Sweet Potato Production in Ontario

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Overview

• Sweet potatoes in Ontario
• Sweet Potato 101
• Notes on Varieties
• Production
• Pests
• Trends
Ontario Sweet Potatoes – a History

- **1940s** - Several hundred acres grown for canning during Second World War
- **Late 1940s to early 1980s** - Very small amounts of sweet potatoes for fresh market
- **1965** – Ontario sweet potato project initiated by horticulturalists, but limited interest
- **1985 to 1991** – Trials by Agriculture Canada and Ontario Ministry of Agriculture and Food staff to assess viability of sweet potato production as an alternative to tobacco
- **1987** – 1st year of commercial production for 36 producers cooperatively producing 25 acres
- **1990s-present** – Acreage increase by a smaller group of growers.
- **2005-2007** – Brief interest in sweet potatoes for ethanol
## Growth of Ontario Sweet Potato Industry 1999-2010

<table>
<thead>
<tr>
<th>Year</th>
<th>Acres</th>
<th>Farmgate Value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td>75</td>
<td>$427,500</td>
</tr>
<tr>
<td>2004</td>
<td>430</td>
<td>$2,500,000</td>
</tr>
<tr>
<td>2005</td>
<td>600</td>
<td>$3,750,000</td>
</tr>
<tr>
<td>2006</td>
<td>800</td>
<td>$4,500,000</td>
</tr>
<tr>
<td>2007</td>
<td>1025</td>
<td>$5,750,000</td>
</tr>
<tr>
<td>2009</td>
<td>1200</td>
<td>$6,840,000</td>
</tr>
<tr>
<td>2010</td>
<td>1260</td>
<td>$7,182,000</td>
</tr>
</tbody>
</table>

* Farmgate value estimates based on avg. yields of 12,000 lbs/acre and avg price of $0.475/lb.
Ontario Sweet Potatoes

• 2013 - ca. 1300 acres
• Ca. 29 growers that we know of
• Many growers are <10 acres – local restaurant or fresh market
• Ca. 10 large growers selling to fresh market retail and processing
Sweet potatoes….not a yam

**Sweetpotato**
- Convolvulaceae (morning glories)
- Smooth, thin skin
- Moist, sweet taste
- US, Ontario, elsewhere

**Yam**
- Dioscoreaceae (related to lilies)
- Rough, scaly skin
- Dry, starchy taste
- Carribean
Sweet potatoes...not a potato

**Sweetpotato**

- Convolvulaceae (morning glory)
- Few commercially cultivated relatives in ON
- Storage root
- Grown from cuttings

**Potato**

- Solanaceae (nightshade)
- Pepper, tomato, eggplant, tobacco
- Tuber (enlarged stem)
- Grown from seed potatoes
Sweet potatoes 101

• *Ipomoea batatas* – tropical vine species native to Central and South America

• Perennial when grown in a tropical climate

• Roots do not require a ripening stage, allowing them to be grown as an annual under temperate climates

• 90 to 150 days to maturity – highly dependant on variety

• Biggest producer - China

• Major US production areas: North Carolina – 55,000 acres, California – 19,000 acres, Mississippi – 18,450 acres, Louisiana – 7,500 acres

• Increasing popularity due to nutritional value:
  • Very high in beta carotene/Vitamin A, good source of vitamin C, manganese, antioxidants
  • Low glycemic index (diabetic-friendly)
Environmental Requirements

- Growth at: 18-35 °C
- Best growth: 25-35 °C
- Hot days/warm nights
- Intolerant of frost
- Very sensitive to chilling temperatures (≤10 °C)
- Grow in areas with ≥ 3000 Corn Heat Units per Season
Ontario:
- Upper extreme of growing area
- Not just a colder version of NC
Temperature (°C)

**AIR**

2012

SOIL (10 cm)

2013

**TEMPERATURE**

- **Max**
- **Mean**
- **Min**
Environmental Requirements

- Ideal: fine, sandy soils
- Heavier soils:
  - Slower to heat up
  - More off-shape roots
  - Less oxygen for storage root initiation
- Clay soils unsuitable in Ontario
- pH 5.5-7 (with soil rot resistant varieties)
- Drought tolerant after root initiation but benefit from uniform water throughout growing season
Sweet potato varieties 101

- Complex genome (90 chromosomes) and vegetative propagation, not true seed
- Leads to accumulation of viruses over time, high frequency of mutations
- Variety decline (e.g. Centennial, Jewel, Georgia Jet)
- More recently: decline slowed by micropropagation and foundation seed
- Micropropagation – plants (mericlones) generated from a few cells, which have been checked for disease and mutations using molecular biology
- Mericlones are bedded to produce foundation seed (G1)
Nuclear Stock Plant – Virus-indexed, “true-to-type” micropropagated plant

Nuclear Plant (Mother Plant) – Greenhouse plant produced by micropropagation unit from Nuclear Stock Plant

Elite Plant – Greenhouse plant produced by certified nurseries from Nuclear Plants.

G1 – Elite plants are bedded in the field to create a G1 planting. Vine cuttings may be taken from the G1 planting to establish a second G1 planting. Roots harvested from G1 cuttings are G1 seed roots.

G2 – G1 roots are bedded in the field the next year to produce G2 plants. Vine cuttings may be taken from G2 plants to produce a second G2 planting. Roots harvested from G2 cuttings are G2 seed roots.

Carry plants to G3, then re-start from foundation seed.
Sweet potato varieties – Breeding programs

North Carolina State University

Louisiana State University

Vineland Research and Innovation Centre - Initial stages. No commercial releases yet.
Sweet potato varieties

Beauregard

Photo: Don Labonte, LSU

Covington

Photo: Ken Pecota, NC State

Orleans

Photo: Don Labonte, LSU

Evangeline

Photo: Don Labonte, LSU
Notes on Varieties

- Overall yields similar but better pack-out for Covington
- Cooler growing conditions affect length and shape of Covington
- Is Covington replacing Beaureagard?
  - North Carolina, California – 95% Covington
  - Louisiana, Mississippi, Alabama – predominantly Beauregard, Evangeline, Orleans
  - Why? Covington shapes up best in loose, sandy soils, warmer tems (e.g. NC). In loamier soils), Covington is shorter and rounder.
- In Ontario – Beauregard more dependable for cooler summers, but more off-size/shape (unmarketable) roots.
Other varieties

LA 07-146

White-flesh varieties (Bonita, O-Henry)

Purple skin/white flesh (Murasaki, Kotobuki)

Okinawa – purple flesh

Photos: Don Labonte, LSU
Slip Production

• Direct planting of sweet potato root pieces leads to inconsistent crops.
• In southern US – seed roots bedded in specialized seed beds from mid-February through early March.
• Slips (cuttings) cut from sprouts emerging above soil.
Slip Production

- Slips can be produced in Ontario in greenhouses
- Difficult to get enough material on time and also $$$
- Most Ontario growers import slips from North Carolina slip suppliers

- Refrigerated truck
- NC to Ontario as soon as possible (ideally 24 hrs)
- Phytosanitary certificate required
- Virus-indexed, certified G1 or G2 plants
- Cannot import from areas with sweetpotato weevil
Land Preparation

- Work as for any other transplanted crop
- Hills, ca. 15 cm high x 40 cm wide (highly variable) formed
- Fumigation? Required in southern US for control of southern root knot and reniform nematode – not present here. Impact of root-lesion and northern root knot nematode less severe?
- Possible benefit may be control of other soil pests
Planting typically begins early June and must be completed by mid-June in order for crop to mature in time.

In-row spacing: 30-40 cm (12-16 in) = 10,000 plants/acre. In North Carolina, Beauregard= 8-9 inch spacing.

Slips should be kept cool and planted as soon as possible.

Place slips ca. 3” deep, with a least 2 nodes underground.
Storage Root Initiation

- Root cells within the underground nodes will begin to form adventitious roots.
- SR initiation = adventitious roots differentiate into storage roots.
- Can be observed as early as 13 days after transplant.

Photos: Arthur Villordon and Tara Smith, Louisiana State University
Storage Root Initiation

- Total storage root numbers determined within 30-40 days after transplant
- Heavily influenced by transplant quality, temperature, humidity, soil moisture, others
- Any stress during this stage can lead to lignification (adventitious root becomes long and pencil-like)
- For first few weeks:
  - Air temperatures > 18°C and < 35 °C
  - Soil moisture at 50% field capacity (not saturated)

Photos: Arthur Villordon and Tara Smith, Louisiana State University
Fertility

- Recommendation for Beauregard – 50 kg N/ha
- Covington generally thought to require more N than Beauregard
- P and K based on soil test. Sweet potatoes are relatively heavy users of K
- In US applications are generally split: phosphate and 1/3 potash applied at planting, nitrogen and 2/3 potash applied ca. 28 days after planting)
- Boron may be required on deficient soils to prevent blistering

Irrigation

- Require sufficient water for 1st 40 days
- Can tolerate subsequent water stress
- Too little water may affect yield or root quality
- Too much water will reduce yields and cause blistering
- Uneven water can cause growth cracks
OMAF/University of Guelph Irrigation Trial 2013

<table>
<thead>
<tr>
<th>Treatment</th>
<th>#1s</th>
<th>Cann</th>
<th>Jumbo</th>
<th>TMY</th>
<th>Culls</th>
<th>Total</th>
<th>% #1s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-irrigated</td>
<td>274 ns</td>
<td>187 ns</td>
<td>23 ns</td>
<td>484 ns</td>
<td>151 ns</td>
<td>635 ns</td>
<td>20.8 ns</td>
</tr>
<tr>
<td>All Season</td>
<td>191</td>
<td>184</td>
<td>0</td>
<td>375</td>
<td>203</td>
<td>578</td>
<td>13.1</td>
</tr>
<tr>
<td>Early</td>
<td>167</td>
<td>170</td>
<td>0</td>
<td>336</td>
<td>124</td>
<td>461</td>
<td>13.8</td>
</tr>
<tr>
<td>Late</td>
<td>260</td>
<td>198</td>
<td>0</td>
<td>458</td>
<td>163</td>
<td>621</td>
<td>15.2</td>
</tr>
</tbody>
</table>

- No effect of irrigation on yield during a wet year
Weed Control

- Herbicides:
  - Several registered – see OMAF Publication 75
  - Dual Magnum (s-metolachlor) – not recommended for Covington in US
- Crop is mechanically cultivated several times in June-July
- Cultivation ceases once vines close over in late July
• Begin when roots have sized up and must end prior to onset of chilling temperatures
• Vines are mowed ca. 1 week before harvest (usually Sept.)
• Modified digger required
• Extreme care required to not wound tuber skin
• Large percentage of roots are culled out in the field
Chilling injury

- Damage due to exposure to ≤10°C
- Not evident at harvest
- Time by temperature effect
- Internal breakdown, hard core, decay

Skinning

- Outer layer of skin tears from root
- Devining 1-7 days before harvest
- Proper curing
- Yearly variability
Curing

- Necessary to convert starches to sugars, heal cuts and thicken skin
- Within 1-2 hrs of harvest
- 4-7 days at 26-29°C and 90-95% RH
- Ventilation and circulation critical

Storage

- 13-15.5°C and 85-90% RH
- Ventilation critical
- Properly cured and stored roots can keep 9-12 months
- Shrinkage, change in sugar content will occur over time
Grading and Packing

- Roots washed, graded, fungicides applied, packed
- 40 lb boxes the standard
- USDA grades can be used as a guide
- Standards vary with retailers, and can change after harvest

**TABLE 9. Size requirements for U.S. sweetpotato grades**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Length (in.)</th>
<th>Diameter (in.)</th>
<th>Weight (oz.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S. Extra No. 1</td>
<td>3</td>
<td>9</td>
<td>1 1/4</td>
</tr>
<tr>
<td>U.S. No. 1 &amp; US Commercial</td>
<td>3</td>
<td>9</td>
<td>1 1/4</td>
</tr>
<tr>
<td>U.S. No. 1 Petite</td>
<td>3</td>
<td>7</td>
<td>1 1/2</td>
</tr>
<tr>
<td>U.S. No. 2</td>
<td>1 1/2</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
Main Insect Pests

Grubs

Japanese beetle, *Popillia japonica*
European chafer, *Rhizotrogus majalis*
June beetle, *Phyllophaga* spp.

Wireworms

*Limonius* spp., *Agriotes* spp.,
*Melanotus* spp., *Aeolus mellilus*, *Ctenicera* spp.,
others?

Millipedes

*Cylindroïulus cateruleocinctus*
*Blaniulus guttulatus*
*Pseudopolydesmus* spp.
Other Insect Pests

Flea beetles
Golden Tortoise Beetle
Spotted Cucumber Beetles

Foliar insecticides rarely required!
Postharvest Storage Disease

- Fungal diseases specific to sweet potato
- Cannot be controlled with fungicides outside of seed bed
- Crop rotation and clean slips required
Postharvest Storage Disease

- Control with proper harvest, curing and storage conditions
- Limited registered products can be applied prior to shipping
Vertebrates

- Predominantly deer and mice
Sweet Potato Pesticide Registrations

- Crop Group Registrations
  - **Crop Subgroup 1C, Tuberous and Corm Vegetables** – Arracacha, Arrowroot, Chinese artichoke, Jerusalem artichoke, edible Canna, Cassava, Chayote root, Chufa, Taro, Ginger, Leren, Potato, **Sweet potato**, Cocoyam, Tumeric, Yam bean, True yam. *Representative commodity* – *Potato*.

- Pest Management Centre (AAFC) trials
- User Requested Minor Use Label Expansion
Pest Control Products

- Publication 75 – sweet potato herbicides
- Publication 838 – sweet potato fungicides and insecticides
- New registrations: www.onspecialtycrops.wordpress.com
- Fumigants???
- Insecticides
  - Mainly soil insect (grub) control
  - Foliar insects rarely need control
  - No registered wireworm products
- Fungicides:
  - Postharvest disease control products used by some
- Herbicides:
  - Used by most growers. Varieties may vary in response to herbicides (e.g. root shape) – always test on new varieties.
Crop Insurance

- **NOT** yield-based
- Fresh market vegetable acreage loss plan – reimbursement for cost/acre, not yield loss
- Options:
  - Frost only (60-85% coverage)
  - Hail only (60-85% coverage)
  - Hail and frost (60-85% coverage)
  - Multi-peril (60-80% coverage)
Research on:

- **Breeding:**
  - Blocky shape
  - High yield
  - Uniform colour
  - Deep orange flesh, sweet
  - Skinning resistance
- **Bulk harvesting**
- **Bulk storage/disease, skinning issues**