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The Organic Farmer

The Organic Farmer (TOF) - A magazine for African farmers

The Organic Farmer (TOF) is a magazine with practical information, it is published monthly and is distributed free of charge to interested farmer groups in Kenya. 60,000 farmers already receive concrete guidance and practical tips on securing and increasing their harvests through simple, environmentally friendly means.

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- Banana
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Avocado
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Banana
Bean flies
Beans

Fodder plants
Food prices
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African armyworm

African

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Mango seed weevil

Scientific name: ***Sternochetus mangiferae***

Order/Family: Curculionidae

Type: pest (insect/mite)

Common names: Mango nut weevil, Mango stone weevil

Host plants: Mango

General Information on Pest and Damage

Geographical distribution

Geographical Distribution of the Mango seed weevil in Africa *(red marked)*

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

Introduction

The mango seed weevil is one of major pest of mangoes in East Africa. The larva, which is the damaging stage of the pest, enters the fruit burrowing through the flesh into the seeds, where they feed until pupation, destroying the seed. Early attack (when the fruits are forming) leads to premature fruit fall. If the attacks occur at a later stage, fruit infestation is very difficult to detect, since there are no external signs of infestation, except for an inconspicuous egg-laying scar, and consequent feeding activity in the seed remains undetected.

Weevils leave the fruit after it has fallen and decayed or when the fruit is ripe. Thus, yield is usually not significantly affected. When the adult emerges, it tunnels through the flesh into the open, leaving a hole in the fruit skin. In late-maturing varieties, it causes post-harvest damage to the pulp as the tunnel turns hard making the fruit unmarketable. This hole also serves as an entry point for secondary fungal infection.

Mango seed weevil is a quarantine pest. Probably its greatest significance as a pest is to interfere with the export of fruit because of quarantine restrictions imposed by importing countries and the market requirement for blemish-free fruit. This is particularly troublesome in the

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

case of the mango seed weevil because, in many instances, weevil attack remains undetected in the field, and is first noticed in storage or in transit.

Weevil feeding reduces the germination capacity of seeds. All the evidence suggests that weevils spread into clean areas through the movement of infested fruit for propagation and consumption. In Australia, young orchards planted from weevil-free-nursery stock have been shown to be free of seed weevil infestation for a number of years after establishment, even in areas known to have seed weevil (Pinese and Holmes 2005).

Host range

Complete development of the mango seed weevil is only possible on mangoes.

Symptoms

Infected fruits are difficult to detect to the untrained eye. The cuts made by egg-laying females are small and generally soon heal, leaving very small, dark, crescent-shaped marks on the fruit skin. Infested fruit present internal rot on the outer surface of the stone. The stones also show holes and the cotyledons turn black and become a rotten mass.

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

When the adult emerges a hole is visible in the fruit skin, which also serves as an entry point for secondary fungal infection.

Affected plant stages

Fruiting stage and post-harvest.

Affected plant parts

Fruits and seeds.

Symptoms by affected plant part

Fruits: internal feeding.
Seeds: internal feeding.

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Biology and Ecology of the Mango Seed Weevil

Eggs are elliptical, about 0.8 mm long and 0.3 mm wide and are creamy-white in colour when freshly laid. They are laid singly in small cavities made by the female in the skin of young fruits. There are

Close-up of an egg-laying mark of mango seed weevil

reports that eggs may also be laid into inflorescences. The female then covers each egg with a brown exudate and cuts a very small crescent-shaped area (of 0.3 mm) in the fruit, near the back end of the egg. The wound creates a sap flow, which hardens and covers the egg with a protective coating. Several eggs may be laid in each fruit. Incubation requires 5 to 7 days.

Larvae are white grubs with a curved body, brown heads and legless. Newly hatched larvae are extremely slender and elongated and about one mm long. Mature larvae are about 17 mm long. After hatching, the larva burrows through the flesh of the fruit and into the seed where they feed until pupation. The development of the larva is usually completed within the maturing seed, but also very occasionally within the flesh.

Grub of mango seed weevil

© A. M. Varela, icipe

The pupae are whitish when newly formed, but change to a very pale red colour just before the adult emerges. They are about eight mm long and seven mm wide. Pupation takes place in the seed within the stone of the fruit.

Pupa of mango seed weevil inside a mango stone

© A. M. Varela, icipe

Mango seed weevils

© A.M. Varela, icipe

The adults are weevils with a compact body, about 8 mm long. They are dark greyish-brown with paler patches. They are usually active at dusk. Adults can fly, but they are not known to be strong fliers; however, there are reports that they are able to fly longer distances than previously thought. They pretend to be dead when touched or disturbed.

Adults are well camouflaged on the bark of mango tree trunks, in branch terminals, or in crevices near mango trees during non-fruiting periods. They may also live in leaf litter around the tree. During flowering the adults leave their sheltered areas and move into the canopy of the tree to feed on new growth and to mate. Females start egg laying 3 to 4 days after mating, when the fruit is about marble-size. Adult weevils feed on mango leaves, tender shoots or flower buds. They can live for two years. The total life cycle takes 40 to 50 days.

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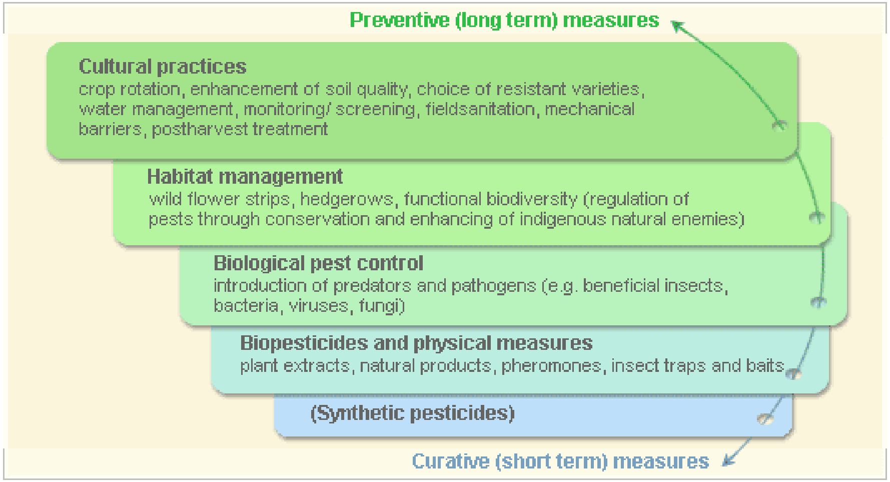
Pest and Disease Management

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 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 Mango seed weevils.

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Cultural practices

Monitoring

Weevil attack can be detected by monitoring for egg-laying marks on young fruit. Regular fruit scouting is important to detect adult activity during fruit growth.

Sanitation

Good orchard sanitation is very important. Collect and destroy all scattered stones and fallen fruits. Chop them finely or bury them deeply (about 50 cm deep).
Keep the tree basins clean, remove fallen fruit, seed and plant debris to prevent hiding of adult weevils.

Orchard quarantine

Avoid movement of fruits from areas known to have mango seed weevils to areas where young orchards, free of seed weevil, have been established.
A strict policy of not bringing mango fruit into the orchard and its surroundings will greatly reduce the chance of infestation.

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Biopesticides and physical methods

Sticky bands

In areas with a history of high infestation, applying sticky bands at the upper end of tree trunks when the trees start flowering helps reducing migration of weevils to branches for egg laying. For more information on sticky traps click here

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Information Source Links

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- African armyworm
- African bollworm
- African cassava mosaic virus (ACMV)
- African maize stalkborer
- Anthracnose

African cassava mosaic virus (ACMV)
Order/Family: Geminiviridae: Begomovirus {GEM2 }
Type: disease (viral)
Host plants: Cassava Castor bean

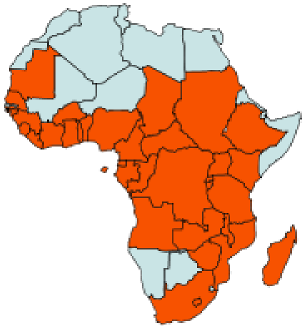
more Images

- General Information on Disease and Damage
- Biology and Ecology of African Cassava Mosaic Virus
- Pest and disease Management
- Cultural practices
- Information Source Links

General Information on Disease and Damage

Geographical distribution

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)



Geographical Distribution of the African cassava mosaic virus in Africa (red marked)

Introduction

In East Africa, African cassava mosaic virus is the most important single

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

factor limiting cassava production. Its wide distribution in the region is primarily due to the use infected planting material, the widespread presence of the vector (Bemisia tabaci) and the use of traditional local varieties that are susceptible to the virus. During the 1990s, a pandemic of an unusually severe form of the disease expanded to cover a large part of East Africa, southern Sudan and eastern Democratic Republic of Congo. This has been associated with the occurrence of a novel and highly virulent cassava mosaic begomovirus. (Legg et al., 2005).

Damage

African cassava mosaic virus is the most important virus disease of cassava, but total losses are extremely difficult to estimate. Yield losses with individual cultivars have been reported from different countries to range from 20 to 95% (Seif, 1982). Losses depend on variety and crop growth stage at infection, but are usually substantial. In Côte d'Ivoire, total losses were estimated to be 0.5 million tonnes per year compared with actual production at the time of 0.8 million tonnes.

Host range

Cassava (*Manihot esculenta*) and castor bean (*Ricinus communis*) are the two major hosts of African cassava mosaic virus. Wild hosts are other plants of the family Euphorbiaceae (for example wild poinsettia, garden

spurge).

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

Symptoms

Symptoms of African cassava mosaic virus disease occur as characteristic leaf mosaic patterns that affect discrete areas and are

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

determined at an early stage of leaf development. Leaf chlorosis may be pale yellow or nearly white with only a shade of green, or just noticeable paler than normal. The chlorotic areas are usually clearly defined and vary in size from that of a whole leaflet to small flecks or spots. Leaflets may show a uniform mosaic pattern or the mosaic pattern is localised to a few areas, which are often at the bases. Distortion, reduction in leaflet size and general stunting can be secondary effects that are associated with symptom severity.

Symptoms vary from leaf to leaf, shoot to shoot and plant to plant, even of the same variety and virus strain in the same locality. Variation in symptoms may be due to differences in virus strain, plant age, and environmental factors such as soil fertility, soil moisture availability, radiation and particularly temperature.

Sometimes leaves between affected ones may seem normal and give the appearance of recovery. This behaviour is influenced by the ambient temperature and host-plant resistance. However, symptoms may reoccur on recovered plants when environmental conditions again favour symptom expression. The first few leaves produced by an infected cutting sometimes do not show symptoms and are subsequently followed by severely affected leaves, but there is a tendency for symptom severity to diminish as plants age, especially in resistant varieties. Symptoms tend to reappear on the axillary growth when the shoot tips are removed. De-topping stem tops is sometimes adopted to enhance expression in

screening clones for resistance.

Affected plant stages
Vegetative growing stage.

Affected plant parts
Leaves.

Symptoms on affected plant parts:
Leaves: Mosaic patterns; leaf deformation.

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Biology and Ecology of African Cassava Mosaic Virus

African cassava mosaic geminivirus (CMGV) is a vector-borne virus, transmitted by the whitefly *Bemisia tabaci* and disseminated in cuttings derived from infected plants.

Cassava is the major CMGV reservoir and possibly the main host of whitefly vectors. Whiteflies are carried by the prevailing wind and can spread the virus over distances of several kilometers from cassava fields.

Even a single whitefly can transmit the virus. Whiteflies prefer to feed on young leaves. Virus spread, cassava growth and whitefly populations are dependent on climatic factors. Also, seasons of fast spread coincide with periods of rapid cassava growth and population of whiteflies carrying the virus. Crop growth in turn, depends on radiation-associated factors in humid conditions or to rain-associated ones in drier environments. Cassava varieties also differ greatly in their susceptibility to the virus (Farguett and Thresh 1994).

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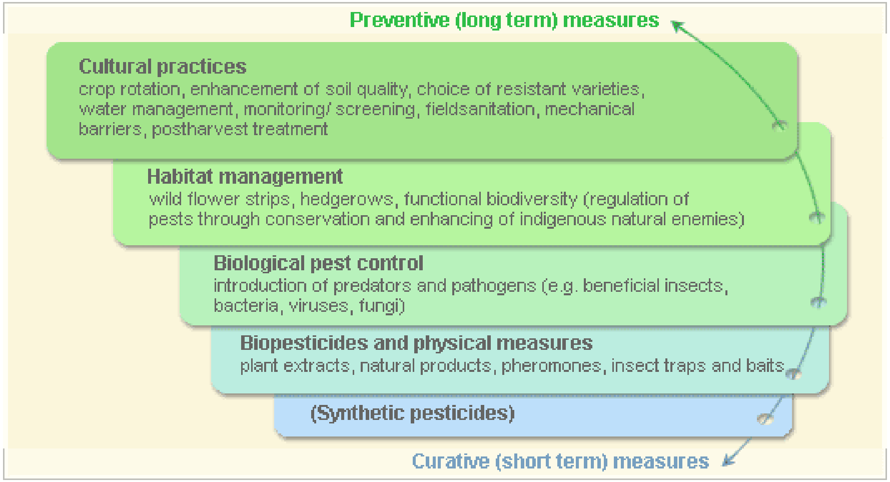
Pest and disease Management

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



This 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 African cassava mosaic virus.

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Cultural practices

Sanitation

- Remove all infected cassava or other host plants from within and around sites to be used for new plantings
- Use virus-free stem cuttings for all new plantings
- Remove diseased plants from within crop stands (roguing)

For more information on sanitation see datasheet on anthracnose.

Roguing

Roguing is a well known means of virus disease control and it is only advocated when disease incidence is low (less than 5%). It has been often recommended to control the cassava mosaic virus.

- Rogue once or twice soon after planting, when any infected cuttings develop shoots expressing obvious symptoms
- Roguing is more effective when practiced by farmers' groups and throughout whole localities.
- Frequent roguing is ineffective where there is a high spread of the

virus to susceptible varieties

- Inspect cassava plantings at least once a week for the first 2-3 months of growth to find and remove immediately any occurring diseased plants

Resistant/tolerant varieties

Use cassava varieties which are resistant and/or tolerant to mosaic virus. For example varieties derived from IITA, Nigeria, such as TMS 30337, TMS 30395, TMS 30572, TMS 60142, TMS 30001 and TMS 4(2)1425) have been widely distributed in Africa and are now grown by producers in many main cassava-producing countries in Africa.

If it is not possible to find cassava plants that are completely free from the disease, select cuttings from stem branches instead of the main stem. Stem cuttings from the branches are more likely to sprout into disease-free plants than stem cuttings from the main stems (James et al, 2000). Also, it has been found that growing of mixture of varieties in the same field aids in reduction of virus transmission (Legg et al, 2005).

Field size and shape

Virus incidence and whitefly numbers tend to be greatest in the

outermost rows of plantings, especially the ones oriented across the prevailing wind.

- **Plant in large, compact blocks.**
- **Elongated plots should be oriented along the prevailing wind, rather than across, so that less plants will be exposed.**
- **Use the outermost rows to raise virus-free cuttings for distribution, or plant a resistant variety of cassava around the field margins.**

Crop disposition

The main spread of cassava mosaic virus is into and not within plantings. Thus, you can facilitate control by selecting suitably isolated sites where the risk of infection from outside sources is limited. There is little information available on the minimum isolation distance needed for an effective infection control.

The risk of infection is much higher where sources of infection are upwind and nearby than when the nearest sources are downwind and remote. Thus, spread can be decreased by planting sequentially in an upwind direction from the source.

Crop spacing

Studies in Uganda and in Ivory Coast showed that spread of cassava

mosaic disease is influenced by host-plant population density and disease incidence was highest at the widest spacing between cassava stands and along footpaths or gaps in the stands. Thus, using uniform dense cassava stands rather than irregular widely spaced ones can help reducing disease incidence.

Planting date

You can facilitate the control of the cassava mosaic virus by avoiding exposition of vulnerable young plants to risk of infection in times when whiteflies are most abundant. Cassava grows readily from stem cuttings, enabling planting throughout much of the year, especially where there is enough rainfall.
In coastal districts of Kenya, spread of cassava mosaic virus occurs during the rains from May to July; it may be an advantage planting later in the year if conditions are not so dry to influence crop growth.

Soil fertility and nutrient status

Cassava is able to grow in unfavourable environments. Plantings are often made in poor soils or after more nutrient-demanding crops. Studies in Uganda showed that poor soil may enhance damage caused by the virus: damage was most severe in the north, where soil conditions and rainfall are generally less favourable than in the south.

In Zanzibar, cassava grown on fertile land was less affected by the disease than on less fertile soils.

Intercropping

In many parts of Africa, cassava is usually grown with other crops including banana, sweet potato, cereals and legumes. Intercropping may improve overall land productivity and may decrease whitefly vector populations, whitefly activity and virus spread. However, intercropping is more likely to complement rather than to replace other more effective control measures.

Plant many local varieties

Studies in Uganda showed that in areas where many varieties of cassava were grown, losses were much less than by planting only one variety. Also disease incidence in a susceptible variety was lower when mixed with resistant varieties than when it was grown alone.

(Thresh and Cooter, 2005)

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African maize stalkborer
Scientific name: ***Busseola fusca*** **(Fuller)**
Order/Family: Noctuidae
Type: pest (insect/mite)
Common names: African maize stalk/stem borer, maize stem/stalk borer, sorghum stalk/stem borer
Host plants: Maize Millet Sorghum

General Information on Pest and Damage

Geographical information: ***Busseola fusca*** **is a common pest in many African countries throughout sub-Saharan Africa. In East Africa it occurs at altitudes of 1000 to over 2700 m while in Central Africa it is the predominant Wszemborzer pests across all altitudes; in West Africa, it is only**

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

Geographical Distribution of the African maize stalk borer in Africa (red marked)

common on sorghum in the dry-hot zones.

Introduction

Busseola fusca is indigenous to Africa. Its distribution and pest status varies with the region. In East and southern Africa it is a pest at higher altitudes (above 600 m), but in Central Africa it occurs from sea level to over 2000 m, while in West Africa it is primarily a pest of sorghum in the dry savannah zone.

Damage

Damage is caused by the caterpillars, which first feed on young leaves, but soon enter into the stems. During the early stage of crop growth, the caterpillars may kill the growing points of the plant, causing what is known as dead-heart (the youngest leaves can be easily pulled off).

Larger grain 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

At a later stage of growth, they make extensive tunnels inside the stem. This disrupts the flow of nutrients to the grain. Tunnelling weakens the stem so that it breaks and falls over. In older plants the first generation caterpillars bore in the main stem but later some of the second generation bore into the maize cobs. Caterpillars also tunnel into the peduncles of sorghum and millet inflorescences, and may seriously affect grain production.

Stem damage on maize stalk by African maize stalk borer

© Anne Bruntse, BioVision

Because they don't produce tillers, maize plants are less able to tolerate stem borer attack than sorghum and pearl millet plants and the effect on grain yields is therefore greater.

Colonisation of the plant by borers, severity of infestation and damage strongly depend on the cropping system and soil fertility, which affects the nutritional status of the plant.
Stemborer damage is aggravated by the poor nutritional status of the plant.

Studies on several stemborers in Africa showed that an increase in nitrogen is related to higher pest loads and tunnel damage. However, soil nutrient levels, such as nitrogen, greatly influenced the plant's tolerance to stemborer attack as well. This is due to an increase in plant vigour, which is reflected in lower yield losses (Setamu et al., 1995).

Damage caused by stemborers can average 20 to 40%, which means between 2 to 4 bags of maize are lost out of every 10 that could be harvested.

Stalkborer larvae (about 8 mm) feeding inside maize stem. Notice brown frass deposits.

© Anne Bruntse, BioVision

Grains damaged by pests such as stemborers become susceptible to infection by mouldy fungi such as *Aspergillus* - see photo on the right side -

processing

Natural pest control

Cultural practices

which produce aflatoxin, a toxic by-product extremely poisonous to people and which can lead to liver cancer.

Maize cobs damaged by the African maize stalk borer (*Busseola fusca*). Note caterpillar and secondary infection by moulds

© Stemborer team, icipe

Host Range:

The main hosts of the African stalkborer are maize and sorghum. This

stemborer is also a pest of pearl millet in Mali, Burkina and Eritrea. It also attacks few grass species, wild sorghum species mainly, but it is rarely found in natural habitats.

Symptoms:

Young plants show small holes and 'window-panes' in the leaf whorls where tissues have been eaten away. Small dark caterpillars may be seen in the funnel. In severe attacks the central leaves die, forming the characteristic dry, withered 'dead-heart'.
Whole plant: dead heart; plant dead; dieback; internal feeding; frass visible. Older caterpillars tunnel in stems, and eat out long frass-filled galleries, which weaken stems and cause breakages.

Early warning signs in maize: Small holes in straight lines on the youngest leaves.

Affected Plant Stages

Flowering stage and vegetative growing stage.

Affected Plant Parts

Growing points, inflorescence, leaves, seeds, grain, ear/ head, stems.

Symptoms by affected plant part

Growing points: internal feeding; boring; external feeding; dead heart; frass visible.
Inflorescence: abnormal colour; internal feeding; frass visible.
Leaves: external feeding; frass visible.
Seeds: frass visible; empty grains.
Stems: abnormal growth; internal feeding; dead-heart; visible frass.
Whole plant: dead heart; plant dead; dieback; internal feeding; frass visible.

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Biology and Ecology of the African Maize Stalk Borer

Eggs are round, flattened and about one mm in diameter. They are usually laid in batches of 30 to 100 under leaf sheaths in a long column stretching up the stem, and may slightly compressed by pressure from the growing stem. They are white when first laid but darken as they age. Eggs hatch in about 7 to 10 days.

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

© Stemborer team, icipe

Caterpillars are light or dark violet to pinkish white in colour, often with a distinctive grey tinge. They lack conspicuous hairs and look smooth and shiny, but have rows of small black spots along the body. On hatching caterpillars are blackish. They crawl up the plant into the funnel where they feed on leaves for two to three days and then either move to other plants or enter inside the maize stem.
After the caterpillars bore into the maize stems, they feed and grow within the stems for 2 to 3 weeks. They grow to a length of about 40 mm. When fully grown, they cut a hole in the side of the stem before pupating within the tunnel inside the maize stem.

Caterpillars of the African

maize stalkborer (*Busseola fusca*).
© D. Cugala, Stemborer team, icipe

The total larval period is usually 35 days when conditions are favourable during the growing season, but during dry and/or cold weather caterpillars enter into a resting period (diapause) of six months or more in stems, stubble and other plant residues. With the beginning of the rains, the caterpillars pupate within the stems.

Pupae are shiny yellow-brown to dark brown and about 25 mm long. After 7 to14 days the adults emerge from the pupae and come out of the stem.

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

The adults have a wingspan of about 25 to 35 mm. Females are generally larger than males. The forewings are light to dark brown with darker markings and the hindwings are white to greyish-brown. There is much seasonal and geographic variation with darker coloration developing in cold wet conditions.

Adult moths of stemborers are seldom seen in fields, as they are inactive during daytime. They become active after sunset

© B. Le Ru, icipe **and lay their eggs during the night.**

They have several generations in a year, so their numbers increase towards the end of the season.

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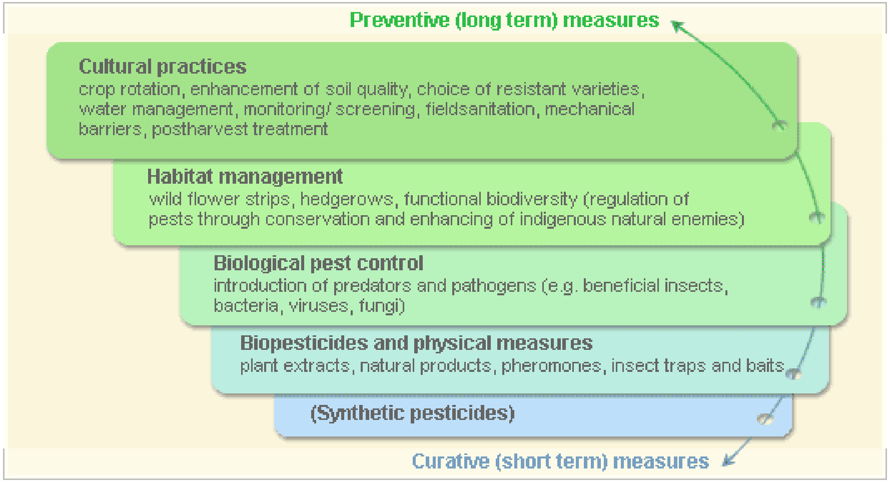
Pest and disease Management

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 African maize stalkborer.

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Cultural practices

Monitoring

Scouting and early control is essential for effective management of stemborers. Check the crop regularly. First signs of stalkborer attack are small holes or 'window panes' in straight lines across the newest leaves of maize or sorghum.

Field sanitation

Destroy crop residues. This is important to kill the pupae left in old stems and stubble and prevent carry-over populations, and so limit initial establishment of the pest on the following season's crops.

Plough and harrow. These practices help reduce borer populations by burying them deeply into the soil or by breaking the stems and exposing the caterpillars to natural enemies and to adverse weather conditions.

Slashing maize and sorghum stubble, complemented with cultivation by disking and ploughing can reduce larval populations by almost 100% (Kfir et al, 2002).
Burning crop residues is an effective way of killing stemborer caterpillars, but can create problems in farms where the organic content of soils is low and soil erosion is severe, since in many cases crop residues are the only organic matter added into soils.
Alternative ways to destroy diapausing caterpillars without destroying the stems are needed in areas where stems of cereals are used as building and fencing materials, fuel, bedding for livestock, or as stakes. In this case, partial burning is recommended, while the leaves are dry but the stalks are not. Heat generated from the burning leaves kills up to 95% of stemborer caterpillars within the stems, and at the same time cures the

stalks, improving their quality as building materials and making them more resistant to termite attack.

Using crop residues for fodder and silage has also been recommended (CABI, 2000; Kfir et al, 2002).

Destruction of wild sorghum, which would act as alternative hosts, may help to reduce population upsurge.

For these cultural measures to be effective, the cooperation of farmers in a region is required because moths emerging from untreated fields can infest adjacent crops.

Improvement of soil fertility

Maintaining soil fertility or applying practices that increase nitrogen use efficiency in maize production are important for management of the African stalkborer. Thus, in studies in Cameroon, soil application of nitrogen improved the nutritional status of maize, which consequently enhanced its tolerance to the African maize stemborer attack (Chabi-Olaye et al; submitted). However, if nitrogen is applied at rates greater than required for maximum yield, plant biomass increases at expenses of

yield.

Technologies to restore soil fertility include cereal-legume rotations, use of farmyard manure and green manure cover crops, among others. Legume cultivation and rotation are highly efficient in improving the supply of nitrogen in the soil.

Crop rotation

Maize-legume rotation sequences improve the supply of nitrogen in the soil and the nutritional status of maize, which compared to maize-maize sequences. This influences the maize susceptibility to pests and diseases.

The use of short duration fallows with leguminous cover crops and grain legumes have been useful in reducing yield losses due to borers in the subsequent crop. Rotation with grain legumes (cowpea and soybean) or leguminous cover crop (pigeon pea and mucuna *Mucuna pririens*) improved the supply of nitrogen in the soil and enhanced the yield of subsequent maize crop in the humid forest of Cameroon.

An improved nutritional status of the plant led to an increase in attacks

by the African stalkborer at the early stages of the plant growth, but also improved plant vigour, resulting finally in a net benefit for the plant and grain yield (Chabby-Olaye et al., 2005).

Intercropping and habitat management

The importance of plant biodiversity in maize agroecosystems for reducing borer's infestation on maize has been recognised in Sub-Sahara Africa.
Maize intercropped with non-host crops (e.g. cassava and grain legumes) have significantly lower stemborer damage and higher yield that monocrop maize. The effect is variable, if the crop to be protected is not planted after the companion crops. In studies in Cameroon, maize monocrops had 3 to 9 times more stems tunnelled and 1 to 3 times more cob damage than maize intercropped with non-host crops cowpea, cassava and soybean, which resulted in a higher yield in the intercropped maize.
In the mixed cropping system maize was planted 12 to 14 days after the non-host plants. Two plant arrangements were used:
1. One maize plant was followed by a non-host plant and 2. Strip planting in which two rows of maize were maize followed two rows of a non-host crop, with one row of non-host plants as borders.

Maize yield losses due to stemborers were about 2 to 3 times higher in monocrops than in intercrops. In addition land-productivity was higher than with monocrop. The maize-cassava crop was the most effective in terms of land use and the most productive compared to pure maize stand with pesticide application. The net production of mixed cropping systems was economically superior to controlling stemborers with insecticide in monocropped maize (Chabi-Olaye et al, 2005; Chabi-Olaye et al, 2006).

Studies in Kenya suggest that intercropping maize and/or sorghum with cowpeas may reduce damage caused by the African stalkborer (Amoako-Atta and Omolo, 1983; Reddy and Masyanga, 1988). Trials in Eritrea showed that sorghum intercropped with haricot beans, cowpea, desmodium and Dolichos lablab had much lower deadheart damage compared to pure stand sorghum (icipe, 2005).

'Push-Pull Strategy'

Push-Pull is a simple cropping strategy, whereby farmers use Napier grass and *Desmodium* legume (silverleaf and greenleaf *Desmodium*) as intercrops. For a more detailed description on push-pull click here

Farmer practices

Application of baits at first signs of stalkborer attack (small holes in straight lines across the newest leaves of maize or sorghum), one pinch per affected plant applied inside the funnel of maize plants.
Examples of bait: Pymack (byproduct of pyrethrum production sold as cattle feed in Kenya) provides some control, maize flour or bran mixed with pyrethrum extract reportedly provides good control.
Scouting and early control is essential for this method to have any effect.
Caution: Application of too much bait inside maize and sorghum funnels can kill the growing point - a pinch of bait per plant is enough.

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Biological pest control

Natural enemies

Many natural enemies of the African stalk borer have been recorded in Africa. The most important are predatory ants, parasitic wasps and parasitic flies. Parasitic wasps may attack eggs (e.g. *Trichogramma* spp.

and *Telenomus* spp.) or caterpillars ((e.g. *Bracon* spp and *Cotesia sesamiae*). Tachinid flies parasitise caterpillars. *Cotesia sesamiae* is the most common larval parasitoid (attack caterpillars) of this stemborer on maize in eastern Africa.
For more information on natural enemies click here.

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Biopesticides and physical methods

Neem

Simple neem products are reported to be effective for control of stemborers, including the African maize stalkborer. It is recommended that a small amount of neem powder (ground neem seeds) mixed with dry clay or sawdust at a rate of 1:1 be placed in the funnel of the plant. One kg powder should be sufficient to treat 1500 to 2000 plants. In this method rainwater dissolves the active substances in neem powder as it gathers in the funnel and washes out the powder. Where rainfall is irregular a liquid neem seed extract can be sprayed into the funnel.

The treatment should be repeated every 8 to 10 days during the sensitive

growing phase. Thus, roughly three treatments are required per crop. This recommendation applies only for young plants before flowering and not for older plants. Neem powder should be always applied as a mixture with inert materials (sawdust, rice hulls or dry fine clay), as the powder alone can be phytotoxic (harm the plants) owing to its oil content (Dreyer, 1986).

In studies in Tanzania, aqueous seed extracts combined with extracted ground neem seeds and sawdust, applied twice to the whorl of corn leaves was as effective in controlling the African stalkborer as endosulfan. The extract was prepared by soaking 120g of neem seeds and 120 g of sawdust in three litre of water for 12 hours. The mixture was filtered and the residue and the aqueous extract were then applied separately to the maize plants (Hellpap, C., 1995). For more information on neem click here.

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Contact links

ICIPE and her partners: 'Push-Pull' Technology for the Control of

Stemborers and Striga weed. www.push-pull.net

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Bagrada bug
Scientific name: *Bagrada cruciferarum, Bagrada hilaris*
Order/Family: Hemiptera: Pentatomidae
Type: pest (insect/mite)
Common names: Bagrada bug, harlequin bug, painted bug, stinkbug
Host plants: Cabbage/Kale, Brassicas Rape, Chinese cabbage, Turnips

General Information on Pest and

Biological pest control

cassava mosaic virus (ACMV)
African maize stalkborer
Anthracnose
Aphids
Bacterial wilt
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Cabbage moth
Cabbage webworm
Couch grass

Damage
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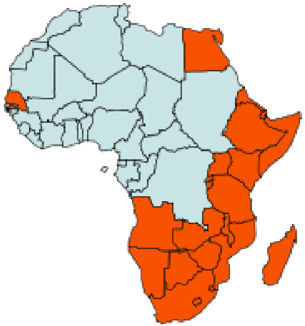
General Information on Pest and Damage

Geographical distribution



Geographical Distribution of Bagrada bug in Africa (red marked)

The bagrada bug (*Bagrada hilaris* is found throughout East and Southern Africa, Egypt, Zaire and Senegal. (*Bagrada cruciferarum*) has been reported in East an Southern Africa. It is a major cabbage pest in Botswana, Malawi, Zambia and Zimbabwe.

Damage

Bagrada bugs damage plants by feeding on young leaves. Both adults and nymphs suck sap from leaves, which may wilt and later dry. Considerable damage is caused to young plants, which may die or have the growth points severely damaged. Significant damage may also be caused to older plants.

Damage caused by the bagrada bug on cabbage

© B. Loehr, icipe

Bagrada bugs are major pests of cultivated crucifers. Severe infestations on cabbage result in stunted plants, leaves turning yellow with a rough texture, and death of the growing point. As a result, damaged plants do not produce heads or produce two or more small unmarketable heads instead of a large central head.

Symptoms

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

The bugs, especially in the early stages of development, gather in masses and suck the sap from plants. Feeding by the bugs causes small puncture marks visible as white patches starting on the edges of leaves. Eventually the leaves wilt and dry. Heavily attacked plants may have a scorched appearance.

Initial symptoms of damage

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

Host range

The bagrada bug is a common stinkbug on cabbage, kale, rape, Chinese cabbage, turnips and other crucifers such as radish. It also attacks potatoes, beetroot, papaya, maize, sorghum and pearl millet, legumes and cotton. It has also been recorded as an occasional pest on groundnuts, wheat, and rooibos tea. The bagrada bug has also been reported as a pest of capper (*Capparis spinosa*) (Colazza et al. 2004).

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Biology and Ecology of the Bagrada Bug

The bagrada bug lays its eggs in clusters on leaves or on the soil underneath host plants. Eggs are barrel shaped, initially white and turn orange with age. A single female can lay as many as 100 eggs within 2 to 3 weeks. The incubation period is 5 to 8 days.

Eggs of the bagrada bug (much enlarged)

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Nymphs pass through five stages changing colour from bright orange to red with dark markings, gradually acquiring the colouration of the adult. Initially they do not have wings; wings are gradually developed as the nymphs grow. Wing pads are visible in the last instar nymph.

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

© F. Haas, icipe

Third instar nymph of the bagrada bug.

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Late instar nymph of the bagrada bug.

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The adult bug is typically shield-shaped, 5 to 7 mm long and 3 to 4 mm broad at its widest area. The upper surface has a mixture of black, white and orange markings, which gives the insect its

common names harlequin bug or painted bug.

The life cycle lasts 3 to 4 weeks and several generations may occur in a year.

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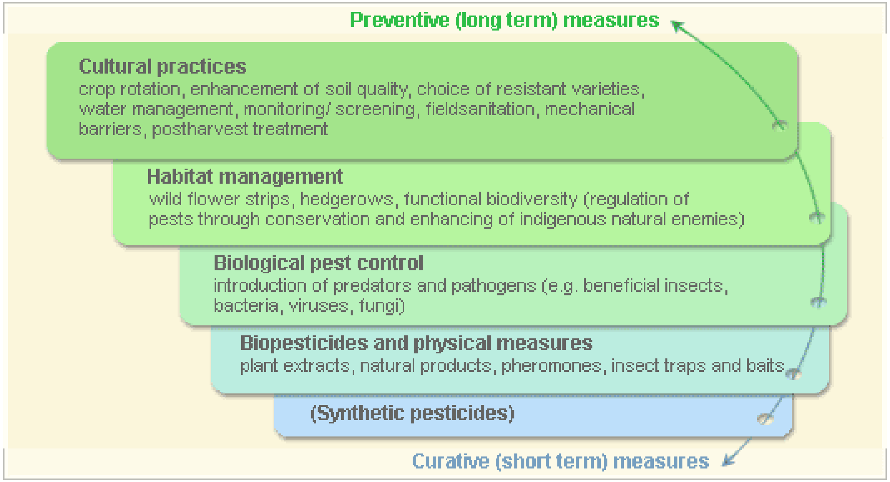
Pest and disease Management

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 Bagrada bug.

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Cultural practices

Monitoring

Regular monitoring of the crop is important to detect bagrada bugd before they cause damage to the crop.

Research in Namibia has shown that control measurements should start if the number of bugs/m² in the early growing stage exceeds one. If the crop is past the early growing stage, a higher threshold level of three bugs/m² can be maintained (Keizer and Zuurbier). However, note that these thresholds are given as examples. Economic thresholds depend on many factors (crop stage, crop age, and socio-economic and climatic conditions) and cannot be adopted without taking into consideration local conditions.

Sanitation

Crop hygiene, in particular removal of old crops and destruction of weeds of the family Cruciferae prevents population build-up.

Hand picking

Handpicking and destruction of the bugs helps to reduce damage. This is particularly important in the early stages of the crop.

Cultivation

Eggs laid in the soil are readily killed by cultivation, so frequent light cultivation (once or twice a week) of the vegetable beds will help in controlling this pest (Keizer and Zuurbier; Horticultural Research Program, Botswana).

Irrigation

Watering and overhead irrigation disturb bugs discouraging them from feeding on the crop. However, note that use of sprinkler irrigation may lead to increase of diseases such as black rot and downy mildew.

Mixed cropping

Growing strong smelling plants such as garlic, onion or parsley near the crop are reported to reduce infestations (Dobson et al, 2002).

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Biological pest control

Natural enemies

Eggs of Bagrada bugs are parasitised by tiny wasps. Bugs are parasitised by flies (e.g. *Alophora* sp.).

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Biopesticides and physical methods

Plant extracts

A mixture of chilli, soap, garlic and paraffin has shown to be an effective control method in trials in Namibia (Keizer and Zuurbier).

Natural products

In Namibia there are reports that sprinkling the plants with crushed Bagrada bugs repels other bugs. This can be used effectively in combination with frequent soil cultivation (Keizer and Zuurbier).

Soap solution

Spraying plants with a soapy solution (bar soap) has been found effective against Bagrada bugs. It helps to wash off young bugs (Dobson et al, 2002; Elwell and Maas, 1995).

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