



Pests, Diseases and Disorders of Babyleaf Vegetables

A FIELD IDENTIFICATION GUIDE

Jenny Ekman, Len Tesoriero and Stuart Grigg





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Insects

Aphid – brown sowthistle

Uroleucon sonchi

DESCRIPTION

Egg: Only laid during cool winter periods; at other times females bear live young.

Nymph: Solid yellow-green to pale brown.

Adult: Wingless adults are one of the largest aphids (3 – 4.5 mm long), shiny and a distinctive dark reddish brown colour. Adults have pale legs with black joints and black antennae.



Brown sowthistle aphids (M Inbar Uni of Haifa)

DAMAGE

Sucks sap from lettuce leaves, causing them to become distorted, wilted and shrivelled. Whole plants may be severely damaged. Can transmit viruses and is also a potential contamination issue.

MOST COMMON

Although most commonly found on sowthistle weeds, this aphid is also a major pest of lettuce. Removing related weeds from around the crop is an important control measure.



Brown sowthistle aphids (S Grigg)



Aphid – cabbage

Brevicoryne brassicae

DESCRIPTION

Nymph: Young nymphs are bright green, but soon develop a grey, mealy appearance due to their waxy coating.

Adult: Wingless adults are also waxy appearing similar to nymphs and up to 2.5 mm long. Winged adults are greyish with black head and thorax.

DAMAGE

Tend to form colonies on the youngest leaves which become stunted and distorted. Can spread cauliflower mosaic virus to brassicas and is also a potential contamination issue.

MOST COMMON

Mainly a pest of leafy brassicas, numbers tend to peak in spring and autumn.



Cabbage aphid adult and nymph (JK Clarke UC Davis)



Adults, nymphs, parasitised 'mummies' and hoverfly larvae (top, S Grigg) and cabbage aphid wingless adults (S Williams)

Aphid – currant lettuce

Nasonovia ribisnigri

DESCRIPTION

Nymph: Yellowish to light brown.

Adult: Wingless adults are greenish with brown markings and up to 3 mm long. The dark markings are more distinct in winged females, which have blackish heads and leg joints. Lettuce aphids tend to be scattered rather than forming

dense colonies. They burrow deep into the leaf rosette in loose leaf lettuce varieties, making them hard to detect.

DAMAGE

Mainly a contamination issue.

MOST COMMON

A major pest of lettuces at all times of year.



Currant lettuce aphid nymph (W Cranshaw CSU, Bugwood.org)

Aphid – green peach

Myzus persicae

DESCRIPTION

Nymph: Varies from yellowish to green.

Adult: Wingless adults are pale yellow to green and around 2 mm long; winged females have black heads with dark red eyes and patterned bodies.

DAMAGE

Causes leaf distortion through feeding, contaminates the product and potentially acts as a vector for many viruses.

MOST COMMON

Found during warmer months on a wide range of host plants.



Green peach aphid winged adult (S Bauer USDA ARS), wingless adults and nymphs (R) and the white 'skins' left after moulting (S Grigg)

Aphid – sowthistle

Hyperomyzus lactucae

DESCRIPTION

Egg: Only laid during cool winter periods; at other times females bear live young.

Nymph: Solid yellow-green to pale brown.

Adult: Wingless adults are 2–3 mm long, solid green with dark tips to their legs and antennae. The winged form is similar in size and colour, but with black patches on the head and abdomen. Similar to currant lettuce aphid, but distinguished by the slightly club shaped siphunculi (tubes) on its abdomen.



Sowthistle aphids (D Fenwick)

DAMAGE

Feeds on the undersides of lettuce leaves causing them to become curled and shriveled. Sowthistle aphids spread lettuce necrotic yellows virus and are a potential contamination issue.

MOST COMMON

Primary hosts are sowthistle and rubus species; this aphid cannot breed on lettuce alone.

Cabbage centre grub

Hellula hydralis

DESCRIPTION

Egg: Oval, creamy, laid on young leaves or the soil surface.

Caterpillar: Chunky, cream coloured caterpillar up to 12 mm long with indistinct reddish brown stripes.

Pupae: Brown, often formed within webbing on the plant.

Adult: Mottled brown moth, wings held in a flattened tent over body, around 12 mm long.

DAMAGE

Caterpillars feed on new growth, producing webbing

as well as frass. Leaves can be webbed together.

MOST COMMON

Usually a minor pest of brassicas during summer through to autumn in QLD and NSW, high numbers occasionally in southern states during spring.



Adult moth (D Hobern) and larvae (DNRE Victoria)

Cabbage white butterfly

Pieris rapae

DESCRIPTION

Egg: Laid singly, yellow to orange, bullet shaped.

Caterpillar: Velvety green with a thin yellow stripe on their sides and top. Mature caterpillars are approx 30 mm long.

Pupae: Yellow green, ridged with prominent spines near the midpoint, attached to a leaf or stem.

Adult: Immediately recognisable white butterfly with one (male) or two

(female) black spots on the forewing. Wings held folded upward at rest.

DAMAGE

Large, irregular chewing damage to leaves and leaf edges, dark green droppings on leaves and in leaf angles.

MOST COMMON

Warmer months. A minor pest which can attack all brassicas, including Asian leafy lines and rockets.



Cabbage white egg (J Ekman)



Cabbage white caterpillar and adult butterfly (J Ekman)

Cluster caterpillar / Tropical armyworm

Spodoptera litura

DESCRIPTION

Egg: Laid in large mass, creamy spheres usually covered with fluffy white hairs and scales. cream markings, reaching 50 mm length. Tend to curl into a ball if disturbed.

Caterpillar: Initially grey-green and feed as a group but separate as they mature. Caterpillars become dark grey to black with red, yellow and

Pupae: Reddish brown, found in the soil.

Adult: Wings held in a tent over back, patterned with brown, cream and grey.

DAMAGE

Caterpillars skeletonise leaves.

MOST COMMON

Spring-autumn in Queensland. Very wide host range, potentially affecting all babyleaf crops.



Emerging (A Carmichael, QUT) and young caterpillars (NSW DPI)



Mature caterpillar (NSW DPI) and adult moth (D Hobern)

Cutworm

Agrotis spp.

DESCRIPTION

Egg: Laid in a large mass, creamy spheres usually covered with fluffy white hairs and scales.

Caterpillar: Initially grey-green and feed as a group but separate as they mature. Caterpillars darken as they age, becoming dark green/grey to black with red, yellow

and cream markings, reaching up to 50 mm length. Tend to curl into a ball if disturbed.

Pupae: Reddish brown, found in the soil.

Adult: Wings held in a tent over back, patterned with brown, cream and grey. The bogong moth is a type of cutworm.

DAMAGE

Larvae cut off seedlings at soil level, usually during the night. Plants may be dragged under the soil to feed on during the day.

MOST COMMON

Damage most likely during spring, especially in damper areas newly converted to cropping.



Active (FT Gort Flickriver) and disturbed (SARDI (inset)) caterpillars



Adult moth (NSW DPI) and cutworm damage to chard (C Longacre)



Damsel bug

Nabis spp.

DESCRIPTION

Egg: Whitish, oval eggs laid into plant tissues.

Nymph: Similar to adults except smaller and lacking wings.

Adult: Slender, light tan bug 8–12 mm long with long, prominent sucking mouthpart for feeding. Long legs, of which the front two are stronger for grasping prey.

DAMAGE

Beneficial insect: Damsel bug nymphs and adults are extremely aggressive predators on other insects, including aphids, leafhoppers and various caterpillar species.

MOST COMMON

Can occur at any time of year.



Damsel bug adult (J Ekman)

Diamondback moth

Plutella xylostella

DESCRIPTION

Egg: Pale yellow, oval eggs are laid in clumps on leaves and stems.

Caterpillar: Initially colourless, developing to bright yellowish green. Tend to drop from the plant if disturbed.

Mature at 10–12 mm long.

Pupae: Silvery mesh cocoon attached to the leaf or stem.

Adult: Slender, brown wings held in a tent over its body. Central light brown stripe along the back edges of the wings incorporates 3 'diamond' shapes.

DAMAGE

As they grow, caterpillars progress from mining the insides of leaves to making



numerous small feeding holes or 'windows' (leaving the upper leaf surface intact). Mature caterpillars leave large holes, especially between leaf veins.

MOST COMMON

Major pest of brassica crops such as Asian leafy, rocket and kale. Numbers increase from spring in South Australia, summer in Victoria and autumn in Queensland. Eggs don't hatch below 8°C while temperatures over 35°C reduce insect survival.



Feeding windows and holes in kale seedling and buk choy leaf (J Ekman)

Caterpillar (R Ottens Uni Georgia, Bugwood.org), pupae (W Cranshaw Colorado SU, Bugwood.org) and adult moth (D Griffiths)

False wireworm

Gonocephalum spp.

DESCRIPTION

Egg: Laid on or just below the soil surface

Larvae: Dark cream to golden larvae with round head and darker mouthparts. Hard, smooth body with obvious segments, up to 30 mm long. Similar to the common mealworm, to which they are closely related.

Adult: Dull dark grey, brown or black oval shaped beetle commonly known as a 'darkling beetle'. Thorax has flanged edges (like a pie dish).

DAMAGE

Larvae live in the soil where they feed on newly germinated seeds and plant roots. Adults chew stems

at ground level, and may ring-bark small plants.

MOST COMMON

Found in districts of NSW and Queensland, larvae develop through autumn and winter but cause most damage during spring. Unlike true wireworms, false wireworms tend not to move around but stay at the junction of loose, cultivated soil and undisturbed soil below.



Adult beetle (U Schmidt) and false wireworm larvae (Virginia Tech)

Flea beetle

Phyllotreta spp.

DESCRIPTION

Egg: White to oval, laid in the soil.

Larvae: White grubs with brown heads which live in the soil.

Adult: Small, shiny beetle, often black with yellowish stripes along its wing covers. The hind legs are enlarged, allowing them to jump like fleas.



DAMAGE

Adults feed on the plant leaves, causing small round pits or holes, while larvae feed on the plant roots. Adult beetles are a potential contaminant.

MOST COMMON

Occasional spring-summer pest, particularly to Asian leafy products and rocket.



Red headed flea beetle (top) (C Mares, QDAFF), flea beetle on rocket (Ontario MAF) and turnip flea beetle (right) (M Deml Encyclopedia of Life)

Fungus gnats

Bradysia spp.

DESCRIPTION

Egg: Tiny, laid in soil.

Larvae: Clear to white maggots with a small black head, 5–8 mm long. Leaves a trail of slime as it travels across the soil.

Adult: Tiny black flies 2–3 mm long with a single pair of clear or smoky wings, long antennae and long, slender legs.

DAMAGE

Larvae live near the soil surface where they feed on

seedling roots and stems. They can also potentially act as vectors for fungal diseases, especially those affecting seedlings. Adults are mainly a contamination issue.

MOST COMMON

Prefer damp conditions where there are high levels of organic matter and/or nutrients.

More commonly a pest of greenhouses than field crops.



Fungus gnat larvae (JK Clark) and adult (A Broadley DAFF)

Green mirid

Creontiades dilutus

DESCRIPTION

Egg: Single eggs are inserted into the leaves, with the tops projecting from the surface.

Nymph: Pale green, pear shaped nymph. Antennae have reddish brown tips.

Adult: Pale green bug approximately 7 mm long with clear wings folded flat over its back. Antennae nearly as

long as the body. Agile bug, sometimes with red markings.

DAMAGE

During feeding adults and nymphs inject digestive enzymes into plants, which can kill growing points.

MOST COMMON

Summer months.



Nymph and adult green mirids (M Khan QDAFF)

Green vegetable bug

Nezara viridula

DESCRIPTION

Egg: Neat rafts of barrel shaped, creamy eggs are laid on leaf undersides, turning golden as they mature.

Nymph: Initially orange-red, then turning green with bright red, black and white patterning. Tend to aggregate together.

Adult: Green, shield shaped bug around 15 mm long.

DAMAGE

Young shoots are damaged by sap sucking. Adults can be hard to see, so a potential contamination issue.

MOST COMMON

Spring-summer on a wide range of host plants.



Nymph (L Turton NSW DPI) and adult bug (S McDougall NSW DPI)

Ground beetle

Carabidae spp.

DESCRIPTION

Egg: Laid in clusters in moist soil debris.

Larvae: Segmented grub with relatively large head and obvious jaws for attacking prey.

Adult: Flattened black beetle 8-12mm long with ridged wing covers. They are fast runners and rarely fly.

DAMAGE

Beneficial insect: larvae and adult beetles are predatory on insects, caterpillars, slugs, snails and other pests. They usually forage in soil litter, or close to the ground.

MOST COMMON

Year round.



Ground beetle (J Ekman)

INSECTS

Heliothis / Native budworm

Helicoverpa armigera, *H. punctigera*

DESCRIPTION

Egg: Laid singly. Ribbed, white domes 1 mm diameter, darkening to yellow, orange and finally brown before hatching.

Caterpillar: Initially 1.5 mm long, light brown with dark heads. They remain this colour until they reach around 15mm long, when they darken and develop distinctive stripes along their length. Colour varies from brown to greenish or reddish. Caterpillars grow up to 50 mm long.

Pupae: Golden colour, generally found just under the soil surface. Rain stimulates emergence.

Adult: Stout moth with lightly patterned brown wings spanning up to 25 mm, held flat across the body, hind wings pale brown with dark edges.

DAMAGE

Large, ragged holes in leaves, frass is a contamination issue.

MOST COMMON

Warm weather. Larvae prefer leaf undersides or the central part of the plant. Common hosts include lettuce and brassica crops, rarer on spinach.



Heliothis eggs (S Grigg)

Heliothis caterpillar (J Ekman), and adult moth (K Power)

Hoverfly

Syrphidae spp.

DESCRIPTION

Egg: Oval white eggs usually laid near aphid colonies.

Larvae: Cream coloured maggot with stripe on upper surface and dark mouth hooks, up to 10 mm long.

Adult: Resembles a bee or wasp with black and yellow bands across its rather flattened abdomen, but actually harmless. Often

hovers near plants, feeding on nectar and pollen.

DAMAGE

Beneficial insect: maggots eat large numbers of aphids. However, larvae can present a contamination issue.

MOST COMMON

Warm weather, especially summer.



Hoverfly (J Ekman) and larvae with cabbage aphid prey (S Grigg)

Lacewing – brown

Micromus tasmaniae

DESCRIPTION

Egg: Cream, oval eggs laid singly on leaves.

Nymph: Slender brown larvae up to 10 mm long with smallish head but large, sickle shaped jaws and long tail.

Adult: Delicate brown insect up to 8 mm long with large, finely veined wings held upright along its body. Large, round, greenish eyes and long antennae. Smaller than green lacewing.

DAMAGE

Beneficial insect: adults and nymphs are voracious predators of aphids, small caterpillars, thrips and mites. However, can be a contamination issue, especially as the adults' large wings may stick to wet leaves.

MOST COMMON

Year round.



Brown lacewing larvae (S Grigg) and adult (J Ekman)

Lacewing – green

Mallada signatus

DESCRIPTION

Egg: Whitish eggs laid on long, thin stalks, either singly or in rough groups.

Nymph: Thick bodied, up to 8 mm long light brown larva which camouflages itself with the remains of its prey.

Adult: Slender, delicate pale green insect 12–15 mm long with transparent, finely veined wings held upright along the body. Large, round red eyes and long antennae.

DAMAGE

Beneficial insect: Adults and nymphs are voracious predators of aphids, small caterpillars, thrips and mites.

MOST COMMON

Year round.



Adult green lacewing (J Ekman)

Ladybird – fungus eating

Illeis galbula

DESCRIPTION

Larvae: White with black dots and reptilian appearance, up to 6mm long.

Adult: Bright yellow with black markings, fast moving and active during the day.



Fungus eating ladybird larvae and adult (J Ekman)

DAMAGE

None: Nymphs and adults feed primarily on powdery mildew fungus. Other fungal species and pollen may also be eaten. Can be an early indicator of pathogen infection.

MOST COMMON

Late spring to autumn.



Ladybird – predatory

Coccinella transversa, *Hippodamia variegata*, *Diomus notescens*

DESCRIPTION

Egg: Upright yellow eggs, laid in small clusters.

Nymph: Black with coloured markings and 'crocodile like' appearance, up to 6 mm long.

Adult: Brightly coloured, dome shaped beetles with distinctive spots and stripes on their outer wing covers.

DAMAGE

Beneficial insect: Both adults and larvae are active predators of aphids, thrips, moth eggs and mites. However, ladybird larvae can represent a contamination risk.

MOST COMMON

Late spring to autumn.



Minute two spotted ladybird (L) and Transverse ladybird (R) (J Ekman)

Transverse ladybird larvae (top) and white collared ladybird (J Ekman)

Leafhopper / Jassid

Family Cicadellidae

DESCRIPTION

Egg: Tiny and laid under the leaf surface.

Nymph: Similar to the adult but wingless. Habit of moving sideways when disturbed.

Adult: Look like tiny cicadas; torpedo shaped, ranging in colour from yellowish to green and mottled brown. Jump away quickly if disturbed. Tend to feed on

the undersides of leaves of a wide range of host plants.

DAMAGE

All lifestages suck plant sap, reducing vigour and leaving whitish patches on the leaves.

MOST COMMON

Warmer months, only occasionally a major pest.

Leafminer – brassica

Liriomyza brassicae

DESCRIPTION

Egg: Small, round white eggs laid singly into the leaf underside.

Larvae: White to creamy yellow maggots up to 3 mm long. Mature larvae drop to the soil to pupate.

Adult: Small grey or black fly about 3–4 mm long.

DAMAGE

Females may puncture leaves multiple times before laying an egg, causing leaf

spots. Developing larvae make increasingly obvious feeding tunnels inside the leaves, depositing dark particles of frass.

MOST COMMON

A major pest of brassicas including leafy Asian greens and rocket, especially during early spring. Several species of parasitoid wasp attack this leaf miner.



Spotted leafhopper (NSW DPI) & feeding damage (L Tesoriero NSW DPI)



Leaf miner feeding tunnels on rocket (J Ekman) and an adult fly.

Leafminer – cineraria

Chromatomyia syngenesiae

DESCRIPTION

Egg: Small eggs laid singly into or on leaf tissue.

Larvae: Cream to yellow maggots up to 5 mm long. Pupates shallowly inside the leaf underside.

Adult: Small grey and black fly about 3–4 mm long.

DAMAGE

The larvae form a narrow, linear mine tending to either the upper or lower leaf surface, making them unmarketable.

MOST COMMON

Commonly feeds on sowthistle and related garden plants (nasturtium, chrysanthemum etc), only an occasional pest on lettuce. Usually controlled naturally by parasitoid wasps.



Cineraria leaf miner feeding tunnels on sowthistle (G Csoka HFRI, Bugwood.org) and lettuce.

Leafminer – spinach

Liriomyza chenopodii

DESCRIPTION

Egg: Small, white, cylindrical eggs laid into the leaf tissue.

Larvae: Cream to yellow maggots up to 3 mm long. Mature larvae drop to the soil to pupate.

Adult: Small black and yellow fly about 2 mm long.

DAMAGE

Females may puncture leaves multiple times before laying an egg, causing leaf spots. Developing larvae make winding feeding

tunnels inside the leaves, making leaves unsaleable.

MOST COMMON

A major pest of spinach and chards. Most common in spring and early autumn in southern Australia. Several species of parasitoid wasp attack this leaf miner.



Leaf miner egg lay into spinach (S Grigg) and feeding tunnels (P Ridland)

Looper

Chrysodeixis spp.

DESCRIPTION

Egg: Laid singly, usually on leaf undersides. Ribbed, flattened domes cream to yellow in colour.

Caterpillar: Light green to dark green slender caterpillars with distinct looping motion (unlike heliothis, they have no central prolegs). Mature larvae are 35–40 mm long and feed openly on a wide range of host plants.

Pupae: Dark brown, attached to the plant.

Adult: Stout moth with richly patterned wings held in a tent over its body.

DAMAGE

Holes in leaves, leaves can be skeletonised.

MOST COMMON

Summer-autumn.



Adult looper (P Hampson, Bugwood.org) and caterpillar (J Ekman)

Lucerne leafroller

Merophyas divulsana

DESCRIPTION

Egg: Flattened, yellow, laid in small clusters.

Caterpillar: Light grey-green to brown, up to 12 mm long. Caterpillar wriggles backwards if ejected from its leaf tunnel.

Adult: Light tan (female) or tan with brown markings (male) moth up to 10 mm long.

DAMAGE

Caterpillars roll leaves up with webbing, then feed from inside.

MOST COMMON

Mainly a pest of lettuce in southeastern Queensland, most common during late summer-autumn.



Leafroller caterpillar and adults (NSW DPI)

Mite – blue oat

Penthaleus spp.

DESCRIPTION

Egg: Round, laid singly or in clusters of 3-6 on the soil surface or on roots and stems of food plants.

Nymph: Pinkish orange, 0.3 mm long immediately after hatching, darkening as they mature.

Adult: Bluish black with 8 bright red legs and distinctive red mark on the back. Moves quickly if disturbed.

DAMAGE

Active during cooler part of the day when it leaves the soil to feed on young leaves



Blue oat mites and damage (Vic DPI) and adult mite (L Schimming)

and shoots. Feeding damages the surface, causing large whitish patches on leaves.

MOST COMMON

Widespread from Tasmania to southern Queensland during the cool, wet part of the year. When daily maximums exceed 20°C diapausing eggs are laid, which hatch only after exposure to high temperatures followed by cool weather and rain.

Mite – clover

Bryobia spp.

DESCRIPTION

Egg: Round, red, measuring approx. 0.2mm diameter, laid singly or in small groups.

Nymph: Bright orange-red, initially with six legs but developing eight in later instars.

Adult: Dark greyish orange or olive green, eight orange-red legs of which the front two are much longer than the others.

DAMAGE

Tends to feed mainly on the upper leaf surfaces, causing distortion and scarring of young leaves.

MOST COMMON

Found on spinach and brassica crops, most active during warm periods but can be found at any time of year.



Clover mite and mite damage on spinach leaves (S Grigg)

Mite – predatory

Phytoseiulus persimilis

DESCRIPTION

There are a number of predatory mite species, of which *Phytoseiulus persimilis* is the most commonly used as a biological control agent.



Egg: Oval, orange tinged, double the size of pest mite egg.

Nymph: Pale orange, pear shaped.

Adult: Orange to reddish, pear shaped, fast moving, slightly larger than pest mite.

DAMAGE

Beneficial mite: Predatory on two spotted mite and bean spider mite.

MOST COMMON

Multiplies rapidly at temperatures over 26°C.



Predatory mite *Phytoseiulus persimilis* (Bugwood.org (top) and M Talbot)

Mite – redlegged earth mite

Halotydeus destructor

DESCRIPTION

Egg: Orange, minute, laid singly on lower stems or soil debris during winter-spring. During summer a diapausing egg is retained within the female mites' body.

Nymph: Reddish pink with 6 legs, 0.2 mm long, darkens as it matures.

Adult: Completely bluish-black body with bright red legs. Generally feeds in groups of up to 30.

DAMAGE

Lacerates plant leaves to release sap, resulting in large, whitish patches on leaves. Mainly feeds in the morning or in overcast conditions. If disturbed it will drop to the ground and hide.

MOST COMMON

Cool, wet weather, generally autumn to early summer in southern parts of Australia. Spends most of the time in the soil.



Redlegged earth mite (NSW DPI)

Mite – spinach crown / bulb

Rhizoglyphus spp.

DESCRIPTION

Egg: Round, semitransparent, barely visible with the naked eye (0.1 mm long), deposited between folds in new leaves.

Nymph & Adult: Nymphs and adults are similar in appearance and only reach 0.7 mm long. All stages are semitransparent with prominent long hairs and light brown legs.

DAMAGE

Mites feed mainly on young, expanding leaves at the centre

of the plant. Emerging tissues are stunted and deformed.

MOST COMMON

Favoured by cool, wet conditions and soils rich in organic matter especially if used for repeated crops of spinach. Mainly a pest of spinach and chard in Tasmania and southern Victoria. Most damage occurs during spring when plant growth is slow, with occasional outbreaks in autumn.



Spinach crown mite (S Tirpak, Rutgers PDL) and damage (S Grigg)

Mite – two spotted

Tetranychus urticae

DESCRIPTION

Egg: Translucent white, laid on leaf undersides.

Nymph: Translucent white, changing to bright orange in overwintering form.

Adult: Whitish to yellow green, around 0.5 mm long with a large dark olive spot either side of its body. Overwintering form has a dark red body and white legs.

DAMAGE

Mites form colonies on lower leaf surfaces, especially near the petiole. These areas become covered in fine webbing. Feeding causes silvery speckling on the leaf surface and the leaves to become twisted and distorted.

MOST COMMON

Mainly during hot, dry weather (25–30°C).



Two spotted mites overwintering form (L, top), normal form with egg (R) (G San Martin) and damage to rocket (J Ekman)

Parasitoid wasps

Trichogramma spp., *Telenomus* spp., *Diadegma* spp.

DESCRIPTION

There are many different types of parasitoid wasps, a number of which are sold commercially for control of caterpillars and aphids.

Adult: Range in size from tiny black wasps less than 0.5mm long that lay their eggs inside moth eggs (eg *Trichogramma* or *Telenomus*) to larger species

up to 18mm long that lay their eggs in pest caterpillars or pupae (eg *Diadegma*, *Netelia* and *Diadromus*). While many are black or grey, others are orange or a mixture of colours. Some parasitoids are highly host specific, others will attack a range of species.



Diadegma sp., a parasitoid of diamondback moth (J Ekman) and pupae with newly emerged adult *Cotesia glomerata*, parasitoid of cabbage white caterpillars (S Grigg)

DAMAGE

Beneficial insect: The adult females lay their eggs inside eggs, caterpillar or pupae of pest moths or butterflies, or directly into aphid adults or nymphs. One or many

larvae live inside their host, eventually killing it.

MOST COMMON

Any time of year.



Parasitised aphid 'mummies' (top) (N Dimmock Uni Northampton, Bugwood.org), *Telenomus* sp. and *Trichogramma* sp. wasps laying into heliothis eggs (NSW DPI)

Plague soldier beetle

Chauliognathus lugubris

DESCRIPTION

Larvae: Soil dwelling, with distinct rounded segments, larvae are strict carnivores that consume insect pupae, insect eggs, young caterpillars and other organisms. Larvae take up to a year to mature.

Adult: Slender beetle with bright orange abdomen and metallic green wings. Up to 15 mm long.

DAMAGE

Beneficial insect: Predatory on aphids, caterpillar eggs and other pests, which are supplemented with nectar and pollen. However, can be a significant contaminant issue.

MOST COMMON

Summer in southeastern Australia. Large swarms periodically form to mate, but the causes of swarming are unknown.



Plague soldier beetle adult (J Ekman)

Rove beetle

Paederus spp.

DESCRIPTION

Adult: Resembles an earwig or large ant more than a beetle due to tiny size of its wing covers. Black head and body with orange-red thorax and wide orange red stripe across the lower part of its body. Although the beetle can fly, it prefers to run and is very agile. It has a habit of curling its abdomen when running or disturbed.

DAMAGE

Beneficial insect: Predatory on various small insects. However, beetles contain a toxin which is released if they are damaged or crushed. This can cause extreme skin irritation, known as *Paederus dermatitus*.

MOST COMMON

On soil around moist places. They are attracted to irrigated areas and hunt actively during the day.



Rove beetle (J Ekman)

Rutherglen bug

Nysius vinitor

DESCRIPTION

Nymph: Pear shaped, reddish brown and wingless. Nymphs mainly feed on a range of weed species, not vegetable crops.

Adult: Slender, dark grey bugs about 5 mm long with transparent wings and black eyes.

DAMAGE

Can cause some feeding damage through sap sucking, although vegetable crops are not preferred hosts.

Main issue is contamination of fresh cut products.



Rutherglen bug (E Tubb, J Ekman)

MOST COMMON

Multiplies during spring in weed species as well as in field crops such as sunflower, sorghum and safflower. Moves into vegetables during summer when other hosts

are unavailable, where it can reach large numbers. May be controlled during late summer in southern states by a naturally occurring fungal infection.



Healthy and parasitised Rutherglen bugs on Victorian lettuce (S Grigg)

Shore flies

Family Scatella

DESCRIPTION

Egg: White, oval, about 0.4 mm long and laid on the soil surface.

Larvae: Pale, brownish maggots grow up to 3 mm long.

Adult: Small black flies with grey wings and reddish eyes, up to 2 mm long, similar shape to drosophila.

DAMAGE

Both adults and larvae do not directly damage plants as they

feed on algae, yeast and soil microorganisms. However, they leave black excrement (fly specks) on the plant leaves and are a contamination issue.

MOST COMMON

Like fungus gnats, shore flies are attracted to damp areas with actively growing algae and high levels of organic matter. More commonly found in greenhouses than field crops.



Shore fly adult (M Suvac) and pupa

Springtails

Family Collembola

DESCRIPTION

Egg: Microscopic, laid within the top 50 mm of soil in batches of up to 50.

Nymph and Adult: Semitransparent, ranging in size from 0.5-2 mm long. Soil inhabiting springtails are effectively blind and semi-aquatic. They lack the springing apparatus of above ground species.

DAMAGE

Springtails feed on plant roots, causing extensive scarring. Roots can become brown or blackened, the plant wilts and may die.

MOST COMMON

Favoured by cool, wet conditions with heavy soils rich in organic materials. They are a particular pest of spinach.



Springtail damage to spinach roots (L Du Toit, WSU)

Thrips – onion, plague, tomato, WFT

Thrips tabaci, *T. imaginis*, *Frankliniella schultzei*, *F. occidentalis*

DESCRIPTION

While there are many species of thrips, onion thrips, plague thrips, blossom thrips and western flower thrips are the main pest species in vegetables. Identification of thrips species is difficult due to their tiny size — significant magnification is required.

Nymph: Cream to yellowish, wingless, generally <1 mm long.

Adult: Light to dark brown with thin bodies approx. 1–2 mm long. Narrow, transparent wings are held along their backs.

DAMAGE

Feeding causes silvering of the leaves, in severe cases leading to leaf curling. The major damage potentially caused by certain thrips species is their transmission and spread of viruses (eg tomato spotted wilt virus) into the crop.

MOST COMMON

ALL crops may be affected, especially during warm, dry weather. Onion thrips are common in early summer, WFT and tomato thrips most common in mid-late summer. Thrips prefer new shoots as well as hiding in the leaf axis of young seedlings. Western flower thrips is known for pesticide resistance.



Western flower thrips (PMJ Ramakers APR, Bugwood.org)



Thrips damage on rocket (Uni Mass. Ext.) and lettuce (Y Pinot, INRA Montpellier (top) and M Mirnezhad Leiden Uni, Bugwood.org)

Weevil – vegetable

Listroderes difficilis

DESCRIPTION

Egg: Pale, laid in soil surface litter in autumn.

Larvae: Up to 12 mm long, creamy yellow or greenish grub with orange brown head. Pupates in the soil in early spring

Adult: Mottled brown about 8 mm long with pale V-shaped mark in the middle of the back and a prominent snout.

DAMAGE

Larvae and adults chew distinctive rounded holes in leaves during the evening and at night. Usually minor pest, damage is generally superficial but affects plant appearance and saleability. Heavy infestations can kill seedlings.

MOST COMMON

Larvae are present during autumn and winter, emerging as adults in spring. Adults are inactive in the soil during summer.



Vegetable weevil larvae (S Learmonth DAFWA), larvae on wombok (A Ryland) and (right) adult (DAFWA)

Larvae in pak choy (D Roos NC State Uni) and spinach leaf damage with young larvae (S Grigg)

Weevil – white fringed

Naupactus leucoloma

DESCRIPTION

Egg: Pale yellow, laid in sticky, gelatinous clumps in ground litter or lower plant stems.

Larvae: Whitish C-shaped grub with brown head and black mandibles, up to 13 mm long.

Adult: Grey-brown striped with white side band and a short snout. Up to 12 mm long. Adults cannot fly but walk long distances.

DAMAGE

Larvae live 5–15 cm deep in the soil where they eat

plant roots. Adults feed on lower leaves but rarely cause major damage.

MOST COMMON

Mainly a pest of potatoes and legumes such as lucerne. However, larvae remaining in the soil following a susceptible crop will attack vegetable plant roots. Larvae are active during autumn to spring, adults emerge in summer. Females can lay eggs without mating.



White fringed weevil larvae with feeding damage to lettuce roots (S Grigg) and adult weevil (S Hinkley & K Walker, Museum Vic)

Wireworm

Family Elateridae

DESCRIPTION

Egg: Laid in batches on the soil surface or in small crevices.

Larvae: Cylindrical or slightly flattened larvae, creamy coloured with a smooth, distinctly segmented body. Brown to reddish head equipped with large mandibles. The tail is also brown to reddish and may be forked with a serrated edge.

Adult: Dark grey, brown or black, torpedo shaped beetle with finely ridged wing covers. Commonly known as 'click beetle' due to its ability to right itself with a clicking noise if placed upside down.

DAMAGE

Larvae live in the soil where they feed on plant roots.

MOST COMMON

Most often a problem in fields recently planted to mulches or weedy. Larvae mainly cause damage during summer and autumn, when they feed on roots in the top 5cm of soil. Transplants are particularly at risk. They burrow deeper into the soil under dry conditions but may re-appear after irrigation or in cooler temperatures.



Wireworm larvae (M Bertone)



Diseases

Alternaria leaf spot / Target spot

Alternaria spp.

SYMPTOMS

Dark grey to black spreading spots with distinct margins and sunken centre, surrounded by a yellow halo. Fine black spores develop in the centres of the lesions. As the lesions age they dry and become papery, eventually falling out to give a 'shot hole' effect.

CROPS AFFECTED

Lettuce and leafy brassicas.

FAVOURED BY

Moist conditions, especially if plants are stressed. Can be seed borne and survive in plant debris, but generally uncommon.



Alternaria leaf spot on mizuna (Ontario MAF)

Anthracnose – spinach

Colletotrichum dematium

SYMPTOMS

Small, circular water soaked lesions which grow in diameter as they develop. Older lesions turn light brown, with tissues becoming thin and papery. Tiny, dark, spines (setae) eventually develop on the outer border of the lesions.

CROPS AFFECTED

Spinach.

FAVOURED BY

Leaves remaining wet for more than a few hours, cool conditions (10 – 20°C).



Anthracnose on spinach (J Damicone (L) L Tesoriero NSW DPI)



Anthracnose – lettuce

Microdochium panattonianum

SYMPTOMS

Small, brownish circular to oval lesions, often developing initially on leaf midribs. These grow and join together, the centres becoming light brown and papery.

CROPS AFFECTED

Lettuce

FAVOURED BY

Damp, cool conditions (15–18°C), where leaves remain wet for 8 hours or more. Most commonly occurs in late winter and spring.



Anthracnose on lettuce seedling and green coral lettuce (S Grigg)

Bacterial leaf spot – brassicas

Pseudomonas spp., *Xanthomonas* spp.

SYMPTOMS

Brownish, angular lesions develop between the leaf veins, often with a dark edge or yellow halo.

CROPS AFFECTED

ALL brassica crops.

FAVOURED BY

Moderately uncommon.



Bacterial leaf spot on rocket (L Tesoriero NSW DPI)

Bacterial leaf spot – lettuce

Xanthomonas axonopodis pv. *vitians*, *X. hortorum* pv. *vitians*

SYMPTOMS

Dark, angular water-soaked lesions develop between the leaf veins, sometimes with a dark edge or yellow halo.

CROPS AFFECTED

Lettuce.

FAVOURED BY

Moderately uncommon.



Bacterial spot on lettuce (L Tesoriero NSW DPI (top), S Grigg)

Bacterial soft rot

Pectobacterium carotovorum

SYMPTOMS

Wet, slimy rot of stems and leaves, often with an unpleasant smell.

CROPS AFFECTED

Asian leafy, lettuce.

FAVOURED BY

Warm, wet conditions.
Common as a secondary infection following other physical damage (eg pest).



Bacterial soft rot in coral lettuce (S Grigg)

Black rot / Bacterial leaf spot

Xanthomonas campestris pv. *campestris*

SYMPTOMS

Roughly 'V' shaped bright yellow to brown lesions, usually on the leaf edges initially but progressing inwards. Veins become blackened within the necrotic area.

CROPS AFFECTED

Brassicas.

FAVOURED BY

Warm, humid conditions. Can be seed borne, also spreads through a crop by equipment or water splash.



Black rot on brassica seedlings (L Tesoriero NSW DPI)

Cercospora leaf spot

Cercospora spp.

SYMPTOMS

Small red or brown-black flecks with reddish borders expand to circular spots with ashy grey centres. These may eventually fall out, giving a "shot hole" appearance.

CROPS AFFECTED

Spinach, chards.

FAVOURED BY

Warm, humid weather.



Cercospora leaf spot on chard (J Ekman) and beet (S Grigg)

Cladosporium leaf spot

Cladosporium variabile

SYMPTOMS

Small, sunken leaf spot <5 mm diameter with distinct margins, white to tan in colour. Spots multiply in number as the disease progresses. Dark green spores develop in older spots.

CROPS AFFECTED

Spinach, chards.

FAVOURED BY

Cool conditions (10–20°C) with high humidity. Disease is seed borne.



Cladosporium leaf spot on spinach (L du Toit WSU)

Clubroot

Plasmodiophora brassicae

SYMPTOMS

Distortion and thickening of the roots, particularly the tap root. Plants tend to wilt, particularly on hot days, lack vigour and have stunted growth. Infected roots are unable to effectively take up water and nutrients, and eventually the plant will die.

CROPS AFFECTED

Asian leafy, rocket, kale.

FAVOURED BY

Warm temperatures combined with wet, acidic (pH<7.0) soil.

Crops which are direct seeded into heavy soil are most at risk, especially if clubroot has been observed on the site within the previous 5 years. Spores can persist in the soil for several years and are easily spread in water, on machinery and within plant trash. There is no cure, so disease management involves using resistant varieties, liming soil to raise pH over 7.0, improving drainage and rotating crop types.



Clubroot on rocket (S Grigg)



Corky root

Rhizomonas suberifaciens

SYMPTOMS

Yellowish patches appear on the roots, which gradually enlarge and turn greenish brown. Cracks and rough, swollen areas develop on the root surface and the entire taproot can become brown and non-functioning. Feeder roots are reduced, breaking off easily when examined. Above ground symptoms include stunting, wilting during warm weather and uneven growth.

CROPS AFFECTED

Lettuce.

FAVOURED BY

Continual cropping with susceptible lettuce varieties, especially if direct seeded under warm (over 20°C) conditions. High soil nitrate levels due to nitrogenous fertilisers increase disease.



Normal (L) and corky root affected (R) lettuce seedlings (M Titley) and closeup of corky root symptoms (L Tesoriero, NSW DPI). Clubroot rocket field (opp) (S Grigg)

Damping off

Pythium spp., *Aphanomyces* spp., *Phytophthora* spp.

SYMPTOMS

Pre-emergence, damping off can cause brown, gelatinous rotting within the seed coat. If seeds do germinate, crop emergence is poor and seedlings are stunted, yellowing and wilted. Water soaked lesions appear on the upper part of the tap root, near the soil junction, sometimes resulting in excess branching of the root system (especially

Pythium). Seedlings tend to fall over or collapse and die.

CROPS AFFECTED

All.

FAVOURABLE BY

Wet soil conditions. The various fungi responsible for damping off can survive in the soil for extended periods, either as resting spores or in plant trash.



Damping off of spinach due to Pythium (E Tubb)



Collapse of spinach seedlings (top) and brown decay at the root/shoot junction (S Grigg)

Damping off – fusarium wilt

Fusarium oxysporum

SYMPTOMS

General wilting of seedlings, foliage loses colour and eventually dies. Roots and vascular tissues turn black.

CROPS AFFECTED

Spinach.

FAVOURED BY

Acidic soils low in organic matter.



Fusarium wilt of spinach (L Tesoriero NSW DPI (top), L du Toit WSU)

Damping off – wire stem

Rhizoctonia solani

SYMPTOMS

Dry, sunken cankers with a sharply defined margin develop near the soil junction soon after seedlings emerge. Plants wilt and collapse. More advanced seedlings may send out new shoots from below the diseased area. Like other causes of damping off, *Rhizoctonia* is common in soil and can survive long periods on plant debris or as sclerotia (hard resting structures).

CROPS AFFECTED

Asian leafy, rocket, spinach.

FAVOURED BY

Warm wet soils especially if combined with physical damage at soil level, eg windy conditions, transplanting or insect damage.



Damping off of spinach due to wire stem (S Grigg)

Downy mildew – brassicas

Peronospora spp.

SYMPTOMS

In the early stages, bleached or yellowish areas start to appear on the leaf upper surfaces. Soft whitish mould develops on the undersides of leaves, turning brown with age. The upper surfaces of cotyledon leaves become puckered and

speckled, while sunken, black, angular speckling develops on more mature leaves.

CROPS AFFECTED

Asian leafy, rocket.

FAVOURED BY

Cool, moist conditions.



Downy mildew on tatsoi and rocket (S Grigg)

Downy mildew – spinach

Peronospora farinosa f.sp. *spinaciae*

SYMPTOMS

Initially, mottled, yellow areas appear, mainly between the leaf veins. Soft, bluish grey mould develops on the undersides of leaves, turning brown with age.

CROPS AFFECTED

Spinach, chard.

FAVOURED BY

Cool (10–20°C) conditions, free water on the leaves.



Downy mildew on spinach early (J Ekman) and advanced (S Grigg)

Grey mould

Botrytis cinerea

SYMPTOMS

Water-soaked rot quickly followed by development of fluffy grey mould on leaves and lower stems. The plant wilts and eventually dies.



Grey mould on cos seedlings (L Tesoriero) and oakleaf lettuce (J Foulkes)

CROPS AFFECTED

All.

FAVOURIED BY

Cool, damp conditions.
A common postharvest disease.

Peppery leaf spot

Pseudomonas syringae pv. *maculicola*

SYMPTOMS

Small, black to purple irregularly shaped spots and speckling develop on leaves, sometimes with very thin yellow margins. Can be seed borne and survive on crop residues.

CROPS AFFECTED

Asian leafy, rocket, kale.

FAVOURIED BY

Prolonged cold, damp conditions, especially if leaves remain wet.



Peppery spot on wombok (L Tesoriero NSW DPI)

Phoma leaf spot

Phoma lingam (asexual form of *Leptosphaeria maculans*)

SYMPTOMS

Round to oval white-brown spots, up to 2 cm in diameter, mainly on the older leaves. Small black specks (spores) are scattered over the leaf spots but more pronounced in its centre. Dry rot can develop on leaf petioles and stem bases, and plants wilt and collapse.

CROPS AFFECTED

Mainly Asian leafy.

FAVOURED BY

High relative humidity and temperatures of 15–20°C. Wet leaves are required for infection. Spores can be spread by wind, rain, crop debris, irrigation water and, potentially, insects.



Phoma leaf spot (L Tesoriero NSW DPI)

Powdery mildew

Erysiphe cruciferarum

SYMPTOMS

Irregularly shaped patches of white, powdery mould on the upper surface of leaves and stems, particularly older leaves. Occasionally also on the lower leaf surface.

CROPS AFFECTED

Asian leafy, rocket, kale, chard.

FAVOURED BY

Warm, dry conditions. Uncommon on babyleaf crops.



Powdery mildew on tatsoi (HJ Jee) and kale (L Tesoriero NSW DPI)

Root rot

Pythium spp., *Aphanomyces* spp., *Phytophthora* spp., *Fusarium* spp.

SYMPTOMS

Root rots are often caused by a complex of different organisms. The resulting symptoms are similar to damping off, but affecting mature plants. Wilting and collapse initially occurs in the older leaves, but eventually affects the whole plant. Sometimes the rot spreads into the basal area of the stem and becomes visible above ground.

CROPS AFFECTED

All. But spinach is particularly susceptible.

FAVOURED BY

A variety of conditions depending on the species complex present; some are favoured by dry conditions, others by wet.



Root rot on spinach (L Tesoriero NSW DPI)

Root rot – black

Thielaviopsis basicola (syn. *Chalara elegans*)

SYMPTOMS

Long red to black lesions develop on the roots, resulting in stunted growth. Cutting across the leaf base reveals blackening in the vascular tissue.

CROPS AFFECTED

Lettuce, Asian leafy.

FAVOURED BY

Soil temperatures <20°C, soil pH >5.6. Reportedly spread by fungus gnats and shore flies within protected cropping environments. Associated with lack of crop rotation.



Black root rot (L Tesoriero NSW DPI (L), INRA)

Root rot – bottom rot

Rhizoctonia solani

SYMPTOMS

Initial symptoms are wilting of the outer leaves. Small, sunken brown lesions appear on the midribs and areas in contact with the soil. These grow rapidly, spreading to internal leaves and stem tissue. Lesions may ooze brownish liquid. Secondary soft rots often develop causing the head to collapse.

CROPS AFFECTED

Lettuces, particularly early season and less upright varieties.

FAVOURED BY

Warm (>25°C), moist weather. The fungus can survive extended periods in fallow soil, so bottom rot is likely to reoccur in soils previously affected and/or which are high in organic matter. This fungus also causes damping off in seedlings.



Bottom rot of lettuce (L Tesoriero NSW DPI)

Septoria leaf spot

Septoria lactucae

SYMPTOMS

Angular yellow leaf spots delimited by the veins, appearing first on the outer leaves. These turn brown and papery with tiny black dots (spores) scattered on the lesions.

but occasionally by seed. Spores can survive on crop debris and weed species.



CROPS AFFECTED

Lettuce.

FAVOURED BY

Cool, moist conditions. Usually spread in water



Septoria spot on lettuce (L Tesoriero NSW DPI)

Stemphylium leaf spot – spinach

Stemphylium botryosum f.sp. *spinacia*

SYMPTOMS

Small, circular to oval grey-green sunken spots. These enlarge, turn light brown in the centre and become papery as the disease progresses.

CROPS AFFECTED

Spinach.

FAVOURED BY

Warm (15-28°C) weather, combined with high humidity. Seedborne disease.



Stemphylium leaf spot on spinach (L. Du Toit WSU, L. Tesoriero NSW DPI)

Stemphylium leaf spot – lettuce

Stemphylium botryosum f.sp. *lactucum*

SYMPTOMS

Usually appears first on the outer leaves. Tiny, water soaked spots (1-2mm diameter) enlarge and multiply, becoming sunken and papery with a darker brown halo.

CROPS AFFECTED

Lettuce.

FAVOURED BY

Warm conditions (25–30°C), wet leaves and close to saturation humidity. The fungus cannot develop at less than 13°C.



Stemphylium leaf spot on lettuce (L. Tesoriero NSW DPI)

Virus – Mosaic

Alfalfa mosaic, Cucumber mosaic (CMV) Tomato spotted wilt virus (TSWV),

SYMPTOMS

General mottling, mosaic or ring spots on leaves. Plants are stunted and young shoots can appear bunched and distorted. Plants may wilt and die, particularly when infected with TSWV and LNYV.

CROPS AFFECTED

Some viruses have specific hosts. Others (such as CMV

and TSWV) affect a wide range of crops and weeds.

FAVOURED BY

Often spread by aphids, except TSWV which is spread by thrips. LMV also spreads by infected seed. Populations of insect vectors commonly build up in weeds and move into crops during dry weather.

Lettuce mosaic virus (LMV), Lettuce necrotic yellows (LNYV) etc



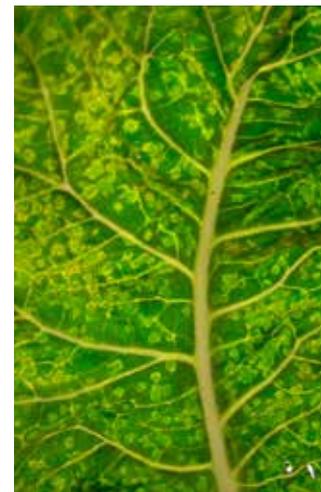
Tomato spotted wilt virus on lettuce (L Tesoriero NSW DPI)



Lettuce necrotic yellows virus (L Tesoriero NSW DPI)



Turnip mosaic virus on leafy brassicas (L Tesoriero NSW DPI)



White blister / white rust

Albugo candida

SYMPTOMS

Raised white spots appear, mainly on the undersides of leaves. Initially smooth, lesions become powdery and blister-like and can cause leaf distortion.

CROPS AFFECTED

Asian leafy, rocket, spinach.

FAVOURED BY

Humid weather. Will develop under a wide range of conditions.



White blister on spinach (J Damicone) and rocket

White leaf spot

Pseudocercospora capsellae

SYMPTOMS

Large numbers of pale, papery spots up to 1cm diameter on leaves. Seedlings may die; heavily infected leaves may yellow and drop off.

CROPS AFFECTED

Asian leafy, rocket, kale.

FAVOURED BY

Cool (10-15°C), wet conditions. Can be seed borne or spread by wind.



White leaf spot on buk choy seedling (L Tesoriero NSW DPI)



Disorders

Blindness

SYMPTOMS

Usually visible on seedlings on the 3rd – 4th true leaf, which is thickened, stunted and distorted. Subsequent growth is reduced, with lettuce failing to develop hearting leaves or normal shape.

CROPS AFFECTED

Lettuce.



Blind lettuce seedling (E Tubb)

CAUSED BY

Unknown. Generally a more frequent problem in transplant lettuce than direct seeded crops and in summer rather than winter. May be caused by a combination of environmental and agronomic factors.



Calcium deficiency – tipburn

SYMPTOMS

Browning of the leaf margins, particularly the inner leaves, which become dry and papery. Affected leaves fail to develop properly and have a cupped appearance. Damaged areas are prone to other diseases and have shortened shelf life.

CROPS AFFECTED

Lettuce.

CAUSED BY

Occasionally related to soil deficiency, but more often caused by the plant growing faster than calcium can move from the roots to the growing tips. Tipburn is most frequent during humid summer weather, when development is rapid but evaporation and, therefore, water movement through the plant is reduced. Particularly affects the inner leaves.



Tipburn in lettuce (S Grigg)

Cold damage

SYMPTOMS

Germination appears patchy, plants lack vigour and leaves may yellow or develop atypical colours. Symptoms may vary across a crop even when all other factors are the same, especially where plantings have been successive.

CROPS AFFECTED

Mainly spinach.

CAUSED BY

Cold temperatures during crop establishment and early growth. Soil temperatures of 10-20°C are optimum for spinach. During germination plants are highly sensitive to temperatures higher or lower than this and may fail to emerge or have reduced vigour.



Normal spinach (L) and cold-damaged plant (R) (M Titley)

Copper toxicity

SYMPTOMS

Small, light brown spots appear, mainly along the leaf veins. These increase and darken as symptoms progress.

CROPS AFFECTED

Lettuce.

CAUSED BY

Copper sprays.



Copper toxicity on lettuce (S Grigg)

Fertiliser burn – lettuce

SYMPTOMS

Dark or blackened necrotic areas appear and expand in the leaf bases. Leaves can wilt, become chlorotic and die.

CROPS AFFECTED

Lettuce.

CAUSED BY

Application of post-transplant fertiliser after more than 4 leaves have started to develop. Fertiliser granules become trapped in the leaf bases, where they burn the plant tissue.



Fertiliser granules and burn on lettuce (S Grigg)

Fertiliser burn – urea

SYMPTOMS

Bleached, papery areas develop on outer edges and exposed areas of leaves.

CROPS AFFECTED

All.

CAUSED BY

Application of foliar urea at too high a concentration or with incorrectly calibrated spray equipment.



Fertiliser burn caused by urea application to spinach (M Tittley)

Frost damage – permanent

SYMPTOMS

Leaves become bubbled and distorted and necrotic areas develop. Large water-soaked areas may appear if injury is severe.

CROPS AFFECTED

All.

CAUSED BY

Frost settling on leaves for an extended period—tolerance varies between species and varieties.



Frost injury on rocket and butter lettuce (S Grigg)

Frost damage – recoverable

SYMPTOMS

Smallish water-soaked spots and diffuse areas appear on leaves. If water-soaked areas affect larger, solid areas then plant may not recover.

CROPS AFFECTED

All.

CAUSED BY

Frost—symptoms generally dissipate within a few hours of damage occurring.



Non-permanent frost damage on lettuce seedlings (S Grigg)

Guttation

SYMPTOMS

Droplets of water (xylem sap) appear around the leaf edges. As these dry, tiny salt deposits are left. These tiny, white deposits can resemble insect eggs or fertiliser/pesticide contamination.

CROPS AFFECTED

Mostly spinach.

FAVoured BY

High soil moisture combined with high relative humidity. Guttation is the result of water pressure building up in the plant roots, usually overnight when stomata are closed. This pressure forces xylem sap out through structures on the leaf edges (hydathodes), forming droplets.



Guttation on spinach leaf (S Grigg)

Hail damage

SYMPTOMS

Physical scarring and spotting of leaves. Light hail damage can resemble a leaf spotting disease, but is non-progressive. Although edibility is unaffected, appearance is less attractive.

CROPS AFFECTED

All.

CAUSED BY

Light hail. Severe hail will result in complete crop loss.



Light hail damage on spinach (S Grigg)

Herbicide damage

SYMPTOMS

Variable symptoms. Pre-emergent herbicide applications can cause the cotyledons to become thickened, twisted and distorted. Post-emergent applications can result in inrolling and distortion of the first true leaves. Other symptoms include the appearance of bleached, chlorotic patches on the leaves, especially on the leaf margins and stunted growth.



Herbicide damage to rocket (S Grigg)

CROPS AFFECTED

All.

CAUSED BY

Potential causes include contamination of the spray tank due to insufficient cleaning, inappropriate herbicide selection and application of a normally non-damaging herbicide to a crop previously treated with a wetting agent.



Herbicide damage to spinach and beet cotyledons (S Grigg) and below, stunting of spinach seedling (R) compared to normal plant (L) (M Titley)



Herbicide damage to pak choy (above) (S Grigg) and lettuce (L) (J Ekman)

Nitrogen Deficiency

SYMPTOMS

Plants are pale and chlorotic and growth is reduced. Older leaves in particular may yellow and die off prematurely. Red or purplish colours can develop in the paler than normal leaves.

CAUSED BY

Nitrogen is required in relatively large amounts for maximum growth. However, it is easily leached, especially from sandy soils low in organic matter. Waterlogging and surface fertiliser application promote release of nitrogen as gas, removing it from the

soil. Incorporation of high carbon soil amendments such as straw can lock up available nitrogen in the soil.



Nitrogen deficiency on pak choy and tatsoi (S Parks NSW DPI)

Oedema

SYMPTOMS

Blistering on the underside of the leaf develops into small, brown, corky growths. These darken and harden with age, sometimes spreading to petioles and stems.

CROPS AFFECTED

Asian leafy, spinach.

CAUSED BY

Excess water in the root zone combined with high humidity and low air temperatures. Pressure builds up inside the internal cells, eventually causing them to blister and burst.



Blistering caused by oedemas on spinach (L Tesoriero, NSW DPI)

Old seed

SYMPTOMS

Seeds germinate but cotyledons fail to develop normally, with variable rates of germination and growth through the crop. Seedlings lack vigour and are slow to grow past the cotyledon stage.

CROPS AFFECTED

Spinach, chard.

FAVOURED BY

Seeds have been stored too long before use, with the result that their carbohydrate reserves are reduced.



Patchy growth due to old seed being used in tatsoi (M Titley)

Pesticide damage

SYMPTOMS

Older seedling leaves have bleached or yellowed margins. New growth is fully green.

CROPS AFFECTED

All.

CAUSED BY

Seedlings which have been drenched in pre-planting systemic pesticide have remained for an extended period in their seedling trays before planting. New growth recovers and is normal.



Pesticide drench damage due to delayed transplanting

Phosphorus deficiency

SYMPTOMS

Poor growth, older leaves (or cotyledons in seedlings) turn bluish green or purple. Stems thin, liable to breakage.

CROPS AFFECTED

Rocket, Asian leafy.

CAUSED BY

Cold weather, which limits phosphorus uptake by the plant, especially if combined with low pH and low levels of available phosphorus in the soil.



Phosphorus deficiency (S Grigg)

Waterlogging

SYMPTOMS

Roots develop on the tops of beds. Leaves become yellow due to inhibition of nitrogen uptake. Plants can become red or purplish.

CROPS AFFECTED

All.

FAVoured BY

Heavy soils, prolonged rainfall, poor drainage.



Poor development associated with waterlogged soil (J Ekman)

Wind damage – lettuce

SYMPTOMS

Plants are stunted and wilt during the day; eventually they may fall over and die.

CROPS AFFECTED

Mainly transplanted lettuce seedlings, such as cos.

CAUSED BY

Strong winds which whip the plant around, abrading the crown. The plant becomes pinched and collapses near the junction with the soil surface. In some cases it will be completely “ringbarked” and will die. Abrasion also creates a potential entry point for soil pathogens.



Wind damaged lettuce (S Grigg)

