Potatoes 101

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NDSU/UM

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Today's Presentation

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

Recognition: Susie Thompson and Gary Secor for help with slides

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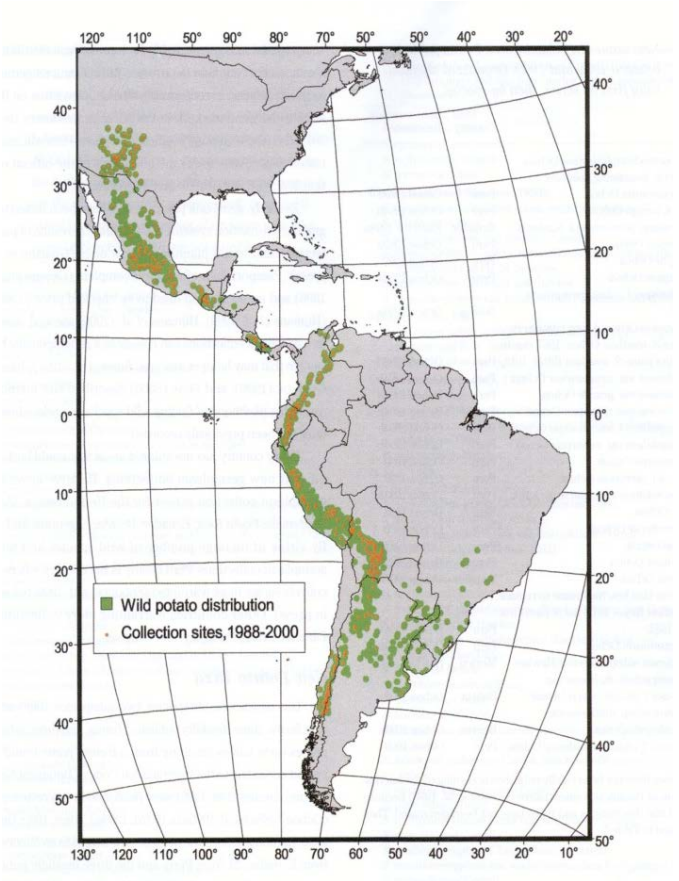
Why Potatoes?

- 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

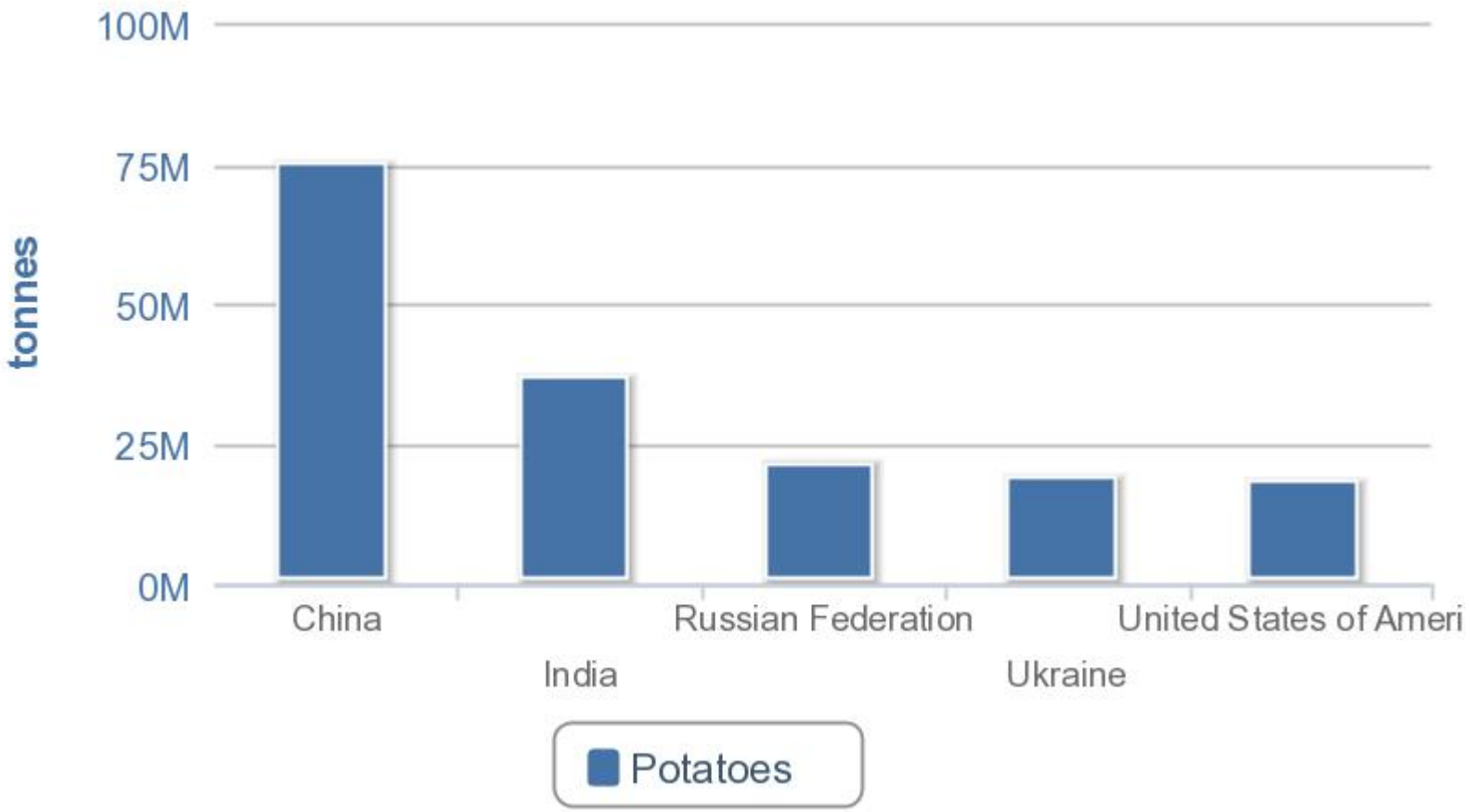
- Indigenous to Peru, Columbia, and Chile
- Utilization documented as early as 7000 yrs. ago
  - Incas domesticated and cultivated
- Introduced to Europe
  - 1570 - Spain
  - 1580 - England
- To the New World
  - Early 1700s



Family and Relatives

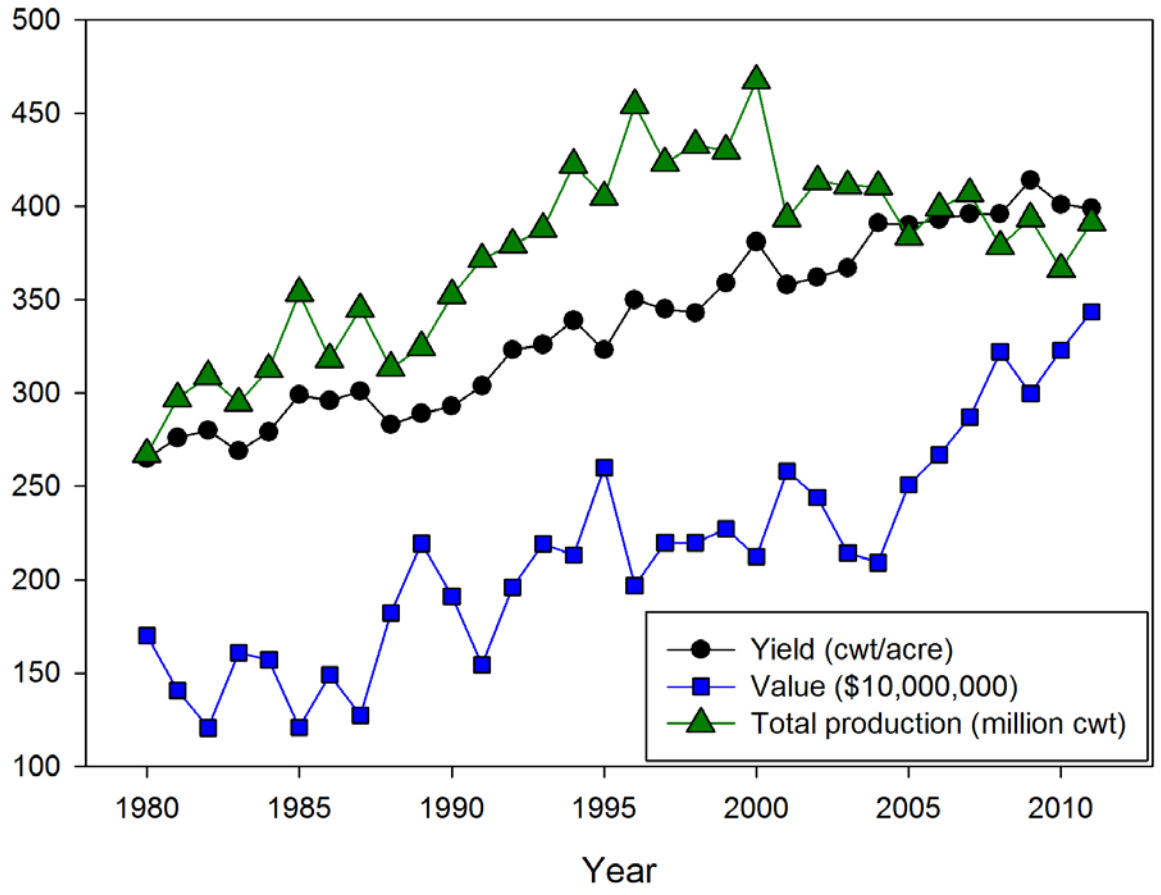
- Nightshade family, *Solanaceae*
  - 2,000 species
  - 160 tuber bearing
  - 20 cultivated species
- Annual dicot, grown for tubers
- Relative of tomato, eggplant, pepper, tobacco, petunia, and nightshade

World Potato Production 2010



FAOSTAT www.fao.org

US Produciton



- Increase in yield and value, while production has decreased.

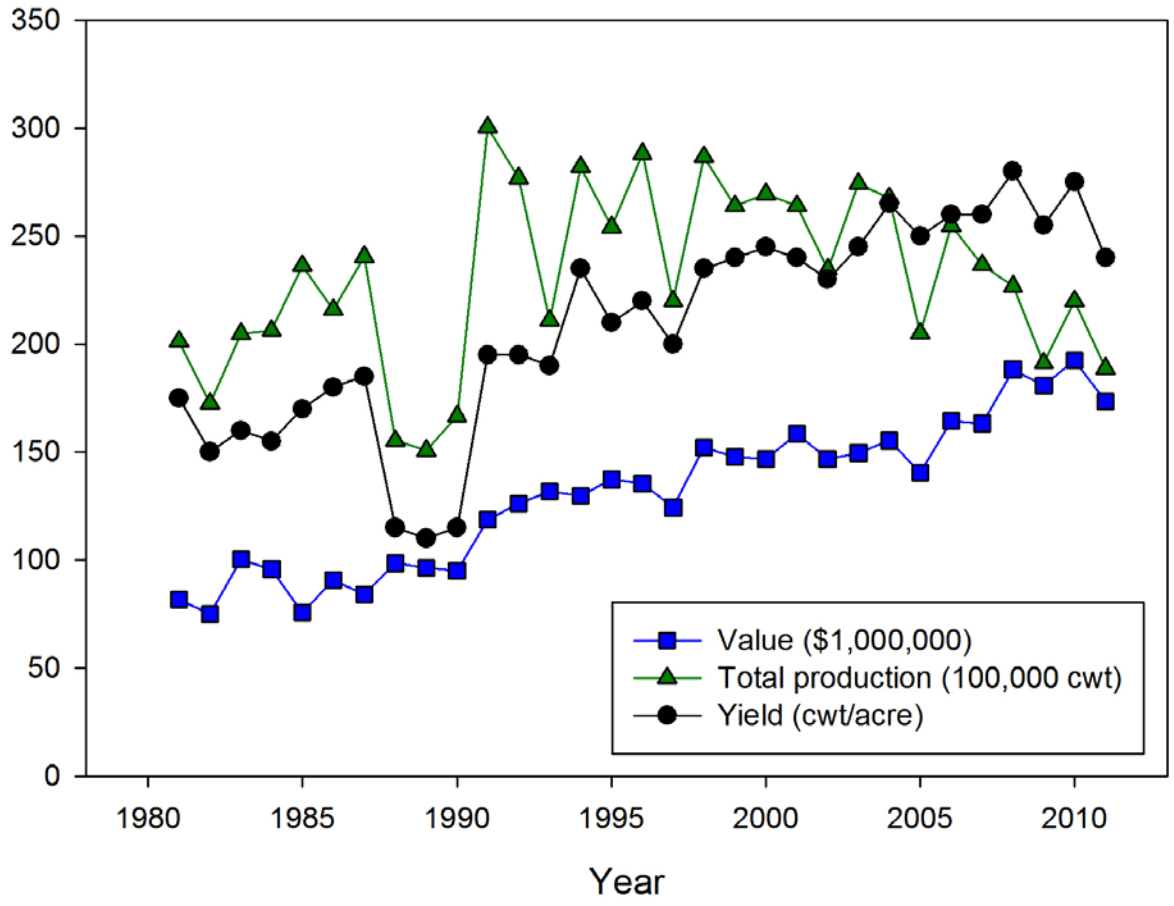
US Potato Production 2011

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

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

http://quickstats.nass.usda.gov

ND Potato Production



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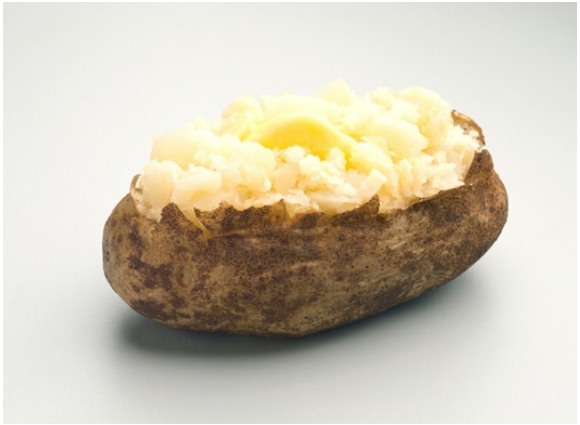
High Nutritional Value

Average potato	**5.3 ounces with skin**
Calories	110 (kcal)
Fat	0 g
Cholesterol	0 mg
Sodium	0 mg
Protein	3 g
Potassium	620 mg (18% of daily value)
Fiber	2 grams (8% of daily value)
Vitamin B6	0.2 (10% of daily value)
Vitamin C	27 mg (45% of daily value)



www.healthypotato.com

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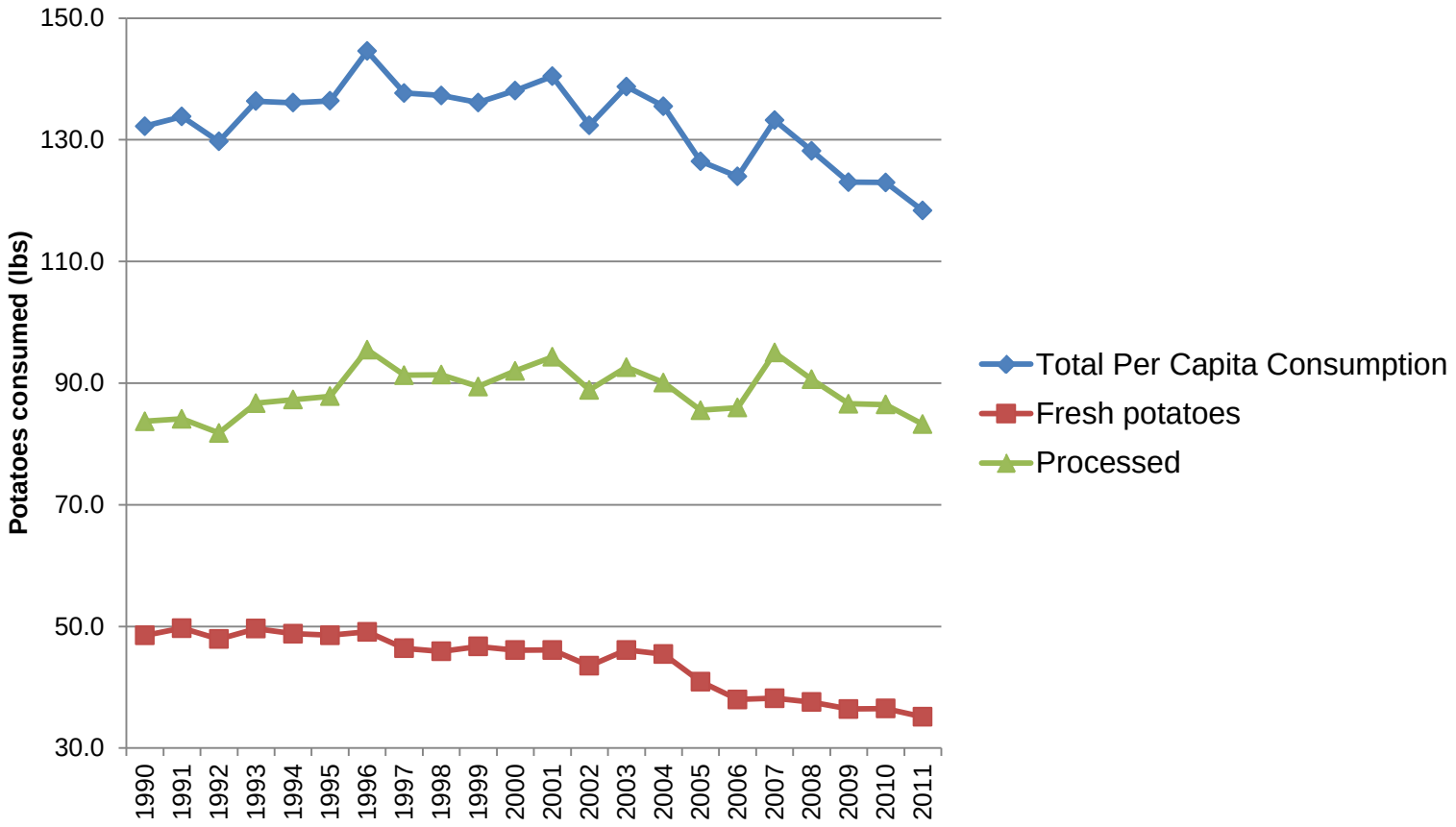
Per Capita Consumption

Total use per capita	lbs
Fresh potatoes	35.1
Processed, total	83.2
French fries	43.3
Other frozen	4.0
Potato chips	16.5
Dehydrated	10.5
Preserved	0.5
Total	118.4

USDA/ERS

US Potato Consumption



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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

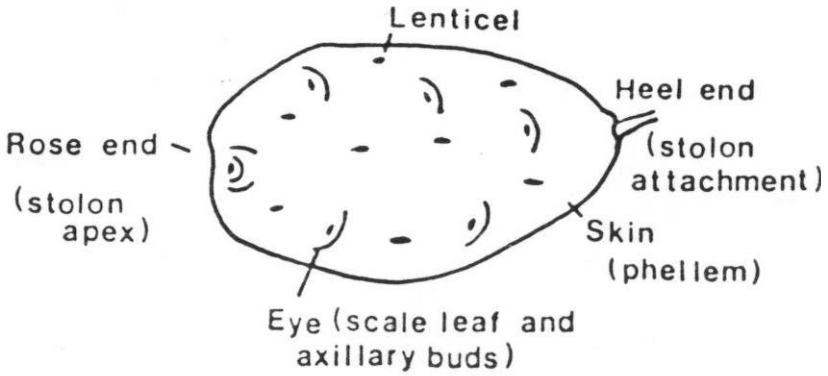
- Use certified seed
- Physiological seed age
- Plant 1.5 to 2.5 oz seed pieces
- Cure cut seed in 90% relative humidity
- Space seed 9 to 12 in
- Plant 3-4 inches below surface

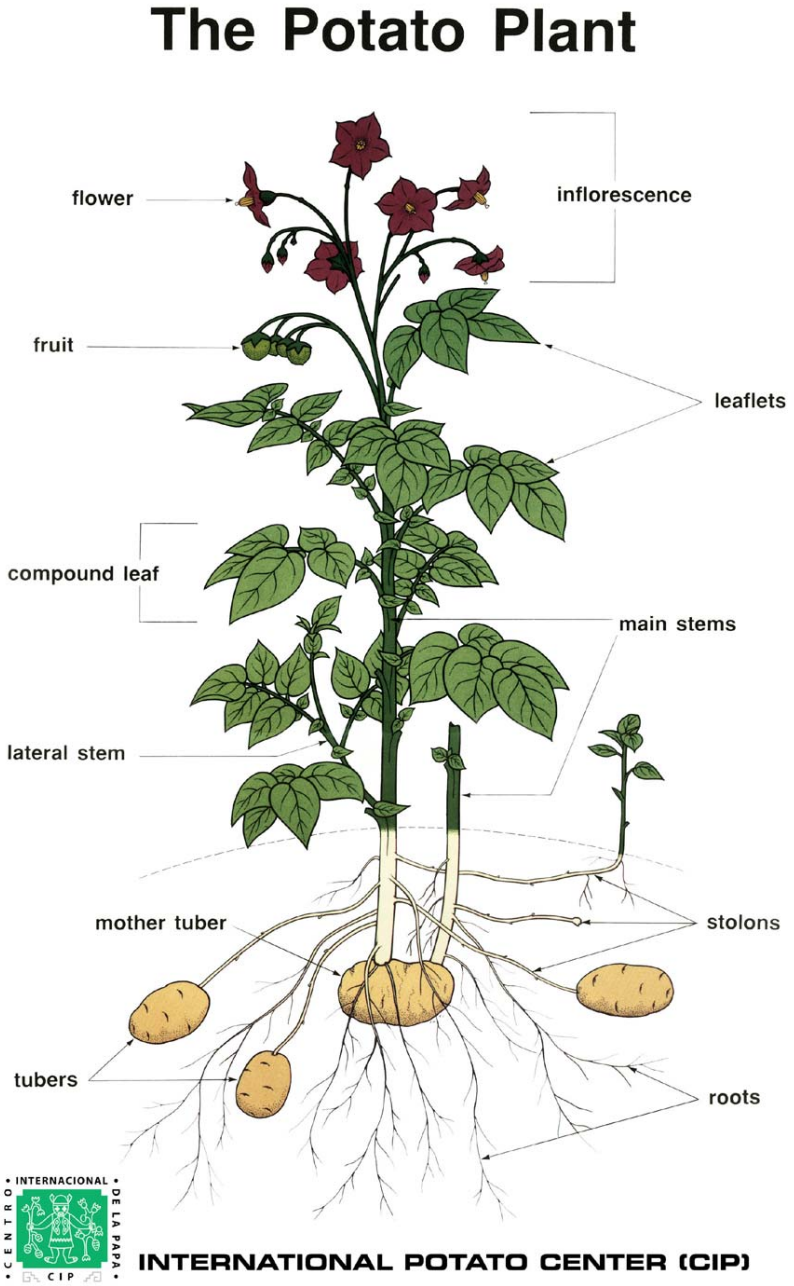
Below the Ground

- Potatoes are shallow rooted
- Like well drained soil
  - Hilling
- Soil pH → nutrient uptake
- Careful with amendments to soil because they can increase disease (esp. scab).

Growth and Development

Morphology





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Shoot

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

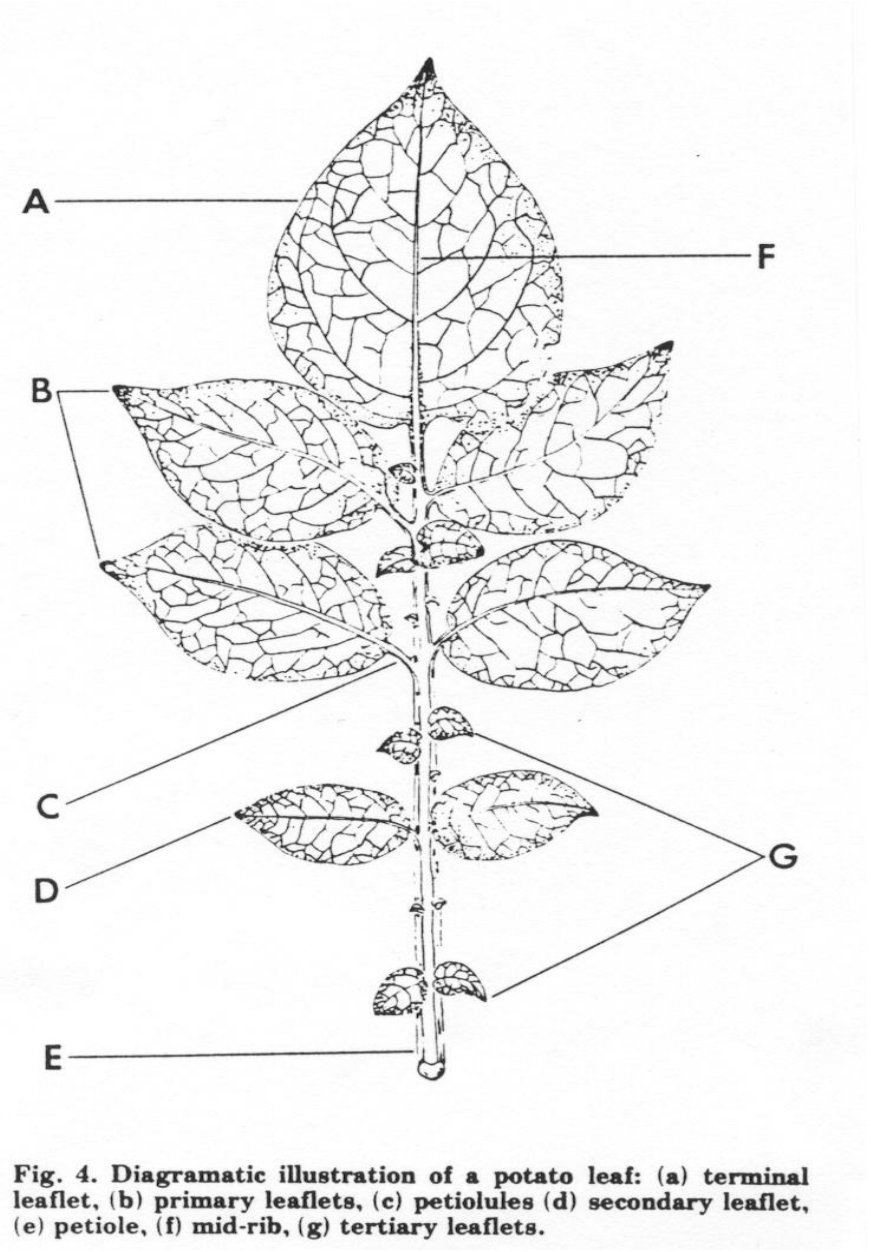


Fig. 4. Diagramatic illustration of a potato leaf: (a) terminal leaflet, (b) primary leaflets, (c) petiolules (d) secondary leaflet, (e) petiole, (f) mid-rib, (g) tertiary leaflets.

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

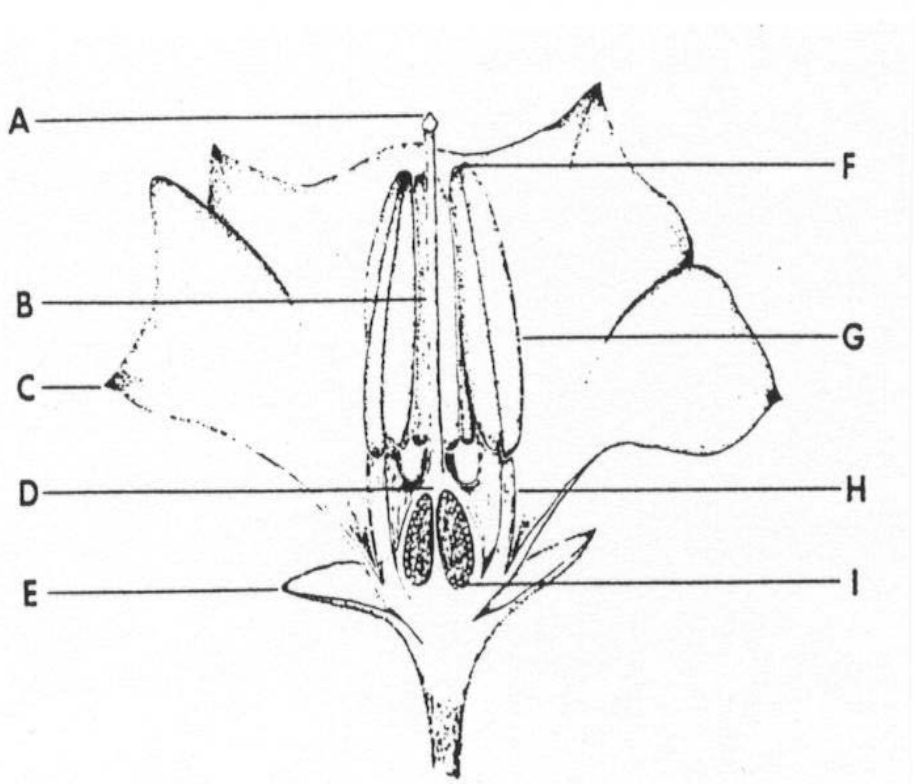


Fig. 2. Diagramatic sectional view of a potato flower: a) stigma, b) style, c) petal, d) ovary, e) sepals, f) pore, g) anther, h) filament, i) ovules (true seeds).

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

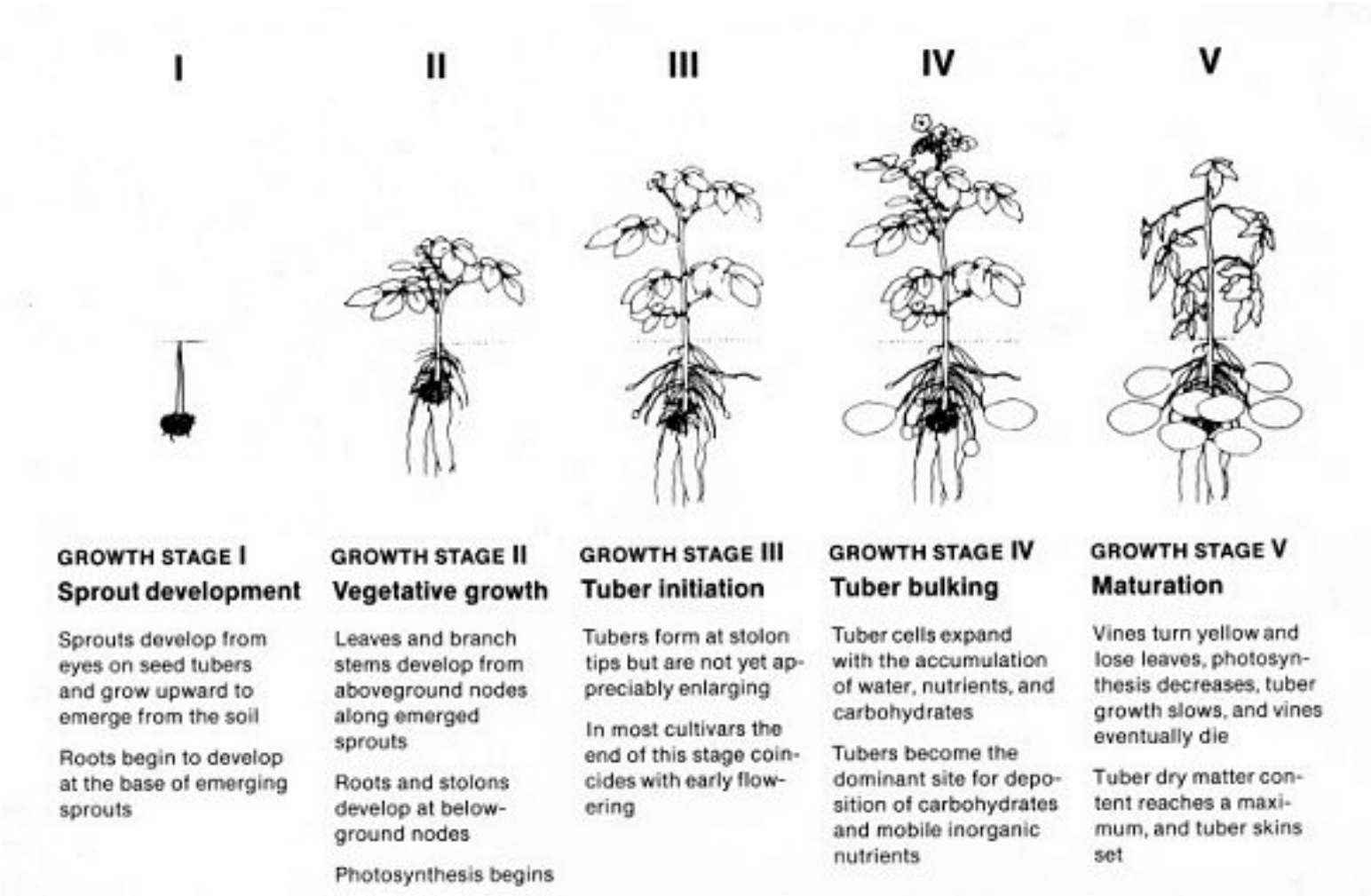
Stolons

- 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



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**

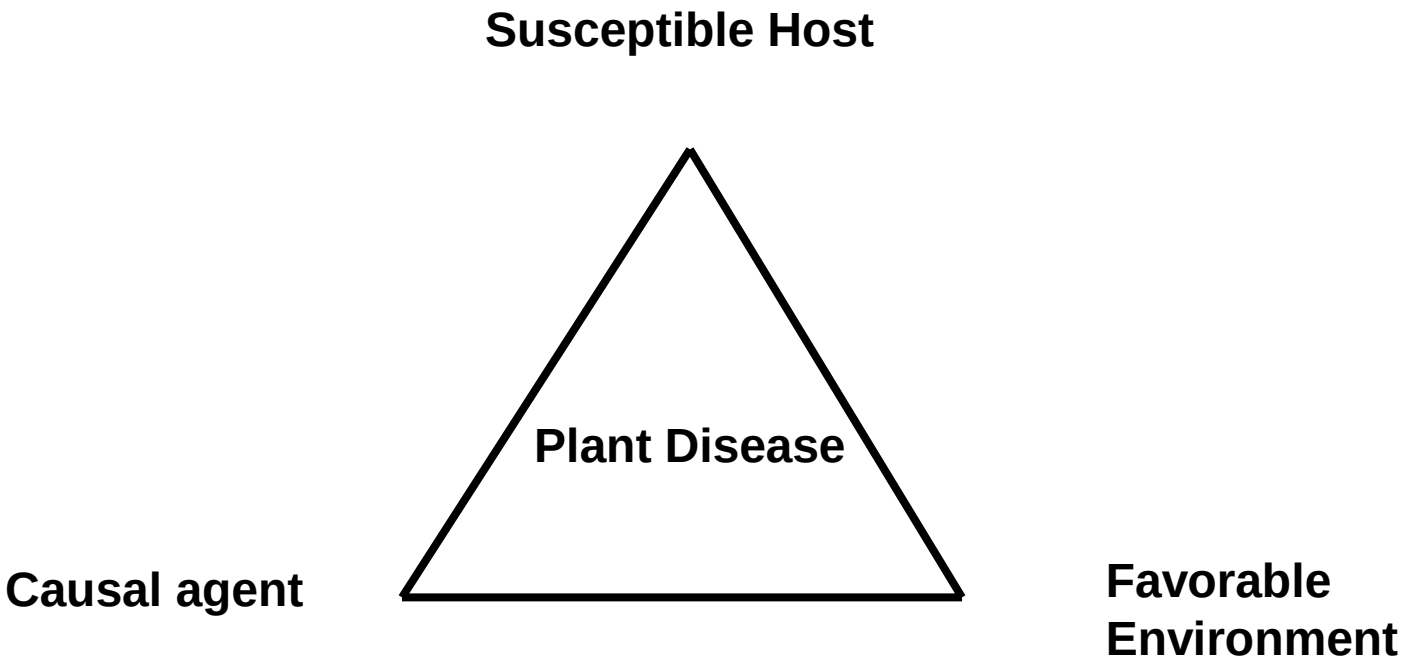
Potato Diseases

- 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



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

Picture courtesy of Gary Secor

Erwinia decay

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

Picture courtesy of Gary Secor

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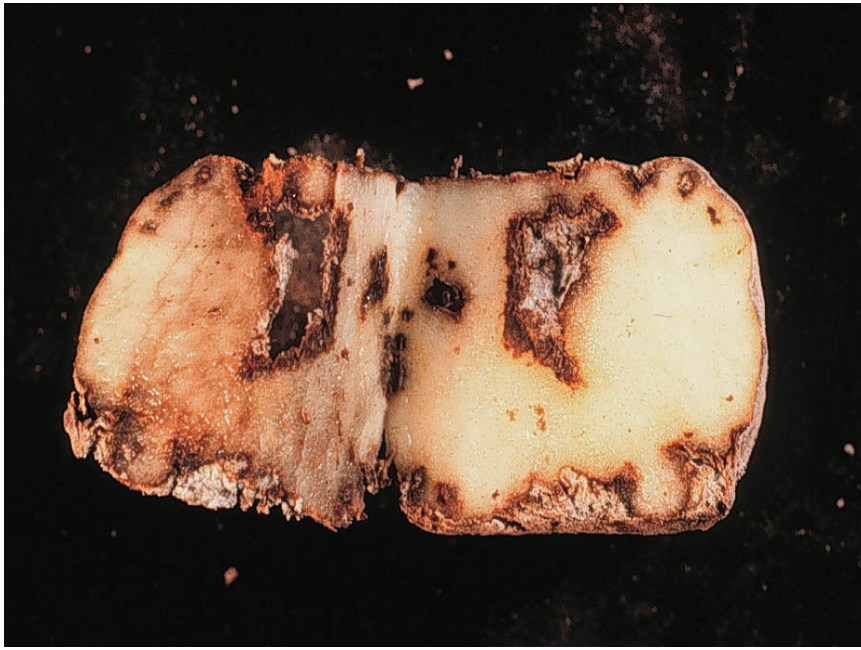
Fusarium dry rot

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



Pictures courtesy of Gary Secor

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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

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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

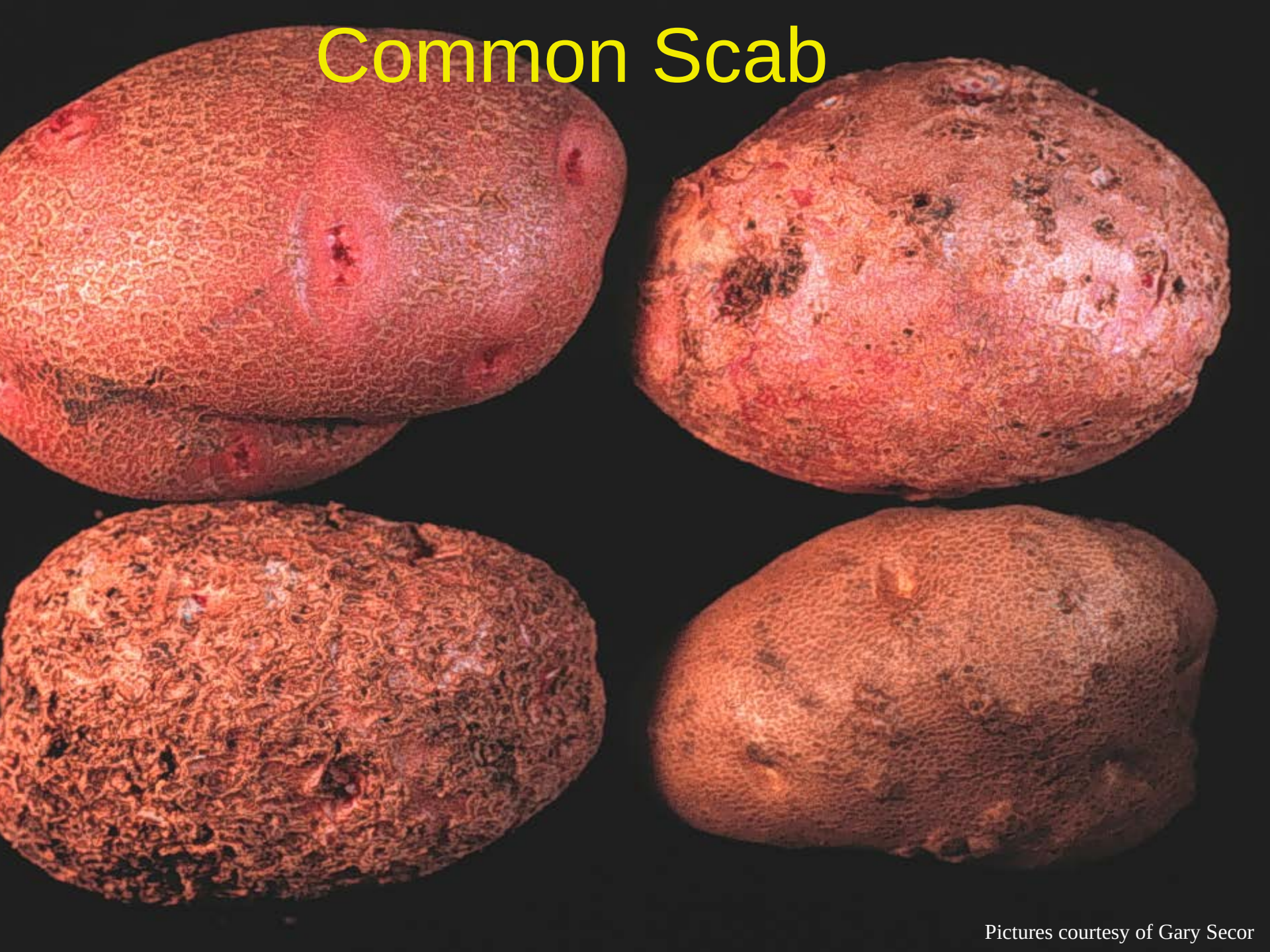
- Y is transmitted by aphids in a stylet borne, non-persistent manner
  - Mouth parts only
  - Persist < 10 hours
  - Transmits immediately before insecticide can kill
- Y has different biological forms called strains
  - PVY ordinary common strain
  - Causes mild mosaic
  - Necrosis in tubers

Picture courtesy of Gary Secor

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

Pictures courtesy of Gary Secor

Pictures courtesy of Gary Secor

Cultural Practices


Picture courtesy of Gary Secor

- 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 ever 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

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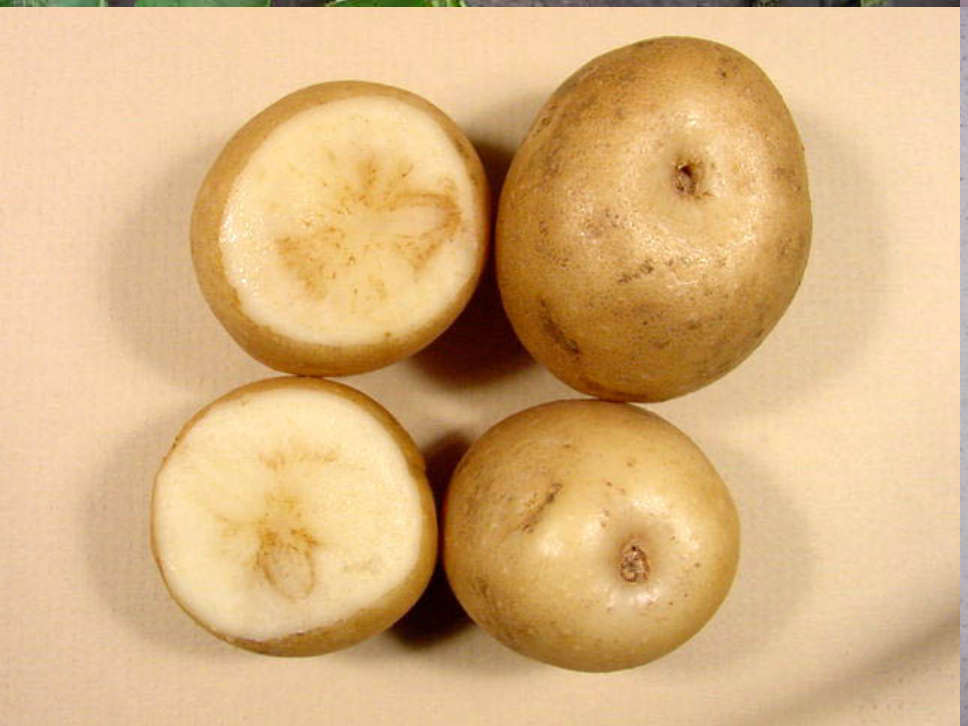
Nematodes

- 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

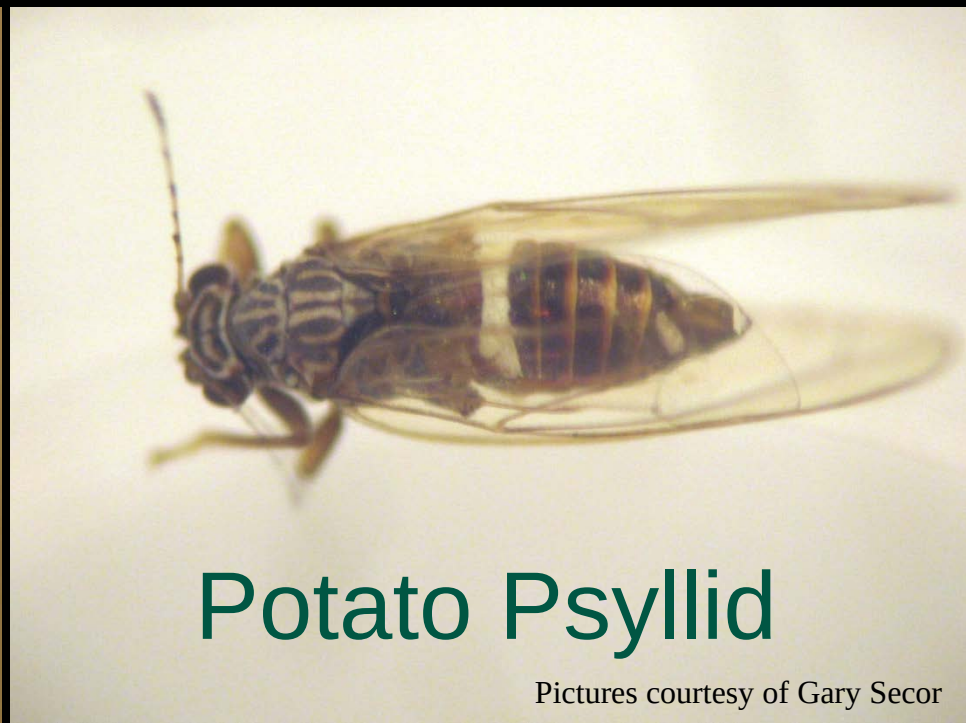
Zebra Chip Disease - Phytoplasm

- 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



Zebra Chip

Pictures courtesy of Gary Secor



Potato Psyllid

Pictures courtesy of Gary Secor

Potato Insects

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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

Jim Baker, North Carolina State University, Bugwood.org

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Wireworm

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

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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?