



ARSEF

ARS Collection of
Entomopathogenic
Fungal Cultures

‘TRICHOMYCETES’

Harpellales and Amoebidiales

(incorporating The University of Kansas, Mycological Laboratory
Culture Collection; RW Lichtwardt, Curator)

plus other Kickxellomycotina

FULLY INDEXED

USDA-ARS Biological Integrated Pest Management Research
Robert W. Holley Center for Agriculture and Health
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IMPORTANT NOTE

Recent phylogenetically based reclassifications of fungal pathogens of invertebrates

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Some seemingly dramatic and comparatively recent changes in the classification of a number of fungi may continue to cause confusion or a degree of discomfort to many of the clients of the cultures and informational resources provided by the ARSEF culture collection. This short treatment is an attempt to summarize some of these changes, the reasons for them, and to provide the essential references to the literature in which the changes are proposed.

As the Curator of the ARSEF collection I wish to assure you that these changes are appropriate, progressive, and necessary to modernize and to stabilize the systematics of the fungal pathogens affecting insects and other invertebrates, and I urge you to adopt them into your own thinking, teaching, and publications.

The identifications in the ARSEF catalogs (<http://arsef.fpsnl.cornell.edu>) are incorporating these new classifications as soon as we can confirm the correct new identifications of fungi and, where genera or species are being split on molecular grounds, to determine and to apply the correct new identifications.

General Reclassification of Fungi

The results of a global cooperative effort involving dozens of mycologists (including the curator of this collection) to reclassify the fungi according to phylogenetically sound principles based on the DNA sequence data for multiple genes has recently resulted in the publication of two monumentally important publications that completely rework mycological systematics. The earlier publication was a phylogenetic overview of virtually all fungi (James *et al.* 2006). The second publication (Hibbett *et al.* 2007) provided the necessary taxonomic readjustments that were indicated by the phylogenetic studies.

Microsporidia

Many mycologists and invertebrate pathologists are now aware that the Microsporidia have been proven beyond any reasonable doubt to be comparatively recent and highly derived endobiotic fungi. They are neither extremely ancient eukaryotes nor affiliated with protozoans as most textbooks indicate. None of this realignment to the fungi is being disputed by either microsporidiologists or phylogenetic mycologists. The rationale for this realignment is presented succinctly in James *et al.* (2006). These fascinating organisms connect to the fungal tree of life at the base of the nonflagellate fungi (among or near the fungi traditionally treated as the Zygomycota) but their exact affinities and nearest remain uncertain.

Zygomycota, Zygomycotina, Zygomycetes and Entomophthorales

The taxonomic revision of the fungi (Hibbett *et al.*, 2007) resulted in significant revision of the traditional view of the most ancestral groups of the nonflagellate fungi. The phylum Zygomycota, subphylum Zygomycotina, and class Zygomycetes disappeared in their widely understood sense to be replaced by the phylum Glomeromycota (for arbuscular mycorrhizal fungi) and a series of new subphyla not yet assigned to any phylum (because of the obviously polyphyletic nature of the zygomycetes as traditionally treated). The Entomophthorales is reclassified in the subphylum Entomophthoromycotina Humber (in

Hibbett *et al.* 2007); the other new subphyla in this group are the Mucormycotina, Zoopagomycotina and Kickellomycotina. Where there had been some question about whether *Basidiobolus* and its close relatives should be retained in the Entomophthorales or moved to a position closer to some of the blastocladialean water molds, James *et al.* (2006) unequivocally retain *Basidiobolus* in an ancestral position in the Entomophthorales.

Despite the short-term frustration of needing to deal with fungi belonging to these groups that the familiar concepts of Zygomycota, Zygomycotina and Zygomycetes are now abandoned. Until such a time as the molecular studies clarify the overall relationships among these fungi and establish a new set of phyla, my practical advice to the clientele of the ARSEF culture collection is to continue to use these discontinued phylum, subphylum and class names since (1) their meanings remain unambiguous in terms of the fungi included, and (2) journals and other outlets may remain unwilling or unable for some time still to handle the concepts of new subphyla with unassigned status (*'incertae sedis'*).

Entomopathogenic Ascomycetes and Associated Anamorphic (Conidial) States

Among all of the major taxonomic changes within the fungi that affect entomopathogenic fungi, the most dramatic and far-reaching involve the ascomycetes and their conidial (anamorphic) states classified among the pyrenomycetous fungi of the order Hypocreales. In one of the first major changes to be noted, those ascomycetous entomopathogens whose asci are produced in perithecia (nearly closed spherical to flask-like fruiting bodies) are now put in the class Sordariomycetes, a name based on a valid generic name, rather than in the historically familiar class Pyrenomycetes, a name based on the morphology of the fruiting body. The great majority of these fungi have long been recognized to belong in the family Clavicipitaceae (mostly in the genera *Cordyceps*, *Torrubiella* or *Hypocrella*). A major phylogenetic reclassification of the Clavicipitaceae (Sung *et al.* 2007; available free of charge at <http://www.studiesinmycology.org>) has split this family into three (Table 1), a long overdue major reworking of the taxonomy of *Cordyceps* and, subsequently, a reshuffling of anamorphic states among these families. This publication by Sung *et al.* (2007) is very long and complex since it includes a highly detailed phylogenetic analysis of these fungi as well as presenting the new taxonomy, descriptions of new families, genera, and species, and a very large number of new combinations (mostly segregating *Cordyceps* into their newly described segregate genera), and listing of the known or suspected anamorphic states associated with these taxa.

Table 1. Summary of some major teleomorphic (sexual) and anamorphic (conidial) genera of Hypocreales pathogenic to invertebrates (Sung *et al.* 2007).

	FAMILY		
	Clavicipitaceae	Cordycipitaceae	Ophiocordycipitaceae
Teleomorphs:	<i>Hypocrella</i> , <i>Metacordyceps</i> , <i>Regiocrella</i> , <i>Torrubiella</i>	<i>Cordyceps s.str.</i> , <i>Torrubiella</i>	<i>Ophiocordyceps</i> , <i>Elaphocordyceps</i>
Anamorphs:	<i>Aschersonia</i> , <i>Metarhizium</i> , <i>Nomuraea</i> , <i>Paecilomyces</i> -like ¹ , <i>Pochonia</i> , <i>Rotiferophthora</i> , <i>Verticillium</i> -like ²	<i>Beauveria</i> , <i>Engyodontium</i> , <i>Isaria</i> , <i>Lecanicillium</i> , <i>Mariannaea</i> -like, <i>Microhilum</i> , <i>Simplicillium</i>	<i>Haptocillium</i> , <i>Harposporium</i> , <i>Hirsutella</i> , <i>Hymenostilbe</i> , <i>Paecilomyces</i> -like ¹ , <i>Paraisaria</i> , <i>Sorospora</i> , <i>Syngliocladium</i> , <i>Tolypoocladium</i> , <i>Verticillium</i> -like ²

¹ Species formerly in *Paecilomyces* sect. *Isarioidea*, now excluded from *Paecilomyces* in the strict sense but also from *Isaria* (which now includes most entomogenous species transferred from *Paecilomyces*).

² Species formerly in *Verticillium* sect. *Prostrata*, now excluded from *Verticillium* in the strict sense but not yet reclassified in the segregate genera recognized by Zare and Gams (see below).

Table 2. Publications eliminating and reclassifying *Verticillium* section *Prostrata*

<u>PART</u>	<u>AUTHORS</u>	<u>SUBJECT COVERED</u>
1	Zare, Gams & Culham (2000)	ITS sequence analyses
2	Sung, Spatafora <i>et al.</i> (2001)	SSU, LSU rDNA sequence analyses
3	Gams, Zare (2001)	Generic reclassification
4	Zare, Gams (2001)	<i>Lecanicillium</i> and <i>Simplicillium</i> monograph
5	Zare, Gams, Evans (2001)	<i>Pochonia</i> , <i>Rotiferophthora</i> monograph
6	Zare, Gams (2001)	<i>Haptocillium</i> monograph

Table 3. Current phylogenetically based classification within Hypocreales of some species formerly classified in *Paecilomyces* sect. *Isarioidea* (following Luangsa-ard *et al.* 2005; Sung *et al.* 2007)

<u>FAMILY</u>	<u>GENUS</u>	<u>INCLUDED SPECIES</u>
Clavicipitaceae	' <i>Paecilomyces</i> ' ¹	<i>carneus</i> , <i>marquandii</i>
Cordycipitaceae	<i>Isaria</i>	<i>amoenorosea</i> , <i>cateniannulata</i> , <i>cateniobliqua</i> , <i>cicadae</i> , <i>coleopterora</i> , <i>farinosa</i> , <i>fumosorosea</i> , <i>ghanensis</i> , <i>tenuipes</i>
Ophiocordycipitaceae	' <i>Paecilomyces</i> ' ¹	<i>lilacinus</i>

¹ No generic re-assignments have been made for these hypocrealean anamorphs that must continue (for lack of any better alternatives) to be treated provisionally as *Paecilomyces* species. The generic affinities of other excluded '*Paecilomyces*' species noted by Luangsa-ard *et al.* (2005) remain uncertain.

Note that Table 1 shows *Torrubiella* to be split between two families. This is an untenable position in a phylogenetically based classification that requires all taxa to represent monophyletic lineages. Future phylogenetic studies that will result in the reclassification of *Torrubiella* are obviously required. Also note that some anamorphic states with morphologies referable to *Hirsutella*, *Paecilomyces* and *Verticillium* (the latter two genera in their old senses from before recent phylogenetic reclassifications discussed below may occur in more than one family; this underscores the need to regard anamorphic states as being named in form-genera defined only by their morphologies and similar modes of development rather than by phylogenetic relatedness.

Phylogenetically based reclassification of *Verticillium* section *Prostrata* – The extensive, phylogenetically based reclassifications of conidial fungi that common pathogens of insects or other invertebrates began with the reclassification of *Verticillium* species. The long-accepted classification of this genus (Gams 1971) recognized two sections (*Verticillium* and *Prostrata*). All species in the type section–*Verticillium* sect. *Verticillium*, which included the phytopathogenic species with well differentiated, erect conidiophores—are conidial states of perithecial ascomycetes in the order Phyllachorales. The species in *Vert.* sect. *Prostrata*, however, are known to be conidial states attributable to several families within the order Hypocreales (Sordariomycetes). Because the current standards of systematics demand that taxa should be monophyletic, it was necessary to remove the species from *Verticillium* section *Prostrata* to other genera. This reclassification was done in six publications (Table 2) reflecting primarily the doctoral research of Rasoul Zare under the guidance of Walter Gams. Most entomopathogens from this group are now placed in *Lecanicillium*, a genus whose type species, *L. lecanii*, was also recognized to be a species complex recognized to include at least three species (*L. lecanii*, *L. muscarium*, and *L. longisporum*) and thus replacing the morphologically highly variable *Verticillium lecanii*.

Phylogenetically based reclassification of *Paecilomyces* section *Isarioidea* – The long-used taxonomy of *Paecilomyces* by Samson (1974) divided this genus into two sections, and with all entomopathogens treated in *Paecilomyces* sect. *Isarioidea*. The type species, *P. variotii* Bainier, and all species in *Paecilomyces* sect. *Paecilomyces* are anamorphic (conidial) states of cleistothecial ascomycetes in the Eurotiomycetes. In an exact parallel with the situation for the two sections of *Verticillium*, all species in *Paec.* sect. *Isarioidea* are anamorphic states of pyrenomycete ascomycetes in the order Hypocreales, mostly in the family Clavicipitaceae although the reclassification of that family by Sung et al. (2007) now disperses these former *Paecilomyces* species among three families (Table 3). The taxonomic revision of *Paecilomyces* section *Prostrata* began with the lectotypification and determination of the status of *Isaria* (Hodge et al. 2005), a genus long ago relegated to synonymy with *Paecilomyces*, and the formal conservation of the generic name *Isaria* (Gams et al. 2005). The next step was a phylogenetic study that confirmed the polyphyletic nature of *Paecilomyces* in the broad sense (Luangsa-ard, Hywel-Jones, Samson 2004), followed then by a formal reclassification (with new combinations) of most species from *Paec.* sect. *Isarioidea* into *Isaria* while several other species from this section were excluded from both *Paecilomyces* and *Isaria* and still await transfers into appropriate anamorphic genera (Table 3).

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ARS COLLECTION OF ENTOMOPATHOGENIC FUNGAL CULTURES

History and Purpose of the ARSEF Collection

The goal of the ARS Collection of Entomopathogenic Fungal Cultures (ARSEF) is to provide fundamental support for basic and applied research on the fungal pathogens of invertebrates. Since its establishment in the early 1970s, this collection has served as a general research resource for the isolation, collection, preservation, and distribution of fungal strains from insects, other arthropods, and nematodes. Emphasis has always been placed on acquiring and distributing strains under active study for use as potential biological control agents. Basic research associated with the collection includes fungal systematics, fungal cytology, pathobiology, and methodology for fungal cryopreservation. The culture collection and its associated collection of microscope slides and herbarium specimens provide invaluable support for taxonomic research on and the diagnoses of fungal pathogens of invertebrates. Identification services for specimens and cultures have always been available free of charge to any laboratories requesting them.

We strive to provide users with pure and accurately identified fungal cultures, and the taxonomies applied to the fungi in this collection are continuously updated to reflect their current accepted classifications. The curator of the collection welcomes all correspondence about nomenclatural or taxonomic changes or possible misidentifications involving any ARSEF strains.

The ARSEF collection began as Richard Soper's research collection in the USDA-ARS laboratory at the University of Maine (Orono; UMO) where its cultures were initially designated by a UMO or RS prefix before adopting ARSEF in 1985. In 1978, the ARS Insect Pathology Research Unit relocated to Ithaca, NY, to work with the Boyce Thompson Institute (BTI) on the Cornell University campus. The Insect Pathology Research Unit became the Plant Protection Research Unit (PPRU) in 1985, and was renamed in 2008 as the Biological Integrated Pest Management Research Unit (BioIPM). The ARSEF collection moved from BTI in 1990 into the US Plant, Soil & Nutrition Laboratory which was rededicated in 2008 as the Robert W. Holley Center for Agriculture & Health to commemorate Dr. Holley's work there to complete the first sequencing of any nucleic acid; he received the 1968 Nobel Prize for Medicine or Physiology for this work.

BioIPM operates the ARSEF culture collection for the USDA Agricultural Research Service; the collection is not now and has never been owned or controlled by the Boyce Thompson Institute. ARSEF is one of the largest germplasm collections in the ARS, and is widely recognized for its active support of research on fungal pathogens of invertebrates. ARSEF and its associated herbarium are registered under the ARSEF acronym since 1985 with the World Federation of Culture Collections' World Data Center on Microorganisms and the International Association of Plant Taxonomists' *Index Herbariorum*, respectively.

From 1977 through 2008, all strains in the collection were preserved by immersion in liquid nitrogen. A program to lyophilize those isolates that could tolerate such was begun in the 1990's, and has expanded in scope and pace. At the end of 2008 the vast majority of the collection was consolidated in a single large nitrogen dewar in a new facility adjacent to the current building. Requests for cultures are filled with either actively growing cultures on appropriate media or, if available, as freeze-dried units.

Identifying and Acknowledging ARSEF Strains in Publications

We request that all publications using or referring to strains obtained from ARSEF acknowledge the U.S. Department of Agriculture, ARS Plant Protection Research Unit and state the ARSEF accession numbers of these strains. We would very greatly appreciate receiving reprints of all past, current, and future publications or even periodic notification about research in progress involving the use of ARSEF strains.

Accession numbers of strains from commercial culture collections such as the American Type Culture Collection (ATCC), Centraalbureau voor Schimmelcultures (CBS), CAB International Mycological Institute (IMI), and other registered general service collections are listed in this catalog to provide complete information about specific isolates. ***Representation of cultures obtained from ARSEF as being from ATCC, CBS, IMI or UAMH or other general service culture collections violates trademark laws, and persons doing so are subject to prosecution.*** Cultures received from ARSEF should be referred to by their ARSEF numbers only even if they are co-deposited in other other culture collections.

Depositing and Exchanging Cultures

BioIPM and ARSEF encourage deposition of entomopathogenic fungal cultures in the ARSEF collection—particularly strains used in published studies—and of voucher and reference specimens to its herbarium. Depositors may reserve the right to limit redistribution of any culture deposited with ARSEF for specified times upon consultation with the curator. Depositors can receive subcultures of their own depositions at any time; these cultures do not affect any allowances of free cultures. Exchanges of cultures between ARSEF and other research or general collections of fungal cultures are encouraged and are not subject to numerical limits.

Prior to shipping cultures from countries outside the United States contact the Curator to obtain the appropriate needed importation permit from the U.S. Department of Agriculture, Animal and Plant Health Inspection Services, Plant Protection and Quarantine.

When sending cultures and/or specimens to ARSEF, it is very important to include as much of the following information as possible:

1. Scientific name (and taxonomic authority) of the fungus.
2. Common and scientific name (with taxonomic authority) of the host.
3. Order and family of the host. (***This information is especially important!***)
4. Date and site of collection.
5. Name of collector.
6. Date and name of isolator.
7. Any collection, accession, or other identifier number(s) applied by the collector or sender.
8. Medium on which a culture is sent.
9. Any special requirements or conditions for growth (such as medium, temperature, pH).

Diagnostic Services for Cultures and Specimens

Specimens and cultures of unidentified fungi from invertebrates can be submitted to ARSEF for diagnosis. This service is an important function of the ARS Collections of Entomopathogenic Fungi and is provided without charge. Identifications and information about the disposition of specimens will be mailed to the sender.

Release of ARSEF Cultures from Containment or Quarantine

Neither the curator nor any employee of ARSEF or of the Plant Protection Research Unit is entitled to authorize the release of any culture it provides from laboratory containment or quarantine in the United States or elsewhere. Recipients of ARSEF cultures are responsible for obtaining appropriate and necessary permissions from or for providing official notifications to State and Federal regulatory agencies.

ORDERING INFORMATION

Please send all requests for isolates directly to the Curator (Richard A. Humber):

ARS Collection of Entomopathogenic Fungal Cultures
Robert W. Holley Center for Agriculture & Health
Tower Rd.
Ithaca, NY 14853–2901

Telephone: [+1] 607 255-1276
OR Fax: [+1] 607 255-1132
Email: richard.humber@ars.usda.gov

Academic, Government, and Other Nonprofit Institutions

1–5 isolates [up to 7 per calendar year]

no charge

6 or more isolates per order [8 or more per calendar year]

US\$50 per strain

Users from nonprofit institutions can receive up to five isolates without charge in any 6 month period, and up to seven cultures in any calendar year. Requests in excess of these limits may be charged at the rate of US\$50 per additional isolate requested. Requests from commercially sponsored research programs undertaken by nonprofit institutions are charged at the commercial rate and are not subject to numerical limits. Prices are subject to change without notice.

Commercial and Industrial Institutions

US\$75 per strain

Nonprofit institutions working on commercially sponsored contractual projects (such as screening programs) are charged at the rate of US\$75 per strain requested. There are no limits on the numbers of cultures that can be requested or shipped. Prices are subject to change without notice.

Commercial or industrial firms supporting research at the ARS Plant Protection Research Unit are entitled to free access to cultures pertinent to contracted projects; all other requests are charged at the current rate.

TERMS OF SHIPMENT

If necessary, billings for isolates are issued through the Boyce Thompson Institute. We encourage prepayment for isolates. *Checks or money orders for strains must be payable to the **Boyce Thompson Institute*** but sent directly to the curator of the ARS Collections of Entomopathogenic Fungi. Consult the curator of the collections with questions about fees due for any particular shipment.

All recipients of cultures are strongly encouraged to provide express shipper account numbers to allow shipping costs to be billed directly to recipients, thus assuring significant cost-savings to the ARSEF collection.

We request confirmation of receipt and viability of cultures shipped. Inviable strains will be replaced.

ARSEF reserves the right to refuse to ship isolates

- to recipients who cannot handle them using standard microbiological practices,
- to laboratories that cannot assure laboratory containment of isolates except after obtaining permissions from applicable State and Federal regulatory agencies, or
- if use of routine mailing or shipping procedures cannot assure the receipt of viable cultures.

Neither ARSEF, BioIPM, nor the Boyce Thompson Institute is liable for damages arising from the misidentification of strains.

INTERPRETATION OF STRAIN ACCESSION DATA

The following examples provide a guide to the arrangement and interpretation of collection data included in this catalog.

***Beauveria bassiana* (Balsamo) Vuillemin**

2828 M Feng (MD8903). *Metopolophium dirhodum* [Homoptera: Aphididae] on spring wheat. 21 Jul 89. USA: Parma, Idaho.

2828	ARSEF accession number.
M Feng (MD8903)	Depositor and depositor's reference or accession number.
<i>Metopolophium dirhodum</i> [Homoptera: Aphididae]	Original host [host's order and family]
On spring wheat	The substrate on which the host was found
21 Jul 89	Date of accession or receipt by ARSEF.
USA: Parma, Idaho	Country of origin followed by the locality and state.

***Conidiobolus thromboides* Drechsler**

73 [CSIRO EM534; FPMI 28] RG Kenneth (3040)←ATCC (24419)←DM MacLeod←G Thoizon. *Rhopalosiphum insertum* [Homoptera: Aphididae]. Rec'd Jan 18 1976. France: Val-de-Marne, La Varenne.

73	ARSEF accession number.
[CSIRO EM534; FPMI 28]	Alternative depositions of this strain in other culture collections.
RG Kenneth (3040)	Depositor and depositor's reference or accession number.
←ATCC (24419)←DM MacLeod ←G Thoizon	Culture provenance: RG Kenneth obtained the culture from ATCC, which received it from DM MacLeod, who received it from G Thoizon.
<i>Rhopalosiphum insertum</i> [Acari: Eriophyidae]	Original host [host's order and family]
Rec'd Jan 18 1976	Date of receipt by ARSEF.
France: Val-de-Marne, La Varenne	Country of origin followed by the locality and region.

***Hirsutella thompsonii* Fisher**

137 [ATCC 24874; CBS 952.73] CW McCoy (Fla. 68). *Phyllocoptruta oleivora* [Acari: Eriophyidae]. Jan 1 1970. USA: Orlando, Florida.

137	ARSEF accession number.
[ATCC 24874; CBS 952.73]	Alternative depositions of this strain in other culture collections.
CW McCoy (Fla. 68)	Depositor and depositor's reference or accession number.
<i>Phyllocoptruta oleivora</i> [Homoptera: Aphididae]	Original host together with the host's order and family.
Jan 1 1970	Date of accession or receipt by ARSEF. Note: January 1 is a default date if an exact date in a year is unknown; the first day of the month is the default if no specific day in a month is known.
USA: Orlando, Florida	Country of origin followed by the locality and state.

ABBREVIATIONS

Information about the world's officially registered culture collections, their registered acronyms (e.g., ARSEF), and more is available from the CCINFO database and from other resources available at the website of the World Data Center for Microbiology <http://wdcm.nig.ac.jp/WDCHomePage_text.html>

ARSEF	ARS Collection of Entomopathogenic Fungi, USDA-ARS BioIPM Research Unit, Robert W. Holley Center for Agriculture & Health, Tower Rd., Ithaca, New York, 14853-2901, USA
ATCC	American Type Culture Collection, PO Box 1549, Manassas, Virginia 20108, USA
CATIE	Centro Agronómico Tropical de Investigación y Enseñanza, Proyecto UIP, Apdo. Postal 7170, Turrialba, Costa Rica.
CBS	Centraalbureau voor Schimmelcultures, Uppsalalaan 8, 3584 CT Utrecht, The Netherlands
CCF	Culture Collection of Fungi, Department of Botany, Charles University, Prague, Czech Republic
CCFC	Canadian Collection of Fungus Cultures, Centre for Land and Biological Resources Research, Room 1015, K.W. Neatby Bldg., Ottawa, Ontario K1A 0C6, Canada
CDC	Centers for Disease Control and Prevention, Atlanta, Georgia 30333, USA
CENARGEN	Centro Nacional de Pesquisa de Recursos Geéticos e Biotecnologia, S.A.I.N. Parque Rural, C.P. 102372, 70770 Brasília, D.F., Brazil
CIRI	Corn Insects Research Unit, USDA-ARS, R.R. Box 45B, Ankeny, Iowa 50021, USA
CNPAF	National Center for Agricultural Research on Rice and Beans, EMBRAPA, Goiânia, Goiás, Brazil
CNPS	National Center for Agricultural Research on Soybeans, EMBRAPA, Londrina, Paraná, Brazil
CP	Strains isolated during joint US-Brazil program funded by US-AID to study fungal biocontrol of the insect pests of cowpeas
DAOM	National Mycological Herbarium, Centre for Land and Biological Resources Research, Agriculture Canada, Central Experimental Farm, Ottawa, Ontario, K1A 0C6, Canada
DAR	New South Wales Department of Agriculture, Rydalmere, NSW, Australia
EFCC	Korean Entomopathogenic Fungal Collection (JM Sung, Curator), Dept. of Agricultural Biology, Kangwon National University, Chuncheon, Rep. of Korea
FI	CSIRO Entomology Division, Collection of Entomopathogenic Fungi, Black Mountain Laboratories, Canberra, ACT, Australia. This collection, formerly curated by R. Milner, is now orphaned and is being transferred to ARSEF.
FPMI	Great Lakes Forestry Center (formerly Forest Pest Management Institute), 1219 Queen Street East, Sault Ste. Marie, Ontario P6A 5M7, Canada. This collection, formerly led by D MacLeod and D Tyrrell is orphaned and endangered. Its surviving isolates <i>may</i> be transferred to DAOM.
GCRI	Horticulture Research International (formerly, Glasshouse Crops Research Institute), Worthing Road, Littlehampton, W. Sussex BN17 6LP, England, UK
HACC	Hindustan Antibiotics Ltd., Pimpri, Poona, India
IMI	(Now incorporated in United Kingdom National Culture Collection [UKNCC]) CABI Bioscience, Bakeham Lane, Egham, Surrey TW20 9TY, UK

INRA	Station de Recherches de lutte Biologique et Biocoenotique, INRA (Institut National de la Recherche Agronomique), La Minière – 78280 Guyancourt, France
IPLB	Unité de Lutte Biologique, Institut Pasteur, 28 Rue de Dr. Roux, 75724 Paris, France
IRRI	International Rice Research Institute, P.O. Box 933, Manila, Philippines
KEFC	(see EFCC)
KSU	Kansas State University, Department of Entomology, Manhattan, Kansas 66506, USA
MAF	Ministry of Agriculture and Fisheries, Canterbury Agriculture and Science Centre, Ellesmere Junction Road, P.O. Box 24, Lincoln, New Zealand
MU	Miami University, Willard Sherman Turrell Herbarium, Department of Botany, 79 Upham Hall, Oxford, Ohio 45056, USA
NCTC	National Collection of Type Cultures, Public Health Laboratory Service, 61 Colindale Ave., London NW9 5HT, England, UK
NRRL	ARS Culture Collection, USDA-ARS National Center for Agricultural Utilization Research, 1815 N. University, Peoria, Illinois 61604, USA
PSU	The Pennsylvania State University, 211 Buckhout Laboratory, University Park, Pennsylvania 16802, USA
QEC	Queen Elizabeth College, University of London, Department of Biology, Campden Hill Road, London W8 7AH, England, UK
QM	U.S. Army Natick Laboratories (formerly, Quartermaster Research and Development Center), Natick Massachusetts. Note: This collection has been transferred to NRRL.
RSA	Rancho Santa Ana Botanic Garden, 1500 North College Ave., Claremont, California 91711, USA
SBI	Sugarcane Breeding Institute, Indian Council of Agricultural Research, Coimbatore – 641 007, Tamil Nadu, India
UAF	University of Arkansas, Department of Entomology, 321 Agriculture Building, Fayetteville, Arkansas 72701, USA
UAMH	University of Alberta Microfungus Collection, Devonian Botanic Garden, University of Alberta, Alberta T6G 2H7, Canada

Amoebidium appalachense Siri, MM White & Lichtwardt
[Mesomycetozoea: Amoebidiales]

- 9181 RW Lichtwardt (TN-27-W1A). *Chironomus* sp. [Diptera: Chironomidae]. Jul 2004. USA: Great Smoky Mountains National Park, Tennessee.
- 9255 RW Lichtwardt (TN-27-A3(a)). *Chironomus* sp. [Diptera: Chironomidae]. Aug 2004. USA: Great Smoky Mountains National Park, Tennessee.
- 9256 RW Lichtwardt (TN-27-W4). *Chironomus* sp. [Diptera: Chironomidae]. Aug 2004. USA: Great Smoky Mountains National Park, Tennessee.

Amoebidium parasiticum Cienkowski
[Mesomycetozoea: Amoebidiales]

- 9182 RW Lichtwardt (FRA-1-14). [Cladocera]. Jun 1968. France: Hérault.
- 9183 RW Lichtwardt (JAP-7-2). *Chironomus* sp. [Diptera: Chironomidae]. Mar 1964. Japan: Honshu.
- 9257 RW Lichtwardt (A1a). [Cladocera]. 1959. USA: southern California, California.

Barbatospora ambicaudata MM White, Siri & Lichtwardt
[Kickxellomycotina: Harpellales]
Legeriomycetaceae

- 9020 RW Lichtwardt (TN-49-W4A). *Simulium vandalicum* [Diptera: Simuliidae]. Aug 2004. USA: Great Smoky Mountains National Park, Tennessee.

Capniomyces stellatus SW Peterson & Lichtwardt
[Kickxellomycotina: Harpellales]

- 9258 RW Lichtwardt (MIS-10-108). *Allocapnia granulata* [Plecoptera: Capniidae]. 1982. USA: southern Missouri, Missouri.

***Coemansia* sp.**
[Kickxellomycotina: Kickxellales]
Kickxellaceae

- 2452 GL Benny (21A). Rec'd 31 Aug 1987. Location not specified.

Furculomyces boomerangus (MC Williams & Lichtwardt) MC Williams & Lichtwardt
[Kickxellomycotina: Harpellales]
Legeriomycetaceae

- 9021 RW Lichtwardt (AUS-77-4). *Tanytarsus nr. inextentus* [Diptera: Chironomidae]. Apr 1987. Australia: Tasmania.
- 9077 RW Lichtwardt (AUS-42-6). *Procladius paludicola* [Diptera: Chironomidae]. Apr 1987. Australia: Victoria.
- 9259 RW Lichtwardt (AUS-42-7). *Psectrocladius paludicola* [Diptera: Chironomidae]. Apr 1987. Australia: Victoria.

Harpellales, genus undetermined
[Kickxellomycotina: Harpellales]

- 9064 RW Lichtwardt (ALG-13-W1). [Trichoptera]. Aug 2004. Canada: Algonquin Provincial Park, Ontario.
- 9089 RW Lichtwardt (AS-42-1). *Corynoneura* sp. [Diptera: Chironomidae]. Jan 1998. New Zealand: South Island.

***Legeriosimilis* sp.**
[Kickxellomycotina: Harpellales]

- 9066 RW Lichtwardt (ALG-10-W3). [Trichoptera]. Aug 2004. Canada: Algonquin Provincial Park, Ontario.

Ramicandelaber longisporus Ogawa, Hayashi, Degawa & Yaguchi
[Kickxellomycotina: Kickxellales]
Originally designated in ARSEF as *Tetrarhiza sinensis* but same fungus published as it *Ramicandelaber longispora*

- 6175 SF Meyer (L0321). Eggs/cysts, *Heterodera glycines* [Tylenchida: Heteroderidae] from roots and soil in soybean field. 30 Aug 1992. PR China: Tong County, Beijing.
- 6176 SF Meyer (L0355). Eggs/cysts, *Heterodera glycines* [Tylenchida: Heteroderidae] from roots and soil in soybean field. 30 Aug 1992. PR China: Tong County, Beijing.
- 6327 RA Humber (1). Single spore reisolate of ARSEF 6175. Rec'd 5 Nov 1999. Laboratory manipulation.
- 6328 RA Humber (2). Single spore reisolate of ARSEF 6175. Rec'd 5 Nov 1999. Laboratory manipulation.
- 6329 RA Humber (3). Single spore reisolate of ARSEF 6175. Rec'd 5 Nov 1999. Laboratory manipulation.
- 6330 RA Humber (4). Single spore reisolate of ARSEF 6175. Rec'd 5 Nov 1999. Laboratory manipulation.
- 6331 RA Humber (5). Single spore reisolate of ARSEF 6175. Rec'd 5 Nov 1999. Laboratory manipulation.
- 6332 RA Humber (6). Single spore reisolate of ARSEF 6175. Rec'd 5 Nov 1999. Laboratory manipulation.
- 6333 RA Humber (7). Single spore reisolate of ARSEF 6175. Rec'd 5 Nov 1999. Laboratory manipulation.
- 6334 RA Humber (8). Single spore reisolate of ARSEF 6175. Rec'd 5 Nov 1999. Laboratory manipulation.
- 6335 RA Humber (9). Single spore reisolate of ARSEF 6175. Rec'd 5 Nov 1999. Laboratory manipulation.
- 6336 RA Humber (10). Single spore reisolate of ARSEF 6175. Rec'd 5 Nov 1999. Laboratory manipulation.
- 6337 RA Humber (11). Single spore reisolate of ARSEF 6175. Rec'd 5 Nov 1999. Laboratory manipulation.
- 6338 RA Humber (12). Single spore reisolate of ARSEF 6175. Rec'd 5 Nov 1999. Laboratory manipulation.

***Smittium* sp.**
[Kickxellomycotina: Harpellales]
Harpellaceae

- 9034 RW Lichtwardt (CR-259-4). [Diptera: Chironomidae]. Nov 1991. Costa Rica.

- 9035 RW Lichtwardt (CR-239-12). *Tanytarsus* sp. [Diptera: Chironomidae]. Nov 1991. Costa Rica.
- 9038 RW Lichtwardt (TN-24-W8). [Diptera: Culicidae]. Jul 2004. USA: Great Smoky Mountains National Park, Tennessee.
- 9050 RW Lichtwardt (NOR-59-2). *Psectrocladius limbatus* [Diptera: Chironomidae]. Aug 2002. Norway.
- 9051 RW Lichtwardt (OR-4-W6). [Diptera]. Sep 2006. USA: Oregon.
- 9065 RW Lichtwardt (ALG-16-W28). [Diptera]. Aug 2004. Canada: Algonquin Provincial Park, Ontario.
- 9070 RW Lichtwardt (TN-27-W1B). Jul 2004. USA: Great Smoky Mountains National Park, Tennessee.
- 9072 RW Lichtwardt (NOR-25-W10A). May 2002. Norway.
- 9079 RW Lichtwardt (culture 12-1-3). [Diptera: Culicidae]. Aug 1996. Australia: Tasmania.
- 9081 RW Lichtwardt (TN-24-W11). [Diptera: Culicidae]. Jul 2004. USA: Great Smoky Mountains National Park, Tennessee.
- 9086 RW Lichtwardt (OR-18-W33). [Diptera: Tipulidae]. Sep 2005. USA: Oregon.
- 9087 RW Lichtwardt (AR-19-4S). [Diptera: Chironomidae]. Nov 1992. USA: Madison County, Arkansas.
- 9088 RW Lichtwardt (ALG-16-W27). [Diptera]. Aug 2004. Canada: Algonquin Provincial Park, Ontario.
- 9119 RW Lichtwardt (ARG-17-4F). [Plecoptera: Gripopterygidae]. Jul 1996. Argentina: Neuquén.
- 9120 RW Lichtwardt (CR-169-22). *Polypedilum* sp. [Diptera: Chironomidae]. Jun 1988. Costa Rica.
- 9121 RW Lichtwardt (MO-16-2). *Orthocladius* sp. [Diptera: Chironomidae]. Jun 1988. USA: Missouri.
- 9145 RW Lichtwardt (MO-6-5). [Diptera: Chironomidae]. Apr 1993. USA: Missouri.
- 9146 RW Lichtwardt (SWE-3-5). *Orthocladius* sp. [Diptera: Chironomidae]. Jul 1971. Sweden: Norrbotten.
- 9147 RW Lichtwardt (SWI-7-6). *Pseudokiefferiella* sp. [Diptera: Chironomidae]. Aug 1971. Switzerland.
- 9148 RW Lichtwardt (TN-46-W8B). [Diptera: Culicidae]. Jul 2004. USA: Great Smoky Mountains National Park, Tennessee.

Smittium acutum Lichtwardt & Grigg
[Kickxellomycotina: Harpellales]
Harpellaceae

- 9092 RW Lichtwardt (OK-5-1). [Diptera: Chironomidae]. May 1990. USA: Haskell County, Oklahoma.

Smittium angustum MC Williams & Lichtwardt
[Kickxellomycotina: Harpellales]

- 9241 RW Lichtwardt (AUS-126-30). *Tanytarsus* sp. [Diptera: Chironomidae]. Apr 1991. Australia: Western Australia.

Smittium annulatum Lichtwardt
[Kickxellomycotina: Harpellales]

- 9242 RW Lichtwardt (CR-143-8). [Diptera: Simuliidae]. May 1988. Costa Rica.

Smittium caudatum Lichtwardt & Grigg
[Kickxellomycotina: Harpellales]

- 9000 RW Lichtwardt (OK-3-20). [Diptera: Chironomidae]. Jan 1989. USA: Oklahoma.
- 9261 RW Lichtwardt (OK-3-21). [Diptera: Chironomidae]. Jan 1989. USA: Haskell County, Oklahoma.

Smittium coloradense Lichtwardt & MC Williams
[Kickxellomycotina: Harpellales]

- 9001 RW Lichtwardt (RMBL-13-41). *Cricotopus* sp. [Diptera: Chironomidae]. Jul 1985. USA: Gunnison County, Colorado.
- 9002 RW Lichtwardt (RMBL-13-49). *Orthocladius* sp. [Diptera: Chironomidae]. Jul 1985. USA: Gunnison County, Colorado.

Smittium commune Lichtwardt & Grigg
[Kickxellomycotina: Harpellales]
Harpellaceae

- 9085 RW Lichtwardt (KS-2-25). [Diptera: Chironomidae]. Mar 1989. USA: Douglas County, Kansas.
- 9243 RW Lichtwardt (KS-5-4). *Microtendipes* sp. [Diptera: Chironomidae]. Apr 1993. USA: Anderson County, Kansas.
- 9244 RW Lichtwardt (KS-5-7). *Microtendipes* sp. [Diptera: Chironomidae]. Apr 1993. USA: Anderson County, Kansas.
- 9245 RW Lichtwardt (KS-5-8). *Microtendipes* sp. [Diptera: Chironomidae]. Apr 1993. USA: Anderson County, Kansas.

Smittium culicis Manier
[Kickxellomycotina: Harpellales]
Harpellaceae

- 5431 RW Lichtwardt (ARG-X-3) ← C Lopez Lastra (#2). 4th instar larva, *Culex renatoi* [Diptera: Culicidae] on *Eryngium cabreriae*. Rec'd 2 May 1997. Argentina: Punta Lara, Boca Cerrada, Ensenada, Buenos Aires.
- 5432 RW Lichtwardt (ARG-X-4) ← C López Lastra (#3). 4th instar larva, *Aedes albifasciatus* [Diptera: Culicidae]. Rec'd 2 May 1997. Argentina: Punta Lara, Boca Cerrada, Ensenada, Buenos Aires.
- 9003 RW Lichtwardt (43-1-2). *Chironomus* sp. [Diptera: Chironomidae]. Aug 1996. Australia: Tasmania.
- 9004 RW Lichtwardt (ARG-X-4). *Aedes albifasciatus* [Diptera: Culicidae]. May 1995. Argentina: La Plata, Buenos Aires.
- 9005 RW Lichtwardt (AUS-62-10). *Austrothaumalea* sp. [Diptera: Thaumaleidae]. Mar 1987. Australia: Victoria.

- 9006 RW Lichtwardt (AUS-62-16). *Limonia* sp. [Diptera: Tipulidae]. Mar 1987. Australia: Victoria.
- 9007 RW Lichtwardt (LCF-43-2). *Corynoneura* sp. [Diptera: Chironomidae]. Jan 1998. New Zealand: South Island.
- 9008 RW Lichtwardt (LEA-7-10). *Simulium vittatum* [Diptera: Simuliidae]. Jul 1981. USA: Leavenworth County, Kansas.
- 9009 RW Lichtwardt (WYO-51-11). *Aedes sticticus* [Diptera: Culicidae]. Sep 1965. USA: Teton County, Wyoming.
- 9010 RW Lichtwardt (GSMNP). [Diptera: Culicidae]. Dec 1989. USA: Great Smoky Mountains National Park, Tennessee.
- 9011 RW Lichtwardt (NY-2-C25). [Diptera: Chironomidae]. Nov 1998. USA: New York.
- 9031 RW Lichtwardt (ARG-X-3). [Diptera: Culicidae]. 1997. Argentina: Buenos Aires.
- 9040 RW Lichtwardt (AUS-62-17). *Limonia* sp. [Diptera: Tipulidae]. Mar 1987. Australia: Victoria.
- 9041 RW Lichtwardt (AUS-62-6). *Austrothaumalea* sp. [Diptera: Thaumaleidae]. Mar 1987. Australia: Victoria.
- 9045 RW Lichtwardt (FRA-15-5). *Chironomus* sp. [Diptera: Chironomidae]. Jul 1968. France: nr. Grenoble, Isère.
- 9046 RW Lichtwardt (FRA-15-7). *Chironomus* sp. [Diptera: Chironomidae]. Jul 1968. France: nr. Grenoble, Isère.
- 9057 RW Lichtwardt (T-12-1-4). [Diptera: Culicidae]. Aug 1996. Australia: Tasmania.
- 9059 RW Lichtwardt (UT-11-W(a)). [Diptera]. Jan 2006. USA: Utah.
- 9073 RW Lichtwardt (ALG-16-W3). [Diptera: Culicidae]. Aug 2004. Canada: Algonquin Provincial Park, Ontario.
- 9074 RW Lichtwardt (ZEA-6-3). *Culex pervigilans* [Diptera: Culicidae]. Jul 1983. New Zealand: North Island.
- 9084 RW Lichtwardt (LCF-8-1). [Diptera: Thaumaleidae]. Dec 1997. New Zealand: North Island.
- 9091 RW Lichtwardt (ALG-5-W8). [Diptera: Tipulidae]. Aug 2004. Canada: Algonquin Provincial Park, Ontario.
- 9093 RW Lichtwardt (LCF-43-12). *Corynoneura* sp. [Diptera: Chironomidae]. Jan 1998. New Zealand: South Island.
- 9123 RW Lichtwardt (culture 12-1-2). [Diptera: Culicidae]. Aug 1996. Australia: Tasmania.
- 9124 RW Lichtwardt (culture 35-1-1). [Diptera: Thaumaleidae]. Aug 1996. Australia: Tasmania.
- 9125 RW Lichtwardt (AUS-77-5). *Tanytarsus* sp. [Diptera: Chironomidae]. Mar 1987. Australia: Tasmania.
- 9126 RW Lichtwardt (CAN-X-1). *Prosimulium* sp. [Diptera: Simuliidae]. 1962. Canada.
- 9127 RW Lichtwardt (FRA-6-16). [Diptera: Chironomidae]. Jun 1968. France: Hérault.
- 9128 RW Lichtwardt (FRA-9-1). *Culex* sp. [Diptera: Culicidae]. Jun 1968. France: Hérault.
- 9129 RW Lichtwardt (FRA-15-2). [Diptera: Chironomidae]. Jul 1968. France: Southeastern France.
- 9130 RW Lichtwardt (WYO-51-14). *Aedes sticticus* [Diptera: Culicidae]. Sep 1965. USA: Teton County, Wyoming.
- 9140 RW Lichtwardt (culture 12-1-1). [Diptera: Culicidae]. Aug 1996. Australia: Tasmania.
- 9141 RW Lichtwardt (culture 12-1-4). [Diptera: Culicidae]. Aug 1996. Australia: Tasmania.
- 9142 RW Lichtwardt (culture 43-1-2). *Chironomus* sp. [Diptera: Chironomidae]. Aug 1996. Australia: Tasmania.
- 9143 RW Lichtwardt (ALG-5-W2b). *Dactylolabis montana* [Diptera: Tipulidae]. Aug 2004. Canada: Algonquin Provincial Park, Ontario.
- 9149 RW Lichtwardt (FRA-8-7). *Culex* sp. [Diptera: Culicidae]. Jun 1968. France: Montpellier, Hérault.

Smittium culicisoides Lichtwardt

[Kickxellomycotina: Harpellales]

Harpellaceae

- 9044 RW Lichtwardt (CR-253-12). [Diptera: Chironomidae]. Nov 1991. Costa Rica.

Smittium culisetae Lichtwardt

[Kickxellomycotina: Harpellales]

Harpellaceae

- 5200 C López Lastra (2^o). Larva, *Aedes crinifer* [Diptera: Culicidae]. 24 Nov 1995. Costa Rica: Buenos Aires, Puntarenas.
- 5430 RW Lichtwardt (ARG-X-2) ← C Lopez Lastra (#1). 4th instar larva, *Culex dolosus* [Diptera: Culicidae]. Rec'd 2 May 1997. Argentina: Punta Lara, Boca Cerrada, Ensenada, Buenos Aires.
- 6810 CE Beard (DP170696). Cytospecies IIIIL-1, *Simulium vittatum* [Diptera: Simuliidae]. 17 Jun 1996. USA: Clemson University, Lamaster Dairy, Willard's Pond outflow, Clemson, South Carolina.
- 7100 CE Beard. 25 Feb 2003. USA: Bull Pen Bog, Jackson County, North Carolina.
- 9012 RW Lichtwardt (COL-18-3). *Culiseta impatiens* [Diptera: Culicidae]. Aug 1963. USA: Gunnison County, Colorado.
- 9013 RW Lichtwardt (FL-X-1). *Aedes albopictus* [Diptera: Culicidae]. Mar 1993. USA: Florida.
- 9014 RW Lichtwardt (HAW-14-8). *Aedes albopictus* [Diptera: Culicidae]. Feb 1964. USA: Oahu, Hawaii.
- 9015 RW Lichtwardt (JAP-77-9). [Diptera: Culicidae]. Jul 1967. Japan: Kyushu.

- 9016 RW Lichtwardt (KS-108-02). *Aedes vexans* [Diptera: Culicidae]. Apr 2004. USA: Douglas County, Kansas.
- 9017 RW Lichtwardt (KS-108-06). *Aedes vexans* [Diptera: Culicidae]. Apr 2004. USA: Douglas County, Kansas.
- 9018 RW Lichtwardt (LEA-7-4). *Simulium vittatum* [Diptera: Simuliidae]. Jul 1981. USA: Leavenworth County, Kansas.
- 9024 RW Lichtwardt (La-6a-L1). [Diptera: Culicidae]. Feb 2002. USA: Baton Rouge Parish, Louisiana.
- 9025 RW Lichtwardt (AUS-2-8). *Chironomus alternans* [Diptera: Chironomidae]. Jul 1983. Australia: New South Wales.
- 9026 RW Lichtwardt (KAU-W-4). [Diptera: Culicidae]. Oct 1984. USA: Kauai, Hawaii.
- 9032 RW Lichtwardt (SC-DP-1). *Simulium vittatum* [Diptera: Simuliidae]. Jun 1996. USA: Pickens County, South Carolina.
- 9039 RW Lichtwardt (TN-27-A8). *Ochlerotatus japonicus* [Diptera: Culicidae]. Aug 2004. USA: Great Smoky Mountains National Park, Tennessee.
- 9047 RW Lichtwardt (HAW-5-8). *Aedes albopictus* [Diptera: Culicidae]. Jan 1964. USA: Hawaii.
- 9048 RW Lichtwardt (JAP-30-4). *Culex* sp. [Diptera: Culicidae]. Jun 1964. Japan: Shikoku.
- 9056 RW Lichtwardt (SMO599). *Culex restuans* [Diptera: Culicidae]. May 1999. USA: Pickens County, South Carolina.
- 9058 RW Lichtwardt (TN-46-6). [Diptera: Culicidae]. Aug 2004. USA: Great Smoky Mountains National Park, Tennessee.
- 9062 RW Lichtwardt (WYO-44-9). *Culiseta* sp. [Diptera: Culicidae]. Jul 1965. USA: Grand Teton National Park, Wyoming.
- 9069 RW Lichtwardt (TN-27-A8). *Ochlerotatus japonicus* [Diptera: Culicidae]. Jul 2004. USA: Great Smoky Mountains National Park, Tennessee.
- 9071 RW Lichtwardt (TN-46-A10). [Diptera: Culicidae]. Jul 2004. USA: Great Smoky Mountains National Park, Tennessee.
- 9075 RW Lichtwardt (ARG-X-5). [Diptera: Culicidae]. 1997. Argentina: La Plata, Buenos Aires.
- 9094 RW Lichtwardt (ARG-X-1). *Aedes crinifer* [Diptera: Culicidae]. 1997. Argentina: La Plata, Buenos Aires.
- 9095 RW Lichtwardt (CAL-X-2). *Culiseta incidens* [Diptera: Culicidae]. 1962. USA: California.
- 9096 RW Lichtwardt (CLW-2-44). *Simulium vittatum* [Diptera: Simuliidae]. 1965. USA: Minnesota.
- 9097 RW Lichtwardt (FRA-7-1). *Dasyhelea* sp. [Diptera: Ceratopogonidae]. Jun 1968. France.
- 9098 RW Lichtwardt (HAW-E-2). [Diptera: Culicidae]. Oct 1982. USA: Hawaii.
- 9099 RW Lichtwardt (HAW-5-5). *Aedes albopictus* [Diptera: Culicidae]. Dec 1963. USA: Oahu, Hawaii.
- 9100 RW Lichtwardt (HAW-5-7). *Aedes albopictus* [Diptera: Culicidae]. Jan 1964. USA: Oahu, Hawaii.
- 9101 RW Lichtwardt (HAW-5-9). *Aedes albopictus* [Diptera: Culicidae]. Jan 1964. USA: Oahu, Hawaii.
- 9102 RW Lichtwardt (HAW-13-2). *Aedes vexans* [Diptera: Culicidae]. Feb 1964. USA: Oahu, Hawaii.
- 9103 RW Lichtwardt (HAW-13-3). *Aedes vexans* [Diptera: Culicidae]. Feb 1964. USA: Oahu, Hawaii.
- 9104 RW Lichtwardt (HAW-14-5). *Aedes albopictus* [Diptera: Culicidae]. Feb 1964. USA: Oahu, Hawaii.
- 9105 RW Lichtwardt (HAW-14-5M). *Aedes albopictus* [Diptera: Culicidae]. Feb 1964. USA: Oahu, Hawaii.
- 9106 RW Lichtwardt (HAW-14-7). *Aedes albopictus* [Diptera: Culicidae]. Feb 1964. USA: Oahu, Hawaii.
- 9107 RW Lichtwardt (JAP-30-3). *Culex* sp. [Diptera: Culicidae]. Jun 1964. Japan: Shikoku.
- 9108 RW Lichtwardt (JAP-30-8). *Culex* sp. [Diptera: Culicidae]. Jun 1964. Japan: Shikoku.
- 9109 RW Lichtwardt (JAP-57-1). [Diptera: Culicidae]. Jul 1964. Japan: Honshu.
- 9110 RW Lichtwardt (JAP-77-7). [Diptera: Culicidae]. Jul 1967. Japan: Kyushu.
- 9111 RW Lichtwardt (JAP-77-8). [Diptera: Culicidae]. Jul 1967. Japan: Kyushu.
- 9112 RW Lichtwardt (LEA-7-2). *Simulium vittatum* [Diptera: Simuliidae]. Jul 1981. USA: Leavenworth County, Kansas.
- 9113 RW Lichtwardt (TN-24-A3). [Diptera: Culicidae]. Aug 2004. USA: Great Smoky Mountains National Park, Tennessee.
- 9114 RW Lichtwardt (WYO-42-26). *Orthocladius* sp. [Diptera: Chironomidae]. Jul 1965. USA: Grand Teton National Park, Wyoming.
- 9115 RW Lichtwardt (WYO-44-1). *Culiseta* sp. [Diptera: Culicidae]. Jul 1965. USA: Grand Teton National Park, Wyoming.
- 9131 RW Lichtwardt (ARG-X-2). *Culex dolosus* [Diptera: Culicidae]. Nov 1995. Argentina: Buenos Aires.
- 9132 RW Lichtwardt (SWI-4-13). [Diptera: Chironomidae]. Aug 1971. Switzerland.
- 9133 RW Lichtwardt (WYO-44-8). *Culiseta* sp. [Diptera: Culicidae]. Jul 1965. USA: Grand Teton National Park, Wyoming.
- 9246 RW Lichtwardt (NE-27-1). *Aedes vexans* [Diptera: Culicidae]. Jul 1979. USA: Kearney County, Nebraska.
- 9247 RW Lichtwardt (WYO-44-15). [Diptera: Culicidae]. Jul 1965. USA: Grand Teton National Park, Wyoming.
-
- Smittium cylindrosporum*** Lichtwardt & Arenas
[Kickxellomycotina: Harpellales]
- 9116 RW Lichtwardt (CHI-27-1). *Cricotopus* sp. [Diptera: Chironomidae]. Dec 1993. Chile: Southern Chile.

- 9248 RW Lichtwardt (CHI-20-04). *Cricotopus* sp. [Diptera: Chironomidae]. Oct 1993. Chile: Southern Chile.
9249 RW Lichtwardt (CHI-20-7). *Cricotopus* sp. [Diptera: Chironomidae]. Oct 1993. Chile: Southern Chile.

Smittium dipterorum Lichtwardt
[Kickxellomycotina: Harpellales]

- 9250 RW Lichtwardt (CR-254-13). *Chironomus* sp. [Diptera: Chironomidae]. Nov 1991. Costa Rica.
9263 RW Lichtwardt (CR-253-14). *Simulium* sp. [Diptera: Simuliidae]. Nov 1991. Costa Rica.

Smittium elongatum Lichtwardt
[Kickxellomycotina: Harpellales]

- 9251 RW Lichtwardt (AUS-59-5S). [Diptera: Chironomidae]. Mar 1987. Australia: Victoria.

Smittium fecundum Lichtwardt & MC Williams
[Kickxellomycotina: Harpellales]
Legeriomycetaceae

- 9022 RW Lichtwardt (RMBL-64-5). *Psectrocladius* sp. [Diptera: Chironomidae]. Jul 1995. USA: Gunnison County, Colorado.
9083 RW Lichtwardt (RMBL-61-13). *Psectrocladius* sp. [Diptera: Chironomidae]. Jul 1995. USA: Gunnison County, Colorado.

Smittium gravimetalum Lichtwardt, Ferrington & Harford
[Kickxellomycotina: Harpellales]

- 9029 RW Lichtwardt (KS-F1-15). *Dicrotendipes fumidus* [Diptera: Chironomidae]. Jun 1996. USA: Cherokee County, Kansas.
9036 RW Lichtwardt (KS-F1-5). *Dicrotendipes fumidus* [Diptera: Chironomidae]. Jun 1996. USA: Cherokee County, Kansas.

Smittium imitatum Lichtwardt & Arenas
[Kickxellomycotina: Harpellales]
Harpellaceae

- 9033 RW Lichtwardt (CHI-9-4). *Simulium* sp. [Diptera: Simuliidae]. Dec 1993. Chile: Los Lagos.

Smittium lentaquaticum Siri, MM White & Lichtwardt
[Kickxellomycotina: Harpellales]

- 9068 RW Lichtwardt (TN-27-A4). *Chironomus* sp. [Diptera: Chironomidae]. Jul 2004. USA: Great Smoky Mountains National Park, Tennessee.
9082 RW Lichtwardt (TN-27-A5). [Diptera: Culicidae]. Jul 2004. USA: Great Smoky Mountains National Park, Tennessee.
9253 RW Lichtwardt (TN-27-A3(s)). *Chironomus* sp. [Diptera: Chironomidae]. Jul 2004. USA: Great Smoky Mountains National Park, Tennessee.

Smittium megazygosporum Manier & Coste
[Kickxellomycotina: Harpellales]
Harpellaceae

- 6275 CE Beard (DP161096). Cytospecies I11L-1, *Simulium vittatum* [Diptera: Simuliidae]. 16 Oct 1996. USA: Clemson University, Lamaster Dairy, Willard's Pond outflow, Clemson, South Carolina.
9037 RW Lichtwardt (SC-DP-2). *Simulium vittatum* [Diptera: Simuliidae]. Jun 1997. USA: Pickens County, South Carolina.

Smittium megazygosporum(?)
[Kickxellomycotina: Harpellales]

- 9027 RW Lichtwardt (BLH-16). *Orthocladius* sp. [Diptera: Chironomidae]. Jan 1999. USA: Chase County, Kansas.

Smittium morbosum Sweeney
[Kickxellomycotina: Harpellales]
Harpellaceae

- 9060 RW Lichtwardt (WKRa). *Ochlerotatus triseriatus* [Diptera: Culicidae]. Sep 2006. USA: South Carolina.
9061 RW Lichtwardt (WKRb). *Ochlerotatus triseriatus* [Diptera: Culicidae]. Sep 2006. USA: South Carolina.

Smittium mucronatum Manier & Mathiez ex Manier
[Kickxellomycotina: Harpellales]
Harpellaceae

- 9028 RW Lichtwardt (FRA-12-3). *Psectrocladius sordidellus* [Diptera: Chironomidae]. Jul 1968. France: Hérault.
9063 RW Lichtwardt (ALG-10-S8). [Diptera]. Aug 2004. Canada: Algonquin Provincial Park, Ontario.
9067 RW Lichtwardt (ALG-7-W7). [Diptera: Chironomidae]. Aug 2004. Canada: Algonquin Provincial Park, Ontario.
9090 RW Lichtwardt (ALG-7-W6). [Diptera: Chironomidae]. Aug 2004. Canada: Algonquin Provincial Park, Ontario.
9144 RW Lichtwardt (ALG-7-W10). [Diptera: Chironomidae]. Aug 2004. Canada: Algonquin Provincial Park, Ontario.

Smittium orthocladii Manier
[Kickxellomycotina: Harpellales]
Harpellaceae

- 9080 RW Lichtwardt (TN-3-4). [Diptera: Chironomidae]. Dec 1989. USA: Sumner County, Tennessee.

Smittium perforatum(?)
[Kickxellomycotina: Harpellales]

- 9055 RW Lichtwardt (RMBL-44-3). *Diamesa* sp. [Diptera: Chironomidae]. Jul 1995. USA: Gunnison County, Colorado.

Smittium phytotelmatum

Smittium tronadorium

Fungal Cultures

Smittium phytotelmatum Lichtwardt

[Kickxellomycotina: Harpellales]

Harpellaceae

9076 RW Lichtwardt (CR-133-2). *Chironomus* sp. [Diptera: Chironomidae]. May 1988. Costa Rica.

Smittium simulatum Lichtwardt & Arenas

[Kickxellomycotina: Harpellales]

Harpellaceae

9042 RW Lichtwardt (CHI-8-7). *Aphrophila bidentata* [Diptera: Tipulidae]. Dec 1993. Chile: Southern Chile.

9078 RW Lichtwardt (CHI-8-3). *Aphrophila bidentata* [Diptera: Tipulidae]. Dec 1993. Chile: Southern Chile.

9117 RW Lichtwardt (CHI-8-4). *Aphrophila bidentata* [Diptera: Tipulidae]. Dec 1993. Chile: Southern Chile.

Smittium simulii Lichtwardt

[Kickxellomycotina: Harpellales]

9019 RW Lichtwardt (JAP-32-4). [Diptera: Chironomidae]. May 1964. Japan: Shikoku.

9043 RW Lichtwardt (CLW-10-6). *Simulium* sp. [Diptera: Simuliidae]. Aug 1965. USA: Minnesota.

9049 RW Lichtwardt (JAP-57-5). [Diptera: Simuliidae]. Jul 1964. Japan: Honshu.

9118 RW Lichtwardt (CLW-10-5). *Simulium* sp. [Diptera: Simuliidae]. 1965. USA: Minnesota.

9134 RW Lichtwardt (CLW-9-15). *Simulium* sp. [Diptera: Simuliidae]. 1965. USA: Minnesota.

9135 RW Lichtwardt (JAP-31-7). *Simulium uchidai* [Diptera: Simuliidae]. May 1964. Japan: Shikoku.

9136 RW Lichtwardt (JAP-33-2). [Diptera: Chironomidae]. May 1964. Japan: Shikoku.

9137 RW Lichtwardt (JAP-51-5). *Simulium* sp. [Diptera: Simuliidae]. Jul 1964. Japan: Honshu.

9138 RW Lichtwardt (JAP-51-18). *Simulium* sp. [Diptera: Simuliidae]. Jul 1964. Japan: Honshu.

9139 RW Lichtwardt (SWE-8-4). *Diamesa* sp. [Diptera: Chironomidae]. Jul 1971. Sweden: Norrbotten.

Smittium stenosporum

[Kickxellomycotina: Harpellales]

9023 RW Lichtwardt (OK-3-14). *Cricotopus* sp. [Diptera: Chironomidae]. Jan 1989. USA: Haskell County, Oklahoma.

Smittium tipulidarum MC Williams & Lichtwardt

[Kickxellomycotina: Harpellales]

9052 RW Lichtwardt (RMBL-14-10). *Elliptera astigmatica* [Diptera: Tipulidae]. Jul 1985. USA: Gunnison County, Colorado.

9053 RW Lichtwardt (RMBL-31-2). *Elliptera astigmatica* [Diptera: Tipulidae]. Jul 1985. USA: Gunnison County, Colorado.

9054 RW Lichtwardt (RMBL-31-4). *Elliptera astigmatica* [Diptera: Tipulidae]. Jul 1985. USA: Gunnison County, Colorado.

9122 RW Lichtwardt (RMBL-31-1). *Elliptera astigmatica* [Diptera: Tipulidae]. Jul 1985. USA: Gunnison County, Colorado.

Smittium tronadorium Lichtwardt, Ferrington &

López Lastra

[Kickxellomycotina: Harpellales]

9030 RW Lichtwardt (ARG-24-20F). *Paraheptagyia* sp. [Diptera: Chironomidae]. Nov 1996. Argentina: Río Negro.

Amoebidium appalachense [Diptera: Chironomidae] <i>Chironomus</i> 9181 9255 9256	Smittium coloradense [Diptera: Chironomidae] <i>Cricotopus</i> 9001 <i>Orthocladius</i> 9002	Smittium cylindrosporum [Diptera: Chironomidae] <i>Cricotopus</i> 9116 9248 9249
Amoebidium parasiticum [Cladocera] Unknown species 9182 9257 [Diptera: Chironomidae] <i>Chironomus</i> 9183	Smittium commune [Diptera: Chironomidae] Unknown species 9085 <i>Microtendipes</i> 9243 9244 9245	Smittium dipterorum [Diptera: Chironomidae] <i>Chironomus</i> 9250 [Diptera: Simuliidae] <i>Simulium</i> 9263
Barbatospora ambicaudata [Diptera: Simuliidae] <i>Simulium vandalicum</i> 9020	Smittium culicis [Diptera] Unknown species 9059 [Diptera: Chironomidae] Unknown species 9011 9127 9129 <i>Chironomus</i> 9003 9045 9046 9142 <i>Corynoneura</i> 9007 9093 <i>Tanytarsus</i> 9125 [Diptera: Culicidae] Unknown species 9010 9031 9057 9073 9123 9140 9141 <i>Aedes albifasciatus</i> 5432 9004 <i>Aedes sticticus</i> 9009 9130 <i>Culex</i> 9128 9149 <i>Culex pervigilans</i> 9074 <i>Culex renatoi</i> 5431 [Diptera: Simuliidae] <i>Prosimulium</i> 9126 <i>Simulium vittatum</i> 9008 [Diptera: Thaumaleidae] Unknown species 9084 9124 <i>Austrothaumalea</i> 9005 9041 [Diptera: Tipulidae] Unknown species 9091 <i>Dactylolabis montana</i> 9143 <i>Limonia</i> 9006 9040	Smittium elongatum [Diptera: Chironomidae] Unknown species 9251
Capniomyces stellatus [Plecoptera: Capniidae] <i>Allocapnia granulata</i> 9258	Smittium culicoides [Diptera: Chironomidae] Unknown species 9044	Smittium fecundum [Diptera: Chironomidae] <i>Psectrocladius</i> 9022 9083
Furculomyces boomerangus [Diptera: Chironomidae] <i>Procladius paludicola</i> 9077 <i>Psectrocladius paludicola</i> 9259 <i>Tanytarsus nr. inextentus</i> 9021	Smittium culisetae [Diptera: Ceratopogonidae] <i>Dasyhelea</i> 9097 [Diptera: Chironomidae] Unknown species 9132 <i>Chironomus alternans</i> 9025 <i>Orthocladius</i> 9114 [Diptera: Culicidae] Unknown species 9015 9024 9026 9058 9071 9075 9098 9109 9110 9111 9113 9247 <i>Aedes albopictus</i> 9013 9014 9047 9099 9100 9101 9104 9105 9106 <i>Aedes crinifer</i> 5200 9094 <i>Aedes vexans</i> 9016 9017 9102 9103 9246 <i>Culex</i> 9048 9107 9108 <i>Culex dolosus</i> 5430 9131 <i>Culex restuans</i> 9056 <i>Culiseta</i> 9062 9115 9133 <i>Culiseta impatiens</i> 9012 <i>Culiseta incidens</i> 9095 <i>Ochlerotatus japonicus</i> 9039 9069 [Diptera: Simuliidae] <i>Simulium vittatum</i> 6810 9018 9032 9096 9112	Smittium gravimetallum [Diptera: Chironomidae] <i>Dicrotendipes fumidus</i> 9029 9036
Harpellales, genus undetermined [Diptera: Chironomidae] <i>Corynoneura</i> 9089 [Trichoptera] Unknown species 9064	Smittium imitatum [Diptera: Simuliidae] <i>Simulium</i> 9033	Smittium lentaquaticum [Diptera: Chironomidae] <i>Chironomus</i> 9068 9253 [Diptera: Culicidae] Unknown species 9082
Legeriosimilis sp. [Trichoptera] Unknown species 9066	Smittium megalazygosporum [Diptera: Simuliidae] <i>Simulium vittatum</i> 6275 9037	Smittium megalazygosporum(?) [Diptera: Chironomidae] <i>Orthocladius</i> 9027
Ramicandelaber longisporus [Tylenchida: Heteroderidae] <i>Heterodera glycines</i> 6175 6176	Smittium morbosum [Diptera: Culicidae] <i>Ochlerotatus triseriatus</i> 9060 9061	Smittium mucronatum [Diptera] Unknown species 9063 [Diptera: Chironomidae] Unknown species 9067 9090 9144 <i>Psectrocladius sordidellus</i> 9028
Smittium sp. [Diptera] Unknown species 9051 9065 9088 [Diptera: Chironomidae] Unknown species 9034 9087 9145 <i>Orthocladius</i> 9121 9146 <i>Polyedilum</i> 9120 <i>Psectrocladius limbatellus</i> 9050 <i>Pseudokiefferiella</i> 9147 <i>Tanytarsus</i> 9035 [Diptera: Culicidae] Unknown species 9038 9079 9081 9148 [Diptera: Tipulidae] Unknown species 9086 [Plecoptera: Gripopterygidae] Unknown species 9119	Smittium orthocladii [Diptera: Chironomidae] Unknown species 9080	Smittium perforatum(?) [Diptera: Chironomidae] <i>Diamesa</i> 9055
Smittium acutum [Diptera: Chironomidae] Unknown species 9092	Smittium phytotelmatum [Diptera: Chironomidae] <i>Chironomus</i> 9076	Smittium simulatum [Diptera: Tipulidae] <i>Aphrophila bidentata</i> 9042 9078 9117
Smittium angustum [Diptera: Chironomidae] <i>Tanytarsus</i> 9241		
Smittium annulatum [Diptera: Simuliidae] Unknown species 9242		
Smittium caudatum [Diptera: Chironomidae] Unknown species 9000 9261		

Smittium simulii

[Diptera: Chironomidae]

Unknown species 9019 9136

Diamesa 9139

[Diptera: Simuliidae]

Unknown species 9049

Simulium 9043 9118 9134 9137 9138

Simulium uchidai 9135

Smittium stenosporum

[Diptera: Chironomidae]

Cricotopus 9023

Smittium tipulidarum

[Diptera: Tipulidae]

Elliptera astigmatica 9052 9053 9054

9122

Smittium tronadorium

[Diptera: Chironomidae]

Paraheptagyia 9030

Animalia

Arthropoda • Crustacea

Cladocera

- France
Amoebidium parasiticum 9182
USA, California
Amoebidium parasiticum 9257

Arthropoda • Insecta

Diptera: Ceratopogonidae

- Dasyhelea* sp.
France
Smittium culisetae 9097

Diptera: Chironomidae

- Australia
Smittium elongatum 9251
Canada, Ontario
Smittium mucronatum 9067 9090
9144
Costa Rica
Smittium culicisoides 9044
Smittium sp. 9034
France
Smittium culicis 9127 9129
Japan
Smittium simulii 9019 9136
Switzerland
Smittium culisetae 9132
USA, Arkansas
Smittium sp. 9087
USA, Kansas
Smittium commune 9085
USA, Missouri
Smittium sp. 9145
USA, New York
Smittium culicis 9011
USA, Oklahoma
Smittium acutum 9092
Smittium caudatum 9000 9261
USA, Tennessee
Smittium orthocladii 9080
Chironomus sp.
Australia
Smittium culicis 9003 9142
Costa Rica
Smittium dipterorum 9250
Smittium phytotelmatum 9076
France
Smittium culicis 9045 9046
Japan
Amoebidium parasiticum 9183

- USA, Tennessee
Amoebidium appalachense 9181
9255 9256
Smittium lentaquaticum 9068 9253
Chironomus alternans
Australia
Smittium culisetae 9025
Corynoneura sp.
New Zealand
Harpellales, genus undetermined
9089
Smittium culicis 9007 9093
Cricotopus sp.
Chile
Smittium cylindrosporium 9116
9248 9249
USA, Colorado
Smittium coloradense 9001
USA, Oklahoma
Smittium stenoporum 9023
Diamesa sp.
Sweden
Smittium simulii 9139
USA, Colorado
Smittium perforatum(?) 9055
Dicrotendipes fumidus
USA, Kansas
Smittium gravimetallum 9029 9036
Microtendipes sp.
USA, Kansas
Smittium commune 9243 9244 9245
Orthocladus sp.
Sweden
Smittium sp. 9146
USA, Colorado
Smittium coloradense 9002
USA, Kansas
Smittium megazygosporem(?) 9027
USA, Missouri
Smittium sp. 9121
USA, Wyoming
Smittium culisetae 9114
Paraheptagyia sp.
Argentina
Smittium tronadorium 9030
Polypedium sp.
Costa Rica
Smittium sp. 9120
Procladius paludicola
Australia
Furculomyces boomerangus 9077
Psectrocladius sp.
USA, Colorado
Smittium fecundum 9022 9083
Psectrocladius limbatellus
Norway
Smittium sp. 9050
Psectrocladius paludicola
Australia
Furculomyces boomerangus 9259
Psectrocladius sordidellus
France
Smittium mucronatum 9028
Pseudokiefferiella sp.
Switzerland
Smittium sp. 9147

- Tanytarsus* sp.
Australia
Smittium angustum 9241
Smittium culicis 9125
Costa Rica
Smittium sp. 9035
Tanytarsus nr. inextentus
Australia
Furculomyces boomerangus 9021

Diptera: Culicidae

- Argentina
Smittium culisetae 9075
Smittium culicis 9031
Australia
Smittium culicis 9057 9123 9140
9141
Smittium sp. 9079
Canada, Ontario
Smittium culicis 9073
Japan
Smittium culisetae 9015 9109 9110
9111
USA, Hawaii
Smittium culisetae 9026 9098
USA, Louisiana
Smittium culisetae 9024
USA, Tennessee
Smittium culisetae 9058 9071 9113
Smittium culicis 9010
Smittium lentaquaticum 9082
Smittium sp. 9038 9081 9148
USA, Wyoming
Smittium culisetae 9247
Aedes albifasciatus
Argentina
Smittium culicis 5432 9004
Aedes albopictus
USA, Florida
Smittium culisetae 9013
USA, Hawaii
Smittium culisetae 9014 9047 9099
9100 9101 9104 9105 9106
Aedes crinifer
Argentina
Smittium culisetae 9094
Costa Rica
Smittium culisetae 5200
Aedes sticticus
USA, Wyoming
Smittium culicis 9009 9130
Aedes vexans
USA, Hawaii
Smittium culisetae 9102 9103
USA, Kansas
Smittium culisetae 9016 9017
USA, Nebraska
Smittium culisetae 9246
Culex sp.
France
Smittium culicis 9128 9149
Japan
Smittium culisetae 9048 9107 9108
Culex dolosus
Argentina
Smittium culisetae 5430 9131

Culex pervigilans
New Zealand
Smittium culicis 9074
Culex renatoi
Argentina
Smittium culicis 5431
Culex restuans
USA, South Carolina
Smittium culisetæ 9056
Culiseta sp.
USA, Wyoming
Smittium culisetæ 9062 9115 9133
Culiseta impatiens
USA, Colorado
Smittium culisetæ 9012
Culiseta incidens
USA, California
Smittium culisetæ 9095
Ochlerotatus japonicus
USA, Tennessee
Smittium culisetæ 9039 9069
Ochlerotatus triseriatus
USA, South Carolina
Smittium morbosum 9060 9061

Diptera: Simuliidae

Costa Rica
Smittium annulatum 9242
Japan
Smittium simulii 9049
Prosimulium sp.
Canada
Smittium culicis 9126
Simulium sp.
Chile
Smittium imitatum 9033
Costa Rica
Smittium dipterorum 9263
Japan
Smittium simulii 9137 9138
USA, Minnesota
Smittium simulii 9043 9118 9134
Simulium uchidai
Japan
Smittium simulii 9135
Simulium vandalicum
USA, Tennessee
Barbatospora ambicaudata 9020
Simulium vittatum
USA, Kansas
Smittium culisetæ 9018 9112
Smittium culicis 9008
USA, Minnesota
Smittium culisetæ 9096
USA, South Carolina
Smittium culisetæ 6810 9032
Smittium megazygosporum 6275
9037

Diptera: Thaumaleidae

Australia
Smittium culicis 9124
New Zealand
Smittium culicis 9084
Austrothaumalea sp.
Australia
Smittium culicis 9005 9041

Diptera: Tipulidae

Canada, Ontario
Smittium culicis 9091
USA, Oregon
Smittium sp. 9086
Aphrophila bidentata
Chile
Smittium simulatum 9042 9078
9117
Dactylolabis montana
Canada, Ontario
Smittium culicis 9143
Elliptera astigmatica
USA, Colorado
Smittium tipulidarum 9052 9053
9054 9122
Limonia sp.
Australia
Smittium culicis 9006 9040

Plecoptera: Capniidae

Allocapnia granulata
USA, Missouri
Capniomyces stellatus 9258

Plecoptera: Gripopterygidae

Argentina
Smittium sp. 9119

Trichoptera

Canada, Ontario
Harpellales, genus undetermined
9064
Legeriosimilis sp. 9066

Nemata • Secernentea

Tylenchida: Heteroderidae

Heterodera glycines
PR China
Ramicandelaber longisporus 6175
6176

Geographical Origin

Argentina

Buenos Aires
Smittium culisetae 5430 9075 9094
 9131
Smittium culicis 5431 5432 9004 9031
 Neuquén
Smittium sp. 9119
 Río Negro
Smittium tronadorium 9030

Australia

New South Wales
Smittium culisetae 9025
 Tasmania
Furculomyces boomerangus 9021
Smittium culicis 9003 9057 9123 9124
 9125 9140 9141 9142
Smittium sp. 9079
 Victoria
Furculomyces boomerangus 9077 9259
Smittium culicis 9005 9006 9040 9041
Smittium elongatum 9251
 Western Australia
Smittium angustum 9241

Canada

Smittium culicis 9126
 Ontario
Harpellales, genus undetermined 9064
Legeriosimilis sp. 9066
Smittium culicis 9073 9091 9143
Smittium mucronatum 9063 9067
 9090 9144
Smittium sp. 9065 9088

Chile

Smittium cylindrosporum 9116 9248
 9249
Smittium simulatum 9042 9078 9117
 Los Lagos
Smittium imitatum 9033

Costa Rica

Smittium annulatum 9242
Smittium culicisoides 9044
Smittium dipterorum 9250 9263
Smittium phytotelmatum 9076
Smittium sp. 9034 9035 9120
 Puntarenas
Smittium culisetae 5200

France

Smittium culisetae 9097
Smittium culicis 9129
 Hérault
Amoebidium parasiticum 9182
Smittium culicis 9127 9128 9149
Smittium mucronatum 9028
 Isère
Smittium culicis 9045 9046

Japan

Honshu
Amoebidium parasiticum 9183
Smittium culisetae 9109
Smittium simulii 9049 9137 9138
 Kyushu
Smittium culisetae 9015 9110 9111
 Shikoku
Smittium culisetae 9048 9107 9108
Smittium simulii 9019 9135 9136

Laboratory manipulation

Ramicandelaber longisporus 6327
 6328 6329 6330 6331 6332 6333
 6334 6335 6336 6337 6338

New Zealand

North Island
Smittium culicis 9074 9084
 South Island
Harpellales, genus undetermined 9089
Smittium culicis 9007 9093

Norway

Smittium sp. 9050 9072

PR China

Beijing
Ramicandelaber longisporus 6175
 6176

Sweden

Norrbottn
Smittium simulii 9139
Smittium sp. 9146

Switzerland

Smittium culisetae 9132
Smittium sp. 9147

USA

Arkansas
Smittium sp. 9087
 California
Amoebidium parasiticum 9257
Smittium culisetae 9095
 Colorado
Smittium coloradense 9001 9002
Smittium culisetae 9012
Smittium fecundum 9022 9083
Smittium perforatum(?) 9055
Smittium tipulidarum 9052 9053 9054
 9122
 Florida
Smittium culisetae 9013
 Hawaii
Smittium culisetae 9014 9026 9047
 9098 9099 9100 9101 9102 9103 9104
 9105 9106
 Kansas
Smittium commune 9085 9243 9244
 9245
Smittium culisetae 9016 9017 9018
 9112
Smittium culicis 9008
Smittium gravimetallum 9029 9036
Smittium megazygosporum(?) 9027
 Louisiana
Smittium culisetae 9024

Minnesota

Smittium culisetae 9096
Smittium simulii 9043 9118 9134

Missouri

Capniomyces stellatus 9258
Smittium sp. 9121 9145

Nebraska

Smittium culisetae 9246

New York

Smittium culicis 9011

North Carolina

Smittium culisetae 7100

Oklahoma

Smittium acutum 9092
Smittium caudatum 9000 9261
Smittium stenosporum 9023

Oregon

Smittium sp. 9051 9086

South Carolina

Smittium culisetae 6810 9032 9056
Smittium megazygosporum 6275 9037
Smittium morbosum 9060 9061

Tennessee

Amoebidium appalachense 9181 9255
 9256

Barbatospora ambicaudata 9020
Smittium culisetae 9039 9058 9069
 9071 9113

Smittium culicis 9010

Smittium lentaquaticum 9068 9082
 9253

Smittium orthocladii 9080

Smittium sp. 9038 9070 9081 9148

Utah

Smittium culicis 9059

Wyoming

Smittium culisetae 9062 9114 9115
 9133 9247
Smittium culicis 9009 9130

Beard, Charles E.

DP161096 *Smittium megazygosporum*
6275
DP170696 *Smittium culisetae* 6810

Benny, Gerald L.

21A *Coemansia* sp. 2452

Humber, Richard A.

1 *Ramicandelaber longisporus* 6327
10 *Ramicandelaber longisporus* 6336
11 *Ramicandelaber longisporus* 6337
12 *Ramicandelaber longisporus* 6338
2 *Ramicandelaber longisporus* 6328
3 *Ramicandelaber longisporus* 6329
4 *Ramicandelaber longisporus* 6330
5 *Ramicandelaber longisporus* 6331
6 *Ramicandelaber longisporus* 6332
7 *Ramicandelaber longisporus* 6333
8 *Ramicandelaber longisporus* 6334
9 *Ramicandelaber longisporus* 6335

Lichtwardt, Robert W.

43-1-2 *Smittium culicis* 9003
A1a *Amoebidium parasiticum* 9257
ALG-10-S8 *Smittium mucronatum* 9063
ALG-10-W3 *Legeriosimilis* sp. 9066
ALG-13-W1 *Harpellales, genus undetermined* 9064
ALG-16-W27 *Smittium* sp. 9088
ALG-16-W28 *Smittium* sp. 9065
ALG-16-W3 *Smittium culicis* 9073
ALG-5-W2b *Smittium culicis* 9143
ALG-5-W8 *Smittium culicis* 9091
ALG-7-W10 *Smittium mucronatum* 9144
ALG-7-W6 *Smittium mucronatum* 9090
ALG-7-W7 *Smittium mucronatum* 9067
AR-19-4S *Smittium* sp. 9087
ARG-17-4F *Smittium* sp. 9119
ARG-24-20F *Smittium tronadorium*
9030
ARG-X-1 *Smittium culisetae* 9094
ARG-X-2 *Smittium culisetae* 9131
ARG-X-2 *Smittium culisetae* 5430
ARG-X-3 *Smittium culicis* 9031
ARG-X-3 *Smittium culicis* 5431
ARG-X-4 *Smittium culicis* 9004
ARG-X-4 *Smittium culicis* 5432
ARG-X-5 *Smittium culisetae* 9075
AS-42-1 *Harpellales, genus undetermined* 9089
AUS-126-30 *Smittium angustum* 9241
AUS-2-8 *Smittium culisetae* 9025
AUS-42-6 *Furculomyces boomerangus*
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AUS-42-7 *Furculomyces boomerangus*
9259
AUS-59-5S *Smittium elongatum* 9251
AUS-62-10 *Smittium culicis* 9005
AUS-62-16 *Smittium culicis* 9006
AUS-62-17 *Smittium culicis* 9040
AUS-62-6 *Smittium culicis* 9041
AUS-77-4 *Furculomyces boomerangus*
9021
AUS-77-5 *Smittium culicis* 9125
BLH-16 *Smittium megazygosporum(?)*
9027

CAL-X-2 *Smittium culisetae* 9095
CAN-X-1 *Smittium culicis* 9126
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9248
CHI-20-7 *Smittium cylindrosporium* 9249
CHI-27-1 *Smittium cylindrosporium* 9116
CHI-8-3 *Smittium simulatum* 9078
CHI-8-4 *Smittium simulatum* 9117
CHI-8-7 *Smittium simulatum* 9042
CHI-9-4 *Smittium imitatum* 9033
CLW-10-5 *Smittium simulii* 9118
CLW-10-6 *Smittium simulii* 9043
CLW-2-44 *Smittium culisetae* 9096
CLW-9-15 *Smittium simulii* 9134
COL-18-3 *Smittium culisetae* 9012
CR-133-2 *Smittium phytotelmatum* 9076
CR-143-8 *Smittium annulatum* 9242
CR-169-22 *Smittium* sp. 9120
CR-239-12 *Smittium* sp. 9035
CR-253-12 *Smittium culicisoides* 9044
CR-253-14 *Smittium dipterorum* 9263
CR-254-13 *Smittium dipterorum* 9250
CR-259-4 *Smittium* sp. 9034
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culture 12-1-2 *Smittium culicis* 9123
culture 12-1-3 *Smittium* sp. 9079
culture 12-1-4 *Smittium culicis* 9141
culture 35-1-1 *Smittium culicis* 9124
culture 43-1-2 *Smittium culicis* 9142
FL-X-1 *Smittium culisetae* 9013
FRA-1-14 *Amoebidium parasiticum* 9182
FRA-12-3 *Smittium mucronatum* 9028
FRA-15-2 *Smittium culicis* 9129
FRA-15-5 *Smittium culicis* 9045
FRA-15-7 *Smittium culicis* 9046
FRA-6-16 *Smittium culicis* 9127
FRA-7-1 *Smittium culisetae* 9097
FRA-8-7 *Smittium culicis* 9149
FRA-9-1 *Smittium culicis* 9128
GSMNP *Smittium culicis* 9010
HAW-13-2 *Smittium culisetae* 9102
HAW-13-3 *Smittium culisetae* 9103
HAW-14-5 *Smittium culisetae* 9104
HAW-14-5M *Smittium culisetae* 9105
HAW-14-7 *Smittium culisetae* 9106
HAW-14-8 *Smittium culisetae* 9014
HAW-5-5 *Smittium culisetae* 9099
HAW-5-7 *Smittium culisetae* 9100
HAW-5-8 *Smittium culisetae* 9047
HAW-5-9 *Smittium culisetae* 9101
HAW-E-2 *Smittium culisetae* 9098
JAP-30-3 *Smittium culisetae* 9107
JAP-30-4 *Smittium culisetae* 9048
JAP-30-8 *Smittium culisetae* 9108
JAP-31-7 *Smittium simulii* 9135
JAP-32-4 *Smittium simulii* 9019
JAP-33-2 *Smittium simulii* 9136
JAP-51-18 *Smittium simulii* 9138
JAP-51-5 *Smittium simulii* 9137
JAP-57-1 *Smittium culisetae* 9109
JAP-57-5 *Smittium simulii* 9049
JAP-7-2 *Amoebidium parasiticum* 9183
JAP-77-7 *Smittium culisetae* 9110
JAP-77-8 *Smittium culisetae* 9111
JAP-77-9 *Smittium culisetae* 9015
KAU-W-4 *Smittium culisetae* 9026

KS-108-02 *Smittium culisetae* 9016
KS-108-06 *Smittium culisetae* 9017
KS-2-25 *Smittium commune* 9085
KS-5-4 *Smittium commune* 9243
KS-5-7 *Smittium commune* 9244
KS-5-8 *Smittium commune* 9245
KS-F1-15 *Smittium gravimetalum* 9029
KS-F1-5 *Smittium gravimetalum* 9036
La-6a-L1 *Smittium culisetae* 9024
LCF-43-12 *Smittium culicis* 9093
LCF-43-2 *Smittium culicis* 9007
LCF-8-1 *Smittium culicis* 9084
LEA-7-10 *Smittium culicis* 9008
LEA-7-2 *Smittium culisetae* 9112
LEA-7-4 *Smittium culisetae* 9018
MIS-10-108 *Capniomyces stellatus* 9258
MO-16-2 *Smittium* sp. 9121
MO-6-5 *Smittium* sp. 9145
NE-27-1 *Smittium culisetae* 9246
NOR-25-W10A *Smittium* sp. 9072
NOR-59-2 *Smittium* sp. 9050
NY-2-C25 *Smittium culicis* 9011
OK-3-14 *Smittium stenosporem* 9023
OK-3-20 *Smittium caudatum* 9000
OK-3-21 *Smittium caudatum* 9261
OK-5-1 *Smittium acutum* 9092
OR-18-W33 *Smittium* sp. 9086
OR-4-W6 *Smittium* sp. 9051
RMBL-13-41 *Smittium coloradense* 9001
RMBL-13-49 *Smittium coloradense* 9002
RMBL-14-10 *Smittium tipulidarum* 9052
RMBL-31-1 *Smittium tipulidarum* 9122
RMBL-31-2 *Smittium tipulidarum* 9053
RMBL-31-4 *Smittium tipulidarum* 9054
RMBL-44-3 *Smittium perforatum(?)*
9055
RMBL-61-13 *Smittium fecundum* 9083
RMBL-64-5 *Smittium fecundum* 9022
SC-DP-1 *Smittium culisetae* 9032
SC-DP-2 *Smittium megazygosporum*
9037
SMO599 *Smittium culisetae* 9056
SWE-3-5 *Smittium* sp. 9146
SWE-8-4 *Smittium simulii* 9139
SWI-4-13 *Smittium culisetae* 9132
SWI-7-6 *Smittium* sp. 9147
T-12-1-4 *Smittium culicis* 9057
TN-24-A3 *Smittium culisetae* 9113
TN-24-W11 *Smittium* sp. 9081
TN-24-W8 *Smittium* sp. 9038
TN-27-A3(a) *Amoebidium appalachense*
9255
TN-27-A3(s) *Smittium lentaquaticum*
9253
TN-27-A4 *Smittium lentaquaticum* 9068
TN-27-A5 *Smittium lentaquaticum* 9082
TN-27-A8 *Smittium culisetae* 9069
TN-27-A8 *Smittium culisetae* 9039
TN-27-W1A *Amoebidium appalachense*
9181
TN-27-W1B *Smittium* sp. 9070
TN-27-W4 *Amoebidium appalachense*
9256
TN-3-4 *Smittium orthocladii* 9080
TN-46-6 *Smittium culisetae* 9058
TN-46-A10 *Smittium culisetae* 9071

Lichtwardt, Robert W.
Meyer, Susan F.

Alternate Collections

TN-46-W8B *Smittium* sp. 9148
TN-49-W4A *Barbatospora ambicaudata*
9020
UT-11-W(a) *Smittium culicis* 9059
WKRa *Smittium morbosum* 9060
WKRb *Smittium morbosum* 9061
WYO-42-26 *Smittium culisetae* 9114
WYO-44-1 *Smittium culisetae* 9115
WYO-44-15 *Smittium culisetae* 9247
WYO-44-8 *Smittium culisetae* 9133
WYO-44-9 *Smittium culisetae* 9062
WYO-51-11 *Smittium culicis* 9009
WYO-51-14 *Smittium culicis* 9130
ZEA-6-3 *Smittium culicis* 9074

Lopez Lastra, Claudia

#1 *Smittium culisetae* 5430
#2 *Smittium culicis* 5431
#3 *Smittium culicis* 5432
2' *Smittium culisetae* 5200

Meyer, Susan F.

L0321 *Ramicandelaber longisporus* 6175
L0355 *Ramicandelaber longisporus* 6176

2452	Coemansia sp.	9048	Smittium culisetae	9118	Smittium simulii
5200	Smittium culisetae	9049	Smittium simulii	9119	Smittium sp.
5430	Smittium culisetae	9050	Smittium sp.	9120	Smittium sp.
5431	Smittium culicis	9051	Smittium sp.	9121	Smittium sp.
5432	Smittium culicis	9052	Smittium tipulidarum	9122	Smittium tipulidarum
6175	Ramicandelaber longisporus	9053	Smittium tipulidarum	9123	Smittium culicis
6176	Ramicandelaber longisporus	9054	Smittium tipulidarum	9124	Smittium culicis
6275	Smittium megazygosporum	9055	Smittium perforatum(?)	9125	Smittium culicis
6327	Ramicandelaber longisporus	9056	Smittium culisetae	9126	Smittium culicis
6328	Ramicandelaber longisporus	9057	Smittium culicis	9127	Smittium culicis
6329	Ramicandelaber longisporus	9058	Smittium culisetae	9128	Smittium culicis
6330	Ramicandelaber longisporus	9059	Smittium culicis	9129	Smittium culicis
6331	Ramicandelaber longisporus	9060	Smittium morbosum	9130	Smittium culicis
6332	Ramicandelaber longisporus	9061	Smittium morbosum	9131	Smittium culisetae
6333	Ramicandelaber longisporus	9062	Smittium culisetae	9132	Smittium culisetae
6334	Ramicandelaber longisporus	9063	Smittium mucronatum	9133	Smittium culisetae
6335	Ramicandelaber longisporus	9064	Harpellales, genus undetermined	9134	Smittium simulii
6336	Ramicandelaber longisporus	9065	Smittium sp.	9135	Smittium simulii
6337	Ramicandelaber longisporus	9066	Legeriosimilis sp.	9136	Smittium simulii
6338	Ramicandelaber longisporus	9067	Smittium mucronatum	9137	Smittium simulii
6810	Smittium culisetae	9068	Smittium lentaquaticum	9138	Smittium simulii
7100	Smittium culisetae	9069	Smittium culisetae	9139	Smittium simulii
9000	Smittium caudatum	9070	Smittium sp.	9140	Smittium culicis
9001	Smittium coloradense	9071	Smittium culisetae	9141	Smittium culicis
9002	Smittium coloradense	9072	Smittium sp.	9142	Smittium culicis
9003	Smittium culicis	9073	Smittium culicis	9143	Smittium culicis
9004	Smittium culicis	9074	Smittium culicis	9144	Smittium mucronatum
9005	Smittium culicis	9075	Smittium culisetae	9145	Smittium sp.
9006	Smittium culicis	9076	Smittium phytotelmatum	9146	Smittium sp.
9007	Smittium culicis	9077	Furculomyces boomerangus	9147	Smittium sp.
9008	Smittium culicis	9078	Smittium simulatum	9148	Smittium sp.
9009	Smittium culicis	9079	Smittium sp.	9149	Smittium culicis
9010	Smittium culicis	9080	Smittium orthocladii	9181	Amoebidium appalachense
9011	Smittium culicis	9081	Smittium sp.	9182	Amoebidium parasiticum
9012	Smittium culisetae	9082	Smittium lentaquaticum	9183	Amoebidium parasiticum
9013	Smittium culisetae	9083	Smittium fecundum	9241	Smittium angustum
9014	Smittium culisetae	9084	Smittium culicis	9242	Smittium annulatum
9015	Smittium culisetae	9085	Smittium commune	9243	Smittium commune
9016	Smittium culisetae	9086	Smittium sp.	9244	Smittium commune
9017	Smittium culisetae	9087	Smittium sp.	9245	Smittium commune
9018	Smittium culisetae	9088	Smittium sp.	9246	Smittium culisetae
9019	Smittium simulii	9089	Harpellales, genus undetermined	9247	Smittium culisetae
9020	Barbatospora ambicaudata	9090	Smittium mucronatum	9248	Smittium cylindrosporium
9021	Furculomyces boomerangus	9091	Smittium culicis	9249	Smittium cylindrosporium
9022	Smittium fecundum	9092	Smittium acutum	9250	Smittium dipterorum
9023	Smittium stenosporum	9093	Smittium culicis	9251	Smittium elongatum
9024	Smittium culisetae	9094	Smittium culisetae	9253	Smittium lentaquaticum
9025	Smittium culisetae	9095	Smittium culisetae	9255	Amoebidium appalachense
9026	Smittium culisetae	9096	Smittium culisetae	9256	Amoebidium appalachense
9027	Smittium megazygosporum(?)	9097	Smittium culisetae	9257	Amoebidium parasiticum
9028	Smittium mucronatum	9098	Smittium culisetae	9258	Capniomyces stellatus
9029	Smittium gravimetallum	9099	Smittium culisetae	9259	Furculomyces boomerangus
9030	Smittium tronadorium	9100	Smittium culisetae	9261	Smittium caudatum
9031	Smittium culicis	9101	Smittium culisetae	9263	Smittium dipterorum
9032	Smittium culisetae	9102	Smittium culisetae		
9033	Smittium imitatum	9103	Smittium culisetae		
9034	Smittium sp.	9104	Smittium culisetae		
9035	Smittium sp.	9105	Smittium culisetae		
9036	Smittium gravimetallum	9106	Smittium culisetae		
9037	Smittium megazygosporum	9107	Smittium culisetae		
9038	Smittium sp.	9108	Smittium culisetae		
9039	Smittium culisetae	9109	Smittium culisetae		
9040	Smittium culicis	9110	Smittium culisetae		
9041	Smittium culicis	9111	Smittium culisetae		
9042	Smittium simulatum	9112	Smittium culisetae		
9043	Smittium simulii	9113	Smittium culisetae		
9044	Smittium culicisoides	9114	Smittium culisetae		
9045	Smittium culicis	9115	Smittium culisetae		
9046	Smittium culicis	9116	Smittium cylindrosporium		
9047	Smittium culisetae	9117	Smittium simulatum		