Papa Criolla Potatoes - Introducing a South American Favorite to NM

- Dr. Stephanie Walker
- Extension Vegetable Specialist
Introduction to Potatoes

• Potatoes are members of the Solanaceous family, closely related to chile peppers, tomatoes, and eggplant

• Grown for their tubers that are formed by the swelling of the terminal end of a stolon (technically rhizomes)

• Asexually propagated
Planting Potatoes

• Use of seed potato most common for planting (‘true seed’ planting rare)

• Seed potato = small potatoes for planting, or potato piece with at least one eye between 1.5 – 2.5 oz

• Use of certified seed potatoes ensures healthy plants

• Use of store-bought potatoes for planting risky
  -potential treatment with sprout inhibitors
  -Diseases easily spread through asexually reproduced seed pieces
Production Considerations

• Best temperature range for vine growth 68 – 77°F
• Vines emerging from soil can tolerate temperatures as low as 28°F
• Best temperature range for tuber development is 59 – 68°F
• At temperatures above 80°F, tubers do not grow and may reduce in size
Production Considerations

• Tuber formation occurs about 5-7 weeks after planting

• Tubers form at the end of stolons (modified stems) that are below the soil line

• Hilling (covering with soil) as the plants grow encourages tuber formation

• Loose, well-worked soil encourages tuber formation

• Optimum irrigation during tuber formation critical for good yield
Critical Day Length (CDL)

• Tuber formation is dependent on critical day length (CDL)

• Tubers will develop only when the day length is less than the CDL for a particular potato variety

• Potatoes grown closer to the equator are short day varieties

• Varieties have been bred for long day growing areas

• **Papa criolla** potatoes tend to be short day varieties
Potato Dormancy

- Dependent on growing conditions, variety, storage conditions
- Tubers will initiate sprouting at end of dormancy period; varieties with long dormancy allows for longer storage
- ‘Russet Burbank’ exhibits long dormancy
- In South America, papa criolla potatoes have been selected for very short dormancy so that they can be immediately planted after harvest
Potato Greening

• Excessive exposure of tubers to sunlight causes ‘greening’

• Tuber pieces with greening, potato sprouts, leaves, flowers and fruit have excessive levels of poisonous alkaloids – do not eat
Potato Breeding

• Potatoes produce **perfect** flowers that contain both male (stamen) **and** female (pistal) parts

• Most commercial varieties are sterile and rarely produce viable seed; propagation is entirely asexual
Potato Breeding

• The formation of *potato berries* indicates a variety with fertile flowers
  -Similar to small tomato fruit in appearance, but highly toxic!

• Breeders rely on lines with fertile flowers that produce viable seed
Introduction to Potatoes

- First domesticated in area of southern border of Peru and western Bolivia at high elevations (12,500’) in the Andes Mountain Range
- Important food source for indigenous populations for at least 10,000 years
- New world crop – one of the true treasures discovered by early European explorers
Introduction to Potatoes

- Potatoes are 4th in worldwide consumption (following corn, wheat and rice)

- Most potatoes grown in US:
  - Genus species - *Solanum tuberosum*
  - Most are white fleshe
  - ‘Russet Burbank’ variety has long dominated commercial production
‘Russet Burbank’ Potato Variety

• Genus and species: *Solanum tuberosum* represents approx. 70% of processing potatoes
• Large tubers, russet skin and white flesh
• Popular because of high yield; good for long French fries; good storability
• Derived from ‘true seed’ line selected by plant breeder Luther Burbank

Luther Burbank (1849-1926)
Nutritional Value of ‘Russet Burbank’

- Excellent source of fiber, 3 g in one medium-sized potato
- Vitamin C, 45% of the recommended daily value
- Potassium (more potassium than bananas)
- *White fleshed potatoes lack Vitamin A and carotenoids*
Human Nutrition

• “Eat a colorful diet!”

• Fruits and vegetables are rich in carotenoids and other healthful pigmented compounds
Carotenoids

• Group of >600 pigments that impart red, orange and yellow color to many vegetables
• Vital to the human diet as antioxidants and Vitamin A precursors
  - β-carotene is a well-known carotenoid

• *Lutein*: Critical in preventing macular degeneration in aging population
• *Zeaxanthin*: Shown to improve brain function in aging population
Lutein + Zeaxanthin Content of 1 Cup Fresh, Boiled Vegetables

- asparagus
- beet greens
- broccoli sprouts
- carrots
- collards
- dandelion greens
- lettuce, butterhead
- lettuce, romaine
- mustard greens
- scallions
- peas
- potatoes
- pumpkin
- spinach
- summer squash
- turnip greens

Micrograms

Slide Courtesy of: K. Haynes, B. Clevidece, J. Novotny
Lutein + Zeaxanthin Content of 1 Cup Fresh, Boiled Vegetables

SlideCourtesy of: K. Haynes, B. Clevendece, J. Novotny
Annual Per Capita Consumption of Vegetables

- Pumpkins have the highest consumption at 130 pounds per capita.

Slide Courtesy of: K. Haynes, B. Clevidence, J. Novotny
‘Yukon Gold’ Potato Variety

• Most widely grown yellow-fleshed potato in North America

• Round tubers with distinctive pink eyes, yellow skin and yellow flesh

• Widely adapted; great choice for novice potato growers

• Released in 1980 by Gary Johnston, Canadian potato breeding program, by crossing: ‘Yema de huevo’ (Solanum phureja) X ‘Norgleam’ (Solanum tuberosum)
Yellow-fleshed Potatoes

• ‘Yukon Gold’
• ‘Yellow Finn’
• ‘Peter Wilcox’
• ‘German Butterball’
• ‘Bintje’
Genetic Diversity of Potatoes

• Although *Solanum tuberosum* dominates production, estimate of 1,000 – 1,700 species of potatoes

• More than 4,500 potato varieties, mostly growing in the Andes Mountain region

• **Papa criolla potatoes** (*Solanum phureja* or *Solanum turberosum* group *phureja*) are highly valued for their quality in South America
Papa Criolla Potatoes (S. phureja)

- Closely related to S. tuberosum potatoes
- Preferred for quality in South America - virtually unknown in the US
- Smaller tubers (about golf ball size)
- Diploid plants (2 sets of chromosomes; most US commercial potatoes are tetraploids with 4 sets)
- Tuberize under short-day conditions
- Very short - or no - dormancy period
- Many with yellow to dark yellow flesh, indicating high lutein and zeaxanthin content
Papa Criolla Project

• Led by Dr. Kathleen Haynes, USDA Potato Breeder; Co-PI, Dr. Lincoln Zotarelli at Univ. of Florida

• Obtained papa criolla germplasm from South American collaborators more than 20 years ago

• Long-term breeding efforts to select for high levels of carotenoids (dark yellow color); larger, uniform tubers; appropriate day length; longer dormancy
Lutein and Zeaxanthin Content in Diploid Potatoes

The graph shows the lutein and zeaxanthin content in micrograms per 100 g FW for various diploid potato cultivars. The cultivars are listed on the x-axis: BD296-2, BD316-4, BD326-4, BD322-4, BD317-4, BD337-3, BD315-1, BD283-4, BD275-4, BD333-4, BD327-1, and Yukon Gold.

- **Lutein** is represented in blue bars.
- **Zeaxanthin** is represented in red bars.

The y-axis represents the micrograms per 100 g FW, with a scale from 0 to 600.

The slide is courtesy of K. Haynes, B. Clevidence, and J. Novotny.
Papa Criolla Project in NM

• NM was invited to conduct trials of Dr. Haynes’ advanced papa criolla lines in 2015

• Trials were conducted at the Los Lunas Agricultural Science Center (2015, 2016); the Leyendecker ASC (2016); and the Farmington ASC (2017)

• Objectives were to determine relative performance of the papa criollas and to identify best performing lines in NM

• Are the papa criolla potatoes a viable alternative crop for NM growers?
Papa Criolla Project in NM

• Las Cruces and Los Lunas
  - Steep learning curve; potatoes were new crop for both Agricultural Science Centers

• Very low yields in Las Cruces (2016); crop was hurt by adverse soil conditions and heat

• Less than optimum yield and tuber size in Los Lunas (2015, 2016); some lines promising
  - Optimum crop timing, fertilization, and irrigation protocols need to be further investigated
• Papa Criolla Potatoes – Los Lunas
Papa Criolla Potato Trials - Farmington

• Planted: April 25, 2017 and Harvested: September 11, 2017 (139 Days after planting)
• 173 breeding lines
• 6’ plots
• 1’ between plants
• Controls:
  • Peter Wilcox (stake #1235)
  • Yukon Gold (stake #1238)
• Measured:
  • Plot yield
  • Tuber characteristics
## Farmington Results: 2017 Top Ten Yielding Papa Criolla Varieties

<table>
<thead>
<tr>
<th>Stake Number</th>
<th>Average Yield (kg per plot*)</th>
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<tr>
<td>3101</td>
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<tr>
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<tr>
<td>1238**</td>
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<td>3074</td>
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</tbody>
</table>

* Plot = 1.16 m² (.76 m x 1.52 m) or 12.5 ft² (2.5 ft x 5 ft)

** 1238 is Yukon Gold
Results - Farmington 2017
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Results – Farmington 2017
Summary & Observations

• The papa criolla potatoes perform well in areas that are also optimum for commercial *S. tuberosum* varieties; several lines provided higher yield than ‘Yukon Gold’

• Production challenges will include harvest and dormancy; heat in southern NM

• Dr. Haynes is currently in the process of preparing the best performing papa criolla breeding lines for release to the public
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Thank you!

Questions?

Dr. Stephanie J. Walker
Extension Vegetable Specialist
New Mexico State University
Extension Plant Sciences
PO Box 30003, MSC 3AE
Las Cruces, NM 88003-8003
Office: (575) 646-4398
Email: swalker@nmsu.edu