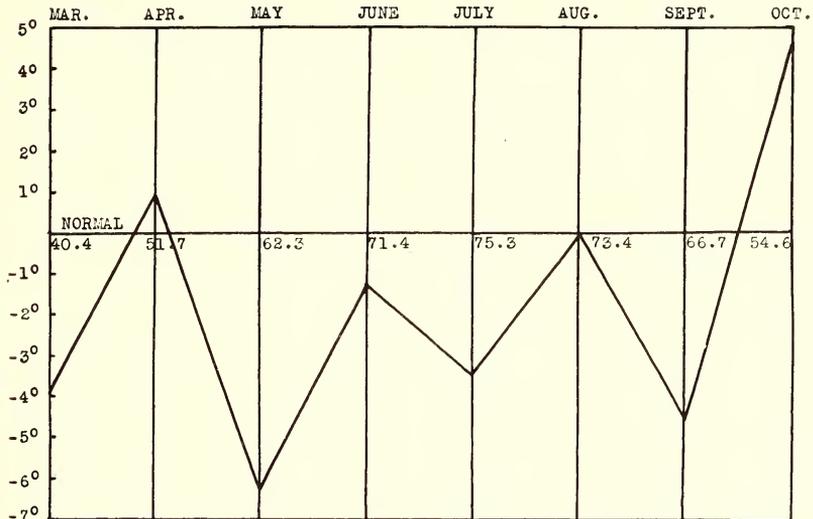


INDIANA PLANT DISEASES, 1924.¹

MAX W. GARDNER,² Purdue University Agricultural Experiment Station.

This is the sixth of a series of annual summaries³ of the plant disease situation in the state. No claim for completeness is made.

DEPARTURES FROM NORMAL TEMPERATURE, 1924.



DEPARTURES FROM NORMAL PRECIPITATION, 1924.

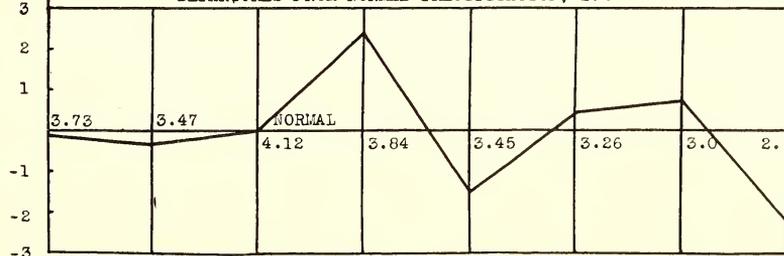


Fig. 1—Departures from normal temperature and precipitation based on monthly averages supplied by J. H. Armington in Climatological Data.

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

² The writer wishes to acknowledge the co-operation of H. S. Jackson, E. B. Mains, J. B. Kendrick, G. N. Hoffer, W. E. Leer, F. P. Cullinan, C. L. Burkholder, C. E. Baker, H. D. Brown, K. E. Beeson, and H. F. Dietz.

³ Gardner, Max W. Indiana plant diseases, 1919. Proc. Ind. Acad. Sci. 1919: 135-156. 1921. Indiana plant diseases, 1920. Same 1920:187-208. 1921. Indiana plant diseases, 1921. Same 1923:163-201. 1924. Indiana plant diseases, 1922. Same 1923: 202-211. 1924. Indiana plant diseases, 1923. Same 1924:297-313. 1925.

"Proc. Ind. Acad. Sci., vol. 34, 1925 (1926)."

The weather during the 1924 season, as shown in the graphs in figure 1, was characterized by a cool May, June, July, and September, high rainfall in June, August, and September, and a hot dry October. The cool wet weather greatly favored such fungus diseases as apple scab, rust, and black rot, tomato leaf spot (*Septoria*), cantaloupe leaf blight, celery late blight, *Rhizoctonia* infection, anthracnoses and downy mildews, while the *Fusarium* wilt diseases and the mosaic diseases were not as serious as usual.

DISEASES ARRANGED ALPHABETICALLY BY HOSTS.

Alfalfa:—Leaf spot caused by *Pseudopeziza medicaginis* was prevalent, and downy mildew (*Peronospora trifoliorum*) was noted in the spring.

Apple:—Scab, caused by *Venturia inaequalis*, was greatly favored by the cool wet spring and was especially serious on Delicious, Rome, Wealthy, and Stayman in southern Indiana. The disease seems to be particularly difficult to control on Delicious. On Delicious trees at Crawfordsville that had not received a pre-pink spray, calyx lobe infection was found on small green fruits showing no typical lesions. The infected calyx lobes⁴ were killed and the fungus was sporulating on them. In Miami Co. evidence was obtained that spring cultivation has been of some benefit in scab prevention. Foliage infection was very severe on Delicious and Rome and was noted on the somewhat resistant Transparent variety. In a 30-acre planting made in 1922 and composed of unsprayed Jonathan, Stayman, Grimes, Rome, and Wealthy trees, the very heavy scab infection had caused considerable defoliation and consequent retardation of growth. This must have originated from wind blown spores and emphasizes the necessity of spraying young orchards.

Blotch, caused by *Phyllosticta solitaria*, was extremely serious although the infection period began later and continued later into the season than usual. The latter conclusion is based to some extent upon the fact that in Orange Co. blotch sprays applied May 1 (petal-fall), 15, 30 and June 13 on Oldenburg gave a poorer control than similar sprays applied May 3 (petal-fall), 17, June 7 and 21 on Ben Davis and May 9 (petal-fall), 30, June 14, and 28 on Rome. This retardation of the infection period is attributed to the very cool spring and early summer, particularly the low temperatures in May.

A considerable section of the experimental orchard near Mitchell is composed of a mixed planting of a large number of varieties, each represented by a few trees. A survey of this orchard made on August 14 showed the presence of blotch cankers on the following varieties not previously recorded as susceptible in Indiana: Florence Crab, McIntosh, Springdale, McMahan, Hightop Sweet, Pease, Milwaukee, Baldwin, Tolman, Early Harvest, Huntsman, Domine, Tetofsky, Red Astrachan, Ralls, and Thaler. Fruit infection was noted on the first four named and on Ralls (1923 crop). McIntosh, McMahan, Summer

⁴ Keitt, G. W., and Jones, L. K. Sepal infection in relation to the seasonal development and control of apple scab. Abs. in Phytopath. 14:36. 1924.

Rambo and Red Astrachan were abundantly cankered. On July 9 a few blotch cankers were found in this orchard on young Delicious trees, a variety previously supposed to be more or less immune to this disease. Blotch has been reported on the Bellflower variety in Morgan Co. According to our present records blotch has been found on a total of 63 varieties in Indiana.

In an old commercial orchard in Miami Co., in which the disease had not been previously noted, one isolated fruit lesion was found on Ben Davis. Fruit infection was noted on old dooryard Wealthy and York trees in Jackson Co. A badly infected home orchard of Smith Cider was reported in White Co. Fruit infection caused a heavy loss in unsprayed Stark trees in Lawrence Co. Badly infected fruit of the Winter Banana variety was sent in from Johnson Co. A few infected fruits were noted in a Jonathan tree in Orange Co. and a canker on 1921 wood was found directly above them.

As to the mode of origin of blotch cankers, the Oldenburg and other varieties have been found similar to Northwestern in that almost all of the cankers on bearing wood are located at leaf scars and are the result of mycelial invasion from basal petiole lesions. Stover and May⁵ have observed that the same is true for Smith Cider in Ohio, and Hesler⁶ has corroborated it for Tennessee conditions. H. F. Dietz⁷ has found blotch in six Indiana nurseries and has found evidence of its introduction on Kansas seedlings.

Because of the extreme prevalence of cankers on Oldenburg it is likely that the use of Oldenburg fillers has served as a means of introducing the disease into many orchards. On account of the alternate bearing habit of this variety and the tendency on the part of growers to omit the sprays when no fruit is present, this variety constitutes a particularly dangerous reservoir of infection.

Black rot, caused by *Phylospora malorum*, in the form of a calyx-end rot of the fruit still on the tree caused very heavy losses in certain varieties in southern Indiana, even in well-sprayed trees. This type of rot was most destructive on Transparent, where brown zoned lesions were produced (fig. 2), and was common also on Delicious, Arkansas, Gideon, Wealthy, and Jonathan. Seldom was the invasion equally extensive on all sides of the calyx and early stages of invasion as observed on Transparent on July 9, showed that the lesion was always at one side of the calyx at first and apparently emanated from one calyx lobe. The lesions were usually zoned with the zones concentrically arranged about the calyx lobe in such a manner as to indicate that the latter was the point of origin of the lesion. In one such case a microscopic examination showed pycnidia with mature pycnospores in the calyx lobe while the pycnidia in the fruit tissue were immature, a condition which might readily result from the earlier infection of the calyx lobe and a later invasion of the fruit tissue from that calyx lobe. It seems very

⁵ Stover, W. G., and May, Curtis. Studies on apple blotch in Ohio. Abs. in Phytopath. 14:60. 1924.

⁶ Hesler, L. R. Apple blotch control. Proc. Tenn. Hort. Soc. 19:49-55. 1924.

⁷ Wallace, Frank N., Dietz, Harry F., and others. Report of the division of entomology. Ind. Year Book 1924:206-228. 1925.

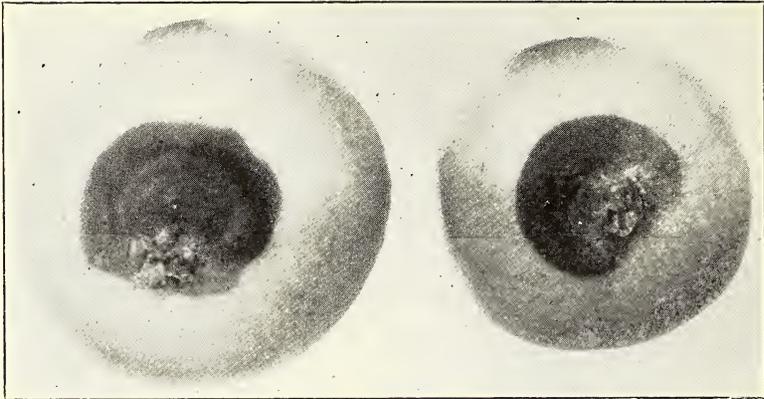


Fig. 2.—Calyx-end black rot lesions on immature apples of the Transparent variety, probably the result of calyx lobe infection.

likely that the calyx-end fruit invasion is the result of calyx lobe infection.

On July 9, rather heavy infection of frog-eye spot was observed on the lowermost leaves of an Oldenburg tree directly above mummied fruits lying on the ground, at once suggesting the possibility of splash infection from the latter source. Shallow cankers are very common in old trees, superficial as a rule, but conspicuous.

Fire blight, caused by *Bacillus amylovorus*, was less destructive than in 1923 but was serious in southern Indiana especially as a twig blight on Jonathan and a blossom blight on Grimes. Cullinan reported a twig blight of Jonathan extremely destructive in the orchard in Franklin Co. in which this disease has recurred annually, and fire blight was reported very severe around Evansville. This disease is a real menace to Jonathan in the southern end of the state. Serious fire blight was noted on the Detroit Red variety in Orange Co. Because of its extreme susceptibility, the Esopus variety is a dangerous reservoir of infection. A case has been found in Orange Co. where a few scattered Esopus trees in a Jonathan block apparently have been responsible for considerable infection of the near-by Jonathans.

In a planting of young Oldenburg trees in Knox Co. that has been under observation during the last three years, blossom and twig blight was serious in 1922 and again in 1924, but was not serious in 1923 when the disease was at its worst in the state as a whole. There is a large, badly blighted pear orchard about one-half mile distant which blossomed in 1922 and 1924 but not in 1923. Between this orchard and the block of Oldenburg above mentioned is a large apiary. Blight in the Oldenburgs seems to be correlated with the seasons in which the pear orchard blossoms and it seems likely that the infection is carried by bees.

Cedar rust (*Gymnosporangium juniperi-virginianae*) was more prevalent in the southern half of the state than has been previously noted by the writer, and because of the high incidence of fruit infection, particularly at the calyx end, became a matter of real concern to com-

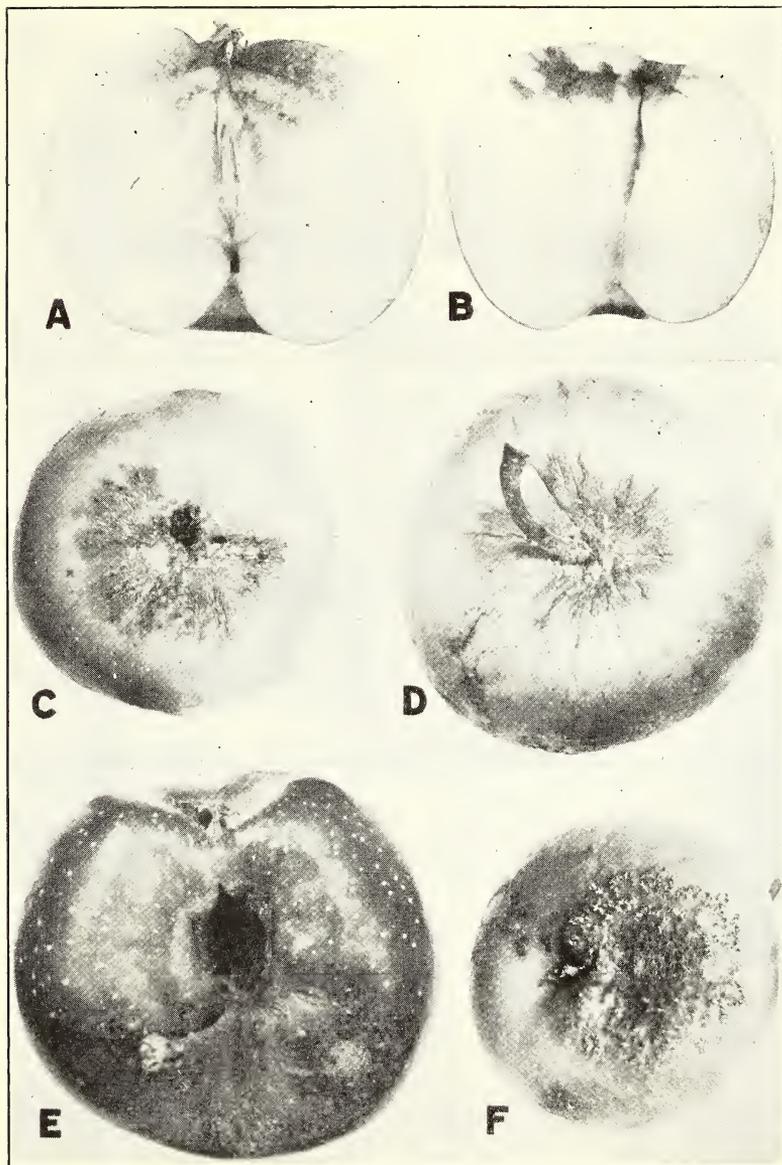


Fig. 3—Effects of cedar rust on apple fruit. A and B. Longitudinal sections showing two types of internal browning of the tissues at the calyx end of the fruit. Gideon variety. C. Brown, shrunken, puckered calyx-end rust lesion showing no pycnia or acia. Gideon variety. D. Brown, puckered lesion at stem end showing no pycnia or acia. Gideon variety. E. Rome apple showing lop-sidedness due to early infection by rust in the stunted side and a deep cavity marking the site of the rust lesion. F. Rust lesion on a Rome apple showing the acia protruding.

mercial growers. Fruit infection was found serious on Oldenburg, Delicious, Wealthy, Rome, Jonathan, Gideon, and Red June and was almost always associated with the calyx, in fact the lesions seemed to emanate from one side of the calyx, as in the case of black rot above recorded. About 30,000 Oldenburg apples were carefully examined in connection with a blotch spray test and of the very considerable number of rust lesions observed fully 95 per cent were located at the calyx end. The same holds true for Wealthy, Jonathan, Gideon, Red June and many other varieties. The impression was obtained that most of the fruit lesions were the result of very early infection of the calyx lobes and it seems possible that the latter may very likely remain susceptible to infection longer than the fruit proper. However, infection at the stem-end and elsewhere was noted on Rome and Wealthy.

In Oldenburg, Delicious, and particularly in Gideon, as observed in Orange Co., many of the fruit lesions were very atypical in that no waxy yellow elevated areas bearing pycnia or accia were present. In these cases the infection had caused a puckering and internal brown necrosis of the tissues about the calyx end (fig. 3, A, B, C). Sections showed that the affected tissues were rather extensively permeated by the intercellular rust mycelium. This type of infection caused rather extreme deformation and sometimes cracking of many of the fruits which, in the case of Delicious, caused considerable financial loss. In fact in all varieties affected, the rust infection frequently caused cracking, deformity, or stunting of the fruit (fig. 3, E), although the majority of the lesions remained rather small and inconspicuous. In Delicious the rust infection sometimes caused a constriction of the fruit just below the apex. On Red June, the lesions were conspicuous because they prevented the red coloration.

In addition to the varieties above mentioned, calyx-end fruit infection of rust was observed on Winesap (trace), Stayman (trace), Grimes (trace), Stark, Transparent, Esopus, Rambo, Arkansas, Ben Davis, and in the Experimental Orchard at Mitchell on Salome, Springdale, Florence Crab, Wagener, Sweet June, Rhode Island, Dr. Matthews, Fall Wine, Excelsior, White Pippin, Indian, Peter, Domine, Winter Banana, and Iowa Blush. Leaf infection was noted on Ben Davis (trace), Grimes (trace), and was severe on Rome, Jonathan, and Wealthy. In the Experimental Orchard leaf infection was observed to be severe on Minkler, Missouri Pippin, Scott's Winter, Sweet Bellflower, Indian, and Winter Banana, and was present on Excelsior, Yellow Bellflower, Peter, Ronk, Paradise Winter Sweet, Sweet June, White Pippin, and Fanny.

No rust infection was found on the following varieties in the Experimental Orchard, all of which were scattered among the infected varieties and without doubt as much exposed to infection as were those which became infected: Genet, York, Wolf River, Westfield, Tolman, Arkansas Black, Kinnard, Jacob's Sweet, Akin, Northern Spy, Pease, Big Rambo, Milwaukee, Baldwin, Jersey Black, Grimes, Maiden Blush, McMahon, Lawver, Huntsman, Arkansas, Stayman, Summer Rambo, Red Astrachan, Winesap, Dwarf Delicious, Fall Queen, Golden Russet, Tetofsky, Detroit Red, Walbridge, and Hibernial.

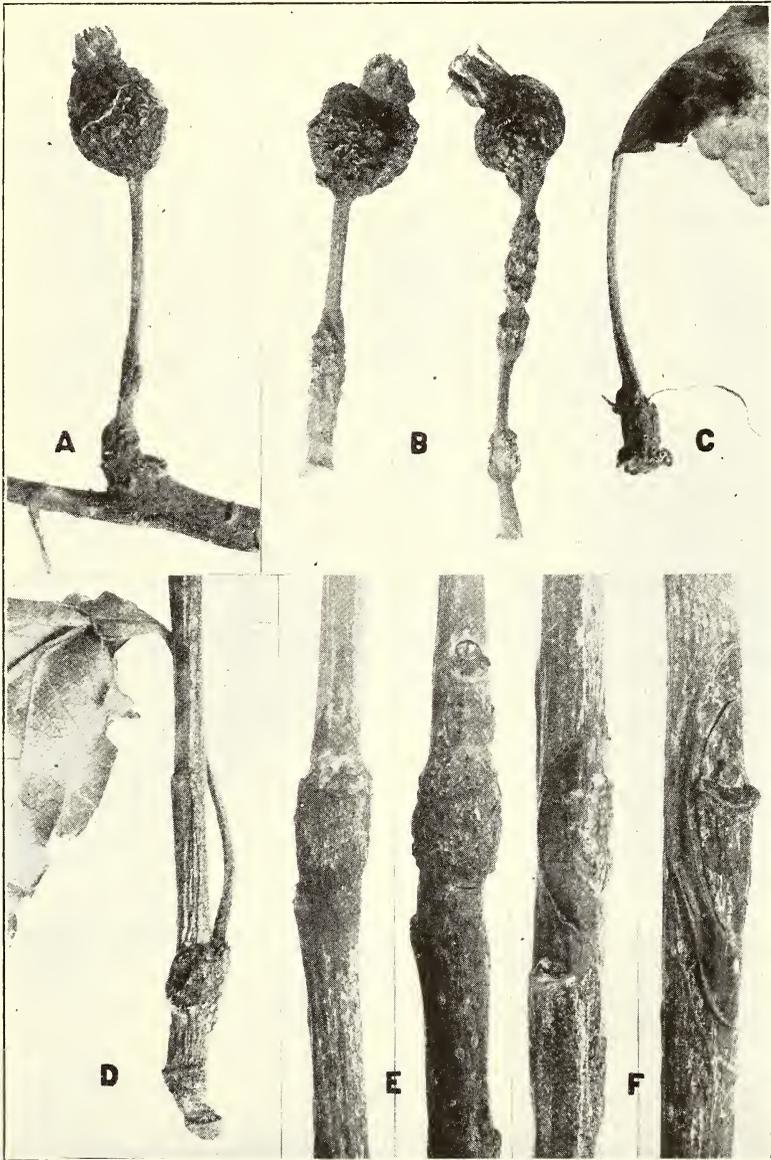


Fig. 4—Unusual effects of the cedar rust fungus on apple (variety, Rome). A. Rust lesions near base of pedicel which have killed the young fruit. The fungus has also invaded the spur at the base of the pedicel. Enlarged X2. B. Two young fruits killed by the swollen rust lesions on the pedicels. Enlarged X2. C. Rust lesion at the base of a leaf petiole which had resulted in the death of the leaf. Enlarged X1½. D. Swollen rust lesion on a twig at the base of an infected leaf petiole. The leaf had been killed by the fungus. Enlarged X1½. E. Two twigs showing barrel-shaped swellings due to rust infection. Enlarged X3. F. Two twigs showing rust cankers. Enlarged X3.

In certain young Rome trees in Orange Co. exposed to heavy infection from near-by red cedars, a variety of very severe and unusual rust symptoms was observed. Many fruits had been killed outright when very small by the swollen pedicel lesions of the rust and remained attached to the twig (fig. 4, A, B). Other fruits were not killed but showed various degrees of stunting as a result of this type of infection and also as a result of stem-end lesions. Other fruits were lop-sided or otherwise deformed as a result of the inhibiting effect of rust lesions and in many of the latter deep cracks exposed the inner tissues (fig. 3, E). As is often the case in the Rome variety, the fruit lesions very frequently bore the aecia of the fungus (fig. 3, F). Abundant petiole and twig infection was also found on these trees, and these lesions as well as the pedicel lesions usually bore a few aecial cups (fig. 4, C). Frequently the swollen petiole lesions had killed the leaf and in certain cases observed, a basal petiole lesion or pedicel lesion was co-extensive with a twig lesion, a condition which suggested that twig lesions may sometimes result from mycelial invasion from infected petioles or pedicels (fig. 4, A, D). However, twig lesions were also present between the leaf scars, so that direct infection of the twigs must also occur (fig. 4, E, F).

The early scab sprays apparently did not prevent fruit infection by the rust, but, in the Oldenburg block sprayed for blotch control, the 2-6-50 and 4-6-50 Bordeaux sprays gave a fair control of rust infection. As a result of observation made during this rust epiphytotic it may be said concerning the important commercial varieties in Indiana that Grimes, Stayman, Ben Davis, and Winesap showed reliable resistance, Jonathan and Oldenburg suffered considerably from fruit infection, and Delicious, Wealthy, and Rome were severely subject to fruit infection. Jonathan, Wealthy, and Rome proved very susceptible to leaf infection.

Bitter rot, caused by *Glomerella cingulata*, was not found serious this year. It occurred on the King David variety and B. A. Porter found a scattering infection on Grimes in Knox Co. early in July, but this never developed into an epiphytotic, probably because of the relatively cool weather. The first fruit lesions were collected on July 1. One grower combats this disease by picking and removing from the orchard all of the infected fruits as soon as they are detected so as to remove sources of infection.

Blister canker, caused by *Nummularia discreta*, occurs to a considerable extent in old orchards. It was found on Transparent and 20-ounce Pippin in Marion Co., on Lawver in Orange Co., and on neglected trees near Lafayette. Sooty blotch (*Phyllachora pomigena*) was reported serious on Winesap, Stayman, Arkansas, and especially on Stark in Orange Co. by H. E. Newland, who made rather extensive observations. Sooty blotch was observed on Grimes in Jackson Co. Brown rot (*Sclerotinia cinerea*) occurred in Esopus and Alternaria core mold in Stayman fruit in Orange Co. An internal core rot not visible externally was found somewhat prevalent in the Transparent variety in an orchard in Orange Co., on July 10. A species of *Fusarium* was associated with this rot.

Jonathan spot was less prevalent than usual and was noted on Jonathan and Esopus in southern Indiana. Bitter-pit or stippen was likewise less prevalent than usual and was noted on Grimes and Stark in southern Indiana. A very general russetting of the fruit on unsprayed as well as sprayed trees in southern Indiana, particularly on Grimes, has been attributed to frost injury, although it closely resembles Bordeaux russet. Typical frost bands were observed on Chenango in Miami Co. Extremely serious Bordeaux russet occurred on Ben Davis, Winesap, Grimes, and Arkansas in Orange Co. as a result of the blotch sprays. In extreme cases the growth of the badly russeted side of the fruit was inhibited and broad surface channels, apparently a result of early cracking of the cuticle, were produced.

Baker found an interesting case of apple scald in which conspicuous green spotting of badly scalded fruit was produced by the complete failure of the scald discoloration to develop in rather definite zones about the numerous stippen lesions. It was also noted that the scald discoloration failed to develop about a wound on one of these fruits. H. E. Newland found a Grimes tree in Orange Co. badly affected with the non-parasitic brown bark spot (Swingle and Morris), and the pimple stage of this disease was found on both the 1923 and 1924 wood of watersprouts of neglected trees near Lafayette.

Barley:—Net blotch, caused by *Helminthosporium teres*, spot blotch, caused by *H. sativum*, and stripe, caused by *H. gramineum* were noted near Lafayette by A. G. Johnson. Mains found anthracnose, caused by *Colletotrichum cereale*, serious near Lafayette and reported a slight amount of leaf rust (*Puccinia simplex*). Covered smut (*Ustilago hordei*) was found by A. G. Johnson. Gregory found loose smut (*Ustilago nuda*) in Harrison Co.

Bean:—Bacterial blight, caused by *Bact. phaseoli*, was somewhat less destructive than usual. Stem lesions were found causing the death of plants in one field in late August and the organism was isolated. In a field plot of 61 varieties, the following escaped infection: Bountiful, Dwarf Horticultural, White Marrow, Challenge Dwarf Wax, Scarlet Runner (*Phaseolus coccineus*) and White Dutch Runner (*P. coccineus* var. *albus*) also escaped infection. Infection was noted on hyacinth bean (*Dolichos lablab*).

Mosaic was observed on all but 18 of the 61 varieties above mentioned and was also noted on White Dutch Runner. It occurred on Wardwell's Kidney Wax, the variety which escaped infection in 1921, 1922, and 1923. Anthracnose (*Colletotrichum lindemuthianum*) was reported from Vanderburg and Marion counties. Rust (*Uromyces appendiculatus*) was serious on the fall crop, particularly the Kentucky Wonder variety. It was worse in the southern part of the state.

Lima bean:—Bacterial blight, caused by *Bact. phaseoli*, was noted in gardens. Bacterial spot, caused by *Bact. vignae*, was serious on the foliage. The variety, Henderson's Bush, which, according to Bailey,⁸ is a species different from the lima bean, shows resistance to this disease. Mosaic was observed on the Henderson's Bush variety.

⁸ Bailey, L. H. Manual of cultivated plants, 851 pp. 1924.

Velvet bean:—Mosaic occurred in an experimental garden as well as foliage infection with *Bact. vignae*.

Beet:—Leaf spot caused by *Cercospora beticola* was noted in gardens.

Blackberry:—Leaf spot, caused by *Mycosphaerella rubi*, was worse than usual but not as severe as on red raspberries. Orange rust (*Kunkelia nitens*) was serious locally. Powdery mildew was found near Lafayette on June 19 by E. C. Stair.

Blueberry:—Dry rot of the fruit caused by *Sclerotinia vaccini-corymbosum*⁹ was found near Elkhart on July 23, by L. Greene.

Buckwheat:—Leaf mold caused by *Ramularia anomala* occurred near Lafayette in October. Seed-carriage of the disease was demonstrated. The sepals remain attached to the "seed" or grain and in inoculation tests sepal infection was obtained, so it seems likely that the fungus is carried in the sepals.

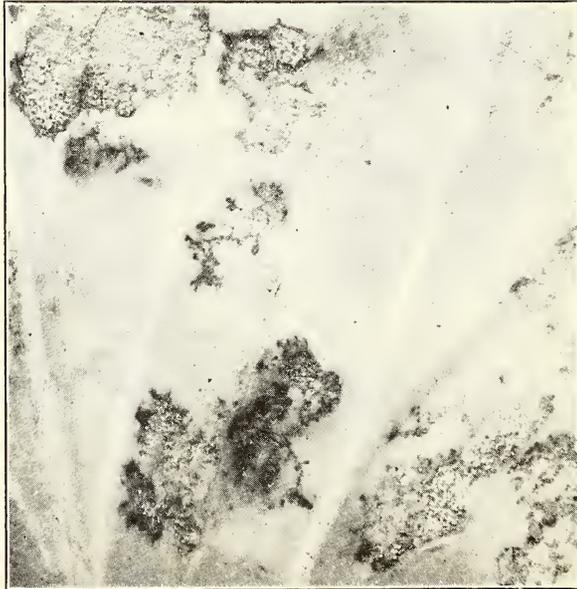


Fig. 5—Under surface of portion of cabbage leaf showing blackened lace-like downy mildew lesions bearing the white sporophores of the fungus.

Cabbage:—Yellows, caused by *Fusarium congenitans*, was less destructive than usual because of the cool season. Black leg, caused by *Phoma lingam*, was serious in seed beds as a result of seed-borne infection. Club-root, caused by *Plasmodiophora brassicae*, was more destructive than usual in the few localities where it occurs, probably

⁹ Reade, J. M. Preliminary notes on some species of *Sclerotinia*. *Ann. Mycol.* 6: 109-115. 1908.

because of the wet season, since Monteith¹⁰ has shown that a high soil moisture content favors the disease. Black-rot, caused by *Bacterium campestris*, was somewhat worse than usual, but was not a serious factor. Black leaf spot, caused by *Alternaria brassicae*, was found serious in a field in Lake Co. in October. The fungus not only caused blackened target-board spots on the leaves, but attacked particularly the bases of the leaves even well up into the head and caused many of the older leaves to drop off. Downy mildew (*Peronospora parasitica*) was found in a field in Lake Co. in October which had been flooded earlier in the season. The downy mildew lesions were large yellowish blotches (1 to 3 cm. in dia.) on the distal halves of the lower leaves with a black lace-like pattern visible in transmitted light and often with a whitish velvety growth of conidiophores (fig. 5).

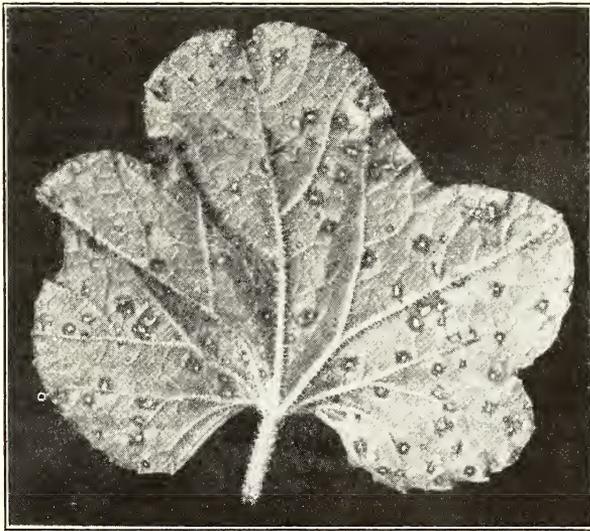


Fig. 6—Cantaloupe leaf showing lesions of leaf blight due to *Macrosporium cucumerinum*.

Cantaloupe:—Leaf blight (fig. 6), caused by *Macrosporium cucumerinum*, assumed major importance this year and by prematurely destroying the foliage was, at least to some extent, responsible for the insipid tasteless fruit. As observed in Jackson Co. on August 27, this disease was the cause of a virtual crop failure. Seventy-five per cent of the leaves were killed and lesions were so numerous on the young leaves as to blight them outright. The fruit was of a very poor quality. Gregory reported a similar condition in Morgan Co. A grower in Allen Co. obtained a good control of this disease by spraying with Bordeaux. Bacterial wilt and mosaic were not as serious as usual. Severely destructive symptoms of mosaic were observed in experimental plots, ranging from the typical mottling and dwarfing to a wilting and death of the plants such as often occurs in the case of cucumbers.

¹⁰ Monteith, John. Relation of soil temperature and soil moisture to infection by *Plasmiodiophora brassicae*. Jour. Agr. Res. 28:549-561. 1924.

Carrot:—Leaf spot, caused by *Cercospora apii carotae*, was serious in market gardens about Indianapolis.

Celery:—Late blight, caused by *Septoria apii*, was worse than usual and was found serious on the late crop in market gardens, killing the older leaves and spotting the petioles. The Fusarium yellows disease was less severe than usual.

Cherry:—Leaf spot, caused by *Coccomyces hiemalis*, was even worse than usual and caused early and complete defoliation.

Chicory or Curled Endive:—A rosetting and stunting, possibly of a mosaic nature, was observed in October in a market garden at Lafayette.

Clover:—Anthracnose, caused by *Colletotrichum trifolii*, was found serious on Italian varieties at Lafayette. Bacterial spot, caused by *Bact. trifoliorum*, occurred on red clover near Lafayette. Powdery mildew was worse than in 1923 but not as bad as in 1922. Sooty spot, caused by *Phyllachora trifolii*, was prevalent on white clover in lawns. Mains observed necrotic leaf spotting as a result of mosaic.

Corn:—Smut (*Ustilago zaeae*) was as prevalent as usual. Mains reported leaf rust (*Puccinia sorghi*) worse than usual, causing the death of the leaves. Stewart's disease, caused by *Bact. stewartii*, was reported on Crosby and Golden Bantam sweet corn. Hoffer reported a 5 per cent loss due to root rot and found ear rots less prevalent than in 1923 because of the dry fall weather.

Cowpea:—Bacterial spot, caused by *Bact. vignae*, was destructive in our field plots due to the frequent rains, and caused a seedling blight, and later, leaf spotting, defoliation, and deformity or partial atrophy of the pods. The disease was found rather general in the field crop (var. New Era) in Jackson Co. Bacterial spot has been found on 23 varieties and no resistant varieties have been found. The disease also occurs on catjang (*Vigna catjang*), asparagus bean (*V. sesquipedalis*), Lima and sieva beans, velvet bean, and the weed, tick trefoil (*Desmodium canescens*). Infection has also been obtained on hyacinth bean (*Dolichos lablab*).

A spot disease¹¹ caused by *Cladosporium vignae* occurred on the Early Buff variety in our plots. Blackened spots occurred abundantly on the peduncles, young stems, and pods and sparingly on the leaves. The causal fungus was isolated and inoculation tests proved that only young growing tissues were susceptible. Seed carriage of the disease was demonstrated. This disease has been found to be most serious on the varieties Early Buff, Progressive White, Columbia, Large Blackeye, and on asparagus bean (*Vigna sesquipedalis*). Infection may occur on resistant varieties but the lesions heal and become mere scars.

The leaf spot caused by *Cercospora eruenta* was serious in September on the Blackeye and Early Buff varieties and was present on the Whippoorwill variety in our plots, but did not occur on the Iron, Groit, New Era and Early Red varieties nor on catjang. Pod lesions were

¹¹ Gardner, Max W. *Cladosporium* spot of cowpea. *Phytopath.* 15:453-462. 1925.

noted. The leaf spot caused by *Amerosporium oeconomicum* was found on the New Era variety in Jackson Co. on August 27, as was also the wilt disease caused by *Fusarium vasinfectum tracheiphilum*. The latter trouble was rather prevalent in one field and was very destructive in its effects. The leaves turned yellow and dropped off leaving the bare stalks. The roots were greatly swollen and the vascular tissues were brown. Many plants had been killed. Early in July, Gregory found considerable crown and root rot caused by *Rhizoctonia solani* in Jackson Co. Many of the affected plants were killed. The wet cool weather of this season was very favorable to Rhizoctonia attack on a number of crops.

Cucumber:—Mosaic was apparently not as serious as usual in the field crop. Gregory found mosaic and bacterial wilt serious in the fall greenhouse crop. Anthracnose, caused by *Colletotrichum lagenarium*, and powdery mildew were noted in a greenhouse. Angular leaf spot, caused by *Bacterium lachrymans*, was found in a market garden seed bed in June.

Currant:—Anthracnose, caused by *Pseudopeziza ribis*, was extremely serious and caused premature defoliation in July and August. Two leaf spot diseases, one caused by *Mycosphaerella grossulariae*, and the other by *Cercospora angulata*, were noted near Lafayette.

Dewberry:—Anthracnose, caused by *Plectodiscella veneta*, and leaf spot caused by *Mycosphaerella rubi* were noted near Lafayette in August.

Eggplant:—The fruit and leaf spot caused by *Phomopsis vexans* was serious locally.

Gooseberry:—Anthracnose, caused by *Pseudopeziza ribis*, and leaf spot caused by *Mycosphaerella grossulariae* caused a serious premature defoliation in Miami County and near Lafayette. The latter disease was much more serious on this host than on currant.

Grape:—Black rot, caused by *Guignardia bidwellii*, was much worse than usual and was the cause of numerous complaints. Control with a 6-6-50 Bordeaux was reported in Jackson County. Serious petiole infection was observed. Downy mildew (*Plasmopara viticola*) was found in Miami and Hancock counties.

Lettuce:—A *Cercospora* leaf spot was found at Lafayette. Gregory reported drop, caused by *Sclerotinia libertiana*, in greenhouses and also found soluble salt injury very common.

New Zealand Spinach:—*Cercospora* leaf spot was present in our experimental plots.

Oats:—The two smuts were present as usual. Leer found a light infection of stem rust (*Puccinia graminis*) near a barberry in Decatur County, and found leaf rust (*Puccinia coronata*) state-wide in its distribution. Mains found blotch caused by *Helminthosporium avenae-sativae* serious in variety plots and noted varietal differences in sus-

ceptibility. A. G. Johnson found halo blight, caused by *Bact. coronafaciens*.

Onion:—Botrytis infection of the lower portions of the leaf sheaths of the outer leaves caused a yellowing of the leaves on green onions in market gardens in May. In car-lot shipments from Kosciusko, Whitley, Noble, and Steuben counties, federal inspection reports show the presence of smudge, caused by *Colletotrichum circinans*, Fusarium rot, black mold (*Aspergillus niger*), neck rot, and bacterial soft rot. The Fusarium pink root disease occurred in Steuben County in August.

Pea:—The stem and root rot,¹² due to *Fusarium martii* var. *pisi*, and the Aphanomyces root rot¹³ have been reported from Indiana.

Peach:—Bacterial spot, caused by *Bact. pruni*, remains the most serious disease in the southern Indiana orchards because of its defoliating effect. Fruit lesions in the form of large, black, gummy craters were noted on Indiana Cling peaches from Vanderburgh County, and Gregory noted severe defoliation in a Hale orchard in that county. Leaf curl, caused by *Exoascus deformans*, was very prevalent on unsprayed trees. In some instances noted the young twig growth was also invaded by the fungus with the resultant production of whitish swollen ridges or keels extending along the twig (fig. 7). The disease was found in a young orchard in Knox County planted the previous year, a fact which suggests that the fungus may have been brought in with the nursery stock. It was reported that this disease caused complete defoliation of an unsprayed orchard in Miami County. The canker stage of scab, caused by *Cladosporium carpophilum*, was widely prevalent in young orchards and is apparently of nursery origin. Burkholder reports that the Cling varieties are especially subject to fruit infection with scab. Brown rot, caused by *Sclerotinia cinerea*, was reported serious in Posey and Vanderburgh counties. Burkholder reports that the Carman variety is especially subject to brown rot. Crown gall was serious in a young planting in Gibson County. The very prevalent leaf-scar cankers on peach twigs in commercial orchards are probably due to arsenical injury from the so-called "lead and lime" sprays.¹⁴

Pear:—Scab, caused by *Venturia pyrina*, was noted on the fruit. Fire blight was serious locally.

Pepper:—Mosaic was observed in gardens causing a serious reduction in yield.

Plum:—Bacterial spot, caused by *Bact. pruni*, was sent in from Lake County. Black knot, caused by *Plowrightia morbosa*, was sent in from Clinton and Warren counties, and Burkholder reported this dis-

¹² Jones, Fred Reuel. Stem and root rot of peas in the United States caused by species of *Fusarium*. Jour. Agr. Res. 26:459-475. 1923.

¹³ Jones, Fred Reuel, and Drechsler, Charles. Root rot of peas in the United States caused by *Aphanomyces euteiches* (n. sp.). Jour. Agr. Res. 30:293-325. 1925.

¹⁴ Haenseler, C. M., and Martin, Wm. H. Arsenical injury of the peach. Phytopath. 15:321-331. 1925. Also, Adams, J. F. The leaf-scar lesions on peach trees. Trans. Penin. Hort. Soc. 38:22-24. 1925.



Fig. 7—Invasion of the tissues of the peach twig by the leaf-curl fungus.

ease serious in a commercial plum orchard in Knox County. He states that the Damson variety is very susceptible, while American plums show resistance. Brown rot, caused by *Sclerotinia cinerea*, was reported from Fulton and Whitley counties.

Potato:—Leaf roll remains the main cause of low yield and degeneration of seed stocks of the Rural New Yorker variety of which the late or main crop is composed and hence this disease is one of the principal reasons for the use of northern-grown certified seed. Mosaic seems to be more serious than leaf roll in the early crop (Early Ohio,

Irish Cobblers and Bliss Triumphs) and necrotic symptoms characteristic of the stipple-streak type are commonly present. This disease is more severe than leaf roll in its effects and by reducing germination and by killing plants prematurely or otherwise preventing tuber formation it tends somewhat to eliminate itself from seed stocks. A few cases of black leg, caused by *B. atrosepticus* (*B. phytophthorus*), were observed in an early crop of Cobblers near Lafayette. Scab, caused by *Actinomyces scabies*, and Rhizoctonia black scurf were prevalent on the tubers. The Early Ohio variety was severely infected with scab at Lafayette and proved much more susceptible than Rurals and Cobblers grown in adjacent rows.

Although it has proved profitable to spray potatoes with Bordeaux, there is no evidence to indicate that late blight (*Phytophthora infestans*) ever occurs in Indiana, so that the chief benefit of the spraying is no doubt in the prevention of leaf hopper injury or hopper-burn. Freezing injury characterized by blackened necrosis of the vascular tissues of the tubers and by circular, blackened, surface spots about 6 mm. in diameter and each centered about a lenticel was observed in stored potatoes.

Pumpkin:—A bacterial leaf spot disease was noted in Jackson County. The spots were small, angular, and blackened, with white centers, and when cut in water mounts, bacteria oozed out in abundance from the cut edges of the lesions. A yellow organism was isolated.

Radish:—Black-root was very destructive in home gardens in Lafayette. White rust (*Cystopus candidus*) was observed in the fall.

Raspberry:—Anthracnose, caused by *Plectodiscella veneta*, remains the limiting factor in commercial plantings. The disease was found very destructive in a commercial plantation in Miami County in July, the lesions occurring up as far as four feet on the 1924 canes and also on the pedicels and berries. There is abundant evidence that the disease is introduced into new plantations with the transplants. In southern Indiana it seems that the latter often become infected in the spring before they are transplanted. The presence of the fungus on the old stub or remnant of the rooting tip has been frequently observed and it is advisable to cut off this stub before planting. On August 1, careful examination of a new plantation set out earlier in the season yielded the following data: 57 out of 366 plants examined showed the old stubs projecting above the ground. Only 32 plants were infected with anthracnose and 25 of these, or 78 per cent, were among the plants with the projecting stubs. Forty-four per cent of the 57 plants with projecting stubs were infected. Clearly there was some correlation between the primary anthracnose infection and the projecting stubs.

Leaf curl is more destructive than anthracnose but is not nearly as prevalent. Mosaic was noted on red raspberries and on the Honey Sweet variety of black caps. Cane blight, caused by *Coniothyrium fuckelii*, was noted in Miami County. Leaf spot, caused by *Mycosphaerella rubi*, was worse than usual this year, and caused serious defoliation of red varieties near Lafayette. It was worse on the red than on the black varieties. H. F. Dietz reports crown gall very prevalent on red and

purple-cap varieties, occasional on black-caps, and absent in blackberries.

Rutabaga:—Mosaic was noted in our experimental garden near a row of mosaic turnips.

Rye:—Mains reported leaf-rust (*Puccinia dispersa*) less prevalent and ergot much more abundant than usual. Mains¹⁵ found a number of grasses infected with ergot in his experimental plots. He found powdery mildew of rye and reported anthracnose (*Colletotrichum cereale*) more serious than usual. A. G. Johnson found leaf spot, caused by *Septoria secalis*, and bacterial blight, caused by *Bact. translucens* var. *secalis*, at Lafayette.

Soybean:—Bacterial spot, caused by *Bact. glycineum*, was generally prevalent. The Manchu variety now constitutes most of the commercial crop in the state and seems to be less subject to mosaic than the Midwest variety. In our experimental plots and in greenhouse tests mosaic was transmitted in seed five years old. Stem blight, caused by *Diaporthe sojae*, was found in Cass County in the Dunfield variety. Rhizoctonia crown rot was rather serious early in the season, due probably to the cool, wet weather, and was found in Marshall, Parke, and Jefferson counties. The plants were killed by stem infection at the surface of the soil. A purplish discoloration of the seed due to a fungus invasion of the seed coat was rather common.

Strawberry:—Leaf spot, caused by *Mycosphaerella fragariae*, was generally prevalent and cases of its introduction with transplants were observed. Leaf scorch, caused by *Diplocarpon (Mollisia) earliana*, was found severe on the Gibson variety in Montgomery County, June 11, while the Dunlap and Burrill varieties in the same field were not infected. Anderson¹⁶ has also reported that these two varieties are resistant. One case of what appears to be a mosaic disease was found in a plot planted with plants of the Everbearing variety from a Michigan grower. The plant was yellowish and stunted. Rhizopus and Botrytis rots were reported in car-lot shipments from Floyd County. A crown rot of unknown origin was reported from several localities.

Tobacco:—Gregory found wildfire, caused by *Bact. tabacum*, black-fire caused by *Bact. angulatum*, and frog-eye, caused by *Cercospora nicotianae*, in Spencer, Scott, and Jefferson counties, and root rot, caused by *Thielavia basicola*, in Spencer County. He found mosaic very prevalent and present in almost all fields.

Tomato:—The outstanding disease of this season, especially in central Indiana, was leaf spot, caused by *Septoria lycopersici*. The frequent rains favored the spread of this fungus and rendered it a truly limiting factor because of the foliage destruction and consequent re-

¹⁵ Mains, E. B. Observations concerning the disease susceptibility of cereals and wild grasses. Proc. Ind. Acad. Sci. 1924:289-295. 1925.

¹⁶ Anderson, H. W. Notes on new diseases of economic crops in Illinois. 1919-1921. Trans. Ill. Acad. Sci. 15 (1922):130-140. 1922.

duction in yield. The loss was aggravated because the abnormally cool season retarded the crop so that the leaves were destroyed before the fruit had developed far enough. However, in southern Indiana, where leaf spot is usually worse, its effects did not materially reduce the yields, probably because the higher temperature favored the crop. The occurrence of the disease in transplant fields in Arkansas and Texas was observed in May and since certain of these fields had not been used for tomatoes before, one is inclined to suspect that the fungus may occasionally be seed borne. Spores might readily gain access to the seed, since sporulating lesions have frequently been observed on the calyx, which may often remain attached to fruits being crushed for seed extraction. Furthermore, a case of actual though limited invasion of the fruit tissue at the margin of the receptacle scar by mycelial growth from a calyx lesion was observed in the greenhouse. However, extensive tests in the greenhouse have failed to demonstrate that this fungus is seed borne.

There was an unprecedented outbreak of early blight, caused by *Alternaria solani*, in transplant fields and plant beds, resulting in the death of many plants. This trouble was extremely serious in central Indiana and also was found very prevalent in plant fields in Arkansas and Texas in May. The source of infection was not determined but there were indications of seed carriage. On a 50-acre farm at Nashville, Ark., on soil never in tomatoes before, early blight was serious only in certain blocks planted with untreated seed. The large, blackened, target-board leaf lesions with yellowish borders were very conspicuous but the worst injury is caused by the blackened stem cankers. When plants thus affected are set out in the field they are very likely to blow over and break off during high winds because the top becomes too heavy for the brittle, weakened, infected region of the stem. This condition has been called foot rot or collar rot. One grower reported a 50 per cent loss in his field due to this trouble. This fungus also causes an occasional green fruit to develop a brown stem-end rot, apparently as a result of calyx infection.

Owing probably to the cool moist season, Fusarium wilt was not at all severe except in the southern end of the state. Likewise, mosaic seemed to be much less destructive than usual, presumably because of the low temperatures. That mosaic is not seed-borne was proved by the fact that no mosaic developed among the 1,466 plants grown under insect-proof cages in the field from seed saved from badly diseased (streak or winter blight) greenhouse plants of the preceding fall. The perennial persistence of the mosaic disease in its weed carriers is proved by its recurrence again this year in the *Physalis subglabrata* shoots from the mosaic rootstocks planted in our garden in 1920. This is the fourth year that these have sent up mosaic shoots.

A severe outbreak of the streak or winter blight type of mosaic was observed in greenhouses at Frankfort, on June 16, characterized by the typical mosaic leaf mottling accompanied by the necrotic spotting of the leaves, streaking of the stems, and mottling and malformation of the fruits. Of the three varieties present, Bonny Best and Grand Rapids were much more severely injured than Livingston's

Globe. One of the interesting features was that certain of the mosaic fruits showed projecting knobs of uninjured tissue intervening between necrotic surface depressions, a condition somewhat suggestive of the projecting green warts on mosaic cucumbers. Severe rupture of the pericarp was noted and in one instance an entire locule was thus exposed. Internal necrotic regions were abundant. In many cases the necrotic areas of the pericarp had dried down to a parchment-like membrane covering the pulp and many of these areas were invaded by saprophytic fungi. Total atrophy of whole locules has been noted causing extreme lop-sidedness in certain fruits.

Bacterial spot, caused by *Bact. vesicatorium*, was much worse than usual in the canning crop, a fact which is attributed to the wet weather and the omission of seed disinfection. Leaf mold, caused by *Cladosporium fulvum*, was serious only in greenhouses, and bacterial wilt, caused by *Bact. solanacearum*, was noted in a greenhouse. One case of buckeye rot, caused by *Phytophthora terrestris*, was observed in an experimental garden in which the disease had been prevalent in previous years. In this garden, however, soil rot, caused by *Rhizoctonia solani*, was extremely destructive. The fruits were infected while they were yet green and just beginning to ripen, always at the point in contact with the soil. The lesions showed brown concentric zones and at the center radial cracks almost always appeared (fig. 8). On the surface of such fruits



Fig. 8—*Rhizoctonia* soil rot of tomato.

the fungus produced its typical sclerotia and also on areas beyond the confines of the lesion produced its frosty white hymenial layer. This rot occurs occasionally in the canning crop and is responsible for one of the tough, brown, core rots familiar to canners.

Watermelon:—In Jackson County considerable foliage infection of *Macrosporium cucumerinum* was observed on August 27, as well as

scattered leaf infection of *Cercospora citrullina*. Foliage lesions of anthracnose (*Colletotrichum lagenarium*) were also observed. Anthracnose was favored by the wet season and was rather serious. Wilt, caused by *Fusarium niveum*, prevents successful watermelon culture on the restricted areas of suitable soil on the sandy ridges along the rivers.

Wheat:—Leaf rust (*Puccinia triticina*) was less prevalent than usual. Leer found one bad infection of stem rust (*P. graminis*) within a quarter of a mile of a barberry bush in Decatur County. Loose smut (*Ustilago tritici*) was reported worse than usual, especially in northern Indiana, and likewise bunt (*Tilletia foetans*), scab, caused by *Gibberella saubinetii*, and anthracnose, caused by *Colletotrichum cereale*, were reported worse than usual. A. G. Johnson found leaf spot caused by *Septoria tritici* at Lafayette. Powdery mildew was also noted.

Trees and Ornamentals:—The non-parasitic yellows or mosaic of asters was exceedingly prevalent and destructive throughout the state. The symptoms closely resemble a similar trouble on the very common related weed, fleabane (*Erigeron* sp.), and a strong suspicion is entertained that the disease may be intercommunicable between aster and fleabane. This disease ruined many aster plantings. The brown patch disease, caused by *Rhizoctonia solani*, occurred in bent grass golf greens near Indianapolis. Mains has found that carnation rust (*Uromyces caryophyllinus*) is most serious on the varieties Enchantress, Natalie, and Edna. Fire blight occurred on flowering crab. Powdery mildew and also what appeared to be a mosaic disease occurred on delphinium. A *Cercospora* leaf spot of Boston fern was found in a Terre Haute greenhouse. Dietz found the leaf and bulb spot of gladiolus caused by *Bacterium marginatum* very prevalent. He also found a seed-bed infestation of hollyhock anthracnose (*Colletotrichum malvarum*) in Indianapolis. Hollyhock leaf spot caused by *Cercospora althaeina* and rust (*Puccinia malvacearum*) occurred at Lafayette. A *Sclerotium* crown rot was the most serious iris disease; the leaf spot caused by *Didymella iridis* was very prevalent and the rust (*Puccinia iridis*) was noted. Dietz found twig and leaf infection of mulberry bacterial blight, caused by *Bact. mori*. Anthracnose (*Gnomonia veneta*) was especially prevalent and destructive on the white oak foliage in June.

Peronospora arthuri and *Puccinia peckii* were found on *Oenothera biennis*. The *Phytophthora* leaf blight of peony occurred at Lafayette, as well as the leaf blotch caused by *Cladosporium paconiae*. Quince leaf spot, caused by *Fabraea maculata*, was observed near Lafayette. Black spot of roses caused by *Diplocarpon rosae*, powdery mildew, and crown canker were observed. Mains found snapdragon rust (*Puccinia antirrhini*) serious in the greenhouse. A non-parasitic yellows disease of strawflower, similar to that of asters and probably due to the same cause,¹⁷ was noted in gardens. There was an extremely severe statewide epiphytotic of sycamore anthracnose, caused by *Gnomonia veneta*. Both twigs and leaves were attacked at the time the buds were opening

¹⁷ Kunkel, L. O. Insect transmission and host range of aster yellows. Abs. in Science 62:524. 1925.

and the result was that many trees remained more or less bare all season. The acervuli of the fungus were found on the twig and bud lesions. Serious defoliation of walnut trees by *Gnomonia leptostyla* (*Marssonina juglandis*) was observed in July in Orange County.

SUMMARY.

The diseases of outstanding importance this season were as follows: apple scab, blotch, black rot, and rust; *Macrosporium* leaf blight of cantaloupe; celery late blight (*Septoria*); cherry leaf spot; corn root rot; currant anthracnose; gooseberry leaf spot and anthracnose; grape black rot; peach bacterial spot; potato leaf roll and mosaic; radish black root; raspberry anthracnose; strawberry leaf spot; tomato leaf spot (*Septoria*) and early blight (*Alternaria*); aster yellows (non-parasitic); sycamore anthracnose.

The diseases or parasitic organisms apparently not previously reported for the state include *Bact. phaseoli* on hyacinth bean, *Bact. vignae* on asparagus bean, *Sclerotinia vaccinii-corymbosum* on blueberry, *Peronospora parasitica* on cabbage, rosette of curled endive, *Bact. trifoliorum* on red clover, *Cladosporium vignae* on cowpeas, cowpea wilt due to *Fusarium vasinfectum tracheiphilum* and crown rot due to *Rhizoctonia solani*, *Plectodiscella veneta* on dewberry, *Cercospora* leaf spot of lettuce, bacterial leaf spot of pumpkin, rutabaga mosaic, *Bact. translucens* var. *secalis* and *Septoria secalis* on rye, *Rhizoctonia* crown rot of soybean, strawberry mosaic, *Cercospora* leaf spot of Boston fern, *Phytophthora* leaf blight of peony, strawflower yellows, *Colletotrichum malvarum* on hollyhock, brown patch disease of bent grass golf greens caused by *Rhizoctonia solani*.

