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

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.

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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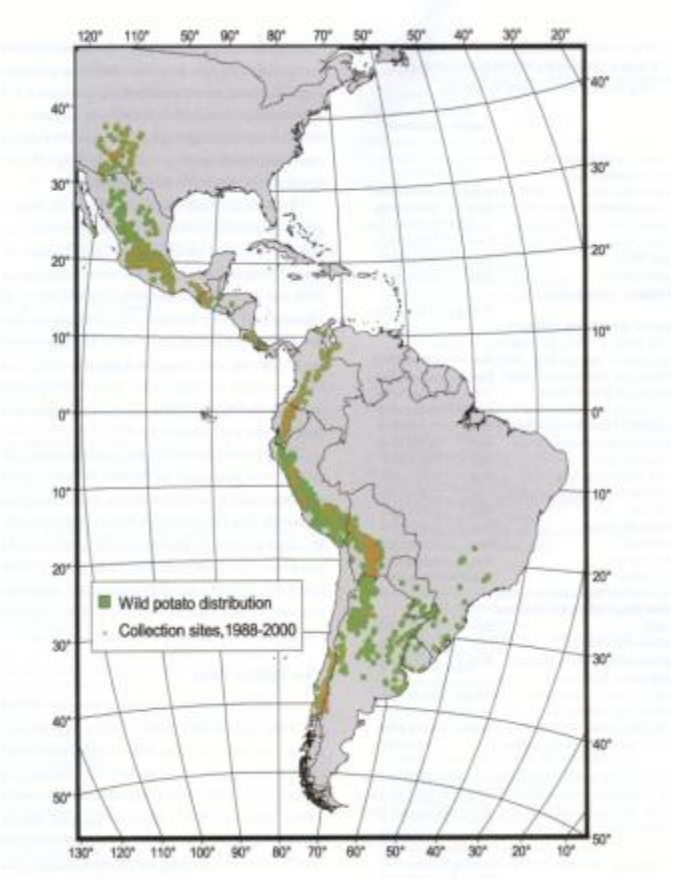
History

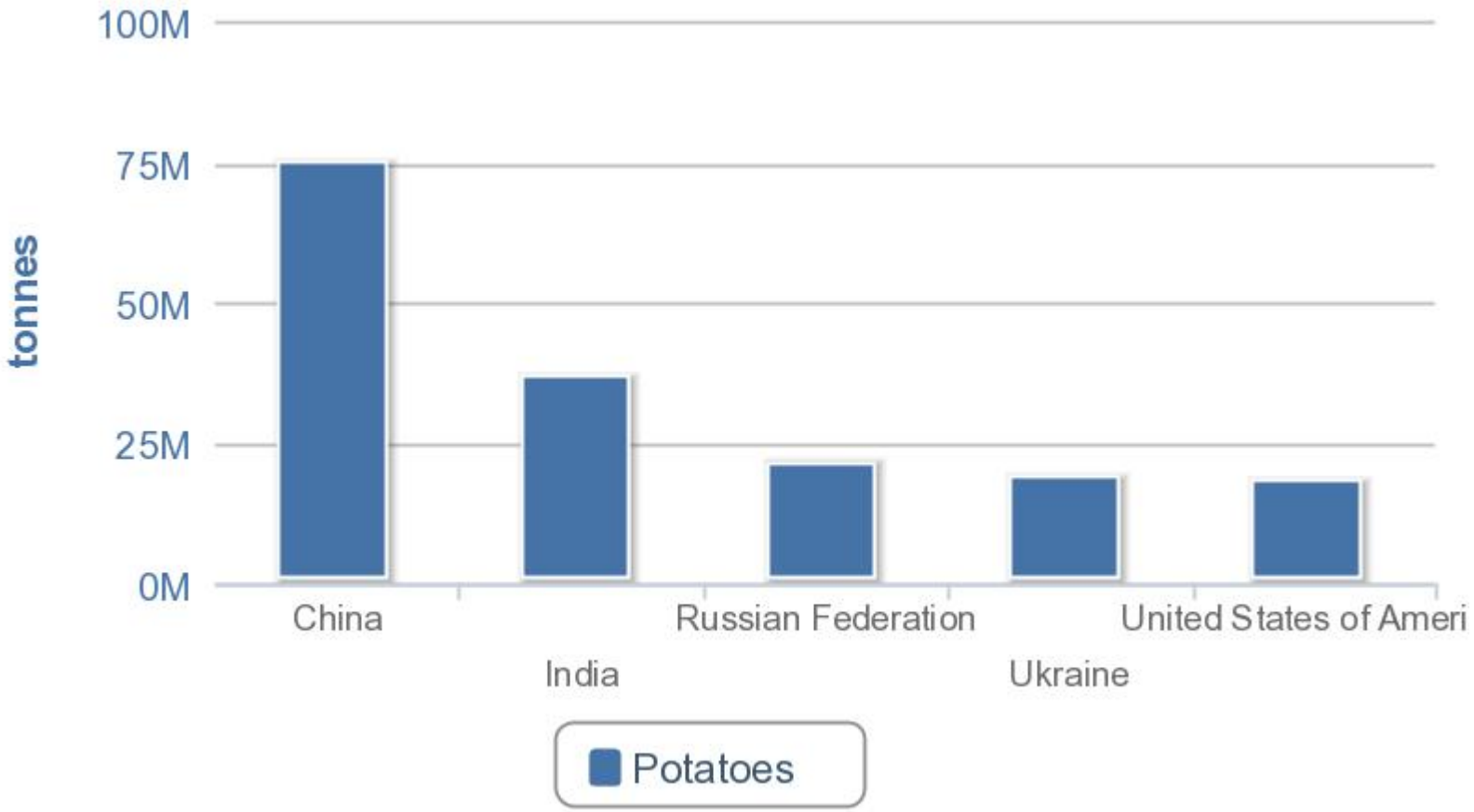
- Indigenous to Peru
- Utilization documented as early as 7000 yrs. ago
  - Incas domesticated and cultivated
- Introduced to Europe
  - 1570 - Spain
  - 1580 - England
- To the New World
  - Early 1700s



Family and Relatives

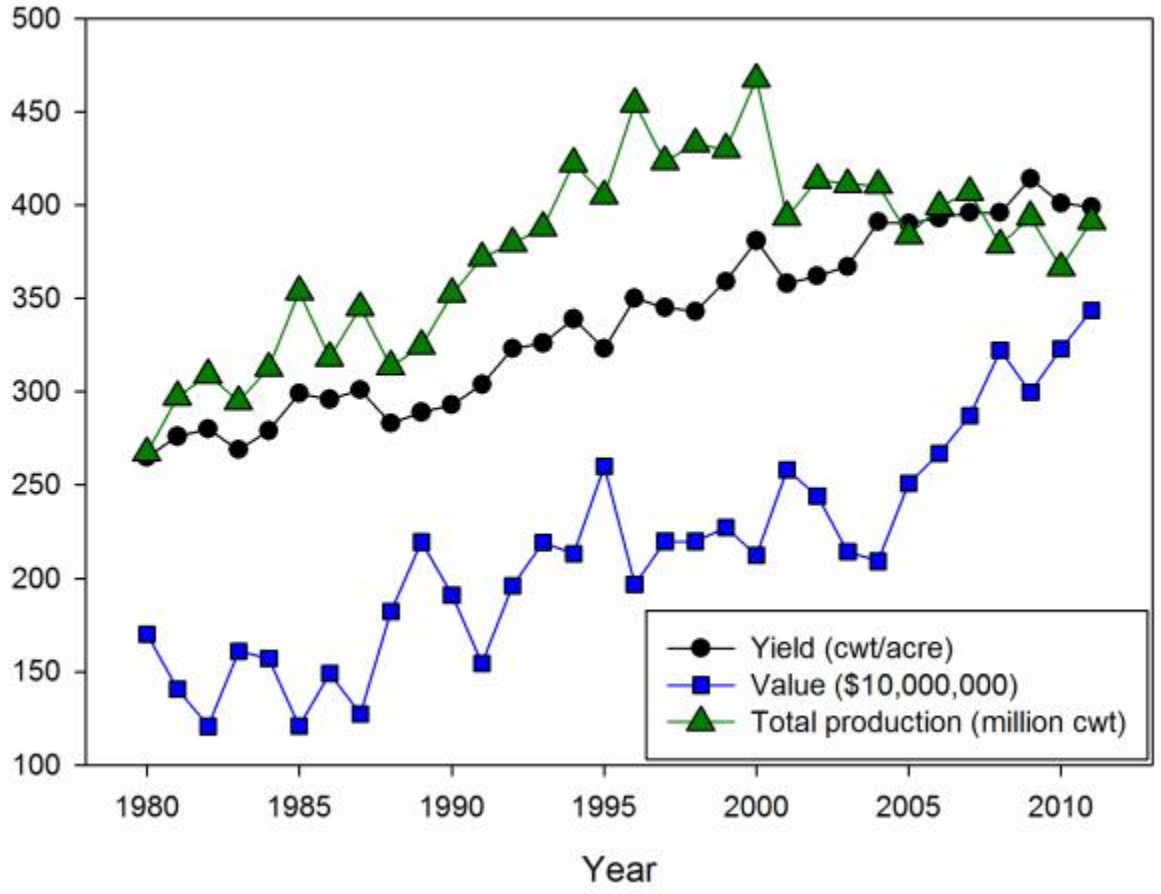
- Nightshade family, *Solanaceae*
  - 2,000 species
  - 160 tuber bearing
  - 20 cultivated species
- Annual dicot, grown for tubers
- Relative of tomato, eggplant, pepper, tobacco, petunia, and nightshade

World Potato Production 2010



FAOSTAT www.fao.org

US Produciton



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

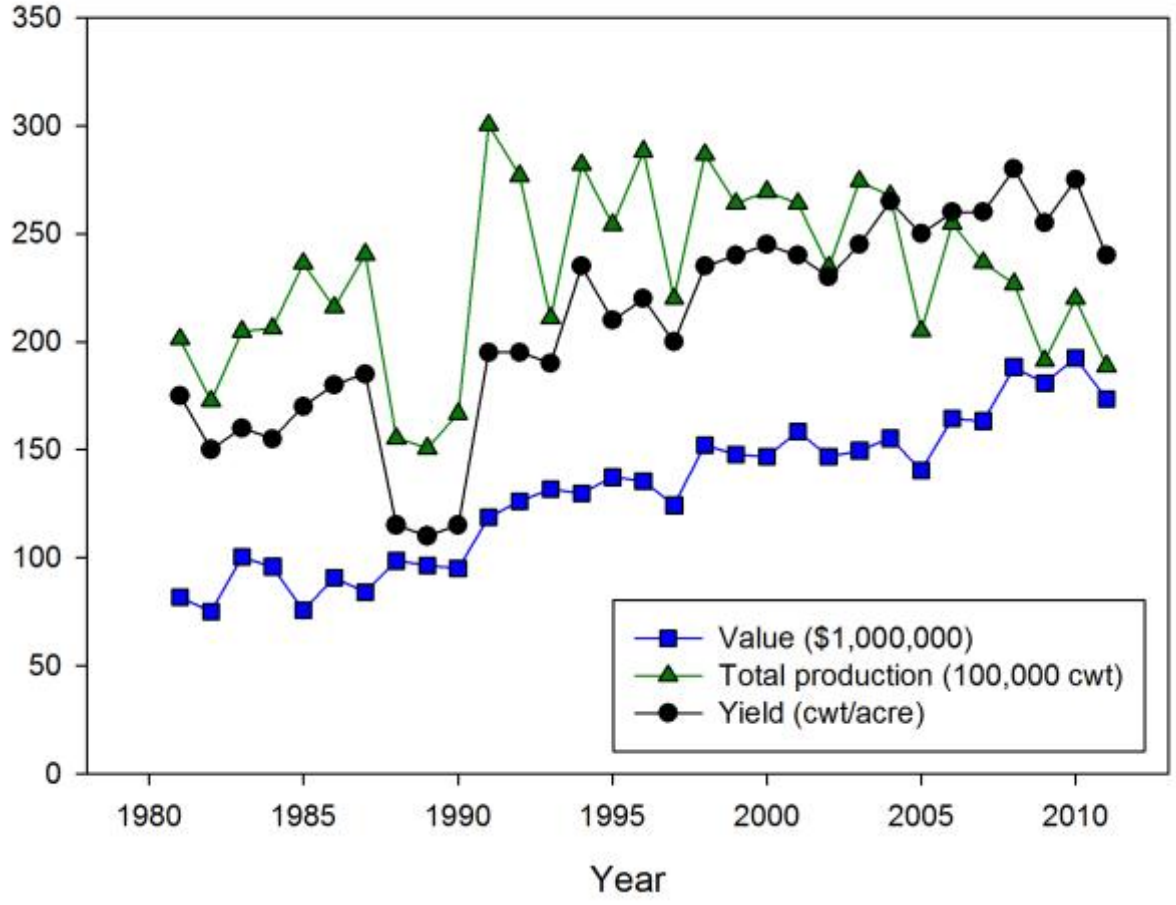
US Potato Production 2011

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

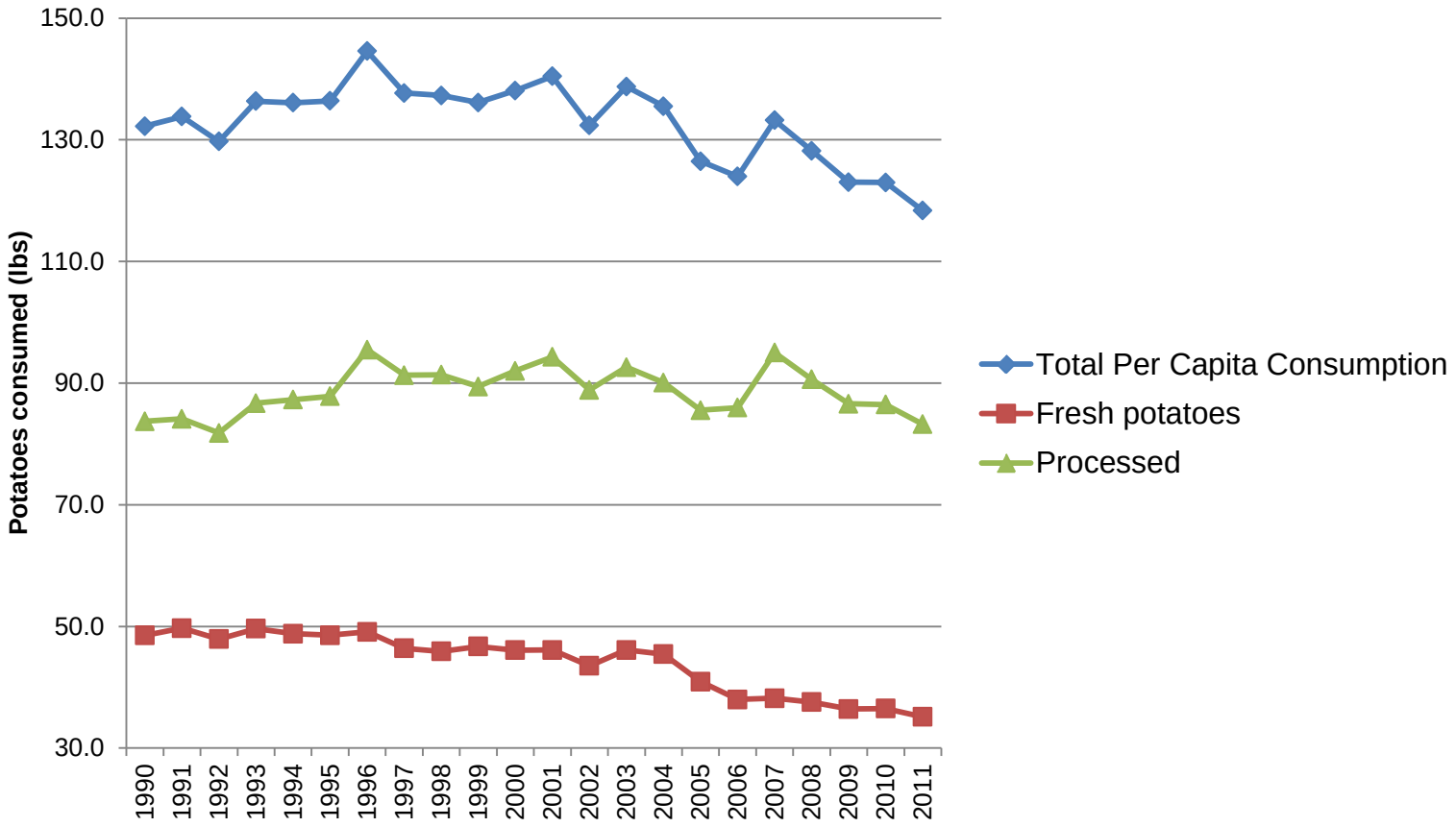


Per Capita Consumption

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.

Potatoes courtesy of Jeff Miller

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, Russet Norkotah, Umatilla Russet, Ranger Russet, Goldrush

Selecting and Planting Seed

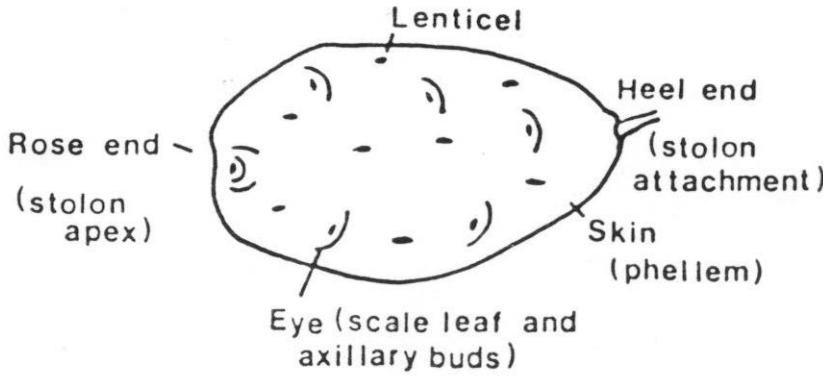
- Use certified seed
- Physiological seed age
- Plant 1.5 to 2.5 oz seed pieces
- Cure cut seed in 90% relative humidity
- Space seed 9 to 12 in
- Plant 3-4 inches below surface

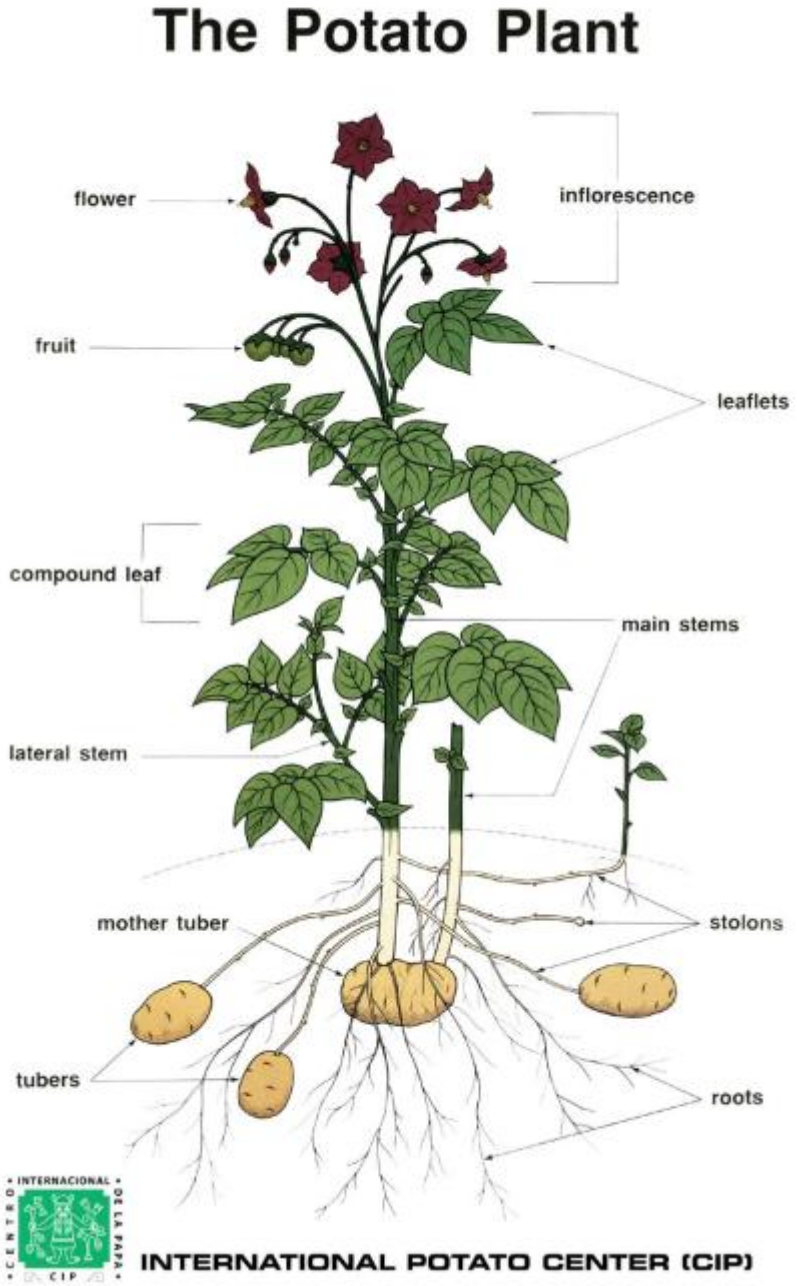
Below the Ground

- 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

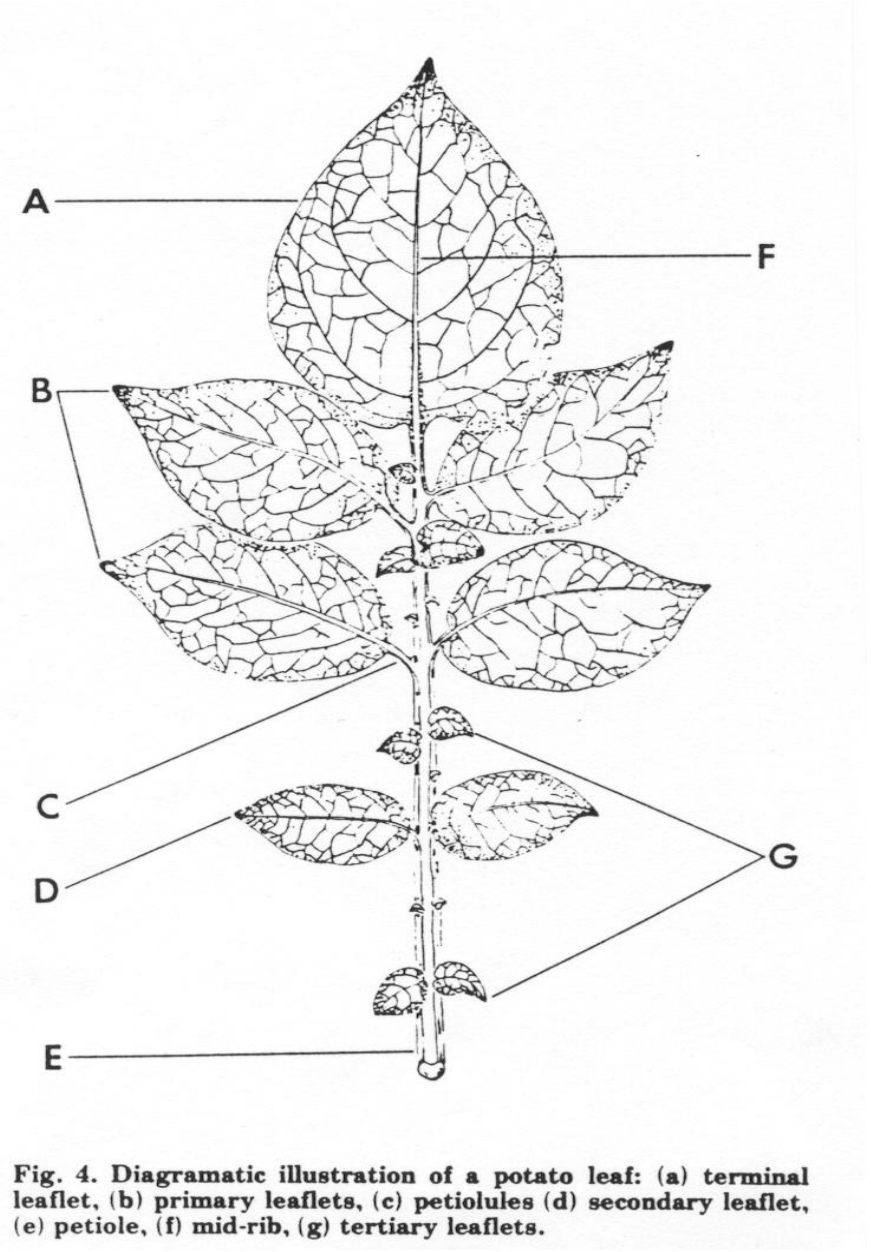


Fig. 4. Diagramatic illustration of a potato leaf: (a) terminal leaflet, (b) primary leaflets, (c) petiolules (d) secondary leaflet, (e) petiole, (f) mid-rib, (g) tertiary leaflets.

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

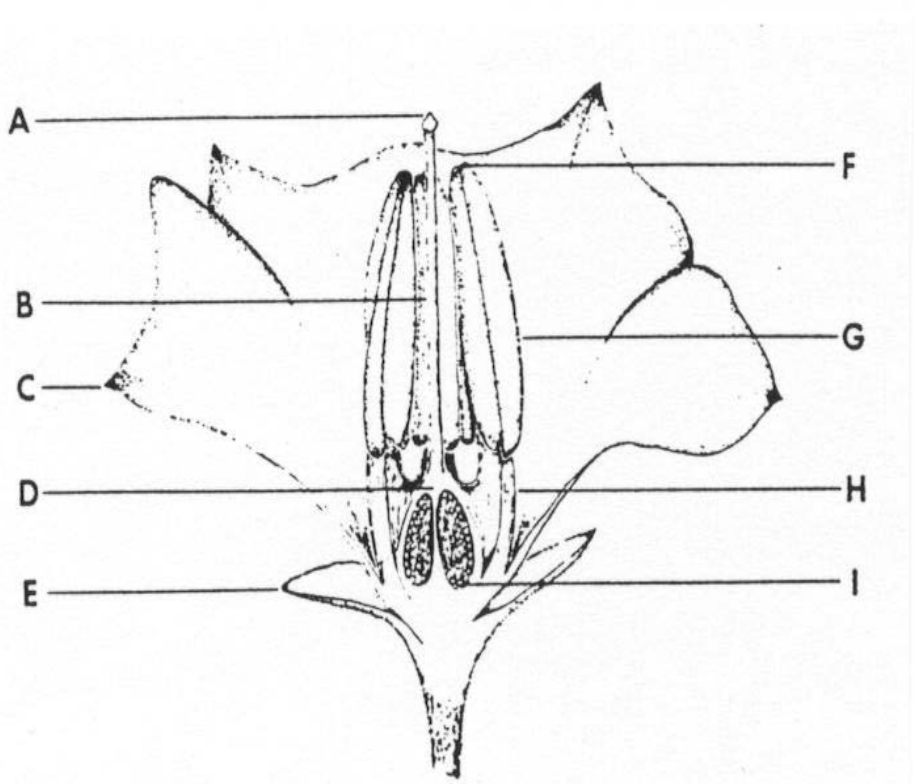


Fig. 2. Diagramatic sectional view of a potato flower: a) stigma, b) style, c) petal, d) ovary, e) sepals, f) pore, g) anther, h) filament, i) ovules (true seeds).

Lana et al. 1976

Shoot

- Fruit
  - A berry
  - Edible in some species, deadly in others
  - 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

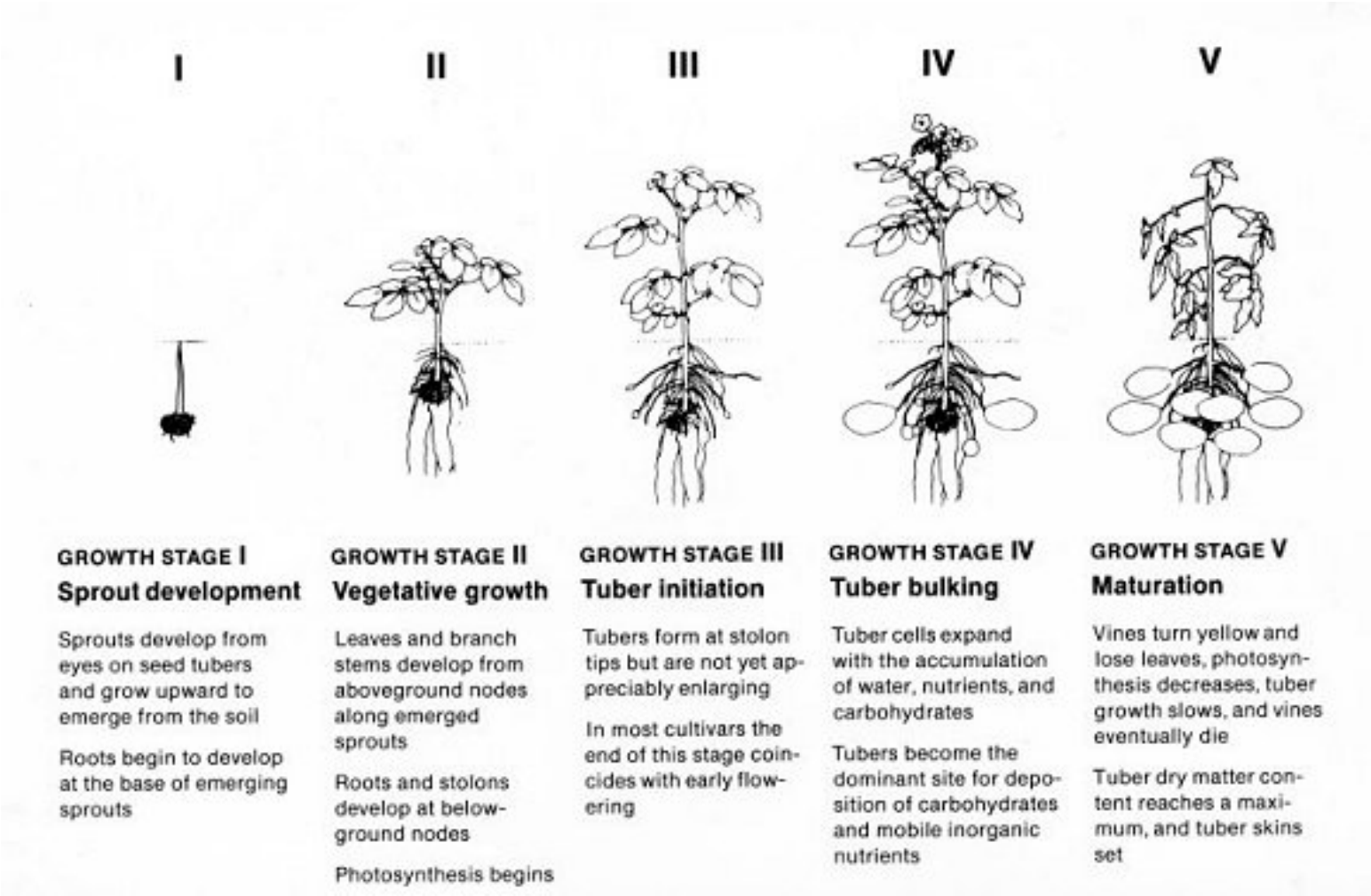
Stolons

- 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**

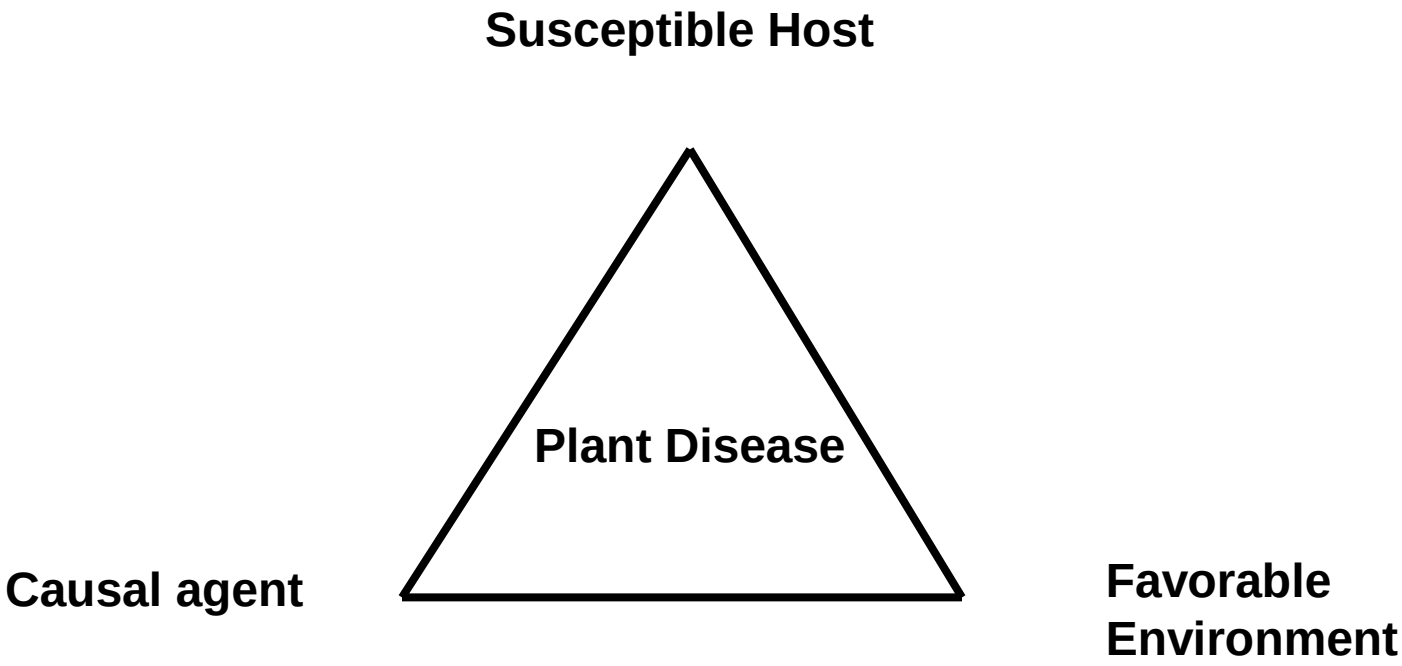
Potato Diseases

- 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
  - Leaf roll
  - PVY
  - 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 mosaic
  - No tuber symptoms

Picture courtesy of Gary Secor

Fungus – Powdery Scab

- It is a primitive but well adapted fungus
- Actually more like a protozoan
- It is an obligate parasite, i.e., it can only grow and multiply when a living host is present
- Cannot be cultured; difficult to work with
- Soil borne; common in many soils
- Transmits potato mop top virus.

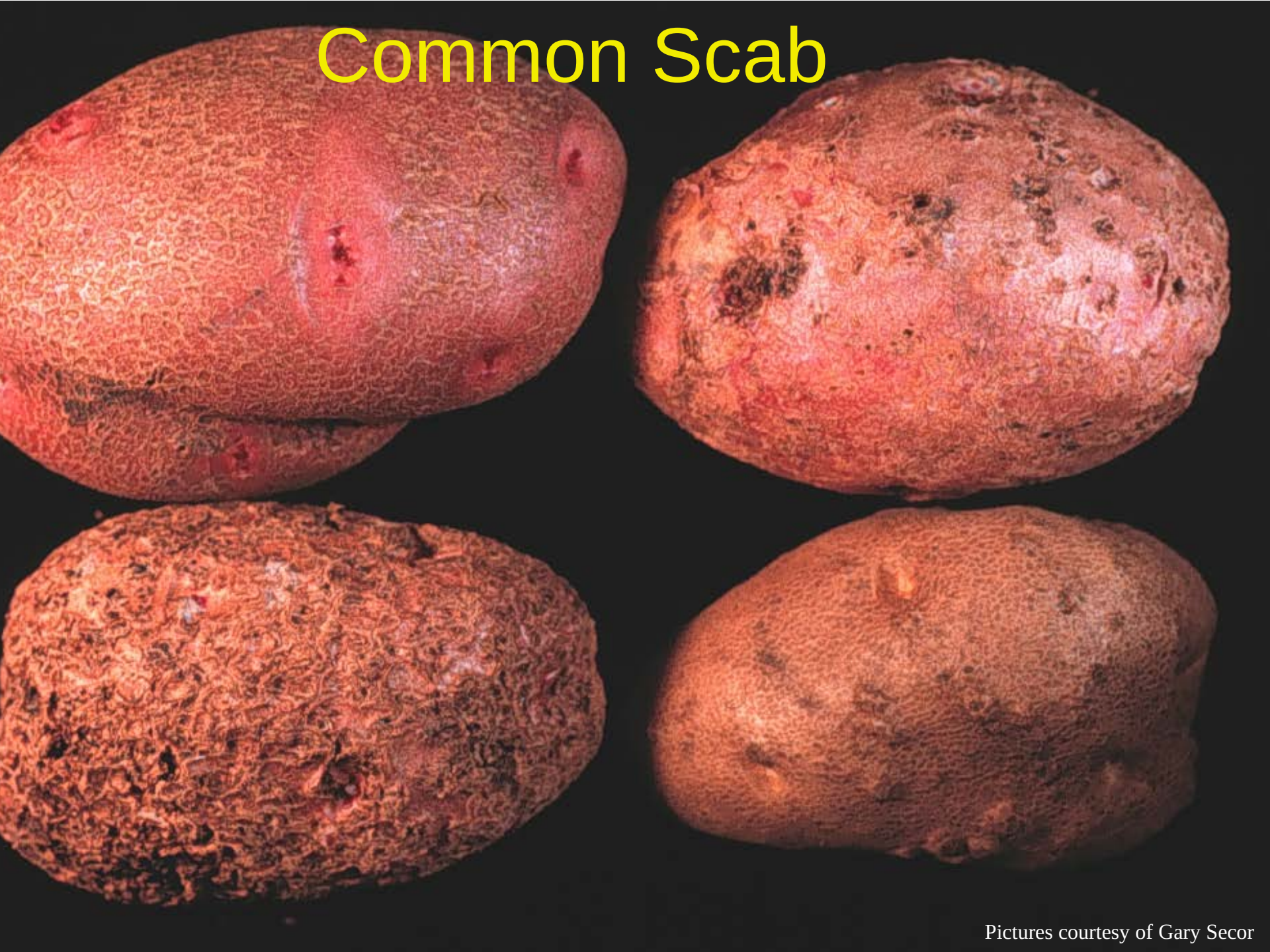
Symptoms

- The disease affects:
  - Tubers: erumpent lesions
  - Roots: galls; barely visible to easily visible
- Powdery scab can be easily confused with regular scab and go unrecognized
- Symptoms not always clear

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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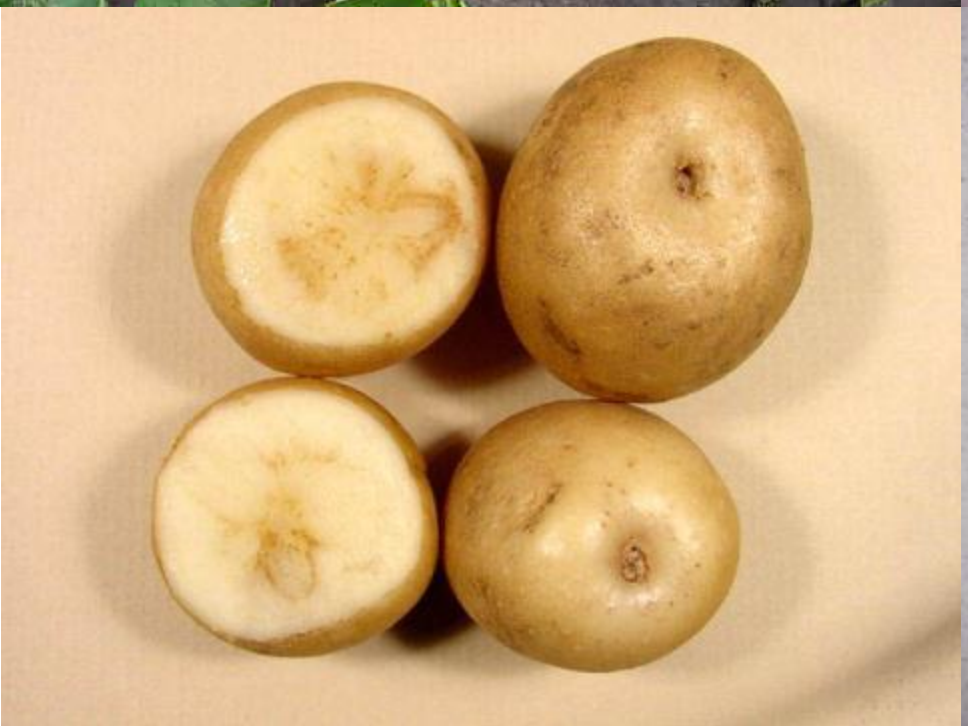
Nematodes

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

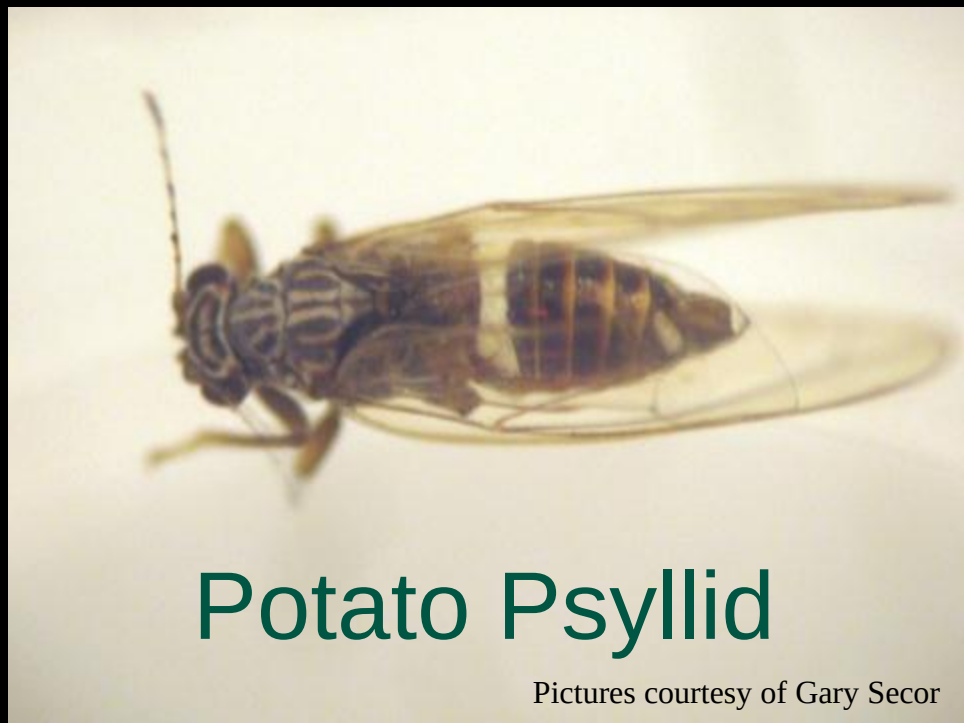
Zebra Chip Disease - Phytoplasm

- A new disease that has worked it's way up from Mexico through 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

Colorado Potato Beetle

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


David Cappaert, Michigan State University, Bugwood.org


Peggy Greb, USDA Agricultural Research Service, Bugwood.org


David Cappaert, Michigan State University, Bugwood.org

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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?