Crop Walkers' Guide

AHDB

Sweetcorn

HORTICULTURE

Every year a significant proportion of the UK sweetcorn crop would be lost to pests and diseases if growers did not monitor their crops and employ effective protection strategies.

This Crop Walkers' Guide aims to assist growers, agronomists and their staff in the vital task of monitoring crops. It is designed for use in the field, to help with the accurate identification of pests, their predators, diseases, nutritional deficiencies and physiological disorders within a crop. Images of key stages of each subject along with typical symptoms have been included, together with bullet point comments to help identification.

It is impossible to show every symptom of every pest or disease, therefore, growers are advised to familiarise themselves with the range of symptoms that can be expressed and be aware of new problems as they occur.

This guide does not attempt to offer advice on available control measures as both chemical active ingredients and their approvals frequently change. However, having identified a particular pest or disease in their crop, growers can refer to other AHDB Horticulture publications that contain information on control measures.

Grace Choto
Research and Knowledge Exchange Manager (Field Vegetables)
AHDB Horticulture

Sweetcorn Crop Walkers' Guide

Contents

Diseases — SECTION 3

Nutrient deficiencies — SECTION 4

Physiological disorders — SECTION 5

References

SECTION 6

Invertebrate pests

Aphids

eg Rhopalosiphum padi, Sitobion avenae, M. dirhodum

- Vary in size from 1.2–3.3mm long.
- Colour varies but is usually green/ reddish-brown.
- Large numbers of aphids feeding can lead to yellowing and stunting of growth.
- Excretion of honeydew can lead to the growth of black sooty mould fungus.
- Some species can transmit virus diseases.

Corn earworm

Helicoverpa armigera

- A migrant pest moth, making it an infrequent pest of sweetcorn.
- Young crops have holes in their leaves, following whorl-feeding on the apical leaf.
- Eggs can be found on silks on larger plants, and silks display grazing evidence.
- The larvae (caterpillars) are highly variable in colour.
- The soft, milky grains in the top few centimetres of cobs are eaten as the sweetcorn ears develop.
- Usually one larva per cob can be observed.

Cutworms

Agrotis segetum

- Turnip moth larvae (caterpillars) are generally grey, sometimes tinged with purple and are one of several species known as cutworms.
- They attack the roots and lower stems.
- Seedlings are cut off at or just below the surface. Small, round shot-holes in seedling leaves.
- Adults lay eggs on plants or on pieces of litter and debris in soil.
- Early crops slightly at more risk than late drilled crops.
- Sporadic pests but damage can be severe.
- Forecasts available on the AHDB Horticulture Pest Bulletin.

European corn borer

Ostrinia nubilalis

- Established in SE England but an infrequent pest at present.
- Larvae (caterpillars) feed within the whorls and on leaves, subsequently boring into the stalks and eventually migrating into the shank portion of the ears.
- Fully-grown larvae are 25mm long with dark-brown spots on each body segment. There is a distinct reddish-brown stripe along the entire length of the body.
- Kernels that are damaged or contaminated with droppings can be hard to detect.

Frit fly

Oscinella frit

- Adult fly about 1.5mm long, shiny and black.
- Larvae are small, white and about 3mm when fully grown.
- Severe attacks on shoots cause stunting and distortion of plants.
- In less severe attacks there may be little effect on growth but rows of small holes will be seen across expanded leaves.

Leafhoppers

Zyginidia scutellaris

- An infrequent pest of sweetcorn.
- Adult leafhopper 2–2.5mm long. Generally yellowish colouration.
- Adults can be very active in warm weather and rapidly jump when disturbed.
- Larvae and adults feed on plant sap throughout the vegetative period leaving small white spots on leaves. Severely affected leaves wither.

Leatherjackets

Tipula spp.

- Leatherjackets are the larvae of crane flies (daddy long legs).
- They can be distinguished from cutworms as they have no legs and no distinct head.
- Feed on roots and underground parts of stems leading to death of young seedlings.
- An infrequent pest of sweetcorn.

Nematodes

Various spp.

- Damage evident as patches of stunted, yellowing plants with damaged root systems.
- Lodging occurs in larger plants.
- An infrequent pest of sweetcorn.

Slugs and snails

Various spp.

- Young plants are most susceptible.
- Slugs graze the leaves leaving slime trails.
- Damp moist soils are favoured by slugs.
- Growing in heavy soils and leaving crop residues close to the soil surface increases risk.

Symphylids

Scutigerella immaculata

- Resembles a small white centipede; live in the soil surface zone or compost heaps.
- Young symphylids have three pairs of legs and go through a series of moults, adding a pair of legs each time until they have 12 pairs in total: this takes three months. Symphylids can live for several years.
- An infrequent pest of sweetcorn; populations rarely build up to damaging levels.
- Occurrence in the field patchy, however, damage in these spots may be severe.
- Feed on decaying vegetable matter and small root hairs. Roots can be severely pruned resulting in severe stunting and plant death.

Western corn rootworm

Diabrotica virgifera virgifera

- The adult beetle is yellow, 5–7mm long with black stripes on the wing cases. Antennae are almost as long as the body.
- Adult beetles feed on aerial plant parts. Young larvae feed on root hairs and the outer layers of root tissue. Older larvae tunnel into the roots, damaging them.
- Larvae grow up to about 15mm long and are white in colour.
- The most effective way of detecting *D. virgifera virgifera* is by using pheromone sticky traps.
- Loss of root tissue reduces water and nutrient uptake in the host, which may kill small plants. Affected plants lose stability and are prone to lodging.

Wireworms

Elateridae

- Legless click beetle larvae, yellow-brown in colour. Feeds on roots.
- Leaves turn reddish-brown.
- Plants may compensate but may fail to form an ear.
- Greatest risk of damage where the crop is grown in the first three years after grass.

Predators

Beetles – Ground

Carabidae

- 360 British species; diverse in size (2–25mm), habitat preference and feeding habits. Many are nocturnal.
- Frequently black or brown, often with metallic sheens.
- Overwinter as adults under tussocky grasses or as larvae underground in fields.
- Many adults and larvae are carnivorous, feeding on a range of insects.
- Good runners and may climb.

Beetles – Rove

Staphylinidae

- About 1,200 British species; variable in size (1–25mm).
- Short wing cases, unlike ground beetles.
- Overwinter as adults under tussocky grasses or as larvae underground.
- Predatory, or fungal-feeding.
- Good fliers and climbers.

Damsel bugs

Nabidae

- All 12 UK species are brown, and slender with long legs. Size ranges from 6–12mm long.
- Adults are flightless, aggressive predators that feed on a wide range of insects.
- They are found on plants, on the ground and in margins, shrubs and trees.

Lacewings

Chrysopa perla

- Adult lacewings are pearly blue-green with a wingspan of about 20–32mm and are around 14mm long. The wings are transparent with the appearance of lace.
- The adults will eat some aphids but it is the larvae that are voracious feeders.
- Larvae are plump, around 8mm long, covered in bristles and have a cream body with brown patches.

Ladybirds

Various spp.

- The two-spotted ladybird is the most common species found. Adults are easily recognisable but the larvae are often mistaken for pests.
- Both adults and larvae are predatory, feeding mainly on aphids.
- The larvae are up to 6mm long with a clearly segmented body. Their colour is a dark slate-grey with small yellow patches on each side of the first and fourth abdominal segments.
- The larvae, like most predators, are very mobile.

Parasitic wasps

Various species eg *Braconids* and *Chalcids*

- Parasitic wasps from several families all play a part in reducing pest numbers.
- One adult female Aphidius wasp can parasitise 200 or more aphids.
- One important group, eg *Aphidius* species are tiny black active wasps that parasitise aphids, cementing the host to the plant before pupating.
- Empty parasitised aphid skins, or mummies (usually golden), remain on the plant.

Diseases

OOMYCETE DISEASES

FUNGAL DISEASES

Damping off

Pythium spp.

- Causes root rot and damping off leading to yellowing and stunting of young plants.
- Affected plants display a range of symptoms such as rotten or discoloured stems and roots and post-emergence seedling damping off as shown in the images.
- Seedlings in damp, poorly drained soils most at risk.
- An infrequent seedling disease of sweetcorn.
- May be seed-borne but survives in plant debris and soil between crops.

Eyespot

Kabatiella zeae

- Small, round to oval lesions (1–4mm) on leaves. Spots are initially water-soaked but later appear as brownish rings around a pale central area, surrounded by a narrow yellow halo that gives the lesion the 'eyespot' appearance.
- Problematic during cool, humid weather in early spring.
- Older leaves may have numerous spots that grow together, thereby killing large amounts of tissue and reducing photosynthetic area and yield.
- Overwinters in corn debris; dispersed by wind and splashing rain.

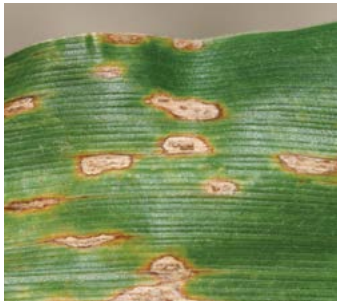
Maize smut

Ustilago maydis

- All above ground parts may be infected.
- Affects actively growing plant tissues and eventually produces galls (few mm to several cm), mainly on the cobs.
- Galls, initially greenish-white to silvery-white tissue. As they mature they produce masses of dry black powdery spores.
- Leaf galls are less dramatic, they remain quite small (about 1.0cm) and do not rupture or produce masses of powdery spores.
- Soil-borne crop debris and seed-borne pathogen.

Rust

Puccinia sorghi



- Oval to elongated cinnamon brown pustules erupting through upper and lower leaf surfaces. In severe epidemics, pustules may also appear on the ears and tassels.
- Partial resistance is expressed as chlorotic or necrotic hypersensitive flecks with little or no sporulation (compare susceptible, and resistant).
- Pustules rupture and expose dusty red spores (urediniospores) that are spread by wind and infect other corn leaves directly.
- Pustules mature and turn brownish-black and release dark-brown overwintering spores (teliospores).
- Occasional disease of sweetcorn in the UK.

Stalk rot

Fusarium spp.

- Various Fusarium species can cause diseases of the root, stem and ear.
- There can be rotting of the internodes and pith.
- Stalk rot produces a grey discolouration in the foliage of mature plants, which is often followed by wilting and yellowing as the plant senesces prematurely.
- Some species may cause pink discolouration inside the stem.
- Can result in lodging.

Nutrient deficiencies

The importance of early diagnosis of crop nutrient deficiencies

Suspected nutrient deficiencies based on the appearance of symptoms should be confirmed by leaf nutrient analysis. In such cases, the leaf nutrient concentrations will usually be well below the 'critical level' and there should, therefore, be little doubt about the diagnosis.

Leaf nutrient analysis should preferably be used to test for sub-clinical deficiencies or toxicities which may be already limiting growth but which are not yet resulting in visible symptoms. Guidance on collecting leaf samples is described on RB209 and other AHDB publications. Interpretation of laboratory results is possible by comparison with normal levels expected for the crop.

Boron

B

- Distortion of spikelets, absence of anthers, barren or partly barren ears, especially at tip, which is pointed.
- Irregular white spots on younger leaves, which can form raised waxy stripes up to 5cm long.
- Leaves thick and midribs brittle.
- Bushy appearance because upper internodes do not elongate.
- Tassels and ear shoots are reduced and may not emerge.
- Favoured by drought, high pH, and sandy soils low in organic matter.

Calcium

Ca

- New leaves emerge twisted and shrivelled at tip, may become trapped inside blade of next leaf, causing them to buckle.
- Tips of several leaves may stick together, giving a ladder-like appearance.
- Serration and curling of the leaf edges.
- May cause severe stunting.
- Favoured by very low soil pH (below 5.5 on mineral soils and 4.8 on organic soils) and on soils high in magnesium and potassium.

Copper

Cu

- Youngest leaves are yellow as they come out of the whorl and the tips may die.
- Stalk is soft and limp.
- Necrosis on edge of older leaves.
- Favoured by soils with very high organic matter and high pH.

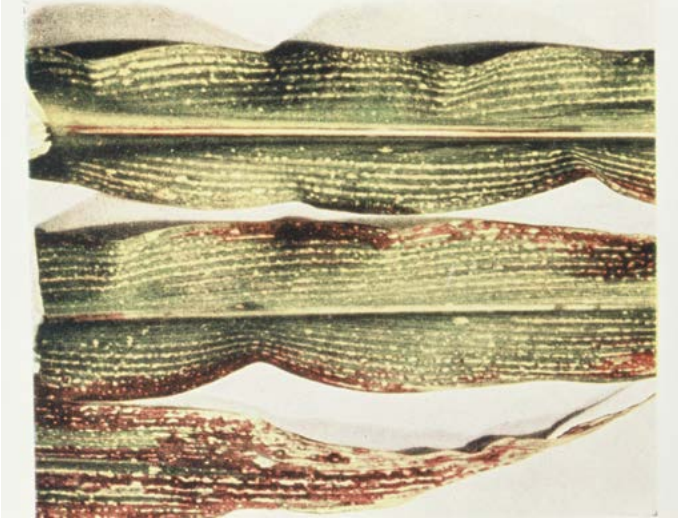
Iron

Fe

- Pale green to white interveinal chlorosis on entire length of new leaves.
- Excess of iron can result in necrotic blotching.
- Favoured by alkaline, wet and poorly aerated soils.
- Note: resembles magnesium deficiency in early stages, but becomes progressively worse on new leaves, which may be completely bleached.

Magnesium

Mg



- Interveinal chlorosis (parallel yellowish-white stripes between green veins) of older leaves.
- Red and purple tints on edges and tips of these leaves, which may die back if deficiency is severe.
- Favoured by very acidic, sandy soils in regions of moderate to high rainfall where magnesium has been extensively leached from the soil profile.
- High levels of potassium in the soil or applied to the soil can induce magnesium deficiency.

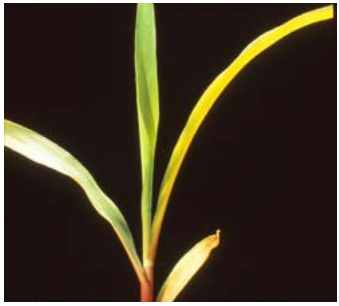
Manganese

Mn

- Young leaves turn olive green and may become streaked; white streaks between green veins.
- Severe: white stripes are elongated, turn brown, deteriorate and fall out.
- Favoured by high soil pH and sandy soils high in organic matter.

Nitrogen

N



- Leaves turn pale, yellowish-green, starting with the older lower leaves and progressing up the plant if deficiency persists. Leaf sheaths purple, reddish-purple veins and edges die back from tip.
- Slender, spindly stalks. 'Shrivel' disorder later in life; kernels fail to fill.
- Drastic loss of yield.
- Favoured in cold, wet or sandy soils, and in soils with low amounts of nitrogen-residues, large amounts of leaching and flooding.
- Refer to AHDB Horticulture factsheet 14/16 'Nitrogen and phosphorus recommendations for optimising yield and quality of sweetcorn'.

Phosphorus

P

- Uniform deep purpling or reddish-purple tips, especially of older leaves and leaf sheaths of young plants. Seedlings very sensitive, but plants may recover later.
- Plants are smaller and grow slower, resulting in delayed silking and poor pollination, causing grains to be arranged irregularly and absent from the tip of the cob.
- Favoured by cold, too wet or too dry soils, insufficient amounts of available phosphorus in soil, restricted root growth in compacted soils, injury to roots by insects, herbicides or cultivators.
- Note: cold weather can also cause purpling and boron deficiency can cause poor grain fill of cobs.

Potassium

K

- Yellowing and necrosis of leaf margins, particularly the tips, spreading over the entire leaf. Found on the lower, older leaves and progressing up the plant if deficiency persists.
- When severe, lower leaves turn yellow and upper leaves turn green.
- Shortened internodes, small ears with pointed tips.
- Favoured by wet, compacted, sandy or too dry soil, strongly geologically weathered soil, and depletion of soil-potassium by previous crop.
- Less stalk strength and more susceptible to stalk diseases; causing lodging in late season – can be accentuated by high nitrogen applications on potassium-deficient soils.

Sulphur

S

- New leaves are a uniform golden yellow, especially towards the base. Old leaf bases are red.
- Stunting of plant and delayed maturity.
- Interveinal chlorosis.
- Favoured by acidic, sandy soils, soils low in organic matter and cold, wet soils that delay release of sulphur from organic matter.
- Rarely deficient due to sweetcorn having a low requirement for the nutrient.

Zinc

Zn

- Broad bands of whitish-coloured tissue appear from the base of the leaf, extending towards the tip of emerging leaves, in the young crop.
- In mild cases, bands may appear as several interveinal stripes (not entire length of leaf).
- 'White bud' – new leaves nearly white.
- Anthers may be missing from tassels and emergence of silks delayed, which can reduce yield due to poor pollination.
- Reddish-brown discolouration at the nodes in stem, and plants stunted due to shortened internodes.
- Favoured by cool, wet and high pH soil, and soil low in organic matter.

Physiological disorders

- Tip and marginal leaf scorch in younger plants.
- Can cause damage to buds leading to leaf contortion.
- Commonly seen in more exposed areas, eg field margins, as well as frost pockets.

Flooding

- Causes oxygen deficiency in root zone.
- Oxygen-deficient plants don't produce enough energy for physiological and biochemical processes, which can result in plants being unable to absorb nutrients such as nitrogen, phosphorus and potassium.
- Low lying areas are prone to flooding.
- Severely affected plants may die within two or three days.

- Herbicide injury to the roots can result in the disruption of physiological processes, leading to symptoms such as wilting, nutrient deficiencies (eg phosphorus) or growth problems.
- Herbicide damage to foliage may cause leaf necrosis and distortion.

Poor ear fill

- Can be caused by drought stress.
- Can result in poor kernel development, inadequate ear fill and poor corn quality.

- Soil compaction causes restricted root growth, which can lead to nutrient deficiencies, such as potassium deficiency as shown in the above image.
- Compaction may also result in waterlogging.

Tillering

- Multiple tillers can grow when exposed to favourable growing conditions (high nitrogen, high rainfall) or when the main stem has broken near the ground.
- Do not need to be removed as they do not affect yield.

- Causes bending of leaves and can result in root lodging or stalk breakage.

References

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We hope that the guide proves a helpful aid to your businesses.

Photographic credits

Section 1 – Invertebrate Pests

1.1 Aphids, (top left and right) Iowa State University Extension and Outreach – Adam Sisson; (bottom left) ADAS; (bottom right) University of Warwick
1.2 Corn earworm, University of Florida – John L. Capinera
1.3 Cutworms, University of Warwick
1.4 European corn borer, (bottom right) Iowa State University Extension and Outreach – Adam Sisson
1.5 Frit fly, Bayer Crop Science
1.6 Leafhoppers, Tristan Bantock
1.7 Leatherjackets, (top) Jon Oakley; (bottom) BBRO
1.8 Nematodes, Bayer Crop Science
1.9 Slugs and snails, (top left and right) ADAS; (bottom left) Jon Oakley; (bottom right) University of Wisconsin-Madison, Bugwood.org – Roger Schmidt
1.10 Symphylids, aphotofauna.com
1.11 Western Corn Rootworm, (top left) Iowa State University, Bugwood.org – Daren Mueller; (top right) Bugwood.org – Eric Burkness; (bottom) William M. Brown
1.12 Wireworms, (top) Iowa State University Extension and Outreach – Adam Sisson; (bottom) Food and Environmental Research Agency (FERA)

Section 2 – Predators

2.1 Beetles – Ground, Roger Umpelby
2.2 Beetles – Rove, Roger Umpelby
2.3 Damsel bugs, (top left) Daren Mueller; (top right) Jon Oakley; (bottom left) J K Lindsey; (bottom right) Kevin McGee
2.4 Lacewings, (top) David Norman; (bottom left) Adam Sisson; (bottom right) Roger Umpelby
2.5 Ladybirds, (top left, bottom left and right) FERA; (top right) Adam Sisson
2.6 Parasitic wasps, Roger Umpelby

Section 3 – Diseases

3.1 Damping off, University of Nebraska–Lincoln, Institute of Agriculture and Natural Resources

3.2 Eyespot, University of Minnesota (extension.umn.edu/agriculture/crop-diseases/corn/eyespot.html) – D. Malvick
3.3 Maize smut, Iowa State University – Daren Mueller
3.4 Rust, (top left and bottom left and right) Iowa State University – Daren Mueller; (top right) Alison Robertson
3.5 Stalk rot, (left) LG 'A Maize Growers Guide'; (top right and bottom right) Amy July

Section 4 – Nutrient deficiencies

4.1 Boron, Warwick Crop Centre
4.2 Calcium, Warwick Crop Centre
4.3 Copper, Horticulture Innovation Australia
4.4 Iron, University of Idaho Extension
4.5 Magnesium, Warwick Crop Centre
4.6 Manganese, (right) University of Idaho Extension
4.7 Nitrogen, (bottom left) University of Idaho Extension
4.8 Phosphorus, (left) Warwick Crop Centre; (right) Mary Anne Hansen
4.9 Potassium, (left) University of Idaho Extension
4.10 Sulphur, (left) Warwick Crop Centre; (right) Iowa State University – Daren Mueller
4.11 Zinc, University of Idaho Extension

Section 5 – Physiological disorders

5.1 Cold/frost, Warwick Crop Centre
5.2 Flooding, Warwick Crop Centre
5.3 Herbicide injury, Department of Botany and Plant Pathology Purdue University
5.4 Poor ear fill, Robert Mulrooney
5.5 Soil compaction, Warwick Crop Centre
5.6 Tillering, Purdue University
5.7 Wind damage, Daren Mueller