



Biodiversity and agriculture: addressing scale insect threats in Kenya

Scale insects photo guide

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Introduction

What are Scale Insects?

Scale insects are a group of sap-sucking insects that insert their tiny, straw like mouthparts into the bark, fruit, or leaves, mostly on trees and shrubs and other perennial plants. Adult females typically have soft bodies and sometimes no limbs and may be concealed underneath domed scales, extruding quantities of wax for protection. The presence of scales can be easily overlooked, in part because they do not resemble most other insects and are easily mistaken for a disease or symptoms. Scale insects are broken into three major distinct groups i.e. *Coccidae* (soft scales); *Diaspididae* (armoured scales); and *Pseudococcidae* (mealybugs)

On Kenyan farms, most scales are serious pests of agriculture and forestry. They attack a wide range of plant species including crops of economic importance in Kenya e.g. coffee, citrus, mango, avocado, sugarcane, paw-paw, cassava etc. Scales and mealybugs cause direct damage by removing a lot of water and biomass from the plant. The toxic saliva injected into the plant by some scales can damage plant tissues, sometimes killing the plant. Some scales have been reported to transmit plant viruses e.g. Citrus mealybug (*Planococcus citri*), Pink sugarcane mealybug (*Saccharicoccus sacchari*), Striped mealybug, *Ferrisia virgata*; cause dieback e.g. the hemispherical scale (*Saissetia coffeae*) on coffee; or cause black spots e.g. the pineapple mealybug (*Dysmicoccus brevipes*) etc.

Some scale insects (soft scales and mealybugs) eliminate sugary honeydew which coats nearby surfaces, e.g. Papaya mealybug (*Paracoccus marginatus*). Black sooty mould grows on the honeydew, disfiguring the plant and produce, so reducing crop yield and its commercial value. Sooty mould also blocks light and air from the leaves, impeding gas exchange and photosynthesis, further reducing productivity.

Scales are difficult to control as the waxy covering protects them effectively from contact insecticides. Their sugary honeydew waste attracts attendant ants, which protect them from activities of natural enemies and aid in their spread. This exacerbates the pest problem. It is for this reason that biocontrol is proposed as the best alternative to insecticides in the management of scale insects and mealybugs.

This photo booklet aims to aid farmers, foresters and extension personnel to correctly diagnose scale insects present in Kenya to inform action. The pest species are covered in four groups (soft scales, armoured scales, mealybugs and other scales); for each pest, a brief description of the morphology, ecology and host species attacked is given.

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Armoured scales

1. Red scale, *Aonidiella aurantii*



Photo: California department of food and agriculture.

- Adult female is brownish or orange-red and oval to circular and about 1.5-2.0 mm long.
- The female produces a sex pheromone to attract the short-lived, winged males
- It attacks host-plants in 178 genera belonging to 84 families, but is mainly known as an important pest of citrus.
- Other crops attacked include avocado, mango, coconut, papaya, guava, passion fruit, pomegranate, okra etc

Armoured scales

2. Cassava white scale, *Aonidomytilus albus*



Photo: USDA ARS, Bugwood.org

- Adults have elongate mussel-shaped scale covers, usually silvery-white and about 2-2.5 mm long
- It is polyphagous and attacks host-plants in 16 genera belonging to 12 families; however, cassava and other species of *Manihot* are its preferred hosts. Other important hosts attacked by this pest include: papaya, mango, eggplant etc
- More often it is a problem on cassava stems stored for later planting
- In the field, infestation of cassava will be noticed by the bushy appearance of the plants, with stems, side shoots being coated with scales.

Armoured scales

3. Cycad aulacaspis scale, *Aulacaspis yasumatsui*



Photo: California Department of Food & Agriculture

- Adult female has a white waxy shield-like cover (1.2-1.6 mm long and highly variable in form) to protect themselves and their eggs.
- When the scale cover is lifted, the exposed live adult female is reddish brown; eggs beneath the scale cover are pale yellow when first laid, becoming reddish brown with age.
- Adult males (0.5-0.6mm long) are orange-brown, and resemble tiny flying midges, with one pair of wings and well-developed legs and antennae.
- Cycads are the only host plants attacked.

Armoured scales

4. Citrus scale, *Lepidosaphes beckii*



Photo: California Department of Food & Agriculture

- Adult female scale cover is elongate and wider at one end, about 2.5-3.5 mm long, mid-brown or purplish brown with a small red spot near the narrow end
- *Lepidosaphes beckii* reproduces either sexually or parthenogenically and each female lays 40-100 eggs, which hatch about 8 days later.
- The scale does not produce honeydew or cause sooty mould
- Has been recorded from hosts in 56 plant genera belonging to 40 families;
- Important hosts attacked include citrus, mango, avocado, guava, passion fruit etc

Armoured scales

5. White mango scale, *Aulacaspis tubercularis*



Photo: California Department of Food & Agriculture

- The scale cover of the female is white, almost circular, flimsy and semi-translucent, 1.5-3.0 mm in diameter, with small cast skins with a dark stripe at one edge of the cover.
- Under the scale cover the adult female is elongate and dark brown
- It is a major pest of mango, attacking all parts of the tree above ground; other hosts include avocado, citrus, coconut, ginger, pumpkins etc.
- The scale does not produce honeydew or cause sooty mould

Armoured scales

6. Cashew scale, *Pseudaonidia trilobitiformis*



Photo: California Department of Food & Agriculture

- In the field, cashew scale has a sub-circular pale- or yellow-brown scale cover, 3.0-4.5 mm in diameter, almost flat, with a yellow or red-brown central or sub-central area (a cast skin).
- The immature male scale covers are smaller, elongate- oval but similar in colour to the female covers.
- It is an important pest of cashew, citrus and cocoa, especially in monoculture.
- Other important hosts include capsicum, chilli, citrus, coconut, papaya, coffee, mango, woody legumes, avocado, guava etc
- The scale does not produce honeydew or cause sooty mould

Armoured scales

7. Coconut scale, *Aspidiotus destructor*



Photo: California Department of Food & Agriculture

- Infestations form closely packed colonies composed of scales resembling miniature translucent fried eggs.
- Adult female coconut scales have a circular or broadly oval cover 1.5-2.0 mm in diameter.
- Attacks perennial plants in more than 60 families.
- Coconut and other palms, fruit trees and bananas are the common perennial crops attacked.
- It sucks sap out of individual plant cells in leaves and green stems and injects toxic saliva as it feeds; no honeydew or sooty mould is produced.

Armoured scales

8. White scale of sugarcane, *Aulacaspis tegalensis*



Photo: David J. Greathead

- The female scale covers are subcircular, convex, thin, greyish white, with yellow cast skins at the margin.
- Immature male covers are white, elongate oval with 3 longitudinal ridges, and much smaller than those of the female.
- It has a restricted host range on grasses and can thrive on cultivated sugarcane.
- Essentially a stem-feeder, aggregating in the nodal regions inside the leaf sheaths, and is only found on leaves as a result of secondary infestation or overcrowding on the stem.
- The nymphs and adult females suck out cell contents and inject toxic saliva; the scales do not produce honeydew or cause sooty mould growth

Soft scales

9. Coffee green scale, *Coccus celatus*



Photo: B.M. Shepard, Clemson University, U.S.A.

- The two soft scale species called coffee green scale are indistinguishable in the field.
- The adult female is about 2.5 to 3.25 mm long, shiny light green with a conspicuous black, irregular U-shaped internal marking visible to the naked eye.
- Infestation forms a rather definite pattern on leaves- preferring both sides of the midrib and lateral leaf veins.
- The scales suck out plant sap and expel large amounts of sugary honeydew that fouls plant surfaces, giving rise to growths of sooty mould.
- Important host plants include: coffee, *Casuarina*, citrus, guava, soursop etc.

Soft scales

10. Coffee green scale, *Coccus viridis*



Coffee green scales, (*Coccus viridis*) along the leaf midrib (Photo: R. J. Gill, Idtools.com)

Soft scales

11. Mango shield scale, *Milviscutulus mangiferae*



Photo: California Department of Food & Agriculture

- The adult female is rounded-triangular to oval, and flat to slightly convex in lateral view.
- Young adults are transparent to yellow-green, whereas older females become brown.
- Its main host is mango; other important hosts include breadfruit, citrus, papaya, guava, avocado and ornamentals like *Hibiscus*.
- The scales suck up phloem sap and eject copious sugary honeydew, which coats nearby surfaces and gives rise to sooty mould growths.

Soft scales

12. Green shield scale, *Pulvinaria psidii*



Photo: California Department of Food & Agriculture

- The adult female is wingless, oval, green to yellow, and becomes thinly covered with a white powdery wax.
- A short ovisac of white wax threads is produced from under the abdomen, into which about 200 eggs are laid.
- It is polyphagous, feeding on host-plants in 141 genera belonging to 67 families; important hosts include avocado, citrus, coffee, ferns, flowering ginger, guava, pomegranate, pepper tree and rose apple.
- The scales suck up phloem sap and eliminate copious sugary honeydew, which coats nearby surfaces and gives rise to sooty mould growths

Soft scales

13. Hemispherical scale, *Saissetia coffeae*



Photo: California Department of Food & Agriculture

- Live adult females are easily seen as shiny brown domes on stems and leaf undersides, close to the major veins.
- The mature adult female is 2-3 mm long, with the red-brown dorsum highly convex, hard and shiny.
- The immature female is flat, yellow-brown, with three dorsal ridges resembling the letter H (see photo); these ridges disappear at maturity.
- It is highly polyphagous, feeding on host-plants in 294 genera belonging to 107 families.
- Important host-plants of *S. coffeae* include coffee, tea, citrus, guava, mango, ornamental shrubs, greenhouse plants and ferns
- The scales suck up phloem sap and eliminate copious sugary honeydew, which coats nearby surfaces and gives rise to sooty mould growths.

Soft scales

14. Soft wax scales, *ceroplastes* species



Ceroplastes rusci. (Photo California Department of Food & Agriculture)

- Adult female soft wax scales are 3.0-5.5 mm long and 1.5-3.0 mm wide, but with the thick wax coating they appear larger.
- The scales usually settle along leaf midribs or petioles; young nymphs form small white wax plates in a star-like rosette with short 'arms'.
- Ants attend the scales because they feed on the sweet honeydew, and they defend the scales from attack by natural enemies.
- They attack a large number of woody plants including citrus, coffee, quince, persimmon, mango, guava and pear.
- The scales suck phloem sap and eliminate copious sugary honeydew, which fouls nearby surfaces and gives rise to black sooty mould growths.

Mealybugs

15. Cassava mealybug, *Phenacoccus manihoti*



Photo: A. Winatoi, Dept. of Agriculture, Thailand; Inset photo: "bunchy top" - Pestnet.org

- Infestations are common on shoot tips, leaf undersides and stems, and form large amounts of white waxy secretions
- The females are wingless, oval, pinkish, and have very short marginal wax filaments.
- One of the most severe pests of cassava (*Manihot esculenta*). Other host plants include tomato, capsicum, sweet potato, nightshade etc.
- Damage to shoot tips results in development of "bunchy tops"

Mealybugs

16. Citrus mealybug, *Planococcus citri*



Photo: California Department of Food & Agriculture

- The females are wingless, up to 3 mm long, oval, white to yellowish or light brown with a coating of white powdery wax, with brown legs and antennae.
- Each female has a characteristic darker longitudinal stripe along the dorsum, and produces a white cottony mass of wax at the posterior end, covering the eggs
- Nymphs settle along midribs and veins on leaf undersides, young twigs and fruit buttons
- Adult males are winged and up to 4 mm long.
- Attendant ants, attracted by the sugary honeydew, defend the mealybugs from their natural enemies and frequently carry them from one tree to another
- Important host plants attacked include: citrus, grapes, mangoes etc.

Mealybugs

17. Long-tailed mealybug, *Pseudococcus longispinus*



Photo: California Department of Food & Agriculture

- Adult female has two protruding slender white waxy filaments, often as long as the body itself.
- The adult female's body is about 3 mm long, oval and yellowish grey, sometimes with a slightly darker longitudinal stripe on the midline
- The male has one pair of wings but the female lacks wings and is only capable of crawling
- Attacks particularly tropical fruits and ornamentals e.g. avocado, citrus, grapes, pear, and pineapple
- The insects suck phloem sap and produce sugary honeydew waste, which sometimes fouls nearby surfaces and results in development of sooty mould

Mealybugs

18. Mango coccid, *Rastrococcus iceryoides*



Photo: <http://nrcb.res.in/>

- The adult female is broadly oval and slightly rounded to convex in lateral view.
- The first-instar nymphs settle on leaf undersides on terminal shoots but migrate to twigs when the population increases.
- It has been reported on over 65 host plants from 35 families
- Important common hosts attacked are cotton, citrus, coffee, mango and cocoa.
- Eliminates copious sugary honeydew during feeding, which fouls nearby surfaces and provides a medium for sooty mould growth impairing gaseous exchange and photosynthesis.

Mealybugs

19 a. Papaya mealybug, *Paracoccus marginatus*



Photo: Fernadis Makale, CABI; Inset: Adults, nymphs and egg sacs of papaya mealybug, (Source: (Walker, Hoy and Meyerdirk, 2018))

19 b. Papaya mealybug, *P. marginatus*



Photo: Fernadis Makale, CABI

- Adult females are wingless, have yellow body contents and are covered with a white powdery wax coating
- Each adult female is approximately 2.2 mm long (1/16 inch) and 1.4 mm wide, with a series of very short wax filaments around the margin
- Adult males are winged and approximately 1.0 mm long, with an elongate oval body that is widest at the thorax (0.3 mm).
- It is polyphagous but prefers pawpaw; other crops include: sugar apple, hibiscus, cassava, citrus, avocado, guava, eggplant among others
- Sugary honeydew is periodically eliminated during feeding; this coats nearby surfaces and nourishes the growth of black sooty mould.

Mealybugs

20. Pineapple mealybug, *Dysmicoccus brevipes*

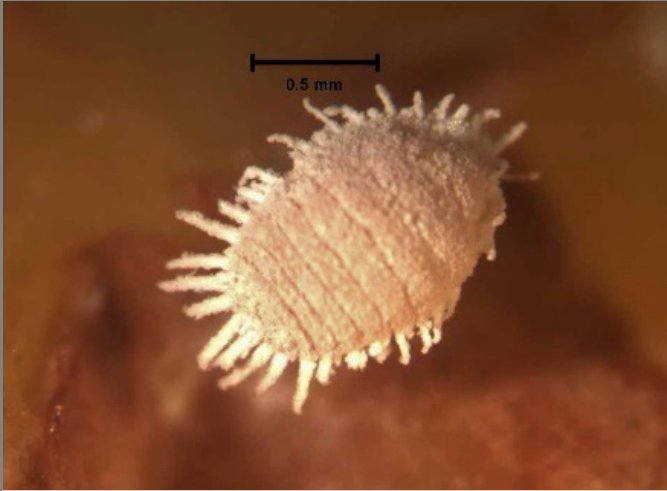


Photo: California Department of Food & Agriculture

- Adult female rotund and broadly oval, with pinkish or pink-orange body contents, and the surface covered in a layer of powdery white wax.
- The mealybugs reproduce parthenogenetically (without fertilization)
- Its damage to pineapple is due to its ability to transmit *Pineapple mealybug wilt-associated virus* to pineapples
- Other crops attacked include avocado, banana, carrot, celery, *Citrus*, cocoa, coconut, coffee, cotton, ginger, *Hibiscus*, mulberry, orchid pineapple, taro, pumpkin and many perennial grasses.
- Sugary honeydew eliminated by the mealybugs fouls the leaves and fruit and serves as a medium for the growth of black sooty moulds often attended by ants
- Ants herd the mealybugs and protect them from their natural enemies, and occasionally carry the mealybugs to new host plants

Mealybugs

21. Pink hibiscus mealybug, *Maconellicoccus hirsutus*



Photo: Jeffrey W. Lotz, Florida Department of Agriculture and Consumer Services, Bugwood.org)

- Adult pink hibiscus mealybugs are small (about 3 mm long) and pink and are covered with a powdery white wax secretion
- When adults are crushed their body fluids are bright pink.
- Adult males are smaller than females, reddish brown and have one pair of wings.
- The mealybugs feed on plant sap and expel sugary honeydew, fouling plant surfaces, on which black sooty moulds develop.
- It is polyphagous, feeding on hosts from 76 families including crops like asparagus, beans, beets, cabbage, peanuts, pigeon pea, cucumber, lettuce, pepper, pumpkin, and tomato; forest trees; and many ornamental plants.

Mealybugs

22. Pink sugarcane mealybug, *Saccharicoccus sacchari*



Photo: Fernadis Makale, CABI

- Adults are soft, oval, wrinkled, wingless and up to 5 mm long, pale pink and covered with white powdery wax.
- Colonies of pink sugarcane mealybug are usually found on the stems beneath leaf sheaths, but can also occur on the underground stems
- The pink sugar cane mealybug is present in every cane-growing country
- Significant quantities of honeydew are produced during feeding.
- Ants attending the mealybugs for their honeydew help to disperse the young crawlers to new feeding sites and protect the mealybugs from attack by natural enemies.

Mealybugs

23. Coffee mealybug, *Planococcus kenyae*



Photo: Rob Reeder, CABI

- The adult female is oval, somewhat flattened, and about 2.5mm long and 1.5mm wide.
- Important hosts include coffee, passion fruit, pigeon pea, yams, sugarcane, sweet potato, *Annona*, citrus, cocoa and guava.
- Sugary honeydew is eliminated during feeding which provides a good medium for the development of sooty mould, covering the plant and nearby surfaces.
- Ants attend the mealybugs to feed on the honeydew. They defend the mealybugs from their natural enemies and sometimes move them to new feeding sites.

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Mealybugs

24. Cryptic mealybug, *Pseudococcus cryptus*



Photo: Fernadis Makale, CABI

- The adult female mealybug is about 2.5 mm long and the body contents are greenish yellow when crushed). At the rear end are two divergent, fairly long white wax filaments, and shorter filaments are present around the rest of the body margins.
- Each female lays pale yellow eggs in a white ovisac under the abdomen.
- It is polyphagous (recorded on 90 host plant species) but is a particularly serious pest of citrus; other crops attacked are mango, avocado, coffee, banana, guava and palms
- It eliminates copious amounts of sugary honeydew that provides a medium for the development of sooty mould fungi.

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Mealybugs

25. Striped mealybug, *Ferrisia virgata*



Photo: ICAR-NBAIR, Bangalore, India

- Adult females are oval, up to 5 mm long, greyish-yellow and coated with a thin layer of powdery white wax apart from two longitudinal, sub-median, interrupted dark stripes of bare cuticle on the dorsum.
- Has two robust posterior white wax tails, each atleast half as long as the body; also crystalline, hair-like rods extending laterally from the body, and no ovisac (egg sac).
- The adult male, if present, has long antennae, six well developed legs, one pair of simple wings, no mouthparts, and a pair of long white wax filaments at the posterior end.
- It is polyphagous feeding on many crops, particularly tropical fruits, nuts and spices and field crops:
- Common crops attacked include: okra, pigeon pea, citrus, avocado, coconut, coffee, soybean, mango, banana etc.

Mealybugs

26. Spherical mealybug, *Nipaecoccus viridis*



Photo: T.R. Weeks, UF/IFAS CREC)

- The adult female is oval, 2.5–4 mm long and 1.5–3 mm wide, becomes very rotund with age, and is coated with a thick layer of mealy wax that is white initially but may turn pale yellow in old specimens.
- A large hemispherical ovisac is formed under the abdomen, composed of white loose wax filaments, and may contain several hundred violet eggs.
- The adult male (1.3–2.5 mm long) is brown–purple with one pair of well-developed forewings.
- It is polyphagous, feeding on mostly woody plants in 18 families, including food, forage, fibre crops like cotton, and ornamental plants.
- Other important crops attacked by this pest include citrus, coffee, soybean, mango, tamarind, pomegranate and grapevines.
- Copious sugary honeydew is eliminated, which fouls nearby surfaces and gives rise to sooty mould growths

Mealybugs

27. Oleander Mealybug, *Paracoccus burnerae*



Photo: Tatiana Masten Milek, Bulletin of Insectology

- The adult female of *P. burnerae* is elongate oval, covered by layer of mealy white wax but with body segmentation visible. Untidy white wax filaments project from the margin, longest at the rear end.
- The mealybugs occur on all parts of citrus branches (stems, leaves and fruit) throughout the year but migrate to fruits in dry conditions when the leaves become less palatable.
- Its hosts include commonly cultivated plants like citrus, coffee, guava, passion fruit, cotton, potato and ornamentals
- Attendant ants, attracted by the sugary honeydew, defend the mealybugs from their natural enemies and frequently carry them from one tree to another.

Other scale insects

28. Breadfruit mealybug, *Icerya aegyptiaca*



Photo: Peter A.C. Ooi, CABI BioScience)

- Adults have orange-red bodies with black legs and antennae, and are covered by thick layer of powdery white wax.
- The species reproduces asexually (without fertilisation/mating); males are absent or unknown.
- Each female lays 70 to 200 oval, yellowish-orange eggs (depending on temperature and host quality) into an egg sac of fluted white wax
- It is polyphagous on mostly woody host-plants, attacking hosts in 113 genera belonging to 59 families.
- Breadfruit is the primary host but avocado, banana, citrus, jack-fruit, mango, soursop, taro, and ornamentals are attacked.
- Sooty mould grows on excreted honeydew, causing reduction of productivity and premature leaf fall; sometimes ant-attended

Other scale insects

29. Seychelles scale, *Icerya seychellarum*



Photo: Fernadis Makale, CABI

- In adult *Icerya seychellarum* the limbs are dark brown to black; the body contents are orange-red and the dorsum is covered in white or white-and-pale yellow powdery wax.
- It is polyphagous on mostly woody hosts, reported on members of over 60 plant families.
- Some common hosts are avocado, breadfruit, *Casuarina*, citrus, *Ficus* and guava.
- The insects suck phloem sap and produce copious sugary honeydew waste, which fouls nearby surfaces and results in development of sooty mould; sometimes ant-attended (see photo).

Other scale insects

30. Cottony cushion scale, *Icerya purchasi*



Photo: A. Urbaneja

- The adult female produces a distinctive elongated, fluted cottony white ovisac (containing reddish eggs and crawlers) up to 2 times longer than the body.
- Adult female's body is orange-red or -brown with some yellowish-brown wax secretions, up to 7 mm long.
- Is a particular pest of citrus and species of *Acacia*, *Casuarina* and *Pittosporum*, but can damage many types of fruit, forest and ornamental trees and shrubs
- It feeds on plant sap and eliminates copious quantities of sugary honeydew, a good medium for development of sooty mould.

Other scale insects

31. Ensign scale, *Insignorthezia insignis*



Photo: Scott Nelson, Flickr

- Adult female forms a fluted white ovisac up to 2 mm long attached to her abdomen, rather than being attached to the plant.
- Female is brownish olive green and about 1.5 mm long and 1.3 mm wide.
- It eliminates copious amounts of sugary honeydew during feeding that fouls nearby surfaces, giving rise to sooty mould growth.
- The honeydew produced attracts attendant ants which protect it from natural enemies

