Potatoes 101

Andy Robinson
Extension Potato Agronomist
NDSU/UM
Today’s Presentation

• History & current production
• Growth and development
• Pest Protection
  – Diseases
  – Insects
  – Weeds

Recognition: Susie Thompson and Gary Secor for help with slides
Why Potatoes?

• 3rd in world food production, after wheat and rice.
  – 4th most consumed.

• Potatoes can be grown in a wide range of environments.

• Consumption:
  – Processed as french fries, potato chips, dehydrated products
  – Fresh potatoes are baked, boiled, put in casseroles, salads, and many other dishes.
History

• Indigenous to Peru, Columbia, and Chile
• Utilization documented as early as 7000 yrs. ago
  – Incas domesticated and cultivated
• Introduced to Europe
  – 1570 - Spain
  – 1580 - England
• To the New World
  – Early 1700s
Family and Relatives

• Nightshade family, *Solanaceae*
  – 2,000 species
  – 160 tuber bearing
  – 20 cultivated species

• Annual dicot, grown for tubers

• Relative of tomato, eggplant, pepper, tobacco, petunia, and nightshade
World Potato Production 2010

- China: 75M tonnes
- India: 25M tonnes
- Russian Federation: 10M tonnes
- Ukraine: 5M tonnes
- United States of America: 3M tonnes

FAOSTAT [www.fao.org](http://www.fao.org)
US Production

- Increase in yield and value, while production has decreased.
## US Potato Production 2011

<table>
<thead>
<tr>
<th>Ranking</th>
<th>State</th>
<th>Production (cwt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Idaho</td>
<td>127,070,000</td>
</tr>
<tr>
<td>2</td>
<td>Washington</td>
<td>98,400,000</td>
</tr>
<tr>
<td>3</td>
<td>Wisconsin</td>
<td>25,000,000</td>
</tr>
<tr>
<td>4</td>
<td>Oregon</td>
<td>23,342,000</td>
</tr>
<tr>
<td>5</td>
<td>Colorado</td>
<td>22,919,000</td>
</tr>
<tr>
<td>6</td>
<td>North Dakota</td>
<td>18,865,000</td>
</tr>
<tr>
<td>7</td>
<td>Minnesota</td>
<td>16,685,000</td>
</tr>
</tbody>
</table>

- ND and MN produced 35,550,000 cwt.

ND Potato Production
High Nutritional Value

<table>
<thead>
<tr>
<th>Average potato</th>
<th>5.3 ounces with skin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calories</td>
<td>110 (kcal)</td>
</tr>
<tr>
<td>Fat</td>
<td>0 g</td>
</tr>
<tr>
<td>Cholesterol</td>
<td>0 mg</td>
</tr>
<tr>
<td>Sodium</td>
<td>0 mg</td>
</tr>
<tr>
<td>Protein</td>
<td>3 g</td>
</tr>
<tr>
<td>Potassium</td>
<td>620 mg (18% of daily value)</td>
</tr>
<tr>
<td>Fiber</td>
<td>2 grams (8% of daily value)</td>
</tr>
<tr>
<td>Vitamin B6</td>
<td>0.2 (10% of daily value)</td>
</tr>
<tr>
<td>Vitamin C</td>
<td>27 mg (45% of daily value)</td>
</tr>
</tbody>
</table>

www.healthypotato.com

NDSU NORTH DAKOTA STATE UNIVERSITY
## Per Capita Consumption

<table>
<thead>
<tr>
<th>Total use per capita</th>
<th>lbs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh potatoes</td>
<td>35.1</td>
</tr>
<tr>
<td>Processed, total</td>
<td>83.2</td>
</tr>
<tr>
<td>French fries</td>
<td>43.3</td>
</tr>
<tr>
<td>Other frozen</td>
<td>4.0</td>
</tr>
<tr>
<td>Potato chips</td>
<td>16.5</td>
</tr>
<tr>
<td>Dehydrated</td>
<td>10.5</td>
</tr>
<tr>
<td>Preserved</td>
<td>0.5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>118.4</strong></td>
</tr>
</tbody>
</table>

USDA/ERS
US Potato Consumption

Potatoes consumed (lbs)

Total Per Capita Consumption

Fresh potatoes

Processed
Selecting Potatoes to Grow
Cultivars

• Shades of white, yellow, red, purple.
• Vary in yield, shape, size, tuber set, days to maturity.
Cultivar Selection

- Yield potential
  - Canopy, growth habit
  - Roots/stolons, tuber development
  - Disease reaction
  - Cultural requirements
- Market acceptance
  - Quality
- Economic advantage
Red-skinned Cultivars

- Lower starch, waxy texture
- Suitable for boiling, roasting, salads, soups, and stews
- Majority have white flesh, some have yellow
- Red LaSoda, Red Norland, Red Pontiac, Sangre, Viking, Modoc
White-skinned Cultivars

- High or low in starch content, mealy texture
- Suited for chipping or frying
- Predominantly white fleshed, but some yellow fleshed cultivars
- Yukon Gold, Irish Cobbler, Kennebec, Ivory Crisp, Dakota Pearl
Russet-skinned Cultivars

• Have brown netted skin
• High dry-matter content (mealy)
• Suited for french fries, baking, and frozen processed products.
• Russet Burbank, Umatilla Russet, Ranger Russet, Goldrush
Selecting and Planting Seed

- Use certified seed
- Physiological seed age
- Plant 1.5 to 2.5 oz seed pieces
- Cure cut seed in 90% relative humidity
- Space seed 9 to 12 in
- Plant 3-4 inches below surface
Below the Ground

• Potatoes are shallow rooted
• Like well drained soil
  – Hilling
• Soil pH $\rightarrow$ nutrient uptake
• Careful with amendments to soil because they can increase disease (esp. scab).
Growth and Development
Morphology

The Potato Plant

- flower
- fruit
- compound leaf
- lateral stem
- main stems
- mother tuber
- stolons
- tubers
- roots
- leaflets
- inflorescence
Shoot

- Leaves
  - Alternate
  - Compound
  - Leaflets of irregular size
  - alkaloids

Lana et al. 1976
Shoot

- Stems
  - Herbaceous
  - Spiral phyllotaxis
  - Initially erect, later becomes partially procumbent

Picture courtesy of Susie Thompson
Shoot

- Flowers
  - Corolla regular, shallowly bell shaped or wheel shaped (rotate)
  - 5 stamens

Fig. 2. Diagramatic sectional view of a potato flower: a) stigma, b) style, c) petal, d) ovary, e) sepals, f) pore, g) anther, h) filament, i) ovules (true seeds).

Lana et al. 1976
Shoot

• Fruit
  – A berry
  – Globe shaped
  – Yellowish-green
  – Production varies by cultivar

Picture courtesy of Susie Thompson
Root

- Fibrous
- Branched
- Early stages of growth restricted to surface soil
- Roots turn downward after extending for some distance horizontally
Stolons

- Botanically a stem, lateral shoots
- Usually from most basal nodes below to soil level
- Typically elongated internodes, hooked at the tip, bearing spirally arranged scale leaves
Tubers

- First tubers usually develop from lowest stolons
- These become dominant over later formed tubers
- 75-85% of total dry matter produced by the plant accumulates in tubers
Growth Stages

I. GROWTH STAGE I
   Sprout development
   Sprouts develop from eyes on seed tubers and grow upward to emerge from the soil.
   Roots begin to develop at the base of emerging sprouts.

II. GROWTH STAGE II
    Vegetative growth
    Leaves and branch stems develop from aboveground nodes along emerged sprouts.
    Roots and stolons develop at belowground nodes.
    Photosynthesis begins.

III. GROWTH STAGE III
     Tuber initiation
     Tubers form at stolon tips but are not yet appreciably enlarging.
     In most cultivars the end of this stage coincides with early flowering.

IV. GROWTH STAGE IV
    Tuber bulking
    Tuber cells expand with the accumulation of water, nutrients, and carbohydrates.
    Tubers become the dominant site for deposition of carbohydrates and mobile inorganic nutrients.

V. GROWTH STAGE V
   Maturation
   Vines turn yellow and lose leaves, photosynthesis decreases, tuber growth slows, and vines eventually die.
   Tuber dry matter content reaches a maximum, and tuber skins set.

http://www.gov.mb.ca
Growth Habit

• Determinate – plants stop producing new growth after tuber initiation
  – Red Norland

• Indeterminate – plants continue producing new growth indefinitely
  – Russet Burbank
Pest Management
Pest Management Concerns

• Diseases
• Insects
• Weeds
Potato Diseases

• Defined as “a harmful alteration of normal physiological and biochemical development of a plant over time” OR “any disturbance of a plant that interferes with its normal structure, function or economic value

• As opposed to injury, which is sudden – example lightning
Potato Diseases

• Disease is due to a continuous irritant and is dynamic

• Two categories of disease:
  – Non-infectious – weather, nutrient excess and deficiency, chemicals etc; not transmissible
  – Infectious – transmissible and caused by a living organism
Disease Triangle

- **Susceptible Host**
- **Causal agent**
- **Favorable Environment**

**Plant Disease**
Types of Diseases

• Bacteria
  – Single celled, have a cell wall, can be cultured, microscopic, need an injury to infect

• Fungi
  – Multicellular (threadlike growth – mycelium), cell wall, visible to the eye (molds)

• Viruses
  – Nucleic acid surrounded by protein coat (RNA or DNA), no cellular structure, need a wound to infect, visible with electron microscope

• Nematodes
  – Small wormlike animals, live in soil, possess a stylet and feed on roots, may transmit viruses

• Phytoplasma
  – Bacteria without cell walls, phloem restricted, transmitted by insects
Emergence and Stand Problems caused by…

- *Erwinia carotovora* – soft rot
- Fusarium dry rot
- Rhizoctonia sprout girdling
Erwinia decay

- Seed borne in lenticels or wounds
- Decay under wet conditions
- Blackleg can follow
- No chemical control, avoid wet conditions
- Common
Fusarium dry rot

- Seed and soil borne
- Slow decay
- Weak plants
- Clean seed, seed treatment

Pictures courtesy of Gary Secor
Rhizoctonia canker

- Caused by *Rhizoctonia solani*
- Survives primarily as sclerotia (black scurf), no important spores formed
- Seed and soil-borne inoculum important
- Attacks stems pre- and post-emergence; stolons also attacked

Pictures courtesy of Gary Secor
Rhizoctonia management

- Crop rotation, 3-4 years
- Clean seed, avoid seed with high percentage of tubers with sclerotia
- Promote rapid emergence
  - Seed and soil same temperature
  - 10 C optimum
- Seed treatments
Potato Viruses

- Alphabet viruses (X, S, A, Y, M, T)
- Most occur infrequently or have been controlled by certification programs
- The most important ones remain
  - PVY
  - Leaf roll
  - Insecticides can control aphids
The Virus

- Y is transmitted by aphids in a stylet borne, non-persistent manner
  - Mouth parts only
  - Persist < 10 hours
  - Transmits immediately before insecticide can kill

- Y has different biological forms called strains
  - PVY ordinary common strain
  - Causes mild mosaic
  - Necrosis in tubers
Fungus - Scabs

• Caused by *Streptomyces spp.*
• A worldwide problem
• Soil borne
• More growers, industry ask how to control than any other disease

• Control
  – Even soil moisture at tuberization
  – Resistant varieties

• A disease waiting for a control
Common Scab

Pictures courtesy of Gary Secor
Late Blight

- Caused by *Phytophthora infestans* (Irish potato famine)
- Community disease because spreads far and fast
- The most serious disease of potato worldwide
- Affects all parts of the plant above and below ground
Cultural Practices

- Crop rotation
- Scout fields for late blight
- Monitor the weather
- Kill hot spots
- Use disease forecasting to predict appearance of the disease and fungicide applications
- Use fungicides when late blight is present
Early Blight

- Occurs every year
- Soilborne
- Foliar fungicides
- Stress and senescence makes disease worse
- Only one that can cause tuber disease in storage
  - Enters in wounds
  - Slow dry decay

Picture courtesy of Gary Secor
Nematodes

- Nematodes are microscopic, unsegmented roundworms that have a stylet
- Nematodes are associated with potato diseases: plant parasitic
- 4 nematodes in potatoes:
  - Pale potato cyst or golden
  - Stubby root
  - Root lesion
  - Columbia root knot
Zebra Chip Disease - Phytoplasm

- A new disease that has worked it’s way up from Mexico into the US
- Affects all market classes of potatoes
- Causes foliar symptoms similar to purple top and striping pattern of tuber vascular rays in raw and chips
- Transmitted by potato/tomato psyllid
- Caused by a phloem limited bacterium *Candidatus Liberibacter solanacearum*
- Manage by insecticides
Potato Psyllid
Pictures courtesy of Gary Secor
Potato Insects

Whitney Cranshaw, Colorado State University, Bugwood.org
Colorado Potato Beetle

- Larvae and adults feed on leaves
- High reproductive potential
- Resistance to most insecticides
Green Peach Aphid

• Difficult to control because of high reproductive potential and diverse range
• Feeds and transmits viruses
• Pale or bright green
• Control using insecticides
Wireworm

- Larvae are shiny, yellow-to-brown worms that feed on potatoes underground
- Make holes in tubers
- Control with insecticides or fumigants, crop rotations
Weed Control

- Most weeds controlled using preemergent herbicides
- Postemergence broadleaf weed control
  - metribuzin and rimsulfuron
Glyphosate Carryover

- Potatoes are sensitive to glyphosate.
- Drift, inversions, and tank contamination can lead to low amounts of glyphosate getting on potatoes.
- Glyphosate will move to tubers and stay there until spring planting.

http://www.state.me.us/agriculture/pesticides/drift/
Symptoms of Glyphosate Carryover in Seed Potatoes

- Erratic and slow emergence pattern
- Bending, twisting, and yellowing of leaves
- Multiple shoots from an eye
- Cauliflower or candelabra formation of shoots
- Enlarged shoots
- Prolific roots or reduced rooting
Questions?