1920
H75

APPLE FLY-SPECK

BY

EDWIN EARL HONEY

B. S. Cornell University, 1916

THESIS

Submitted in Partial Fulfillment of the Requirements for the

Degree of

MASTER OF SCIENCE

IN BOTANY

IN

THE GRADUATE SCHOOL

OF THE

UNIVERSITY OF ILLINOIS

1920

1920
H75

13 SP 22 LAP

UNIVERSITY OF ILLINOIS

THE GRADUATE SCHOOL

May 14, 1920.

I HEREBY RECOMMEND THAT THE THESIS PREPARED BY _____

Edwin Earl Honey

ENTITLED Apple Fly-Speck

BE ACCEPTED AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE
PROFESSIONAL DEGREE OF Master of Science

F. L. Evans
Wm. Valjean
Head of Department of *Botany*

Recommendation concurred in:

} Committee

502413

Table of Contents

	Page
I. Introduction.	1
II. Materials and Methods.	3
III. Description of fly-specks.	5
1. On apple.	5
2. On raspberry.	13
3. On blackberry.	15
4. On peach.	17
5. On sassafras.	18
6. On charlock.	20
7. On Evonymus.	22
8. On persimmon.	23
9. On watermelon.	25
IV. General Discussion.	31
V. Summary.	38
VI. Acknowledgments.	39
VII. Bibliography.	40
Description of Plates.	42

Digitized by the Internet Archive
in 2013

<http://archive.org/details/appleflyspeck00hone>

APPLE FLY-SPECK

I. Introduction

The present study was undertaken for the purpose of determining the exact morphological characters of the fungus commonly known as "fly-speck" fungus occurring upon the fruit of apple, *Pyrus Malus* L. It forms but a preliminary study of the fungus, and is to be followed by further inquiry into its physiology, life history and relation to other fungi. The same fungus has been reported by Selby (1897), Hesler and Whetzel (1917), Colby (1919), and others upon pear, *Pyrus communis* L., and by Shearer (1907) upon cranberry, *Vaccinium Oxycoccos* L.

According to Duggar (1909: p.367) a fly-speck and a sooty-blotch, which he considers another form of the same fungus, occur associated upon the woody stems of about twenty-five different host plants along a roadside near Columbia, Missouri. The writer has made somewhat similar findings in and near Urbana, Illinois, and it has been deemed advisable to make a comparative study of the fly-speck fungi from various host plants. Therefore, this study not only includes the fly-speck fungus occurring upon apple, but also the fly-speck fungi occurring upon the following hosts: blackberry, raspberry, peach, *Evonymus*, sassafras, persimmon, watermelon, and charlock.

The life-history of this fungus is little understood, (spores have very rarely been seen and doubt exists as to whether they have ever been seen).

A comparative study of fly-speck upon various hosts should not only add to our knowledge of its distribution but also help in the determination of its morphology and life-history.

These fungi are recognized on the fruit or stems of various hosts by the small black spots, in general appearance resembling fly specks, the name aptly describing them. These spots or specks occur singly or in little groups of from two or three to a hundred or more. Or they may be distributed in abundance and more or less uniformly over the fruit or stems as seen in Plates I, VI, VII, IX, X, and XI. These fungi are entirely superficial, above the cuticle, and have been classed by various authors as either saprophytes, epiphytes or parasites. No rot or malformations of the host tissue is apparent, the injury merely being in the unsightly appearance.

From all the evidence at hand, the fungi may appear at the latter part of the growing season especially when the rainfall is abundant. Shade, aeration and temperature evidently are also important factors in their development. Fly-speck upon sassafras has been known to develop late in the fall upon the winter buds. (Plate VII, figure 1).

In the case of apple fly-speck, as is also true on various of the other above-named hosts, a sooty-blotch occurs associated upon the host, more or less closely with the fly-speck fungus. A striking feature of their association on all the hosts is the line of demarkation between the colonies of the two fungi; thus exhibiting the phenomenon, apparently, of strong antagonism.

Until 1900 when Selby grouped the two fungi under the same technical name (*Leptothyrium pomi* (Mont. et Fr.) Sacc.) they were regarded as separate species. After the publication of Duggar's "Fungous diseases of plants" (1909), these two fungi have generally, though not universally, been accepted as different forms or aspects of the same fungus.

Recent work by Colby (1919) on sooty-blotch goes to prove

that the two forms are separate distinct fungi and ^{he}/proposes a new genus *Gloeodes* for the sooty-blotch fungus.

The present paper dealing separately and solely with the fly-speck form should contribute to a better understanding of the morphology and lead to a correct knowledge of its life-history, taxonomic position and relationship to sooty-blotch and other fungi.

II. Materials and Methods

Specimens of fly-speck fungus on various plant hosts were received from Dr. A. S. Colby, Urbana, Illinois; Dr. J. E. Elliott, Fayetteville, Arkansas; Dr. B. B. Higgins, Experiment, Georgia; Dr. E. R. Hopkins of Auburn, Alabama, and also secured by the writer during collecting trips in and near Urbana, Illinois during the late fall and winter of 1919-1920.

The material was studied in the fall in both living and killed conditions and specimens wintered over out of doors and brought into the laboratory for study at various times during the winter and spring seasons. For example, the watermelon fly-speck was placed in a garden with the fly-specked side in the natural position lying upon the bare garden soil; other specimens of the same fly-speck were placed upon a grass sod and part turned with the fly-specked side uppermost. In this way the influence of the various conditions of light, moisture, heat and aeration were secured and an attempt made to meet the requirements of the fungus in such a way that a normal development, and a production of spores might be secured.

In making mounts for microscopical study, an attempt was made to follow the cellidin method described by Stevens (1916). This proved unsuccessful and therefore studies were made in the following ways:

1. Sections of the epidermis bearing the fungus were cut as thin as possible parallel to the surface of the fruit, inverted in water and scraped to remove as much of the tissue as possible, killed in absolute alcohol, cleared with xylol and mounted in balsam. It was found necessary to overcome the density of the host cells in order to accurately observe the cellular structure of the fly-specks and for this purpose about fifteen different clearing solutions were tested. Lactic acid and carbol-turpentine proved to be the most satisfactory and therefore it became customary to immerse the sections in lactic acid or carbol-turpentine for twenty-four to forty-eight hours, and then run them into xylol and mount in balsam. Sections made in this manner give a view directly down upon the fly-speck fungus as it is in position upon the host tissue. It was found possible to remove the fly-specks from the host by means of a scalpel or a razor blade, but this was undesirable in making permanent mounts for as a rule the marginal growth broke from the central portion of the membrane and remained on the host and the membrane, even if almost entirely removed, would curl to such an extent that it was found more advantageous to contend with the density of host tissue rather than to remove the speck for study.

2. Material was killed, in absolute alcohol or chromo-acetic acid killing fluid, embedded in paraffin, and cut with the rotary microtome (a) in cross-section and (b) tangentially. The microtome sections were made from ten to four microns in thickness and stained with safranin, safranin and gentian-violet, (Chamberlain 1905), Planeze III b (Vaughan 1914), and acid fuschin and erythrosin. Good results were obtained with all of these stains but it was frequently found as desirable to omit the stains entirely and mount in balsam and study.

All microscopical descriptions in this paper are based on observations made either in looking directly down upon the fungus speck or membrane or from cross-sections through the speck, with the high power of a compound microscope (ocular three and objective seven).

III. Description of Fly-specks

As has been stated above, this study covers the observations of fly-speck occurring upon nine different hosts. These nine hosts are distributed in six different families of Cormophytes as follows:

1. Rosaceae, represented by apple, *Pyrus Malus* L., black raspberry, *Rubus occidentalis* L., blackberry, *Rubus allegheniensis* Porter, and peach, *Prunus Persica* (L.) Stokes.
2. Lauraceae, represented by *Sassafras variifolium* (Salisb.) Ktze.
3. Cruciferae, represented by charlock, *Brassica arvensis* (L.) Ktze.
4. Clastraceae, represented by *Evonymus atropurpureus* Jacq.
5. Ebenaceae, represented by persimmon, *Diospyros virginiana* L.
6. Cucurbitaceae, represented by watermelon, *Citrullus vulgaris* Schrad.

Rosaceae

1. Fly-speck fungus upon apple.

a. Macroscopic observations

The fly-speck fungus occurs upon the cuticle of the fruit. It is quite possible that it also occurs upon the young twigs and petioles of the same host, but this has never been observed by the writer. The fungus appears as small, black spots or specks upon the

epicarp singly or in groups of three to several hundred.

The color, size and general appearance is aptly suggested in the term "fly-speck". (Plate I, figures 1 and 2). To the naked eye they appear as small black, shiny, dry specks with no evidence of a mycelium connecting the specks. These specks vary in size and while they are in general round to elliptical, they may also vary slightly in shape.

Notwithstanding the fact that it is superficial and contrary to what has frequently been maintained for it, this fungus is not easily rubbed off. Frequently, associated with the fly-speck fungus is the sooty, olivaceous roundish areas or colonies of fungous growth known as sooty-blotch or sooty-smudge. In fact it is quite characteristic to find the two fungi upon the same fruit, but this is not always the case and either may be found separately.

A still more striking and possibly more significant feature is the fact that in a great many of the cases where the two fungi are associated, there is a distinct line of demarkation between their thalli thus showing that one or the other or both exert an inhibiting effect upon the growth of the other.

Plate II, figure 2 shows a more or less circular colony of fly-speck fungi surrounded by the sooty-blotch fungus and showing this antagonism. It is held by some authorities that fly-speck (and also sooty-blotch) is more common on the calyx end of the fruit than the stem end. While fly-speck may be found on both calyx end and stem end, there does seem to be grounds for the belief that it is more common or at least more abundant upon the calyx end or basin (Plate II figure 1). It may be that the source of infection is from below, and as the weight of the apple causes it to hang calyx end down, greater amount of infection takes place at this end.

Also the calyx end may secure more shade and the moisture relations may be different than on the upper side. Where the tree is rather thick in foliage, with shade and moisture abundant, and there is a lack of aeration, fly-speck may become very abundant over the entire fruit (Plate I figure 2). This is especially true during a damp season.

b. Microscopical observations

1. Color: In looking down upon the fungus speck it appears dark brown to light brown, the central portion being darker than the marginal-wreath which is light brown to hyaline.

The darker color in the center is largely due to the greater number of thicknesses of fungus cells and also the fact that they are pressed together in a much more close, dense mass, than at the edge. In cross-section, the upper layer of cells forming the membrane is dark brown to almost black, but the cells beneath are hyaline. (Plate V figure 1).

2. Shape: Round to elliptical with marginal-wreath somewhat irregular (Plate III figure 2). Occasionally two specks close together form a union by the passing from one to the other of certain lines of mycelium, which with their characteristic branchings form a network of hyphae, thus joining the two specks or membranes. (Plate IV figure 2).

In cross-section the specks appear superficial, lying entirely above and upon the cuticle (Plate III figure 1). It presents a somewhat flat to convex body, three to five cells thick in the central portion, and diminishing in thickness to that of one cell at the margin which is dried and flattened to the cuticle.

The cells in the cross-section beneath the membrane appear as the cut ends or transverse sections of the cells; occasional-

ly some appear more elongate and the arrangement in still other suggest that the interval cells of the speck are those of an interwoven hyphal mass forming a more or less pseudo-parenchymous^{at} hyaline tissue. Measurements in cross-section have shown the convex body of the fly-speck to be from 13.2 u to 25 u in depth.

The cuticle appears normal beneath the spot, there being no evidence of shrinkage or penetration or other action of the fungus upon it.

3. Membrane structure: In the above description, the fly-speck fungus body has been differentiated into two parts, first, the hard, brittle darkened membrane coverings and, second, the hyaline pseudo-parenchymous^{at} tissue beneath.

The structure of the membran^{ous} coverings is very important in the characterizing of the fungus, and in differentiating the various fly-specks.

We will describe the membrane structure under two headings, (1) the central portion of the membrane, and (2) the marginal portion or marginal-wreath. In speaking of the "speck", we refer to entire thalli of the fungus including both the membrane and pseudo-parenchymous^{at} tissue^{beneath}. / A colony is composed of a group of these specks.

(a). Center of membrane. In looking directly down upon the fungus speck the first conspicuous detail to be noticed is the presence of prominent main lines of mycelia passing across or partly across the entire speck or membran^{ous} surface. Frequently these may cross each other at more or less acute angles and as is commonly the case form or outline larger or smaller triangular areas on the membrane. Between these lines of main hyphae whose cells generally appear somewhat elongate, rectangular and placed end to end may be seen the more roundish to angular cells placed apparently in no definite

arrangement, but filling up all intervening spaces and extending to the margin. The cells of the membrane are not inverse-radiate, a character of the Microthyriaceae (Theissen 1913), but on the contrary the cells are massed or crowded together in little, and in part, no definite fashion, and appear as composed of more or less irregularly angular (roundish to hexagonal, pentagonal, triangular, square or otherwise) cells.

The walls to the cells composing the membran^{ous} structure are dark brown in color, thick and merged together to form the hard dark colored membraneous covering. The dark brown to black appearance of the central cells of the membrane are not alone due to the color of the cell walls, but also to the greater number of underlying cells. The color grades out to a lighter brown at or near the margin. No ostiole is apparent in the membrane.

As stated above the membrane is brown, and brittle. This is readily demonstrated under the high power of the compound microscope. In removing the fly-speck from the fruit epidermis to a glass slide and covering the same with a cover-glass, we first note the brown to dark brown somewhat black membrane. Upon crushing this slightly with pressure upon the cover-glass with a needle, the center of the membrane breaks up into fragments consisting of one to several cells, showing the hyaline tissue beneath. On releasing the pressure the fly-speck fragments will draw back together and appear as before the pressure had been applied. This indicated the viscid elastic nature of the underlying cells as they apparently furnish the force causing the drawing together of the brittle fragments of the membrane to normal or near normal position. If a greater pressure is applied, the center of the membrane will be entirely crushed to fragments and be dispersed throughout the mount.

When crushing the body in this manner numerous oil globules but no spores have been observed. In nature, it is very characteristic for the center or fragments of the center to break out leaving merely the marginal wreath or the marginal wreath and a greater or smaller portion of the membrane center.

Frequently membranes show a small rupture at the apex of the speck in a manner very suggestive of their functioning as ostioles; however, that they do function as such has never been demonstrated.

(b). Marginal-wreath of membrane. The marginal wreath about the fungus body is but one cell in depth though several in width. It is very light brown to hyaline and the cells are not crowded together as in the center of the membrane. Many of the main hyphal lines described as occurring in the center of the membrane continue through or across the margin, the cells becoming more distinctly elongate, light brown to hyaline and extending out from the center a few cells length where they become evanescent, end abruptly and therefore lead to no other structure, with the exception of cases where two fly-specks or membranes are located close together, and the two structures are thus joined (Plate IV figure 2). The marginal hyphae show a very characteristic branching - somewhat at right angles - which joins the various lines of mycelium and forms a loose network over the margin (Plate V figure 3). It is characteristic for mycelial strands or hyphae to join each other forming with the cells of other marginal hyphae a more or less triangular outline with lateral branches at right angles

4. Size of Fly-speck: The size is quite variable. Measurements were made in two directions at right angles to one another and passing approximately through the center of the specks. The fol-

lowing results will illustrate:

555.0 u x 499.0 u

555.0 u x 440.0 u

440.0 u x 388.5 u

440.0 u x 355.0 u

333.0 u x 233.0 u

333.0 u x 277.5 u

It will be seen from this that the specks may vary from 550.0 u x 499.0 u to 333.0 u x 277.5 u.

Apple fly-speck is generally known in literature by the name *Leptothyrium pomi* (Mont. et Fr.) Sacc. Saccardo (1884) lists *Labrella Pomi* M. et Fries, as a synonym or rather he takes *Labrella pomi* Mont. et Fr. and gives the citation to the original description and changes its name to *Leptothyrium pomi* (Mont. et Fr.) Sacc. Because of this synonymy it was very desirable to compare type material of *Labrella Pomi* Mont. et Fr. with that of the apple fly-speck.

Through the efforts of Dr. William Trelease and the kindness of the Director of the Museum in Paris, type material of *Labrella Pomi* Mont. was received for examination by Dr. A. S. Colby (1919) in connection with his study of sooty-blotch of pomaceous fruits. The writer is indebted to these gentlemen for the opportunity of examining and comparing the type material with that of the apple fly-speck studied in the laboratory. They are of special interest due to their historical value.

The portion of the type material of *Labrella Pomi* numbered 847 examined by the writer consists of three slides, each of which showed several freehand cross-sections of the fungus upon the cuticle of apple fruit. The fungus appeared flat to convex, entirely above the cuticle and in every respect resembled the apple fly-speck fungus

commonly known in this country under the name *Leptothyrium Pomi* (Mont. et Fr.) Sacc.

The upper or outer fungus layer forms a brown, dark, heavy-^{at}walled membrane with hyaline fungous pseudo-parenchymous tissue beneath which extends from the membrane to, and rests upon the cuticle. No indentation or etching out or penetration of the cuticle was in evidence beneath the fungus. Neither were any spores found. Some of the cross-sections of *Labrella Pomi* appear to be three cells deep, the upper outer layer of cells being brown and thick-walled on the outer exposed surface, but the walls of these same surface cells were hyaline and thinner on the inner unexposed side. In one of the slides a section had been turned in mounting so as to bring the upper brown surface of the membrane into view. This revealed the brown irregular angular cells similar to those of apple fly-speck of my own collections.

Measurements of the various cross-sections at the point of greatest convexity gave the following thicknesses to the fungus body: 12.8 u., 16.0 u., 20.8 u., and 24.0 u.

Measurements across from end to end which would represent the diameter, or a portion of it, gave the following lengths: 120.0 u., 144.0 u., 160.0 u., and 176.0 u.

In addition to the type material described above, a permanent mount was made of *Labrella Pomi* Mont. number 124 of *Fungi Selecti Exsiccati*, Roumeguere collected in the autumn of 1878. With this mount, one can look directly down upon the membrane structure of the fungus as it occurs upon the apple skin. Plate III figure 3 shows one of these specks with part of the center and marginal-wreath gone.

There seems to be no doubt but that *Labrella Pomi* Mont. and Fr. and *Leptothyrium Pomi* (Mont. and Fr.) Sacc. are names applied to

the same fungus.

Montague (1834) in his brief Latin description states that the spores are globular. However, the writer failed to find spores in the slides of the type material examined.

2. Fly-speck fungus upon Raspberry.

a. Macroscopical observations

The fungus occurs as small, black, shiny dots or specks upon the one and two year old twigs and stems of the raspberry. In general shape and color, they resemble very much the fly-specks occurring upon the fruit of apple. These specks may be found singly or in groups of three to ten or twenty, or scattered promiscuously up and down the stem.

The fly-speck fungus colonies are also present at the nodes upon the base of petiole that is left after the leaf has fallen. Petiole infection has never been observed. The specks are not restricted to any one side of the stem, but on the terminal twigs are about equally abundant on all sides. When sooty-blotch is associated with fly-speck upon this host a distinct line of demarkation between most of the colonies is in evidence.

b. Microscopical observations

1. Color: Brown, similar to apple fly-speck; darker brown in central portion of speck. Frequently there appears a light narrow zone about half way between the center and margin of the speck. The light zone is apparently due to the refraction of light in the region of greatest rise of the convex center of the speck.

2. Shape: Elliptical, some very short elliptical to circular and others long elliptical becoming sub-linear.

If the fly-speck is located on the stem near a large lenticel the general outline is modified by the failure of the fly-speck

to grow over the edge of the lenticel, thus producing an indentation or deviation of the margin from its normal elliptical shape. The reason suggested for this selection of host surface or inability to spread and grow due to type of host surface is that the fungus is restricted to tissue covered by cuticle and the cork layer of the lenticel has lost its cuticular covering. In cross-section the appearance is that of a flat body becoming convex in the center.

3. Membrane structure:

a. Center of membrane

Dark brown in color composed of irregularly angular cells with lines of more elongate hyphal cells running through the structure or at least part way from the margin towards the center. These main hyphal lines are not as conspicuous in raspberry as in apple fly-speck.

In the specks which are more ^{nearly} linear in form the hyphal lines of elongate cells often run the entire length of the membrane rather than from the lateral margin to center or in a radial direction. The membranes of the fly-specks having an elliptical to linear form usually have their long axes parallel to the axis of the twig. It is evident that the general shape of the membrane is greatly influenced by the furrows or slight ridges or other conformations of the host stem.

b. Marginal wreath

The margin forms a wreath of lighter brown elongate, rectangular shaped cells which branch at right angles forming more or less of a network. This light brown margin is not as wide as in the case of apple fly-speck though in every other way the margin is identical in the two forms.

The hyphal lines running through the membrane are often

continued and joined to mycelial strands growing over the host epidermis between the fly-speck structure.

4. Size: The size as well as the shape is quite variable in this fly-speck. Measurements show a range from 330.0 μ x 286.0 μ to 550.0 μ x 444. μ , with possibly the greatest number about 444.0 μ x 333.0 μ .

3. Fly-speck fungus upon Blackberry

a. Macroscopical observations

The fly-speck appears as minute, black, shiny dots or specks in groups numbering from two to twelve, or more. They are often found at the nodes just beneath the raised persistent petiole base (Plate VI figure 1a). The specks also appear upon the stem on the internodes, generally, although not strictly, in the grooves formed by the irregular or angular form of the stem (Plate VI figure 1b). On the internodes it is more common to see the specks scattered though they are also frequently grouped. The fly-speck fungus may be found not only on the current years growth or the young terminal twigs, but also upon the older main stalks from one to two feet above the ground, more particularly upon the shaded or north side of the stem. The sooty-blotch fungus occurs very abundantly also upon this host associated with the fly-speck but showing definite lines of demarkation between the colonies of the two fungi.

b. Microscopical observations

1. Color: Brown, to light brown, similar to the apple fly-speck. A narrow zone or ring of light brown color encircling the center similar to that described for raspberry and apparently due to difference in thickness of the underlying fungus cells is present in many of the specks.

2. Shape: Round to elliptical having a tendency to be more

elongate elliptical to sub-linear.

The speck appears flat becoming convex in the center due to a greater number of cells.

3. Membrane structure :

a. Center of membrane

Conspicuous main lines of hyphae extend across the surface of the dark brown membrane very similar to those found in both apple and raspberry fly-specks. Between these lines of elongate hyphal cells and covering the remaining surface of the membrane are the irregularly angular cells. These cells appear to have no special arrangement, and are not inverse-radiate.

The general appearance of the cells is similar to those of both apple and raspberry fly-speck. The tissue beneath the upper membrane is composed of hyaline and thin-walled cells which possess a viscid elastic quality as is demonstrated when the speck is crushed. No ostiole is present.

b. Marginal-wreath of the membrane

The marginal-wreath is light brown to hyaline in color, but differs slightly from the apple fly-speck in that the lines of hyphae do not branch so nearly at right angles neither is the marginal wreath so well developed or wide. The marginal cells become more elongate, similar to the cells of the hyphal lines. Occasionally the speck grows around the base of one or several of the club-shaped plant hairs allowing the plant hair to perforate the membrane either in the center or in the marginal wreath, as the case may be. This phenomenon is not so common on blackberries as on some of the other hosts, but it has occasionally been observed with from one to three plant hairs passing through the speck. This is a similar phenomenon to that commonly observed in the sporophores of *Fomes* or

other wood rotting fungi when they grow around a weed or stick, which obstructs its course.

4. Fly-speck fungus upon peach

a. Macroscopical observations

The fly-speck fungus occurs almost entirely upon the cuticle of the green under surfaces of the young twigs (Plate VI figure 2) where the epidermis has not been replaced by a cork layer. The specks appear as minute, black, shiny dots upon the cuticle, as a rule not grouped in definite colonies but scattered up and down the stem, abundant alike at the nodes and internodes.

As with all the fly-specks under observation, it is apparent with the naked eye, as well as with the hand lens and compound microscope, that the specks vary slightly in size.

Sooty-blotch also occurs on the same twig with a more or less definite line of demarkation between the colonies of the two fungi. The sooty-blotch is not as abundant or conspicuous upon this host as upon the species of *Rubus* observed.

b. Microscopical observations

1. Color: Brown, similar to apple fly-speck.

2. Shape: Circular to elliptical, the majority being elliptical; flat, becoming convex in the center in cross-section. The light zonation as described for other fly-specks is present in many of these specks.

3. Membrane structure :

a. Center of membrane

Main lines of hyphal cells pass across the center of the membrane as in apple fly-speck. The crossing and triangular outlines formed by these main hyphal lines described for apple also occur in the peach fly-speck. Between these more conspicuous lines of elon-

gate cells placed end to end are the more irregular angular cells characteristic of the fly-specks described on other Rosaceous hosts. No ostiole is present; neither is the membrane perforated by openings for plant hairs.

The hard crustaceous membrane when crushed with the cover-glass is found to be viscid and similar to all the other fly-specks described.

b. Marginal-wreath

The marginal wreath is composed of elongate hyphal cells passing from the center outward to the periphery, and which branch more or less at right angles forming a network of hyphal cells. These hyaline, marginal cells are not massed so closely together as in the center and, due to their branching, form a hyaline to light brown marginal-wreath around the brown crustaceous membrane of the fly-speck.

4. Size: The majority of the peach fly-specks measure 440.0 μ x 440.0 μ or 440.0 μ x 335.0 μ .

Lauraceae

5. Fly-speck fungus on sassafras

a. Macroscopical observations

The fly-speck fungus occurs upon the woody, one and two year old stems in great abundance (Plate VII figures 1 and 2). The specks appear as minute, shiny, black dots upon the light green stems forming definite groups or scattered indiscriminately up and down the stem at the nodes or on the internodes.

Specimens collected in January (1920) in Arkansas showed fly-speck occurring upon the terminal winter bud scales demonstrating the development of the fungus late in the season. On this host the antagonism between the fly-speck and sooty-blotch colonies is

very conspicuous. As a rule the sooty-blotch is restricted to one side of the twig and the fly-speck to the other side or lower surface, although this is not constant and both may occur on the same surface with definite lines of demarkation between the colonies of the two fungi.

b. Microscopical observations

1. Color: Brown in center shading to light brown and hyaline at margin similar to other fly-specks.

2. Shape: Round to elliptical. As a rule the specks are elliptical with a margin made irregular due to the intrusion of the marginal-wreath partly around plant hairs or by certain hyphae extending out a short distance from the margin.

3. Membrane structure:

a. Center of membrane

Similar to the fly-speck fungus upon Rosaceous hosts the center of the membrane is composed of dark thick-walled cells, irregularly angular and massed together in no definite fashion with the exception of the main hyphal lines composed of somewhat more elongate or rectangular cells placed end to end.

These main lines of hyphae extend entirely or in part across the membrane in definite lines of direction and may meet or cross each other out-lining more or less triangular areas upon the membrane. (Plate VIII figures 1 and 2).

A conspicuous feature of this fly-speck is the openings in the membrane, both in the center and in the margin, through which the plant hairs pass and which apparently are caused by the growth of the fungus around the trichomes during the formation of the speck. These openings or perforations may not always be present and therefore may vary from none or one or two to twelve or more depending up-

on the position of the speck in relation to plant hairs.

b. Marginal wreath

The marginal wreath is very similar to fly-speck upon apple in the shape of the cells and angle of branching. The cells are elongate, narrow, branching somewhat regularly at right angles, anastomosing and forming a network light brown to hyaline in color. The margin is more narrow than the apple fly-speck, and is frequently irregular due to the presence of plant hairs passing through the membrane at or near the margin.

4. Size: The size averages below that of apple fly-speck. The following measurements will illustrate the variations in size and shape:

396.0 u x 330.0 u

333.0 u x 277.5 u

270.0 u x 270.0 u

222.0 u x 222.0 u

222.0 u x 166.5 u

198.0 u x 154.0 u

The majority of specks range about 333.0 u x 277.5 u in size.

Cruciferae

6. Fly-speck upon charlock

a. Macroscopical observations

The fly-speck fungus appears as minute, black, shiny dots or spots upon the stems of the above named host, either at the nodes or at the internodes (Plate IX Figure 1). They may occur in circular or somewhat circular colonies of about twenty or more specks or they may be in considerably larger numbers scattered between the nodes. It is common also to find one to three specks separately on

the stem. Sooty-blotch has not been observed with the fly-speck fungus upon this host.

b. Microscopical observations

1. Color; Brown varying as in all the fly-specks somewhat with the size or thickness or density of the fungus body or speck. It is common to find in this fly-speck that the smaller specks have a lighter brown membrane than the larger ones, both possessing the still lighter brown to hyaline marginal wreath.

2. Shape: Round to elliptical. The majority of specks being elliptical. In cross-section flat, becoming convex.

3. Membrane structure:

a. Center of membrane

The center of the membrane is crossed by the easily recognizable main hyphal lines similar to those described for the fly-specks above. These main hyphal lines may meet or cross each other as has previously been described. Between the main hyphal strands occur the more irregular angular cells. There is no essential difference between the character of this membrane and that of the fly-specks occurring upon Rosaceous hosts, with the exception that it has been noticed that many of the membranes do not break out from the center in irregular pieces as in other fly-speck (Plate III Figure 2), but rather a cleft or slit breaks open along the longer axis of the membrane and generally extending nearly the diameter of the membrane center.

b. Marginal wreath

This fly-speck possesses a very evident light brown to hyaline marginal-wreath. The hyphae branch at more or less right angles and anastomose (Plate IX Figure 2). Occasionally one to several long hyaline mycelial strands extend out over the surface of

the host, suggesting that there was probably a mycelium between the spots which later disappeared for the most part.

4. Size: The fly-speck upon charlock is distinctly smaller on the average than any of the other fly-specks. The largest measurement that has been made is 272.0 u x 224.0 u. The majority run about 224.0 u x 176. u or smaller.

Celastraceae

7. Fly-speck fungus upon Evonymus

a. Macroscopical observations

The minute, black, shiny specks occur upon the one year old woody twigs (Plate X Figure 1). The colonies are not as clustered as is often the case on other host plants, but are more or less scattered upon either surface of the young green-colored terminal twigs mostly between the nodes.

The arrangement of the specks is quite irregular, however, frequently three to seven specks appear in a direct alignment or row. Sooty-blotch is associated with the fly-speck upon the same twig, but a distinct antagonism is apparent between the two fungi.

The green color of the Evonymus stem makes it somewhat more difficult to find the fly-speck fungus than on most of the other hosts, but the sooty-blotch, where it is present, causes the stem to appear darker and by searching in the lighter restricted areas on the epidermis near the tips of the past season's growth (especially the last four or five internodes) the minute black dots are readily seen with the naked eye. Even with the naked eye a variation in the size of the specks can be seen.

b. Microscopical observations

1. Color: Dark brown, deeper brown than commonly found on

most fly-speck yet of the same general quality.

2. Shape: Round to elliptical when looking directly down upon the speck; flat becoming quite convex in cross-section.

3. Membrane structure

a. Center of membrane

The center of the membrane is similar to that of fly-speck upon other hosts. Main hyphal lines pass cross the membrane between which occur the irregular angular cells.

b. Marginal wreath

The marginal wreath is greatly abbreviated or entirely lacking. The marginal wreath lacks the light brown to hyaline cells, but is principally composed of the ends of the main hyphal lines extending a short distance from the center. The branching at right angles characteristic of other fly-specks is almost entirely lacking in the specimens studied.

4. Size: The average size of the fly-speck upon Evonymus is rather below that of apple fly-speck. Following are a few measurements commonly made from this fly-speck.

256.0 u x 144.0 u

240.0 u x 160.0 u

224.0 u x 176.0 u

176.0 u x 176.0 u

176.0 u x 128.0 u

Ebenaceae

8. Fly-speck fungus upon persimmon

a. Macroscopical observations

Fly-speck upon this host appears as small, minute, black dots in more or less definite colonies. The colonies covering a

somewhat round area on the twig may be composed of as many as twenty specks in a group, and may be located either at the node or scattered along the internode. The general brown to gray brown color and pubescence of the twigs render these specks much less noticeable than upon the fruit of apple, and they do not appear to be as abundant upon twigs of persimmon as upon sassafras. The fly-speck fungus colonies have been found on the last year's growth and the two-year old twigs.

b. Microscopical observations

1. Color: Dark brown, similar to apply fly-speck.

2. Shape: Round to elliptical when seen from directly above with somewhat irregular margin, partly due to its extension among plant hairs. No ostiole is present. In cross-section, the speck appears flat, becoming convex in the center.

3. Membrane structure:

a. Center of membrane

Definite lines of hyphal cells pass across the center of the membrane often reaching from the margin to one of the perforations through which a trichome passes and there apparently ending; or else turning aside it passes partly around the plant hair and continues across the membrane at an angle to its previous line of direction. Between these main lines of hyphae are the irregularly angular cells so characteristic of all the fly-specks.

One of the most conspicuous features of this fly-speck is the presence of the perforations or openings through which the colorless pointed plant hairs pass. Apparently in the formation of the speck, the growth of the fungus surrounds or partly surrounds, as the case may be, the trichomes present upon the host tissue. There may be from one to fifteen or more of these openings in the

membrane depending upon the presence or absence of plant hairs, the number varying considerably.

b. Marginal wreath

The marginal-wreath is light brown to hyaline and in the specimens examined appears to be slightly less developed than in the apple fly-speck.

Due to the extension of the margin partly around a trichome the margin is frequently made more or less irregular. Also the margin is limited in width because of the fact that the main hyphal lines soon after leaving the membrane center ^{appear to} become evanescent. The branching at right angles is not so abundant or evident as in apple fly-speck.

In general characteristics, the fly-specks upon sassafras and persimmon closely resemble one another.

4. Size: The size is quite variable. Following are representative measurements made:

309.0 u x 257.5 u

288.0 u x 224.0 u

272.0 u x 256.0 u

224.0 u x 224.0 u

192.0 u x 160.0 u

Cucurbitaceae

9. Fly-speck fungus upon watermelon

a. Macroscopical observations

The material for the study of this fly-speck was collected late in October at White Heath, Illinois. As previous observations on this fungus had not been made, the time of its first appearance in the growing season is not known. At this late season

the fungus was very abundant, it being possible to find a great number of colonies upon the lower surface of nearly every watermelon (Plate XI) in a field of several acres. The marketing season was over at this time, but the field was plentifully covered with the immature melons or those caught by the frost. Upon rolling these fruits over, the specks were readily visible to the naked eye as small shiny, black dots forming colonies upon the uncolored surface which had been in contact with the ground. The fly-speck colonies also spread to the green portions of the fruit, but were there less conspicuous, and they were entirely lacking on the upper more exposed sides of the fruit. Some of the striking features of this fungus are, first, its great abundance on the lower surface of each fruit and its general occurrence throughout the field and, second, the variations in size of the specks. Upon every fruit a few colonies appear made up of decidedly larger specks and of darker color (due to size and thickness) than the majority of the specks (Plates XI and XII). The first impression is that possibly two different types are present. Microscopic examination later showed the specks of specks to be of the same general nature but some possibly more mature or older.

A variation in shape is also to be noticed. It is possible, especially with a hand lens, to note that in many of the specks a whole or part of the black membrane center has dropped out (Plate XII) leaving a dark narrow margin.

No sooty-blotch was associated with this fly-speck. The only other fungus conspicuously present on the melons was *Colletotrichum lagenarium* (Pass) Ell and Harkn.

b. Microscopical observations

1. Color: The fly-speck upon watermelon from observation through the compound microscope is seen to be entirely different

from any of the fly-specks thus far described. This difference is not so marked in the color possibly as in other characters yet even in this character a differentiation can be made.

The color is dark brown to black in the center of the membrane gradually becoming lighter brown in the marginal-wreath. The dark brown becomes almost black, and due to this darker brown to black color is differentiated slightly from other fly-specks. This color differentiation is due (1) to the much finer dark heavy-walled mycelium forming the membrane and which thus imparts or intensifies the dark brown color, there being a relatively greater number of dark cell walls present, and (2) to the greater thickness of the body of the speck and thus contributing with its density to the darker color. On the whole, therefore, watermelon fly-speck is darker brown than any of the other fly-specks described.

2. Shape: The shape is quite variable, much more so than in apple fly-speck. In looking directly down upon ^{them} / the specks may be round to elliptical or exceedingly irregularly round to elliptical (Plates XII, XIII, XIV). Frequently two round specks may coalesce by the union of their margins and form a twin or paired speck as has also been noted with apple fly-speck and others.

3. Membrane structure:

a. Center of membrane

The structure of the center of the watermelon fly-speck (Plate XIV figures 1 and 2) is very difficult of description. This is partly due to the dark to black membrane obscuring to a large degree the real nature of the cell arrangement, and also to the complex arrangement of the very fine mycelia composing the membrane. The membrane is hard and brittle, and is composed of a network of very fine hyphal threads which branch and rebranch and anastomose in

a most intricate manner. The branches become more distinct in the marginal portion where ^{they are} less black, and dense. Without question there are main hyphal lines crossing and anastomosing over the membrane, but these are ^{of} finer character and obscured by the black surface color of the speck.

If the brown to blackish colored membrane be teased apart, a hyaline to slightly amber colored substance is revealed beneath. The exact structure of this internal portion has not been definitely ascertained, but in a few of the mounts it was found possible, by using great care, to separate the brown outer membrane entirely from the hyaline structure beneath. This internal portion retained the general shape of the flat to convex fly-speck, and appeared to be composed of hyphae radiating from the center of the convex surface. By crushing this hyaline internal portion it was found to be rich in oil globules, and the cells separated and dispersed in the mount. This sub-membrane structure was found to be viscid corresponding in that respect to that of other fly-specks.

In cross section measurements showed the depth of many of the specks to be 27.2 u to 28.8 u. In this section the cells are crowded together appearing hexagonal in outline and arranged more or less in arching rows from the center outward. Looking directly down upon the speck a light zone indicating a different density due to an arching of the fly-speck has been noted in a few of the water-melon specks as well as a light spot in the center of the membrane suggesting that a rupture or ostiole might develop there; but such an opening has never been definitely demonstrated.

b. Marginal wreath

The marginal-wreath may or may not be present. Normally it is present, but a common occurrence is for it to break away and be

lost leaving merely the black or dark brown fly-speck body on the cuticle. Where the above phenomenon has not taken place the very fine, main, brown, branching hyphae radiate out over the host surface and join one speck with another. The radiating branching and connecting hyphae forming this mycelial network over the surface between the fly-specks becomes very light brown to hyaline. One will observe, however, upon focusing upon this spreading hyphal growth between the specks, cellular structures as figured in Plate V, figures 4b and c. At first sight they look somewhat similar to the hyphopodia present in the genus *Meliola* (Stevens 1916). They appear as single brown cells with either a thin round place in the cell wall or a small round opening. These brown walled cells are joined to hyaline cells as shown in the figure, and this is but part of the surface mycelium.

Upon focusing upward, one will find that this small round hyaline thin walled portion or opening is but the point of attachment of a dark brown heavy walled four to five septate hypha ranging from 32.0 μ to 51.2 μ in length, and which joins another of the spreading hyaline hyphae at another point on the host surface (Plate V, figures 4a and d). Occasionally these bridging hyphae or anastomosing hyphae become broken near one or the other end of attachment and they then appear as setae upon the more or less hyaline mycelium between the specks. The presence of these bridging or anastomosing hyphae is a very novel feature and a conspicuous one in the case of watermelon fly-speck. One of the anastomosing hyphae is in focus in the photomicrograph of Plate XIV, figure 2a.

The brown basal cells are in evidence in various parts of the same figure around the black fly-speck which occupies the center of the picture.

In summarizing the conditions found with watermelon fly-speck, we have first, the black to dark brown superficial speck with membrane of exceedingly fine hyphae (not inverse-radiate). This forms a lighter brown marginal-wreath which normally merges with a fine hyaline spreading network of hyphae which joins one speck with another. Abundantly distributed over this spreading hyaline network are the brown basal cells and bridging or anastomosing hyphae.

4. Size: The size is much more variable in watermelon fly-speck than in the other fly-specks described. This is true of both the horizontal and vertical measurements. The watermelon fly-specks attain a much greater size as some of the following measurements show:

220.0 u x 220.0 u

308.0 u x 242.0 u

336.0 u x 336.0 u

368.0 u x 368.0 u

384.0 u x 384.0 u

412.0 u x 360.5 u

466.0 u x 255.0 u

555.0 u x 550.0 u

777.0 u x 777.0 u

IV. General Discussion

From the morphological studies of fly-speck upon nine different hosts we find a number of characters common to all. In the first place, all nine fly-specks are entirely superficial, never penetrating even the cuticle of the host upon which they occur; also in cross-section they are all flat, becoming convex in the center or they may be termed shield-shaped or halved; looking directly down upon the specks they are in general elliptical varying on the one hand to circular and on the other to sub-linear; they are all of the same general color, namely, brown, with a distinct difference in the degree of brown to black between apple fly-speck together with seven of the other described fly-specks and watermelon fly-speck; brittleness of the membrane and the somewhat viscid elastic nature of the sub-membrane tissue is common to all the fly-specks; and lastly, the failure to locate any spore form thus far during the investigation is true in all the fly-specks under observation.

While the above named characters are universally present in all nine of the fly-specks, it is quite apparent that there is a distinct difference in the watermelon fly-speck and apple fly-speck. It is also clearly shown that there is a strong similarity between apple fly-speck and the seven other fly-specks (raspberry, blackberry, peach, sassafras, charlock, Evonymus, and persimmon) studied. Following, is a comparison of watermelon fly-speck and the apple fly-speck group in which we will for the present include the specks occurring upon the eight different hosts.

1. The watermelon fly-speck has a much wider range and greater variation in size and shape of the specks than the eight other fly-specks.

2. In watermelon fly-speck the specks are joined with a fine hyaline mycelial growth or network upon which are developed the brown septate bridging hyphae.

The connecting hyphae between the specks of the other eight described specks if ever present become evanescent or they are lacking entirely, as are also the bridging hyphae.

However, in several of these fly-specks described, traces of a probably connecting hyphal growth was indicated by a few hyphal threads extending from the membrane structure.

3. The marginal-wreath of the watermelon fly-speck is composed of fine radiating spreading hyphae while that of the other eight fly-specks is composed of coarser hyphal lines which branch at somewhat right angles, and appear to become evanescent at the periphery.

Thus it is clearly evident that there is a distinct difference between the watermelon fly-speck and the apple fly-speck group.

A separation of the apple fly-speck group into several smaller groups on minor characters will be given in the following key.

Key to Fly-speck fungi

Membrane structure superficial, above the cuticle; shield-shaped; (flat becoming convex in center) brown to black, brittle round to elliptical, and in some forms very irregular. No ostiole.

I. Membrane composed of fine dividing, much branched, spreading mycelium, anastomosing hyphae present on network of connecting or spreading mycelium.

(1) Watermelon fly-speck

II. Membrane composed of main hyphal lines between which irregularly

angular cells are massed. Connecting mycelium absent or evanescent.

1. Membrane structure growing around plant hairs thus generally leaving openings through membrane

(2) Fly-speck on sassafras

(3) Fly-speck on persimmon

2. Membrane entire (not perforated)

- a. Marginal wreath generally well developed

(4) Fly-speck on charlock

(5) Fly-speck on apple

(6) Fly-speck on peach

- b. Marginal-wreath, not well developed; membrane structures long elliptical to sub-linear

1. Membrane structure with medium width margin

(7) Fly-speck on raspberry

(8) Fly-speck on blackberry

2. Membrane structure with margin very much abbreviated or lacking, elliptical

(9) Fly-speck on Evonymus.

It is possible to formulate a key which would separate out each kind (according to host) of fly-speck by itself rather than into small groups of two or more by the use of certain host characters, such as shape of the plant hairs protruding through the fungus membrane perforations and shape or color of host cells upon which the fungus grows, but this seems both superfluous and undesirable. The mere difference of host is insufficient to indicate a separate species.

The key given above separates the fly-specks upon fungus characters and divides the nine fly-specks into two main groups and

four sub-groups.

Certain characters as size and shape were found to be entirely too variable to be used as characters of separation, doubtless because they depend to a large degree upon age and environment.

Other characters used in the sub-division of the second or apple-fly-speck group are also quite variable, and appear to the writer as of minor significance, and that the same fundamental morphological characters are common to all eight of the fly-specks.

Due to the lack of any other characters (such as size, septation, and color of spores) the type of membrane necessarily had to be relied upon entirely in describing and separating the fly-speck fungi after the first separation into the watermelon and apple fly-speck groups. Therefore, for the present it appears to the writer that all eight of the fly-specks placed in the apple fly-speck group should be provisionally regarded as one species, or varieties of the same species, at least, until observations have continued over a longer period and stronger and more evidence is accumulated.

Should future findings reveal the presence of spores, it may be possible to establish differences of a specific value in the apple fly-speck group.

Theissen (1913) concluded from his study of the Microthyriales that there was a stronger, more deeply-seated hereditary difference in the membrane structure than in the septa or color of the spores. Spores not being known in these fly-speck fungi here studied, comparative observations can not be made of their color or septation in contrast to the membrane structure. However, it is the belief of the writer that the membrane structure here as in Microthyriaceae is of primary fundamental importance in their classi-

fication, and that this will remain true even should spores be discovered during subsequent investigations.

The present study is the result of observations over a period of about six months, and it is impossible therefore to definitely state what may be expected in the differentiation of the flat to convex shield shaped fungus body and in the production of spores.

Observations must be extended to cover from one to several years before a definite knowledge and understanding can be obtained on this point. There is a striking resemblance between the above described fly-speck fungi and the Hemisphaeriaceae of Theissen(1913). These resemblances might be summarized as follows:

(1). The Hemisphaeriaceae are composed of half-spherical shield shaped fungous structures lying above the cuticle, that is they comprise only surface-growing species. The fly-specks, likewise, are flat to convex, becoming half-spherical shield shaped fungous structures growing above the cuticle.

(2). Thiessen divides the Hemisphaeriaceae into two groups, one with a net-like membrane or Dictyopeltineae, and one with "schollig" membrane or Thrausmatopeltineae.

The fly-specks correspond to the second group, both in shape and cell arrangement and in color of membrane (brown).

(3). The presence of the net-like margin in the Thrausmatopeltineae is also similar to the marginal-wreath described in the fly-specks. The only character failing to throw the fly-specks into the Hemisphaeriaceae is the absence of the proper fruiting or spore form stage. If the half spherical fungous body of the fly-speck should differentiate into a definite fruiting structure with (1) a dark membrane covering, (2) a fruiting layer (asci and paraphyses) and (3) a soft hyaline ground layer of hyphae, it would unquestiona-

bly belong to this Hemisphaeriaceae of Theissen's.

On the other hand it might be found to develop into a dimidiolate pycnidium in which case it would remain in the Fungi Imperfecti. Thus far the fungus has been found to consist of (1) a dark membrane covering including the raised center and the appressed marginal-wreath and (2) beneath the raised center a soft, hyaline mass of fine hyphae several cells in depth and resting directly upon the cuticle of the host.

It would be logical to believe that this hyaline mass of cells beneath the hard brittle membrane might differentiate into fruiting bodies of some nature. If such differentiation does not take place, several theories concerning the cause of this fungus structure might be advanced. Among these suppositions might be mentioned (1) that the structure is a degenerate form of a fungus belonging, possibly, to the Microthyriales or some other fungus group, and which has become sterile and would therefore be placed with the Mycelia-sterilia. It does not seem possible to consider the shield shape or convex disk fungus body as a sclerotium, but it is possible that it does break away and the fragments function as chlamydospores in propagating the fungus and in completing its life cycle. (2) The fungus consists of a fine hyphal network over the cuticle of the host and upon receiving certain stimuli is induced to branch abundantly latterly, forming the shield shaped structure which grows first from the crossing hyphal cells of the original vegetative network and later from the margins of the fungus body. At the same time, that the surface membrane development takes place the hyaline cells are developed beneath by a massing together of hyphal strands and the formation of a pseudo-parenchymous tissue ^{at}.

The stimuli causing the change in growth and the formation

Subscription price, Five Dollars per Annum in Advance. Single Copies, Fifteen Cents.
Entered as Second-Class Matter, May 2, 1882. Postpaid at Special Rate of \$3.75 per Annum.
Acceptance for mailing at Special Rate of Postage provided for in Act of October 3, 1917.
Authorizes sale by mail.

Published by the American Medical Association, 535 North Dearborn Street, Chicago, Ill.
Subscription orders, notices of change of address, and other communications should be sent to the Editor.
Advertisements should be sent to the Business Manager.
Copyright, 1919, by American Medical Association

Published by the American Medical Association, 535 North Dearborn Street, Chicago, Ill.
Subscription orders, notices of change of address, and other communications should be sent to the Editor.
Advertisements should be sent to the Business Manager.
Copyright, 1919, by American Medical Association

Published by the American Medical Association, 535 North Dearborn Street, Chicago, Ill.
Subscription orders, notices of change of address, and other communications should be sent to the Editor.
Advertisements should be sent to the Business Manager.
Copyright, 1919, by American Medical Association

Published by the American Medical Association, 535 North Dearborn Street, Chicago, Ill.
Subscription orders, notices of change of address, and other communications should be sent to the Editor.
Advertisements should be sent to the Business Manager.
Copyright, 1919, by American Medical Association

Published by the American Medical Association, 535 North Dearborn Street, Chicago, Ill.
Subscription orders, notices of change of address, and other communications should be sent to the Editor.
Advertisements should be sent to the Business Manager.
Copyright, 1919, by American Medical Association

Published by the American Medical Association, 535 North Dearborn Street, Chicago, Ill.
Subscription orders, notices of change of address, and other communications should be sent to the Editor.
Advertisements should be sent to the Business Manager.
Copyright, 1919, by American Medical Association

Published by the American Medical Association, 535 North Dearborn Street, Chicago, Ill.
Subscription orders, notices of change of address, and other communications should be sent to the Editor.
Advertisements should be sent to the Business Manager.
Copyright, 1919, by American Medical Association

Published by the American Medical Association, 535 North Dearborn Street, Chicago, Ill.
Subscription orders, notices of change of address, and other communications should be sent to the Editor.
Advertisements should be sent to the Business Manager.
Copyright, 1919, by American Medical Association

Published by the American Medical Association, 535 North Dearborn Street, Chicago, Ill.
Subscription orders, notices of change of address, and other communications should be sent to the Editor.
Advertisements should be sent to the Business Manager.
Copyright, 1919, by American Medical Association

Published by the American Medical Association, 535 North Dearborn Street, Chicago, Ill.
Subscription orders, notices of change of address, and other communications should be sent to the Editor.
Advertisements should be sent to the Business Manager.
Copyright, 1919, by American Medical Association

Published by the American Medical Association, 535 North Dearborn Street, Chicago, Ill.
Subscription orders, notices of change of address, and other communications should be sent to the Editor.
Advertisements should be sent to the Business Manager.
Copyright, 1919, by American Medical Association

Published by the American Medical Association, 535 North Dearborn Street, Chicago, Ill.
Subscription orders, notices of change of address, and other communications should be sent to the Editor.
Advertisements should be sent to the Business Manager.
Copyright, 1919, by American Medical Association

of the shield-shaped fungus body might be of various natures, for instances the influence or effect of toxins or enzymes either of the fungus itself or from other fungi or colonies upon the same or nearby parts of the host. In this second supposition, the fungus body would be regarded as a purely vegetative structure. In some cases the surface network between the specks may be evanescent (as in apple fly-speck etc.) or it may be permanent as in watermelon fly-speck.

The first of these is the fact that the
  

V. Summary

1. Fly-speck fungi have been found and studied upon members of five separate families of Cormyophytes.
2. The fly-speck occurring upon watermelon has been shown to possess a persistent mycelial growth connecting the specks. Upon this connecting hyphae are formed peculiar brown-colored anastomosing hyphae.
3. Apple fly-speck and watermelon fly-speck show sufficient morphological differences to make it advisable to consider them as distinct species.
4. Using the membrane structure as a basis for classification, eight of the nine fly-specks studied are considered provisionally as one species or varieties of the same species.
5. No evidence of a differentiation of these fly-specks into a fruiting condition has as yet been observed.
6. Type material of *Labrella Pomi* Montagne and Fries. has been examined and compared with the apple fly-speck, commonly known as *Leptothyrium Pomi* (Mont. and Fr.) Sacc. and the two fungi found to be identical in morphological characters.
7. It is quite evident that this study is inconclusive as to the nature of fungous fly-speck, due to the short period during which the investigation has been conducted. Various questions have been raised and lines of future investigation suggested.

 

V. Acknowledgments

The writer wishes to express his appreciation to Dr. F. L. Stevens for suggesting this paper, and for criticisms during its preparation, and also to Dr. A. S. Colby and others mentioned in the text for suggestions and materials.

VII. Bibliography

- Montague, C. and Fries.
1834 Labrella Pomi Mont. (Fr. in litt.)
In Cryptogames nouvelles de France. Am.
Sc. Nat. bot. 2.1 p.347.
- Saccardo, P. A.
1884 Leptothyrium Pomi (Mont. et Fr.) Sacc.
Mich. 2: p.113. in Sylloge Fungorum 3: 632.
- Selby, A. D.
1897 Sooty-fungus and fly-speck fungus in some
diseases of orchard and garden fruits.
Ohio Agr. Exp. Sta. Bull.79, pp.133-134,
figures 8-9.
- 1900 Sooty fungus and fly-speck fungus Lepto-
thyrium pomi (Mont. et Fr.) Sacc. in A
condensed handbook of the diseases of cul-
tivated plants in Ohio. Ohio Agr.Exp.Sta.
Bull.121, pp.13-14, figure 12.
- Chamberlain, Charles J.
1905 Methods in plant histology. 2d edition.
University of Chicago Press.
- Shear, C. L.
1907 Leptothyrium pomi (Mont.) Sacc. in Cran-
berry diseases. U.S.Dept. of Agr. Bur.
Pl.Ind. Bull.110, p.44.
- Duggar, B. M.
1909 Sooty blotch and fly-speck of the apple
and other plants. Leptothyrium Pomi
(Mont. and Fr.) Sacc. in Fungous diseases
of plants, pp.367-369, figures 137-138.
Boston, Mass.
- Theissen F.
1913 Uber Membranstructuren bei den Microthy-
riaceen als Grundlage für den Ausbau der
Hemisphaeriales. Mycologisches Central
blatt. 3: 6. 273-286. (mit 1 Tafel und 4
Textfiguren).
- Vaughan, R. E.
A method for the differential staining of
fungous and host cells. Annals of the Mo.
Bot.Garden 1: 241-242.
- Stevens, F. L.
1916 The genus Meliola in Porto Rico. Illinois
Biological Monographs 2: No.4, pp.7-86
with 5 plates.
- 1916 A convenient little-known method of making
micromounts of fungi. Phytopathology 6:
367.
- Hesler, L. R. and Whetzel, H. H.
1917 Sooty-blotch and fly-speck. Leptothyrium
pomi (Mont. et Fr.) Sacc. in Manual of
fruit diseases pp.104-108, figures 28-29.
New York.

Colby, A. S.
1919

Sooty blotch of Pomaceous fruits.
Thesis, University of Illinois.

DESCRIPTION OF PLATES

Plate I.

Figure 1.

Small colonies of fly-speck and sooty-blotch upon the cuticle of apple. (X 1.1).

Figure 2.

Fly-speck scattered over entire cuticle of apple. (X 1.1).

Plate II.

Figure 1.

Fly-speck fungus occurring near to and in the basin of apple fruit. (X 1.1).

Figure 2.

Exhibition of antagonism between colony of fly-speck and sooty-blotch upon the cuticle of apple. (about X 8).

Plate III.

Figure 1.

Cross-section through apple fly-speck showing the superficial nature of the fungus. (about X 200).

Figure 2.

Looking directly down upon an apple fly-speck membrane, and showing the distinct hyphal lines of cells crossing the membrane and in some cases out-lining triangular areas upon it. Also the lighter marginal-wreath with its characteristic branching. Part of the membrane at two points near the edge has started to break out leaving the marginal-wreath attached to the cuticle. (about X 200).

Figure 3.

Looking directly down on speck of *Labrella pomi* Mont. from

Fungi Selecti Exsiccati Roumeguere No. 124.

Plate IV.

Figure 1.

An individual fly-speck upon apple. (about X 260).

Figure 2.

Two adjacent fly-specks joined by a net-work of hyphae extending from the margin of each speck, and showing the hard brittle membrane slightly crushed and broken revealing the hyaline fungus cells beneath. (about X 260).

Plate V.

Figure 1.

Cross-section through speck of apple fly-speck. (about X 700)

Figure 2.

Small portion of the center of the apple fly-speck membrane showing the main lines of hyphae extending across the membrane from the points a and b. At c several of the irregular angular cells have broken out. (about X 8000).

Figure 3.

Membrane of apple fly-speck showing a portion of the center and a portion of the marginal-wreath. (about X 5000).

Figure 4. a and d.

Bridging or anastomosing dark brown hyphae occurring in the spreading mycelium of watermelon fly speck. (about X 875)

Figure 4, b and c.

Brown cells joining with the anastomosing hyphae and appearing with an opening in it very much like ^{those in} the hyphopodia present in the genus *Meliola*. By focusing up the bridging hyphae joining these cells may be seen.

Plate VI.

Figure 1.

Fly-colony at the node (a) and in the groove (b) of the internode of blackberry twigs. (about X 6).

Figure 2.

Fly-speck upon peach twigs. (about X 6).

Plate VII.

Figure 1.

Fly-speck upon twigs of sassafras, showing specks, also upon the terminal winter bud scales in addition to the nodes and internodes. (about X 6).

Figure 2.

Fly-speck distribution upon the internodes of sassafras twigs, edge of one colony of sooty-blotch showing. (about X 6).

Plate VIII.

Figure 1.

Fly-speck upon cuticle of sassafras showing general character of membrane (looking directly down upon it). Main lines of hyphae cross the membrane surface similar to fly-speck upon apple. Several perforations through which plant hairs passed are shown and the lighter marginal-wreath is present. (X 360).

Figure 2.

Fly-speck upon sassafras similar to figure 1, but removed entirely from the cuticle, mounted in balsam and photographed. (X 260).

Plate IX.

Figure 1.

Fly-speck colonies upon stem of charlock. (about X 6).

Figure 2.

An individual speck upon charlock showing characteristics of membrane.

Plate X.

Figure 1.

Fly-speck colonies upon twig of Evonymus. (about X 4).

Figure 2.

Twigs of persimmon with fly-speck and sooty-blotch colonies exhibiting strong antagonism toward each other. (about X 6).

Plate XI.

Figure 1.

Fly-speck colonies upon under-side of watermelon fruit.
(slightly reduced).

Plate XII.

Fly-speck colonies upon under-side of watermelon fruit showing the breaking out of part or all of the center of the membrane leaving but the margin in many of the specks. (about X 8).

Plate XIII.

Showing about twelve fly-specks in colony upon cuticle of watermelon. Host cells showing distinctly between the specks and less distinctly through the specks. (X 260).

Plate XIV.

Figure 1.

Fly-specks upon cuticle of watermelon showing nature of membrane (X 260).

Figure 2.

Fly-speck upon cuticle of watermelon showing nature of membrane and also in lower right-hand corner (a) a short rod-shaped hypha which is one of the bridging anastomosing hyphal strands so abundant and conspicuous in the spreading surface mycelium of this fungus. (X 260).

Plate I.

Figure 1

Figure 2

Plate II.

Figure 1

Figure 2

Plate III.

Figure 1

Figure 2

Figure 3

Plate IV.

Figure 1

Figure 2

THE LIBRARY
OF THE
UNIVERSITY OF ALABAMA

1

2

3

THE LIBRARY
OF THE
MUSEUM OF NATURAL HISTORY

Figure 1

a

b

Figure 2

THE LIBRARY
OF THE
UNIVERSITY OF CHICAGO

Figure 1

Figure 2

Figure 1

Figure 2

Plate IX.

Figure 1

Figure 2

Plate X.

Figure 1

Figure 2

Plate XI.

THE
OF THE
OF THE

Plate XII.

Plate XIII.

Plate XIV.

Figure 1

Figure 2

UNIVERSITY OF ILLINOIS-URBANA

3 0112 079097843