Post Doctoral Report – May,1993
Boyce Thompson Institute. Cornell University, Ithaca-NY, USA.

MOSQUITO ENTOMOPATHOGENIC FUNGI - AN OVERVIEW REGARDING A POSSIBLE INTEGRATION IN *Aedes aegypti* AND *Aedes albopictus* CONTROL PROGRAMS IN BRAZIL.

(*FUNGOS ENTOMOPATOGÊNICOS DE MOSQUITOS - UMA ABORDAGEM GERAL CONSIDERANDO-SE UMA POSSÍVEL INTEGRAÇÃO EM PROGRAMAS DE CONTROLE DE Aedes aegypti E Aedes albopictus NO BRASIL*)

Andrade, Carlos Fernando S.

cfeandra@unicamp.br
Depto. Zoologia, IB – UNICAMP
Cx.P. 6109 – Cep 13083-971 Campinas, SP

Acknowledgments to the advisors: Dr. Donald W. Roberts, Boyce Thompson Institute, ITHACA, NY and Dr. Richard A. Humber, USDA-ARS, ITHACA, NY.

INTRODUCTION

The origin of *Aedes albopictus* is considered to be in southeast Asia, and the recent introduction of the species into the United States and Brazil hás been regarded as the most singular medical entomological event of the past decade in Americas[56,63]. Geographic strains may vary markedly in oral susceptibility to dengue virus, showing therefore different vectorial competencies. One strain from Brazil (State of Espirito Santo) showed to be able to transmit under laboratory conditions, all four-dengue serotypes and a sylvan strain of yellow fever[57]. Furthermore, under laboratory conditions Brazilian strains of *Ae. albopictus,* showed to have a degree of vertical transmission of dengue viruses and have therefore the potential to play a role in the maintenance of dengue viruses in nature[121]. Even so, no epidemics has been correlated to this species in Brazil unless when occurring in sympatric with *Ae. aegypti.* Recent reviews have concerned about the genetics[59], biology[60] and importance in Americas[55] of this species.

In many parts of the world where both species are recorded to be introduced, ecological studies on the interaction between the two species have been done in order to evaluated the possible epidemiological consequences. Competitive displacement can permit that *Ae. aegypti* populations spread throughout the *Ae. albopictus* distribution, eliminating this last species. Otherwise, and as seems to occur in the United States and Hawaii, *Ae. albopictus* could displace Ae. *aegypti* populations[55]. The vectorial competence of each species or introduced strain should be taken in account. Also, inter-specific hybrids mainly between *Ae. albopictus* males and Ae. *aegypti* females can occur in the field[61]. The vectorial competence must be in the same way determined to the hybrids.

Dengue epidemics have not evolved where only *Ae. albopictus* populations occur in Brazil and due to this fact authorities have given emphasis and priority, in practice, to *Ae. aegypti* control. Furthermore, the occurrence of Ae. *albopictus* in semi-urbanized and rural environments sometimes in association with its native breeding microhabitats such as tree holes[58] or bamboo stumps (personal observation), bring an additional difficulty to its control in Brazil. Besides dengue, an additional problem could be raised since epidemics of urban yellow fever could be restarted with Ae. *albopictus* acting as a link to the common sylvatic cycle of the viruses. Ae. *albopictus* population densities much higher than that of Ae. *aegypti* are being quite frequent and even predictable to some regions in the last years. Once the official monitoring programs detect Ae. *aegypti* occurrences, efforts are done until the complete eradication of the foci. In detriment, common high populations densities of Ae. *albopictus* leave out of control and Breteau indexes as great as 25 or 30 are recorded.

Naturally in this situation, a mosquito strain with a supposed relatively low vectorial competence could cause epidemics, as previously reported to *Ae. aegypti* and sylvatic yellow-fever in Nigéria[61].

As a rule, control campaigns in Brazil nave followed the precepts of WHO and PAHO[89], mainly based in breeding site reduction whether with community participation or not, and treatments with chemical insecticides. In short, this late consists in the use of thermonebulization and residual sprays in resting sites against adults and larvicidal water treatment with pyrethroids and organophosphorus compounds. Besides these practices, a great interest upon alternatives to conventional control can be noted among governmental personnel involved in *Aedes* control campaigns.

Studies and attempts on the biological control of mosquitoes have been extensively revisited in last decades and the reasons why can be summarized as follow:

1. Many examples of agricultural insect pests consistently controlled either by the introduction of natural enemies or by the application of pathogens, lending to the industrialization of microbial insecticides;
2. Frequent epizootic among some mosquito populations permitting the self-maintenance of a natural control that can lower the costs of man-made control;
3. A higher ecological compatibility permitting lower environmental hazard risks due to a greater specificity of the biological control agents when compared with chemical insecticides. In the same way, safer to man and domestic animals. And,
4. A lower risk of resistance development.

The two basic approaches in utilizing fungi as microbial control agents would be either by inoculation of the pathogen in the environment followed by its natural spread (colonization method) or as biological insecticide. The first method should result in a continuous control, but not always total, acting as a density dependent mortality factor. Some survivors will be always desirable in order to carry and maintain the fungus. The late method results in a non-self maintained control, since the fungus itself is not able to multiply and/or reinfect under natural conditions. This late method is also totally dependable upon man-made controlled applications and could result in the total elimination of the target mosquito population. Due to the gravity of the epidemiological aspects usually related to *Ae. aegypti* and *Ae. albopictus,* it seen that efforts on the second approach should ever have priority. Even so, considering some features pointed out to Ae. *albopictus* in Brazil, colonization could also be taken in account against this species. Any way, compatibility and a possible integration of selected fungi candidates with conventionally used chemical insecticides may concern. General aspects of possible interactions among entomopathogenic fungi and chemical insecticides has been pointed out by many authors[115,114,134,105].

In Brazil, there is a lack of laboratory and field studies regarding *Ae. aegypti* and *Ae. albopictus* biological control with *Bacillus thuringiensis* var. *israelensis* (BTI) and *Bacillus sphaericus.* The possibility of integration of BTI and the larvicide temephos was evaluated recently under laboratory conditions, against a field collected *Ae. aegypti* larval population in Campinas (State of São Paulo, Brazil)[77].

The aim of the present study is to point out the best-known entomopathogenic fungi recorded in *Aedes* species or related culicid in many parts of the world. Some biological features of the cited fungi species or supra specific groups are also presented, as well as aspects regarding to its production, compatibility with chemical insecticides and attempts to utilization in control operations. The present paper intent principally to motivate the search for native species and strains of mosquito entomopathogenic fungi suitable for local use, since there are very few findings in Brazil. A recent book published by Weizer[113] would be helpful as guideline in fieldwork on collecting and handling pathogens from mosquitoes.

RESULTS

Ecological as well as biological aspects of selected fungi related to Aedes species are presented in Tables l (**A** to **D**). Aspects of cultivation and large-scale production are presented in Tables 2 (A to D). Some Information on compatibility with chemical insecticides currently used in mosquito control, laboratory or field tests with the fungi will appear in Tables 3 (A to C). In this way, tables **A-** shows Information available to selected Hyphomycetes. Tables **B-** presents aspects to Zygomycetous fungi. Tables **C-** and tables **D-** to Oomycetes and species of the genus *Coelomomyces* respectively.

COMPLEMENTARY REMARKS AND REFERENCES

The records in Tables **A** related to occurrences of the fungi in *Aedes* spp or other mosquito genera were merely compiled from literature, reflecting therefore not only truly natural infections under field conditions but also accidental infection or attempts to infect under laboratory conditions. These late situations, consisting any way in a new host record to the pathogen. Even so, priority was given to records taken under natural conditions, mainly to fungi with worldwide distribution and wide host spectrum.

Geographic regions or countries listed in the present paper, in the same way, can reflect a natural collection site (as for example *Metarhizium anisopliae* occurring in *Ae. crinifer* in Argentina and *Beauveria bassiana* in former USSR) or even a successful attempt to introduction and colonization, as cited to *Coelomomyces stegomyiae* in

Tokelau Islands. Some strains of promising fungi have been traveled with mycologists from one continent to another or even accidentally in infected insects and the original occurrence of such fungi could actually only be speculated.

TABLE 1-A. Occurrences and geographical distribution of some **Hyphomycetous** fungi related to *Aedes* spp. or related genus.

[ORDER] *Species*	OCCURRENCE IN MOSQUITO	RECORDS IN BRAZIL	*Aedes* AS HOST OR OTHER CULICIDAE (STAGE)*	NON MOSQUITO HOSTS
[MONILIALES]				
Culicinomyces bisporalis	Australia	-	*Ae. kochi* ( )	
Culicinomyces clavisporus	Australia USA	-	*Ae. rupestris* ( )	Other Dipterans[23]
Tolypocladium cilisdrosporum	New Zealand Czekoslovakia USA	-	*Ae. australis* *Ae. sierriensis* (L,A)	*Daphnia* Copepods *Musca*[15]
Verticillium lecanii	USA	APHIDS	*Ae. triseriatus* ( )	APHIDS SCALES THRIPS
Beauveria bassiana	USSR	BEETLES CATERPILLARS ANTS, BUGS	*Cx. pipiens* (L,A)	MANY SPECIES
Metarhizium anisopliae	Argentina USA	BEETLES STINK BUGS CATERPILLARS	*Ae. crinifer*[136](A) *Ae. triseriatus*[137] (L)	> 300 SPECIES
Paecilomyces farinosus	USA USSR Argentina	BEETLES CATERPILLARS	*Ae. sierriensis* *Ae. excrucians* *Ae. albifasciatus* (L,A)	BEETLES CATERPILLARS

REFERENCES [73,744,75,76] [39] [73,74,75,76]

* E= egg, L= larvae, P= pupae, A= adult

TABLE 1-B. Occurrences and geographical distribution of some **Zygomycetous** fungi pathogenic to *Aedes* spp. or related genus.

[ORDER] *Species*	OCCURRENCE IN MOSQUITO	RECORDS IN BRAZIL	*Aedes* AS HOST OR OTHER CULICIDAE (STAGE)*	NON MOSQUITO HOSTS
[ENTOMOPHTHORALES]				
Conidiobolus thromboides	Czechoslovakia	-	*Cx. pipiens* ( )	APHIDS
Erynia aquatica	USA	IN APHIDS	*Ae. sp* *Ae. Fitchii* *Cu. morsitans* (L,P,A)	
Eryniae ovispora	Sweden	-	....	....
Zoophthora radicans	France	IN LEAFHOPPER CATERPILLAR	.... (A)	9 OTHER INSECT ORDERS
Entomophaga conglomerata	USSR France	-	*Ae. comunis* *Cx. p. pipiens* *Cx. p. molestus* (L,A)	CHIRONOMIDAE TIPULIDAE
Entomophthora culicis	USSR , Tunisia Poland, Spain Switzerland	-	*Ae. aegypti*[10] *Aedes sp* , *Culex sp* (L,A)	ADULTS SIMULIID[8]
[HARPELLALES]				
Smitium culicis	USA France	-	*Ae. Aegypti* , *Ae. berlandi* *Ae. Caspius* ; *Ae. detritus* *Ae. Geniculatus* ; *Ae. melanimon* (L)	.....

REFERENCES [73,74,75,76] [39] [73,74,75,76]

* E= egg, L= larvae, P= pupae, A= adult

TABLE 1-C. Occurrences and geographical distribution of some **Oomycetous** fungi pathogenic to *Aedes* spp. or related genus.

[ORDER] *Species*	OCCURRENCE IN MOSQUITO	RECORDS IN BRAZIL	*Aedes* AS HOST OR OTHER CULICIDAE (STAGE)*	NON MOSQUITO HOSTS
[LAGENIDIALES]				
Lagenidium giganteum	USA, India Africa, UK Antarctica		*Ae aegypti*[46] *Ae. melanimon* *Cx. quinquefasciatus* *Psorophora* sp. (L)	*Daphnia* COPEPODS[35] CERATOPO-GONIDAE[85]
Crypticola clavulifera	Australia	-	*Ae. kochi* *Forcipomyia marksae* (L)	-
[PERONOSPORALES]				
Pythium sp. (near *P. aderens*)	USA	-	*Ae. sierriensis* *Cu. inornata* *Cu. Insidens* *An. freeborni* (L)	-
[SAPROLEGNIALES]				
Leptolegnia chapmanii	USA	-	*Ae. triseriatus* *Cx. Quinquefasciatus* *Culex* sp. *Mansonia* sp. (L)	-

REFERENCES [73,74,75,76] [39] [73,74,75,76] /

* E= egg, L= larvae, P= pupae, A= adult

TABLE 1-D. Occurrences and geographical distribution of some **Chrytridiomycetous** fungi pathogenic to *Aedes* spp. or related genus.

[ORDER] *Species*	OCCURRENCE IN MOSQUITO	RECORDS IN BRAZIL	*Aedes* AS HOST OR OTHER CULICIDAE (STAGE)*	OBLIGATE ALTERNATIVE HOST
[BLASTOCLADIALES]				
Coelomomyces stegomyiae var. stegomyiae	Malaya, Japan New Guinea Tokelau Solomon Isl. Philippines Sri Lanka		*Ae.aegypti* *Ae.albopictus* *Ae. Polynesiensis* *Ae. Multiformis* *Ae. Quadrimaculatus* *Ae. flavopictus* (L,A)	*Phyllognathopus viguieri*[100]
Coelomomyces stegomyiae var. chapmani	Taiwan China		*Ae. albopictus* *Ae. subalbatus* *Ae. yanbarensis* (L)	NOT KNOWN
Coelomomyces dentialatus	Madagascar		*Ae. aegypti* *Ae. albopictus* (L)	NOT KNOWN
Coelomomyces dentialatus	Burma,Fiji China, USA Thailand		*Ae. aegypti* *Ae. albopictus* *Ae. polynesiensis* *Ae. alcasidi* (L) *Toxorynchytes rutilus septentrionalis*[95]	NOT KNOWN
Coelomomyces indicus	India, Egypti Nigeria, Zambia Thailand, Kenia		*Ae. aegypti*[101] beyond 20 to 24 species in other genera[97,99] (L)	*Cyclops* sp[101]
Coelomomyces psorophorae	USA Canada		*Ae. aegypti* *Aedes* spp (L,A) *Cx. quinquefasciatus* *Cu. inornata* *Psorophora howardii*	*Cyclops vernalis*
REFERENCES	[73,74,75,76]	[39]	[73,74,75,76]	

* E= egg, L= larvae, P= pupae, A= adult

TABLE 2-A. Aspects of cultivation and large-scale production of some **Hyphomycetous** fungi related to *Aedes* species.

[ORDER] *Species*	CULTURE	PRODUCTION	MASS STORAGE

[MONILIALES]

Culicinomyces bisporalis *Culicinomyces clavisporus*	Different media according to the strain [7]	Possible	Dry mycelium[25,40]. Few months at -20^{0}C [69]
Tolypocladium cilindrosporum	Easily done Submerged or surface	Possible	Some months [40,44,70]
Verticillium lecanii	Already done. Granular or submerged aerated[118]	Conidia or blastospores [118]	
Beauveria bassiana	Easily done Submerged or surface	Already done [27,107,108].	Dry mycelium[71]
Metarhizium anisopliae	Easily done Submerged or surface	Already done in Brazil [39b,108,108]	Depend upon the substrate of growth[72].
Paecilomyces farinosus	Already done [124]		

TABLE 2-B. Aspects of cultivation and large scale production of some **Zygomycetous** fungi related to *Aedes* species.

[ORDER] *Species*	CULTURE	MASS PRODUCTION	STORAGE
[ENTOMOPHTHORALES]			
Conidiobolus thromboides	Easily done[9.] Forms resting spores [,37,38]	Resting spores in liquid media[10,37,38]	
Erynia aquatica *Erynia ovispora*	Very difficult Need cold water		
Zoophthora radicans	Easily done in suitable media[11,21,80]	Dry mycelium method. Patented[12]	
Entomophthora conglomerata	Probably not easy	Regarding the genus[125]	
Entomophthora culicis		Regarding the genus[125]	
[HARPELLALES]			
Smithium culicis	Some species can be cultured		

TABLE 2-C. Aspects of cultivation and large scale production of some **Oomycetous** fungi related to *Aedes* species.

[ORDER] *Species*	CULTURE	MASS PRODUCTION	STORAGE
[LAGENIDIALES]			
Lagenidium giganteum	Easily done. Zoosporogenesis stimulated[16]	Already done[30]	Encapsulation in alginates[38]
Crypticola clavulifera	Easily done		
[PERONOSPORALES]			
Pythium sp. (near *P. adhaerens*)	Easily done		
[SAPROLEGNIALES]			
Leptolegnia chapmanii	Easily done		Not done

TABLE 2-D. Aspects of cultivation and large scale production of some **Chytridiomycetous** fungi related to *Aedes* species.

SPECIES	CULTURE	MASS PRODUCTION	STORAGE
C. stegomyiae var. stegomyiae	-	-	-
C. stegomyiae var. chapmani	-	-	-
C. dentialatus	-	-	-
C. macleayae	-	-	-
C. indicus	In vivo[102]	-	-
Coelomomyces psorophorae	In vitro or In vivo [131,94]	Difficult	Sporangia in millipore filter at 5^0 C [26]

REFERENCES [130]

TABLE 3-A. Compatibility with chemical insecticides and evaluations against *Aedes aegypti* and *Ae. albopictus* of some **Hyphomycetous** fungi.

[ORDER] *Species*	COMPATIBILITY WITH CHEMICAL INSECTICIDES	LABORATORY STUDIES AND EVALUATIONS AGAINST *Ae.aegypti* AND/OR *Ae.albopictus*

[MONILIALES]

Culicinomyces bisporalis		LC_{50}=10^3-10^4 conidia/ml against 3rd instar *Ae. aegypti* larvae[7]
Culicinomyces clavisporus		10^5-10^7 conidia/ml resulted in 20-48% mortality in 2nd instar *Ae.albopictus* larvae[54].
Tolypocladium cilisdrosporum		Pathogenesis in Ae*. agypti*[53].
Verticillium lecanii	42 insecticides evaluated. Diflubenzuron showed to be toxic[5]	Higher mortality at 10^8 blastospores or conidia/ml against *Ae. aegypti* larvae[2]; total control in 5 days against adults[49].
Beauveria bassiana	Same as *P. farinosus.* Can be damage by Malathion[39,88,106] *B. brongniartii* was also evaluated[6].	
Metarhizium anisopliae	Same as *P. farinosus.* Can be inhibited by Malathion[88]. Temephos, Leptophos and Malathion higly toxic to esporulation[4]. Affected by diflubensuron[7].	Toxaemia or septicemia as mode of action in *Ae. albopictus*. Efficient at 3x10^5 conidia/ml against 4th instar larvae[1,110]. Two Russian strains showed at least 50% efficiency against larvae of some mosquitoes[51].
Paecilomyces farinosus	Growth and sporulation not affected by Diazinon, Pirimicarb and Cypermethrin[43].	

REFERENCES [106, 34]

TABLE 3-B. Compatibility with chemical insecticides and evaluations against *Aedes aegypti* and *Ae. albopictus* of some **Zygomycetous** fungi.

[ORDER] *Species*	COMPATIBILITY WITH CHEMICAL INSECTICIDES	LABORATOTY STUDIES AND EVALUATIONS AGAINST *Ae.aegypti* AND/OR *Ae.albopictus*
[**ENTOMOPHTHORALES**]		
Conidiobolus thromboides	Malathion: incompatible[39a], conidia germination[86] and resting spores inhibited[87]	
Erynia aquatica		10.7% adult mortality in *Ae. aegypti* when inoculated in pupae[3]
Erynia ovispora		
Zoophthora radicans		$CL_{50=}$350-600 conidia/mm^2 against *Ae. aegypti* adults[22]
Entomophthora conglomerata	Regarding the genus[119]	
Entomophtora culicis	Not affected by Diflubenzuron.	
Smithium culicis	[81].	

REFERENCES [106, 34]

TABLE 3-C. Compatibility with chemical insecticides and evaluations against *Aedes aegypti* and *Ae. albopictus* of some **Oomycetous** fungi.

[ORDER] *Species*	COMPATIBILITY WITH CHEMICAL INSECTICIDES	LABORATOTY STUDIES AND EVALUATIONS AGAINST *Ae. aegypti* AND/OR *Ae. albopictus*
[LAGENIDIALES]		
Lagenidium giganteum	BHC, DDT, Toxaphene, Chlorpyrifos and Fenthion are toxic. Methoprene, Malathion and Temephos are probably compatible at recomended rates [32]	General [36, 30]. Recycle in *Ae. aegypti* and persisted for 10 weeks [112].
Crypticula clavulifera		
Pythium sp. (near *P. adhaerens*)	[78]	
Leptolegnia chapmanii	??	

REFERENCES [32, 36, 30].,

References

124. AGUDELO, F. & FALCON, L.A. Mass production, infectivity, and field aplication studies with the entomogenous fungus *Paecilomyces farinosus. J. Invertebr. Pathol.,* **42**: 124-32, 1983.

39a. ALVES, S.B. Fungos Entomopatogênicos. In Alves, S.B., coord. *Controle Microbiano de insetos.* São Paulo, Ed. Manole, 1986. p. 73-126.

39b. ALVES, S.B. Produção de Fungos Entomopatogênicos. In Alves, S.B., coord. *Controle Microbiano de insetos.* Sao Paulo, Ed. Manole, 1986. p. 311-23.

47. ANDERSON, J.F. & RINGO, S.L. *Entomophthora aquatica* sp.n. infecting larvae and pupae of floodwater mosquitoes *J. Invertebr. Pathol.,* **13**: 386-93, 1969.

77. ANDRADE, C.F.S. & MODOLO, M. Susceptibility of *Aedes aegypti* larvae to temephos and *Bacillus thuringiensis* var. *israelensis* in integrated control. *Rev. Saude. publ.,* S. Paulo, **25**: 184-7, 1991.

137. ANDRADE, C.F.S.. New records of some mosquito pathogens in New York State. http://www.cxcxccxcxcxcxc.xcxcxcx;cxcxcxc (Neste site)

114. AXTEL, R.C. Principles of integrated pest management (IPM) in relation to mosquito control. *Mosq. News*. **39**: 709-18, 1979.

115. BENZ, G. In Burges, H.D. & Hussey, N.W. eds. *Microbial Control of insects and Mites.* N. Y. and London, Academic Press, 1971. p. 327-55.

94. BLAND, C.E. Cultures. In Couch, J.N. and Bland, C.E. eds. *The Genus **Coelomomyces**.* N.Y. and London, Academic Press, 1985. p. 349-59.

97. BLAND, C.E., COUCH, J.N. & NEWELL, S.Y. Identification of *Coelomomyces,* Saprolegniales and Lagenidiales. In: Burges H.D. ed. *Microbial Control of Pests and Plant Diseases 1970-1980.* N.Y. and London, Academic Press, 1981. p. 129-62.

16. BOSWELL, J.S. Zoosporogenesis in *Lagenidium giganteum,* a fungal parasite of mosquito larvae, in response to nutritional supplements. *Diss. Abstr. Int. B. Sci. Eng.,* **38**: 1528B-9B, 1977.

116. BURGES, H.D. Safety, safety testing and quality control of microbial pesticides. In: Burges H.D. ed. *Microbial Control of Pests and Plant Diseases 1970-1980.* N.Y. and London, Academic Press, 1981. p.737-68

58. CASTRO GOMEZ, A., MARQUES, G.R.A., Encontro de criadouro natural de *Aedes (Stegomyia) albopictus* (Skuse) no Estado de São Paulo, Brasil. *Rev. Saúde publ.* S. Paulo, **22**: 245. 1988.

78. CLARK, T.B., KELLEN, W.R., LINDEGREN, J.E. & SANDERS, R.D. *Pythium* sp. (Phycomycetes: Pythiales) pathogenic to mosquito larvae. *J. Invertebr. Pathol.,* **8**: 351-4, 1966.

48. CLARK, T.B. Experiments on the biological control pf

mosquitoes with the fungus *Beauveria bassiana* (Bals.) Vuill. *Proc. Calif. Mosq. Control Assoc.,* **35**: 99.

49. CLARK, T.B., KELLEN, W.R., FUKUDA, T. & LINDEGREN, J.E. Field and laboratory studies on the pathogenicity of the fungus *Beauveria bassiana* to three genera of mosquitoes. *J. Invertebr. Pathol.,* **11**: 1-7, 1968.

41. CHAPMAN, H.C. Ecology and use of *Coelomomyces* species in biological control: a review. In Couch, J.N. and Bland, C.E. eds. *The Genus **Coelomomyces**.* N.Y. and London, Academic Press, 1985. p. 361-69.

96. CHAPMAN, H.C., DAVIDSON, E.W., LAIRD, M., ROBERTS, D.W. & UNDEEN, A.H. Safety of microbial control agents to non-target invertebrates. *Environ. Conserv.,* **6**: 278-80, 1979.

111. CHARLWOOD, J.D. & WILKES, T.J. Observations on the biting activity of *Anopheles triannulatus bachmanni* from the Mato Grosso, Brazil. *Acta Amazonica,* **11**: 67-9, 1981.

35. COUCH, J.N. A new saprophitic species of *Lagenidium* with notes on other forms. *Mycologia,* **27**: 376-87, 1935.

64. COUCH, J.N. Revision of the genus *Coelomomyces*, parasitic in insect larvae. *J. Elisha Mitchell Sci. Soc.,* **61**: 124-36, 1945.

91. COUCH, J.N. & BLAND, C.E. Taxonomy. In Couch, J.N. and Bland, C.E. eds. *The Genus **Coelomomyces**.* N.Y. and London, Academic Press, 1985. p. 81-297.

99. COUCH, J.N. & BLAND, C.E. eds. *The Genus **Coelomomyces**.* N.Y. and London, Academic Press, 1985. 399 p.

72. DAOUST, R.A. & ROBERTS, D.W. Studies on the prolonged storage of *Metarhizium anisopliae* conidia. Effect of growth substrate on conidia survival and virulence against mosquitoes. *J. Invertebr. Pathol.,* **41**: 161-70, 1983.

22. DUMAS, J.L. & PAPIEROK, B. Virulence de l'entomophthorales *Zoophthora radicans* (Zygomycetes) a l'egard des adultes de *Aedes aegypti* (Dipt.: Culicidae). *Entomophaga,* **34**: 321-30, 1989.

117. EGERTON, J.R., HARTLEY, W.J., MULLEY, R.C. & SWEENEY, A.W. Susceptibility of laboratory and farm animals and two species of duck to the mosquito fungus *Culicinomyces* sp. *Mosq. News,* **28**: 260-3, 1978.

26. FEDERICI, B.A. Mosquito control by the fungi *Culicinomyces, Lagenidium* and *Coelomomyces.* In: Burges H.D. ed. *Microbial Control of Pests and Plant Diseases 1970-1980.* N.Y. and London, Academic Press, 1981. p. 555-72.

102. FEDERICI, B.A., TSAO, P.W., PRASERTPHON, S., GABRIEL, B.P. & PADUA, L.E. Induction of meiospores cleavage and release from resistant sporangia of *Coelomomyces africanus* and *Coelomomyces indicus. J. Invertebr. Pathol.,* **39**: 258-60,1982.

13. FEDERICI, B.A., TSAO, P.W. & LUCAROTTI, C.J. *Coelomomyces*(Fungi). In Chapman, H.C. ed., *Biological Control of Mosquitoes*. Bull.n.6, march 1985. American Mosquito Control Association.

63. FORATTINI, O.P. Identificação de *Aedes (Stegomyia) albopictus* no Brasil. *Rev. Saude publ.* S. Paulo, **20**: 244-5,

1986.

85. FRANCES, S.P., SWEENEY, A.W. & HUMBER, R.A. *Crypticola clavulifera* gen. et sp. nov. and *Lagenidium giganteum*: Oomycetes pathogenic for dipterans infesting leaf axils in an Australian rain forest. *J. Invertebr. Pathol.,* **54**: 103-11, 1989.

11. GALAINI-WRAIGHT, S., WRAIGHT, S.P., CARRUTHE, R.I. & ROBERTS, D.W. Temperature-dependent germination and host penetration of the entomophthoralean fungus *Zoophthora radicans* on the leafhopper *Empoasca kraemeri. Mycol. Res.,* **96**: 38-42, 1992.

70. GARDNER, J.M. & PILLAI, J.J.*Mycopathologia,* **97**: 77-82, 1987.

14. GARDNER, J.M. & PILLAI, J.J. *Tolypocladium cylindrosporum* (Deuteromycotina: Moniliales), a fungal pathogen of the mosquito *Aedes australis.* III. Field trials against two mosquito species. *Mycopathologia,***97**: 83-8, 1987.

42. GLENN Jr., F.E. & CHAPMAN, H.C. *Mosq. News,* **38**: 522-4, 1078.

44. GOETTEL, M.S. Conidial viability of the mosquito pathogenic hyphomycete *Tolypocladium cylindrosporum*, following prolonged storage at -20° C. *J. Invertebr. Pathol.,* **50**:327-9, 1987.

52. GOETTEL, M.S. Preliminary field trials with the entomopathogenic hyphomycetes *Tolypocladium cylindrosporum* in central Alberta. *J. Amer. Mosq. Control. Assoc.,* **3**: 239-45, 1987.

53. GOETTEL, M.S. Pathogenesis of the hyphomycete *Tolypocladium cilindrosporum* in the mosquito *Aedes aegypti. I. Invertebr Pathol.,* **51**: 259-274, 1988.

40. GOETTEL, M.S., SWEENEY, A.W. & ROBERTS, D.W. Effects of drying and rehydration on mycelia of the mosquito pathogenic fungi *Culicinomyces clavisporous* and *Tolypocladium cylindrosporum. Mycologia,* **81**: 472-5, 1989.

118. HALL, R.A. The fungus *Verticillium lecanii* as microbial insecticide against aphids and scales. In: Burges H.D. ed. *Microbial Control of Pests and Plant Diseases 1970-1980.* N.Y. and London, Academic Press, 1981. p. 483-512.

87. HALL, I.M. & DUNN, P.H. The effect of certain insecticides and fungicides on fungi pathogenic to the spotted alfalfa aphid. *J. Econ. Entomol.,* **52**: 28-9, 1959.

45. HASSAN, A.E.M. & CHARNLEY, A.K. Combined effects of diflubenzuron and the entomopathogenic fungus *Metarhizium anisopliae* on the tobacco hornworm *Manduca sexta*. Proc. 10th Int. Congr. Plant Protec., **3**: 790, 1983.

60. HAWLEY, W.A. The biology of *Aedes albopictus. J. Am. Mosq.Control Assoc.,* **4** (suppl. 1): 1-39, 1988.

128. JAQUES, R.P. & MORRIS, O.N. Compatibility of pathogens with other methods of pest control and with different crops. In: Burges H.D. ed. *Microbial Control of Pests and Plant Diseases 1970-1980.* N.Y. and London, Academic Press, 1981. p. 695-716.

73. JENKINS, D.W. Pathogens, parasites and predators of medically important arthropods. Annotated list and bibliography. *Bull. WHO,* **30** (suppl.): 1-150, 1964.

51. KALVISH, T.K. & KUKHARCHUK, L.P. Pathogenic mycoflora of blood-sucking mosquitoes of western Siberia and the Far East. *Med. Parazitol. Parazit. Bolezni,* **43**: 57-64, 1974.

17. KELLER, V.S. Untersuchungen uber den Einfluss von Dimilin (diflubenzuron) auf das Wachstum und Konidienkeimung einiger Insekten-pathogener Pilze. *Anz. Schaedlingskd. Planzenschutz Umweltschutz,* **51**: 81-3, 1978.

82. KELLER, V.S. Arthropod-pathogenic Entomophthorales of Switzerland. I. *Conidiobolus, Entomophaga* and *Entomophthora.* ***?:*** 122-67.

122. KERWIN, J.L., DRITZ, D.A. & WASHINO, R.K. Nonmammalian safety tests for *Lagenidium giganteum* (Oomycetes, Lagenidiales). *J. Econ. Entomol.*, **81**: 158-171, 1988.

30. KERWIN, J.L. & WASHINO, R.K. Ground and aerial application of the assexual stage of *Lagenidium giganteum* for control. *J. Amer. Mosq. Control Assoc.,* **3**: 59-64, 1987.

9. KING, D.S. & HUMBER, R.A. Identification of the Entomophthorales. In: Burges H.D. ed. *Microbial Control of Pests and Plant Diseases 1970-1980.* N.Y. and London, Academic Press, 1981. p. ??-??.

10B. KRAMER, J.P. *Entomophthora culicis* as a pathogen of adult *Aedes aegypti* (Diptera: Culicidae). *Aquatic Insects,* **4**: 73-9, 1982.

37. KREJZOVA, R. Submerged cultivation of *Entomophthora virulenta Ceska Mykologie,* **24**: 87-94, 1970.

23. KNIGHT, A.L. Host range and temperature requirements of *Culicinomyces clavosporus. J. Invertebr. Pathol.,* **36**: 423-5, 1980.

56. KNUDSEN, A.B. The significance of the introduction of *Aedes albopictus* into the southern United States with implications for the Caribbean, and perspectives of the Pan American Health Organization. *J. Amer. Mosq. Control Assoc.,* **2**: 420-3, 1986.

38. PATEL, K.J., RUEDA, K.M. & AXTEL, R.C. Comparisons of different types and concentrations of alginates for encapsulation of *Lagenidium giganteum* (Oomycetes: Lagenidiales), a fungal pathogen of mosquito larvae. *J. Amer. Mosq. Control Assoc.,* **6**: 101-4, 1990.

10a. LATGE, J.P., SOPER, R.S. & MADORE, C.D. Media suitable for industrial production of *Entomophthora virulenta* zygospores. *Biotechnology and Bioengineering,* **19**: 1269-84,1977.

15. LAM, T.N.C., GOETTEL, M.S. & SOARES Jr., G.G. Host records for the entomopathogenic hyphomycete *Tolypocladium cylindrosporum. Florida Entomologist,* **71**: 86-9, 1988.

90. LAIRD, M. Studies of mosquitoes and fresh water ecology in the South Pacific. *Bull. -R. Soc. N. Z.* **6**:1-213, 1956.

93. LAIRD, M. Use of *Coelomomyces* in biological control:Introduction of *Coelomomyces stegomyiae* into Nukunono, Tokelau Islands.In Couch, J.N. and Bland, C.E. eds. *The Genus* ***Coelomomyces****.* N.Y. and London, Academic Press, 1985. p. 370-390.

127. LAIRD, M. et al. Safety of Microbial Insecticides. Boca

Raton, Florida. CRC Press, 1989. 288p.

62. LEAHY, M.G., CRAIG Jr., G.B. Barriers to hybridization between *Aedes aegypti* and *Aedes albopictus* (Diptera: Culicidae). *Evolution,* **21**: 41-58.

98. LEÃO, A.E.A. & PEDROSO, M.C. Nova espécie do gênero *Coelomomyces* parasito de ovos de *Phlebotomus. Mycopathol. Mycol. Appl.,* **26**: 305-7, 1965.

136. LOPEZ-LASTRA. (*M. anisopliae* in *Aedes crinifer).*

50. LOWE, R.E. *Entomophthora coronata* as a pathogen of mosquitoes. *J. Invertebr. Pathol.,* **11:** 506-7, 1968.

100. LUCAROTTI, C.J. *Coelomomyces stegomyia* infection in adult *Aedes aegypti*. *Mycologia,* **79**: 362-9, 1987.

12. McCABE, D. & SOPER, R.S. Preparation of an entomopathogenic fungal insect control agent. **U.S. Patent 4,530,834**. Jul., 1985.

36. McCRAY Jr., E.M., WOMELDORF, D.J., HUSBANDS, R.C. & ELIASON, D.A. Laboratory observations and field tests with *Lagenidium* against California mosquitoes. *Proc. and Papers Calif. Mosq. Control. Assoc.* **41:** 123-128, 1973.

29. McCRAY Jr., E.M. *Lagenidium giganteum.* In: Biological Control of Mosquitoes. *Bull. Amer. Mosq. Control Assoc.* **6**: 87-98, 1985.

28. MERRIAM, T.L. & AXTELL, R.C. Evaluation of the entomogenous fungi *Culicinimyces clavosporous* and *Lagenidium giganteum* for control of the salt marsh mosquito *Aedes taeniorhynchus. Mosq. News* **42**: 594-602, 1982.

32. MERRIAM, T.L. & AXTELL, R.C. Relative toxicity of certain pesticides to *Lagenidium gifganteum* (Oomycetes: Lagenidiales), a fungal pathogen of mosquito larvae. *Environm. Entomol.* **12:** 515-21, 1983.

57. MILLER, B.R. & BALLINGER, M.E. *Aedes albopictus* mosquitoes introduced into Brazil: Vectorial competence for yellow fever and dengue virus. *Trans. R. Soc. Trop. Med. Hyg.* **82:** 476-7, 1988.

61. MILLER, B.R., MONATH, T.P., TABACHNICK, W.J. & EZIKE, V.I. Epidemic yellow fever caused by an incompetent mosquito vector. *Trop. Med. Prasit.* **21:** 396-9,1989.

2. MIRANPURI, G.S. & KHACHATOURIANS, G.G. Larvicidal activity of blastospores and conidiospores of *Beauveria bassiana* (strain GK 2016) against age groups of *Aedes aegypti*. Veterinary Parasitology **37:** 155-62,1990.

121. MITCHELL, C.J. & MILLER, B.R. Vertical transmission of dengue virus by strains of *Aedes albopictus* recently introduced into Brazil. *J. Amer. Mosq. Control Assoc.* **6:**251-3,1990.

4. MOHAMED, A.K.A., PRATT, J.A. & NELSON, F.R.S. Compatibility of *Metarhizium anizopliae* var. *anisopliae* with chemical pesticides. *Mycopathologia* **99:**99-105,1987.

68. MULLER-KOGLER, E. & ZIMMERMANN, G.*Entomophaga* **25:** 301-11, 1980.

89. MULLEY, R.C., EGERTON, J.R., SWEENEY, A.W. & HARTLEY, W.J. Further tests in mammals, reptiles and an amphibian to delineate the host range of the mosquito

fungus *Culicinimyces* sp. *Mosq. News,* **41: 528-31,** 1981.

103. MUSPRATT, J. Destruction of the larvae of *Anopheles gambiae* Giles by a *Coelomomyces* fungus. *Bull. World. Health. Organization,* **29**: 81-6,1963.

101. NNAKUMUSANA, E.S. Susceptibility of mosquito larvae to *Coelomomyces indicus. Indian Jour. Med. Res.* **82**: 316-20, 1885.

95. NOLAN, R.A. A mosquito parasite from a mosquito predator. *J. Invertebr. Pathol.* **21**: 172-5, 1973.

120. ORDUZ, S. & AXTELL, R.C. Compatibility of *Bacillus thuringiensis* var. *israelensis* and *Bacillus sphaericus* with the fungal pathogen *Lagenidium giganteum* (Oomycetes: Lagenidiales). *J. Amer. Mosq. Control Assoc.* **7**:188-93, 1991.

21. PAPIEROK, B. Obtention *in vivo* des azygospores d'*Entomophthora thaxteriana* Petch. champignon pathogene de pucerons(Homoptera: Aphididae). *C. R. Acad. Sci. Paris, 286. serie D.* 1503-1506, 1978.

38. PATEL, K.S., RUEDA, K.M. & AXTELL, R.C. Comparisons of different types and concentrations of alginates for encapsulation of *Lagenidium giganteum* (Oomycetes: Lagenidiales), a fungal pathogen of mosquito larvae. *J.Amer. Mosq. Control Assoc.* **6**: 101-4.1990.

80. PATTERSON, R.R.M. Effects of variations in nitrogen and carbon sources on the physiology of growth of *Erynia radicans*, a potential mycoinsecticide. *Biotechnol. Letters* **4**: 115-20,982.

107. PEREIRA, R.M. & ROBERTS, D.W. Dry mycelium preparations of the entomopathogenic fungi *Metarhizium anisopliae* and *Beauveria bassiana. J. Invertebr. Pathol.* **56**: 39-46,1990

108. PEREIRA, R.M. & ROBERTS, D.W. Alginate and cornstarch mycelial formulations of entomopathogenic fungi *Beauveria bassiana* and *Metarhizium anisopliae. J. Econ. Entomol.* **84**:1657-61,1991.

55. RAI, K.S. *Aedes albopictus* in the americas. *Annu. Rev.Entomol.* **36**: 459-84,1991.

59. RAI, K.S. Genetics of *Aedes albopictus. J. Amer. MOsq.Control Assoc.* **2**: 429-36,1986.

88. RAMARAJE URS, N.V., GOVINDU, H.C. & SHIVASHANKARA SHASTRY, K.S. The effect of certain insecticides on the entomogenous fungi *Beauveria basiana* and *Metarrhizium anisopliae. J. Invertebr. Pathol.* **9**: 398-403,1967.

110. RAMOSKA, W.A., WATTS, S. & WATTS, H.A. Effects of sand formulated *Metarhizium anisopliae* spores on larvae of three mosquito species. *Mosq. News* **41**: 725-8,1981.

1. RAVALLEC, M., RIBA, G. & VEY, A. Sensibilite d'*Aedes albopictus* (Dipt.:Culicidae) a l'hyphomycete entomopathogene *Metarhizium anisopliae. Entomophaga* **34**:209-17,1989.

54. RAVALLEC, M., VEY, A. & RIBA, G. Infection of *Aedes albopictus* by *Tolypocladium cylindrosporum. J. Invertebr. Pathol*. **53**: 7-11,1989.

126. ROBERTS, D.W. Some effects of *Metarrhizium anisopliae* and

its toxins on mosquito larvae. In: van der Laan ed. *Insect Pathology and Microbial Control* 1967

104. ROBERTS, D.W. *Coelomomyces, Entomophthora, Beauveria* and *Metarrhizium* as parasites of mosquitoes. *Misc. Publ. Ent. Soc. Amer.* **7**: 140-55,1970.

74. ROBERTS, D.W. & STRAND, M.A. (eds.) Pathogens of Medically Inportant Arthropods. Supp. 1. *Bull. W.H.O.* **55**: 1-419, 1977.

75. ROBERTS, D.W. & CASTILLO, J.M. (eds.) Bibliography on Pathogens of Medically Important Arthropods: 1980. Supp. *Bull. W.H.O.* **58**: 1-197,1980.

71. ROBERTS, D.W., DAOUST, R.A. & WRAIGHT, S.P. (eds.)Bibliography on Pathogens of Medically Important Arthropods: 1981. W.H.O. Doc. VBC/83.1, Geneva, Switzerland, 324 pp.

34. ROBERTS, D.W. & CAMPBELL, A.S. Stability of entomopathogenic fungi. *Misc. Publi. Entomol. Soc. Amer.* **10**: 19-76,1977.

133. ROBERTS, D.W. & SWEENEY, A.W. Production of fungi imperfecti with vector control potential. In: Invertebrate Pathology and Microbial Control. Proc. 3rd Int. Colloq. Invertebr. Pathol., Brighton, England, 409-13,1982.

65. ROBERTS, D.W. & HUMBER, R.A. Entomopathogenic fungi. In Roberts, D.W. and Aist, J.R. eds. *Infection Processes of Fungi. A Bellagio Conference.* N.Y., Rockefeller Foundation, 1984. p. 21-5.

25. ROBERTS, D.W., DUNN, H.M., RAMSAY, G. SWEENEY, A.W. & DUNN, N.W. A procedure fro preservation of the mosquito pathogen *Culicinomyces clavisporous. Appl. Microbiol. Technol.,* **26**:186-8,1987.

27. ROMBACH, M.C., AGUDA, R.M. & ROBERTS, D.W. Production of *Beauveria bassiana* (Deuteromycotina: Hyphomycetes) in different liquid media and subsequent sporulation of dry mycelium. *Entomophaga* **33**: 315-24,1988.

71. ROMBACH, M.C., AGUDA, R.M. & ROBERTS, D.W. Storing dry *Beauveria bassiana* mycelium. *Int. Rice Res. Inst.Newsletter* **13**: 37-38,1988.

112. RUEDA, L.M., PATEL, K.J. AXTELL, R.C. Efficacy of encapsulated *Lagenidium giganteum* (Oomycetes: Lagenidiales) against *Culex quinquefasciatus* and *Aedes aegypti* larvae in artificial containers. *J. Amer. Mosq. Control Assoc.* **6**: 694-9,1990.

5. SAITO, T. Control of *Aphis gossypii* in greenhouses by a mycoinsecticidal preparation of *Verticillium lecanii* and the effect of chemicals on the fungus. *Jap. Jour. Appl. Entomol. and Zool.* **32**: 244-7,1988.

135. SHADDUCK, J.A., ROBERTS, D.W. & LAUSE, S. Mammalian safety tests of *Metarhizium anisopliae*: Preliminary Results. *Environm. Entomol.* **11**: 189-92. 1992

131. SHAPIRO, M. & ROBERTS, D.W. Growth of *Coelomomyces psorophora* mycelium *in vitro. J. Invertebr. Pathol.* **27**:399-402,1976.

8. SHEMANCHUK, J.A. & HUMBER, R.A. *Entomophthora culicis* (Phycomycetes: Entomophthorales) parasitizing blackfly

adults (Diptera: Simuliidae) in Alberta. *Can. Entomol.,* **110**: 253-6,1978.

123. SIEGEL, J.P. & SHADDUCK, J.A. Safety of the entomopathogenic fungus *Lagenidium giganteum* (Oomycetes: Lagenidiales) to mammals. *J. Econ. Entomol.* **80**: 994-7, 1987.

66. SOARES Jr., G.G., PINNOCK, D.E. & SAMSON, R.A. *Tolypocladium cylindrosporum*, a new fungal pathogen of mosquito larvae with promise fro use in microbial control. *Proc. Calif. Mosq. Vect. Control Assoc.* **47**: 51-4,1979.

3. STEINKRAUS, D.C. & KRAMER, J.P. Development of resting spores of *Erynia aquatica* (Zygomycetes: Entomophthorales) in *Aedes aegypti* (Diptera: Culicidae). *Environm. Entomol.* **18**:1147-52,1989.

109. SWEENEY, A.W. Preliminary field tests of the fungus *Culicinomyces* against mosquito larvae in Australia. *Mosq. News* **41**: 470-5,1981.

69. SWEENEY, A.W.*J. Invertebr. Pathol.* **38**: 294-6,1981.

24. SWEENEY, A.W. The potential of the fungus *Culicinomyces clavisporous* as biocontrol agent for medically important Diptera. In: Laird, M. & Miles, J.W. eds. *Integrated Mosquito Control Strategies.* N.Y. and London, Academic Press, 1985. p. 269-84.

7. SWEENEY, A.W. & ROBERTS, D.W. Laboratory evaluation of the fungus *Culicinomyces clavosporous* for control of blackfly (Diptera: Simuliidae) larvae. *Environm. Entomol.* **12**: 774-8, 1983.

105. TELENGA, N.A. Le probleme de l'utilisation des micro-organismes entomopathogenes en conbinaison avec les insecticides. *Entomophaga*, Mem. Hors Ser. **2**: 531-44,1964.

132. THOMAS, K.C., KHACHATOURIANS, G.G. & INGLEDEW, W.M. Production and properties of *Beauveria bassiana* conidia cultivated in submerged culture. *Can. J. Microbiol.* **33**:12-30,1987.

84. UMPHLETT, C.J. & McCRAY Jr., E.M. A brief review of the involvement of *Lagenidium*, an aquatic fungus parasite, with arthropods. *Marine Fisheries Review,* **37**: 61-4,1975.

106. URS, N.V.R., GOVINDU, H.C. & SHASTRY, K.S.S. The effect of certain insecticides on the entomogenous fungi *Beuveria bassiana* and *Metarrhizium anisopliae. J. Invertebr. Pahtol.* **9**: 398-403,1967.

43. VANNINEN, I. & HOKKANEN, H. Effects of pesticides on four species of entomopathogenic fungi *in vitro. Annales Agriculturae Fenniae* **27**: 345-53,1988.

6. VYAS, R.V., YADAV,D.N. & PATEL, R.J. Compatibility of *Beauveria brogniartii* with some pesticides used in groundnut pest management. *Ann. Biol. (Ludhiana)* **6**: 21-6,1990.

46. WASHINO, R.K. ET AL. The stablishment of *Lagenidium giganteum*, an aquatic fungal parasite of mosquito, three years after field introduction. *Proc. and Papers Calif. Mosq. Control. Assoc.* **44**: 52,1976.

113. WEISER, J. Biological Control of Vectors: Manual for

Collecting, Field Determination and Handling of Biofactors for Control of Vectors. J. Wiley Pub. & UNDP/World Bank/WHO.

66. WEISER, J. & PILLAI, J.S. *Tolypocladium cylindrosporum* (Deuteromycetes, Moniliales) a new pathogen of mosquito larvae. *Entomophaga*, **26**: 357-61,1981.
119. WILDING, N.Pest Control by Entomophthorales.In: Burges H.D. ed. *Microbial Control of Pests and Plant Diseases 1970-1980.* N.Y. and London, Academic Press, 1981. p. 539-554.
31. WILDING, N. & LATTEUR, G. The Entomophthorales-problens relative to their mass production and their utilization. *Med. Fac. Landbouww. Rijksuniv. Gent,* **52**: 159-64,1987.
18. W.H.O. Data sheet on the biological control agent *Lagenidium giganteum* (Couch,1935). *WHO/VBC/79.753, VBC/BCDS/79.02,*6pp,1979.
19. W.H.O. Data sheet on the biological control agent *Metarhizium anisopliae* (Metschnikoff),Sorokin *WHO/VBC/80.758, VBC/BCDS/80.04,* 9pp,1980.
20. W.H.O. Data sheet on the biological control agent *Culicinimyces sp*. *WHO/VBC/80.755, VBC/BCDS/80.03,* 4pp, 1980.
79. WOLF, F.T. Entomophthorales and their parasitism of insects. *Nova Hedwigia* **46**: 121-4,1988.

86. YENDOL, I.M. & DUNN, P.H. Factors affecting germination of *Entomophthora* conidia. *J. Invertebr. Pathol.* **10**: 116-21,1959.

obs. Reference numbers: 10a, 31, 33, 36, and 41 are void!