Management of nematodes and carrot diseases

Mary Ruth McDonald,
Dennis Van Dyk, Kevin Kooi and Laura Riches
The research was mostly conducted in the Holland Marsh. Onions and carrots are the two major crops on the marsh. High organic matter soil: 48-80% om, pH 5.0-7.2
Muck Vegetable Production in Ontario (acres)

- Carrots - 7750 acres
  - Half on muck soil
- Onions - 5600
  - All on muck soil
- Chinese cabbage - 3197
- Other Asian veg?
- Red beets - 1428
- Celery - 619
- Green onions - 522
- Lettuce - 430
- Radishes - 327
- Leeks - 166
Carrots in Ontario

- Cello pack
- Jumbo
- Processing - mineral soil
- Bunched (minor)
- Cut and peel (baby cut) carrots, also minor
- Some interest in multicoloured “heirloom” carrots
Nematode Damage

- Root Knot Nematode
- Lesion Nematode Damage
- Also carrot cyst nematode
- Root Knot Damage
- Lesion Nematode Damage
Products

Biologicals
• MustGrow: Oriental mustard seed meal
• Dazitol
  • Essential oil of mustard + oleoresin of capsicum
• Agri-Mek: Abamectin *Streptomyces avermitilis*

Nematicides
• Nimitz: Fluensulfone
• Movento: Spirotetramat (also an insecticide)

Fumigants
• Pic Plus: Chloropicrin
• Busan/Vapam: Metam sodium
• Basamid: Dazomet
Root knot nematode: Carrot growth room trials

- Treatments
  1. Non-inoculated check
  2. Inoculated check
  3. Movento at 350 ml/ha spray post-plant
  4. Agri-Mek at 20 L/ha
  5. Dazitol at 60L/ha
  6. Basamid at 392 kg/ha
  7. Nimitz EC at 8.3 L/ha
  8. MustGrow at 1680 kg/ha
  9. 5-5-5 slow release fertilizer
  10. Busan 1236 at 275 L/ha
Carrot Growth Room Trial

Percent with Nematode Damage

MUSTGROW | Incoculated check | Fertilizer | AgriMek | MOVENTO | DAZITOL | NIMITZ | BUSAN | BASAMID | Non-inoculated check

Nematode damage (%)
Nematode management

Field Trials

Pic Plus – chloropicrin
Applied below the seed, in the hill, at the time of seeding

Applying PIC PLUS
Assessing Pic Plus, Dazitol and other products – 2 trials
Carrot Fumigant Field Trial - 2014

Mineral soil (1 of 2 trials)

Percent of roots infected

Check  Dazitol  Pic Plus

A  B  B
Stunting of carrots can be caused by nematodes and Pythium

Biocontrols for Pythium root dieback?
## Treatments for carrots Pythium and Nematodes  2014

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Timing of Applications (DBS)</th>
<th>Equipment</th>
<th>Product Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>PIC PLUS</td>
<td>at seeding</td>
<td>custom seeder</td>
<td>banded -25cm below seed</td>
</tr>
<tr>
<td>DAZITOL</td>
<td>2 DBS</td>
<td>custom fumigator</td>
<td>broadcast 25 cm below soil</td>
</tr>
<tr>
<td>LUNA TRANQUILITY</td>
<td>at seeding</td>
<td>HYPRO roller pump</td>
<td>in-furrow above seed</td>
</tr>
<tr>
<td>NIMITZ</td>
<td>7 DBS</td>
<td>custom fumigator</td>
<td>broadcast 15 cm below soil and soil surface</td>
</tr>
<tr>
<td>BACTERIA A</td>
<td>at seeding</td>
<td>HYPRO roller pump</td>
<td>in furrow above seed</td>
</tr>
<tr>
<td>NIMITZ + BACTERIA</td>
<td>7 DBS + at seeding</td>
<td>HYPRO roller pump</td>
<td>broadcast 15 cm below soil and soil surface + in-furrow</td>
</tr>
<tr>
<td>QUADRIS + REASON</td>
<td>at seeding</td>
<td>HYPRO roller pump</td>
<td>in-furrow above seed</td>
</tr>
<tr>
<td>Check</td>
<td>--</td>
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</tbody>
</table>
Field site on muck soil. Some products have to be applied 2 weeks before seeding.
Nematicides and fungicides to control Pythium stunt and carrot cyst nematode

Percent carrots with stunting
2014 Trial 2 on muck soils
Treatments

1. Untreated check
2. PicPlus (at seeding)
3. Vapam (broadcast 2 weeks before seeding)
4. Nimitz (broadcast/incorporate 1 week before seeding)
5. PicPlus + Vapam
6. PicPlus + Nimitz
7. AgriMek (drench over furrow during seeding)
8. MustGrow (granular broadcast 2 weeks before seed)
9. Dazitol (broadcast 3 days before seeding)
Field trials- nematode control -2015
Muck soil

Percent damage

Note: Nimitz is not expected to be effective on high organic matter soils
Managing carrot nematodes

- Fumigants provided most consistent control
- Nimitz reduced nematode damage comparable to fumigation in some trials
- Agri-Mek reduced nematode damage in some trials, Dazitol in one trial
- No advantage of combining fumigants and Nimitz

New regulations for applying fumigants:
- Tarping, separation distances, notification
Carrot Leaf Blights

- Two diseases are managed together:
  - *Alternaria dauci* ((Kuhn) Groves and Skolko)
  - *Cercospora carotae* ((Pass. Solheim))
Cercospora Leaf Blight

Alternaria Leaf Blight
Background

- Suncor, a petroleum company, has developed a good grade oil, Civitas, that is registered for use on turf grass.
- They are interested in potential registrations of similar products for edible crops.
- Different products, adjuvants, and methods of application.
Food grade oil has some interesting activity, but also some problems:

- The adjuvants often separate in the spray bottle (constant agitation needed)
- Different adjuvants (not bright green) are needed

Food grade oil = A
Green adjuvants = B
Treatments

- Cv Belgrado
- Seeded 2, 3 June
- Randomized complete block, 4 reps per treatment
- 4 rows (raised beds), 5 m in length
- Food grade oil in combination with 4 adjuvants (B-E)
- Second type of food grade oil in 2014
- In combination and comparison to fungicide boscalid (Lance) in 2013
- Endura (boscalid /Lance) and Quadris Top (azoxystrobin plus difenoconazole) in 2014
- Drench, foliar sprays, drench plus foliar sprays (500 L/ha)
- 5 sprays at 2 week intervals, starting 6 Aug (2013) and 30 July (2014)
## Treatments 2014

<table>
<thead>
<tr>
<th><strong>1st Application</strong></th>
<th><strong>2nd, 3rd, 4th, 5th Applications</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Products</strong></td>
<td><strong>Rates (L/ha)</strong></td>
</tr>
<tr>
<td>check</td>
<td>--</td>
</tr>
<tr>
<td>QUADRIS TOP at</td>
<td>1.0</td>
</tr>
<tr>
<td>QUADRIS TOP + A + B</td>
<td>1.0+ 25 + 1.6</td>
</tr>
<tr>
<td>Endura/ LANCE</td>
<td>315 g</td>
</tr>
<tr>
<td>Endura/ LANCE</td>
<td>315 g + 25 + 1.6</td>
</tr>
<tr>
<td>A + B (soil drench(^1))</td>
<td>100 + 6.3</td>
</tr>
<tr>
<td>A + B (std rate)</td>
<td>25 + 1.6</td>
</tr>
<tr>
<td>A + B (half rate)</td>
<td>12.5 + 0.8</td>
</tr>
<tr>
<td>A + B + C</td>
<td>25 + 1.6 + 4</td>
</tr>
<tr>
<td>A + D</td>
<td>25 + 1.6</td>
</tr>
<tr>
<td>A + B + E</td>
<td>25 + 1.6 + 5</td>
</tr>
<tr>
<td>G at 25 L + B</td>
<td>25 + 1.6</td>
</tr>
</tbody>
</table>

Soil drench on 31 July applied at 2,000 L/ha drench volume.
Disease Assessments

9 October, 26 September
10 plants per rep harvested and all leaves sorted into classes
Scale of 0 – 5
0 = all healthy
1 = < 10% disease leaf blight per leaf
2 = 11-25%
3 = 26-50%
4 = 51-75%
5 = over 75%
A disease severity index was calculated (0-100)
Dead leaves were counted separately
Number of plants per rep with symptoms of aster yellows
Yield and quality

- Harvested 29, 22 October
- 2 x 1.16 m sections of row
- Total yield (tonnes/ha)
- Percent culls,
- % medium (2.0- 4.4 cm diameter,
- % Jumbo (> 4.4 cm dia)
Food grade oil and carrot leaf blight 2013

Disease severity index

A+B+boscalid  Boscalid  A+B X2  A+B  A+B+C  A+B drench  A+B half  Check
Food grade oil and carrot leaf blight 2014

Disease severity index

- A+B+boscalid
- Boscalid
- A+B x2
- A+B
- A+B+C
- A+B drench
- A+B half
- Check
- Quadris Top

The graph shows the disease severity index for different treatments.
Food grade oil and carrot leaf blight 2015

Disease severity index

Quardris Top | Prod A | A+B | Prod B | Check
---|---|---|---|---
| a | b | c | d | d

Differences:
- Quadratis Top: a
- Prod A: b
- A+B: c
- Prod B: d
- Check: d
Conclusions - leaf lights

Leaf blight pressure was moderately high all years.

The food grade oil plus adjuvant, or alone, suppressed carrot leaf blights.

There was no advantage to combining food grade oil with the fungicide boscalid or azoxystrobin plus difenoconazole for leaf blights.

In 2014, Quadris Top was more effective than Endura (boscalid) for reducing leaf blight.
Aster yellows of carrots

Caused by a phytoplasma
*Caandidatus phytoplasma asteris*

Spread by the aster leafhopper *(Macrosteles quadrilineatus)*

Many pale green leaves from crown meristem

Red leaves in canopy

“Hairy roots” and bitter taste= unmarketable carrots
Food grade oil and aster yellows of carrots: 2013

Percent aster yellows

Very low aster yellows in 2014, 2015
Food grade oil and yield 2013

Disease severity index and yield (tonnes/ha)

No differences in yield
Food grade oil and yield 2014
Low aster yellows

Disease severity index

- A+B+boscalid
- Boscalid
- A+B x2
- A+B
- A+B+C
- A+B drench
- A+B half
- Check
- Quadris Top
Aster yellows was very high in 2013, very low in 2014 and 2015

The food grade oil plus adjuvant (and boscalid) suppressed symptoms of aster yellows

There was no advantage to combining food grade oil with the fungicide boscalid

The mode of action is not known

Does the food grade oil induce resistance to the phytoplasma or make the plants less attractive to the leaf hoppers?
All research trials are summarized in the Annual Report.

Download at the Muck Station web site:
www.uoguelph.ca/muckcrop

The report will also be on the web site of the Ontario Ministry of Agriculture, Food and Rural Affairs.
Annual Muck Vegetable Growers Conference: Bradford, Ontario, Canada

2016 conference June 22 and 23

Carrot day- June 22

Onion day - June 23
Acknowledgements

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Suncor
Engage and Engage Plus programs of NSERC
Thank you
Mineral Soil Results 2013

Stunt Nematode Counts

- PIC PLUS A
- DAZITOL B
- Check B

Stunt nematode count (per kg soil)
Carrot Growth Room Trial

Root Knot Nematode Infection

Average Gall Rating

- Inoculated Check
- Movento
- Dazitol
- MustGrow
- Nimitz
- Abamectin
- Busan 1236
- Non-Inoc Check

Legend:
C = Complete Control
B = Below Control
AB = Above Control
A = Extreme Above Control
Food grade oil and yield 2013

Disease severity index and yield (tonnes/ha)

No differences in yield

A+B+boscalid, Boscalid, A+B x2, A+B, A+B+C, A+B drench, A+B half, Check
Food grade oil and carrot leaf blight 2014

Disease severity index

- A+B+boscalid
- Boscalid
- A+B x2
- A+B
- A+B+C
- A+B drench
- A+B half
- Check
- Quadris Top

Categories: A, B, C
50 – 60% of carrots in Ontario are grown on muck soil, primarily for packaging and processing.
Food grade oil and leaf blight (number of dead leaves) in relation to aster yellows of carrots
Food grade oil and carrot leaf blight 2014

Disease severity index

- A+B+boscalid
- Boscalid
- A+B x2
- A+B
- A+B+C
- A+B drench
- A+B half
- Check

Legend:
- a
- ab
- bc
- bcd
- cd
- d
Most years, growers apply 5-7 fungicide sprays based on field scouting and crop growth stage (canopy closure)
Food grade oil and carrot leaf blight (number of dead leaves)
Food grade oil and carrot leaf blight 2013 and 2014

Disease severity index Number of dead leaves
Food grade oil and dead leaves per plant 2013 and 2014

Number of dead leaves