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## THE TRUE IDENTITY OF THE FUNGUS REPORTED AS *HIRSUTELLA GIGANTEA* FROM EASTERN SPRUCE BUDWORM IN CANADA

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In 1949, D. M. MacLeod at the Forest Insect Laboratory, Sault Ste. Marie, Ontario, sent specimens of a fungal entomopathogen isolated from eastern spruce budworm (*Choristoneura fumiferana* (Clem.)) collected in Ontario to E. B. Mains, University of Michigan for identification. Mains tentatively identified the pathogen as *Hirsutella gigantea* Petch; we assume that it was a tentative identification because he wrote “may be this species” (Mains, 1951). Following Mains, MacLeod (1959) and Loughheed (1963) in Ontario, and Lim (1984) in Newfoundland all referred to isolates of *Hirsutella* from spruce budworm as *H. gigantea*.

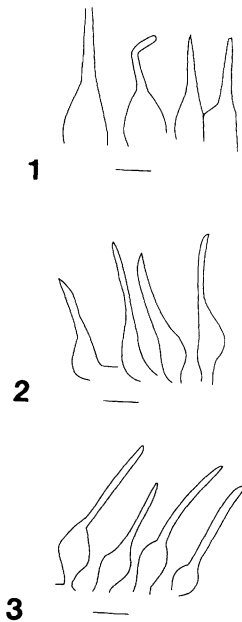
Meanwhile, over the past decade, we have examined more than 10,000 spruce budworm specimens collected from seven sites in New Brunswick, Canada. Some of these specimens yielded two *Hirsutella* species not previously reported from spruce budworm. We identified one as *Hirsutella nodulosa* Petch and the other as a new species *Hirsutella longicolla* Strongman, Eve-

leigh & Royama with a variety *H. longicolla* var. *cornuta* Strongman, Eveleigh & Royama (Strongman et al., 1990). Curiously, however, we have never recovered *H. gigantea* from our collections in New Brunswick.

The complete absence of *H. gigantea* in our large collections made us wonder whether the fungal isolates previously reported as *H. gigantea* from spruce budworm had in fact been misidentified. To check this possibility, we examined specimens identified as *H. gigantea* from three sources: MacLeod's original specimens from Ontario (ONT) that Mains examined; Lim's specimens from Newfoundland (NFLD); and the type of *H. gigantea* (FH 6126). We compared these with the type of *H. longicolla* (DAOM 196534). TABLE I summarizes the measurements and description of these specimens. We compared the phialide morphology of *H. gigantea* (FH 6126) (FIG. 1) with MacLeod's (ONT) (FIG. 2) specimen and *H. longicolla* (DAOM 196534) (FIG. 3) from New Brunswick.

TABLE I  
SUMMARY OF MEASUREMENTS FOR *HIRSUTELLA* SPECIES

Trait	<i>H. longicolla</i> New Brunswick Type	' <i>H. gigantea</i> ' Newfoundland	' <i>H. gigantea</i> ' MacLeod, 1949	<i>H. gigantea</i> Petch, 1937 Type
Synnema	Green, simple 0.1–1 cm	Green, simple <1 cm	Green, simple <1 cm	Brown, simple or branched 2–10 cm
Phialide base	6–14 × 6–10 μm	7–10 × 7–12 μm	7–15 × 6–8 μm	16–20 × 8–9 μm
Phialide neck	21–36 μm	12–27 μm	15–23 μm	<20 μm
Spores	Cymbiform tapered 6.5–10.5 × 2.5–5 μm	Cymbiform obtuse 8 × 4 μm	Cymbiform tapered 8 × 4 μm	Cymbiform obtuse 9–10 × 3–4 μm



FIGS. 1–3. Phialide morphology of *Hirsutella*. 1. *H. gigantea* type specimen (FH 6126). 2. *H. gigantea* (MacLeod specimen, ONT). 3. *H. longicolla* type specimen (DAOM 196534). Scale bars = 10  $\mu$ m.

The comparisons reveal that the ONT and NFLD specimens are, indeed, more like *H. longicolla* than *H. gigantea*. The critical comparison is the phialide dimensions since this is the main feature for separation of species in this genus (Mains, 1951; Minter and Brady, 1980). The phialide base of *H. gigantea* (FH 6126) is more cylindrical than the globose phialide base in the other specimens (FIGS. 1–3). (*H. nodulosa*, the other species known from spruce budworm, has warty phialides with a helical, twisted tip (Minter and Brady, 1980) making it very distinct from both *H. longicolla* and *H. gigantea*.) Furthermore, the synnemata of the ONT and NFLD specimens are similar in size to those of *H. longicolla* (DAOM 196534), but they are much smaller than those of the type of *H. gigantea* (TABLE I).

An interesting observation comes from Loughheed (1963). During his sporulation experiment with an isolate named *H. gigantea* from spruce budworm in Ontario, he noted that the phialide and spore characteristics in vitro matched neither the original description of the species by Petch (1937) nor Mains' (1951) redescription of

the type. However, the morphological measurements recorded by Loughheed match those for *H. longicolla*.

Apart from the questionable records of *H. gigantea* from the spruce budworm mentioned above, we are aware of a few more records of this fungus, all from northeastern USA. Petch (1937) mentions three records: the type specimen from the American dagger moth (*Acronicta* (= *Apatela*) *americana* (Harris)), one from *Acronicta* (= *Apatela*) sp., and one more from an unidentified host. Wagner and Leonard (1980) reported it from the satin moth (*Leucoma salicis* (L.)). It may be that *H. gigantea* attacks macrolepidoptera, unlike *H. longicolla* which has so far been restricted to microlepidopteran hosts (Strongman et al., 1990).

In conclusion, we are certain that the *Hirsutella* specimens from Ontario and Newfoundland are actually *H. longicolla* and believe that this species occurs throughout the geographical range of the eastern spruce budworm.

We thank the University of Michigan Herbarium (M) for the loan of the MacLeod (ONT) specimens, the Farlow Herbarium (FH) for the loan of the type of *H. gigantea*, and K. P. Lim, Forestry Canada, St. John's, Newfoundland for the NFLD specimens. We also thank Drs. C. J. Lucarotti and Tom Royama for their critical comments on the manuscript. This work was funded in part by a Natural Science and Engineering Research Council Visiting Fellowship and operating grant to D. B. Strongman.

Key Words: *Choristoneura fumiferana*, *Hirsutella gigantea*, *Hirsutella longicolla*, spruce budworm, taxonomy

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## SCUTELLOSPORA ARMENIACA, A NEW SPECIES IN GLOMALES (ZYGOMYCETES) FROM POLAND

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Spores of an undescribed species of the genus *Scutellospora* Walker & Sanders were found in soils collected from the root zone of plants colonizing maritime dunes of the Hel Peninsula and the Słowiński National Park and of plants growing on the Błędowska Desert (a site situated ca 500 km from the Baltic Sea). Because of the apricot-yellow color of the spores, the species was named *S. armeniaca*.

Soils were collected from around plant roots and then refrigerated until processing. Spores were extracted by wet sieving and decanting (Gerde-mann and Nicolson, 1963). Spores were first propagated in 500 cm<sup>3</sup> pot cultures prepared from autoclaved quartz sand to which about 200 g of a field-collected soil/root mixture containing a large number of spores and mycorrhizal roots was added. The potting medium was then seeded with *Festuca rubra* L. and *Sorghum sudanense* (Piper) Staph. After 3–5 months of culture, newly formed spores were used to prepare pure pot cultures. An autoclaved soil:sand mixture (1:3, v/v), pH 6.4, 10 and 21 mg/kg P and K, respectively, was the pot medium. Plants were grown in a greenhouse at 18–30 C with 12 h photoperiod (combined incandescent and cool white fluorescent light) and watered once a day. Fifteen-day-old red-fescue and sudangrass seedlings were inoculated with 40–70 spores sandwiched between two layers of roots. Pot cultures were harvested after a year, spores extracted, roots stained (Phillips and Hayman, 1970) and examined for

the presence of mycorrhizae. About 50 field- and 50 pot-collected spores were mounted in polyvinyl alcohol/lactic acid/glycerol (PVLG) (Koske and Tessier, 1983) and examined. Another 10–20 spores were crushed in a mixture of PVLG and Melzer's reagent (1:1, v/v). Wall descriptions and terminology follow those suggested by Morton (1986), Spain et al. (1989), and Walker (1983, 1986). Spore color was examined under a dissecting microscope on freshly collected specimens immersed in water. Colors were determined according to Kornerup and Wanscher (1983). Specimens have been preserved in 5% formalin and PVLG and deposited in the Department of Plant Pathology (DPP), Academy of Agriculture, Szczecin, Poland, and in the herbarium at Oregon State University (OSC), USA. Spelling of scientific names is according to Almeida (1989) and Walker (1991). Classification is that of Morton and Benny (1990).

*Scutellospora armeniaca* Błaszowski, *sp. nov.*

Figs. 1–11

Sporocarpia ignota. Sporae singulae in solo vel in radicibus eformatae, terminaliter vel lateraliter gestae; armeniacae-luteae vel flavido-brunneae; globosae vel subglobosae; (140–)196(–240) μm diam; aliquando ovoideae; 140–200 × 220–250 μm. Tunica sporae e stratis septem in turmis duabus. Turma externa e stratis tribus (strati 1–3); uno rigido, griseolo-aurantiaco, (0.7–)0.9(–1.2) μm crasso; duobus laminato, armeniacae-luteo vel flavido-brunneo, (5.4–)8.7(–13) μm crasso, in solutione Melzeri aliquando granato-rubro; tribus