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Diseases of Fruit and Nut Crops

in the United States in 1921

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DISEASES OF FRUIT AND NUT CROPS IN THE UNITED STATES IN 1921*

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CONTENTS

INTRODUCTORY STATEMENT

The present summary on diseases of fruit crops in the United States is based on information furnished by the working pathologists of the country, most of whom are collaborators or correspondents of the Plant Disease Survey. In the organization of the Survey in most states one or more chief collaborators take charge of assembling the data for their state and of submitting them to the Washington Office. The names of the collaborators appear on the opposite page. The compilers have attempted to make clear the various sources of information throughout this report, and, as a rule, have given the name of the

*Summaries of the diseases of fruit crops in the United States for the years 1918, 1919, and 1920 have been presented in U. S. Dept. Agr. Plant Dis. Bul. Supplements 1: 1-41. 1919; 9: 82-179. 1920; 14: 1-114. 1921.

contributor in connection with each note. Wherever possible, collaborators have been quoted directly. In referring to material contained in this publication, authors should cite the original contributor, if possible.

The members of the Office of Fruit Disease Investigations of the Bureau of Plant Industry and various persons connected with the market inspection of fruits and vegetables of the Bureau of Markets and Crop Estimates have contributed to the summary by furnishing reports.

In the preparation of this digest most of the important 1921 literature on fruit diseases in the United States has been consulted and many of the references to the various publications are given in the following pages.

THE WEATHER OF 1921

During the year 1921 many unusual climatological phenomena occurred, particularly with regard to variations in temperature and rainfall. These unusual conditions prevailed not only in the United States but in other parts of the world as well. Word has been received that in England the year was the driest that has been experienced in over 100 years.

In the United States, the winter of 1920-21 was unusually mild and generally deficient in snow; spring opened nearly a month in advance of the regular time and was, for the most part, warm except for frequent damaging cold waves; the summer will long be remembered as one of unusual heat with drought in many places; and the fall was, for the most part dry and warm with killing frosts long delayed.

Naturally these unusual conditions greatly influenced the occurrence and severity of plant diseases. The high winter temperatures favored the overwintering of some pathogenes while the lack of precipitation and snow covering was probably detrimental to others. The advanced and warm spring favored early development of some diseases such as apple scab and brown rot of stone fruits, and peach buds opened quickly before many orchardists were ready to apply the spray for leaf curl. With the warm spring weather, crops advanced rapidly only to be set back sharply and in some cases very seriously damaged or ruined by the freezes of late March and April. The hot summer, accompanied by dry weather in certain regions, caused an unusual amount of trouble from such diseases as Fusarium wilt of tomatoes, bitter rot of apples, etc., while dry weather checked many diseases that depend on an abundance of moisture for development, such as fire blight and brown rot. Although killing frosts occurred unusually early in the northern Rocky Mountain regions, they were exceptionally late over most of the country, with the result that many crops continued to grow much later in the fall than usual. This resulted in prolonging the diseases of these crops and, in some instances, they became more than normally serious late in the season.

Temperature by Months

(Abstracted from United States Department of Agriculture Weather Bureau Climatological Data, 8: 1921.)

January averaged warmer than normal in all states except California and there it was but a trifle colder. The excess of temperature was large nearly

everywhere between the Rockies and the Appalachians, and in the greater part of the Missouri Valley ranged from 9° to 14° per day. In Iowa this was the warmest January of the 32 years for which state-wide averages have been computed, and in several other states it was almost the warmest.

February averaged warmer than normal in every state. East of the Rocky Mountains it was at least 2° warmer in every state; from Kansas and Missouri northward to the Canadian border the average temperature was from 9° to 15° above normal, and in some localities it was the warmest February on record.

March was warm, although during the month a number of brief cold periods occurred. Every regular station of the Weather Bureau, save North Head, Washington, had a mean temperature above normal, and east of the Rocky Mountain Divide almost every district averaged at least 6° warmer than normal. The cold spells of the month occurred during the first week, and about the 9th, the 20th, and the 27th to 30th. This latter cold wave, which involved states east of the Rocky Mountains, was very damaging to vegetation which was well advanced in many places.

April temperatures averaged above normal over the northern and central districts from the Plains eastward, but in the Gulf States, save Florida, and to the westward as well as in most districts west of the Continental Divide, the month averaged cooler than normal. The month was especially noteworthy on account of the freezing temperatures that occurred and that caused much injury to the advanced fruits and vegetables which had either escaped damage by cold in March, or had partially recovered from its effects.

May was generally cool during the first half of the month, but just before the middle of the month a cold wave caused damaging frosts in many localities from the Dakotas and northern Iowa eastward to Michigan. The last two weeks of the month, however, were distinctly warmer than normal, practically everywhere from the Rocky Mountains eastward.

June, except in New Mexico and parts of Texas, was warmer than normal.

July was marked by steady heat but with scarcely any exceedingly high temperatures. In nearly all of the country the month averaged warmer than normal. At several stations in the north-central portion of the country the average July temperature was higher than that of any previous month on record.

August was a month of nearly average summer temperature as no state had a mean temperature as much as 3° away from normal.

September was characterized by abnormal warmth and high monthly means, for the most part, which were due to continued warmth throughout the month rather than to periods of unusually high temperatures. Over much of the East the month was the warmest September in more than fifty years, but over the Plateau and central and northern Rocky Mountain regions the month was 3° to 6° cooler than normal, while at points in Idaho, Oregon, and Montana, it was the coldest September on record and the killing frosts were the earliest ever known.

October. The month averaged warmer than normal over nearly the whole country with especially large excess, from 4° to 7°, over the Middle Plateau and Middle and Northern Rocky Mountain and Plains States. The southeast portion, extending as far as the Ohio River and southern Pennsylvania, showed a slight deficiency in the monthly mean temperature.

November. All along the northern border from Montana to Maine the month averaged colder than normal, and in the central portion it was colder down to

latitude 40° (northern Missouri). In almost all other parts of the country the month was warmer than normal and from central Texas eastward to Mississippi it averaged 5° to 7° warmer than normal.

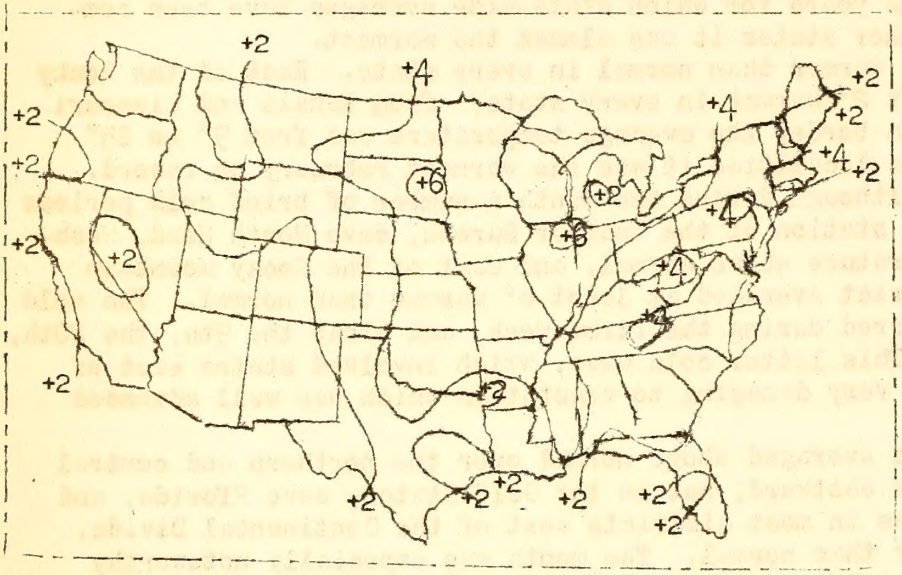

Fig. 1. Departure of mean temperature from normal, for the year of 1921. (From Nat. Weather and Crop Bul. Series 1921. No. 49. Jan. 21, 1922.)

December. Mild weather continued during the month, the temperature averaging above normal throughout the country except in the extreme northeast and northwest districts.

The year 1921. The temperatures for the entire year averaged above normal in all sections of the country. (See Fig. 1.)

Rainfall by Months

(Abstracted from United States Department of Agriculture Weather Bureau Climatological Data, 8: 1921.)

January rainfall totaled less than normal in most portions of the country except in California, Oregon, and western Washington and in much of Idaho and Utah as well as in an area embracing most of Colorado and parts of adjacent states. The snowfall was mainly scanty except in some of the Rocky Mountain states.

February had few widespread rains of importance and rainfall and snowfall were generally light. Only the states of Oregon, Washington, and Tennessee had more than 10% above their average precipitation and none of these had over 30% excess.

March. Over most districts, especially from the northern Plains eastward to the Middle Atlantic coast, the snowfall was considerably less than the average for March. Total average precipitations in excess of normal occurred in the Mississippi and Ohio Valley regions.

April precipitation averaged near or above normal in most states. Those that experienced a more or less serious deficiency were western Texas, New Mexico, and parts of Arizona and California.

May rainfall was above normal in the region from Pennsylvania southward to the Gulf, above or near normal over much of the upper Mississippi and central Missouri Valleys, and in some of the western states excesses also occurred.

June. The rainfall for the month averaged below normal in most states. The following had an excess, however: Colorado, Wyoming, Missouri, Kansas,

New Mexico, Arkansas, Oklahoma, Texas, and Louisiana.

July was characterized by irregular and mainly scanty rainfall. Most of New England, Arizona, New Mexico, and the South Atlantic and Gulf States, however, had excesses. The generally dry weather of this month, accompanied by protracted heat, had a deleterious effect on many crops.

August. The rainfall of this month was irregularly distributed. Some states, such as those from the eastern edge of the Plains to the Appalachians, and parts of New Jersey, Georgia, southern Alabama, and Arizona, had rather heavy precipitation, but on the other hand the majority of the Atlantic and Gulf States had comparatively little.

September precipitation was small in the middle and east Gulf and Atlantic Coast States and from the Rocky Mountains westward, but was much above normal in most of the Ohio and middle Mississippi Valley States, and in some northern border districts, southwestern Texas, and portions of the far Southwest.

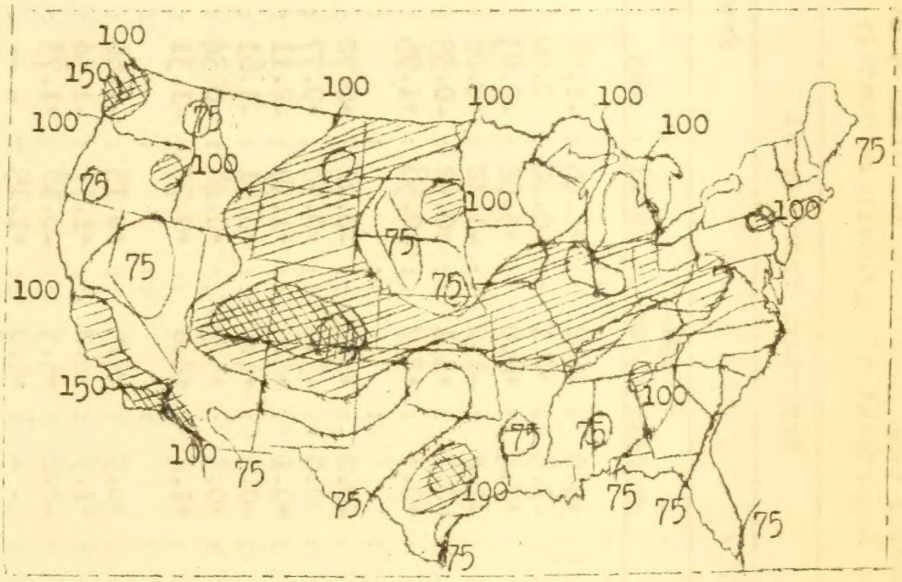

Fig. 2. Percentage of normal precipitation for the year 1921. (After map in Nat. Weather and Crop Bul. Series 1921. No. 49. Jan. 21, 1922.)

October. The nearly universal deficiency in precipitation of the month of October was its most marked feature. Only seven of the 48 states had more than the normal amounts, and only two corner states, Florida and Washington, had as much as a fifth part above normal.

November. The monthly totals were above normal nearly everywhere east of the Mississippi River, though portions of Florida and Mississippi had considerable deficiencies. West of the Mississippi River there was more than normal nearly everywhere from North Dakota and Wyoming westward and about twice the normal quantity of rain fell in most of northeastern Oregon and nearby districts. In other states deficiencies prevailed.

December. The precipitation was moderate to light in most sections of the country.

Table 1 shows the temperatures and precipitation from April to September, 1921 and the departures from the normal.

Table 1. Departures from the normal temperature and rainfall by states - April to September, 1921. (Figures taken from United States Department of Agriculture Monthly Weather Review 49: 1921.)

State	Departure from normal												
	Temperature (°F.)						Precipitation (inches)						
	April	May	June	July	August	September	April	May	June	July	August	September
Ala.	-0.8	-0.7	+2.9	+1.5	+0.9	+6.2	+2.05	-1.96	-2.18	-0.34	-0.48	-0.76
Ariz.	-1.6	-0.9	+0.1	-0.4	-1.5	+0.1	-0.20	0.00	0.00	+1.70	+1.40	-0.37
Ark.	-1.1	+0.7	+2.1	+2.2	+2.4	+6.0	+3.02	-2.83	+0.60	-1.43	+1.40	+0.03
Calif.	-2.0	-3.9	-0.3	0.0	-1.4	-1.2	-1.22	+0.88	-0.15	+0.01	+0.02	-0.08
Colo.	-2.3	+1.5	+0.5	+0.5	-0.1	+1.1	+0.72	-0.39	+1.52	+0.36	+1.17	-0.97
Fla.	+0.4	-2.2	+0.7	-0.7	+0.3	+2.7	-0.58	+1.95	-2.74	+1.43	-2.32	-4.53
Ga.	+0.2	-1.9	+2.0	-0.2	-0.2	+6.2	-0.22	+0.72	-2.00	+1.13	-0.95	-1.44
Ida.	-2.9	+1.2	+2.8	+0.6	0.0	-3.9	+0.38	+0.77	-0.40	-0.43	+0.05	-0.30
Ill.	+3.9	+2.9	+5.2	+4.8	+0.1	+4.6	+1.39	-2.11	-0.08	-1.57	+1.81	+3.10
Ind.	+3.9	+2.1	+4.7	+5.1	-0.5	+4.7	+0.81	-1.81	-0.33	-1.27	+2.09	+2.58
Iowa	+3.7	+2.8	+5.6	+3.8	+0.3	+3.9	+0.48	-0.34	-0.62	-1.43	+1.36	+3.36
Kans.	+0.9	+2.4	+1.6	+1.1	+1.4	+4.6	+0.72	-1.31	+0.81	-0.37	+0.26	+0.58
Ky.	+2.3	+0.3	+4.1	+4.4	+0.3	+5.5	+0.15	-1.50	-1.26	-1.66	+1.72	+2.61
La.	-1.2	-0.8	+0.2	+0.8	+1.7	+4.2	+1.77	-1.54	+0.55	+0.35	-2.08	-0.74
Md.-Del.	+5.5	-1.6	+2.2	+2.6	-2.2	+5.3	-0.18	+1.73	-1.54	-0.23	-0.73	+0.23
Mich.	+6.3	- -	+6.1	+7.0	- -	+5.0	+1.15	- --	-0.92	-0.62	- --	+0.73
Minn.	+4.0	+2.8	+6.2	+5.1	+1.3	+2.8	-0.29	+0.12	-1.27	0.00	-1.04	+1.56
Miss.	-1.3	-0.4	+1.9	+1.7	+1.9	+5.9	+4.09	-3.00	-1.43	-0.61	-0.66	-0.33
Mo.	+0.9	+2.0	+3.4	+2.9	+0.8	+4.7	+1.52	-1.20	+1.15	-1.77	+1.63	+3.15
Mont.	-1.1	+0.3	+3.6	+1.5	+1.8	-3.9	+0.13	-0.32	+0.01	0.00	-0.63	-0.28
Nebr.	+1.0	+1.6	+3.8	+1.8	+1.1	+2.7	-0.53	+0.01	-1.44	+0.67	-0.29	+0.19
Nev.	-1.8	0.0	+2.2	+1.6	+0.4	-0.4	-0.09	+1.12	-0.05	-0.16	+0.09	-0.22
New Eng.	+5.6	+0.8	0.0	+3.0	-1.5	+3.3	+0.77	-0.76	-0.53	+1.10	-1.02	-1.12
N. Y.	+6.8	-0.2	+1.8	+2.8	-2.3	+4.5	-0.11	+0.21	-0.30	-0.99	-0.45	-1.26

State	Departure from normal												
	Temperature (°F.)						Precipitation (inches)						
	April	May	June	July	August	September	April	May	June	July	August	September
N. M.	-2.4	0.0	-1.8	-1.4	-0.5	+1.9	-0.85	+0.73	+1.95	+1.66	+0.12	-0.65
N. Y.	+7.6	+1.6	+1.6	+5.3	-0.6	+4.6	+0.45	-1.41	-0.83	+0.36	-0.70	-0.79
N. C.	+2.6	-2.8	+1.8	+1.1	-0.3	+6.6	+0.51	+0.41	-2.08	-0.57	-2.45	-1.03
N. D.	-0.6	+1.2	+5.5	+3.9	+1.8	+0.6	+0.43	-0.09	+0.55	+0.43	-0.36	+1.66
Ohio	+5.3	+1.3	+4.2	+4.2	-1.1	+4.6	+0.67	-0.43	-0.93	-1.03	+0.71	+1.67
Okla.	-0.7	+2.5	-0.6	+0.4	+2.1	+5.0	+0.18	-2.84	+4.24	-0.60	-1.11	+0.01
Ore.	-1.4	+0.3	+2.2	-1.0	-0.1	-2.3	+0.19	-0.02	-0.08	-0.50	-0.23	-0.01
Pa.	+6.7	-0.6	+2.7	+3.9	-2.0	+5.1	-0.23	+0.26	-1.18	-0.03	-0.32	+1.35
S. C.	+1.0	-3.1	+1.7	-0.2	-0.6	+5.8	-0.48	+1.79	-2.08	+1.50	-1.94	-0.51
S. D.	+2.4	+1.4	+6.9	+3.8	+0.9	+1.0	-0.34	+0.02	-1.59	+0.76	+0.52	+2.07
Tenn.	+0.9	-0.3	+3.8	+2.9	+0.4	+6.6	+0.46	-1.78	-1.66	+0.15	+1.50	+1.33
Texas	-1.8	+0.6	-0.8	0.0	+1.7	+4.0	+0.46	-1.74	+3.39	-0.42	-1.60	+1.20
Utah	-3.1	+0.8	+2.1	+1.2	-0.3	-0.8	+0.71	+0.40	-0.22	+0.01	+0.95	-0.69
Va.	+4.7	-2.7	+1.5	+1.8	-1.4	+5.9	-0.44	+0.76	-2.03	-0.86	-2.28	-0.58
Wash.	-2.2	+0.3	+1.9	-1.2	+0.6	-2.9	+0.49	-0.66	+0.09	-0.57	+0.01	+0.47
W. Va.	+4.1	-0.7	+3.2	+2.6	-2.0	+5.1	-1.00	+0.45	-0.44	-1.17	+1.55	+1.99
Wis.	+5.1	+3.4	+5.6	+6.7	+1.3	+3.9	+1.98	-0.93	-1.52	-0.36	+0.56	+1.39
Wyo.	-2.6	+1.0	+3.3	+1.3	+0.8	-0.7	-0.19	+0.06	+0.36	-0.18	-0.27	-0.77

FRUIT DISEASES OF 1921

In reviewing the history of fruit diseases in 1921 several important facts should be borne constantly in mind. In the first place, a large portion of the fruit area was devastated by the spring freezes so that in a wide belt extending the length of the eastern fruit region there was very little fruit. This shortage of the crop resulted in few reports of diseases that affect the fruit itself. In many instances the percentage of affected fruit may have been about as great as normal, but the actual loss in bushels, of course, was very small in 1921 as compared with other years.

In the second place, the destruction of the crop by freezing led to discontinuation of the spraying program in many commercial orchards and plantations with the result that where there was any fruit it was more subject to disease than usual, and furthermore, the foliage remained unprotected, thus affording an unusual opportunity for the development of leaf diseases.

A third important factor affecting disease prevalence was the unusual weather of 1921, which already has been discussed. Warm weather naturally favored diseases with high optimum temperatures, and dry weather in many parts of the country was unfavorable for fungi requiring considerable moisture, but favorable for non-parasitic troubles brought on by drouth conditions.

APPLE

The apple crop and the spring freezes

The 1921 apple crop was very light, being less than half that of 1920. Final estimates of the Bureau of Markets and Crop Estimates place the yield of the total crop at 96,881,000 bushels as compared with 223,677,000 bushels for 1920, and the yield of the commercial crop at 20,098,000 barrels as compared with 33,905,000 last year.

The apple sections of the West had a full crop, much better than usual in many cases, and northern New York also had good yields. However, in all of the great apple producing area of the East, from Nebraska to the Coast and from the northern portion of the Gulf States to the Great Lakes, the crop was very short, some states having practically no crop whatsoever. The accompanying table (Table 2), showing the actual production and also the percentage of a full crop by states, both for 1920 and 1921, gives an understanding of the geographical range of the crop shortage.

A number of factors doubtless contributed to this great falling off in apple production, but by far the most important was the freezing weather of March and April, 1921. Indeed the difference between the state figures for 1920 and 1921 may be taken as an index of the amount of damage done by the frost. When such a set of figures is put on a map as in Fig. 3, it will be seen that the crop from Nebraska eastward was decidedly short. This area coincides with that where the most damage from freezing occurred.

Owing to the unusually warm March weather, the season was from three to four weeks earlier than usual with the result that apples were in bloom

Table 2. Comparative estimates of condition and production of apples in 1920 and 1921. (U. S. Dept. Agr. Mo. Crop Reporter 7: 137 and 157. Nov. and Dec. 1921.)

State	Percent of a full crop		Total production (December estimate) (Bushels, 000 omitted)	
	1921	10-year average	1921	1920
Maine	85	60	4,060	1,680
New Hampshire	42	62	700	1,200
Vermont	40	55	600	993
Massachusetts	25	67	1,125	3,575
Rhode Island	15	65	63	390
Connecticut	31	63	758	2,375
New York	28	61	12,557	47,087
New Jersey	24	69	667	2,842
Pennsylvania	12	63	2,208	18,584
Delaware	7	64	68	822
Maryland	8	65	225	2,600
Virginia	4	63	708	13,744
West Virginia	4	61	420	8,040
Kentucky	9	55	636	5,022
Tennessee	12	52	754	4,280
North Carolina	13	57	593	6,320
South Carolina	50	61	293	440
Georgia	40	59	698	1,270
Alabama	45	56	890	1,186
Mississippi	41	54	145	190
Louisiana	46	56	35	34
Texas	45	56	274	274
Oklahoma	24	56	486	585
Arkansas	2	61	120	3,900
Ohio	19	54	3,390	13,960
Indiana	15	51	1,029	4,596
Illinois	15	54	2,381	5,866
Michigan	40	61	6,317	16,500
Wisconsin	40	68	1,050	2,250
Minnesota	47	70	900	1,350
Iowa	16	52	630	4,410
Missouri	4	51	480	4,724
South Dakota	30	71	126	180
Nebraska	7	51	125	797
Kansas	4	43	172	1,144
Montana	81	75	975	825
Wyoming	-	-	19	18
Colorado	65	61	3,200	2,830
New Mexico	30	69	483	434
Arizona	30	80	47	80
Utah	83	73	1,037	1,069
Nevada	50	68	24	36
Idaho	91	74	4,280	3,420
Washington	103	80	29,062	21,502
Oregon	90	77	5,571	4,158
California	75	79	6,500	6,000
United States	33	60.3	96,881	223,677

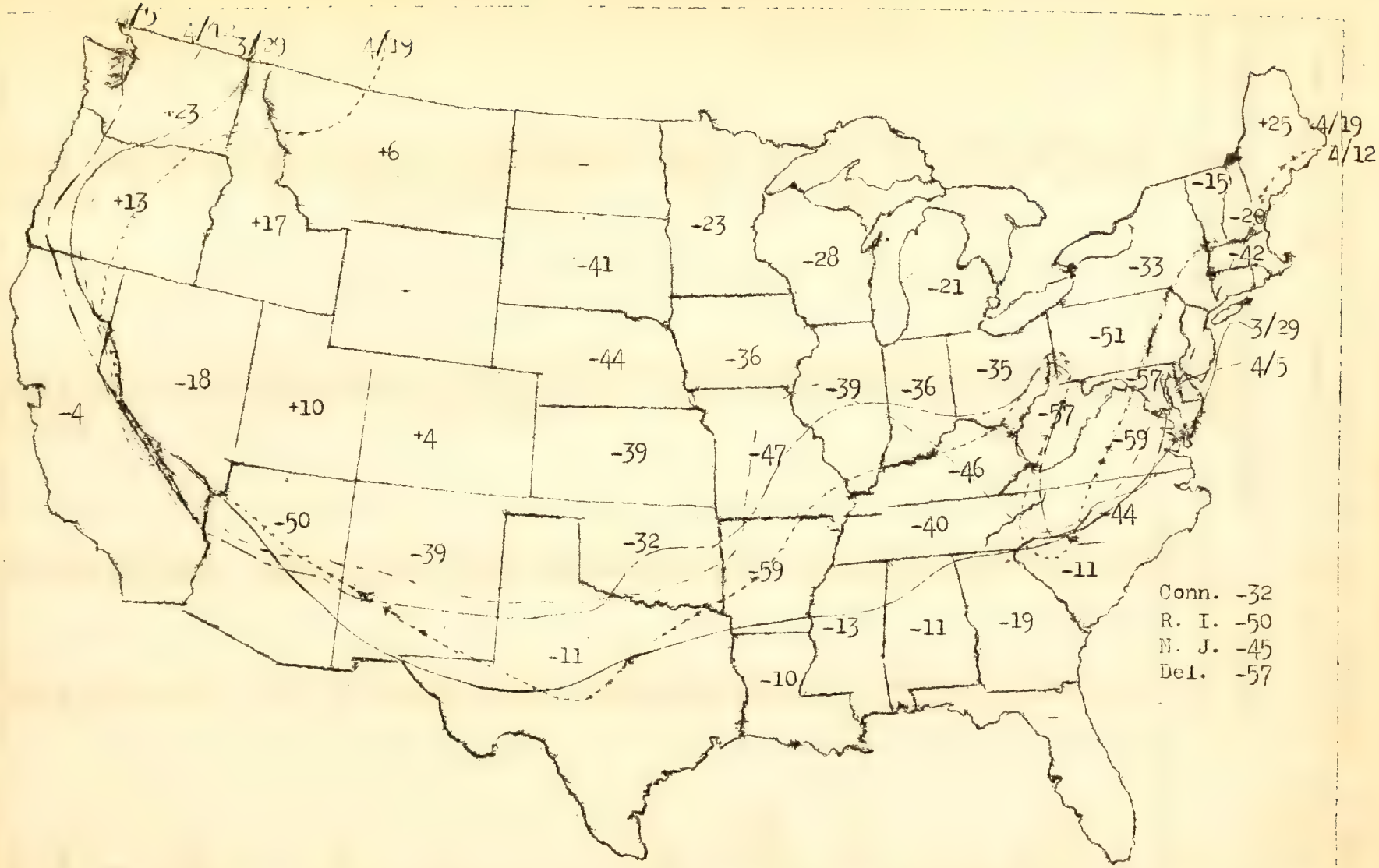

Fig. 3. Departures of 1921 apple crop from the 10-year average, and weekly southern limits of freezing temperatures, March 22 to April 19. (Figures represent departure from the 10-year percentages of a full crop. Lines represent isotherms for 32°F. for weeks ending March 29, April 5, 12, and 19, 1921.)

northward from the Ohio River on March 22. During the period from March 27 to March 30 a severe freeze occurred extending down into the Gulf States and killing exposed flowers and young fruit. The line of 20° F. extended well southward of the northern limits of the sections where early flowering fruits were in bloom. This freeze was followed by alternating periods of warm and cold weather which first advanced the fruit buds and then froze them. The frosts of April 10 and 11 and of April 17 and 18 caught successive sets of blossoms so that in many localities complete destruction of the prospective crop resulted.

The injury occurred in a belt extending through the central portion of the country from the 100th meridian to the Atlantic Coast; diminishing northward, where the fruit buds were less developed at the time of the frosts, and southward, where the freezes were not so frequent or so severe. New Mexico and Arizona suffered very heavily and in parts of California, also, severe damage took place. Fig. 3. with its figures and isotherms showing the southern limits of freezing temperature during this critical period, gives an idea of the location and extent of this damage.

Collaborators' reports on losses within the various states have been given in another publication (Pl. Dis. Bul. 5: 9-11. July, 1921), but the following additional reports have recently been received and may be of interest:

New Hampshire: Destructive at blossoming time in the southern part of the state. Total loss in many instances. (Butler).

Connecticut: Freeze when blossoms were swollen did most injury while a little was caused by late frost after the blossoms had opened. Less injury near Long Island Sound than in other parts of the state. Frost killed the pistils rather than the petals and injured McIntosh and Greening more than other varieties. (Clinton).

New York: Freezes of April and also a late frost in June injured the buds and possibly also russetted the fruit. In Niagara County Dutchess, Wealthy, McIntosh, and Greening escaped serious injury, although damage to other varieties was great. The following statements by counties are given:
Niagara County, injury great. Dutchess, Wealthy, and McIntosh escaped serious injury.
Seneca County, isolated cases of injury to Baldwin and McIntosh.
Onondaga County, Baldwin, Greening, Dutchess suffered severely. McIntosh, Spy, and Rome Beauty most hardy.
Wayne County, practically no injury.
Dutchess County, apples not hurt.
Genesee County, early April - 25% buds killed.
Orange County, evidently no harm done.
Orleans County, a few buds on Dutchess and the early varieties killed.
Ulster County, Baldwin, 40-50% buds killed; other apples 10-15%.
Wyoming County, severe injury on early varieties.
Columbia County, McIntosh seems to have suffered most. (Chupp).

Virginia: Frost reduced crop from promising one to 4% of a full crop. A few apples were produced in Frederick, Clarke, Fauquier, Loudoun,

and Rappahannock Counties. Practically no apples in other sections except a few along the eastern slope of the Blue Ridge and around Chesapeake Bay. (Fromme).

West Virginia: Many apples showed banding and blotching as a result of late frost. Others show the effect of frost injury and of course much of the fruit was a total loss. Some varieties were favored by late blooming. (Giddings).

North Carolina: Fruit a total loss all over state. (Foster).

Georgia: Greatly reduced the crop in north Georgia. (McClintock).

Mississippi: Very little complaint was received regarding frost injury with the exception of one observation in Alcorn County and there the damage was moderate. (Neal).

Arkansas: Crop almost entirely destroyed in all commercial sections. (Elliott).

Ohio: Russetting and killing of fruit occurred generally. Stark variety found to be exceptionally susceptible to fruit russetting and injury, while Baldwin, McIntosh, Hubbardston, and Jonathan were susceptible to wood injury. (Thomas).

Indiana: Blossoms were killed, fruit banded and extreme malformation of Ben Davis occurred in the southern half of the state where the crop was ruined. Rome Beauty was the only variety to bear in southern Indiana. (Gardner).

Wisconsin: Most severe in Mississippi Valley. Scattering loss in south central part of state. The Lake Shore region was free from injury. (Vaughan).

Scab caused by *Venturia inaequalis* (Cke.) Wint.

During 1921 scab was reported from all parts of the main apple producing area of the East, and from the Northwest in western Montana, northern Idaho, Washington, and Oregon. The disease was especially abundant along the northern Atlantic Coast from New Hampshire to Delaware; in the Appalachian fruit belt from Pennsylvania to northern Georgia; in the tier of states comprised of West Virginia, Ohio, Indiana, Illinois, and Iowa; in the Ozark fruit region of northwestern Arkansas and southwestern Missouri; and in northern Idaho and eastern Washington. It will be noted that most of these areas coincide with those where severe injury from the spring freezes occurred.

The following table prepared from collaborators' statements shows not only that the disease was more prevalent than usual in the particular regions mentioned, but that it was considerably less frequent than last year in the extreme northern tier of states from Maine to Montana. It will be noted that these states were among those least affected by spring frosts.

Table 3. Prevalence of apple scab in 1921 as compared with the average year and with 1920. Data from annual reports of state collaborators.

Prevalence compared with average			Prevalence compared with 1920		
More	Same	Less	More	Same	Less
N. H.	N. Y.	Vt.	Conn.	N. Y.	Vt.
Mass.	Wis.	Tenn.	R. I.	Va.	N. H.
R. I.		Miss.	Pa.	Kans.	N. J.
Conn.		Mich.	Del.	W. Wash.	W. Va.
Md.		Minn.	Md.	Mo.	Tenn.
W. Va.		N. D.	N. C.		Miss.
N. C.		Iowa	Ark.		Mich.
Ga.		Mont.	Ohio		Wis.
Ark.			Ind.		Minn.
Ohio			Ill.		N. D.
Ind.			Ida.		Iowa
Ill.			E. Wash.		Mont.
Ida.			Ore.		
Ore.					

In the Pacific Northwest scab was unusually abundant. Thus it was said to be more common than for the past three years in northern Idaho and more prevalent than any year since 1915 in eastern Washington. Regarding the appearance of scab in Washington this year, D. F. Fisher reported as follows:

> "I merely wish to record the first appearance of scab in the main Wenatchee Valley. It was of no importance this year and probably will not become so but it is of interest to note this sudden appearance in an isolated arid district entirely dependent upon irrigation."

From western Washington (west of the Cascades), Arthur Frank reported scab as very prevalent and severe in 1921, being much worse than in 1920. In eastern Oregon the disease was negligible as usual, but in the Umpqua and Willamette Valleys and coast counties the heaviest infection in many years took place according to Barss.

Losses from scab

The quantitative reduction in yield of marketable apples due to scab in 1921, was, of course, much less than usual on account of the small apple crop, but percentage figures on loss, which naturally do not fluctuate greatly with the size of the crop, compare rather closely with those of other years. A large part of the injury that occurred cannot be measured or expressed by figures. The year was one of severe injury to the apple foliage in many states, and defoliation with consequent weakening of the trees was reported from Rhode Island, Maryland, West Virginia, North Carolina, Georgia, Arkansas, Illinois, and western Oregon. Heavy primary and early secondary infection

was probably responsible for some of this, but the failure of growers to spray for leaf protection in the absence of fruit is taken to be the chief reason for the large number of reports on foliage destruction. Other states mentioning injury to the foliage especially are Vermont, New York, Pennsylvania, Delaware, Virginia, Ohio, Indiana, Kansas, and Montana. In this connection it should be remembered that other factors besides scab, such as the spring freezes or high temperatures and dry weather, may have been contributing causes in this defoliation. Another way in which the leaf infection of 1921 may cause an indirect loss is by providing an abundance of overwintering fungus for infection of the 1922 leaves and fruit. Undoubtedly, this will be a factor of considerable importance in the many commercial orchards that were not sprayed in 1921.

The estimated percentages of loss to the fruit in 1921 are given in Table 4. Complete figures, including the estimated loss in bushels will be published later by the Plant Disease Survey.

Table 4. Percentage loss from apple scab, 1921.

Percentage reduction in yield	States
10-15	Connecticut, Pennsylvania, Illinois, Iowa.
8	Ohio.
5	New York, West Virginia, Georgia, Indiana, Wisconsin, Missouri.
4	Virginia, Maryland.
3	New Jersey.
2	Vermont, Delaware, Michigan.
1	Minnesota, Kansas, Oklahoma, Montana, Idaho.
t	Tennessee, Mississippi, Arkansas.

Importance of scab as reported by collaborators in 1921

Maine: The season of 1921 was not a bad one for the control of apple scab in Maine so I should say that the amount of scab was considerably below the average. One reason for this was that we had an extremely dry season, particularly in the apple growing section of the state, although I have seen less scab with a season of greater rainfall. On a susceptible variety like the Ben Davis, records made by sorting eighteen barrels at random from the two central rows of four unsprayed rows in a rectangular block of about 1200 trees gave 22% of scabby fruit. This really means that 78% of the unsprayed fruit was absolutely free from scab and that the 22% included all fruit that had any evidence of scab whatever. In contrast to this, an equal amount of apples sorted from random samples taken from the same orchard where three applications of summer-strength lime sulphur had been made showed only 4% scab. (Morse).

New Hampshire: Very injurious on sensitive varieties. (Butler).

Vermont: Of small importance. Less than average. (Lutman).

Massachusetts: September 1 - Worse this year than usual in all parts of the state. (Osmun).

Rhode Island: November 1 - Leaf infection especially serious, fruit infection not as serious as anticipated. On the whole a very bad outbreak of scab throughout the state. (Browning).

Connecticut: September 1- The worst I have ever seen it in the state, recently, however, it has not spread further. (Clinton).

New York: Same as or less than last year, always important. (Chupp).

New Jersey: Disease very severe in some localities but of little importance in others. (Cook).

Pennsylvania: July 1 - Very prevalent again this year, will cause heavy damage even where there is no fruit. (Thurston).

Delaware: More than last year. Very important. (Adams).

Maryland: November 1 - More than last year. Greatest loss was to the foliage when premature defoliation resulted. (Temple).

Virginia: Very general on foliage and growers are greatly alarmed at prospects of injury next season due to carry-over of infective material. Practically no fruit in state. (Fromme).

West Virginia: November 1 - Quite prevalent in most sections. It has not caused very heavy fruit losses this year, but it has weakened many trees for production next year and is also producing much infectious material which will likely cause trouble next spring. (Giddings).

North Carolina: July 15 - The fruit (in the mountain sections) was all killed by frost and very little spraying was done, except the dormant and pre-pink. Nearly all of the trees are defoliated by the prevalence of scab. (Foster).

South Carolina: September 1 - No damage of note. (Ludwig).

Georgia: Probably did more damage than any other apple disease. Above the average amount. (McHatton).

Mississippi: Unimportant. (Neal).

Oklahoma: Quite important. (Stratton).

Arkansas: Very heavy leaf infection because of lack of spray applications. (Elliott).

Ohio: September 1 - The season of 1921 in Ohio has shown more than normal infection from apple scab. While the late freezes destroyed a heavy portion of the crop in southeastern district where scab susceptible varieties are grown to a very large extent, scab infection has extended over practically the whole state. A tendency to quit spraying after the freezing, has left many orchards without protection and resulted in very severe infections of both fruit and foliage for the midsummer period. These infections are not so marked in southeastern Ohio, possibly due to high temperatures and light rainfall during the usual period of disease spread. (Selby).

August 15 - Scab has ruined, at least for market purposes, much of the crop in northern Ohio. The leaves all over the state are heavily infected and since these leaves are the means by which the disease overwinters, there probably will be heavy infection of the young fruit next spring. (Clayton).

Indiana: Extremely destructive. Worst in northern Indiana. Frosts caused protracted blooming period, hence it was impossible to spray effectively. There was a blooming period of a month in some localities. The discouraging effects of frosts also caused many growers to omit sprays. Consequent heavy foliage destruction especially where no crop was set. In northern Indiana, late infection was well controlled. (Gardner).

Illinois: Most important apple disease. Very serious on the foliage throughout the season. (Anderson).

Michigan: Not of commercial importance this year. (Coons).

Wisconsin: Less than usual, important in orchards where trees were not sprayed. (Vaughan).

Minnesota: Most serious apple disease, but much less than usual. (Section of Plant Pathology).

Iowa: Injury severe, but would have been more so except for frost. Ten percent reduction in yield is estimated. This estimate is based on annual report of Extension Department spray demonstrations where fruit counts on check plots were made in many orchards. I feel that apple scab damage has been much underestimated. (Melhus).

Montana: Little or no spread through midsummer and early fall. Of slight importance in western apple districts. (Jennison).

Idaho: Important in northern Idaho. (Hungerford).

Washington: General in western Washington. More in eastern Washington than any year since 1915. (Dana).

Oregon: Scab negligible in Jackson County and absent from eastern Oregon. The Umpqua and Willamette Valleys and coast counties are showing unusually heavy infection, some orchards having lost much of the crop while in blossom; much defoliation was experienced in some sections. The losses will be more severe than in many years on account of spring weather favorable to scab and unfavorable to spraying for which many growers are not adequately equipped as yet. Not less than one-third of crop will be a loss in these two valleys. Hood River Valley will have not more than 2% loss from scab as fruit infections did not follow earlier and rather abundant foliage attack because of the practical absence of rain since petals fell. (Barss).

Ascospore discharge

Observations on the development of the scab perithecia and of the host were made at a number of stations last year. Information of this kind is of much value as it provides a basis for estimating the time when the spray applications should be made. It is hoped that more stations will take records of this kind in other years. Reports from six states follow:

Massachusetts: The first ascospores were discharged April 25; and the last June 13. The heaviest discharge was between April 27 and May 4. (W. S. Krout).

New York: First mature ascospores found in old leaves in Tompkins County (Forest Home), March 28. Earliest ever recorded here. (Chupp).

Virginia: Ascospore discharge at Blacksburg as follows: Slight March 22, 25, 27, April 14, 15; heavy April 17; moderate April 22, 30; slight May 4, 10, 25. (Fromme).

Michigan: Spore discharge started April 21 and continued with few spores being discharged until April 25. The three days of maximum spore discharge were April 25, 26, and 27. Few spores were left to be discharged after April 28. (C. W. Bennett).

Wisconsin: The first ascospore discharge was observed at Sturgeon Bay on May 13 and the last on June 16. No heavy or protracted discharges occurred. Experiments during the last two years have shown incubation periods of from 14 to 18 days. (G. W. Keitt[1]).

Minnesota: Ascospores found April 12 at St. Paul. (Section of Plant Pathology.

When these dates are compared with those of last year (U. S. Dept. Agr. Plant Dis. Bul. Supplement 14: 8. 1921) it will be seen that they are consist-

ently earlier than those of 1920, and when compared with the rainfall both before and after spore projection their relations to the rainy periods will be seen. (Tables 5 and 6.)

Table 5. Rainy days at places where observations on ascospore discharge were made. Parentheses ( ) indicate approximate dates of first ascospore discharge.

Place	Dates on which rain occurred (Dash - indicates period without rain)
Amherst, Mass.	April 1 - 7,8,9 - 15,16,17,19,21,22,23,24,(-),29,30, May 1 - 5.6 - 13,14,15,16 - 22,23 - 25 - 29.
Ithaca, N. Y.	March 1,2,3,4,5,6,7 - 9 - 12,13 - 16,17,18,19,20,21,22, 24,25,26,27,(28),29 - 31, April 1 - 8,9,10 - 13,14,15, 16,17,18 - 20,21,22,23,24 - 29,30.
Blacksburg, Va.	March - 3 - 9 - 12 - 14,15,16 - 21,(-),23,24,25 - 31, April 1 - 8,9,10,11 - 16,17,18 - 23 - 26,27,28,29.
Sturgeon Bay, Wis.	May - 12,(13), - 15 - 17 - 25 - 27,28 - June - 2 - 6,7 - 10 - 12 - 15.
St. Paul, Minn.	April - 5,6,8,9,( ) - 14 - 21,22 - 25 - 30, May 1 - 9,10, 11,12,13 - 16,17,18,19,20 - 23,24 - 26,27 - 29,30.

Table 6. Dates of earliest appearance of scab, according to collaborators.

State	Date	Locality
New Hampshire	May 24	Hollis
Connecticut	May 31	Watertown
New York	May 2	Wayne and Niagara Counties
Pennsylvania	May 11	Adams County
Delaware	April 21	Nassau
Virginia	May 10	Blacksburg
West Virginia	April 25	
Mississippi	July	Agricultural College
Oklahoma	June 14	Watonga
Arkansas	May 1-7	Fayetteville
Ohio	April 25	Southern part of state
Indiana	April 24	Surrey
Illinois	May 3	Champaign
Wisconsin	May 15	Madison
Minnesota	May 16	St. Paul
Kansas	July 14	Troy

Varietal susceptibility

Practically all of the New England states, and also New York, Pennsylvania, and Ohio, reported McIntosh as being especially susceptible to scab last year as in other years. Rhode Island Greening and crab-apples were badly scabbed as usual in Connecticut and New York and other varieties mentioned as scabbing heavily were: Fall Pippin in Connecticut, Early Ripe and Stayman in Pennsylvania and Delaware, Rome Beauty in Pennsylvania and Ohio, Northwestern Greening in Wisconsin, and Wealthy and Virginia Crab in Minnesota.

Elliott in Arkansas reports Maiden Blush as being very resistant.

The following observations reported by M. W. Gardner of Indiana are of interest:

"Scab lesions caused extreme hypertrophy on Ben Davis at Peru. Observations on varietal susceptibility in an orchard at Mooresville were made September 15 as follows: Noted on fruit of Maiden Blush, Wealthy, York Imperial, and Jonathan. Foliage infection bad on Maiden Blush, Pewakee, Chenango, Benoni, Wealthy, Stark, Jonathan, and Indiana Favorite. Foliage infection very light on Grimes and York Imperial. None noted on Transparent or Winter Maiden Blush.

"C. L. Burkholder reports failure of spray control of Winter Banana in De Kalb County. He also found Delicious as susceptible as Fameuse."

Scab control

Connecticut: Even sprayed trees of the most susceptible varieties were more or less scabbed; the dusted more so; and the unsprayed mostly worthless. (Clinton).

Delaware: Because of irregular fruit set spraying was not effective for fruit protection. (Adams).

West Virginia: September 1 - Scab has been readily controlled in sprayed orchards, and we have had fair success with dust. (Giddings).

North Carolina: July 15 - Very little spraying was done except the dormant and pre-pink. (Foster).

Georgia: Proper spraying seemed to be very effective. (McHatton).

Arkansas: Two or three scab sprays controlled the disease. Very little spraying done except in best orchards on account of loss of crop. (Elliott).

Ohio: July 1 - The severe loss from freezing of crop south of the latitude of Columbus after blooming, has led to reduced interest in scab control. More than normal scab infection of fruit and leaves has occurred in other areas outside the southeastern district so that we recommended late June and early July spraying with weak Bordeaux mixture to guard against defoliation from scab and serious carry-over of the disease to next season. Scab

control has been satisfactory from pre-blossom application of stronger Bordeaux mixture. The evidence shows the basic value of this spray for scab control. Weak Bordeaux spray applied following calyx cup spray proved satisfactory check to scab on leaves in southeast. (Selby).

This year has shown again that pink spray is the important one for scab control. One trial comparing Bordeaux and lime sulphur sprays indicated that the Bordeaux was superior. (Clayton).

Indiana: Frosts caused protracted blooming period, hence it was impossible to spray effectively. Many growers omitted sprays. (Gardner).

Illinois: Few growers continued to spray after the fruit was killed. (Anderson).

Michigan: Dusting is reported by Dutton to be efficient again this year in controlling scab. (Coons).

Wisconsin: Spraying controlled better than last year. (Vaughan).

Scab development was insufficient to furnish an adequate test of the efficiency of the various spray and dust programs. (Keitt).

Oregon: Western Oregon growers who are getting the best results are putting on two separate applications before the blossoming period (delayed dormant and pink). Then they follow with two or three more through the moist spring weather. (Barss[2]).

Dusting for scab in 1921

The results of cooperative dusting and spraying experiments in 1921 conducted in the states of Connecticut, New York, Pennsylvania, and West Virginia and in Ontario, Canada, have been reported by the Crop Protection Institute[3]. In a number of other states the lack of a crop or the slight scab development interfered with dusting experiments that had been planned or were under way. The status of dusting in Nova Scotia, Illinois, and California is discussed in references 4-8, given below.

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Blotch caused by Phyllosticta solitaria E. & E.

In 1921 the geographical range of blotch was about the same as usual (See map, Fig. 4.), but collaborators in some of the more northern states report an advance of the disease into some of their more northern counties. The progress of blotch northward during recent years has been pointed out in various publications from the United States Department of Agriculture and from the State Experiment Stations. The following quotations from collaborators of the Survey throw further light on the northern march of blotch:

Ohio: Apple blotch has been noticed in Ohio for about ten years. The Ohio Experiment Station in 1910 received reports of its appearance in seven counties. In 1911 it was reported from 16 counties and it has increased in prevalence rapidly ever since. It is now known to be in about 60 of Ohio's counties. While the disease is most common in southwestern Ohio and seems to have radiated from there in its distribution over the state, it is by no means a strictly southern Ohio disease. It can be found occasionally within 50 miles of Lake Erie which bounds the northern part of the state. We find most of the blotch in Ohio in orchards south of Columbus, just as it is most commonly observed in Indiana south of Indianapolis. Its distribution in Ohio is quite similar to its spread over Indiana. (Beach[2]).

Apple blotch has heretofore been looked upon as a disease prevalent or dangerous only in the southern half or even in the southeastern portion of the state. The season of 1921 has proved the danger of this view-point. Under the practice of the omission of pre-blossom or midsummer applications of copper sprays along with the known tendency toward dispersal of spores, the disease has advanced practically across the whole of Ohio. The suscept-

ibility of varieties, and the condition as to origin and treatment of trees make for sharp variations in occurrence. Investigations since July 1 have brought the blotch invasion northward sharply into view. As reported July 1, specimens have been studied from many additional counties and recent collections in Wayne, Lucas, and Ashland have pointed to the real arrival of this orchard parasite at the northern boundaries of the state. (Selby).

Illinois: In southern Illinois, blotch is considered by far the most serious apple disease on susceptible varieties and the hardest to control. Northern growers may be prepared to go to the trouble and expense of extra spraying within the next few years for the disease is now in the northern section and will continue to spread and become better established each year. (Anderson[1]).

Of the states reporting blotch in 1921 those in the southern and central portions of the blotch area report the disease as being less prevalent than last year or about the same. However, the states along the northern border of the blotch area report that the disease was more prevalent than last year. Thus Temple and Jehle in Maryland report very much more than last year or the average year. In Delaware Adams states that the disease was very severe as the trees received only the dormant and pink sprays. Blotch is reported on the increase in Delaware. In West Virginia Giddings reports more than in most seasons and makes the additional statement that blotch is becoming of importance in West Virginia and is fast spreading over the state. From Ohio R. C. Thomas writes that the disease is of considerable importance, being worse than last year or during the average year. In Indiana Gardner reports that blotch was the worst disease on the susceptible varieties and that it was worse than usual in 1921. Anderson in Illinois also reported the disease as more prevalent than usual.

These variations in amount of blotch are probably largely attributable to weather conditions during the season. The shortage or absence of the apple crop in many places would also influence the amount of disease that is noticeable on the fruit. The shortage of the crop, however, would probably not influence infections of leaves and twigs very greatly.

Losses from blotch

The losses from blotch took the form of fruit blemishes, in many cases followed by secondary rots, leaf and petiole lesions and twig cankers, Naturally the loss in bushels in 1921 was small because of the light crop in the blotch area. However, the percentage of affected fruit does not vary greatly from the normal, although as compared with 1920, higher percentages in the northern part and lower percentages in the southern part of the area were noticeable. The accompanying map (Fig. 4) shows the losses in percentage of the crop by states, both in 1920 and in 1921.

The money loss from blotch was naturally much less in 1921 than during the previous year on account of the small amount of fruit to be affected. However, the crop shortage resulted in high prices so that the loss of a bushel

of fruit in 1921 represented more loss in dollars than a bushel of fruit in 1920. Nevertheless it is true that on account of the fruit scarcity, apples of poor quality were accepted and sold at good prices in the markets.

Fig. 4. Estimated percentage loss from apple blotch, 1920 and 1921. (Numerator indicates loss in 1921, denominator - loss in 1920.)

Dates of first appearance of blotch according to collaborators, 1921

Pennsylvania	June 4	Adams County
Delaware	June 26	Bridgeville
Mississippi	June 1	Starkville
Louisiana	July	Calhoun
Oklahoma	July 16	Stillwater
Arkansas	July	Booneville
Ohio	July	Washington County
Indiana	June 4 (fruit)	Floyd County
Illinois	May 28	Anna
Kansas	March 31	Harper

Weather relations

As has been stated (page 2), the growing season was generally warm, except during August in the northern part of the blotch area where temperatures were about normal or slightly below. The rainfall for May in the northern part of the blotch area was about normal, but June and July were characterized by a small amount of rain which undoubtedly inhibited blotch. August was somewhat dry in the southern part of the blotch area, but the central and northern portions had an abundance of rain. This apparently favored secondary blotch infections with the result that the disease was bad, particularly in

the northern portion of the belt. H. W. Anderson in Illinois reports that:

> "The first infections in southern Illinois occurred during the latter part of May. The secondary infections occurred about June 19 after a heavy rain and a late heavy blotch infection evidently took place during the latter part of August, after the rainy periods of that month."

Origin of blotch cankers

M. W. Gardner presented a paper at the Toronto meeting of the American Phytopathological Society, December, 1921[3], pointing out that in Indiana a high percentage of twig cankers on Northwestern Greening occur at leaf scars. Basal petiole lesions are common and cases of actual crossing over of the lesions from petiole to twig were observed. Most of the cankers do not appear until the following season, however. Gardner states that:

> "Cultural tests .... indicate that the fungus may grow down within the petiole and cross the abscess layer before the leaf falls. Another type of twig lesion seems to result from bud scale infection. Direct infection of suckers and water sprouts between the leaf scars is of common occurrence."

Varietal susceptibility

In recent papers by Roberts[4] the following list showing varietal susceptibility is given:

Among the most susceptible are:

Missouri Pippin	Arkansas Black
Northwestern Greening	Ben Davis
Red Limbertwig	Smith Cider
Maiden Blush	Lansingburg
Dutchess	

Resistant varieties are:

Winesap, Jonathan, and York Imperial

Moderately susceptible varieties are:

Mammoth Black Twig, Stayman, and Rome Beauty

During the year collaborators have collected some additional data on varietal susceptibility, as is shown in the following reports. Although Jonathan is usually listed as a resistant variety, it will be noted that collaborators in both Ohio and Indiana observed the disease on that variety this past year.

Delaware: Fruit infection observed on Ben Davis, Langford, Harvest

Pippin, Smith Cider, Gilpin (Carthouse), Poorhouse (Winter Green), Golden Pippin, Dutchess. (Adams).

Georgia: Poorhouse and Rome Beauty susceptible. (McHatton).

Indiana: Additions to susceptible varieties as listed in 1920 report (Pl. Dis. Bul. Suppl. 14: 16. 1921). Found on fruit of Grimes, York, and Jonathan in Morgan County; on fruit of Grimes in Franklin County; and a few cases on Stayman in Tippecanoe County. Cankers found on Aiken, Champion, Gideon, Summer Rambo, and Salome in Lawrence County. (Gardner).

Ohio: In Lucas County on August 6, R. C. Thomas found 95% seriously affected leaves of Jonathan. On this variety little fruit infection was found. (Selby).

Varieties, very susceptible to attack by blotch, which have been regarded as a menace to less susceptible varieties and which have frequently replenished the wood pile, include the following: Smith Cider, Missouri Pippin, Mann, Oldenburg, Stark, Maiden Blush, Northwestern Greening, and Ben Davis. (Beach[2]).

Iowa: High percentage of cankers noted on certain varieties of nursery seedlings such as Fameuse. (Melhus).

Blotch control

Three or four sprayings with 3-4-50 Bordeaux mixture at intervals of three weeks after petal-fall are generally recommended for blotch control, but, naturally these recommendations have to be altered more or less, depending upon conditions in the various states. In some places, however, we find lime-sulphur being used.

Thus, in Ohio Agricultural Experiment Station Bulletin 333, Selby recommends Bordeaux mixture:

3-4-50 3 weeks after petal-fall
Same 3 weeks after first application
Same 3 weeks after second application

In Illinois, however, Gunderson (Illinois Agr. Exp. Sta. Bul. 222: 551-575. Sept. 1919) recommended:

1. Lime-sulphur (2.5 gals.), arsenate of lead (2 lbs. powder), water (100 gals.) - three weeks after petal-fall.
2. Same, five weeks after petal-fall.
3. Extra sprays when needed later in the season.

The following reports concerning blotch control have been received from collaborators:

Ohio: The mid-July spray has been found to give perfect control in

some cases due to the fact that June was a dry month. The inefficiency of dusts (both lime-sulphur and dehydrated copper sulphate) to control blotch and scab was sharply demonstrated in one orchard of Jonathan in Lucas County. (Selby).

Indiana: Good control of leaf and fruit infection with Bordeaux mixture two, four, and six weeks after petal-fall. Scarcity of fruit caused failure to spray this season and consequent heavy infection of leaves and twigs. (Gardner).

Illinois: A number of growers neglected to spray on account of poor crop and thus lost heavily on what little fruit they had. In several cases in southern Illinois where delayed dormant was applied, the fruit was clean with no further applications. In other cases, however, this was not true. (Anderson).

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Bitter rot caused by Glomerella cingulata (Stonem.) S. & von S.

During 1921 bitter rot was reported from the usual states in the belt extending from New Jersey on the northeast to Missouri and Arkansas on the southwest. No extension of normal range of the disease seems to be apparent from the reports received, although it might be supposed that the unusually warm weather of 1921 would have promoted progress northward.

Less bitter rot than usual was reported from the northeastern states from Rhode Island to Virginia. Arkansas and Iowa also report less of the

disease, but the collaborators in the remaining bitter rot states report an average or a greater amount than last year.

It should be remembered that it was in this bitter rot belt that the crop was very greatly damaged and even ruined in many cases by the spring freezes. Consequently, the yield of apples was very low and there was a general lack of interest in the crop. The freezing damage caused a general cessation of spraying with the result that in some cases bitter rot had a chance to develop without hindrance on the small amount of fruit that set. Thus we have two important factors aside from the weather affecting the importance of bitter rot in 1921;,(1) a very small crop to be affected, and (2) lack of spraying which permitted abundant infection on the unsprayed fruit.

The accompanying map shows the estimated percentage of loss from bitter rot in the United States during 1921. (Fig. 5).

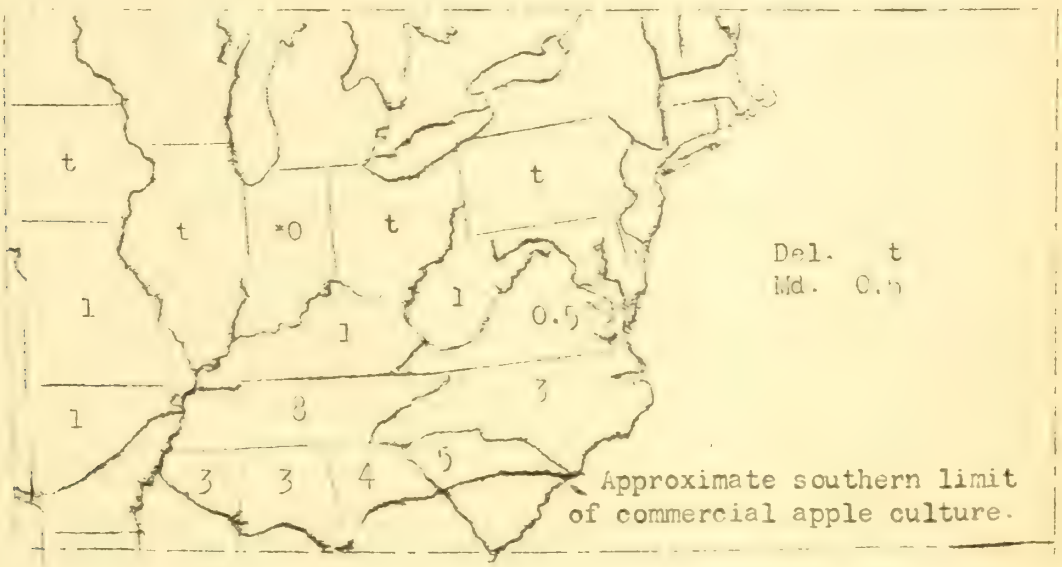

Fig. 5. Percentage loss from bitter rot, 1921.

Scarcity of fruit in the southern apple belt resulted in the marketing of much fruit affected with bitter rot and other diseases.

Relation of weather to bitter rot in 1921

Collaborators in South Carolina, Georgia, Mississippi, and Illinois report that bitter rot did its greatest damage at the time when the fruit was approaching maturity, which was in August and September. Therefore, the weather of these two months should be considered in studying weather relations.

The month of July was considered unusually warm throughout the country and the temperature was above normal in practically all of the bitter rot states. The rainfall, however, was deficient in these states with the exception of South Carolina and Georgia. Here rainfall was abundant, averaging about 7 inches in the two states. Further northward and westward the rainfall became lighter and in many cases took the form of heavy showers with rather long periods of drought. The July rainfall, therefore, cannot

be considered as being especially favorable to bitter rot except in the southeastern portion of the area and it will be noted that in this locality the disease was reported as being worse than usual.

August was a cool month, the temperature being about normal in most states, but below in Pennsylvania, Ohio, West Virginia, Virginia, North Carolina, and parts of South Carolina. The August rainfall was heavy in West Virginia, Ohio, Indiana, Illinois, Missouri, and Arkansas, being from 1 to 2 inches above normal in these states. A deficiency, however, occurred in the Atlantic Coast and Gulf States from Virginia to Texas. It would appear then, that as far as rainfall is concerned conditions were favorable for bitter rot in the southern and northern portions of the belt. The temperatures, however, were probably somewhat lower than the optimum for the disease.

September was a warm month, being above normal in all of the states concerned. Plenty of rain occurred in Ohio, Indiana, Illinois, Missouri, West Virginia, Kentucky, and Tennessee; but again there was a deficiency along the Atlantic Seaboard and Gulf States. Apparently, then, September was favorable for the disease in the central and northern portion of the belt, and this checks with reports of collaborators in these sections that the disease was most active late in the season.

Dates of first appearance according to collaborators for 1921

Pennsylvania	July 12	Crawford County
Delaware	August 9	Bridgeville
South Carolina	July 15	Clemson College
Louisiana	July	Calhoun
Illinois	July 25	Centralia

Varietal susceptibility

The following notes on varietal susceptibility were furnished by L. R. Hesler and N. D. Peacock, of Tennessee:

Ben Davis, susceptible - probably the worst rotting variety.
Yellow Transparent, Champion, Early Harvest - susceptible.
Stayman, Delicious, York Imperial - moderately susceptible.
Winesap - one of our most resistant varieties.

The variety King David was reported as being especially affected in Delaware.

Blister canker caused by Nummularia discreta Tul.

During 1921 blister canker was reported to the Survey from states in the eastern half of the country with the exception of the South Atlantic and Gulf States, and also Iowa, Minnesota, and Wisconsin.

Collaborators' statements indicate that the disease was about as active as usual although from Indiana it was reported that cankers made considerable growth during the year. If blister canker makes more rapid progress during years of drought as is reported by Gloyer[1], one would suppose that the disease would be favored by the generally dry summer of 1921.

The following notes concerning occurrence of the disease in some of the states have been received:

Ohio: As in 1920, blister canker has shown increased attack on older apple trees, especially to the southward in Ohio. The early removal of the infected branches, certainly before the sprays applied at the time of swelling of buds, is properly insisted upon. (Selby).

Indiana: Especially in the southern two-thirds of the state. (Gardner).

Illinois: General, but worse in the south wherever Ben Davis is grown (Anderson).

Michigan: Serious canker infestation found on a few trees of Ben Davis variety near Paw Paw. This makes the third location for this fungus known for Michigan, and the only location where the fungus has been found killing the limbs of the trees. (Coons).

The following losses were reported during the year. In Arkansas 2% loss of the crop is attributable to this disease. Blister canker is always important in that state where a high percentage of the susceptible Ben Davis variety is grown. In Indiana 0.1% loss is estimated and in Illinois 1-2%. Melchers in Kansas reports the disease as serious, sometimes affecting all of the trees in an orchard, but probably not causing a reduction in yield of more than 5%. It is estimated that about three-quarters of the Kansas apple orchards have the disease present in them.

The following notes from collaborators concerning the subject of disease susceptibility have been received:

Arkansas: Jonathan, Winesap group, resistant. Ben Davis group and Delicious, Grimes, Yellow Transparent, quite susceptible. (Elliott).

Indiana: Has been noted on Grimes and Ben Davis. Serious problem on Ben Davis in certain orchards. (Gardner).

Illinois: Ben Davis worst. Observed on most varieties grown in Illinois. Observed on Benoni for the first time. (Anderson).

Recent literature

Cited:

1. Gloyer, W. O. Blister canker of apple and its control. New York (Geneva) Agr. Exp. Sta. Bul. 485: 1-71. Pl. 1-15. Jan. 1921.

Not cited:

Anderson, H. W. Some factors influencing the practical control of blister canker in apple orchards. Proc. Amer. Soc. Hort. Sci. 17 (1920): 111-116. 1921.

Black rot caused by <u>Physalospora cydoniae</u> Arnaud
(<u>Sphaeropsis malorum</u> (Berk.) Pk.)

During the year black rot was reported from practically all of the eastern apple states and also from Oregon and from Idaho where one collection was made. The disease is of rare occurrence and minor importance in the West. Regarding its occurrence in Oregon Barss reports that, "It is unreported outside of western Oregon where it is scattered but never important."

For the United States as a whole, the losses from black rot during 1921 (Fig. 6) were second only to those for scab. In Maryland and Virginia the disease was the most important apple trouble of the year, according to collaborators, and in Indiana C. L. Burkholder reported frog-eye worse than he had ever before noted it.

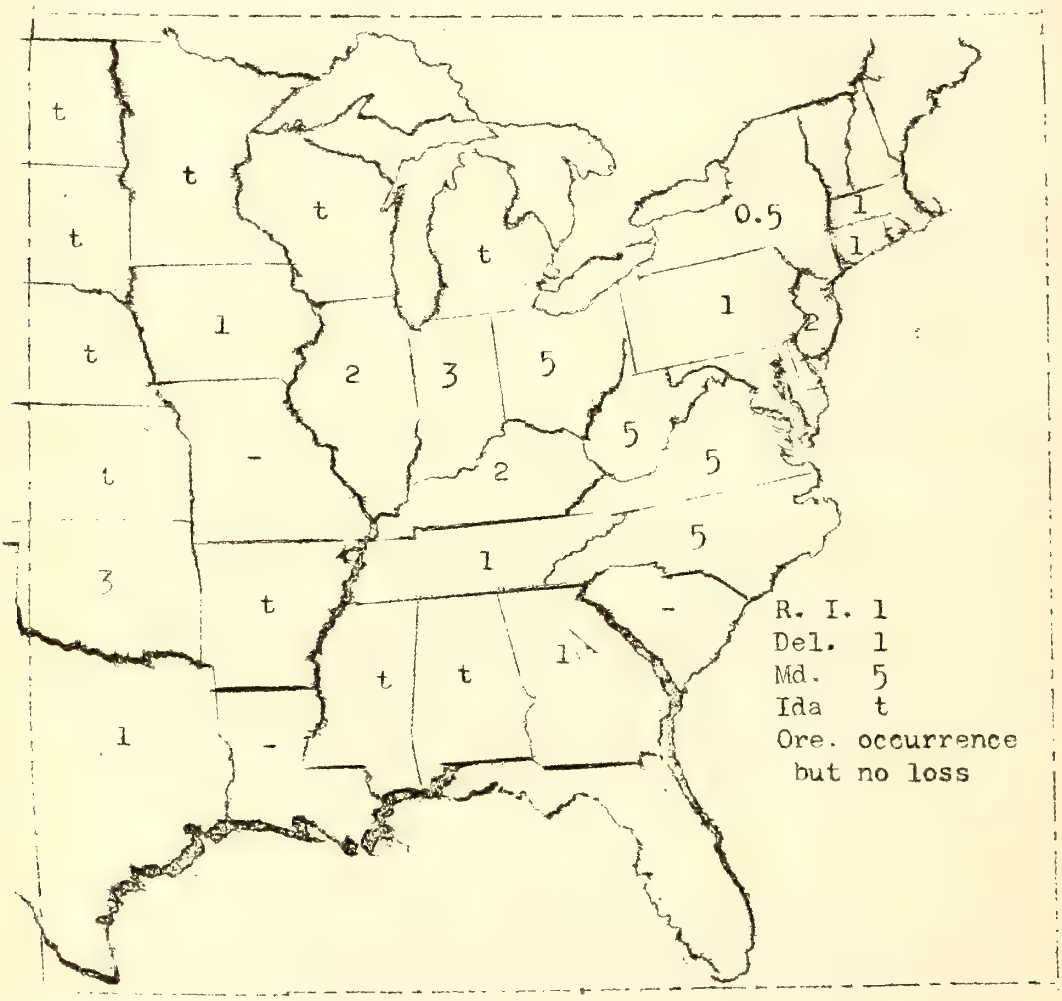

Fig. 6. Estimated percentage of 1921 apple crop lost from black rot. The loss is largely due to defoliation, resulting in reduced yields, both for 1921 and 1922. Some loss, however, is a result of rotting of the fruit.

Nature of injury from black rot

In considering the losses from black rot, the nature of the injury must be taken into account. During 1921 leaf infection was very heavy, particularly in east-central United States. In this area, which roughly corresponds to that where frost damage was severe, heavy defoliation of the trees occurred because of the frog-eye leaf spot. From Indiana the report was received that the frog-eye lesions seem to be considerably larger than usual. It is thought that this unusual amount of the leaf spot in the area affected by frost may be due to the failure of growers to spray, thus permitting the fungus to develop without interference. The fruit rot form of the disease was also common in some localities where there was any fruit. It was suggested by Anderson, of Illinois, that the excess of fruit rot in some localities was probably due to an abnormal amount of worm injury which had resulted from the reduced spraying program. F. P. Cullinan, of Indiana, reported heavy losses from the fruit rot following growth-crack injury on Grimes in Franklin County. An unusual amount of twig infection was reported from Ohio (See fire blight, page 32). Regarding the situation in that state A. D. Selby further reports as follows:

> "Next to apple scab, the infection of apple twigs, leaves and fruit from black rot and blotch over practically the entire state has been the striking feature of the season. Black rot cankers are so much in evidence and the Sphaeropsis malorum so closely follows fire blight or other dying of twigs as to make a real black rot problem."

In Virginia Fromme found that:

> "The relation of early foliage infections to infected twigs was very evident. Twigs are the chief source of over-wintering in this state."

It is very probable that the killing of blossoms and shoots by the spring freezes provided an unusual opportunity for the black rot fungus to gain entrance to apple twigs and branches.

Regarding the relation of the weather to black rot, collaborators in Ohio report that favorable conditions prevailed in April and also late in the season, and in Illinois and Indiana the warm and wet fall was favorable for the fungus.

Dates of first appearance on leaves or fruit

New Hampshire	June 22	Nashua
Connecticut	June 1	Cheshire
New York	May 9	Columbia County
Pennsylvania	April 28	Cumberland County
Delaware	April 29	Bridgeville
Virginia	May 10	Blacksburg
Mississippi	May 10	Agricultural College
Arkansas	May	Fayetteville
Ohio	June	Washington County
Indiana	April 28	Vincennes
Minnesota	June 5	Wabasha

Varietal susceptibility

Regarding susceptibility of varieties, collaborators report:

Massachusetts: Baldwin most severely attacked. (Osmun).

Rhode Island: Serious defoliation in spring. Baldwin most seriously affected. (Browning).

Connecticut: Most reports on the Baldwin. Not much rot of the fruit. (Clinton).

New York: Mentioned as common on McIntosh, Alexander, Ben Davis, and Baldwin, (Chupp).

Ohio: Yellow Transparent, Jonathan, Ben Davis, Northern Spy, have been considered this year to be very susceptible, especially to twig blight. (Thomas).

Indiana: Differences in varietal susceptibility were observed in an orchard at Mooresville as follows:

Leaf spot bad on Ben Davis, Maiden Blush, Pewaukee, Yellow Transparent, Chenango, Wealthy, Winter Maiden Blush, and Northwestern Greening.

Leaf spot not as bad on Benoni, Grimes, Stark, and Jonathan.

No leaf spot on Indiana Favorite and York Imperial.

Fruit rot noted on Grimes, Jonathan, and as a blossom-end rot of York Imperial.

Cankers were destructive on Ben Davis at Peru, and were also noted on young Grimes in Orange County following seventeen-year locust injury of 1918. (Gardner).

Michigan: Occasionally does a small amount of damage to Russian varieties at the Agricultural College and this year was reported as serious on Alexander at Benton Harbor and on an unknown variety at Bay City. (Coons).

Control of black rot.

Regarding control of black rot Giddings in West Virginia, states that it is one of the most difficult apple troubles to combat, but that spray and also dust will control it. In Indiana, Gardner reports that Bordeaux mixture as applied for blotch at 2, 4, and 6 weeks after petal-fall in Clark County gave poor control for frog-eye leaf spot on Ben Davis, the check trees showing about 60% and the sprayed trees about 45% of frog-eye.

Fire blight caused by Bacillus amylovorus (Burr.) Trev.

During the year fire blight was reported from practically all of the eastern states and also from Montana, Idaho, and the Pacific Coast region. Most

of the states reported the disease as generally scattered in occurrence but many of the losses were local rather than general. According to collaborators there was more disease in northern Illinois than in the central and southern portions of the state and in Montana the disease was mostly in the western portion of the state, especially in the Bitter Root Valley. In Washington the White Salmon section was the one where the disease was especially noted, and in Oregon the southern part of the state and the region east of the Cascades showed more or less blight.

Fire blight on the apple was reported as being of considerable importance in the northern states of New York, Michigan, Wisconsin, Minnesota, northern Indiana, northern Illinois, and Montana. In the South it was mentioned as being important in South Carolina, Mississippi, and Texas. For the most part collaborators in other states considered this disease as of only moderate or slight importance in its effect on the apple crop.

Collaborators in the following states mentioned the disease as being more prevalent than in 1920: Vermont, Michigan, Illinois, and Montana; while those in Vermont, Connecticut, Michigan, Wisconsin, Illinois, Montana, and North Carolina mentioned it as being above the average in prevalence. States that reported less in 1921 than in 1920 include New Jersey, Maryland, Texas, Georgia, Arkansas, Indiana, Minnesota, North Dakota, Kansas, and Oregon; while those reporting less than the average year were Pennsylvania, Maryland, Arkansas, Ohio, Indiana, Minnesota, North Dakota, and Oregon.

Fig. 7. Estimated percentage loss from fire blight of apples, 1921.

Preliminary estimates of percentage of loss from fire blight during 1921 have been made and are recorded on the accompanying map (Fig. 7). Complete and final estimates on losses from fire blight will appear later.

From Oregon H. P. Barss reported as follows concerning fire blight, July 1:

> "Noticeable in many orchards in Jackson County according to Cate, but damage will be far less than last season. None is reported in the Umpqua, Willamette, and Hood River Valleys up to this time, It is serious in some orchards in Wasco County. It is not reported from eastern Oregon sections as yet this year."

It will be noted that the most severe losses occurred in two belts, one along the northern portion of the country and the other in the southern part of the eastern apple area. In the east central portion of the country, where earlier in the season frost damage was heavy, the losses were very slight. Perhaps one explanation of this may be found in the fact that the killing of the apple blossoms in the spring eliminated very much of the blossom infection. In the northern states the disease continued to cause considerable loss as in 1920, although in Minnesota and North Dakota the disease was considerably less important.

Weather relations of fire blight, 1921

The somewhat dry weather during certain parts of the summer was unfavorable for the dissemination of the fire blight organism, and also for infection of the host. In the spring the weather conditions, with the exception of the killing frosts, were quite favorable for the disease, but the dry weather of June and the subsequent months tended to check growth and harden the apple wood thus retarding the growth of the fire blight bacteria.

Collaborators report as follows concerning weather conditions:

Vermont: Very common earlier in the season as a twig blight, but has dried up like everything else. (Lutman, July 15).

Pennsylvania: Dry weather not particularly favorable for fire blight. (Thurston and Orton).

Delaware: Little rain this season. Unfavorable to development. (Adams).

Ohio: The freezing appears to have limited sources of infection by killing pear blooms. Blossom infection is locally severe, although decidedly restricted. Twig infection is rather slight but quite general on susceptible varieties. (Selby).

The fire blight attack seems to have been checked materially by the dry weather of the past month. (Clayton, August 15).

Michigan: Very common this year, especially the blossom blight.

Frost decimated the blossoms and in some cases blight took what remained. The blight on apple was checked largely by the dry summer. Cold, moist spring in blossoming time favorable for the disease. (Coons).

Minnesota: Dry, hot weather. Unfavorable. (Section of Plant Pathology).

North Dakota: Dry weather conditions which have prevailed throughout the summer have apparently prevented excessive growth, with the result that fire blight has not done the usual amount of damage to apple trees. (Bolley).

Kansas: The late frosts killed most of the blossoms and no doubt killed many aphis and other insects which figure in spreading blight. (Melchers).

Oregon: Cool spring unfavorable to insects and blight. (Barss).

Nature of injury

Collaborators for the most part report that the chief damage this year took the form of twig blight. However, rather heavy cases of blossom infection were reported. In Ohio Selby and Thomas found the black rot fungus (Sphaeropsis malorum) fruiting on many of the dead apple twigs and the question arose as to how great a part the black rot organism was playing in the killing of the twigs. Regarding this R. C. Thomas writes as follows on September 1:

"Throughout my entire trip I was very much impressed with the amount of twig blight. The organism present was the black rot fungus. Question arises as to whether black rot is the primary cause or whether fire blight followed by black rot has been the logical manner of attack."

Another form of injury was a blighting of the roots reported from Maryland and the collar-rot disease which may or may not be due to fire blight was reported from Indiana, Ohio, and Idaho. (See collar-rot, page 46).

Dates of first appearance according to collaborators, 1921

Vermont	June 10	Burlington
Connecticut	June 23	Danbury and New Haven
New York	April 12	Tompkins County
Pennsylvania	May 16	State College
Delaware	May 19	Bridgeville
Virginia	May 24	Poquoson
Mississippi	June 25	Agricultural College
Ohio	June	Wayne County
Indiana	June 4	Floyd, Decatur, and Shelby Cos.
Illinois	May 5	Anna
Michigan	May 10	Bangor

Wisconsin	June 15	Madison
Minnesota	June 16	Hutchinson
Kansas	June	Manhattan
Colorado	June	Fort Collins
Oregon	May 25	Jackson County

Varietal susceptibility

Regarding the susceptibility of various varieties of apples collaborators report as follows:

Vermont: Yellow Sweet is not especially susceptible. (Lutman).

Connecticut: Greening, Fall Pippin, Hulburt, Stark, and Gravenstein, susceptible in order named. (Clinton).

New York: Most common on Greenings. York Imperial and King seem very susceptible. (Chupp).

Delaware: Prevalent only on Yellow Transparent. (Adams).

Indiana: Severe on Jonathan in one locality; not on Grimes, King David, Stayman, Delicious, or Winesap in the same orchard. (F.P.Cullinan).

Illinois: Very serious body blight of variety Willow observed in Calhoun County. (Anderson).

Michigan: One hundred percent blossom blight observed on Dutchess. (Coons).

Wisconsin: All fruit dropped from Tolman Sweet; on most other varieties infection was confined to new growth. Other particularly infected varieties were Yellow Transparent, McMahon, Wealthy, and Transcendent. (Vaughan).

Montana: Marked differences noted in varietal susceptibility. (Jennison).

Idaho: Important on Spitzenburg. (Hungerford).

Control of fire blight

The only state reporting on fire blight control this year was Wisconsin. Regarding the work in that state R. E. Vaughan reports as follows:

"Blight control by eradication of Transcendent Crab and any other varieties with hold-over cankers is being undertaken by the community around Hatchville, Dunn County. Every farm owner within a radius of 3 miles has agreed to take out the offending trees. The Western

Orchards Company has over 100 acres in young orchards and was chiefly instrumental in starting the work. The Wisconsin State Department of Agriculture and College of Agriculture are cooperating with the local growers.

"So far as known this is the first community in Wisconsin to undertake a comprehensive campaign against blight."

Rust caused by Gymnosporangium juniperi-virginianae Schw.

During the year 1921 rust was reported from practically all of the states where it has occurred previously. These states include all of those where apples are grown east of the 100th meridian.

The year was one in which rust attracted only slight attention. Nearly all of the states reporting it say that it was present on the apple foliage in about the same amounts as last year, or, in some cases, it was said to be less prevalent. There were indications, however, that the disease was slightly more common than usual in Connecticut and some of the reports indicate a heavier foliage infection in parts of Arkansas and Missouri than last year.

When the losses for the United States as a whole are considered, rust will be seen to have caused only comparatively small damage. The accompanying map (Fig. 8) shows the estimated percentages of loss from rust in 1921. In general, these figures are somewhat lower than those of last year. Complete estimates of loss, both in percentage and in bushels, will be issued later by the Plant Disease Survey.

The accompanying map also shows the outer limits of the range of red cedar and the approximate outer limits of apple culture. Much more detailed maps showing the prevalence of the cedar within the various states would be very helpful in studying the relation between rust losses and the abundance of cedars. Collaborators report that this disease is localized in many of the states. Thus, in New York the disease is not serious outside of the Hudson Valley, but in that region it is an important factor. In states like Virginia, West Virginia, and North Carolina

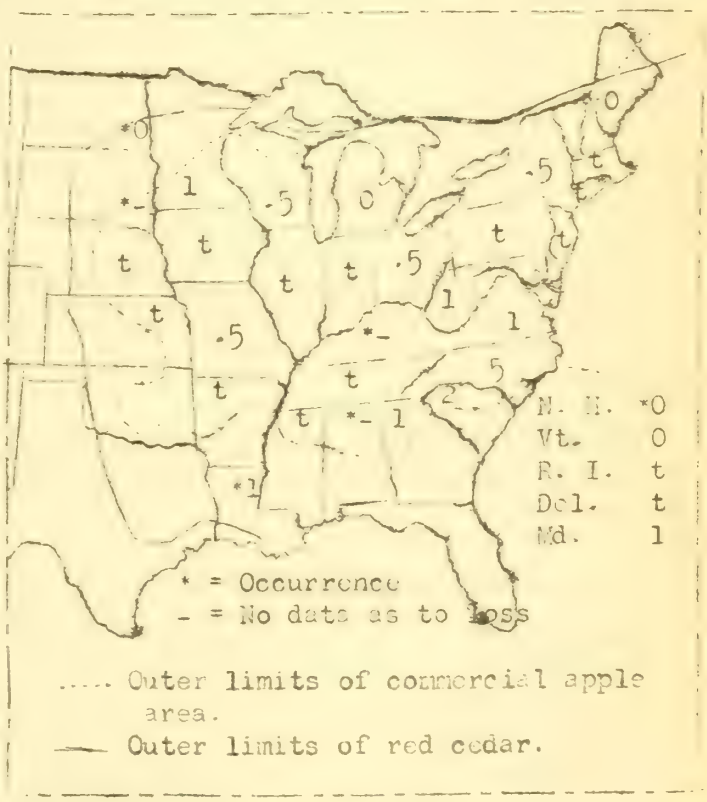

Fig. 8. Estimated percentage loss from apple rust, 1921.

collaborators state that the disease is confined to the Piedmont regions where cedars are prevalent. In Indiana and Illinois the disease is chiefly in the southern portions. Minnesota reports heaviest occurrence in the central section this year, while the collaborator from Nebraska reports it as common in the southeastern part of the state. An intensive survey for cedar trees and apple rust in these portions of various states where the disease is particularly common would throw much further light on the matter of the relation of the red cedar to the rust.

Leaf infection was the form of injury commonly reported in 1921. Local defoliation occurred in parts of Ulster County, New York, and in Ohio as well as in the Appalachian fruit district where the disease is always of importance. Melchers in Kansas reports that infection is always confined to foliage in that state and that affected fruit has never been observed, while Hopkins in Missouri reports the finding of rust on the twigs this year, as well as on the leaves.

A comparison of rust occurrence with weather conditions would be of much interest in this connection, but unfortunately the data at hand are not sufficient to draw any conclusions. The great shortage in the apple crop has undoubtedly led many collaborators to report that the disease was less prevalent than usual, even though the disease might have been fully as common as usual on the leaves. N. J. Giddings, of West Virginia, has furnished the following note concerning weather relations:

> "Apple rust was also showing up to a very slight extent at this time (April 25). Weather conditions were not particularly favorable for development of diseases during the first week in May The weather was very moist, but the temperature was too low for infection."

It is quite likely that the temperaturesin some of the states bordering on West Virginia were also too cold to favor infection during the first week of May.

Dates of first appearance of rust on the apple, according to collaborators,1921

Connecticut	June 18	Cheshire
New York	June 13	Columbia County
Pennsylvania	May 6	Adams County
Delaware	June	Newark
Maryland	April 23 (first telial horns)	Leland
Virginia	May 10	Blacksburg
West Virginia	April 25	
Mississippi	June 1	Columbus
Arkansas	May 15-30	Fayetteville
Ohio	July	Washington County
Indiana	May 27	Orange County
Minnesota	June 5	Carver County
Kansas	July 16	Parker

Varietal resistance

The following notes on varietal resistance, supplementing those already given in various numbers of the Plant Disease Bulletin Supplement, have been received during 1921:

Connecticut: In an orchard of 50 trees at Central Village, there was so much rust on the variety Wealthy that the apples did not mature. (Sheldon).

New York: Relatively abundant in Ulster County, especially on Winter Banana and Wealthy. (Department of Plant Pathology).

Georgia: Always present and serious on Shockley. (McHatton).

Indiana: Noted only on foliage of York Imperial, Jonathan, and Wealthy. (Gardner).

Illinois: Noted on Benoni, York, and Wealthy. (Anderson).

Minnesota: Wealthy very susceptible. Patton showed some resistance as did also Northwestern Greening. (Section of Plant Pathology).

Iowa: Most injury on Wealthy and other stocks having wild crab as parents at some time in their history. (Melhus).

Rust control

From Arkansas Elliott reports that most of the cedars have been cut in the commercial apple region. From Ohio Thomas writes that the removal of cedar trees gives satisfactory control; and from West Virginia the following interesting note concerning the results of cedar eradication has been received:

"Apple rust is causing practically no injury in the large commercial orchards this year. All indications pointed to a heavy rust infection, but the cedar eradication has added another season to the evidence of possible effective control by that means. It is interesting to note that the amount of rust in the south-central part of the state has been increasing very markedly during the past few years. The fungus is evidently becoming established upon the hosts in that section."

R. E. Vaughan in Wisconsin reports that certain orchards were not infected with the rust, whereas adjacent but unsprayed orchards were in some cases seriously defoliated. He reports ten times more rust on trees in proximity to red cedars.

Fruit spot caused by Phoma pomi Passer.

Fruit spot was of very little importance during 1921. This was probably partially due to the destruction of the fruit crop in many places, particularly in some states that usually report more or less damage; and again, it is probably true that the character of the weather tended to keep down the amount of the disease.

The report of most severe damage comes from Michigan where Coons reports it to be of almost equal importance to bitter pit as a storage spot of apples. He estimates 10% affected apples in the stored fruit of 1920-1921. The disease was present in about the same amounts as usual in New Hampshire, Connecticut, New York, and Illinois. Less was seen in Delaware and the disease was not observed nor reported in Pennsylvania, Maryland, Virginia, Tennessee, South Carolina, Georgia, Mississippi, Arkansas, Ohio, Wisconsin, Minnesota, and Missouri.

In New York the disease is confined almost wholly to the Hudson Valley. In Delaware it is distributed generally over the state and in West Virginia it is reported as becoming of increasing importance in the northeastern fruit section. In Illinois it is of importance only locally; only one report was received.

Earliest reports of the disease this year were September in Delaware, and October in southern New Hampshire.

Anthracnose caused by Neofabraea malicorticis (Cord.) Jackson

Anthracnose, which is restricted to the apple sections of the Northwest, was not reported as being especially serious during 1921. Pathologists in Idaho did not observe the disease on the 1921 crop nor did they receive specimens. However, inspections during April and May of 1921 of car shipments of apples grown in 1920 in northern Idaho showed from a trace to 20% of the fruit affected with the disease.

In Washington the disease was especially common, as usual, west of the Cascades and, according to Heald and Dana, was severe in the White Salmon section. They do not report the disease from the Spokane section or from the Yakima or Wenatchee Valleys. However, market inspection indicated a considerable amount of the anthracnose in 1920 fruit, shipped from these regions during the first five months of 1921. Arthur Frank reported as follows:

> "More than ordinarily common throughout Western Washington. Most severe cases in Whatcom, Thurston, Cowlitz, and Klickitat Counties. At White Salmon and near there, very severe cases were found."

In Oregon the disease was present throughout the western part of the state. In the Willamette Valley losses were general and severe, according to Barss, and in the Hood River Valley lack of properly timed sprays has caused the disease to become the most serious trouble of apples in that section. Leroy Childs, of the Hood River, reports that orchard valuations have depreciated fully 10% on account of anthracnose. This loss, however, is recoverable if attention is given to proper spraying. H. P. Barss[1] reports as follows concerning the present status of the disease in his state:

"Apple tree anthracnose is the most serious canker disease of Western Oregon. It has caused premature destruction of many promising orchards and undoubtedly will result in large losses in the future, unless growers are prepared to adopt the methods required to combat it. The disease can be held in control by spraying, but there is only one season when spraying can accomplish the desired results and that is in the fall. Bordeaux mixture is the best material to use for the purpose, according to the experience of the growers, as it seems to retain its effectiveness for a long time, regardless of rains and cool temperatures. The usual time of application, where but one spraying is given, is immediately after the crop is harvested. Earlier applications would be preferable from the standpoint of disease control, but the grower naturally objects to covering his fruit with a heavy coating of spray just before picking."

Inspections of carloads of apples shipped from the Northwest from January to July 1921 show a considerable amount of anthracnose in the 1920 fruit. An examination of the records shows the following:

Oregon - Salem section: Two cars of Spitzenberg, and one car of Yellow Newtown, all shipped in January, showed about 6% anthracnose.
Hood River section: Three cars of Yellow Newtowns and one of Spitzenberg showed 2%, 2%, 12%, and 15% respectively.
Grant's Pass section: Two cars of Winesap contained 13% and 22%.
Portland section: Three cars of Newtowns, inspected during February, showed 10%, 5%, and 25%.
Umpqua Valley section: One car of Princess Umpqua, 35%.
Roseburg section: One car Princess Umpqua, 40%.

Washington - Wenatchee section: Twenty-three cars of Winesap, inspected from February 10 to May 23, showed anthracnose in varying amounts. One car contained 43%, the second highest 24%, while the average was about 8%.
Yakima Valley section: Twenty-four cars of Winesap showed the following percentages during the period from March 25 to May 31: t, 9%, 5%, 8%, 8%, 14%, 2%, 8%, 11%, 8%, 6%, 12%, 7%, 1%, 5%, 11%, 20%, 7%, 2%, 18%, 7%, 7%, 9%, and 9%.
Seattle section: Two cars of Newtown showed 1% each, and 6 cars of Winesap showed the following percentages during the period from April 2 to June 15: 2%, 8%, 9%, 10%, 35%, and 33%.
Spokane section: Eight cars of Winesap showed the following percentages during the period from April 22 to May 25: 13%, 4%, 2%, 2%, 3%, 5%, 10%, 6%.
White Salmon, Grand View, and Cashmere sections: A few shipments from each of these apple centers showed anthracnose in considerable amounts. Winesap and Yellow Newtown were the varieties.

Recent literature

1. Barss, H. P. Apple tree anthracnose. Biennl. Rept. Oregon Bd. Hort. 16 (1919-20): 127-130. illus. 1921.

European canker caused by Nectria galligena Bres.

This disease has been reported in the past from most of the states along the Atlantic Seaboard from Maine to North Carolina, and also from Ohio, Indiana, Illinois, Minnesota, and the three states on the Pacific Coast. This year West Virginia is the only state reporting the disease to the Survey for the first time, and in that state the canker is said to be of minor importance. New Hampshire reported the disease as of very slight importance and occurring in about the average amounts. In well sprayed orchards it is practically absent. Massachusetts reported the disease as common in many old orchards but causing no great amount of damage. New York - the disease can usually be found to some extent each year in most counties of the apple section. Virginia and West Virginia report the disease as of rare occurrence. In Illinois one specimen was received at the Experiment Station by H. W. Anderson from Marion County, July 25, and the disease was observed by Tehon in Stephenson County. From Oregon the disease was reported as being present in the western part of the state, but not causing any appreciable damage. No reports were received from any of the other states, collaborators in most of them indicating that no specimens nor complaints had been received.

In England, where this disease is of more importance than in the United States, an important paper has been published during the year[1]. Wounds have generally been considered necessary for infection with the European canker fungus, but Wiltshire states that infection through leaf scars, both in the autumn and during the following year, is responsible for a large percentage of canker at Long Ashton, Bristol. The fungus appears to enter through small cracks which appear in the leaf scar tissues, in the autumn immediately after defoliation and in the spring when the buds are swelling. The possibility of preventing this infection by disinfecting the leaf scars by fungicides is discussed and results of preliminary trials recorded.

Marked differences in varietal susceptibility are mentioned.

1. Wiltshire, S. P. Studies on the apple canker fungus. I. Leaf scar infection. Ann. Appl. Biol. 8: 182-192. Illus. pl. 3. Nov. 1921.

Zeller, S. M. and C. E. Owens. European canker on the Pacific slope. Phytopath. 11: 464-468. Illus. Nov. 1921 (Feb. 1922).

Powdery mildew caused by Podosphaera leucotricha (E. & E.) Salm.

As in other years the heavy losses from powdery mildew of apple occurred in the apple districts of the Pacific Northwest, where climatic conditions are particularly favorable for its development. In the East the disease was commonly distributed as usual, but reports indicate that it was considerably more prominent than normally. It is likely that the warm and dry summer was especially influential in developing mildew in certain localities of the East. The disease was much worse than usual in New York, Pennsylvania, Delaware, North Carolina, Indiana, and Illinois, causing injury to the young shoots and to the leaves. In Indiana new growth was killed in some cases. The disease cannot be considered of any general importance in the East although in some nurseries and young orchards it was, without doubt, quite destructive. Collaborators in New York, Delaware, Kentucky, and Tennessee mention it as

causing considerable local damage. The following notes from New York are significant: "Seneca County - affected the growth severely in one orchard. Ulster County - on Winter Banana, attacking fruit pedicels, stunting fruit and causing it to die. Orleans County - every terminal shoot in one orchard affected."

In the West the disease was apparently about as prevalent as usual, although reports from Utah and Washington indicate that it may have been somewhat more common. In Idaho, Hungerford reported it as important in unsprayed orchards throughout the state, and some fruit injury was noted in Idaho this year. In Oregon Barss reported it as of some small importance in all apple sections, russetting the fruit and causing loss of grade. First observed this year May 5 at Banks, Oregon. From California, W. S. Fields reported that in an inspection in the vicinity of Watsonville, Santa Cruz County, August 1, he observed considerable defoliation due to powdery mildew and states that, "the mildew is general in the Pajaro Valley this year, but in spite of this there will be a fair crop of apples harvested, as apparently, only the terminal shoots were defoliated."

Dates of first appearance of powdery mildew of apple, 1921

New York	May 6	Schuyler County
Delaware	April 21	Nassau County
Tennessee	July	Knoxville, Cleveland
Mississippi	July	Starkville
Ohio	June	Cuyahoga County
Indiana	April 28	Knox County

Of the varieties mentioned as being affected, the Jonathan is reported from Delaware as being especially susceptible, and Jonathan, Spitzenberg, and Ortley, in the order named, are most affected in Oregon, according to Barss. Grimes is also badly mildewed in that state, and the disease was noted on Winter Banana in New York, Rome Beauty in Pennsylvania, and Transparent, Corson, and Winesap in Indiana.

Concerning control, Adams, in Delaware, reported that lime sulphur controlled the disease; Barss, in Oregon, stated that the disease is serious only where the scab sprays are neglected; and Hungerford, in Idaho, reported mildew important in unsprayed orchards only. However, a case was noted in Morgan County, Indiana, May 12 where lime-sulphur spray was not controlling mildew.

Crown gall caused by Bacterium tumefaciens EFS & Towns.

Crown gall was reported during 1921 from most of the states east of the Mississippi, and from Texas, Oklahoma, Arkansas, Montana, Utah, Idaho, Washington, and Oregon. In the three states last named the disease was said to be local in occurrence while in other states its distribution was apparently the same as that of the host. Wisconsin reported it as coincident with the nurseries in that state. In most cases it was apparently no more prevalent than is usually the case, but Maryland, Mississippi, and Ohio reported more than during either the preceding or the average year.

As usual, the loss reported as due to crown gall was mainly to nursery stock, but in some states the disease was said to be troublesome in the orchard also. For instance Adams in Delaware stated that it was, "very common with trees 8-10 years old showing drought effects." In Tennessee it was said to be common in orchards on certain varieties, and according to Elliott, it causes the death of some trees every year in Arkansas.

The greatest loss from crown gall reported during the year was 15% in nursery stock in Wisconsin. Neal in Mississippi estimated 4%, also in nurseries. Virginia, North Carolina, Texas, and Arkansas all reported 1% loss, apparently in orchards, while Illinois reported only a trace. The disease was said to be important in Delaware, Ohio, and Utah, but no estimates of loss were given. In Kansas, according to Melchers, 25% infected stock was usual in nurseries. C. E. Temple and R. A. Jehle in Maryland made the following statement: "About 20,000 trees out of 60,000 shipped into Maryland from Texas, Kansas, and Oklahoma had conspicuous crown galls, and were destroyed."

Dwarfing of the trees with consequent reduction in yields was reported from New Jersey and Virginia.

The following table gives the figures for loss and amount of infection as reported by collaborators:

Table 7. Data concerning losses due to crown gall of apple as reported by collaborators, 1921.

State	Percent infested plantings	Percentage affected trees in infested plantings	Percentage affected trees in State	Percentage loss	Maximum per cent found in any one planting
Virginia	-	-	-	1	-
North Carolina	.5	2.	.1	1	2
Mississippi	30.	5.	1.5	4	75 (nurseries)
Texas	-	-	-	1	-
Arkansas	50.	5-100	40.	1	100
Illinois	-	-	-	t	-
Wisconsin	75.	15.	11.	15 (nursery)	-

The "hairy root" form of the disease was reported this year only from Arkansas where it was the most common type. Both root and aerial galls occurred in Delaware and Mississippi, while root galls were most common in Ohio.

In Oregon, H. P. Barss reports aerial galls of undetermined cause as scattered over the state wherever apples are grown. It does not appear to be detrimental to the trees. The general features point to an infective origin, but Barss doubts its being identical with the common crown gall.

Varieties reported as especially susceptible were Early Harvest and Rome Beauty in Tennessee, and Okabena and Duchess in Wisconsin. In Ohio there was little apparent variation in susceptibility.

Vaughan in Wisconsin states that the disease is "carried along row by plow and cultivation until 75% of individuals may become infected".

Experiments conducted at the Iowa Experiment Station (See Melhus, I. E., and T. J. Maney. Studies on the infection and control of crown gall on apple grafts. (Abstract) Phytopath. 12: 55. Jan. 1922.) indicate that the percentage of crown gall on grafts may be greatly reduced without injury to the grafts by disinfection with Bordeaux mixture 8-8-50. Stronger Bordeaux was somewhat more effective but decreased the stand. Soluble fungicides were injurious to the grafts. The results of the experiments concerning infection of the grafts are stated as follows:

> "Most of the infection takes place the first year during the formation of the callus at the union. Well-made and poorly-made grafts showed little difference in the amount of infection. Using an unusually large, heavy string wrap over the union leads to girdling and excessive callusing of the trees, which seems to facilitate crown-gall infection. Cloth applied over the union as a wrapper, either with or without string, decreases the amount of crown gall. Scion wood cut from trees infected with crown gall at the union, did not show any increased amount of infection. Hairy root seedlings when used as stocks did not transmit hairy root to the scion, but the stock portion of the graft usually remained infected."

No control methods were reported by collaborators.

Sooty blotch and fly speck caused by Phyllachora pomigena (Schw.) Sacc. and Leptothyrium pomi (Mont. & Fr.) Sacc.

Sooty blotch and fly speck are usually associated with one another, and for this reason, and also because of similar morphological characters, they have been considered by many as different stages of the same fungus. Colby[1] who has recently studied these forms, says that "They should be regarded as separate fungi unless full proof that they are connected can be adduced". He proposes the name Gloeodes pomigena (Schw.) Colby for the sooty blotch fungus (Phyllachora).

The diseases were of only slight importance in 1921. They were reported from Rhode Island, Connecticut, New York, Pennsylvania, Delaware, West Virginia, Virginia, Ohio, Indiana, and Oklahoma. In all of these states except Indiana the diseases were of the same or less prevalence than usual. In Indiana, however, largely because of failure of growers to spray, they blemished the fruit to greater extent than ordinarily. In New York they were found to some extent in all parts of the state, but were more common in the Hudson Valley. In West Virginia they were more prevalent in the Ohio and Kanawha Valleys.

The susceptible varieties reported were: Rhode Island Greening in Rhode Island; Rome Beauty, Smith Cider, and Ben Davis in Delaware; Maiden Blush, Grimes, and York Imperial in Oklahoma; and Northwestern Greening, Maiden Blush and Grimes in Indiana.

In Indiana Gardner reported cases of control of sooty blotch by the application of an extra spray applied about August 1.

Recent literature

1. Colby, A. S. Sooty blotch of pomaceous fruits. Trans. Illinois State Acad. Sci. 13: 139-175. 1920.

Collar rot (cause undetermined)

Reported as follows by four collaborators:

Ohio: Considerable as usual on certain varieties. Grimes variety recognized to be especially susceptible. (Thomas).

Indiana: This is the limiting factor in the use of the otherwise very desirable Grimes variety. Causes heavy loss in old orchards in southern half of the state. Two percent loss estimated for state. In old orchards Grimes trees are being saved by March grafting. The trouble is avoided by using double worked Grimes stock in new orchards. Cullinan reports this trouble also on Rhode Island Greening, Dutchess, and Tompkins King.(Gardner).

Idaho: Collar rot probably caused by Bacillus amylovorus occurred in southern irrigated sections in about the usual amounts. Not very important. (Hungerford).

Oregon: Decay at collar noted only in Columbia Basin from Hood River eastward. Of small importance. (Barss).

Root rots caused by various fungi

Black root-rot caused by Xylaria sp.

Eight states, New York, Pennsylvania, Virginia, West Virginia, North Carolina, Kentucky, Illinois, and Arkansas, reported the presence of Xylaria root-rot in 1921, while 17 other eastern states reported non-occurrence of the disease.

New York: Root-rot, caused by either Xylaria or Armillaria, is increasing and is seemingly of importance. It is general throughout the state and possibly follows winter or mechanical injury. In Orleans County it is one of the outstanding problems, as it is taking a large toll of trees. In Genesee County it was found in two new orchards this year. (Chupp).

Virginia: In prevalence it does not vary greatly with seasons so far as I know. It is the most important apple root-rot in the state, probably causing as much as 1% loss and affecting as high as 25% of the trees in some orchards. It occurs throughout the commercial apple belt. Tests show Northern Spy root-stocks to be superior in resistance to French Crab. (Fromme).

West Virginia: Of some importance, slight loss, probably generally distributed in state. (Giddings).

Kentucky: This root rot is causing very serious losses each year in Kentucky. (Valleau).

Illinois: Same as usual, occurs in a few localities in extreme south. Not important except locally. (Anderson).

Arkansas: Same as last year and average year. Caused a trace of loss: seems to attack weak or dead trees. (Elliott).

During the year an important piece of investigation bearing on the pathogenicity of the fungus and resistance of root-stock has been reported as follows: (Fromme, F. D. Susceptibility of apple root-stocks to black root rot. (Abstract) Phytopath. 12: 54-55. Jan. 1922.)

"Inoculation of apple trees on seedling roots with Xylaria sp. (X. digitata?), the species which commonly causes black root-rot of apple in Virginia, produced infection and death of three-fourths of the trees within a period of three years. Similar inoculation of trees on Northern Spy roots produced infection of only one-fifth of the trees. One-third of these were only slightly infected. The others died within three years. Similar resistance was shown by other Northern Spy rooted trees which were set in orchards as replants following trees killed by root rot. The Northern Spy appears to be markedly superior to the seedling root-stocks used by nurserymen."

Armillaria root-rot caused by Armillaria mellea (Fr.) Quelet

Seven states reported the occurrence of this disease in 1921 and 18 states reported that it has not been noted during the year. In West Virginia Giddings reported the disease as of some importance. In Arkansas this fungus along with Clitocybe monodelpha caused about the usual amount of general damage (loss a trace). Elliott makes the additional statement that Grimes seems to be most susceptible to this disease. Vaughan, in Wisconsin, reported the disease of minor importance, being found mostly in the north-central section where the trees were set in new land. The rot is rare in Illinois, and in Iowa it occurs in isolated localities, such as about Missouri Valley, Harrison County. The following note was received from Darss in Oregon, July 1, 1921:

"Present over Western Oregon, but no worse than usual. Mostly on newly cleared land. In the Hood River Valley up to 5 or 10% losses of trees are reported in individual orchards, but according to Childs not 1% of the total number of trees in this section are lost annually."

From California, W. S. Fields wrote of a case observed at Chico where a tree was dying from the attacks of Armillaria.

Ozonium root-rot caused by Ozonium omnivorum Shear

Ozonium root-rot was prevalent on apples in the black, waxy lands of Texas, causing about 5% loss according to J. J. Taubenhaus.

Root-rot following fire blight on the roots was reported in considerable quantities from Maryland.

Root-rot (cause unknown) was reported by Gardner from southern Indiana where it caused premature death of trees and is a limiting factor on newly cleared land. (See Fig. 9.) Gardner states that, "It occurs on many varieties in the sassafras soils of the region indicated on the map and is found on Northwestern Greening, Grimes, Black Twig, Indiana Ben Davis, Dutchess, and Gideon."

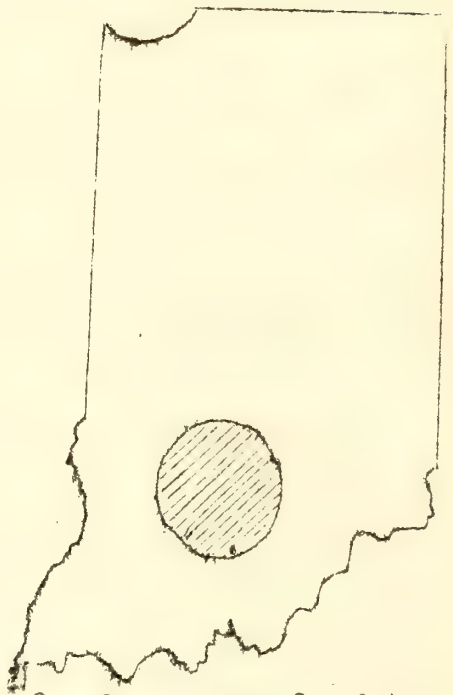

Fig. 9. Occurrence of undetermined root-rot of apple in Indiana. (After map by C. L. Burkholder and M. W. Gardner.)

Jonathan spot (non-parasitic)

According to collaborators' reports this trouble seems to have been much worse than usual in the states of Ohio, Indiana, Illinois, Wisconsin, and Oregon. In Ohio there was considerable of it in some sections of the northern half of the state. R. C. Thomas reported that it hastened the premature marketing for the Jonathan crop in some sections and thusoccasioned various losses. In Indiana, Cullinan, Burknolder, and Gardner reported the disease as worse than usual, mostly on Jonathan, but noted also on King David and Hubbardston. From Illinois Anderson wrote that it was worse than usual and very important on Jonathan and largely confined to that variety. The loss was not large on account of the small crop. Much of this spot developed in storage during the fall in Wisconsin, according to Vaughan, and Coons reported the trouble common as usual in Michigan. In Oregon it was somewhat important in some orchards, causing shallow discolored spots on the skin after storing. Severe trouble was only reported from the Umpqua and Rogue River Valleys up to January 1, 1922. Other states reporting were New Jersey (said to be due to Alternaria), Delaware (much less), Maryland, West Virginia, Iowa, Missouri, Kansas (less, trace loss), Nebraska, Montana, Utah (below average,

relatively unimportant), and Idaho (very important on stored apples, always severe when apples are allowed to remain too long on the trees. - Hungerford).

It might be expected that the warm weather of the early storage period would be conducive to the Jonathan spot.

Bitter pit (Stippen, Baldwin spot) - non-parasitic

During 1921 the states of Connecticut, New York, Indiana, and Minnesota reported more bitter pit than the average, while the same or a less amount than usual was reported from New Hampshire, New Jersey, Pennsylvania, Delaware, Maryland, Ohio, Illinois, Michigan, Colorado, Idaho, Washington, and Oregon.

In none of the states reporting was the disease said to be of much importance. However, in some localities and on some varieties in the northern states, where apples were produced, the disease was an important factor. The percentage of loss for any one state, however, is not over a small fraction of 1%.

Regarding the geographical occurrence of bitter pit within the states, New York reports that it occurrs wherever apples are grown but is less common in the Lake Ontario district north and west of Lake Seneca. In the remainder of the state the disease is of frequent occurrence. In Ohio it was reported from the northern portion of the state, particularly, and in Minnesota in the central and southern parts. In Washington it seemed to be reported most frequently from the western section, while in Oregon it was coexistent with the crop.

Dates of first appearance, according to collaborators, 1921

Connecticut	September 6	Mount Carmel
New York	June 13	Orange County
Delaware	September	Newcastle County
Ohio	September	Wayne County
Minnesota	September 10	Ramsey County
Colorado	August	Delta County

In McAlpin's recent article (McAlpin, D. Bitter pit in apples and pears, latest results in preventative measures. Phytopath. 11: 366-370. Sept. 1921.) he summarizes his ideas of the cause of bitter pit as follows: "Briefly, it may be stated that rapid alternations between dry and moist conditions, combined with fluctuating temperatures, during the growing stages of the fruit, is the exciting cause of bitter pit."

The following notes on varietal susceptibility were reported during the year: Rhode Island (Browning): Common on Baldwin and Northern Spy. Connecticut (Clinton): On Baldwin and Rhode Island Greening. New York (Crupp): Baldwin most susceptible. Pennsylvania (Thurston and Orton); Severe on Baldwin in Center County. Indiana (Gardner): F. P. Cullinan reported bitter pit bad on Grimes, Baldwin, and Black Twig at Laurel in Franklin County. Burkholder reports it very bad on Baldwin because of early ripening. Minnesota (Section of Plant Pathology): All reports were of injury on Wealthy and Northwestern Greening.

Investigations for the control of bitter pit in Australia have been

along three main lines, according to McAlpin (l.c.) - (a) Experiments with different stocks, (b) crossing of susceptible and non-susceptible varieties, (c) breeding of bitter-pit proof varieties by selection and crossing. Considerable progress is reported, particularly with the use of various stocks, but the whole program is a long-time one so that definite results will be slow in forthcoming. McAlpin wishes to call the attention of persons engaged in developing apple stocks and varieties to the need for apples and pears resistant to bitter pit.

Reference

Heinicke, A. J. The seed content and the position of the fruit as factors influencing stippen in apples. Proc. Amer. Hort. Sci. 17 (1920): 225-232. 1921.

Spray injury

Arsenical injury was reported from two states. In Virginia, blossom-end burn occurred in at least one orchard in Page County, according to Fromme. In Ohio arsenical injury occurred on fruit of Gano and Ben Davis, as shown by blossom end rot and spotting of foliage according to Selby. Greater care in the amounts of lead used was recommended in that state.

Copper injury was reported by J. F. Adams from Delaware as follows: "Considerable leaf injury and defoliation from summer sprays occurred in many orchards where Bordeaux was used. Bordeaux russetting from summer spray was very severe on Ben Davis and the Williams variety was very susceptible to leaf injury." The following notes on the susceptibility of varieties to leaf and fruit injury have been furnished by Adams:

Variety	Leaf injury	Fruit injury
Ben Davis	Severe	Severe
Jonathan	"	"
King David	"	"
Williams	"	No observation
Northwestern Greening	Slight	Severe
York Imperial	"	Free
Grimes Golden	"	Slight
Nero	"	"
Rome Beauty	"	Free
Stayman	Free	Slight
Winesap	"	"
Stark Delicious	"	"

Lime sulphur injury was reported from Massachusetts by W. S. Krout as follows:

> "Very common in most places where liquid lime sulphur was used as a spray. Factors contributing to this type of injury were, lack of agitation of spray, excessive amounts of the spray, and previous injury to the epidermis of the leaf."

Lye injury was reported by Heald from Washington where a number of cases of foliage injury, due to the use of lye as a spreader for lead arsenate occurred.

Winter injury

Owing to the mild winter of 1920-21 not much injury from winter-killing occurred. However, the following notes indicate that some damage may have been done:

Massachusetts (Krout): Very abundant in many orchards. Probably caused by the severe winter of several years ago. The Gravenstein variety most severely attacked. Ohio (Selby): Contrary to expectations, this mildest winter of record in Ohio for many years, has yielded serious winter injury by freezing on young apple trees 1 to 5 years from setting, especially in Cuyahoga, Geauga, Lake, Summit, Lorain, and other counties. This explanation is found in failure of growth to mature in fall. The low temperature of December 26-31 was actually but slightly, if at all, below zero Fahrenheit. From 5-65% of trees of different varieties were seriously injured. Baldwin showed about 65% injury, which was highest percentage of injured trees. Jonathan and Hubbardston 45-50%, while Rome Beauty gave about 5%. Kansas (Melchers): Winter injury to young seedlings particularly severe. Result of late growing in fall. Washington (Heald): Winter injury, including collar rot, frequently reported from most of the irrigated sections of the state. Oregon (Burss): A silver leaf effect typical of the so-called silver leaf disease was observed at Creswell, September 10. This is perhaps an after effect of the 1919 freeze.

Recent literature

Fisher, D. F. Winter injury to fruit and nut trees. Better Fruit. 16[6]: 5-6, 18-19. illus. Dec. 1921.

Carrick, D. B. Resistance of the roots of some fruit species to low temperature. New York (Cornell) Agr. Exp. Sta. Mem. 36: 613-661. Fig. 164; col. pl. IX-X. June 1920.

Hail injury

Idaho experienced considerable local damage to the apple crop from hailstorms, as seen by the following note from C. W. Hungergord:

"Two severe hailstorms in Lewiston orchards section caused total loss in some orchards. Over 75% of the crop in this section was seriously injured."

Measles - Cause unknown

Measles was first reported from Arkansas in 1913 when it was described by Hewitt in Bulletin 112 of the Arkansas Experiment Station. Since that year

the disease, or one believed to be the same, has been reported from Pennsylvania (1915, 1917, 1918), Maryland (1915), Virginia (1919), Alabama (1917), Michigan (1917, 1919), Arkansas (1914, 1916, 1917), and New Mexico (1919, 1920). Leonian in New Mexico attributed the disease to excess of nitrates in the soil, while Coons in Michigan believed it to be due to insect injury of the young twigs. It is probable that what is being called measles in the various states is a trouble resulting from different causes. In New Mexico it was apparently of some importance, but in most cases in other states it caused little injury. Pennsylvania reported Smith Cider as the only variety commonly affected, but Maiden Blush was attacked in 1915.

During 1921 the disease was reported again from Pennsylvania on Smith Cider, and for the first time from Illinois and Kansas. In each case it was local and of little importance.

Drought-spot (non-parasitic)

Crinkle, similar to that described by R. H. Roberts (Phytopath. 9: 261-263. pl. 16-17. 1919), was reported from Minnesota in 1921 by the Section of Plant Pathology. The disease was local in occurrence and was confined to the Northwestern Greening. It was first observed this year, August 12 at University Farm, St. Paul and one tree was found with 60% affected fruit. According to E. C. Stakman, this disease has been noticed on the Northwestern Greening in Minnesota since about 1915. No tendency was noted for the formation of cavities in the affected areas such as were described for "crinkle" or "hollow apple" by the Smiths (Smith, R. E. and E. H. Smith. California Sta. Agr. Exp. Sta. Bul. 218: 1-93. 1911) or by Barss (Barss, H. P. Physiological disorders of developing fruits. Oregon Agr. Exp. Sta. Crop. Pest and Hort. Rept. 3: 159-166. Jan. 1921.)

Drought spot causing sunken areas in York Imperial and Stayman Winesap was reported by Adams from Delaware where it was first noted August 1; by Hungerford from Idaho where it was of slight importance, but common in the dry land sections, and by Barss from Oregon (serious occasionally, coextensive with apple culture, first report July 15 from Newberg).

Cork - reported from Okanogan, Chelan, and Benton Counties, Washington.

Miscellaneous fruit rots and leaf spots

Soft rot caused by Penicillium expansum (Lk.) emend. Thom. was probably as usual the most important of all apple storage rots. From Illinois H. W. Anderson reported more of this rot this year, due to the long and warm fall and the prevalence of worm injury.

Brown rot caused by Sclerotinia cinerea (Bon.) Schröt. This rot was reported from Vermont (common, first observed September 10 at Burlington); New York (found sparingly on a few trees); Maryland (more, trace loss); Virginia (of no importance); West Virginia (of no importance); North Carolina (common in orchards below 3000 feet level where apples are present); South Carolina (present but not very abundant nor important; observed August 29 at Clemson

College); Indiana (one report September 13 on Jonathan); Illinois (somewhat worse than last year, but of very little importance, mostly on wormy apples); Michigan (common on windfalls, loss none); Wisconsin (more than average but of minor importance; injury trace, causing rot of fruit at maturity; first report August 10, Sturgeon Bay; serious on Wolf River, found mostly near plum trees); Iowa (less); and Oregon (never found except on late hanging, injured or dropped fruit).

Phytophthora rot caused by Phytophthora sp. was reported for the first time from Indiana by M. W. Gardner, This rot was first observed at Lafayette September 10 and was found in two other localities during the fall. It occurred mostly on Grimes that had fallen off, also on lower fruits hanging near the ground. Ben Davis and Northwestern Greening were affected to some extent. The rot is firm, only slightly discolored and progresses rapidly.

Alternaria core rot was reported from Idaho as common on certain varieties in storage, particularly Jonathans.

Alternaria dry rot at calyx end was reported as general in Ohio. First observed in July in Wayne County. Infection through lesions caused by arsenical injury thought probable.

Spongy dry rot caused by Volutella fructi Stevens & Hall was reported from Massachusetts and Pennsylvania on fallen fruit.

Cercospora leaf spot caused by Cercospora mali E. & E. - trace reported by Taubenhaus from Texas.

Chlorosis of leaves - reported once August 8 from Orleans County, New York by G. E. Smith as follows: "Occurred first on early Primate, 3-4 years old. Spread to Baldwin and Sweet Bough,"

Miscellaneous bark cankers

Orange pox canker caused by Leptosphaeria coniothyrium (Fckl.) Sacc. - collected in Orange County, New York, April 28, and reported from Kansas by Melchers as follows:

> "Occurs in northeastern Kansas in one or two counties where trees are in proximity to brambles. First observed this year, June 6, at Troy, Kansas. More than in 1920".

Cytospora canker associated with Cytospora sp. - reported from New York (Schuyler County, May 6), Pennsylvania (two trees in Center County), and Colorado (reported from one apple section).

Superficial bark canker caused by Myxosporium corticolum Edgerton was said to be very common in Massachusetts. (Wiltshire, S. P. The bark canker disease of apples. Jour. Bath & West & So. Co. Soc. Agr. 15: 128. 1921.

Canker caused by Planodomus fuscomaculans (Sacc.) Coons - reported by Coons from Michigan as follows:

> "Two locations, Old Mission, and Chatham, Michigan. This canker is common on impoverished trees that are making a poor growth. It is

characterized by the killing of the bark in strips, chiefly on the underside of the limbs; the killed bark separates in strips from wood. The fungus fruits on the wood. Minor in importance, and readily controlled by improving conditions."

Rough bark caused by Phomopsis mali Roberts - reported for the first time from Illinois at Assumption, March 18, 1921. Not important and associated with blotch, according to H. W. Anderson.

Valsa canker caused by Valsa leucostoma (Pers.) Fr. was reported by Leonian from New Mexico as present in almost every apple section and apparently of some importance. Inoculation experiments showed the fungus to be a weak wound parasite. (Leonian, L. H. Studies on the Valsa apple canker in New Mexico, Phytopath. 11: 236-243. June 1921.)

Heartwood rot caused by Fomes applanatus Fr. - reported by Clinton, June 28, from Cromwell, Connecticut.

Heart rots caused by various polypores, following the serious freezing injury of 1919, are common in western Oregon, according to Barss.

Miscellaneous non-parasitic apple diseases

Scald - reported from Indiana apple area on Grimes in Storage. Reference: Brooks, Charles, Apple scald - its cause and prevention. Better Fruit. 15: 24-26. Dec. 1920; 15: 11-12. Jan. 1921.

Rosette - reported from Delaware (more than last year and increasing in importance; local in Sussex County and particularly serious on Williams) and Idaho (serious in some sections and occurring in almost every part of the state). According to Hungerford, it seems to be less serious where alfalfa or clover are used as cover crops.

Growth crack - especially on the Stayman Winesap, was reported from Indiana and Illinois, the injury often being followed by rots of various kinds. In Indiana it was reported as very destructive on Stayman Winesap, and occurred principally in the northern part of the state. Some of the trouble was found on the Grimes variety also in Indiana.

Internal breakdown was reported from various parts of Idaho, affecting Jonathan and Winesap especially. According to Hungerford, over-irrigation seems to aggravate the trouble. It is not a disease of any great importance in that state, however.

The following non-parasitic diseases of apple were reported from the state of Washington this past year:

Rough bark.
Spot necrosis - (Okanogan, Chelan, and Benton Counties) - Jonathan.
Freckle - (Stevens County).
Brown bark spot - (Spokane County).
Blister - (Stevens and Grant Counties).
Senility necrosis - (King County).
Gravenstein trouble - (Western Washington) - twisting of the branches with flattened surfaces, common according to Frank.

PEAR

Fire blight caused by Bacillus amylovorus (Burr.) Trev.

In general less blight on pears was reported in 1921 than during 1920, Connecticut and Montana being the only two states reporting more of the disease than last year. The majority of the states report less than, or the same as, the average, so that the year cannot be considered a bad one, as far as pear blight is concerned. The disease is always important in the southern states, however, and in many years is very severe in the other pear states. Quotations from the individual reports of collaborators in the southern states indicate that blight is the limiting factor in pear production in the South and that throughout a great part of that region the disease has driven out the commercial pear entirely.

Virginia: Especially prevalent in southwestern portion of state, but occurs to some extent wherever pears are found. (Fromme).

Kentucky: Very severe as a twig blight; limiting factor in pear production. (Valleau).

North Carolina: Most destructive disease of pears, practically prohibiting the growth of them in this state. Very common wherever pears are grown and being a source of infection to the apples. We have received a large number of complaints from orchardists of the state relative to methods of control of this disease. The larger growers practice the cutting out of the blighted limbs but are rather lax in the use of disinfectants. (Foster).

South Carolina: Present on all trees. Damage probably 10%. Still greater loss due to fact that pear growing can hardly be made profitable - prospective growers must stay out of business. (Ludwig).

Georgia: The pear crop this year was almost an absolute failure in the vicinity of Cairo due apparently to blight. On account of the ravages of blight all commercial pear orchards in this section have been cut down. There are still some about Thomasville and Talahassee. (J. B. Wright).

Practically wiped out the industry. Only a few orchards of Kieffers and Le Contes left. (McHatton).

Florida: The pear orchards are in a very bad condition in Florida, due to this disease. In many sections the growing of pears has been abandoned. (Burger).

Mississippi: Important as a twig and blossom blight; present in most pear orchards throughout the state. (Neal).

Louisiana: Very severe as usual. (Edgerton).

Texas: Very prevalent. (Taubenhaus).

Oklahoma: Very important. (Stratton).

Arkansas: Severe as usual all over the state. (Elliott).

The following tabulation (Table 8) showing estimated percentages of amount of blight in pear plantations in the South is compiled from the annual report cards of collaborators for 1921:

Table 8. Estimated percentages of fire blight in some of the southern states, according to collaborators, 1921.

State	Percent infested orchards	Percent infected trees in infested orchards	Percent infected trees in state	Percent loss in state
North Carolina	90	95	85	10
South Carolina	99	95	94	50
Georgia	10	99	--	75
Mississippi	45	35	14	10
Arkansas	100	100	100	10

Other estimates of losses in states are as follows: New York 10-20%, Maryland 5%, West Virginia 3%, Texas 1%.

Regarding the prevalence of the disease in the more northern states and the East, the following reports are typical.

Ohio: The chief source of loss to pear plantings occasioned by fire blight is recognized to be in scattered home plantings throughout the state. Where pears are grown on a commercial scale little of the disease has been noted. How much of this is due to protective sprays and how much to pruning, it would be difficult to say. Possibly both have contributed. While little difficulty is experienced in obtaining specimens from nearly all sections of the state, the loss occasioned by fire blight was thought to be less this season than normal. (Thomas).

Indiana: Not a serious disease this year; mostly twig blight. (Gardner).

New York was the only northern state that reported much damage from pear blight. In this state it was very important, according to collaborators, occurring wherever pears are grown. In Wisconsin the disease was said to be of minor importance, and the statement was made that pears seemed to be more resistant than apples in that state. One reason why it should be of more importance on the apple crop there, is that apples are grown over a wider area than are pears, most of which are along the southeastern Lake Shore.

In the Northwest the disease was reported from Montana, Utah, Idaho, Washington, and Oregon. No reports were received from California because of the scarcity of collaborators in that state, but the indications are that there was considerable blight in California last year. In Oregon, however, the disease was much less prevalent than usual, according to Barss, being less severe than for several years. It is coextensive with the crop in that state except in the Willamette Valley, where it is confined to an occasional wild host.

Dates of first appearance of fire blight of pear, according to collaborators

New York	April 2	Monroe County
Mississippi	May	Agricultural College
Oklahoma	May	Stillwater
Arkansas	May	Hot Springs
Ohio	June	Wayne County
Indiana	May 20	Marion
Kansas	June 28	Atwood
Arizona	June 3	Winkleman
Oregon	May 20	Dufur

Only three states reported any relation between weather conditions and the amount of blight in 1921. Anderson in Illinois said that the disease was checked by the extremely hot June and July weather. Coons, of Michigan, reported that an epidemic started but was checked by drought, while Barss, in Oregon, stated that the spring in the Rogue River Valley, which is a blight stronghold, was unfavorable to dissemination of the organism.

Regarding susceptibility of varieties, Chupp in New York said that the Clapps Favorite and Bartlett were more susceptible than other varieties. McHatton's statement that only a few orchards of Kieffers and Le Contes remained in Georgia, indicates that these varieties show more or less resistance when compared with the others. McClintock in Georgia reports that several sand pears and Doctor White's crosses are resistant. In Michigan, Coons states that certain Kieffer orchards near Lansing, where control was neglected, were completely killed.

During the year investigation of control measures for fire blight progressed along the lines of the development of resistant varieties. This work was reported on in last year's summary. (Pl. Dis. Bul. Suppl. 14: 62-63. April, 1921.) Most of the work is being done in California by the Office of Foreign Seed and Plant Introduction and in Oregon by the Agricultural Experiment Station.

An important recent development is the introduction of fire blight into New Zealand (1,2), where it has spread rapidly and become a serious menace to the fruit industry. The situation is made even more serious there than in the United States on account of the great abundance of susceptible hawthorns in the vicinity of commercial apple and pear orchards.

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Scab caused by Venturia pyrina Aderh.

During 1921 scab was reported from most of the states in the northeastern section of the country and from North Carolina, Wisconsin, and the Pacific Coast states. A trace of the disease was also observed in Florida. Reports of non-occurrence or of no observation, were received from New Hampshire, Virginia, Tennessee, the Gulf Coast states (except Florida), Illinois, Michigan, and several of the western states.

In the majority of the states reporting scab the disease was not of very great importance, but in Rhode Island it was destructive in many cases causing severe cracking of the fruit; in New York it was important in a considerable number of orchards and was present to a greater or less extent wherever pears are grown; in Ohio more specimens were received than during any other previous season. On the Pacific Coast the disease was bad during 1921. The following reports from collaborators there indicate the severity of the disease:

Western Washington: Very prevalent and severe this season. Much worse than last season. Severe enough to cause large number of cracked fruits everywhere throughout western Washington. Loss through this cause very great. (Frank).

Oregon: The worst pear disease in western Oregon. Disease worse this year than last and more prevalent than the average year. The Rogue River section thinned off practically all scab, and Hood River has it well controlled. Largest losses met with in Willamette Valley, where it was severe although not as bad as apple scab. (Barss).

The following estimated percentages of loss from scab were reported: Vermont, 2-5%; New York, 1-5%; Maryland, 1%; West Virginia, 1%; and Oregon, 3%.

Dates of first observation

Vermont	September 20	Burlington
Connecticut	May 21	New Haven
Ohio	September 13	Ottawa County
Oregon	May 25	Jackson County

Reports of scab on Flemish Beauty were common in New York. Scab control is not reported on by collaborators.

Leaf blight caused by Fabraea maculata (Lev.) Atk.

Two areas where leaf blight was epidemic in 1921 have been reported. One of these was in the East and involved New Jersey, Delaware, Maryland, and southwestern Pennsylvania. It is probable that neglect in spraying had something to do with the outbreak, but it is also probable that the disease was considerably influenced by weather conditions. The blight was abundant on the foliage in this area, causing defoliation in many cases. Adams, in Delaware, reported 100% leaf infection in some orchards, and on August 1 stated that 60% defoliation had occurred. Temple and Jehle, in Maryland, reported premature defoliation to such an extent as to cause an estimated injury to next year's crop of 5%. One percent loss was reported in West Virginia.

The other epidemic centered in southern Illinois. Regarding the situation in that section, H. W. Anderson writes as follows:

> "Much worse than last year, or the average year. Very important, especially in nurseries. Not bad on fruit as there was no crop. Worst epiphytotic ever experienced on mature trees. Especially bad in Marion and Union Counties, where most of the pears are grown. Also severe in nurseries on French seedling stock. In one nursery French seedlings completely defoliated while Kieffer showed no injury. Serious on Kieffer in the orchards, however. No spraying done this season since no crop was expected."

Other states reporting this leaf disease are New York, South Carolina, and Ohio, but in none of these states was it of any special importance.

Dates of first observation were:

Delaware	June 2	-
South Carolina	July 15	Clemson College
Ohio	September	Wayne County

Leaf spot caused by Mycosphaerella sentina (Fr.) Schröt. (Septoria pyricola Desm.)

A few scattered local reports of this leaf disease were received by collaborators in some of the eastern states during the year. New York reported one orchard which did not receive a calyx spray as being heavily infested. In Pennsylvania specimens showing heavy infection were collected only in Center County. In Delaware 50% leaf infection was reported in some cases. The disease was of slight importance, however. In Virginia one record of severe infection was reported from York County on May 24. In South Carolina severe infection on nursery stock in Greenville County was observed August 1. In Florida the disease was reported from the western part of the state. In Ohio it was found in four north-central counties, according to Thomas. In Illinois it was observed only once during the season. In Michigan it was reported as the most serious pear disease in a orchard of 1,400 trees in Lenawee County. Negative reports were received from states west of the Mississippi River.

Black rot caused by Physalospora cydoniae Arnaud

Since there were not many pears produced in 1921, only a very few reports of black rot on the fruit were received. Twenty-eight states filled out annual report cards for this trouble, but of these, only the five states of New York, Maryland, North Carolina, Mississippi, and Ohio definitely reported the presence of black rot, and in all of these states the disease was unimportant, although in Ohio it did assume some importance as a twig blight.

Powdery mildew caused by Podosphaera leucotricha (E. & E.) Salm.

A notable feature of the pear disease situation was the outbreak of powdery mildew in Washington and Oregon. Regarding the situation in the latter state Barss reported that in general the loss from the disease was slight, but that considerable of the russetting that has been attributed to sprays, or weather, may be really due to mildew which is rather inconspicuous on the pear. The disease occurred chiefly in the western part of the state, russetting the fruit, and producing powdery mildew on leaves and shoots. It was first observed July 1 at Hood River.

Concerning the Washington situation, D. F. Fisher reports for central Washington as follows:

> "Very general and severe on Idaho, Anjou, Bartlett, and Louis Bonne. Less severe onFlemish Beauty and Winter Nelis, latter very resistant. Many Anjou crops reduced 50-75% and remaining fruit badly russetted and scarred. On this variety the scars resemble early scab infection. Idahos often completely covered with russet and greatly stunted in size. All affected pears are reduced in market grade. Fungus makes a sparse growth on foliage and twigs but apparently does not stunt growth nor devitalize the tree as seriously as on apples. Affected leaves are russetted on the under side and become cupped or curled and eventually drop. Perithecia have been found on pear fruit, but not on twigs.
>
> "This is the first time the disease has been serious or at all widespread on pears, even on pear trees interplanted with mildewed apple trees. The fungus was well established before its prevalence was observed and consequently no control measures were undertaken this year."

Pythiacystis brown rot caused by Pythiacystis citrophthora Sm. & Sm.

This fungus which has recently been described as attacking deciduous nursery stock, including pears, in California, was epidemic last year on nursery trees in parts of that state. (Hunt, T. Francis. Pythiacystis "brown rot" affecting deciduous trees. Mo. Bul. California Dept. Agr. 10: 143-145. April 1921.)

Other diseases

Blossom blight caused by Monila sp. (not Sclerotinia cinerea) - reported by Barss in Oregon as of slight importance in the moister sections of the western part of the state, causing a blossom and spur blight. According to Barss, Winter Nelis is especially susceptible, 30-90% loss may occur on individual trees of this variety. First observed May 17 at Corvallis.

Incense cedar rust caused by Gymnosporangium libocedri (P. Henn.) Kern (G. blasdaleanum (Diet. & Holw.) Kern) - reported by Barss as of very slight importance in Oregon this year. It occurs in the western part of the state from Salem southward, and causes aecial cushions on young fruit and leaves. First observed this year on pear, March 2 at Eugene.

Crown gall caused by Bacterium tumefaciens EFS & Towns. - reported from Washington, Benton County.

European canker caused by Nectria galligena Bres. - reported by Barss from Oregon as being serious as a canker of limbs and trunks in certain plantings of pears. Maximum amount in any one orchard was 100% of trees with cankers. Occurs only in the western part of the state. D'Anjou and Bose seem especially susceptible while Bartlett is a little affected according to Barss.

Bitter pit (non-parasitic). Specimen received at Ithaca from Wyoming County, New York, September 20. Also reported from Western Washington by Heald and Dana.

Brown rot caused by Sclerotinia cinerea (Bon.) Schröt. - reported from Puget Sound region, Washington.

Texas root rot caused by Ozonium omnivorum Shear - prevalent in Texas, causing serious losses in pears, according to Taubenhaus.

False silver leaf, cause unknown, reported once on pears from Cottage Grove, Oregon, July 1. Of no importance; causing milky appearance of leaves. It is very probably related in some way to the effects of the freeze of 1919, according to Barss.

Black ends, probably caused by a deficiency of water. A darkening and hardening of the skin at the calyx end is reported by Barss from Oregon. For the state as a whole it is unimportant, but some orchards showed 30% affected fruit. It seems to occur only on dry types of soil. Bartlett is sometimes badly affected, and a large percent of that crop rendered worthless.

Cracking of fruit (non-parasitic). Cracking of otherwise healthy fruit was reported as severe in at least two orchards in New York state. Some trees had nearly every fruit cracked, so that the pears were unsalable. It is evidently a question of moisture supply, according to Chupp.

Rough bark disease (non-parasitic) - reported by Dana from Benton County, Washington.

QUINCE

Spring frost injury caused by low temperatures

As with other orchard fruits, quince suffered heavily from the freezing temperatures of March and April, but apparently the crop was not injured so much as some of the other less hardy fruits. In New York 10-20% reduction in

yield was estimated and in Orleans County of that state 75-80% of the buds were reported killed. In New Jersey and Delaware the crop was practically destroyed, while in Maryland 80% of the crop was lost, according to collaborators. Injury was also more or less important in West Virginia and Illinois. No injury was reported from any of the southern or western states, although no doubt considerable occurred in some of them.

Fire blight caused by Bacillus amylovorus (Burr.) Trev.

Quinces, like pears, are very susceptible to fire blight, and in some sections of the country the disease does a great deal of damage. In 1921 it was reported from Connecticut, New York, Pennsylvania, New Jersey, Delaware, Maryland, Virginia, Georgia, Ohio, Arkansas, and Utah. In New York it was said to be very important, as it was last year, causing a reduction of about 5-10%. It occurred wherever quinces were grown in the form of twig and blossom blight. In Pennsylvania it was reported that 18 out of 24 young quince trees were removed from one orchard in Indiana County because of collar blight. In Georgia, McClintock reported it about as prevalent as usual, greatly reducing the amount of fruiting wood. In Ohio, Thomas reported more than last year, and more than the average year. The disease is more marked on the quince than on the apple in some sections of Ohio. In none of the other states reporting blight was the disease said to be of much importance on the quince.

Dates of first appearance according to collaborators were: New York, June 13, Albany County; and Ohio, June 2, Cuyahoga County.

McClintock in Georgia reports that the so-called quinconia is more resistant to fire blight than quince.

Leaf blight caused by Fabraea maculata (Lev.) Atk.

As on the pear, this disease was unusually severe throughout the New Jersey-Delaware-Maryland section, and it was reported as bad also in South Carolina and Georgia. Other states reporting it were Connecticut, New York, West Virginia, Ohio, Indiana, and the western parts of Washington and Oregon. Negative reports were received from a considerable number of the eastern and western states.

In New York it is said to be important in neglected orchards, and was first observed July 27 in Orleans County. A trace to 1% reduction in yield is estimated. Delaware reported more of the disease than last year, due to neglect of spraying, 100% affected leaves were visible in some orchards. It was first observed at Bridgeville in August. In Maryland more of the disease was reported; 3% reduction in yield was estimated. In South Carolina, Ludwig reported the disease as probably worse than usual, causing a leaf spot with resulting defoliation in the northwestern part of the state, where it was first noted June 28 at Clemson College. In Georgia trees were defoliated prematurely, according to McClintock.

Rust caused by Gymnosporangium germinale (Schw.) Kern
(G. clavipes Cke. & Pk.)

Rust was of very little importance in 1921, it being reported only from New Hampshire, Connecticut, New York, and Michigan. In none of these states was it of economic importance. Negative reports of occurrence were received from thirteen other states, all of which were in the eastern half of the country.

DISEASES OF STONE FRUITS

PEACH

The crop and the frost damage

As with apples, the spring frosts of March and April destroyed most of the prospective peaches in the belt of states extending from Iowa and Kansas to New Jersey. However, the extreme northeast corner of the peach region

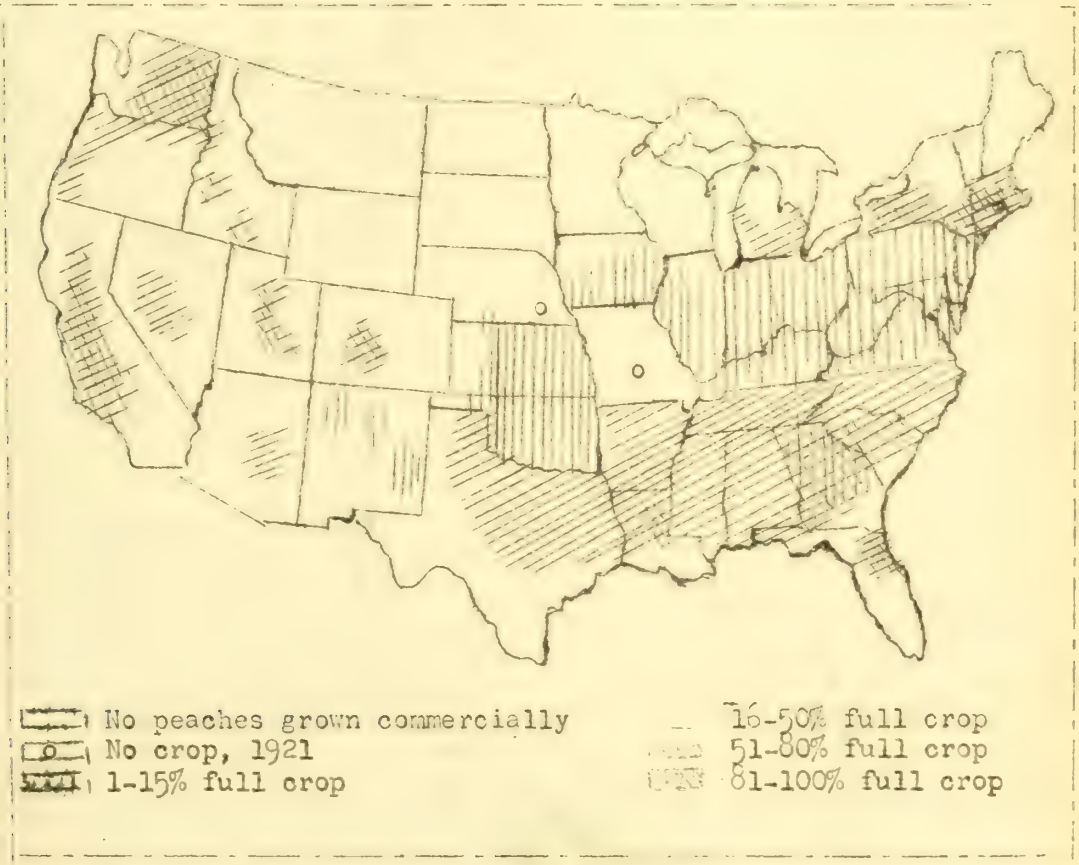

Fig. 10. Peach production in 1921 - Percentage of a full crop. (From figures in U. S. Dept. Agr. Mo. Crop Reporter 7: 110. Sept. 1921.)

Fig. 11. Peach production in United States, 1921. (Each dot represents 10,000 bushels.) (Figures from U. S. Bu. Crop Est. Mo. Crop Reporter 7: 157. Dec. 1921.)

escaped severe damage so that New England had a better crop than for some years and New York's output amounted to 1,700,000 bushels, which was about 65% of the unusually large crop of 1920.

The extreme southern states also escaped much of the freezing damage, Georgia producing heavily at the rate of 6,550,000 bushels while Texas and Alabama followed with 2,200,000 and 1,230,000 bushels, respectively.

The Pacific Coast states and the irrigated sections of the West, with the exception of Arizona, New Mexico, and Nevada, were not affected to any appreciable extent by freezing temperatures and good crops were obtained. As usual, California led all other states in peach production this year with 12,848,000 bushels or about 40% of the entire United States crop.

The accompanying maps (Figs. 10 and 11.) show where the peaches were produced in 1921 and indicate also the area and relative amounts of the crop shortage resulting from spring frost injury. The importance of the states of California, Georgia, and New York is brought out very strikingly in Fig. 11, and the belt of states through the central and eastern portion of the country, where the crop was practically wiped out, is very evident.

Brown rot caused by Sclerotinia cinerea (Bon.) Schröt.

Since most of the peach crop in the East was wiped out by frost, brown-rot, as well as other diseases of the peach fruit, attracted only slight attention this year. In fact only a few collaborators in the area hit by the frost have reported any losses from brown rot. Of course what few peaches were produced in this region were probably affected to some extent, but they were so scattered that it was difficult to obtain any sort of reliable data on losses. The fungus caused some damage to the trees themselves by blighting the twigs and producing cankers, but, apparently, this was of not much importance in the frost affected areas.

However, in the extreme Northeast and in the South and West good peach crops were obtained and in these sections brown rot seemed to be about as common as usual. In Connecticut more of the disease was reported than in 1920 because in that year there was practically no crop. In most of the other states the disease seems to have prevailed in about the average, or perhaps slightly less, amounts.

Brown rot conditions in leading peach states

As will be noted from figures above, the states of California, Georgia, Texas, and New York were the four states leading in peach production in the order named. It is, therefore, important to note the situation prevailing in these four states which together produced over two-thirds of the entire United States crop. From California not many data are at hand for 1921, but in 1920 W. L. Howard[3] stated that peaches in the coastal valleys or along the coast of California are often attacked by the fungus causing a blossom and fruit spur blight particularly, and also some rot. Howard states, however, that so far the disease has not been important, and that in 1920 for the first time the disease was a source of serious loss at ripening time, especially in the Santa Clara Valley.

In Georgia the disease was not so prevalent as last year owing to the strenuous spraying campaign that was carried on in the peach section against curculio and brown rot. It will be recalled that in 1920 curculio and the subsequent rot were extremely serious in and about the Fort Valley section of Georgia. During 1921 the efforts put forth to combat these troubles met with considrable success with the result that brown rot was not so serious as during the previous year. Regarding the situation in that state, J. A. McClintock reports that the disease was not so bad as last year, but was probably somewhat more prevalent than the average. Combined with curculio injury it caused a loss of 35% of the fruit in some orchards. Blossom blight, twig canker, fruit-rot and leaf-blight were reported and the disease was general throughout the state. Blossom blight was much more serious on the early varieties and the fruit rot was worse on late varieties, due to rainy weather and cracking. McHatton, from the Experiment Station at Athens, Georgia, reports the general prevalence of the disease, but states that, "It was better controlled than in 1920. Curculio injury was reduced by hard work and brown rot minimized. Weather conditions helped the control."

A comparison of the amounts of brown rot found in shipments of peaches from Georgia during 1920 and 1921 shows less rot in the shipments during the latter year. (Table 9). It will be seen that in 1920 more cars with high percentages of decay were inspected than in 1921 when the majority of cars fell in the low percent class. A smaller percentage of the cars inspected in 1921 showed brown rot than in 1920.

Table 9. Losses from brown rot of Georgia peaches caused by Sclerotinia cinerea in 1920 and 1921, as shown by examination of cars at destination by inspectors of the Bureau of Markets and Crop Estimates.

1920		1921	
No. cars	Percent decay	No. cars	Percent decay
3	75-82	4	80-95
27	50-65	10	50-65
119	25-49	62	25-49
240	10-24	171	10-24
128	5-9	163	5-9
80	1-4	267	1-4
597	Av. 17	677	Av. 11

Total No. cars Georgia peaches inspected, 1920 - 621
" " " " " " 1921 - 783

Per cent cars with brown rot, 1920 - 96%
" " " " " " 1921 - 86%

In Texas J. J. Taubenhaus reported on July 1 that the disease was very prevalent in that state owing to the wet season, and in December he reported that a reduction in yield of 3% probably took place. Texas peaches on the market in some of the northern states were reported by some of the collaborators as being affected with brown rot.

New York reported about the same amount of rot as last year from the Lake Ontario and Hudson Valley fruit sections. The following notes by counties throw more light on the situation there:

Orleans County, May 16 - Twig blight rather serious following blossom infections. May 23.- Twig blight serious in many orchards. May 31 - Very marked results where pink spray was applied for twig or blossom blight. Very little rot where this spray was used.

Ulster County, May 16 - Some old brown rot blossom blight has been observed. July 11 - showing up considerably due to the hot, muggy weather of the past week.

Wayne County, April 8 - Brown rot mummies in shape to discharge spores during rainy periods. June 13 - Showing up in some cases.

Importance of brown rot in other states

The accompanying map (Fig. 12) shows the percentage of loss from brown rot as reported by collaborators in 1921, and Table 10 shows the percentages of brown rot in carload shipments. In 1921, 71% of the total number of cars inspected (1048) showed brown rot, while in 1920, 82% of the total number (1299) showed the disease.

Table 10. Losses from brown rot caused by Sclerotinia cinerea, as shown by examination of cars at destination by inspectors of the Bureau of Markets and Crop Estimates, 1921.

Origin of shipment	No. of cars with decay	Average percentage of decay	Range of percentage of decay: No. cars	Range of percentage of decay: Percent	Remarks as to seriousness of decay, etc.
Alabama	3	6	3	3-9	
Arkansas	1	10	1	10	
California	2	7	2	2-12	Associated with other decays
Colorado	1	2	1	2	Advanced decay
Georgia	677	11	9	55-95	Associated with other decays
			67	25-50	" " " "
			601	1-24	" " " "
New York	28	9	28	2-35	
North Carolina	8	8	8	2-25	
South Carolina	2	3	2	3-4	Well advanced
Texas	15	13	2	37-43	" "
			13	4-17	Mostly advanced stage
Virginia	1	6	1	6	Associated with Rhizopus rot
Unknown	3	5	3	3-8	Mostly early stages

Total ..... 741 Total number of cars of peaches inspected ... 1048

Regarding the nature of injury and the importance of the disease, collaborators reported as follows:

Massachusetts (Osmun, August 15): On the increase since the wet period of early August. Rather serious. Rhode Island (Browning, August 15): Very common, becoming more so on our late maturing peaches; 8-10% infection. Connecticut (Clinton): Bad on early varieties but less on the late ones. The twig and fruit spur rot in the early season was much more conspicuous than usual and the early varieties rotted, but the late ones came off fairly free. Not so much harm was done, therefore, as the late peaches are the chief crop. New York (Chupp): Important in some orchards. Blossom and twig blight, fruit rot, and canker observed. Pennsylvania (Thurston and Orton): Severe on what fruit there was. Mostly fruit infection, but some twig blight. Delaware (Adams): Canker prevalent but none observed on fruit. West Virginia (Giddings): Fruit rot observed in southern Ohio Valley where a few peaches escaped frost.

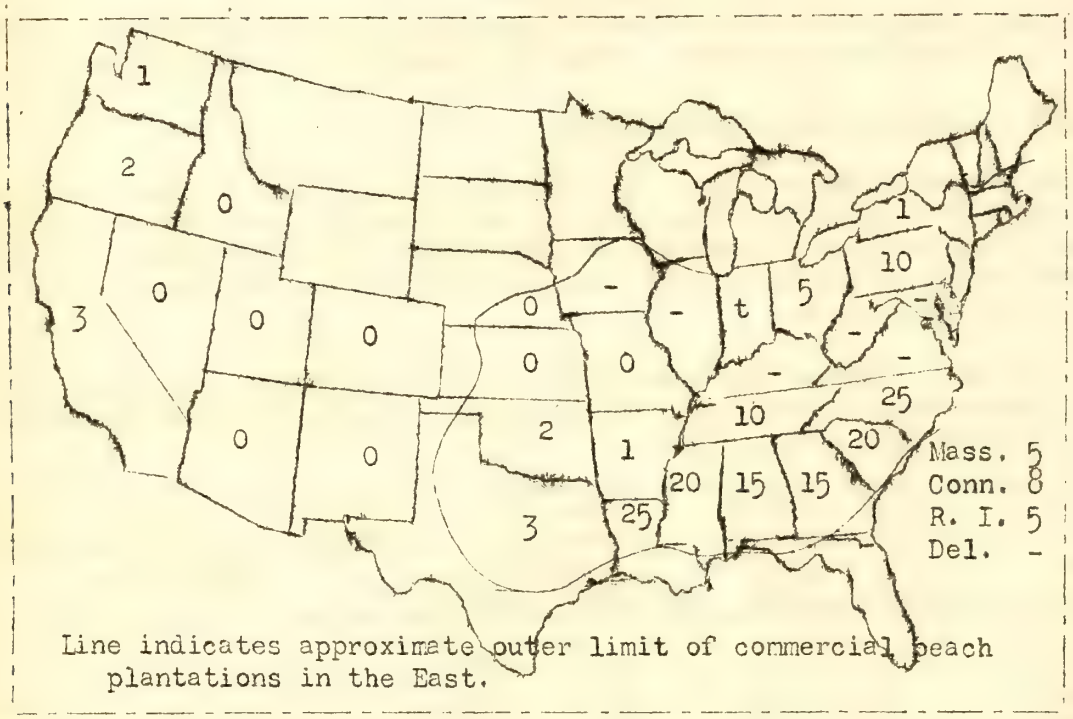

Fig. 12. Estimated percentage loss from peach brown rot in 1921.

Tennessee (Hesler, June 9): Blossom blight which was so abundant in 1920 was reported from three counties only. Twig and leaf blight reported from three counties; canker from four counties. (Sherbakoff, August 11): Brown rot serious on fruit. Twig blight in some cases caused considerable damage in eastern Tennessee. North Carolina (Foster): Very destructive over entire state. Found mainly in small orcherds where spraying is not practiced. Fruit rot form especially observed. South Carolina (Ludwig): Very important; our worst peach disease, causing a rot of the fruit and blight of the blossoms and twigs. Mississippi (Neal): Important, causing fruit injury. Very little blossom blight observed. Louisiana (Edgerton): Severe as usual. Texas (Taubenhaus): Very prevalent. Oklahoma (Stratton): Prevalent, causing rot of fruit and cankers. Arkansas (Elliott): Not serious this year. Ohio (R. C. Thomas): Only a few reports this season because of failure of the peach crop. Indiana (Gardner): Not important. Observed as a fruit rot and canker. Oregon (Barss): Probably not very important, causing slight loss. Pacific Northwest (D. F. Fisher): Fisher[2] states that brown rot is "one of the most serious menaces to the stone fruits in the humid sections of the Pacific Northwest.....

There is never difficulty in finding plenty of fruit destroyed by brown rot during the ripening season, on cherries, plums, and other stone fruits in the humid sections west of the Cascades, and if there happens to be a rainy period at this time a large proportion of the crop may be destroyed..... Brown rot is omnipresent in all orchards of this section and it is due to this fact that long distance shipments of the ripe fruit is impracticable."

Prospects of brown rot in 1922 and 1923

One naturally supposes that the absence of fruit rot in the frost-stricken area this year will influence the amount of disease in 1922 and 1923. The absence of mummies both on and under the trees eliminates the source of infection from 1921 fruit, but just how great a part the ascospores from the two-year old, 1920, mummies will play, remains to be seen. Roberts[3] has shown that one-year old as well as two-year old mummies are capable of producing apothecia. Will the lack of 1921 mummies influence the amount of disease in future crops and if so will the influences be evident in 1922 or 1923 or during both years? This question is worthy of special observations.

Dates when brown rot infection was first reported by collaborators

New York	May 16	Orleans County
Virginia	May 24	Poquoson
North Carolina	March 25	Raleigh
South Carolina	Blossoming time	Clemson College
Georgia	March 12	Fort Valley
Mississippi	June	Agricultural College
Ohio	June 4	Summit County
Indiana	June 28	-

Weather relations

Not many collaborators reported on the relation of the weather to the disease during 1921. Osmun in Massachusetts, however, reported an increase in the amount of rot following the wet period of early August. A similar increase was reported by Browning from Rhode Island on August 15. In North Carolina the disease was said to have done its greatest injury from May to July on account of favorable temperature and moisture conditions. In South Carolina the disease was checked somewhat on the late crop by dry weather. In Mississippi dry weather was helpful in keeping down the rot.

Brown rot control

Regarding control of brown rot, Ludwig of South Carolina reported that spraying decreases the damage from the disease but never absolutely controls it. In Georgia McClintock[4] in his recent bulletin concludes:

> "From the data collected in a number of commercial orchards in various sections of this State during the past two years and from the spray tests conducted in a commercial orchard in 1921 it is concluded that the cleaning up of orchards as a community proposition following harvest, in order to destroy peach insects and diseases over large

areas, is the only sure means of holding these pests in check. If the orchards are thoroughly cleaned, then three or possibly four applications of spray or dust may be expected to protect the fruit from the few insects which remain. And with curculio under control brown rot will no longer prove a menace to the peach industry of Georgia."

In Michigan, Coons reported that Dutton secured an increased keeping quality of the fruit by dusting peaches with sulphur just before harvest time[1]. In Ohio, R. C. Thomas reported[6] the results of spraying tests conducted by the Department of Botany in which lime-sulphur-glue mixture was used. These experiments, conducted during 1920, showed that this mixture will control brown rot. Four applications were made, one on June 12, a second three weeks later, a third five weeks later, and a fourth about two weeks before harvesting the variety Champion. The orchard consisted of 35 trees of Champion and 60 trees of Elberta and Lemon Free. On the Champions, counts showed no brown rot of the fruit on September 6, whereas unsprayed trees showed 18-20%. On the Elbertas, determinations made September 25 showed the sprayed fruit free from infection while the unsprayed showed 10-15%. The formula for this mixture is:

Flowers of sulphur (superfine)..... 8 pounds
Hydrated or mason's lime..... 4 pounds
Ground glue..... 1.5 to 2 ounces
Water to make up 50 gallons

Recent literature

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2. Fisher, D. F. Controlling brown rot of stone fruits. Better Fruit. 15[10]: 3-4, 15-16. illus. Apr. 1921.
3. Howard, W. L. An old disease in a new place. Amer. Hort. Soc. Proc. 17: 102-104. 1920.
4. McClintock, J. A. Peach disease control. Georgia Agr. Exp. Sta. Bul. 139: 1-30. Dec. 1921
5. Roberts, J. W. The age of brown rot mummies and the production of apothecia. Phytopath. 11: 175-177. Apr. 1921.
6. Thomas, R. C. Brown rot of peaches and its control. The spraying test conducted by the Department of Botany, Mo. Bul. Ohio Agr. Exp. Sta. 6: 26-30. Jan.-Feb. 1921.

Not cited:

Cook, M. T. The blossom blight of the peach. Phytopath. 11: 290-294. Pl. 12. July 1921.
Urbahns, T. D. Twig blight of peach and apricot trees. Calif. Cult. 55: 787. Dec. 18, 1920.

Leaf curl caused by Exoascus deformans (Berk.) Fckl.

Leaf curl was generally of much less importance in 1921 than during the preceding year, when it was epidemic. Judging from reports, it may be said that the disease was below the average in prevalence. Collaborators in New England and New York report either more than or about the average amount of leaf curl, but from Pennsylvania southward and in all the other peach states of the East, with the exception of Arkansas, the disease was said to be either less prevalent than or about the same as last year. In Oregon, however, it was even worse than last year in severity, according to Barss. The following table (Table 11) compiled from collaborators' reports, shows the prevalence and importance more in detail.

Table 11. Prevalence and importance of peach leaf curl in 1921.

State	Prevalence compared with: last year	Prevalence compared with: average year	Importance
New Hampshire	Worse	Worse	Caused a great deal of injury
Rhode Island	-	-	Very common on leaves
Connecticut	Same	Less	Few complaints only
New York	Same	-	Very important in unsprayed orchards
New Jersey	Less	-	
Pennsylvania	Less	-	Slight this year
Delaware	Less	-	Much less important this year. Trace in some orchards
Maryland	Less	Less	
Kentucky	-	Same	
Tennessee	Less	Less	Very little this year
North Carolina	Same	Same	Common, but unimportant
South Carolina	-	-	Damage slight
Georgia	-	-	Not serious commercially - general in neglected orchards
Mississippi	Less	Less	Unimportant
Texas	-	-	Unimportant
Oklahoma	-	-	Unimportant
Arkansas	More	More	General and severe
Ohio	Same	Same	Severe in unsprayed orchards, no serious damage
Indiana	Less	Less	Considerable importance on unsprayed trees
Illinois	Same	More	Serious in a few orchards - little damage
Michigan	-	-	Prevalent in some orchards
Iowa	Less	Same	
Missouri	Less	-	
Nebraska	-	-	Slight amount
Kansas	Less	-	Unimportant
Montana	Same	Less	
Idaho	Less	Less	Important where not sprayed
Washington	-	-	Abundant this season throughout western Washington
Oregon	Worse	Worse	Very destructive

It is difficult to explain the reason for this marked reduction in the amount of leaf curl from that of last year, but undoubtedly the unusual weather conditions of the spring of 1921 were responsible in some way. It is possible that the weather at the time of the swelling of the buds was too warm for infection, perhaps the high temperatures of March advanced the buds so rapidly as to escape infection. On the other hand, the freezing temperatures that occurred in the spring after bud opening may have played some part in reducing the amount of leaf curl. It would seem that a sufficient amount of moisture was available during the time when peach buds were swelling and when infection was taking place, although dry weather during this critical time would have interfered.

The heaviest losses from peach leaf curl in 1921 occurred in the Northeastern area, in the belt of states from Ohio to Iowa, and on the Pacific Coast. Considerable loss of foliage also occurred in parts of Arkansas and Mississippi. On account of the short crop in the northern states the loss to the fruit this year was not very significant, but the loss of the leaves weakened the trees for producing new growth and next year's fruit buds. The following table gives collaborators' estimates for losses from leaf curl (Table 12).

Table 12. Estimated percentage reduction in yield from leaf curl, 1921.

Percent reduction	States
5-10	Oregon
3	Pennsylvania
2	Washington
1	New York, Illinois, Iowa, Mississippi, Arkansas, and California
0.5	Ohio, Indiana, and Missouri
t	Connecticut, New Jersey, North Carolina, Georgia, Tennessee, Michigan, Nebraska, Kansas, Oklahoma, and Idaho
No data	Delaware, Maryland, West Virginia, Virginia, Kentucky, South Carolina, Alabama, and Texas.
No loss	Remaining states

Collaborators have reported the dates when they first observed leaf curl, or when the disease was first brought to their attention by letter or by specimens, as follows:

New Hampshire	May 24	Hollis
Connecticut	May 18	Danbury
New York	May 9	Nassau County
Pennsylvania	April 3	Arendtsville
Delaware	June	Milford
Georgia	March	Griffin
Mississippi	May	Meridian
Arkansas	May	Fayetteville
Ohio	May	Wayne County
Indiana	April 11	Posey County
Illinois	May 5	Lilly

The only reports concerning the susceptibility of varieties are from Oregon, where Barss reports Elberta as the worst affected, being almost a complete failure in some sections; and from California, where G. P. Weldon observed a Salway tree in the check plots of his experiment on leaf curl control that showed almost absolute resistance.

A number of collaborators report complete control when the dormant applications with lime sulphur are made in time. Barss reports good control by spraying with Bordeaux mixture in the winter time in Oregon. A number of collaborators mention that, owing to the early season, many growers were late in applying the leaf curl spray, but that when it was applied on time good control was secured.

George P. Weldon[1] tested the dry lime-sulphur, comparing it with commercial liquid lime-sulphur in the control of leaf curl in California, and found the two sprays to be equally effective when applied as follows:

Liquid - 1 gal. - 10 gal. water
Dry - 2 lbs. - 10 gal. water

Liquid - 1 gal. - 20 gal. water
Dry - 2 lbs. - 20 gal. water

Liquid - 1 gal. - 30 gal. water
Dry - 2 lbs. - 30 gal. water

Literature cited

1. Weldon, G. P. Dry lime-sulphur solution vs. lime-sulphur in the control of peach leaf curl. Mo. Bul. California Dept. Agr. 10: 170-172. May-June, 1921.

Scab caused by Cladosporium carpophilum Thüm.

Although scab was reported from the majority of the eastern states where the disease is known to occur, it was not a factor of any great commercial importance during 1921. Many of the states which commonly report considerable trouble with scab had a very small crop this year. However, Georgia and some of the other southern states that had good crops do not report that scab was of much importance. In Georgia McClintock reports that the disease was prevalent in about the usual amounts and was serious only on the unsprayed fruit, and McHatton reports much less injury than last year. Only a very small fraction of a percent of the Georgia peaches were affected with the disease. In New York where about two and one-half million bushels of peaches were harvested, collaborators report scab in about the same amounts as last year and state that it was important in a few orchards which were not well sprayed. In California, where about one-third of the United States crop was produced last year, scab is rare and of no importance. The same statement applies to the other western peach producing states.

The states in the eastern part of the country which had little fruit in general reported the disease to be about as usual on the twigs. New York New Jersey, Delaware, Indiana, and Illinois all mention especially the prevalence of twig infection. Rhode Island and Ohio report considerable cracking

of the fruit in connection with the scab lesions. Chupp, in New York, reported the disease on the leaves.

Only a few states reported percentage losses from scab, which are as follows: Rhode Island 75% affected fruit in unsprayed orchards; Connecticut, moderate, 1-3%; New York, trace of loss; Maryland, 1%; Ohio, 2-3%; Mississippi, trace; Texas, 1-5%.

Dates on which scab was first observed by collaborators, 1921

Connecticut	August 9	Seymour
New York	July 28	Tompkins County
Georgia	June	Marshallville
Massachusetts	July 8	Agricultural College
Ohio	July 15	Erie County

Two states report on varietal susceptibility this year. Chupp in New York reported that Carman was most severely affected in Tompkins County, and McClintock, in Georgia, reported the Georgia Belle as more seriously affected than any other variety, except wild seedlings.

According to Bensaude and Keitt (Bensaude, M. and G. W. Keitt. A preliminary report on cross-inoculation experiments with strains of Cladosporium from stone fruit. (Abstract.) Phytopath. 12: 46. Jan. 1922.) the Cladosporium from Amygdalus persica L. (Elberta) cross infected P. americana Marsh and P. armeniaca L. and the strains from P. americana crossed to A. persica and P. armeniaca.

Bacterial spot caused by Bacterium pruni EFS

Bacterial spot apparently occurs in every peach growing state from Nebraska to Massachusetts and from Texas to Florida (Fig. 13). The Survey has no reports of the disease from Massachusetts, Kentucky, Tennessee, Florida, Iowa, or Kansas, but it has been found in those states, according to Rolfs (A bacterial disease of stone fruits. New York (Cornell) Agr. Expt. Sta. Memoir 8. July, 1915.) and Roberts (Control of peach bacterial spot in southern orchards. U. S. D. A. Bul. 543. Aug. 8, 1917.). In 1920 the disease was reported from Arizona for the first time (Pl. Dis. Bul. Suppl. 14: 77. 1921. The loss reported was 1%, instead of 10%, as given in the Supplement.)

The injury due to bacterial spot in individual states varies considerably from year to year, but in general it appears to be most serious in the southern part of its range. In recent years it has apparently become increasingly important in Delaware, Indiana, and Illinois. Losses really due to the disease are difficult to estimate, since they may take place indirectly through reduced vigor of the trees. In many cases, also, bacterial spot is said to attack only trees already weakened by some other cause, such as frost injury, poor soil conditions, neglect, etc.

The leaf spot is the most frequently reported form of the disease. The fruit spot, however, is often reported as the cause of considerable loss, and at times the twig canker does severe damage.

In 1921 bacterial spot occurred in most of its usual range and was reported again from Arizona. Connecticut (Clinton): About the same amount as last

year, more prevalent than usual, but not serious; found on fruit for the first time. New York (Chupp): Probably the same as last year, not important; leaf spot on otherwise weakened trees; first reported June 20 in Orleans County.

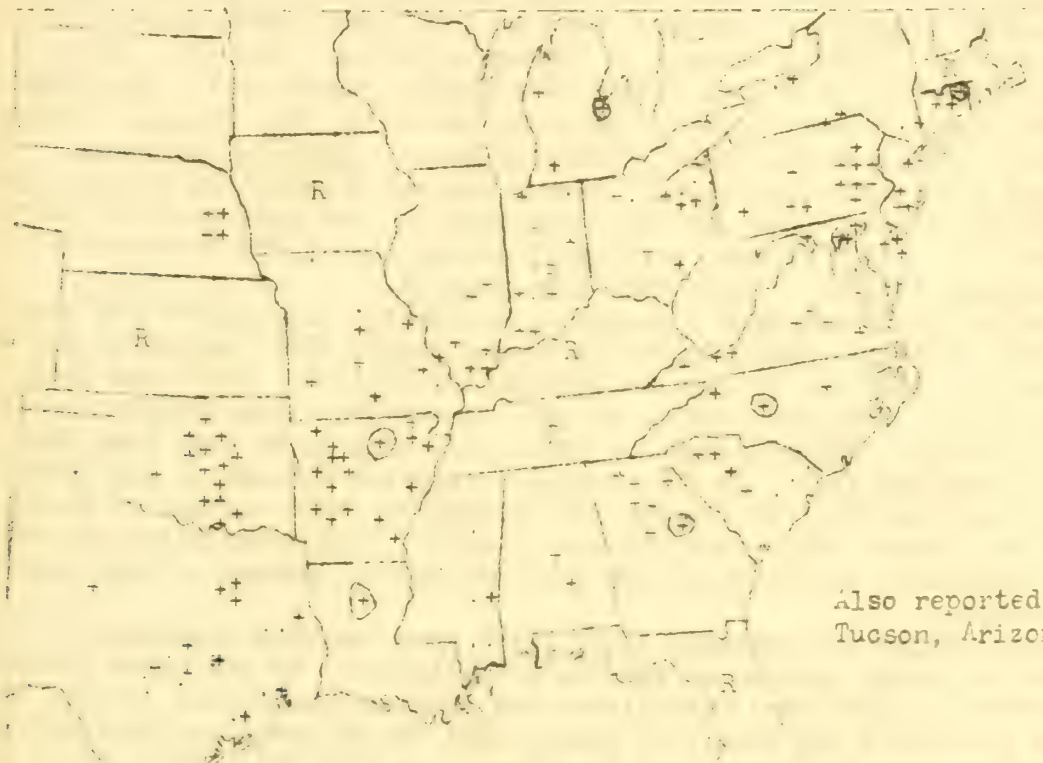


Fig. 13. Distribution of bacterial spot of peach.

New Jersey (Cook): None reported, but probably present on foliage. Delaware (Parker): More than last year; very important, leaf and twig lesions; first report on April 29 at Bridgeville. Maryland (Temple and Jehle): Trace. North Carolina (Foster): Piedmont section, same as last year and average year; unimportant; 1% reduction in yield. South Carolina (Ludwig): General about same as usual, unimportant to moderate, reduction in yield .5% or less; caused leaf spot and defoliation. First observed June 20 at Rowesville. Georgia (McClintock): Piedmont section, same as usual; serious on leaves and fruit. Mississippi (N. [illegible]): [illegible] one of most important diseases in eastern and southern part of state. Caused leaf injury; fruit spot rare. Severe defoliation in many orchards. Many trees observed completely defoliated by August 15. First report in May from Tassell. Louisiana (Edgerton): Observed a few times. Texas (Taubenhaus): Prevalent. [illegible] loss. Oklahoma (Stratton): Quite important, affected practically

all leaves, caused defoliation. Arkansas (Elliott): More, quite important; affects 50% of the trees; loss a trace. Severe in orchards following frost, and in nurseries. Mostly leaf and twig injury on nursery stock. Earliest record in April at Piggot. Ohio (Thomas): Of slight importance, confined chiefly to northern sections; on fruit, leaves and young twigs. First reported August 5 from Erie County. Indiana (Gardner): Same as last year, worse than usual. Worst peach disease. limiting factor in Vincennes region. Loss 2%. Twig blight early in spring, leaf spot, early defoliation, fruit spot. Specimens received from DeKalb County which is quite far north for this disease. Worse on poorer sandy ridges than in more fertile hollows. Illinois (Anderson): Less than last year, more than usual. Caused serious defoliation in some sections. Michigan (Coons): Not general, considerable leaf spot here and there. Missouri (Hopkins): Very common; one report states that 1,000 trees were affected. Arizona (Brown): Less, loss less than 1%.

Varieties which have been reported as especially susceptible are Lady Ingold in North Carolina, 1917; Salway in Pennsylvania, 1918; Mayflower and Arp Beauty in Georgia, 1920; J. H. Hale in Indiana and Illinois, 1920; and Lemon Free in Ohio, 1920. Hale was said to be more susceptible than Elberta in both Indiana and Illinois. White-meated varieties were said to be free from the disease in Indiana and 1920. In 1921 Delaware reported Elberta as the most commonly infected variety. In Georgia the disease was most serious on Hale, but occurred on Carman, Hiley, and Elberta as well. Perfection Cling was said to be very susceptible in Illinois, and Hale was again reported as more susceptible than Elberta.

Virginia (1919) and Arkansas (1917,1919) have reported beneficial results from the use of nitrate of soda as a fertilizer. On the other hand, Illinois reported in 1920 that fertilizers and cultivation did not control the disease, and Indiana in the same year stated that two or three applications of nitrate of soda during the season had no effect. In 1921 Delaware reported that nitrate treatment was not especially successful.

Blight caused by Coryneum beijerinckii Oudem.

Coryneum blight of peach has been reported from both the eastern and western peach-growing sections of the country, but while it occurs only locally and occasionally in the East, in the West it is prevalent and of much importance, especially in California and Oregon (Fig. 14).

In 1921 the disease undoubtedly occurred in California, although no report of it was received. It is said to be a serious trouble in the interior valleys, where spraying is necessary for its control, but it rarely causes loss in the coast districts[2]. In Oregon, according to Barss, all forms of the disease were severe wherever peaches were grown, due probably to the fact that the blight spray was generally neglected. The loss for the state was estimated at 20%. The disease was reported from several counties in Washington, and occurred on nectarines in King County. In Idaho, Coryneum blight seems to be increasing in importance. Hungerford states that it is becoming so destructive that growers will be forced to spray for it. In Utah, although the disease was somewhat more destructive than usual, and caused severe winter bud destruction in certain districts, it was confined to Cache County, and was considered to be of minor importance. The fruit spot caused considerable loss in Delta County, Colorado, according to C. D. Learn, who says:

"The Coryneum blight of the peach was very destructive in Delta County. A survey of 38 growers was made and the loss ranged from 2.2% to 27% when it came to marketing the fruit. Mr. W. L. May, who took these data, estimated the loss in that county could have been put at $20,000. The past year was very wet in comparison with previous years, which accounts for the sudden outbreak."

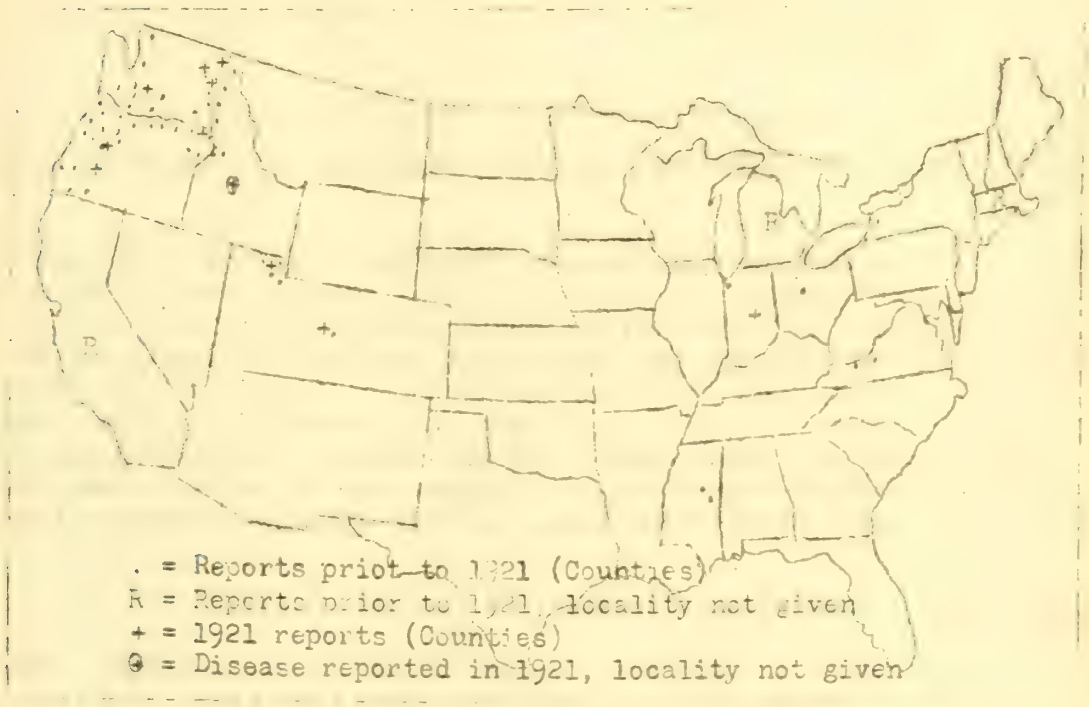


Fig. 14. Distribution of Coryneum beijerinckii on peach, according to records of the Plant Disease Survey, 1903-1921.

According to publications of the California and Oregon Experiment Stations, the disease is readily controlled by spraying in the fall and early spring with either lime-sulphur or Bordeaux. Spring spraying alone is too late, since infection occurs in the early part of the year. An experiment conducted in an orchard of Muir peaches near Fresno, California, indicated that the disease can be controlled by both the dry and the liquid lime-sulphurs. The materials used were: liquid brands - Rex, Orchard, and Ortho; dry compounds - Glidden's Dry Lime-sulphur, Sherwin-Williams Dry Lime-sulphur, and "B. T. S." a barium-sulphur compound; all at the strengths recommended on the labels, except Ortho, which was used at approximately one-half the recommended strength. A single application was made November 13, 1920. The results which were noted March 24 and April 14, 1921, are summarized by T. K. Howard in Table 13.

Table 13. Results obtained in peach spraying experiment on the Brooks Ranch, Fresno, California, 1920.

Spray	Diseased twigs, Average per tree
Rex (liquid)	4.5
Orchard (liquid)	3.5
Glidden (dry)	4.1
Sherwin-Williams (dry)	3.4
B. T. S. (dry)	5.4
Ortho (liquid)	3.5
Check	25.8

Howard makes the following statement concerning the results of this experiment:

"The two outstanding features, resulting from this test, are that the dry lime-sulphurs, when applied at the strength recommended by the manufacturers, did effectually control peach blight, and that the solution of liquid lime-sulphur, applied at approximately one-half the strength recommended, was equally effective in the control of this disease. This fact alone seems to answer the arguments which have been made that the dry lime-sulphurs did not contain a sufficient quantity of active sulphur to control this disease, and it seems to show also that the liquid preparations have, in fact, been used stronger than is necessary."

Literature cited

1. Howard, Fred K. Effect of sulphur sprays on peach blight. Amer. Fruit Grower 41?: 5, 14. July 1921.
2. Howard, W. L. and W. T. Horne. Brown rot of apricots. California Agr. Expt. Sta. Bul. 326. Jan. 1921.

Rosette (cause unknown)

Since 1903, as will be seen from the accompanying map (Fig. 15), rosette has been reported to the Survey from West Virginia, Tennessee, South Carolina, Georgia, Alabama, Missouri, and Oklahoma. According to E. F. Smith (Peach yellows and peach rosette, U. S. Dept. Agr. Farmers Bul. 17: 13. 1894.), the disease has also been found in Arkansas and in the vicinity of Manhattan, Kansas, but the Survey has no record of its occurrence in those states.

In practically every case rosette has been reported as of slight general importance, even in Georgia where it seems to be most prevalent. The following list of quoted or abstracted statements of collaborators indicates the prevalence and importance of the disease and the frequency with which it has been reported from each state.

West Virginia. 1920 - Two trees with typical rosette growing in chicken yard in Morgantown, Monongalia County. (John L. Sheldon).

Tennessee: 1913 - Only scattering cases found. (E. H. Essary).
1917 - Reported from one place (Henderson County) in West Tennessee. (Essary).
1920 - Few trees in one orchard observed. (L. R. Hesler).

Fig. 15. Distribution of peach rosette as reported to the Plant Disease Survey, 1903-1921. Each dot represents a county from which the disease has been reported. Shaded areas indicates occurrence in Kansas, according to U. S. Dept. Agr. Farmers' Bulletin 17, 1894.

South Carolina: 1913 - Saluda County. (F. M. Rolfs).
1915 - Union county; only a few cases reported. (H. W. Barre).
1919 - Local. (J. L. Seal).

Georgia: 1903 - Occasional throughout the entire peach-growing belt of the state. Only occasional trees become affected; usually promptly removed. Damage not appreciable. (Wilmon Newell).

1904 - Does very little damage, although occasionally found in the middle and north sections. In one place that came under personal observation (Cobb County) many small orchards within a radius of a few miles contained several "rosette trees," one orchard of about 75 trees having twelve badly infected trees. (R. I. Smith).

1905 - Peach rosette, while existing in several localities, cannot be said to do a great deal of damage. The spread of this disease has not been very rapid within the past year, and there are few orchards where this disease occurs that contain more than a few infected trees, generally removed as soon as the trouble is discovered. One orchard only has come under my observation in which the infestation of practically all the trees was observed.

1906 - About the same as last season. Control - cutting down diseased trees. (A. C. Lewis).

1907 - Less than last year. Control - cutting down diseased trees. (Lewis).

1909 - Less than previous year; found in 1% of orchards. Control - cut down diseased trees. (Lewis).

1910 - Less than last year or average year. One percent of trees affected. Most growers now cut down trees as soon as the disease appears. (Lewis).

1911 - Less, as diseased trees are cut down each year. (Lewis).

1912 - Very little rosette. (Lewis).

1918 - General; injury and loss slight. Found on Elberta. No treatment. (J. B. Berry).

1919 - General; injury 0-100%; loss slight. (Berry).

More abundant than last season; injury .01%. Found scattered throughout commercial orchards on both young and old trees. Is gradually increasing in commercial orchards, as well as neglected trees. No varietal resistance observed. (J. A. McClintock).

1920 - About same, slightly more than last year or than usual. Serious where infected trees are not removed. Occurs in middle Georgia. On all varieties. (McClintock).

Alabama: 1912 - Observed only at Salem. (F. A. Wolf).

Missouri: 1903 - Last year rosette was observed in five different counties - Howell, Texas, Wright, Greene, and Newton. This year, owing to limited traveling, it has been noticed only in Wright and Texas Counties. Four cases have been noticed near the Station within a radius of three miles. (Paul Evans).

1905 - The same as last season; only isolated cases. (Evans).

1906 - A serious outbreak of rosette was observed in several orchards at Mountain Grove. (W. M. Scott).

1907 - Same excepting a few new localities. This disease is confined almost entirely to seedlings along fence rows. There are very few instances in which it has been found in commercial orchards, but it seems spreading slowly. (Evans).

1908 - Reported from seven southern counties. Treatment - dig up and burn.

1909 - Abundant, injury and loss not known. (F. M. Rolfs).

1910 - Considerable. (Rolfs).

Oklahoma: 1906 - Scarce; two reports, injury and loss insignificant. Treatment - destruction of trees; results good.

During 1921 rosette was said to be present in the normal amount in middle Georgia, where it was, as usual, not serious, although affecting all varieties. According to T. H. McHatton the disease is "not serious in commercial districts. Most common in poorly cared-for plantings in Piedmont, Georgia." Rosette was rather doubtfully reported from South Carolina also by C. A. Ludwig, who states that "This trouble is placed here doubtfully because the symptoms of root knot are similar. It appears that in at least one case reported, howe-

ever, root knot is absent or the infestation is slight." The disease referred to occurred in Anderson and Richland Counties, and was apparently rather important in affected orchards.

Yellows (Cause undetermined)

Yellows was reported during the year from the group of states in the eastern part of the country, including Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, West Virginia, and Ohio. In New York it was important only in the lower Hudson River Valley and on Long Island, and was not reported from the Ontario Lake region, as has sometimes been the case. In Pennsylvania the disease was by far the most serious in the southeastern part of the state, and in Maryland it was the worst, as usual, east of the Alleghany Mountains, but it was not reported from the Eastern Shore, south of Delaware. New Jersey and Delaware report the disease as generally distributed throughout both states. The accompanying map (Fig. 16) shows the states from which yellows has been reported to the Survey during the past five years. The area of occurrence seems to be of a more limited extent than was the case twenty-eight years ago when the disease was reported by Dr. Smith in Farmers' Bulletin 17. It is possible that the disease still exists in much of the territory reported infested at that time, but a number of collaborators report that they have never seen the disease in their states although older records indicate its former occurrence. During 1921 the following states specifically mention that the disease was not observed nor reported: South Carolina, Georgia, Tennessee, Indiana, Illinois, Missouri, Arkansas, Mississippi, Texas, Kansas, and Nebraska.

XXXX Region where yellows is most important
Territory from which yellows has been reported to the Survey during last 5 years
? = Limit of yellows in 1894 (U.S.D.A. Farmers Bul. 17: 1894)

Fig. 16. Geographic distribution of peach yellows.

Regarding the importance of this trouble, collaborators in New Jersey, Delaware, Pennsylvania, and Maryland are the only ones that reported it as being of a serious nature.

Inspection of peach orchards for yellows was conducted in Pennsylvania last year by the State Department of Agriculture and the following summary by W. A. McCubbin gives the results of the inspection:

> "The success of the yellows inspection, put on this year in a methodical manner for the first time, far exceeded our expectations, both in regard to the area covered and in the attitude of the peach growers, who were everywhere pleased with this service. This year's inspection covered all the commercial orchards in ten counties: Franklin, Adams, Chester, York, Lancaster, Bucks, Montgomery, Lebanon, Berks, and Dauphin, and a partial inspection was made in Cumberland, Lackawanna, Luzerne, Philadelphia, and Wayne. The records indicate an examination of 324 orchards during the season numbering 387,446 trees of which 17,376 or 4.45% were marked for yellows. The cost of this inspection lies between one-half and three-fourths cent per tree. The amount of yellows varied widely; 59 orchards were reported free, Adams and Franklin leading in this respect, 121 orchards had less than 2%, 41 had more than 20%, and 18 more than 50%, these last being practically worthless.
>
> "In a general survey of peach orchards in Erie County no yellows was seen, hence our inspection program was not put into effect there.
>
> "The year's work brings out very clearly in every county the fact that where serious attempts were previously made to control the disease, the percentage of yellows found this year was small. The success of our program in future years is therefore assured.
>
> "Inspection was made difficult this season by (1) absence of fruit, (2) borer injury, (3) drought, starvation and neglect, and (4) second growth after an early summer check. That even under difficult conditions the summer's work was so successful is due to the energy and enthusiasm of the inspection staff, and to their good judgment derived from long orchard experience."

During the year M. T. Cook of New Jersey has published an article[1] reporting the results of histological examinations of leaves and twigs from healthy peach trees and from those affected with yellows, and little peach. All of these studies on both leaves and new growths indicated that the translocation of starch is partially or completely inhibited in the diseased trees, probably dependent upon the severity of the disease. Large amounts of starch were present in leaves and green twigs from diseased trees early in the morning as compared with relatively small amounts in leaves and green twigs from healthy trees at the same hour. According to Cook, "In all cases the results are an accumulation of starch in the leaves which may account for the leathery texture, but does not offer an explanation for the willowy growth of the final stage of yellows ..... Furthermore, the reduction, or inhibition, of the translocation of carbohydrates may also account for the enlarged premature fruit which is characteristic of trees affected with yellows." Cook also finds that trees that have been girdled or injured by label wires, borers, or freezing injury, show an accumulation of starch similar to that in trees diseased with yellows.

1. Cook, M. T. Peach Yellows and little peach. Bot. Gaz. 72: 250-255. Pl. 6-7. Oct. 1921.
   Blake, M. A., M. T. Cook, and C. H. Conners. Recent studies on peach Yellows and little peach. New Jersey Agr. Expt. Sta. Bul. 356: 1-62. Illus. 2 pl. Oct. 1921.

Little peach (cause undetermined)

Little peach has been reported to the Survey in past years from Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, Ohio, Michigan, and Missouri. A doubtful report was also received from South Carolina. During the past five years, however, reports have been received only from New Jersey, Delaware, and Pennsylvania, and in 1921 only three reports, from Connecticut, New Jersey, and Delaware were made. Whether or not this lack of reports from other states indicates a limitation in the range of little peach is uncertain. In Connecticut one report from Yalesville, in New Haven County, was received. In New Jersey, Cook states the disease to be severe but it occasioned less complaint than usual on account of the small crop. In Delaware Adams reported the disease to be very important and the same as last year. Negative reports were received in 1921 from New Hampshire, New York, Maryland, West Virginia, Tennessee, South Carolina, Ohio, Illinois, and Michigan.

1921 Literature

Blake, M. A., M. T. Cook, and C. H. Conners (l.c.: see Yellows).
Cook, M. T. Peach yellows and little peach. Bot. Gaz. 72: 250-255. Pl. 6-7. Oct. 1921.

Verticillium wilt caused by Verticillium sp.

This newly described peach disease was reported for the first time in 1921 by C. M. Haenseler, who found the disease occurring in parts of Burlington and Camden Counties, New Jersey. Fig. 17 shows the approximate distribution in the state. Haenseler reported as follows concerning the disease, at the Toronto meeting. (Haenseler, C. M. A new peach wilt disease. (Abstract). Phytopath. 12: 56-57. Jan. 1922.)

> "During the summer of 1921 a new peach wilt disease affecting from 5-20% of the trees was observed in several two to four-year old orchards in Camden and Burlington Counties, New Jersey. The disease started when the new growth was in its most rapid development, became most severe during a June drought, and ceased further development after August..... Microscopic examination of old and new diseased wood shows a copious fungus growth in the wood vessels. Tissue cultures from over thirty twigs taken from different orchards gave a species of Verticillium in approximately 75% of the cases. This Verticillium was compared with V. albo-atrum from okra and eggplant, but no marked morphological or cultural differences could be noted.

Fig. 17. Occurrence of Verticillium wilt of peach (After map by M. T. Cook).

The symptoms are described by Haenseler.

Infection appears to take place through the roots and the wood is darkened, sometimes up into the small twigs.

Root knot caused by Heterodera radicicola (Greef) Müll.

South Carolina, Georgia, and Texas report root-knot on peaches. According to Ludwig, this is an important disease in South Carolina, affecting about half of the orchards and one-quarter of the trees in the state. An estimate of 5% reduction in yield is made and as high as 95% affected trees have been found in a single orchard. The disease is generally distributed over the state, but is present especially in the lower sections. In Georgia, according to McClintock, it is becoming more important each year due to increase in plantings and is prevalent in central and southern Georgia. Heavy infestation of the roots and stunting of the growth occur. The majority of varieties are susceptible, but McClintock has one seedling which thus far shows marked resistance. In Texas, only traces of root-knot are found on peaches and the disease is regarded as unimportant by Taubenhaus.

Rust caused by Puccinia pruni-spinosae Pers.

Reports of rust from South Carolina, Texas, and California were received in 1921. The disease appeared to be of very little importance in these states on peaches.

Powdery mildew caused by Sphaerotheca pannosa (Fr.) Lev.

In Orleans County, New York, infection with powdery mildew was very heavy in parts of one orchard. On some trees practically every peach was affected. It was first observed in this locality on June 27. For the state as a whole, it is a very minor disease, however. Considerable powdery mildew was reported by Muncie from Erie County, Pennsylvania, and he states that one application of self-boiled lime sulphur, June 16, was efficient in control. South Carolina and Texas also noted the disease, and Washington and Oregon on the Pacific Coast reported it as unimportant.

Other diseases

Die back associated with Valsa leucostoma Fr. - reported from New York (trace), Georgia (general in distribution; serious in old and neglected plantings), and Ohio (noted following winter injury; of slight importance and less than last year.)

Sooty blotch and fly speck, probably caused by Phyllachora pomigena (Schw.) Sacc. and Leptothyrium pomi (Mont. & Fr.) Sacc. Gardner in Indiana reports the collection of this disease in Knox County, and states that it was of no importance and mostly inconspicuous in the form of black specks or occasional sooty blotch colonies on young twigs. No cultures were made, but they are supposed to be the same as the apple fungi.

Crown gall caused by Bacterium tumefaciens E.F.S. & Towns. - reported from Oregon.

Ozonium root rot caused by Ozonium omnivorum Shear - reported by J. G. Brown from Arizona.

Root rot, probably caused by Armillaria mellea (Fr.) Quelet, was reported by Gardner as very destructive in one region in southern Indiana on newly cleared "sassafras" land.

Mottle leaf (non-parasitic) - reported by Cook from Burlington and Camden Counties, New Jersey.

Chlorosis, said to be caused by an excess of lime in the soil, was reported as prevalent and causing about 2% loss in Texas, according to Taubenhaus.

Silver leaf, associated with winter injury, was reported from York County, Pennsylvania, by Orton and Thurston.

Stem end discoloration, often accompanied by cracks one-half to one and one-half inches long, was reported as being commonly found in Georgia peaches shipped to northern markets. D. H. Rose, of the Bureau of Markets and Crop Estimates Inspection Service, attributes this injury to drenching of the fruit with arsenate lead, or to using this solution at too concentrated a strength.

PLUM AND PRUNE

Spring frost injury

The plum crop was affected by the severe spring frosts over approximately the same area as that described for peaches. A brief preliminary report on the frost injury to plums has already been given (Pl. Dis. Bur. Pul. 5: 1-14. July 1, 1921), but some additional data have been received which are included in this summary. The accompanying map shows the general area in the eastern part of the country where the frost injury occurred (Fig. 18). There was some injury in the West, particularly in Nevada, and the crop was very slightly affected also in Montana, Washington, and Oregon. The damage in the western sections, however, in no way compared with that in the East.

Estimates of losses have been made by collaborators in a considerable number of states as follows: New York, 10% loss; New Jersey, almost 100%; Pennsylvania, about 20%; Delaware, almost 100%; Maryland,

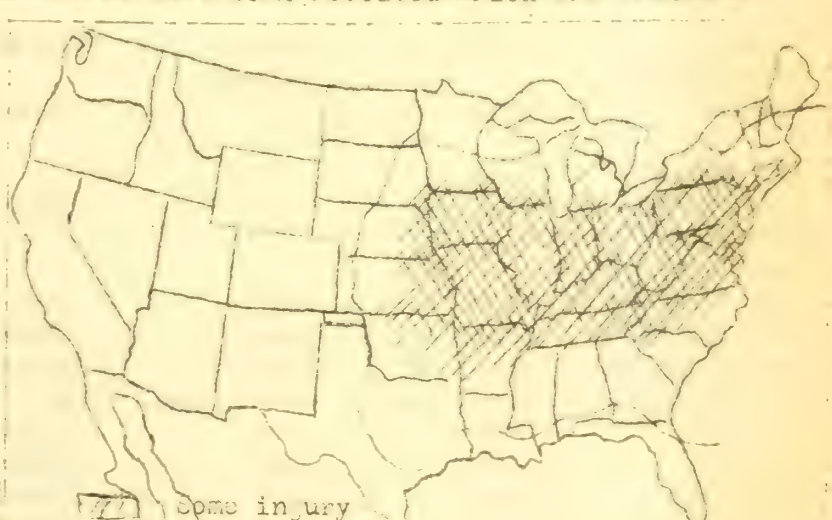


Fig. 18. Approximate extent of spring frost injury to plums.

95%; West Virginia, 95%; Virginia, almost 100%; Indiana, 95%; Illinois, 95%; Arkansas, 95%; Iowa, 95%; Nebraska, practically 100%; Kansas, practically 100%.

Regarding the geographical distribution of the affected area within states, Chupp in New York reports the injury in the Upper Hudson Valley and in the Ontario Lake district, back from the lake. Giddings, in West Virginia, reported general killing in all parts of the state except in the southern Ohio Valley, where there were few plums. Elliott in Arkansas reported the injury in the northern half of the state. Gardner in Indiana reported the yield ruined in the southern part of the state. Vaughan, in Wisconsin, reported the injury general except immediately along the shore of Lake Michigan. It will be noted that the favorable influence of the Great Lakes was evident at least in New York and Wisconsin.

Brown rot caused by Sclerotinia cinerea (Bon.) Schröt.

Less brown rot than usual was reported during the year largely on account of the small crop. The accompanying table (Table 14) shows the prevalence of the disease as compared with last year and with the average year, and also gives the collaborators' estimates of its importance.

Table 14. Prevalence and importance of brown rot of plums and prunes, according to collaborators, 1921.

State	Prevalence compared with		Importance	Reduction in yield
	Last year	Average year		
Vermont	Much less	Less	Small	2-5
Connecticut		Average		
New York	Same		Important in unsprayed orchards	3-5
New Jersey	Less			
Pennsylvania	Less		Important	8
Delaware	Less			
Maryland				1
West Virginia	Same	Same	Important	5
North Carolina	More	More	Important	
South Carolina	Less	Less	Important	5-10
Mississippi	About same	About same	Not important	t
Arkansas	Less	Less	Slight importance	
Ohio	Less	Less	Slight importance	
Wisconsin	Same	Same	Important	
Minnesota	Less	Less	Important	2
Iowa	Same	Same	Important	
Oregon	Less	Less	Slight importance	1+

In addition to the states mentioned in the table, the following states reported the disease: Rhode Island (very common), Louisiana (trace), Oklahoma, Indiana, Michigan (slight), and Washington. Reports of no occurrence, or no

observations, were received from New Hampshire, Missouri, Nebraska, Kansas, Montana, Colorado, Utah, and Idaho.

Examinations of car-load shipments of plums during 1921 by inspectors of the Bureau of Markets and Crop Estimates showed seven cars of California plums with an average of 1-2% brown rot. One car of Michigan plums was also inspected which showed 15% of this disease. In all, approximately 26 cars of plums from all states were inspected during the calendar year 1921 and only the eight mentioned above were found to contain an appreciable amount of brown rot.

Dates of earliest appearance of brown rot of plum, 1921

Vermont	September	Burlington
Connecticut	July 26	East Granby
New York	June 27	Nassau County
North Carolina	March 30	Raleigh
Georgia	June	Griffin
Mississippi	May	Gulf Port
Ohio	June	Wayne County
Kansas	April 30	Harper County
Oregon	March	Edenbower

The following valuable observations were reported by the Section of Plant Pathology of the Minnesota Experiment Station:

> "Apothecia first found April 15. First infection on plum twigs May 29, Chisago County. Blossom blight was serious. The dry weather seemed to check the disease and not much was found after the latter part of July." (Stakman).

In Oregon, Barss reported that the dry summer and picking season lessened the amount of brown rot, and that the losses were lower than in 1920, when constant rain through September cracked the prune fruit and favored infection.

Self-boiled lime sulphur and atomic sulphur held brown rot in check on plums in Georgia, according to McClintock; and in Michigan, Dutton of the Department of Horticulture, Michigan Agricultural College, secured improved keeping quality of harvested plums by dusting the fruit with sulphur about ten days prior to picking.

Dutton, W. C. The control of brown rot in fruits - spraying and dusting peaches and plums to prevent brown rot in storage and during shipment. Quart. Bul. Michigan Agr. College 4: 53-55. Nov. 1921.

Howard, W. L. An old disease in a new place. Amer. Hort. Soc. Proc. 17: 102-104. 1920.

Black knot caused by *Plowrightia morbosa* (Schw.) Sacc.

During 1921 black knot was reported on the cultivated plum from New England and in states along the Atlantic Coast to North Carolina, and also in the North Central States. In the Southern States, and in all of those west of

the 100th meridian, the disease was not reported on plum or prune, but in many of them it was mentioned as occurring on wild species of Prunus. An interesting observation in this connection is that of McClintock in Georgia, who reports that "the knots increase in size from year to year, but do not appear to spread to other trees through spore formation." The range of this disease on its various hosts and the relative susceptibility of the different species of the genus, as well as the possibility of various biological strains of the fungus itself, need further investigation.

On plum the disease seemed to be most severe in New England, New York, and in the belt of states from New Jersey to Illinois. In Indiana Gardner reported "Many inquiries from all parts of the state, and specimens accompanying same, indicate that there was considerable spread of the disease during the 1920 season." Tehon, in Illinois, also reports that black knot was worse during 1921 than in previous recent years. He estimates that the disease is of much importance, with about 20% of the plum plantations more or less affected, probably 5% of the trees having one or more knots, and the reduction in yield for the state is placed at 1%. Other estimates of loss are Vermont, trace to 1%; New York, 1-3%; Maryland, 1%.

Temple and Jehle, in Maryland, report the Damson as being especially susceptible to black knot.

Leaf blight caused by Coccomyces prunophorae Higgins

Reports of occurrence of leaf blight were received from Vermont, New York, Pennsylvania, Delaware, Virginia, West Virginia, North Carolina, Georgia, Mississippi, Arkansas, Ohio, Illinois, Michigan, Wisconsin, Minnesota, and Oregon. It was reported as important only in New York, Pennsylvania, Delaware, and North Carolina. In New York it was serious only in a few orchards, and the reduction in yield for the state amounted only to a mere trace. Mr. Strickland of Niagara County reported it as bad on Japanese plums and in some cases on Fellenburg prunes. The first report was on May 31 from Niagara County. In Pennsylvania more than the average amount of leaf blight occurred, 100% being found in some orchards. The effect on this year's crop was of no especial significance because there was practically no fruit. The injury had its effect on the growth of the tree. In Delaware Adams reported that the disease was much more abundant than last year, and very important because of neglected spraying. In North Carolina it was important in the Piedmont section, according to Foster. A case of severe injury was also noted in Virginia.

Oregon was the only state reporting the disease from the Pacific Coast. According to Barss it was less prevalent than last year, being present principally in the western part of the state and especially in the Willamette Valley. It was not generally important but in local instances leaf spotting and defoliation was heavy. The loss for the state was slight.

Dates of first observation, 1921

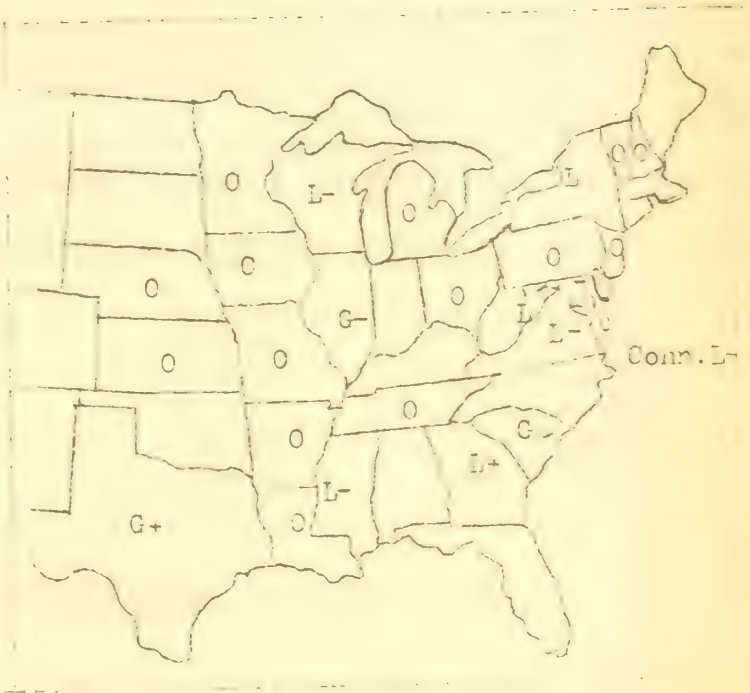
New York	May 31	Niagara County
Delaware	June 29	Newark
Mississippi	May	-
Arkansas	May	Fayetteville
Minnesota	July 29	University Farm
Oregon	May 19	Nehalem

Bacterial spot caused by Bacterium pruni EFS

The accompanying map (Fig. 19) shows the distribution and importance of bacterial spot of plum as it was reported during 1921. The loss due to this disease was estimated at 1% in South Carolina and 3% in Texas, while in other states it was not more than a trace.

Connecticut reported fruit spot; Virginia, limb cankers; Mississippi, leaf spot; Georgia, fruit spot and twig cankers; and Texas, leaf spot and twig cankers, the latter being much more destructive.

The varieties affected in Connecticut were Duarte and Santa Rosa. In Georgia the Japanese varieties were said to be most severely attacked.



Legend

L =Local
G =General
- =Unimportant
✓ =Moderately important
+ =Important
O =Negative report

Fig. 19. Occurrence of bacterial spot of plum in 1921.

Pockets caused by Exoascus pruni (Berk.) Fckl. and E. communis Sad.

A larger number of state reports of plum pockets were received this year than usual. This does not necessarily indicate an increased prevalence of the disease, however, but may be due to the fact that collaborators were furnished labeled questionnaires concerning this disease. The following states reported the disease in 1921: New Hampshire, North Carolina, Mississippi, Indiana Illinois, Michigan, Wisconsin, Minnesota, Iowa, North Dakota, and Kansas. In most cases it was said to be present in about the same amounts as, or less than, the average, but in Illinois, Anderson reports leaf curl and deformed twigs caused by Exoascus as considerably worse than usual, and of importance locally. Collaborators in the tier of states from Michigan to North Dakota, mentioned that the disease is particularly important on Prunus americana Marsh. This species seems to be particularly susceptible to plum pockets. In some of the other states also the disease is reported as especially common on some of the wild plums, which may, or may not be P. americana. Regarding the range of this species of plum, Hedrick (Hedrick, U. P. The plums of New York. New York

Sta. Dept. Agr. 18th Ann. Rpt. 32: 1-616. J. B. Lyon Co., Albany, N. Y. 1911.) reports that it is seemingly increasing, making it impossible to give definite limits. The northern boundary line in 1911 was said to pass through central New York to central Michigan, thence through southern Wisconsin to South Dakota, then northwestward to Manitoba, reaching its western limit in Utah. It occurs locally southward to northern New Mexico. It is rare in Oklahoma and absent from Texas, but is represented in Missouri. East of the Mississippi River, it occurs southward to northern Florida. This being the case, plum pockets, if especially prevalent on Prunus americana, may be expected over a wide area in eastern United States where and when climatic conditions permit. Recent reports indicate it as especially prevalent in the north central states where Prunus americana is most common.

Most of the states reporting the disease stated that the fruits were affected, but West Virginia and Illinois reported twig infection.

Dates of first appearance, according to collaborators

New Hampshire	June 15	Lancaster
Mississippi	May 10	Starkville
Illinois	April 22	-
Minnesota	June 16	Hutchinson, McLeod County
Kansas	May 13	Thayer
North Dakota	June 13	Sheldon

Blotch caused by Phyllosticta congesta Heald & Wolf

This disease was reported in an article by Roberts in November of last year. (Roberts, J. W. Plum blotch, a disease of the Japanese plum, caused by Phyllosticta congesta Heald and Wolf. Jour. Agr. Res. 22: 365-370. Nov. 1921.) He states that Heald and Wolf described this fungus as occurring on the leaves of Prunus sp. from Boerne, Texas, 1911. On the plum early collections were made by Scott in June, 1905, near Fort Valley, Georgia, and on May 27, 1908 at Montezuma, Georgia. On May 29, 1917, Roberts again collected the disease on the Japanese plum at Montezuma, Georgia. He reports that in all probability the disease no longer exists as the Japanese plum has disappeared from Georgia. However, it is to be looked for throughout the South. The disease occurs both on the fruit and on the leaves and the lesions resemble those of apple blotch. The varieties Abundance, Burbank, and an unnamed seedling were found affected. Collaborators of the southern states should keep watch for this disease

Blossom blight caused by Monilia sp.

This disease was reported by Barss on plums and prunes throughout the Willamette and Umpqua Valleys, but was worse in the latter section. During 1921 it was worse than last year, if anything, Douglas County being the center of injury. One hundred percent infection was found in some orchards, but the

percentage of reduction in yield for the state was slight. According to Barss, "Some plums and Petite prunes appear much more susceptible than Italian prune, which suffers seriously only in moist, narrow valley-bottoms. Spraying just before bloom very beneficial."

Blue mold rot caused by Penicillium sp.

Table 15. Losses to plums and prunes from blue mold rot caused by Penicillium sp., as shown by examination of cars at destination by inspectors of the Bureau of Markets and Crop Estimates, 1921.

Origin of shipment	Plum		Prune	
	No. of cars with decay	Percentage of decay	No. of cars with decay	Percentage of decay
California	2	1-2		
Idaho			2	13-35
			21	2-8
New York	1	6		
Oregon			1	63
			2	13
			10	2-8
Washington			10	1-12

Total number cars with blue mold, plums 3, prunes 46
Total number cars inspected, plums 26, prunes 85

Rhizopus rot caused by Rhizopus sp.

Table 16. Losses to plums and prunes from Rhizopus rot caused by Rhizopus sp., as shown by examination of cars at destination by inspectors of the Bureau of Markets and Crop Estimates, 1921.

Origin of shipment	Plum		Prune	
	No. of cars with decay	Percentage of decay	No. of cars with decay	Percentage of decay
California	10	1-10		
Idaho			3	1-3
Michigan	1	15		
Oregon			4	2-13
Washington			3	3-6

Total number cars with Rhizopus rot, plums 11, prunes 10
Total number cars inspected, plums 26, prunes 85

Other diseases

Scab caused by Cladosporium carpophilum Thüm. - reported from Minnesota as occurring practically everywhere plums are grown. Less of the disease in 1921 than usual, and of only slight importance.

Fire blight caused by Bacillus amylovorus (Burr.) Trev. - reported from St. David, Arizona, September 29, according to J. G. Brown.

Armillaria root rot caused by Armillaria mellea (Fr.) Quelet. According to Barss, this root rot continues troublesome in western Oregon, girdling the trees by killing the bark at the base. Always present in lands cleared of forests, especially oak timber. Ten percent affected trees in some orchards.

Rust caused by Puccinia pruni-spinosae Pers. - reported from Texas (unimportant) and California. In the latter state it is common in the Santa Clara Valley on prunes, according to W. S. Fields.

Blight caused by Coryneum beijerinckii Oudem. - reported from Whitman County, Washington.

Crown gall caused by Bacterium tumefaciens EFS & Towns. - reported from Yakima County, Washington.

Heart rot caused by "Trametes carnea Nees" (= Fomes roseus Fr.) According to S. M. Zeller, of the Oregon Experiment Station, this is the worst heart rot of the prune tree, in that state, and is very common throughout western Oregon. Other heart-rot producing fungi on Oregon prunes and plums are Lenzites sepiaria (Wulf.) Fr. and Fomes pinicola (Fr.) Cke. Curiously these three fungi are usually found on coniferous hosts.

Yellows, cause undetermined, - reported on four Japanese varieties in Lancaster County, Pennsylvania.

Rosette, cause undetermined, - reported by McClintock from Georgia as unimportant but killing a few trees in certain localities.

False silver leaf, probably an after effect of the winter injury of 1919-20, was reported from Washington and Oregon. There was no evidence of ill effects on the tree or growth, according to Barss. It caused a milky appearance of the foliage.

A silver leaf disease, cause undetermined, was noted in the Experiment Station orchard, Madison, Wisconsin, September 1. It was not doing any particular damage, however.

Fruit drop, non-parasitic - reported from southern Idaho and from western Washington. Regarding it, Arthur Frank reported this as a very common trouble each season in western Washington. Due chiefly to climatic and nutritional or physiological causes.

Drought spot, non-parasitic - reported from Washington.

Chlorosis, probably due to excess of lime in the soil, - reported from Texas.

CHERRY

Frost injury

The destructive freezes of the spring swept over the main section of the eastern cherry-producing area, almost completely ruining the crop in the belt of states from Nebraska to New Jersey. The important cherry-producing states of New York, Michigan, and Wisconsin were not so badly affected as some of the other states farther south. The states on the Pacific Coast did not suffer any

losses from this cause, but Montana and Idaho mention severe losses of cherries in some localities. In Montana one-half of the sweet cherry crop was lost, according to Jennison, but the sour cherries were not affected.

Collaborators in Connecticut, Pennsylvania, New Jersey, Delaware, Maryland, Virginia, Indiana, Illinois, Iowa, Nebraska, and Kansas reported that practically all the crop was killed by the spring frosts.

The most detailed information concerning the extent of the damage to the varieties of cherries was received from New York. The following reports are taken from the Weekly News Letter of the Departments of Plant Pathology and Entomology of the New York State College of Agriculture:

Columbia County (D. V. Rivenburg): April 11 - The cold wave the latter part of March practically wiped out the sweet cherry crop. Some sour ones too, were frozen.

Onondaga County (D. D. Ward): April 1 - Montmorencies and Early Richmonds-buds killed 65-90%; Morellos - buds killed 50-75%.

April 18 - Last Saturday, April 10, and Sunday nights, frost caused additional injury to cherry, plum, and apple buds in certain localities. Sour cherries, except Morellos, will have only a very small percent blossoming (possibly 20-30%). Sour cherries commencing to blossom.

Orleans County (C. E. Smith): April 11 - The hard freeze of March 28 did not do much damage except to early varieties.

Ulster County (J. B. Palmer): April 11 - During the low temperatures, starting March 28, sweet cherries were injured about 80%, Early Richmond sour cherries about 50-60%, and Montmorencies and Morellos were apparently uninjured.

April 18 - Damage from frost estimated as follows: Sweet cherries, 80-85% buds killed; Montmorency, 30-40%; Early Richmond, 60-70%; Morello, 10%.

Wayne County (P. D. Rupert): April 11 - The following figures of injury by frost, beginning about March 28, were obtained by cutting 100 buds and by counting 100 blossoms in each case:

	South part of county	Along ridge	Close to lake
Montmorencies:			
Blossoms killed	69%	70%	65%
Buds killed	47%	53%	42%
Morellos:			
Blossoms killed	31%	-	-
Buds killed	9%	-	-

April 18 - The freeze last week, April 10, killed considerable of the remaining cherries, especially Montmorency. Windsor possibly suffered less than other varieties of sweet cherries.

Genesee County (L. C. Tyler): April 18 - An approximation of injury done by the freezing of April 8 has been secured: Sour cherries, 40% fruit buds killed; sweet cherries, 80% fruit buds killed.

Nassau County (H. C. Huckett): April 18 - Temperature on April 10 fell from 54° to 27°. Sweet cherries have had a small portion of the blossoms killed (15%).

Chautauqua County April 18: - Frost of April 10 destroyed considerably more than 75% of the cherry fruit buds. The trees are just coming into bloom. Frost did very little damage to fruits other than cherries in the Chautauqua Lake region. Reports indicate that there will be practically no cherries in the county.

Leaf spot caused by Coccomyces hiemalis Higgins

This disease was the most important cherry disease of 1921. Since it affects primarily the leaves, the spring frosts resulting in the small crop did not reduce the amount of infection, but on the other hand, the lack of spraying following the freezing injury gave the leaf spot an unusual opportunity to develop. The disease was reported from practically all of the eastern states where cherries are grown commercially, as far west as Nebraska and Kansas. It was also reported from western Washington and western Oregon.

The majority of collaborators unite in saying that the disease is a very important factor in cherry production. Regarding its prevalence and importance last year, they have submitted the following:

Connecticut: More than last year. (Clinton).

New York: Important in some orchards. Trace to one percent loss for the state. In Wayne County many orchards showed 50% infected leaves. (Chupp).

New Jersey: Of very great importance. Present throughout the state but most severe in southern part. (Cook).

Pennsylvania: More than last year. Bad defoliation in southeastern part of state. (Thurston and Orton).

Delaware: Much more than last year, very important because of neglected spraying. Ninety-five percent leaf infection on some varieties. (Adams).

Virginia: Much more than last year. Brought to our attention as a serious disease by commercial growers for the first time. Eighty percent defoliation was noted in an orchard of 3,000 trees, June 10. The most important cherry disease. (Fromme).

North Carolina: About the same as last year, important. (Foster).

South Carolina: About the same as last year, important. (Ludwig).

Arkansas: More than last year, or the average. Very severe, causing defoliation all over the state. One hundred percent infection in some orchards. (Elliott).

Ohio: About the same as last year, of considerable importance where no control is attempted. (Thomas).

Indiana: Worst disease of cherries, causing defoliation in midseason. About the same as last year. (Gardner).

Illinois: Worse than last year, or the average year. Very important generally, causing serious defoliation rathern late in the season. (Anderson).

Michigan: More than the average. Considerable leaf cast in the first half of the summer. This is the most serious cherry disease. (Coons).

Wisconsin: Less than usual, of minor importance. No damage to crop if the fruit is sprayed. (Vaughan).

Iowa: Five percent loss. (Melhus).

Kansas: Much more than last year. Very important. Present in 90% of the orchards and 100% infection noted. Epidemic. (Melchers).

Oregon: Worse than usual in the western part of the state, causing defoliation and attack of fruit pedicels. Of considerable importance in some orchards. In a few places in the north-central Willamette Valley it caused considerable loss. Generally, however, it is unimportant. (Barss).

Nature of losses

The effects of the heavy defoliation from leaf spot in 1921 will be evident in the crop of 1922, since new wood, growth, and fruit-bud development were interfered with. Another way in which injury from leaf spot may occur is pointed out by Coons[1], who states that trees devitalized through premature defoliation are more subject to winter injury. He says, "Winter injury to cherries should be uncommon considering the hardiness of this fruit, but the actual fact is that cherries in Michigan very frequently winter kill. It is notorious that orchards where leaf spot has injured the trees, suffer most winter injury. The impoverished limbs and twigs do not possess resistance."

Weather relations

Not much information is given by collaborators concerning the relation of weather to the 1921 outbreak of leaf spot. Elliott, in Arkansas, however, mentioned a second infection occurring late in the year on the second crop of leaves that had been developed. Coons, in Michigan, stated that most of the leaf cast occurred in the first half of the summer, while Vaughan, in Wisconsin reported an unusual outbreak following late summer rains.

Dates of first observations, according to collaborators, 1921

Connecticut	August 15	West Haven
New York	May 9	Columbia County
Pennsylvania	May 17	Adams County
Delaware	June 29	Newark
Virginia	June 10	Shipman

South Carolina	June 28	Clemson College
Arkansas	May	Fayetteville
Ohio	June 8	Montgomery County
Kansas	June 3	Fort Scott
Oregon	May	Salem

A large number of heavily infected leaves on the ground provides an unusually great abundance of infective material for 1922, and outbreaks, or an epidemic of leaf spot, can be predicted if favorable weather conditions prevail and if orchard sanitation and spraying are not practiced thoroughly.

Varietal susceptibility

In Wayne County, New York, the disease was reported as being prevalent on Montmorency to an alarming extent. Niagara County also reported the disease on this variety especially. In Delaware, Adams made observations in the Experiment Station orchard and found the following susceptible: May Duke, English Morello, Lambert, Rockfort, Napoleon, Elton, Sudar, Empress Eugenie, Governor Wood, Black Tartarian. From Illinois, H. W. Anderson reports that all of the varieties of sweet and sour cherries in the experimental orchard at Urbana were affected. These varieties were reported on last year, (Pl. Dis. Bul. Suppl. 14: 86. 1921).

Control measures

Thomas in Ohio reports Bordeaux mixture as giving excellent control except on sweet varieties, and Vaughan in Wisconsin states that the lime-sulphur is efficient. Coons (l. c.) makes the statement that two things are necessary in controlling leaf spot - first, sanitation by turning under the fallen leaves in the early spring; and, second, protection of the plants by spraying with Bordeaux or lime-sulphur. Times of application of the spray are as follows, according to Coons:

(1) When the petals fall (Spray with lime-sulphur, 1.5 gallons to 50 gallons of water).
(2) About three weeks later.
(3) Directly after the fruit is picked. (For sweet cherries 1 gallon of lime-sulphur to 50 gallons of water, or self-boiled lime-sulphur is advised rather than the stronger lime-sulphur or Bordeaux.)

Literature cited

1. Coons, G. H. Cherry leaf spot, or yellow leaf; life history, effects and method of control explained. Quart. Bul. Michigan Agr. Expt. Sta. 3: 93-96. Feb. 1921.

Black knot caused by Plowrightia morbosa (Schw.) Sacc.

Black knot was not reported as of importance on cultivated cherries in any of the states, but a considerable number, both in the East and in the West,

reported it as common on wild cherries of various kinds. Apparently, it is not a factor of great consequence in commercial orchards. Isolated trees in home orchards, however, or neglected plantations, are sometimes found heavily infected.

In New York, the English Morello is reported as one of the most susceptible varieties, and the sweet cherries in that state are said to be less susceptible than sour. The only states definitely reporting black knot on cultivated cherries in 1921 are in the northeastern part of the country from Ohio and the Virginias to Maine.

Brown rot caused by Sclerotinia cinerea (Bon.) Schröt.

Twenty-six states returned annual report cards for this disease, but of these, only seven definitely reported brown rot This was largely on account of the fact that there was practically no fruit over a large part of the cherry producing section of the country. States in the East that did report the disease mentioned it as occurring chiefly in the form of twig and blossom blight. In New York, however, where there were some cherries, a small amount of fruit rot occurred. In one orchard in Columbia County, New York, English Morellos just at the close of blossoming were severely attacked and the tips in many cases were killed back from 4-6 inches. Many of the trees had as high as 50% of the tips affected in this manner. Five to ten percent of the sweet cherries in one county were estimated destroyed by the brown rot fungus.

Two of the reports of brown rot were from western Washington and western Oregon. In the former section, Arthur Frank reports "Common throughout the district this season. Very few cases of blossom blight, but twig blight, gumming, and fruit rot are very common. Large losses due to this disease." In Oregon Barss reports the disease as general in the western part of the state, but on the whole there was less of the disease than usual and the losses were small. The chief loss in Oregon occurred in the form of fruit rot.

Other diseases

Powdery mildew caused by Podosphaera oxyacanthae (Fr.) De Bary, - reported from Tennessee, Iowa, Kansas, and Washington. In Iowa it was said to be quite important, affecting perhaps 30% of the trees in the state and causing a loss of perhaps 3% which will follow in 1922. Much more of the disease is reported from Kansas also, where it was first collected June 21 at Isabel.

Witches broom caused by Exoascus cerasi (Fckl.) Sad. - reported by collaborators as general throughout western Oregon and western Washington.

Scab caused by Cladosporium carpophilum Thum. - reported from Iowa.

Crown gall caused by Bacterium tumefaciens E.F.S. & Towns. - reported from western Washington.

Gummosis caused by Bacterium cerasi Griffin - general in young orchards in western Oregon. Mazzard or sweet cherry seedlings highly resistant, also sour cherry varieties, according to Barss.

Blossom blight caused by Monilia sp. - worse than usual in western Oregon orchards, destroying the blossoms and fruit spurs. Probable reduction

in yield 5%. Sour cherry trees in some sections showed nearly a total destruction of bloom. Much damage in sweet cherries where air drainage was poor.

Fire blight caused by ~~Bacterium~~ amylovorus (Burr.) Trev. was collected May 3 in Summit County, Ohio, according to R. C. Thomas.

Shot hole caused by Cercospora circumscissa Sacc. - reported from Seneca County, Ohio, September 18 by Thomas.

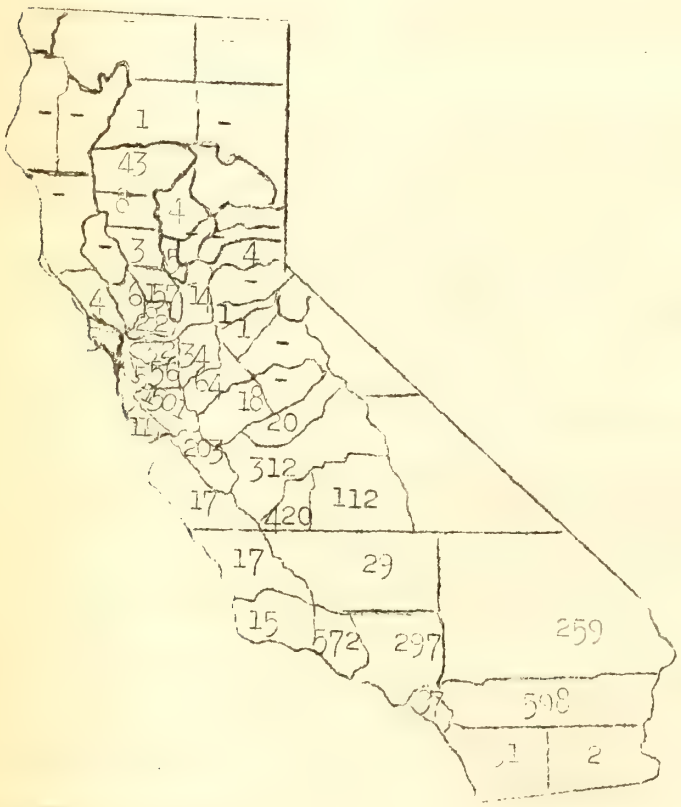
Blight caused by Coryneum beijerinckii Oudem. - reported from western Washington.

Drought spot (non-parasitic) - reported June 18 from The Dalles, Oregon, a section of deficient moisture.

Winter injury (non-parasitic) - reported from Ohio. In Oregon the effects of the 1919 injury are still evident in the gradual dying of the trees and secondary invasion by heart rot organisms.

Gummosis (non-parasitic) - reported from Washington.

APRICOT



Since California produces most of the apricots in the country, nearly 6,000,000 bushels being harvested in 1919, it is not out of place to give a map of California (Fig. 20) showing the relative importance of the various counties of the state in the production of apricots. Santa Clara County leads all others by producing 1,500,981 bushels in 1919, about three times as much as any other county and approximately one-fourth of the crop of the entire state. Other counties in order of their importance are - Riverside (598,260 bushels), Ventura (571,764), Alameda (556,269), Kings (420,107), Fresno (312,400), and Los Angeles (296,633).

Fig. 20, Apricot production in California in 1919, according to the census of 1921. (Figures in bushels with 000 omitted, dash - indicates less than 500 bushels.

+ Bacillus

Brown rot caused by Sclerotinia cinerea (Bon.) Schröt.

In 1920 W. L. Howard[1] stated that an increasing number of complaints had been received during the past four or five years from growers in the coastal valleys or along the coast where the trouble is almost exclusively confined. The disease does most damage in places where frost injury is likely to occur and causes blossom and fruit-spur blight at blooming time. According to Howard, it caused a reduction in yield during 1920 in the region along the coast where most of the apricots are grown. One application of lime-sulphur 1-10, dry lime-sulphur 12-50, or Bordeaux 4-5-50 as near the blooming period as possible controls to within 4 or 5% and crude oil emulsion gives promise of being an effective remedy when the spraying is done after buds begin to swell. Rot of the ripe fruit, apparently, is not a serious problem.

In California Bulletin 326, Howard and Horne[2] also give a good account of the brown rot situation in California together with results of spraying experiments for its control.

During 1921 little data have been received concerning the prevalence of the disease in California, but in the course of G. R. Lyman's visit to California in April 1921 he observed that brown rot was very bad on apricots and that the twig blight form was especially prevalent, April 23. The Weekly Crop Notes of the Bureau of Markets and Crop Estimates also contained a statement on April 14 that apricots were affected with brown rot in California.

Literature cited

1. Howard, W. L. An old disease in a new place. Amer. Hort. Soc. Proc. 17: 102-104. 1920.
2. Howard, Walter L. and W. T. Horne. Brown rot of apricots. California Agr. Expt. Sta. Bul. 326: 73-88. 5 fig. Jan. 1921.

Blight caused by Coryneum beijerinckii Oudem.

Idaho, Washington and California report Coryneum blight on apricot. In Idaho it was serious in some regions, but less than last year. In Washington it was reported from Whatcom and Stevens Counties. In California Howard and Horne[1] distinguish between this disease and the brown rot caused by Sclerotinia cinerea and state that:

> "The peach blight fungus is active during the wet weather of winter and spring. On apricots it causes winter killing of buds, or bud blight, shot-hole disease on the early leaves, and small corky spots on young, green fruit. Peach blight fungus causes serious losses in the interior valleys and foot hills, but is rarely serious in the Coast district, whereas, brown rot is confined almost entirely to the Coast region. Treatment for peach blight fungus on peaches and apricots consists in spraying with winter strength lime-sulphur solution, or Bordeaux mixture in November or early December, and again as the buds swell in the spring."

Literature cited

1. Howard, Walter L. and W. T. Horne. Brown rot of apricots. California Agr. Expt. Sta. Bul. 326: 73-88. 5 fig. Jan. 1921.

Bloom blight caused by Monilia sp.

This was reported again by Barss from Oregon as worse than last year and probably about the same as the average year. It caused rather severe injury in places, blighting the blossoms and spurs. It was prevalent especially in the Umpqua Valley, although only a few apricot trees are growing there, and was first observed May 27 near Roseburg. Barss makes the statement that cherries and prunes are also susceptible and that almonds are almost as badly attacked as apricots. Excessive and prolonged spring moisture, together with cool temperature, doubtless favored the disease.

Other diseases

Shot hole caused by Cylindrosporium sp. - trace reported from Texas.
Scab caused by Cladosporium sp. - prevalent, causing 5% loss in Texas, according to Taubenhaus.

DISEASES OF SMALL FRUITS

GRAPE

Frost injury

Grapes suffered less injury from the spring frosts than did most of the other fruits, but throughout the center of the frost belt heavy losses occurred. Thus, in New York a 5-10% reduction in yield was reported with serious injury in the Lake Erie fruit belt. In Delaware 60% of the crop was reported killed; in Maryland 25%; West Virginia 50%; Kentucky approximately 75%; Arkansas 55%; Illinois 25%; and Michigan about 10%. In Arizona, the only state in the West reporting injury, D. C. George reported serious injury to cuttings in the Casa Grande district, in some plantations 75% of the young shoots being frozen back.

In the most important grape-producing areas of California, New York, Michigan, and Ohio, the production of commercial grapes was not greatly reduced because of frost. On September 1, 1921 the Bureau of Markets and Crop Estimates estimated the condition of grapes for the United States as 56.1%, as compared with the ten-year average, 85.1%.

Black rot caused by Guignardia bidwellii (Ellis) V. & R.

Reports of black rot were received from practically all states east of the 100th meridian. The disease does not occur in the dry regions of the West, and is not a factor on the Pacific Coast. In the East it was very prevalent in most places where grapes are grown, but as usual it was not a factor of great importance in the commercial sections, such as those of New York, Ohio, and Michigan. Thus, in New York, E. F. Gladwin reports that the disease was not observed in the Chautauqua or Keuka Lake sections during 1921, and in Ohio, Thomas states, "It is interesting to note that in the grape-growing sections, particularly in northern Ohio, this is a comparatively rare disease, whereas, throughout the other sections of the state, where grapes are not grown commercially, but only for home use, attacks of the fungus are very severe."

During 1921 the disease appeared to be more prevalent than usual, especially in Connecticut, Maryland, Michigan, and in the Upper Mississippi Valley. It was also prevalent in Virginia, Arkansas, Louisiana, and Texas. The following collaborators' reports supply more detailed information:

Connecticut: More complaints than usual, 5-15% loss. Even on some sprayed vines it was bad. (Clinton).

New York: Some black rot in the Hudson River Valley. Reported as common and sometimes serious in Ulster County. (Chupp).

New Jersey: Less than usual. (Cook).

Pennsylvania: Probably less. Unusually severe in Philadelphia County. (Thurston).

Delaware: Of slight importance. (Adams).

Maryland: More, 10% loss. (Jehle and Temple).

Virginia: Very severe in College vineyard at Blacksburg, causing 80% loss. (Fromme).

West Virginia: Important, general as fruit rot and leaf spot, 25% loss. (Giddings)

South Carolina: Less than the average, but important, causing estimated reduction in yield of 10%. (Ludwig.)

Georgia: About the same, not serious on the Muscadine grapes, which are the ones most grown in state. (McClintock).

Louisiana: Very common. (Edgerton).

Texas: Very prevalent, 3-5% loss. (Taubenhaus).

Arkansas: Considerable importance, causing about 10% loss. Less than last year. (Elliott).

Ohio: About the same as the average; of considerable importance outside of the commercial grape sections. (Thomas).

Indiana: Much worse than the average. Worst disease of the crop. (Gardner).

Illinois: Most serious grape disease. Unusually bad on unsprayed vines this year. Almost total loss of crop in some localities. About 10% loss. (Anderson).

Michigan: Much more than last year or the average year. Epidemic in uncared for vineyards, rendering entire crop unsalable in some cases. Estimated reduction for state 10-25%. (Coons).

Wisconsin: More than usual, but of minor importance. (Vaughan).

Minnesota: Of minor importance, and in few localities. Occurs chiefly on wild grapes. (Section of Plant Pathology).

Iowa: More than usual. Serious in some vineyards causing 5% loss from the state. (Melhus).

Other states reporting black rot, besides those above, were Vermont, North Carolina, Oklahoma, and Nebraska.

Dates of first appearance according to collaborators, 1921

Connecticut	August 9	Torrington
New York	July 20	Dutchess County
Pennsylvania	July 28	State College
South Carolina	June 10	Clemson College
Arkansas	June	Fayetteville
Indiana	June 21	Switzerland County
Illinois	May 20	Anna
Minnesota	June 5	Carver County

Collaborators did not contribute much on the relation of weather to black rot, but it is suggested that the moist weather of August was conducive to the disease in the Upper Mississippi Valley and the Great Lakes region. It is also probable that the high summer temperatures favored the fungus. In South Carolina Ludwig reports that the abnormally dry season was probably responsible for the reduced amount of the disease in his state.

Practically no data on varietal resistance or control were obtained during the year.

Downy mildew caused by Plasmopara viticola (B. & C.) Berl. & de Toni

Downy mildew was reported from the majority of states east of the Missouri and Mississippi Rivers, and slight amounts of the disease also occurred in

Arkansas and Texas. Most of the southern states, however, did not report its occurrence, although Ludwig, in South Carolina stated that in the northwestern part of the state infection was heavy late in the season.

The disease was not of much importance, except possibly in a few local instances. Most of the states reported it as affecting the leaves only and a number of them indicated that infection occurred too late in the season to do much damage. In New York F. E. Gladwin, reporting for the Keuka lake section, stated that it was not so serious as usual. It is possible that the dry weather of the year held the disease more or less in check.

Dates of first appearance according to collaborators, 1921.

New Hampshire	July 15	Rochester
Connecticut	August 29	East Wallingford
Delaware	June 30	Georgetown
South Carolina	August 4	Clemson College.
Arkansas	May	Fayetteville
Minnesota	June 5	Carver County

Reports that the disease was more common on the wild than the cultivated grapes were made by collaborators in New York and Wisconsin. In Ulster County, New York, it was said to be serious on Delaware and Niagara, and in the Keuka Lake section of New York, Catawba is always more or less infected, according to F. E. Gladwin. In Arkansas it was reported on the viniferous grapes of the experimental plots at Fayetteville.

An important occurrence in the history of this disease is its recent introduction into Australia from Europe. It was first discovered in 1917 in Victoria, and since that time it has spread rapidly throughout Queensland, South Australia, and New South Wales, and is the cause of serious damage. The following references give further details concerning the Australian situation:

Manuel, H. L. Downy mildew. Agr. Gaz. New South Wales. 32: 745-747. Oct. 1921.

Osborn, T. G. B. Downy mildew in South Australia. Jour. Dept. Agr. South Australia 24: 1007. July 1921.

_____ Downy mildew. Jour. Dept. Agr. South Australia 25: 120-125. Illustrated. Sept. 1921.

Powdery mildew caused by *Uncinula necator* (Schw.) Burr.

Although powdery mildew occurred scatteringly throughout the East on American grape varieties, it was most important, as usual, in the Pacific Coast states on vinifera grapes. Eastern states reporting traces of the disease are Connecticut, New York, Delaware, Maryland, West Virginia, Ohio, Michigan, Wisconsin, Illinois, Iowa, and Arkansas.

In the West, Arizona experienced a slighter attack than usual. D. C. George attributes the drought in the early part of the season as the cause for the slow development of the disease. In Oregon, Barss reported the disease serious where it was not controlled, causing a leaf mildew and shriveling of the berries. Sulphur dust controls readily in that state. Unfortunately, no 1921 reports are at hand concerning occurrence of powdery mildew in California, where the disease is usually more important than in any other state.

Anthracnose caused by Sphaceloma ampelinum De Bary (Gloeosporium ampelophagum Sacc.)

Annual report cards for this disease were returned from 26 states, but of these, only 5 states report its presence. In New York, Chupp reports that there is usually some in most of the grape sections. Maryland reports a trace of the disease. In Georgia, McClintock says the disease is not serious on the Muscadine varieties, but it occurred last year in about the same amounts as usual. In Louisiana, Edgerton reports it as very common, while in Illinois, Tehon reported an anthracnose of the grape, but states that this may not be caused by Gloeosporium ampelophagum.

Other diseases

Dead arm caused by Cryptosporella viticola (Red.) Shear - New York, Pennsylvania, and Nebraska report this disease in 1921. For the Chautauqua grape section of New York Gladwin reports "Dead arm was not so commonly noted as usual. This trouble has seemed to be on the decrease for the past few years."

Crown gall caused by Bacterium tumefaciens EFS & Towns. - reported from Washington.

Bitter rot caused by Melanconium fuligineum (Scrib. & Viala) Cav. - reported from Delaware in September as of slight importance, and also from the District of Columbia and Virginia.

Root rot caused by Ozonium omnivorum Shear - prevalent in Texas, according to Taubenhaus.

Rust probably caused by Physopella vitis (Thüm.) Arth. - collected by O. F. Burger on grapes at Oldsmar, and specimens of affected wild grape were received at the Office of Fruit Disease Investigations from Miami, Florida. According to Arthur (North American Flora 7^2: 102-103. 1907.) this rust occurs on Vitis vinifera in Florida, South Carolina, Cuba, and Jamaica.

Leaf spot caused by Isariopsis clavispora (B. & C.) Sacc. - reported from Oconee County, South Carolina, July 26, by Ludwig.

Non-parasitic diseases

The following presumably non-parasitic diseases were reported during the year: Drought spot, from Oregon (caused internal, brown, hard cell-masses around seeds in western Oregon); tip burn, from several localities in Idaho; chlorosis, from Texas; shriveling and rotting of Thompson's Seedless, Cornichon, and Tokay varieties in Arizona; blossom blast, spot necrosis, winter injury, and spray injury from Washington.

STRAWBERRY

Frost injury

The spring frost caught the strawberry crop in full bloom in many localities in the East. Many blossoms were killed and the crop reduced mater-

ially, but in many instances late blossoms developed which set considerable fruit. In Massachusetts 50% damage was reported in the eastern part of the state, and a similar loss was recorded in Rhode Island. In Delaware, Adams reported about 30% reduction, and in Maryland, Temple and Jehle estimated 20%. Other states reporting percentage reduction were Arkansas, with 30% and Illinois, with 50%. In general strawberries suffered less from the spring freezes than did the orchard fruits.

Leaf spot caused by Mycosphaerella fragariae (Schw.) Lindau

Leaf spot appeared to be generally distributed with the strawberry crop in 1921, it being reported from states scattered all over the country from Texas and Florida on the South to New England in the Northeast and Washington in the Northwest. None of the collaborators mention any particular parts of individual states where the disease was especially bad. It seems that owing to the dry weather, there was less leaf spot than usual in states along the Atlantic Coast, but somewhat more of the disease than ordinarily occurs was recorded from some of the north-central states where there was more rainfall.

Collaborators in Ohio and Indiana report this as the worst strawberry disease. Two percent reduction in yield is estimated in the latter state, and 5% in Iowa.

Dates of first appearance according to collaborators, 1921

New Hampshire	May 24	Hollis
Connecticut	August 29	Branford
New York	August 20	Onondaga County
Ohio	May 7	Williams County
Indiana	April 19	Lafayette
Colorado	August	Fort Collins
Oregon	May 23	Ada

In Maryland, Temple reports that growers are avoiding the disease, more or less, by using mainly the more resistant varieties, and from Louisiana, Edgerton reports "More or less common, but causing little loss except on susceptible varieties. The Klondyke, which is largely grown in this state, shows considerable resistance." Thomas, in Ohio, mentions Senator Dunlap as especially susceptible, and in South Dakota, E. J. Petry made the following notes on the susceptibility of varieties at Brookings:

Minnesota No. 1	slight infection
Minnesota No. 2	heavy infection
Alaska	slight to medium infection
South Dakota No. 1	slight to medium infection
South Dakota No. 3	medium infection
Indian Head No. 1	considerable infection
A wild form	some infection

Strawberry beds that were dusted or sprayed showed control of leaf spot in Delaware, according to Manns. In Ohio, Thomas reports that excellent results were obtained where spraying was practiced as a means of control. In general, however, it seems that in most sections of the country spraying is

rarely practiced.

Frank, Arthur. Diseases and insect pests of strawberries. Berry Grower 16: 7. March 1921.

Powdery mildew caused by Sphaerotheca humuli (Fr.) Burr.

New York and Maryland in the East, and Washington and Oregon in the West, report the occurrence of this disease. For the most part, it seems to be of only slight importance, but in Oregon, at least, it was a factor to be reckoned with. Regarding the disease in that state H. P. Barss reported as follows (July1):

"Childs reports powdery mildew on strawberry not as general as usual in the Hood River Valley though in a few rather large plantings the disease was quite severe. In one acreage a fourth of the fruit, or 700 crates, was put in special grade on account of powdery mildew. Not more than 2% of the Hood River crop was affected. Mildewed berries generally bring 25-50% less per crate than healthy fruit. One grower tried lime-sulphur spray and succeeded in reducing the disease, although some burning of foliage resulted.

"The disease was of little general importance in the Willamette Valley or southward as far as can be judged by reports."

Gray mold rot caused by Botrytis sp.

This disease was reported on berries in the field in Rhode Island, Delaware, Maryland, Florida, Louisiana, Washington, and Oregon. In some

Table 17. Losses from gray mold rot caused by Botrytis sp., as shown by examination of cars at destination by inspectors of the Bureau of Markets and Crop Estimates, 1921.

Origin	No. of cars with decay	Average percentage of decay	Range of percentage of decay: No. cars	Range of percentage of decay: Percent	Origin	No. of cars with decay	Average percentage of decay	Range of percentage of decay: No. cars	Range of percentage of decay: Percent
Ala.	5	2	5	1-4	Mo.	12	13	2	32-35*
Ark.	37	11	4	30-60#				10	1-17*
			33	1-18#	N. Y.	7	13	2	27-35*
Del.	11	10	2	20-40*				5	1-12
			9	1-15	N. C.	1	12	1	12
Fla.	1	87	1	87*	Ore.	1	3	1	3
Ky.	5	7	5	1-25*	Tenn.	49	7	6	15-30#
La.	53	3	1	30				43	1-14*
			52	1-12*	Texas	1	1	1	1
Md.	11	7	1	45*	Va.	12	6	12	1-13
			10	1-10*	Wash.	1	20	1	20*
Miss.	3	7	3	1-20	Unkn.	6	9	1	30
								5	1-12

Total ... 216
Number cars inspected 480

* = Associated with Rhizopus rot
# = " " other decays

localities it caused considerable damage, 2-3% loss being reported from Delaware, and 4% loss from Maryland. In Florida, Burger reported the disease from various parts of the state, but said that it was doing considerable damage in the Plant City district. In Oregon it was not severe except along the Coast. In some fields 10% of the crop was affected, but the loss for the state was very slight.

This was undoubtedly the most serious decay of strawberries in transit. Amounts of the disease found in carload shipments of strawberries are shown in Table 17.

Rhizopus rot caused by Rhizopus nigricans Ehr.

Collaborators in the states of Rhode Island, Delaware, Maryland, Florida, Louisiana, Texas, and Oregon reported this rot in 1921. A number of collaborators state that the season was too dry for fruit rots, and was even very detrimental to the crop itself. In Delaware losses of 5-10% were reported in over-ripe fruit, and in Maryland, Temple states that it always causes a great deal of loss both before and after the berries are picked, causing altogether about 10% loss.

This, and the gray mold rot, are the two most common decays of strawberries on the market. In 1921 inspectors of the Bureau of Markets and Crop Estimates examined about 480 cars of strawberries and found more or less Rhizopus rot in 175 of them. The average amount of decay in all of the 175 cars was approximately 14%. Some cars showed from 20-40%, and six of them showed from 50-75%.

Fruit rot caused by Pezizella lythri (Desm.) Shear & Dodge, (Haineşia lythri (Desm.) v. Höhn; (Patellina fragariae Stevens & Peterson)

According to Shear and Dodge[1], this fungus is generally distributed throughout eastern United States and also occurs in Washington. In their article the various names that have been given to the different stages of this fungus are listed and the synonymy is thoroughly worked out. During 1921 the only collaborator reporting this fruit rot was Edgerton, who states that it was very common in Louisiana, causing perhaps from 2-5% loss.

1. Shear, C. L. and B. O. Dodge. The life history and identity of Patellina fragariae, Leptothyrium macrothecium, and Peziza oenotherae. Mycologia 13: 135-170. May 1921.

Leaf scorch caused by Mollisia carliana (E. & E.) Sacc. (Marssonia potentillae fragariae Sacc.)

This leaf spot was said to be very common and causing more loss than Mycosphaerella in Louisiana, and in Illinois, Anderson states that it was very important locally on a number of varieties obtained from a Michigan nursery

Root rot (cause undetermined)

A considerable number of complaints of strawberry root rot have been received during the past year as follows:

New York: Seems to be increasing. Reported from four counties. In Onondaga County it was severe on Glen-Mary,, Fans, Red Head, Big Joe, Sample, and Amanda. (Chupp).

Maryland: Local, causing some loss. Has been found for the past seven years, but not much complaint has been made concerning it until this year. (Temple).

Kentucky: A root rot of considerable importance has been reported from the southern and western portions of the state. (Valleau).

Alabama: A root rot (cause yet undetermined) has caused 1% loss on the hundred-acre planting. The percentage of infection in this area was about 5%. On the small planting in one garden the percentage of infection was 75-80% and the loss 60-70%. (Povah).

Illinois: Worse than last year. Very important locally. (Anderson).

Idaho: Scattered throughout the state, rotting the plant at the crown. More prevalent than last year, and important. (Hungerford).

Other diseases

Rhizoctonia reported attacking roots and killing plants in Washington, particularly in the western part, by Frank, Heald, and Dana.

Leaf blight caused by Dendrophoma obscurans (E. & E.) And. - reported from New Jersey (severe in one locality), and from Chesterfield County, South Carolina (unimportant).

Leaf spot caused by Ascochyta fragariae Sacc. - rather common about Ithaca, New York.

Slime mold (Spumaria alba Bull.) was reported by Goss as important locally in Nebraska. A considerable number of reports were received and heavy infestation was found in some cases.

Root knot caused by Heterodera radicicola (Greef) Müll. - reported from Washington.

Nematode (Tylenchus dipsaci (Kühn) Bastian) - reported from Kittitas County, Washington, and from Oregon. Regarding its occurrence in the latter state H. P. Barss reports:

> "Found doing some damage on strawberries in the Coast sections of Lane and Coos Counties and in Benton County. All badly infected fields in Lane County were destroyed last season and only a few patches now show infestation. The disease was discovered in Coos County for the first time this spring. The extent is not known as yet."

Chlorosis, cause unknown, was found on Kellogs Prize in two localities in Illinois, according to Anderson. He states that it seems to be confined to that variety.

Watery soft rot caused by Sclerotinia libertiana Fckl. Thirty-four out of the 400 cars of strawberries inspected during the year were found to contain more or less watery soft rot. Usually the decay was associated with that produced by other organisms.

Frank, Arthur. Diseases and insect pests of strawberries. Berry Grower 1^{5}: 7-8. Illustrated. March 1921.

RASPBERRY

Frost injury

Owing to the fact that raspberries bloom later than most of the other fruits, there was comparatively little frost injury to the crop. However, in some sections of the East considerable damage was reported, largely in the form of killing back of the leaves and shoots.

Anthracnose caused by Plectodiscella veneta Burkholder (Glocosporium venetum Spog.)

During the year anthracnose was reported from most of the states in the north-central and northeastern parts of the country. Reports are also at hand from Arkansas and Kansas and from the western sections of Washington and Oregon. The disease was of considerable importance in a number of states. Thus, in Maryland 7% loss was estimated, in Arkansas 25%, in West Virginia 2%, in Wisconsin 33%, in Indiana 10%, and in Iowa 8%. Gardner in Indiana reports it as a limiting factor in the production of black varieties; Anderson in Illinois considers it as next to crown gall in importance, while Vaughan in Wisconsin states that it probably affects about 90% of the plants in the state, causing an estimated reduction of about 33%.

Dates of first appearance, 1921

Connecticut	May 27	Glastonbury
New York	July 1	Monroe County
Ohio	February 22	Van Wert County
Indiana	April 18	Lafayette
Wisconsin	May 17	Madison
Minnesota	June 15	University Farm
Kansas	April 21	Emporia
Oregon	May 25	Aloha

Several states mention black varieties as being much more severely affected than red. In Arkansas the Kansas Black was considered susceptible while

in western Washington Frank reports the disease on the Cuthbert and Antwerp raspberries.

During the year results of experiments on control of anthracnose have been reported. L. K. Jones[1] conducted experiments during 1920 and 1921 using lime-sulphur alone and in combination with other substances as adhesives, and also Bordeaux mixture alone and in combination. In both seasons the disease was controlled satisfactorily by spraying, lime-sulphur giving better results than Bordeaux. "With lime-sulphur, glue and gelatines gave the best results as adhesives; with Bordeaux mixtures, gelatin and casceinlime." A two spray program (1) after the first two or three leaves have unfolded, and (2) about one week prior to the opening of any blossoming buds, gave satisfactory control each season. In 1921 the first application alone of the lime-sulphur and gelatin gave very promising results, but the second application alone, failed to control.

1. Jones, Leon K. A preliminary report on the control of raspberry anthracnose (Abstract). Phytopath. 12: 57-58. Jan. 1922.

Crown gall caused by Bacterium tumefaciens EFS & Towns.

Crown gall ranks as one of the most important diseases of raspberry. During 1921 it was reported in most of the eastern states from Connecticut to North Carolina and west to Kansas. Reports of slight occurrence also were received from Arizona, Montana, and Washington. The disease seemed to be of most importance in the belt of states from West Virginia to Iowa and Kansas. It was reported as very common in Michigan also. In Illinois it was rated as the most serious raspberry disease, probably causing from 5-10% loss. Almost all of the states reported the disease to be about the same as usual with regard to prevalence and severity.

In a recent paper Riker[1] has stated that during the course of his investigations at Madison, Wisconsin, no standard varieties of red or black raspberries were found to be strikingly resistant to crown gall, nor was evidence obtained indicating that infection had any immunizing effect.

1. Riker, A. J. Studies of crown gall (Abstract.). Phytopath. 12: 55-56. Jan. 1922.

Yellows (cause undetermined)

According to Rankin, Hockey, and McCurry[1], this disease in reality consists of two separate troubles; namely, leaf curl and mosaic. In their paper presented at the Toronto meeting they give the distinguishing characteristics of these two diseases.

Under the name of "yellows" collaborators reported the disease from Connecticut, New Jersey, and all states bordering on the Great Lakes with the exception of Pennsylvania and Indiana. Some yellows was also reported in North Dakota.

In New York, Chupp stated that the disease is very important, causing

losses of from 10-50%, and occurring wherever raspberries are grown. It was found on wild as well as cultivated raspberries in Tompkins County. In Ohio E. E. Clayton reported it as very serious in the northern part of the state. In Michigan Coons reported it as very common and found in every red raspberry patch observed. It was of considerable importance also in Minnesota, occurring wherever the crop is grown and affecting 90% of the plants in some places.

Regarding the susceptibility of varieties, New York reports that in Ulster County at least it is ruining the Perfection variety, but that the variety Empire is less affected. In Ohio it is especially marked on Cuthberts, according to Thomas, while in Wisconsin the Marlboro is badly affected. Rankin, Hockey, and McCurry (l.c.) find that in Ontario leaf curl is epiphytotic in Cuthbert, affecting from 5-10% of the stand, while mosaic is epiphytotic in Cuthbert and Marlboro to the extent of about 20-30% infection. Commercial control of leaf curl has been accomplished in Ontario by roguing diseased plants as soon as the bushes leaf out, and control of mosaic is anticipated by roguing in August, thus preventing the eggs of the disseminating agent, Aphis rubiphila, from overwintering on diseased wood.

1. Rankin, W. H., J. F. Hockey, and J. B. McCurry. Leaf curl and mosaic of the cultivated red raspberry (Abstract). Phytopath. 12: 58. Jan. 1922.

Cane blight caused by Leptosphaeria coniothyrium (Fckl.) Sacc.

Cane blight was reported from New York, both in the Ontario and Hudson River Valley fruit districts, where it was important in a few plantations. In New Jersey it was common, while in Virginia and West Virginia it was important locally. In Arkansas it was said to be severe in the northwestern part of the state, reducing the crop about 5%. In Ohio, Indiana, Minnesota, Kansas, and Idaho, it seemed to be present in about the same amounts as usual and of some importance in certain local instances.

Spur blight caused by Mycosphaerella rubina (Pk.) Jacz.

Spur blight was reported in 1921 from Connecticut, New York, Indiana, (important locally on red varieties), western Washington and western Oregon. In Washington Arthur Frank reported it as doing some damage to Cuthberts by killing the buds on the lower parts of the cane. No bud killing was apparent on Antwerps, however. On Marlboros it was rarely present, according to Frank.

Regarding the parasitism of this fungus in Oregon, Barss reports, "While this fungus appears to be common on unhealthy plants, it cannot be considered the probable cause of the unhealthy condition as far as we can judge."

Blue stem (cause undetermined)

A blue stem disease of black raspberry is being reported from Ohio and Michigan. This disease appears to be entirely different from the blue stem

of the Pacific Northwest, which is caused by a Verticillium or Acrostolagmus. Concerning it, E. E. Clayton of Ohio reports as follows:

> "Blue stem is a very serious disease of black raspberries that seems to be confined at present to the large berry section of Lorain, Cuyahoga, and Lake Counties. This disease is certain death to every plant attacked. The symptoms are dwarfing and generally unhealthy appearance of the plant, coupled usually with purplish splashes of color on the stems.
>
> "Berry growers should guard against introducing this disease. In the section where it is prevalent, it is the principal cause of "running out" of patches. Careful eradication of all diseased plants is the best control."

Leaf spot caused by Mycosphaerella rubi Roark (Septoria rubi Westd.)

The ascigerous stage of Septoria rubi Westd. was first found in Wisconsin in 1917 and reported by Roark in 1921[1].

During 1921 the leaf spot that the fungus produces was reported from New Jersey, Ohio, Indiana, South Carolina, Minnesota, and Iowa.

1. Roark, E. W. The Septoria leaf spot of Rubus. Phytopath. 11: 328-333. Aug. 1921. (Dec.)

Other diseases

Orange rust caused by Gymnoconia interstitialis (Schlecht.) Lagerh. - reported only from New York, Ohio, and Minnesota.

Rust caused by Phragmidium imitans Arth. was common on red raspberry throughout western Washington, according to Frank.

Blue stem of black raspberry caused by Acrostolagmus caulophagus Lawrence - reported from Washington and Oregon (reported as Verticillium). In the latter state Barss reported that the total damage is probably more than suspected because no one is giving close attention to cane-fruit troubles. It occurs in western Oregon at least in the Willamette Valley.

Armillaria root rot caused by Armillaria mellea (Fr.) Quelet. A field of Marlboro raspberries was found affected severely with this trouble. The rhizomorphs were found upon the older parts of the crown which had rotted. (Frank)

Pezizella lythri (Desm.) Shear and Dodge - reported on the cultivated red and black raspberries (see strawberry).

Powdery mildew caused by Sphaerotheca humuli (DC.) Burr. - reported from Washington.

Bacterial blight (cause undetermined) - reported from Pierce County, Washington.

Double blossom, caused by Fusarium sp. - observed on wild raspberry near Ithaca, New York.

Dodder (Cuscuta sp.). One Illinois grower reported dodder killing many young sprouts. First report on raspberries in the state.

BLACKBERRY, LOGANBERRY, and DEWBERRY

Frost injury

As with raspberries, these fruits were not injured badly by the spring freezes. Delaware and Maryland report slight damage and Arkansas, considerable. Aside from these reports, however, very few indicate much injury.

Orange rusts caused by Cymnoconia interstitialis (Schlecht.) Lagerh. and Kunkelia nitens (Schw.) Arth.

In general collaborators do not distinguish between these two rusts of the blackberry. The first one is presumably the most common one in the North, and the second, (Kunkelia) is the prevailing species in the South. Gardner, in Indiana, states that at Lafayette the two species overlap. +

The disease was reported on wild or cultivated ~~raspberries~~ from almost all of the eastern states with the exception of those in the South bordering on the Gulf. Most of these reports indicate that it was common on the wild blackberries, but of only slight importance on cultivated varieties. Kansas, however, reports this as the most serious disease of the crop, being present in about 80% of the plantations and causing a reduction of about 10% for the state. It attacks both the foliage and young wood, oftentimes killing the entire plant. Considerable damage is reported from Iowa also. Less of the disease was reported than usual in some of the north Atlantic states.

In the Pacific Northwest an orange rust is reported from Washington and from Oregon on blackberry, but the exact identity of the rust is not known.

Dates of first appearance, 1921

New Hampshire	June 2	Milford
New York	May 22	Suffolk County
Ohio	June	Wayne County
Minnesota	June 10	Becker County
Kansas	April 21	Emporia

Anthracnose caused by Plectodiscella veneta Burkholder (Gloeosporium venetum Spog.)

On blackberries anthracnose was reported from New York, New Jersey, Delaware, Maryland, Kentucky, Ohio, Indiana, Illinois, Wisconsin, Minnesota, Iowa, Kansas, Arkansas, Oregon, and Washington. On loganberries it was reported from Oregon. In practically all cases the disease was of slight importance only, being much less severe on this host than on the black raspberry. However, in some cases a certain amount of damage occurred. Thus in Kentucky, Valleau reports complete failure in at least one commercial planting.

On loganberry in western Oregon it is not often destructive, according to Barss. The first collection of it there this past year was on May 19 at Mohler. It is controlled by Bordeaux mixture in Oregon.

+ blackberries

Frank, Arthur. Anthracnose of blackberries, logans, and raspberries. Berry Grower. 22: 6, 15. Dec. 1921.

Crown gall caused by Bacterium tumefaciens EFS & Towns

Crown gall was observed on blackberry in Texas, Indiana, and Washington and on loganberry in Washington and Oregon. In the latter state it seems to be on the increase on loganberry. At present most plantings are entirely free but occasionally a bad case is reported.

Leaf spot caused by Mycosphaerella rubi Roark (Septoria rubi Westd.)

Septoria leaf spot was reported from New Hampshire, New Jersey, Texas, Indiana, Iowa, and Washington. It was of slight importance in all cases except in Iowa where Melhus estimated that about 90% of the plants in the state were affected and that the reduction in yield was about 3%.

Cane blight caused by Leptosphaeria coniothyrium (Fckl.) Sacc.

Cane blight was reported as negligible from New York (August 10, Westchester County) and from Ohio.

Other diseases

Root rot caused by Armillaria mellea (Fr.) Quelet - reported on black berry from Washington.

Root rot caused by Rhizoctonia sp. Several cases of young plants rotted by Rhizoctonia were reported in western Washington.

Double blossom caused by Fusarium rubi Wint. - reported from Texas.

Powdery mildew caused by Sphaerotheca humuli (DC.) Burr. was reported by Anderson as being noted for the first time in Illinois (Marion County).

Gray mold rot of Evergreen blackberries, caused by Botrytis sp., was reported by Barss from the Coast section of Oregon, where it was first collected September 6 at Yaquima.

Pezizella lythri (Desm.) Shear and Dodge - reported by Shear and Dodge (l.c., see strawberry) on blackberry and the Lucretia dewberry.

Dieback of loganberries caused by the canes lying on the ground through a wet winter was reported as the most serious trouble in Oregon, by Barss, causing a reduction in yield of about 25%. The canes were often killed back from the tips to within two to six feet of the crown. Wherever the buds rested along the ground they were killed. Fall training of the canes on wires was a complete preventive.

CURRANT

Anthracnose caused by Pseudopeziza ribis Klebahn

Anthracnose was reported from Connecticut, New York, New Jersey, Illinois, North Dakota, Washington, and Oregon. Cook in New Jersey reported a heavy leaf fall as a result of the disease, and Anderson in Illinois stated that it was very serious locally and worse than usual. The other states merely mentioned occurrence. The dates when it was first noticed were: June 24, South Britain, Connecticut; July 2, Delaware County, New York; May 6, Urbana, Illinois; August 15, Fargo, North Dakota; and June 25, Union Experiment Station, Oregon.

Leaf spot caused by Mycosphaerella grossulariae (Fr.) Lind.

Leaf spot was reported from New York, Pennsylvania, Illinois, Iowa, and Oregon. In Illinois it was noted only in the extreme northern part of the state. In Iowa 8% loss was recorded.

Other diseases

Blister rust (Cronartium ribicola Fisch. von Waldh.) was not recorded by collaborators as doing any particular damage to the currants of any state. (For full discussion of the geographic distribution of this rust, see Department publications on white pine blister rust.)

Angular leaf spot caused by Cercospora angulata Wint. - reported from Illinois and Iowa.

Cane blight caused by Botryosphaeria ribis Gross. & Duggar - reported from the Hudson Valley, New York, and from New Jersey by C. L. Shear, and West Virginia by Giddings.

Powdery mildew caused by Sphaerotheca mors-uvae (Schw.) B. & C. This mildew was reported on currants as occurring scatteringly in Washington and Oregon. In the following publication, issued during the past year, the Fay's Prolific currant is said to have been immune to powdery mildew at Wye College, Kent, England, while Raby Castle and some other unknown varieties were badly mildewed.

> Salmon, E. S. and H. Wormald. Varietal resistance to American gooseberry-mildew in red currants. Gard. Chron. III, 70: 47. Illus. July 1921.

GOOSEBERRY

Powdery mildew caused by Sphaerotheca mors-uvae (Schw.) B. & C.

During the year this disease was reported from Virginia, Indiana, Arizona, Idaho, Washington, and Oregon. In Virginia it was very severe on young fruit at Blacksburg, causing almost complete loss of the fruit, according to

Fromme. It was first noted there on April 25. In Arizona it was serious causing destruction of fruits and was particularly prevalent in the Snowflake region of Navajo County where it was first observed June 7. In Idaho it was serious in some sections and in Oregon it is considered the worst gooseberry disease, probably reducing the yield 10%. In the latter state it is co-extensive with the host, except that it was not found on Coast plantings that were examined. It was first reported May 9 from McKee, Oregon. In a recent article Arthur Frank[1] has reported on the control of this disease for Washington and he recommends at least three applications of lime-sulphur, (a) lime-sulphur 1-30, applied when the buds have burst and leaf tips show green about one-quarter of an inch; (b) lime-sulphur 1-40, applied just before blossoming time; (c) lime-sulphur 1-40, just after blossoming time. In bad cases or with susceptible varieties further applications may be required.

1. Frank, Arthur. Currant and gooseberry troubles. Berry Grower 15: 5. April 1921.

Downy mildew caused by Plasmopara ribicola Schröt.

This rare downy mildew was reported from Coos County, Oregon, by Barss. The disease was unimportant, causing only slight damage even where most abundant, and may be confined to the moist, mild Coast climate. It was first noticed June 13 at Coquille. No Sphaerotheca mildew was found associated with it.

Other diseases

Leaf spot caused by Mycosphaerella grossulariae (Fr.) Lindau - Collections of this leaf spot on gooseberry were made in New York, Indiana, and Illinois.

Blister rust caused by Cronartium ribicola Fisch. von Waldh. - reported from Connecticut and other states both on cultivated and wild gooseberries.

Dieback caused by Botrytis sp. - reported from Coos and Marion Counties, Oregon (importance not known, probably scattering throughout western Oregon and more common than reports indicate, first report May 20, Aumsville. - Barss).

CRANBERRY

Only two reports from collaborators concerning diseases of the cranberry were received.

Blossom end rot, presumably caused by Fusicoccum putrefaciens Shear occurred in Oregon, where Barss reports it as the worst disease of cranberries. In the Clatsop County cranberry section spraying as practiced appears not completely successful against this disease, according to Barss.

Early rot caused by Guignardia vaccinii Shear - reported from New Jersey.

Several important publications (1-6) on cranberry diseases and their control have been issued recently.

Recent literature:

1. Fracker, S. B. False blossom in cranberry inspection records. Proc. Ann. Meet. Wisconsin State Cranberry Grow. Assoc. 33: 44-46. 1920.
2. Rudolph, B. A. The principal diseases of cranberries in Wisconsin. Proc. Ann. Meet. Wisconsin State Cranberry Grow. Assoc. 34: 20-26. 1921.
3. Shear, C. L. The present cranberry disease situation. Proc. Ann. Meet. Wisconsin State Cranberry Grow. Assoc. 33: 7-18. 1920. (Discussion: p. 11-16.)
4. _____ Cranberry diseases and their control. U. S. Dept. Agr. Farmers Bul. 1081: 1-22. Dec. 1920.
5. Stevens, N. E. and H. F. Bergman. The relation of water-raking to the keeping quality of cranberries. U. S. Dept. Agr. Bul. 960. Aug. 1921.
6. Stevens, N. E. Water-raking and keeping quality. Proc. Ann. Meet. Wisconsin State Cranberry Grow. Assoc. 34: 6-8. 1921.

MULBERRY

A new disease, characterized by enlarged portions of the fruit, has recently been determined by Siegler and Jenkins[1] to be due to Sclerotinia carunculoides n. sp. The type material was collected at Scranton, South Carolina, March 1921. Ludwig reports the disease as more abundant than usual last year, and states that while it is only locally important, when once established it completely prevents the production of berries. This disease has also been reported from Texas by Taubenhaus[2], as "pop-corn" disease.

Leaf spot caused by Mycosphaerella morifolia (Fckl.) Lin. - reported from Fulton County, Indiana.

Texas root rot, caused by Ozonium omnivorum Shear was very prevalent in Texas according to Taubenhaus, 50% reduction in yield being reported for the state.

Powdery mildew caused by Phyllactinia corylea (Pers.) Karst. and Uncinula geniculata Gerard - were reported as occurring in Ohio in a recent publication by Bruce Fink[3]. Apparently these mildews were collected in some year prior to 1921.

1. Siegler, E. A., and A. E. Jenkins. A new Sclerotinia on mulberry. Science n. s. 55: 353-354. March 31, 1922. No. 1422.
2. Taubenhaus, J. J. On a peculiar disease of mulberry fruit. Nature Study Rev. 17: 282-285. Illus. Oct. 1921.
3. Fink, Bruce. Notes on the powdery mildews of Ohio. Ohio Jour. Sci. 21: 211-215. April 1921.

DISEASES OF SUB-TROPICAL FRUITS

CITRUS

Canker caused by Bacterium citri (Hasse) Jehle

The report of the Department of Citrus Canker Eradication of the Florida State Plant Board[1] shows that up to September 30, 1921 no new citrus trees were found in Florida infected with canker. The general summary of the situation then stands as was reported last year in the Plant Disease Bulletin, except that two of the properties which were classed as "infected" on December 31, 1920 were taken out of this class and declared no longer "danger centers."

The disease was reported by Edgerton as still present in several localities in Louisiana, and recent word from that state indicates that the satsuma growers of the Lower Gulf Coast are in grave danger on account of citrus canker. Satsuma growers of Louisiana are petitioning the state Legislature for an appropriation to combat the disease. No other reports concerning occurrence in the United States were received during the year.

A study as to the cause of resistance to canker has recently been reported by McLean[2]. He studied the Szinkum mandarin which is resistant to citrus canker, and a Florida seedling grapefruit, which is susceptible. Differences in the stomata were discovered which may explain the reason for resistance. In the mandarin the external opening is narrow, practically excluding water, whereas, in the grapefruit variety, the external opening is larger permitting water to enter.

In the Philippines H. A. Lee[3] reported progress in citrus canker control. He used Bordeaux and Burgundy mixtures with some success. Good control was secured on the more resistant kinds of grapefruit, but poor, or no control, was secured with the susceptible types. Regarding this, Lee says:

> "The conclusion is apparently safe that control upon the very susceptible lime and grapefruit varieties is not economically feasible by the methods employed. Upon the sweet oranges of Florida origin and such varieties of less susceptibility, control may be practicable; further work is now in progress upon this point. The sweet orange of the so-called Mediterranean varieties, some of the lemons, and the Unshiu orange varieties comprise a class of fruits of very moderate susceptibility; control apparently would be economically practicable on such varieties. Control was very easily obtained, and was hardly necessary upon the mandarin orange varieties, the calamondins, and the citrons."

Attempts to obtain complete eradication of canker without destruction of the trees resulted negatively in a small plat. At the end of his paper Lee concludes:

> "In a district or region in which the extremely susceptible varieties such as the limes and grapefruits constitute the important, commercial orchards, either complete eradication of the affected host plants or substitution of less susceptible hosts is apparently the only means of preventing severe losses from this disease. From the results presented in this paper such is not the case, however, with the less susceptible species."

Recent literature

Cited.

1. Florida State Plant Board. Department of citrus canker eradication. Quart. Bul. 5: 28-29. Oct. 1920.
2. McLean, Forman T. A study of the stomata of two species of Citrus in relation to citrus canker. Bul. Torrey Bot. Club 48: 101-106. April 1921.
3. Lee, H. A. Citrus-canker control; a progress report of experiments. Philippine Jour. Sci. 19: 129-173. Aug. 1921.

Not cited.

Lyon, H. L. and H. A. Lee. Citrus canker in the Hawaiian Islands. Phytopath. 11: 377. Sept. 1921.

Scab attributed to Cladosporium citri Massee

According to J. R. Winston, of the United States Department of Agriculture, citrus scab occurs in India, South China, Formosa, Japan, Hawaii, Paraguay, Brazil, the Canal Zone, Yucatan, Louisiana, Mississippi, Alabama, Florida, Cuba, Isle of Pines, Porto Rico, and the Lesser Islands of the West Indies. It has also been reported from the Canary Islands and the Union of South Africa.

During 1921 the Plant Disease Survey received reports of scab from Florida, Alabama, Louisiana, Porto Rico, and the Canal Zone. In Florida, J. R. Winston reported the disease as general throughout the citrus belt on grapefruit, causing rind blemish and leaf and twig lesions. As a disease of nursery stock, Winston reports it as being of great importance in Florida, stunting the growth, crinkling the leaves, and scarring twigs. An estimate of 25% reduction in growth of nursery stock was made for 1921. In grapefruit groves and also in nurseries the disease appeared to be less abundant than last year or the average year. In Alabama, Winston reports more of the disease than usual on satsumas in Baldwin and Mobile Counties. The majority of satsuma groves had more or less scab in them. In Louisiana, C. W. Edgerton reported scab in the southern part of the state causing considerable injury to satsumas. It was as prevalent as usual according to Edgerton. From Porto Rico, Matz reports scab as less prevalent than usual, causing only a slight loss, and from the Canal Zone very good specimens of scab were collected February 18, 1921, by Zetek and Molino and sent to the Plant Disease Survey.

Scab was first observed by Winston in Florida during January on nursery stock and on February 1 on grapefruit trees (Arcadia, Florida). In Alabama the earliest recorded appearance for the year was during March at Hammond. Peltier and Frederich[1] have recently reported concerning the relation of weather to citrus scab epidemics in Alabama and find that the late spring with late development of new growth is favorable for an outbreak, whereas an early spring and early season tends towards scab escape in that the first spring growth is about complete when optimum conditions for infection occur. Under Alabama conditions, a light or bad scab year can be predicted, according to Peltier and Frederich, by the monthly mean temperature during March, a low average indicating severe scab and a high one light infection. The mean temperatures for March 1921 were much above normal in Florida and the Gulf Coast States so that, according to that theory, there should have been less scab than usual. This seems to check with reports for the most part, although more scab on satsumas was reported from Alabama last year.

Regarding the relation of weather to scab infection, J. R. Winston states that if the weather is wet when parts are susceptible, infection is likely to occur, but if the weather is dry, very little infection develops regardless of temperature. The spring of 1921 was quite dry in Florida with very little infection. When summer rains came on infections became abundant on parts then in susceptible stage.

In their work on citrus canker, Poltier and Frederich[2] made notes on the susceptibility of various citrus plants to scab and they reported that the disease appears to be strictly limited to the citrus fruits and their hybrids. In the abstract of their paper they gave the susceptibility of a considerable number of citrus hybrids and concluded that, "Scab susceptibility is not as clear cut as that observed for canker and appears to be influenced by reaction of the host plant to environmental conditions essential for scab infection and subsequent development of disease."

Lemons are very susceptible to scab and Winston says that the disease is largely responsible for the failure of the lemon industry in Florida. He states that all commercial varieties of grapefruit except Triumph and Royal are quite susceptible and that rough lemon, sour orange, calamondin, bitter sweet, tangelo, and some varieties of avocado are very susceptible. In nurseries he mentioned that stocks such as rough lemon and sour orange are very susceptible, being much more severely attacked than grapefruit. Satsumas in Alabama are also very susceptible, according to Winston.

Regarding scab control, Winston reports that excellent results follow where copper sprays are applied, both on grapefruit and on satsumas. Sulfur sprays do not control scab effectively under severe conditions. Most of the satsuma groves in Alabama were well sprayed and excellent control resulted in practically all cases where copper sprays were used. Growers who used sulfur sprays did not get goodcontrol. In nursery stock occasional applications of copper sprays are every effective.

Literature cited

1. Poltier, G. L. and Wm. J. Frederich. Weather and its relation to citrus scab epidemics in Alabama (Abstract). Phytopath. 12: 57. Jan. 1922.
2. Poltier, G. L. and Wm. J. Frederich. Relative susceptibility of citrus plants to Cladosporium citri Massee. (Abstract) Phytopath. 12: 57. Jan. 1922.

Melanose caused by Phomopsis citri Fawcett

Melanose was reported to the Survey from Florida, and Edgerton in Louisiana stated that although the disease was not seen it was probably present. From Florida, O. F. Burger sends the accompanying statement and map (Fig. 21) concerning melanose in 1921. As will be noted Burger sent out a large number of questionnaires concerning this disease and the map is based on the results of this inquiry.

"I have included a map showing the distribution of melanose. The figures on the map are the average percentages taken from 500 answers to the inquiry sent out. You can see that the disease

is worse on the West Coast and through the center of the state. Very little disease is present on the East Coast.

"The letters also show that the seedling (orange trees) are the worst affected and grapefruit comes next. Perhaps one reason for this distribution is that there are more seedling groves on the west coast and through the center of the state than on the east coast. There may, of course, be other factors entering in, but I am not yet sure."

J. R. Winston states that the disease was less severe than in 1920 in Florida, but was of about the average prevalence, occurring throughout the the citrus belt, particularly on properties where there is considerable dead wood in the trees, causing brown spots on fruit and lesions on twigs and leaves. An estimate of $750,000 loss is made for the state. It was first observed by Winston April 1 at Orlando. All varieties or oranges and grapefruits are susceptible, and Bordeaux oil-emulsion spray gives excellent results, according to Winston.

Fig. 21. Importance of melanose in Florida, 1921. (After map prepared by O. F. Burger.)

Brown, T. A. Melanose of citrus fruits. Citrus Industry. 24: 3-4. April 1921.

_____ Melanose of citrus. Proc. Florida State Hort. Soc. 33 (1920): 166-168. 1921.

Tear stain caused by rust mites (formerly attributed to Colletotrichum gloeosporioides Penz.)

This injury which affects principally the round orange and grapefruit in Florida, particularly grapefruit, has recently been studied and reported by Winston[1] who concludes that practically all of the so-called wither-tip tear stain in Florida is caused by rust mites rather than a fungus. He states that it is not impossible that Colletotrichum may cause some tear staining, but if it does it must be extremely rare.

1. Winston, J. R. Tear-stain of citrus fruits. U. S. Dept. Agr. Bul. 924: 1-12. Jan. 1921.
2. _____ Tear stain of Florida citrus fruits, its cause and control. Proc. Florida State Hort. Soc. 33 (1920): 122-127. 1921.

Stem end rot caused by Phomopsis citri Fawcett and Diplodia natalensis Ev.

Regarding this disease Fulton, Winston, and Bowman have recently reported[1] that the effects of these two fungi on the fruit are so closely similar as to be indistinguishable in the early stages except by laboratory methods, and that the life habits of the fungi appear to be closely parallel. They are different, however, as regards temperature requirements, Diplodia making its best growth, for the temperatures tested, at 86°F. and Phomopsis at 77° F. Regarding the geographic distribution of these rots and their relation to temperatures, the above investigators report as follows:

> "In Florida Diplodia stem end rot infection, contrary to previous opinion, occurs generally over the state. Its slower rate of development at ordinary temperatures, as compared with Phomopsis has resulted in the latter showing up first in fruits really infected with both fungi. While Phomopsis occurs in the major portion of the citrus belt of Florida, there are some sections of its southernmost portion that appear to be free from it. In such sections Diplodia effect is not masked by the more rapid growth of Phomopsis, and has long been recognized there as the cause of stem end rot.
>
> "In Porto Rico all of the stem end rot so far studied has been of the Diplodia type, conditions there being similar in this respect to southernmost Florida.
>
> "In California the Phomopsis type of stem end rot has been recently found by Dr. O. F. Burger[2] from certain definite localities of limited extent."

In 1921 Winston reports somewhat less Phomopsis stem end rot in Florida than last year and that it was much worse in the spring months (crop set 1920) than in fall months (crop 1921). He states that is is a very serious disease in old groves, especially those with lots of dead wood present. It is usually not severe in young groves, and is likely to be prevalent where melanose is abundant. In fact the distribution of the two diseases practically coincide. Oranges are much more susceptible than grapefruit but differences in varietal susceptibility were not observed.

Table 18. Losses to Florida citrus fruits from stem end rot caused by Phomopsis citri and Diplodia natalensis, as shown by examination of cars at destination by food-products inspectors of the Bureau of Markets and Crop Estimates.

Grapefruit		Oranges		Tangerines	
Number cars with decay	Percent stem end rot	Number cars with decay	Percent stem end rot	Number cars with decay	Percent stem end rot
Shipping season* beginning October 15, 1920 and ending June 7, 1921 (crop set 1920)					
1	57	6	20-30	1	3
4	14-20	3	10-15		
16	1-6	30	1-8		
21	Av. 8	39	Av. 7		
Shipping season* beginning October 21, 1921 to January 16, 1922 (crop set 1921)					
1	27	2	30-45	1	55
2	10-13	12	10-23	1	2
18	2-9	33	2-9		
21	Av. 6	47	Av. 9	2	Av. 29

*The shipping season includes the crop of one entire growing season.

Stem end rot caused by Diplodia was reported by Matz from Porto Rico as common and injuring about 10% of the crop.

1. Fulton, H. R., J. R. Winston, and J. J. Bowman. Stem end rot of citrus fruit, Citrus Ind. 2[12]: 10, 22. Dec. 1921.
2. Burger, O. F. Decay in citrus fruits during transportation. Mo. Bul. Calif. Dept. Agr. 9: 365-370. Sept. 1920.

Wither tip and anthracnose attributed to Colletotrichum gloeosporioides Penz.

Anthracnose was reported by Winston as about the same as usual on grapefruits in Florida, but was of minor importance. It was mostly confined to the east coast but there was some along the west coast in Lee County and in the central part of the state. According to Winston all commercial varieties of grapefruit are apparently equally susceptible, and spraying is of questionable value.

The wither tip, resulting in a dying back of twigs and yellowing of foliage both of orange and grapefruit, was more prevalent than last year or the average year and occurred throughout the citrus belt, being very prevalent in groves on thin, high and dry soils. Grapefruit was more susceptible than orange. As usual, it was most conspicuous on under-nourished trees or in groves which had not been handled properly.

In a recent publication[1] Burger states that the reason for the more severe injury in Florida than in California is the greater rainfall in the former state. The spores of the fungus must have an abundance of moisture in

order to germinate and the dry summer in California is not favorable.

The disease was reported from southern Louisiana where it was of minor importance.

1. Burger, O. F. Variations in Colletotrichum gloeosporioides. Jour. Agr. Res. 20: 723-736. Feb. 1, 1921.

Wither-tip of lime caused by Gloeosporium limetticolum Clausen

Lime wither-tip was reported by Winston as occurring in about the same localities in Florida from which he reported it last year. It was apparently less prevalent, however, than in 1920, probably on account of the dry weather. This is the only major disease of lime in Florida, being present in practically all of the groves and affecting 25% of the plants. A loss of $5,000 was estimated for 1921. The Key or Mexican lime which is the only commercial variety of consequence, is very susceptible to infection.

Mottle leaf (cause undetermined)

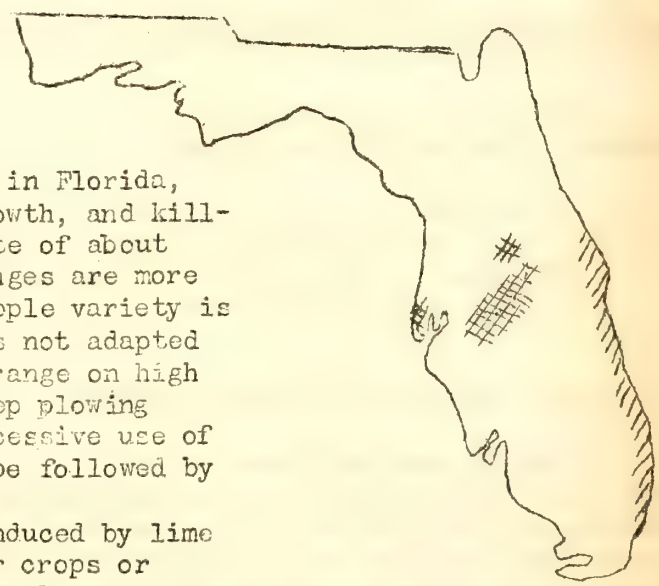


Fig. 22. Areas in Florida where mottle leaf is most prevalent according to J. R. Winston, 1921.

Mottle leaf was reported from Florida and the Philippines during 1921. Winston regards this as one of the major diseases of oranges in Florida, mottling the leaves, reducing annual growth, and killing back the twigs. He makes an estimate of about $250,000 loss in Florida for 1921. Oranges are more susceptible than grapefruit. The Pineapple variety is quite susceptible. Trees on root stocks not adapted to particular soil type, such as sour orange on high pine land are likely to be mottled. Deep plowing sometimes seems to induce mottling. Excessive use of lime on thin soil is almost certain to be followed by mottle leaf.

Where the injury is apparently induced by lime the use of organic matter, such as cover crops or stable manure, is very efficient in control.

In the Philippines, Lee[1] has observed that certain stocks are conducive to mottle leaf. Thus trees upon pummelo stock were badly affected, while trees upon mandarin, orange, and calamondin stocks under the same conditions did not mottle.

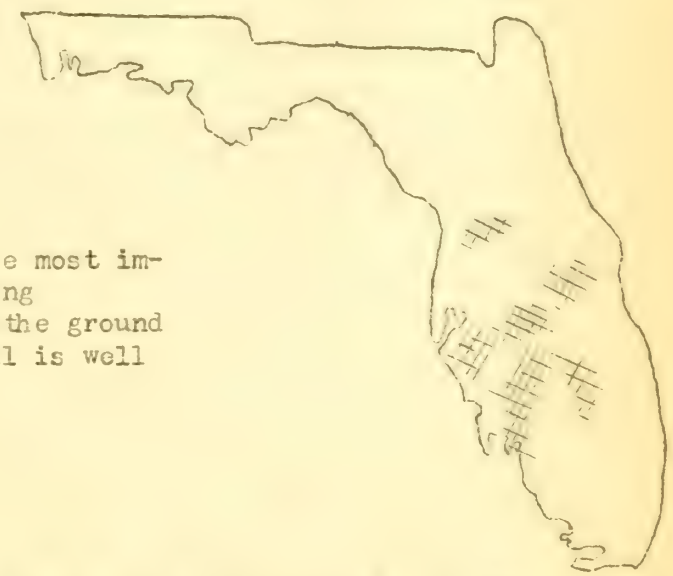
1. Lee, H. Atherton. The relations of stocks to mottled leaf of citrus trees. Philippine Jour. Sci. 18: 85-95. Jan. 1921.
2. Kenney, W. P. and A. B. Cummins. Composition of normal and mottled citrus leaves. Jour. Agr. Res. 20: 161-191. Nov. 1920.

Blue mold rot caused by Penicillium spp.

Blue mold rot was reported from Florida but, apparently, there was less of it than usual as conditions were not especially favorable for its development. This year it was confined mainly to the packing house. Grapefruit seems to stand rougher handling than oranges, according to Winston, and fruit from certain localities seems somewhat predisposed to the trouble. In the markets considerable blue mold rot was prevalent, as usual. Three hundred and forty-four cars of California oranges inspected between the dates of January 4 and October 31 showed an average of 5% blue mold rot, while 342 cars of Florida oranges inspected during the same period showed an average of 6% decay. With grapefruit, 242 cars from Florida inspected between January 4 and June 7 showed 6% blue mold rot. Only two cars, which averaged 9% infection, of California grapefruit were inspected during the same period. In 133 cars of California lemons there was an average of 8% decay between the dates of March 2 and October 8, and in 39 cars of Florida tangerines 7% decay was found from January 3 to March 21.

Dieback (cause undetermined)

Fig. 23. Occurrence of dieback in Florida, according to Winston, 1921.



Dying back of trees "ammoniated" fruit, was more prevalent than usual in Florida, according to Winston, and was one of the most important citrus diseases, probably causing $1,000,000 loss. Bluestone applied to the ground sometimes gives good results if the soil is well drained.

Blast and black pit caused by Bacterium citriputeale C. O. Sm.

These diseases have been shown by Fawcett, Horne, and Camp[1] to be caused by the same bacterium which has also been described by Lee under the name of Bacterium citrarefaciens. The organism causes black pit only in southern California, but in northern California produces both blast and black pit abundantly.

1. Fawcett, H. S., W. T. Horne, and A. F. Camp. Citrus blast and black pit. Calif. Citrogr. 6: 234. May 1921.

Foot rot (cause undetermined)

Foot rot was reported by Winston from Florida as a disease of major importance in old seedling groves, and also coming into groves on lemon stock in low situations. The smaller amount of this disease this year is probably due to the unusually dry weather. A foot rot causing slight injury is also reported from Porto Rico, and the following reference apparently deals with a similar disease in South Africa.

Putterill, V. A. Plant disease in the western province II. Collar rot in orange trees. Jour. Dept. Agr. South Africa 3: 259-263. Illus. Sept. 1921.

Internal decline of lemons (non-parasitic)

The following report concerning internal decline of lemons in California is by E. T. Bartholomew:

"Owing to better market conditions which warranted regular and close pickings and apparently also to climatic conditions the loss of lemons due to internal decline during 1921 was much less than in 1920.

"I believe that a description of this trouble has not yet appeared in print and the following summary of the symptoms may be of interest to the public.

"The cause of the trouble known as internal decline of lemons is not yet definitely known, but the problem is being worked upon at the present time. It is a physiological malady. About the time the fruits begin to mature there is an internal physiological breaking down of the cells, first in the rind, just outside of the fleshy pulp, at the stylar end of the fruit. Coincident with the breaking down of the cells a pinkish to rust-brown deposit of gum appears. As the trouble progresses the tissues in the core and in the fleshy pulp break down also and lose water. If allowed to remain on the trees a quarter to one-third or more of the fruit will become internally broken down in this manner. About this time an abscission layer forms and the fruit drops.

"It is often difficult, especially in the green fruit, to detect the trouble because there is no external evidence except a possible change in the color of the rind at the stylar end of the fruit. The breaking down of the cells does not appreciably progress after the fruit has been removed from the tree.

"The malady is a serious one for not only as much as 10-60% of an entire pick may be affected but these lemons, many of which because of lack of external evidence, it is impossible to cut out, appear to be weaker and thus more susceptible to disease during storage or shipment."

Reference

Bartholomew, E. T. Bearing of water relation to internal decline of lemons. California Citrograph 7: 126, 128-129. Feb. 1922.

Other diseases

Nail head rust caused by Cladosporium herbarum citricolum Fawcett - reported by Winston from Florida as prevalent in many localities, but especially in Pinnelas and Brevard Counties, causing a spotting of the fruit and killing of a few twigs.

Blight (cause undetermined). Probably not more than 20 properties are affected with this disease in Florida, according to Winston. It causes a slow wilting and subsequent death of tree.

Black spot caused by Phoma citricarpa McAlp. - reported from Formosa and China by Lee[2].

Sun and sulfur spray burn. C. F. Burger furnishes the following note concerning this trouble in Florida. "On account of the dry weather there has been a good deal of sun-burned fruit. Also the grower spraying in the heat of the day has injured his fruit. In some local groves I have seen injury produced by sun and spray to the amount of 5%."

Citrus root nematode (Tylenchus semipenetrans Cobb). During the year Byars[1] has reported on this disease. He states that the initial report of the nematode was from California and since that time it has been collected from Florida, Spain, Malta, Palestine, Australia, and Algeria. Byars collected the disease in three localities in Florida, namely; Glen St. Mary, Gainesville, and Brooksville, all of which are places where there has been considerable introduction of citrus stocks from other states or foreign countries.

Chlorosis. The soil relations of citrus chlorosis is discussed by C. B. Lipman[3].

Literature

1. Byars, L. P. Notes on the citrus root nematode, Tylenchulus semipenetrans Cobb. Phytopath. 11: 90-93. Feb. 1921.
2. Lee, Henry Allerton. Black spot of citrus fruits caused by Phoma citricarpa McAlpine. Philippine Jour. Sci. 17: 635-641. Dec. 1920.
3. Lipman, C. B. A contribution to our knowledge of soil relationships with citrus chlorosis. Phytopath. 11: 301-305. Aug. 1921.
4. Reinking, Otto. Citrus diseases of the Philippines, southern China, Indo-China, and Siam. Philippine Agr. 9: 121-179. Jan. and Feb. 1921.

FIG

Rust, probably caused by Physopella fici (Cast.) Arth. - reported from Rockdale County, Georgia, May 2, 1921, and from Texas.

Anthracnose caused by Glomerella cingulata (Stonem.) S & von S. was reported by Ludwig from South Carolina as important locally in the southeastern part of the state, and by Taubenhaus from Texas, as unimportant.

Canker caused by Macrophoma fici Alm. & S. Trace reported from Texas.
Leaf spot caused by Cercospora sp. Trace reported from Texas.

DATE

Leaf spot caused by Graphiola phoenicis (Mong.) Poit. was reported from southeastern California by J. G. Brown. It was serious on three-year old seedlings at the Government Station at Bard, practically destroying the leaves. Apparently the variety Deglet Noor was very susceptible. Burning over the nursery is advised. This process does not kill the seedlings, according to Mr. Shamblin.

Smut - reported from Texas.

Leaf spot caused by Exosporium palmivorum Sacc. - reported from Texas.

Fruit rot associated with Macrosporium and Helminthosporium spp. was reported by J. G. Brown from Arizona. All varieties were attacked but the Deglet Noor was the most susceptible. Spraying with Bordeaux mixture, 5-5-50, three times gave a 25% greater harvest.

PINEAPPLE

Root rot of pineapple in Hawaii has been shown by Carpenter[1] to be associated with Pythium butleri Subr.

1. Carpenter, C. W. Morphological studies of the Pythium-like fungi associated with root rot in Hawaii. Hawaiian Sug. Plant Assn. Expt. Sta. Bul. 3: 59-65. Aug. 1921.

Red wilt (cause undetermined) was reported by J. R. Winston as very prevalent in the pineapple sections of Florida. He estimates that the disease is probably responsible for 75% of all deaths of plants one or more years old.

AVOCADO, MANGO, PAPAYA, GUAVA

The following article furnishes valuable information on the diseases of these fruits.

Stevens, H. E. Some diseases of the avocado and other subtropical fruits. Proc. Fla. State Hort. Soc. 33 (1920): 77-91. 1921.

DISEASES OF NUTS

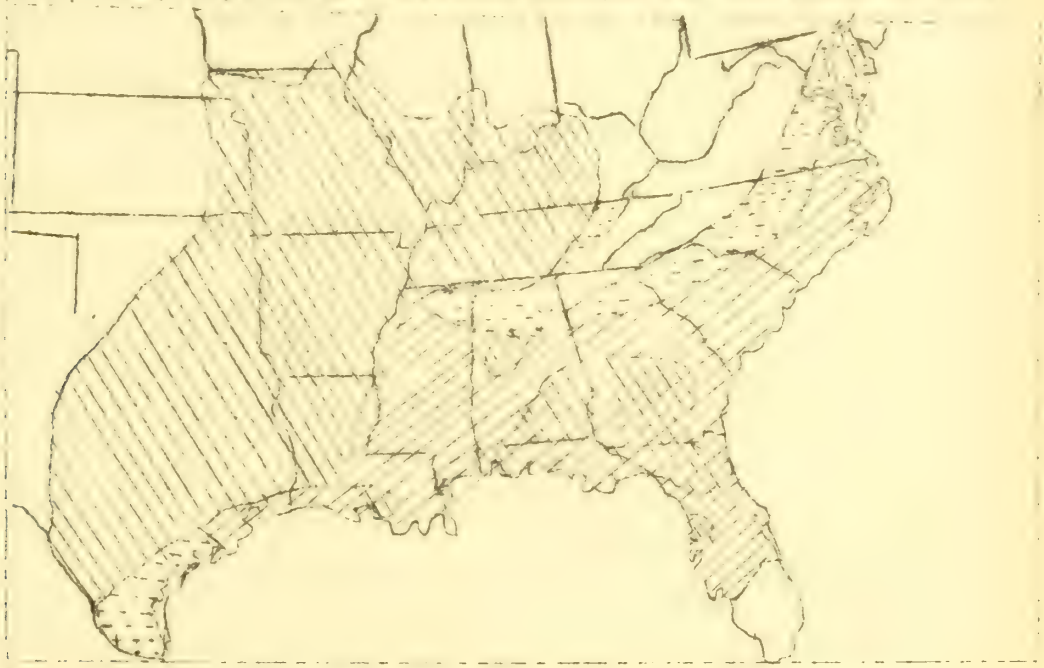
PECAN

Scab caused by Fusicladium effusum Wint.

The apparently general distribution of pecan scab in regions where the host is of economic importance is indicated by the accompanying maps (Figs. 24 and 25) showing the range of the pecan according to C. A. Reed (The pecan. U. S. Dept. Agr. Bur. Pl. Ind. Bul. 251: 9. 1912), and also that of the disease as it has been reported to the Survey.

The following statement concerning the distribution and importance of the disease during 1921 is by J. B. Demaree, of the Office of Fruit Disease Investigations:

"Scab appears to have caused a greater loss to pecan growers during the season of 1921 than during any other season on record. It was especially severe in northwest Florida and south and central Georgia. These same sections were visited by frequent rainy days and a heavy rainfall during May and July. The United States Weather Bureau reports 24 rainy days at Thomasville, Georgia for the month of July.



Area to which the pecan is native
Area in addition to its native habitat within which the pecan has been successfully planted
Area of most intensive planting
Area of scattered planting

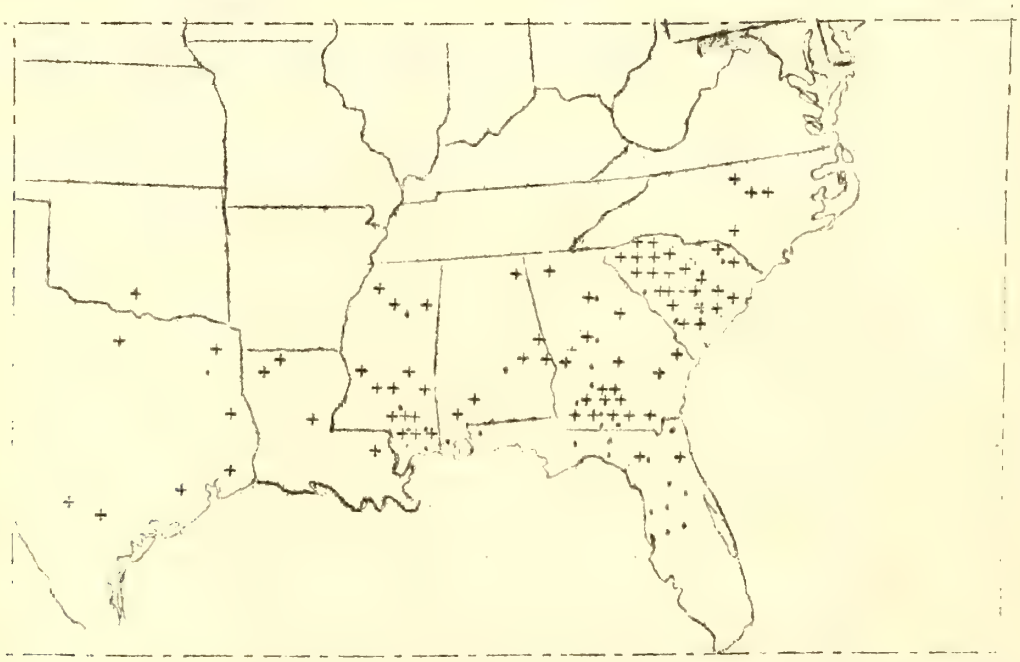
Fig. 24. Distribution of the pecan in the United States. After map by C. A. Reed (U. S. Dept. Agr. Bur. Pl. Ind. Bul. 251: 9. 1912.)

"The variety Georgia and many highly susceptible seedlings were a total loss practically throughout the southern pecan belt. The Delmas was also a total loss in northern Florida, Georgia, Alabama, and Mississippi south of latitude 32 and the disease was quite severe on this variety as far north as Fort Valley, Georgia, and Montgomery Alabama. An extensive grower reported scab on Delmas for the first time near Winona, Texas.

"In the great pecan region in the vicinity of Albany, Georgia, the Delmas was an entire failure, except where sprayed. Alley scabbed to the extent of 75% and the disease appeared on Schley for the first time. In the vicinities of Thomasville, Georgia, and Monticello, Florida, Delmas, Alley, and Van Deman were a total failure while the loss to Schley was from 50-75% and to Mobile from 35-40%

"Since this past season was comparatively dry, along a narrow belt bordering the Gulf of Mexico, including Mobile, Alabama, Pascagula, Ocean Springs, and Biloxi, Mississippi, the loss from scab was confined principally to the varieties Delmas, Alley, and Pabst."

Reports which agreed in general with that of Demaree were received from collaborators in Florida, Georgia, Mississippi, Texas, and North and South Carolina. Foster stated that scab was found in nearly every orchard visited in North Carolina, causing heavy loss in many cases. According to Ludwig the disease was important in the central part of South Carolina. Georgia and Florida reported more than usual, and Mississippi slightly less, confined mostly to the Gulf Coast. In Texas the disease was said to be very prevalent.



+ = Counties from which scab was reported prior to 1921
. = Counties from which scab was reported during 1921.

Fig. 25. Distribution of pecan scab, as reported to the Plant Disease Survey.

Losses estimated by collaborators were 2% in South Carolina and Texas and 4% in Mississippi.

The dates when the disease was first noticed and the periods during which it caused greatest injury are given in the following tabulation.

Table 19. Pecan scab. Dates and places of first appearance and period of greatest injury as reported by collaborators.

State	Date of first appearance	Place of first appearance	Period of greatest injury
South Carolina	June 25	Orangeburg	August 18 - October 12
Florida	April 2	-	June and July
Mississippi	May 10	Ocean Springs	May 20 - June 10

Regarding the susceptibility of varieties, Demaree says:

> "The following standard varieties are quite resistant to pecan scab: Moneymaker, Stuart, Frotscher, Teche, Curtis, Success, and Russell. The following are the most susceptible standard varieties and about in order as named: Georgia, San Saba, Delmas, Alley, Van Deman, Schley, Pabst, and Mobile."

Delmas and Alley were said to be most seriously affected in Georgia, but infection was general on other varieties. Neal in Mississippi includes Alley among varieties resistant in that state: Stuart, Frotscher, Moneymaker, Alley, Teche, and Moore. Susceptible varieties reported by Neal were: Pabst, Van Deman, Success, and Schley.

The following statement concerning control methods is also from Demaree's report:

> "While Bordeaux mixture has proven to be very effective in controlling pecan scab, comparatively few growers are spraying. During August and September of this past season a severe drouth prevailed which apparently lowered the vitality of the trees. On account of this, all orchards sprayed with Bordeaux mixture shed their leaves prematurely. This resulted in undersized and poorly filled nuts. The number of trees of the most susceptible varieties are becoming less each year owing to the general practice of topworking these to the resistant varieties."

McHatton in Georgia and Burger in Florida both said that the disease could be controlled by spraying, the latter recommending the use of Bordeaux 4-4-50.

Rosette (non-parasitic)

The following quotation is from Demaree's report:

> "The amount of rosette does not vary materially from year to year. Possibly 25% of all pecan trees in southeastern United States show

some symptoms of this disease. This however, does not mean that 25% of all trees are non-productive. Even moderately rosetted trees often produce good crops of nuts.

"It is unusual to find an orchard where some rosette is not present. On the other hand, we often find orchards where all trees are more or less affected.

"This disease is closely associated with certain types of soil. It is prevalent most generally in impoverished soils, deep sandy soils or badly washed hillsides. Many growers are slowly overcoming the disease with the use of stable manure and cover crops."

South Carolina: More than usual or than last year. Important, 5% reduction in yield. General in state. First appearance January 17, in Hopkins County. Caused most injury during the period from August 4-26. Drier weather than usual probably responsible for increase in disease. (Ludwig).

Georgia: Same as usual, always important. Occurs in central and southern Georgia. (McHatton).

Mississippi: Several cases of pecan rosette have been observed in the eastern part of the state (Clarke County), the Gulf coastal section, and also here at the horticultural orchards. Not nearly so severe as has been observed previously by the writer in other states, especially Georgia. (Neal.)

Recent literature

Bullard, W. P. Pecan rosette. Amer. Nut Jour. 15: 62. Nov. 1921.
Halbert, H. A. Treatment for rosette. Amer. Nut. Jour. 15: 7. July 1921.
Palmer, W. B. Practical treatment of rosette with marked success. Amer. Nut Jour. 14: 68. June 1921.
Rand, Frederick V. Pecan rosette: its histology, cytology, and relation to other chlorotic diseases. U. S. Dept. Agr. Bul. 1038: 1-42. Pl. 1-12. Mar. 20, 1922.
Weaver, W. A. Pecan rosette - a practical discussion. Amer. Nut Jour. 14: (26). 30-31. March 1921.

Nursery leaf blight caused by *Phyllosticta caryae* Peck

"The nursery leaf blight is generally present in all southern pecan nurseries. The disease is especially severe to the young trees in the nursery during their first year's growth. The severe spotting of the leaves, due to this disease, results in undersized trees that frequently do not attain a size sufficient to bud by mid-summer of their second year.

"Five applications of Bordeaux mixture, at two and three weeks interval through the spring and summer months, effectively controls this disease in nurseries.

"This leaf blight is also occasionally present in pecan orchards but is found here only under conditions similar to those when brown leaf-spot is severe." (J. B. Demaree).

Neal reported the disease as causing very slight damage in nurseries in the southern part of Mississippi.

Brown leaf spot caused by Cercospora fusca Rand.

"Found in practically all pecan orchards throughout the southern pecan belt. The fungus causing this disease does not appear to be a strong parasite and does not develop the spots until about midsummer.

"The disease is not considered serious to thrifty, rapidly growing trees but often causes premature defoliation to trees in neglected orchards or trees weakened with rosette or borers. This leaf spot is also frequently found doing damage in orchards where the trees are planted too closely." (Demaree).

South Carolina: Unimportant. Reported from nursery in Orangeburg, August 18. (Ludwig).

Mississippi: Present in many parts of the state and apparently on all varieties of pecans as well as seedlings. Damage slight. (Neal.)

Anthracnose caused by Glomerella cingulata (Stonem.) S. & von S.

"Anthracnose caused by Glomerella cingulata occasionally attacks pecan nuts at or near the end of the growing season. Consequently, little loss is incurred.

"This pecan disease was not observed by the writer this past season except in one orchard near Americus, Georgia. In this case it seemed to be associated with pecan scab." (Demaree).

The disease was reported from Mississippi as causing slight damage on Pabst pecans at Ocean Springs.

Kernel spot (non-parasitic)

"During 1921 reports of the presence of pecan kernel spot have been received from South Carolina, Georgia, Florida, Alabama, Mississippi, and Texas. According to these reports the loss was slight in all sections except South Georgia and North Florida. The varieties, Curtis, Schley, and Frotscher, are the most susceptible of the budded sorts to this injury. The writer has demonstrated this past season (report in preparation) that this trouble is caused by punctures of the southern stink bug, Nezara viridula Linn. The kernel spot is only present in localities and orchards where this bug is present.

"Since these spots cannot be seen until the shell is removed, the amount of damage done by kernel spot is difficult to determine. Undoubtedly, many growers have unknowingly marketed spotted nuts. The loss in one Frotscher orchard near Thomasville, Georgia was estimated to be from 15-20%. The loss in a 5,000 pound crop of Curtis near Blackshire, Georgia was determined by the writer to have been about

62%. A grower near Valdosta, Georgia, reports a loss of about 75% for Schley. In a Schley orchard near Thomasville, Georgia the loss was about 10%." (Demaree).

Miscellaneous diseases

Powdery mildew caused by Microsphaera alni (Wal.) Salm. South Carolina (general, unimportant); Florida (about same as usual); Texas (very prevalent, loss .1%).

Crown gall caused by Bacterium tumefaciens EFS & Towns. Crown gall is rarely found on pecan trees and is a disease of only minor importance. It was observed by the writer at only one point (Cairo, Georgia) during the season of 1921. (Demaree).

Die-back caused by Botryosphaeria berengeriana De Not. Important locally in central South Carolina, affecting the entire orchard in some cases. (Ludwig).

Die-back, cause unknown, perhaps due to malnutrition, was reported from several places in Florida. In one or two places the soil was of a sandy nature and no fertilizers had been applied. (Burger).

Black-pit (cause unknown) was reported by Neal as causing slight loss in Lauderdale and Warren Counties, Mississippi.

WALNUT

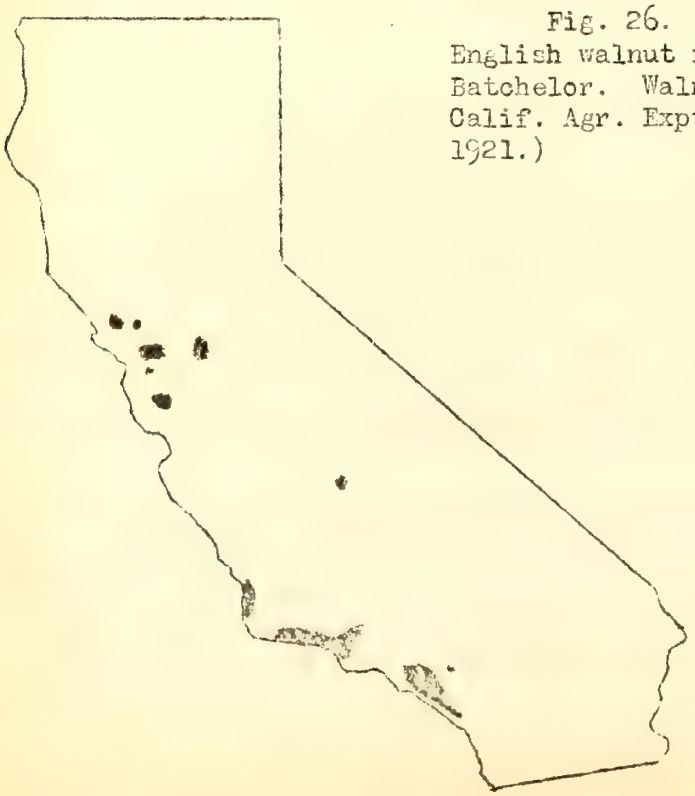


Fig. 26. Commercial distribution of English walnut in California. (L. D. Batchelor. Walnut Culture in California. Calif. Agr. Expt. Sta. Bul. 332: 144. June 1921.)

Blight caused by Bacterium juglandis (Pierce) EFS

Bacterial blight of the English walnut was first reported from California in 1901[2], when it was already a serious trouble. The Pacific Coast and New Zealand were the only regions in which the disease was known to occur until 1913, when it was reported by M. B. Waite as having been found in Texas and Louisiana[1]. Since that year (McMurran, l.c.) its presence has been demonstrated in Pennsylvania, Delaware, Maryland, the District of Columbia, and Virginia. The Survey has reports from the additional states of New Jersey and Georgia. Apparently the disease has not become so important in the East as it is on the Pacific Coast, due perhaps to the later infection period in the former region. (McMurran, l.c.)

In 1921 walnut blight was reported from Virginia, Washington, Oregon, and California as follows:

Virginia: Moderate infection at Shipman, Nelson County. First reported June 10. (Fromme).

Washington: One report, Cowlitz County. (Dana).

Oregon: Same as average year, possibly worse than last year. Most serious cause of loss to crop. Occurs throughout western Oregon. Reduction in yield 25%+; 50% infection found in one 212 acre orchard. First report July 8 at McMinnville. Long, cool, moist spring. No resistant kinds grown commercially. No method of control known. (Barss).

California: This disease was unusually severe in this state during 1921. The disease seemed to be general. Some varieties as the Eureka seem to be more resistant than others. I heard the manager of the Walnut Growers Association state that the association was culling 20 to 30% more than ordinarily in packing. In addition the loss on the trees would amount to 20-30%. It is safe to estimate the loss at 40% for the state, including destruction of nuts and injury to quality. (Milbrath).

Investigations on infection and resistance of varieties to walnut blight were conducted by C. O. Smith at Riverside, California. The results were summarized by him as follows[3]:

"1. The source of the natural infection of the walnut blight organism is the old blight cankers on the twigs.

"2. The blight organism is found on the leaf and catkin buds some time before growth begins in the spring, but probably causes little or no infection until the new growth begins.

"3. Dormant buds do not often become infected, as shown by inoculation experiments, until new tissue (visible new growth) has developed.

"4. Water as fog or rain and pollen from infected catkins act as carriers of the organism and in its distribution. The soil (from experimental work) thus far does not seem to act as a medium in which the organism can grow.

"5. The tests of several commercial varieties of walnuts indicate differences in their resistance to walnut blight, the Ehrhardt being less susceptible than the Placentia and seedlings. This seems to be confirmed by orchard observations."

References

1. McMurran, S. M. Walnut blight in the eastern United States. U. S. Dept. Agr. Bul. 611. Dec. 10, 1917.
2. Pierce, N. B. Walnut bacteriosis. Bot. Gaz. 31: 272-273. 1901.
3. Smith, C. O. Some studies relating to infection and resistance to walnut blight. Mo. Bul. Calif. State Dept. Agr. 10: 367-371. Sept. 1921.

ALMOND

Blossom blight caused by Monilia sp.

This disease was reported on almond by H. P. Barss, from Douglas County in western Oregon. Very few almonds are grown in this section, but these are very susceptible to this blight and year after year they show much loss from Monilia attack on the blooms. Last year it was more severe than in 1920 and was first observed May 27 at Riddle.

Other diseases

In a recent California bulletin[1] the more important diseases of the almond in that state are briefly discussed. Crown gall (Bacterium tumefaciens), Armillaria root rot (Armillaria mellea), blight (Coryneum beijerinckii), shot hole (Cercospora circumscissa), shot hole (Gloeosporium amygdalinum), rust Puccinia pruni), heart rot, die-back, sour sap, and fruit drop.

1. Taylor, R. H. The almond in California. California Agr. Expt. Sta. Bul. 297: 1-84. fig. 1-23. Mar. 1921.

FILBERT

Bacterial blight caused by bacteria

According to H. P. Barss this is the most serious disease of young filbert plantings in Oregon, being present throughout the western part of the state. It blights the shoots and causes a leaf spotting, and in some plantations 100% of the trees are attacked. This year it was noted first on April 28 at Corvallis. The varieties Barcelona, Du Chilly, and White Aveline are badly attacked.

Blight caused by Cryptosporella anomala (Pk.) Sacc.

This disease, which is common on the wild American hazel (Corylus americana), was reported on the cultivated filbert this year only from Yarrow, Maryland. It is this disease that has made commercial filbert culture in the East impossible. It does not occur on the Pacific Coast where filberts are now being cultivated successfully on a large scale, but if it were introduced there, it would doubtless do great damage and perhaps even wipe out the industry.

This whole subject has recently been discussed by Barss[1] in a paper before the Western Plant Quarantine Board at Victoria, British Columbia, June 7-10, 1921. After discussing the history of the disease and telling of its distribution and importance, Barss urges the placing of an embargo against the shipment of cultivated and American wild hazel from territory east of the Rockies, both in the United States and in Canada. The Western Plant Quarantine Board passed a resolution asking the Federal Horticultural Board and the authorities of the Dominion of Canada to investigate the problem and to take action on it.

1. Barss, H. P. Eastern filbert blight problem: Mo. Bul. California Dept. Agr. 10: 250-253. July 1921.

COCONUT

Bud rot caused by Phytophthora sp. The following publications concerning this disease have come to attention:

1. Reinking, Otto A. Coconut bud rot in the Philippines. Phytopath. 12. Jan. 1922.
2. Ashby, S. F. Relation between cacao pod rot and coco-nut bud rot. Agr. News 20: 318. Oct. 1921.

Stem bleeding disease (cause undetermined). "Upon coconuts, stem bleeding disease has come to our attention for the first time during this year. It is very common in Zulu Archipelago. This is the first report of the disease from the Philippines." (H. Atherton Lee).

BRAZIL NUT

(Bertholletia nobilis Miers and B. excelsa Humb. & Bonpl.)

During the past year a contribution to our knowledge on decays of the Brazil nut has been made by E. R. Spencer (Spencer, E. R. Decay of Brazil nuts. Bot. Gaz. 72: 265-292. Pl. 8-12. Nov. 1921). Spencer studied nuts obtained from wholesale firms in Chicago and from grocerie in Urbana and Champaign, Illinois. It is probable that most of these diseases originate in the native home of the Brazil nut, but on the other hand, infection by some

of them may occur under unfavorable transit and storage conditions. They are of considerable economic importance in the marketed product. Decayed Brazil nuts are well known to everybody.

Black crust caused by Pellioniella macrospora Spencer. Fully 5% of all diseased Brazil nuts are affected with this disease, according to Spencer. There are no external symptoms, shells being of normal color and weight. The kernel, however, has a dull black appearance owing to a thin layer of dark mycelium in the endosperm layer. Affected nuts are often covered with other fungi such as Penicillium or Aspergillus. The organism is described and named as a new species of the hitherto monotypic genus Pellioniella.

White mold - Cephalosporium bertholletianum Spencer. This is not so common as black crust and is probably responsible for less than 1% of the Brazil nut decay. No external signs of disease except loss of weight. Kernel covered with white mold, yellow endosperm, and musty odor but no distinguishing taste. The fungus characters are described and it is named as a new species.

Dry rot caused by Fusarium sp. Shell usually mottled, somewhat lighter in color, and the nut much below normal in weight. The kernel often adheres closely to the shell and is dry-rotted throughout and filled with mycelium. The cultural characters and morphology of the fungus are given.

Aspergillus decay caused by Aspergillus sp. No external signs except perhaps in most advanced cases when the weight is appreciably lowered. The kernel shrinks and has a rancid or putrid odor and sour or bitter taste. The fungus fruits on the outside of the nut and the mycelium penetrates to all tissues. The fungus is described.

Bacterial decay caused by an undetermined organism. The shell of affected nuts is black and greasy and usually exhales a rancid odor. The kernel is entirely decayed, and shrinks to a small white mass. The organism, which appears to be a new one, is described but not named.

Actinomyces decay caused by Actinomyces braziliensis Spencer. Occasionally found among Brazil nuts. Empty but normal colored shells, which when cracked show the inner wall covered with pinkish, velvety pustules, characterizes the disease. The organism is described as a new species.

Phomopsis decay caused by Phomopsis bertholletianum Spencer. Found on one nut only. No external sign, kernel rich brown in color, pycnidia near one end, odor pleasant and taste agreeable. New species.

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