Participatory Potato Breeding Program

2016 Common Garden Research Update

University of Manitoba, Agriculture and Agri-Food Canada
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• Cross made by Dr. Benoit Bizimungu at Agriculture and Agri-Food Canada
• Distributed to farmers

1. Crosses in greenhouse
2. Mini-tubers send to farmers
3. Planted on organic farms
4. Farmers make selections
Participating farmers across Canada

5 organic farmers from British Columbia, Manitoba, Ontario, and Quebec

2 field evaluation sites
- Carman, Manitoba, U of M
- Fredericton, New Brunswick, AAFC
## Timeline of Events

<table>
<thead>
<tr>
<th>Year</th>
<th>Activity</th>
<th>AAFC</th>
<th>On-farm</th>
<th>Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>Crosses</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td>Plant seed in greenhouse to produce mini-tubers</td>
<td>X</td>
<td></td>
<td>500-1000 mini-tubers harvested/cross</td>
</tr>
<tr>
<td>2013</td>
<td>On-farm selection – 1&lt;sup&gt;st&lt;/sup&gt; year</td>
<td>X</td>
<td></td>
<td>500 mini-tubers planted/population, 10-30 plants selected</td>
</tr>
<tr>
<td>2014</td>
<td>On-farm selection – 2&lt;sup&gt;nd&lt;/sup&gt; year</td>
<td>X</td>
<td></td>
<td>10-30 tubers planted/population, 5-10 clones selected</td>
</tr>
<tr>
<td>2015</td>
<td>On-farm selection – 3&lt;sup&gt;rd&lt;/sup&gt; year; research station evaluation</td>
<td>X</td>
<td>X</td>
<td>5-10 clones planted/population, 2-5 selected</td>
</tr>
<tr>
<td>2016</td>
<td>On-farm selection and evaluation in replicated trials</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>
Materials and Methods

- RCBD with 3 replicates
- Seeded May 4 2016
  - 7 seed tubers/plot
- Hilled June 14 and July 8

- Measurements:
  - Plant population
  - Vigour
  - Flowering
  - Leaf diseases
  - Colorado Potato beetle damage
  - Maturity
  - Yield
<table>
<thead>
<tr>
<th>Treatment</th>
<th>Pedigree</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Farmer Selected Tubers</strong></td>
<td><strong>Check Cultivars</strong></td>
</tr>
<tr>
<td>LO-1-1</td>
<td>King Harry/V1002-2</td>
</tr>
<tr>
<td>LO-1-3</td>
<td>King Harry/ V1002-2</td>
</tr>
<tr>
<td>LO-1-4</td>
<td>King Harry/V1002-2</td>
</tr>
<tr>
<td>FA-4-2</td>
<td>F01031/Redsen</td>
</tr>
<tr>
<td>FS-6-19</td>
<td>Multa/Redsen</td>
</tr>
<tr>
<td>FS-6-20</td>
<td>Multa/Redsen</td>
</tr>
<tr>
<td>FS-6-21</td>
<td>Multa/Redsen</td>
</tr>
<tr>
<td>FS-6-23</td>
<td>Reddale/A11272-02</td>
</tr>
<tr>
<td>FS-7-10</td>
<td>Reddale/A11272-02</td>
</tr>
<tr>
<td>JT-10-1</td>
<td>Rochdale Gold Doree/AC Chaleur</td>
</tr>
<tr>
<td>JT-10-2</td>
<td>Rochdale Gold Doree/AC Chaleur</td>
</tr>
<tr>
<td>JT-10-3</td>
<td>Rochdale Gold Doree/AC Chaleur</td>
</tr>
<tr>
<td>M-11-3</td>
<td>Saginaw Gold/AC Chaleur</td>
</tr>
<tr>
<td></td>
<td><strong>Agria</strong></td>
</tr>
<tr>
<td></td>
<td>Quarta/Semlo</td>
</tr>
<tr>
<td></td>
<td><strong>Atlantic</strong></td>
</tr>
<tr>
<td></td>
<td>B5141-6 (Lenape)/Wauseon</td>
</tr>
<tr>
<td></td>
<td><strong>Chieftain</strong></td>
</tr>
<tr>
<td></td>
<td>la1027-18/La1354</td>
</tr>
<tr>
<td></td>
<td><strong>Kennebec</strong></td>
</tr>
<tr>
<td></td>
<td>[(Chippewa/Katahdin)/(3895-13/Earlaine)]</td>
</tr>
<tr>
<td></td>
<td><strong>Envol</strong></td>
</tr>
<tr>
<td></td>
<td>F68123/Simcoe</td>
</tr>
<tr>
<td></td>
<td><strong>Yukon Gold</strong></td>
</tr>
<tr>
<td></td>
<td>Norgleam/W5279-4</td>
</tr>
</tbody>
</table>
How did farmer sel’ns compare to check varieties?

- **Plant population**

  **Emergence, June 2**
  - Farmer Sel'ns: 4 plants/plot
  - Checks: 4 plants/plot

  **July 8**
  - Farmer Sel'ns: 5 plants/plot (A)
  - Checks: 5.5 plants/plot (B)

  *p-value = 0.0344*
How do they compare to each other?

### June 2 2016

- **p-value** = 0.0018

![Bar chart showing comparison of plants on June 2, 2016 with significant differences marked by letters A through D.]

### July 8 2016

- **p-value** = 0.036

![Bar chart showing comparison of plants on July 8, 2016 with significant differences marked by letters A through D.]

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**Plants/plot (p7)**

- LO-1-1
- LO-1-3
- LO-1-4
- FA-4-2
- FS-6-19
- FS-6-20
- FS-6-21
- FS-6-23
- FS-7-10
- JT-10-1
- JT-10-2
- JT-10-3
- M-11-3
- Agria
- Atlantic
- Cheiftain
- Kennebec
- Envol
- Yukon Gold
How did farmer sel’ns compare to check varieties?

• Vigour Ratings (1-9 scale)

Photos taken July 5

![Vigour rating 2](image1)

![Vigour rating 9](image2)

Early Vigour Ratings (June 6)

<table>
<thead>
<tr>
<th></th>
<th>Farmer Sel'ns</th>
<th>Checks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Average</strong></td>
<td>4.5 ± 0.2</td>
<td>4.5 ± 0.2</td>
</tr>
</tbody>
</table>

Mid-Season Vigour Ratings (July 5)

<table>
<thead>
<tr>
<th></th>
<th>Farmer Sel'ns</th>
<th>Checks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Average</strong></td>
<td>5.0 ± 0.3</td>
<td>5.0 ± 0.3</td>
</tr>
</tbody>
</table>
How do they compare to each other?

**Early Vigour Ratings (June 6)**

- **Vigour Ratings (1-9)**
  - LO-1-1
  - LO-1-3
  - LO-1-4
  - FA-4-2
  - FS-6-19
  - FS-6-20
  - FS-6-21
  - FS-6-23
  - FS-7-10
  - JT-10-1
  - JT-10-2
  - JT-10-3
  - M-11-3
  - Agria
  - Atlantic
  - Chieftain
  - Kennebec
  - Envol
  - Yukon Gold

- **p-value = 0.0017**

**Midseason Vigour Ratings (July 29)**

- **Vigour Ratings (1-9)**
  - LO-1-1
  - LO-1-3
  - LO-1-4
  - FA-4-2
  - FS-6-19
  - FS-6-20
  - FS-6-21
  - FS-6-23
  - FS-7-10
  - JT-10-1
  - JT-10-2
  - JT-10-3
  - M-11-3
  - Agria
  - Atlantic
  - Chieftain
  - Kennebec
  - Envol
  - Yukon Gold

- **p-value = 0.012**
How did farmer sel’ns compare to check varieties?

- Disease ratings (1-9 scale)

![Disease rating 1](image1.jpg) ![Disease rating 9](image2.jpg)

**Disease ratings August 17**

<table>
<thead>
<tr>
<th></th>
<th>Farmer Sel'ns</th>
<th>Checks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disease rating</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

**Disease ratings September 1**

<table>
<thead>
<tr>
<th></th>
<th>Farmer Sel'ns</th>
<th>Checks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disease rating</td>
<td>3</td>
<td>5</td>
</tr>
</tbody>
</table>
How do they compare to each other?

August 17

$p-value = <.0001$

September 1

$p-value = .0011$
How did farmer sel’ns compare to check varieties?

• Yield Data

![Yield Data Chart]

Yield - damage removed

<table>
<thead>
<tr>
<th></th>
<th>Farmer Sel'ns</th>
<th>Conventional Checks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rendement (tonnes/ha)</td>
<td>42</td>
<td>40</td>
</tr>
</tbody>
</table>
How do they compare to each other?

$p\text{-value} = .0233$
How did farmer sel’ns compare to check varieties?

How do they compare to each other?

Potato grades according to the Canada Agriculture Products Standards Act
Round type potatoes

<table>
<thead>
<tr>
<th>Grade</th>
<th>Size Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small</td>
<td>38.1-57.2 mm (1-1/2 to 2-1/4&quot;) in diameter</td>
</tr>
<tr>
<td>Canada No. 1</td>
<td>57.2 - 88.9 mm (2-1/4 to 3-1/2&quot;) in diameter</td>
</tr>
<tr>
<td>Large</td>
<td>88.9 - 114.3 mm (3-1/2 to 4-1/2&quot;) in diameter</td>
</tr>
<tr>
<td>Culls</td>
<td>&lt;38.1 and &gt;114.3 mm (&lt;1-1/2 and &gt;4-1/2&quot;) in diameter</td>
</tr>
</tbody>
</table>

Tuber Diameter

p-value = .0337
How did farmer sel’ns compare to check varieties?

How do they compare to each other?

Appearance (1 – 9 scale)

- Farmer Sel’n
- Checks

Rating = 1, FS-6-19
Rating = 6, Yukon Gold
Rating = 9, FA-4-2

p-value = .0005
How did farmer sel’ns compare to check varieties?

How do they compare to each other?

Eye Depth (1 protuding – 9 very deep)

![Bar charts and images of potatoes with ratings]

Rating = 1, Kennebec
Rating = 6, FS-6-19
Rating = 8, LO-1-4

p-value = .0219
How did farmer sel’ns compare to check varieties?

How do they compare to each other?

Internal Defects (damaged /10 subsample)

$p$-value = .0004

Farmer Sel’n Checks

# damaged tuber/10

0 0.5 1 1.5 2 2.5 3 3.5 4 4.5 5 6 7

$p$-value = .0023

FS-7-10

JT-10-3
How did farmer sel’ns compare to check varieties?

How do they compare to each other?

Scab Rating (1-9 scale)
Other diseases...

Late Blight

Atlantic

Yukon Gold

M-11-3

Rhizoctonia

Atlantic

Envol

Yukon Gold
Conclusions

• Although 2016 was a tough year for potatoes at Carman...

• In all cases, farmer selected varieties did not significantly differ from registered checks
  • Speaks to farmers ability to make good selections
Future Directions

• Still waiting on results from Fredericton, NB

Season 2017:
• Plan to repeat the experiment in Manitoba, southern Ontario and possibly Quebec and New Brunswick