

AI167

HANDBOOK OF
Pea Diseases

D. J. Hagedorn



Table of Contents



SEEDLING DISEASES	
Rhizoctonia Seedling Blight	2
NONPARASITIC DISORDERS	
Freezing Injury	3
Hail Injury	4
Purple Blight	5
Water Congestion	6
BLIGHTS AND/OR BLOTCHES	
Bacterial Blight	7
Ascochyta Diseases	8
Anthracnose	10
Septoria Blotch	11
MILDEWS	
Downy Mildew	12
Powdery Mildew	13
LEAF MOLDS	
Botrytis (Gray) Mold	14
Pythium Tip Blight	15
WILTS AND ROOT ROT	
Near-Wilt and Other Pea Wilts	16
Aphanomyces Root Rot	18
Fusarium Root Rot	19
VIRUS DISEASES	
Enation Mosaic	20
Mosaic	21
Streak	22
Stunt	23
Seed-Borne Mosaic	24
SELECTED PUBLICATIONS ON PEA DISEASES	25

Preface and Acknowledgments

This HANDBOOK OF PEA DISEASES is published to provide essential scientific information and meaningful visual guidance regarding the most common diseases of pea, *Pisum sativum* L., especially those of canning and freezing peas. Not all of the known pea diseases could be included due to expense. Minor and rarely occurring diseases, as well as those peculiar to isolated areas outside the United States, have been omitted. Scientific knowledge on occurrence, symptoms, cause, transmission, environmental factors, cultivar reaction, control, and literature references are presented in an outline form. It is not the purpose of this publication to give a complete treatise on each disease. Instead, I hope this handbook will be helpful to those who want to identify a pea disease, understand why it occurred, and determine how it can be controlled. Further information on pea diseases can be obtained from selected publications listed at the back of this handbook. This is a revision of the handbook published in January 1976.

The control of pea diseases by crop rotation is referred to quite often in this handbook. Generally, at least a five-year rotation is recommended with peas following a grain or corn crop instead of a legume.

Sincere and grateful acknowledgment is expressed to The Asgrow Seed Company whose funds made possible the publication of this handbook. Thanks are also expressed to E.T. Gritton, R.E. Rand, and W.R. Stevenson for reviewing the manuscript. Photographs are provided by the author and used by permission of the American Phytopathological Society.

D.J. Hagedorn
September 1991
Madison, Wisconsin

Rhizoctonia Seedling Blight

Occurrence

Rhizoctonia seedling blight, sometimes called Rhizoctonia tip blight and stem rot of pea, occurs only occasionally and is generally of minor importance. However, it may have economic significance primarily in western and midwestern pea-growing areas of the United States.



Symptoms

The aboveground symptom of this disease is the death of the growing tip of very young pea seedlings. Rhizoctonia attacks up to ½ inch (1.3 cm) of the tip of the shoot just as it emerges through the soil and before leaves expand. Often one or two auxiliary shoots arise from the seed within a few days after the first. They may also become infected, or they may proceed to produce a normal (but later) plant. A tan to dark brown stem rot may occur near the ground surface area of pea seedlings.

Cause, Spread

This disease is caused by a common soil-borne fungus, *Thanatephorus praticolus* (often called *Rhizoctonia solani*). The pathogen spreads by any means which moves soil. There is no significant spread of the disease from plant to plant in the field.

Environmental Factors

This disease requires warm temperatures, occurring most severely when surface soil temperatures are 75°–85°F (24°–29°C). Because sandy soils warm up relatively rapidly, Rhizoctonia seedling blight is often more serious on these soils. Higher soil and air moisture is more conducive to the disease than drier conditions.

Cultivar Reaction

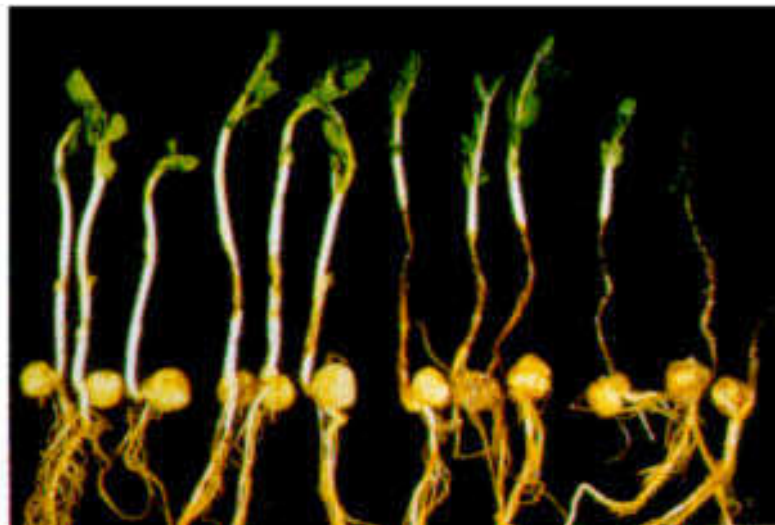
No known resistant commercial cultivars are available.

Control

Rotate peas with crops known to be relatively poor hosts of the fungus, such as grain crops and corn.

Literature

Flentje, N. T., and Hagedorn, D. J. 1964. Rhizoctonia tip blight and stem rot of pea. *Phytopathology* 54:788–791.



Freezing Injury

Occurrence

Freezing injury is widespread in the pea-growing areas of the world, especially in the northern latitudes. It often causes significant economic loss by reducing the yield and quality of the pea crop because pods mature unevenly. Freezing injury is more severe in low-lying portions of pea fields or where air movement is restricted.

Symptoms

On young pea plants frost kills the growing point producing the most obvious symptom of freezing injury. This growing point is located inside a protective “clam shell” of very young leaflets and stipules at the top of the plant.

Frost-injured young leaves may develop jagged edges or become bilobed giving them a leathery feel. On slightly older leaves, the undersides develop long, water-soaked, translucent lesions due to

deterioration of the tissue between the main veins. Affected areas develop into necrotic (dead) bands and are very diagnostic of this problem.

When the growing point is killed, dormant buds in leaf axils at the base of the plant begin growing. Ordinarily, the new shoot from one of these buds becomes dominant and it grows rapidly. Only occasionally do two or three shoots develop completely. This new shoot may grow as tall as an uninjured plant, but will generally mature later. A frost-injured young pea stem may develop long splits in the outer tissue which lead to stem cankers.

Cause, Spread

Cold temperatures—near or below 32°F (0°C).

Environmental Factors

Environmental conditions following a freeze may be important in aiding or hindering the recovery of injured pea plants. Cool temperatures and plenty of soil moisture will aid; hot, dry conditions will hinder plant recovery.

Cultivar Reaction

There are no known cold-tolerant pea varieties.

Literature

Walker, J. C. 1939. Freezing injury to canning peas. *Phytopathology* 29:188–194.



Hail Injury



Occurrence

Hail occurs worldwide, but is more common in areas such as the midwest United States, where severe thunderstorms often contain large hailstones. Hail may severely reduce yield and quality.

Symptoms

A pea field severely damaged by hail appears flattened for five to ten days after the hailstorm. Close examination will reveal broken and crushed stems, and whitish bruised areas covering the entire plant.

Hailstones can also split leaves, giving the foliage a tattered look.

If pods are present, they will have bruised areas of various sizes and shapes. Bruised areas may turn from a whitish to a rust color, and finally dark brown. Peas may stop developing, especially in the area immediately inside the pod injury. If the pod wall is punctured, the peas may turn brown, seriously reducing processing quality.

Injured tissues are easily infected contributing to decay of stems and pods and further complicating plant recovery.

Cause, Spread

Hailstones.

Environmental Factors

Environmental conditions following a hailstorm significantly influence an injured plant's ability to recover. Generally, cool weather and good soil moisture are most helpful.

Cultivar Reaction

No known tolerance.

Literature

Walker, J.C. 1952. *Diseases of vegetable crops*. McGraw-Hill Book Company, New York. 529 pp.



Purple Blight

Occurrence

This disease is known to occur in New York state and in the Midwest, where it may cause serious yield reduction in local situations.

Symptoms

Irregularly shaped blotches of rust-colored tissue appear on the outer margins of yellowed lower leaves. These affected areas are 2–4 mm in size. As the disease progresses, the blotches cover most of the interveinal surface of leaves and stipules, and change color from rust-brown to purple. Soon after the purple color develops, the leaves die.

A severely diseased plant is typically stunted, with purple, shriveled leaves at the bottom, purplish leaves along the lower middle stem, rust-colored leaves just above those which are purple, and then yellow and green leaves toward the top of the plant. One or two very small pods may form.



Cause, Spread

Manganese toxicity.

Environmental Factors

Manganese becomes toxic in acid soils (pH less than 5.5).

Cultivar Reaction

No resistant cultivar is known.

Control

Apply lime to the soil to raise the pH to above 6.0.

Literature

Schroeder, W.T., Peck, N.H., and Vittum, M.T. 1979. *Purple blight—A physiological disorder of pea.* Search: Agriculture. New York State (Geneva) Agricultural Experiment Station 9(5):5 pp.



Water Congestion

Occurrence

This nonparasitic disease is widespread in the United States, but is probably more common and severe in the Midwest.

Symptoms

Initial symptoms are tiny, water-soaked spots located near the outer edges and on the underside of leaves and stipules. These spots gradually increase in size and number until the outer portions of the foliage are completely water-soaked and appear off-green in color (darker on light green foliage). The affected tissue dies, beginning at the outermost tip and edge of the foliage and

progressing toward the midveins. Necrotic (dead) tissue is shrunken, dry, and generally straw-colored. Severely diseased plants can lose up to 80% of the foliage at one to several nodes, resulting in significant loss of the photosynthetic surface and reduced plant vigor.

These symptoms typically do not extend over the entire plant. Instead, they appear on the two to four nodes which are developing when environmental conditions are conducive to disease development.

Cause, Spread

No pathogen is involved. "Harmful" environmental conditions are implicated. There is no transmission from plant to plant.

Environmental Factors

Water congestion occurs most commonly in areas with high soil moisture, high relative humidity, and warm temperatures (83°–90°F; 28°–32°C). All three conditions need not be present for disease occurrence. Peas grown in red clay or muck soil develop more disease than those in silt or sandy loam soils.

Cultivar Reaction

Some greenhouse studies indicate that early processing pea cultivars are somewhat more susceptible than midseason cultivars. However, field experiments do not support these results. They do indicate that none of the 133 pea cultivars or 180 pea plant introductions (PIs) tested were immune. Only 5% of the cultivars and 9% of the PIs were "slightly diseased."

Literature

Hagedorn, D.J., and Rand, R.E. 1971. Water congestion of pea, *Pisum sativum*. *Plant Disease Reporter* 55(3):249–253.

Hagedorn, D.J., and Rand, R.E. 1971. Reaction of *Pisum sativum* to the water congestion disease. *Plant Disease Reporter* 55(6):533–535.



Bacterial Blight

Occurrence

This disease occurs worldwide. It was formerly common, but now appears only occasionally. Bacterial blight has been found in peas grown after beans infected with bacterial brown spot. It occurs first in localized areas in a field if introduced via the seed. If the primary inoculum is from overwintered plant debris, disease may be widespread throughout the field.

Symptoms

Lesions appear on all aboveground plant parts. They begin as small, water-soaked, oval spots. Individual leaf and stipule lesions enlarge to approximately 3 mm in diameter with an angular shape. Pod lesions are 6 mm or more in width, and stem lesions lengthen to resemble stem streaks. Lesions vary in color, but on foliage they generally turn brown, shiny, and translucent. Pod lesions, which may expand along either suture, slowly change from a water-soaked to greasy appearance with purplish-brown margins. Peas inside infected pods may develop brown discoloration. Long stem lesions turn brown with age.

Multiple lesions often run together, forming large diseased areas which may cover large portions of infected plants. This may cause plants to look "blighted" and dry prematurely.

Cause, Spread

There are four known races of the causal bacterium *Pseudomonas syringae* pv. *pisi*. of this pathogen. The bacterium overwinters in infected plant debris and in the seed coat. Splashing water spreads the disease locally; infected seed spreads the disease long distance.

The bean bacterial brown spot pathogen, *Pseudomonas syringae* pv. *phaseoli*, can also attack peas causing bacterial blight symptoms.

Environmental Factors

Cool, overcast weather with high humidity promotes disease development. Warm, dry conditions slow the disease.

Cultivar Reaction

No cultivars are resistant to all races of the pathogen.

Control

Use disease-free seed and at least a three-year rotation with non-host crops. Use resistant cultivars.

Literature

- Hagedorn, D.J., and Wade, E.K. 1964. Bacterial blight of Wisconsin canning peas in 1963. *Plant Disease Reporter* 48(4):318-320.
- Ludwig, C.A. 1926. *Pseudomonas (Phytomonas) pisi* Sackett, the cause of a pod spot of garden peas. *Phytopathology* 16:177-183.
- Sackett, W.G. 1916. *A bacterial stem blight of field and garden peas*. Colorado Agricultural Experiment Station. Bulletin 218. 43 pp.

Skoric, V. 1927. Bacterial blight of pea: Overwintering, dissemination, and pathological histology. *Phytopathology* 17:611-627.

Taylor, J.D. 1972. Races of *Pseudomonas pisi* and sources of resistance in field and garden peas. *New Zealand Journal of Agricultural Research* 15:441-447.



Ascochyta Diseases: Mycosphaerella Blight, Ascochyta Foot Rot, Ascochyta Leaf and Pod Spot

Occurrence

Ascochyta diseases occur worldwide and are occasionally economically significant when cropping procedures and environmental conditions favor development. *Mycosphaerella* blight is the most important of the three *Ascochyta* diseases of pea.

Symptoms

***Mycosphaerella* Blight.** Small, purple spots develop on the surface of the foliage, stems, and pods. On leaves, the purple spots may enlarge to 5–6 mm in diameter and turn dark brown to black. Small lesions usually have no definite shapes or margins, but larger lesions are circular with distinct margins and opaque centers. Leaves and stipules with many lesions turn straw-colored, dry out, and die. Dead leaves remain attached to the plant.

Pinpoint-sized pod lesions are similar to those on foliage, and they may run together and enlarge into sunken, oval lesions with dark margins. Severely infected young pods wither, thereby lowering the processing quality of the peas.

***Ascochyta* Foot Rot.** This disease is similar in appearance to *Mycosphaerella* blight on leaves and foliage, although it is often most apparent on the lowest leaves and stipules and on the lower stem and upper root.

Purple to blue-black lesions up to 1 cm in length extend along the stem. These lesions often run together, girdling the stem and giving it a blue-black look. Severe stem infections may cause the entire plant to mature rapidly and prematurely.



Mycosphaerella Blight



Ascochyta Foot Rot

Ascochyta Diseases: *Mycosphaerella* Blight, *Ascochyta* Foot Rot, *Ascochyta* Leaf and Pod Spot

Leaf and Pod Spot. This disease has lesions distinct from those described above. Typical lesions on foliage and pods are larger—5–8 mm in diameter—and are sunken and tan, with a dark, distinct border. Lesions are oval on foliage and pods, elongated on stems.

The centers of lesions caused by all three pathogens show dark pimple-like structures containing the easily dispersed spores which spread the disease.

Spread

Three fungi, *Mycosphaerella pinodes*, *Phoma medicaginis* var. *pinodella*, and *Ascochyta pisi*, incite *Ascochyta* disease of peas. The pathogens are carried in infected seeds and overwinter in infected plant debris. Spores originating from overwintered plant debris spread in two ways. The first, in early spring, is by asexual conidia which depend upon water for discharge and dissemination. Wind-blown rain is an important carrier. The second, in early June in northern states, is by sexually-formed ascospores which are forcibly discharged into the air and then carried by air currents for ¼ mile (0.4 km) or more. Ascospores disseminate the disease more widely than do conidia.

Environmental Factors

Disease development is favored by high moisture conditions (repeated rain and high humidity) and can take place over a range of temperatures.

Cultivar Reaction

Some pea cultivars have been found tolerant on a regional basis, but not universally.

Control

Use western-grown disease-free seed. Use a 3- or 4-year rotation. Moldboard-plow pea refuse deeply and completely. Isolate new pea fields ¼ mile (0.4 km) from old ones.

Literature

Hare, W.W., and Walker, J.C.
1944. *Ascochyta* diseases of canning pea. Wisconsin Agricultural Experiment Station Research Bulletin 150. 31 pp.

Jones, L.K. 1927. *Studies of the nature and control of blight, leaf and pod spot, and footrot of peas caused by species of Ascochyta*. New York State (Geneva) Agricultural Experiment Station. Bulletin 547. 46 pp.

Wallen, V.R. 1974. Influence of three *Ascochyta* diseases of peas on plant development and yield. *Canada Plant Disease Survey* 54:86–90.



Leaf and Pod Spot

Anthracnose

Occurrence

Pea anthracnose has been reported from several pea-producing areas around the world, but is only seen rarely and is generally of minor importance.

Symptoms

Leaf and stipule lesions are oval, 2–8 mm in diameter, and have brown margins with gray-tan centers. Lesions on the stem are long and similar in color to those on the leaves. Gray-tan pod lesions are round and sunken, with reddish-brown borders. These are most dramatic when they form on immature pods, causing them to develop abnormally and show brown discoloration.



Cause, Spread

The fungus *Collectotrichum pisi* is not an aggressive pathogen. Severe disease symptoms, especially on stems, are often associated with wounds or Ascochyta infections. The fungus lives from one growing season to the next on infected plant debris and on seed, although seed transmission is extremely slight. Spattering and wind-blown rain are the primary means of local dissemination of the infectious spores.

Environmental Factors

Frequent wind-blown rain, high humidity, and warm temperatures are most conducive to disease development.

Cultivar Reaction

This aspect of the disease has not been reported.

Control

Practice crop rotation.

Literature

Hagedorn, D.J. 1974. Recent pea anthracnose and downy mildew epiphytotics in Wisconsin. *Plant Disease Reporter* 58(3):226–229.

Jones, F.R., and Vaughan, R.E. 1921. Anthracnose of the garden pea. *Phytopathology* 11:500–503.

Ou, S.H., and Walker, J.C. 1945. Anthracnose of garden pea. *Phytopathology* 35:565–570.

Septoria Blotch

Occurrence

Septoria blotch, though a common disease in the Midwest, is rarely significant because it occurs primarily on old foliage, pods, and stems.

Symptoms

Disease lesions are yellow areas of varying size and shape with no definite margins. They are often so numerous that they cover whole leaves or stipules. In these cases, the affected foliage may dry out, giving the plant a prematurely aged look. As the blotches dry out, many pinpoint-sized black pycnidia (fungus fruiting bodies) may be seen scattered widely on the infected plant parts, including pods.

Cause, Spread

The fungi *Septoria pisi* and, more rarely, *Septoria flagellitera* cause the disease. The organism overwinters on infected plant debris. Anything that spreads infected debris also spreads the fungus. Spattering water promotes field spread. Seed transmission may occur, but little is known about this phenomenon, and it is not considered important.

Environmental Factors

Disease development favors prolonged high humidity (at least 24 hours) and moderate temperatures of 70°–80°F (21°–27°C).

Cultivar Reaction

In general, later-maturing cultivars are more tolerant than those maturing early, and Perfection-type canning peas are more tolerant than market-garden types. Immunity has not been reported.

Control

Practice crop rotation.

Literature

- Cruickshank, I.A.M. 1949. Studies on a fungus (*Septoria pisi* Westend.) causing a foliage disease of peas (*Pisum sativum* L.). *New Zealand Journal of Science and Technology* 31(3):17–23.
- Melhus, I.E. 1913. *Septoria pisi* in relation to pea blight. *Phytopathology* 3:51–58.
- Zaumeyer, W.J. 1942. Reaction of pea varieties to *Septoria pisi*. *Phytopathology* 32:64–70.



Downy Mildew

Occurrence

Downy mildew is present primarily during the early part of the growing season and is seldom of economic importance in most pea-growing areas of the United States. However, in northern Europe and other areas where peas are grown under cool, moist conditions, downy mildew is a common and troublesome pea disease.



Symptoms

On the upper side of the foliage, lesions appear as irregularly shaped, yellow to brown areas with indistinct margins. On the underside of the foliage, these discolored areas have patches of mouse-colored, fluffy fungus and fruiting bodies. If the growing point of the plant becomes systemically infected, the upper portion of the plant becomes distorted and stunted. Such plants may turn yellow. In humid weather, the fungus fruits abundantly on the systemically invaded tissues.

The disease may appear on pods, even if there are no foliage symptoms. Young pods are particularly susceptible. Several to many yellowish-brown diseased areas of varying size and shape appear on pods. These blotches may be slightly sunken, but have indefinite margins. The inside of the pod opposite the outer diseased area may have a white, felt-like growth. This is not fungus mycelium, but rather a rapid growth of the cells of the inner pod wall. Oospores of the fungus may be found in these areas, between the pod walls. Peas developing near these areas remain small, and may have brown, sunken spots.

Cause, Spread

The fungus *Peronospora viciae* causes downy mildew. Six races of the pathogen are known. Oospores in the soil can infect pea seedlings

systemically. These diseased plants provide the wind-blown spores that spread the disease in the field.

Environmental Factors

Cool, moist weather favors rapid spread and disease development.

Cultivar Reaction

None are resistant, but tolerant cultivars are available.

Control

Practice crop rotation. Deep tillage to bury crop debris. Use tolerant cultivars and metalaxyl seed treatment.

Literature

Campbell, L. 1935. *Downy mildew of peas caused by Peronospora pisi (DeB.) Syd.* Washington Agricultural Experiment Station Bulletin 318. 42 pp.

Hagedorn, D.J. 1974. Recent pea anthracnose and downy mildew epiphytotics in Wisconsin. *Plant Disease Reporter* 58(3):226-229.

Hubbeling, N. 1975. Resistance to downy mildew and distinction of races of *Peronospora pisi* Syd. *Meded. Fac. Landbouwwet. Rijksuniv. Gent* 40:539-543.

King, J.M., and Gane, A.J. 1962. *Downy mildew of peas—A progress report 1955-1962.* Peterborough, England: Processors and Growers Research Organisation. 162-168.

Miller, M.W. and deWhalley, C.V. 1981. The use of metalaxyl seed treatments to control pea downy mildew. *Proceedings of the British Crop Protection Conference* 1:341-348.

Snyder, W.C. 1934. *Peronospora viciae* and internal proliferation in pea pods. *Phytopathology* 24:1358-1365.



Powdery Mildew

Occurrence

This disease is very widespread and often economically important in semi-arid regions of western United States. It is occasionally important in the Midwest and Northeast. Powdery mildew is usually more important on late season crops in these areas.

Symptoms

First symptoms appear on the upper surface of the foliage as very small, slightly discolored spots. These soon give rise to white powdery areas which continue to enlarge. As they do so, the white color and powdery appearance become more pronounced. Tissue beneath these areas may turn purplish, then brown. Multiple infections may cover the entire aboveground plant. Severely infected plants are unthrifty and have poor yield and quality. Small, oval, black fruiting structures may form in mature lesions.

Cause, Spread

The fungus *Erysiphe pisi* overwinters on infected plant debris and in alternate hosts. Air currents spread the fungus locally and over long distances.



Environmental Factors

The absence of rain and presence of at least slight dew favor disease development. Rain controls the disease by washing off the spores and causing them to burst instead of germinate.

Cultivar Reaction

Resistant cultivars are available and more are being developed.

Control

Use sulfur spray or dust or benomyl. Use resistant cultivars.

Literature

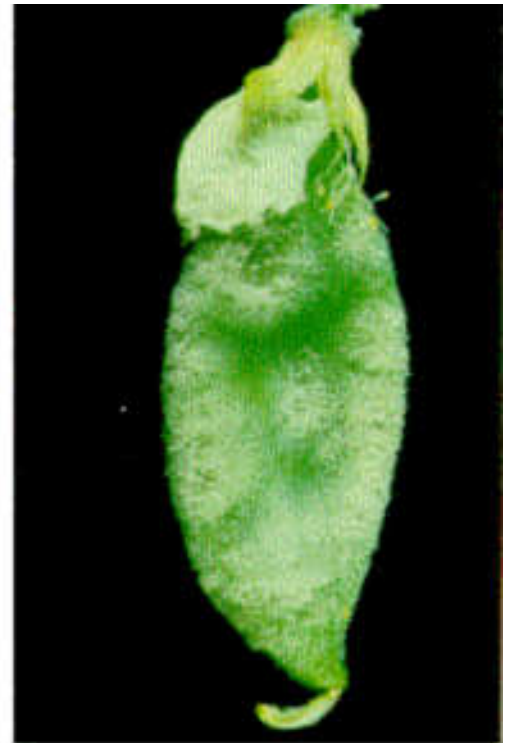
Crawford, R.F. 1927. *Powdery mildew of peas*. New Mexico Agricultural Experiment Station Bulletin 163. 13 pp.

Gritton, E.T., and Hagedorn, D.J.

1971. Registration of Wisconsin pea cultivars. *Crop Science* 11:941.

Pierce, W.H. 1948. Resistance to powdery mildew in peas. *Phytopathology* 38:21.

Reeser, P.W., Hagedorn, D.J., and Rouse, D.I. 1983. Quantitative inoculations with *Erysiphe pisi* to assess variation of infection efficiency on peas. *Phytopathology* 73:1238-1240.



Botrytis (Gray) Mold

Occurrence

Botrytis is a common and troublesome disease of peas in northern Europe and occurs occasionally in the more humid pea-growing areas of the United States.

Symptoms

The most striking and economically important symptoms are on the pod, although foliage and stem infections may also occur. Pod lesions usually occur at the terminal end, where adhering blossom parts provide an excellent medium for rapid saprophytic growth of the fungus. The fungus then spreads upward into the young pod and forms an oval or semicircular lesion up to $\frac{3}{4}$ inch (2 cm) in diameter.

Initially this lesion is water-soaked, but it soon turns gray from the many fruiting structures which develop on the lesion surface. Occasionally kernel-like, black, hard sclerotia of the fungus form in the older decayed tissue.

Cause, Spread

The fungus *Botrytis cinerea* incites this disease. The pathogen is common and widespread because it can live and grow on dead or decaying organic materials. Spores form prolifically on the surface of infected organic matter and are readily airborne. *Botrytis cinerea* can infect pea plants by spores that have been blown or splashed onto blossoms or by mycelium growing onto leaves touching the debris. Any activity which spreads infected plant debris also spreads the fungus.

Environmental Factors

Moderate temperatures (60°–70°F, 16°–21°C) and moist (nearly 100% relative humidity) conditions are favorable for disease development. Potassium deficiency before and during flowering may make the plant more susceptible.

Cultivar Reaction

No resistant cultivars are known.

Control

Rotate crops and fertilize properly.

Literature

Ford, R. E., and Haglund, W.A. 1963. *Botrytis cinerea* blight of peas associated with senescent blossoms in northwestern Washington. *Plant Disease Reporter* 47(6):483–485.

Wijngaarden, T.P., and Ellen, J. 1968. Influence of some environmental factors on the susceptibility of *Pisum sativum* to *Botrytis cinerea*. *Netherlands Journal of Plant Pathology* 74:8–11.



Pythium Tip Blight

Occurrence

This is not a common or consistently important disease, but it is important occasionally, when conducive weather prevails. It has been found in the Midwest particularly.

Symptoms

The name “tip blight” is very descriptive of the overall effect of the disease on the pea plant: the upper, growing tip portion of the plant is blighted. Infection begins in a leaf axil several inches (5 cm) above the ground. On young plants it starts in the bud or growing point. Several internodes of the plant may be affected. At first the diseased tissue appears water-soaked. Then the rapidly killed, desiccated areas shrivel and turn straw-brown or greenish-purple. When the disease penetrates the leaf axils, it kills the attached leaf and often girdles the stem, killing the part of the plant above the girdle.

Tip death from *Pythium* tip blight may activate one or more lower axillary buds. Often one new shoot will become dominant, taking over plant development, although the plant will mature later than plants that were not diseased.

NOTE: Another pea disease, caused by a similar *Pythium* fungus, results in preemergence killing of germinating seeds. It is called “damping off” and is controlled by treating pea seeds with an appropriate seed protectant.

Cause, Spread

The common soil fungi *Pythium* spp. cause this disease. Several species of *Pythium* are involved, including *P. ultimum*, *P. debaryanum*, *P. aphanidermatum*, and *P. arthenomanes*. Farm implements, irrigation water, and wind spread these fungi from field to field. Water droplets carry spores up into leaf axils where the spores germinate, infecting mainly plant tissue.

Environmental Factors

Cool, moist, overcast, highly humid conditions are favorable for disease development.

Cultivar Reaction

Unknown.

Control

None.

Literature

Hare, W.W. 1949. Tip blight of garden pea. *Journal of Agricultural Research* 78(9):311–324.



Near-Wilt and Other Pea Wilts

Occurrence

Near-wilt was a problem primarily in the Midwest between 1930 and 1960, but is now of lesser importance due to the availability of resistant cultivars. Wilt is present throughout the United States, but is rarely a problem because almost all cultivars are resistant. Race 5 and race 6 wilts are known to be troublesome only in western Washington state.

Near-wilt diseased plants are scattered throughout the field, rather than occurring in localized patches. In contrast, plants infected with pea wilt appear in localized spots in the field.

Symptoms

Initial symptoms of near-wilt begin about late blossom/first pod stage. Foliage loses its normal green color and the paler leaves and stipules curl downward. These symptoms often appear on one side only and wilting may not extend to the other side of the plant until the wilting process is well-advanced.

As the plant wilts, it gradually turns a tannish-straw color. Diseased plants are stunted. Internally they show a brick-red discoloration of the vascular system which may extend to the top of the plant. Generally, there are no external symptoms on the lower stem and upper taproot, but occasionally the cortical tissue may be slightly decayed. Infected plants eventually die. Near-wilt is most common on mid- or late-season cultivars.

Pea wilt attacks young plants. Early maturing cultivars may be affected and show yellow-orange internal discoloration in the lower internodes. Race 5 and race 6 wilt symptoms are similar to those of wilt.

Cause

Different races of the fungus *Fusarium oxysporum f. pisi* cause pea wilts (race 2 causes near-wilt; race 1 causes wilt). These fungi can live indefinitely in the soil, with or without the presence of peas. Local spread of the fungus may be by water or farm implements moving infested soil or infected pea vines. Infected seed can transmit the fungus over long distances.

Environmental Factors

Near-wilt occurs later in the growing season than the other wilts because the optimum temperature for disease development is higher: 79°F (26°C) for near-wilt and 70°F (21°C) for the other wilts.

Cultivar Reaction

Most peas are resistant to wilt and a few cultivars are resistant to both wilt and near-wilt. Race 5 wilt formerly affected all cultivars, even those resistant to both other wilts. There are cultivars with resistance to race 5 wilt.

Control

Use resistant cultivars.



Near-Wilt and Other Pea Wilts

Literature

- Hagedorn, D.J. 1953. *The New Era canning pea*. Wisconsin Agricultural Experiment Station Bulletin 504. 8 pp.
- Haglund, W.A., and Kraft, J.M. 1970. *Fusarium oxysporum* f. *pisi*, Race 5. *Phytopathology* 60:1861–1862.
- Haglund, W.A., and Kraft, J.M. 1979. *Fusarium oxysporum* f. sp. *pisi*, Race 6: Occurrence and distribution. *Phytopathology* 69:818–820.
- Harter, L.L. 1934. A new wilt of peas. *Phytopathology* 24:950–951.
- Linford, M.B. 1928. *A Fusarium wilt of peas in Wisconsin*. Wisconsin Agricultural Experiment Station Research Bulletin 85. 44 pp.
- Snyder, W.C., and Walker, J.C. 1935. Fusarium near-wilt of pea. *Zentralblatt für Bakteriologie, Parasitenkunde und Infektionskrankheiten (Zweite Abteilung)* 91:355–378.
- Walker, J.C. 1931. *Resistance to fusarium wilt in garden, canning and field peas*. Wisconsin Agricultural Experiment Station Research Bulletin 107. 15 pp.



Aphanomyces Root Rot

Occurrence

This is the most important pea disease in the Midwest and in northeast United States. It is becoming troublesome in the Northwest. *Aphanomyces* root rot occurs in fields or portions of fields with high soil moisture. The causal fungus is found in the roots of other plants, especially legumes.

Symptoms

First signs of infection are long, soft, water-soaked areas on the surface of the lower stem and root. These areas soon become light tan and spread to cover the whole root system. Because the disease kills branch roots, only the water- and food-conducting tissues of the upper taproot remain intact when the plant

is pulled. Diseased plants are stunted and weakened and in severe cases they wilt, turn yellow, shrivel, and die prematurely.



Cause, Spread

The fungus *Aphanomyces euteiches* f. sp. *pisi* overwinters in infected plant debris as durable, thick-walled oospores. It is viable in infested soils for 20 years or longer. The fungus is spread by water and the movement of infected plant debris or infested soil by farm implements.

Environmental Factors

Warm temperatures and high soil moisture favor disease development, even though infection may occur at cool to moderate temperatures.

Cultivar Reaction

No resistant cultivars are available, but they are being developed.

Control

To avoid soil infestation, use long rotations. Select fields with well-drained, friable soil. Test fields for root rot potential to avoid severely infested fields. Use good fertilization practices. Trifluralin herbicide applications may be helpful. New studies indicate helpful control by pre-cropping with *Brassica* spp. or oats, by treating seeds with the bacterium

Pseudomonas cepacia, and by using resistant cultivars when they become available.

Literature

Gritton, E.T. 1990. Registration of five root rot resistant germplasm lines of processing pea. *Crop Science* 30:1166–1167.

Harvey, R.G., Hagedorn, D.J., and DeLoughery, R.L. 1975. Influence of herbicides on root rot in processing peas. *Crop Science* 15:67–71.

Jones, F.R., and Drechsler, C. 1925. Root rot of peas in the United States caused by *Aphanomyces euteiches*. *Journal of Agricultural Research* 30(4):293–325.

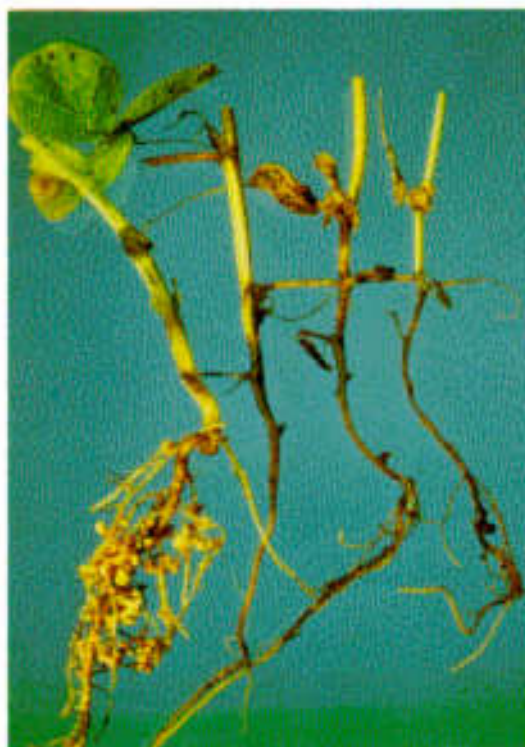
Kraft, J.M. 1988. *Aphanomyces* root rot resistance in peas. *Phytopathology* 78:1545.

Muehlchen, A.M., Rand, R.E., and Parke, J.L. 1990. Evaluation of crucifer green manures for controlling *Aphanomyces* root rot of peas. *Plant Disease* 74:651–654.

Parke, J.L., Rand, R.E., Joy, A.E., and King, E.B. 1991. Biological control of *Pythium* damping-off and *Aphanomyces* root rot of peas by application of *Pseudomonas cepacia* or *P. fluorescens* to seed. *Plant Disease* 75(10):987–992

Sherwood, R.T., and Hagedorn, D.J. 1958. *Determining common root rot potential of pea fields*. Wisconsin Agricultural Experiment Station Bulletin 531. 12 pp.

Sherwood, R.T., and Hagedorn, D.J. 1962. Studies on the biology of *Aphanomyces euteiches*. *Phytopathology* 52:150–154.



Fusarium Root Rot

Occurrence

Fusarium root rot is a troublesome and sometimes important pea disease in almost all of the pea-producing areas of the United States. It is probably most destructive in the states of Washington, Idaho, and Oregon, although it is not uncommon in the Midwest where it may occur on plants also suffering from near-wilt and/or *Aphanomyces* root rot.

Symptoms

Initial symptoms often appear near the area of seed piece attachment and consist of slender, light brown lesions along the taproot and on the side roots. These lesions enlarge and run together until the main roots become completely covered, shrunken, and dark brown or light red in color. This discoloration and shrinking continues upward to 1–2 inches (2.5–5 cm) above the soil line. The shrinking is caused by the collapsing of dead cortical cells. The vascular tissue also shows red discoloration extending upward one to three nodes above the soil line.

Diseased plants appear unthrifty, variously dwarfed depending upon the severity of infection, and may wilt and die.

Cause, Spread

The disease is caused by the soil-borne fungus *Fusarium solani* f. *pisi*. Any activity which spreads soil also spreads the fungus.

Environmental Factors

Relatively high soil temperatures of 77°F (25°C) and above are optimum for disease development. Soil moisture has little influence, needing only to be within ranges conducive to good plant growth.

Cultivar Reaction

There are no known commercial processing pea cultivars with immunity or high level resistance to *Fusarium* root rot. Some breeding lines and cultivars do have a measurable tolerance, however.

Control

Rotate crops. Plant infested fields early or use an early maturing cultivar. Use tolerant cultivars.

Literature

- Hagedorn, D.J. 1960. Testing commercial pea varieties for reaction to *Fusarium* root rot, *Fusarium solani* f. *pisi*. *Phytopathology* 50:637.
- Jones, F.R. 1923. Stem and rootrot of peas in the United States caused by species of *Fusarium*. *Journal of Agricultural Research* 26:459–477.
- Kraft, J.M., and Roberts, D.D. 1970. Resistance in peas to *Fusarium* and *Pythium* root rot. *Phytopathology* 60:1814–1817.
- Lockwood, J.L., and Ballard, J.C. 1960. *Evaluation of pea introductions for resistance to Aphanomyces and Fusarium root rots*. Michigan Agricultural Experiment Station Quarterly Bulletin 42(4):704–713.



Enation Mosaic

Occurrence

Enation mosaic is very likely the most important virus disease of peas in the United States. It has been especially severe in the Northeast and Northwest, but not of major importance in the Midwest. It is also important in some of the pea-growing areas in other parts of the world.



Symptoms

The characteristic symptom is the enations (blister-like outgrowths) which occur on the underside of foliage and on the pods. Diseased foliage has yellowed areas scattered over the surface, some of which develop into translucent “windows.” Enations are often near the underside edge of these windows, or near veins. This malformation may be so extreme that it is somewhat difficult to identify the diseased specimen as a pea plant. Infected pods are grotesquely malformed and stunted. The few peas produced are difficult to remove at harvest. Diseased plants may die prematurely.

Cause, Spread

The pea enation mosaic virus overwinters in clovers or vetches and is spread to peas by aphids. The virus is persistent in the pea aphid: the aphid can feed repeatedly and retain the virus for up to eight days.

Environmental Factors

Virus symptoms are typical at moderate temperatures (72°F, 22°C) and are masked at temperatures above 86°F (30°C).

Cultivar Reaction

There are a number of commercial pea lines with resistance to enation mosaic.

Control

Monitor aphids. Apply insecticide when aphid populations reach two per plant. Use resistant cultivars.

Literature

- Hagedorn, D.J., and Hampton, R.O. 1975. Pea enation mosaic virus resistance among commercial breeding lines of *Pisum sativum*. *Plant Disease Reporter* 59(11):895–899.
- Ruppel, E.G., and Hagedorn, D.J. 1963. Comparisons of pea enation mosaic virus isolates. *Phytopathology* 53:813–818.
- Schroeder, W.T., and Barton, D.W. 1958. The nature and inheritance of resistance to the pea enation mosaic virus in garden pea, *Pisum sativum* L. *Phytopathology* 48:628–632.



Mosaic

Occurrence

Pea mosaic has been one of the common virus diseases in most of the important pea-growing areas of the world. Some mosaic outbreaks result in significant economic loss, although ordinarily this is not the case.

Symptoms

Distinct mottling of the foliage is the most conspicuous symptom. The tissue yellows between the veins, leaving patches of normal green tissue scattered irregularly over the surfaces of both leaves and stipules. Vein clearing is not always apparent. If infected when young, plants become stunted. The upper leaves and stipules are wrinkled and twisted and axillary buds often proliferate. Pods may be fewer and smaller than normal. Severity of the symptoms depends upon the virus and pea cultivar involved, and on the environment.

Cause, Spread

Two viruses cause this disease: the pea common mosaic virus and the bean yellow mosaic virus (bean virus 2). There are several strains of each of these viruses. They overwinter in leguminous hosts such as

clover and vetches, and are spread to peas by aphids. Seed transmission is absent or very rare.

Environmental Factors

Disease symptoms are masked or greatly delayed at temperatures below 60°F (16°C), but develop typically at temperatures of 65°–75°F (18°–24°C).

Cultivar Reaction

Pea cultivars vary widely in their reaction to pea mosaic. Many are resistant, including a large number of Perfection types—both canners and freezers.

Control

Use resistant cultivars and monitor aphids closely. Apply insecticide when aphid populations reach two per plant.

Literature

- Hagedorn, D.J. 1974. *Virus diseases of pea*, *Pisum sativum*. Monograph No. 9. St. Paul, Minnesota: American Phytopathological Society 47 pp.
- Hagedorn, D.J., and Walker, J.C. 1954. *Virus diseases of canning peas in Wisconsin*. Wisconsin Agricultural Experiment Station Research Bulletin 185. 31 pp.



Streak

Occurrence

Pea streak is very widespread and occasionally economically important throughout the world. It may be more troublesome in late-season pea crops.



Symptoms

The most conspicuous symptoms are stem streaks. They begin as light-brown to purple oblong lesions of varying sizes developing lengthwise along the stem and petioles. The streaks enlarge, run together, and develop a more intense purple-brown color extending for several internodes along the stem. Vein necrosis and leaf yellowing are common, especially on terminal foliage. Pods develop brown to purple dead areas which are slightly sunken and vary in size and shape. Pods may also be malformed and fail to develop peas. Plants are often somewhat stunted due to failure of the upper internodes to elongate properly.

Cause, Spread

Several individual viruses and/or combinations of viruses cause streak. Pathogens include Wisconsin pea streak virus, western pea streak virus, alfalfa mosaic virus, and red clover vein-mosaic virus plus bean yellow mosaic virus. These viruses overwinter in several leguminous plants (such as alfalfa, red clover, and sweet clover) and are transmitted locally by aphids.

Environmental Factors

Moisture is not too important. Warm temperatures and lack of severe thunderstorms encourage aphid multiplication, resulting in more pea streak.

Cultivar Reaction

No resistant cultivars are available, but they are being developed.

Control

Monitor aphids closely. Control when aphid populations reach two per plant.

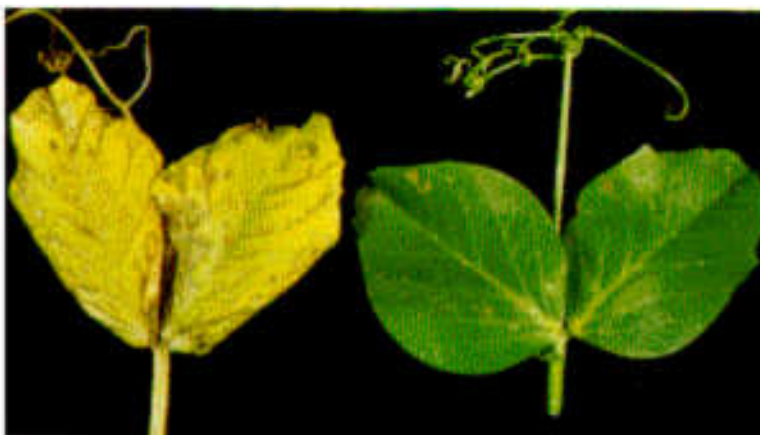
Literature

Hagedorn, D.J., and Walker, J.C. 1949. Wisconsin pea streak. *Phytopathology* 39:837-847.

Kim, W.S., and Hagedorn, D.J. 1959. Streak-inciting viruses of canning pea. *Phytopathology* 49:656-664.

Schroeder, W.T., Provvidenti, R., and McEwen, F.L. 1959. Pea streaks naturally incited by combinations of viruses. *Plant Disease Reporter* 43(12):1219-1226.

Zaumeyer, W.J. 1938. A streak disease of peas and its relation to several strains of alfalfa mosaic virus. *Journal of Agricultural Research* 56(10):747-772.



Stunt

Occurrence

Pea stunt is found in many pea-growing areas of the world as a bothersome and occasionally economically important virus disease.

Symptoms

The most striking symptoms are severe stunting of the plant and malformation of the apical foliage into a tight rosette of leaves, stipules, and blossoms. Internode lengths are greatly reduced. Leaves and stipules show a definite vein yellowing, are reduced in size, and are twisted or curled and fail to open properly. Axillary buds proliferate. Plants form only a few small pods. Middle and lower leaves suffer some vein necrosis (death). There is no mottling. Diseased plants may die prematurely.

Cause, Spread

The red clover vein-mosaic virus overwinters in clovers and vetches and is spread to pea fields by aphids.

Environmental Factors

Low temperatures (60°F, 16°C) cause a significant delay in symptom development. Vein clearing is the most common symptom under these conditions. As the temperature rises to 82°F (28°C), symptom severity increases and development is hastened.

Cultivar Reaction

All pea cultivars and plant introductions tested have shown susceptibility to Wisconsin isolates of the red clover vein-mosaic virus. However, four pea plant introductions were resistant to a western strain of the virus. There are no known resistant commercial cultivars.

Control

Practice effective aphid control.

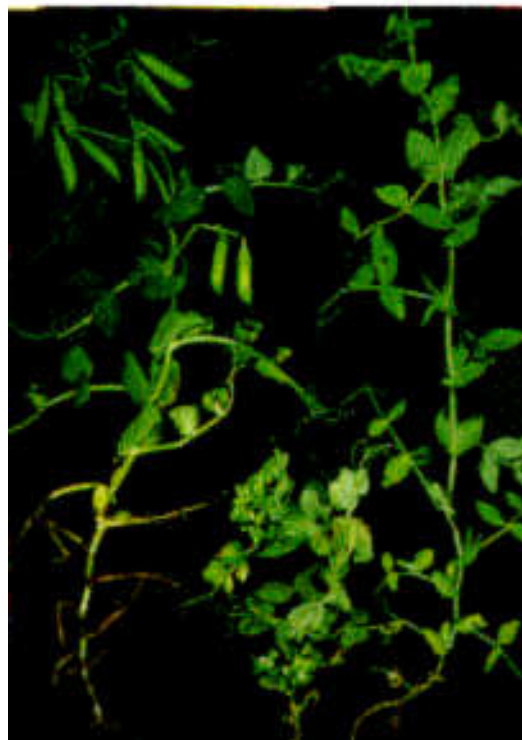
Literature

Hagedorn, D.J. 1968. Disease reaction of *Pisum sativum* plant introductions to three legume viruses. *Plant Disease Reporter* 52(2):160-162.

Hagedorn, D.J., and Hanson, E.W. 1951. A comparative study of the viruses causing Wisconsin pea stunt and red clover vein mosaic. *Phytopathology* 41:813-819.

Hagedorn, D.J., and Walker, J.C. 1949. Wisconsin pea stunt, a newly described disease. *Journal of Agricultural Research* 78(12):617-626.

Hagedorn, D.J., Bos, L., and van der Want, J.P.H. 1959. The red clover vein-mosaic virus in the Netherlands. *Netherlands Journal of Plant Pathology* 65:13-23.



Seed-Borne Mosaic

Occurrence

This potentially important virus disease has been found to be common in pea germplasm collections in many countries, including the United States. However, because of vigorous research on identifying the presence of the virus in pea seed and destruction of seed fields in which the virus is found, this disease has rarely caused substantial economic loss in commercial pea fields in this country.



Symptoms

Symptoms on pea seedlings include stunting and downward leaf curling. Vein clearing and mosaic may also be present. Diseased plants continue to be stunted and appear malformed because of foliage curling, apical malformation, and failure of internodes to elongate. Pods are often very short and stubby and contain few, if any, peas. Seed coats of infected seeds may be cracked or show a necrotic line pattern. The tendrils often curl into tight balls. Some plants may carry the virus but exhibit no symptoms.

Cause, Spread

The pea seed-borne mosaic virus. Rates of seed transmission of up to 30% have been reported. Several strains of the virus occur. The virus can infect at least 30 plant species (mostly legumes) but has a very limited host range in nature. It is readily transmitted by several aphid species including the pea aphid.

Environmental Factors

Normal temperatures and moisture are satisfactory for disease development. Warm, dry weather, which encourages aphid population build-up, may aid virus spread in the field. Seed transmission may be suppressed by high temperatures (above 95°F, 35°C).



Cultivar Reaction

Although few, if any, commercial pea cultivars are resistant to this disease, a number of pea plant introductions have shown good resistance. Resistant or immune processing-type breeding lines have been developed and released by governmental pea breeders.

Control

Plant pea seed lots that have been tested and found free of the virus. Control aphids. Use resistant, or preferably immune, pea cultivars.

Literature

- Hagedorn, D.J., and Gritton, E.T. 1973. Inheritance of resistance to the pea seed-borne mosaic virus. *Phytopathology* 63:1130-1133.
- Hampton, R.O., and Mink, G.I. 1975. *Pea seed-borne mosaic virus*. Descriptions of Plant Viruses No. 146. Kew, Surrey, England: Commonwealth Mycological Institute and Association of Applied Biologists.
- Khetarpal, R.K., and Maury, Y. 1987. Pea seed-borne mosaic virus: a review. *Agronomie* 7(4):215-224.
- Stevenson, W.R., and Hagedorn, D.J. 1969. A new seed-borne virus of peas. *Phytopathology* 59:1051-1052.
- Stevenson, W.R., and Hagedorn, D.J. 1970. Effect of seed size and condition on transmission of pea seed-borne mosaic virus. *Phytopathology* 60:1148-1149.
- Stevenson, W.R., Hagedorn, D.J., and Gritton, E.T. 1970. Resistance to the pea seed-borne mosaic virus. *Phytopathology* 60:1315-1316.

SELECTED PUBLICATIONS ON PEA DISEASES

- Gane, A.J., King, J.M, and Gent, G.P. 1988. *Pea growing handbook*. Peterborough, England: Processors and Growers Research Organisation.
- Hagedorn, D.J. 1973. Peas. In *Breeding plants for disease resistance: Concepts and applications*. Edited by R.R. Nelson. 326–343. University Park: Pennsylvania State University Press.
- Hagedorn, D.J. 1974. *Virus diseases of pea*, *Pisum sativum*. Monograph No. 9. St. Paul, Minnesota: American Phytopathological Society. 47 pp.
- Hagedorn, D.J. (editor). 1984. *Compendium of pea diseases*. St. Paul, Minnesota: American Phytopathological Society. 57 pp.
- Hagedorn, D.J. and Walker, J.C. 1954. *Virus diseases of canning peas in Wisconsin*. Wisconsin Agricultural Experiment Station Research Bulletin 185. 31 pp.
- Walker, J.C. and Hare, W.W. 1943. *Pea diseases in Wisconsin in 1942*. Wisconsin Agricultural Experiment Station Research Bulletin 145. 33 pp.
- Walker, J.C. and Snyder, W.C. 1933. *Pea wilt and root rots*. Wisconsin Agricultural Experiment Station Bulletin 424. 16 pp.
- Zaumeyer, W.J. 1962. *Pea diseases*. USDA Agriculture Handbook 228. 30 pp.

Author: D.J. Hagedorn is an emeritus professor of plant pathology, College of Agricultural and Life Sciences, University of Wisconsin-Madison. Produced by Cooperative Extension Publications, University of Wisconsin-Extension.

University of Wisconsin-Extension, Cooperative Extension, in cooperation with the U.S. Department of Agriculture and Wisconsin counties, publishes this information to further the purpose of the May 8 and June 30, 1914 Acts of Congress; and provides equal opportunities and affirmative action in employment and programming.

This publication is available from your Wisconsin county Extension office or from Cooperative Extension Publications, Rm. 245, 30 N. Murray St., Madison, Wisconsin 53715. Phone 608-262-3346.

A1167 HANDBOOK OF PEA DISEASES

R-06-92-3.5M-700-S