

PP1790

Pea Disease Diagnostic Series

Photo: S. Markell, NDSU

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Fusarium root rot

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

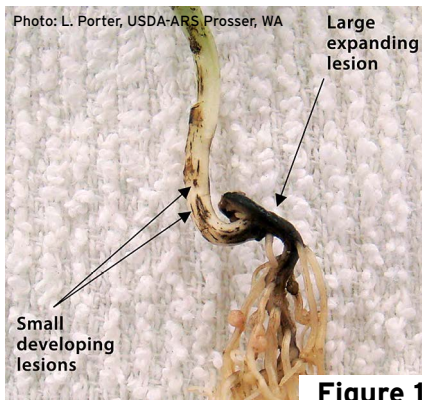


Figure 1

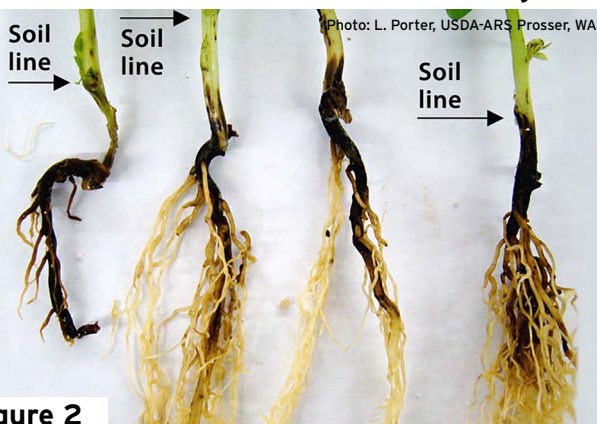


Figure 2

Figure 3





Fusarium root rot

Fusarium avenaceum

F. solani f. sp. *lisi* 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

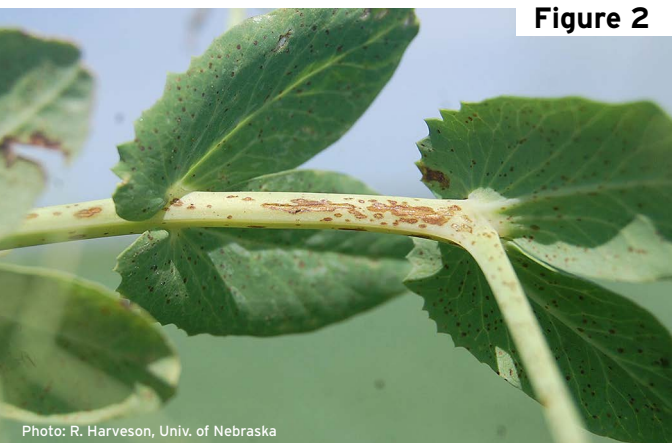


Figure 2

Photo: R. Harveson, Univ. of Nebraska



Figure 3

Photo: R. Harveson, Univ. of Nebraska



Bacterial blight and brown spot

Pseudomonas syringae pv. *psii*
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

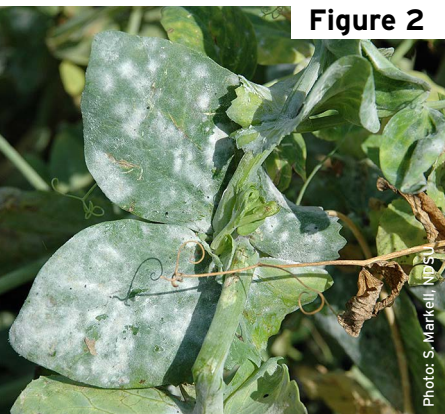


Photo: S. Markell, NDSU

Figure 3



Photo: S. Markell, NDSU

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

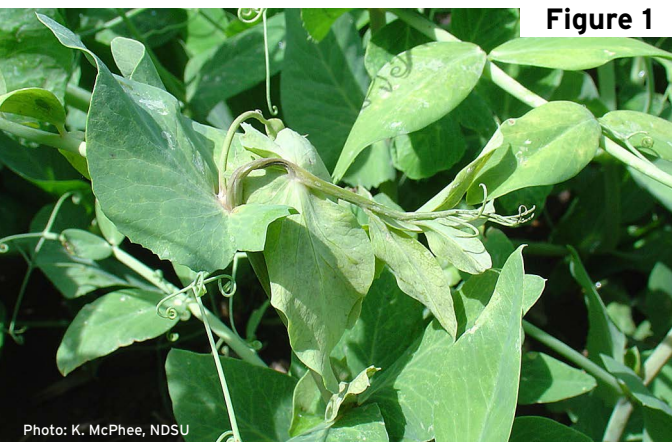


Figure 1

Photo: K. McPhee, NDSU



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

Figure 2

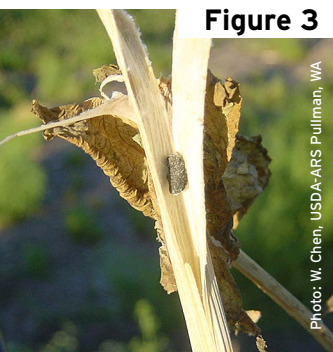


Figure 3

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

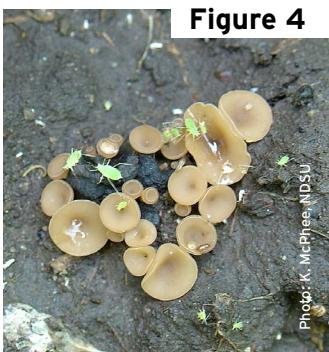


Figure 4

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

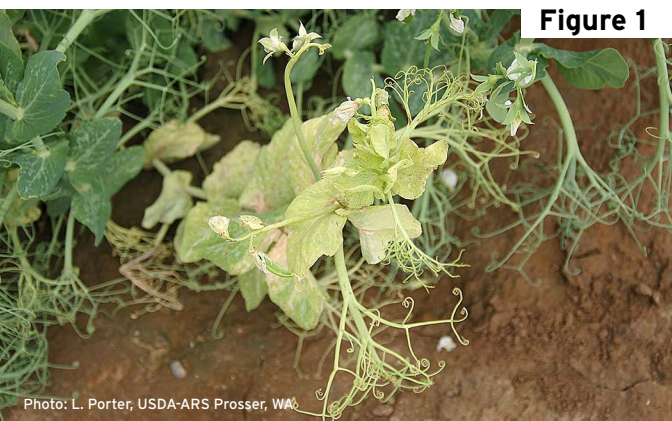


Figure 1

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



Photo: M. Wunsch, NDSU

Figure 3



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

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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