- Ontario Ministry of Agriculture, Food & Rural Affairs

Indirect Insect Pests - *Foliar*

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Direct vs Indirect Pest

Depends upon which plant part is attacked

- **Direct**: insects that feed on **fruit**
- **Indirect**: insects that attack **leaves, trunk** and **other parts of the tree**

Major pests have the potential to cause major economic loss

- Most **direct** pests are also considered **major** pests
- Although **indirect** pests may limit fruit yield, they are usually considered **minor** pests

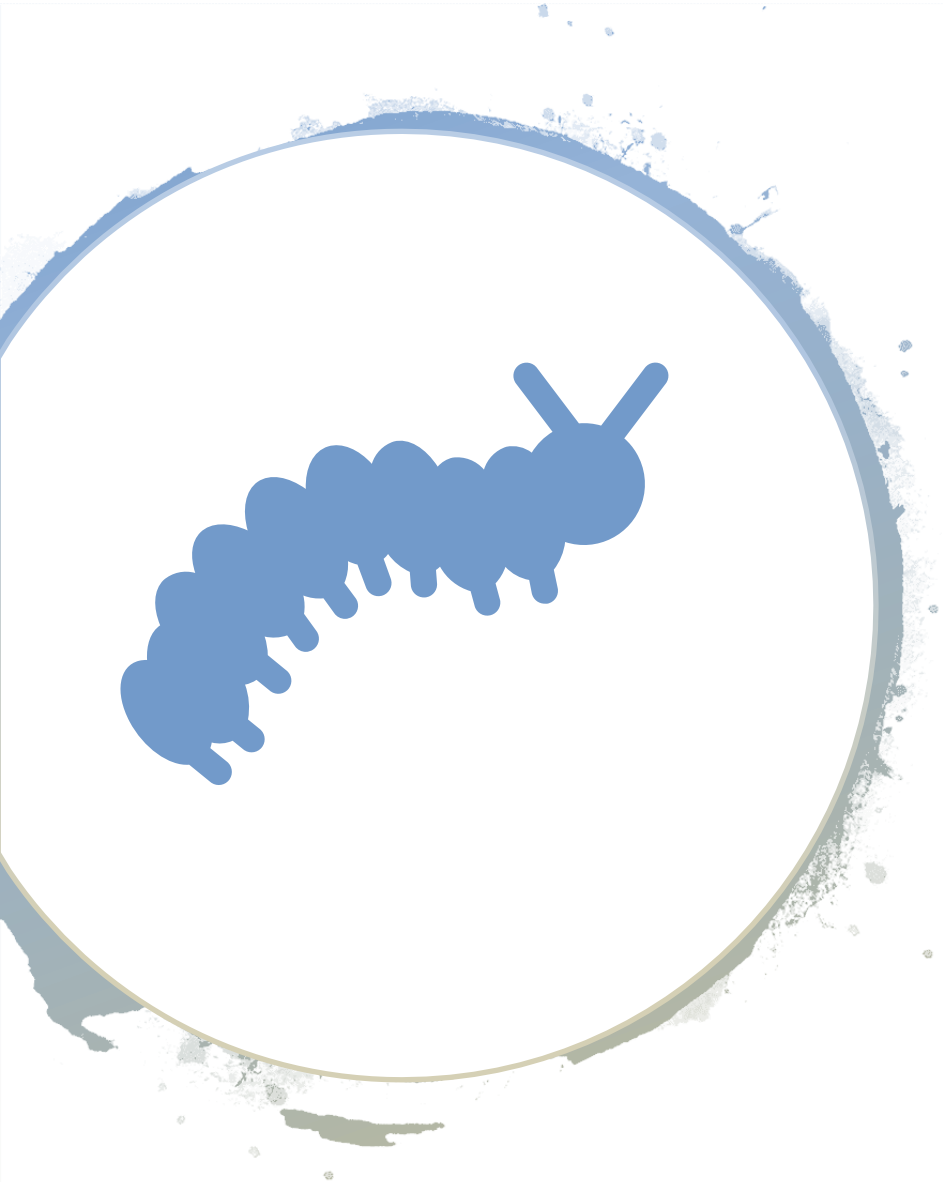
Indirect Insect Pests

- Spotted tentiform leafminer
- Leafhoppers
- Leafcurling midge
- Japanese beetle

Spotted Tentiform Leafminer,

Phyllonorycter blancardella

Sap-feeder	Tissue-feeder	Adult
• Flat head capsule • Wedge-shaped	• 4^{th}-5^{th} instar • Oval head capsule • cylindrical	• Gold, white and black striped moth • Active at night, rest on underside of leaf in day



- 3 generations per year
  - 1st generation adults: **late April to May**, peak emergence from pink to bloom
  - 2nd generation adults: **mid to late June**
  - 3rd generation adults: **August into September**
- Pupate within leaves, OW on orchard floor
- Healthy trees tolerate considerable injury
- High populations can cause premature fruit drop in cultivars like McIntosh

Spotted tentiform leafminer

Sap-feeder damage

- Mesophyll layer on underside of leaf

Tissue-feeder damage

- Parenchymal and epidermal layers of leaf (see from top)

Spotted tentiform leafminer

- Pheromone traps (optional), predict egg hatch
- **Five fruit spurs/leaves from 10 trees**, lower part of canopy
- Stop when tissue-feeding mines predominant – insecticides do not control this stage

Stage of growth	Gen.	Threshold
Pre-bloom – calyx	1	3 eggs per spur (prior to egg hatch) **OR** 1 mine per leaf (after egg hatch)
June – July	2	2 mines per leaf (stressed) **OR** 4 mines per leaf (healthy)
August – Sept.	3	Control measures are not generally recommended for this generation

Management strategies for leafminer

Cultural controls

- Mulch fallen leaves or apply urea to enhance decomposition and reduce OW populations

Biological controls

- Predators such as spiders and ground beetles feed on pupae on orchard floor
- Lacewings feed on larvae
- Parasitic wasps most important – as high as 80% parasitism in some orchards

Chemical controls

- Sprays are often unnecessary as controlled by natural predators or insecticides used to manage other pests
- Select insecticides that are safe on beneficial insects

Spotted tentiform leafminer

White apple leafhopper

Leafhoppers

Potato leafhopper

White Apple Leafhopper, *Typhlocyba pomaria*

nymph

adult

Leaf stippling

- caused by sucking sap of leaves
- pale white or greenish stipples
- more prevalent in June or July

Leafhoppers

Fruit spotting

- randomly spaced spots that can be washed off (unlike flyspeck)
- more prevalent in August

University of New Hampshire

Leafhoppers

- Most numerous in **late May to early June** and again **mid-summer to harvest**
- Nymphs and adults feed on plant juices
- 2 generations per year

- Begin monitoring late bloom or petal fall
- Check undersides of **5 leaves from 20 trees**
- Select mid-age to older leaves, or arm's length into canopy

- Threshold: **2 -5 nymphs per leaf in a 100 leaf sample**

Potato Leafhopper, *Empoasca fabae*

Nymph

Adult

Iowa State University

WALH vs PLH differentiated by walk when disturbed

- WALH walk forward and backward
- PLH walk backward or sideways (crab-like)

- Injects toxin into plant while feeding, blocking normal movement of water and nutrients to affected area
- **“Hopperburn”** – brittle, brown leaf margins

Leafhoppers

Potato leafhopper - terminals

Rosy apple aphid - fruit spurs

Telling the difference…

- Wide host range
- Do not overwinter in ON, carried in by air currents **early to mid-June -- after 1st cut of hay**
- 2-4 overlapping generations

- **Check undersides of leaves** during weekly scout
- Looked for **curled leaves, reduced shoot growth**
- Easily disturbed and move off leaf

- Thresholds: None

HOWEVER, 1 or 2 nymphs per leaf can cause damage if they feed for a few days.

Management strategies for leafhoppers

Cultural controls

- Do not plant alfalfa or establish hay fields near orchard

Biological controls

- Natural enemies do not provide effective economic control

Chemical controls

- Most effective on young nymphal stages early season
- For PLH, apply at first sign of injury on nursery and non-bearing trees

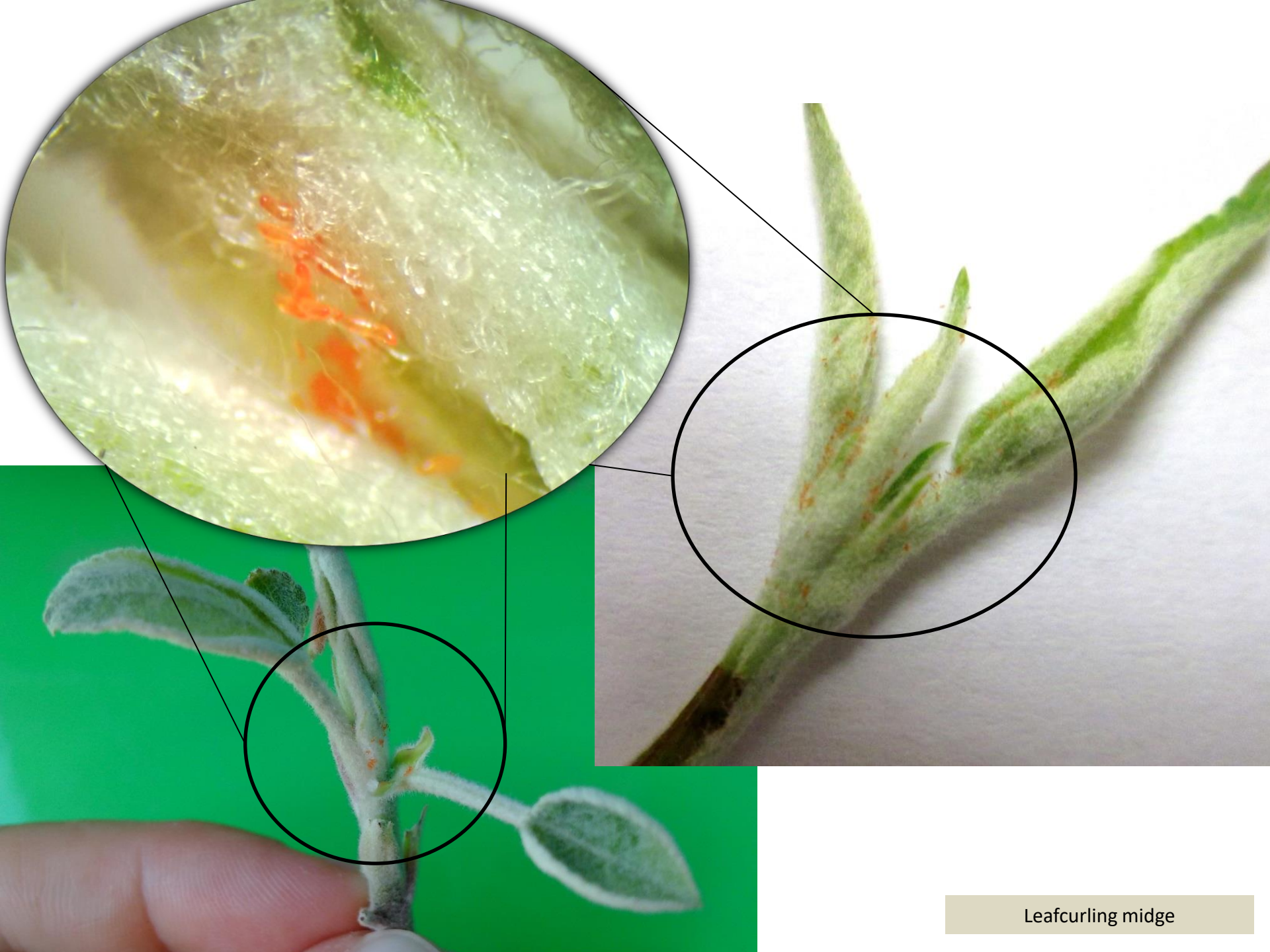
Apple Leafcurling Midge, *Dasineura mali*

Adults

- Small fly, 1.5-2.5 mm
- Long legs
- Beaded antennae
- Red heamolymph on traps

Leafcurling midge

Leafcurling midge



Leafcurling midge

- Margins of infested leaves are rolled in towards the mid-vein
- Leaves become purple / red and brittle before dropping from the tree
- Curled leaves usually contain 20-30 larvae or more
- Reduced photosynthesis, stunted growth of terminal shoots

Leafcurling midge

Leafcurling midge

Leafcurling midge – discoloured, brittle

Leafroller – webbing, frass

Telling the difference…

Leafcurling midge

- OW as larva in leaf litter
- Adults emerge from **pre-bloom through petal fall**, larva can be present until harvest
- Rainfall affects development and larval emergence from leaves; dry summer delays development
- 3 generations per year (1 prebloom), potential fall generation

- **Pheromone traps** at tight cluster to pink
- Note **leaf curling and discoloration** during regular terminal checks

- Threshold: **None**

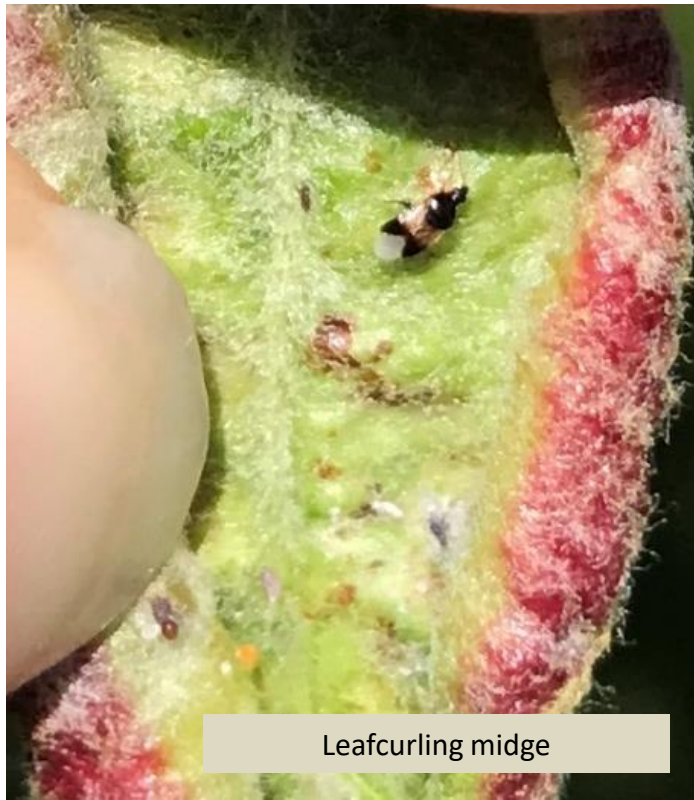
Leafcurling midge

Biological controls

- Several beneficial insects including minute pirate bug (Orius) and mullein bug, as well as parasitiods attack ALCM larvae

Chemical controls

- Difficult to manage using insecticides since well protected in leaves



Leafcurling midge

Japanese beetle, *Popillia japonica*

- Metallic greenish-bronze beetles, with coppery red wings and white tufts on sides and tips of abdomen
- Larvae are milky white, C-shaped grubs in soil

Japanese beetle

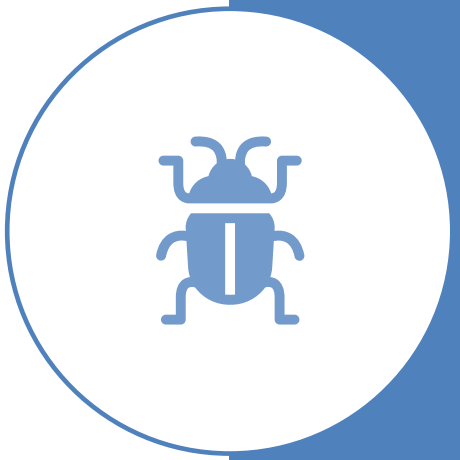
- Adults feed on upper surface of leaves
- Damage often starts at top of plant and moves downward
- Skeletonized appearance
- Feed in groups

Japanese beetle

- One generation per year
- OW as grubs in soil
- Adults emerge **late June to early July**
- Produce aggregation pheromones, feeding induces plant host volatile response that attracts others = **mass amounts of beetles!**

- Adults readily observed in orchard during regular monitoring
- Monitoring traps available BUT can lead to more damage due to attractiveness

- **No thresholds**
- Presence of high numbers of beetles or signs of damage on preferred cultivars such as Honeycrisp warrant management



Japanese beetle

Management strategies for Japanese beetle

Cultural controls

- Reduce tree stress (drought, high temperatures, high crop load)

Biological controls

- Natural enemies do not provide effective economic control

Chemical controls

- Insecticides applied to control other orchard pests such as codling moth general provide effective JB control
- Tendency to feed at top of canopy = proper coverage essential
- May require multiple applications due to migratory behaviour in/out of orchard

Thank You!

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