

INDIANA PLANT DISEASES, 1920.¹MAX W. GARDNER.²

INTRODUCTION.

In accordance with the plan outlined in last year's report,³ the plant disease situation in Indiana for the season of 1920 is summarized herein as completely as our reports and observations permit. As in the previous report, the economic point of view is maintained.

WEATHER CONDITIONS.

The important relation of the weather to crop diseases warrants a brief report based upon the monthly summaries of Mr. J. H. Armington of the federal weather bureau at Indianapolis.

The extremely cold, wet weather of April delayed farm operations and retarded crops several weeks. The first half of May was also very cold, culminating in frosts the 14th and 15th which caused considerable injury to fruit. In some localities seed potatoes rotted in the ground because of the cold wet weather.

The latter part of May and all of June and July were in general favorable to crops. June and July were exceptionally cool and rainfall was fairly abundant. Severe hail injury occurred at Vincennes, June 1, at Madison, June 14, and at Kokomo, Berne and Decker the 23rd. At Decker the injury to corn, wheat, oats, tomatoes, melons, peaches and apples caused a loss estimated at 150,000 dollars.

August was also fairly cool and the whole summer up to the end of August was characterized by the absence of any period of heat and drouth. This type of weather greatly lessened the destructiveness of the *Fusarium* soil diseases such as cabbage yellows and favored the prevalence of such diseases as *Septoria* leaf-spot of tomato.

September was very hot especially during the latter half with less rainfall than in previous years in central and northern Indiana and dry warm weather continued well into October. This type of weather favored the ripening of fall crops and at the same time was not especially conducive to plant diseases. Light frosts occurred October 20 and heavy frosts the end of the month.

In general the 1920 season was distinctly different from its predecessor and the difference in weather is rather strikingly reflected in the plant disease conditions.

¹Contribution from the Botanical Department, Purdue Agricultural Experiment Station, Lafayette, Indiana.

²The writer wishes to acknowledge the assistance of Prof. H. S. Jackson, Mr. F. J. Pipal, Mr. G. N. Hofer, Mr. J. B. Kendrick, Dr. C. T. Gregory and Dr. E. B. Mains of the Botanical Department and Messrs. C. L. Burkholder, F. P. Cullinan, F. C. Gaylord and H. D. Brown of the Horticultural Department of Purdue Agricultural Experiment Station. Most of the illustrations are taken from photographs made by Mr. Kendrick.

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DISEASES ARRANGED BY HOSTS.

APPLE.

Blotch (Fig. 1) caused by *Phyllosticta solitaria* was severe on the susceptible varieties throughout the southern half of the state and was noted at Peru by F. P. Cullinan, in DeKalb county by C. T. Gregory, and as far north as Delphi, Columbia City, Stenben county and Lake county by C. L. Burkholder. The Mann and Maiden Blush should be added to the list of



Fig. 1. Apple blotch.

susceptible varieties in the 1919 report. At Mitchell, Prof. Greene noted abundant fruit infection June 10 and petiole lesions were noted at Mooresville June 11. Unsprayed Northwestern Greenings at Knightstown showed as high as 91 per cent fruit infection and 39 per cent petiole infection and at Mooresville as high as 97 per cent fruit infection and 83 per cent petiole infection. Counts made by Burkholder in Clark county showed 97 per cent fruit infection on unsprayed Ben Davis trees. Good control was secured with Bordeaux sprays 2, 4 and 6 weeks after petal fall, while sulphur dust, Bordeaux dust and dormant sprays were ineffective.

Scab (Fig. 2) caused by *Venturia inaequalis* was especially severe in the southern part of the state but rather light in the northeast quarter of the state where its ravages are usually the worst, according to reports by Burkholder and Cullinan. Burkholder reports very little scab on unsprayed check plots in Whitley county except upon Ben Davis and Fameuse. On the other hand, the same observer reports that scab was more severe in the region between Crawfordsville and the Ohio river than in the preceding three seasons. At Mooresville, June 25, scab was noted to be abundant on



Fig. 2. Apple scab.

the leaves and fruit of Chenango, Benona, N. W. Greening, Jonathan, and Ben Davis, while there was very little on the Transparent and Duchess. Early infection of the fruit caused much cracking and malformation which was followed by secondary rots late in the season.

Observations upon varietal susceptibility by Burkholder indicate that the varieties Moyer's Pride, Salome, Ben Davis, Winesap, Rome Beauty, Delicious and Fameuse are very susceptible to scab, while resistance is shown by the varieties Yellow Transparent, Early Harvest, Stark, Flore Belle, Bellflower, Stayman Winesap, York Imperial, Black Twig and Grimes Golden.

Black rot due to *Physalospora cydoniac* occurred generally throughout the state on apple foliage. In one orchard in May the extreme prevalence of the frog-eye leaf-spot on trees badly affected with blotch was of interest because the black rot fungus is very commonly present in the old blotch cankers. In an orchard near Vincennes a local out-break of the frog-eye leaf-spot was very evidently associated with a limb which probably had been killed by fire-blight and was harboring the black rot fungus. On the other hand this leaf-spot was also present on young, well cared-for trees. June 25 the leaf-spot was noted to be especially bad on the varieties Ben Davis and Jonathan. The fruit rot of the blossom-end type as well as the type following blotch, scab and worm injury was very common late in the season.

Fire blight due to *Bacillus amylovorus* was very common on apple trees near blighted pear trees. Because of the prolonged growing season this year the attacks of fire blight continued well into the summer. July 2 this disease was found rather prevalent on certain varieties in a large orchard near Vincennes. An orchardist at Laurel found that thorough spraying for aphid control was effective against blight and that improper spraying resulted in an increased amount of blight.

Sooty blotch and fly speck (*Leptothyrium pomi*) were very common on certain varieties.

Rust (*Gymnosporangium juniperi-virginianae*) was very severe on the foliage of susceptible varieties. It was noted on Jonathan fruit and foliage in Morgan County June 25.

Powdery mildew (*Podosphaera leucotricha*) was found on the Missouri Pippin variety at Ladoga by Dr. P. J. Anderson.

The collar rot of the Grimes variety which was recorded last year (as root rot) as prevalent in southern Indiana causes the greatest fatality when the trees are 20 to 25 years old according to Burkholder. He reports one case of a 25-year-old orchard near Madison in which 25 per cent of the trees are dead or dying. Since the Grimes is otherwise a very desirable variety for southern Indiana it has been successfully top worked on other stocks.

In the case of all varieties planted on newly cleared land, Burkholder reports that a certain percentage of root rot has occurred.



Fig. 3. Apple Jonathan spot.

Jonathan spot (Fig. 3) was noted at Mooresville. Cullinan reports this trouble as very prevalent this year and found it present on unpicked fruit at Laurel. Burkholder noted the same thing in Porter County and on King and Black Twig apples still on the trees at Aurora.

Bitter pit was rather common on Stark apples at Mooresville and is reported by Cullinan as common on Stark, Grimes, and Baldwin apples. Water core was found at Knightstown.

Frost injury occurred in many sections. At Mooresville blossom clusters and whole spurs were killed outright and the set of fruit was severely cut. Some frost banding also occurred. The first leaves were stunted, dark green and wrinkled and many turned yellow and dropped off.

Severe hail injury occurred near Decker June 23 and the quality of the crop was greatly lowered. In one orchard the entire crop was rendered unfit for market by the extreme malformation resulting from the hail bruises.

According to Burkholder spray injury to leaves and fruit occurred at

Mitchell and in Clark county where a drenching application of 4-6-50 Bordeaux was used in blotch control work.

ASTER.

The Fusarium wilt is a very serious problem for the florists of the state and is of rather general occurrence.

BARLEY.

Bacterial blight caused by *Bacterium translucens* was noted May 26 near Lafayette. *Helminthosporium teres*, *H. gramineum*, *H. sativum* and *Rhynchosporium secalis* were noted near Lafayette by Dr. A. G. Johnson June 10.

Loose smut (*Ustilago nuda*) was reported by F. J. Pipal as severe in some fields. Stem rust was found in one field in Lake county.

BEAN.

Bacterial blight caused by *Pseudomonas phaseoli* was the most serious disease of this crop and was exceptionally severe this year both on foliage and pods. It was prevalent in the Indianapolis market gardens and was also noted near Kokomo, Wanatah, Plymouth, Hammond and Campbellsburg. Blight also was found severe on the foliage and pods of a row of Lima beans adjacent to a row of badly blighted kidney beans.

Mosaic was generally present in most gardens observed, but not as a rule on a high percentage of the plants until late in the season.

Root rot due to a Fusarium species was noted early in the season causing the death of scattered plants in market gardens. Rust (*Uromyces appendiculatus*) was found in fields near Plymouth and Wanatah. No anthracnose was noted.

Leaf-spot of Lima bean due to *Phyllosticta phaseolina* was very prevalent and destructive in gardens near Indianapolis and Lafayette.

BEET.

Leaf-spot caused by *Cercospora beticola* was not at all common this year and was noted only at Goshen late in the fall. A crown rot caused by Rhizoctonia invasion through growth cracks and broken leaf bases was found in the sugar beet crop about Hammond.

Nematode root-knot caused by *Heterodera radicum* was found in muck soil near Goshen and badly affected plants were stunted and worthless. An area of several acres in the celery marsh near that city has been infested with nematodes and rendered unfit for truck crops for at least six years.

BLACKBERRY.

Pipal reports that orange rust (*Gymnoconia peckiana*) destroyed one planting in Posey county. Anthracnose caused by *Plectodiscella veneta* was

noted in one planting near Mooresville, but was not nearly as severe as on raspberries.

CABBAGE.

Yellows caused by *Fusarium conglutinans* remains the limiting factor in this crop but was not as severe this year as in 1919 owing to the cooler temperatures. It was prevalent in small gardens as well as fields and the cabbage soils of the state are pretty generally infested. In Lake county the resistant Wisconsin Hollander is coming into rather general use as a late crop. A trial of the yellows-resistant Copenhagen developed at the Iowa station was made in Lake and Marion counties but the growers were not satisfied with the type.

Black rot caused by *Pseudomonas campestris* was noticed this year and black-leg due to *Phoma lingam* was found in Lake county and in several market gardens near Indianapolis. Clubroot occurred in a few fields in Lake county. Hail injury intumescences were noted in one field near Indianapolis.

CANTALOUPE.

Bacterial wilt caused by *Bacillus tracheiphilus* was the most important disease of this crop and its attacks continued until much later in the season than usual. Early in July, 2 to 10 per cent infection was found in fields near Decker and Princeton and the disease was later noted near Indianapolis and Lafayette. Where the hill system of culture is used, wilt often causes large blanks in the fields and in a bad wilt season like 1920 the row system is preferable.

Leaf blight caused by *Alternaria brassicæ nigrescens* was generally prevalent and particularly destructive this year. In the Decker region it was just beginning to show up July 1 and by the end of the season was the most prevalent disease. Not only was it severe on the old cantaloupe fields, but it also occurred in new soil not previously in cantaloupes. In the latter case, however, the epidemic came too late to do serious damage.

Mosaic was found in several fields early in July and was rather serious even at that early date in one field near Princeton. Some plants showed such extreme effects of the disease that it seemed likely that the trouble was contracted before they were transplanted from the plant bed. Late in the season mosaic was very general in the Decker region but the attack seemed to have been of rather late inception and probably was correlated with the heavy aphid infestation. No anthracnose was found.

CARNATION.

Rust (*Uromyces caryophyllinus*) was generally present in greenhouses.

CARROT.

Nematode root-knot occurred in the infested area of muck soil near Goshen.

CAULIFLOWER.

Yellows caused by *Fusarium conglutinans* occurred in several market gardens about Indianapolis. A *Sclerotinia* stem rot was found killing many plants in one garden.

CELERY.

The *Fusarium* yellows was not serious this year. The growers near Lafayette and Goshen are using the resistant Easy Bleaching variety in place of the susceptible Golden Self-blanching.

Early blight caused by *Cercospora apii* was found very severe in the Goshen crop and also near Lafayette late in the fall. The bacterial leaf-



Fig. 4. Celery bacterial leaf spot.

spot (Fig. 4) was severe in the Goshen crop and along with early blight was killing many leaves. Long petiole lesions were very common. This disease was also found near Lafayette and Indianapolis.

Late blight caused by *Septoria petroselinii* was noted near Goshen and Lafayette but was not as destructive as early blight. Possibly the higher temperatures prevailing in Indiana cause early blight to be more destructive than late blight.

A mottling of the foliage of the Easy Bleaching variety suggestive of a mosaic disease was noted at Goshen and Lafayette. Nematode root-knot was found at Goshen. Affected plants were badly stunted and displayed a peculiar type of tipburn.

CHERRY.

Leaf-spot (Fig. 5) due to *Coccomyces hiemalis* was the most serious disease. Yellowing of the leaves and defoliation are caused and unaffected

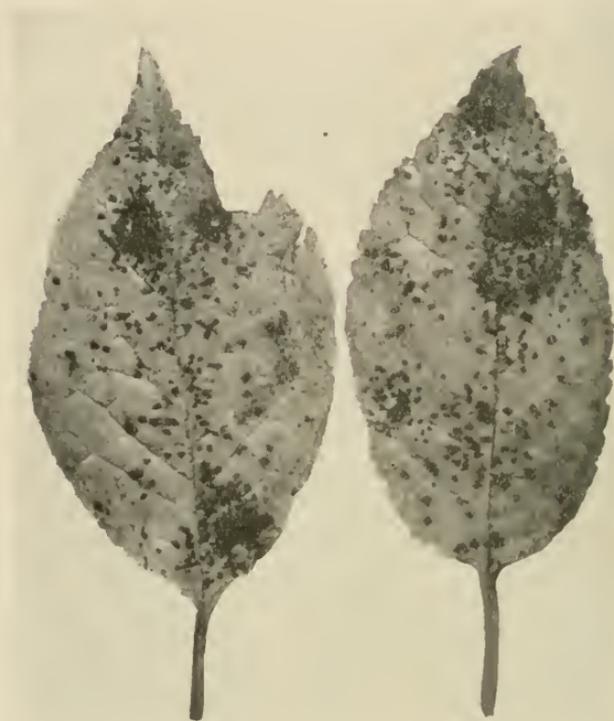


Fig. 5. Cherry leaf spot.

trees are rarely found. Powdery mildew (*Podosphaera oxycanthae*) was noted at Wanatab.

CHRYSANTHEMUM.

Leaf-spot due to *Septoria chrysanthemella* was noted in a greenhouse.

CLOVER.

Anthrax due to *Colletotrichum trifolii* was the most important disease.

CORN.

As was the case in 1919, the *Fusarium* root, ear and stalk rots were the most serious diseases. Pupal reports three fields plowed up because of root rot.

Smut was generally abundant this year and was especially severe on sweet corn. Gregory reports observations which indicate that early smut

infection caused barrenness. Rust was of general occurrence. One plant affected with the leaf-spot caused by *Physoderma zeae-maydis* was found at Shelbyville by J. F. Trost. Severe hail injury occurred in many sections.

COWPEA.

Leaf-spot due probably to *Phyllosticta phascolina* was found very abundant both on leaves and pods in a field near Decker August 19. This disease was noted at Vallonia in 1919.

CUCUMBER.

By far the most serious disease was bacterial wilt due to *Bacillus tracheiphilus*. This disease was noted in greenhouses and market gardens, and in the pickle crop about Plymouth wilt was far worse than previously recorded and continued its attack well into the season. Where the single-plant-to-the-hill system of culture was used, wilt caused many unproductive blank spaces in the fields, and row planting would have been preferable to hill planting this season.



Fig. 6. Cucumber mosaic.

Mosaic (Fig. 6) was not prevalent in greenhouses but in the pickle crop was very destructive and ranked next to wilt in importance. It was found in 12 out of 15 fields examined near Plymouth, August 31, but in general the attack seemed to be of recent inception. The outstanding symptom was the yellowing rather than the mottling of the foliage.

Anthraenose due to *Colletotrichum lagenarium* was destructive in the same greenhouses where it occurred last year and was again associated with the practice of overhead watering. No fruit infection has been noted.

Angular leaf-spot caused by *Bacterium lachrymans* was found in cold-frame cucumbers and to a slight extent in the pickle crop about Plymouth. Seed disinfection for this disease is now practiced by the Heinz company and their crop is relatively free from infection.

A basal canker bearing the sclerotia of a *Sclerotinia* was found killing one greenhouse plant.

EGGPLANT.

Wilt (cause unknown) was present in the market garden where it was noted in 1919 but was not as destructive this year.

GOOSEBERRY.

Powdery mildew (*Sphaerotheca humuli*) occurred in Wabash county. Specimens of anthracnose caused by *Pseudopeziza ribes* were received from Marion, Indiana.

GRAPE.

Leaf-spot caused by the black-rot fungus (*Guignardia bidwellii*) was found abundant in a planting in Morgan county. Downy mildew (*Plasmopara viticola*) occurred in White and Pulaski counties and severe fruit infection was noted. The disease was also noted on the foliage of wild grape at Decker and in DeKalb county. Undoubtedly the wet season favored the appearance of this disease.

KALE.

Yellows caused by *Fusarium conglutinans* was very destructive in the Indianapolis market gardens.

LARKSPUR.

A root and crown rot apparently caused by *Sclerotium rolfsii* was found near Indianapolis by Dr. W. W. Bouns of the Eli Lilly Company.

LETTUCE.

Downy mildew and Botrytis rot were as usual prevalent in the winter greenhouse crop. A spotting of lettuce apparently of bacterial origin was found rather destructive in a market garden near Indianapolis August 17. Nematode root-knot was found in the infested muck soil near Goshen.

OATS.

Leaf-spot caused by *Helminthosporium avenae* was noted near Lafayette, May 26. Halo blight caused by *Bacterium coronafaciens* was found in Lake county. The smuts are becoming less abundant owing to the rather general practice of seed disinfection.

ONION.

Smut caused by *Urocystis cepulae* (Fig. 7) was again present in the two onion set fields in Lake county mentioned in last year's report but was



Fig. 7. Onion smut.

fairly well controlled by the formalin drip on the seed drill. The soil of these fields is heavily infested.

Smudge caused by *Colletotrichum circinans* occurred to some extent on white bulb onions in market gardens.

PARSNIP.

A leaf-spot of unknown cause and nematode root-knot were found near Goshen.

PEACH.

Taking the state as a whole, leaf curl caused by *Eroscus deformans* was by far the most destructive peach disease and according to Burkholder was much worse than it was during the three previous seasons. Burkholder reports that the disease was severe in Marion, Henry, Shelby, Bartholomew, Brown, Monroe, Putnam, Knox, Daviess, Gibson and Vanderburg counties and especially severe in Morgan and Montgomery counties. Not only was

extreme defoliation caused but the young fruit was directly attacked by the fungus. As a result there was a heavy fall of the fruit at the time of the attack and the fruit continued to drop off all through the season. In an unsprayed orchard near Mooresville examined June 25, most of the fruits still remaining on the trees were affected with the large, red, "birth-mark" lesions of this disease which in most cases caused marked cracking and malformation. At this time most of the affected leaves had fallen and were replaced by new foliage. In the fall Burkholder noted that in such orchards the foliage was held about two weeks longer and that only about one-half the normal twig growth was made.

In the Mooresville orchard mentioned above, the varieties Elberta and Big Red were much more severely affected than the Champion and Hale and most of the fruit on the first two varieties had fallen prematurely. The following observations on varietal susceptibility were made by Burkholder: The Crawford was damaged more than any other variety in the state and in Morgan and Montgomery counties there was a total loss of the crop on this variety. The crop on the Elberta variety was cut from three bushels to one peck and the variety Belle of Georgia was fully as susceptible as the Elberta. The Champion variety bore but half a crop because of this disease. In the same localities the varieties Admiral Dewey, Carman, Smock and Salway bore full crops. Smock and Salway were especially resistant and showed practically no foliage infection and bore so heavily that it was necessary to thin the crop one-half. Burkholder further observed that Sealecide was not effective against curl and that a thorough application of the lime sulphur dormant spray was necessary. The disease was destructive in an orchard where the spraying was done with a spray gun on a windy day and unsprayed strips were left on the branches.

Next to leaf curl, black spot caused by *Bacterium pruni* was the most serious peach disease and was much worse than in 1919. Burkholder reports that this disease was severe in Vanderburg, Daviess, Orange, Greene and Lawrence counties and worst in Knox and Gibson counties. Black spot was so destructive on the Hale variety in one orchard near Vincennes that the affected fruits were hauled out by the barrel in June. Early in July it was found prevalent on foliage and fruit and to some extent on twigs of the current year's growth. Yellowing of the affected leaves and defoliation were the result. Severe hail injury to the fruit occurred in the region about Decker and almost every hail wound was infected with this organism so that large blackened cavities occurred on a considerable percentage of the fruit. Twig invasion through hail wounds was also very general and Burkholder observed twig attack which was severe enough to cause shriveling and premature dropping of the fruit.

Burkholder further observed that in orchards containing both the Elberta and Hale varieties the Hale was much more severely affected by this disease. The same observer noted that no control of this disease was obtained in orchards thoroughly sprayed with lime sulphur but that orchards, 11 to 12 years old, which had received several heavy applications of barnyard manure during their history, showed remarkable resistance to this disease. He further noted that two to three applications of sodium nitrate to orchards of the Hale variety during the current season had no apparent effect upon the disease.

Burkholder reports brown rot, caused by *Sclerotinia cinerea*, from Knox, Gibson, Vanderburg, Daviess, Greene, Morgan, Henry, Montgomery, Floyd, Clark and Jefferson counties. He found brown rot worse in the orchards affected with the black spot disease and according to his observations the varieties Champion and Carman were most severely affected. Hale was less severely attacked, while the Elberta variety was affected the least. Except in Vanderburg county where brown rot was the worst, Burkholder found that spraying controlled the disease fairly well. Very little brown rot was found in the crop in the Decker region probably because of the care given to the orchards.

Scab due to *Cladosporium carpophilum* was unusually prevalent in the Decker region and was generally present on fruit in local markets.

Die-back attributed to *Valsa leucostoma* was found by Burkholder in neglected sod orchards in Brown, Bartholomew, Greene, Orange and Daviess counties.

In the Decker region the hail storm of June 23 caused severe damage to fruit and limbs. Splitting and breaking down of the heavily loaded trees in one orchard at Decker were attributed to 1918-19 winter injury and Burkholder reports 1919-20 winter injury in Spencer County.

PEAR.

Fire blight continued its attack rather late into the season and was generally present throughout the state. Leaf infection was noticed at Knightstown July 6.

Sooty blotch was noted at Knightstown September 21. Black rot caused by *Physalospora cydoniac* was rather prevalent in the crop about Mooresville.

PLUM.

Brown rot was unusually destructive this year. Plum pockets was reported from Delaware county.

POTATO.

Tipburn or hopperburn was not as severe as in 1919 although it caused a heavy loss in the late crop. It seemed to be worse in the central part of the state. Bordeaux sprays seemed to control this trouble at Lafayette.

Fusarium wilt was the most serious disease in the northern half of the state and caused considerable loss. F. C. Gaylord reports the disease from Porter, LaPorte, St. Joseph, Elkhart, Kosciusko, DeKalb, Tippecanoe, Hancock, Marion, Owen and Decatur counties. Gregory found wilt also in Lagrange and Floyd counties. Undoubtedly much of this trouble was due to the use of infected seed. A field test near Valparaiso showed a marked reduction in yield due to the use of infected seed stock. That soil infestation is responsible for much of the wilt is indicated by the occurrence of the disease in about equal percentages in test plots planted with seed from widely separated sources and by the abundance of the disease in a field planted with seed carefully selected for freedom from wilt.

Early blight caused by *Alternaria solani* was found epidemic in a field of early potatoes near Indianapolis July 17, and the disease was also noted at Lafayette in the late crop. In October Gregory and Gaylord found early blight prevalent in Floyd and Clark counties in the extreme southern end of the state.



Fig. 8. Potato scab.

Common scab (Fig. 8) was of general occurrence where untreated seed was used and soil infestation is not uncommon since scab occurred in some fields planted with treated seed. As a result of the observations of Gaylord and Gregory scab is known to have been present in Lake, Porter, Laporte, St. Joseph, Lagrange, Dekalb, Fulton, Cass, Whitley, Carroll, Tippecanoe, Clinton, Madison, Hancock, Marion, Clark and Floyd counties.

Black scurf caused by *Rhizoctonia solani* was of widespread occurrence as a blemish of the tubers. The disease also caused the stunting and death of young plants. Gaylord and Gregory report black scurf from Lake, Porter, St. Joseph, Elkhart, Lagrange, Fulton, Tippecanoe, Madison and Clark counties. In seed disinfection tests in Lake county as high as 67 per cent of the tubers in the check rows showed black scurf. The occurrence of a small percentage of black scurf on the tubers from disease-free and treated seed indicated that the soil of this field which had not been in potatoes for five years was infested to some extent.

Gregory reports cases of black-leg caused by *Bacillus phytophthorus* in Laporte, Tippecanoe and Hancock counties.

Gregory found the non-parasitic leaf roll disease in St. Joseph, Noble, Fulton, Hancock, Clark, Floyd and Dekalb counties and reports it rather serious in fields noted in the latter three counties. In one field in Dekalb county he reports a 50 per cent incidence of the disease and a 25 per cent reduction in yield. When potatoes grown in the Wanatah region were planted in the greenhouse a low percentage of typical leaf roll plants resulted.

Three typical and extreme cases of the mosaic disease occurred in an

experimental field at Lafayette planted with Indiana-grown Rural New Yorker seed. Gregory reports a 37 per cent loss in yield in a field of Early Ohio potatoes in Dekalb county due to mosaic and a 100 per cent infestation of mosaic in a field of the Bliss Triumph variety in Floyd county.

The potato situation in the vicinity of Hammond presents a serious problem. In past years high yields were obtained but now 40 to 60 bushels per acre is representative. The plants are distinctly stunted, the leaves curled and wrinkled and the yield reduced to one or two small tubers. Imported seed, especially from the Wanatah region, is considered far more desirable than home grown seed. Typical mosaic symptoms are not present but it is suspected that the trouble is due to this disease.

Considerable difficulty was experienced this year as a result of rotting of the seed pieces in the soil before the sprouts were up. This caused the occurrence of many blank spaces in the fields.

QUINCE.

Fire blight caused by *Bacillus amylovorus* was reported from several localities.

RADISH.

Black-root was noted in cold frames near Indianapolis June 4. Downy mildew (*Peronospora parasitica*) and white rust (*Cystopus candidus*) were found on plants going to seed July 17. Marked hypertrophy of the floral parts was caused and lesions caused by both fungi were present on the seed pods.

RASPBERRY.

Anthracnose caused by *Plectodiscella veneta* is undoubtedly the limiting factor in raspberry culture in many sections of the state and was especially severe this year. Burkholder reports the disease present in the following counties: Lake, Laporte, Lagrange, Steuben, Cass, Miami, Wabash, Fountain, Bartholomew, Greene, Knox, Vanderburg, Warrick, Lawrence, Orange, Washington, Floyd and Jefferson. Specimens were received from Whitley and Madison counties and it was also found in Morgan and Marshall counties. The coalescence of old lesions of the previous year about the bases of the bearing canes produces a girdling effect which causes the leaves to be stunted and yellowish and the fruit to ripen prematurely. Affected canes often die before any fruit is matured. Anthracnose lesions were noted on newly planted scions and the disease is undoubtedly introduced into new plantings with diseased cuttings.

Leaf-spot due to *Septoria rubi* was found in Lake county.

RHUBARB.

Leaf-spot due to *Ascochyta rhei* was present in practically all plantings examined.

ROSE.

Powdery mildew (*Sphaerotheca pannosa*) was prevalent this year. Black spot caused by *Diplocarpon rosae* (Fig. 9) occurred in greenhouses.



Fig. 9. Rose black spot.

RYE.

Ergot was noted on volunteer rye. Stem rust was found in one field in Lagrange county by R. J. Hosmer. Six specimens of a head smut (*Ustilago* sp.) were found by Jackson in one field in Porter county.

SOYBEAN.

Bacterial blight caused by *Bacterium glycineum* was prevalent in fields near Lafayette. Leaf infection was very heavy but pod infection was not as abundant.

An unmistakable mosaic disease occurred on a small percentage of the plants in one field. The leaves showed typical mosaic symptoms, the pods were fewer and smaller, and very few seeds were produced. In fact mosaic plants were practically a total loss so far as seed production was concerned. There were several rows of garden beans along one side of this field which were severely affected with mosaic and it is possible, of course, that the disease may have crossed over to the soybeans from the garden beans.

SPINACH.

The non-parasitic yellows or blight which is so severe in the truck region near Norfolk, Va., was found near Goshen in October. Typical stunting of the plants and yellowing of the leaves were produced.

SQUASH.

Bacterial wilt was noted near Lafayette.

STRAWBERRY.

Leaf-spot caused by *Mycosphaerella fragariae* was of general occurrence.

SWEET POTATO.

Black rot caused by *Sphaeronema fimbriatum* (Fig. 10) and scurf caused by *Monilochactes infuscans* were present in the seed being planted on one farm near Vincennes.

Fusarium stem rot was of rather widespread occurrence and was noted at Vincennes, Indianapolis and Lafayette, in some cases, in fields not previously in sweet potatoes. This disease caused stunting, yellowing or wilting, and premature death of the vines and a conspicuous blackening of the interior portions of the stems.



Fig. 10. Sweet potato black rot.

TIMOTHY.

Stripe smut caused by *Ustilago striaciformis* was collected near Lafayette by Dr. A. G. Johnson.

TOMATO.

Septoria leaf-spot was worse than last year and was by far the most serious and widespread parasitic disease of tomatoes. It was generally present in gardens and the canning crop and the wet weather greatly favored its development. In many cases extreme defoliation was caused and the fruit was exposed to sunscald. In an experimental field near

Lafayette the disease was so severe that late in September only tufts of the youngest leaves remained on the plants.

As usual *Fusarium* wilt was severe in the Indianapolis greenhouses. The wilt-resistant Marvel variety has proved acceptable to one greenhouse grower as a substitute for the Bonny Best. Out of numerous single plant selections made last year with the purpose of isolating a wilt-resistant strain of Bonny Best, two showed good resistance but both came into bearing too late to suit the desires of the growers.

In the field crop wilt was noted as a rule only on scattered plants. From two to six per cent of wilt was found in 12 out of 14 fields visited near Kokomo July 13. In certain of these fields set with southern-grown plants it was practically certain, judging from the distribution and severity of the disease, that it was introduced with these plants. This illustrates a danger in the use of southern-grown tomato plants by Indiana canners. Wilt has not yet become a serious factor in the Indiana canning crop owing to the fact that so much new soil has been available and crop rotation has been practiced. In gardens and old tomato fields the disease persists and there are indications that it is also harbored in plant beds. The disease is very destructive under Indiana conditions and infestation of the soil should be guarded against.

Mosaic was not as severe as in 1919, although it was very general late in the season. In a late epidemic of this kind the yield is not noticeably reduced but plants infected early in the season are likely to be valueless. In one field near Indianapolis there was practically 100 per cent infection of mosaic, much of it of the dwarfed, fern-leaf type which results in a very marked reduction in yield. In certain fields there was some indication that mosaic was carried with the seed but carefully controlled and rather extensive tests with seed from mosaic plants have so far yielded only negative results.



Fig. 11. Tomato anthracose.

Evidence of the spread of mosaic by cultural practices in greenhouses was afforded in a canning crop near Hammond, the plants for which were grown in a greenhouse and trimmed back with a shears. One mosaic plant was found among the plants in the greenhouse and in the field crop grown from these plants mosaic was epidemic. In a greenhouse crop at Lafayette the spread of mosaic was very evidently associated with the use of the pruning knife.

Early blight caused by *Alternaria solani* was rather conspicuous in one greenhouse near Indianapolis, causing large target-board lesions on the leaves. The disease occurred in the Paoli region but was not very prevalent in central Indiana.

Leaf mold (*Cladosporium fulvum*) was severe in many greenhouses.

Anthrachnose caused by *Colletotrichum phomoides* (Fig. 11) was especially prevalent this year late in September. In fields at Lafayette, a considerable percentage of the ripe tomatoes showed anthrachnose lesions.

Bacterial spot caused by *Bacterium citiosum* (Fig. 12) was rather general in the canning crop and was noted on seedlings in Georgia being grown for shipment to Indiana growers. It was also noted in plant beds in Indiana by H. D. Brown. Its attack on the foliage of plants in the field is not noticeably destructive but serves as a source of fruit infection which probably takes place through wounds made by insects. The black, scabby fruit lesions are very objectionable from the canner's point of view. The disease is carried over winter with the seed and seed disinfection in corrosive sublimate 1 to 3,000 for 5 minutes has been recommended as a control measure.



Fig. 12. Tomato bacterial spot.

Buckeye rot due to *Phytophthora terrestris* was noted in three greenhouses near Indianapolis. Only the lower fruits were infected and it is evident that infection was the result of splashing from the soil underneath. In one case the rotting fruits were picked off and thrown on the ground thus affording the fungus every opportunity to develop and spread to other fruits. Strict sanitation should of course be practiced in attempting to control this disease.

Blossom-end rot was very destructive in both the greenhouse and field crops on the early set of fruit and in the Lafayette region where the soil dries out very quickly the disease continued to be prevalent well into the season. In fields near Lafayette, H. D. Brown reports a loss of three tons per acre of green fruit actually removed because of this disease. This loss is appalling when one considers that the final yield was but eight tons per acre.

In the canning crop growth cracks probably occasion more loss in the aggregate than all the parasitic diseases combined and this trouble is about equal to blossom-end rot as a source of loss. Not only are growth cracks an objectionable blemish in themselves but most of the fruit rot late in the season in the canning crop both in the field and in the crates is due to the infection of these growth cracks by rot-producing organisms. Growth cracks cause heavier losses to the canner than to the grower since much of the fruit rot occurs after picking, whereas the loss due to blossom-end rot falls largely upon the grower.

Sunscald was very common owing to the foliage destruction by *Septoria* leaf-spot and consequent exposure of the fruit. Catface was very prevalent in the canning crop and is an objectionable blemish from the canner's standpoint. According to Dr. B. J. Howard of the Federal Bureau of Chemistry, the catface scars are prone to crack and permit rot infection.

A peculiar type of non-parasitic wilting of the plants occurred in the Paoli region and at Lafayette. Affected plants showed the hollow stem condition, the pith having dried out and collapsed even in the very young shoots. At Lafayette the affected plants were near a row of trees along the edge of the field and a similar relation was reported from Paoli so it is possible that this hollow stem wilt was due to soil drouth produced by the tree roots.

A small, circular, conspicuously white, raised spot with a darker center occurred rather commonly on tomatoes about Lafayette and Indianapolis. This has been called "white spot" or "bird's-eye spot" and is often associated with bacterial spot. Probably it is due to an insect injury.

A *Sclerotinia* stem rot was found on a few greenhouse plants following wounds and wilt infection. Wind scalding of the leaves was noted at Hammond July 27. Hail injury was conspicuous on fruits and stems in the Indianapolis region July 17.

From the standpoint of disease introduction the importation of tomato plants grown in the south for the Indiana canning crop is distinctly dangerous. Evidence of the introduction of *Fusarium* wilt into fields with southern plants was secured. Wholesale nematode infestation of the roots of the seedlings was found in shipments from several points in the south. Infested plants lived throughout the season when set out in Indiana fields but were stunted and below normal in yield. The galls on the old

roots became very large and additional galls were formed on the new secondary roots sent out above the original infestation. Whether or not the soil of Indiana fields will remain permanently infested with nematodes is not known and tests are now under way to determine this point. In view of the persistence of the nematode infestation in muck soils near Goshen and Akron,—and the Goshen infestation is of at least six years standing,—it would appear to be a questionable practice to flood Indiana each spring with nematode-infested plants. Furthermore, H. D. Brown found nematode galls on tomato seedlings in a cold frame at Hardinsburg, a fact which would indicate that these nematodes already may be indigenous in certain localities in southern Indiana.

TURNIP.

An unquestionable mosaic disease of turnips was found near South Bend, Oct. 12, associated with a rather heavy infestation of tarnished plant bugs. The diseased plants were stunted and the leaves showed characteristic mosaic etiolation, mottling and dark green puffy areas.

Turnips and cabbage growing in the nematode-infested muck soil near Goshen were not affected with root-knot.

WATERMELON.

Fusarium wilt seemed to be generally present in fields previously used for watermelons. In one field near Princeton not in watermelons in six years about 2 per cent of the plants were killed by wilt. This indicated that the fungus persisted at least six years in the soil. In an 80-acre field on new soil near Vincennes no wilt was found.

Leaf-spot or blight caused by *Alternaria brassicæ nigrescens* was found prevalent in one field near Decker August 19.

WHEAT.

The foot-rot widely announced as "take-all" in 1919 was found only in an experimental field near Wanatah where the disease occurred in 1919. The other infested fields were not replanted with wheat this year, however. This disease seems to be rather closely associated with the varieties Red Cross and Salzer's Prize-taker.

Scab caused by *Gibberella saubinetii*, which was very abundant in 1919, was not at all common this year. Pipal reports that it was serious locally in Davis and Posey counties.

Stem rust was not at all abundant on winter wheat except locally. Hosmer reports that some stem rust was noted in practically all localities where barberries were found and one rather extensive infestation occurred in Knox county. On spring wheat stem rust was more common. Leaf rust was common on spring wheat but was present to only a slight degree on winter wheat. In general this was not an epidemic year for either stem or leaf rust.

Bunt or stinking smut is in general becoming less prevalent in Indiana because of the wide use of the formaldehyde seed treatment. It was worse

in the northern third of the state and its occurrence locally seemed to be associated with certain threshing rings.

Loose smut of wheat was not as prevalent as in 1919. While the average loss was about 2 per cent, in certain fields as high as 25 per cent of loose smut was found. Pipal reports that in 400 demonstration fields a practically perfect control was obtained by the hot water treatment while an average of 5.1 per cent of smut occurred in the check fields. The central treating plant control method is meeting with marked success.

SUMMARY.

The plant diseases of outstanding economic importance as observed during the 1920 season are as follows:

Apple.....	blotch; scab; black rot; (hail injury).
Aster.....	Fusarium wilt.
Bean.....	bacterial blight; mosaic.
Cabbage.....	yellows.
Cantaloupe.....	bacterial wilt; leaf-blight; mosaic.
Celery.....	early blight; bacterial spot.
Cherry.....	Coccomyces leaf-spot.
Corn.....	Fusarium root, stalk and ear infection; smut.
Cucumber.....	bacterial wilt; mosaic.
Kale.....	yellows.
Onion (sets).....	smut.
Peach.....	leaf curl; black spot.
Pear.....	fire blight.
Plum.....	brown rot.
Potato.....	Fusarium wilt; hopperburn or tipburn.
Raspberry.....	anthracnose.
Soybean.....	bacterial blight . . .
Tomato.....	Septoria leaf-spot; Fusarium wilt; mosaic; blossom-end rot; infected growth cracks.
Watermelon.....	Fusarium wilt.
Wheat.....	loose smut; stinking smut.

Plant diseases found in 1920 which have not been previously recorded for Indiana:

Apple.....	water core.
Barley.....	bacterial blight caused by <i>Bacterium traustuccus</i> ; leaf-spot caused by <i>Rhynchosporium secalis</i> .
Bean.....	root rot due to Fusarium species.
Beet.....	nematode root-knot.
Carrot.....	nematode root-knot.
Cauliflower.....	yellows caused by <i>Fusarium conglutinans</i> .
Chrysanthemum....	leaf-spot due to <i>Septoria chrysanthemella</i> .
Corn.....	<i>Physoderma zeae-maydis</i> .
Cucumber.....	nematode root-knot.
Larkspur.....	<i>Sclerotium rolfsii</i> .
Lettuce.....	nematode root-knot.
Oats.....	Halo blight caused by <i>Bacterium coronafaciens</i> .
Parasnip.....	nematode root-knot.
Peach.....	die-back (<i>Falsa leucostoma</i>).
Pear.....	sooty blotch
Soybean.....	bacterial blight caused by <i>Bacterium glycicicum</i> (previously noted, Plymouth, 1918); mosaic.
Spinach.....	blight or mosaic.
Squash.....	bacterial wilt.
Sweet potato.....	scurf caused by <i>Monilochaetes infusans</i> ; Fusarium stem rot.
Tomato.....	white spot or bird's-eye spot (cause unknown).
Turnip.....	mosaic.