

# Weird and Wild World of Physiological Disorders



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# What is a physiological disorder?

- Non-infectious (do NOT spread).
- Not caused by insects or nematodes.
- Reduce quality/marketability of tubers.
- Can be on surface and/or interior of tubers.

# Physiological disorders

- Primary cause of non-infectious disorders are difficult to determine.
- Difficult to study because they are not consistently expressed.
- Chemicals or diseases may accentuate disorders.
- Can lead to secondary pathogens entering tubers.

# USDA Visual Aids for Red Potatoes

## FIRMNESS



Not shriveled or flabby  
U.S. No. 1 - maximum allowed

## SHAPE



Fairly well shaped  
U.S. No. 1 - maximum allowed

## SHAPE



Fairly well shaped  
U.S. No. 1 - maximum allowed



Practically no skinning\*

## SURFACE CRACKS



U.S. No. 1\*

## CUTS



U.S. No. 1 - maximum allowed

## AIR CRACKS



U.S. No. 1 - maximum allowed



Slightly skinned\*

## EXTERNAL DISCOLORATION



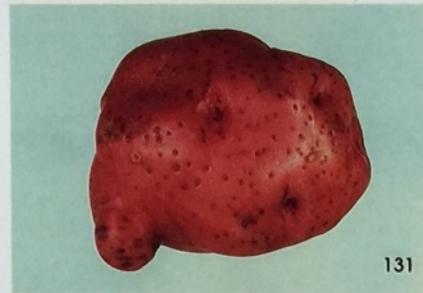
U.S. No. 1 - maximum allowed

## RHIZOCTONIA



U.S. No. 1 - maximum allowed

## SECOND GROWTH



U.S. No. 1 - maximum allowed



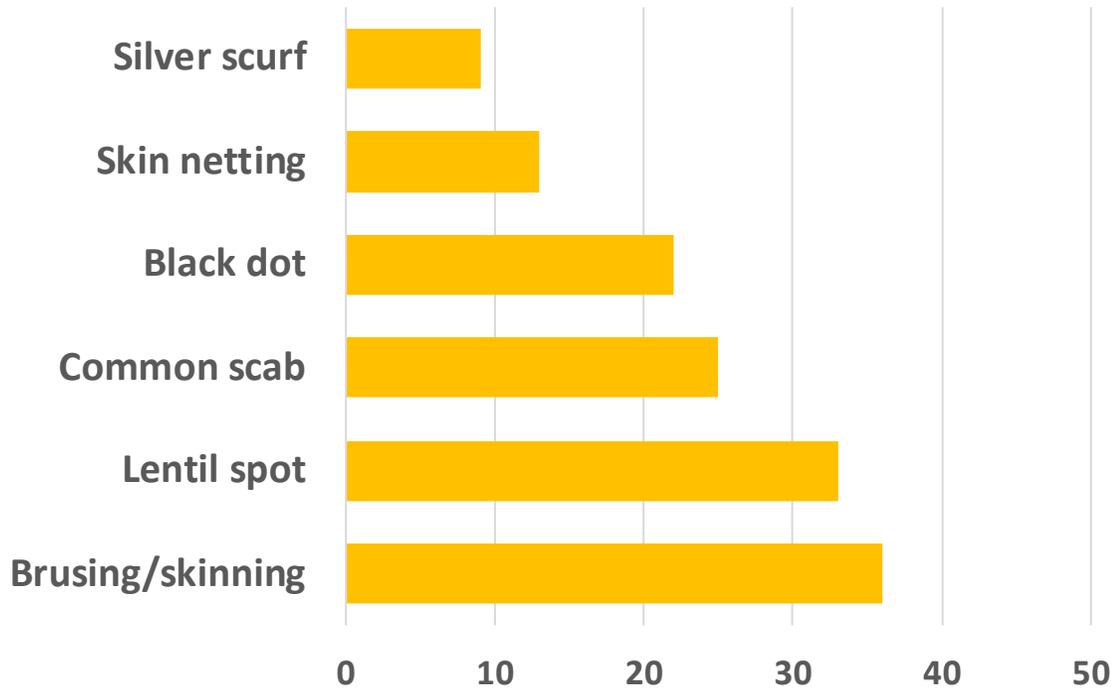
Moderately skinned\*



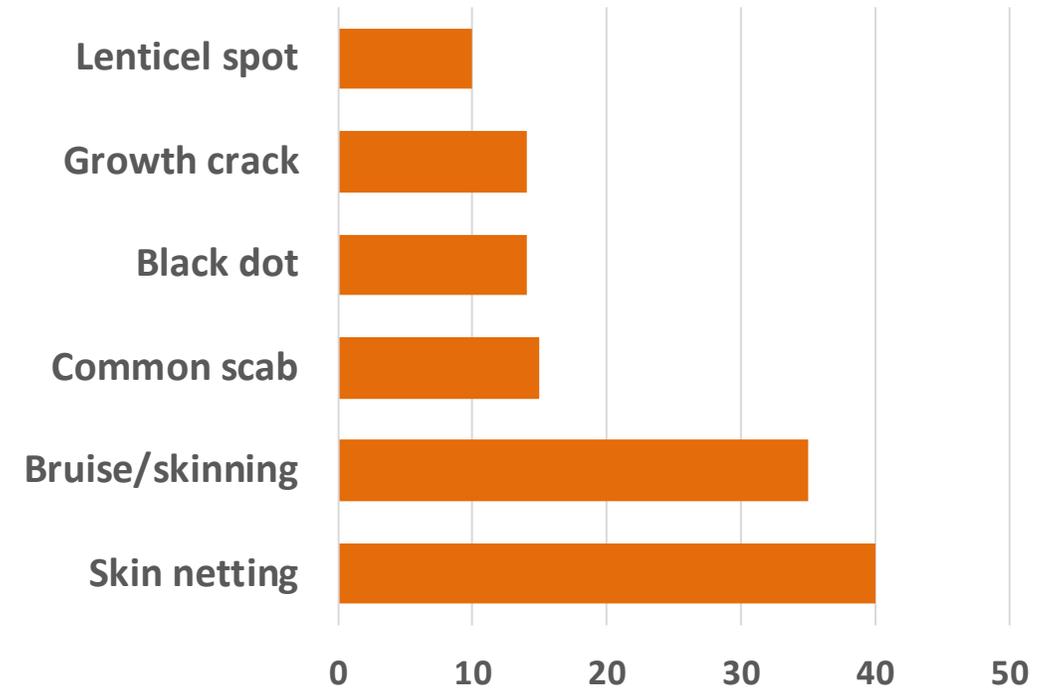
Badly skinned\*

# Blemish survey - 2015

## Minnesota blemish survey 2015



## ND blemish survey 2015



# Bruise/Skinning



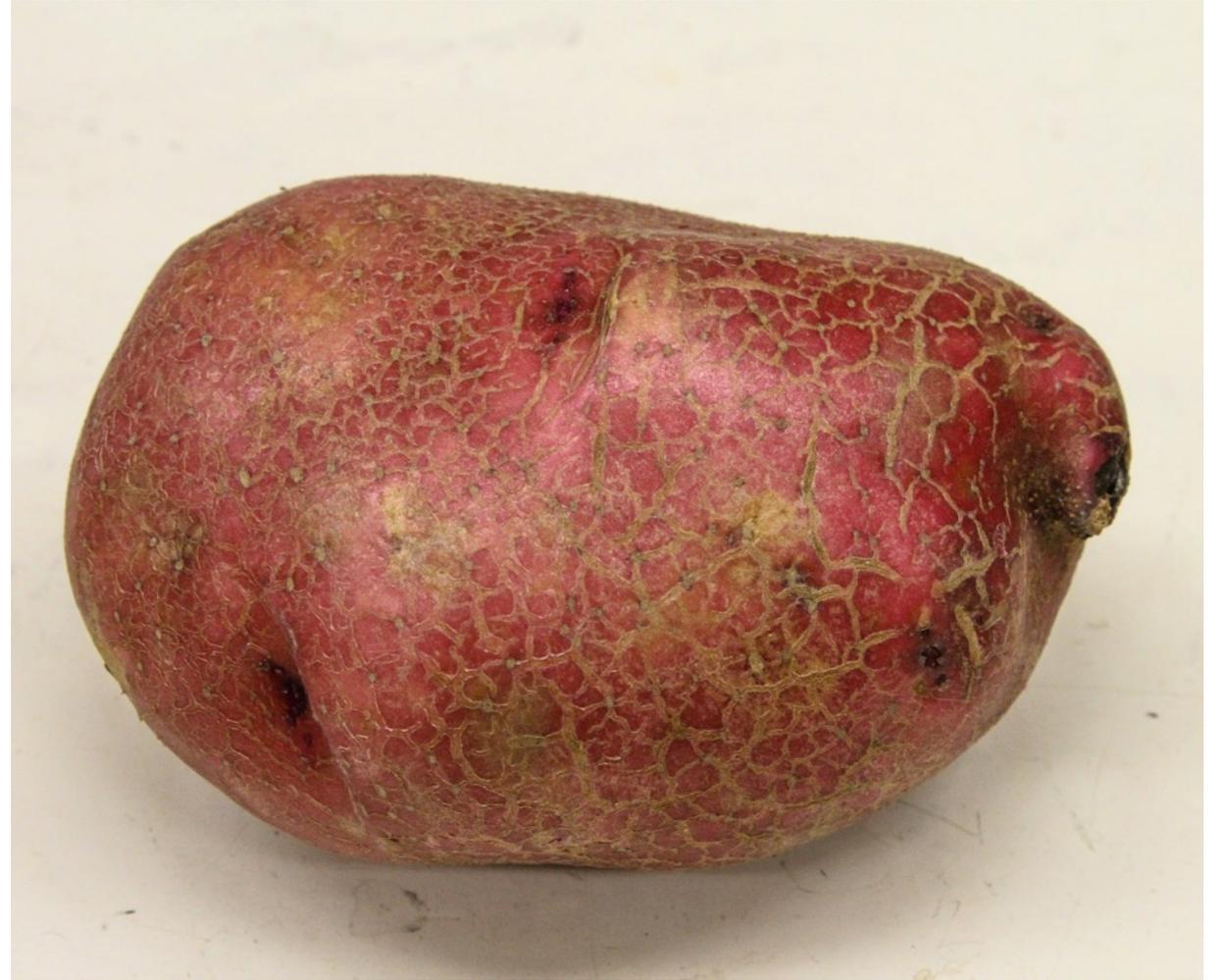


# Bruise/Skinning



- Cause: handling and storing
- Skin set is important to reduce severity
- Can cause moisture loss and entry point for diseases on tuber skin.

# Russeting/Road Mapping



# Russeting/Road Mapping



- Appearance of russet-like skin.
- Commonly found on smooth-skinned tubers.
- Result of extra skin layers to protect the tuber from heat stress.
- Some data indicate calcium can reduce this disorder.

# Enlarged Lenticels



# Enlarged Lenticels



# Enlarged Lenticels



- Caused by anaerobic conditions
- Lenticels open for oxygen and CO<sub>2</sub>
- Cause 'popcorn' looking area and when dries appears as scab
- Opening for pathogen entry

# Tuber Cracking



# Tuber Cracking

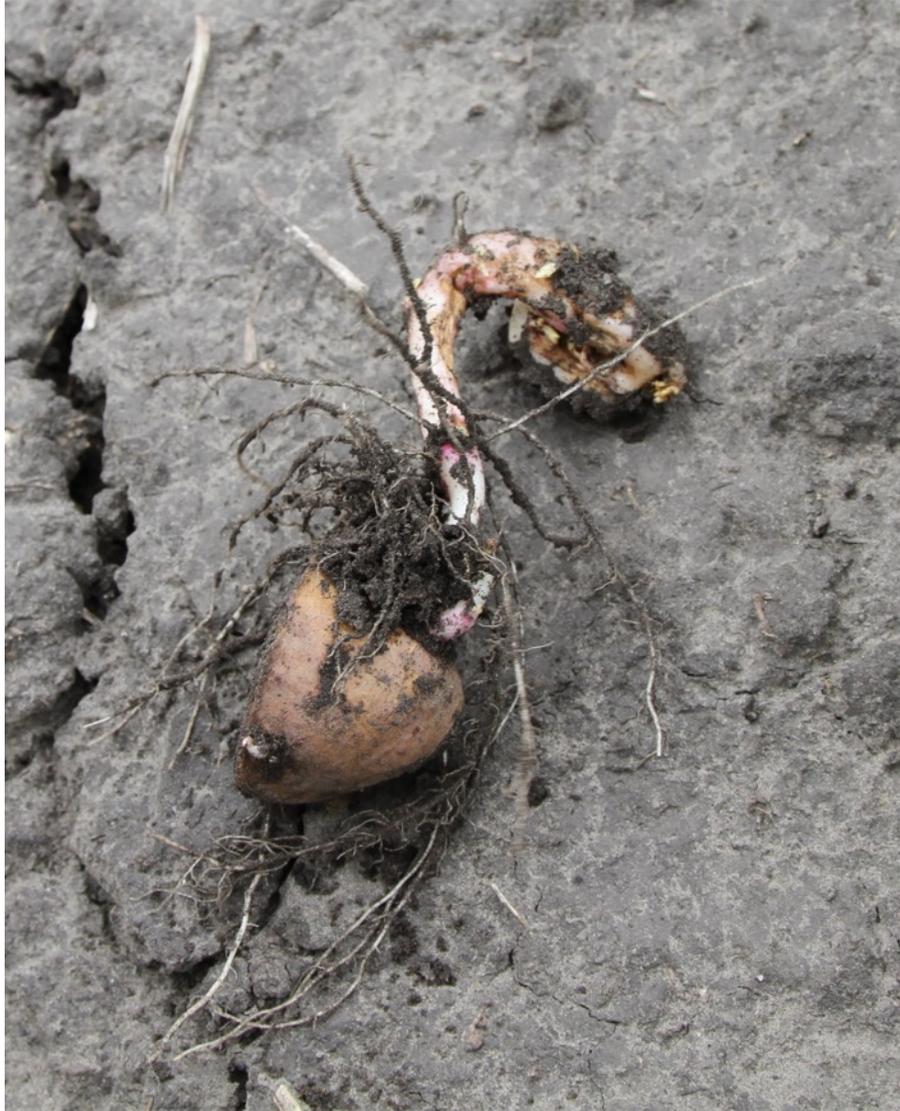


# Tuber Cracking



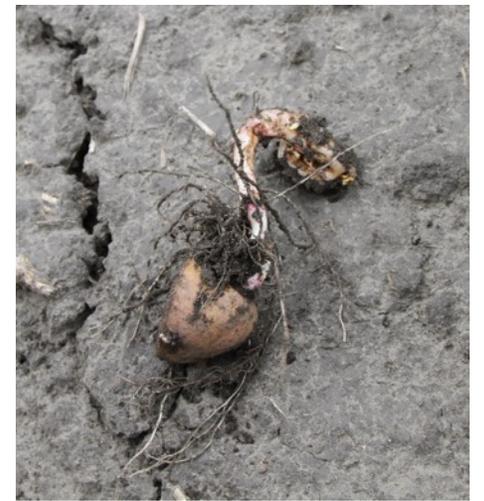
- Many causes
  - Environmental stress, nutritional imbalance, disease, herbicide injury or genetics.
- Results of high turgor pressure and rapid tuber growth
- Earlier cracking = larger cracks

# Coiled Sprout



# Coiled Sprout

- Abnormal sprout development
  - Coiled, split, cracked
- Cause loss of apical dominance
  - Axillary shoots and delayed emergence
- Causes
  - Early planting, soil type, cultivar
  - Ethylene imbalance – physiological aging, disease, or microorganism production



# Freeze Damage



# Freeze Damage

- Death to foliage
- Regrowth from axillary buds
- Tuber damage can occur in late season



# Heat Crinkle





# Heat Crinkle



- Sprouts suddenly encounter high temperature and stress plant
- Can increase stem number
- More common in sandy soils
- Russet Burbank is sensitive

# Greening

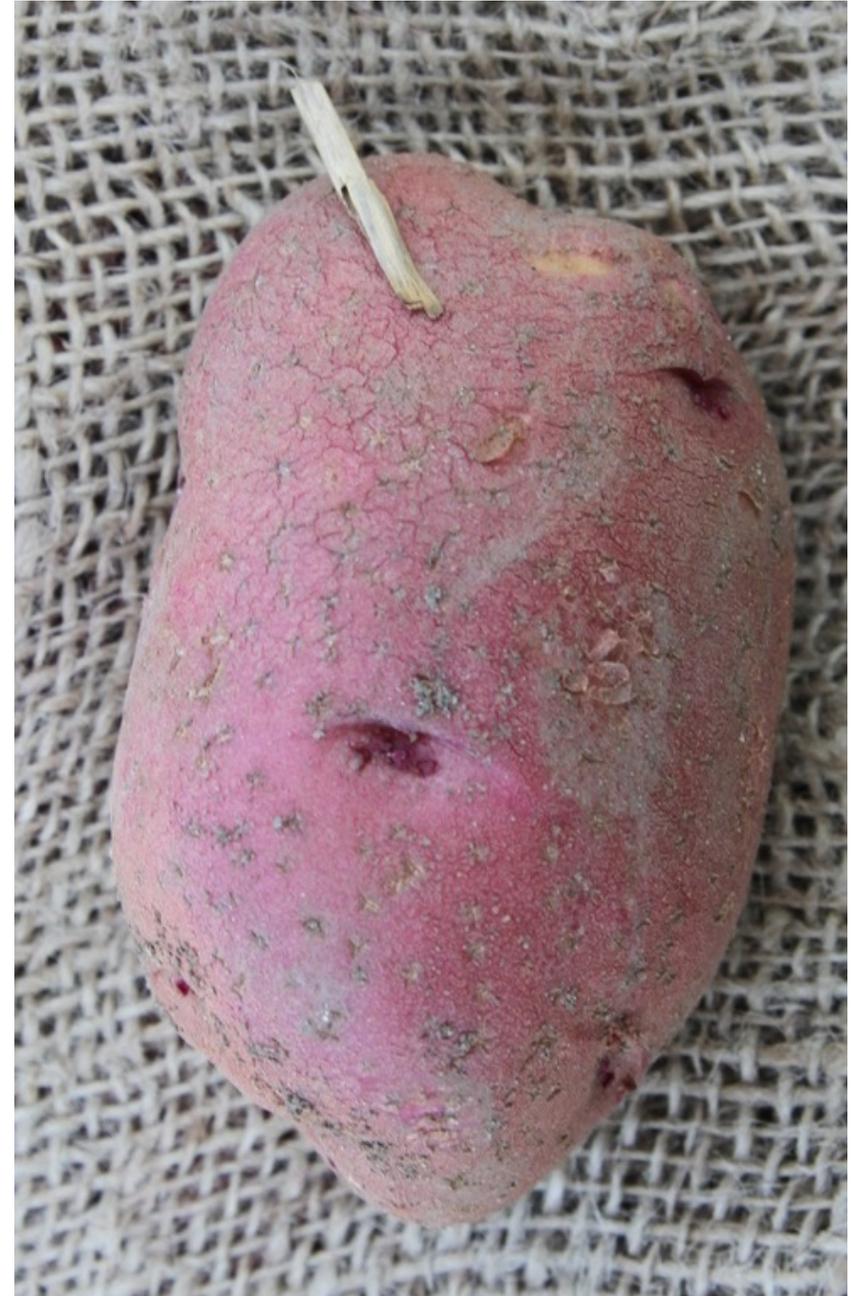


# Greening

- Exposure to sunlight
- Green from chlorophyll
- Contains glycoalkaloids– cannot consume
- Hilling and cultivar selection can reduce this disorder



# Elephant Hide



# Elephant Hide



- Rough or thick coarse russeting
- Causes:
  - High temperatures, genetic traits, soil fertility, soil moisture or chemical treatments
- Diseases
  - Rhizoctonia and mop-top
- Herbicides
  - ALS chemistry and glyphosate

# Pink Eye



# Pink Eye

- Puffy, pink-colored area around eyes
- Usually found on bud-end first
- Will fluoresce when exposed to blacklight
- Excessive moisture, soil compaction and high temperature can lead to low oxygen soil conditions = cell damage



# Stem End Disorder



# Stem End Disorder

- Result of low starch content.
- Can fry dark because of increased reducing sugar levels.
- Commonly occurs on stem end.
- Result of stress-triggered mechanisms:
  - Heat, drought & fertility



# Tuber Malformations





# Tuber Malformations



- Result of:
  - Sudden growth interruption, rapid growth following a stress
- Bottleneck, dumbbell, or pointed end appearance, this is indicative of when growth interruption occurred.
- Herbicides can interrupt growth and cause malformations.

# Blackheart

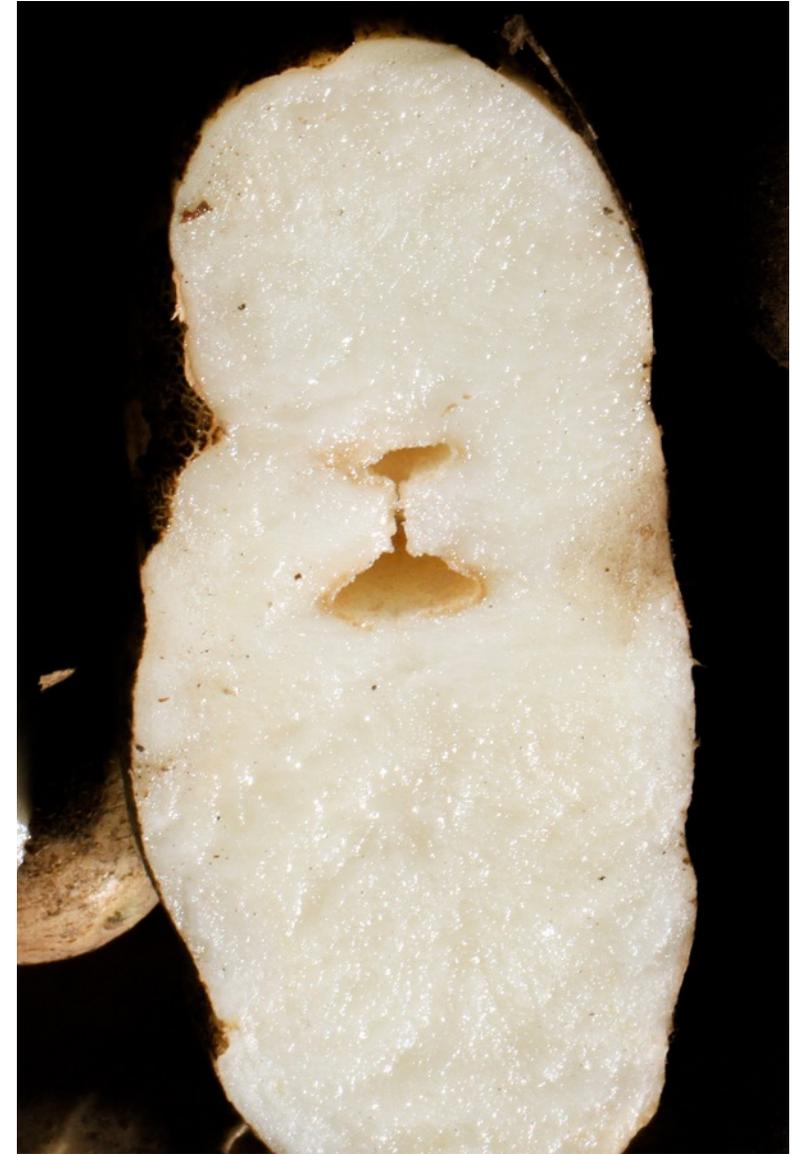


# Blackheart



- Caused by lack of oxygen, leading to dark, necrotic cavities.
- Can occur during tuber development and/or storage.
- Increased temperature can intensify blackheart, especially after vine kill and when soils are saturated.

# Hollow Heart



# Hollow Heart



- Occurs in the growing season
- Precursor is brown center and can develop into hollow heart as tuber expands.
- Cause:
  - Stress growing conditions followed by rapid tuber growth.

# Heat Necrosis



# Heat Necrosis



- Likely caused by several environmental stimuli:
  - high day and night temperatures, high soil temperatures & low soil moisture
- Symptoms not observed on foliage.
- Color, intensity and area affected will increase through time and can intensify in storage.

# Internal Anthocyanin Pigmentation



# Internal Anthocyanin Pigmentation



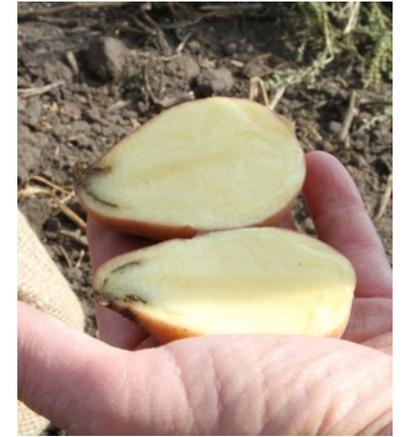
- The same anthocyanins are naturally found in the tuber skin of red and purple potato tubers and in the flesh color.
- Not a normal, thus causes concern to farmers and consumers.

# Vascular Discoloration



# Vascular Discoloration

- Discoloration of the vascular ring at the stem end.
- Can result from rapid vine death, especially when plants are less mature.
- Verticillium and fusarium wilt have similar symptoms.



# Internal weed sprout



# Little tubers



# That's All Folks!

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