Downy mildew and neck rot on onion and stem and bulb nematode on garlic.
Holland Marsh, Ontario, Canada 44° 15’ N, 79° 35’ W
Onion downy mildew

- Develops in cool, humid weather
- Fungicides must be applied before infection takes place
- Disease forecasting important

- Sporulation when temperatures below 75 °F, (24 °C) previous day
- **Temperatures over 81 °F inhibit sporulation**
- Temp 38 - 75 °F (4 – 24 °C) at night
- Humidity above 95%, but not rain at night,
- Infection: 43-79 °F, 3-6 hours leaf wetness
- Takes 9 to 16 days from infection until sporulation
- No symptoms until sporulation occurs
Downy mildew developed late in the season in 2014.

Onion Downy Mildew - 2014

There was no onion downy mildew in 2016, the weather was hot and dry.

Disease forecasting with DOWNCAST was effective – no fungicides recommended and no disease.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Rate (per ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZAMPRO (ametoctrandin+dimethomorph)</td>
<td>1.0 L + 0.25% v/v Sylgard</td>
</tr>
<tr>
<td>ORONDIS (oxathiapiprolin formerly QGU42)</td>
<td>350 mL</td>
</tr>
<tr>
<td>DITHANE (macozeb 75%)</td>
<td>32.5 kg</td>
</tr>
<tr>
<td>QUADRIS TOP (azoxystrobin+difenoconazole)</td>
<td>1.0 L</td>
</tr>
<tr>
<td>RIDOMIL/ALIETTE² (mefanoxam/ fosetyl-Al)</td>
<td>2.5/2.8 kg</td>
</tr>
<tr>
<td>OMEGA (Allegro, fluazinam 50%)</td>
<td>1.16 L</td>
</tr>
<tr>
<td>CABRIO (pyraclostrbin 20%)</td>
<td>840 g</td>
</tr>
<tr>
<td>Check</td>
<td></td>
</tr>
</tbody>
</table>
Onion downy mildew - 2016

- Results from past years indicate that fungicides Orondis and Zampro are effective for downy mildew control
- We will continue this work until downy mildew develops in the trial
Onion neck rot

*(Botrytis allii, B. aclada, B. byssoidea)*

- Can be on onion seed
  - The cotyledon becomes infected from the seed coat, fungus can sporulate on the dying cotyledon, and infect other leaves.
- Airborne spores land on leaves during the growing season
- Infection takes place during cool, (50-68°F) humid weather
- “Latent” infection. Usually no symptoms until onions are in storage
Onion neck rot

- Infection can also occur at harvest if the necks have some green or moist tissue.
- Does not spread from bulb to bulb in storage, but can become worse the longer the bulbs are stored.
- White onions and some late maturing red onions are very susceptible.
Onion neck rot - Objectives

- To evaluate fungicides for the control of onion neck rot
- To evaluate the timing of fungicide applications to optimize the control of neck rot
  - White dehydrator onion
Onion neck rot: Methods

- Seeded mid May
- Fungicides sprays began mid July
- 5 sprays at ~ 10 day intervals)
- Onions pulled late Sept 29 to early October (late harvest)
  - not subjected to artificial curing.
  - 7.5 feet of row harvested
- All onions were assessed in late January to early February
- Bulbs were cut and examined for symptoms

neck rot

healthy
## Fungicides for neck rot control-2014, 2015

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Active ingredient</th>
<th>Rate L/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fontelis</td>
<td>penthiopyrad</td>
<td>1.75</td>
</tr>
<tr>
<td>Pristine</td>
<td>boscalid + pyraclostrobin</td>
<td>1.3</td>
</tr>
<tr>
<td>Luna Tranquility</td>
<td>fluopyram+pyrimethanil</td>
<td>1.2</td>
</tr>
<tr>
<td>Omega</td>
<td>fluzainam</td>
<td>1.16</td>
</tr>
<tr>
<td>Switch</td>
<td>cyprodinil+fludioxonil</td>
<td>975 g</td>
</tr>
<tr>
<td>Quadris Top</td>
<td>azoxystrobin + difenoconzole</td>
<td>1.0</td>
</tr>
<tr>
<td>Scala</td>
<td>pyrimethanil</td>
<td>2.0</td>
</tr>
<tr>
<td>Check</td>
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</tr>
</tbody>
</table>
Evaluation of fungicides for the control of onion neck rot: dehydrator onion 2014
# Fungicides for neck rot control-2016

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Active ingredient</th>
<th>Rate L/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fontelis</td>
<td>pentytropyrad</td>
<td>1.75</td>
</tr>
<tr>
<td>Pristine</td>
<td>boscalid + pyraclostrobin</td>
<td>1.3</td>
</tr>
<tr>
<td>Luna Tranquility</td>
<td>fluopyram + pyrimethanil</td>
<td>1.2</td>
</tr>
<tr>
<td>Gavel 75 DF</td>
<td>zoxzmide and mancozeb</td>
<td>2.2 kg</td>
</tr>
<tr>
<td>Syngenta A19649B</td>
<td>experimental</td>
<td>0.75</td>
</tr>
<tr>
<td>Quadris Top</td>
<td>azoxystrobin + difenoconzole</td>
<td>1.0</td>
</tr>
<tr>
<td>Coronet seed treatment</td>
<td>boscalid + pyraclostrobin</td>
<td></td>
</tr>
<tr>
<td>Check</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Evaluation of fungicides for the control of onion neck rot: dehydrator onion- 2016

Percent bulbs with symptoms

- **Check**: c
- **Coronet**: bc
- **Gavel**: abc
- **Luna Tranquility**: abc
- **Quadris Top**: ab
- **Fontelis**: a
- **Pristine**: a
- **Syngenta**: a
Fungicide spray timing for control of neck rot 2014, 2015

- Disease forecasting systems were tested
  - First true leaf (to prevent infection from cotyledon) (1)
  - **Botcast** – developed for Botrytis leaf blight (4,6) (combination of temp. and leaf wetness)
  - **Tomcast** with Disease Severity Values of 20 and 30 (combination of temp. and leaf wetness) (8,7)
  - 5th or 6th true leaf (6, 5)
  - 2nd week of August (before lodging) (3, 2)
  - Just before lodging (1)
  - Unsprayed (0)
Evaluation of spray timing with Fontelis for the control of onion neck rot: dehydrator onion 2014 and 2015

No differences in neck rot levels

Percent bulbs with symptoms

- Check
- 2 Lvs
- 5 Lvs
- Botcast
- Tomcast 20
- Tomcast 30
- August
- Lodging

2014

2015
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>1st true leaf</td>
<td>X</td>
<td>-</td>
<td>X</td>
<td>X</td>
<td>-</td>
<td>-</td>
<td>X</td>
<td>X</td>
<td>-</td>
<td>X</td>
<td>-</td>
<td>X</td>
<td>-</td>
<td>X</td>
<td></td>
<td>9</td>
</tr>
<tr>
<td>4 true leaf stage</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>X</td>
<td>X</td>
<td>-</td>
<td>X</td>
<td>-</td>
<td>X</td>
<td>-</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>BOTCAST 20</td>
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<td>-</td>
<td>-</td>
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<td>1</td>
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<td>X</td>
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<td>5</td>
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<tr>
<td>TOMCAST 30</td>
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<td>-</td>
<td>-</td>
<td>X</td>
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<td>-</td>
<td>X</td>
<td>-</td>
<td>X</td>
<td>-</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>2ND week of August</td>
<td>-</td>
<td>-</td>
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<td>-</td>
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<td>-</td>
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<td>-</td>
<td>-</td>
<td>X</td>
<td>-</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Coronet Seed treatment</td>
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<td>-</td>
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<td>-</td>
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<td></td>
<td>0</td>
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<tr>
<td>Check</td>
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<td>-</td>
<td></td>
<td>0</td>
</tr>
</tbody>
</table>
Evaluation of spray timing with Fontelis for the control of onion neck rot: 2016

No differences in neck rot levels

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Number of Neck Rot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check</td>
<td>0</td>
</tr>
<tr>
<td>Seed treatment</td>
<td>1</td>
</tr>
<tr>
<td>1 leaf</td>
<td>9</td>
</tr>
<tr>
<td>4 leaves</td>
<td>6</td>
</tr>
<tr>
<td>Tomcast 20</td>
<td>5</td>
</tr>
<tr>
<td>Tomcast 30</td>
<td>4</td>
</tr>
<tr>
<td>Botcast</td>
<td>1</td>
</tr>
<tr>
<td>2nd week Aug</td>
<td>1</td>
</tr>
</tbody>
</table>
Fungicides and spray timing for the control of onion neck rot - Conclusions

- White dehydrator onions are very susceptible.
- Fontelis, Pristine, and a new fungicide from Syngenta were very effective. Quadris Top also reduced disease.
- Fungicide sprays starting at the 4-5 leaf stage and seed treatments and Tomcast 30 for further testing.
- Cultural methods to ensure dry necks at harvest are important to reduce neck rot.
Garlic Production in Ontario

Small industry:
- 200-300 acres officially, probably ~ 600
- In Canada: up to 1000 acres?
- Many farms are less than 5 acres
- Many organic growers
- There is a high demand for local garlic
- Stem and bulb nematode is the limiting factor

Garlic is planted in October and harvested in July.
Stem and Bulb Nematode

*Ditylenchus dipsaci*

- microscopic nematodes 1.2 mm long
- migratory endo-parasites
- live and feed inside bulb and stems of plants but travel in soil pores filled with water
- live in plants and feed on stems, leaves, bulbs, buds, rhizomes and flowers but rarely roots
- they are transferred easily in garlic cloves used for seed
A low level of infection may result in no symptoms, but heavy infection destroys the bulbs.
Soaking cloves in Agri-Mek (abemectin) for 4 hours is very effective. There is a problem getting this registered, so alternative products were investigated:

- **Agri-Mek (abamectin)**
- **Nimitz (fluensulfone)**
- **Movento (spirotetramat)**
- **Velum Prime (fluopyram)**

Also compared to clean seed from the tissue culture facility at New Liskeard (Becky Hughes).
## Rates and preplant soak time for cloves treated with Velum Prime (fluopyram) and Agri-Mek 2015-2016

<table>
<thead>
<tr>
<th>Product</th>
<th>Rate ml/L</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nematode free</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water</td>
<td></td>
<td>2 and 4 hours</td>
</tr>
<tr>
<td>Agri-Mek</td>
<td>0.83</td>
<td>4 hours</td>
</tr>
<tr>
<td>Velum Prime</td>
<td>0.35</td>
<td>2 and 4 hours</td>
</tr>
<tr>
<td>Velum Prime</td>
<td>0.7</td>
<td>2 and 4 hours</td>
</tr>
<tr>
<td>Velum Prime</td>
<td>1.4</td>
<td>2 and 4 hours</td>
</tr>
</tbody>
</table>

Infected cloves had an average of 380 nematodes per gram of dry bulb.
Effect of pre-plant treatment on yield of garlic

Yield per plot (kg)

Treatment and soak time

Water  Agri-Mek  Nematode free  VP 0.35  VP 0.7  VP 1.4

Treatment and soak time:
- 2 hour
- 4 hour

Legend:
- a
- b
- c
Nematicide Trials 2015-2016

- Nematode infected garlic cloves (av. 830 nematodes/g) were treated in the Fall of 2015, prior to planting. Harvested July 2016
- Planted in non-infested soil
- Products:
  - Agri-Mek (abamectin)
  - Nimitz (fluensulfone)
  - Movento (spirotetramat)
  - Velum Prime (fluopyram)
- Severity rated 0-4: 0 = no symptoms, 1- slight damage, 4- dead
<table>
<thead>
<tr>
<th>Product</th>
<th>App'n Method</th>
<th>Rate</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGRI-MEK SC</td>
<td>Soak</td>
<td>0.9 mL/L</td>
<td>4 hour soak</td>
</tr>
<tr>
<td>AGRI-MEK EC</td>
<td>Soak</td>
<td>3.76 mL/L</td>
<td>soak</td>
</tr>
<tr>
<td>AGRI-MEK SC</td>
<td>Dbl rate soak</td>
<td>1.7 mL/L</td>
<td>soak</td>
</tr>
<tr>
<td>VELUM PRIME</td>
<td>Soak</td>
<td>1.67 mL/L</td>
<td>soak</td>
</tr>
<tr>
<td>VELUM PRIME</td>
<td>Drench</td>
<td>0.5 mL/L</td>
<td>over-the-open-row drench at planting</td>
</tr>
<tr>
<td>NIMITZ 480 EC</td>
<td>Soak</td>
<td>20 mL/L</td>
<td>4 hour soak</td>
</tr>
<tr>
<td>NIMITZ 480 EC</td>
<td>Drench twice</td>
<td>6 mL/L</td>
<td>drench at planting and 3 May</td>
</tr>
<tr>
<td>NIMITZ 15G &amp; NIMITZ 480 EC</td>
<td>In-furrow &amp; drench</td>
<td>0.768 g/m, 6 mL/L</td>
<td>in-furrow at planting and drench 3 May</td>
</tr>
<tr>
<td>MOVENTO</td>
<td>Foliar</td>
<td>400 mL/ha</td>
<td>foliar applications on 3, 18 May &amp; 1, 15 June</td>
</tr>
</tbody>
</table>
Severity of stem and bulb nematode- 2016

S = 4 hour soak before planting  
D = Drench in open furrow immediately after planting  
F = foliar spray in spring (May) after emergence
Marketable yield of garlic - 2016

Percent of bulbs

S = 4 hour soak before planting
D = Drench in open furrow immediately after planting
F = Foliar spray in spring (May) after emergence
Velum Prime as a soak provided excellent control of stem and bulb nematode, even at high levels of infection in the planting materials (830 nematodes/g)

Velum Prime and Agri-Mek soaks resulted in yields similar to those of the nematode-free seed, when levels of infection were lower (380 nematodes/g)

Important to get Velum Prime registered for this use on garlic
Since fluopyram is a fungicide, will it control white rot also?
Rotation crops and possible hosts: white beans, kidney beans, dry and fresh peas, soybeans, wheat, onions, alfalfa.
Trials 2016-2017
Planted October 2016

- Nematode infested garlic cloves were treated in the Fall of 2016, prior to planting
- Planted in non-infested soil – 2 sites
- Treatments:
  - Agri-Mek (abamectin) - soak
  - Averland Reach (nano formulation of abamectin) - drench
  - Velum Prime (fluopyram) - soak
  - Nimitz (fluensulfone) - soak
  - ProMax (thymol) - soak
  - Phostoxin gas – preplant fumigation of seed
- Nematode free cloves
All research trials are summarized in the Annual Report

Download at the Muck Station web site:

www.uoguelph.ca/muckcrop

2016 report will be available by the end of March

Annual Muck Vegetable Growers Conference April 12 and 13, 2017
Onion Day: Thursday, April 13
Acknowledgements

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