Crop Walkers' Guide

AHDB

Outdoor Cucurbits

HORTICULTURE

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

This Crop Walkers' Guide is aimed at assisting growers, supervisors and their staff in the vital task of monitoring courgettes, marrows, pumpkins and squashes. It is designed to help with the accurate identification of pests, diseases, nutritional deficiencies and physiological disorders within a crop and on harvested produce. Images of key stages in the life cycles of pests and diseases are included along with short easy-to-read comments to help with identification.

As it is impossible to show every symptom of every pest or disease, growers are advised to familiarise themselves with the range of symptoms that can be expressed.

This guide does not offer any advice on the measures available for controlling pests or diseases as both chemical active ingredients and their approvals frequently change. However, having identified a particular pest or disease in their crop, growers should refer to other AHDB Horticulture publications that contain information on a range of control measures.

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

Outdoor Cucurbits

Contents

Invertebrate pests — SECTION 1

Bean seed fly 1.1
Black bean, melon-cotton, peach-potato aphids 1.2
Cutworm 1.3
Glasshouse whitefly 1.4
Onion thrips, Western flower thrips (WFT) 1.5
Slugs 1.6
Spider mite 1.7

Diseases — SECTION 2

BACTERIAL DISEASES

Angular leaf spot 2.1

FUNGAL DISEASES

Anthracnose 2.2
Botrytis (grey mould) 2.3
Fusarium rots 2.4
Gummy stem blight and black rot 2.5
Powdery mildew 2.6
Scab (gummosis) 2.7
Sclerotinia rot 2.8
Verticillium wilt 2.9

OOMYCETE DISEASES

Downy mildew 2.10

VIRAL DISEASES

Cucumber Mosaic Virus *2.11*
Zucchini Yellow Mosaic Virus 2.12

Nutrient deficiencies

SECTION 3

Boron (B) 3.1
Calcium (Ca) 3.2
Copper (Cu) 3.3
Iron (Fe) 3.3
Magnesium (Mg) 3.4
Manganese (Mn) 3.5
Nitrogen (N) 3.6
Phosphorus (P) 3.7
Potassium (K) 3.8
Sulphur (S) 3.9
Zinc (Zn) 3.9

Physiological disorders

SECTION 4

Chilling/frost injury 4.1
Drought stress 4.2
Hollow heart 4.3
Poor pollination 4.4
Stem splitting 4.5
Waterlogging 4.6
Wind damage 4.7

References

SECTION 5

Acknowledgements 5.1
Photographic credits 5.2

Invertebrate pests

Bean seed fly

Delia platura, Delia florilega

- Adults are greyish-brown, about 5mm long. Females are attracted to freshly disturbed soils, particularly if high in organic matter, to lay eggs.
- Larvae are white with no legs, 6–8mm long when fully grown, found in the soil.
- Young cucurbit plants raised in peat blocks can be damaged soon after planting out, especially in May when first generation flies are active.
- Affected plants can wilt, collapse and die.

Black bean, melon-cotton, peach-potato aphids

Aphis fabae, A. gossypii, Myzus persicae

- Black bean aphid (top) and melon-cotton aphid (bottom right) can develop large populations on leaf undersides or growing points in hot summers.
- Black bean aphid is matt black, melon-cotton aphid is yellow-green, olive-green or black. Both have short black siphunculi (tubes at rear).
- Peach-potato aphid (bottom left) is green, pink or red. The siphunculi have dusky black tips. This species and melon-cotton aphid can transmit *Cucumber mosaic virus* (CMV), see 2.11.

Cutworm

Caterpillars of certain moth species, eg *Agrotis segetum*

- Greyish-brown caterpillars with faint longitudinal lines along the back and sides.
- Young cutworms make holes in leaves. More serious damage is done by older caterpillars which feed on stem bases above and below ground. Affected plants are chewed off at ground level.
- Plants are most at risk on weedy sites and where they are not irrigated during dry summers.

Glasshouse whitefly

Trialeurodes vaporariorum

- An occasional pest, especially on glasshouse-raised plants in warm weather.
- Found on leaf undersides and on growing points.
- Adults are white, moth-like insects, about 1mm long.
- Larvae (known as ‘scales’) are oval, translucent when young and white when older, and are sedentary.
- Sticky honeydew excreted by whiteflies can enable sooty moulds to develop.

Onion thrips, Western flower thrips (WFT)

Thrips tabaci, Frankliniella occidentalis

- Small, slender insects (2mm long), on leaves, buds and flowers. Adults have fringed wings.
- Onion thrips (bottom left) are more common outdoors, but glasshouse-raised plants could be infested with WFT.
- Onion thrips adult females are greyish-yellow to brown and larvae are greenish (there are no males in the UK).
- WFT adult females (bottom right) are yellow and brown, males are smaller and yellow as are larvae (top left).
- Damage symptoms include white or silvery flecks and patches on leaves, containing small black faecal spots.

Slugs

eg the grey field slug, *Deroceras reticulatum*

- The most common slug species damaging field crops is the grey field slug, which is grey-brown or cream.
- Most damaging on heavy soils in wet weather.
- Damage symptoms are leaf holes or shredding and presence of slime.
- Some snail species can do similar damage.

Spider mite

Tetranychus urticae

- Very small mites (0.5mm) on leaf undersides.
- Young mites and summer adults are green with two black patches on each side of their bodies. In the autumn, adult females turn brick-red before over-wintering.
- Feeding damage causes fine, yellow speckling on leaves, coalescing into necrotic patches.
- In hot, dry summers, large populations can build up, causing severe damage and conspicuous spider-like webbing.

Diseases

BACTERIAL DISEASES

FUNGAL DISEASES

OOMYCETE DISEASES

VIRAL DISEASES

Diagnosis of viral diseases from symptoms is problematic and should always be confirmed by laboratory investigation

Angular leaf spot

Pseudomonas syringae pv. lachrymans

- Can affect seedlings (seed-borne), mature plants and fruit.
- Water-soaked to grey leaf lesions are angular (clearly defined by leaf veins) and may have yellow borders. Older, dried lesions fall out giving leaves a 'shot hole' appearance.
- In humid conditions, bacteria ooze onto lesion surfaces and dry as a white residue.
- Fruit lesions (1–5mm in diameter) are water-soaked then brown, sometimes with a white deposit; internal and secondary rots may develop.

Anthracnose

Colletotrichum orbiculare [=C. lagenarium]

- Leaf symptoms vary with cucurbit species but generally lesions are brown, roughly circular and may exceed 1cm in diameter. Leaf distortion may occur and old lesions may crack or fall out.
- On petioles and stems, lesions are shallow, elongated brown areas.
- Fruit symptoms are circular, water-soaked areas that later become black sunken lesions.
- Fruit and stem lesions may be covered with minute black fungal structures and pink spore masses.

Botrytis (grey mould)

Botrytis cinerea

- Can infect throughout production (including post-harvest), colonising seedlings, flowers and old or damaged tissue, causing plant collapse and death.
- Symptoms on flowers (blossom rot) and fruit are irregular water-soaked then brown lesions. Infection may spread from flowers to developing fruit.
- Typically develops as abundant fluffy grey-brown fungal strands bearing spore masses.
- Infection is most common in cool conditions (around 15°C) with prolonged high humidity.

Fusarium rots

eg *Fusarium culmorum* and *F. oxysporum*

- Primarily on pumpkin and squash.
- Severe brown lesions on stem bases and upper root tissues can result in plant wilting and death.
- On mature plants or after cutting, lesions can girdle stem 'handles' resulting in stem breakage; white/pink fungal growth may develop on affected areas.
- Surfaces of fruit in contact with soil develop circular to oblong brown, firm, sunken lesions, some containing concentric rings. Secondary soft wet rots may also develop.

Gummy stem blight and black rot

Didymella bryoniae [=Phoma cucurbitacearum]

- Brown spots often at leaf margins enlarge and merge to give leaf blight.
- Brown stem lesions may girdle the stem, resulting in foliar wilting and death; brown sticky exudate may ooze from lesions.
- Tiny black fungal structures develop in older leaf and stem lesions.
- On fruit, particularly pumpkin and squash, small water-soaked spots enlarge and exude gummy material; lesions contain black fungal structures; stored fruit may crack.

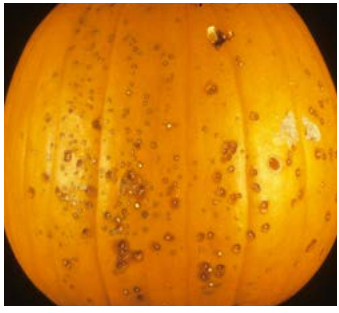
Powdery mildew

eg *Golovinomyces cichoracearum* and *P. xanthii*

- Common on a wide range of cucurbits and some weed species.
- White powdery growth develops on both leaf surfaces, petioles and stems, but rarely on fruit.
- Mature lower leaves are affected first; infected foliage may turn yellow, then wither and die.
- Plants can be stunted, producing reduced yields of small fruit and may senesce prematurely. Leaf loss can lead to scorched fruit due to direct sunlight exposure.

Scab (gummosis)

Cladosporium cucumerinum



- Leaf lesions are initially pale green and irregularly shaped, progressing to grey, sometimes with yellow borders.
- When severe, leaf distortion occurs and dead tissue cracks, giving a tattered appearance.
- Small (2–4mm) water-soaked sunken lesions on fruit darken to grey or brown, and develop as large cavities; secondary rots may occur.
- When humid, dark green spores can cover lesions on leaves, petioles and fruit, producing sticky exudates ('gummosis').

Sclerotinia (white rot)

Sclerotinia sclerotiorum

- Occasionally severe; infection is via any damaged tissue such as dead tendrils and petioles or withered flowers on developing fruit.
- Early symptoms are water-soaked lesions on stems and fruit, followed by development of dense masses of white, cottony fungal strands.
- Hard black resting bodies (sclerotia) develop in or on stems and fruit, particularly in seed cavities. The size of sclerotia varies from a few millimetres to over 1cm.
- Occasionally, infected fruit dry out and become mummified.

Verticillium wilt

Verticillium dahliae

- Affects most cucurbit crop species but rare on outdoor crops in the UK.
- Initial symptoms (wilting of lower leaves in warm/bright weather) are not usually seen until fruit has set.
- An important diagnostic feature is brown discolouration of the vascular tissue seen when roots and stems are cut open.
- Symptoms progress with leaf yellowing, withering, necrosis and eventually plant collapse and death. Wilting may only affect leaves and shoots on one side of a plant.

Downy mildew

Pseudoperonospora cubensis

- Initially seen as pale water-soaked lesions on upper leaf surfaces; lesions are angular and delimited by leaf veins.
- Leaf lesions turn yellow then brown with age giving a mottled appearance. Lesions expand and merge, resulting in leaf death.
- Patches of light grey to dark purple spores may develop on leaf undersides.
- Can cause plant stunting or death if infection is early and severe; fruit production, maturation and flavour may be affected.

Cucumber Mosaic Virus

CMV

- Causes severe plant stunting, yellow leaf mosaic or mottle, downward leaf curling, and a reduction of leaf size and stem internode length.
- Young leaves at the growing point may form a rosette.
- Flowers may be distorted with greenish petals.
- Fruits can be small, malformed and discoloured with poor seed production.
- Common on cucurbits; seed-borne and present on weed hosts; spread by aphids.

Zucchini Yellow Mosaic Virus

ZYMV

- Leaves are severely distorted with yellow mosaic, narrow lamina, serrated edges, swellings, necrosis and other malformations.
- Plants may be stunted with short internodes.
- Fruit can be greatly distorted with knobs, swellings and cracks.
- Seed production may be reduced and seeds are frequently deformed.
- Occasionally severe crop loss; spread by aphids, seed and cutting knives.

Nutrient deficiencies

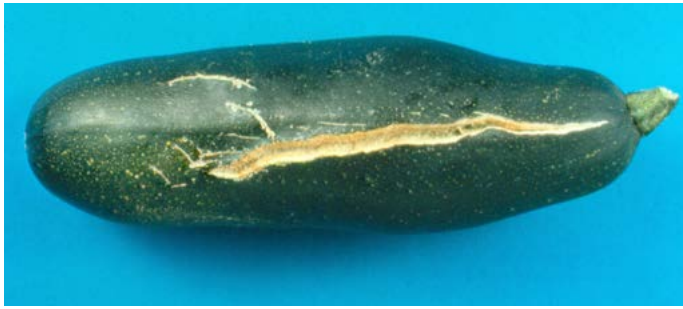
The importance of early diagnosis of crop nutrient deficiencies

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



- New leaves become small, stiff, brittle and misshapen.
- Leaves become chlorotic and eventually necrotic.
- Fruits may crack and have necrotic spots.
- More common on light textured soils with pH above 6.5 particularly in dry seasons.

Calcium

Ca

- Tipburn and concave cupping of very young leaves.
- Cupping may become convex to produce a claw shape.
- Patchy chlorosis at leaf tip and between veins.
- Fruit may develop blossom end rot if water supplies become limiting.

Copper

Cu

- Leaves may crinkle and distort.
- Plant growth stunted.
- Leaves eventually become chlorotic and then necrotic.
- More common on light sands, peats and shallow soils over chalk.

Iron

Fe

- Younger leaves develop chlorosis although larger veins remain green.
- Progresses to whole leaf chlorosis and necrotic spots.
- More common on light calcareous soils or soils with a pH above 7.

Magnesium

Mg

- Yellowing between leaf veins.
- Chlorotic marbling and white speckling on older leaves.
- Progresses to very severe interveinal scorch and stunting.
- Most likely to occur during rapid growth and fruit enlargement.
- More common on coarse textured acidic soils.

Manganese

Mn

- Interveinal chlorosis on younger leaves.
- Progression to older leaves and marginal scorch.
- May be caused be over-liming particularly on organic soils.

Nitrogen

N

- Uniform yellowing of older leaves.
- Can occur during periods of rapid growth and fruit set.
- Plants and fruit stunted in severe cases.
- More likely on sandy soils or where the crop is oversupplied with water.

Phosphorus

P

- Difficult to detect.
- Overall stunted appearance.
- Young leaves dull emerald-green or slightly purple, very flat and expand very slowly.

Potassium

K

- Starts with faint marginal chlorosis on green leaves.
- Progresses to uniform chlorosis and marginal scorch/necrosis.
- Fruit growth is irregular.

Sulphur

S

- Young leaves are a uniform pale yellowish-green.
- Plants may become stunted with greater contrast between veinal and interveinal areas.
- More common on sandy or shallow soils after wet winters.

Zinc

Zn

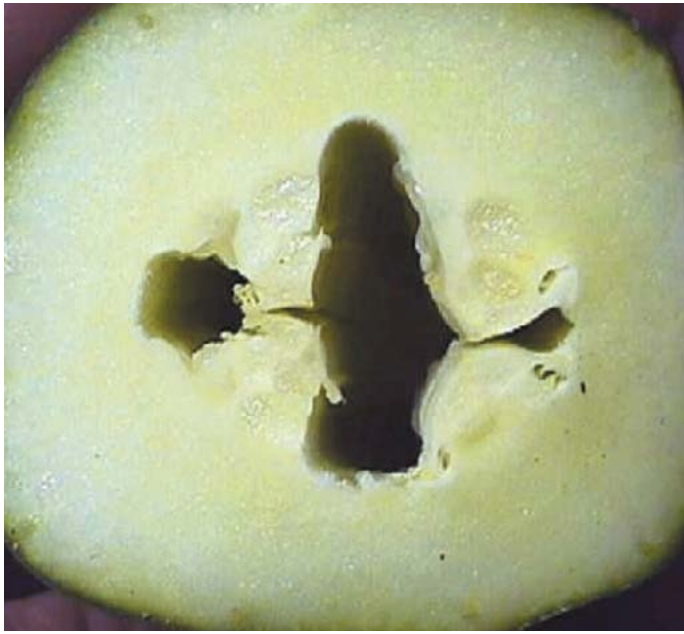
- Reduced leaf size and interveinal chlorosis on new growth.
- Progresses to necrosis and shortened internodes.
- Occasionally seen on sandy soils with high pH and phosphate status.

Physiological disorders

- Temperatures at or below freezing can severely damage all cucurbits.
- Young plants may be severely stunted or killed by low temperatures (above freezing).
- Immediately after exposure, damaged tissue appears watersoaked, progressing to a grey-green scorched appearance, before turning brown and papery after a day or two.

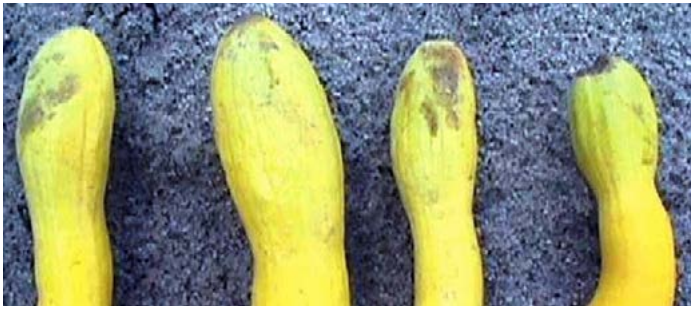
Drought stress

- May result in undersized fruit.
- Blossom end rot may occur as reduced water uptake also reduces calcium uptake.
- Cucurbits are shallow rooted, so regular irrigation is essential to avoid the soil drying out.



- The formation of a cavity inside the fruit. This may result from a number of factors including uneven irrigation and low boron levels.

Poor pollination



- Fruits may appear misshapen and small. The blossom end of the fruit shrivels up and is prone to rot.
- Several visits from pollinators on the day that a flower is open are often required for the development of healthy fruit.
- Poor weather and low temperatures lead to reduced activity of honeybees. Early and late season crops may also suffer from an imbalance of male and female flowers.
- Early morning spraying or irrigating discourages pollinating insects active at that time.

Stem splitting

- Seedlings raised as transplants may suffer split stems as a result of low temperatures, or following a period of rapid growth as a result of an irrigation event, high temperatures or excessive nutrient supply.

Waterlogging

- Waterlogging often induces nutrient deficiency symptoms.
- Causes a generalised yellowing of the leaves.
- Plants become stunted and vulnerable to root disease.

Wind damage

- Cucurbits are prone to wind damage due to their large leaves.
- Damage to stems and leaf burn may occur.
- Young stems are particularly vulnerable so avoid transplanting when strong winds are forecast.

References

AHDB Horticulture is very grateful to:

Jude Bennison (RSK ADAS Ltd) for writing the pest section of the guide

Kim Parker (formerly of RSK ADAS Ltd, now at AHDB) and Peter Gladders (RSK ADAS Ltd) for writing the diseases section and

Rob Lillywhite (University of Warwick) for writing the nutrient deficiencies and physiological disorders sections of the guide

Our gratitude also goes to Derek Hargreaves and Clive Rahn for technical editing of the guide.

Finally, our thanks go to the Outdoor Cucurbits Growers' Association for supporting the production of this publication – we very much hope that it proves a helpful aid to your businesses.

Photographic credits

Section 1 – Invertebrate Pests

All images are courtesy and copyright of ADAS RSK Ltd except the following:

1.1 Bean seed fly, (top image) FLPA – Nigel Cattlin; (bottom left) Jon Oakley
1.3 Cutworm, (bottom) Colorado State University, Bugwood.org – Frank Peairs
1.4 Glasshouse whitefly, (bottom) Kansas Department of Agriculture Archive, Bugwood.org
1.5 Onion thrips and WFT, (top left) University of Warwick; (bottom left and right) FLPA – Nigel Cattlin
1.6 Grey field slug, (top) Jon Oakley

Section 2 – Diseases

All images are courtesy and copyright of ADAS RSK Ltd except the following:

2.7 Scab (Gummosis), (all) Cornell University, Vegetable MD online – T.A. Zitter
2.10 Downy mildew, (bottom left and right) S.T. Koike

Section 3 – Nutrient deficiencies

All images are courtesy and copyright of the University of Warwick Ltd except the following:

3.2 Calcium, (bottom) Utah State University – Daniel Drost
3.6 Nitrogen, (top) Coolong, University of Kentucky Extension Service

Section 4 – Physiological disorders

4.1 Chilling/frost, Utah State University – Daniel Drost
4.2 Drought stress, (top) Coolong, University of Kentucky Extension Service; (bottom) Cornell University, Vegetable MD online – T.A. Zitter
4.3 Hollow heart, University of Georgia, Bugwood.org – David B. Langston
4.4 Poor pollination, (top) Utah State University Extension; (bottom) University of Georgia, Bugwood.org – David B. Langston
4.5 Stem splitting, University of Georgia, Bugwood.org – David B. Langston
4.6 Waterlogging, University of Kentucky Extension Service
4.7 Wind damage, (top) growfruitandveg.co.uk – Bernie; (bottom) Utah State University – Daniel Drost

Produced for you by:

AHDB Horticulture
Stoneleigh Park
Kenilworth
Warwickshire
CV8 2TL

T 024 7669 2051
E comms@ahdb.org.uk
W horticulture.ahdb.org.uk
@AHDB_Hort

If you no longer wish to receive this information, please email us on **comms@ahdb.org.uk**

AHDB