identified a single male *Ae. mitchellae*. The identification was confirmed by Dr. George B. Craig, Jr. This represents a new state record for the species. The individual was collected on July 15, 1983 behind the Olive Elementary School in New Carlisle, IN during an extended dry spell. Attempts to locate larval habitats were unsuccessful. The specimen has been deposited in the U. S. National Museum.

There are two other reports of this species from the Great Lakes area. A female, originally recorded from Chicago, Illinois in 1906 as *Aedes taeniorhynchus*, was considered by Ross (1947) to be *Ae. mitchellae*. However, the northernmost record of this species is that of a female taken by a CO_2-baited CDC light trap in Kalamazoo, Michigan on August 10, 1979 (J. Freier and H. D. Newson, personal communication).

References Cited

Darsie, R. F., Jr. and R. A. Ward. 1981. Identification and geographical distribution of the mosquitoes of North America, north of Mexico. American Mosquito Control Association, Fresno, CA. 313 pp.

Ross, H. H. 1947. The mosquitoes of Illinois (Diptera, Culicidae). Bull. Ill. Nat. Hist. Sur. 24:1–96.

NON-SUSCEPTIBILITY OF *CHAOBORUS FLAVICANS* (CHAOBORIDAE) TO THE MOSQUITO PATHOGEN *LAGENIDIUM GIGANTEUM* (OOMYCETES)[1]

S. T. JARONSKI AND R. C. AXTELL

Department of Entomology, North Carolina State University, Raleigh, NC 27650

The oomycetous fungus *Lagenidium giganteum* Couch is currently under evaluation as a biological control agent for mosquitoes (Axtell et al. 1982, Jaronski 1983, Fetter-Lasko and Washino 1983). The published host spectrum of this fungus includes, in addition to the major genera of mosquitoes, gnats in the family Chaoboridae. The inclusion of the chaoborids was based on reports by Brown and Washino (1977, 1979) that the fungus gave partial control of the Clear Lake gnat, *Chaoborus astictopus* (Meigen), in small-scale field tests.

During evaluations of *L. giganteum* against larval mosquito populations in North Carolina, we were able to collect larvae of another chaoborid, C. *flavicans* (Meigen) and test their susceptibility to the North Carolina (NC) isolate of the fungus in an attempt to corroborate the observations of Brown and Washino. Both *C. flavicans* and *C. astictopus* are benthic/planktonic predators of copepods, chironomids, mosquitoes, oligochaetes and rotifers in ponds and lakes and the two species are ecologically and biologically similar (Saether 1972). In our bioassays *C. flavicans* was not susceptible to the fungus.

The fungus was cultured in Z Medium and plated onto hemp-seed agar according to the procedures of Jaronski et al. (1983). These cultures were stored for 7 days at 20°C before being used in the bioassays. For the bioassay, ½ petri dish of fungus culture was added to each of 3 plastic tubs (17 cm diam) containing 1.5 liters deionized water. Eight hours later (just before the start of zoospore production), 25 second-instar *C. flavicans*, freshly collected from the field, were added to each tub. At the same time 20 second-instar larvae of *Aedes aegypti* (Linn.) and 25 second-instar larvae of *Culex quinquefasciatus* Say were added to each tub to determine the infectivity to mosquitoes of the fungus used in the test. Both mosquito species were from laboratory colonies. An additional tub of water containing 25 larvae of each of the 3 species was left untreated. The bioassay was conducted at 20°C. After 4 days all larvae were collected by pipette and examined microscopically for infection by the fungus. By this time any fungal infections would have become visible, yet secondary infections would not have been manifest.

Mean percentage infection for *Cx. quinquefasciatus* was 82.7% (S.D. = 9.1), and for *Ae. aegypti*, was 86.6% (S.D. = 7.6). None of the chaoborid larvae became infected. Control mortality was 0%.

These results indicate that *C. flavicans* is not susceptible to *L. giganteum*. The mosquito larvae in each replicate tub were heavily infected by the fungus, yet none of the chaoborid larvae present with the mosquitoes succumbed. No zoospore encystment of the chaoborids' cuticles was evident by microscopic examination, nor were there any signs of aborted penetration by the fungus in the chaoborids. Evidently, nonsusceptibility was mediated on the level of zoospore-host interaction. It is doubtful that the fungal zoospores were preferentially attracted to the mosquito larvae, since we have been unable to observe any positive chemotaxis or chemokinesis in response to larvae, using either direct observation of zoospores in the vicinity of larvae or the assay technique used by Pommerville (1977) in his studies of oomycete behavior (Jaronski and Axtell, unpublished data).

[1] Paper No. 8864 of the Journal Series of the North Carolina Agricultural Research Service, Raleigh, NC 27650. This research was supported in part by NIH grant IR01 AI17024.

Since *C. astictopus* is related to *C. flavicans*, the reported susceptibility of *C. astictopus* to the fungus is surprising. In their field tests, Brown and Washino (1977) added zoospore suspensions to large volumes of pond water containing chaoborid larvae and measured adult emergence rates from treated and untreated water. No larval infections were observed, but gnat emergence from ponds with medium and high doses of zoospores was lower than from the untreated ponds. The zoospore doses used were much lower than the estimated output of a *Lagenidium* culture on hemp-seed agar (ca. 10^7 zoospores, Jaronski et al. 1983). In subsequent work, Brown and Washino (1979) reported reduced emergence from an agricultural pond treated with the fungus, but were unable to re-isolate the fungus from collected chaoborids. At the same time sentinel mosquito larvae in the pond became infected with *L. giganteum*. A very brief description of the laboratory tests that they conducted indicated that the chaoborids may have been infected by the fungus, but apparently emergence rates were used rather than observed infection rates. The differences between treated and untreated chaoborid populations may have been the result of factors other than infection by *L. giganteum*. Direct evidence of *Lagenidium* infection in *C. astictopus* has not been reported. Our assay showed that the closely related *C. flavicans* is not infected under laboratory conditions by the NC isolate of the fungus. Therefore, there is some uncertainty about including *C. astictopus* among the species susceptible to *L. giganteum*. It is possible that *C. astictopus* was infected and the difference in susceptibility between the two chaoborids is due to differences among isolates of the fungus. However, Koethe[2], found no major differences between the infectivities of the NC and Louisiana isolates for several species of mosquito. Further investigations are needed to determine whether or not Chaoboridae are susceptible to infection by *Lagenidium giganteum*.

The authors gratefully acknowledge the identification of the chaoborids by Dr. Sam Moseley, N.C. State University and the laboratory assistance of Ms. Maureen Cullen.

References Cited

Axtell, R. C., S. T. Jaronski and T. L. Merriam. 1982. Efficacy of the mosquito fungal pathogen *Lagenidium giganteum* (Oomycetes: Lagenidiales). Proc. Calif. Mosq. Vector Control Assoc. 50:41–42.

Brown, J. K. and R. K. Washino. 1977. Developments in research with the Clear Lake gnat *Chaoborus astictopus* in relation to the fungus *Lagenidium giganteum*. Proc. Calif. Mosq. Vector Control Assoc. 45:106 (Abstr.).

Brown, J. K. and R. K. Washino. 1979. Evaluating the fungus *Lagenidium giganteum* for the biological control of the Clear Lake gnat, *Chaoborus astictopus*, in an agricultural pond in Lake County, California. Proc. Calif. Mosq. Vector Control Assoc. 47:37 (Abstr.).

Fetter-Lasko, J. F. and R. K. Washino. 1983. In situ studies on seasonality and recycling pattern in California of *Lagenidium giganteum* Couch, an aquatic fungal pathogen of mosquitoes. Environ. Entomol. 12:635–640.

Jaronski, S. T. 1983. Oomycetes in mosquito control. Symposium on the biological control of vectors. Proc. 3d Intl. Colloq. Invertebr. Pathol. Sussex Univ., England. pp. 420–424.

Jaronski, S. T., R. C. Axtell, S. M. Fagan and A. J. Domnas. 1983. In vitro production of zoospores by the mosquito pathogen *Lagenidium giganteum* (Oomycetes: Lagenidiales) on solid media. J. Invertebr. Pathol. 41:305–309.

Pommerville, J. 1977. Chemotaxis of *Allomyces* gametes. Expt. Cell Res. 109:43–51.

Saether, O. A. 1972. Chaoboridae. p. 257–280. *In*; Elster, H.-J., and W. Ohle (eds.) Die Binnengewasser. Teil 1. E. Schweizerbart'sche Verlagsbuchhandlung, Stuttgart, Germany.

[2] Koethe, D. C. 1982. Comparisons of two isolates of *Lagenidium giganteum* Couch (Oomycetes: Lagenidiales), a fungal pathogen of mosquito larvae. M. S. Thesis, N.C. State Univ., Raleigh, 61 p.

MALATHION RESISTANCE IN *CULEX PIPIENS* IN SOUTHERN ITALY

G. C. BREEDEN[1], G. MAJORI[2] AND T. P. BREAUD[3]

During the summer and fall months, the beach housing areas just north of Naples, Italy experience very large numbers of *Culex pipiens* Linn. Mosquito control is limited to rare adulticiding with various aerosol fogs on only one or two holidays per season. The primary breeding source for *Cx. pipiens* is a network of slow-moving irrigation and drainage canals. These concrete-lined canals crisscross the heavily-farmed coastal vegetable-growing areas adjacent to the beach housing developments. These

[1] U.S. Navy Environmental and Preventive Medicine Unit No. 7, (Naples, Italy) Box 41, FPO, New York 09521.

[2] Istituto Superiore di Sanita, Viale Regina Elena 299, 00161 Roma, Italia.

[3] Preventive Medicine Service, Naval Hospital, Camp Lejeune, NC 28542.