Muck soil developed for agriculture in Ontario
The Holland Marsh is the largest continuous area of muck soil in Canada – about 7,000 acres

First drained in the late 1920’s, most dyked and drained in the 1930’s
Onions and carrots are the two major crops on the marsh.
Onions and carrots are the main rotation crops.
High organic matter soil: 48 -80% om, pH 5.0-7.2

~ 10,000 acres in the Bradford and District Marshes
Keswick Marsh located at the south end of Cook’s Bay, Lake Simcoe
Muck Soil in Ontario

Depth of organic soil: over 20 ft to less than 2 ft.

Underneath there is a range of soils, from blue clay to sand

Protected from development because it is a flood plane. However, there are other pressures with increasing urbanization

Wetlands are protected, no more draining for agricultural use.

Pesticide residues and nitrate nitrogen are within drinking water levels
Phosphorous in the water is the big issue.
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

- Bunched (minor)
- Packaging cello pack
- Jumbo
- Processing - mineral soil
- Cut and peel (baby cut) carrots, also minor
- Some interest in multicoloured “heirloom” carrots
Onions in Ontario

- Yellow bulb onions, mostly
- Some production of red bulb onions - harder to grow and store
- Some Spanish onions - grown on mineral soil, from bare-root transplants from the U.S.
- Shallots - very low acreage
- Green bunching onions
Transplants

- About 10% of the bulb onions are grown from transplants.
- Usually 2-3 plants per plug.
- Growers receive more money for the early onions. If more early onions were produced, then the price would decrease.
Asian vegetables

- At least 30 different crops:

  Baby bok choy
Other crops grown on muck soil in Ontario

Other Asian vegetables:
- Flowering Chinese cabbage
- Pak choy
- Chinese chives
- Chinese broccoli
- Water spinach
- Edible chrysanthemum
- Mustard greens

Other vegetables:
- Root celery (celeriac)
- Herbs: dill, parsley, root parsley
- Artichokes (occasionally)
  for buds and flowers
- Amaranth (calaloo)
Amaranth

Artichokes
Cover crops

Spring wind abatement crops
Mostly barley in onions and carrots

Fall cover crops are used after onions and wherever possible

Barley is the most common cover crop. Oilseed radish has been used, and other combinations for fall cover crops.

We need a fall cover crop that can grow in October, for use after carrots
Muck Veg Challenges

- Marketing – low Canadian dollar helps
- Labour
  - Family farms plus mostly off-shore labour
- Crop Protection
  - Effective pest management
  - Registration of Crop Protection Materials
- Other issues-
  - Phosphorous use
  - Permits to take water
  - Carrot Washwater treatment
Lots of research, not many recommendations, except to use less P fertilizer.

Source: Lake Simcoe Protection Plan, 2009
Carrot washwater treatments

Concerns to reduce phosphorous and organic material from going into waterways

Some water treatment approaches

Smith Gardens Keswick Marsh
Production Challenges

- Onions -
  - Weed control
  - Onion thrips
  - Downy mildew
  - Onion maggot
  - Onion smut
  - Allium white rot
  - Botrytis leaf blight
  - Bacterial diseases

The Weather!
Production Challenges

- **Carrots-**
  - Weed control - Linuron resistant pigweed
  - Carrot weevil and carrot rust fly
  - Cavity spot
  - Carrot leaf blights
  - Aster yellows
  - Sclerotinia rot (white mold)
Production Challenges

- **Celery**
  - Late blight (Septoria)
  - Early blight (Cercospora)
  - Leaf curl (Colletotricum)
  - Tarnished plant bug
  - Aphids

- **Lettuce**
  - Downy mildew
  - Drop (Sclerotinia)
  - Aphids
  - Tarnished plant bug

- **Asian Brassica crops**
  - Flea beetle
  - Clubroot
  - Swede midge
Pest management program for muck vegetables

- Onion downy mildew
  - DOWNCAST and spore traps
- Botrytis leaf blight
  - BOTCAST
- Carrot leaf blights
- Lettuce downy mildew (Bremcast and spore trap)
- Onion maggot – degree days and traps
- Carrot weevil and rust fly – degree days and traps
- Onion thrips- field scouting

- Fields are scouted twice each week and information provided to individual growers and summarized for the region

The program is supported by the local grower Coop, by the Holland Marsh Growers’ Assoc., through sponsorship by chemical companies and through research projects. The university provides expertise and office space.
Onion downy mildew
Onion downy mildew
*(Peronospora destructor)*

- Occurs only some years – disease forecasting very useful
- Starts in “hot spots”
- Grows systemically in the plant, no symptoms until it sporulates

**Forecasting with Downcast**

Indicates weather favourable for sporulation and infection
A few cycles of downy mildew sporulation and infection can destroy a crop. In 2015, downy mildew developed in August. The DOWNCAST program correctly predicted the first sporulation and infection periods. This crop was not sprayed on time.
Stemphylium leaf blight

Caused by fungus *Stemphylium vesicarium*. First identified in the Bradford area in 2009.

Typically attacks leaf tips, other lesions, and injured or dying onion leaves.

Starts with small light brown lesions, these expand and black conidia develop.

Infection may kill entire leaves.

Fungicides are only partly effective. Better spray timing needed?
A new, or emerging, disease of carrots in Ontario

*Fusarium* infection that develops in the field is unusual - it is most often seen as *Fusarium* dry rot in storage.

No effective controls, fumigation can reduce disease incidence

Source: Howard et al. Diseases and Pests of Vegetable Crops in Canada

Brown to black, leathery lesions
Celery leaf curl

Caused by the fungus *Colletotricum fioriniae*

Relatively new disease (2011)
Curling of leaves and dark lesions on petioles

Wide host range? Apples, strawberries, weeds?

Spread in water - rain splashes, irrigation
No fungicides registered, but some may be effective

Some differences in susceptibility
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
Acknowledgments

• Muck Crops Research Station Staff
• OMAFRA/University of Guelph Partnership
Questions?
Weather Data 2011-2014

<table>
<thead>
<tr>
<th>Month</th>
<th>Mean Temperature (°C)</th>
<th>Rainfall (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>May</td>
<td>14.1</td>
<td>15.9</td>
</tr>
<tr>
<td>June</td>
<td>18.4</td>
<td>20.1</td>
</tr>
<tr>
<td>July</td>
<td>22.8</td>
<td>22.2</td>
</tr>
<tr>
<td>Aug</td>
<td>20.2</td>
<td>20.1</td>
</tr>
<tr>
<td>Ave</td>
<td>18.9</td>
<td>19.6</td>
</tr>
</tbody>
</table>

Record yields (at least 20% above average) in 2014. Why? Even rainfall, a bit cooler?
The Muck Crops Research Station is located in the Bradford/ Holland Marsh, near the intersection of Highway 400 and Hwy 9. This region is the largest area of organic (muck) soil developed for agriculture in the province and one of the most intensive areas of agricultural production in the country.

The facilities at this station include a plant pathology lab, greenhouses with ebb and flow benches and computer monitored environment, cold storage facilities to provide the specific requirements for long term storage of onions and carrots and several sites for field research. There are 4 ha of organic soil research plots on site, a further hectare of organic soil, rented from a local grower and located in another area of the Marsh, and, recently, 2 ha of mineral soil nearby, to allow field trials to be conducted on mineral soil. Field trials are also conducted in commercial vegetable fields in cooperation with local growers.

Research at the Station focuses on the vegetable crops grown in the region, especially onions, carrots, lettuce, celery and Asian vegetables, but includes

Web site www.uoguelph.ca/muckcrop
Check for the Agriphone, research reports, publications
New Crops

- Coloured carrots
- Amaranth
- Artichokes
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
Aerial photography for IPM and plot assessment
Infrared photographs for NDVI assessments

carrot

onions
Field plots on 2 Sept., 2010. A greenness rating (1-5) was conducted on 24 Aug.
The IPM Program of the Muck Crops Research Station

Objectives:

- Provide growers with timely, accurate and convenient access to insect and disease pest information
- Scout growers’ fields
- Disease and insect forecasting information
- Identify/diagnose diseases, insect pests and weeds
- Update and improve the IPM program
# Fungicides for onion downy mildew in Canada

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Active Ingredient</th>
<th>Rate/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quadris Top</td>
<td>azoxystrobin + difenoconazole</td>
<td>13.7 oz</td>
</tr>
<tr>
<td>Luna Tranquility</td>
<td>fluopyram + pyrimethanil</td>
<td>16.4 oz</td>
</tr>
<tr>
<td>Inspire</td>
<td>difenoconzole</td>
<td>7.0 oz</td>
</tr>
<tr>
<td>Fontelis</td>
<td>penthalpyrad</td>
<td>19.2 oz</td>
</tr>
<tr>
<td>Pristine</td>
<td>pyraclostrobin + boscalid</td>
<td>1.2 lb</td>
</tr>
<tr>
<td>Manzate/Dithane</td>
<td>mancozob</td>
<td>2.9 lb</td>
</tr>
<tr>
<td>Switch</td>
<td>cyprodinil + fluodioxinil</td>
<td>0.9 lb</td>
</tr>
<tr>
<td>Bravo</td>
<td>chlorothalonil</td>
<td>65.7 oz</td>
</tr>
</tbody>
</table>
Comparison of disease ratings for *Stemphylium* leaf blight symptoms and marketable yield of onions treated with fungicide at different periods, 2013.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Spray date</th>
<th>% Total Leaf Length with Symptoms</th>
<th>Marketable Yield (Bushel/A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOMCAST 30</td>
<td><strong>Jul 12, 25</strong> Aug 2, 9, 19</td>
<td>15.5 a¹</td>
<td>889.4 ns¹</td>
</tr>
<tr>
<td>TOMCAST 20</td>
<td><strong>Jul 3, 22</strong> Aug 2, 9, 19</td>
<td>16.3 a</td>
<td>1044.4</td>
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<tr>
<td>Calendar spray</td>
<td><strong>Jul 15, 25</strong> Aug 2, 9, 19</td>
<td>16.3 a</td>
<td>986.7</td>
</tr>
<tr>
<td>Spore trap</td>
<td><strong>Jul 15, 25</strong> Aug 2, 9, 19</td>
<td>16.5 a</td>
<td>728.8</td>
</tr>
<tr>
<td>BOTCAST</td>
<td>Aug 2, 9, 19</td>
<td>17.9 a</td>
<td>720.9</td>
</tr>
<tr>
<td>Check</td>
<td>Not sprayed</td>
<td>23.7 b</td>
<td>794.8</td>
</tr>
</tbody>
</table>
Irrigation

Rainfall varies from year to year (313-398 mm May – Aug)
~ 40 in (101 cm) a year of precipitation

Sprinklers
Guns
Traveling guns or booms - most common
Phosphorus flowing in to Lake Simcoe is a major issue

Slides provided by Deanna Nemeth and Donna Speranzini
Colletotricum on celery

Celery leaf curl
• Off-shore labour:
• Most from Mexico and the Caribbean
• Federal – provincial program
• Come to Canada for up to 8 months a year
Onions in Canada

- Yellow bulb onions, mostly
- Some production of red bulb onions - harder to grow and store
- Some Spanish onions - grown on mineral soil, from bare-root transplants from the U.S.
- Shallots - very small acreage
- Some green bunching onions
Managing Downy Mildew

- Crop rotation and sanitation
- Forecasting – Downcast - also spore trapping
- Very effective in Ontario
- Systemic fungicides timed according to forecasts
- Timing of the first spray is critical!
Harvest

- Onions for storage sprayed with maleic hydrazide to inhibit sprouting
- Onions lifted and windrowed for 2 days – 3 weeks
- May be kept in the field for 2-3 weeks (plastic covers on boxes)
- Over half the crop placed in cold storage- sold until April - June
- Artificial curing is very common (reduces neck rot and other problems)
- Average yields: 1000 – 1200 50 lb bags per acre (56-67 tonnes/ha)
Weed control

Yellow nutsedge continues to be a problem. Linuron resistant pigweed is a newer problem.
Onion production in Canada 2012
Total 5,500 ha
In the United States: 50,000 ha

Total Canadian production 191,000 tonnes

New York State 5000 ha