

VIERAEA	Vol. 32	107-115	Santa Cruz de Tenerife, diciembre 2004	ISSN 0210-945X
---------	---------	---------	--	----------------

Laboulbeniales (Ascomycota) of the Canary Islands

ERIK ARNDT * & SERGI SANTAMARÍA **

**Anhalt University of Applied Sciences, Department LOEL, Strenzfelder Allee 28, D-06406 Bernburg, Germany. Correspondence address.*

***Unitat de Botànica, Departament de Biologia Animal, de Biologia Vegetal i d'Ecologia, Facultat de Ciències
Universitat Autònoma de Barcelona, E-08193-Bellaterra
(Barcelona), SPAIN*

ARNDT, E. & S. SANTAMARÍA (2004). Laboulbeniales (Ascomycota) de las islas Canarias. *VIERAEA* 32: 107-115.

RESUMEN: Se presenta una lista con 23 especies y 8 géneros de Laboulbeniales (Ascomycota). Seis de ellas son primeras citas para las islas Canarias. La mayoría de las especies citadas infectan Carabidae (Coleoptera). Muchas de las especies de hospedantes (23) son endémicas, siendo sólo nueve las de hospedantes que también se encuentran fuera de la región Macaronésica. Los Carabidae, como familia más diversa de hospedantes, incluyen 21 especies endémicas y 6 de amplia distribución. Las pautas de distribución de Laboulbeniales dependen de dos factores ecológicos (humedad y biodiversidad de los hospedantes) que varían mucho entre las distintas islas.

Palabras clave: Laboulbeniales, Carabidae, Staphylinidae, Anthicidae, Blattaria, Ephydridae, islas Canarias.

ABSTRACT: The list includes 23 species of Laboulbeniales (Ascomycota) in 8 genera. Six species are new for the Canary Islands. The majority of recorded species infests Carabidae (Coleoptera). Most host species (23) are endemic, only nine hosts also occur outside the Macaronesian region. There are 21 endemic and 6 widespread host species in the Carabidae as most diverse host family. The distribution pattern of Laboulbeniales corresponds with two ecological factors (moisture and host biodiversity respectively) which vary strongly between the different islands.

Key words: Laboulbeniales, Carabidae, Staphylinidae, Anthicidae, Blattaria, Ephydridae, Canary Islands.

INTRODUCTION

The Canarian Archipelago has an extremely high biodiversity (Báez *et al.* 2001). More than 6.850 arthropods, 1.995 vascular plants and 2.928 species of fungi are known (Izquierdo *et al.*, 2001, completed by unpublished data). The number of endemic arthropod species is 2.709 which corresponds to 39.6 % of the total species number and 0.364 species per km². This exceeds probably the ratio of the most other hotspots of biodiversity, however confirmed data are only available for plant and vertebrate species (Myers *et al.*, 2000).

The diversity of Canarian arthropod species lets expect a high number of Laboulbeniales which are parasites of insects and other arthropod groups. However, there are described only two endemic species: *Laboulbenia machadoi* W. Rossi and *L. dicrodonti* W. Rossi, both on Carabidae (Rossi, 1991). A number of further carabid infesting species, which concern European or cosmopolitan species of Laboulbeniales, were summarized by Machado (1992). However, Canarian records of Laboulbeniales on other host families are very rare.

It is the aim of this paper to summarize all records of Laboulbeniales from the Archipelago, to indicate new parasite-host relations and to complete the actual list of terrestrial fungi, plant and animal species (Beltrán Tejera, 2001).

MATERIAL

The present list is based mainly on the collections of the authors and on data in the literature. A part of the material was gained during an ecological project in laurel forests by E. Arndt. It allows conclusions on infesting rates of the considered species. We received some of the infested carabid beetles by A. Kopetz (Erfurt, Germany) and the Natural History Museum Erfurt (M. Hartmann) which is gratefully acknowledged.

The material is deposited in following collections: BCB - Institutional Herbarium in Universitat Autònoma de Barcelona, Sergi Santamaria, Spain. EA - coll. Erik Arndt, Anhalt University, Bernburg, Germany. WR - coll. Walter Rossi, Università dell'Aquila, Coppito, L'Aquila, Italy.

We follow Machado (1992) concerning the taxonomy of Carabidae (Coleoptera).

LIST OF SPECIES

Dioicomycetes anthici Thaxt.

Host. *Anthicus* sp. (Coleoptera, Anthicidae).

Locality. **Isla de Montaña Clara** (north-eastern most part of the Archipelago), 1989 [BCB].

New for the Canary Islands.

Remarks. A widespread species reported from all continents except Australia. Hosts are several genera of Anthicidae (*Anthicus s.l.*, Santamaria, 2002).

Herpomyces tricuspидatus Thaxt.

Host. Questionable; determined as *Epilampra excelsa* [= *Rhabdoblatta excelsa* (Navás, 1904)] (Blattaria, Epilampridae), see remarks.

Locality. **Lanzarote**, Puerto Arrecife, 1935 [BCB]. New for the Canary Islands.

Remarks. The mentioned blattarian host is doubtful because *R. excelsa* is not known outside its type locality in India. This species is also not included in the recent checklist of the Canary Islands (Oromí, 2001). *R. excelsa* is similar to *Rhyparobia maderae* (Fabricius), which is widespread on the Canarian Archipelago and known as host of *H. tricuspoidatus* (Spegazzini, 1915).

Laboulbenia atlantica Thaxt.

Host. *Lobrathium multipunctatum* (Gravenhorst) (Coleoptera, Staphylinidae).

Locality. **Gran Canaria**, Pajonales, 1987 [BCB]. New for the Canary Islands.

Remarks. *L. atlantica* was previously recorded on Madeira (Thaxter 1908), in France, and Belgium (Santamaria *et al.*, 1991). It is one of the few known *Laboulbenia* species infesting two host families, Staphylinidae (as mentioned) and Carabidae (*Zargus schaumii* Wollaston).

***Laboulbenia basilewskyi* Balazuc**

Host. *Lymnastis gaudini* Jeannel (Coleoptera, Carabidae).

Locality. **Tenerife**, Icod de los Vinos, Cueva Felipe Reventón, 1986 [BCB]. New for the Canary Islands.

Remarks. *L. basilewskyi* was described originally from the Central African host *Lymnastis jeanneli* Basilewsky. The genus *Lymnastis* Motschulsky is distributed with a few species worldwide in tropical and subtropical regions. Balazuc (1975) indicates affinities between *L. basilewskyi* and the Mediterranean species *Scalonomyces endogaeus* (Picard) I. I. Tav. (=syn. *L. endogaea* Picard, *L. coiffaiti* Balazuc). *S. endogaeus* infests small endogaenic Scaritini or Bembidiini. *Lymnastis* belongs to the Bembidiini with endogaenic life history. A transfer of *L. basilewskyi* to the genus *Scalonomyces* should be verified.

***Laboulbenia caffi* Thaxt.**

Host. *Cafius xantholoma* (Gravenhorst) (Coleoptera, Staphylinidae).

Locality. **Gran Canaria**, Juan Garde, 1986 [BCB]. New for the Canary Islands.

Remarks. The species infests *Cafius* and related genera world wide, however it was not recorded in Africa so far (Santamaria, 1998).

Laboulbenia colasii Lepesme

Host. *Dromius* sp. (Coleoptera, Carabidae).

Locality. **Tenerife**, without exact locality (Balazuc, 1974).

Remarks. *L. colasii* occurs in Europe and Tenerife, it infests species of the genus *Dromius* s.l. (Santamaria *et al.*, 1991).

Laboulbenia dicrodonti W. Rossi

Hosts. *Dicrodontus aptinoides* (Wollaston) and *D. brunneus* (Dejean) (Coleoptera, Carabidae).

Localities. **Tenerife**, without locality (Machado, 1992); **La Gomera**, El Cedro, 1985 [WR] (Rossi, 1991).

Remarks. The host species are endemic in laurel forests. The fungus seems to be more or less rare, because we did not record it during our ecological investigations.

[*Laboulbenia disenochi* Thaxt.]

Host. Unidentified Carabidae.

Locality. “Canary Islands”, without details (Colla, 1926).

Remarks. *L. disenochi* was described by Thaxter (1902, 1908) from Hawaiian carabid species. The record by Colla (1926) is very questionable.

Laboulbenia egens Speg.

Host. *Tachyura haemorrhoidalis* (Ponza) (Coleoptera, Carabidae).

Localities. **Gran Canaria**, Arucas, and **Tenerife** without locality, on *Tachyura haemorrhoidalis* (Huldén, 1985).

Remarks. *L. egens* is a cosmopolitan species which parasitizes hosts of the carabid group Tachyini (Bembidiinae) (Santamaria, 1998).

***Laboulbenia flagellata* Peyrit.**

Hosts. Different species of the genera *Calathus* Bonelli and *Paranchus* Lindroth, as well as *Agonum marginatum* (Linné), *Eutrichops canariensis* (Brullé), and *Dicheirotichus obsoletus* (Dejean) (Coleoptera, Carabidae).

Localities. **Lanzarote**, *Dicheirotichus obsoletus* (Thaxter, 1908 as *D. levistratus*); **Gran Canaria**, *Paranchus debilis* (Wollaston) (Thaxter, 1908; Machado, 1992); **Tenerife**, without locality on *Calathus carinatus* Brullé (Spegazzini, 1915), *Eutrichops canariensis* (syn. *Argutor angularis*) (Thaxter, 1908; Machado, 1992), without locality on *Calathus depressus* Brullé (Siemaszko & Siemaszko, 1932), Las Mercedes, 1964 [BCB] on *Calathus depressus*; Monte Esperanza, 1964 [BCB] on *C. freyi* Colas; **La Gomera**, 1964 [BCB] on *Calathus marcellae* Colas, *Agonum marginatum* (Huldén 1985), *Paranchus debilis* (Wollaston) (Thaxter, 1908; Machado, 1992); **El Hierro**, different localities in laurel forests and *Erica* forests, 2003 [EA] on *Calathus spretus* Wollaston.

Remarks. *L. flagellata* is one of the most widespread and polyphagous *Laboulbenia* species. According to Majewski (1994) at least 80 genera of Carabidae are hosts of this species. However, this number can vary because of different opinions on the generic state of several subgenera belonging to the large groups *Pterostichus* Bonelli (in widest sense) and *Platynus* Bonelli (in widest sense). The known host genera represent 12 different tribes including big-sized taxa like *Calosoma* Weber or *Macrocheilus* Hope which are not infested by any other *Laboulbeniales* species.

The distribution of *L. flagellata* in the Canarian archipelago seems to be heterogeneously. We know 24 endemic *Calathus* species, five of which were recorded as hosts. While *C. spretus* from El Hierro is frequently infested (about 30% of the beetles were parasitized), *L. flagellata* is extremely rare on the other species on La Gomera and Tenerife. We know only the thalli from 1964 though hundreds of *Calathus* specimens were examined in the last years.

Laboulbenia machadoi W. Rossi

Host. *Zargus crotchianus* Wollaston (Coleoptera, Carabidae).

Locality. **La Gomera**, El Cedro, Chipude, 1983 [WR] (Rossi, 1991).

Remarks. The host species is endemic in laurel forests on La Gomera. The parasite seems to be more or less rare, because we did not record it during our ecological investigations.

Laboulbenia olisthopi Speg.

Host. *Olisthopus glabratus* Brullé (Coleoptera, Carabidae). New for the Canary Islands.

Locality. **Tenerife**, Monte de la Esperanza, 1994 [EA].

Remarks. *L. olisthopi* occurs in Europe and on Madeira on carabid hosts of the genus *Olisthopus* Dejean (Santamaria, 1998).

***Laboulbenia pedicellata* Thaxt.**

Hosts. *Bembidion (Philochtus) vicinum* Lucas, *Tachys dimidiatus* Motschulsky (Coleoptera, Carabidae).

Locality. **Lanzarote**, Guanapay, 1986 on *Bembidion (Philochtus) vicinum* [BCB]; without exact locality, on *Tachys dimidiatus* [WR] (Machado, 1992); Machado (1992) mentions a further record without detailed locality on *B. vicinum*.

Remarks. A cosmopolitan parasite of mainly ripicolous carabids (mostly on Bembidiini, less numerous on Trechini, Clivinini, Brachinini, Platynini, see Santamaria *et al.*, 1991).

***Laboulbenia perpendicularis* Thaxt.**

Host. *Ocydromus atlanticus* (Wollaston) (Coleoptera, Carabidae).

Locality. **Tenerife**, without locality (Thaxter, 1908; Machado, 1992).

Remarks. *L. perpendicularis* was described by Thaxter (1896) as parasite of *Bembidium* species from Virginia and Washington (U.S.A.). The only record outside North America is the specimen from Tenerife.

***Laboulbenia proliferans* Thaxt.**

Host. *Chlaenius canariensis* Dejean (Coleoptera, Carabidae).

Locality. **Tenerife**, without locality (Machado, 1992). Colla (1926) mentioned this species on an undetermined Carabidae from Santa Cruz de Tenerife.

Remarks. *L. proliferans* infests carabid beetles from several tribes and subfamilies (e.g. Brachinini, Licinini, Callistini, Panagaeini) in Europe, Asia, Africa, and Australia. Most host species occur in riparian environments (Santamaria, 1998).

***Laboulbenia vulgaris* Peyrit.**

Hosts. Different species of the genus *Bembidion* Latreille (in widest sense) (Coleoptera, Carabidae).

Localities. **Gran Canaria**, *Ocydromus schmidtii* (Wollaston) (Huldén 1985 as *B. subcallosum*); **Tenerife**, Barranco de Masca, 1946 [BCB], Monte Aguirre, 1947 [BCB] on *Ocydromus fortunatus* (Wollaston); Teno, Puerto de Erjos, 1994 [EA] on *Bembidion varium* (Olivier) and *O. schmidtii*; Adeje, Barranco del Infierno, 1994 [EA] on *O. atlanticus* and *O. fortunatus* also recorded from Tenerife by Huldén (1985); **La Gomera**, *O. atlanticus* (Huldén, 1985). Thaxter (1908) also mentioned material from the Canary Islands without exact locality.

Remarks. *L. vulgaris* is a variable and extremely polyphagous cosmopolitan species. Most hosts are representatives of the carabid groups Bembidiini and Trechini (Santamaria *et al.*, 1991), the parasite occurs mainly in ripicolous habitats. The Canary hosts include widespread as well as endemic species.

***Misgomyces dyschirii* Thaxt.**

Host. *Dyschiriodes clypeatus* (Putzeys) (Coleoptera, Carabidae).

Locality. **Gran Canaria**, Maspalomas (Huldén, 1985 as *Dyschirius pusillus*)

Remarks. *M. dyschirii* is widespread in Europe, Asia, North Africa, and North America (Santamaria *et al.*, 1991). Its hosts are species of *Dyschirius* (*s.l.*) and the genus *Bledius* Mannerheim (Staphylinidae). *Bledius* and *Dyschirius* co-occur in the ground of ripicolous habitats or salt marshes.

Peyritschiella furcifera (Thaxt.) I. I. Tav.

Host. *Philonthus discoideus* (Gravenhorst) (Coleoptera, Staphylinidae).

Locality. Thaxter (1908) did not give a detailed locality. The host species occurs on all islands except El Hierro.

Remarks. *P. furcifera* is distributed worldwide. Hosts are several genera of the subfamily Staphylininae (Santamaria *et al.*, 1991).

Peyritschiella hybrida (Thaxt.) I. I. Tav.

Host. *Philonthus* sp. (Coleoptera, Staphylinidae).

Locality. Thaxter (1908) did not give a detailed locality.

Remarks. *P. hybrida* is distributed in Asia, Europe, Madeira, the Canary Islands, West Indies and Eastern North America. Hosts are species of the genus *Philonthus s.l.* (Santamaria *et al.*, 1991; Tavares, 1984).

Prolixandromyces triandrus Santam.

Host. *Velia lindbergi* Tamanini (Hemiptera, Veliidae).

Locality. **Tenerife** (Santamaria *et al.*, 1991).

Remarks. *P. triandrus* is known from France, Portugal, Spain, and Tenerife. It infests bugs of the genus *Velia* Latreille like all *Prolixandromyces* (Santamaria *et al.*, 1991).

Rhachomyces canariensis Thaxt.

Hosts. Several species of the genus *Trechus* Clairville (Coleoptera, Carabidae).

Localities. **La Gomera**, Alto de Garajonay, 2000 [EA] on *T. flavocinctus* Jeannel; **La Palma** on *T. flavocircumdatus* Jeannel (Machado, 1992); **Tenerife** on *T. flavocinctus* [WR] (Machado, 1992).

Remarks. Thaxter (1900) described *Rhachomyces canariensis* from Tenerife and indicated *Trechus flavomarginatus* as host. Because this host species is endemic on Madeira, it is unclear if the host name or the type locality was an error. However, this *Rhachomyces* species was confirmed for the Canary islands by later authors.

Majewski (1994) characterized *R. canariensis* as a very variable species occurring in Europe, North Africa, Canary Islands and Madeira on many species of genus *Trechus*. Tavares (1985) suggested to investigate if these data from several hosts distributed over large areas include more than one taxon. All Canarian hosts are endemic.

Rhachomyces lavagnei (F. Picard) W. Rossi

Host. *Microlestes gomerensis* Lindberg (Coleoptera, Carabidae).

Locality. **Lanzarote** [WR] (Machado, 1992).

Remarks. *R. lavagnei* is distributed in Southern Europe and Africa infesting several *Microlestes* species (Santamaria *et al.*, 1991). *M. gomerensis* is an endemic Canarian species.

Rhachomyces tenenbaumii J. Siemaszko & Siemaszko

Host. *Thalassophilus whitei* Wollaston (Coleoptera, Carabidae).

Localities. **Tenerife**, Adeje, Barranco del Infierno, 1994 [EA]; **La Gomera**, El Cedro, Las Mimbreras, Las Creces, Alto del Contadero and several other localities in the laurel forest [EA, WR] (Huldén, 1985); **La Palma**, Caldera (Huldén, 1985).

Remarks. *R. tenenbaumii* occurs frequently on *Thalassophilus longicornis* (Sturm) in Europe (Santamaria *et al.*, 1991). *T. whitei* is a frequent endemic host on the Canary islands.

Stigmatomyces trianguliapicalis T. Majewski

Hosts. Species of the genus *Parydra* Stenhammar (Diptera, Ephydriidae).

Locality. **Gran Canaria**, Los Lagunetas (Huldén, 1985).

Remarks. Huldén (1985) noted *P. coarctata* (Haliday) as Canary host of *S. trianguliapicalis*. However, *P. coarctata* is not specified for the Canary islands. Probably *P. fossarum* (Haliday) is the correct host name, because it is the only known species from Gran Canaria and also the host from the type locality of *S. trianguliapicalis* (Majewski, 1994). *S. trianguliapicalis* is widespread in Europe and Africa, it occurs on species of *Parydra* and *Pelina aenea* (Fallén).

Table I. Distribution of known Laboulbeniales in the Canary Archipelago. Abbreviations: H - El Hierro, P - La Palma, G - La Gomera, T - Tenerife, C - Gran Canaria, [F - Fuerteventura], L - Lanzarote (and adjacent small islands). * - Endemic Canary species. ? Data from literature without specification of an island.

Species	Islands						
<i>Dioicomyces anthici</i>							(L)
<i>Herpomyces tricuspидatus</i>							L
<i>Laboulbenia atlantica</i>					C		
<i>Laboulbenia basilewskyi</i>				T			
<i>Laboulbenia cafii</i>					C		
<i>Laboulbenia colasii</i>				T			
<i>Laboulbenia dicrodonti</i>			G	T			*
<i>Laboulbenia egens</i>				T	C		
<i>Laboulbenia flagellata</i>	H		G	T	C		L
<i>Laboulbenia machadoi</i>			G				*
<i>Laboulbenia olisthopi</i>				T			
<i>Laboulbenia pedicellata</i>							L
<i>Laboulbenia perpendicularis</i>				T			
<i>Laboulbenia proliferans</i>				T			
<i>Laboulbenia vulgaris</i>			G	T	C		
<i>Misgomyces dyschirii</i>					C		
<i>Peyritschiella furcifera</i>							?
<i>Peyritschiella hybrida</i>							?
<i>Prolixandromyces triandrus</i>				T			
<i>Rhachomyces canariensis</i>		P	G	T			
<i>Rhachomyces lavagnei</i>							L
<i>Rhachomyces tenenbaumii</i>		P	G	T			
<i>Stigmatomyces trianguliapicalis</i>					C		

DISCUSSION

Actually 23 species of Laboulbeniales (eight genera) are known in the Canarian Archipelago (Tab. 1). Six species and two genera are new for the Canary Islands. Two species are endemic in the Archipelago (Tab. 1). The majority of recorded Laboulbeniales species (15, including both endemic) infests Carabidae, though ground beetles represent only 4.0 % of the pterygote insect species of the Canarian Islands. Most host species (23) are endemic, only nine hosts occur outside the Macaronesian region as well. There are 21 endemic and 6 widespread host species of Carabidae.

The largest number of Laboulbeniales was found on Tenerife with 12 species, six occur on Gran Canaria and La Gomera, four on Lanzarote, two on La Palma, and one on El Hierro. No record is known from Fuerteventura. This pattern corresponds with two ecological factors: moisture and host biodiversity. The eastern islands Lanzarote and Fuerteventura are extremely arid, permanent rivers or other fresh water as well as forests are lacking there. Laboulbeniales however occur most frequently on hosts in moist habitats.

The laurel forests in the westernmost islands provide with its leaf litter and small creeks suitable habitats for many potential host species. The biodiversity of insects in general and carabid species in particular decreases however from Gran Canaria, Tenerife, and La Gomera to La Palma and El Hierro (see Izquierdo *et al.*, 2001; Machado, 1992).

In the future, a special attention should be directed to other potential host families (e.g. Staphylinidae) and to the population ecology of several parasite species. The abundances of some recorded *Laboulbenia* species seem to fluctuate strongly from year to year. The population ecology could explain such observations.

REFERENCES

- BÁEZ, M., J.L. MARTÍN ESQUIVEL & P. OROMÍ (2001). Diversidad taxonómica terrestre, pp. 119-125. In: FERNÁNDEZ-PALACIOS, J. M. & J. L. MARTÍN ESQUIVEL, (eds.). *Naturaleza de las Islas Canarias. Ecología y Conservación*. Publicaciones Turquesa S.L., Tenerife.
- BALAZUC, J. (1974). Laboulbeniales de France. *Bulletin mensuel de la Societe Linnéenne de Lyon* 43: 12-21.
- BALAZUC, J. (1975). Description de 4 espèces nouvelles de *Laboulbenia* (Ascomycetes) parasites de Coléoptères. *Acta Mycologica* 11: 67-76.
- BELTRÁN TEJERA, E. (2001). Fungi. En IZQUIERDO, I., J.L. MARTÍN, N. ZURITA & M. ARECHA VALETA (eds.) *Lista de especies silvestres de canarias (hongos, plantas y animales terrestres)*. Consejería de Política Territorial y Medio Ambiente Gobierno de Canarias, p.: 29-62.
- COLLA, S. (1926). Laboulbeniali osservati nelle collezioni del R. Museo Zoologico di Torino. *Atti della Reale Accademia Nazionale dei Lincei, Memorie della Classe di scienze fisiche, Roma ser. 6, 2*: 153-193.
- HULDEN, L. (1985). Floristic notes on Palaearctic Laboulbeniales (Ascomycetes). *Karstenia* 25: 1-16.

- IZQUIERDO, I., J.L. MARTÍN, N. ZURITA & M. ARECHAVALETA (eds.) *Lista de especies silvestres de canarias (hongos, plantas y animales terrestres)*. Consejería de Política Territorial y Medio Ambiente Gobierno de Canarias, 437pp.
- MACHADO A. (1992). *Monografía de los carábidos de las Islas Canarias*. IBCER, La Laguna, Tenerife 734pp.
- MAJEWSKI, T. (1994). The Laboulbeniales of Poland. *Polish Botanical Studies* 7: 1-466.
- MYERS, N., R.A. MITTERMEIER, C.G. MITTERMEIER, G.A.B. DA FONSECA, & J. KENT (2000). Biodiversity hotspots for conservation priorities. *Nature* 403: 853-858.
- OROMÍ, P. (2001). Mantodea, Blattaria. En: IZQUIERDO, I., J.L. MARTÍN, N. ZURITA & M. ARECHAVALETA (eds.). *Lista de especies silvestres de canarias (hongos, plantas y animales terrestres)*. Consejería de Política Territorial y Medio Ambiente Gobierno de Canarias, p.: 176.
- ROSSI, W. (1991). Due nuove Laboulbeniali delle isole Canarie (Ascomycetes). *Fragmenta Entomologica*, Roma 23: 1-6.
- SANTAMARIA, S. (1998). *Laboulbeniales, I. Laboulbenia*. *Fl. Mycol. Iber.*, Vol. 4: 186pp.
- SANTAMARIA, S. (2002). A taxonomic revision of the genus *Dioicomycetes*. *Mycological Research* 106: 615-638.
- SANTAMARIA, S., J. BALAZUC, & I. I. TAVARES (1991). Distribution of the European Laboulbeniales (Fungi, Ascomycotina). An annotated list of species. *Treballs de l'Institut Botànic de Barcelona* 14: 1-123.
- SIEMASZKO, J., & W. SIEMASZKO (1932). Owadorosty polskie i palearktyczne. II. *Polskie Pismo Entomol.* 10: 149-188.
- SPEGAZZINI, C. (1915). Laboulbeniali ritrovate nelle collezioni di alcuni musei italiani. *Anales del Museo Nacional de Historia Natural de Buenos Aires* 26: 451-511.
- TAVARES, I. I. (1985). Laboulbeniales (Fungi, Ascomycetes). *Mycologia/Memoir* 9: 1-627.
- THAXTER, R. (1896). Contributions toward a monograph of the Laboulbeniaceae. *Memoirs of the American Academy of Arts & Sciences* 12: 187-429.
- THAXTER, R. (1900). Preliminary diagnoses of new species of Laboulbeniaceae. 2. *Proceedings of the American Academy of Arts and Sciences* 35: 407-450.
- THAXTER, R. (1902). Preliminary diagnoses of new species of Laboulbeniaceae. 5. *Proceedings of the American Academy of Arts and Sciences* 38: 7-57.
- THAXTER, R. (1908). Contributions toward a monograph of the Laboulbeniaceae. Part II. *Memoirs of the American Academy of Arts & Sciences* 13: 217-469.