UNIVERSITY OF IDAHO
AGRICULTURAL EXPERIMENT STATION
Department of Plant Pathology

PEA DISEASES IN IDAHO

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*Not yet reported on peas in Idaho.

Pea Diseases in Idaho

The Relation of Weather to Plant Diseases

THE popular opinion that root rot of peas and many other plant diseases are caused by wet weather is based on the observation that certain diseases cause serious losses only during or following rainy weather. The equally accurate observation may be made that barn roofs leak only during rainy weather. However, during wet weather only those barn roofs leak that have holes, and only those pea fields are damaged by root rot that are infested with fungi capable of causing disease. Of course, soil may become too wet for peas to thrive, and damage may be permanent if the soil is badly puddled, yet, in the absence of fungi capable of causing disease, no fungus diseases will occur.

The Value of Crop Rotation in Controlling Diseases

The first step in controlling diseases is to prevent the organisms that cause them from accumulating in the soil. Many plant disease fungi, including those causing wilt, near wilt, and Aphanomyces root rot and other root rots of peas, survive in the soil indefiinitely. Once the soil is heavily infested with one of these, heavy losses may occur even with a lapse of several years between susceptible crops, and crop rotation for their control may appear to be either futile or impractical because of the extreme length of the rotation required.

Even with diseases that cause serious losses only under unusual weather conditions it is important to practice crop rotation to prevent the soil from becoming heavily infested. If the fungus is present in the soil in only a small amount, favorable conditions for its development must persist for a long time for any considerable amount of damage to occur to the crop. With a great amount of inoculum present, all plants are promptly infected with the onset of favorable conditions for the fungus, and considerable damage may be done in a relatively short time.

The length of crop rotations necessary for disease control depends upon the crops employed, the diseases involved, water and air drainage, and local soil and climatic conditions. Even taking these into consideration, crop rotations planned well in advance sometimes cannot be carried out because of unfavorable weather conditions for planting some crop, freezing out of a fall-planted crop, or economic or other reasons. The farmer should be sufficiently well acquainted with the important diseases of the crops he grows so that he will have a background for good judgment as to the cropping practice that is most practical under the particular conditions he finds.

Three- or four-year rotations are the most practical for the prevention of accumulation of disease organisms in the soil. The planting of two or more successive crops of peas is hazardous because any parasite present in the first crop that survive the winter find a convenient susceptible crop to continue multiplication. Some disease organisms that multiply little,

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Dr. W. J. Virgin, who was in charge of pea disease investigation for the Idaho Agricultural Experiment Station from 1938 to 1942 took the photographs for Figures 5, 6, and 7. Dr. E. C. Blodgett took those for Figures 2 and 3.

if any, in the soil (such as pea powdery mildew and bacterial blight) may survive 2 or 3 years in rotting plant refuse which is turned under after the first crop, but, in a 2-year rotation, is turned up again for the next susceptible crop. A 3-year rotation is the shortest rotation of value.

Crops for rotation with peas should be resistant to such pea diseases as are giving trouble or are likely to give trouble. Small grains, grasses, and corn appear to be immune to all important pea diseases. Alfalfa and sweet clover and vetch are slightly susceptible to Aphanomyces root rot of peas. Vegetable crops are all more or less susceptible to both Rhizoctonia and Sclerotinia.

Diseases That May Cause Serious Losses in Yield

The most destructive diseases of peas in Idaho are Aphanomyces root rot, the Sclerotinia disease, and Fusarium wilt. Other root rots, damping-off, near wilt, and powdery mildew may cause losses locally or during some seasons.

DAMPING-OFF caused by many different fungi

Poor stands may result from damping-off which includes seed decay as well as rotting off of the stems of young seedlings.

Control: Varieties with wrinkled seeds are more susceptible than varieties with smooth seeds and weakly germinating seeds are more subject to the disease than strongly germinating seeds. Any condition that delays emergence and early growth in seedlings in wet soil favors damping-off. Avoid planting peas in very wet soil and do not hurry to get them planted before a rain storm. Plant no deeper than necessary. If soil tilth is good and weather conditions are favorable, damping-off generally causes no trouble. Under less favorable conditions seed treatments may improve stand greatly. Under very adverse conditions even seed treatment does not offer sufficient protection to control the disease. Semesan at 2½ ounces per bushel is suggested for seed treatment since it appears to be more effective against damping-off caused by Sclerotinia than is the now popular Spergon. It is useless to inoculate seed with nitrogen-fixing bacteria if they are to be treated with Semesan because the fungicide will kill the bacteria. Spergon is less injurious to the bacteria. It may be employed on inoculated seed at 1½ ounces per bushel. For small gardens it is simplest to treat the seed with Spergon or red copper oxide because a moderate over-dose of these chemicals does no harm if the excess is screened off. A small quantity of one of the chemicals may be added to the seed in a glass jar and shaken up until the seeds are thinly coated with the chemical.

APHANOMYCES ROOT ROT caused by *Aphanomyces eutiches*

The outer tissues of the lower stem and tap root of affected plants become soft, moist, and slightly discolored. The fine roots are finally killed so that when an infected plant is pulled, the root pulls out as a fibrous string of water-conducting tissues freed from the outer tissues and fine roots *(Figure 1)*. Plants attacked early may wilt and die suddenly or may recover depending upon the amount of fungus in the soil and the duration of conditions favoring its development. This root rot is favored by warm weather and develops most aggressively in low, poorly drained soils and in heavier soils with a high moisture-holding capacity.

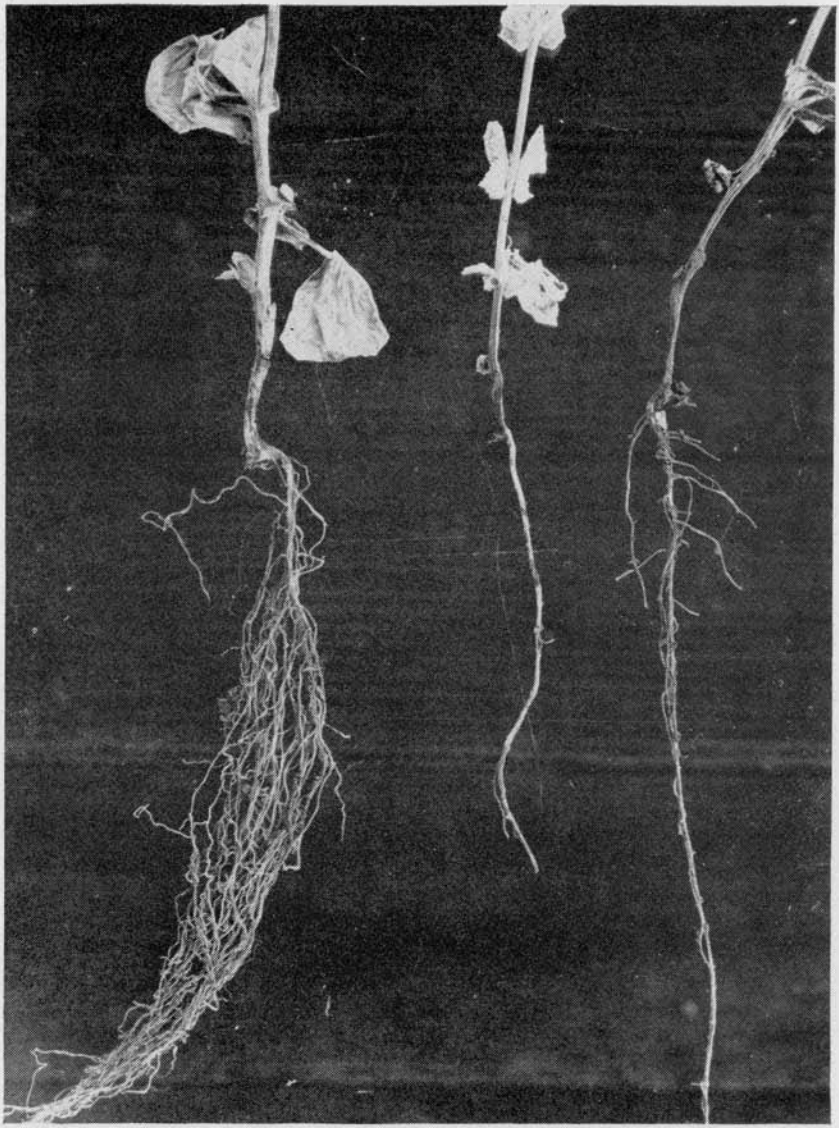

Figure 1.—Root rots. The plants at right and center are affected with Aphanomyces root rot. The one at the right was carefully removed from the soil and shows the rotted condition of the outer tissues and fine roots. The plant in the center was pulled so that the outer tissues and fine roots stripped off leaving a long fiber consisting of water-conducting tissues. The plant on the left has Rhizoctonia root rot. Note the fungus lesions on the upper tap root and lower stem.

Control: Heavy losses from Aphanomyces root rot will probably be confined to years of very wet springs. On heavy soils in wet years when peas cannot be planted until late, there is hazard in planting peas if the land has been used for peas two or more times previously, and the grower may well consider planting some other crop. The disease should not cause trouble on hillsides because of the good drainage thus afforded.

On land where the disease has not yet occurred, a crop rotation of at least 3 or 4 years is advisable in order to prevent accumulation of the fungus in the soil. It has been demonstrated that a 2-year rotation is insufficient. Once the disease has occurred in a field, it is likely to occur again with disastrous results any time conditions favor its development, even though some pea crops may escape serious damage when the spring weather is either dry or cool. Alfalfa, sweet clover, and vetch are somewhat susceptible to Aphanomyces root rot and should not precede peas on land where the disease is likely to cause trouble. The disease is known to occur in Idaho, Nez Perce, and Freemont counties and may be present elsewhere. It affects all varieties of peas although Austrian Winter peas appear to be less injured by it under northern Idaho conditions. The organism is spread by any agency that carries soil, such as on plows, tractor treads, and by run-off water. Possibly the fungus may occur on wild hosts before peas are planted. Even if so, soil is apparently never heavily infested until after 2 or more crops of peas have been grown.

OTHER ROOT ROTS caused by *Fusarium Rhizoctonia,* and other fungi

Other root rots of peas have been reported in Idaho. They differ from Aphanomyces root rot in that they generally cause pitting or girdling of the lower stem and root so that the plant breaks when pulled instead of the outer tissues of the root stripping off.

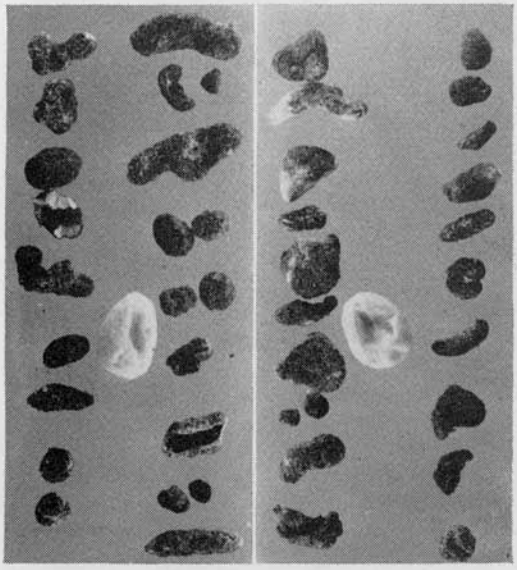

Figure 2.—Sclerotia of the Sclerotinia disease with pea seeds for comparison in size.

Control: These root rots are probably more common in Idaho but generally much less destructive than Aphanomyces root rot. Many of the same organisms that cause damping-off can cause root rot of peas. It is advisable to practice a 3- or 4-year crop rotation and avoid planting peas in very wet soil.

THE SCLEROTINIA DISEASE caused by *Sclerotinia* spp.

This disease causes damping-off and stunting of infected plants that

survive, but also girdling of the stems of older plants by the downy, white fungus resulting in death of portions of plants. In heavy stands approaching maturity the vines may become slimy underneath as a result of a watery soft rot of the lower leaves. On the stems and matted, rotting leaves the fungus produces hard, black bodies called sclerotia, somewhat resembling the excreta of mice and rats *(Figure 2)*. Austrian winter peas appear to be highly resistant to the seedling phase of the disease but are very susceptible to sliming of the leaves. The amount of damage caused by Sclerotinia depends upon the abundance of the fungus and the duration of conditions favoring its development; that is, warm humid weather. The disease is widespread in Idaho, both in irrigated and non-irrigated areas, and has caused heavy losses in some instances.

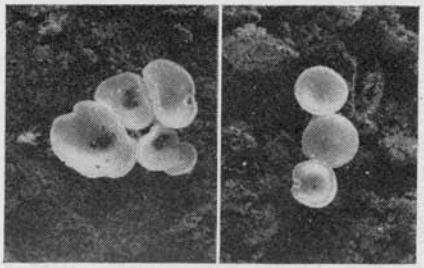

Figure 3.—Apothecia or mushrooms arising from sclerotia collected on lettuce. Those produced from sclerotia on pea vines are very similar.

The sclerotia survive winter weather and germinate to produce small, cup-shaped mushrooms *(Figure 3)* in which are borne spores ("seeds") of the fungus. The spores are carried to susceptible plants by the wind. Sclerotia may occur in great abundance in seed cleanings and may be carried with and planted with seeds of peas, beans, and possibly other crops.

Control: The principal preventive measures for the Sclerotinia disease are sanitation and prevention of accumulation of the fungus in the soil. Seed treatment with Semesan at 2½ ounces per bushel may be of some value in preventing spread with seed. Because infection appears to start each season from wind-blown spores produced by mushrooms growing from sclerotia, the sclerotia should not be left on or near the surface of the soil. Frequently many sclerotia are produced on rotting plant material after the crop is harvested. It is advisable to turn under the straw or remove it for feeding as soon as practical after the crop is harvested. When sclerotia are plowed under deeply they cannot give rise to the mushrooms, but probably when turned up again by plowing they may do so. Consequently it would seem advisable to plow deeply following a severely affected crop of peas, beans, or other susceptible crop, follow by a non-susceptible crop such as wheat, and not plow deeply again until after another susceptible crop is harvested.

Beans, lettuce, celery, cabbage, carrots, onions, and rape are susceptible to Sclerotinia and so are undesirable in short rotations with peas. Small grains, grass crops, corn, potatoes, sugar beets, and forage legumes appear to be satisfactory for rotation with peas in control of the disease.

When seed screenings, rotting carrot roots, onion bulbs, cabbage, or lettuce leaves are dumped, sclerotia present or produced there by the fungus may give rise for a long period of time to the mushroom stage of the fungus. Such refuse should be burned or buried under a considerable depth of soil.

With crops that are affected by Sclerotinia the disease is almost certain to develop in flooded areas, and not only damage or ruin the crop there, but leave the soil heavily infested with sclerotia of the casual fungus. Under irrigation, susceptible crops should not receive any more water than necessary for good growth and development. Water flowing through a bean field may carry sclerotia into a lettuce, pea, or carrot field depending on how the irrigation system is laid out. This should be kept in mind when the cropping plan is made.

POWDERY MILDEW caused by *Erysiphe polygoni*

The pale gray, dusty mold on the leaves, stems and pods of peas that usually is found at least to a limited extent in the fall is known as powdery mildew *(Figure 4)*. The powder on the leaves consists of spores of the fungus which are scattered by the wind and spread the disease. In a late stage of development the fungus produces numerous minute black dots on the leaves, stems, and pods. These structures contain the overwintering spores of the fungus.

The disease causes most damage when dew is regularly heavy, that is, when days are hot and nights are cold. Frequent rains tend to check its development. Peas become more susceptible to powdery mildew as they approach maturity. When pea vines become very dusty with mildew only after the seed crop is practically made, loss in yield is probably slight. If infection occurs earlier very serious damage may result. The market value of hamper peas may be reduced by spotting and distortion of the pods. The vines are rarely killed but early heavy infection may result in shrinkage of the seeds.

Control: Crop rotation is less important in control of this disease than is manner of disposal of the pea straw and trash. The organism is not soil-borne but overwinters on pea trash. If the straw has been disced in or otherwise not thorougly covered, the overwintering spores of the fungus escape to infect peas in neighboring fields. Powdery mildew is generally considered to be seed-borne only in trash carried with the seed.

Dusting with sulphur controls powdery mildew. However, the New Mexico Agricultural Experiment Station[1] finds that a better yield is obtained when powdery mildew is severe if the vines are dusted with a lime-sulphur mixture consisting of 60 percent air slaked lime and 40 percent of a good grade of dusting sulphur (325 mesh or finer).

In areas where powdery mildew is a serious enough factor to warrant control measures, peas should be planted early, using only thoroughly cleaned seed. If powdery mildew appears before the peas approach maturity, cover the plants well with lime-sulphur dust as soon as the disease is noted, and continue dusting about every 10 days until the peas are practically mature. Badly mildewed straw should be turned under or fed. If the straw is used for feed or bedding for livestock, the manure should be well rotted before it is spread.

FUSARIUM WILT caused by *Fusarium oxysporium pisi race* 1

Infected plants turn pale green, are stunted, and may wilt and die. The fungus invades the water-conducting tissues of the roots causing

[1]Crawford, R. F. POWDERY MILDEW OF PEAS. New Mexico Agr. Exp. Sta. Bull. No. 163. 1927

Figure 4.—Powdery mildew. The leaves, stems, and pods are covered with a grayish white, powdery coating. Note also the minute black dots on the leaves, stems, and pods. These are structures containing the overwintering spores of the fungus.

them to turn an orange-brown color. The disease generally attacks earlier, kills a higher percentage of plants in infected areas, and causes a somewhat different discoloration of the interior of the root than does near-wilt with which it is often confused. The fungus is seed-borne to a slight extent. Once Fusarium wilt has been introduced and becomes well established as a result of growing susceptible varieties without adequate crop rotation, the soil remains infested for many years.

Control: Many good varieties and selections of peas are resistant to Fusarium wilt. These may be obtained from reliable seedsmen.

NEAR-WILT caused by *Fusarium oxysporium pisi race 2*

This disease is somewhat similar to Fusarium wilt but generally affects plants later, causing death usually after pod formation begins. Typically, the water conducting tissues of the roots and lower stems are discolored a brick red. The disease affects wilt-resistant as well as wilt-susceptible varieties. To cause damage it requires warmer weather than does Fusarium wilt.

Control: A 3- or 4-year crop rotation should be practiced to prevent accumulation of the fungus in the soil. All other crops are resistant.

ROOT-KNOT NEMATODE or EELWORM caused by *Heterodera marioni*

Small worms penetrate the roots causing swellings. Affected plants are sickly and unproductive. The swellings somewhat resemble nodules formed by nitogen-fixing bacteria but differ in that the swellings arise from within the roots, whereas nodules resemble small bags loosely attached to the roots. The disease occurs in Idaho, and, although it has not been noted on peas, it will affect them if they are planted on infested soil.

Control: Avoid introducing the nematodes with soil or trash from other fields. If the disease appears in a field, avoid moving soil from the area with farm implements and crop it only with immune crops for at least 4 years. The only immune crops suited to this area are small grains, grasses, and corn. All vegetable crops are more or less affected, and some very seriously injured, by root-knot nematodes.

Diseases That May Reduce the Value of Seed

Idaho has a special market for pea seed free from seed-borne Ascochyta blight, anthracnose, and bacterial blight. These are foliage diseases dependent upon frequent rains for development, and so cause no loss in yield under most Idaho conditions. Serious losses may occur in humid climates when infected seed is employed. In order to maintain the market for disease-free seed it is important to aim at complete control of these diseases, since even a small amount of seed-borne infection greatly reduces the value of the seed to eastern and midwestern growers. Failure to rotate crops and use of diseased seed might result in a sufficient incidence of these diseases such as to affect the value of Idaho pea seed.

ASCOCHYTA BLIGHT caused by *Ascochyta pisi, A. pinodella,* and *Mycosphaerella pinodes*

This name applies to diseases caused by any one or more of three closely related fungi that cause blighting of the foliage and sometimes root rot. The spots on the leaves and pods are from the size of a pin

head up to 1/8 inch in diameter. The spots are at first purple, becoming brown and frequently target-board like on enlarging. The spots on the stem are irregular in shape and bluish-black in color.

ANTHRACNOSE caused by *Colletotrichum pisi*

The fungus produces brown spots on the leaves, stems, and pods. The spots on the leaves are irregular in outline, those on the pods sunken, and those on the stems elongated. It is easily confused with Ascochyta blight.

BACTERIAL BLIGHT caused by *Pseudomonas pisi*

The bacteria produce water-soaked spots on the leaves, stems, and pods. The spots *(Figure 5)* remain water-soaked or greasy in appearance, whereas those on the leaves and stems generally turn brown with age. Bacterial blight freqently can be found in Idaho pea fields after a hail storm which provides spattering water to spread the bacteria, and wounds for them to gain entrance into pea plants.

Figure 5.—Bacterial blight on a pod.

Control of Ascochyta Blight, Anthracnose, and Bacterial Blight: Anthracnose has never been found in Idaho, and the other diseases are not frequent in occurrence. In 1943 there was only one report of bacterial blight in the state, and none for Ascochyta blight even though plant pathologists from the University of Idaho watched for it on plant disease surveys. This good record can be maintained if a few precautions are taken. Employ only locally grown seed, avoiding seed from fields where even a trace of any one of the diseases is found. This, together with a crop rotation of not less than 3 years should insure freedom from the diseases. These recommendations apply especially to seed companies who sometimes take advantage of Idaho weather to "clean up" seed lots that are known to carry disease organisms.

Minor Diseases

Several diseases which are usually of little economic importance in Idaho may be more or less conspicuous on pea fields. Generally no control measures are necessary.

VIRUS DISEASES

There are many virus disease that affect peas in Idaho, although generally they cause little damage. These may cause mottling of the leaves (mosaic), stunting, and malformation. Sometimes the pods are badly distorted *(Figure 6)*. These virus diseases are spread by insects, mostly

aphids, although the tomato spotted wilt virus, which causes a "streak" disease on peas, is spread by thrips.

Control: Generally there is little damage from virus diseases except where peas are planted unusually late or a late variety is employed. In that case there may be considerable damage if the pea field is close to alfalfa or clover infected with mosaic. Damage from the tomato spotted wilt virus may be expected to occur on peas in home gardens where perennial ornamentals such as dahlias are infected with the disease. Virus-infected perennial ornamentals should be destroyed for the protection of crop plants. Symptoms associated with virus diseases are dwarfing, mottling, curling, or distortion of the leaves, shortening of the internodes giving a "witch's broom" effect, abnormal flowers containing leafy structures, and departure from normal habit of growth such as too erect, or prostrate instead of erect.

Figure 6.—A virus disease of peas. Exact identity unknown, but showing typical symptoms of virus diseases. Note distortion and mottling of pods and leaves.

DOWNY MILDEW
caused by
Peronospora viciae

This disease is characterized by grayish violet, fluffy patches of fungus on the lower surfaces of the leaves with inconspicuous yellow spots on the upper surfaces *(Figure 7)*. Although occasional plants affected by downy mildew frequently can be found, it is capable of causing serious damage only in areas where cool, moist weather persists for long periods of time. In Idaho no control measures are necessary.

SEPTORIA BLOTCH caused by *Septoria pisi*

Although occurring in Idaho, this disease is of minor imporance even in humid climates. The fungus attacks old leaves, beginning with those near the base of the vine as the plant approaches maturity. The leaves turn yellow and brownish blotches appear. Sometimes the blotches have a target-board appearance, or at least an outer ring of darker brown color. Black dots, the fruiting bodies of the fungus, appear in the discolored areas.

RUST caused by *Uromyces fabae*

A rust of peas similar in appearance to that commonly found on red clover has been observed in Idaho, but apparently it is of little importance.

Figure 7.—Downy mildew. Note grayish violet, velvety, fungous growth on lower surface of the leaves.