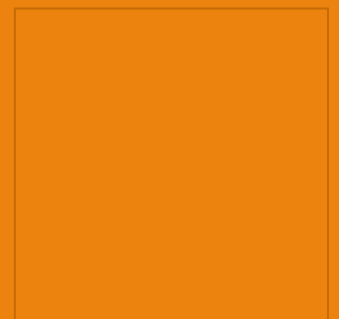
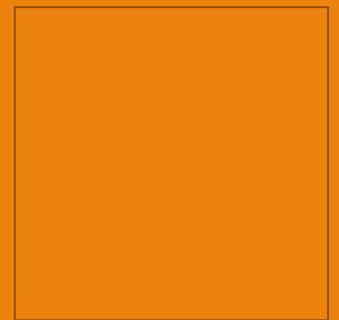
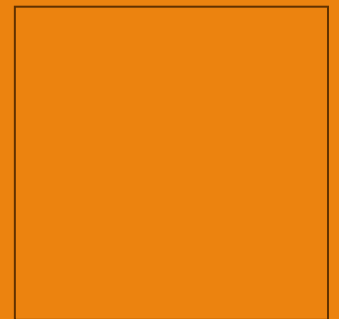
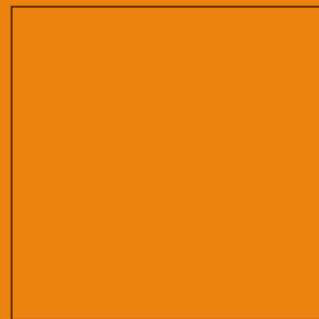
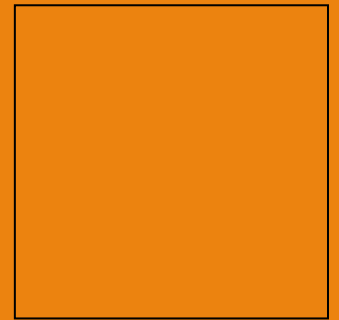
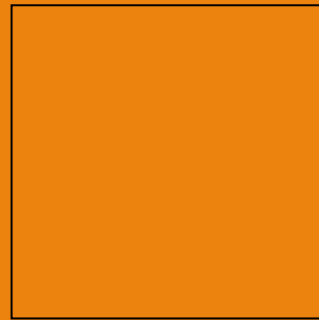
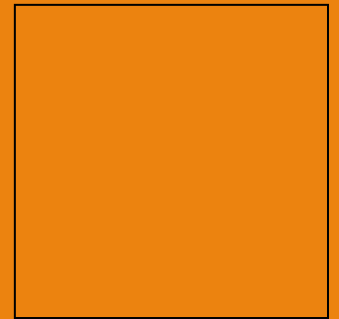
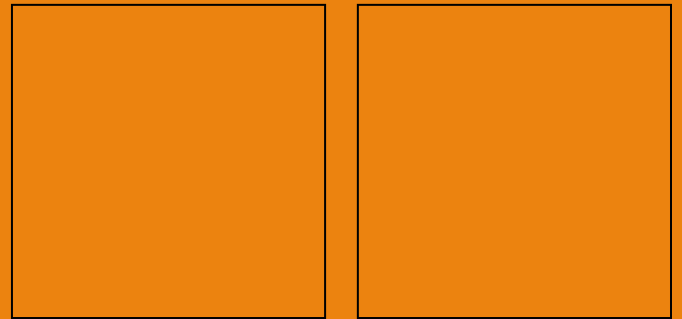


Diseases of Herbs



Rust

(*Puccinia* spp.)

The disease:

Rust occurs frequently on herb crops. All members of the Labiate family are susceptible, eg rosemary, bergamot, thyme, sage, lavender, marjoram and savoury, although mint (especially peppermint) is the most prone. Rust attacks other herbs particularly perennial tarragon and chives. Rust not only affects plant appearance, which is important for culinary and pot herbs, but also reduces crop and oil yields.

Symptoms:

Typical symptoms are orange pustules on leaves, but symptoms vary with different stages in the rust life-cycle. Mint rust can over-winter within crop debris and stolons (underground stems), which become thickened and distorted (bull stems) in spring. From summer to autumn, leaves (undersides) and stems are typically covered in yellow/dark brown pustules. Infected plants become pale and twisted.

Conditions for infection and control:

Rust fungi prefer warm humid conditions, with leaf wetness required for infection. Low temperatures delay disease development, allowing the fungus to persist until conditions are favourable. Ensure planting material is clean e.g. by hot water-treating stolons. Remove crop debris and destroy old foliage with flaming or a desiccant. Specific fungicides are available for rust control on outdoor but not protected herbs.



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- 1 Mint rust (*Puccinia menthae*)
Underside of mint leaf showing characteristic yellow/brown rust pustules
- 2 Rust (*Puccinia allii*) on chives
(Photo 1, 2: Holt Studios)



Parsley leaf spot

(*Septoria petroselini*)

The disease:

Leaf spot is an important foliar disease of parsley. The fungus can be seed-borne and may also survive in plant debris, on volunteer plants and on wild umbelliferous weeds. A closely related fungus causing celery leaf spot (*Septoria apiicola*) does not infect parsley. Under favourable environmental conditions, the disease can spread rapidly, affecting both yield and quality.

Symptoms:

Typical symptoms are brown sunken lesions sometimes with yellow haloes, on leaves and cotyledons (when the disease is seed-borne). As the lesions age, the centres turn tan or light grey and tiny black fungal spore cases (pycnidia) are often visible. When infection is severe, leaves may die and drop off, and lesions may develop on petioles.

Conditions for infection and control:

Prolonged leaf wetness favours disease development, particularly at warmer temperatures. Spores are readily spread by rain-splash or irrigation. Use of clean seed (treated with thiram fungicide) is the best method of disease prevention. Flat-leaf parsley varieties are generally more susceptible than curly-leaf types. Isolate new plantings to avoid splash dispersal of spores from any adjacent affected crops. Protectant fungicides can be used to control the disease.



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- 1 Leaf spot on flat leaf parsley (*Septoria petroselini*)
- 2 Black fruiting bodies (pycnidia) visible in septoria lesions on parsley (Photo 1, 2: Holt Studios)



Powdery mildew

(*Oidium* spp. and *Erysiphe* spp.)

The disease:

Powdery mildews are common in members of the Umbelliferae (eg dill, fennel and parsley), Labiatae (eg mint, bergamot, thyme, sage, lavender and rosemary) and the Compositae (eg feverfew and tarragon). Powdery mildews are usually highly host-specific, being restricted to single or closely related hosts, or to a particular plant family. The disease can seriously reduce plant vigour.

Symptoms:

Typical symptoms appear as sparse white fungal growth over leaves (especially upper surfaces) and stems. A severe attack may lead to yellowing and leaf drop. Disease spread through the crop may be rapid, as dispersal spores are carried by wind/air currents. Powdery mildew may over-winter as small black resting spores, which are just visible in host tissue and can persist in crop debris.

Conditions for infection and control:

Infection usually starts from dispersal spores, particularly under high humidity. Subsequent disease development is favoured by warm, dry periods. Young plants are especially susceptible to infection. In glasshouses, good air circulation can minimise infection and overhead watering can reduce fungal growth. Regular crop monitoring is important for early detection of the disease. Potassium bicarbonate has a Commodity Substance Approval for use against powdery mildew.



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- 1 Parsley powdery mildew
- 2 Parsley powdery mildew close up
- 3 Powdery mildew on apple mint
- 4 Mint powdery mildew close up
- 5 Sage powdery mildew



Grey mould

(*Botrytis cinerea*)

The disease:

Botrytis cinerea is common on a wide range of herbs including woody labiates (lavender, rosemary and sage) and especially delicate herbs such as basil and dill. The fungus readily colonises damaged or ageing tissues. Flowers and leaves are often affected first, although botrytis may attack any plant part, particularly under cool, humid conditions.

Symptoms:

Botrytis first appears as a white 'mould', often near the plant base, but darkens to grey as air-borne dispersal spores are formed. Black resting spores may also develop in affected tissue, enabling long-term survival of the fungus. Symptoms include water-soaked spotting on flower petals, and leaf and stem rot. Infected woody stems are often discoloured but may not develop the typical grey spore mass.

Conditions for infection and control:

The main sources of grey mould are diseased plants and infected crop debris. The fungus prefers cool, humid conditions (autumn/winter). Disease risk can be minimised by avoiding plant damage and through good crop hygiene. In protected crops, manipulate environmental conditions to avoid high humidity and periods of prolonged leaf wetness. Where practical, affected plants should be removed. Fungicides with activity against botrytis are available; alternate products from different groups to avoid fungicide-resistance.



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- 1 Botrytis producing spores on basil stems
- 2 Botrytis lesions on basil stems (Photo 1: Holt Studios)



Damping-off

(*Pythium* spp., *Phytophthora* spp. and *Rhizoctonia solani*)

The disease:

Damping-off can occur in both glasshouse and field-sown crops and is most commonly caused by *Pythium* spp., *Rhizoctonia solani*, and occasionally *Phytophthora* spp. A wide range of herbs can succumb to damping-off.

Symptoms:

One symptom of damping-off is poor seedling emergence. Emerging seedlings typically show stem collapse, with the affected area having a water-soaked appearance that enlarges and turns brown/black, often becoming constricted. Plants may also rot progressively from the tips of the roots. Seedling death may be scattered, or occur in rapidly lengthening sections of freshly seeded rows or trays. Fungal growth may be seen on the surface of the potting media or on the seedlings themselves.

Pythium species are the most common cause of damping-off. These fungi are water moulds, which thrive under wet soil conditions, producing both fine white fungal strands and resting spores in infected plants. A common symptom of pythium infection is the sloughing of the outer root cortex leaving only the thread-like root stele intact. *Phytophthora* spp. are closely related to pythium and occasionally cause damping off in young plants, as well as leaf, stem and root rots of older plants (e.g. crown rot of parsley).

Rhizoctonia solani. In addition to death of seedlings prior to, or just after emergence, rhizoctonia infection on older seedlings can lead to discolouration and constriction of the stem base ('wire stem'). *Rhizoctonia* can survive for long periods as resting bodies in soil, or as fungal strands in infected roots.

Conditions for infection and control:

Under protection, minimise the risk of damping off by using clean seed, sterilised planting media and containers, and by watering with clean water. Provide optimum growing conditions of light and bottom heat and avoid over-crowding of plants and excessive nitrogen applications. Over-watering, particularly from overhead misting systems should also be avoided. Under field conditions, cold wet soils which slow plant germination and growth, prolong the time that seedlings are susceptible to damping-off. Fungicide drenches are available.



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1 *Pythium* root rot in coriander
2 Damping off in Euphorbia



Downy mildews

(*Peronospora* spp., *Plasmopara* sp.)

The disease:

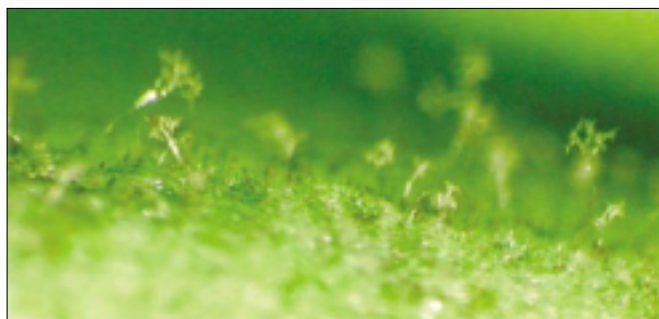
Downy mildew can occur on many herbs including basil, chives, sage, savory and parsley. However incidence in the UK is not common but can be very severe and rapid when it occurs. The fungus produces large numbers of spores on the lower surface of leaves and these are spread on air-currents and by water-splash. Several fungi cause downy mildew on herbs but they are host specific, with different species infecting chives, parsley and the mint family.

Symptoms:

Downy mildews are primarily foliar diseases. Symptoms vary with host plant but are generally of two types. Discoloured patches, often angular in shape, develop on the leaf surface and there may be 'downy' white or brown growth on the leaf underside due to fungal spore production. Stunting and distorted growth may also occur, together with pale foliage and profuse spore production. In some cases, resting spores (oospores) may be produced in large numbers in internal tissues. On chives, the leaves are covered with a blue-green down of spores. Laboratory examination can be useful to distinguish downy from powdery mildew, as management practices are different.

Conditions for infection and control:

Infected plants are the main source of disease, although resting spores can survive for extended periods in plant debris and soil. Development of downy mildews is favoured by conditions of high humidity and prolonged leaf wetness. Temperature requirements vary with species. Free moisture is required for infection to occur. Spores are normally produced during the night and released into the air in the morning as the temperature rises and humidity falls. Risk can be reduced by avoiding prolonged leaf surface moisture and not irrigating late in the day. For glasshouse crops, ventilate well, provide adequate plant spacing and raise the temperature to decrease humidity and increase evaporation. For subsequent crops, avoid proximity to affected crops and sheltered sites, which are more prone to the disease than exposed fields. Effective fungicides are available, though fungal resistance could occur from over use.



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- 1 Production of downy mildew spores on a leaf surface
- 2 Symptoms of downy mildew on basil
- 3 Dark angular lesions due to downy mildew on variegated lemon balm



Parsley root and Crown rot

(Phytophthora primulae)

The Disease:

The soil-borne fungus *Phytophthora primulae* can cause rotting of roots and crowns in parsley particularly in field-grown crops. *Rhizoctonia solani* can occasionally cause similar symptoms on light soils and therefore accurate diagnosis is necessary, to ensure appropriate disease management.

Symptoms:

In a field, patches of stunted plants with yellowing foliage may be the first indication of a crown rot problem. When the roots and crown are cut open, brown discolouration is visible, which becomes darker as the infection progresses. The outer cortex of the root may easily slough away. Severe infection results in foliage collapse and eventual plant death.

Conditions for infection and control:

Parsley should be grown in well drained soils since the spread of *Phytophthora* spores is facilitated in wet or poorly drained soils. It may be worth while growing the crop on small ridges to avoid water-logging. Extending the interval between one crop and the next can reduce inoculum in the soil, but it has been found that even after 5 years the fungus can still survive. In addition to crop rotation and good drainage, the disease can also be managed with a fungicide based on metalaxyl-M.



1 Root discolouration due to crown rot (right) and healthy root (left)
 2 Stunted plant with crown rot
 3 Plants yellowing due to crown rot



Wilts

(*Verticillium dahliae* and *Fusarium oxysporum*)

The disease:

Verticillium and fusarium infect plant roots, then invade and block the vascular system (water pathways), resulting in wilting. Verticillium is soil-borne and attacks perennial herbs such as mint, sage and camomile. Fusarium wilt is seed- and soil-borne with *F. oxysporum* f. sp. *basilici* specific to basil. Other *F. oxysporum* sub-species can attack other herbs eg parsley and coriander, but UK occurrence is rare.

Symptoms:

Verticillium wilt is initiated by survival structures (microsclerotia), which germinate, and infect roots. The fungus grows up into the vascular system and stems. For mint, stunted plants with smaller, twisted top leaves develop in patches. The plant foliage turns yellow/brown and the vascular tissue becomes dark brown/black. Plants die progressively from the bottom up. Microsclerotia develop in diseased plants and remain several years in the soil.

Fusarium wilt of basil causes stunting of the plant, browning of the vascular tissue, and premature defoliation. Young plants are most susceptible. Spore masses of the fungus may be visible on diseased stems as a pale pink layer.

Conditions for infection and control:

Verticillium spreads readily via diseased planting stock and soil-contaminated equipment. To avoid verticillium wilt, ensure that disease-free planting material is used. Practice long rotations (eg 7 years) with non-susceptible crops. Disease risk may be higher after susceptible crops (potato, strawberry and linseed), and soil disinfection may be required. Ideally, affected plants should be burnt.

To avoid fusarium wilt under protection, use disease-free seed and clean growing media. Affected plants should be disposed of promptly. Disinfect production areas prior to cropping, if there has recently been an outbreak of the disease.



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1 Basil plant dead due to fusarium wilt
2 Leaf yellowing on basil due to fusarium



Sclerotinia rot

(*Sclerotinia sclerotiorum*)

The disease:

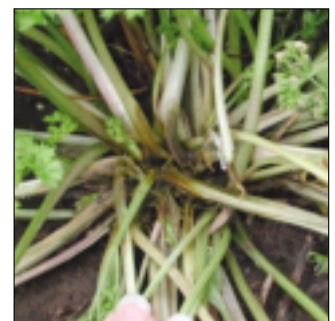
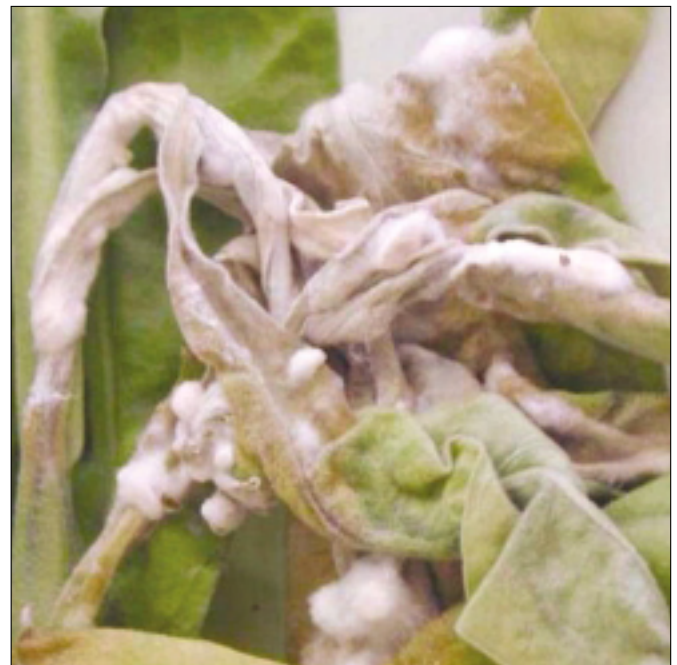
Sclerotinia rot is very common affecting a wide range of crops, as it is generally non-host specific. The biennial or perennial non-woody herbs are most susceptible; crops such as coriander, fennel, mint, parsley and tarragon are recorded as hosts. Sclerotinia rot affects plants in all stages of growth including seedlings, mature plants and harvested products.

Symptoms:

The typical early symptom of Sclerotinia rot is the development of brown, soft-rotted tissue on either the stem, leaves or senescing flowers. This is often accompanied by dense masses of white fluffy mycelial growth. Large hard black survival structures (sclerotia), form on affected plant tissue and contaminate the soil where they remain viable for many years. They germinate to produce either fungal strands (mycelium) which infect plants directly, or cup-shaped fruiting bodies (apothecia) on the soil surface, which liberate large numbers of ascospores into the air, resulting in further infection.

Conditions for infection and control:

Once infection by *S. sclerotiorum* has occurred, rapid disease progress is favoured by warm (15–20°C) and moist conditions in dense crops. The sclerotia can survive in the soil for many years and a long rotation with break crops provides the only long-term control solution. Herb crops should not be grown after susceptible crops such as lettuce or celery. Under protection, implement cultural practices to avoid prolonged leaf wetness and high relative humidity. Where practical, remove any affected plants immediately. Fungicides with activity against sclerotinia are available (eg boscalid + pyraclostrobin); for glasshouse crops, use soil sterilisation pre-planting. Ensure harvested products are stored under cool, dry conditions.

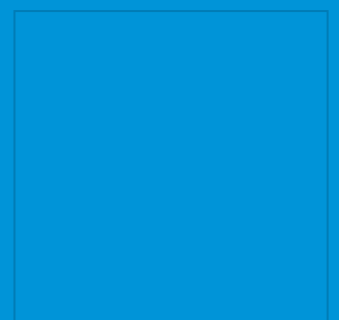
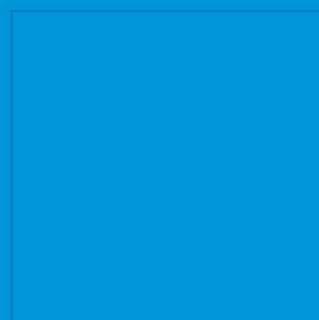
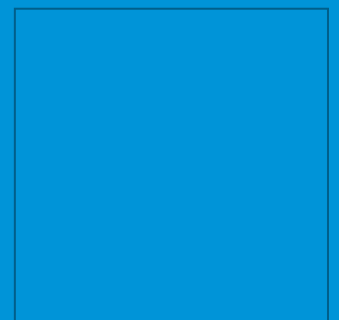
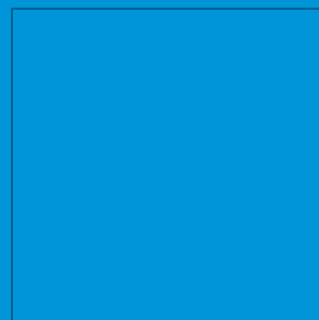
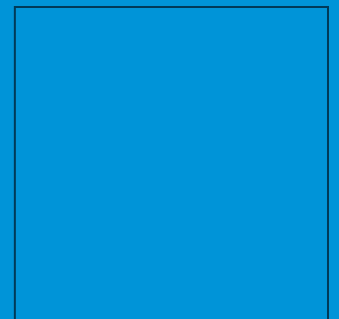
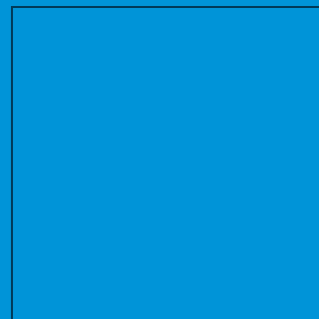
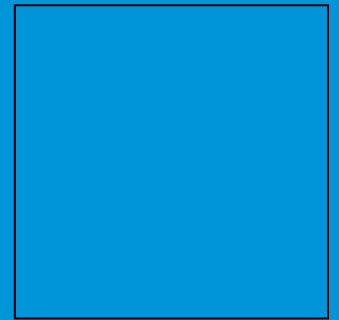
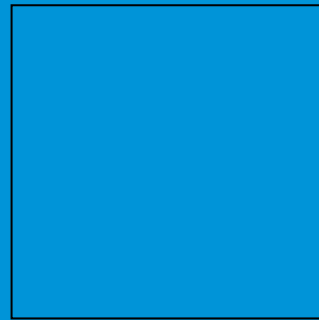
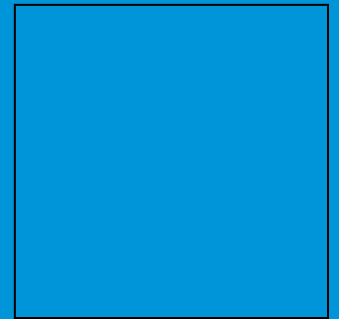
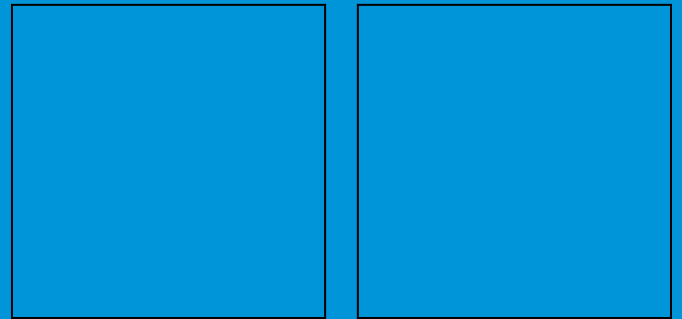


- 1 Dense white mycelium of *S. sclerotiorum* and early development of sclerotia
- 2 Mature sclerotia – size and shape may vary
- 3 Sclerotinia on parsley

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Pests of Herbs



Flea beetles

Description and host plants:

Flea beetle damage is common on sorrel and on Cruciferae eg rocket and mustards. Flea beetles have massively developed hind legs, which enable them to jump. Those that commonly attack herbs are 1–3 mm long. All flea beetles are oval and shiny, but the colour varies with species, from black, dark metallic green, blue or bronze, brown, to yellowish. Some species are black with longitudinal yellow stripes. Eight species of *Phyllotreta*, (including *P. undulata*, *P. nemorum* and *P. diademata*), occur on Cruciferae (eg rocket, mustards) and *Chaetocnema concinna* occurs on sorrel and spinach.

Symptoms:

Adult flea beetles feed on the cotyledons and foliage causing small pits or 'shot-holes', which makes leafy herbs unmarketable. Seedlings and rootlets can also be attacked underground, leading to plant losses or reduced plant vigour. The larva of one species, *Phyllotreta nemorum*, is a leaf miner in cotyledons.

Sources of infestation:

Flea beetle adults overwinter in plant debris in hedgerows, field margins etc. and move into host crops in spring. Peak activity typically occurs between the second week of April and the third week of May. However, severe outbreaks can occur through June and July and different species cause damage at other times of the year.

Control:

Cultural control measures include siting susceptible outdoor crops well away from the previous year's susceptible crops, having a break in growing favoured crops during peak beetle activity, and using fine-meshed crop covers, or screens on doors or vents. There are no biological control agents available for flea beetles. If necessary, an approved pyrethroid insecticide can be used, but this may not always be effective and would be harmful to biological control agents used against other pests within IPM programmes.



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1 Flea beetle damage to rocket
2 Adult flea beetle
(Photo 2: © Nigel Cattlin/FLPA)



Slugs and snails

Description and host plants:

On field-grown herbs, the main slug species is likely to be the field slug, *Deroceras reticulatum* and on protected herbs the main species is the chestnut slug, *Deroceras panormitanum*. On nurseries growing both pot herbs and ornamentals, a small snail, *Oxyloma pfeifferi* is also common. Herbs susceptible to slugs and snails include basil, mint, thyme and sage. *D. reticulatum* is up to 5 cm long with a light grey or fawn body. *D. panormitanum* is up to 3.5 cm long with a brownish-grey body, a pale underside, and a pale halo around the breathing hole on the right hand side of the body. *O. pfeifferi* is up to 12 mm long, pale to dark brown and the shell is pointed at one end.

Symptoms:

Both slugs and snails cause leaf holing or shredding, and slugs can also sever young shoots and stems. Slime or dark faecal trails can often be seen on the leaves, which help to distinguish the damage from that caused by caterpillars.

Conditions suitable for infestation:

Damp conditions favour both slugs and snails. Weeds and plant debris can provide breeding sites. *O. pfeifferi* can also feed on algae on the growing medium or floor/bench covering.

Control:

Good crop hygiene and avoiding overwatering can help to minimise damage. Slug pellets are available for chemical control and parasitic nematodes, *Phasmarhabditis hermaphrodita* ('Nemaslug') are available for biological control.

Further details are given in HDC Factsheet 07/02 and in the HDC reports for HNS 105 and 105b.



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- 1 Chestnut slug, *Deroceras panormitanum*
- 2 *Oxyloma pfeifferi*
- 3 Slug damage to mint



Leafhoppers

(Eupteryx melissae)

Description:

The most common leafhopper species found on both protected and outdoor herbs is *Eupteryx melissae*, the chrysanthemum leafhopper, often known by growers as the 'sage leafhopper'. Adult *E. melissae* are approximately 3 mm long, pale green with distinctive brown and black spots on the body and wings. They are very active and hop from the plants when disturbed. The eggs are laid in the leaf veins and petioles and are not easily detected even under a microscope. The young nymphs are pale yellowish green and the older nymphs develop dark bands across the body and tips of the wing buds. The nymphs are much less mobile than the adults and are usually found under the leaves next to a leaf vein. There are five nymphal stages and when each stage moults, the cast skins are left behind on the leaf, which can be mistaken for live leafhoppers. The potato leafhopper, *Eupteryx aurata* can also infest various labiate herbs, particularly mints. This leafhopper is larger (3.5–4 mm long) than the 'sage leafhopper' and is pale yellow or orange in colour with distinct black net-like markings on the body.

Symptoms:

Leafhopper damage appears as indistinct white or pale yellow spots or flecks on the leaves which later coalesce to form bleached areas leading to necrosis. Small black faecal spots left by the leafhoppers on the leaves are sometimes visible.

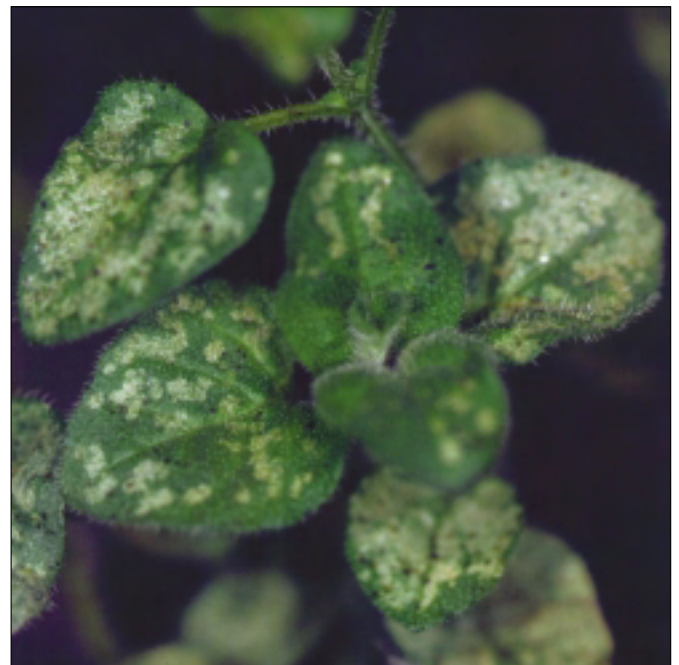
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- 1 Adult chrysanthemum leafhopper or 'sage leafhopper', *Eupteryx melissae*
- 2 *Eupteryx melissae* nymph
- 3 Leafhopper damage to marjoram



Host plants and conditions suitable for infestation:

Sages are amongst the main herb species severely damaged both outdoors and under protection. Other herb species which are commonly damaged include balms, basil, bergamot, French lavender, mints, marjorams and oregano, rosemary and thymes. Various weed species can also act as hosts, eg burdock, dead-nettle, fleabane and horehound. The pest overwinters as eggs in host plant stems and also as adults or nymphs, both outdoors and under protection. It is more of a problem on perennial crops eg sage, and on protected herb nurseries where infested stock plants are kept from one season to the next. Short-term pot herbs grown from seed are less susceptible, particularly if favoured host plants such as sages are not grown on the nursery.

Control:

Very few pesticides are approved or effective against leafhopper on herbs. Potential biological control agents have been investigated in HDC project PC 210.

Further details on the pest and on control measures are given in HDC Factsheet 05/01 and in the HDC reports for PC 178 and PC 210.



Aphids

Description and host plants:

Aphids are commonly known as 'greenflies' or 'blackflies' but they can be various colours. Several species can infest both outdoor and protected herbs. Aphids can be winged or wingless. The larger wingless aphids are easiest to identify, using the diagnostic features of colour and shape of the body and of the two siphunculi ('exhaust pipes') at the rear end.

The willow-carrot aphid, *Cavariella aegopodii* is common on umbelliferous herbs eg parsley, coriander, dill and chervil. The body is yellowish-green and the siphunculi are slightly swollen at the tips. There is a protuberance at the rear end of the body above the cauda ('tail'), giving the appearance of a double 'tail'. This aphid and the hawthorn-parsley aphid, *Dysaphis apiifolia* can be serious pests of protected parsley. The latter species can form dense colonies at the stem bases and is yellowish-green, pinkish-green or greyish-green, with a slight powdery coating. The siphunculi are black, with rusty-orange patches around the bases. The mint aphid, *Ovatus crataegarius* is mottled green, commonly found on mint stems and leaves. The head has two prominent bumps between the antennae. The siphunculi are tapered and green without black tips. The shallot aphid, *Myzus ascalonicus* can infest chives, where it forms dense colonies at the stem bases. The body is pale green or dirty yellow and the siphunculi are slightly swollen.

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- 1 Deformed basil leaves, damaged by the peach-potato aphid, *Myzus persicae*
 - 2 Peach-potato aphid, *Myzus persicae*
 - 3 Willow-carrot aphid, *Cavariella aegopodii*
 - 4 Hawthorn-parsley aphid, *Dysaphis apiifolia*
 - 5 Mint aphid, *Ovatus crataegarius*
 - 6 Melon or cotton aphid, *Aphis gossypii*
 - 7 Glasshouse-potato aphid, *Aulacorthum solani*
- (Photos 2,3,4,5,7: © Nigel Cattlin/FLPA)

The peach-potato aphid, *Myzus persicae* is a common pest of many plants, including some herbs eg basil and parsley, particularly those under protection. The body is green, pink or red and the siphunculi have dusky tips. The melon or cotton aphid, *Aphis gossypii* is another polyphagous species, sometimes infesting herbs eg basil, coriander, lemon verbena and parsley. This small aphid varies from yellowish green to dark mottled green or black, sometimes with patches of powdery wax. The siphunculi are short and black. This aphid can form dense colonies on growing points and stems. The glasshouse-potato aphid, *Aulacorthum solani* is a common pest of ornamentals and occasionally infests herbs including sage. The body is shiny green with darker green patches around the bases of the siphunculi. The siphunculi are green with distinct black tips.

Symptoms:

Damage symptoms depend on the aphid species but can include leaf distortion and curling. Aphids and/or white cast aphid skins are visible on the leaves or stems, often with sticky honeydew excreted by the aphids, which allows the growth of sooty moulds. Some aphid species, such as willow-carrot aphid, can also transmit viruses which can be very damaging.

Sources of infestation:

Winged aphids can migrate to herb crops from overwintering plant hosts or from neighbouring infested crops, hedgerows or weeds. Bought-in young plants can also be a source of infestation.

Control:

Several pesticides have approval or off-label approval for aphid control on herbs. However, both *M. persicae* and *A. gossypii* can be resistant to some of these pesticides. Growers of protected herbs can use biological control agents for aphid control, including parasitic wasps, predatory midge larvae and predatory lacewing larvae. Choice of biological control agent depends on aphid species as the parasitic wasps do not attack all species.



Spider mites

Description and host plants:

Spider mites are more common on protected crops than those grown outdoors, but serious problems are uncommon on herb crops. Susceptible herbs include lemon balm, lemon verbena, mints and tarragon. The most common spider mite species is the two-spotted spider mite, *Tetranychus urticae*. The eggs are small, clear and round and the young mites and summer adults are up to 0.5 mm long, oval and green with two black patches. In autumn and in heavy infestations, adult females turn a brick-red colour.

Symptoms:

Spider mites feed on the undersides of the leaves, causing fine yellow speckling, later developing into yellow or necrotic patches, rendering plants unmarketable. In severe attacks, leaves or plants can senesce and the mites can produce extensive webbing.

Conditions suitable for infestation:

The source of the pest is usually from overwintered females that hibernate in the glasshouse or tunnel structure and migrate onto susceptible plants in the spring. Hot, dry conditions favour the pest.

Control:

Biological control agents available for spider mites include the predatory mite, *Phytoseiulus persimilis* and the predatory midge, *Feltiella acarisuga*. Very few pesticides approved for use on herbs have activity against mites, but contact pesticides containing plant extracts can give some control.



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1 Two-spotted spider mites (red and green forms)
2 Spider mite damage to lemon verbena



Caterpillars

Description and host plants:

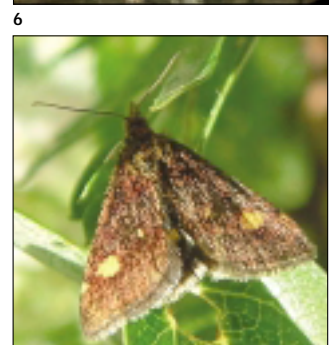
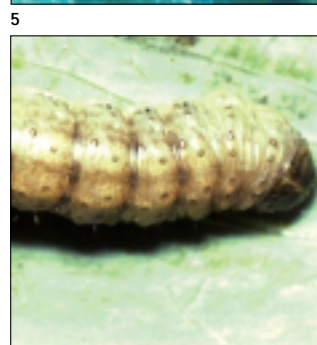
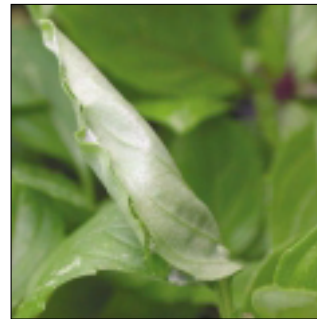
Caterpillars are the larvae of moths and butterflies. They usually have a head capsule, three pairs of small true legs at the front end and five pairs of larger prolegs further back, one pair being at the rear end. There is a row of spiracles (breathing holes) down each side of the body. Various caterpillar species can damage both outdoor and protected herbs.

Cruciferous herbs eg rocket can be attacked by cabbage caterpillars eg the large white (*Pieris brassicae*) which is hairy and yellow with black spots, the small white (*Pieris rapae*) which is velvety green with a narrow yellow stripe along the back, and the cabbage moth (*Mamestra brassicae*) which is fat, smooth and mottled green or brown. Silver y (*Autographa gamma*) caterpillars can damage various herbs including basil, parsley and brassicas. They are green with dark stripes along the back and a narrow yellow line down the side, and are unusual in having only three pairs of prolegs. Angle shades caterpillars can attack protected herbs eg basil and parsley and are green or brown with V-shaped marks. A particular pest of mint is *Pyrausta* sp., a small leaf-rolling green or purple caterpillar with yellow stripes and black spots. Carnation tortrix (*Cacoecimorpha pronubana*) is another small green leaf-rolling caterpillar which can damage some herbs including mint. Although uncommon on herbs, soil-grown crops could be damaged by cutworms, eg the caterpillar of the turnip moth, *Agrotis segetum*, a plump, greyish-brown caterpillar with faint darker stripes.

Symptoms:

Damage symptoms depend on the caterpillar species but include leaf holing, leaf rolling and webbing and contamination with droppings. Cutworms feed on the leaves when young but older caterpillars feed underground and can sever the stems.

continued overleaf...



1 Carnation tortrix leaf rolling damage to mint
 2 Carnation tortrix droppings on mint
 3 Angle shades caterpillar
 4 Caterpillar damage to basil
 5 Cabbage moth caterpillar
 6 Carnation tortrix caterpillar
 7 Turnip moth caterpillar (cutworm)
 8 *Pyrausta* sp. moth
 9 Large white caterpillars
 (Photo 5: © Ben Emmett)
 (Photo 8: © Roger Umpelby)

Source of infestation:

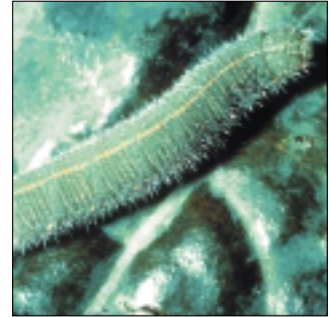
Adult moths fly into crops and lay eggs on susceptible crops, and these hatch into caterpillars. There may be more than one generation per year, depending on species. Turnip moths lay their eggs on crops, plants or debris from late May to late June, and the risk of damage is only in dry summers as the young caterpillars are knocked off the plants by rain and subsequently perish.

Control:

Approved pesticides are available for caterpillar control, but these may not be compatible with biological control agents used within IPM on protected crops. The bacterium, *Bacillus thuringiensis*, applied as a spray, is safe within IPM. For some moth species the results from pheromone traps will help with the timing of control measures. The HDC pest bulletin includes a cutworm warning scheme, which gives guidance on timing of control measures.



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- 10 Silver y caterpillar
- 11 Small white caterpillar
- 12 *Pyrausta* sp. caterpillar and damage to mint
(Photo 10: © Ben Emmett)
(Photo 12: © Roger Umpelby)



Glasshouse whitefly

(*Trialeurodes vaporariorum*)

Description:

The adults of the glasshouse whitefly, *Trialeurodes vaporariorum* are small, white, moth-like insects, approximately 1 mm long, usually found underneath the leaves and in growing points. They make short flights from the plants when disturbed. The yellowish, conical eggs are laid on the undersides of leaves, and these turn black just before hatching into the first nymphal stage or 'crawler', which is active for only a few days. The older nymphal stages or 'scales' are immobile and turn from greenish-white when young to white when fully grown. The adult whitefly emerges from the final larval stage or pupa by cutting a slit in the top of the scale.

The quarantine pest, the tobacco whitefly, *Bemisia tabaci* can also infest herbs, and imported herbs are a potential source of this pest. Tobacco whitefly adults are slightly smaller than those of the glasshouse whitefly, and tend to hold their wings slightly apart when at rest, exposing the yellow body. The mature scales of tobacco whitefly tend to be yellow rather than white.

Symptoms:

Whitefly damage is caused by their excretion of honeydew onto the leaves, which leads to the growth of black sooty moulds. The presence of whiteflies on herb plants can also lead to crop rejection.

Host plants and conditions suitable for infestation:

Glasshouse whitefly is much more common on protected herbs than those grown outdoors. However, it can overwinter outdoors, and many weed species both outdoors and under protection can be important sources of the pest. The whitefly has a wide host range and commonly infested herb species include sages, lemon verbena, mints, marjorams, bergamot, basil, balms and rue. Whiteflies can also overwinter on herb plants not normally acting as hosts, such as protected parsley and coriander grown for cutting. In addition to herbs, the pest infests many protected vegetable and ornamental crops, which may be a source of the pest on mixed cropping nurseries.



1 Healthy whitefly scales (white) and those parasitised by *Encarsia formosa* (black)
2 Adult glasshouse whitefly, *Trialeurodes vaporariorum*



Control:

Very few pesticides are approved or effective against whiteflies on herbs. The pest is commonly resistant to many pesticides. Biological control agents including the parasitic wasp, *Encarsia formosa*, are available for use against glasshouse whitefly under protection, although biological control of the pest on herbs is not always reliable. Further details on glasshouse whitefly on herbs and on control measures are given in HDC Factsheet 05/01 and in the HDC report for PC 178.

Any whiteflies suspected to be *Bemisia tabaci* should be immediately reported to your local Plant Health and Seeds Inspector. Contact details are available from:

PHSI HQ, York

Tel. 01904 455174

www.defra.gov.uk/planth/senior.htm

