

INDIANA PLANT DISEASES, 1919.¹

MAX W. GARDNER.

INTRODUCTION.

The parasitic fungi of economic importance in Indiana have been previously recorded by Pipal² and by Osner^{4,5}. While additions to this list will be included in subsequent reports the nature of the report will be essentially altered so that it will constitute a somewhat detailed account of the general crop pathology and the diseases of considerable economic importance during the season in question. Relative prevalence, geographical distribution, local epidemics, new or unusual features observed, and losses incurred, especially specific instances, will be among the data included. It is hoped that by such an annual procedure, a clearer understanding of Indiana plant disease conditions may be obtained. For this report no claim of completeness is made. Diseases of forest trees and ornamentals are not included. Diseases not reported in the previous lists are enumerated in the summary.

WEATHER CONDITIONS.

Because of the very intimate bearing of the weather upon crop pathology, it is deemed not out of place to present a brief resumé of the weather conditions prevailing during the 1919 growing season as summarized by Mr. J. H. Armington in the monthly reports of the Weather Bureau at Indianapolis.

Very warm weather early in April advanced vegetation very rapidly and caused fruit to blossom in the central and southern portions of the state. Consequently the freezing temperatures attained April 25th. to 27th. resulted in very serious injury to peaches, cherries, plums, apples, wheat, and rye. After this followed a month of cool, cloudy, wet weather resulting in a marked retardation of grains, a yellowing of wheat and rye in wet soil, a subsequent lodging of wheat, and a delayed planting of corn and truck crops.

June and July were exceptionally hot and dry. The rainfall during June was in the form of local thunder storms and was deficient in the east and central portions of the state. In general, however, the weather during June was not unfavorable to crops. Except for a light rain, July 14th., there was practically no rain at all during that month until the 31st. This prolonged drouth, coupled with the excessive heat, resulted in severe retarda-

¹Pipal, F. J. A list of plant diseases of economic importance in Indiana with bibliography. Proc. Ind. Acad. Sci. 1915 :379-413. 1916.

²Osner, Geo. A. Additions to the list of plant diseases of economic importance in Indiana. Proc. Ind. Acad. Sci. 1916 :327-332. 1917.

³Osner, George A. Additions to the list of plant diseases of economic importance in Indiana. Proc. Ind. Acad. Sci. 1917 :145-147. 1918.

⁴Contribution from the Botanical Department of Purdue University Agricultural Experiment Station, Lafayette, Indiana.

⁵The writer wishes to acknowledge the assistance of Prof. H. S. Jackson, Mr. F. J. Pipal, Mr. G. N. Hoffer, Dr. C. T. Gregory, and E. B. Mains in preparing this report.

tion and drouth injury of corn and truck crops. The heavy rainfall of July 31st. and August 1st. was state-wide and relieved the drouth situation to a large extent although certain localities continued to suffer.

There was hail injury to truck crops and strawberries at Madison, June 12th. and to truck crops, corn and oats at Berne and Winona Lake, July 19th.

August was not especially hot and local rains were frequent. The rainfall was, however, below normal and was insufficient, especially in certain localities, to offset the drouth injury of July. The first half of September was also hot and dry, thus further injuring potatoes and truck crops. Heavy rains, September 18th. to 22nd., followed by an exceptionally warm, wet, and late fall, with no frost until late in October, resulted in a very favorable late growing season.

To summarize briefly, we have had this year an early period of warm weather in April followed by a destructive freeze, a cold wet May, an exceptionally hot and dry June and July period, followed by a generally favorable growing season lasting until late in October. Certain types of parasitic plant diseases are markedly influenced by such weather conditions. For example, the cold wet weather of May was especially favorable to certain fruit diseases such as apple scab, the subsequent hot dry weather to the *Fusarium* root diseases such as cabbage yellows, and the late growing season resulted in a prolonged exposure of crops to certain types of disease such as the *Septoria* leaf-spot of tomato which increase in prevalence and severity as the season advances.

DISEASES ARRANGED BY HOSTS.

ALFALFA.

Leaf-spot caused by *Pseudopeziza medicaginis* was generally prevalent.

APPLE.

Blotch caused by *Phyllosticta solitaria* was the most serious disease in the southern part of the state on the susceptible varieties, Northwestern and Rhode Island Greenings, Stark, Ben Davis, Smith Cider, Duchess, and Arkansas Red, according to C. L. Burkholder who further reports that blotch was much worse than usual this year. According to J. Oskamp, C. L. Burkholder, and F. P. Cullinan, the northern limit of blotch as an important commercial factor in Indiana could be represented by a line across the state north of Indianapolis through the counties of Fountain, Montgomery, Boone, Hamilton, and Madison. The disease occurs, however, on the Stark and Northwestern Greening to a considerable degree as far north as the Wabash valley. The above observers also report that, in the badly infested southern half of the state, the disease seemed to be most severe in the southwestern corner and along the Ohio River. Oskamp reports severe blotch at Solon, Indiana. Blotch was found in neglected orchards about Lafayette and in sprayed orchards at Bedford, Mooresville, Greenfield, and Knightstown.

At Greenfield cankers on 1918 wood were not at all common. Counts

made September 18th at Greenfield showed fruit infection ranging from 45 to 72%, at Knightstown, 78 to 86%, and at Mooresville, 77 to 96%. Petiole infection ranged between 57 and 74% at Mooresville. In the Greenfield orchard blotch was found on two young Grimes trees that were overhung by diseased Greenings, indicative of drip infection. Good control of blotch on the fruit was secured by the Bordeaux sprays, but no success was had with the concentrated lime sulphur dormant spray.

Scab, caused by *Venturia inaequalis*, is the most important apple disease in Indiana and seemed to be equally prevalent throughout the state. Because of the wet weather in May, scab was particularly severe on the foliage and blossoms. It was not, however, as severe on the fruit as the early infection led one to expect. However, it was generally prevalent on fruit in the northern part of the state. H. H. Swain reports difficulty in finding scab-free fruit in a sprayed orchard near South Bend. Cullinan found in an experimental orchard at Peru, practically 100% defoliation and no fruit in unsprayed check plots as a result of scab. He further reports that the Ben Davis variety suffered severely from this disease. Burkholder found scab worse this year in southern Indiana than he had previously noted. Owing to the very early and vigorous start made by the disease, spray control was less successful than usual.

Taking the state as a whole, black rot caused by *Sphacelopsis malorum* was by far the most prevalent disease. The frog-eye leaf-spot was particularly ubiquitous and destructive, and the blossom-end type of fruit rot was rather common on certain varieties. The latter condition was noticed in an orchard at Knightstown, June 17th., and on Summer Rambo in an orchard near Bedford, July 15th. Cullinan found black rot very severe on Ben Davis apples in an orchard at Bicknell in August in the shape of a blossom-end rot associated with a heavy San Jose scale infestation of the calyx ends which had caused cracking of the fruit. While this disease is usually worse on old unpruned trees, it was found very severe in a large orchard of young trees near Paoli, May 28th., resulting in a noticeable yellowing of the foliage. Considerable defoliation was caused by this disease and in cases carefully noted it was found that five or six lesions were sufficient to cause the leaf to drop.

Early in the season, fire blight caused by *Bacillus amylovorus* occasionally was noted to be severe in apple trees, particularly those near diseased pear trees. A striking example of this was noted near Knightstown, June 17th., where there was a row of badly blighted pear trees along one side of an orchard. The apple trees along this side were badly blighted, while farther over there was not much blight to be found. In a dooryard in Orleans, a case was observed where there was considerable blight on one side of an apple tree, the side adjoining a blighted pear tree. In a small orchard of young trees near Indianapolis, the extreme susceptibility of the Winter Banana variety to fire blight was clearly indicated.

Sooty blotch caused by *Leptothyrium pomi* occurred rather commonly in the central and southern parts of the state. Considerable sooty blotch was noted on the fruit from an orchard near Mooresville.

Rust caused by *Gymnosporangium juniperi-virginianae* was rather severe, according to Pipal, in the southeastern part of the state. The abundance of the red cedar in southern Indiana is of course very conducive to rust epidemics.

Oskamp reports that blister canker due to *Nummularia discreta* is increasing in importance in Indiana and further reports its extreme severity on the Ben Davis variety near Greencastle. It is also reported to be present on that variety in an orchard near Peru.

According to the observations of Oskamp and Pipal, bitter rot caused by *Glomerella cingulata* was not as destructive as usual this year. Bitter rot occurs mainly in southern Indiana.

A serious root trouble occurs to a considerable extent in central and southern Indiana, especially on the Grimes variety. This root rot usually results in the death of the affected trees and cases are on record where whole orchards have been destroyed in the southern part of the state. Whether or not this is the *Nylaria* root rot has not been ascertained.

Frost injury to apple blossoms was of course severe in certain sections of the state and caused a marked reduction in yield. A very bad case of this was noted in a large orchard near Goshen where absolutely all of the blossom clusters were killed. A peculiar crinkling of apple leaves due to the death of the lower epidermis was very widely noted during June and was attributed to freezing injury. There was a marked prevalence of frost marking of the fruit in the central and southern parts of the state in all stages from narrow frost bands and blossom-end russet to russetting of the entire surface of the fruit, and even malformation of the fruit. So prevalent was this type of injury that it assumed considerable significance as a blemish in the prize exhibits in the shows.

The lace-like russetting of the fruit resulting from Bordeaux injury and arsenical burning of the foliage was found in sprayed orchards.

ASPARAGUS.

Rust caused by *Puccinia asparagi* was not found in the Indianapolis market gardens but was noted at Lafayette.

ASTER.

Fusarium wilt was severe locally.

BARLEY.

Thirty-six barley fields in 15 counties were examined in the federal cereal disease survey. Ergot caused by *Claviceps purpurea* was found in two fields. Spot blotch caused by *Helminthosporium sativum* was reported from eight fields, net blotch caused by *Helminthosporium teres* from 11 fields, and stripe caused by *Helminthosporium gramineum* from two fields. Spot blotch is the most serious of these diseases in Indiana and was very abundant in the eight fields above noted, all of which were in Madison, Delaware and Noble counties. Scab caused by *Gibberella saubinetii* was found in 19 or

53% of the 36 fields with an average incidence of 3.3%. One field in Madison County showed 35% scab. This field was in corn in 1918.

Leaf rust caused by *Puccinia simplex* was found in six out of the 36 fields with an average incidence of 1.2% and a maximum of 20%. Stem rust caused by *Puccinia graminis* was found in 13 fields with an average incidence of 2.1% and a maximum of 20%. Neither of these diseases was of any considerable economic importance.

Covered smut caused by *Ustilago hordei* was found in 10 of the 36 fields with an average incidence of less than ½% and a maximum of 8%. Loose smut due to *Ustilago nuda* was found in 30 or 83% of the fields with an average incidence of 1.6% and a maximum of 25%. None of the 36 fields examined had been planted with treated grain.

BEAN.

The garden crop suffered severely from drouth injury, which was evidenced by a downward curling and extreme distortion of the leaves accompanied by marginal browning. Bacterial blight caused by *Pseudomonas phaseoli* was generally present in all gardens and constituted a serious loss-producing factor. Late in the season, the mosaic disease became very prevalent. Its symptoms may have been masked by the universal drouth injury earlier in the season. The leaf spot caused by *Phyllosticta phaseolina* was found at Lafayette.

BEET.

The sugar beet crop of Lake County seemed to be more or less free from disease except for some leaf-spot caused by *Cercospora beticola*. A little scab due to *Actinomyces scabies* was found, and crown gall was reported by growers. A crown rot of the roots was noted in DeKalb County.

Garden beets throughout the state were generally infected with the leaf-spot due to *Cercospora beticola*, but as a rule the attack was not particularly severe.

BLACKBERRY.

Orange rust due to *Gymnoconia peckiana* was very widespread and abundant throughout the state in late May and early June.

BLUEGRASS.

The slime mold, *Phyvarum cinereum*, caused conspicuous patches in lawns early in the spring.

CABBAGE.

The limiting factor in the cabbage crop of Indiana this season was the yellows disease caused by *Fusarium conglutinans*. The extremely hot weather was especially favorable to this disease and it was widespread throughout the state both in small gardens and in truck fields. In certain of the market gardens near Indianapolis, the early crops of Wakefield and

Copenhagen were failures because of yellows and market growers about Shelbyville reported that yellows was forcing them entirely out of the cabbage industry. In the Lake County truck region near Highland, yellows was found to a greater or less extent in a rather large number of fields of kraut cabbage examined and no fields were found to be free from it. Yellows is frequently present in seed beds and the use of diseased transplants is a prolific means of dissemination of this disease. Especially is this the case when one grower secures plants grown by another, a practice commonly indulged in.

Clubroot caused by *Plasmodiophora brassicae* was found in several (5) fields near Highland in Lake County and where it occurs a heavy reduction in yield results. In one instance a grower had knowingly introduced both yellows and club root into clean soil with his purchased transplants.

Black-leg caused by *Phoma lingam* was found in a few fields near Highland, but was not very destructive. Black rot due to *Pseudomonas campestris* was not noted. Black leaf-spot caused by *Alternaria brassicae* was noted in Lake County. In the early crop in the Indianapolis market gardens there was some loss due to a rot of the stem and leaf bases caused by *Sclerotinia libertiana*. The same fungus was observed earlier in the season on seedlings in a greenhouse. Likewise there was noted a damping-off of cabbage seedlings due to Rhizoctonia.

A non-parasitic tip-burn of the leaves was found in Lake County, in September, which was not confined to the exterior leaves, but occurred also on interior leaves as well. This disease caused a considerable loss. Affected heads are unmarketable because the killed leaf margins almost invariably become infected with rot-producing fungi such as *Botrytis*.

CANTALOUPE.

Fields were examined in Knox, Jackson and Marion Counties. The most important disease was wilt due to *Bacillus tracheiphilus*. This caused the death of a small percentage of the plants early in the season. It was found actively spreading June 26, and July 24 its ravages were attested by numerous blanks and dead plants. It was not serious in the Indianapolis market gardens but was generally recognized at Decker and Vallonia as the worst cantaloupe disease. No indications of *Fusarium* wilt were found.

Leaf blight or "rust" due to *Alternaria brassicae* var. *nigrescens* was very generally prevalent in all fields examined. It was severe in the Decker region, even as early as June 26th., and by July 24th, was killing the older foliage extensively. On many of the fields in this district cantaloupes have been grown for the last 20 to 30 years and the severity of leaf blight may be largely due to this lack of crop rotation.

The mosaic disease, characterized by dwarfed vines and mottled leaves was found in several fields in Knox County. This disease reduces the yield very materially.

White porcelain-like areas due to sunscald were found on the upper surfaces of melons in the field, July 24th. In the packing shed, melons were dis-

carded as culls because of deep cracks and because of a rot resulting from scab-like lesions on the side of the melon that was in contact with the soil in the field.

CARROT.

Leaf-spot caused by *Cercospora apii* var. *carotae* was found in the Indianapolis market gardens.

CATALPA.

Leaf-spot due to *Macrosporium catalpae* was widespread.

CELERY.

The most serious disease of celery as observed near Lafayette and Indianapolis was the root trouble known as the "stunting disease"^{1,2}, "crown rot," or "yellows". This is caused by a soil fungus, *Fusarium*, and is essentially similar in its effects to the cabbage yellows disease. Affected plants show a yellow color or premature bleaching of the older leaves usually on one side, exhibit all degrees of stunting, and may die early in the season or continue a sickly existence. The fungus persists in the soil and the diseased areas enlarge year by year. The disease is confined chiefly to the highly desirable Golden Self-bleaching variety and green or late varieties are practically immune. In 1914 this disease was so prevalent in the celery marshes at Kalamazoo, Michigan, and Goshen, Indiana, that the industry was threatened with failure. Steam soil sterilization was found to be effective but rather impracticable, and the situation was relieved by the discovery that the Easy Bleaching variety, though slightly less desirable commercially, was highly resistant to the disease. This variety has now completely supplanted the Golden Self-bleaching variety at Kalamazoo and Goshen. At present the disease is just gaining a foothold in the Indianapolis market gardens. This season it caused one grower to plow under his celery, and caused a practical failure for another. A small area was found in a third field, and in another case two diseased plants were found in the cold frames early in the season and a few scattered plants in the field later. In this disease, as in cabbage yellows, dissemination is largely by means of diseased transplants.

In the Goshen crop, early blight caused by *Cercospora apii* was very destructive as observed in early September. Late blight due to *Septoria petroselinii* occurred in a garden in Rush County in September. The bacterial leaf-spot was found near Lafayette, August 11th., and in some of the Indianapolis market gardens, August 22nd. Some nematode injury was found at Goshen where there is a large area of muck soil so badly in-

¹Coons, G. H. ' The Michigan plant disease survey for 1914. Mich. Acad. Sci. 17th. Ann. Rpt. :126-127. 1915.

²Coons, G. H. Michigan plant disease survey for 1917. Mich. Acad. Sci. 20th. Ann. Rpt. :444. 1918.

fested with nematodes that its use for truck crops has been discontinued. This nematode infestation has been present at least five years.

CHERRY.

Leaf-spot caused by *Coccomyces hiemalis* was the most serious cherry disease and was generally prevalent and widespread. It was responsible for a marked yellowing of the foliage and consequent defoliation. Undoubtedly leaf-spot is a limiting factor in cherry production in Indiana. C. L. Burkholder reports that a successful spray control was secured by R. A. Simpson at Vincennes, using Bordeaux 2-4-50.

Brown rot due to *Sclerotinia cinerea* was reported by one grower near Indianapolis to be very severe on the Ox-heart variety.

Powdery mildew due to *Podosphaera oxycanthae* was found in Jackson County.

CLOVER.

Anthraxnose due to *Colletotrichum trifolii* was very serious on red clover. A badly diseased field was noted near Hartford City.

Leaf-spot caused by *Pseudopeziza trifolii* was found in Hancock County.

A spotting of sweet clover due to *Ascochyta caulicola* was found in Jefferson County.

CORN.

The most serious disease of corn was the root rot due to *Fusarium* species. G. N. Hoffer reports that this disease was state-wide in distribution but was worst in Shelby, Noble, and Bartholomew counties. It is worse in the lighter soils and in clay spots in the fields. The disease causes firing of the lower leaves and results in barrenness and nubbin production. The loss in yield due to root rot is estimated at 5% to 10%. The fungus is carried in the seed and also persists in the soil.

Leaf sheath, nodal, ear and root infection with the fungus *Gibberella saubinetii* has been the cause of much loss this year according to Hoffer. The most important injury is due to the shank infection which causes the ears to lop over and to the root rot. This is the same fungus which causes wheat scab.¹

Hoffer also reports that corn ear rots due to *Fusarium* and *Diplodia* were not prevalent this year because of the fact that the weather was very favorable for the ripening of the grain. October and November floods in southern Indiana have caused much loss in seed corn, however, due to molding of the ears both on the stalk and in the shock.

Smut caused by *Ustilago zeae* was present in the usual abundance. It was worse in sweet corn and in fields where corn was grown in 1918.

Rust caused by *Puccinia sorghi* was less abundant than usual and was most common in the late plantings of sweet corn.

Stewart's disease caused by *Bacterium steewartii* was found near Ladoga,

¹Hoffer, G. N., Johnson, A. G., and Atanasoff, D. Corn root—rot and wheat scab Jour. Agr. Research 17:611-612. 1918.

Shelbyville, and Indianapolis. Hoffer reports that the infection was rather light, ranging from 2 to 3%.

Drouth injury to corn became very severe in July and a marked firing of the leaves especially on the lighter soils was one of the results. Certain localities suffered worse than others in this regard.

CUCUMBER.

Bacterial wilt caused by *Bacillus tracheiphilus* occasioned heavy losses in certain greenhouses near Indianapolis and Terre Haute and was common in the field crop in Lake County. In the greenhouse crop heavy infestation of fruits on diseased vines was noted.

Mosaic was of considerable importance in the greenhouse and cold-frame crop but was not as prevalent as usual in the pickle crop.

Anthraxnose caused by *Colletotrichum lagenarium* was very destructive in certain greenhouses where overhead watering was practiced. The disease was very destructive on all of the foliage up as high as the watering pipes.

Angular leaf spot due to *Bacterium lactucae* was noted in the field crop but was not found in the greenhouses. This disease was prevalent in the pickle crop about Plymouth, LaPaz, and Lakeville in 1917 and 1918.

Powdery mildew caused by *Erysiphe cichoracearum* was noted occasionally in greenhouses and was more prevalent on the fall crop.

Downy mildew caused by *Peronospora cubensis* was found to a limited extent on the fall crop in one greenhouse.

Nematodes are one of the worst difficulties encountered in growing cucumbers in the greenhouse. One grower reports that the inroads of this trouble occasioned the installation of a system of control which entailed an original outlay of \$15,000 and an annual operation cost of \$500.

EGGPLANT.

Leaf-spot and fruit rot caused by *Phomopsis vexans* was found in the Indianapolis market gardens. More serious, however, was a wilt disease of undetermined origin.

KALE.

Yellows due undoubtedly to *Fusarium conglutinans* occurred in certain of the Indianapolis market gardens.

LETTUCE.

In the greenhouses, downy mildew caused by *Bremia lactucae* was prevalent in the winter crops. It has been found that a low temperature greatly favors spore germination and this may explain why the disease is not so severe in the spring crop under glass and is absent in the field crop. Downy mildew affects mainly the older leaves and not only renders the older leaves unfit for market, but also predisposes them to a Botrytis rot. Botrytis not only attacked these older leaves, but also caused a stem rot which usually resulted in the death of the affected plants.

Drop caused by *Sclerotinia libertiana* occurred to a serious extent in some greenhouses in the late crop during cloudy weather.

A leaf-spot, probably of bacterial origin, and a rosette probably due to *Rhizoctonia* were also found in the greenhouse crop.

MAPLE.

Sunscald or drouth injury was severe on hard maples along city streets. The injury occurred in July and its effects were visible for several weeks. The leaves turned brown about the margins and between the veins and curled upward.

Oak.

Sunscald similar to that on maples occurred on shade trees during July.

OATS.

Leaf-spot or spot blotch caused by *Helminthosporium avenae* was reported from 28 out of the 254 fields of oats examined in the federal cereal disease survey. R. V. Allison found it very abundant in fields in Madison, Delaware, Wabash, Noble and Lagrange counties. Septoria leaf-spot was found in four of these fields, bacterial blight in six, and scab caused by *Gibberella saubinetii* was found in eight with a maximum incidence of 45%. Blast was reported from 92 of the fields and was found very abundant in Noble, Lagrange, Wabash, Delaware and Madison counties.

Covered smut caused by *Ustilago leavis* was reported from eleven fields. Loose smut caused by *Ustilago avenae* was found in 208 or 82% of the fields examined, with an average incidence of 3.3% and a maximum of 24%. Out of 30 fields, the seed for which was treated by the wet formaldehyde method, 13 showed loose smut with an average incidence of 0.2% and a maximum of 2%. Out of 26 fields planted with seed treated by the dry formaldehyde method, 22 showed loose smut with an average incidence of 0.8% and a maximum of 8%.

Leaf rust caused by *Puccinia coronata* was reported from 197 or 77% of the 254 fields with an average incidence of 17% and a maximum of 100%.

Stem rust caused by *Puccinia graminis* was found in only 17 fields, with an average incidence of 0.6% and a maximum of 30%.

ONION.

Smut caused by *Trocyctis cepulae* has been found by C. T. Gregory in a few fields at Hammond just across the state line from an area of infection in Illinois.

Smudge caused by *Colletotrichum circinans* was found on white bulb onions in the Indianapolis market gardens.

Pink root and Fusarium bulb rot were found in one field near Garrett in Dekalb County.

In Dekalb and Fulton counties there was considerable difficulty with onions in muck soils due to a severe stunting of a large percentage of the plants which resulted in a marked irregularity of the stand and con-

sequent lack of uniformity in the size of the bulbs. In addition there was in the field a distinct bleaching and burning of the leaf tips. This trouble could not be attributed to any parasitic attack and was quite likely due to an excess of soluble salts in the surface soil, according to S. D. Conner. The latter¹ has found that there is an accumulation of soluble salts in the surface layers of muck soils, composed largely of nitrates, and in comparative analyses of soil from areas where onions were not growing well and from the rest of the field, he has found the concentration of nitrates three times as great in the surface inch of the diseased areas. In such concentrations there is a toxic effect upon the plant.

June 17th., there was observed in one field in Dekalb County a peculiar type of injury characterized by a bleached area and constriction of the leaf just above the ground line. The leaves usually broke over at this lesion. This trouble is likewise due probably to injury resulting from a temporary concentration of soluble salts in the surface soil.

Localized nematode infections were found in one field in Fulton County. Instead of root galls the effect was a clump of secondary roots at the point of infestation.

PARSNIP.

Leaf-spot due to *Cercospora apii* was found rather abundant in the fall near Lafayette.

PEA.

The bacterial spot and the blight caused by *Ascochyta pisi* were found in small gardens.

Canners report serious trouble in their crops. It is quite likely that this will prove to be a soil difficulty due to a *Fusarium*. Hoffer reports that specimens received in previous years showed root infestation by *Fusarium* species.

PEACH.

Early in the season there was a particularly widespread and destructive epidemic of peach leaf curl caused by *Eroasens deformans*. The disease was noted in nine counties. A very high percentage of the foliage on diseased trees was infected.

Later in the season the leaf-spot and shot-hole caused by *Bacterium pruni* became the most serious disease. It occurred in Greene and Hancock counties and was found in abundance in Knox county where defoliation was clearly attributable to this disease. In the last case, the attack on the fruit was not at all severe, however.

Cankers and twig blight due to *Sclerotinia cinerea* were noted early in the season in Tippecanoe and Orange counties. This disease seems to be most common on neglected farm yard trees. Growers report that brown rot is apt to occur in the hollows in the orchards.

¹Conner, S. D. Excess soluble salts in humid soils. Jour. Am. Soc. Agronomy, 9:297-301. 1917.

Twig lesions of the scab disease caused by *Cladosporium carpophilum* were found very common on the 1918 wood and were noted in four counties. In the Knox County crop, fruit infection was rather abundant but occurred too late to be of economic importance except as a minor blemish.

A root rot caused by *Armillaria mellea* was found in Brown County.

The severe winter injury of 1917-18 is conspicuous in the peach orchards near Paoli, which were rendered practically worthless. Frost injury to the blossoms reduced the Indiana crop severely this season.

PEAR.

Fire blight caused by *Bacillus amyglorovus* was very severe early in the summer, especially in the southern half of the state. Pipal reports that fire blight is ruining orchards in Tippecanoe and Gibson counties. Some of these have yielded no fruit for several years.

Leaf-spot caused by *Septoria pyricola* is common on dooryard trees.

Scab caused by *Venturia pyrina* occurred locally.

PEPPER.

Sunscald of the green fruits was undoubtedly the cause of the greatest losses in this crop. The scalded areas are readily invaded by rot-producing fungi.

Mosaic was rather common late in the season.

PLUM.

Brown rot caused by *Sclerotinia cinerea* was severe on farm yard trees in general. Twig blight due to the same fungus was noted also.

The leaf-spot caused by *Bacterium pruni* was noted in Blackford, Floyd, and Marshall counties. It was found quite serious near Plymouth, June 3rd.

Black knot due to *Plowrightia morbosa* was found in White County and Pipal reports a case in an orchard in Hendricks County in which every tree is being killed by black knot.

Twig injury caused by *Erosacus pruni* was very severe in an orchard in Hancock County early in the season.

Frost injury to the blossoms reduced the yield. Russet and cracking of the fruit due to frost injury was noted at Plymouth, June 3rd.

POTATO.

The hot dry summer season was very unfavorable to the potato crop. The vines as a rule remained undersized, the leaves were small with a tendency to roll upwards, and the yield was low.

The weather conditions which prevailed this season were especially conducive to the non-parasitic disease known as tip-burn, which was prevalent throughout both the early and late crops. Undoubtedly soil and seed stock have some influence on the severity of this disease. The relative importance of the leaf-hopper as a causal agent in connection with tip-burn is still in question. C. T. Gregory and F. C. Gaylord found that a combined spray of

Bordeaux and nicotine sulphate seemed to result in improved vine vigor and yield where no fungous leaf diseases were present. This is hard to explain except upon the basis of the partial leaf-hopper control secured or the possible stimulation of the plant by the copper.

Fungous diseases of the foliage were of no importance in the Indiana crop this year. Late blight was not reported. Early blight caused by *Alternaria solani* was found in Marion and Blackford counties in June and in Clark and St. Joseph counties in October, but was evidently of no economic importance.

Fusarium wilt was, however, the cause of serious losses in the late crop and was by far the most important fungous disease of Indiana potatoes. The percentage of yellowing or dead plants or shoots to be noted late in the season was very high in many fields in the northern part of the state. The disease seemed to be especially destructive near Valparaiso. The vascular discoloration in the base of the main stem and in the stolons was pronounced. Tubers from diseased plants usually showed vascular discoloration at the stem end frequently accompanied by a rotted area externally visible as a sunken, wrinkled region about the stem end. The effect of wilt on the amount of yield is not known, but tubers showing the incipient stem end rot do not endure storage. Whether or not this disease as it occurs in Indiana, is primarily due to soil or to seed infestation is not known. There was undoubtedly a high incidence of infection due to soil infestation but in addition there was striking evidence of seed carriage of disease in fields planted with seed from different sources as observed by Gregory. For example, in a field near Valparaiso, seed from Wisconsin showed less than 1% of wilt August 13th., field run Indiana seed, 25% wilt, and Indiana seed selected for freedom from Fusarium infection, only 5% wilt.

There was also in many fields a great abundance of localized root lesions in connection with which the relative importance of Rhizoctonia and Fusarium as causative factors has not yet been determined. Unmistakable Rhizoctonia cankers with the cracked brown tissue were of frequent occurrence on the lower stem and with these were associated similar root lesions. Lateral roots were found entirely cut off by these lesions and in severe cases the root system was severely reduced. In Lake County this type of root trouble was very bad and apparently resulted in an uneven stand. Cases of a red discoloration of the rootlets suggesting Fusarium attack were also frequently found.

Black leg caused by *Bacillus phytophthorus* was found by Gregory in a small percentage of plants in one field near Indianapolis.

Among the tuber diseases, in addition to the Fusarium stem end rot associated with wilt, common scab, black scurf, and russet scab were of importance. Common scab caused by *Actinomyces scabies* was very severe in the heavier soils, but was successfully controlled by seed disinfection. In a test field in Dekalb county, 59% of the tubers grown from untreated seed were scabby, as compared with 5 to 17% from treated seed. Black scurf caused by *Rhizoctonia solani* is of very general occurrence. A fairly successful control of this disease was also secured by the mercury bichloride

treatment. In an experimental plot in Dekalb county, untreated seed yielded tubers showing 87% infection of black scurf as compared with 41% from treated seed. In a similar test in Lake county, there was 69% black scurf where untreated seed was used as compared with 6 to 13% where treated seed was used.

Russet scab was found in Lake County. Its cause is not well understood. Silver scurf caused by *Spondylocladium atrovirens* was found on seed stock in Dekalb County. Leak caused by *Pythium* was found at Lafayette in freshly dug tubers kept in a warm place.

A rather careful search of the state for the black wart disease accompanied by educative propaganda to enlist the assistance of the growers and consumers in the search was made in cooperation with the federal plant disease survey by J. H. Weghorst. None of the disease was found.

RADISH.

Black-root attributed to *Rhizosporangium aphanidermatum* was the most serious disease of radishes and was an important loss-producing factor in the culture of the white varieties especially in heavy clay soils. Not only are the blackened lesions objectionable in themselves, but are generally invaded by rot-producing organisms.

White rust caused by *Cystopus candidus* was prevalent in certain greenhouses. A rot of the leaf bases due to *Sclerotinia libertiana* was also noted in greenhouses.

RASPBERRY.

Orange rust due to *Gymnoconia peckiana* was of widespread occurrence early in the summer.

Anthrachnose caused by *Gloeosporium venetum* was very severe this year and was the worst disease of black raspberry in Indiana. It was especially important in Fountain County. In a plantation near Silverwood this disease has been so severe that it has led to a method of culture in which the vines are forced until two or three good crops are secured after which they are destroyed and replaced.

The non-parasitic yellows disease occurred locally.

RHUBARB.

Leaf-spot caused by *Aecochytra rhei* was of general occurrence.

ROSE.

Powdery mildew (*Sphaerotheca pannosa*) was very destructive in greenhouses, especially on the Killarney variety. It was also prevalent on the Ramblers in June.

Black spot caused by *Aclonema rosae* was found in the greenhouse crop and was most serious on the Russell variety.

RYE.

Twenty-eight fields in 17 counties were examined in the course of the federal cereal disease survey. *Septoria* on the heads was reported from

three of these fields. Ergot caused by *Claviceps purpurea* was reported from 15 fields but was not nearly as prevalent as in 1918.

Pipal reports that anthracnose, caused by *Colletotrichum cereale* was serious in southern Indiana. The disease was also found in Cass County.

Scab caused by *Gibberella saubinetii* was found in 24 or 85% of the 28 fields above mentioned, with an average incidence of 5.4% and a maximum of 40%. In addition, the disease was found in two counties not included in that survey.

Leaf rust (*Puccinia dispersa*) was found in nine of the 28 fields with an average incidence of 4.4% and a maximum of 45%. It is quite likely, however, that leaf rust occurred to some extent in all fields. Mains reports that leaf rust was very severe on rye cover crops late in the fall of 1918, citing one case near Logansport where a field was quite yellow with the rust. Stem rust (*Puccinia graminis*) was found in 5 fields with an average incidence of less than 1% and a maximum of 15%.

Stem smut caused by *Urocystis occulta* was found to a very limited extent in Lake and St. Joseph counties. One head of loose smut was found in the latter county by Gregory.

SNAPDRAGON.

Rust (*Puccinia antirrhini*) is steadily increasing in prevalence in Indiana, according to H. S. Jackson.

STRAWBERRY.

Leaf-spot caused by *Mycosphaerella fragariae* was very generally found in all plantings but was not especially destructive since its attack did not become severe until after the fruit was picked. Pipal reports that the disease was prevalent in the commercial crop at Borden, Clark County.

SWEET POTATO.

Black rot due to *Sphaerotheca fimbriatum* occurred in Jay County where it caused losses on several farms.

TOMATO.

Leaf-spot caused by *Septoria lycopersici* was the most important disease of field tomatoes and was present in almost all fields to a greater or less degree. This disease usually does not become destructive until late in the season. By killing the lower leaves the disease not only reduces the leaf area of the plant but exposes the fruit to sunscald. Tests with copper sprays conducted by W. B. Clark of the U. S. Bureau of Plant Industry at Paoli indicate that leaf-spot may be held in check to some extent but not satisfactorily controlled by spraying. This is largely owing to the impossibility of thoroughly covering the foliage after the plants become large. Increases in yield were secured by spraying, however. Leaf-spot was much worse in the region near Paoli than in the Indianapolis region. The disease was found to some extent in greenhouses near Indianapolis.

Early blight caused by *Alternaria solani* occurred to some extent in plant beds causing a leaf-spot and also an elongated, blackened stem

lesion. Later the disease became rather prevalent in the field. In central Indiana early blight did not become a serious factor but about Paoli it assumed some importance late in the season. August 8th. there were found in the fields near Paoli numerous spindling plants which showed a dry blackened stem lesion about the stem at and below the ground line. Whether or not these plants were the result of using transplants with the elongated stem lesions above noted is not known.

Wilt caused by *Fusarium lycopersici* caused severe losses to certain growers and seems to be becoming more prevalent in the state. It was unquestionably the most serious disease of greenhouse tomatoes and numerous instances of complete or partial crop failure due to this disease were found in the Indianapolis region. Owing to the persistence of this disease in the soil, its high virulence under greenhouse temperatures, and the extreme susceptibility of the Bomby Best variety, the greenhouse situation is especially deplorable. In the field crop in central Indiana, the wilt occurred to a considerable extent locally in areas of various sizes and as scattered infected plants in the fields.

At Frankfort, August 14th., a field was observed in which there was a large area of dead plants surrounded by a narrow zone of plants showing all stages of *Fusarium* infection. An experimental field near Frankfort was planted with seed from a large number of varieties and single plant selections, one to each row. There were scattered plants in this field killed by wilt, a few rather definite areas of wilt, and a single striking case of one row, a single plant strain, showing practically 100% wilt. In a 100-acre field of tomatoes near Indianapolis no wilt was found and the Paoli region was practically free from the disease. Quite likely this disease, like the *Fusarium* root diseases of cabbage and celery, is disseminated by means of diseased transplants.

Leaf mold caused by *Cladosporium fulvum* was exceedingly serious in many greenhouses, the infection being so general in some instances as to cause the death of the plants. The disease was at its height during the ripening period of the summer crop and was favored by the high temperature and humidity existing in the houses at that time. Leaf mold appeared in epidemic form in the fall greenhouse crop at Lafayette and Terre Haute. Bordeaux spray and sulphur dust seem to be ineffective as control measures and a fine sulphur spray has been recommended. The disease was found to a limited extent late in the fall in an experimental field at Frankfort.

A bacterial spot disease previously reported from Michigan¹ as "caulker" was widespread and abundant in central Indiana late in the season. This disease is characterized by conspicuous black lesions on the fruit and by rather inconspicuous black lesions on the leaves, petioles and stems. The black fruit lesions are very objectionable from the canner's point of view and the disease assumed considerable economic importance this year.

Buckeye rot of the fruit caused by *Phytophthora terrestris* was found in one greenhouse near Indianapolis. Only the lower fruits in certain areas were affected.

Anthraco-nose caused by *Colletotrichum phomoides* was noted on the ripe fruit at an Indianapolis canning factory.

The mosaic disease became generally prevalent throughout central Indiana during the last half of the season. The disease was not noted to any extent in the Paoli region nor in Lake County, but was found in Knox, Marion, Clinton and Tippecanoe counties. It also occurred very generally in the greenhouses early in the summer and has already (November) become epidemic in the fall crop in one house. Most fields showed from 50 to 100% infection. Except for the low percentage of fern-leaf plants which yield no marketable fruit whatever, the effect of the disease upon yield is not known. The attack seemed to have occurred too late to noticeably reduce the yield this season. However, the disease has extremely destructive possibilities and should be considered a distinct danger to the tomato industry. No resistant strains or varieties have been found.

The non-parasitic blossom-end rot was prevalent in the greenhouse summer crop and in the first fruit set in the canning crop, especially in the Paoli region. The non-parasitic injury is almost invariably invaded by some rot-producing fungus, such as *Alternaria* or *Fusarium*, so that affected fruits are a total loss. A very considerable reduction in yield may be attributed to this trouble. In a series of fertilizer plot tests at Paoli, no difference was noted in the incidence of blossom-end rot.

In the field crop later in the season, the non-parasitic growth cracks were very prevalent and were responsible for a large proportion of the fruit rot since these cracks are subject to invasion by rot-producing organisms. While the loss due to growth crack invasion was considerable this year, especially in canning stock shipped by rail, it was not nearly as heavy as in years which are characterized by frequent rains during the picking season.

Sunscald was rather common in the market garden crop which was badly affected with leaf-spot and to some extent in the canning crop as a result of the hot weather early in September. Sunscald also affords an avenue of invasion for rot-producing fungi.

Catface, a disfiguration of the blossom-end of the fruit, was very common in the canning crop. This does not predispose the fruit to rot. A very shallow, brown, lace-like blemish on mature fruit, called "blotch" because of the shape of the lesion, was found rather commonly.

Among locally grown fruit on the sorting belts in a canning factory at Indianapolis, September 30th, 10% showed infected growth cracks, 5%-bacterial spot, 5%-blotch, 3%-sunscald, 1%-catface, 0.5%-anthracnose.

Hollow stem was of common occurrence this year where spindling transplants were used. Hollow stem was also caused by the extreme drouth, the moisture being absorbed from the pith to supply the needs of the green tissue. A conspicuous upward curling of the leaves and premature death of the older leaves among garden tomatoes has also been attributed to drouth.

Nematode root infestation was found in certain greenhouses. Affected

¹Coons, G. H. Michigan plant disease survey for 1917. Mich. Acad. Sci. 20th. Am. Rep. 446. 1918.

plants are checked in their growth, the lower leaves die prematurely, and the whole plant usually wilts and dies before maturing fruit so that infested plants are practically a total loss.

TURNIP.

Peronospora parasitica was found causing darkened regions within the roots late in the storage season. The diseased tissue is readily invaded and rotted by *Rhizoctonia* or the soft rot bacteria.

WATERMELON.

The limiting factor in the watermelon industry in Indiana is the *Fusarium* wilt disease. This soil trouble has rendered much land unfit for water melon culture and necessitates the use of new soil each year. Wilt has caused the growers in many districts to give up watermelon growing entirely. For example, Vallonia was once an important watermelon shipping point, but now practically no watermelons are grown in that district. The disease is serious in Knox County, also.

Anthraxnose caused by *Colletotrichum lagenarium* was not at all prevalent this year and was found only in two fields, one near Vincennes and the other near Vallonia. A number of fields about Vincennes were planted with treated seed.

In one instance of a small watermelon patch in a large cantaloupe field, the leaf blight caused by *Alternaria brassicae* var. *nigrescens* occurred on the watermelons as well as the cantaloupes.

There was considerable rotting of the fruits in the field in Knox County due to infection through the non-parasitic blossom-end rot by *Fusarium* and *Diplodia*. Stem-end rot is not encountered in shipments of Indiana melons, according to J. R. Cavanaugh.

WHEAT.

Very general concern was occasioned by the discovery of a foot rot of wheat much resembling the Australian "take-all" disease.¹ This disease was first found in Madison County, Illinois, where a considerable acreage was involved. In Indiana the disease was found in one field in Tippecanoe County, in five fields near Laporte, and in six fields in Porter County between Valparaiso and Wanatah. All but two of these fields were planted with Salzer's Red Cross Variety.

This disease occurs either in well defined spots in the field or may involve more or less all of the field. When first noted during May the diseased plants were distinctly stunted, being only a few inches high while normal plants were knee high. The affected plants showed excessive tillering and the rosette effect as well as a darker green color were very marked. A large percentage of plants were killed outright. Closer examination showed a dark brown discoloration and rotting of the leaf sheaths and stem just above the ground line.

In some cases this disease was so destructive that the crop was plowed under. In other fields a fair yield was secured. In order to prevent a spread of the disease, state authorities compelled the burning of the straw from the infested fields and a thorough disinfection of the grain in formaldehyde. None of the grain was allowed to be used for seed. Growers were advised not to plant wheat in these fields for several years. The cause of the disease has not been determined.

In connection with the rather careful statewide search made for the above disease, a very considerable amount of frost injury to wheat was found. This was evidenced by a shriveling and brown discoloration of the stems just above the nodes.

Wheat scab caused by *Gibberella saubinetii* was the most serious wheat disease and was an important loss-producing factor this season. As a result of the federal cereal disease survey, scab was found in 442 or 74% of the 596 fields examined with an average incidence of 17%. James Dickson, in charge of this survey, reports cases of infection as high as 90% in Orange and Posey Counties. Pipal reports authentic cases in Vanderburg, Knox, and Posey counties where the crops were not even harvested and he estimates that there was a 50% loss in badly infected fields in general.

Since recent investigation indicates that the wheat scab fungus lives over winter on corn stalks the following observations are of interest. Pipal reports an instance of a farm near Martinsville where 35% scab occurred in wheat following corn and only a trace in the other field on fallow ground. On another farm the corn stalks were carefully removed from one acre in a large field planted to wheat. This acre later showed 3% scab as compared with 10% in the rest of the field. From Dickson's report it appears that out of the 13 fields examined in Hancock County, the percentage of scab ranged from 5 to 45% in the six fields where wheat followed corn, with an average of 20%, while in the seven fields which were not in corn in 1918, the percentage of scab ranged from 5 to 75% with an average of 29%. Among the latter is a case of 60% scab following clover and another of 75% following wheat. From the same report it further appears that in the 10 fields surveyed in Posey County, there was an average of 77% scab in the four fields which were in corn in 1918 and an average of 65% in the other six fields. Furthermore, in the 10 fields surveyed in Orange County, there was an average of 45% scab in the six fields in corn in 1918 and 13% in the other four fields. The evidence therefore is not conclusive and factors other than the corn must be considered. It seems quite likely that other plant residues are also of importance as a source of infection. Dickson gives as his opinion that the two important factors are the abundance of the parasite, and the presence of organic matter such as plant residues on the soil for the propagation of the parasite. He intimates that the preparation of the soil is as important as the crop rotation utilized. According to Hoffer, seed from diseased heads yields weak plants but does not constitute an important means of dissemination of the scab fungus.

¹Humphrey, Harry B. and Johnson, Aaron G. Take-all and flag smut, two wheat diseases new to the United States. U. S. Dept. Agr. Farmers' Bul. 1063:1-8. 1919.

A seedling disease characterized by a yellow stripe extending the entire length of the leaves was found rather commonly during the last half of May. The cause of this disease is unknown.

A slight infection of ergot was found on Red Wave wheat in Noble County, July 10th., by R. V. Allison. Powdery mildew (*Erysiphe graminis*) was abundant in the latter part of May, probably owing to the prolonged wet weather. The bacterial disease, black chaff, was found in Morgan County.

The Septoria leaf-spot was very prevalent early in the season. Later the Septoria on the glumes became widespread. Out of the 596 fields examined in the course of the federal cereal disease survey, these diseases were found in 133.

Anthraxnose caused by *Colletotrichum cereale* was reported from 10 of the 596 fields above mentioned. A field very badly affected with anthracnose was found near Lafayette, June 26th., by Allison. The affected plants in this field were already killed at this time.

Leaf rust (*Puccinia triticina*) was as usual very severe in Indiana, especially in the southern part of the state. Very heavily infected fields were seen in Martin County, May 28th., and in Hendricks County, June 26th. Leaf rust was reported from 214 or 35% of the 596 fields examined in the federal survey, with an average incidence of 1.4% and a maximum of 75%. It is probable that leaf rust occurred to some extent in all fields, however.

Stem rust (*Puccinia graminis*) was reported from 202 or 33% of the 596 fields above mentioned, with an average incidence of 6.2% and a maximum of 100%. This rust was not epidemic except in the neighborhood of barberries. Pipal reports cases of epidemic outbreaks near barberries in Randolph, Spencer, Knox, and Lagrange Counties.

Bunt or stinking smut caused by *Tilletia foetans* was reported from 90 or 15% of the 596 fields above mentioned with an average incidence of less than 1%. Pipal reports that the disease was serious only in the northeast corner of the state (Steuben and Lagrange Counties). As to the control of the disease it is of interest to note that out of 39 fields planted with seed treated with wet formaldehyde, bunt was found in seven and in these cases to the extent of not over 1%. Out of eight fields planted with seed treated by the dry method (formaldehyde), a trace of bunt was found in 1 field. In the 45 fields for which the seed was treated by the hot water method, bunt was found in only one field, and only to the extent of 1%.

This season was especially favorable to loose smut caused by *Ustilago tritici* and the disease was especially prevalent. According to Pipal's observations and to the results of the federal cereal disease survey, it was found in 760 fields in the state with an average incidence of about 3% and a maximum of 30%. Loose smut was most severe in the area comprising the following counties: Morgan, Marion, Hancock, Shelby, Rush, Bartholomew, Decatur and Jennings. The greatest losses were suffered in Shelby County where the average infection, according to Pipal, on 33 farms ob-

¹Prevalence of the loose smut of wheat in Indiana in 1919. Proc. Ind. Acad. Sci. 1919.

served was about 10%. As is elsewhere reported by Pipal¹, a striking control of loose smut was secured in certain districts with the hot water seed treatment.

SUMMARY.

The plant diseases of outstanding economic importance as observed during the season are as follows:

- Apple: Blotch; scab; frost injury.
- Bean: Drouth injury.
- Cabbage: Yellows.
- Cantaloupe: Bacterial wilt; leaf blight.
- Celery: Yellows or stunting disease.
- Cherry: *Coccomyces* leaf-spot.
- Clover: Anthracnose.
- Corn: *Fusarium* root rot; local infection of *Gibberella saubinetii*.
- Cucumber: Bacterial wilt; mosaic.
- Eggplant: Wilt.
- Maple: Sunscald.
- Onion: Soil salt injury.
- Peach: Leaf curl; black leaf-spot; frost injury.
- Pear: Fire-blight.
- Pepper: Sunscald.
- Plum: Brown rot; frost injury.
- Potato: *Fusarium* wilt; *Fusarium* tuber rot; common scab; *Rhizoetonia* root and stem infection.
- Radish: Black-root.
- Raspberry: Anthracnose; orange rust.
- Rose: Powdery mildew.
- Tomato: *Septoria* leaf-spot; *Fusarium* wilt; leaf mold; mosaic; blossom-end rot; fruit rot from infected growth cracks.
- Watermelon: *Fusarium* wilt.
- Wheat: Foot rot; scab; loose smut; frost injury.

Plant diseases found in 1919 which have not been previously listed by Pipal and Osner are as follows:

- Celery: Yellows or stunting disease due to a *Fusarium*; nematode root injury; bacterial leaf-spot.
- Sweet clover: *Ascochyta caulicola*.
- Corn: Root rot due to *Fusarium*; Local infection with *Gibberella saubinetii*; Stewarts' disease due to *Bacterium stewartii*.
- Eggplant: Wilt (cause not determined).
- Kale: Yellows due to *Fusarium conglutinans*.
- Oats: Scab due to *Gibberella saubinetii*; blast.
- Onion: Pink root and bulb rot due to a *Fusarium*; soil salt injury; nematode injury.
- Parsnip: Leaf-spot due to *Cercospora apii*.
- Peach: Root rot due to *Armillaria mellea*.

Pepper: Sunscald.

Potato: Black leg due to *Bacillus phytophthorus*; leak due to *Pythium*.

Radish: Black-root, petiole rot due to *Sclerotinia libertiana*.

Rye: Septoria disease of heads; scab caused by *Gibberella saubinetii*.

Tomato: Buckeye rot due to *Phytophthora terrestris*; bacterial spot; fruit rot due to infected growth cracks; sunscald; hollow stem; nematode wilt.

Watermelon: Blossom-end rot.

Wheat: Foot-rot resembling "take-all"; black chaff.