Muck Vegetable Research at the Muck Crops Research Stn.

- Mary Ruth McDonald, Dennis Van Dyk, Kevin Vander Kooi, Laura Riches, Selasi Tayviah, Bruce Gossen, Ahmed Abd-Elmagid, Katerina Jordan, Cynthia Scott-Dupree
Vegetable research

Muck Station
Pest management for muck vegetables

- Carrot weevil and rust fly
- Carrot nematodes
- Onion maggot
- Onion thrips - field scouting
- Onion downy mildew

Many of the forecasting programs are based on research from AAFC St. Jean-sur-Richelieu.

Carrot rust fly trap
Carrot rust fly damage

Small tunnels, often in lower part of root

Carrot weevil damage

Large tunnels. Most damage in top third of root
Carrot weevil

In 2013, 2014 and 2015, we saw carrots that were killed by carrot weevil larvae

Some years, trap catch and insecticide application are not related to damage
A Need to Improve Chemical Control of Carrot Insect Pests

- **Seed treatments**
  - Highly selective to insects feeding on the carrot
  - Eliminates the need for accurate timing

- **In-Furrow application**
  - Eliminates the need for accurate timing
  - Control against overwintering population
Evaluation of insecticides and different application methods for control of carrot weevil and carrot rust fly

Admire (imidacloprid)
Success (spinosad)
Delegate (spinetoram)
Matador 120 EC (lambda cyhalothrin)
Imidan 50-WP (phosmet)
Clutch (clothianidin)
Coragen (chlorantraniliprole)
Exirel and Verimark (cyantraniliprole)
Movento (spiratetramat)

Seed treatments, in-furrow treatments and foliar sprays
**Seed treatments**

- Carrots (cv. Bolero) were seeded by hand on May 28 (6 m X two beds) per treatment; 4 replicates
- Seeds treated with 4.51 g ai per 100 g seed
- Some foliar treatments applied June 22
- Two 1.5 m subsamples were taken from each plot on August 13 and assessed for CW damage and again at harvest

**Foliar sprays**

- Carrots (cv. Enterprise) were seeded on June 4
- Four replicates (5 m X three beds) for each insecticide
- All products applied once on June 25 at label rate
- Two 1 m subsamples were taken from each plot on August 10 and assessed for CW damage and again at harvest in October

In-furrow treatments applied by a modified carrot seeder with a grower-cooperator
Seed treatments for control of carrot weevil: 2015

No differences in yield
Products to control carrot rust fly and weevil: in-furrow and foliar - 2014

Admire and Verimark applied in-furrow. Exirel and Movento applied twice to foliage.
Foliar sprays for control of carrot weevil - 2015

No differences in yield

No products with lower damage than the untreated check
A biocontrol for carrot rust fly and weevil: drench applications - 2015

The biocontrol is a formulation of an entomophagous nematode
Matador was sprayed twice
Carrot insects

- Damage levels vary from field to field
- Registered products are not always effective
- Other products – nematodes?
- Need more information on monitoring and predicting these pests
- Trap counts do not always relate to damage
- How do weather conditions affect damage. Does hot dry weather kill rust fly eggs?
Nematode Damage

Root Knot Damage

Also carrot cyst nematode

Root Knot Nematode

Lesion Nematode Damage
Products for nematode control

- MustGrow: oriental mustard seed meal
- Dazitol: essential oil of mustard + oleoresin of capsicum
- Agri-Mek: abamectin *Streptomyces avermitilis*

- Nimitz: fluensulfone
- Movento: spirotetramat

- 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 Run 1

Root Knot Nematode Infection

Average Gall Rating

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

A

AB

A

C

C

C
### Treatments for carrots 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><strong>PIC PLUS</strong></td>
<td>at seeding</td>
<td>custom seeder</td>
<td>banded -25cm below seed</td>
</tr>
<tr>
<td><strong>DAZITOL</strong></td>
<td>2 DBS</td>
<td>custom fumigator</td>
<td>broadcast 25 cm below soil</td>
</tr>
<tr>
<td><strong>LUNA TRANQUILITY</strong></td>
<td>at seeding</td>
<td>HYPRO roller pump</td>
<td>in-furrow above seed</td>
</tr>
<tr>
<td><strong>NIMITZ</strong></td>
<td>7 DBS</td>
<td>custom fumigator</td>
<td>broadcast 15 cm below soil and soil surface</td>
</tr>
<tr>
<td><strong>BACTERIA A</strong></td>
<td>at seeding</td>
<td>HYPRO roller pump</td>
<td>in furrow above seed</td>
</tr>
<tr>
<td><strong>NIMITZ + BACTERIA</strong></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><strong>QUADRIS + REASON</strong></td>
<td>at seeding</td>
<td>HYPRO roller pump</td>
<td>in-furrow above seed</td>
</tr>
<tr>
<td><strong>Check</strong></td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>
Nematode management

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

Applying PIC PLUS
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 stuntina

- Untreated
- Quadris +Reason
- Nimitz+Bacteria
- Bacteria A
- Nimitz
- Luna Tranaq
- Dazitol
- Pic Plus
Carrot Fumigant Field Trial - 2014

Mineral soil

Percent of roots infected

Pic Plus  Dazitol  Check

A  A  B
Modifications for applying Nimitz
Field trials- nematode control -2015
Muck soil

Percent damage

PIC PLUS  PIC +Nimitz  Nimitz  Check

0  10  20  30  40  50  60  70  80  90  100

a  ab  ab  b
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
Onion maggots and seed corn maggots are very damaging to onions—up to 70 to 100% loss, most years.
## Insecticide seed treatments- 2010

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Chemical name and concentration</th>
<th>Rate (g a.i./ 100 g seed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARIA</td>
<td>50% flonicamid</td>
<td>5.13</td>
</tr>
<tr>
<td>AVICTA 400</td>
<td>37% avermectin</td>
<td>5.13</td>
</tr>
<tr>
<td>AVICTA +CRUISER</td>
<td>37% avermectin +47.6% thiamethoxam</td>
<td>5.13 +5.13</td>
</tr>
<tr>
<td>CYAZYPYR</td>
<td>cyantraniliprole</td>
<td>5.13</td>
</tr>
<tr>
<td>DERMACOR X-100</td>
<td>50% chlorantraniliprole</td>
<td>5.13</td>
</tr>
<tr>
<td>ENTRUST</td>
<td>80% spinosad</td>
<td>5.13</td>
</tr>
<tr>
<td>ENTRUST +CRUISER</td>
<td>80% spinosad + 47.6% thiamethoxam</td>
<td>5.13 +5.13</td>
</tr>
<tr>
<td>EXP- 3</td>
<td>thiodicarb</td>
<td>5.13</td>
</tr>
<tr>
<td>SEPRESTO</td>
<td>56.25% clothianidin + 18.75% imidicloprid</td>
<td>6.15</td>
</tr>
<tr>
<td>Governor (Trigard)</td>
<td>75% cyromazine</td>
<td>5.0</td>
</tr>
<tr>
<td>Untreated check</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Seed and in-furrow treatments - 2012

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Active ingredient</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capture</td>
<td>Bifluthrin (granular)</td>
<td>0.38 g/m</td>
</tr>
<tr>
<td>Force</td>
<td>tefluthrin (drench)</td>
<td>0.46 ml/m</td>
</tr>
<tr>
<td>Lorsban</td>
<td>15% chlorpyrifos</td>
<td>32 kg/ha</td>
</tr>
<tr>
<td>Movento + Sylgard</td>
<td>24% spriottetromat + syloxilated polyether 76%</td>
<td>375 ml +0.375%</td>
</tr>
<tr>
<td>Avicta 400</td>
<td>37% abamectin</td>
<td>4.55</td>
</tr>
<tr>
<td>Entrust</td>
<td>80% spinosad</td>
<td>4.55</td>
</tr>
<tr>
<td>Entrust +Cruiser</td>
<td>80% spinosad+70% thiamthoxam</td>
<td>4.55 +4.55</td>
</tr>
<tr>
<td>Sepresto</td>
<td>56.25% clothianidin + 18.75% imidicloprid</td>
<td>5.45</td>
</tr>
<tr>
<td>Governor (Trigard)</td>
<td>75% cyromazine</td>
<td>5.0</td>
</tr>
<tr>
<td>Untreated</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
First generation maggot damage - 2012

Percent damage

- Untreated
- Lorsban
- Movento
- Capture
- Force
- Entrust
- Avicta
- Sepresto
- Entrust+Cruiser
- Governor

In-furrow
First generation maggot damage - 2015

Percent damage

Untreated | Lorsban | Capture | Entrust | Sepresto | Farmore 5 | Governor
---|---|---|---|---|---|---
0 | 0 | 0 | 0 | 0 | 0 | 0

In-furrow
Conclusions: Maggot control

- Seed treatments most effective
- Seed treatments Entrust, Entrust plus Cruiser (FarMore Fl 500, Farmore 5), Sepresto, Governor- standard treatment and Avicta all reduced maggot damage.
- In-furrow applications of Capture (bifenthrin) reduced maggot damage in some years
- increased plant health with in-furrow treatments
- Lorsban (chlorpyrifos) is widely used, but efficacy is often low- some resistance is present
Thrips control on onions

- Onion thrips (*Thrips tabaci*)
- Multiply rapidly in warm weather
- Thrips feed in the leaf axils and can be difficult to control with insecticides
- They develop resistance to insecticides quickly
- Spray threshold 1 thrips per leaf
Ontario recommendations for thrips control are based on research by Prof. Brian Nault – Cornell University, NY and our own research

New York recommendations:
• Spray threshold: 1 larvae per leaf (3 for Radiant)
• Start with 2 sprays of Movento, followed by 2 sprays of Agri-Mek then Radiant (Delegate)
• Movento is effective for eggs and larvae, not for adults
• Usually 6-8 sprays per season

Ontario recommendations:
• Threshold based on counts of adult and larval thrips
• 1 thrips per leaf
• This threshold can probably be raised, now that there are effective insecticides
• First 2 sprays Movento, followed by Delegate (Radiant), then use Agri-Mek or Dibrom if needed.
Insecticides for control of onion thrips  2011

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Chemical name and concentration</th>
<th>Product Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGRI-MEK</td>
<td>abamectin</td>
<td>1 L/ha</td>
</tr>
<tr>
<td>CONCEPT</td>
<td>imidacloprid + deltamethrin</td>
<td>650 ml/ha</td>
</tr>
<tr>
<td>CYAZYPYR</td>
<td>cyantraniliprole</td>
<td>750 ml/ha</td>
</tr>
<tr>
<td>RADIANT/ Delegate</td>
<td>spinetoram</td>
<td>400 g/ha</td>
</tr>
<tr>
<td>DIBROM</td>
<td>naled</td>
<td>550 ml/ha</td>
</tr>
<tr>
<td>DIBROM+SYLGARD 309</td>
<td>naled + Sylgard</td>
<td>550 ml/ha</td>
</tr>
<tr>
<td>MOVENTO</td>
<td>spirotetramat</td>
<td>375 ml/ha</td>
</tr>
<tr>
<td>SYLGARD</td>
<td>siloxylated polyether</td>
<td>0.375 v/v</td>
</tr>
</tbody>
</table>

Movento x 2, Concept x 2
Movento x 2, Delgate x 2
Movento x 2, Dibrom x 2

Also a biological control MET 52 composed of the fungus *Metarrhizium*
Evaluation of insecticides for control of onion thrips - 2011

Thrips per plant

MET 52  Check  Movento  Concept  Dibrom+Sy...  Mov/Concept  Agri-Mek  Mov/Dibrom  Mov/Agral  Mov/AgriMek  Delegate  Mov/Deleg...
Thrips plot Aug 14, 2012 - relatively high thrips damage

New insecticides are working well

Movento - spirotetramat
Delegate - spinetoram
Onion downy mildew

- Sporulates when temperatures below 75 °F, (24 °C) previous day
- Temp 38 - 75 °F (4 – 24 °C) at night
- Humidity above 95% at night, No rain after 1:00 am
- Infection occurs in 3-6 hours, temp 38- 78 °F (4- 26 C)
  - Takes 10 to 12 days from infection until sporulation
  - NO symptoms until sporulation occurs
## Fungicide treatments for downy mildew control - 2014

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Rate (per ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZAMPRO (ametoctradin+dimethomorph)</td>
<td>1.0 L + 0.25% v/v Sylgard</td>
</tr>
<tr>
<td>Orondis (oxathiapipronil 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/ALIETTE(^2) (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>
Fungicides for control of onion downy mildew: 2014

No significant differences
Onion downy mildew

- Downy mildew develops first in small hot spots - not evenly distributed
- Fungicides must be applied before infection takes place, but with correct timing, even maneb can reduce disease
- Warm temperatures and dry weather halt disease development
- Fungicides Zampro + adjuvant and Orondis look very promising for downy mildew control
New Technologies for IPM

Evaluating aerial photography with unmanned aerial vehicles (UAV’s) to enhance integrated pest management and assessment of research plots.

UAV taking pictures weekly for July and August, plus mid- June and mid-Sept.

Relate to scouting results and field assessments

First 2 years in Holland Marsh, extended for 2016
Sponsored by the Bradford Coop and the Fresh Vegetable Growers of Ontario
High Eye Aerial Imaging
Aerial photography

Octocopter with 2 different types of cameras

Working with a company High Eye, that has the UAV’s, expertise and permits
Stemphylium on onions 2014
Stitched eNDVI of Muck Station

Near infra red photograph
New Technologies for IPM

- Aerial photography is more effective in July and August, than in the early season (too much bare soil)
- Identifies differences in soils, old creek beds etc
- Foliar diseases such as Stemphylium can be identified, not as effective in showing onion white rot
- Just getting started analyzing the images to detect differences in plant stress
- More efficient or cost effective than field scouting? Can this be integrated with field scouting?
All research trials are summarized in the Annual Report

Download at the Muck Station website:

www.uoguelph.ca/muckcrop
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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• Grand Bend Growers’ Association
Merci
Thank you
In-furrow treatments and rust fly damage: 2015

% of carrots damaged

Control
Minecto Duo + Sivanto
Admire + Sivanto Prime
Ripcord
Minecto Duo + Exirel
Admire + Exirel

ns
ns
ns
ns
ns
ns
Fungicides for control of Stemphylium on onion -2013

Disease severity

Quadris Top
Luna Tranquility
Dithane
Pristine
Fontelis
Switch
Inspire
Check
cv. Patterson

abc
Carrot Growth Room

Damaged carrots (%)

Non-Inoculated Check  BASAMID  BUSAN 1236  NIMITZ  DAZITOL  MOVENTO  AGRI-MEK  Fertilizer  Inoculated Check  MUSTGROW

A  AB  ABC  BC  BC  C  C  C  C  C
Seed Treatments, In-furrow
Foliar sprays

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