Crops/ fruits/ vegetables
Pests/ diseases/ weeds
African armyworm
African bollworm
African cassava mosaic virus (ACMV)
African maize stalkborer
Anthracnose

more Images

Banana weevil
Scientific name: *Cosmopolites sordidus*
Order/Family: Coleoptera: Curculionidae
Type: pest (insect/mite)
Common names: Banana weevil borer, banana root weevil, banana root borer, banana rhizome weevil, banana borer, plantain weevil, corm weevil, banana beetle
Host plants: Bananas Plantain and Ensete

General Information on Pest and Damage

Geographical distribution

The banana weevil *(C. sordidus)* is known from virtually all banana-growing countries of the world, including the New World, Afrotropics, Oriental and Australasian regions.

Geographical Distribution of Banana weevil in Africa (red marked)

Damage

Grubs feed making irregular tunnels in the corm and rootstock. Tunnels are roughly circular and can reach up to about 8 mm in diameter. The corm can be

riddle with tunnels, which promotes fungal infection and decay reducing it to a black mass of rotten tissue. Injury to the corm can interfere with root initiation and sap flow in the plant, as a result the leaves turn yellow, wither and die prematurely. In particular young suckers show symptoms of wilting and die, but older plants are retarded in their growth. Heavily infested plants produce small bunches, and are easily blown over by the wind. Spent stems, cut or standing are attacked rapidly.

Damage is worst in neglected plants. In fertile soils and with good crop husbandry it is seldom serious. Banana weevil numbers are often low in newly planted fields. Population build-up is slow and weevil problems are most often encountered in ratoon crops. The banana weevil damage is more serious in low altitude areas that in highland areas as a result of the influence of temperature. Weevils are usually not a problem beyond 1500 m above sea level (Karubaga and Kimaru, 1999; Gold and Messiaen, 2000).

Banana corm damaged by banana weevil. Note tunnelling by weevil grubs and rotting of corm.

© A. M. Varela, icipe

Host range

Banana weevil is an important pest of banana and plantain (*Musa* spp.), and ensete (*Ensete* spp.). Weevil problems appear to be most severe in plantains, highland cooking bananas and ensete. The weevil has contributed to the decline and disappearance of highland cooking banana in parts of East Africa. Weevil pest status in other groups of bananas is variable. In commercial Cavendish plantations, the banana weevil has been reported to be relatively unimportant (Gold and Messiaen, 2000).

Symptoms

Infestation by the banana weevil begins at the base of the outermost leaf-sheath and in injured tissues at the lower part of the pseudostem. Initially the young grubs make several longitudinal tunnels in the surface tissue until they are able to penetrate to adjacent inner leaf-sheaths; they then bore into the pseudostem base and rhizome/corm, but also into the base of suckers and into roots. Larval tunnels may run for the entire length of fallen pseudostems. Infested plants have dull yellow green and floppy foliage. Young infested suckers often wither and fail to develop. Plants are easily blown down by mild to strong winds.

processing

Natural pest control

Cultural practices

Affected plant stages

Flowering stage, fruiting stage, seedling stage and vegetative growing stage.

Affected plant parts

Roots and stems.

Symptoms by affected plant part

Roots: internal feeding
Stems: internal feeding

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Biology and Ecology of the Banana Weevil

The eggs are elongate-oval, about 2 to 3 mm long and white in colour. Eggs are laid singly in small cavities that are chewed out by the female in the base of the pseudostem just above ground level, in the upper part of the corm, in roots near the soil surface and at the end of cut stems (stumps). Due to their white colour they are rarely seen in the corm tissue. The duration of the egg stage is very variable (4 to 36 days) depending on temperature. Hatching takes place after 6 to 8 days under tropical conditions.

The larvae (grubs) are creamy white legless grubs, stout and distinctly curved and swollen in the middle of the body. The head is reddish-brown with strong mouthparts.

Grubs of banana weevils in tunnel in banana corm. The fully-grown larva is about 1 cm long.

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Fully-grown grubs are about 12 mm long. Under tropical conditions, the larvae complete their development and pupate in 20 to 25 days.

Pupa of banana weevil is white and about 12 mm long (picture much enlarged). As it develops,

Pupae are white and about 12 mm long. Pupation takes place in holes bored by the grubs; as it develops, the shape of the adult becomes visible. Adults emerge from the pupae 5 to 7 days after pupation.

the shape of the adult becomes visible.

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Banana weevil

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Adults are 10 to 16 mm long weevils (snout beetles), hard-shelled, with a rather long curved snout. Newly emerged weevils are red brown, turning almost black after a few days. They are free living, they are most commonly found between leaf sheaths, in the soil at the base of the mat or associated with crop residues. They often remain within the plant before biting the external sheath and leaving the banana plant. They feed on dead banana plants, newly cut stems and other decaying plant material near the base of banana plants. Weevils may live for up to two years, and can live without food for six months, but are very sensitive to desiccation and will die within 48 hours if kept in a dry substrate. They are active at night. The adults are sluggish rarely fly, but commonly walk over the soil surface and vegetation and feign death when disturbed. Adults are not strong flyers and only cover short distances.

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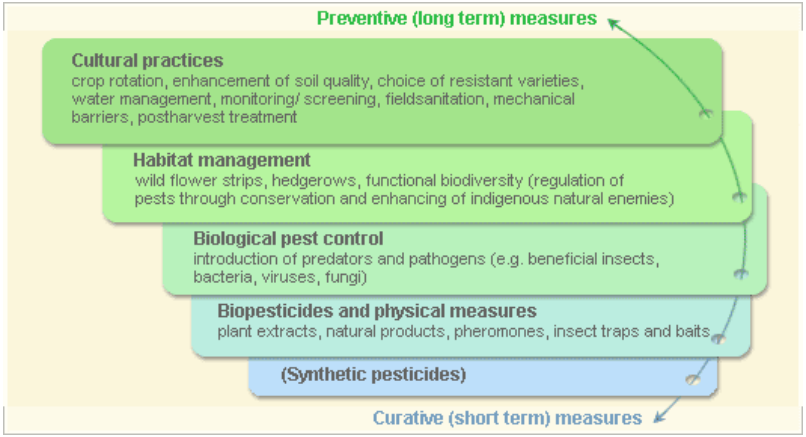
Pest and disease management

Pest and disease Management: General illustration of the concept of *infonet-biovision*



These illustration shows the methods promoted on infonet-biovision. The methods shown at the bottom have a long-term effect, while methods shown at the top have a short-term effect. In organic farming systems, methods with a long-term effect are the basis of crop production and animal husbandry and should be used with preference. On the other hand methods with a short-term effect should be used in emergencies only. On infonet we do not promote synthethic pesticides.

Further below you find concrete preventive and curative methods against Banana weevil.

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Cultural practices

Use clean planting material. Planting infected rhizomes/corm and suckers increases damage. This can be done by:

- **Selecting vigorous healthy planting material obtained from plants free of weevils. Examine planting material by taking one or two slices from it. If grubs, pupae or tunnels are present, the material should be destroyed.**

- **Paring (Trimming). If clean planting material is not available the planting material should be pared (trimmed) to reduce the number of eggs and grubs. However, badly damaged suckers should not be used for planting. Paring allows for superficial inspection of the rhizome surface and rejection of suckers containing weevil damage. However, significant internal damage may be present on suckers in which the rhizome displays little evidence of attack. Paring and removal of outer leaf sheaths also helps to remove most weevil eggs and nematodes.**

- **Hot water treatment. Recommendations suggest immersing clean trimmed suckers in a bath with hot water at 52 to 55°C for 15 to 27 minutes before planting. There have been reports of hot water treatment killing remaining eggs and a high percentage of grubs. For example, Gettman et al. (1992) reported over 99% mortality of weevil eggs and grubs when suckers of dessert bananas were placed in a water bath of 43°C for 3 hours. However, other sources indicate that**

hot baths are very effective in eliminating nematodes, but kill only a third of the weevil grubs. Thus, hot water treatment of planting material is likely to provide protection against weevil for several crop cycles only (Gold and Messiaen, 2000).

A simple method for farmers to control temperature has been developed in Kenya. It consists of a pith block (of about three cm) or a small piece of wood tied to an iron plate (3 x 3 cm and weighing about 10 g) covered with a thin film of candle wax. This device is allowed to sink in a half-empty oil drum with water, in which the banana material to be treated is placed. Wood is burnt underneath the drum, when the temperature rises to 55°C the wax melts releasing the pith or piece of wood, which then floats to the surface. At this moment the firewood is removed. (Prasad and Seshu Reddy, 1994).

Do not replant previously infested land while old corms remain on the ground, or where insufficient time has passed for adult weevils to die after remnants of the previous crop has been removed.

Plant clean planting material as soon as possible in a new plantation. They should not be left overnight in heaps since they attract weevils and could be reinfested before planting.

Harvesting of all mature pseudostems at certain intervals, rather than continually, is suggested as a preventive measure of control. This discourages the continuous breeding of the weevil, as then there will be periods in which few young suckers

are present (CABI).

Avoid moving infested plant material from plantation to plantation as this will spreads banana weevils.

Sanitation

Practice good crop hygiene:

- **Cut old stems after harvesting at ground level. Covering the cut rhizome with a layer of soil is said to prevent the weevil's entry and egg laying.**
- **Cut old stems as soon as the bunch is harvested and wind-damaged pseudostems (stumps) into small pieces and scatter them so that they quickly dry and thus do not attract the weevils. Alternatively, they can be cut into larger pieces and use for trapping weevils (see below)**
- **Dig out and remove old corms, trash and other materials in which weevils may breed.**

Practice good crop husbandry to produce vigorous banana plants, which are more able to tolerate weevil damage:

- **Use mulch. Spread mulch away from banana stool leaving a clear ring of about 60 cm from the base of the stool to keep the roots from growing towards the surface, and to avoid moist conditions near the stool, which will attract banana weevils.**
- **Desucker and remove water suckers regularly**
- **Clean matts of dead leaves and plat debris**

- **Keep the plantation free of weeds at all times.**
- **Ensure proper fertilization. Application of manure is important in the early stages of growth of the banana plant.**

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Biological pest control

Natural enemies

Predatory ants such as the bigheaded ant (*Pheidole megacephala*) and *Tetramorium* spp. are important predators of the banana weevil. Although these ants are generalists (feed on a wide variety of food materials such as nectar, sugar, honeydew, other insects substances with high fat content, etc.) high populations in banana stands make them very efficient predators. They will enter crop residues and living plants in search of weevil eggs, grubs and pupae. These ants have reportedly contributed to the successful control of banana weevil in plantain in Cuba. These ants can be encouraged to nest in pseudostem pieces that can then be used for further distribution. They are widespread and may also be important predators on the weevil in other localities. Studies in Tanzania and Uganda have shown that several species of ants are important natural enemies of the banana weevil in the region (Aberra, et al, 2007, A. M. Varela, icipe, personal communication).

Some fungi (e.g. *Beauveria bassiana* and *Metarhizium anisopliae*) have shown efficacy as control agents of this pest. Some of them caused weevil mortality of

over 90%. In Cuba, the fungus *Beauveria bassiana* is reported to be effective against the banana weevil in combination with ants (CABI, 2000). However, there is little information on the performance under field conditions. Moreover, the distribution and application of these biocontrol agents are still restricted by lack of facilities and high costs.

Some nematodes, (*Steinerma* and *Heterorhabditis* spp.) attack both adults and grubs in the field, but economic cost and their efficacy restricted only to high weevil population levels limit their use on a larger scale (Gold and Messiaen, 2000).

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Biopesticides and physical methods

Neem (*Azadirachta indica*)

Applications of neem powder effectively controlled weevils and nematodes in on-farm trials and in farmer's fields in Kenya. Application of 60 to 100 g of neem seed powder or neem cake at planting and then at four months intervals significantly diminished pest damage and increased yields. Application of over 100 g or neem oil was phytotoxic (harmful to plants) and uneconomical.

Neem applications were economical in fertile soils with moderate pest infestation. Neem applications to banana plants grown in poor soil and under very high pest attack were uneconomical. A combination of application of cow dung and neem treatments resulted in yield increases of 50 to 75% (Musabyimana, 1999). Dipping

suckers in a 20% neem seed solution at planting protects the young suckers from weevil attack by reducing egg laying through its repellent effect on adult weevils. Egg hatching rates may also be lowered in neem-treated plants (Gold and Messiaen, 2000).
For more information on Neem click here.

Trapping

Disc-on-stump traps and old pseudostems can be used for trapping weevils. Disc-on-stump traps consist of corm slices placed on top of harvested plants cut at the rhizome. Old pseudostems can be cut into lengths of 20 to 60 cm and split each length, and placed on the ground near the corm bases with the cut surface downwards. Adult weevils are attracted to the cut stems or corms for shelter, to feed and to lay eggs. When the eggs hatch the life cycle cannot continue as the cut pieces dry out and the grubs die from desiccation. The weevils can be collected by hand and destroyed. The efficiency of the traps depends on their numbers and frequency of trapping. Disk-on-stump traps collect 3 to 7 times as many weevils as pseudostem traps.

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Pests/ diseases/ weeds

African armyworm

African bollworm

African cassava

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Sweet potato weevil
Scientific name: *Cylas* spp
Order/Family: Coleoptera: Brentidae (=Curculionidae)
Type: pest (insect/mite)
Host plants: Sweet potato (Minor host plants: Coffee, maize, cowpea, sesame)

General Information on Pest and Damage

Biology and Ecology of Sweet Potato Weevil

Cultural practices

Biological pest control

mosaic virus (ACMV)
African maize stalkborer
Anthracnose
Aphids
Bacterial wilt
Bagrada bug
Banana weevil
Black rot
Cabbage looper
Cabbage moth
Cabbage webworm
Couch grass
Cowpea seed beetle
Cutworms

Pest and Disease Management **Information Source Links**

General Information on Pest and Damage

Geographical distribution

Geographical Distribution of the Sweet potato weevils in Africa (red marked)

Introduction

The African sweet potato weevil (*Cylas puncticollis*) is one of the most important pests of sweet potato in tropical Africa, notably Uganda, Rwanda, Kenya and Cameroon. *Cylas brunneus* is known from West and Central Africa and some countries in East Africa (Rwanda, Burundi and Kenya). These two species are found together attacking sweet potatoes in East and West Africa (Hill, 1983). *Cylas*

formicarius **is a destructive pest of sweet potato throughout most of the tropical and subtropical regions and occurs in several African countries.**

Damage

Adult weevils feed on leaves, the underground storage roots (tubers) and the vines of sweet potatoes. They prefer to feed on storage roots, but at the beginning of the growing season, when the plants have not yet produced storage roots, the adult weevils live on the stem and leaves. They lay eggs on vines and leaves, and the grubs will feed in the stem or the leaf and pupate inside the vines.

As the plant gets older and starts to form storage roots, the weevils search for exposed roots. Since they cannot dig, they reach the tubers through cracks in the soil. Weevils feed on the storage roots and lay eggs just below the surface of the root. Feeding and egg-laying punctures (numerous small holes) lower the quality of the root and can reduce the market price. If roots with egg punctures are stored they will serve as source of infestation for the clean roots stored beside them. Adult feeding on the foliage seldom is of importance.

The grubs are more damaging, feeding and boring and making tunnels into the stems and roots. Damage to the stems may cause serious mortality to seedlings. Allard et al. (1991) report on serious weevil attacks on sweet potato nurseries in Ethiopia. Feeding in the vines causes thickening and malformation and often cracking of the tissue. A damaged vine is discoloured, cracked, or wilted. Stem damage is believed to be the main reason for yield loss, although damage to the vascular system caused by feeding, larval tunnelling and secondary rots reduces

- nematodes
- Snails (Giant East African Snail)
- Spider mites
- Spotted stemborer
- Storage pests
- Sweet potato weevil
- Termites
- Thrips
- Tomato Yellow Leaf Curl Virus Disease (TYLCV)
- Turnip Mosaic Virus (TuMV)

the size and number of roots.

Sweet potato weevil symptoms on tuber.

© Courtesy of Institute of Plant Biotechnology for developing Countries, Ghent University, Belgium (www.ipbo.ugent.be)

An infested tuber is often riddled with cavities or tunnels; these wounds serve as entry point for infections, causing rotting of tubers. Attacked tubers start rotting from the top and develop an unpleasant smell and a bitter taste, making them unfit for human consumption. Even low level of infestation can reduce root quality and marketable yield because the plants produce a bitter toxin (a terpenoid) in response to feeding by weevils.

Weevil damage increases the longer the crop remains not harvested. In Kenya, where farmers practice piecemeal harvesting, losses are in the order of 10%. Pest damage usually continues during storage, therefore infested tubers cannot be stored for a long time. In conjunction with other beetle pests, *C. puncticollis* can completely destroy sweet potato plantations.

Damage by weevils can be recognised by the holes in the vines or the tunnels in the tuber when you pull them up from the soil.

Host range

The main host of all species of sweet potato weevil is sweet potato, alternate hosts are morning glory, water spinach (*Ipomoea aquatica*) and other Ipomea weeds.

Weeds
Whiteflies
Medicinal plants
Fruit and vegetable processing
Natural pest control
Cultural practices

Cylas bruneus **has only been reported on sweet potatoes.** ***Cylas puncticollis*** **has also been reported on coffee, maize, cowpea, sesame, and** ***Cassia acutifolia*** **(*C. senna*)(CABI).**

Symptoms

A symptom of infestation by sweet potato weevils is yellowing, cracking and wilting of the vines, but a heavy infestation is usually necessary before this is apparent. Damage by weevils can be recognised by the holes in the vines or the tunnels in the tuber when you pull them up from the soil. Attacked tubers become spongy, brownish to blackish in appearance.

Affected plant stages

Flowering stage, fruiting stage, post-harvest and vegetative growing stage.

Affected plant parts

Leaves, roots and stems.

Symptoms by affected plant part

Leaves: external feeding
Roots: rot; internal feeding; external feeding.
Stems: external discoloration; abnormal forms; internal feeding; external feeding.

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Biology and Ecology of Sweet Potato Weevil

The egg is oval in shape and yellowish-white in colour. It is laid singly in small cavities on the sweet potato root or at the base of the vine. The cavity is then sealed with a plug of the mother's excrement (faecal material). The egg hatches in about 3 to 7 days depending on the environmental conditions.

The larva is a legless grub, white in colour. The fully-grown grub is about 8 mm long. The head is comparatively large, and brown or pale-yellow. The body is slightly curved. The grub is found feeding on the vine near the base of the plant and goes down to the roots to feed. Larvae develop for 11 to 33 days before pupating.

Sweet potato weevil larvae on sweet potato. The full-grown larva about 8 mm long.

The fully-grown grub turns into a pupa in an enlarged area of the feeding tunnel. The pupa is whitish and about 6 mm long. Initially it is white, but with time it becomes greyish in colour with darker eyes and legs. The pupa is similar to the adult in appearance, although the wings, the head and the long snout are bent downwards. Adults emerge after 7 to 28 days depending on the environmental conditions.

The adult insect is a weevil. Weevils are beetles

with a long pointed snout. The body of the sweet potato weevil is slender resembling ants. The length of the adult is between 6 to 8 mm. They vary in colour in size according to the species. *Cylas puncticollis* is larger and entirely black. *Cylas brunneus* is brown with blue or bluish-green elytra (hard wings) and reddish legs, and is smaller than *C. puncticollis*. *Cylas formicarius* is as small as *C. brunneus* but has a bluish-black abdomen and a red thorax.

The weevils complete their lifecycle in the storage roots (tubers). They flight infrequently and generally only for short distances (500 to 1000 m). The development of the weevil from egg to adult takes 32 days in average.

Sweet potato weevil. Adult female, body length 6 to 8 mm.

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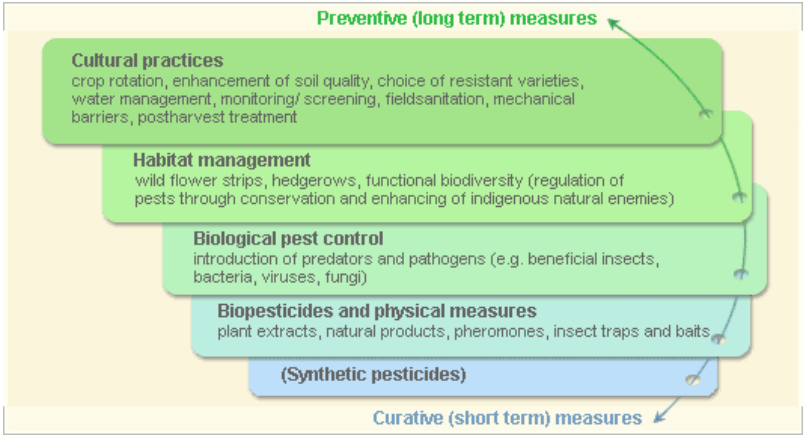
Pest and Disease Management

Pest and disease management: General illustration of the concept of *infonet-biovision*



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Further below you find concrete preventive and curative methods against Sweet potato weevils.

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Cultural practices

Monitoring

At the beginning of the growing season, when the plants have not yet produced any storage roots, the adult weevils are commonly found on the foliage, but they quickly drop to the ground if disturbed. During the day they often hide under leaves or in soil cracks. Most of the larvae are found in the upper 15 cm of the tubers and basal 10 cm of the vine. Select storage roots that appear soft, smell, or have external scarring or small, darkened holes. Cut these open and look for tunnelling and larvae. Pheromone traps are useful in monitoring weevil populations, but this technology is expensive and not widely available. Efforts are going on to develop pheromones traps for monitoring and control in East Africa (refer to section on traps below).

Among various control measures attempted, modification of cultural practices has the greatest potential in combating the sweet potato weevil at low cost.

Crop rotation

Avoid planting sweet potatoes in the same area for two to three successive seasons. It has been suggested that, if possible, sweet potatoes should be grown in a field only once every five years. Rice and sorghum are often used in rotation with sweet potatoes. This rotation will help break up the cycle of the weevil and will help to control sweet potato weevil, particularly if integrated with other management approaches, such as the ones described below.

Intercropping

Experimental studies in Taiwan showed that intercropping with chickpea, coriander, pumpkin, radish, fennel, black gram and yard long bean reduced weevil infestations considerably. However, intercropping with black gram, fennel, pumpkin, and yardlong bean also reduced sweet potato yields. The best results were obtained with coriander. Similarly, reduced weevil damage was observed when sweet potato was intercropped with proso millet and sesame, but sweet potato yield was also considerable reduced. Sweet potato has been found to inhibit germination of proso millet (Peterson et al., 1999).

Planting time

Plant early or plant early maturing varieties. This will allow harvesting before the end of the growing season, minimising in that way the risk of drought and consequently the damaging effect of weevils, which enter the soil through cracks.

Use of clean cuttings

Carry-over of the weevils from an infested crop to the new planting could be reduced by carefully selecting fresh cuttings for planting a new crop. Use clean (insect-free) vines as planting material. Prefer planting material from vine tips. Weevils tend to lay eggs in the older woodier parts of the vine, so if the tender tips are used for planting they are less likely to be infested by weevils. Studies in Taiwan showed that cuttings (25 to 30 cm long) taken from fresh terminal growth, even from an infested crop, were rarely infested with weevils, whereas older portions of the stem were (AVRDC).

Keep distance to infected fields

Planting away from weevil-infested fields, and or use barrier crops such as cassava, maize, bananas or sorghum planted around the perimeters in stripes of at least 3 to 5 m in width between fields to restrict movement of weevils between fields (CIP, VITAA).

Avoid soil cracking

Avoid or minimise cracks in the soil. Soil cracks are the major route of weevil access to roots. This can be done by:

- **Planting cuttings deep in the soil and using of deep-rooted cultivars reduce weevil damage. The growth of roots, especially in cultivars that set roots near the soil surface can produce cracks and increase exposure of roots to the weevil.**
- **Ridging: it prevents the soil from cracking by hilling the area around the plant. Re-hill mounds about 30 days after planting to close soil cracks. Close ridges after piecemeal harvests to cover exposed tubers. This should be implemented before the adult weevil reaches the roots.**
- **Mulching: mulches conserve soil moisture and minimise soil cracking. The physical cover made by mulching materials further reduces access of roots to the weevil even if the soil cracks. The soil surface should be covered soon after planting and the cover should be maintained until harvest.**
- **Routine irrigation: it is important to provide sufficient water to prevent soil cracking. This is a practical method for farmers with a reliable water supply.**

Sanitation

Remove and destroy (through burying, burning or feeding to livestock) any crop residues left in the field after harvest. Infested roots must be complete buried (over 15 cm deep); avoid cracks, which allow emerging weevils to reach the soil surface. If vines are left in the field to improve soil fertility, care should be taken to ensure they are dead and not able to sprout. Care should be taken to remove and destroy any infested roots when doing piecemeal harvest.

Field sanitation is important because weevils survive in roots and stems and infest succeeding or neighbouring sweet potato plantings. However, to effectively reduce weevil infestation it should be practised in a large area or community. Clean cultivation is particularly important where rotation is not possible, for example in areas where sweet potato is a staple food and is planted year-round.

Flooding of fields

Flooding of infested fields for at least 48 hours after completing harvest drowns weevils induces rotting of the leftover plant materials and thereby reduces weevil densities from one planting to the next. This is an option in areas where rotation is not possible.
Flooding of fields between two consecutive sweet potato crops may reduce the immediate source of weevils from the field.

Early harvesting

Harvest the crop as soon as it has developed roots of acceptable size.

Control of alternative hosts

Alternative hosts of the sweet potato weevil (e.g. morning glory, water spinach, wild Ipomoea etc) can shelter weevils between planting seasons and serve as a source of weevil infestation when a new crop of sweet potato is planted. Therefore, removal of these host plants growing in the vicinity of sweet potato plantings is recommended as a control measure. However, indiscriminate elimination of these plants is not recommended since they may also be lead to undesirable ecological effects. To minimise this, all Ipomoea could be eliminated for one cropping season and allowed to grow in the subsequent seasons, once the area is free of the weevils.

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Biological pest control

Natural enemies

Predatory ants, earwigs, spiders and ground beetles are important predators of the sweet potato weevil. Among those ants seem to be most important. In Cuba, two species of predatory ants, *Pheidole megacephala* and *Tetramorium guineense*, which are common inhabitants of banana plantations, are used for control of sweet potato weevils. These ants are encouraged in reservoir areas, such as patches of forest, where they are naturally abundant. Ants nests are moved by a simple

method using rolled banana leaves as 'temporary nests' to transport the ants from their natural reservoir to sweet potato fields, or banana stems, baited with honey, are placed in the reservoir areas and, when covered in ants, transported to the sweet potato fields. The ants then prey upon sweet potato weevils and other insects. Setting up colonies in the field 30 days after planting with 60 to 110 nests/ha can keep weevil infestation at low levels (3 to 5%) (FFTC; Sheehy Skeffington, 2006).

Disease-causing microorganisms, especially the fungus *Beauveria bassiana*, have been observed to cause high mortality of sweet potato weevils in the field under conditions of high humidity and high insect density. This fungus is commercially available in some countries. It can be used for treating the planting material and the soil to reduce soil infestation.

Traps

Pheromone traps are widely used for monitoring the sweet potato weevils. However, these traps are expensive and not widely available. In 1995, a collaborative project of the National Agricultural Research Institutes, Natural Resources Institute (NRI), and the International Potato Center (CIP) began developing pheromones for monitoring and controlling the African sweet potato weevils in East Africa. Pheromone compounds that proved effective in catching male weevils under field conditions in Uganda were identified, and several traps were tested. A five-litre plastic jerry can with rectangular openings of 11×5 and 6×5 cm filled with 0.5 l soapy water (1 g Omo/1 l water), with 0.1 mg lures to be replaced every 8 weeks is presently the most effective and robust trapping system.

Experiments on the use of these traps for mass trapping of males for weevil control are going on (CIP; Smit et al., 1997).

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Information Source Links

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Crops/ fruits/ vegetables

Pests/ diseases/ weeds

African armyworm

more Images

Couch grass
Scientific name: *Cynodon dactylon*
Order/Family: Cyperales, Poaceae
Type: weeds
Common names: Bermuda grass, Bahama grass, Common star grass, Dhub grass, Devil grass
Host plants: Maize

General Information on Pest and Damage
Biology and Ecology
Pest and Disease Management
Notes for REVISION
Cultural practices
Information Source Links

General Information on Pest and Damage

Geographical distribution

Couch grass *(C. dactylon)* is thought to have originated in Africa but now occurs worldwide in both tropical and subtropical regions.

Geographical Distribution of Couch grass in Africa *(red marked)*

Introduction

The couch grass *(C. dactylon)* is treated by Holm et al. (1977) as the second most important weed in the world (after *Cyperus rotundus*), a status that is justified by its occurrence in virtually every tropical and subtropical country and in virtually every crop in those countries.

The weed is an alternate host of some plant diseases such as brown spot, leaf spot, early blight, stripe disease of rice, barley yellow dwarf, lucerne dwarf and of nematodes. Couch grass is used as a cover crop to control erosion and for soil stabilization, feed for livestock, lawn beautification and herbal medicine.

Description:

The stem creeps at full-length along the ground. The leaves are small, linear and blue-green with rough margins. The undersides are smooth but hairy on the upper surfaces. The flowering stalks bear many slender and purplish spikelets. The fruit is reddish-brown or orange-red. The seeds are flattened, oval and straw-coloured. The weed can be spread through seeds, runners, rooting nodes or underground rootstocks. It is mat forming. A single plant can produce up to 720 seeds. It can endure both extensive flooding and drought.

Host Range:

The crops in which couch grass is most commonly a major problem are those of the subtropics that are planted in wide rows, for example, cotton, sugarcane, tobacco, citrus, olive, deciduous fruit, forestry and ornamental species and many

vegetables, but also some closer-planted but less competitive crops such as rice, lucerne, lucerne and grass pastures, onion and jute.

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Biology and Ecology

C. dactylon **tolerates a wide range of temperatures, especially very high temperatures in near-desert conditions. Freezing point ranges from -2 to -3°C. Growth is favoured by medium-to-heavy, moist, well-drained soils but *C. dactylon* will also grow on acid and quite highly alkaline soils and the rhizome system can survive flood conditions and drought.**

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Pest and Disease Management

Pest and disease Management: General illustration of the concept of *infonet-biovision*

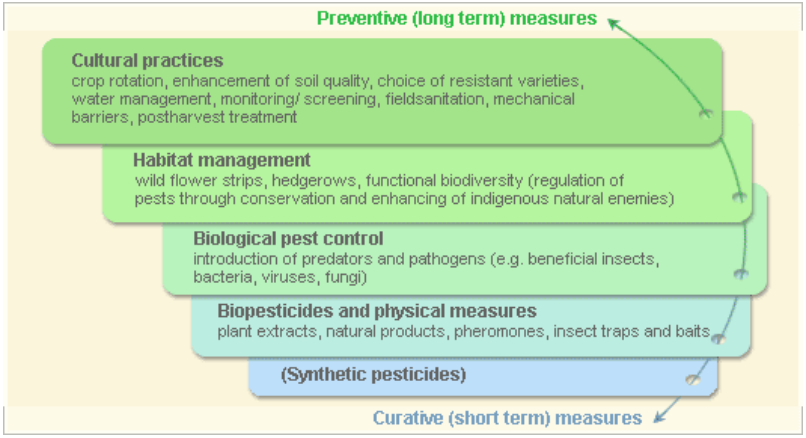
- **Turnip Mosaic Virus (TuMV)**
- **Weeds**
- **Whiteflies**

Medicinal plants

Fruit and vegetable processing

Natural pest control

Cultural practices



These illustration shows the methods promoted on infonet-biovision. The methods shown at the bottom have a long-term effect, while methods shown at the top have a short-term effect. In organic farming systems, methods with a long-term effect are the basis of crop production and should be used with preference. On the other hand methods with a short-term effect should be used in emergencies only. On infonet we do not promote synthethic pesticides.

Further below you find concrete preventive and curative methods against Couch grass.

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Notes for REVISION

mh, 26.6.09 most open points have not been adressed since the last version received on 23 may 08. pls describe 'spikelets' for inclusion into glossary or exchange word.

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Cultural practices

Control Methods

- **Proper selection of seeds (ensure whatever crop you plant its seeds are not contaminated with couch grass seeds)**
- **Thorough land preparation**
- **Regular plant monitoring**

Legumes or other cover crops are sometimes used for smothering *C. dactylon* since the weed does not tolerate deep shade. Vigorous crops and higher crop density may be important in reducing weed competition.

Traditional techniques of controlling *C. dactylon* rely very little on manual methods, as it easily survives shallow hoeing and positively thrives on mowing. However, the benefits of deep cultivation have been confirmed in Botswana and Zimbabwe where double ploughing, either after crop harvest or before the onset of the next season's rains, provided a high degree of control and was beneficial to crop yields.

The main non-chemical approaches to control couch grass are deep tillage and shading/smothering crops.

For more information on weeds click here

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Information Source Links

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vegetables

Pests/ diseases/ weeds

African armyworm
African bollworm
African cassava mosaic virus (ACMV)
African maize stalkborer
Anthracnose
Aphids
Bacterial wilt
Bagrada bug
Banana weevil
Black rot

more Images

Damping-off diseases
Scientific name: *Pythium* spp., *Rhizoctonia solani* (*Thanatephorus cucumeris*).
Order/Family: *Pythium* spp: Pythiales: Pythiacae *Rhizoctonia* spp: Ceratobasidiales: Ceratobasidiaceae
Type: disease (fungal)
Common names: Wilt, Damping-off, Seedling blight, Root rot, Rhizoctonia damping-off, Rhizoctonia
Host plants: Amaranth Cabbage/Kale, Brassicas Carrot Citrus plants Coffee Cotton Cowpea Cucumber Green gram Groundnut Okra Peppers Rice Sorghum Tomato Wheat

General Information on Disease and Damage
Biology and Ecology of Damping-off Diseases
Pest and Disease Management
Cultural practices
Information Source Links

General Information on Disease and Damage

Geographical distribution

- Cabbage looper
- Cabbage moth
- Cabbage webworm
- Couch grass
- Cowpea seed beetle
- Cutworms
- Damping-off diseases
- Diamondback moth (DBM)
- Downy mildew
- Early blight
- Fruit flies
- Fusarium wilt
- Larger grain borer
- Late blight
- Leafmining

Geographical Distribution of Damping-off Diseases in Africa (red marked)

Damage

Damping-off is caused by a fungus, it usually occurs in small patches at various places in the seedbeds or field. The disease spots often increase from day to day until the seedlings harden. Seedlings are extremely susceptible for about two weeks after emergence. As the stem hardens and increases in size, the injury no longer occurs. Some seedlings are not killed at once, but the roots are severely damaged and the stem is girdled at the ground level. Such plants remain stunted and often do not survive

flies (leafminers)
Mango seed weevil
Mealybugs
Powdery mildew
Purple witchweed
Root-knot nematodes
Snails (Giant East African Snail)
Spider mites
Spotted stemborer
Storage pests
Sweet potato weevil
Termites

transplanting.

The injury from damping-off fungi is of two types:

Okra seedlings affected by damping-off

© A.A. Seif & A.M. Varela, icipe

- Pre-emergence damping off consists of a decay of the germinating seed or death of the seedling before it can push through the soil. This injury is a common cause of poor stands, which are often attributed to inferior quality of the seed or the untreated seeds. *Pythium* spp. and *Phytophthora* spp. cause seed decay.

- Post-emergence damping-off which occurs after the seedlings have emerged from the soil but while still small and tender. The roots may be killed, and affected plants show water soaking and shrivelling of the stems at the ground level; they soon fall over and die. Post-emergence damping-off is mostly caused by *Rhizoctonia* spp.

Host range

The fungal disease caused by *Rhizoctonia solani* has a very wide host range, infecting plant species belonging to 32 families, and 20 weed species from 11 families.

Symptoms

Thrips
Tomato Yellow Leaf Curl Virus Disease (TYLCV)
Turnip Mosaic Virus (TuMV)
Weeds
Whiteflies
Medicinal plants
Fruit and vegetable processing
Natural pest control
Cultural practices

In crucifers, this fungus causes damping-off and wirestem of seedlings in the seedbed; bottom rot and head rot in the field; and storage and root rot of horseradish, radish, rutabaga and turnip.

Damping-off:
Seeds can decay in cold wet soils and stems can become light brown and water-soaked near the soil line. Such seedlings wilt, topple and die. Wet soils and temperatures at or above 24°C favour disease development.

Wirestem in cabbage:
This is the most common and destructive phase of the disease. The stem above and below the soil line shrivels and darkens, and outer tissues come off leaving a dark wiry and woody inner stem. Such plants do not fall over, but they have an unhealthy stunted appearance. Some may die, but most survive and do poorly when transplanted to the field. When moisture is adequate, plants may produce a small poor-quality head.

Bottom rot in cabbage:
The disease occurs in mid-season as a carry-over from wirestem seedlings and from new infections that occur when outer leaves come in contact with moist infested soil. Lower leaves wilt, decay and turn black, but do not drop off. Some plants may recover and produce heads, but usually bottom rot develops into head rot.

Head rot in cabbage:

A firm to slimy dark decay at the base of outer leaves and in cabbage heads develops during the period between head formation and maturity. The fungus grows up to main stem, passing between the leaf petioles. Foliage leaves die and drop off, thus exposing the stem beneath the head. Over the whole head surface, brown fungus mycelia and tiny brown resting fungal bodies (sclerotia) may develop and be visible over the head surface. Secondary rot bacteria usually invade the diseased tissue and turn the head into a slimy foul-smelling mass.

Root rot:
It is usually dark brown, sunken and spongy. Infected tissues easily separate from advancing edges of the rot. A white to brown surface mould and irregular brown sclerotia distinguish this rot form other root rots. It mainly affects horseradish, radish, rutabaga and turnip.

Affected plant stages

Heading stage (in cabbage), post-harvest (in cabbage), pre-emergence, seedling stage and vegetative growing stage.

Affected plant parts

Leaves, roots, seeds, stems and whole plant.

Symptoms by affected plant part

Leaves: lesions; abnormal colours; abnormal forms; wilting; fungal growth.
Roots: lesions.

Seeds: rot; discolorations.
Stems: external discoloration; canker; abnormal growth; mycelium visible.
Whole plant: plant death; dieback; damping-off.

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Biology and Ecology of Damping-off Diseases

Many fungi are associated with damping-off diseases and seedling blights. The species most often encountered belong to *Pythium* spp. and *Rhizoctonia* spp. For the two an excess of moisture is recognized as the most important condition for damping-off and seedling blights.

Infection by *Pythium* spp. and *Rhizoctonia* spp. is favoured by:

- **heavy soils**
- **low pH**
- **heavy seeding resulting in dense planting**
- **careless handling**
- **excessive soil moisture**
- **low light and presence of weeds**

Exudates derived from host plants stimulate growth of these fungi.
Other fungi also implicated in causing damping-off and seedling blights include *Aphanomyces* spp., *Alternaria* spp., *Botrytis cinerea, Colletotrichum* spp., *Fusarium* spp., *Helminthosporium* spp., *Phytophthora* spp., *Sclerotinia* spp., and *Thielaviopsis* spp.

One feature that many of the fungi concerned have in common is their ability to survive for relatively long periods in soils. There are several forms in which they do so:
(1) as mycelium in the soil (e.g. *Rhizoctonia* spp.)
(2) as resting spores (e.g. oospores of *Pythium* spp. and *Phytophthora* spp., chlamydospores of *Fusarium* spp.) and
(3) as sclerotia (tiny brown resting fungal bodies) (e.g. *Sclerotinia* spp., *Rhizoctonia* spp. and *Botrytis cinerea*).

Spread of damping-off fungi depends primarily on the mechanical transfer of mycelia, sclerotia or resting spores in infested soilparticles (on flats, tools, baskets or end of the watering hose) or infected plant tissue.

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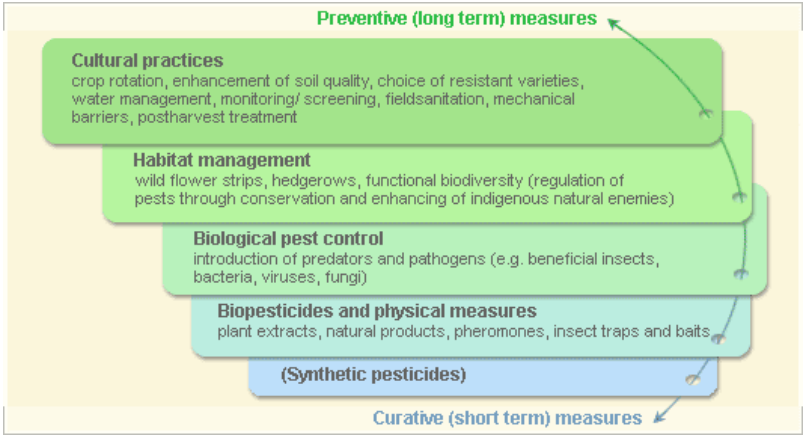
Pest and Disease Management

Pest and disease Management: General illustration of the concept of *infonet-biovision*



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Further below you find concrete preventive and curative methods against Damping-off Diseases.

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Cultural practices

General disease prevention

- **Good seedbed management**
- **Avoid fields with a history of the disease.**
- **Practise crop rotation.**
- **Deeply plough fields**
- **Use certified disease-free seeds. If using own seed, hot water treatment can be used. For more information on hot water treatment click here.**
- **Solarisation of seedbeds should be done where feasible. For more information on solarisation click here.**
- **Thin the seedlings in seedbeds to permit good air circulation.**
- **Avoid excessive watering and fertilisation, particularly with nitrate.**
- **Plant on raised beds to reduce moisture content in the root zone and provide the appropriate drainage in the field to prevent waterlogged conditions.**
- **Schedule planting times to avoid temperature and moisture conditions that are conducive to the pathogen. It also will reduce disease severity.**
- **As free water is important for distribution and development of the diseases, efforts to reduce soil moisture will help to reduce disease severity.**
- **Products of the soil fungus *Trichoderma* spp. are reported to suppress damping-off fungi**

Additional measures for:

- **Tomatoes: The seedbed should not be sited on a field previously planted with eggplant, pepper, potatoes, tomatoes or other related crops. Do not site the**

seedbed next or near to tomato production fields. The seedbed should preferably be up-wind to tomato fields.

- **Brassicas: Seedbeds and production fields should not have had crucifers for at least 3 years. All seedlings with wirestem symptoms should be discarded. During cultivation, take care to avoid throwing soil into plant heads.**
- **Okra: Avoid fields previously planted with cotton or other related crops.**

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Information Source Links

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Crops/ fruits/ vegetables

Pests/ diseases/ weeds

African armyworm

African bollworm

African cassava mosaic virus (ACMV)

African

Images

Mango seed weevil adult, after emerging of a mango. It is 8 mm long.

- maize stalkborer
- Anthracnose
- Aphids
- Bacterial wilt
- Bagrada bug
- Banana weevil
- Black rot
- Cabbage looper
- Cabbage moth
- Cabbage webworm
- Couch grass
- Cowpea seed beetle
- Cutworms
- Damping-off diseases
- Diamondback

Mango seed weevil close-up, after emerging of a mango. It is 8 mm long.

Damage by mango seed weevil larvae. First instar larvae of the mango seed weevil are elongate, cylindrical, legless and extremely slender; they are 1.3 to 1.4 mm long. The body is white and the head is black. Final instar larvae are white and legless, they have a curved form, and are 1.6 - 1.8 cm long.

moth (DBM)
Downy mildew
Early blight
Fruit flies
Fusarium wilt
Larger grain borer
Late blight
Leafmining flies (leafminers)
Mango seed weevil
Mealybugs
Powdery mildew
Purple witchweed
Root-knot nematodes
Snails (Giant East

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Egg of mango seed weevil on mango fruit. The very small egg laying scars are barely discernable at harvest. When freshly laid the eggs are creamy-white. They are extremly small (0.8 mm long).

Adults of the mango seed weevil *(Sternochetus mangiferae)* have a compact body, they are about 7 to 9 mm long.

African Snail)
Spider mites
Spotted stemborer
Storage pests
Sweet potato weevil
Termites
Thrips
Tomato Yellow Leaf Curl Virus Disease (TYLCV)
Turnip

Mar 24, 2010 - Disclaimer

Crops/ fruits/ vegetables

Pests/ diseases/ weeds

- African armyworm
- African bollworm
- African cassava mosaic virus (ACMV)
- African maize stalkborer
- Anthracnose
- Aphids
- Bacterial wilt
- Bagrada bug
- Banana weevil

Images

African Cassava Mosaic Disease (ACMD). The leaves of this local cultivar of cassava are expressing severe ACMD symptoms.

African mosaic virus on cassava - transmitted by whiteflies (*Bemisia tabaci*)

Black rot
Cabbage looper
Cabbage moth
Cabbage webworm
Couch grass
Cowpea seed beetle
Cutworms
Damping-off diseases

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Crops/ fruits/ vegetables

Pests/ diseases/ weeds

Images

Caterpillars of the African maize stalkborer (*Busseola fusca*).

- African armyworm
- African bollworm
- African cassava mosaic virus (ACMV)
- African maize stalkborer
- Anthracnose
- Aphids
- Bacterial wilt
- Bagrada bug
- Banana weevil
- Black rot
- Cabbage looper
- Cabbage moth

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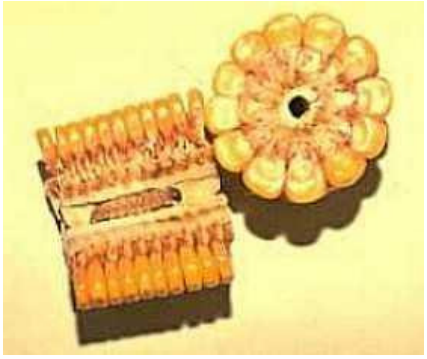

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Caterpillar of the African maize stalkborer and damage to maize cob.

Cabbage webworm
Couch grass
Cowpea seed beetle
Cutworms
Damping-off diseases
Diamondback moth (DBM)
Downy mildew
Early blight
Fruit flies
Fusarium wilt
Larger grain borer
Late blight
Leafmining flies (leafminers)
Mango seed weevil

(www.ecoport.org).

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Moth of the African maize stalkborer (*Busseola fusca*).

Stemborer damage to a maize plant.

- **Mealybugs**
- **Powdery mildew**
- **Purple witchweed**
- **Root-knot nematodes**
- **Snails (Giant East African Snail)**
- **Spider mites**
- **Spotted stemborer**
- **Storage pests**
- **Sweet potato weevil**
- **Termites**
- **Thrips**
- **Tomato Yellow Leaf Curl Virus**

© Stemborer team, icipe

Stemborer damage to maize cob.

- Disease (TYLCV)
- Turnip Mosaic Virus (TuMV)
- Weeds
- Whiteflies

Medicinal plants

Fruit and vegetable processing

Natural pest control

Cultural practices

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African maize stalkborer eggs.

Eggs of the African maize stalkborer (*Busseola fusca*).

Female moth of African maize stalkborer (*Busseola fusca*) . Wingspan is about 2.5 to 3.5 with females and larger males.

© B. Le Ru, icipe

Male moth of African maize stalkborer (*Busseola fusca*) .

Images

The adult bagrada bug (*Bagrada hilaris*) is typically shield-shaped, 5-7mm long and 3-4mm wide. The upper surface has a mixture of black, white and orange markings.

Late instar nymph of the bagrada bug.

stalkborer
Anthracnose
Aphids
Bacterial wilt
Bagrada bug
Banana weevil
Black rot
Cabbage looper
Cabbage moth
Cabbage webworm
Couch grass
Cowpea seed beetle
Cutworms
Damping-off diseases
Diamondback moth (DBM)

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Third instar nymph of the bagrada bug.

Downy mildew
Early blight
Fruit flies
Fusarium wilt
Larger grain borer
Late blight
Leafmining flies (leafminers)
Mango seed weevil
Mealybugs
Powdery mildew
Purple witchweed
Root-knot nematodes
Snails (Giant East African

© F. Haas, icipe

Newly emerged nymphs (first instar) of the bagrada bug.

- Snail)
- Spider mites
- Spotted stemborer
- Storage pests
- Sweet potato weevil
- Termites
- Thrips
- Tomato Yellow Leaf Curl Virus Disease (TYLCV)
- Turnip Mosaic Virus (TuMV)
- Weeds
- Whiteflies

Medicinal plants

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Eggs of the bagrada bug (much enlarged)

Fruit and vegetable processing

Natural pest control

Cultural practices

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Initial symptoms of damage by bagrada bugs . Note small white punctures on the edges of leaves.

Kale plant severely damaged by bagrada bugs

© B. Loehr, icipe

Kale plant severely damaged by bagrada bugs

© B. Loehr, icipe

Kale plants killed by attack by bagrada bugs

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Pests/ diseases/ weeds

African armyworm
African bollworm
African cassava mosaic virus (ACMV)
African maize stalkborer
Anthracnose
Aphids
Bacterial wilt
Bagrada bug
Banana weevil
Black rot
Cabbage

Severe Turnip Mosaic Virus symptoms (mosaic and distortion) on cabbage leaves (*Brassica oleracea*)

Turnip Mosaic Virus

looper
Cabbage
moth

Georgia, Bugwood.org

Mar 24, 2010 - Disclaimer

Crops/ fruits/ vegetables
Pests/ diseases/ weeds
African armyworm
African bollworm
African cassava mosaic virus (ACMV)
African maize

Images

Bacterial black rot on cabbage

© G. Gichini, icipe

- stalkborer
- Anthracnose
- Aphids
- Bacterial wilt
- Bagrada bug
- Banana weevil
- Black rot
- Cabbage looper
- Cabbage moth
- Cabbage webworm
- Couch grass
- Cowpea seed beetle
- Cutworms
- Damping-off diseases
- Diamondback moth (DBM)

Bacterial black rot on cabbage

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Black rot on cabbage. Characteristic yellowish V-shaped areas at the leaf margin, sites of infection by black rot, *Xanthomonas campestris* pv. *campestris*.

- Downy mildew
- Early blight
- Fruit flies
- Fusarium wilt
- Larger grain borer
- Late blight
- Leafmining flies (leafminers)
- Mango seed weevil
- Mealybugs
- Powdery mildew
- Purple witchweed
- Root-knot nematodes
- Snails (Giant East African

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Black rot on cabbage. Black rot leaf internal symptom. Note blackening of veins

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Bacterial black rot. Note blackening of water-conducting tissues of the stem

- Snail)
- Spider mites
- Spotted stemborer
- Storage pests
- Sweet potato weevil
- Termites
- Thrips
- Tomato Yellow Leaf Curl Virus Disease (TYLCV)
- Turnip Mosaic Virus (TuMV)
- Weeds
- Whiteflies

Medicinal plants

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Bacterial black rot on kales

Bacterial black rot on cabbage

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Bacterial soft rot. Note slimy rot (whitish) of the centre of the cabbage head

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Bagrada bug

Banana weevil

Black rot

Images

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Cabbage webworm caterpillar (*Hellula undalis*), about 1.5cm long, and damage on kale leaf.

First instar caterpillars of the cabbage webworm feeding in a leaf of kale.

- Cabbage looper
- Cabbage moth
- Cabbage webworm
- Couch grass
- Cowpea seed beetle
- Cutworms
- Damping-off diseases
- Diamondback moth (DBM)
- Downy mildew
- Early blight
- Fruit flies
- Fusarium wilt
- Larger grain borer
- Late blight
- Leafmining

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Caterpillar of the cabbage webworm (*Hellula undalis*) feeding in the stem of a kale plant. Caterpillars attain a length of 1.5 cm when fully grown.

- flies (leafminers)
- Mango seed weevil
- Mealybugs
- Powdery mildew
- Purple witchweed
- Root-knot nematodes
- Snails (Giant East African Snail)
- Spider mites
- Spotted stemborer
- Storage pests
- Sweet potato weevil
- Termites

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Cabbage webworm (*Hellula undalis*) feeding on a cabbage head. The caterpillars have dark brown or black heads. The body is creamy white with light pinkish-brown longitudinal stripes, attaining a length of 1.2-1.5 cm when fully grown.

Moth of the cabbage webworm - Adults are greyish-brown with pale dusky hindwings. Wings ca 1.2cm long in males, 1.4 cm in females.

- Thrips
- Tomato Yellow Leaf Curl Virus Disease (TYLCV)
- Turnip Mosaic Virus (TuMV)
- Weeds
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Cabbage webworm adults are greyish-brown with pale dusky hindwings; each forewing has a prominent black spot and zigzagging, light brown lines, central band between lines sometimes filled with darker brown scales. Wings ca 1.2 cm long in males, 1.4 cm in females.

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Damage by the cabbage webworm as stemborer on a kale plant

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Damage to the growing tip of a kale plant caused by the cabbage webworm

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- Bagrada bug
- Banana

Images

Downy mildew on cabbage

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Downy mildew (*Peronospora parasitica*) on Brassica oleracea

- weevil
- Black rot
- Cabbage looper
- Cabbage moth
- Cabbage webworm
- Couch grass
- Cowpea seed beetle
- Cutworms
- Damping-off diseases
- Diamondback moth (DBM)
- Downy mildew
- Early blight
- Fruit flies
- Fusarium wilt
- Larger grain borer

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Downy mildew (*Pseudoperonospora cubensis*) on cucumber. Severe defoliation of cucumber caused by infection from downy mildew. Fruits are not infected, but those that form are small and do not ripen properly.

- **Late blight**
- **Leafmining flies (leafminers)**
- **Mango seed weevil**
- **Mealybugs**
- **Powdery mildew**
- **Purple witchweed**
- **Root-knot nematodes**
- **Snails (Giant East African Snail)**
- **Spider mites**
- **Spotted stemborer**

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Cabbage looper on cabbage - The first instar is white and almost clear with a black head capsule. Later instars are green with a thin white line on each side. Mature larvae reach 3 to 4 cm in length.

Young cabbage looper feeding on a kale leaf. Mature caterpillar reach 3 to 4 cm in length.

- Banana weevil
- Black rot
- Cabbage looper
- Cabbage moth
- Cabbage webworm
- Couch grass
- Cowpea seed beetle
- Cutworms
- Damping-off diseases
- Diamondback moth (DBM)
- Downy mildew
- Early blight
- Fruit flies
- Fusarium wilt
- Larger grain

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Cabbage looper caterpillar (approximately 2cm long). Mature caterpillar reach 3 to 4 cm in length.

borer
Late blight
Leafmining flies (leafminers)
Mango seed weevil
Mealybugs
Powdery mildew
Purple witchweed
Root-knot nematodes
Snails (Giant East African Snail)
Spider mites
Spotted stemborer
Storage pests
Sweet

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Pupa of the cabbage looper. During its last larval stage the caterpillar spins a cocoon.

Cabbage looper adult. The adult is ca 2.5 cm in length and mottled, grayish-brown. The wingspan is ca. 4 cm.

- potato weevil
- Termites
- Thrips
- Tomato Yellow Leaf Curl Virus Disease (TYLCV)
- Turnip Mosaic Virus (TuMV)
- Weeds
- Whiteflies

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Moth of the cabbage looper. Real size: ca 2.5 cm in length, wingspan is ca. 4 cm

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Damage by cabbage looper on cabbage

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- Anthracnose
- Aphids
- Bacterial wilt
- Bagrada bug
- Banana

Images

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Cabbage moth larva: When fully grown (1.5 to 2 cm long), larvae move to pupate in the soil. The pupal stage lasts about 10 days.

Eggs of cabbage moth are laid in clusters and held together by a gelatinous glue.

- weevil
- Black rot
- Cabbage looper
- Cabbage moth
- Cabbage webworm
- Couch grass
- Cowpea seed beetle
- Cutworms
- Damping-off diseases
- Diamondback moth (DBM)
- Downy mildew
- Early blight
- Fruit flies
- Fusarium wilt
- Larger grain borer

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Cabbage moth larvae: Upon hatching, larvae feed together on leaves and complete 5 instars in about 12 days.

- Late blight
- Leafmining flies (leafminers)
- Mango seed weevil
- Mealybugs
- Powdery mildew
- Purple witchweed
- Root-knot nematodes
- Snails (Giant East African Snail)
- Spider mites
- Spotted stemborer
- Storage pests
- Sweet potato

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Caterpillars of the cabbage moth *(Crocidolomia binotalis)* feeding on cabbage. Fully grown larvae are 1.5 to 2 cm long.

The cabbage moth (*Crocidolomia binotalis*). Cabbage moth adults emerge during the night. Wingspans are 2 to 2.5 cm.

- weevil
- Termites
- Thrips
- Tomato Yellow Leaf Curl Virus Disease (TYLCV)
- Turnip Mosaic Virus (TuMV)
- Weeds
- Whiteflies

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Cabbage plant damaged by caterpillars of the cabbage moth

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- Aphids
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Images

The Giant African Snail *(Achatina fulica)*. Adults of the species may exceed 20 cm in shell length but generally average about 5 to 10cm

The Giant African Snail *(Achatina fulica)*. Adults of the species may exceed 20 cm in shell length but generally average about 5 to 10cm

- Banana weevil
- Black rot
- Cabbage looper
- Cabbage moth
- Cabbage webworm
- Couch grass
- Cowpea seed beetle
- Cutworms
- Damping-off diseases
- Diamondback moth (DBM)
- Downy mildew
- Early blight
- Fruit flies
- Fusarium wilt
- Larger grain

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The Giant African Snail *(Achatina fulica)* damage on banana plant

borer
Late blight
Leafmining flies (leafminers)
Mango seed weevil
Mealybugs
Powdery mildew
Purple witchweed
Root-knot nematodes
Snails (Giant East

(www.ecoport.org)

The Giant African Snail *(Achatina fulica)*. Adults of the species may exceed 20 cm in shell length but generally average about 5 to 10cm

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African cassava mosaic virus (ACMV)
African maize stalkborer
Anthracnose
Aphids
Bacterial wilt
Bagrada bug
Banana weevil
Black rot
Cabbage

Termites (*Coptotermes formosanus*)

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Termite *Macrotermes jeanneli* mound at Marigat, Kenya.

looper
Cabbage moth
Cabbage webworm
Couch grass
Cowpea seed beetle
Cutworms
Damping-off diseases
Diamondback moth (DBM)
Downy mildew
Early blight
Fruit flies
Fusarium wilt
Larger grain borer
Late blight
Leafmining flies

© Zipporah Osiemo

Termites and fungi in Kenya

(leafminers)
Mango seed weevil
Mealybugs
Powdery mildew
Purple witchweed
Root-knot nematodes
Snails (Giant East African Snail)
Spider mites
Spotted stemborer
Storage pests
Sweet potato weevil
Termites
Thrips

© Zipporah Osiemo

Termite *Coptotermes* spp.

- **Tomato Yellow Leaf Curl Virus Disease (TYLCV)**
- **Turnip Mosaic Virus (TuMV)**
- **Weeds**
- **Whiteflies**

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Close-up termites on mango stem

Harvester termites taking plant material into the nest.

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