TWO NEW SPECIES OF HIRSUTELLA PATOUILLARD

FRAN. E. FISHER

(WITH 4 FIGURES)

During the summer and fall of 1948, epizootics were observed of two economically important arthropods, rust mites [*Phyllocoptruta oleivora* (Ashm.)] and purple scales (*Lepidosaphes beckii* Newm.), on *Citrus* in Florida. The occurrence of a fungus consistently associated with dead first instar nymphs of purple scales was reported by Fisher *et al.* (2), and tentatively identified as a species of *Hirsutella*. Later, a fungus on dead rust mites was also reported (1) as probably being *Hirsutella* sp. Further study has shown that these fungi on dead rust mites and dead first instar nymphs of purple scales are not only separate and distinct species, but also are species which have not previously been described.

Both of these fungi are easily recognized under a dissecting microscope with a magnification of 15 ×. On young purple-scale nymphs, the *Hirsutella* exhibits an extensive growth of mycelium which originates from the ventral surface of the insect's body. Only a few hyphae are present on rust mites; these hyphae typically extend posteriorly or anteriorly from the mite's body, but, occasionally, lateral hyphae are found. The direction of the mycelial growth depends upon the portion of the mite's body from which the hyphae emerge. For instance, if a hypha emerges from the posterior region of a rust mite's body, the typical growth of that hypha will be a direct extension posteriorly from the body.

Since the larger-bodied scales give rise to a fuller mycelium than do the smaller-bodied mites, the variations between the two species were at first considered to be non-specific and to be directly related to the food supply. It has been found, however, that the dissimilarities between these two species are not only in size and extent of mycelium, but also in the shape of the phialides and the spores, and the color of the older mycelia.

Morphologically, neither of these species of *Hirsutella* is entirely typical of the genus. Although the conidiophores are characteristic of *Hirsutella*, the production of synnemata has not been observed on rust mites and only two synnemata have been found on young purple-scale nymphs. Other workers have observed that when growing with an insufficient supply of food often the synnemata are not produced, but, instead, single hyphae. Therefore, it would appear that these species do belong to the genus, *Hirsutella*, but that they grow on such small hosts that they can not, or only infrequently, produce synnemata.

Each of these species exhibits a specificity as to host. The species which attacks first-instar purple scales has not been found on rust mites and *vice versa*. Neither of these species has been observed growing on any other insects which are found on *Citrus*.

Whether or not these fungi are responsible for the periodic epizootics of young purple scales and rust mites remains to be proved. However, if they are not parasitic they both appear to be specific indicators of one particular disease of each of the two arthropods.

Hirsutella Besseyi sp. nov. on LEPIDOSAPHES BECKII Newm.

Entomogena. Synnematibus plerumque deficientibus sed raro praesentibus. Mycelio primo albo, deinde cinereo vel brunneo; hyphis erectis vel procumbentibus, 3.3–5.8 μ diam., septatis; conidiophoris a latere vel erectis, rigidis, attenuatis, supra hyalinis infra leve fuliginis, 29.9–74.7 μ longe; phialidibus acuminatis 2.5–4.9 μ × 21.6–66.4 μ, typice in sterigmata attenuatis, 8.3–19.9 μ longe, aliquando 1–3 additicia sterigmata minus 8.3 μ ab phialidis apici gignentibus; conidiis ad apicem, hyalinis, anguste elongatis sed citriformis a capsula gelatinosa visis, 2.5–5.8 μ × 4.1–8.3 μ. Rhizoidibus digitatis.

Hab. in nymphorum primo instar *Lepidosaphes beckii*, in foliis *Citri* spp. prope Lake Alfred, Florida, Amer. Bor. Aug., 1948, Febr., 1949, et Mart., 1949.

Entomogenous. Synnemata infrequently produced. Mycelium white, later gray to brown; hyphae erect or decumbent, 3.3–5.8 μ in diameter, septate; conidiophores lateral or erect, rigid, tapering, hyaline above, pale fuliginous below, 29.9–74.7 μ in length; phialides acuminate, 2.5–4.9 μ × 21.6–66.4 μ, typically attenuated into a sterigma 8.3–19.9 μ in length, occasionally 1–3 additional sterigmata developing within 8.3 μ of phialidal apex; conidia apical, hyaline, narrowly elongate but appearing lemon-shaped due to a gelatinous capsule, 2.5–5.8 μ × 4.1–8.3 μ. Rhizoids digitate.

On first instar nymphs of *Lepidosaphes beckii* Newm., on leaves of *Citrus* spp., vicinity of Lake Alfred, Florida. August, 1948, February and March, 1949.

It has been observed by the author that occasionally large numbers of first-instar purple scales, which are typically white in color,

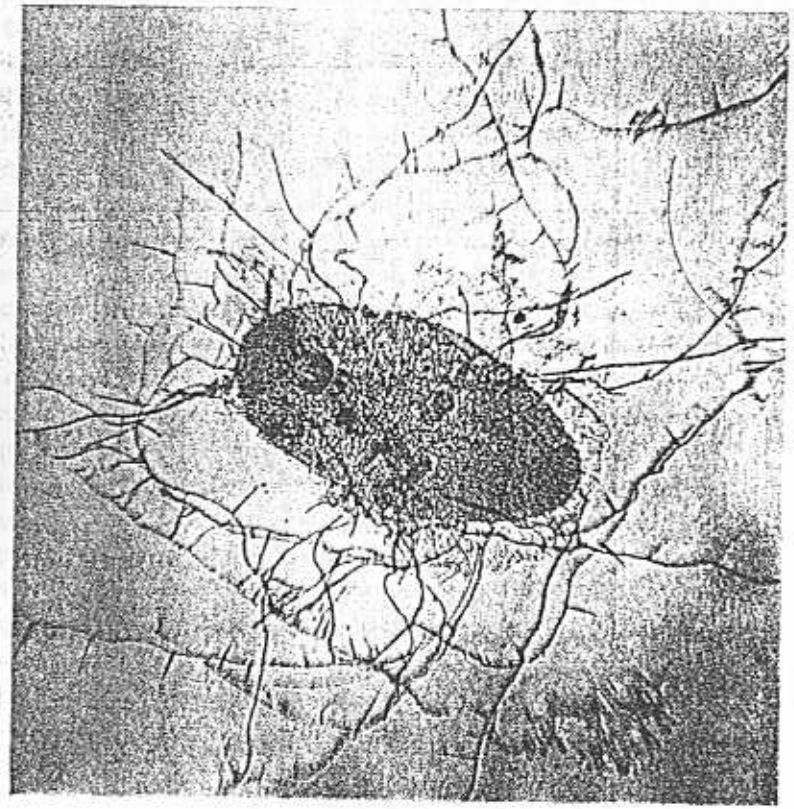

FIG. 1. *Hirsutella Besseyi.*

become yellow and a high mortality follows. A species of *Hirsutella* has been found to be consistently associated with nymphs exhibiting the abnormal yellow color.

The mycelium was well developed over the dorsal surface of the host, and was attached to the leaf surface by digitate rhizoids. With a hand lens the fungus appeared translucent to silvery white in color. Older specimens appeared gray to brown.

In early stages the mycelium was fine, hyaline, and septate, later developing thicker cell walls and becoming pale fuliginous in color. Hyphae occurred singly, averaging 4.0 μ in diameter, ranging from 3.3 μ to 5.8 μ. Closely associated parallel hyphae have not been frequently observed. Typically, synnemata were not produced, but in two instances have been found. Figure 1 shows a first-instar nymph of purple scale with a well-developed mycelium bearing conidiophores and conidia.

The fungus fruited abundantly. The conidiophores were lateral or erect and produced regularly on the mycelium. The phialides were acuminate in shape and attenuated into a long sterigma. Occasionally one to three additional sterigmata occurred within 8.3 μ of the apex of the phialide. Phialides bearing more than one sterigma were more commonly observed in older specimens than in young specimens. Each sterigma bore a single, narrowly elongated spore which was surrounded by a gelatinous matrix, or capsule, thereby giving the spore the appearance of being lemon-shaped. Figure 2 shows two conidiophores each of which is attenuated into one sterigma bearing a conidium.

In naming this species, it is the desire of the author to honor a great mycologist, teacher, and friend, Ernst A. Bessey.

Hirsutella Thompsonii sp. nov. on PHYLLOCOPTRUTA OLEIVORA (Ashm.)

Entomogena. Synnematibus deficientibus. Mycelio primo albo deinde griseo; hyphis procumbentibus, 1.7–3.3 μ in diam., breve septatis; conidiophoris a latere vel erectis, rigidis, hyalinis, 10.8–16.7 μ longe; phialidibus conicis ad strobiloidibus, 3.3–4.9 × 5.4–9.9 μ, typice in dua sterigmata attenuatis, 1.7–6.7 μ, saepe uno sterigmato vel aliquando tribus sterigmatis apice gignentibus; conidiis apicibus, hyalinis, ovoidis vel rotundis, citriformis a capsula gelatinosa visis, 2.1–3.3 × 2.1–3.3 μ. Rhizoidibus digitatis.

Hab. in *Phyllocoptruta oleivora* (Ashm.) in foliis *Citri* spp. prope Lake Alfred, Florida, Amer. Bor. Aug., 1948, Febr., 1949, et Mart., 1949.

Entomogenous. Synnemata not produced. Mycelium white, later grayish; hyphae decumbent, 1.7–3.3 μ in diameter, short-septate; conidiophores lateral or erect, rigid, hyaline, 10.8–16.7 μ in length; phialides conoid to strobiloid, 3.3–4.9 × 5.4–9.9 μ, typically attenuated into two sterigmata, 1.7–6.7 μ, but frequently only one sterigma or occasionally 3 sterigmata develop at apex;

of these large numbers of off-colored mites, a high mortality re-

host, and was attached to the leaf surface by digitate rhizoids. With a hand lens the fungus appeared translucent to silvery white in color. Older specimens appeared gray to brown.

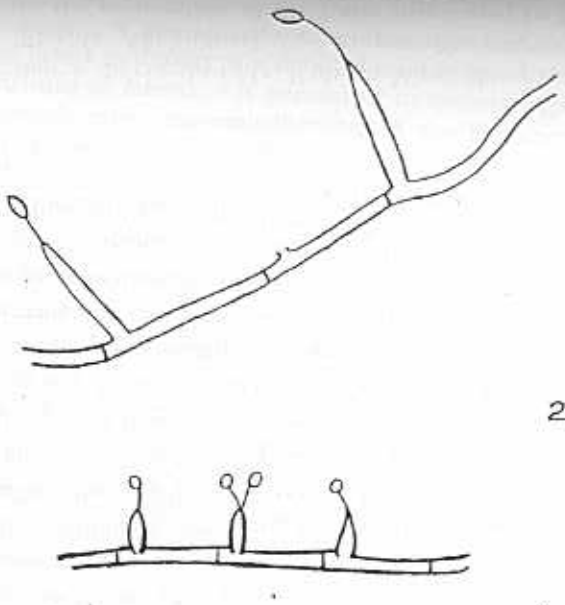

FIG. 2. Mycelium, phialides, and spores of *Hirsutella Besseyi*. 645 ×.
FIG. 4. Mycelium, phialides, and spores of *Hirsutella Thompsonii*. 645 ×.

conidia apical, hyaline, oval to round, may appear lemon-shaped due to a gelatinous capsule, 2.1–3.3 × 2.1–3.3 μ. Rhizoids digitate.

On *Phyllocoptruta oleivora* (Ashm.) on leaves of *Citrus* spp., vicinity of Lake Alfred, Florida. August, 1948, February and March, 1949.

Type specimens of *Hirsutella Besseyii* and *H. Thompsonii* have been deposited in the Herbarium of the University of Florida, Gainesville, Florida, the Farlow Herbarium, at Harvard University, Cambridge, Massachusetts, and the Herbarium of the Commonwealth Mycological Institute, Kew, Surrey, England.

During October, 1948, an epizootic of rust mites occurred in an unsprayed control plot at Lucerne Park, Florida. Large numbers of the living mites exhibited a dark yellow to tan color rather than the light lemon-yellow color which is typical of healthy rust mites. The characteristics of these abnormal mites correspond to the description by Speare and Yothers (3). Following the occurrence

septate; conidiophores lateral or erect, rigid, hyaline, 10.8–16.7 μ in length; phialides conoid to strobiloid, 3.3–4.9 × 5.4–9.9 μ, typically attenuated into two sterigmata, 1.7–6.7 μ, but frequently only one sterigma or occasionally 3 sterigmata develop at apex;

of these large numbers of off-colored mites, a high mortality resulted in the rust mite population. In association with the death of the mites a fungus identified (1) as a species of *Hirsutella* was consistently found to be present on the mites.

Mites which had been dead for a short time and which exhibited a dark yellow to light brown color were mounted for examination.

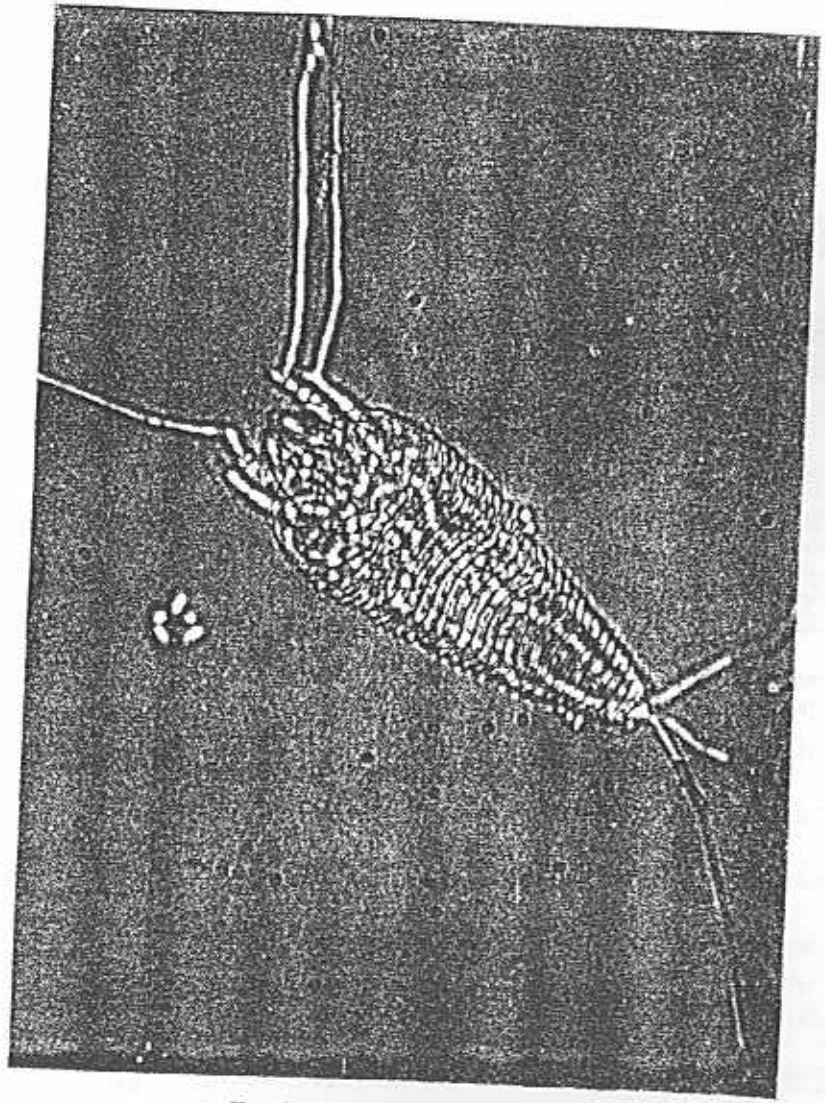

FIG. 3. *Hirsutella Thompsonii*.

Some of these mites contained one or more strands of a fungus mycelium growing longitudinally through the body. On mites which had been dead for a longer period of time, hyphae were growing apparently from the interior through both the anterior and posterior portions of the body. In some specimens lateral emergence of the hyphae occurred. The anterior and posterior emergence of 1–4 hyphae was typical. Under a hand lens, the fungus was silvery-white in color.

During all stages of growth the mycelium was fine and hyaline. The mature hyphae were septate. Hyphae averaged 2.4 μ in diameter, but ranged from 1.7 μ to 3.3 μ. All of the hyphae occurred singly, did not adhere laterally in synnemata, and were attached to the leaves by digitate rhizoids. Figure 3 shows a rust mite with 3 young hyphae growing from both the anterior and the posterior regions. The three hyphae growing from the anterior portion of the mite's body emerged through three of the mite's legs. Several hyphae can be seen extending longitudinally through the body of the mite.

The fungus fruited rather abundantly. Conidiophores were lateral or erect and were produced regularly on the mycelium. Phialides were conoid to strobiloid and attenuated into one or more sterigmata. Although one sterigma was frequently produced by each phialide, the phialides seemed to be typically terminated by two sterigmata, and occasionally three sterigmata were observed on one phialide. Each sterigma bore one oval or round spore surrounded by a gelatinous matrix, or capsule, which in some cases gave the spore a lemon-shaped appearance. Figure 4 shows mycelium bearing three phialides one of which bears two sterigmata.

This species is named to honor a colleague, W. L. Thompson, who has been instrumental in developing the spraying schedule for *Citrus* in Florida, and who provided the author with the first specimens.

ACKNOWLEDGMENTS

The author is indebted to Mr. Erdman West, Botanist and Mycologist, Florida Agricultural Experiment Station, Gainesville, Florida, for the preparation of the Latin diagnoses; to Dr. Ernst A. Bessey, Professor of Botany, retired, Michigan State College, East Lansing, Michigan, for assistance in the identification of the species herein identified; and to Dr. L. Carl Knorr, Histologist, Citrus Experiment Station, Lake Alfred, Florida, for helpful suggestions in the preparation of the manuscript.

UNIVERSITY OF FLORIDA,
CITRUS EXPERIMENT STATION,
LAKE ALFRED, FLORIDA

LITERATURE CITED

1. Fisher, F. E., J. T. Griffiths, Jr., and W. L. Thompson. An epizootic of *Phyllocoptruta oleivora* (Ashm.) on Citrus in Florida. Phytopath. 39: 510–512. 1949.
2. Fisher, F. E., W. L. Thompson, and J. T. Griffiths, Jr. Progress report on the fungus diseases of scale insects attacking Citrus in Florida. Florida Ento. 32: 1–11. 1949.
3. Speare, A. T., and W. W. Yothers. Is there an entomogenous fungus attacking the citrus rust mite in Florida? Science (n.s.) 60: 41–42. 1924.

found in insects. A prerequisite to a thorough understanding of the principles of insect pathology is a detailed knowledge of the anatomy and

Now, just as insect pathology can be useful to other branches of entomology, the converse is true. Insect pathology is absolutely dependent