DEVELOPMENT OF THE CITRUS-SCAB ORGANISM, 
SPhACELOMA FAWCETTI1

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INTRODUCTION

During February and the spring of 1925, field observations were made by the writer on characteristics of the citrus-scab organism (Sphaceloma fawcettii Jenkins) (9) as developed on citrus in the rutaceous collection at the United States Citrus Disease Field Laboratory at Orlando, Fla. Based on these studies, the general aspect of the disease, particularly as affecting leaves of citrus, was later outlined by the writer, as reported by Fawcett and Lee (7, p. 223–226, 487, and fig. 63).

In September, 1928, additional observations were made in the same place, as well as in the collection at the Florida Agricultural Experiment Station at Gainesville. The present paper embodies the data thus obtained, especially those based upon the superficial development of the fungus in Florida on spring and autumn growth of leaves of sour orange (Citrus aurantium L.) and on young fruit of grapefruit (C. grandis Osbeck), as shown in Plate 1 and Figures 1 and 2, and on similar leaf growth of grapefruit and Tahiti lime (C. aurantiﬁolia Sw.). Secondary fungi associated with the fungus are mentioned, and data on cultural studies and inoculation tests are included.

The main purpose of the present paper is to present data relative to citrus scab and its pathogene that will aid in distinguishing them from other diseases and organisms with which they have been confused. For this reason data such as those pertaining to the coloration of the fungus are given in considerable detail. Except in the historical section, no reference is made to scab in other citrus-growing countries, as the writer hopes to present later an account of comparative studies of the pathogene in this and other countries.

HISTORICAL REVIEW

The first published report of the occurrence of Sphaceloma fawcettii in Florida, in other citrus-growing regions of the United States, or

1 Received for publication Nov. 25, 1930; issued May, 1931. Most of the data presented in this paper, of which the title was previously published (11) as “Certain Characteristics of the Citrus-Scab Organism,” are part of a thesis presented to the faculty of the Graduate School of Cornell University in June, 1927, in partial fulfillment of the requirements for the degree of doctor of philosophy.

2 Thanks are due H. M. Fitzpatrick, L. M. Massey, and A. J. Eames, under whose direction the work was done. The writer also appreciates the assistance rendered by H. R. Fulton, F. W. Pennell, T. R. Robinson, H. E. Stevens, G. F. Weber, Erdman West, O. E. F. Winberg, J. R. Winston, and others in obtaining some of the material on which the studies were based, as well as that rendered by H. S. Fawcett in various other ways. The work was done in cooperation with the Office of Horticultural Crops and Diseases, Bureau of Plant Industry, U. S. Department of Agriculture, and with the Department of Plant Pathology at Cornell University and at the University of Florida. Color drawings are by J. Marion Shull, and photographs and photomicrographs by Marcel L. F. Foubert, with the exception of those in Figure 4, C and D, which are by J. F. Brewer.

3 Reference is made by number (italic) to Literature Cited, p. 557.

4 In the account reported by Fawcett and Lee the next to the last sentence concluding the first paragraph should read as follows: “Old lesions on grapefruit often remain pink or rose colored, presenting a smooth scarred appearance.”
FIGURE 2.—Sphaecoma facetii on lower side of 2-weeks-old scabbed sour-orange leaves. A. White or pale masses of conidiophores and conidia. × 1. B, a, Dark-colored masses of conidiophores and conidia. × 1. C, a, and D, a, Secondary Fusarium. × 6½. E, Isolated groups of conidial fructifications, some in circular arrangement (a) on rims of prominent galls. × 6½.
Material from Gainesville, Fla., September, 1928.
even in the Western Hemisphere, appears to be that by Scribner (17), dated August, 1886. The account is based upon specimens or information transmitted to the United States Department of Agriculture from Ocala and Deland, Fla., during 1885 and 1886. Swingle and Webber (21) later noted that the disease had been recognized in Florida "in about the year 1884." W. T. Swingle has recently informed the writer that this date is based upon the observation of scab at that time in a nursery near Lake Weir, afterwards visited by himself and H. J. Webber. From examinations of specimens from Florida and Paraguay recently identified by the writer and now inserted in the Mycological Collections of the Bureau of Plant Industry, it is evident that the organism was established on citrus in both North America and South America at an even earlier date. The specimen from Florida, labeled only "May 1, 1878, Fla.," was originally from a collection of fungi owned by the late W. H. Seaman. The more complete information on the label of the South American specimen reads as follows: "B. Balansa—Pl. du Paraguay. 1878-1884. No. 3543. Ecorces d'oranges douces. Villa Rica, 13 janvier 1882." On this specimen, although acervuli were numerous, no conidia were seen, so that until additional data are available the specific identification of the fungus as \textit{S. fawcettii} should perhaps be regarded as not absolutely positive. The circular arrangement of scab lesions on leaves of citrus (fig. 2, B) grown in Paraguay, noted by Spegazzini (18), corresponds to that on such growth developed in Florida and later described by the writer, as reported by Fawcett and Lee (7, p. 225).

Scribner (17) thought that \textit{Sphaceloma fawcettii} was of recent occurrence in Florida. Swingle and Webber (21) expressed the opinion that it had been introduced on Satsuma (\textit{Citrus nobilis unshiu} Sw.) from Japan, from which country the first importation of this citrus variety was brought to Florida in 1876 (1). As identified by W. T. Swingle for the writer, the kind of citrus represented by the Seaman specimen is probably sour orange, which is the same species as that on which the Satsuma was first budded in this country (1). It is of interest to note that the fungus is not present on material of sour orange and other citrus varieties, not including Satsuma, contained in the Schweinitz herbarium, as acquired by the Academy of Natural Sciences, Philadelphia, in 1834. These specimens bear no date.

Comparisons of \textit{Sphaceloma fawcettii} with the similar species of Sphaceloma causing the disease of avocado (\textit{Persea spp.}) known as avocado scab, made in 1925 by the writer (10), revealed that these two organisms had formerly been confused (19, 20, 25) and that the one from citrus is not pathogenic on avocado, or at least not on some varieties, as heretofore supposed (19, 20). On the basis of information then in part unpublished, the writer (9) had formerly assumed that the two organisms or diseases were identical.

Scribner (17) reported that sour orange and lemon (\textit{Citrus limonia Osbeck}) were particularly susceptible to citrus scab, but that the sweet orange (\textit{C. sinensis Osbeck}), even now regarded as immune or highly resistant (25, 26) was not affected. Swingle and Webber (21) commented upon the economic importance of scab in the lemon groves of Florida, and more recently Winston (25) has explained that to this disease was largely due the "failure of the lemon industry in" that State, which before the fungus became established there
“gave promise of becoming a very profitable undertaking.” Many rutaceous hosts other than those named in the present paper are known to be susceptible to attack by *Sphaceloma fawcettii*, or by what, so far as known, is this species (25, 26). This fungus, or at least a *Sphaceloma* on citrus, is firmly established in all citrus-growing regions where climatic conditions favor its development (6, 13, 25). Peltier and Frederich (13) do not include Java among such regions, but scabbed citrus at hand, collected at Buitenzorg in 1919 by R. D. Rands, leaves no doubt of the occurrence there of a *Sphaceloma* on citrus. Whether this organism is identical with *S. fawcettii* remains to be determined.

**FRUCTIFICATIONS ON SCAB LESIONS**

DISTRIBUTION

On young scab lesions found on leaves the fungus generally fruits in abundance on the surface originally infected. It was with reference to this surface that the writer made the statement (7, p. 224) that the central, often craterlike area of young galls (fig. 2, B, a), i. e., the type of lesion whose histologic structure is described by Cunningham (3) and Butler (2), is covered with a fine velvety layer of conidiophores and conidia, which slowly disappears with the aging of the leaf. As concerns young lesions of the gall type, particularly those considerably raised, subsequent observations have revealed that such surfaces from the first may be practically free from fructifications of the fungus; or that the fructifications may occur only in small solitary clumps or larger masses on the marginal regions or rims (fig. 2, E), sometimes outlining troughlike depressions or grooves (figs. 2, E, a, and 3, A, a). Where a layer of phellem extends as a continuous band from one side of the leaf to the other, the fungus sometimes fruits on both surfaces of the intervening region of the lesion, although in greater abundance on the surface originally infected. Where the necrotic centers of such lesions have fallen away, the fungus may fruit scantily on the faces of the hypertrophied tissue thereby exposed. On lesions in which the tissue has become completely necrotic (fig. 1, A, b, and C), possibly owing to the absence of a well-developed phellem, conidial fructifications often cover practically the entire area of the surface originally infected (fig. 3, B), and may also be numerous on the opposite side (fig. 3, D). The necrotic lesion shown in Figure 1, A, b, and C, of which a section is shown in Figure 3, D, is a compound lesion; while that illustrated in Figure 3, B, as in the case of the gall type of lesion shown in Figure 3, A, probably resulted from an individual infection. Fructifications of the fungus were present only on the lower side of the compound lesion of the gall type illustrated in Figure 1, A, a, and B; that is, on the surface there represented.

At Orlando, Fla., during the spring of 1925, a record was made of the persistence of conidial fructifications of *Sphaceloma fawcettii* on living scabbed leaves of sour orange. The record showed that they may be present on the same lesions for as many as four months.

**COLORATION**

Masses of conidia and conidiophores on the surface of the lesions on young fresh leaves, stems, and fruits of citrus, as observed at
FIGURE 3.—Cross sections through scabbed leaf lesions. A, Large sporodochium on concavity on lower surface of gall; a, solitary clump of conidiophores and conidia. X about 200. B, Fructifications covering thickened region of necrotic lesion. C, Enlargement of peripheral region of B, showing more clearly (a) clump of conidiophores bearing conidia there labeled a. B, X 100; C, X about 600. D, Fructifications on compound necrotic lesion, covering not only the entire lower surface but also part of the upper. X about 200. Material from Gainesville, Fla., September, 1928.
A, scab lesions on young fruit of grapefruit; B–D, scab lesions on lower side of several-weeks-old leaves of sour orange, conidial fructifications of the causal fungus visible only on the confluent lesion shown in C. XI. Material from Orlando, Fla., in the spring of 1925.
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Orlando during the spring of 1925, were usually drab in color; on leaves approximately 2 months old they ranged from drab to vinaceous drab or dark olive-gray (7, p. 224-225). Other colorations of the fungus observed in 1925 are Saccardo's umber, pinkish cinnamon, fuscous, and a brownish color termed "hair brown." Hair brown represented the color of the fungus on a single leaf of grapefruit fully 2 months old, and fuscous its development on succulent leaves not more than 2 weeks old. The older leaf was taken from a large tree and the younger ones from small nursery plants. Of the numerous color readings made at Orlando in 1925, these particular colorings were recorded only once. On young scabbed citrus observed at Orlando in the autumn of 1928 the Sphaceloma cover on the surface of the lesions, as well as the lesions themselves, was of essentially the same appearance as in the spring of 1925. None of the fuscous-colored growth was observed. At Gainesville, however, this was the prevailing color of conidial fructifications of the fungus on young sour-orange leaves (figs. 1 and 2, B and E), although occasionally they were pure white or just becoming colored (fig. 2, A). Contrasting sharply with the warm bright hues of the lesions or the immediately surrounding green healthy leaf surface, the fructifications were most noticeable when fuscous in color. (Figs. 1 and 2, B.) In their drab or nearly drab coloration (pl. 1, C), however, they were rather delicate in appearance and, except as seen through a hand lens, often were practically obscured by the warm hues of the lesions themselves (pl. 1, A, B, and D).

MICROSCOPIC APPEARANCE AND DEVELOPMENT

Conidiophores

Many of the small, compact acervuli of Sphaceloma fawcettii, often enlarging to form sporodochia (fig. 3, A and D), were originally confined to a single cell or a few epidermal cells. Their early development was similar to that previously illustrated by the writer (9, fig. 3) for this fungus as produced in culture and here represented in Figures 4, A, and 3, C, a. The latter illustration shows the formation of conidiophores in the leaf tissue, but whether they are beneath the epidermis or beneath only the cuticle is not clear. At an earlier stage in its development the acervulus shown in Figure 4, A, b, probably resembled that represented in Figure 4, A, c; both apparently arose from horizontal hyphae like those faintly shown in Figure 4, A, a. Original clumps of conidiophores were often distinct, even after continued growth from them had taken place. (Fig. 4, E and G.) As in culture (9, fig. 3), when first produced on the citrus substrate the conidiophores were mostly continuous or 1-septate (fig. 4, A, b). They were sometimes colored even before being exposed; often they seemed to be firmly held together, or embedded, in a clear hardened substance apparently derived from their walls. Where conidiophores had continued to grow, by the formation of conidia remaining in situ or by further hyphal growth, they were ordinarily not more than 25 or 30 μ long, suggesting those of Cladosporium or Fusicladium. In the unusually large sporodochial development on the gall type of lesion represented in Figure 3, A, the longest conidiophores measured approximately 100 μ. Some of those composing

9 Color readings, based on Ridgway's color guide, are by J. Marion Shull, F. R. Cole, and the writer.
FIGURE 4.—Parts of cross sections through necrotic lesions. A, a, Hyaline hyphae; b and c, acervuli. × about 600. B, a, Small spherical conidia produced on conidiophores. × about 600. C, a, A conidiophore which first produced a conidium and then continued its growth as a hypha instead of producing another conidium. × 400. D, a, Septate elongate conidium which has produced a secondary conidium while still attached to conidiophore. × 400. E, Enlargement of part of section shown in Fig. 3. D, a, Conidium in situ from which several secondary conidia have developed. × about 600. F, a, Group of spindle-shaped conidia partially dislodged from conidiophores. × about 600. G, Small clumps of conidiophores one of which bears a cluster of conidia at its apex; a, hyphae penetrating the leaf structure. × about 600. Material from Gainesville, Fla., September, 1928.
the pale cottony growth illustrated in Figure 2, A, attained twice this length. Dark conidiophores of more usual length often arose from the entire surface of thick pale-colored stromata, covering the central areas of lesions of the gall type or extending for a considerable distance on the surface of lesions entirely necrotic. Figure 4, C, a, represents a conidiophore which first produced a conidium and then continued its growth as a hypha instead of producing another conidium.

Conidial Forms

Conidia in preparations made from the Sphaceloma cover on scab lesions consisted of (1) ovoid elliptical hyaline conidia, (2) ovoid elliptical (fig. 3, C, a) or spindle-shaped (fig. 4, F, a) colored conidia, and (3) small spherical conidia (fig. 4, B, a) not previously reported. These three types were considered to be homologous or merely to represent older or younger forms. The colored conidia ranged from pale yellowish to reddish brown or nearly black. At times it could be discerned that their dark coloration was limited to a hardened outer wall or epispore. Occasionally this was irregularly thickened or roughened, although ordinarily it was smooth. Where the epispore of dark-colored elongate conidia had become ruptured the hyaline endoconidia thus exposed were indistinguishable from newly formed elongate hyaline conidia such as have been previously illustrated by the writer (9, figs. 3 and 4).

The elongate colored conidia, which were present in great numbers, commonly measured about 10 by 4 μ, although occasionally they reached 16 μ in length. They were usually continuous but sometimes 1-septate or, more rarely, 2-septate. (Figs. 3, C, a, and 4, E–G). In the 1-septate type a number were seen to be breaking apart at the septum or to have become entirely separated. They were sometimes produced on the sides of the conidiophores, or what were originally conidia, all or part of the way from the base to the apex, extending outward more or less at right angles. (Fig. 4, E, a.) The septate structure shown in Figure 4, D, a, appears to be a primary conidium continuing its growth in situ on the conidiophore on which it was borne; a secondary conidium has been produced.

Elongate hyaline conidia were usually seen in preparations made during periods of precipitation or when the leaves were wet with dew. Usually detached, many of them had sprouted from colored elongate conidia of which they were only younger forms; they were usually produced at the end or perhaps even more commonly at a point just to the side, as is illustrated by Petch (14, figs. 3 and 4) for what appears to be a comparable mode of conidial formation in Myriangium duriaeii Mont. and B., not hitherto interpreted as such. They were formed in the same manner in from 1 to 3 hours when the elongate, colored conidia were sown in drops of water on glass slides.

The spherical microconidia were seen on numerous occasions at Orlando, Fla., during the spring of 1925. They ranged from 1 to 4 μ in diameter. Those of the hyaline type were often glistening or highly refringent, particularly when thick-walled. As in the case of the elongate conidia, they sometimes budded from each other. On a few occasions they were produced from the surfaces of elongate colored conidia sown on corn-meal agar medium. The masses of glistening or refringent bodies embedded in the free mucilaginous
substance previously reported as present in this fungus (7, p. 490) were probably masses of microconidia. In one instance small glistening microconidia, about the size of those shown in Figure 4, a, were seen grouped about the pointed apexes of conidiophores still contained within an unruptured epidermal cell. Possibly under more favorable circumstances the larger elongate conidia would have formed. Assuming that the refringent granules observed in Sphaceloma ampelinum DBy. by Prilleux (15, p. 316; 16, p. 37-38), by Viala (22, p. 304-305, fig. 119), and by Viala and Pacottet (23, p. 663; 24, p. 89, fig. 22) were all microconidia, those of S. fawcettii would, of course, correspond to them, as in the case of those produced by S. symphoricarpi Barrus and Horsfall (12).

The comparatively few swollen or germinated conidia seen on the surface of scab lesions corresponded to those formerly illustrated as developed in culture from elongate hyaline conidia (9). Elongate colored conidia that had become greatly swollen and 1-septate or muriform suggested forms referred to Coniothecium by Guéguen (8, pl. 10). Spherical hyaline bodies, visible through the walls of one of them, were probably homologous to the sporelike bodies observed in culture by Fawcett (5) within what was probably the original cell of germinated hyaline conidia 3 days old. Several hundred small conidia of various sizes, present in the vicinity of an elongate colored conidium that had germinated, apparently had been produced from its surface.

ISOLATIONS AND CULTURES

Sixteen or more isolations of Sphaceloma fawcettii from scabbed citrus grown in Florida were made by the writer during 1925 and 1926. Most of them consisted of dilution-plate cultures from the elongate colored conidia on bittersweet orange, sour orange, grapefruit, Satsuma, Tahiti lime, calamondin (Citrus mitis Blanco), and a lemon hybrid. A single set of isolation cultures often produced hundreds of small colonies characteristic of those previously described for this organism (4; 5; 7, p. 490; 25). In order to compare them in parallel, a culture from practically every set of isolations was preserved. The inoculum for such stock cultures ordinarily consisted of a single isolated colony; in most cases this probably represented growth from a single conidium. One culture from Tahiti lime (culture 71), was definitely known to have developed from a single conidium. These cultures and culture 8, which is the single conidium strain of the Stevens culture isolated in 1916 (9), were compared in parallel on test-tube slants of carrot, Molisch's, potato-dextrose, and other agar media. The inoculum here consisted of a mass of stromatic growth about 5 mm. in diameter transferred from each stock culture. In common with culture 8, on the three media named most of the cultures produced a convoluted type of colony. (Fig. 5, A.) Culture 71, however, proved to be decidedly pulvinate as compared with culture 8 or with most of the other isolations that have been made to date. (Fig. 5, B.) Its coloration also was somewhat different; for example, compared in parallel with culture 8, in a certain set of 17-day-old cultures on carrot agar, it was vinaceous brown; ranging lighter and darker; whereas culture 8 was at the same time Tilleul buff. An isolation from bittersweet orange showed features intermediate between those of cultures 8 and 71, in being pulvinate or hemispherical.
on Molisch's medium, even when several weeks old (fig. 5, C) and
definitely convoluted on carrot-agar medium (fig. 5 D.)
The culture from the bittersweet orange is no longer alive, but
cultures 8 and 71 are still in the stock-culture collection. Although
they have been transferred many times, their gross cultural character-
istics still remain distinct as described. Such marked cultural varia-
tions are of course to be taken into consideration when comparisons
are based upon gross cultural characteristics. Their significance
otherwise is not understood. It may be noted, however, not only
that corresponding cultural differences have been observed by the
writer for some of the species of Sphaceloma listed in a previous
publication (12, p. 46–47), but also, judging by Petch's (14) illustra-
tions, that similar types of growth occur in Myriangium as developed
on the host plant. Fawcett has informed the writer recently that in
Sphaceloma fawcettii he has observed
the pulvinate as well as the convolute
type of growth here described.
Culture 8, in 1-week-old cultures
on potato-dextrose agar slants held
for a week at constantly maintained
temperatures of 0°, 7.5°, 10°, 15°, and
20° C., had produced none or only a
little growth at 5°, and slight growth
at 7.5°. A mucous covering, like that
shown in Figure 5, C, was present on
all of the cultures grown at these
temperatures, being most abundant
in the cultures held at 10° and 15°.
Practically the same results were ob-
tained with isolations of a number
of other Sphaceloma fungi grown in
parallel cultures with culture 8. In
the cultures of S. ampelinum, caus-
ing anthracnose of grape (Vitis), it
was produced in a noticeably larger
quantity than in any of the others,
appearing as a thick, clear, glisten-
ing mass. After 12 days at a temperature of 20°, the mucous cov-
ering was still present in only this one species. At any one temper-
ature all of the different isolations grew at about the same rate.

ASSOCIATED FUNGI

A Fusarium, identified by C. D. Sherbakoff as F. fructigenum Fr.,
was observed both at Orlando and at Gainesville, Fla., as forming
fluffy pinkish borders about the scab lesions or galls, often covering
all but the central area occupied by the Sphaceloma. (Fig. 2, C,
a, and D, a.) This may be the Fusarium that J. B. Ellis found on
early specimens of scabbed citrus from Ocala, Fla., sent him by
Scribner, and which Ellis thought might be the cause of the disease
(17, p. 182). Two other secondary fungi occasionally seen on scab
lesions are Colletotrichum gloeosporioides Penz. and a pycnidial fungus
which is possibly a species of Phoma. Superficially both resembled
dark acervuli of Sphaceloma fawcettii such as are shown on the upper
surface of the section illustrated in Figure 3, D. The first secondary fungus grew on the upper side of necrotic leaf lesions and the second on the gall type of lesion on young stems. At Orlando, on scab lesions on an old lemon fruit still hanging on the tree, were coarse conidial fructifications identical with or resembling those usually referred to *Cladosporium herbarum* Massee. It was not determined whether they were identical with a Cladosporium common on the Orlando citrus collection, which sometimes developed in original isolation cultures of *S. fawcettii*.

The Cladosporium referred to previously as occasionally developing in original isolation cultures of *Sphaceloma fawcettii* was readily distinguishable from this organism. Rather delicate as seen in culture, its pale grayish colonies developed much faster than those of *S. fawcettii* and were noticeably less stromatic. The different types of conidia produced by the Cladosporium in culture were sometimes indistinguishable from those of *S. fawcettii* as developed on citrus in the rutaceous collection. The usual absence of conidial fructifications in cultures of *S. fawcettii* has been noted previously (25). This similarity included not only size, color, and general form, but also methods of conidial formation, among them the prompt development of hyaline oval or elliptical biguttulate conidia when the elongate colored conidia were transferred from a less humid to a more moist environment. Although generally longer than the Cladosporiumlike conidiophores of *S. fawcettii*, they were of about the same width.

**INOCULATIONS**

Through inoculation tests the pathogenicity of culture 8 on lemon was proved in 1924 (9). In parallel inoculations with other *Sphaceloma* isolations representing the same or other species, this culture has since been employed in inoculation tests on four other kinds of citrus, namely, rough lemon (*Citrus limonia*, No. 7610?), grapefruit, Thomasville citrangequat (*Fortunella marginata* × Willits citrange, No. 48010), and Cuban shaddock (*Citrus* sp. hybrid, No. 11893). The rough lemon was inoculated in 1926, the others in 1927. The inoculations were made in greenhouses at the Arlington Experiment Farm, United States Department of Agriculture, or in those of the department of plant pathology, Cornell University, none of which at the time contained any citrus other than that employed in the tests. Leaves were inoculated in all cases. The method of inoculation was essentially that described by Winston (25). Small stromatic masses of the fungus, developed in culture, were placed on bits of wet cotton so applied that the fungus came in contact with the leaf surface, and the whole was then wrapped in waxed paper. After about 48 hours all of the coverings were removed. The checks were treated in the same manner except that no inoculum was used. From two to seven individual inoculations, with as many checks, were made for each kind of plant. On Cuban shaddock, inoculations were also made with culture 71, as representative of the other distinct but less usual type of cultural growth. The final readings on infection were made from 18 to 21 days after making the inoculations.

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7 The serial numbers cited are those of crop physiology and breeding investigations, Office of Horticultural Crops and Diseases, Bureau of Plant Industry, U. S. Department of Agriculture, by which the plants to be inoculated were contributed.
With the exception of the citrangequat, infection resulted in all the inoculated plants, although not on every leaf inoculated. No reisolutions were made. The checks remained uninfected. Of seven leaves of Cuban shaddock inoculated with culture 71, four became infected; and of seven leaves of the same variety inoculated with culture 8, at least one became infected. In addition to establishing the pathogenicity of these two strains of Sphaceloma fawcettii on certain rutaceous hosts, these inoculations serve to show that an isolation grown continuously in pure culture for as many as 11 years is still capable of producing infection. They also furnish a record of the fact that two isolations from different sources, markedly different in their gross cultural characteristics, were not physiologically different in their ability to infect a common citrus host, Cuban shaddock, on which no infection had previously been observed (26).

SUMMARY

This paper presents data pertaining to the development of conidia and conidiophores of Sphaceloma fawcettii, the causal fungus of citrus scab in Florida, especially as based upon the superficial development of the fungus in Florida on spring and autumn growth of leaves of sour orange, grapefruit, Tahiti lime, and young fruit of grapefruit. Other data included deal with cultural studies, inoculation tests, and secondary fungi associated with this fungus. Mention is made of the occurrence of S. fawcettii in Florida as early as 1878 and of probably the same fungus in South America in 1882 as well as its distribution in Java. The inoculation tests proved the pathogenicity of the organism on citrus after it had been grown in culture for a period of 11 years, and also its power to infect Cuban shaddock. In connection with the cultural studies of the fungus, colonies of two markedly different types are reported.

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