

Interesting Species of the Laboulbeniales from Upo Swamp

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Eight species belonging to two genera of the Laboulbeniales, parasitic on the family Carabidae and Staphylinidae of the order Coleoptera, were collected from Upo natural swamp in 1996-2001. They are as follows; *Laboulbenia anoplogeni* parasitic on *Platynus daimio*, *L. cristata* on *Paederus parallelus*, *L. egens* on *Tachys laetifica*, *L. flagellata* on *Platynus daimio*, *L. pedicellata* on *Bembidion morawitzi*, *L. philonthi* on *Philonthus wuesthoffi*, *L. stenolophi* on *Acupalpus inornatus* and *Philonthus longicornis*, and *Peyritschiella biformis* on *Philonthus micaticollis*. Among these species, the genus *Platynus* as the host of *L. anoplogeni* and the genus *Acupalpus* as the host of *L. stenolophi* are new to science. *Bembidion morawitzi* as the host of *Laboulbenia pedicellata* and *Philonthus micaticollis* as the host of *Peyritschiella biformis* are new to Korea.

KEYWORDS: Ascomycotina, Coleoptera, *Laboulbenia*, Laboulbeniales, *Peyritschiella*.

Upo is the natural swamp which had been formed, the downstream ground of Nakdong river falling down, by the waters gravity in Jurassic period. It is located 7 kilometers away from the west of Changnyoung-eub, Gyeonnam Province, is surrounded with rather low hills and composed of three swamps, Upo, Okpo, Sajinpo and several small swamplands. It has an area of 16 million square kilometers.

It has been known as a treasury of biological flora, for the diversity of species are abundant and its ecosystem is stable. Therefore, the insect fauna as a host of Laboulbeniales in this region seems to be abundant.

The authors collected many different insects repeatedly to study the fauna of the Laboulbeniales from 1996 to 2001 and these insects were observed by the authors in the laboratory. As a result, 8 species and 2 genera of the Laboulbeniales were found in this region and recored in this paper.

Description of Species

1. *Laboulbenia anoplogeni* Thaxter. Proc. Amer. Acad. Arts Sci. 35: 156, 1899 et Men. Amer. Acad. Arts. Sci. 13: 348, 1908; Sugiyama, Ginkgoana 2: 42, 1973; Balazuc, Bull. Soc. Linn. Lyon 43: 12, 1974; Sugiyama & Phanichapol, Not. Hist. Bull. Siam Soc. 31(2): 71, 1984; Lee & Na, Kor. Jour. Mycol. 27(3): 208, 1998.

Thallus suffused with yellowish or blackish brown, consisting of a receptacle and perithecium. Total length to the top of perithecium 345-424 μm . The thickest portion of the thallus 85-117 μm . Receptacle comprising receptacle proper and distal two appendages; receptacle proper

233-306 μm long, 40-54 thick; each layers one-celled except for the fourth one; basal two layers forming a stalk of thallus; the stalk stright, thickest at the distal end, gradually tapering toward the basal blackish obconical foot; the first layer 76-88 μm long, 26-36 μm thick; the second layer more or less thicker than the first ones, 53-61 μm long, 38-53 μm thick; the third layer about twice as long as thick, 41-53 μm long, 28-37 μm thick; the fourth layer composed of three cells arranged antero-posteriorly; the distal end of the posterior cell slightly projecting upwards; insertion cell blackish, band-shaped, forming a constricted part of the receptacle, 7-8 μm long, 20-21 μm thick; distal appendages of receptacle placed above the insertion cell, arranged inner-outerly 306-348 μm long; the inner appendage dichotomous, forming lateral antheridia; the outer appendage branched once or twice above the basal cell.

Perithecium composed of a stalk and perithecium proper; the stalk consisting of a large basal cell and a few small distal cells; the basal cell formed on the anterior side of the second layer of the receptacle proper, seperated from it by an oblique septum, united to the third layer of receptacle proper in lateral side; perithecium proper ellipsoidal, softly constricted and blackened at subapical portion, about a half of perithecium free from the receptacle proper, 141-176 μm long, 61-80 μm thick. Spores 45 \times 5 μm .

Host genera: *Abaceus*, *Agonoderus*, *Anoplogeni*, *Platynus* (new), and *Stenolophus*. (Carabidae, Coleoptera).

Host species in Korea: *Platynus daimio* (Bates) and *Stenolophus quinquepustulatus* Widemann.

Distribution: Madagascar, Ceylon, Formosa, India, Japan, Thailand, U.S.A. and Korea.

Specimens examined: Upo swamp, Changnyoung, Gyeo-

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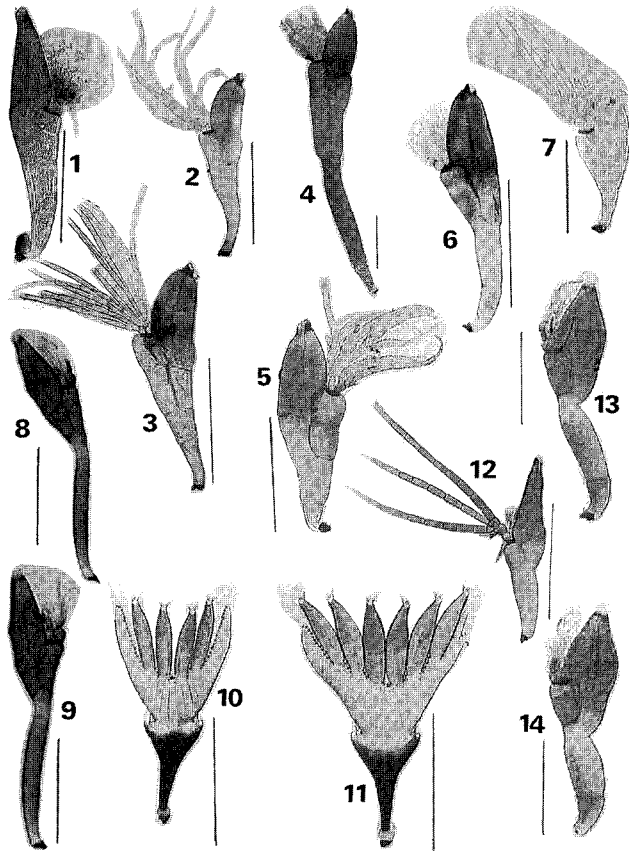


Fig. 1. 1. *Laboulbenia philonthi* on *Philonthus wuesthoffi*, 2 and 3. *L. anoplogenii* on *Platynus dimio*, 4. *L. flagellata* with the long receptacle on *Platynus dimio*, 5. *L. flagellata* with the short receptacle on *P. dimio*, 6. *L. stenolophi* on *Acupalpus inornatus*, 7. *L. stenolophi* on *Philonthus longicornis*, 8 and 9. *L. egens* on *Tachys laetifica*, 10 and 11. *Peyritschiella biformis* I. Tavares on *Philonthus micanticollis*, 12. *L. cristata* on *Paederus parallelus*, 13 and 14. *L. pedicellata* on *Bembidion morawitzi*. Scales: 1, 2, 3, 4, 5, 6, 10, 11 and 12; 200 μ m, 7, 8, 9, 13 and 14; 100 μ m.

ngnam, Prov., July 6, 2001, L-Y-2071 and 2072, on the leg and thorax of *Platynus daimio* (Bates).

The main character of this species is the outer cell of the fourth layer of the receptacle which becomes divided into three cells. The present species is also characterized by the branches of the receptacle which are branched at lower position. The hosts of this species have been collected on only four genera, *Abaceus*, *Agonoderus*, *Anoplogenus* and *Stenolophus*, of the family Carabidae up to the present time (Thaxter, 1899, 1908; Sugiyama, 1973; Balazuc, 1974; Sugiyama and Phanichapol, 1984; Lee and Na, 1998). This thallus parasitic on *Platynus dimio* (Bates) is very unique and new to science. The thalli are collected from this host together with *L. flagellata* Peyritsch.

2. *Laboulbenia cristata* Thaxter. Proc. Amer. Acad. Arts Sci. 28: 174, 1893 et Mem. Amer. Acad. Arts Sci.

12: 330, 1896 et ibid. 13: 1908; Picard, Bull. Soc. Mycol. France 29: 540, 1913; Bull. Scient. France et Belgique 50: 454, 1917; Spegazzini, Redia 10: 49, 1914; An. Mus. Nac. Hist. Nat. Buenos Aires 26: 491, 1915; Baumgartner, Jahrb. Philos. Facult. II, Univ. Bern 3: 265, 1923; Siemaszko, Polskie Pismo Entomol. 10: 178, 1932; Balazuc, Bull. Soc. Inn. Lyon 43: 19, 1974; Balazuc, Espadaler & Girbal, Collnea. Bot. Barcinone 13 (2): 408, 1982; Sugiyama, Ginkgoana 2: 47, 1973; Trans. Mycol. Soc. Japan 18: 276, 1977; Lee, A Festschrift Celebrating sixtieth birthday of Dr. Ji Yul Lee: 120, 1982; Lee, Kor. J. Plant. Tax. 16 (2): 134, 1986; Majewski, Polish Bot. Stud. 7: 110, 1994; S. Kaur & K. G. Mukerji, Mycoscience 36: 311, 1995.

Host genera: *Megapaederus* and *Paederus* (Staphylinidae, Coleoptera).

Host species in Korea: *Paederus fuscipes* Curtis and *P. parallelus* Weise.

Distribution: Europe, India, Japan, Korea and North, Central and south America.

Specimens examined: Upo swamp, Changnyoung, Gyeonngnam Prov., August 10, 1996, L-Y-1304, 1305, 1306, 1307, 1308, 1309; August 11, 1996, L-Y-1333, 1334, 1335, 1336; October 27, 1999, L-Y-1584; July 12, 2001, L-Y-2077, 2078, 2079. on whole body, antenna, legs, thorax, abdomen of *Paederus parallelus* Weise.

This species is characterized by a blackish, bristle-like posterior branchlets of the receptacle. Thalli are variable in length of the receptacles, but the following characters seem to be stable; 1) The perithecium is laterally free from the receptacle and reddish brown, giving a striking contrast with the hyaline stalk and receptacle. 2) The posterior branch of receptacle is branched first at the distal end of the subbasal cell, and longer than the anterior one. Above 90% of the host insects collected in Korea were parasitized by this fungus species.

3. *Laboulbenia egens* Spegazzini. An. Soc. Cient. Argent. 85: 325, 1918; Hulden, Karstenia 25: 4, 1985; Majewski, Trans. Mycol. Soc. Japan 29: 39, 1988; Majewski, Polish Bot. Stud. 7: 113, 1994; Lee & Na, Kor. Jour. Mycol. 26(1): 111, 1998.

Host genus: *Tachys* (Carabidae, Coleoptera).

Host species in Korea: *Tachys gradatus* Bates and *T. laetifica* (Bates).

Distributions: Asia, Africa, Europe and Central America.

Specimens examined: Swamp Upo, Changnyoung, Gyeonngnam Prov., August 11, 1996, L-Y-1314, 1315, 1316, 1317, 1318; August 30, 1996, L-Y-1389, 1390, 1391, 1392, 1393, 1394, 1395, 1396, 1397, 1398, 1399, 1400, on the elytra, abdomen, legs, throax of *Tachys laetifica* (Bates).

The present species is characterized by the protuberances on the external surface of the perithecium and the convex upper part of the outer basal cell of the append-

age. Infected hosts occurred on grass field or ground of pondside.

4. *Laboulbenia flagellata* Peyritsch. Sitzungsber. Kais. Akad. Wissensch. Math-naturwiss. Cl. 68: 247, 1873; Thaxter, *Laboulbenia elongata*, Proc. Amer. Acad. Arts Sci. 24: 10, 1890; Spegazzini, Redia 10: 50, 1914; An. Mus. Nac. Hist. Nat. Buenos Aires 29: 623, 1917; Balazuc, Livre du Cinquantenaire Institute de Spéologie 'Emile Racovitza' Bucarest: 469, 1971; Bull. Soc. Inim. Lyon 43(2): 59, 1974; et ibid. 51: 13, 1982; Sugiyama, Trans. Mycol. Soc. Japan 13: 261, 1972; Ginkgoana 2: 51, 1973; Huldén, Karstenia 23: 55, 1983; Lee, Kor. J. Mycol. 9(4): 184, 1981; Lee, Kor. J. Plant. Tax. 16(2): 136, 1986; Lee & Choi, Kor. J. Mycol. 20: 183, 1992; Majewski, Polish Bot. Stud. 7: 98, 1994.

Host genera: *Acanthogenius*, *Agonum*, *Anchomenus*, *Anisodactylus*, *Argutor*, *Antisphodrus*, *Calatus*, *Colpodes*, *Coptodera*, *Harpalus*, *Limosthenes*, *Loricera*, *Nevria*, *Macrochilus*, *Onypterygia*, *Platynus*, *Pleuosoma*, *Pseudopristonuchus*, *Pterostichus* and *Stomis* (Carabidae, Coleoptera).

Host species in Korea: *Agonum buchani* Hope, *Harpalus* sp. (1), (2), *Pterostichus microcephalus* Motschulsky and *Platynus dimio* Bates.

Distribution: Africa, Europe, China, Japan, Korea, Australia, New Zealand and North and South America.

Specimens examined: Upo Swamp, Changnyoung, Gyeongnam Prov., August 11, 1996, L-Y-1224, 1225, 1226, 1227, 1228, 1229, 1230, 1231, 1232; August 15, 1996, L-Y-1343; August 18, 1996, L-Y-1364, 1365, 1366, 1367, 1368, 1369, 1370, 1371, 1372, 1373, 1374, 1375, 1376, 1377, 1378; April 5, 1997, L-Y-1551, 1552, 1553, 1554, 1555, 1556; July 6, L-Y-2001, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072. On the antenna, head, pronotum, thorax, abdomen, elytra, legs of *Platynus dimio* Bates.

This is a cosmopolitan species, being everywhere one of the most common representatives of the Laboulbeniales. This species parasitizes at least 80 beetle genera of the family Carabidae (Majewski, 1994). A typical outer appendage is once branched on the second cell and the inner appendage forms usually only four branches or sometimes even only two. Numerous variations of this species were found on members of Carabidae in the world.

5. *Laboulbenia pedicellata* Thaxter. Proc. Amer. Acad. Arts Sci. 27: 44, 1892; Huldén, Karstenia 23: 58, 1983; Santamaria, An. Jard. Bot. Madrid 42(2): 279, 1986; Majewski, Polish Bot. Stud. 7: 114, 1994; Lee & Na, Kor. J. Mycol. 26(1): 114, 1998.

Total length to the perithecium 317–325 μm long, 78–90 μm thick. Thallus brownish yellow. Receptacle consisting of the basal and distal portion; the basal portion elongated, cylindrical, composed of five superposed cells,

tapering toward the base, forming a blackish foot, stout or slender, variable in shape and size of cells 210–235 μm long, 37–46 μm thick; cell I cuneiform, 30–31 μm thick, 50–57 μm long; cell II stout, 35–37 μm thick, 105–124 μm long, 2–5 times longer than breadth, slender, cylindrical, often narrowed and nearly hyaline in the upper half; cell III isodiametric, slightly elongated, rarely up to 2 times longer than breadth, 30–31 μm thick, 39–40 μm long; cell IV similar to cell V in size, isodiametric, 10–15 μm thick, 15–20 μm long; cell V usually narrower, 10–15 μm thick, 15–20 μm long; insertion cell constricted, dark, 15 μm thick, 5–8 μm long; the distal portion of receptacle composed of two basal cells and appendages; basal cell of outer appendage externally inflated, subtending a ramified branch, its branches numerous, hyaline, the exterior branchlet with black septum and external blackening in the lower part, fragile; basal cell of inner appendages smaller than the outer ones, subtending several ramified branchlets directed upwards. Antheridia produced on short inner branchlets. Branchlets in mature thalli usually not exceeding the top of perithecium.

Perithecium dark, brownish, composed of the perithecium proper and a stalk; perithecium ovate, 66–76 μm thick, 125–132 μm long, about 2/3–4/3 free from the receptacle, with subapical darkening, somewhat producing interior lips; stalk composed of a large basal cell and some distal cells, united from the distal portion of cell II to the interiorly lateral portion of cell III.

Host genera: *Bembidion* and *Dyschirius* (Crabidae, Coleoptera).

Host species in Korea: *Bembidion thermarum* Motschulsky and *B. morawitzi* Csiki (new in Korea).

Distribution: Africa, America, Asia and Europe.

Specimens examined: Upo Swamp, Changnyoung, Gyeongnam Prov., August 18, 1996, L-Y-1341, 1342, 1345, 1362; August 20, 1996, L-Y-1379, 1380, 1381, 1382; September 6, 1997, L-Y-1567, 1568, 1569, 1570. On all parts of *Bembidion morawitzi* Csiki and *B. thermarum* Motschulsky.

This species is close to *L. egens* Spegazzini (Majewski, 1994). However, this species is distinguished from the latter in having the perithecium without distinct protuberance. On some hosts they occurred together with the thalli of *L. vulgaris* Peyritsch.

6. *Laboulbenia philonthi* Thaxter. Proc. Amer. Acad. Arts Sci. 28: 174, 1893; Majewski, Polish Bot. Stud. 7: 119, 1994; Lee & Na, Kor. J. Mycol. 26(1): 115, 1998.

Host genera: *Gabrius*, *Paragabrius* and *Philonthus* (Staphylinidae, Coleoptera).

Host species in Korea: *Philonthus wuesthoffi* Bernhauer.

Distribution: Europe, Turkey, North and Central America and Korea.

Specimens examined: Swamp Upo, Changnyoung, Gyeongnam Prov., July 25, 1996, L-Y-1261, 1262, 1263, 1264, 1265, 1266, 1267; August 10, 1996, L-Y-1284, 1285, 1286; August 11, 1996, L-Y-1337; August 18, 1996, L-Y-1348, 1349, 1350, 1351, 1352, 1353, 1354, 1355, 1356, 1357; July 6, 2001, L-Y-2058, 2059, 2060, 2061, 2062, on abdomen, head, elytra, legs of *Philonthus wuesthoffi* Bernhauer.

The present species is closely related to *Laboulbenia barbara* Middlehoek et Boelens. However, this species has characteristic dark septa of the appendages. The hosts were found on the moist ground and grass around the swamp.

7. *Laboulbenia stenolophi* Spegazzini. Redia 10: 65, 1914; An. Mus. Nac. Hist. Nat. Buenos Aires 27: 64, 1915; Lee & Sugiyama, Trans. Mycol. Soc. Japan 25: 252, 1984; Lee, Kor. J. Plant Tax. 16(2): 54, 1986; Lee & Na, Kor. J. Mycol. 26(1): 115, 1998.

Total length to the perithecium 177~384 μm , the widest portion of thalli 68~90 μm . Receptacle hyaline, olivaceous, composed of the basal and distal portions; the basal portion cylindrical, consisting of five cells, 128~256 μm long, 26~40 μm thick; cell I gradually tapering towards the base, forming basally a blackish conical foot 13~71 μm long, 13~29 μm thick; cell II rather variable in length, 22~103 μm long, 22~41 μm thick; cell III 25~62 μm long, 25~36 μm thick; cell IV 26~29 μm long, 40thick; cell V 26~29 μm long, 15~20 μm thick; the distal portion of the receptacle composed of two hyaline branches, 89~188 μm long, each branch divided once or twice at the basal portion.

Perithecium hyaline or dark brownish, ovate, becoming narrower toward the apex, united to the receptacle at the basal half or less, 90~155 μm long except for the stalk, 47~72 μm thick; the stalk consisting of a large basal cell and few small distal cells arranged transversely, completely united to cell II and cell III. Antheridia formed on the inner branches of the distal receptacle, 15 \times 5 μm . Spores 30~40 μm long.

Host genera: *Acupalpus* (new), *Anoplogenus* and *Stenolophus* (Carabidae, Coleoptera) and *Philonthus* (Staphylinidae, Coleoptera).

Host species in Korea: *Acupalpus inornatus* (Bates), *Anoplogenus cyanescens* Hope and *Philonthus longicornis* Stephens.

Distribution: Italy, Germany, Tunisia, Taiwan, Bali Island and Korea.

Specimens examined: Swamp Upo, Changnyoung, Gyeongnam Prov., July 25, 1996, L-Y-1275, 1276, 1291, on elytra, abdomen, thorax of *Acupalpus inornatus* Bates; August 10, 1996, L-Y-1283-1, 1283-2, on pronotum of *Philonthus longicornis* Stephens.

This species is closely related to *L. anoplogenii* Thax-

ter. However, *L. stenolophi* is distinguished from the latter by having two cells of the fourth layer of receptacle. In *L. anoplogenii* the fourth layer is composed of more than two cells. *L. stenolophi* have been collected only on two genera, *Anoplogenus* and *Stenolophus*, of the family Carabidae and one genus, *Philonthus*, of the family Staphylinidae up to the present time (Spegazzini, 1914, 1915; Lee and Sugiyama, 1984; Lee, 1986; Lee and Na, 1998). The host species of the present thallus parasitic on *Acupalpus inornatus* (Bates) is new to science.

8. *Peyritsiella biformis* (Thaxter) I. Tavares, Mycol. Mem. 9: 270, 1985; *Dichomyces biformis* Thaxter, Proc. Amer. Acad. Arts Sci. 35: 422, 1900; Mem. Amer. Acad. Arts Sci. 13: 254, 1908; *Dichomyces biformis* Thaxter, Lee, Kor. J. Mycol. 9(4): 182, 1981; *Dichomyces biformis* Thaxter, Huldén, Karstenia 23: 47, 1983; *Dichomyces biformis* Thaxter, Lee, Kor. J. Plant Tax. 16(2): 125, 1986; D. Kesel A. & Rammeloo J., Belg. Journ. Bot. 124(2): 211, 1991; Santamaria, Nova Hedwigia 54: 486, 1992; Lee & Choi, Proc. Asian Mycol. Symp.: 87, 1992; Majewski, Polish Bot. Stud. 7: 173, 1994.

Total length to the top of perithecium 344~394 μm , 176~260 μm wide. Receptacle fan-shaped, hyaline in distal and blackened in basal portion, consisting of four layers of cells, 314~318 μm long, 176~249 μm wide, the number of cells and the width of layers increasing from the base to the top; the basal three layers forming a stalk of thallus, tapering gradually towards the base; the first layer one-celled, hyaline, forming basally a blackish foot, 20~24 μm thick, more or less longer than thick; the second and third layers blackened, continuously broadening from the base of the second layer (24~30 μm wide) to the distal end of the third layer (90~103 μm wide); the third layer more or less rounded on either lateral side; the fourth layer hyaline, consisting of more than 40 cells arranged in a transverse series, becoming gradually narrower towards both lateral ends, free from the third layer at both lateral portions, extending symmetrically at an angle of 30, forming a thin distal plate, 230 μm wide. Appendages hyaline, one-celled, cylindrical, with a narrow septum at the base, 42~71 μm long, 5 μm thick.

Perithecium hyaline, pale yellowish brown, cylindrical, becoming thinner towards the rounded apex, formed on the distal plate of the receptacle, 4~6 in each individual, bearing a pair of short projections with rounded tip near the top, 103~128 μm long, 18~33 μm in diameter. Antheridia horn-shaped, producing on the third layer of the receptacle, 19~21 μm long, 6~10 μm wide.

Host genus: *Philonthus* (Staphylinidae, Coleoptera).

Host species in Korea: *Philonthus pelimerus* Kraatz and *P. micanticollis* Sharp (new in Korea).

Distribution: Europe (Spain, Great Britain, Belgium, Poland, Russia), Japan, Korea, North and Central America.

Specimens examined: Swamp Upo, Changnyoung, Gyeonnam Prov., August 18, 1996, L-Y-1358, 1359, 1360, 1361; April 5, 1997, L-Y-1532, on the abdomen and legs of *Philonthus micanticollis* Sharp.

The outstanding character of the present species is the basal three layers forming a slender stalk of thallus which are almost entirely or only laterally blackened. Hosts were collected on plant remains and banks of ponds. The host species of this thallus parasitic on *Philonthus micanticollis* Sharp is new to Korea.

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