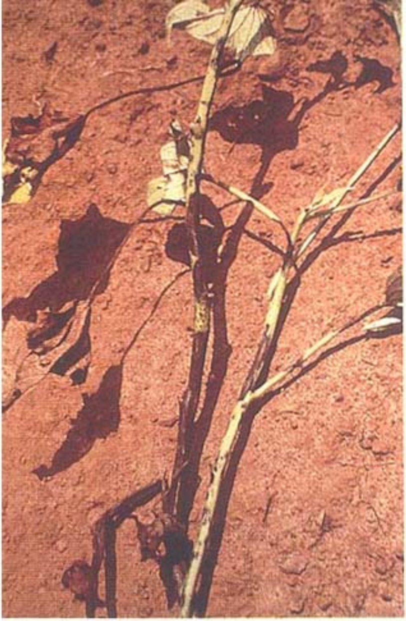


Fig. 1. Black lesions caused by *Alternaria* spp. on sweetpotato petioles and stems. Courtesy L.G. Skoglund.

Fig. 2. Blackened leaf debris on the ground under sweetpotato vines affected by *Alternaria* spp. Courtesy L.G. Skoglund.

Foliar and Stem Diseases Caused by Fungi

Alternariosis, Anthracnose, Blight

Alternaria solani, Alternaria spp.

Symptoms. Brown lesions with a typical "target" appearance of concentric rings occur on leaves, especially older leaves. Black lesions appear on petioles and stems (Fig. 1). Bases and middle sections are more affected than terminals of vines. Death of vines can occur. The ground under affected vines is often carpeted with blackened leaf debris (Fig. 2).

Biology. On the basis of published information and experience, Alternaria blight can be considered as the most important fungal disease in East Africa. Disease and lesion size increase as altitude increases. High relative humidity or free water is necessary for infection and sporulation. The fungus survives in debris. Spores are spread through infected planting material, wind, splashing rain, and water.

Though *Alternaria* spp. can be found infecting sweetpotato in all agroecological zones of the region, the form known as alternariosis or anthracnose occurs at mid to high elevations.

Control. Susceptibility to the pathogen varies among varieties. Pathogen-free planting material of the more resistant varieties and good sanitation practices should be used.

Fig. 3. Sweetpotato leaf spot caused by *Phomopsis ipomoea-batatas*. Brown lesions with a dark brown margin on affected leaves. Courtesy L.G. Skoglund.

Fig. 4. *Phomopsis ipomoea-batatas* pycnidia in the center of leaf lesions. Courtesy L. G. Skoglund.

Phomopsis Leaf Spot (Phyllosticta Leaf Spot)

Phomopsis ipomoea-batatas (*Phyllosticta batatas*)

Symptoms. Whitish to tan to brown lesions, usually less than 10 mm in diameter, form on upper and lower surfaces of leaves. These usually have a dark brown or purple margin (Fig. 3). Pycnidia are visible in the center of the lesions (Fig. 4).

Biology. The fungus survives in debris and is not known to have other hosts. Spores are spread through infected planting material, wind, splashing water, and possibly insects.

The disease is widespread in East Africa and occurs in all agroecological zones. It is not known to depress yield, but can reduce the quality of vines for planting material and fodder.

Control. No control measures are known.

Fig. 5. Brown lesions caused by *Cercospora* sp. on sweetpotato leaves. Courtesy W.S. Wu.

Minor Leaf Spot Fungi

Other fungi cause leaf spots and can be identified by inspecting spores with a microscope. These fungi include *Alternaria* spp., *Cercospora* sp. (Fig. 5), *Septoria* sp., *Ascochyta* sp., *Curvularia* sp., *Colletotrichum* sp., and *Pestalotia batatae.*

Control. No control measures are known.

Fig. 6. Mucilaginous layer containing mycelium and sporodochia of *Fusarium lateritium*. Courtesy C.A. Clark.

Fig. 7. Stunting distortion and chlorosis of sweetpotato vines caused by *Fusarium lateritium*. Courtesy C.A. Clark.

Chlorotic Leaf Distortion

(*Fusarium lateritium*)

Symptoms. The first sign or symptom noticed is a white, waxy (crusty) mucilaginous layer that contains mycelium and sporodochia, covering newly expanded leaves (microscopic observation reveals it is also on apical meristems and axillary buds) (Fig. 6). As the leaves age, the waxy covering predominates along the leaf margin but eventually disappears. In some cultivars and environments, leaves become chlorotic. Occasionally, leaves become distorted and plants are stunted (Fig. 7).

Biology. The pathogen may be present in the entire surface of the aerial part of the plant and can be transmitted through true seed (it cannot be eliminated by surface disinfection of the seed). Symptoms are more severe in hot, dry weather. There is a long latent period (3 to 6 weeks) from infection to symptom expression.

The disease has been found in only a few areas of East and Central Africa, primarily at low altitudes where it is hot and dry. It is not known to cause economic damage in its less virulent form. When stunting and distortion occur, losses should be expected.

Control. Pathogen-free planting material is essential. Varietal differences in susceptibility are observed. Use vegetative planting material from plants free of symptoms. Do not harvest true seed from diseased plants, especially if the seed is to be shipped to areas where chlorotic leaf distortion is not present. No chemical control is known.

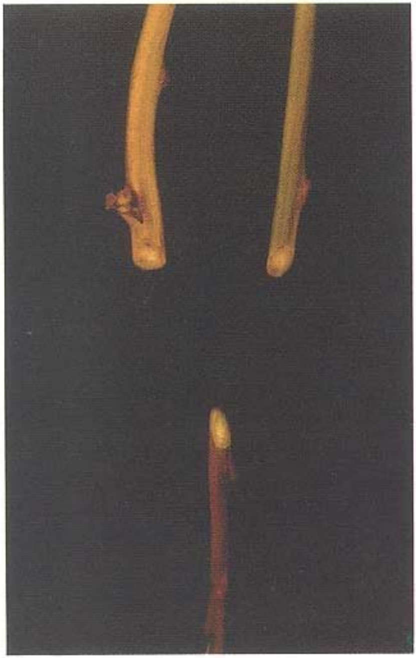


Fig. 8. Vascular discoloration in fusarium wilt disease caused by *Fusarium oxysporum* f. sp. *batatas*. Courtesy C.A. Clark.

Fusarium Wilt

(*Fusarium oxysporum* f. sp. *batatas*)

Symptoms. The first indication of this disease is a dullness and yellowing of leaves. This is followed by wilting and death of the vine. Affected vines show the vascular discoloration typical of fusarium wilt disease (Fig. 8).

Biology. The fungus is a soil inhabitant and specific to sweetpotato, a few close relatives, and burley and flue-cured tobacco. It can survive in the soil and in debris for several years. Though tip cuttings are usually pathogen-free, roots and cuttings from the base of the vine can be infected. Movement of infested soil on implements and by animals can lead to outbreaks of the disease in new areas. The disease occurs under a variety of environmental conditions. Yields are reduced depending upon the stage of growth when disease occurs.

Control. Good sanitation will help reduce the impact of the disease and limit its spread. Some varietal resistance has been observed, and breeding programs in some countries have released resistant varieties.

Fig. 9. An advanced stage of *Plenodomus* foot rot. Numerous pycnidia are revealed when a portion of periderm is peeled back. Courtesy C.A. Clark.

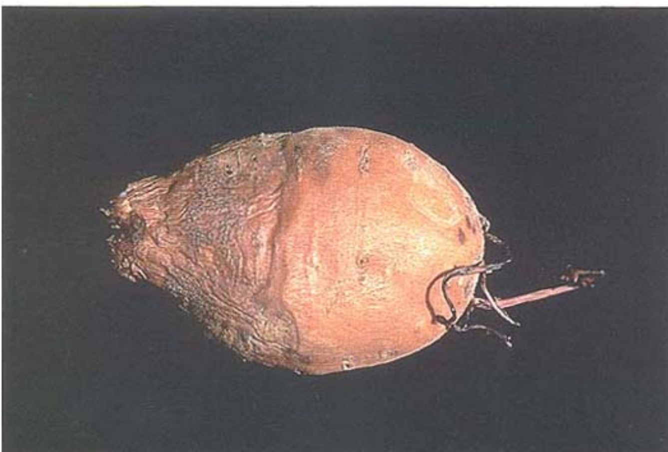


Fig. 10. Dark brown decay caused by *Plenodomus destruens* on the proximal end of sweetpotato storage root. Courtesy W.J. Martin.

Storage Root and Postharvest Diseases

Foot Rot

(*Plenodomus destruens*)

Symptoms. Brown lesions form on the stem at or below the soil line. Wilting and death occur in severe cases. Black pycnidia can be seen (Fig. 9). The canker extends down the stem to affect the proximal end of the storage root (Fig. 10). This decay is dark brown, firm, and dry.

Biology. The fungus does not survive well in the soil except in infected roots and stems. It is spread by infected cuttings, especially those from the base of the vine, and by contact with spores from infected roots in storage. Other hosts include members of the Convolvulaceae. Storage damage can reduce marketability and cause losses. Diseased roots should not be stored.

Control. Sanitation and use of healthy vine tips for planting are the best means of control in the field.

Fig. 11. Java black rot caused by *Lasiodiplodia theobromae* at one or both ends of sweetpotato storage roots. Courtesy J-Y. Lo.

Java Black Rot

Lasiodiplodia theobromae (*Diplodia gossypina*)

Symptoms. This rot is firm and moist early on, but in a short time storage roots become totally blackened and mummified. Rot starts at one or both ends of the storage root and first appears brown, later turning black. Erumpent black stromatic masses that bear pycnidia are a diagnostic feature (Fig. 11).

Biology. Spread is by infested soil, infected storage roots, and contaminated storage boxes, baskets, or tools. Infection occurs via wounds, especially the cut stem end. Though the pathogen can infect stems, it grows very little and is seldom a problem. Yields can be reduced in the field or through storage losses.

Control. Timely harvesting can reduce losses. Good sanitation and care in handling to reduce wounding are important.

Fig. 12. *Rhizopus stolonifer* sporulating on the surface of rotting storage roots. Courtesy W.J. Martin.

Soft Rot

(*Rhizopus stolonifer, Mucor* sp.)

Symptoms. Soft rotting occurs after harvest. Storage roots become soft, wet, and stringy, often starting at one end. A strong alcohol-like odor is produced. These fungi are commonly seen sporulating on the surface of rotting storage roots (Fig. 12).

Biology. Spread is by infested soil or airborne spores that enter wounds. Optimum relative humidity and temperature for progress of infection and disease vary with the variety, but are usually high. Soft rot can destroy harvested roots in 48 hours, if they are left unprotected under sunlight.

Control. Washing storage roots is especially conducive to rot. Care in handling and proper curing can reduce disease incidence. So far, no resistance has been found. The only difference is that some varieties rot faster than others because they are more susceptible.

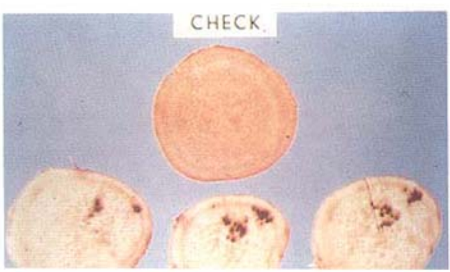
Curing is accomplished by storing after harvest at 29-32°C and 95-100% relative humidity for 5 to 7 days with adequate ventilation (at least 8 cubic feet of air per ton per day). Subsequent storage is best at around 13°C and 95% relative humidity.

Fig. 13. Chlorosis along midribs and feathering induced by SPFMV. Courtesy S. Fuentes.

Fig. 14. Chlorotic spots with and without purple margins induced by SPFMV. Courtesy S. Fuentes.

Fig. 15. Russet crack induced in storage roots by SPFMV. Courtesy W.J. Martin.

Fig. 16. Internal cork of storage roots induced by SPFMV. Courtesy J.W. Moyer.



Viral Diseases

Sweetpotato Feathery Mottle Virus (SPFMV)

Aphid-transmitted potyvirus

Symptoms. Generalized symptoms are irregular chlorotic patterns—feathering (Fig. 13)—along midribs and faint to distinct chlorotic spots with or without purple margins (Fig. 14). Some cultivars become quite purple with green "islands" scattered over the surface. Some strains cause russet crack (angular necrotic lesions) (Fig. 15) or internal cork of storage roots (Fig. 16).

Biology. Symptoms associated with this virus are influenced by cultivar and environment as well as virus strain. SPFMV can be latent in the vines. Lack of symptoms depends upon cultivar susceptibility, degree of stress, growth stage, or virulence of the isolate. Increased stress can lead to symptom expression. Rapid growth often results in symptom remission.

SPFMV is transmitted by aphids in a nonpersistent manner. It is widespread and can cause economic losses, especially when it occurs in multiple infections with other viruses.

Control. Aphid control is not economically feasible. The only control measures are the use of virus-free planting material and sanitation. Resistant clones have been reported.

Fig. 17. Leaf mottling and stunting induced by SPMMV. Courtesy S. Fuentes.

Sweetpotato Mild Mottle Virus (SPMMV)

Whitefly-transmitted potyvirus

Symptoms. Predominant symptoms associated with SPMMV are leaf mottling and stunting (Fig. 17). Vein clearing can occur, as can distortion. None of these symptoms is easy to diagnose in the field and the virus can be latent.

Biology. SPMMV is transmitted by the whitefly, *Bemisia tabaci*. It occurs throughout the region. Its effects on yields are not known, though they are probably similar to those of SPFMV. SPMMV can also act together with SPFMV.

Control. Planting virus-free propagating materials and sanitation should be used for control.

Fig. 18. Vein clearing, leaf distortion, and stunting induced by SPCSV. Courtesy L.G. Skoglund.

Other Viruses

Other viruses have been identified in East Africa through serological identification techniques. These include sweetpotato latent virus (SPLV), sweetpotato chlorotic fleck virus (SPCFV), sweetpotato caulimo-like virus (SPCLV), sweetpotato ring spot virus (SPRSV), cucumber mosaic virus (CMV), and sweetpotato chlorotic stunt virus (SPCSV) (Fig. 18). Sweetpotato virus disease (SPVD) is due to a complex of viruses.

Fig. 19. Flat fasciation
of vines. Courtesy
L.G. Skoglund.

Another Problem

Fasciation

(Cause unknown)

Symptoms. Vines become very broad and flattened—fasciated (Fig. 19). This symptom becomes more pronounced towards the shoot tip.

Biology. Fasciation is found throughout the agroecological zones where sweetpotato is grown. It is not known whether yields are affected. Plants have been known to exhibit spontaneous remission of symptoms. It has been suggested that this is a physiological disorder or that it is caused by a bacterium of the *Rhodococcus* genus.

PART II

Insect Pests of Sweetpotato and Their Control

A large number of insect pests attack sweetpotato in East Africa. The importance of the different species varies among agroecological zones. Within a zone, the importance of species changes over the season; many insect pests are a problem mainly in the dry season.

In this guide, we divide pest species into three groups: those causing foliage damage, those causing stem damage, and those causing storage root damage. Defoliation reduces yield depending upon the severity of infestation and upon the growth stage of the sweetpotato crop in which it occurs. Leaf feeders are a serious problem only during severe outbreaks, and control measures are seldom necessary. In addition to feeding, certain insect species such as aphids and whiteflies transmit viruses. Extensive stem damage can result in the plant wilting and even dying. Damage done to the vascular system by feeding, tunneling, and secondary rots can reduce the size and number of storage roots. Damage to storage roots, the plant part generally consumed by humans, is of two kinds. Storage roots with only external damage suffer more of a qualitative loss than a quantitative loss. Although their market price may drop or they may become unsalable, they can often still be consumed in the farm household. Internal damage often causes a complete loss.

Fig. 20. Eggs of sweetpotato butterfly (*Acraea acerata*) on sweetpotato leaves. Courtesy N.E.J.M. Smit.

Fig. 21. Older caterpillar of sweetpotato butterfly. Courtesy N.E.J.M. Smit.

Fig. 22. Adult sweetpotato butterfly. Courtesy N.E.J.M. Smit.

Fig. 23. Defoliation caused by sweetpotato butterfly. Courtesy N.E.J.M. Smit.

Foliage Feeders

Sweetpotato Butterfly

Acraea acerata (Lepidoptera: Nymphalidae)

Description and biology. Pale yellow eggs (Fig. 20) are laid in batches of 100-400 on both surfaces of the leaves. The caterpillars are greenish-black and covered with branching spines. These larvae are concentrated in a protective webbing during the first 2 weeks after hatching. Then they become solitary and hide from the sunlight on the ground during the day (Fig. 21). The pupae are yellowish and hang singly on the underside of leaves or other support. The attractive adult butterfly has orange wings with brown margins (Fig. 22). The whole life cycle is about 34 days.

Damage. The caterpillars feed on the leaves. Young caterpillars feed on the upper leaf surface, while older larvae eat the whole leaf lamina except the primary midribs. Complete defoliation may result from heavy attacks (Fig. 23).

Pest status. Outbreaks are sporadic and seasonal and are usually reported at the beginning of the dry season.

Control. Sweetpotato fields should be observed for sweetpotato butterfly adults and damage early in the dry season. Webs containing young caterpillars should be collected and destroyed weekly. Early planting and harvesting enable the crop to escape heavy attacks. In case of severe outbreaks, chemical control can be carried out with carbaryl, pyrethrum, etc.

Fig. 24. Larvae and damage of tortoise beetle. Courtesy L.G. Skoglund.

Fig. 25. Adult of tortoise beetle *Aspidomorpha* sp. Courtesy L.G. Skoglund.

Tortoise Beetles

Aspidomorpha spp. and others (Coleoptera: Chrysomelidae)

Description and biology. Eggs are laid on the underside of the sweetpotato leaves or other Convolvulaceae in batches cemented to the leaves. Larvae are characteristically flattened and spiny. The tail is carried held up over the back, usually carrying excreta and previous cast skins (Fig. 24). The pupa is less spiny than the larva, and is fixed inert to the leaf. The adults are broadly oval and may be bright, patterned, or metallic (Fig. 25). Larvae, pupae, and adults are found on both sides of the foliage. Four species of *Aspidomorpha* and eight other Chrysomelidae have been recorded in Kenya on sweetpotato.

Damage. Large round holes are eaten in the leaves by both adults and larvae. Attacks are sometimes sufficiently severe to completely skeletonize the leaves and even peel the stems.

Pest status. Seldom a serious pest, tortoise beetles are widely distributed and often common, and their damage is quite conspicuous.

Control. This pest does not usually warrant control measures. Removal of Convolvulaceae weeds in the surrounding area reduces the problem. If chemical control is required, malathion can be used.

Fig. 26. Last instar hornworm (*Agrius convolvuli*). Courtesy CIP photo collection.

Fig. 27. Pupa of hornworm. Courtesy N.E.J.M. Smit.

Sweetpotato Hornworm

Agrius convolvuli (Lepidoptera: Sphingidae)

Description and biology. The small, shiny eggs are laid singly on any part of the plant. The larvae have a conspicuous posterior "horn." Their color varies from green to brown with distinct patterns. The last instar caterpillars reach 9.5 cm in length (Fig. 26). Hornworms are found mainly on young shoots. The larval period lasts 3 to 4 weeks. Pupation (Fig. 27) takes place in the soil and takes 5 to 26 days according to the temperature. The large, reddish-brown pupa is characterized by a prominent proboscis, which is curved downward. Adults are large, gray hawkmoths with black lines on the wings. Wingspan is 8 to 12 cm.

Damage. The large caterpillar can defoliate the plant. It feeds on the leaf blade, causing irregular holes, and may eat the entire blade, leaving only the petiole.

Pest status. Although widespread, it is not usually a serious pest.

Control. Handpicking the larvae from the leaves is usually sufficient. Ploughing the land between crops exposes the pupae.

Fig. 28. Grasshopper and the damage caused on sweetpotato leaves. Courtesy N.E.J.M. Smit.

Minor Leaf-Feeding Pests

Grasshoppers and locusts

Both adults and nymphs of *Zonocerous variegatus* (Orthoptera: Pyrgomoriphidae), the variegated grasshopper, can defoliate sweetpotato (Fig. 28). Outbreaks seldom occur and control is rarely needed.

Leaf folders

Young caterpillars of leaf folders such as *Brachmia convolvuli* (Lepidoptera: Gelechiidae) feed inside a folded leaf, leaving the lower epidermis intact. In most cases, only one larva is found per leaf fold. Damage results in a lace-like appearance of the leaf while the leaf veins are left intact. Control is rarely needed.

Strobiderus beetle

Strobiderus aequatorialis (Coleoptera: Chrysomelidae) is a small, yellowish beetle, 5 to 7 mm long. The adults perforate the leaves and cause damage similar to that of tortoise beetles. Control measures are not usually necessary.

Rough weevil

Blosyrus spp. (Coleoptera: Curculionidae) adults feed on the leaves of sweetpotato, but their important pest stage is the larvae, which affect the storage roots (see section "Storage Root Feeders").

Sweetpotato weevils

Cylas spp. (Coleoptera: Curculionidae) adults feed on the leaves of sweetpotato, but the more important damage is done to the storage roots and stems (see section "Storage Root Feeders").

Fig. 29. Aphids on sweetpotato. Courtesy CIP photo collection.

Virus Transmitters

Aphids

Aphis gossypii and others
(Homoptera: Aphididae)

Description and biology. Aphids are soft-bodied insects, 1 to 2 mm long, yellowish-green to black, with or without wings (Fig. 29). Aphids can multiply asexually, resulting in fast population buildup. Several generations occur a year.

Damage. Aphids damage plants by sucking sap from growing shoots. Symptoms of aphid attack are wrinkling, cupping, and downward curling of young leaves. During heavy infestation, plant vigor is greatly reduced.

As aphids feed and move from plant to plant in the field, they transmit viruses. The most important virus is the sweetpotato feathery mottle virus. Winged forms may travel long distances and introduce viruses into new areas. *Aphis gossypii* has a wide host range, including cotton, cucurbits, and many legumes.

Control. Control is rarely necessary. Predators, such as lady beetles, naturally reduce aphid populations. In case of heavy outbreaks or when producing virus-free planting materials, insecticides (e.g., diazinon and malathion) can be used.

Fig. 30. Whitefly nymphs on sweetpotato. Courtesy N.E.J.M. Smit.

Fig. 31. Whitefly adults on sweetpotato. Courtesy CIP photo collection.

Whiteflies

Bemisia tabaci (Homoptera: Aleyrodidae)

Description and biology. The female of *B. tabaci* lays eggs on the underside of leaves. All the nymphal stages (Fig. 30) are greenish-white, oval in outline, scale-like, and somewhat spiny. The adult (Fig. 31) is minute and is covered with a white, waxy bloom. Development of one generation takes 3 to 4 weeks.

Damage. High whitefly populations may cause yellowing and necrosis of infested leaves. The pest is more important as a transmitter of viruses, especially the sweetpotato mild mottle virus. *B. tabaci* has a wide host range, including cotton, tomato, tobacco, and cassava.

Control. Control measures are not usually needed, but if they are, dimethoate and pyrethrum sprays are recommended. The spray should be directed at the underside of leaves as much as possible.

Fig. 32. Pupal cases of clearwing moth in swollen stem. Courtesy N.E.J.M. Smit.

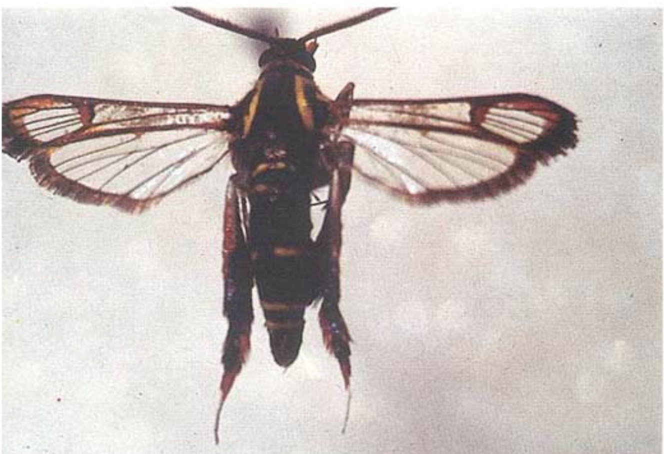


Fig. 33. Adult clearwing moth (*Synanthedon* sp.). Courtesy N.E.J.M. Smit.

Stem Feeders

Clearwing Moths

Synanthedon spp. (Lepidoptera: Sesiidae)

Description and biology. Adults lay batches of 70-100 yellowish eggs on vines and leaf stalks. The larvae burrow into the vines at hatching and tunnel downward. The larvae are whitish, with a transparent skin and a brown head capsule. They can become up to 2.5 cm long. Pupation occurs in the main stem just above ground level and the grayish-brown pupal (Fig. 32) case can be seen protruding from the swollen stem. The adult moth is characterized by having transparent wings (Fig. 33).

Damage. The larvae burrow into the vines and sometimes into the storage roots. The vine base is characteristically swollen and is traversed with feeding galleries. During heavy infestation, the vine easily breaks off at the base.

Pest status. Three closely related species of *Synanthedon* are regularly found in sweetpotato, but they are prominent pests only in some localities.

Control. Frequent earthing-up around the plant base will reduce the incidence of this pest. Other cultural control measures, such as the ones practiced for sweetpotato weevil species, will also help to control clearwing moth.

Fig. 34. Adult striped weevil (*A[cidodes dentipes*). Courtesy IIBC.

Fig. 35. Larvae of striped weevil in swollen stem. Courtesy N.E.J.M. Smit.

Striped Sweetpotato Weevil

Alcidodes dentipes and *A. erroneus*
(Coleoptera: Curculionidae)

Description and biology. Adult *A. dentipes* is about 1.4 cm long and has conspicuous white stripes longitudinally along the elytra (Fig. 34). Adult *A. erroneus* is bigger than the former, and is brownish-black with an irregular yellowish patch on each elytron. Larvae of both are white, with an orange-brown head capsule, and are C-shaped. Larvae and pupae (Fig. 35) are found inside the sweetpotato vine, most often at the base. The adults eat their way out of the vine. The life cycle is comparable to that of sweetpotato weevils. Larvae and pupae also resemble those of immature *Cylas* weevils, but the *Alcidodes* later instars are much bigger.

Damage. The larvae bore into the vines and sometimes into the storage roots. The vine base swells up. Adult weevils girdle the vines, causing wilting.

Pest status. *Alcidodes* is a minor pest in most localities.

Control. Control is not usually required. Frequent earthing-up around the plant base will reduce the incidence of this pest. Other cultural control measures, such as the ones practiced for sweetpotato weevil species, will also help to control *Alcidodes* weevils.

Other Stem-Damaging Species

Peloropus weevil

A reddish-brown, compact, 3-4 mm weevil (*Peloropus batatae*) (Coleoptera: Curculionidae) has been found inside stems and storage roots at some locations. The last instar of the white larva is longer than one would expect considering the small size of the adult. The larva makes long tunnels in the stem and can go down to the storage root via the storage root "neck." Pupae and adults are found at the end of the tunnels. The life cycle is probably long compared with that of other sweetpotato weevils: 2 months or more. Because the larva enters via the storage root neck, storage roots that seem undamaged on the outside might be inedible because of several tunnels on the inside. Control is not usually required.

Long-horned beetle

A species of long-horned beetle (Coleoptera: Cerambycidae) has been found to attack stem bases in some localities. The larvae are large, with big heads, and they are found inside the stem base. They cause severe swelling. Control is seldom necessary.

Sweetpotato weevils

Cylas spp. larvae can do considerable damage to sweetpotato vine bases by tunneling. These species are discussed in the section "Storage Root Feeders."

Fig. 36. Rough sweetpotato weevil adult (*Blosyrus obliquatus*). Courtesy N.E.J.M. Smit.

Fig. 37. Eggs of rough weevil on underside of wilted sweetpotato leaves. Courtesy N.E.J.M. Smit.

Fig. 38. Damage of rough weevil to storage roots. Courtesy N.E.J.M. Smit.

Storage Root Feeders

Rough Sweetpotato Weevil

Blosyrus sp. (Coleoptera: Curculionidae)

Description and biology. Adult weevils are blackish or brownish and the surface of the elytra is rugged (Fig. 36). This makes them look like a lump of soil. Larvae are whitish and C-shaped. The adult weevils lay eggs underneath fallen leaves (Fig. 37). The larvae develop freely in the soil and pupate there. Adult weevils are found on the ground underneath foliage during the day.

Damage. Adult weevils feed on foliage, but the larvae cause greater damage. While feeding under the soil surface, they gouge shallow channels on the enlarging storage roots (Fig. 38). These "grooves" reduce marketability. When extensively damaged, the skin of the storage root has to be thickly peeled before eating, because the flesh discolors just under the grooves.

Pest status. This weevil is a common pest of sweetpotato in East Africa, and is serious in some localities.

Control. Some of the cultural control measures used to control *Cylas* should be effective in reducing incidence of this pest, especially rotation and sanitation. The possibility of biological control is under investigation.

Fig. 39. Adult *C. puncticollis*. Courtesy IIBC.

Fig. 40. Egg of *C. puncticollis*. Courtesy IIBC.

Fig. 41. Larva of *C. puncticollis*. Courtesy IIBC.

Fig. 42. Pupa of *C. puncticollis*. Courtesy IIBC.

Sweetpotato Weevils

Cylas spp. (Coleoptera: Curculionidae)

Description. Three species of the genus *Cylas* are pests of sweetpotato; they are commonly called sweetpotato weevils. All three species—*Cylas formicarius, C. puncticollis,* and *C. brunneus*—are found in Africa. The elongate, ant-like adults of the three species can be distinguished from each other.

C. puncticollis is the easiest to distinguish because the adult is all black and larger than the other two (Fig. 39). *C. formicarius* has a bluish-black abdomen and a reddish-brown thorax. *C. brunneus* adults are small and not uniform in coloring. The most common type can easily be confused with *C. formicarius.*

In all species, the eggs are shiny and round (Fig. 40). The legless larvae (Fig. 41) are white and curved, and the pupae white (Fig. 42).

Damage. Damage symptoms are similar for all three species. Adult sweetpotato weevils feed on the epidermis of vines and leaves. Serious damage may cause the leaf to shrivel and die. Adults also feed on the external surfaces of storage roots, causing round feeding punctures, which can be distinguished from oviposition sites by their greater depth and the absence of a fecal plug (Fig. 43). The developing larvae of the weevil tunnel in the vines and storage roots, causing significant damage. Frass is deposited in the tunnels. In response to damage, storage roots produce toxic

Fig. 43. Damage to the storage root by sweetpotato weevils. Courtesy N.E.J.M. Smit.

Fig. 44. Cracking of vine affected by sweetpotato weevils. Courtesy N.E.J.M. Smit.

terpenes, which render storage roots inedible even at low concentrations and low levels of physical damage. Feeding inside the vines causes malformation, thickening, and cracking of the affected vine (Fig. 44).

Pest status. These weevils are a serious pest of sweetpotato, especially during dry periods.

Distribution. *C. formicarius* is an important pest in India and Southeast Asia, Oceania, the USA, and the Caribbean. In Africa, it has been found only in Natal, South Africa, and at one location in coastal Kenya. *C. puncticollis* and *C. brunneus* are confined to Africa.

Biology. All sweetpotato weevil species have a similar life history. The adult female lays eggs singly in cavities excavated in vines or in storage roots, preferring the latter. The egg cavity is sealed with a protective, gray fecal plug. The developing larvae tunnel in the vine or storage root. Pupation takes place within the larval tunnels. A few days after eclosion, the adult emerges from the vine or storage root. The female weevil finds storage roots in which to lay her eggs, through soil cracks. Alternate hosts of sweetpotato weevils are *Ipomoea* weeds.

Adults of all species may be conveniently sexed by the shape of the distal antennal segment, which is filiform (threadlike, cylindrical) in males and club-like in females. The males have larger eye facets than the females.

At optimal temperatures of 27-30°C, *C. formicarius* completes development (from egg to egg)

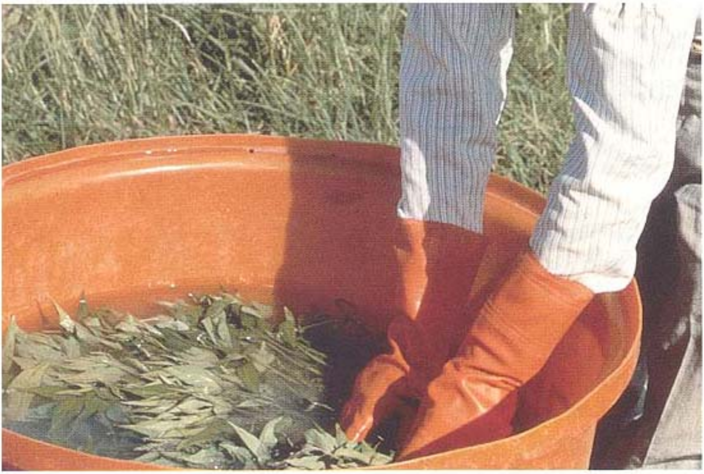


Fig. 45. Dipping of sweetpotato vines with insecticide. Courtesy N.S. Talekar.

in about 33 days. Adult longevity is 2 1/2 to 3 1/2 months and females lay between 100 and 250 eggs in this period. At suboptimal temperatures, development takes longer.

At 27°C, *C. puncticollis* has a total development time of about 32 days, whereas *C. brunneus* takes 44 days. Adults of the first species live an average of 100 days, while the latter dies after about 2 months. *C. puncticollis* females lay 90 to 140 eggs in their lifetime, while *C. brunneus* females lay 80 to 115.

Control. Where sweetpotato weevil populations are high, no single control method provides adequate protection. The integration of different techniques provides sustainable protection.

Cultural control. Cultural control has proven to be very effective against the sweetpotato weevil. Cultural practices include:

- Use of noninfested planting material, especially vine tips.
- Crop rotation.
- Removal of volunteer plants and crop debris (sanitation).
- Timely planting and prompt harvesting to avoid a dry period.
- Removal of alternate, wild hosts.
- Planting away from weevil-infested fields.
- Hilling of plants and filling in of soil cracks.
- Applying sufficient irrigation to reduce soil cracking.

Fig. 46. *C. puncticollis* infected by *Beauveria bassiana*. Courtesy IIBC.

Chemical control. Dipping planting material in an insecticide like carbofuran or diazinon for 30 minutes prior to planting (Fig. 45) can control sweetpotato weevils for the first few months of the growing season.

Use of less susceptible varieties. Varieties completely resistant to sweetpotato weevil have not yet been detected. Less susceptible varieties that escape weevil damage because their storage roots are produced deep in the soil are available.

Biological control. The most promising biological control agents for sweetpotato weevils appear to be a fungus (*Beauveria bassiana*) (Fig. 46) and nematodes (*Heterorhabditis* spp. and *Steinernema* spp.). The fungus attacks and kills the adult weevils, whereas the nematodes kill the larvae. Research on biological control is ongoing.

Sex pheromones. The sex pheromone that is released by female *C. formicarius* and attracts males has been identified and is commercially available. It is used in control programs through mass-trapping of males. *C. puncticollis* and *C. brunneus* are not attracted to this pheromone. In Africa, the *C. formicarius* pheromone has its role in indicating the absence of this species. It could be used as a quarantine tool because the traps (Fig. 47) are so sensitive that their failure to catch weevils is a good indication that the pest is not present.

Fig. 47. Sex pheromone traps for *C. formicarius*. Courtesy N.E.J.M. Smit.

Other Storage Root-Damaging Species

Clearwing moth

The larvae can tunnel through the vine into the storage roots. Mostly, only the tip of the storage root is affected. This pest was discussed in the section "Stem Feeders."

Peloropus weevil

The larvae of the *Peloropus* weevil can tunnel down the vines to the storage roots. This species was discussed in the section "Other Stem-Damaging Species."

White grubs

White grubs, larvae of the Scarabaeidae beetles, live in the soil. They are large, fleshy grubs with swollen abdomen, well-developed head capsules, and large jaws and thoracic legs. They usually adopt a C-shaped position. White grubs can gouge out broad, shallow areas on storage roots. Most species attack a wide range of host plants. Control is not usually necessary. Handpicking of exposed grubs during land preparation and weeding is useful.

Fig. 48. Erinose induced by the mite *Aceria* sp. Courtesy L. G. Skoglund.

Mites

Erinose

Eriophyid mites, *Aceria* sp. (Acari: Eriophyidae)

Symptoms. Vines and leaves become excessively hairy, beginning at the shoot tip (Fig. 48).

Biology. Erinose is encountered throughout Eastern and Central Africa. The problem is more pronounced at lower altitudes where it is hot and dry. Research indicates that yields are reduced, but this has not been confirmed by farmers.

Control. Control is through selection of mite-free planting material and good field sanitation. However, this might not be effective enough because mite populations can build up rapidly.

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Teresa Ames de Icochea
Bill Hardy

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Rubén D. Gutiérrez
Cecilia Lafosse

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