

INDIANA PLANT DISEASES, 1922.¹MAX W. GARDNER², Purdue University.

This is the fourth of a series of annual summaries of the plant disease situation in the state (2)³. Attention is confined mostly to the dis-

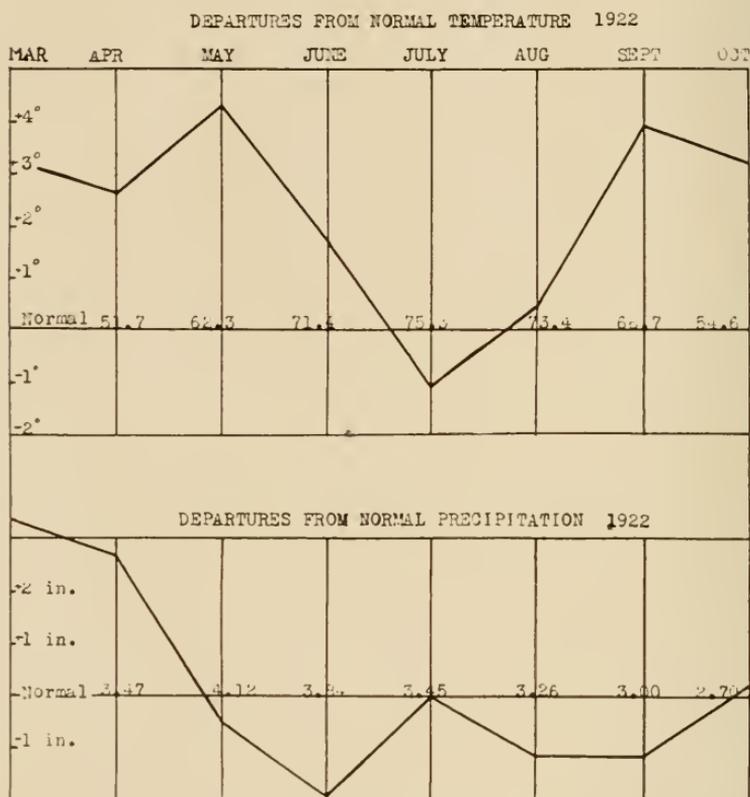


Fig. 1. Departures from normal temperature and precipitation based on monthly averages, 1922.

eases of economic importance on agricultural crops. No claim for completeness is made. The diseases are arranged alphabetically by hosts.

WEATHER CONDITIONS.

Temperature and rainfall have a very marked effect upon the prevalence of most diseases. The graphs in figure I represent the departures

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³ Numbers in parenthesis refer to "literature cited".

from normal temperature and rainfall in Indiana in 1922 based upon monthly averages given by J. H. Armington, of the U. S. Weather Bureau, in the Indiana section of "Climatological Data." The season of 1922 was characterized by high temperatures during all the months except July and by high rainfall in the spring and low rainfall during May, June, August and September.

DISEASES ARRANGED BY HOSTS.

Alfalfa.—Leaf spot, caused by *Pseudopeziza medicaginis*, was of general occurrence. Mains reports rust (*Uromyces medicaginis*) exceptionally abundant.

Asparagus.—Rust (*Puccinia asparagi*) was worse than usual.

Aster.—Wilt due to *Fusarium conglutinans callistephi* was extremely severe owing to the hot dry weather.

Apple.—Blotch, caused by *Phyllosticta solitaria*, was very destructive on the susceptible varieties because of the warm wet spring and the failure of many growers to spray the year before. Infection started earlier than in 1920 and 1921 and the spray two weeks after petal fall was too late to prevent serious infection (3).

Scab, caused by *Venturia inaequalis*, was much worse than usual, probably because of the wet spring and the failure of many growers to spray in 1921. The heavy rains in April and a protracted blooming period not only favored scab but also rendered it difficult to apply the sprays on schedule time. Cullinan found scab severe on Grimes, a variety usually somewhat resistant to scab, and Burkholder reports that the disease caused early defoliation of an orchard of young Grimes trees. Cullinan found a serious reduction in the size of Ben Davis fruit due to early scab defoliation and found sulfur dust ineffective in controlling scab. The disease was severe on Fameuse, Winter Banana, Ben Davis, Red June, and Delicious. In an orchard of mixed varieties, Grimes, York, and Transparent showed resistance to leaf infection.

Black-rot, caused by *Phylospora cydoniae*, was widespread and serious. Late summer defoliation due to the leaf lesions was especially harmful and was not controlled by the sprays applied for scab and blotch. In an orchard of mixed varieties, York escaped leaf infection, and Grimes and Benoni showed much less leaf infection than Northwestern, Wealthy, Chenango, Transparent, Ben Davis, and Jonathan. Shallow bark infection was very conspicuous on old Ben Davis trees in an orchard in Miami County. The extreme heat of early September favored the fruit rot following scab, blotch, and insect injuries on early varieties.

Fire-blight, due to *Bacillus amylovorus*, was serious locally in Knox and Franklin counties, possibly due to the warm wet April and subsequent hot weather. Twig blight was prevalent in young orchards of Transparent, Oldenburg, Jonathan, and Willow. In certain cases, blighted pear trees were the evident source of infection for nearby apple trees. Blister canker, caused by *Nummularia discreta*, was favored by the hot dry summer weather. Powdery mildew occurred on young trees in Morgan County.

Rust (*Gymnosporangium juniperi-virginianae*) was much worse than usual due probably to the warm wet spring. Burkholder reported severe defoliation and complete loss of crop in the portion of a young orchard near a group of red cedars. Fruit infection was noted on Wealthy, Rome, Jonathan, Oldenburg, Salome, and Esopus. Leaf infection occurred on these varieties and on Red June, Benoni, Arkansas and Indiana Favorite. Twig infection was noted on 1922 wood of Jonathan and Rome. The rust cankers on Rome twigs as observed in Orange County, May 5, 1923, were red to brown, elliptical with a raised uniform margin often surrounded by a fissure in the bark. In many an elevated region at the center bore the remnants of pycnia and aecia. Some resembled the Bellflower twig lesions illustrated by Hopkins (9). In some cases the distal portion of the infected twig was killed and in some cases infection of spurs had progressed into the bark of older limbs causing considerable hypertrophy. Dried aeciospores were found in the old aecial cups.

Bitter rot, caused by *Glomerella eingulata*, caused one grower in Gibson County a great loss in Grimes, Stayman, Rome and Champion, owing apparently to heavy local rains accompanied by high temperatures late in July. The Grimes had not been sprayed, and the tendency to omit the fungicidal sprays on this variety is a dangerous practice in southern Indiana where bitter rot may occur. Brown rot, caused by *Sclerotinia cinerea*, occurred on unsprayed Esopus fruit in transit from Orange County and in a car of Transparents from Madison County.

The surface type of bitter pit was a severe blemish on many varieties, according to Cullinan. It was found on Grimes, Mann, Ben Davis, Stayman, and Arkansas. A reduction in size of fruit and early maturity and dropping were attributed to the hot dry weather of August and September, in the case of Jonathan, Grimes, Winesap, and Ben Davis. Water core was found on Northwestern. Frost marks were conspicuous on Ben Davis fruit in Miami County.

Sooty blotch and fly speck (*Glocodes pomigena* and *Leptothyrium pomi*) were not serious, probably because of the dry August and September. The blemishes were noted on Wealthy, Grimes, Maiden Blush, Jonathan, and York. What appears to be the same fungi were noted on the stems of *Smilax hispida*.

Barley.—The following diseases of barley occurred: Stripe, caused by *Helminthosporium graminum*; loose smut (*Ustilago nuda*); covered smut (*Ustilago hordei*); stem rust (*Puccinia graminis*); and leaf rust (*Puccinia simplex*).

Bean.—Blight, caused by *Bacterium phaseoli*, seemed to be less destructive than usual, possibly owing to the general drouth.

Mosaic was the most destructive disease of this crop. In a plot of 52 varieties grown by H. D. Brown, 35 showed mosaic. Wardwell's Kidney Wax and Black Valentine, which showed no mosaic in a similar plot in 1921, also showed none this year, while the other four varieties which remained free in 1921 showed mosaic as follows: Red Kidney, 2%; Saddleback Wax, 8%; Dwarf Horticultural, 49%; Robust Pea, 1%.

A serious outbreak of rust (*Uromyces appendiculatus*) occurred in

the fall on Kentucky Wonder pole beans in market gardens where overhead irrigation was practiced. The foliage was destroyed and plants were killed outright. Abundant and conspicuous pod lesions occurred.

Lima Bean.—Blight due to *Bacterium phaseoli* was rather serious. A *Sclerotinia* stem rot was noted.

Beet.—Leaf-spot, due to *Cercospora beticola*, was serious in garden and sugar beets. The peculiar mosaic-like disease noted in 1921 was severe in sugar beets.

Blackberry.—Rust (*Kunkelia nitens*) occurred on wild and cultivated plants in southern Indiana.

Cabbage.—Yellows, caused by *Fusarium conglutinans*, was especially destructive because of the hot dry weather. The disease was reported from 31 counties. The use of resistant types is becoming general. In the spring black-leg, caused by *Phoma lingam*, was found serious locally by Gregory, who also noted black rot, due to *Pseudomonas campestris*, in a few localities. A *Sclerotinia* stem-rot was noted in Lake County.

Cantaloupe.—Bacterial wilt caused by *Bacillus tracheiphilus* was as usual the most serious disease. Anthracnose (*Colletotrichum lagenarium*) fruit lesions were found on the Tip-top variety in October. Leaf blight caused by *Alternaria brassicae nigrescens* was very serious, causing premature death of the leaves and poor flavor in the fruit. Mosaic was worse than usual, stunting the plants and preventing proper maturity of the fruit. Milkweed, a mosaic carrier, was found commonly in diseased fields.

Carrot.—Leaf-spot, caused by *Cercospora apii carotae*, was noted in market gardens.

Cauliflower.—Stem rot, due to *Sclerotinia libertiana*, was noted in May, killing scattered plants.

Celery.—The high temperature of this summer favored the *Fusarium* yellows disease which is fatal to the Golden Self-blanching variety and is widespread in market gardens. Early blight caused by *Cercospora apii* remained the most prevalent celery disease. A few cases of mosaic were noted.

Cherry.—The limiting factor in cherry growing is the leaf-spot, due to *Coccomyces hiemalis*, which causes serious defoliation and devitalization of the trees. Burkholder reports it worse than usual this year and complaints were received from growers in eleven counties during June and July. Brown rot (*Sclerotinia cinerea*) was worse than usual owing to the warm weather. Powdery mildew was noted.

Clover.—In common with the rest of the country, all Indiana clover fields became conspicuously whitened with an unprecedented epidemic of powdery mildew (*Erysiphe polygoni*). The attack lasted all season and occasioned innumerable inquiries, mostly concerning the possible injuriousness of the mildewed clover as feed for live-stock. Mains (12) found that the mildew was restricted to red clover and that American varieties were more susceptible than European varieties. Mosaic occurred very generally on red clover. Mains noted rust (*Uromyces trifolii*) rather sparingly.

Corn.—Hoffer found that root and stalk rots, caused by *Gibberella* and *Fusarium* species, were less prevalent than usual, as were also the ear rots due to *Fusarium* and *Diplodia*. Hoffer and Trost (8) have found that excess iron and aluminium compounds in the soil predispose the corn plant to infection, particularly at the nodes.

Smut (*Ustilago zaeae*) was less prevalent than usual.

Rust (*Puccinia sorghi*) occurred to a slight extent. One case of brown spot due to *Physoderma zaeae-maydis* was found by J. F. Trost. Bacterial wilt caused by *Aplanobacter stewartii* was found abundantly on sweet corn in home gardens, and was favored presumably by the hot weather.

Cowpea.—The bacterial spot disease (5), caused by *Bacterium vignae*, was widespread, probably because it is seed-borne. Powdery mildew was very destructive on cowpeas grown in a greenhouse. A few mosaic plants were found in Knox County.

Cucumber.—Wilt caused by *Bacillus tracheiphilus* and mosaic are the worst diseases of both garden cucumbers and the pickle crop. Mosaic has become so prevalent in its weed hosts that cucumber growing is unprofitable in many localities. As a result of seed disinfection, angular leaf spot, due to *Bacterium lachrymans*, is no longer destructive in the pickle crop. Anthracnose occurred in certain greenhouses.

Currant.—Root rot, caused by *Fomes ribis*, was found in Jefferson County by Cullinan.

Eggplant.—Leaf spot, caused by *Phomopsis vexans*, and a serious wilt disease were of common occurrence.

Gooseberry.—Anthracnose, caused by *Pseudopeziza ribis*, was destructive locally.

Grape.—Black rot, caused by *Guignardia bidwellii*, was found on the green fruit in a sprayed vineyard in Brown County on July 26. Dead-arm, caused by *Cryptosporella viticola*, was destructive early in the season and was reported from four localities.

Kale.—Yellows, due to *Fusarium conglutinans*, was noted in Marion County in May.

Lettuce.—Downy mildew (*Bremia lactucae*) was destructive in greenhouses, as was also drop due to *Sclerotinia libertiana*. Leaf-spot, caused by *Septoria consimilis*, was found serious in market gardens in October. A stunting due to an excess of soluble salts in the soil occurs commonly in greenhouses.

Mustard.—Mosaic was noted in market gardens in October.

Oats.—The smuts (*Ustilago avenae* and *U. levis*) caused the usual loss. Crown rust was serious and stem rust was noted.

Onion.—Smut (*Urocystis cepulae*) occurred in Lake and Jasper counties (7). Smudge (*Colletotrichum circinans*) was noted in market gardens. The U. S. Bureau of Markets reported black mold (*Aspergillus niger*), blue mold (*Penicillium* sp.), neck rot (*Botrytis* sp.), *Fusarium* rot, and bacterial soft rot in car-lot shipments from Indiana.

New Zealand Spinach.—A leaf spot caused by a species of *Cercospora* was found in October.

Parsnip.—Leaf-spot, caused by *Cercospora pastinacae*, was found in October.

Pea.—A root-rot was found by Gregory in Vigo County in May, causing a heavy loss. The roots were blackened and black cankers occurred at the bases of the stems.

Peach.—Bacterial spot, caused by *Bacterium pruni*, remains the worst disease of this crop, owing to the premature defoliation, twig blight, and fruit infection. The high temperatures of this year favored the disease. Exposure of the fruit by this defoliation resulted in severe sunscald in July. Defoliation had begun as early as April 27 in Knox County. A trace of the disease was found in a peach nursery.

The dormant spray controls leaf curl, due to *Exoascus deformans*, very effectively and serious outbreaks occur only in orchards not well sprayed. Peculiar, red, protuberant fruit lesions were noted. Scab, caused by *Cladosporium carpophilum*, occurred rather generally in southern Indiana. Brown rot, caused by *Sclerotinia cinerea*, was serious in unsprayed orchards and on fruit affected with sunscald and caused some losses in transit to market. Cankers on small limbs with which *Valsa leucostoma* was associated were found in February by Burkholder.

Throughout southern Indiana the fruit suffered severely from sunscald in July, especially on trees defoliated by *Bacterium pruni*, and widespread alarm was occasioned among growers. Large, red-bordered brown necrotic areas appeared on the upper exposed surfaces usually near the stem. These occurred on unsprayed as well as sprayed trees and hence were not attributable to spray injury.

Pear.—Fire-blight, due to *Bacillus amylovorus*, was worse than in 1921, owing probably to the warm wet spring, and was reported from ten counties. Scab, due to *Venturia pyrina*, occurred on leaves and fruit in northern Indiana. Black rot caused by *Physalospora cydoniae* was destructive. The conspicuous fruit lesions of *Fabraea maculata* were noted in Knox County.

Pepper.—Mosaic was of general occurrence in market gardens. Leaf infection of bacterial spot, caused by *Bacterium vesicatorium* (6), was found in market gardens.

Plum.—Black knot, caused by *Plowrightia morbosa*, occasioned a number of inquiries. Brown rot, caused by *Sclerotinia cinerea*, was serious on unsprayed trees. Gregory noted crown gall (*Bacterium tumefaciens*) and Burkholder noted plum pockets due to *Exoascus pruni*. Gregory found the latter on wild plums also. Fruit lesions of *Bacterium pruni* were found on Abundance plums in Jefferson County.

Potato.—The hot dry weather was very favorable to *Fusarium* wilt which was prevalent in the early crop in southern Indiana and the late crop in northern Indiana. Leaf-roll has proved to be the most serious disease of the late crop Rurals, causing a marked decrease in yield even though its symptoms cannot be recognized readily in the field. Because of the spread of this disease under Indiana conditions it is advisable to use certified northern-grown seed stocks. Mosaic is the most serious disease of the early crop (Early Ohios and Irish Cobblers) and occurs occasionally in Rurals. It reduces the yield even more severely than

leaf-roll and supplies another potent reason for using northern-grown certified seed stocks. Mosaic may be more readily detected in the field than leaf-roll.

Black-leg, caused by *Bacillus phytophthorus*, was noted in the early crop. Early blight, caused by *Alternaria solani*, occurred rather generally late in the season. Tuber blemishes due to scab (*Actinomyces scabies*) and black scurf (*Rhizoctonia solani*) were generally prevalent where seed disinfection was omitted or soil infestation existed. The hot weather made scab worse. Silver scurf, caused by *Spondylocladium atrovirens*, was found causing a shrivelling of potatoes of the 1921 crop in storage.

Quince.—Fruit lesions of *Fabracea maculata* were found in Miami County as well as an *Alternaria* rot of the fruit.

Radish.—Black-root, caused by *Nematosporangium (Rheosporangium) aphanidermatum*, occurred very generally near Lafayette early in the spring.

Raspberry.—Anthracnose, caused by *Plectodiscella veneta*, is the limiting factor in the black cap industry and by its girdling effect near the ground line kills the canes just before the fruit is matured. Leaf spot, caused by *Mycosphaerella rubi*, occurred very generally. Crown gall was noted in a few localities.

Rhubarb.—Leaf-spot, caused by *Ascochyta rhei*, was prevalent as usual.

Rye.—Anthracnose, caused by *Colletotrichum cereale*, stem rust, stem smut (*Urocystis occulta*), powdery mildew (*Erysiphe graminis*), and ergot (*Claviceps purpurea*) were reported.

Soybean.—Blight caused by *Bacterium glycineum* was widespread. Mosaic occurred in variety test plots and greatly lowered the yield of seed (11).

Spinach.—Brown reported mosaic severe in the market garden winter crop near Evansville.

Strawberry.—Leaf-spot, caused by *Mycosphaerella fragariae*, was very serious. It was also noted on cinquefoil. A *Sclerotinia* stem rot was found in June.

Sweet Potato.—*Fusarium* wilt and black rot (*Ceratostomella fimbriata*) were noted.

Tomato.—Leaf-spot, caused by *Septoria lycopersici*, was serious in the canning crop in central and especially southern Indiana and in gardens. The worst defoliation was noted on the poorer soils in Gibson County. The summer drouth tended to check the disease.

The hot dry summer was favorable to wilt, caused by *Fusarium lycopersici*, which was the most destructive disease of this crop this year. In the canning crop the disease was associated with the use of southern-grown plants. Evidence was obtained that the fungus persists four years in the soil. Mosaic was generally prevalent in fields and greenhouses and was more or less associated with the weed carriers (4). Fruit lesions were not uncommon. In field tests at Kempton the effectiveness of eradication of the weed hosts, *Physalis* species, was shown.

Early blight, caused by *Alternaria solani*, caused a collar-rot in the field in Hancock County as a result of plant-bed stem lesions, and also a prevalent spotting of the late-set fruits. These fruit spots were oval or circular, with an even margin, sunken, smooth, black or brown in color and in no way resembled the nailhead spot of the south. Leaf mold, caused by *Cladosporium fulvum*, was very destructive in greenhouses and was noted sparingly in the field. Buckeye rot, caused by *Phytophthora terrestris*, was serious on the low-hanging fruits in certain greenhouses. It did not occur in the field where it was serious in 1921 (10), however.

Seed disinfection combined with unfavorable dry weather rendered bacterial spot, caused by *Bacterium vesicatorium*, very uncommon (6). Bacterial wilt, caused by *Bacillus solanacearum*, was found in a greenhouse in Cass County in May causing the death of the plants. The pith and vascular elements were brown and water-soaked and the lower leaf petioles were reflexed as Dr. E. F. Smith has pointed out (13, p. 179). There were brown or black surface lesions along the upper side of the petioles. The causal organism was isolated and its pathogenicity proved. Bluish pigment formation was shown by colonies on potato dextrose agar.

Anthraxnose of the ripe fruit due to *Gloeosporium phomoides* was very abundant in the canning crop in October. Nematode root-knot was serious in greenhouses and was found in a few fields. Blossom-end rot was not particularly severe. Hollow stem in the young plants was more common than usual. Lightning injury (1) was found in one field.

Watermelon.—Anthraxnose (*Colletotrichum lagenarium*) was less prevalent than usual, due to the dry weather, while the heat favored the wilt, due to *Fusarium nivium*. The leaf-spot, due to *Alternaria brassicae nigrescens*, was noted. Blossom-end rot occurred rather commonly.

Wheat.—Loose smut (*Ustilago tritici*) was very serious where untreated seed was used. Covered smut (*Tilletia laevis*) was of minor importance. Stem rust (*Puccinia graminis*) was severe only near barberries, according to K. E. Beeson, who reports four serious and two minor outbreaks in the state this year. These were in Rush, Decatur and Johnson counties. Mains reports leaf rust (*Puccinia triticina*) the most serious wheat disease of the season, causing a reduction in yield of about 7 per cent. It was worst in the southern third of the state.

Scab, caused by *Gibberella saubinetii*, occurred only rarely. Anthraxnose (*Colletotrichum cereale*) was not serious. Septoria leaf-spot was found near Laporte by Kendrick, causing a yellowing and stunting of the young plants. Powdery mildew (*Erysiphe graminis*) occurred to a slight extent. Rosette was found in Laporte County by Kendrick. Jackson found a small amount of foot-rot on the farm in Knox County where he found *Ophiobolus graminis* in 1921.

Forest and shade trees.—Among trees, the following diseases should be recorded: Powdery mildew of catalpa from Floyd County; chestnut blight, due to *Endothia parasitica*, in a nursery at Lafayette; cedar rust on flowering crab; Penicillium and Fusarium rots of hickory nuts;

maple anthracnose (*Gloeosporium apocryptum*) extremely serious and widespread, occasioning numerous inquiries from seven counties; maple tar-spot (*Rhytisma acerinum*) in Whitley County; maple sunscald and drouth injury of leaves very prevalent owing to the hot dry weather; and sycamore anthracnose (*Gloeosporium nervisequum*) causing defoliation in May.

Ornamentals.—Among ornamentals the following diseases occurred: a bacterial soft rot of calla lilies in a greenhouse; carnation rust (*Uromyces caryophilinus*) in greenhouses; the bacterial spot of geraniums, due to *Bacterium erodii*, in greenhouses at Lafayette; the hard rot of gladiolus, due to *Septoria gladioli*; hollyhock rust (*Puccinia malvacearum*); the Botrytis blight of peonies; rose powdery mildew (*Sphaerotheca pannosa*), which was very destructive and occasioned inquiries from eight counties; rose black spot, due to *Diplocarpon rosae*; snapdragon rust (*Puccinia antirrhini*), which was very serious; and sunflower downy mildew (*Plasmopara halstedii*).

SUMMARY.

The diseases of outstanding economic importance were the Fusarium soil troubles, the mosaic diseases, apple scab, blotch, and rust, cherry leaf spot, clover powdery mildew, peach bacterial spot and sunscald, potato leaf roll, raspberry anthracnose, and the cereal leaf rusts. Clover powdery mildew attracted the most attention.

The diseases found in 1922 which have not been previously recorded for Indiana in the Academy Proceedings are as follows: Lima bean stem rot—*Sclerotinia libertiana*; calla lily bacterial soft rot; cauliflower stem rot—*Sclerotinia libertiana*; cowpea mosaic; currant root rot—*Fomes ribis*; geranium bacterial spot—*Bacterium erodii*; gladiolus hard rot—*Septoria gladioli*; meadow fox tail leaf spot—*Scolecotrichum graminis*; mustard mosaic; New Zealand spinach leaf spot—*Cercospora* sp.; peach sunscald; peony blight—*Botrytis* sp.; pepper bacterial spot—*Bacterium vesicatorium*; plum crown gall; strawberry stem rot—*Sclerotinia* sp.

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