



CLIMATE CHANGE ADAPTATION PROGRAM

Downy Mildew in Hops

Fact Sheet

Funding for this project has been provided by the Governments of Canada and British Columbia through Growing Forward 2, a federal-provincial-territorial initiative. The program is delivered by the Investment Agriculture Foundation of BC.

Opinions expressed in this document are those of the author and not necessarily those of the Governments of Canada and British Columbia or the Investment Agriculture Foundation of BC. The Governments of Canada and British Columbia, and the Investment Agriculture Foundation of BC, and their directors, agents, employees, or contractors will not be liable for any claims, damages, or losses of any kind whatsoever arising out of the use of, or reliance upon, this information.

DELIVERED BY

FUNDING PROVIDED BY



Downy Mildew in Hops

Pseudoperonospora humuli

January 2018

Downy mildew is a re-emerging disease in the re-emerging hops industry. This disease affects yield and quality in cones and could cause complete loss in marketable yield or kill plants. Multiple management methods must be used to help keep downy mildew in check throughout the growing season

Symptoms



Dark purple spores under a leaf

Shoots

- Infected shoots (“basal spikes”) emerge in spring, with distinct stunted growth and yellow or brown curling, brittle leaves
- Secondarily-infected shoots (“aerial spikes”), such as the tips of main bines and side shoots, have similar symptoms, but stunted growth may be less noticeable
- Frost causes similar damage, keep in mind when monitoring in early spring

Leaves

- Necrotic (light to dark) brown angular lesions appear on the topside of the leaves, confined within the veins. They are generally scattered on the mature lower leaves and die in warmer weather, leaving behind dead leaf tissue
- Dark purple or black spots composed of spores are visible on the underside of leaves

Burrs and cones

- Infected burrs turn dark brown and may drop from plants; cones turn dark brown and cease development
- Severely affected cones may have a striped or variegated appearance later in the season

Roots/crown

- Reddish-brown streaks develop on infected crowns and roots



Dark brown infected cones

Life Cycle

Shoot infections become systemic and disease spreads to the crown

Disease overwinters in crown and dormant buds, and spreads into developing buds in early spring

Infected shoots grow from diseased crown and buds

Leaf lesions appear. In favourable conditions, spore production continues, and spreads to leaves, shoots, and cones

With favourable conditions, infection cycle will repeat throughout season

Spores produced on infected shoots spread to bine tips and lateral shoots in wet weather above 10°C

Created by:

Delivered and funded by:



Climate Action Initiative
BC AGRICULTURE & FOOD



british columbia raspberries



Monitoring and Management for Downy Mildew in Hops

Monitoring

- Begin weekly monitoring when plants start growing in spring and until dormancy
- Look for symptoms on leaves, shoots and burrs or cones
- Monitor each variety, especially in areas with a history of high disease incidence
- Walk diagonally through the sections, checking edges and inner areas
- Change the path each time you walk to scout different areas

When to spray? - If these critical conditions are present, apply a fungicide!

Critical times for management	Ideal conditions for disease development
Immediately before and after training	High humidity ~ 83%
Lateral branch development	Free moisture ~ At least 4-12 hours
During: <ul style="list-style-type: none">• Bloom• Cone development• Post-harvest	Mild to warm temperatures ~ 18°C (can still infect at 5°C)

Chemical control

- Always follow the product label; be particularly aware of long pre-harvest intervals
- Spray preventatively, most fungicides have limited efficacy after infection
- Fungicides applied in the establishment season may reduce future crown infections
- In a field with infection history, spray systemic products early, when first shoots appear. Begin spring pruning after the spray has had time to work into the plant
- Time sprays later in the season with major infection events (see table above)
- Downy mildew can become resistant to fungicides, so rotate chemical groups.

Cultural control

- Select more tolerant varieties as they vary in susceptibility, although none are fully resistant
- Plant susceptible varieties in dryer areas of the farm
- Plant disease-free material
- Remove all foliage during spring pruning. Prune as late into the season as possible, but balance timing of pruning with training to avoid yield reduction
- Train bines early to minimize soil contact
- Harvest infected yards early
- Do not over-apply nitrogen fertilizer

Keep up sanitation

- Remove basal spikes weekly to reduce risk of future infection
- Remove and burn infected bines, leaves and crowns, including plant material from pruning
- Clean and disinfect pruning tools regularly

Reduce canopy humidity

- Remove basal leaves after training and strip leaves off first meter of bines when the plant is $\frac{3}{4}$ full trellis height, around mid to late June. Do not strip excessively if crop is unhealthy
- Control weeds and cultivate soil, especially post-harvest
- Avoid overhead irrigation
- When planting, space hops ~3.5 feet apart to promote airflow

Links and Resources

Management and product updates: onspecialtycrops.wordpress.com/category/hops/hops-pest-management/

PMRA database: pr-rp.hc-sc.gc.ca/lr-re/index-eng.php

Washington State University field guide: usahops.org/cabinet/data/Field-Guide.pdf

