



**BOTANIC
GARDENS**
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IPSN

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Sentinel Network

Classification of damage by leaf-feeding (phyllophagous) arthropods

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This guide describes the major types of damage caused by leaf-feeding arthropods, with accompanying images of typical examples; showing how variable damage can be. It also indicates the different arthropod orders or families that are most likely to cause each type of damage.

Skeletonisation

Characteristic of damage

- Eating soft tissue, leaving leaf veins
- Sometimes low or upper epidermis remain untouched
(if feeding is on upper side of the leaf in the first case and is on lower side of the leaf in the second)



Potential cause

- Larvae of many lepidoptera
- Larvae of some Hymenoptera
- Larvae and adults of some Coleoptera

Perforation

Characteristic of damage

- Gnawing holes in the leaf lamina between the leaf veins
- Size of holes will vary and depend upon insect size (bigger insect, bigger holes)



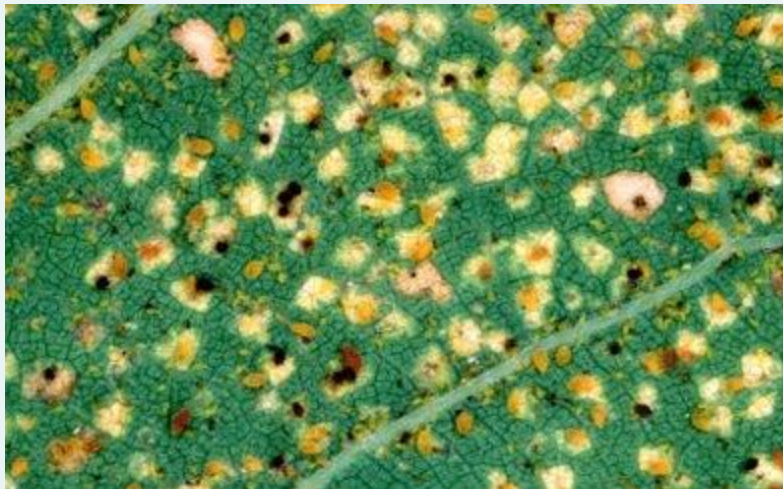
Potential cause

- Mainly Coleoptera (for example, larvae and adults of Chrysomelidae)

Piercing (and Sucking)

Characteristic of damage

- Tiny injury
- Only noticeable by paleness, yellowing or reddening in places of feeding on the leaf lamina



Potential cause

- Insects with piercing-sucking mouthparts (aphids)

Cut-outs

Characteristic of damage

- Damage to leaf margin
- Can be any shape: square, oval or circular cuts



Potential cause

- Usually, adult insects
- Some Coleoptera (Curculionidae)
- Some Hymenoptera (Megachilidae)

Rough Eating

Characteristic of damage

- Eating away soft tissue of the lamina including veins
- The main leaf vein and other hard parts of other veins may be left untouched



Potential cause

- Larvae of many Lepidoptera
- Larvae of some Hymenoptera
- Larvae of some Coleoptera

Leaf Mining

Characteristic of damage

- Eating out the inner tissue, leaving untouched lower and upper epidermis
- Cavities (so-called mines) have various shapes (blotches, tunnels etc.)
- Dependent on location, mines can be:
 - Upper side (in epidermis or in palisade parenchyma)
 - Lower side (in epidermis or in spongy mesophyll)
 - Full depth (all green tissue eaten out)



Potential cause

- Larvae of Lepidoptera
- Larvae of Hymenoptera
- Larvae of Coleoptera
- Larvae of Diptera

Galling

Characteristic of damage

- Outgrowth of plant tissue; can be the leaf lamina, vein or petiole
- The shape, size and colour can vary greatly and is dependent on the particular insect causing the damage



Potential cause

- Hymenoptera (Cynipioidea)
- Diptera (Cecidomyiidae)
- Hemiptera
- Some mites (Acari)

Leaf folding and rolling

Characteristic of damage

- Deformation of the leaf lamina
- Creates a shelter where the insect continues to feed by cutting and folding/rolling
- Leaf can be strapped (pulled over) or cut in a certain way, then glued



Potential cause

- Some Lepidoptera
- Some Coleoptera (Attelabidae)

Leaf curling

Characteristic of damage

- Caused by abnormal growth of the leaf tissue
- Makes a shelter for continued eating
- Can also be caused by certain fungi and viruses



Potential cause

- Aphidoidea
- Larvae of some Lepidoptera
- Some mites (Acari)

10. Leaf construction (nests)

Characteristic of damage

- Nests made of leaves/needles spin together by silk (secreted from insect glands)
- Larvae feed in nests; can disperse and organise new nests
- Often larvae will be rough eating the leaf's lamina in or around nests



Potential cause

- Some lepidoptera



11. Presence of Wax

Characteristic of damage

- Waxy scales; the remains of exoskeletons shed during moulting
- Protect insects from predators
- Allows for feeding (sucking sap from phloem)



Potential cause

- Coccoidea



12. Presence of Froth or Spittle

Characteristic of damage

- Moist balls of bubbles (foam); frothed plant sap produced by leafhoppers
- Protect larvae from predators and dehydration
- Allows for feeding (sucking sap from phloem)



Potential cause

- Cicadellidae

Identifying Pests

- These guidelines gives an indication of what could be causing damage, however (unless familiar with the pest in question) only a plant health diagnostician will be able to make a formal identification
- If you are particularly worried about a pest please contact your local diagnostic lab.
- If you are unsure who this is, please contact your NPPO (please see 'IPSN guide to Plant Health Governance' guide
- In order to make a positive identification diagnosticians will require a physical adult sample (or a larvae if molecular analysis is available for the species in question). Please see IPSN guidance on how to package samples for diagnostic purposes

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Image references



4	Top image (left): oak skeletonizer, <i>Bucculatrix ainliella</i> , James Solomon, USDA Forest Service, Bugwood.org (Host = <i>Quercus texana</i>) Top image (right): Mexican bean beetle, <i>Epilachna varivestis</i> , David Cappaert, Michigan State University, Bugwood.org (Host = <i>Phaseolus</i> spp.) Bottom image: Lyonetiid moth, Minnesota Department of Natural Resources Archive, Minnesota Department of Natural Resources, Bugwood.org
5	Top image: Coleoptera, Chrysomelidae, <i>Pyrrhalta viburni</i> , larvae, viburnum beetle, <i>Viburnum</i> , UK, UPDATED AK – S Martin (Fera, UK) Bottom image: Chrysomelidae, larvae, <i>Acer platanoides</i> , UK, Surrey, RHS Wisley, Andrew Halstead, 24/4/9 – Chris Malumphy (Fera, UK)
6	Top image: oak phylloxera, <i>Phylloxera quercus</i> , Andrea Battisti, Universita di Padova, Bugwood.org (Host = <i>Quercus pubescens</i>) Bottom image: oak phylloxera, <i>Phylloxera quercus</i> , Andrea Battisti, Universita di Padova, Bugwood.org (Host = <i>Quercus pubescens</i>)
7	Top image: erythrina gall wasp, <i>Quadrastichus erythrinae</i> , Albert (Bud) Mayfield, USDA Forest Service, Bugwood.org (Host = <i>Erythrina</i> spp.) Bottom image: leaf cutter weevil, <i>Amblyrhinus poricollis</i> , William Fountain, University of Kentucky, Bugwood.org
8	Top image: Coleoptera, Chrysomelidae, <i>Paropsisterna selmani</i> , Hymenoptera, RBG, Kew – Chris Malumphy (Fera, UK) Bottom image: grape sawfly, <i>Waldheimia vitis</i> , Lance S. Risley, William Paterson University, Bugwood.org (Host = <i>Vitis</i> spp.)
9	Top image: leaf chestnut miner, <i>Cameraria ohridella</i> , Ellie Barham BGCI (Host = <i>Aesculus hippocastanum</i>) Bottom image: <i>Stigmella speciosa</i> , Gyorgy Csoka, Hungary Forest Research Institute, Bugwood.org (Host = <i>Acer pseudoplatanus</i>)
10	Top image: Elm sack-gall aphid, <i>Tetraneura ulmi</i> , Jan Liska, Forestry and Game Management Research Institute, Bugwood.org (Host = <i>Ulmus</i> spp.) Bottom image: Asian chestnut gall wasp, <i>Dryocosmus kuriphilus</i> , Ignazio Graziosi, University of Kentucky, Bugwood.org (Host = <i>Castanea sativa</i>)
11	Top image: leaf-rolling weevil, <i>Homoeolabus analis</i> , Lacy L. Hyche, Auburn University, Bugwood.org Bottom image: larger canna leafroller, <i>Calpodes ethlius</i> , Herbert A. 'Joe' Pase III, None, Bugwood.org
12	Top image: leafcurl ash aphid, <i>Prociphilus fraxinifolii</i> , Steven Katovich, USDA Forest Service, Bugwood.org (Host = <i>Fraxinus pennsylvanica</i>) Bottom image: woolly elm aphid, <i>Eriosoma americanum</i> , Steven Katovich, USDA Forest Service, Bugwood.org (Host = <i>Ulmus americana</i>)
13	Top image: pine processionary moth, <i>Thaumetopoea pityocampa</i> , John H. Ghent, USDA Forest Service, Bugwood.org (Host = <i>Pinus</i> spp.) Bottom image (left): fall webworm, <i>Hyphantria cunea</i> , Lacy L. Hyche, Auburn University, Bugwood.org Bottom image (right): cherry web-spinning sawfly, <i>Neurotoma fasciata</i> , Lacy L. Hyche, Auburn University, Bugwood.org (Host = <i>Prunus serotina</i>)
14	Top image, bottom image (right): horse chestnut scale, <i>Pulvinaria regalis</i> , Chris Malumphy, Fera UK (Host = <i>Aesculus hippocastanum</i>) Bottom image (left): Pseudococcidae, <i>Balanococcus diminutus</i> , M Delaney Fera UK
15	Top image: spittlebugs or froghoppers, John H. Ghent, USDA Forest Service, Bugwood.org Bottom image: spittlebugs, <i>Clastoptera</i> spp., Whitney Cranshaw, Colorado State University, Bugwood.org (Host = <i>Quercus gambelii</i>)