

PP1790 (Reviewed Oct. 2022)

# Pea Disease Diagnostic Series

Photo: S. Markell, NDSU

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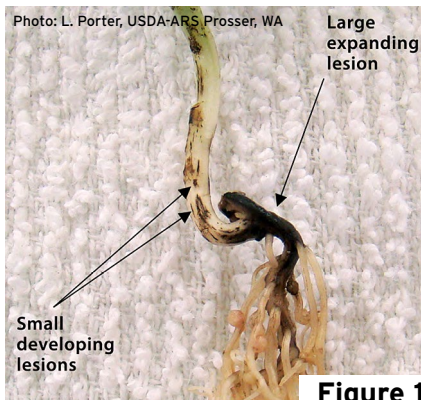
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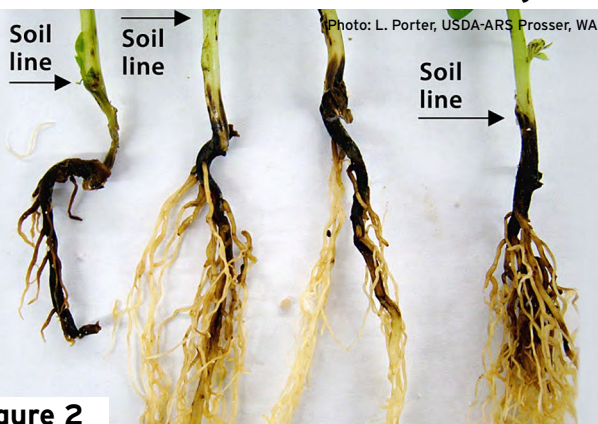


# Fusarium root rot

*Fusarium avenaceum*,  
*F. solani* f. sp. *pisi* and other species



**Figure 1**



**Figure 2**

**Figure 3**





# Fusarium root rot

*Fusarium avenaceum*

*F. solani* f. sp. *pisii* and other species

**AUTHORS:** Julie S. Pasche, Lyndon Porter and Kimberly Zitnick-Anderson

## SYMPTOMS

- Red to brown-black below-ground lesions
- Lateral root reduction and complete destruction in severe infections
- Below-ground red discolored vascular tissue is possible
- Above-ground stunting, yellowing and necrosis

**FIGURE 1** - Discrete lesions expanding from the point of seed attachment and coalescing into larger lesions

**FIGURE 2** - Advanced lesions affecting large areas of roots and hypocotyls

**FIGURE 3** - Infected plants yellowing from the base upward

## FACTORS FAVORING DEVELOPMENT

- Temperatures from 73 to 83 F and wet soils
- Soil compaction and plant stress
- Contaminated seed or plant debris

## IMPORTANT FACTS

- Alternative hosts include dry beans, soybean, chickpea and lentil
- Often seen in a complex with other root rots
- Above-ground symptoms often not seen until flowering
- Can be confused with other root rots and abiotic stress (water damage, etc.)

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# Aphanomyces root rot

*Aphanomyces euteiches*

Photo: L. Porter, USDA-ARS Prosser, WA

**Figure 1**



**Figure 2**



Photo: L. Porter, USDA-ARS Prosser, WA

**Figure 3**



Photo: L. Porter, USDA-ARS Prosser, WA



# Aphanomyces root rot

*Aphanomyces euteiches*

**AUTHOR:** Lyndon Porter

## SYMPTOMS

- Caramel-brown root and below-ground stem
- Outer root and below-ground stem tissue will slough off, exposing the vascular tissue
- Lower leaves turn yellow; the plant may be stunted, wilt and/or die prematurely

**FIGURE 1** - Caramel-brown infected roots (R) and healthy roots (L)

**FIGURE 2** - Infected roots and yellowing lower leaves

**FIGURE 3** - Outer root tissue sloughing off and exposing inner vascular tissue

## FACTORS FAVORING DEVELOPMENT

- Cool and wet spring conditions
- Low-lying areas
- Short rotations with peas or lentils

## IMPORTANT FACTS

- Thick-walled spores can survive in soil for 20 years or more
- Lentils are a host, but chickpeas and faba beans are not
- Crop rotations of six or more years with nonhost can help reduce disease
- Can be confused with other root rots and abiotic stress (water damage, etc.)



# Pythium seed and seedling rot

*Pythium ultimum* and other *Pythium* species

Photo: L. Porter, USDA-ARS Prosser, WA

**Figure 1**



Photo: L. Porter, USDA-ARS Prosser, WA

**Figure 2**



**Figure 3**



Photo: L. Porter, USDA-ARS Prosser, WA



# Pythium seed and seedling rot

*Pythium ultimum* and other *Pythium* species

**AUTHOR:** Lyndon Porter

## SYMPTOMS

- Rotted seeds often are coated with soil that is difficult to remove, even with washing
- Rotted tissue appears light brown
- Stunted plants, poor vigor and pinching-off of secondary roots

**FIGURE 1** - Light brown internal seed rot

**FIGURE 2** - Rotted seed coated with soil

**FIGURE 3** - Emerged plants with reduced vigor

## FACTORS FAVORING DEVELOPMENT

- Conditions that delay emergence, including planting into cool soils, poor seed vigor and compacted soils

## IMPORTANT FACTS

- Common seed rot pathogen across the U.S.
- Manage by maximizing speed of emergence by planting as shallow as possible in warm soils with high-quality seed
- Fungicide seed treatments effective on *Pythium* should be used
- Can be confused with water damage and other root rots





# Rhizoctonia seed, seedling and root rot

*Rhizoctonia solani* AG 2-1, 4, 5 and 8

Photo: L. Porter, USDA-ARS Prosser, WA

**Figure 1**



**Figure 2**



Photo: L. Porter, USDA-ARS Prosser, WA

**Figure 3**



Photo: K. Chang, Alberta Agriculture and Forestry



# Rhizoctonia seed, seedling and root rot

*Rhizoctonia solani* AG 2-1, 4, 5 and 8

**AUTHORS:** Timothy Paulitz,  
Dipak Sharma-Poudyal, Lyndon Porter,  
Weidong Chen and Lindsey du Toit

## SYMPTOMS

- Seeds may rot in soil, resulting in poor emergence
- Seedlings have reddish-brown, sunken lesions on roots and base of stem
- Pinching-off of tips of the main tap root and secondary roots
- Plants become stunted and yellow

**FIGURE 1** - Sunken brown lesions on below-ground stem tissue

**FIGURE 2** - Browning of the roots and pinching-off of root tips

**FIGURE 3** - Peas infected with Rhizoctonia

## FACTORS FAVORING DEVELOPMENT

- Wet, cool soils
- Seed with poor germination

## IMPORTANT FACTS

- Pathogen can survive in soil and plant debris
- Rotation is largely ineffective and resistant cultivars are not available
- Fungicide seed treatments are recommended
- Can be confused with other root rots, water damage

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# Fusarium wilt

*Fusarium oxysporum* f. sp. *pisii*

**Figure 1**



**Figure 2**



**Figure 3**



**Figure 4**





# Fusarium wilt

*Fusarium oxysporum* f. sp. *pisi*

**AUTHOR:** Stephen Guy

## SYMPTOMS

- Leaves curl and yellow progressively from the base of the plant upward, sometimes more severe on one side of the plant
- Root vascular tissue is shades of yellow, orange or red, extending into the base of stem
- Field distribution is scattered plants or concentrated patches
- Plants may wilt

**FIGURE 1** - Yellowing and curling of leaves

**FIGURE 2** - Curling and yellowing of lower leaves on one side of the plant only

**FIGURE 3** - Orange-red vascular discoloration extending into the stem

**FIGURE 4** - Severe vascular discoloration

## FACTORS FAVORING DEVELOPMENT

- Previous history of disease in the field
- Frequent cropping of susceptible varieties
- Late planting

## IMPORTANT FACTS

- Can survive in soil for 10 years or more
- The fungus penetrates root tips and blocks vascular tissue
- Pathogen has more than one race and resistant varieties may not be effective against all races
- Can be confused with *Aphanomyces* and *Fusarium* root rots and abiotic stress

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# Ascochyta blight

*Ascochyta pisi*, *A. pinodes*,  
*Phoma medicaginis* var. *pinodella*

**Figure 1**



Photo: M. Wunsch, NDSU

**Figure 2**



Photo: M. Wunsch, NDSU

**Figure 3**



Photo: M. Wunsch, NDSU

**Figure 4**



Photo: M. Wunsch, NDSU



# Ascochyta blight

*Ascochyta pisi*, *A. pinodes*,  
*Phoma medicaginis* var. *pinodella*

**AUTHOR:** Michael Wunsch

## SYMPTOMS

- Leaf lesions are dark, irregular flecks and/or circular to oval lesions, with a concentric ring pattern
- Purplish stem lesions develop at nodes, elongate and may girdle stem
- Pod lesions are small, irregular to circular and brown to purplish black
- Seed may be discolored

**FIGURE 1** - Oval lesions with concentric rings

**FIGURE 2** - Irregular flecks on leaf, extending to petioles and stems

**FIGURE 3** - Small, irregular pod lesions

**FIGURE 4** - Stem lesions

## FACTORS FAVORING DEVELOPMENT

- Cool, wet weather
- Short rotational intervals between pea crops

## IMPORTANT FACTS

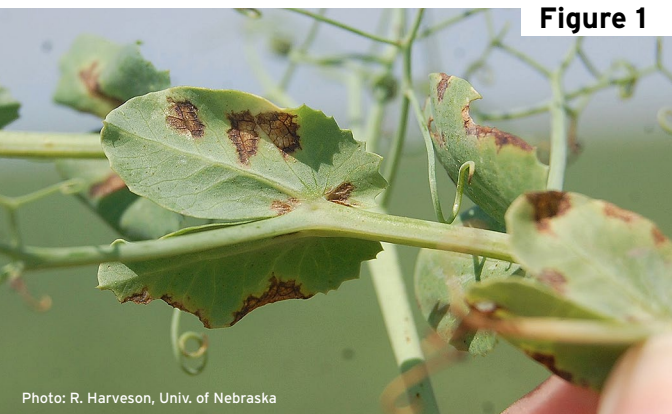
- Primarily residue-borne but can be seedborne
- Crop rotation reduces but does not eliminate pathogen inoculum
- The host range of the causal pathogens is limited to field peas
- Can be confused with bacterial blight or Septoria blight

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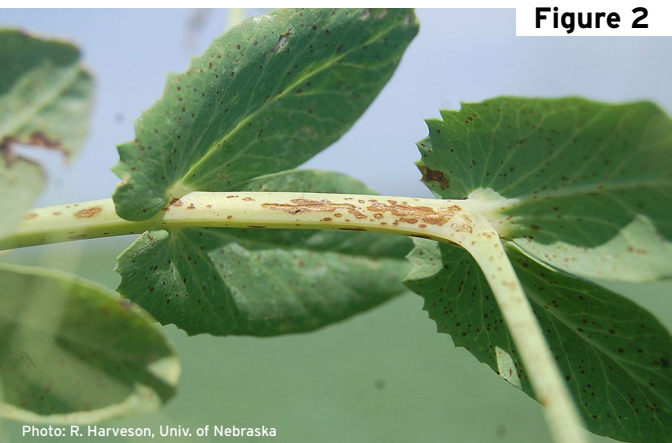
# Bacterial blight and brown spot

*Pseudomonas syringae* pv. *pisii*  
and *P. syringae* pv. *syringae*



**Figure 1**

Photo: R. Harveson, Univ. of Nebraska



**Figure 2**

Photo: R. Harveson, Univ. of Nebraska



**Figure 3**

Photo: R. Harveson, Univ. of Nebraska



# Bacterial blight and brown spot

*Pseudomonas syringae* pv. *psis*  
and *P. syringae* pv. *syringae*

**AUTHOR:** Robert M. Harveson

## SYMPTOMS

- Symptoms occur on all above-ground plant parts
- Lesions initially are water-soaked and later turn necrotic
- Lesions are vein-delimited, angular in shape and translucent
- Bacterial ooze may be seen under conditions of high humidity

**FIGURE 1** - Angular leaf lesions delimited by veins

**FIGURE 2** - Watery stem lesions forming in linear patterns as disease progresses

**FIGURE 3** - Bacterial ooze emerging from pod lesions

## FACTORS FAVORING DEVELOPMENT

- Warm temperatures
- High humidity or leaf moisture

## IMPORTANT FACTS

- Pathogens are seedborne
- Spread can occur with any type of mechanical contact on wet leaves or by splashing water
- Planting clean seed and use of disease resistant cultivars are the most effective management tools
- Can be confused with fungal leaf spots

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# Powdery mildew

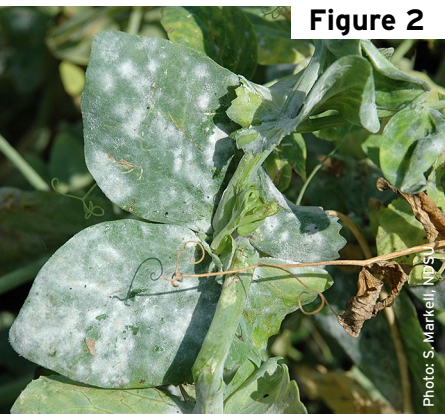
*Erysiphe pisi* and *E. trifolii*

Photo: M. Wunsch, NDSU

**Figure 1**



**Figure 2**



**Figure 3**



**Figure 4**



Photo: R. Attanayake, Washington St. U.



# Powdery mildew

*Erysiphe pisi* and *E. trifolii*

**AUTHORS:** Renuka N. Attanayake, Weidong Chen and Michael Wunsch

## SYMPTOMS

- White powdery tufts of fungal growth
- New fungal growth can be rubbed off easily
- Fungal growth will expand and may cause plant tissue to become chlorotic
- Late in the season, black fungal structures may appear
- Infection on pods can cause a gray-brown discoloration of the seeds

**FIGURE 1** - Small tufts of fungal growth

**FIGURE 2** - Progression of fungal growth

**FIGURE 3** - Fungal growth rubbed off right side of leaf

**FIGURE 4** - Sever infection late in the season; note black fungal structures

## FACTORS FAVORING DEVELOPMENT

- Temperatures of 59 to 77 F are optimal
- Heavy dew or fog
- Late planting

## IMPORTANT FACTS

- Pathogen can be soil-borne, seed-borne and wind-dispersed
- Management tools include resistant cultivars, crop rotation and foliar fungicides
- Most prevalent late in the season

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# Rust

*Uromyces viciae-fabae*

Photo: S. Markell, NDSU

**Figure 1**



Photo: S. Markell, NDSU

**Figure 2**



Photo: S. Markell, NDSU

**Figure 3**





# Rust

*Uromyces viciae-fabae*

**AUTHORS:** Sam Markell and Julie Pasche

## SYMPTOMS

- Affects all above-ground plant parts
- Pustules erupt from tissue, causing holes and large lacerations
- Pustules are filled with dusty cinnamon-brown spore that easily rub off
- Severe infection causes yellowing, premature senescence and yield loss

**FIGURE 1** - Pustules filled with dusty brown spores on leaf

**FIGURE 2** - Pustules lacerating branch

**FIGURE 3** - Severe infection causing premature senescence and plant death

## FACTORS FAVORING DEVELOPMENT

- Heavy dew or fog

## IMPORTANT FACTS

- Disease observed annually in northern Great Plains but rarely widespread
- Epidemics can progress quickly once disease is established
- Foliar fungicides can help manage disease
- Also can infect lentils and garden peas



# Septoria blight

*Septoria pisi*

Photo: S. Markell, NDSU

**Figure 1**



Photo: S. Markell, NDSU

**Figure 2**



Photo: S. Markell, NDSU

**Figure 3**





# Septoria blight

*Septoria pisi*

**AUTHORS:** Mary Burrows and Sam Markell

## SYMPTOMS

- Symptoms occur on all plant parts
- Necrotic lesions with small black fungal structures (pycnidia)
- Often occur late in the season

**FIGURE 1** - Young leaf lesion with black fungal structures (pycnidia)

**FIGURE 2** - Oblong lesions with pycnidia

**FIGURE 3** - Necrotic lesion with pycnidia on branch

## FACTORS FAVORING DEVELOPMENT

- Warm temperatures (70 to 80 F)
- High humidity or heavy dews

## IMPORTANT FACTS

- The pathogen survives on crop stubble or infected seed; spores are wind-dispersed
- Planting clean seed, rotation and foliar fungicides are the most effective management tools
- No variety resistance is known
- Can be confused with *Ascochyta* blight and bacterial blight. Note that *Septoria* pycnidia are distributed randomly and *Ascochyta* pycnidia are distributed in a circular, target pattern. Bacterial blight does not have pycnidia.



# White Mold

*Sclerotinia sclerotiorum*

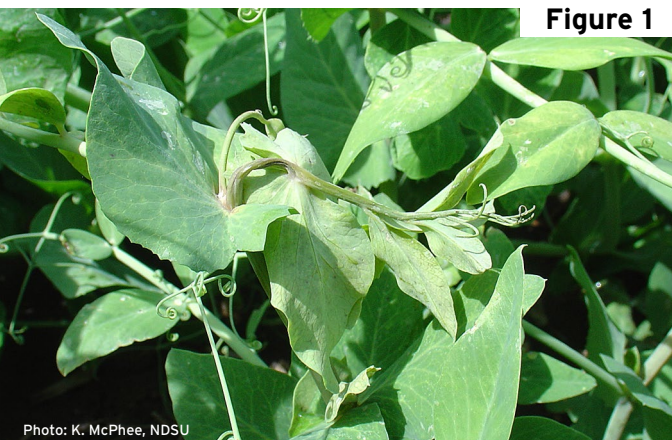


Figure 1

Photo: K. McPhee, NDSU



Figure 2

Photo: L. Porter, USDA-ARS Prosser, WA

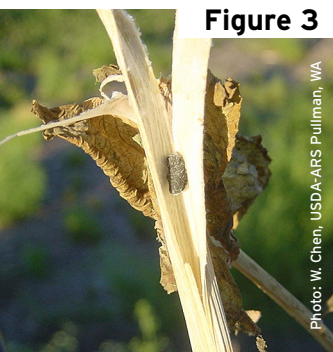


Figure 3

Photo: W. Chen, USDA-ARS Pullman, WA

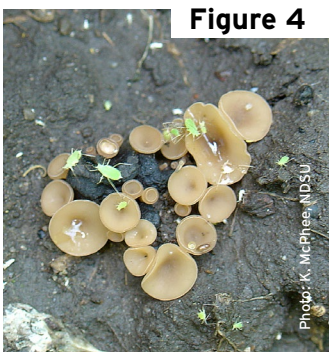


Figure 4

Photo: K. McPhee, NDSU



# White Mold

*Sclerotinia sclerotiorum*

**AUTHORS:** Weidong Chen, Lyndon Porter and Kevin McPhee

## SYMPTOMS

- Lesions occur on stems, leaves and pods
- Lesions initially are water-soaked but appear bleached and necrotic as they age
- White, puffy fungal growth (white mold) may appear on lesions
- Mouse-dropping-sized black sclerotia may form on and in infected tissue

**FIGURE 1** - Water-soaked lesion on an infected plant

**FIGURE 2** - Necrotic lesions and white mycelium (mold)

**FIGURE 3** - A black sclerotium in a pea stem

**FIGURE 4** - Apothecia (mushrooms) developed from sclerotia

## FACTORS FAVORING DEVELOPMENT

- Cool and moist conditions
- Lush vegetative growth
- Heavy canopy

## IMPORTANT FACTS

- Sclerotia can survive for many years in soil
- Pathogen infects most broadleaf crops
- Plant-to-plant spread can occur by physical contact
- Management tools include clean seed, fungicide applications, rotation to cereal crops and irrigation management

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# Alfalfa mosaic

*Alfalfa mosaic virus*

Photo: L. Porter, USDA-ARS Prosser, WA

**Figure 1**





# Alfalfa mosaic

*Alfalfa mosaic virus*

**AUTHORS:** Lyndon Porter

## SYMPTOMS

- **Yellow mottling of foliar tissue (not always prominent)**
- **Purple or brown streaks in leaf veins**
- **Dead tissue on leaf or stem**

**FIGURE 1** - Yellow mottling of foliar tissue

## FACTORS FAVORING DEVELOPMENT

- Presence of pea and green peach aphids, which transmit the virus
- Proximity to alfalfa fields

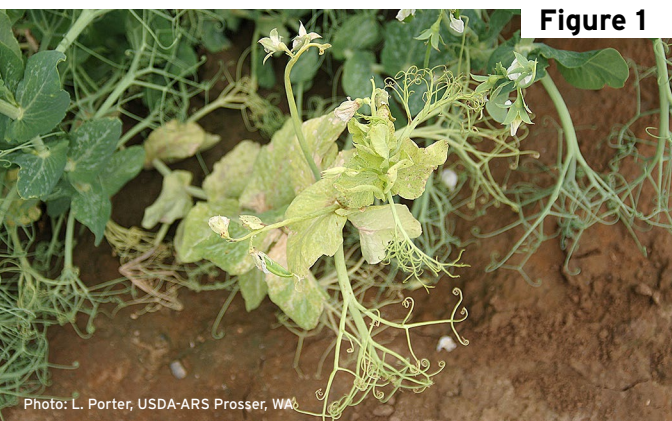
## IMPORTANT FACTS

- Pea, green peach, foxglove, bean and potato aphids transmit the virus
- No resistant cultivars are available
- Insecticides may reduce secondary spread of virus by killing vectors (aphids)
- Can be confused with pea streak virus



# Bean leaf roll or pea leaf roll

*Bean leaf roll virus*



**Figure 1**

Photo: L. Porter, USDA-ARS Prosser, WA



**Figure 2**

Photo: L. Porter, USDA-ARS Prosser, WA



**Figure 3**

Photo: L. Porter, USDA-ARS Prosser, WA



# Bean leaf roll or pea leaf roll

*Bean leaf roll virus*

**AUTHORS:** Lyndon Porter

## SYMPTOMS

- Plants are yellow and stunted
- New tissue is distorted and twisted while old growth may be normal
- Leaflets curl downward and are brittle

**FIGURE 1** - Yellow, distorted and twisted leaves

**FIGURE 2** - Down-curved leaves

**FIGURE 3** - Yellow and distorted new growth; old growth is normal

## FACTORS FAVORING DEVELOPMENT

- Presence of pea aphids transmitting the virus

## IMPORTANT FACTS

- Virus is not seed-transmitted
- Often occurs with pea enation mosaic virus
- Later infections are less likely to have an impact on yield
- Cultivars with resistance may be available
- Can be confused with other viruses, root rots, herbicide damage or abiotic stress



# Pea enation mosaic

*Pea enation mosaic virus*

Photo: L. Porter, USDA-ARS Prosser, WA

**Figure 1**



Photo: L. Porter, USDA-ARS Prosser, WA

**Figure 2**



Photo: L. Porter, USDA-ARS Prosser, WA

**Figure 3**





# Pea enation mosaic

*Pea enation mosaic virus*

**AUTHORS:** Lyndon Porter

## SYMPTOMS

- Leaves may be brittle and have a mosaic of green and yellow rough bumps (enations), translucent spots or clear veins
- Pods may be distorted and fill poorly

**FIGURE 1** - Leaf with mosaic pattern of white/clear spots (windows)

**FIGURE 2** - Misshapen pods

**FIGURE 3** - Enations (bumps) on leaf

## FACTORS FAVORING DEVELOPMENT

- Presence of pea aphids transmitting the virus

## IMPORTANT FACTS

- Virus is not seed-transmitted
- Often occurs with bean leaf roll virus
- Early infections more severely impact yield than late infections
- Insecticides may reduce secondary spread of virus by killing vectors (aphids)
- Can be confused with other viruses, herbicide damage



# Pea seedborne mosaic

*Pea seedborne mosaic virus*

Photo: L. Porter, USDA-ARS Prosser, WA

**Figure 1**



**Figure 2**



Photo: A. Beck, NDSU

**Figure 3**

Photo: M. Wunsch, NDSU





# Pea seedborne mosaic

*Pea seedborne mosaic virus*

**AUTHORS:** Lyndon Porter, Kevin McPhee and Julie Pasche

## SYMPTOMS

- Leaves may curl downward
- Plants are stunted with a rosette appearance on new growth
- Pods may be deformed and fill poorly
- Seed may be water-soaked, scarred or cracked
- Maturity of infected plants is delayed

**FIGURE 1** - Deformed growth

**FIGURE 2** - Seed with water soaking and scarring symptoms

**FIGURE 3** - Delayed maturity of infected plants

## FACTORS FAVORING DEVELOPMENT

- Presence of pea, green peach or potato aphids, which can transmit the virus
- Infected seed

## IMPORTANT FACTS

- Virus is readily seed-transmitted
- Virus infects many plants, including lentil, chickpea, alfalfa and vetch
- Manage by planting virus-free seed and resistant cultivars
- Insecticides may reduce secondary spread of virus by killing vectors (aphids)
- Can be confused with other viruses or herbicide damage





# Pea streak

*Pea streak virus*



**Figure 1**

Photo: L. Porter, USDA-ARS Prosser, WA



**Figure 2**

Photo: L. Porter, USDA-ARS Prosser, WA



# Pea streak

*Pea streak virus*

**AUTHORS:** Lyndon Porter

## SYMPTOMS

- Purple to brown streaks on leaves, stems and pods
- Leaf-yellowing and dieback of growing tips
- Pods may appear blistered, deformed and fill poorly
- Streaks on pods differ in size and shape and often are sunken

**FIGURE 1** - Malformed pea pods with blistering

**FIGURE 2** - Purple sunken streaks on infected plants

## FACTORS FAVORING DEVELOPMENT

- Presence of pea or green peach aphid transmitting virus

## IMPORTANT FACTS

- Virus is not seed-transmitted
- Virus also can infect alfalfa, red and white clover, and vetch
- Rarely associated with significant damage in pea fields
- Insecticides may reduce secondary spread of virus by killing vectors (aphids)
- Can be confused with other viruses, herbicide or abiotic damage



# Botrytis gray mold

*Botrytis cinerea*

Figure 1



Photo: Z. Zhu, Institute of Crop Sciences, CAAS

Figure 2



Photo: Z. Zhu, Institute of Crop Sciences, CAAS

Figure 3



Photo: Z. Zhu, Institute of Crop Sciences, CAAS

Figure 4



Photo: Z. Zhu, Institute of Crop Sciences, CAAS



# Botrytis gray mold

*Botrytis cinerea*

**AUTHORS:** Zhendong Zhu and Weidong Chen

## SYMPTOMS

- Symptoms occur on all above-ground plant parts
- Leaf lesions are water-soaked, grayish, irregular or circular lesions, with a concentric ring pattern
- Stem lesions are initially fuzzy, gray lesions, later turn tan and girdle stem
- Pod lesions are initially irregular or circular, water-soaked, later turn tan and sunken
- Gray, fluffy mycelium are produced on lesions under conditions of high humidity

**FIGURE 1** - Circular lesion with a concentric ring pattern on leaf

**FIGURE 2** - Tan lesions covered grayish mycelium on tendrils

**FIGURE 3** - Tan lesions girdling stem

**FIGURE 4** - Tan, sunken lesions covered grayish mycelium on pods

## FACTORS FAVORING DEVELOPMENT

- Cool and high humidity conditions

## IMPORTANT FACTS

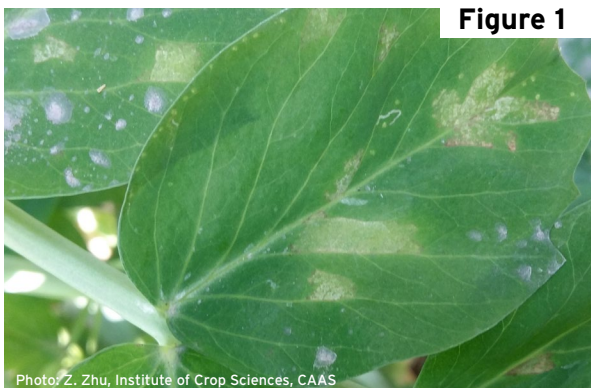
- Pathogen can survive in soil and plant debris or on growing plants
- Pathogen can be dispersed by splashing water, wind, or farm machinery
- Pathogen infects many plants
- Resistant cultivars are not available
- Foliar fungicides can help manage disease

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# Downy mildew

*Peronospora viciae* f. sp. *pisii*



**Figure 1**

Photo: Z. Zhu, Institute of Crop Sciences, CAAS



**Figure 2**

Photo: Z. Zhu, Institute of Crop Sciences, CAAS

**Figure 3**



Photo: Z. Zhu, Institute of Crop Sciences, CAAS

**Figure 4**

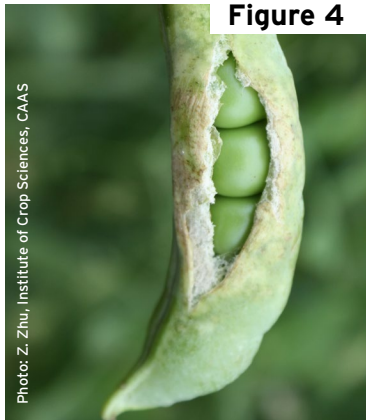


Photo: Z. Zhu, Institute of Crop Sciences, CAAS



# Downy mildew

*Peronospora viciae* f. sp. *pisi*

**AUTHORS:** Zhendong Zhu and Weidong Chen

## SYMPTOMS

- Symptoms may be systemic or local
- Systemically infected plants are stunted, distorted
- Local lesions are greenish yellow to brown, angular blotches on upper leaf surfaces, with fluffy, grey inoculum on lower surfaces directly under lesions on the upper leaf surfaces
- Infected pods may be deformed and have yellow to brownish areas and superficial blistering

**FIGURE 1** - Greenish yellow to brown, angular blotches on upper leaf surfaces

**FIGURE 2** - Fluffy, mouse-grey inoculum on lower leaf surfaces

**FIGURE 3** - Yellow to brownish areas and superficial blistering on infected pod

**FIGURE 4** - Infected pod cracked

## FACTORS FAVORING DEVELOPMENT

- Cool and moist conditions
- Late planting

## IMPORTANT FACTS

- Oospores can survive for 10-15 years in soil
- Pathogen can be soil-borne, seed-borne and wind-dispersed
- Management tools include resistant cultivars, crop rotation and foliar fungicides