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A COMPARISON OF A SCLEROTINA FOUND ATTACKING
APRICOT FRUITS IN CALIFORNIA WITH VARIOUS
AMERICAN AND EUROPEAN FRUIT SCLEROTINIAS

EDITH M. PHILLIPS

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- a. Introductory - obtaining of the various
strains and the history and inoculation
work
- b. Apricot inoculations to obtain rates of
growth, type of growth, color of
fruit, etc.

**A COMPARISON OF A SCLEROTINA FOUND ATTACKING
APRICOT FRUITS IN CALIFORNIA WITH VARIOUS
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- a. Strains
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and 12

By

Edith H. Phillips

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and 12 into the apple to further test their
individuality

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**April, 1918
Berkeley, California**

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A COMMITTEE OF AGRICULTURAL EXPERTS
HAS BEEN APPOINTED TO STUDY THE
PROBLEM OF THE AGRICULTURAL
INDUSTRY AND TO REPORT TO THE
COMMISSION ON AGRICULTURE.

WALTER H. FRIEDMAN

1911, 1912
1913, 1914

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I. The Problem.

During the past few years the brown rot fungus, a species of *Sclerotinia*, has grown increasingly important in the central coast regions of California largely because of its parasitic attacks upon apricot trees and blossoms. The ripening fruit is likewise often attacked. This fungus occurring in California is locally called *Sclerotinia fructigena*, but should it be called by this name or by a different name? It was to find definitely if possible the answer to the above question that I undertook the experimental work later described.

II. History of species and present status of the species question.

a. In Europe.

Persoon (1) in 1796 gives the following description of a fruit rot fungus:

Torula fructigena: cinero-albida, subrotunda, filorum articulis ovatis.

Hab. in variis fructibus putridis Pruni domesticae Amygd. Persicae, autumnno praecipue frequens in piris putridis, cespitulos crassos subrotundus efficiens. Obs. Fila in novo hocce genere nec in capitula stipitata colliguntur, qualia exhibent Moniliae negue digitiformia trunco imposita, uti in genere Aspergillo locum obtinet, and articulata; articulis deciduis, and glabra simplicissima sunt, quae in Dematio non observantur.

The above may be translated:

During the past few years the problem of the origin of the California Indians has been the subject of much discussion. The prevailing view is that the Indians of California are descended from the Indians of the Pacific Northwest. This view is based on the fact that the Indians of California and the Indians of the Pacific Northwest have many characteristics in common. These characteristics include physical features, language, and customs. It is also noted that the Indians of California and the Indians of the Pacific Northwest have a common history. This history is based on the fact that the Indians of California and the Indians of the Pacific Northwest have lived in the same region for many centuries.

II. History of the Indians of California

The history of the Indians of California is a complex one. It is based on the fact that the Indians of California have lived in the same region for many centuries. The history of the Indians of California is based on the fact that the Indians of California have lived in the same region for many centuries.

III. Physical Features of the Indians of California

The physical features of the Indians of California are a subject of much interest. The physical features of the Indians of California are based on the fact that the Indians of California have lived in the same region for many centuries. The physical features of the Indians of California are based on the fact that the Indians of California have lived in the same region for many centuries.

Torula fructigena: grayish-white, nearly round, egg-shaped united in chains.

Habitat: in various fruits of the domestic plum when decaying, peach, in autumn especially frequent in decaying pears, producing nearly round thick knobs.

Observation. There are chains in this new kind and they are not collected into crowded heads in like manner to the Monilia, and not like finger-like forms imposed on a trunk, as takes place in the Aspergillus form, and they are articulated: the articulations separate and are smooth and very simple, which are not observed in Dematium.

His color term cinero-albida seems to refer to the color of the spores under the microscope, and not to the color of the fungus on the fruit as seen by the unaided eye. "Nearly round thick knobs" is his most definite morphological description. When he says, "There are chains in this new kind and they are not collected into crowded heads, etc." he seems to be referring again to the appearance of the fungus under the microscope. His description of his group Monilia is not very enlightening.

Monilia. Erecta, filis moniliformibus capitulum constituentibus.

His description of Torula is just as vague.

Torula. Acaulis, fila moniliformia intricata, indeterminata effusa.

Persoon changed the name of this fungus from Torula to Monilia and Monilia it remained for 100 years, or until the Monilia form was found to be an imperfect stage of a Sclerotinia.

Female (young): grayish white, mostly round, egg-shaped

united to others.

Male: in various forms of the domestic form when feeding, each

in various especially frequent in feeding posture, producing nearly

round thick knobs.

Observation: There are chains in this new kind and they are not

collected into rounded heads in like manner to the female, and are

like finger-like forms instead of a knob, as before placed in the

female form, and they are arranged: the articulation appears to

and the smooth and very elastic, which are not observed in female.

The color form female seems to refer to the color of the

apertures under the microscope, and not to the color of the fungus on

the fruit as seen by the unaided eye. "Nearly round thick knobs" is

his more definite morphological description. When he says, "There

are chains in this new kind and they are not collected into rounded

heads, etc." he seems to be referring again to the appearance of the

knobs under the microscope. His description of his group female

is not very satisfactory.

Female, erect, little magnification and some characteristics.

His description of female is just as vague.

Female, erect, little magnification and some characteristics.

Female changed the name of this fungus from female to female

and female is retained for 100 years, or until the female form was

found to be an imperfect stage of a female.

Ehrenberg (2) in 1818 gives the following:

Moniliae

Oideum Lk.

laxum mihi 4) inpruno armeniaco putrido

4) OIDEUM laxum: floccis erectis divergentibus pallido cinereis; articulis rarius confluentibus pellucidis magnis. Habitu et colore ab O. fructigena Schmidt valde differt, cujus specimina, in herbario nostro servata, ab ipso amico Dr. Schmidt examinata sunt. Noster fungus Sporotrichum fere refert

Ehrenberg's description may be translated:

Moniliae

Oideum Lk.

laxum mine 4, in decaying apricots

4) OIDEUM laxum: tufts erect diverging pale ashen; spores large, pellucid, rarely holding together. Habit and color which differs exceedingly from O. fructigena Schmidt, whose specimens, which have been preserved in our herbarium, have been examined by Dr. Schmidt himself. Our fungus is closely related to Sporotrichum.

The first part of this description seems to be the only part of much value. Ehrenberg seems to describe a fungus different from the one Persoon describes, the difference apparently lying in the morphological appearance of the conidial pustules.

According to Aderhold and Ruhland (3) the name Oideum laxum was changed to Oospora laxa by Wallroth in 1833, and was later determined by Saccardo and Voglina as Monilia.

Thereby (2) in 1918 gives the following

Results

Results

Results (3) 1918-1919 (1918-1919) 1918-1919

(4) 1918-1919 1918-1919 1918-1919 1918-1919

Results (5) 1918-1919 1918-1919 1918-1919 1918-1919

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Results (23) 1918-1919 1918-1919 1918-1919 1918-1919

Results (24) 1918-1919 1918-1919 1918-1919 1918-1919

Bonorden (4) in 1851 claims to have found another fruit rot fungus which he calls Monilia cinerea and describes it as follows:

Monilia cinerea N; Kommt auf faulenden Früchten vor und hat graue Hyphen und unregelmässig - elliptische Sporen. Bildet kleine graue, etwas bräunliche Büschel oder Häufchen deren Mycelium in den Früchten (Kirschen) sehr leicht beobachtet werden kann, wenn man seine perpendikuläre Schnitte davon unter das Mikroskop bringt. Das Mycelium besteht aus artikulierten Fäden, welche sich ästig in den Zellen der Frucht verbreiten und mit spitzen, nicht septierten, im Inneren Körnigen, frei in die Zellen hineinragenden Faden endigen.

The above may be translated as follows:

Monilia cinerea Mine; habitat on decaying fruits. Hyphae gray; spores irregularly elliptical; sporodochia small, gray, somewhat brownish; mycelium from which sporodochia are produced is readily seen in vertical sections of the fruit (cherries). Mycelium of septate filaments which spread, branching in the cells of the fruit, and end in free filaments containing granular contents within the cells.

Saccardo (5) in 1886 mentions the three species of Monilia, fructigena, laxa and cinerea and besides these gives two varieties of M. fructigena, var. syconophila and var. candida.

Monilia fructigena Pers. Oidium fructigenum Link, Torula fructigena Pers. caespitulis compactiusculis, pulvinatis, saepe circinantibus confluentibusque, tomentosis, albidis dein carneo-ochraceis, hyphis fasciculatis breve ramosis; conidiis longe ramoso-catenulatis, ovoides v. oblongis 25 10-2 e hyalino carneolis.

Section (4) in 1951 refers to some local weather trials

language which is called local weather and describes it as follows:

Local weather is known as local weather and is known

to be a very important - especially in the local weather

which is known as local weather and is known as local weather

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For above may be translated as follows:

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Section (5) in 1951 mentions the local weather of the

local weather and is known as local weather and is known as local weather

which is known as local weather and is known as local weather

Local weather is known as local weather and is known as local weather

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which is known as local weather and is known as local weather

Section (6) in 1951 mentions the local weather of the

Hab. in fructibus Piri, Mali, Persicae. Armeniacae in Germania, Gallia, Italia, Britannia, Belgio, Austria, America bor.

Var. syconophila. Cfs. Rabenh. Flora 1850 p. 632

conidiis acutionibus; caespitulis subaurantiacis. In fructibus Fici sicciae Casamicciola Ital. austri.

Var. candida Walk (sub Oospora): caespitulis candidis. Ad poma sub dio putrescentia in Thuringia. An haec var. mera typi forma junior? Sporotrichum fructigenum Link. videtur quoque status infans.

Monilia cinerea Bon. caespitulis minutis, cinereis compactiusculis; hyphis cinereis ramulosis septatis; conidiis irregulare ellipsoideis v. saepius limoniiformibus, 15-17- 10-12, e concreto hyalinis, longe concatenatis.

Hab. in fructibus putrescentibus Pruni Cerasi in Germania et Italia.

Monilia laxa Walk Sacc. et Vogl., Oospora laxa Walk., Oidium laxum Ehrenb., Acrosporium laxum Pers., conidiis catenatis, erectiusculis, divergenti-ramosis, dense aggregatis, griseis in articulos (conidia) singulos, ovaes secedentibus.

Hab. in fructibus putridis Pruni Armeniacae in Germania (Ehrenberg)

"An diversa a M. cinerea Bon?"

The foregoing descriptions by Saccardo may be translated thus:

Monilia fructigena Pers. Oidium fructigenum Link, Torula fructigena Pers. spore masses more or less compact, cushion-shaped, often rounding and confluent, hairy, whitish then flesh color with ochre yellow, hyphae bunched, with short branches; conidia in long branching chains, egg-shaped or oblong 25 x 10 -12 microns, from transparent to flesh color (carneolis).

Habitat. in the fruit of pears, apples, peaches and apricots in

Germany, France, Italy, England, Belgium, Austria and North America.

Var. syconophila. Cfr. Rabenh. Flora 1850 p. 632:

with rather pointed conidia; spore masses shading into orange.

On the dried fruits of the fig in Casamicciola, southern Italy.

Var. candida Walk (sub *Oospora*): spore masses white. In fruit (apple) rotting in the open in Thuringia. "Is this variety an early form of the genus? - one will recall that Sporotrichum fructigenum Link seems also an undeveloped form."

Monilia cinerea Bon. minute tufts, ashy (colored) more or less compacted; hyphae ashy (colored), branching, septate; conidia irregularly ellipsoidal or more frequently lemon-shaped, 15-17 x 10-12 microns, from ashy to transparent, in long connected chains.

Hab. in rotting cherry fruits in Germany and Italy.

Monilia laxa (Walk) Sacc. et Vogl., Oospora laxa Walk. Oidium laxum Ehrenb. Acrosporium laxum Pers. with conidia in chains, more or less erect, branching divergently, thickly clustered, ashy (colored) separating into single oval spores.

Hab. in rotten fruit of the apricot in Germany (Ehrenberg) "Is this *Monilia* different from *M. cinerea*?"

In general Saccardo's descriptions, with their names, agree with the descriptions of the three forms already given.

Woronin (6) in 1900 definitely establishes two species of *Sclerotinia*, which he calls *Sclerotinia fructigena* and *Sclerotinia cinerea*. At that time none of the apothecia of any of the fruit rot *Monilias* had been found and described, but Woronin was so sure that the forms he was

Germany, France, Italy, England, Ireland, Scotland and North America.

For information, Mr. Johnson, 1110 E. 1st St.

1110 E. 1st St. is a building which is being built into a house.

On the first floor of the building, there is a large hall.

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working with were really the imperfect stages of a Sclerotinia that he called the two forms Sclerotinia fructigena and Sclerotinia cinerea instead of Monilia fructigena and Monilia cinerea.

He gives for the average size of the conidia of Sclerotinia fructigena taken from the surface of naturally infected pears and apples, which have fallen to the ground, as 20.9 x 12.1 microns. The maximum measurements for conidia produced in the open he gives as 24.5 x 13.2 microns. In cultures on different favorable media the size of the conidia increases still more, reaching 20.7 - 30.8 x 14.9 - 16.5 microns.

Spores of Sclerotinia cinerea taken from leafy shoots of cherry and peduncles of cherry blossoms and from the surfaces of different stone fruits average 12.1 x 8.8 microns. He says however, that the size is not constant. The largest spores of Sclerotinia cinerea collected by him in the open measure 13.2 x 9.9 microns. Spores in cultures on different favorable media are larger, and measure usually 17.5 x 11.2 microns. Single spores he adds in the favorable culture media may reach even 24.2 x 13.2 microns.

Woronin found the most striking difference between these two forms to lie in the general form and color of the conidial pustules. Sclerotinia fructigena produced the compact knob-like yellowish pustules, while Sclerotinia cinerea produced the grayish more powdery pustules. See Plate 28 for copies of the color blocks appearing with Woronin's work.

Aderhold and Ruhland (3) in 1905 claim the distinction of rediscovering the species laxa. In their work they compare the apothecial stage of the species they call laxa with the apothecial stage

of S. fructigena, and compare the conidial stage of their species with the conidial stage they call cinerea. The species they call laxa is quite distinct from S. fructigena, but in the final analysis about the only distinction between their S. cinerea and S. laxa is the fact that S. laxa occurs naturally on apricots, and S. cinerea on other stone fruits, especially cherries, although S. laxa is supposed to have somewhat larger conidia than their S. cinerea.

They also decide that the form attacking peaches and plums in North America is S. cinerea and not S. fructigena, as Norton calls it, for the following reasons:

1. Preserved asci and ascospores they obtained from Norton are somewhat smaller than the asci and ascospores of their above Sclerotinia laxa.

2. Because Smith, E.F. describes conidia occurring on the peach in the Eastern United States as ashen-gray.

The first reason they think bars Norton's species from laxa, the second reason from fructigena.

Following are the principal distinguishing characteristics of Sclerotinia fructigena as given by Aderhold and Ruhland (3):

... (7) 1910 gives only one name, and that Sclerotinia fructigena ...
 ... the form that attacks apples, cherries, plums and peaches ...
 ... he says that the fungus fruits are grayish-white or whitish. He describes ...
 ... the conidial stage as follows: ...
 ... "asexual fruiting of single or branched chains of oval or round ...
 ... shaped hyaline spores. 11-22 x 10-12 microns.

The sizes of the spores here given correspond more nearly to the

of E. tricolor, and compare the middle stage of E. tricolor with the middle stage they call cinerea. The species they call lata is quite distinct from E. tricolor, but in the final analysis about the only distinction between their E. cinerea and E. lata is the fact that E. lata occurs naturally on apocynaceae, and E. cinerea on other plants, especially chrysomelids, although E. lata is supposed to have somewhat larger numbers than their E. cinerea.

They also decide that the form tricolor is present and place in North America is E. cinerea and not E. tricolor, as Norton calls it, for the following reasons:

1. Preserved such and such specimens they obtained from Norton are somewhat smaller than the ones and specimens of their above Belostomatidae lata.

2. Because Smith, E. F. described cinerea occurring in the north in the Western United States as cinerea. The first reason they think that Norton's species from lata, the second reason from tricolor.

Following are the principal distinguishing characteristics of Belostomatidae tricolor as given by Ashmead and Haldane (3):

Table I. Showing principal distinguishing characteristics of Sclerotinia fructigena, Sclerotinia laxa, and Sclerotinia cinerea as given by Aderhold and Ruhland.

Species	Ascospores (microns)	Conidial tufts	Asci (microns)	Habitat
<u>S. fructigena</u>	11-12.5 x 5.6 -6.8 pointed, without oil drops	yellow, larger	120-180 x 9x12	pomes
<u>S. laxa</u>	11.5-13.5 x 5.2-6.9 blunt, often with small oil drops	gray smaller	121.5-149.9x8.5- 11.8	apricot
<u>S. cinerea</u>	6.2 -9.3 x 3.1 - 4.6 blunt	gray smaller	8.9-107.6 x 5.9- 6.8	stone fruits

The foregoing measurements for Sclerotinia cinerea were made from apothecia on a peach mummy sent to Aderhold and Ruhland by Norton, the measurements for Sclerotinia fructigena and Sclerotinia laxa were made from material obtained in their own country.

Massee (7) 1910 gives only one name, and that Sclerotinia fructigena, to the form that attacks apples, cherries, plums and peaches in England. He says that the fungus fruits are grayish-white or whitish. He describes the Monilia stage as follows:

"tufts consisting of simple or branched chains of ovoid or lemon-shaped hyaline spores, 21-25 x 10-12 microns."

The sizes of the spores here given correspond more nearly to the

Table 1. Comparative measurements of *Polystichum* species
of *Polystichum* (L.) Presl, *Polystichum* (L.) Presl, and *Polystichum*
measured by given by *Polystichum* and *Polystichum*

Species	Measurements (mm)	Color	Length
<i>Polystichum</i>	11-12.5 x 5.5-6.5	Yellowish green, with brownish spots	120-130 x 12
<i>Polystichum</i>	11-12.5 x 5.5-6.5	Yellowish green, with brownish spots	120-130 x 12
<i>Polystichum</i>	11-12.5 x 5.5-6.5	Yellowish green, with brownish spots	120-130 x 12
<i>Polystichum</i>	11-12.5 x 5.5-6.5	Yellowish green, with brownish spots	120-130 x 12
<i>Polystichum</i>	11-12.5 x 5.5-6.5	Yellowish green, with brownish spots	120-130 x 12
<i>Polystichum</i>	11-12.5 x 5.5-6.5	Yellowish green, with brownish spots	120-130 x 12
<i>Polystichum</i>	11-12.5 x 5.5-6.5	Yellowish green, with brownish spots	120-130 x 12
<i>Polystichum</i>	11-12.5 x 5.5-6.5	Yellowish green, with brownish spots	120-130 x 12
<i>Polystichum</i>	11-12.5 x 5.5-6.5	Yellowish green, with brownish spots	120-130 x 12
<i>Polystichum</i>	11-12.5 x 5.5-6.5	Yellowish green, with brownish spots	120-130 x 12

The foregoing measurements for *Polystichum* species were taken from the plants on a patchy swampy forest in the vicinity of the station, the measurements for *Polystichum* (L.) Presl, and *Polystichum* (L.) Presl were taken from the plants obtained in their own country.

Source (1) lists only one name, and that *Polystichum* (L.) Presl, to the form that attacks the plant, and the measurements are given. He says that the larger plants are grayish-green or white. He describes the plants as follows:

"Plants consisting of single or branched stems of 10-15 cm. The stems of the species have a brownish color, more or less as the

sizes given by Saccardo for fructigena than for cinerea, but the color of the spores corresponds more nearly to cinerea than fructigena.

Wormald (8) 1917 in studying the classification of Monilias distinguishes four types of Monilia as found on cultivated fruit trees of the genera Pyrus and Prunus. He used prune juice agar plate cultures, and cultures on steamed potato in Roux' tubes as a basis for his classification, which is given below.

Prune juice agar
plate cultures

Cultures on steamed
potato in Roux tubes

(1) Monilia

fructigena
occurring com-
monly on apples
and plums and
frequently on
sweet cherries

Margin almost entire or
lacinate; no known color-
ation; conidia absent

Conidial tufts yellow,
well-developed at upper
end of potato, forming
raised zones

(2) Blossom wilt

Monilia of the
apple, also
occurring occasion-
ally on plums

Margin with deltoid or
flabelli form lobes, growth
usually arrested about mid-
way between center and side
of plate, and new outgrowths
as flabelli-form lobes develop
usually from the sinuses; olive
green to brown zones appear,
the first usually at 0.5 to 1 cm.
from the center; conidia absent

(3) A grey

Monilia
frequent on
plums and
sweet cherries

As above but no brown zones
appear

conidial tufts grey
more numerous than in (2)
often appearing in
concentric circles
around point of inocu-
lation.

(4). American
form of Monilia.

Margin entire or crenate;
conidial tufts numerous,
usually in concentric
circles; brown color-
ation of the agar absent
or appears as a peripheral
band near the edge of the
plate; growth generally
more rapid than in (2)
or (3) and more uniform

Conidial tufts grey,
almost covering the whole
surface in a continuous
layer.

Sclerotina fructigena is the only form to which he gives a specific name. In his summary however he says in part:

"The causal organism is a grey Monilia easily distinguished from M. fructigena; at present it is to be referred to Monilia cinerea Bon.

On culture media the habit of the fungus is different from that of the grey Monilia (also referred to M. cinerea by American workers) which is commonly found in North America."

b. In the United States

Smith (9) in 1889 states that Monilia fructigena causes a destructive rot of peach fruit and blight of young peach branches in the orchards of Delaware and Maryland. He says,

"In the fungus the common mode of propagation from peach to peach, and the only known one, is by means of ash-gray conidia, which are produced in great numbers on the brown surface of the affected parts. These spores generally occur in little hemispherical tufts or confluent masses on bundles of hyphal threads which have burst through the skin of the peach."

Smith says that he first discovered the blight in the summer of 1887 in Delaware. He also says that this fungus occurs destructively on peaches, apricots, plums and cherries, and to some extent also on apples, pears, and quinces.

Cordley (10) in 1899 gives the name Monilia fructigena to the form occurring on prunes, cherries, peaches, apples, pears and quinces in Oregon. As to color he says:

"In passing through almost any of our prune orchards when the green fruit is being picked, or even earlier, one may see here and there a

distinction is the only one which is given a

name. In the ordinary course of life it is

the usual expression is a very definite and

from the fact that it is to be referred to as a

but

to which the name of the person is given from that

of the fact that it is referred to as a person (name)

which is commonly found in the world

in the United States

and (2) in 1902 the name of the person is given a distinctive

not of which is not given a name which is the basis of

between the two names

in the United States the name of the person is given a distinctive

the only name which is given a name which is the basis of

to be given a name which is the basis of

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prune that is partly or wholly covered with this ash-grey or blue-gray 'mold' On cherries and peaches As the disease spreads the surface of the diseased tissues becomes covered with the characteristic ash-grey conidial tufts. In apples, pears, and quinces the disease spreads in much the same way but more slowly, and usually with a less abundant spore formation."

He says that the name of this fungus was determined in 1895 by means of prune specimens.

Norton (11) in 1902 changes the name of the form found in Maryland peach and plum orchards from Monilia fructigena to Sclerotinia fructigena, after definitely connecting the Monilia stage with a perfect stage. Norton says that the asci and paraphyses are of the usual form of the Pezizaceae and of the genus, and that the asci are 45-60 microns long and 3-4 microns wide with 8 spores in the apical half. He also says that cultures obtained from the ascospores produced the characteristic yellowish gray conidia of Monilia fructigena.

The question of the identification of species has interested several workers in this country, they no doubt being stimulated by the work of Worozin, Aderhold and Ruhland and other European workers. But our workers seem to have given little consideration to the possible Sclerotinia laxa, or, disregarding the specific names, to the fact that there may be more than two specific, economic fruit rot Sclerotinias. It will be remembered that Norton called the form he studied fructigena.

Read (12) in 1908 calls the form he has collected on various hosts fructigena. The measurements of the asci he gives as 125-215 x 7-10 microns.

... that is partly or wholly covered with blue-grey or blue-grey
'mould' ... on character and growth ... as the fungus spreads
the surface of the blighted tissues becomes covered with the characteristic
blue-grey mouldy matter. In apple, pear, and nutmeg the disease
appears in much the same way but more slowly, and usually with a less
obvious sporulation.

It says that the name of this fungus was determined in 1883 by means
of spore specimens.

Newton (11) In 1883 changed the name of the form found in Maryland
from *Aspergillus* to *Aspergillus* ...
after definitely comparing the conidia with a perfect mould.
Newton says that the soil and atmosphere are of the same form of the
fungus and of the fungus, and that the soil are 25-30 microns long
and 4-5 microns with 3 spores in the radial half. He also says that
cultures obtained from the atmosphere produced the characteristic yellowish
grey mould of *Aspergillus* ...

The question of the identification of species has interested several
workers in the country, they are being tested against the most of
various, including the *Aspergillus* and other *Aspergillus* species. But the workers
seem to have given little consideration to the possible identification of
or, attributing the specific names to the fact that there was no more
than one species, according to the *Aspergillus*. It will be remembered
that Newton called the form he studied *Aspergillus*.

Newton (12) In 1883 called the form he had collected as various *Aspergillus*
... The measurements of the spore he gives as 18-22 x 7-10 microns.

The spores he says are ellipsoid, ends round or less pointed, hyaline, often containing refractive granules, and measure 10-15 x 5-8 microns. The measurements of chlamydospores, conidia, he gives as 10-28 x 7-17 microns, mostly 7 x 11 microns. He gives the color of the pustules as at first cinereous, later on cherries and plums becoming ochraceous-buff to Isabella color (R), on peaches even drab to Isabella color (R), on pears and apples acquiring a blackish tinge. He says also they are lemon-shaped, continuous, hyaline, inarticulate di - or trichotomously branched chains without disjunctors.

Reade's description seems to fit better into Aderhold and Ruhland's description of S. laxa than their description of S. fructigena. S. fructigena is supposed to have ascospores pointed at both ends, which do not contain granules or oil drop.

Mathney (13) in 1913 decides that the American brown-rot fungus is Sclerotinia cinerea and not Sclerotinia fructigena. He knows of Aderhold and Ruhland's work dealing with the three species, fructigena, laxa and cinerea but he evidently does not consider laxa very seriously.

Mathney's general averages of ascospore measurements taken from Connecticut, Massachusetts, Maryland, New York, Indiana, and Wisconsin follow:

Host	Asci Microns	Ascospores Microns
Peach	135-190 x 6.9-10.5 mostly 163 x 8.9	10.5 -14.5 x 5.2-7.5 mostly 12.5 x 6
Plum	135-173 x 6.8-10.8 mostly 151x9.4	9.3-14.2 x 5-7.4 mostly 11.8 x 6.3

The average measurements for the American brown-rot conidia he gives as 14.7 x 9.9 microns. Conidia from California, Indiana, and New Hampshire and local conidia were used in getting these measurements. These measurements

The species he says are abundant, and found in large colonies, hyaline, often containing reticulate granules, and measure 10-15 x 3-5 microns. The measurements of *Chlamydomonas*, conidia, he gives as 10-25 x 7-17 microns, mostly 7 x 11 microns. He gives the color of the plasmas as at

first clear, later on granules and giving becoming conspicuous until in *Isabella* color (B), on reaching even dark to testaceous color (B), on passing and giving a bluish tinge. He says also they are in colonies continuous, hyaline, fusiform, 11- or 12-celled, branched chains without diaphragms.

Recent descriptions seem to fit better into *Isabella* and *Isabella*'s

description of *B. laxa* than their description of *B. fruticulosa*. B.

fruticulosa is supposed to have numerous pointed at both ends, which do not

contain granules at all.

Wahlgren (18) in 1912 decides that the American brown-red fungus is

Beloniella cinerea and not *Beloniella fruticulosa*. He shows that *Isabella*

and *Isabella*'s work do fit with the true species, *Beloniella laxa* and

cinerea but no evidently have not been very carefully.

Wahlgren's general averages of average measurements taken from

Connecticut, Massachusetts, Maryland, New York, Indiana, and Wisconsin

follow:

Length	Breadth	Depth
150-180 x 6-9-10.5	10.5-14.5 x 3-5-7.5	10.5-14.5 x 3-5-7.5
mostly 155 x 8.5	mostly 12.5 x 5	mostly 12.5 x 5
155-180 x 6-8-10.5	9.5-12.5 x 3-5-7.5	9.5-12.5 x 3-5-7.5
mostly 155 x 8	mostly 11.5 x 5.5	mostly 11.5 x 5.5

The average measurements for the American brown-red conidia he gives

as 14.5 x 5.5 microns. Conidia from California, Indiana, and New Hampshire

and local conidia were used in giving these measurements. These measurements

might find a place either under Scleritinia cinerea or Sclerotinia laxa as given by Aderhold and Ruhland.

Mathney gives the color of the conidia of Sclerotinia fructigena as yellowish; of Sclerotinia cinerea as ash-gray.

c. In California

In California the brown rot fungus is called Sclerotinia fructigena. A strain, which is apparently typical of the California form is discussed more in detail under Experimental.

d. General Summary

I. There are three early virginal descriptions of fungi, all of which have finally been put into the genus Sclerotinia, which attack the common domesticated fruits. Vague though these descriptions be, Persoon, describing Torula fructigena in 1796, Ehrenberg describing Oideum laxum in 1818, and Bonorden describing Monilia cinerea in 1851 all seem to be describing different fungi.

II. That there are more than three forms of Sclerotinia, or Monilia as he calls them, that attack the common domesticated fruits is demonstrated by Wermald. He distinguishes four kinds. The only form he calls definitely by name is Sclerotinia fructigena.

III. There is great need for exact systematic work with standardized methods in order to determine the number of species of fruit rot Sclerotinias.

III. Experimental

a. Introductory - Obtaining of the various strains used in culture and inoculation work.

might find a place either under Salicaria or Salicaria...

as given by Strehlitz and Strehlitz...

Further after the order of the Salicaria...

as Salicaria of Salicaria...

in Salicaria...

in Salicaria was given by Strehlitz...

a Salicaria, which is Salicaria...

There is Salicaria...

a Salicaria...

There are Salicaria...

which may finally be found in Salicaria...

common Salicaria...

There is Salicaria...

in this, the Salicaria...

There is Salicaria...

There are Salicaria...

as we can see, that Salicaria...

is Salicaria...

There is Salicaria...

There is Salicaria...

There is Salicaria...

There is Salicaria...

There is Salicaria...

There is Salicaria...

As apothecia¹ have never been reported in California and as they are often difficult to get in other places, the cultural work has been confined to the *Monilia* stage.

1. I searched in the spring of 1917 during the blossoming period of the apricot trees for apothecia of our fruit rot, *Sclerotinia*, and for apothecia of *Sclerotinia libertiana*. I brought to the laboratory from one orchard several of what I supposed to be *Sclerotinia libertiana* apothecia. These were all taken from the soil and none had any evident connection with a "mummy". Miss Smith (assistant professor of Plant Pathology at the University of California) placed these apothecia in a moist chamber with the adhering soil and considerable water. In a short time three apothecia showed to be slightly different from the typical *Sclerotinia libertiana* apothecia. They were somewhat darker and redder, a little coarser and tougher and more cup-shaped. Miss Smith used two of these apothecia to make rough cultures, first rinsing off the apothecium with distilled water and then planting a piece of it in a flask of bread and prune juice. From four flasks three apparently pure cultures of *Monilia* were obtained. Examination of the asci and ascospores of the other apothecium revealed a great ~~great~~ similarity to *Sclerotinia libertiana* asci and ascospores. The spores were somewhat larger than the spores of *Sclerotinia libertiana* and were inclined to be egg shaped, and possessed a ready ability to form a cross wall, and produce sterigmata and gonidia without first producing mycelium. Gonidia were sometimes produced directly by an ascospore without the interposition of a typical sterigma. The spores of *Sclerotinia libertiana* do not act this way, as far as I know. The above facts are extremely suggestive.

Other persons have searched for the apothecia of our fruit rot, *Sclerotinia*, but have not found them to their knowledge, apparently three of those mentioned above were apothecia of our fruit rot *Sclerotinia*. There seems to be some chance of confusing them with the often abundant apothecia of *Sclerotinia libertiana*.

In all I possessed sixteen strains of Sclerotinias. The word "strain" is here used for want of a better word.

In no case am I responsible for any of the following specific names. The cultures were so labeled before they were sent to me. Where a strain is not given a specific name, no name came with the culture. In the case of strains 1, 7 and 8, the California strains, the specific names are not known.

Sclerotinia sp. designated as strain 1 was obtained in the following manner:

A ripe but undried French prune was inoculated without sterilizing with spores and probably mycelium from the surface of a naturally infected apricot. The spores which formed on the French prune were used to make three poured plates of standard nutrient agar. From one of these plates a pure single spore culture was obtained by constant watching under the microscope and transferring to fresh culture medium. This is the strain the name of which I desire to determine.

Westerdijk's Sclerotinia cinerea designated as strain 2 was obtained either from cherry or plum in Holland and forwarded to me by Dr. Johanna Westerdijk. In her letter accompanying this culture she says that this form was obtained from cherry, but the label on the culture says it was obtained from plum.

Westerdijk's Sclerotinia fructigena designated as strain 3 was obtained from apple in Holland and forwarded by Dr. Westerdijk along with strain 2.

 

station is not used for any of the other work.

In no case is it responsible for any of the following

work. The station was as located before the work was done.

A station is not given a specific name, but is given the name of the

the case in station 1, 2 and 3, the California station, the station name

 

English Sclerotinia fructigena designated as strain 4 was obtained at the Oregon Agricultural Experiment Station from a pear fruit sent to them by Dr. Salmon from Kent in England, and forwarded from Oregon here.

Oregon Sclerotinia cinerea designated as strain 5 was isolated at Corvallis, Oregon from an apple fruit.

Michigan Sclerotinia cinerea designated as strain 6 was obtained from an apothecium on a peach "mummy" Hart, Michigan. It was received through the Wisconsin Agricultural Experiment Station.

Apricot twig Sclerotinia designated as strain 7 was obtained in California during May from a small twig that had evidently been killed back during the previous blossoming period of the tree. It was not a single spore strain.

Apricot leaf Sclerotinia designated as strain 8 was obtained from a dead leaf at the time strain 7 was obtained. It was not a single spore strain.

Westerdijk's apricot Sclerotinia designated as strain 9 was isolated from conidia on apricot obtained in Germany, and sent here by Dr. Westerdijk.

Westerdijk's plum Sclerotinia designated as strain 10 was isolated from conidia on plum obtained in Holland and sent here by Dr. Westerdijk.

Westerdijk's cherry Sclerotinia designated as strain 11 was isolated and sent here by Dr. Westerdijk.

Westerdijk's apple Sclerotinia designated as strain 12 was isolated from conidia on apple obtained in Holland and sent him by Dr. Westerdijk.

Isolation of the virus from the infected tissue

was obtained at the Oregon Agricultural Experiment Station from a pair

kept at home by Dr. Salmon from 1914 to 1915, and forwarded

from Oregon State.

Isolation of the virus from the infected tissue

Isolation of the virus from the infected tissue was made at

the Oregon Agricultural Experiment Station by Dr. Salmon

from the infected tissue on a small amount of tissue. It was received

from the Oregon Agricultural Experiment Station.

Isolation of the virus from the infected tissue

Isolation of the virus from the infected tissue was made at

the Oregon Agricultural Experiment Station by Dr. Salmon

from the infected tissue on a small amount of tissue. It was received

from the Oregon Agricultural Experiment Station.

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Isolation of the virus from the infected tissue

Isolation of the virus from the infected tissue was made at

the Oregon Agricultural Experiment Station by Dr. Salmon

from the infected tissue on a small amount of tissue. It was received

from the Oregon Agricultural Experiment Station.

Isolation of the virus from the infected tissue

Strains 9, 10, 11, 12 were not given a specific name by Dr. Westerdijk.

Washington prune blossom Sclerotinia designated as strain 13 was isolated from prune blossoms obtained in Clarke County, Washington and forwarded here by Dr. F. D. Heald.

Washington prune Sclerotinia designated as strain 14 was isolated from prune mummies obtained in Clarke County, Washington and forwarded here by Dr. F. D. Heald.

Prunus demissa Sclerotinia designated as strain 15 was obtained from Washington through Dr. Heald, where it causes a common blight and rot of the fruit of Prunus demissa.

Amelanchier Sclerotinia designated as strain 16 is a Sclerotinia that is found on the Amelanchier in the Palouse Country, Washington. It was sent here by Dr. Heald.

The best plan for studying these different strains and for arriving at some solution of the problem, namely the identification of our species, seemed to be to grow the strains on fresh fruits, as well as on prepared media, and to observe the type and color of growth, size and shape of spores, and other noticeable features. In the first series of inoculations ripe apricots were used.

b. Apricot inoculations to obtain rate of growth, type of growth, color of conidia, and approximate sizes of conidia.

The first twelve strains were used to inoculate fresh ripe apricots. Attempts to sterilize the apricots before inoculating injured the fruit so much, that the apricots were finally inoculated just as they were

Strains 9, 10, 11, 12 were not given a specific name by Dr.

Wentworth.

Strain 13 was designated as strain 13.

was isolated from a group of strains obtained in Clark County, Washington.

and forwarded him by Dr. F. A. Hensley.

Strain 14 was designated as strain 14 and was isolated

from a group of strains obtained in Clark County, Washington and forwarded

him by Dr. F. A. Hensley.

Strain 15 was designated as strain 15 and was obtained

from Washington through Dr. Hensley, where it was a common illness and

not of the type of strain 15.

Strain 16 was designated as strain 16 and was isolated

from a group of strains in the Pacific Northwest, Washington.

It was sent him by Dr. Hensley.

The first plan for studying these strains and for

arriving at some solution of the problem, namely the identification

of our species, seemed to be to grow the strains on fresh media, as well as

on aged media, and to observe the type and color of growth, size

and shape of spores, and other microscopic features. In the first series

of observations the strains were used.

b. Further investigations to obtain data of growth, type of growth,

color of media, and microscopic features of media.

The first twelve strains were used to determine from the spores

attempts to establish the system before including in the list

so much, that the spores were finally included just as they were.

picked from the tree after being placed in covered glass dishes.

Two fruits were inoculated with each strain and two fruits were used as checks for each strain. All strains had been growing the same length of time on identical media at the time they were used for inoculating the apricots. The fruits were picked July 19, 1916 and were inoculated July 21, 1916. Table 2 gives rate of growth, type of growth, and color of conidia.

...the first of the ...
...the first of the ...

...the first of the ...

...the first of the ...

...the first of the ...

...the first of the ...

...the first of the ...

Table 2. Giving rate of growth, type of growth and color of conidia of the first twelve strains on ripe apricots

Strain	Rate of Growth 5 days old	Type of growth	Color	Remarks 5 days old
1	1st 1/3 brown 2nd brown 3 cm. diameter	Profuse spore production typical	A little lighter than Saccardo's ¹	Cks. normal Growth and color typical for strain
2	1st normal 2nd brown 1.5 cm. diam. to one side of pt.	Scant spore production Tendency of fruit to wrinkle as fungus ad- vances decided	Seems to be like a very few spores for deter- mining	Cks. normal
3	1st-3/4 brown 2nd brown 3 cm. diam.	Profuse spore production Similar to <u>1</u>	See <u>1</u>	Cks. normal
4	1st normal 2nd 1/3 brown	Profuse spore production Compact felty looking pus- tules	Cartridge buff (R) ²	cks. normal
5	Very much ad- vanced in decay Skins blackening progressively	Profuse low growing spores similar to <u>1</u>	See <u>1</u>	Cks. normal
6	Both 1/2 brown	See <u>1</u>	See <u>1</u>	Cks. normal
7	1st 1/2 brown 2nd brown 3 cm. diam.	Well developed Barely showing	Grayish olive (R)	Cks. normal
	1st normal 2nd 1/3 brown	In one week first growth overgrown with secondary whitish mycelium	do.?	Cks. normal

Table 1. Results of the first series of experiments on the effect of the concentration of the solution on the rate of growth of the mycelium.

Concentration of the solution	Rate of growth of the mycelium	Color of the mycelium	Character of the mycelium
0.1%	1.5 mm	White	Normal
0.2%	1.5 mm	White	Normal
0.3%	1.5 mm	White	Normal
0.4%	1.5 mm	White	Normal
0.5%	1.5 mm	White	Normal
0.6%	1.5 mm	White	Normal
0.7%	1.5 mm	White	Normal
0.8%	1.5 mm	White	Normal
0.9%	1.5 mm	White	Normal
1.0%	1.5 mm	White	Normal
1.1%	1.5 mm	White	Normal
1.2%	1.5 mm	White	Normal
1.3%	1.5 mm	White	Normal
1.4%	1.5 mm	White	Normal
1.5%	1.5 mm	White	Normal
1.6%	1.5 mm	White	Normal
1.7%	1.5 mm	White	Normal
1.8%	1.5 mm	White	Normal
1.9%	1.5 mm	White	Normal
2.0%	1.5 mm	White	Normal
2.1%	1.5 mm	White	Normal
2.2%	1.5 mm	White	Normal
2.3%	1.5 mm	White	Normal
2.4%	1.5 mm	White	Normal
2.5%	1.5 mm	White	Normal
2.6%	1.5 mm	White	Normal
2.7%	1.5 mm	White	Normal
2.8%	1.5 mm	White	Normal
2.9%	1.5 mm	White	Normal
3.0%	1.5 mm	White	Normal
3.1%	1.5 mm	White	Normal
3.2%	1.5 mm	White	Normal
3.3%	1.5 mm	White	Normal
3.4%	1.5 mm	White	Normal
3.5%	1.5 mm	White	Normal
3.6%	1.5 mm	White	Normal
3.7%	1.5 mm	White	Normal
3.8%	1.5 mm	White	Normal
3.9%	1.5 mm	White	Normal
4.0%	1.5 mm	White	Normal
4.1%	1.5 mm	White	Normal
4.2%	1.5 mm	White	Normal
4.3%	1.5 mm	White	Normal
4.4%	1.5 mm	White	Normal
4.5%	1.5 mm	White	Normal
4.6%	1.5 mm	White	Normal
4.7%	1.5 mm	White	Normal
4.8%	1.5 mm	White	Normal
4.9%	1.5 mm	White	Normal
5.0%	1.5 mm	White	Normal
5.1%	1.5 mm	White	Normal
5.2%	1.5 mm	White	Normal
5.3%	1.5 mm	White	Normal
5.4%	1.5 mm	White	Normal
5.5%	1.5 mm	White	Normal
5.6%	1.5 mm	White	Normal
5.7%	1.5 mm	White	Normal
5.8%	1.5 mm	White	Normal
5.9%	1.5 mm	White	Normal
6.0%	1.5 mm	White	Normal
6.1%	1.5 mm	White	Normal
6.2%	1.5 mm	White	Normal
6.3%	1.5 mm	White	Normal
6.4%	1.5 mm	White	Normal
6.5%	1.5 mm	White	Normal
6.6%	1.5 mm	White	Normal
6.7%	1.5 mm	White	Normal
6.8%	1.5 mm	White	Normal
6.9%	1.5 mm	White	Normal
7.0%	1.5 mm	White	Normal
7.1%	1.5 mm	White	Normal
7.2%	1.5 mm	White	Normal
7.3%	1.5 mm	White	Normal
7.4%	1.5 mm	White	Normal
7.5%	1.5 mm	White	Normal
7.6%	1.5 mm	White	Normal
7.7%	1.5 mm	White	Normal
7.8%	1.5 mm	White	Normal
7.9%	1.5 mm	White	Normal
8.0%	1.5 mm	White	Normal
8.1%	1.5 mm	White	Normal
8.2%	1.5 mm	White	Normal
8.3%	1.5 mm	White	Normal
8.4%	1.5 mm	White	Normal
8.5%	1.5 mm	White	Normal
8.6%	1.5 mm	White	Normal
8.7%	1.5 mm	White	Normal
8.8%	1.5 mm	White	Normal
8.9%	1.5 mm	White	Normal
9.0%	1.5 mm	White	Normal
9.1%	1.5 mm	White	Normal
9.2%	1.5 mm	White	Normal
9.3%	1.5 mm	White	Normal
9.4%	1.5 mm	White	Normal
9.5%	1.5 mm	White	Normal
9.6%	1.5 mm	White	Normal
9.7%	1.5 mm	White	Normal
9.8%	1.5 mm	White	Normal
9.9%	1.5 mm	White	Normal
10.0%	1.5 mm	White	Normal

Table 2, continued

Strain	Rate of growth 5 days old	Type of growth	Color	Remarks 5 days old
9	1st normal 2nd nearly 1/2 brown	Spores barely showing on brown fruit	Grayish olive (R)	1 ck. normal other contaminated in 3 days
10	1st normal 2nd brown 1 1/2-2 cm. diam.		See 1	Cks. normal
11	1st normal 2nd 1/3 brown	Similar to <u>1</u>	Grayish olive (R)	1 ck. normal other contaminated in 4 days.
12	1st normal 2nd 1/3 brown	Similar to <u>4</u>	Cartridge buff (R)	cks. normal

1. Saccardo, P.A. Chromotaxia seu Nomenclator Colorum 1894
2. Ridgeway, Robert Color standards and Nomenclature 1912

To obtain the color of the spore masses, a small mass of them was placed in the bottom of the dish, so that the spores could be placed over and near the color blocks to get the colors. Thus the light was partially transmitted, partially reflected.

All the strains were similar in that they readily induced a rotten condition of the apricot fruits. Some however did this much more rapidly than others. Strain 2, Westerdijk's Sclerotinia cinerea, progressed very slowly, in fact it was the slowest growing of all. Strain 5, Oregon Sclerotinia cinerea, became established first and grew most rapidly of all the strains. The other strains lay between these two extremes with a tendency to approach 5 rather than 2, 2 remaining distinctly in a class by itself as regarded the rate of growth.

In the matter of type of growth there seemed to be four different forms.

- (1) Profuse somewhat loose spore pustules. Strain 1 typical.
- (2) Profuse, compact, felty-looking spore pustules. Strain 4 typical.
- (3) Abundant surface mycelium with very few spores. Strain 8 the only strain with this characteristic.
- (4) Scant surface mycelium with very few spores. Strain 2 the only strain with this characteristic.

Nearly all the forms resembled the first above. The second had only two representatives, the third and fourth one representative each.

There seemed to be three different spore colors:

- (1) Cartridge buff (R)
- (2) Grayish olive (R)
- (3) Drab - a little lighter than Saccardo's drab.

To obtain the color of the spots present, a small mass of them was placed in the bottom of the dish, so that the spots could be placed over and under the color plates to get the colors. Thus the light was partially transmitted, partially reflected.

All the strains were similar in that they readily induced a rotten condition of the animal tissue. Some however did this more rapidly than others. Strain 2, Streptococcus faecalis strain 2, grew very slowly, in fact it was the slowest growing of all. Strain 1, Streptococcus faecalis strain 1, became established first and grew most rapidly of all the strains. The other strains lay between these two extremes with a tendency to approach 2 rather than 1, a tendency distinctly in a class by itself as compared to the rest of the group.

In the matter of type of growth there seemed to be four distinct

types:

- (1) Surface growth, loose, more powdery. Strain 1 typical.
- (2) Surface, compact, felt-like, more granular. Strain 4 typical.

- (3) Abundant surface growth with very few spores. Strain 5

The only strain with this characteristic.

- (4) Small surface colonies with very few spores. Strain 3 the

only strain with this characteristic.

Nearly all the forms resembled the first above. The second and only two representative forms, the third and fourth and representative each.

There seemed to be three distinct types of spores:

- (1) Large, half (-)
- (2) Small, half (-)
- (3) Small - a little larger than Strain 2's spores.

The two strains, 4 and 12, that had the profuse, compact, felty-looking spore pustules were the two that had the cartridge buff spores. The strain that had abundant surface mycelium with very few spores, strain 8, seemed to have grayish olive (R) spores, while the strain that had scant surface Mycelium with few spores, strain 2, seemed to have the drab-colored spores. All the other forms had either the drab-colored or grayish-olive spores.

If color must be considered as an important factor we would have five different types.

	Drab	Cartridge buff	grayish olive
Growth form 1			
Growth " 2			
Growth " 3			
Growth " 4			

Diagram 1, showing possible types if color must be considered an important factor. Combination shown where solid lines cross.

The colors of all these forms did not remain constant as will be brought out later.

In getting the dimensions of the conidia they were mounted in ethyl alcohol (about 50%). The oil immersion lens was used. The values of the spaces of the ocular micrometer were calculated by means of comparing with a corrected stage micrometer. The value of the smallest spaces of the ocular micrometer was 1.9 microns, and, in measuring the spores, only the lines and an imaginary line half way between the lines were considered. That is if a spore, in length, covered 9 spaces and a

The two strains, 1 and 2, that had the greatest amount of leafy-looking spots were the two that had the greatest amount of spots. The strain that had smallest amount of spots with very few spots, strain 3, seemed to have greater olive (2) amount, while the strain that had small amount of spots with few spots, strain 4, seemed to have the most-colored spots. All the other strains had either the most-colored or greater-olive spots.

It color must be considered as an important factor in determining

Five different types.

Strain	Color	Amount of spots
1	Green	100%
2	Green	100%
3	Green	100%
4	Green	100%
5	Green	100%

Strain 1, showing possible types of color that is considered as

important factor. Combination of color and olive spots.

The colors of all these types are the same, but the amount of spots will be

different and later.

In getting the dimensions of the colonies they were measured in mm

and the diameter of the colonies was measured in mm. The values

of the spots of the colonies were calculated by means of com-

paring with a standard area of spots. The value of the smallest

spots of the colonies measured was 1.5 mm. and, in measuring the

spots, the diameter and the length of the spots were measured. The

area of the spots was calculated. That is if a circle, in length, covered 2 spots and a

little over ~~over~~ but was nearer 9 than 9.5 spaces it was considered as 9 spaces, or 17.1 microns long. Unconscious selection was eliminated as far as possible by taking the spores as they came in crossing the field, but often masses of spores had to be skipped. 100 spores of each strain, as grown on the spricot fruits, were measured in this way. Plates 1-12 show graphical representations of the results.

The curves for spore width, with one notable and one minor exception, have a single peak. The curves for spore length all have more than one peak. That is there was more variation in the lengths of a set of spores than there was in the widths of the same set of spores.

A study of the curves revealed the following facts:

Strain 12, Westerdijk's apple Sclerotinia had the widest spores and the longest spores of all the strains. They were also longer in proportion to their width than in any other strain. Strain 4, English Sclerotinia fructigena had the next widest and longest spores, and the spores that stood next in their excess of length over width.

Aside from these general conclusions nothing more definite could be hazarded. Thus spore size differences, in this case at least, did not offer a very hopeful basis for differentiation. For this reason no more measurements were taken. Other workers have laid considerable stress on conidia dimensions.

The next series of cultures was grown on steamed rice.¹

-
1. 10 grams of rice and 50 cc of water placed in a flask and sterilized in the autoclave for 30 minutes at about 15 pounds pressure.

 

Table 3. Giving colors of conidia of the first twelve

c. Steamed rice cultures to obtain the color of the conidia of the first twelve strains.

Flasks of steamed rice were inoculated with the first twelve strains, the ones used in the apricot inoculations. These cultures, as before, had been grown on the same medium the same length of time before using for inoculating. The colors were obtained by viewing the less dense masses of conidia through the flasks. All these cultures were planted November 23, 1916. Table 3 gives the colors on rice and the date the colors were determined, together with the colors as found on the apricot fruits.

	See 1 on apricot	12/2/16
4	Cartridge buff (R) Cartridge buff (R)	12/1/16
5	Light grayish olive (R) See 1 on apricot	12/2/16
6	Do. See 1 on apricot	12/2/16
7	Do. Grayish olive (R)	12/2/16
8	Light mineral gray (R) Do.	12/2/16
9	Light grayish olive (R) Grayish olive (R)	12/2/16
10	Do. See 1 on apricot	12/2/16
11	Do. Grayish olive (R)	12/2/16
12	Cartridge buff (R) Cartridge buff (R)	12/2/16

5. Stained rice cultures to obtain the color of the contents of the

first twelve flasks.

Flasks of stained rice were inoculated with the first twelve

strains, the ones used in the spirit of inoculation. These cultures, as

before, had been grown on the same medium and were in the length of time before

being for inoculating. The colors were obtained by viewing the flasks

under masses of cobble through the flasks. All these cultures were

planted November 22, 1916. Table 2 gives the colors on rice and the

data the colors were determined, together with the colors as found

on the spirit of rice.

Table 3. Giving colors of conidia of the first twelve strains when grown on steamed rice as compared with the colors of the conidia on apricot fruits.

Strain	Color of Conidia on rice	Color of Conidia on apricot	Date Color on Rice
1	Light grayish olive (R)	A little lighter than Saccardo's drab	12/1/16
2	Do.	Seems to be like 1 on apricot	12/2/16
3	Do.	See <u>1</u> on apricot	12/2/16
4	Cartridge buff (R)	Cartridge buff (R)	12/1/16
5	Light grayish olive (R)	See 1 on apricot	12/2/16
6	Do.	See <u>1</u> on apricot	12/2/16
7	Do.	Grayish olive (R)	12/2/16
8	Light mineral gray (R)	Do?	12/2/16
9.	Light grayish olive (R)	Grayish olive (R)	12/2/16
10.	Do.	See <u>1</u> on apricot	12/2/16
11.	Do.	Grayish olive (R)	12/2/16
12	Cartridge buff (R)	Cartridge buff (R)	12/2/16

Table 2. Giving colors of animals of the first twelve strains when given an element plus an amount of the colors of the animals on which they are based.

Strain	Color of animals on which	Color of animals on element	Date
1	Light grayish blue (R)	A little lighter than element's group	12/2/18
2	Do.	Deemed to be like 1 on element	12/2/18
3	Do.	See 1 on element	12/2/18
4	Dark grayish blue (R)	Cartridge butt (R)	12/2/18
5	Light grayish blue (R)	See 1 on element	12/2/18
6	Do.	See 1 on element	12/2/18
7	Do.	Grayish blue (R)	12/2/18
8	Light blueish gray (R)	Do	12/2/18
9	Dark grayish blue (R)	Cartridge butt (R)	12/2/18
10	Do.	See 1 on element	12/2/18
11	Do.	Grayish blue (R)	12/2/18
12	Cartridge butt (R)	Cartridge butt (R)	12/2/18

On examining mounts from the culture of strain 8 no typical conidia could be found, only a mass of mycelium, irregular and spore-like at times.

Comparing Table 3 with Table 2, it was found that strains 4 and 12 were the only strains that had the same color of conidia when grown on rice that they had when grown on the apricot fruits. Three of the strains, 7, 9 and 11 were very nearly the same color on rice that they were on the apricot fruits, all of these being light grayish olive (R) on rice and grayish olive (R) on apricot.

These rice cultures apparently offered little as a basis for differentiating the strains.

The next set of cultures was made on ripe Royal Anne cherries, all sixteen strains being used this time.

d. Cherry inoculations to obtain color of conidia and general appearance of fungi on the fruits for all of the sixteen strains.

Ripe Royal Anne cherries were picked from one tree June 29, 1917. June 30th the cherries were inoculated. Five cherries were used for each strain. The cherries were placed on 5 x 7 inch glass plates in position for photographing, with their appropriate numbers. The three outside cherries of each lot were used for inoculating, the two inside cherries being saved for checks. Two strains were present on each plate. plates 13-20. Glass dishes were placed on the fruit, which was kept on top of a laboratory table where there was a strong north light. Some temperatures secured by means of a thermometer which lay on the table with the cultures were as follows:

On examining samples from the culture of strain 3 no typical
colonies could be found, only a mass of granular, irregular and spore-like
at times.

Comparing Table 3 with Table 2, it was found that strains 4 and 12
were the only strains that had the same color of colonies when grown on
rice that had been grown on the same soil. However, the strains
7, 8 and 11 were very nearly the same color on rice that they were on the
applied media, all of these being light grayish olive (R) on rice and
grayish olive (R) on nutrient.

These rice cultures apparently offered little or no basis for differen-
tiating the strains.

The next test of culture was made on rice straw and charcoal, all
sixteen strains being used this time.

2. Twenty inoculations to obtain color of colonies and general
appearance of fungi on the media for all of the sixteen strains.

Rice straw and charcoal were added from one rice straw 12, 1919.
Five strains were inoculated. Five strains were used for

each strain. The charcoal was placed on 5 x 7 inch glass plates in
position for photographing, at the left of the rice straw. The three

outside chambers of each jar were used for inoculating, the two inside
chambers being saved for control. Two strains were placed on each plate.

12-20. Glass dishes were placed on the table, which was kept on
top of a laboratory table where there was a strong north light. Some

specimens stored by means of a thermometer which lay on the table with
the cultures were as follows:

Date	Hour P.M.	Temp. °C
June 30	5:30	23.5
July 2	6:00	20.5
" 3	5:00	20.5
" 5	5:00	21.4
" 6	4:00	20.6
" 7	1:00	22.6
" 9	5:00	20.7
" 11	1:00	21.0

The photographs, taken July 7, 1917, show the results of inoculating the cherries with the different strains. Strains 2, 15 and 16 failed absolutely to develop. The other strains showed varying degrees of development. The colors were taken by approaching the fruits as closely as possible with the color chart without touching them. Masses of the pores were not removed to the glasses as was done when getting the color of the spores on the apricots. The fruit was inoculated on the 30th of June and the colors were obtained on the 14th of July or two weeks after inoculating. Following is the list of colors obtained.

Strain	Color
1	Drab (S)
2	No fungus developed
3	Very slightly grayer than drab (S), but so close to it that the difference would ordinarily be overlooked.
4	Drab (S)
5	
6	

Date	Hour, M.	Temp., °C
June 30	5:30	22.5
July 1	8:00	30.5
"	3:00	30.5
"	2:00	31.5
"	4:00	30.5
"	1:00	30.5
"	9:00	30.7
"	1:00	31.0

The photographs, taken July 1, 1917, show the results of incubating the embryos with the different alcohols. Embryos 2, 13 and 18 failed absolutely to develop. The other embryos showed varying degrees of development. The color was taken by spraying with fuchsine as closely as possible with the color of the embryo. The color of the green was not removed to the placenta as was done with the other color of the embryo on the embryo. The fruit was incubated on the 10th of June and the embryos were obtained on the 10th of July or two weeks later. Following is the list of colors obtained:

Embryo	Color
1	Greenish
2	No development
3	Very slightly greenish (10)
4	Very slightly greenish (10)
5	Very slightly greenish (10)
6	Very slightly greenish (10)
7	Very slightly greenish (10)
8	Very slightly greenish (10)
9	Very slightly greenish (10)
10	Very slightly greenish (10)
11	Very slightly greenish (10)
12	Very slightly greenish (10)
13	No development
14	Very slightly greenish (10)
15	Very slightly greenish (10)
16	Very slightly greenish (10)
17	Very slightly greenish (10)
18	No development

7	Drab (S)
8	Whitish mycelium but there seem to be no spores
9	Drab (S)
10	"
11	"
12	Cream (S)
13	Drab (S)
14	"
15	No fungus developed
16	"

Strain 1 showed itself in a typical manner on the cherry fruit.

Strain 2 failed to develop. Strain 3 was typical. But what happened to strain 4? Instead of appearing as formerly with the smooth, felty-looking, cartridge buff pustules, it appeared in a form so closely resembling strains 1 and 3 that the three strains could not be distinguished. Up to this time strains 4 and 12 were alike as far as external appearances were concerned. There was a slight indication of a difference between 4 and 12 when the different strains were grown on the apricot fruits the previous year. When grown on the apricot fruits the spores of 12 were the longest of any with no exception. See graphs, plates 1-12. The easiest way to explain the situation would be to say that the cultures were probably mixed. I will not agree to such an explanation. We must leave the problem without a solution remembering the following:

Strain 4 which originally had the smooth, felty-looking, cartridge buff pustules, and which was called Sclerotinia fructigena, at the Oregon

Agricultural Experiment Station, resembled strain 3, which strain typically has had, ever since I have possessed it, dusty-looking drab-colored pustules, and which was called by Dr. Westerdijk Sclerotinia fructigena and that this strain 3 so closely resembled strain 1, or the California fruit rot form, that they could not be distinguished. These three strains were similar to several others, namely 5, Oregon *Sclerotinia cinerea*, 6, Michigan *Sclerotinia cinerea*, 7, Apricot twig *Sclerotinia* (California), 9, Westerdijk's apricot *Sclerotinia*, 10, Westerdijk's plum *Sclerotinia*, 11, Westerdijk's cherry *Sclerotinia*, 13, Washington prune blossom *Sclerotinia*, and 14, Washington prune *Sclerotinia*.

Strain 5 as it appeared on the cherries was characteristic for this strain, that is it was similar to strain 1. Strains 6 and 7 acted in a typical manner. Strain 8 which habitually produced abundant mycelium acted in a characteristic manner. No spores could be detected on the fruit. Strains 9, 10 and 11 were all characteristic and similar to strain 1. Strain 12 appeared as formerly with compact, felty-looking cream colored pustules. Strains 13 and 14 showed to be similar to strain 1, while strains 15 and 16 failed to develop.

As far as macroscopic characteristics go there were three different types that developed on the cherries.

(1) Profuse somewhat loose spore pustules drab (S) in color. Strain 1 typical.

(2) Profuse, compact, felty-looking spore pustules cream (S) in color. Strain 12 the only strain.

(3) Abundant surface mycelium with apparently no spores.

Strain 8 the only strain.

Strain 2, which had always remained in a class by itself, failed to develop.

All the forms, that developed, with the exception of 8 and 12 resembled strain 1, or the California fruit rot strain.

In this lot of inoculations there were only two colors represented, drab(S) and cream(S). Strain 12 had the cream-colored pustules, and all the others had drab-colored pustules with the exception of 8 which apparently had no spores.

After the experimental work which has been described above had been completed it was decided that there were four possible forms among the cultures, 1, 2, 8 and 12 being the typical forms. Strain 8, the California strain obtained from an apricot leaf, was discarded at this stage of the work. Single spore strains of 2 and 12 were obtained in the conventional manner. Strain 1 was already a single spore strain. Because of the peculiar behavior of strain 4 a single spore culture of it was also obtained, and likewise a single spore strain of 3. These single spore strains were used to make planted plate cultures on Czapeck's agar.¹

1. Czapeck's agar

Distilled water.....	1000.00	cc
Magnesium sulfate.....	.50	grams
Dipotassium hydrogen phosphate.....	1.00	"
Potassium chloride.....	.50	"
Ferrous sulphate	.01	"
Sodium nitrate	2.00	"
Cane sugar	30.00	"
Agar agar.....	15.00	"

e. Czapeck's agar cultures to obtain general types of growth of strains 1, 2, 3, 5 and 12.

This formula was chosen because it was a complete nutrient medium, because it could be readily duplicated by other workers, and because due to its lack of color, and because of its transparent qualities it was considered a desirable medium to use in photographing the cultures.

Poured plates were made in the usual way and were inoculated with the five strains, 1, 2, 3, 4 and 12, August 16, 1917. The photographs of these five strains were taken August 28, 1918 or twelve days after the plates were inoculated. Plates 21-25. These are typical photographs of the different cultures.

Strain 1 produced spores abundantly. In obtaining the color of the pustules the petri dish was placed over the color chart, the lid of the dish having first been removed. The spore pustules of this strain were very close in color to pale olive-buff (R). The general outline and appearance of the culture may be seen from the photograph of this strain. Plate 21.

Strain 2 produced a compact, somewhat moist looking culture that was barely raised above the surface of the agar, and to the unaided eye there seemed to be no spores present. An examination of material from the culture under the microscope revealed some spore-like pieces of mycelium, but no typical spores. Plate 22.

Strain 3, called by Dr. Westerdijk Sclerotinia fructigena produced spores abundantly and was so similar to strain 1 that the two could not be distinguished. Plate 23.

The same was true of strain 4, which to begin with had the felty-looking, cartridge buff pustules. Plate 24.

General's most cultures in which general types of growth

of strains 1, 2, 3 and 12.

This formula was chosen because it was a complete nutrient medium,

because it could be readily duplicated by other workers, and because due

to the lack of color, and because of its simplicity of use it was

considered a desirable medium to use in photographing the colonies.

Plated plates were made in the usual way and were incubated with

the five strains, 1, 2, 3, 4 and 12, August 16, 1917. The photographs

of these five strains were taken August 23, 1918 or twelve days after

the plates were inoculated. (Figures 1-5). These are typical photographs

of the different colonies.

Strain 1 produced sparse growth. In obtaining the color of the

medium the part of the plate which was placed over the color white, the lid of the

dish being first been removed. The sparse growth of this strain was

very close in color to pale olive-buff (R). The concentration was

appearance of the colonies may be seen from the photograph of this strain.

Figure 1.

Strain 2 produced a compact, somewhat colorless colony that was

directly related above the surface of the agar, and to the visible eye

there seemed to be no sparse growth. An examination of material from

the culture under the microscope revealed some warty-like places on

surface, but no typical warty. (Figure 2).

Strain 3, called by Dr. Westerman *Chlorobacterium*

produced sparse growth and was similar to strain 1 but the two

could not be distinguished. (Figure 3).

The same was true of strain 4, which is again with the fatty-

looking, warty-like growth. (Figure 4).

Strain 12 remained distinct. On this agar it was the most rapid grower of any of the strains. Pustules were not produced, and a microscopic examination was necessary to find if there were any spores present. A few typical conidia were found. Plate 25.

These cultures were kept on the same table as the cherry cultures where some of the temperatures were:

Date	Hour P.M.	Temp. ° C.
August 16	3:30	18.5
" 17	3:30	18.5
" 18	1:00	18.4
" 20	4:30	20.5
" 21	3:00	18.5
" 22	4:30	19.5
" 23	1:30	18.5
" 24	12:30	20:0
" 25	4:30	21.7
" 27	4:00	21:3

To further test the individualities of these five selected strains it was decided to grow them all together on one medium. A Seek-no-further apple was chosen for this inoculation work.

f. Inoculations of the five strains, 1, 2, 3, 4 and 12 into one apple to further test their individuality.

For this experiment a nearly ripe Seek-no-further apple was carefully picked from the tree, placed in a moist chamber and inoculated

with the five strains used for the Czapeck's agar cultures, 1, 2, 3, 4 and 12. This was done on August 17, 1917. Five check punctures were made, one below each inoculation point, and these remained unchanged until overgrown by the fungus from above. The photograph was taken August 27th, 1917, or ten days after inoculation. Plate 26. In it the five letters, A, B, C, D, E represent the strains 1, 2, 3, 12 and 4 respectively.

A, C, E or strains 1, 3, 4 again could not be distinguished. They produced spores abundantly, especially A and E. The pustules were a little lighter than drab (S). B, or strain 2, grew so slowly that it was soon surrounded by A and C. Strain 2 produced a circular brown decayed spot, with a crack in the epidermis of the apple running through the point of inoculation. Microscopic examination revealed the fact that there were typical conidia present in the crack.

D, or strain 12, produced its most characteristic pustules. immediately around the letter. These were typically compact, felty-looking, and were cartridge buff(R) in color.

Thus again there were what seemed to be three distinct strains.

The inoculation of this apple terminated the experimental work.

with the live larvae used for the Gause's egg counts.

1, 2, 3, 4 and 5. This was done on August 17, 1917. Five check

quantities were used, including each inoculated lot, and those received

uninoculated until overgrown by the fungus from above. The photograph

was taken August 27th, 1917, or ten days after inoculation. (Plate 23)

In all the five lotlets, A, B, C, D, E, representing the series 1, 2, 3,

12 and 4 respectively.

A, B, C, D, E, and 4 again could not be distinguished. They

produced no visible abundance, especially A and B. The parasites were a

little lighter than dark (B). D, or strain 5, grew so slowly that it

was seen surrounded by A and B. Strain 3 produced a circular brown

decayed spot, with a crack in the center of the spot showing through

the point of inoculation. Microscopic examination revealed the fact that

there were typical conidia present in the spot.

D, or strain 12, produced the most characteristic fungus.

Immediately around the center, there were typically orange, felt-

looking, and sometimes button-like in color.

From again there were some to be found distinct strains.

The inoculation of this case terminated the experimental work.

G. Summary and conclusions.

I. The Sclerotinia found attacking apricot fruits in California (strain 1 is typical) produces conidia abundantly on many artificial and natural media. The pustules are rather loose and powdery, the color of these pustules being typically a drab, a little lighter than Saccardo's drab. These pustules may appear scattered or in more or less concentric zones.

II. This strain is similar to, and seems to be identical with, the following forms.

A strain attacking apple in Holland and called by Dr. Westerdijk Sclerotinia fructigena. This strain never has produced, while in my possession, the yellowish pustules supposed to be typical for Sclerotinia fructigena.

A strain attacking apples in Oregon, and called Sclerotinia cinerea at the Oregon Agricultural Experiment Station.

A strain attacking peaches in Michigan and called by the Wisconsin Agricultural Experiment Station Sclerotinia cinerea

A strain attacking apricot twigs in California.

A strain attacking apricot fruits in Germany.

A strain attacking plum in Holland

A strain attacking cherry in Holland

A strain attacking prune blossoms in Clarke County, Washington.

A strain attacking prune fruits in Clarke County, Washington.

III. The strain mentioned under I of this summary is distinct from two other Sclerotinias which produce fruit rots, and which in turn are distinct from one another.

Summary and conclusions.

I. The Helicoverpa found attacking various fruits in California (species I is typical) produces certain characteristic on many cultivated and natural hosts. The greatest are apples, looses and peaches, the most of these producing being typically a few, a little larger than the others. These produce may appear scattered or in mass or loose concentrated masses.

II. This species is similar to, and seems to be identical with, the following forms.

A certain Helicoverpa found in California and Hawaii is Helicoverpa Helicoverpa. This strain never is recorded, while in my possession, the yellowish posterior segment is typical for

Helicoverpa Helicoverpa.
A strain attacking apples in Oregon, and called Helicoverpa Helicoverpa at the Oregon Agricultural Experiment Station.

A strain attacking peaches in Washington and called by the Washington Agricultural Experiment Station Helicoverpa Helicoverpa.

A strain attacking various fruits in California.
A strain attacking various fruits in Germany.

A strain attacking plum in Holland.
A strain attacking cherry in Holland.

A strain attacking various fruits in Ohio, Canada, Washington.
A strain attacking various fruits in Ohio, Canada, Washington.

III. The strain mentioned under I of this summary is identical from two other Helicoverpa which produce fruit rot, and which in turn are identical from one another.

One is typically slow growing and produces very few conidia, which seem to be typically the same color as the conidia of the California fruit rot Sclerotinia, that is a light drab, and sometimes more grayish. This form, called Sclerotinia cinerea by Dr. Westerdijk, was obtained from cherry or plum in Holland.

The other form produces typically felty-looking cartridge-buff (R) pustules. It was isolated from conidia on apple in Holland.

IV. These three distinct forms seem to correspond to the three original descriptions of Persoon, Ehrenberg and Bonorden.

The commonest form, of which the California apricot rot Sclerotinia is typical, seems to correspond in general to Ehrenberg's description. I suggest that it be called Sclerotinia laxa.

The form with the cartridge-buff pustules seems to correspond to Persoon's description. I think it should be called Sclerotinia fructigena.

The third form, called by Dr. Westerdijk Sclerotinia cinerea I think should retain that name.

One is typically slow growing and produces very few canthi.

which seem to be typically the same color as the canthi of the

California form of Helicoverpa, and is a light blue, and sometimes

more grayish. This form, called Helicoverpa albipennis by Dr. Westerblick,

was obtained from a pupa of Helicoverpa in Holland.

The other form, which is typically light yellowish-brown (H)

canthi. It was isolated from canthi on apple in Holland.

17. These forms, which seem to correspond to the forms

original descriptions of Persea, Thunberg and Boeckler.

The commonest form, of which the California form of Helicoverpa

is typical, seems to correspond in general to Thunberg's description.

I suggest that it be called Helicoverpa albipennis.

The form of the Helicoverpa albipennis which seems to correspond

to Persea's description. I think it should be called Helicoverpa

albipennis.

The third form, called by Dr. Westerblick Helicoverpa albipennis

I think should retain its name.

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ILLUSTRATIONS

Plates 1-12. Graphical representations of the lengths and widths of 100 spores of each strain from strains 1-12 inclusive as grown on ripe apricot fruits. The dotted line representing widths and the solid line lengths.

Plates 1-12. Graphical representations of the lengths and widths of 100 spores of each strain from strains 1-12 inclusive as grown on ripe apricot fruits. The dotted line representing widths and the solid line lengths.

Plates I-12. Geometrical representations of the lengths
and widths of 100 spores of each strain
from strains I-12 inclusive as grown on ripe
apricot fruit. The dotted line representing
widths and the solid line lengths.

1.17
T. 1.17
T. 1.17
T. 1.17
T. 1.17

2

4

5

6

7

8

9

12

Plates 13-20. Photographs showing the results
of inoculating ripe Royal Anne
cherries with strains 1-16 inc.
respectively.

Fruit inoculated June 30, 1917
Photographed July 7, 1917
Cherries are natural size.

Part II

Appendix

on horn plates in the

in the

1877

2/17/17

Plates 21-25

Photographs showing character
of growth of the strains 1, 2
3, 4 and 12 respectively.

Cultures planted August 16, 1917

Photograph August 28, 1917

Natural size

On Czapeck's agar

Strain 1

Plates 21-22
Photographs showing character
of growth of the strains 1, 2,
3, 4 and 12 respectively.

Cultures planted August 16, 1914
Photographs August 28, 1917
Material also

On Czapeck's agar

Strain #1

Strand 1

Strain 2

1874

Strain #3

3

2nd 12

Strain #4

22

Strain #12

12

Spain 12

Plate 26. Results of inoculating a ripe
Seek-no-further apple with the
five strains 1, 2, 3, 4 and 12

A 1
B 2
C 3
D 12
E 4

Inoculated August 17, 1917
Photographed August 27, 1917
Natural size

Plate 26. Results of inoculating a rose
 Bush no further again with the
 five strains 1, 2, 3, 4 and 12

A 1
 B 2
 C 3
 D 12
 E 4

Inoculated August 17, 1917
 Photographed August 27, 1917
 Natural size

apricot fruit rot

Plate 27. Upper. Diamond plums inoculated with spore material from a naturally infected apricot

Inoculated Sept. 5, 1914
Photographed Sept. 11, 1914

Lower. Pond Seedling plums inoculated with spore material from a naturally affected apricot.

Inoculated Sept. 5, 1914
Photographed Sept. 11, 1914

These pictures are typical of the California apricot fruit. rot.

Diamond plums inoculated
with spore material from
a naturally infected apricot

Inoculated Sept. 5, 1914
Photographed Sept. 11, 1914

Pond Seedling plums inocu-
lated with spore material
from a naturally affected
apricot.

Inoculated Sept. 5, 1914
Photographed Sept. 11, 1914

These pictures are typical of the California

apricot fruit rot.

Plate 27. Lower.

Lower.

Plate 28. Upper. Photograph showing result of inoculating a quince with spore material from a naturally infected apricot.

Inoculated Sept. 28, 1914
Photographed about October 21, 1914

Lower. A. Sclerotinia cinerea, color of pustules. Copied from Woronin's work in St. Petersburg Academie Memoires Ser. VIII, V. 10, pl. IV, 1900.

B. Sclerotinia fructigena, color of pustules. Same source as A.

C. California Apricot rot, Sclerotinia, strain 1, Shewing color of pustules on prune juice and bread culture in a flask.. 23 days old. This color is typical.

D. Color of gonidial mass of strain 1 when grown on sterilized green beans in a test tube. Culture 2 months old.

Plate 28. Upper. Photograph showing result of inoculating a guinea with spore material from a naturally infected squirrel.

Inoculated Sept. 28, 1914
Photographed about October 21, 1914

Lower. A. Californiae strain, color of pusules. Copied from Worthing's work in St. Petersburg Academy. Memorias Ser. VII, V. 10, pl. IV, 1900.

B. Californiae strain, color of pusules. Same source as A.

C. Californiae strain, color of pusules. Showing color of pusules on guinea (also and bread culture in a flask, 28 days old. This color is typical.

D. Color of gonidial mass of strain I when grown on sterilized green beans in a test tube. Culture 2 months old.

Photograph August 11, 1914

A B C D

Plate 29. Photograph showing result of
inoculating a Valenica orange
with the California apricot rot
Sclerotinia. (not a pure culture)
No decay.

Inoculated August 31, 1914
Photograph. September 11, 1914

Plate 29. Photograph showing result of
inoculating a Valencia orange
with the California sprout rot
bacterium. (not a pure culture)
No decay.

Inoculated August 31, 1914
Photograph September 11, 1914

Plate 30. Upper

Photograph showing fresh cankers being produced on an apricot that was attacked the previous year and which remained hanging in the tree through the winter. These fresh

Thomas

Plate 30. Upper

Photograph showing fresh conidia being produced on an apricot that was attacked the previous year and which remained hanging in the tree through the winter. These fresh conidia serve as a source of infection to the blossoms, as well as fresh conidia produced on twigs killed the previous season with the fungus.

Photograph during the blossoming period Spring, 1917

Lower.

Photograph showing result of inoculating Spitzenberg apple with the California apricot rot Sclerotinia (not a pure culture) Inoculated November 7, 1914

Photograph

by W. W. Thomas

Upper Plate 30.

Photograph showing fresh conidia being produced on an ascarid that was attached the previous year and which remained hanging in the tree through the winter. These fresh conidia serve as a source of infection to the blossoms, as well as fresh conidia produced on twigs killed the previous season with the fungus.

Photograph during the blossoming period Spring, 1917

Lower

Photograph showing result of inoculating Spitzenberg apple with the California ascarid rot bacterium (not a pure culture) inoculated November 7, 1914
by W. W. Thomas

Plate 31. Photograph showing results of
inoculating a seedling with a fungus

Plate 31. Photograph showing results of
inoculating a seedling apricot branch
with strain 1.
Check at left.
Inoculated November 22, 1914
Photograph January 21, 1916
Natural size

Plate 31. Photograph showing results of
inoculating a seedling sprout branch
with strain A.
Check at left.
Inoculated November 22, 1914
Photograph January 21, 1915
Natural size

4/21/16

X1

Plate 32. Photograph showing results of
inoculating a seedling peach branch
with strain 1.
Check at lower right
Inoculated November 22, 1914
Photograph January 21, 1916
Slightly reduced.

Plate 32. Photograph showing results of
inoculating a seedling peach branch
with strain I.
Growth at lower right
Inoculated November 22, 1914
Photograph January 21, 1915
Slightly reduced.

The image displays four cross-sections of fruit, arranged in a 2x2 grid. The top-left section is a peach, showing a smooth, rounded shape. The top-right section is a spricot, appearing more elongated and irregular. The bottom-left section is a check, showing a more rounded shape with some internal texture. The bottom-right section is an inoculation, showing a more rounded shape with some internal texture. The text is centered between the top and bottom rows of sections.

Plate 33. Photograph showing cross sections of
cankers and checks shown in plates
31 and 32. Peach at left, spricot
at right. Upper; check, lower:
inoculation.
Photograph January 28, 1916 (x $1\frac{1}{2}$)

Plate 33. Photograph showing cross sections of
cannery and chassis shown in pieces
31 and 32. Piece of left, spruce
at right. Upper; check, lower;
insulation.
Photograph January 20, 1916 (x 15)

Plate 34.

A. Showing variation in size and shape of conidia of strain 1 when grown on sterilized plum wood in a test tube. Culture 15 days old. (x1000)

B. Showing variation in size and shape of conidia of strain 1 when grown on standard nutrient gelatine in a test tube. Culture 15 days old. (X 1000)

C. 1) These numbers 1, 3, 4, 12
3) correspond to the strains of
4) the same number, and show the
12) appearance of separating conidia.
Taken from Royal Anne cherries
July, 1917. (x 1000)

[Faint, illegible text, possibly bleed-through from the reverse side of the page]

[Faint, illegible text, possibly bleed-through from the reverse side of the page]

Plate 35. A) Conidia from the surface of an apricot

B)

naturally infected with the California
apricot rot Sclerotinia (x 1000)

C. 3 mature conidia from a culture of
strain 1 on Solanum tuberosum 14 days old
(x 1000) and germinating conidium of
California apricot rot Sclerotinia (2 days
in tap water) (X 1000)

D. Spore-like bodies from culture on
Diamond plum (x 1000) September 19, 1914.
See plate 27, upper photograph.

E. Germinating gonidium of the California
apricot rot Sclerotinia in 100% peach juice,
the acidity of which was +10.4. Drop culture
8 days old. (x 2000).

F. Gonidia of the California apricot rot
Sclerotinia produced in a tap water drop
culture of conidia from a naturally infected
apricot. 49 days old. (x 1000).

G. 3 germinating gonidia of the California
apricot rot Sclerotinia in distilled water
drop culture. 3 days old. (x 2000)

Plate 22. A) Conidia from the surface of an apricot

B) naturally infected with the California apricot rot *Botrytis* (x 1000)

C. 3 mature conidia from a culture of strain 1 on *Solanum tuberosum* 14 days old (x 1000) and germinating conidium of California apricot rot *Botrytis* (2 days in tap water) (x 1000)

D. Spore-like bodies from culture on Diamond plum (x 1000) September 12, 1914. See plate 27, upper photograph.

E. Germinating conidium of the California apricot rot *Botrytis* in 100% peach juice, the acidity of which was +10.4. Prop culture 8 days old. (x 2000).

F. Conidia of the California apricot rot *Botrytis* produced in a tap water drop culture of conidia from a naturally infected apricot. 45 days old. (x 1000).

G. 3 germinating conidia of the California apricot rot *Botrytis* in distilled water drop culture. 3 days old. (x 2000)

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