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FIFTEEN SPECIES OF MOSQUITOES AS POTENTIAL HOSTS OF A MERMITHID NEMATODE *ROMANOMERMIS* SP.[1]

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The species of mermithid nematodes reported from mosquitoes of the Nearctic Region vary in their degree of host specificity. *Agamomermis culicis* Stiles appears to be host specific for *Aedes sollicitans* (Walker) (Petersen *et al.*, 1967), and *Paramermis canadensis* Steiner appears to be highly specific for *Aedes vexans* (Meigen) (Hearle, 1926); both these mermithid species seem to complete their parasitic stage only in adult mosquitoes. However, most other mermithids that have been reported from North American mosquitoes restrict their development to the larval stages of the host and appear to be less host specific than those maturing in adult mosquitoes. Stabler (1952) reported finding larvae of a species of *Aedes* and two species of *Culex* parasitized by an undescribed mermithid, and Welch (1960) reported that *Hydromermis churchillensis* Welch parasitized larvae of at least three species of mosquitoes though at least three other species seemed to be resistant. Also, an undescribed species of *Romanomermis* in Louisiana was observed parasitizing larvae of at least 13 species of mosquitoes in nature and 32 species in the laboratory (Petersen *et al.*, 1968). Since the distribution of this *Romanomermis* sp. is apparently somewhat restricted because it prevents pupation and thus cannot be disseminated by the host, tests were made to evaluate 15 mosquito species as potential hosts.

MATERIALS AND METHODS. First instar larvae of the selected mosquito species were exposed to the newly hatched preparasitic juvenile nematodes in the laboratory. However, the preliminary tests indicated that it would be difficult to predict the degree of infection that would result. We therefore included a control species (one known to be a suitable host) which could be used to determine the potential infectivity of the preparasitic nematodes and would also allow us to make a direct comparison between the two species. Though *Culex pipiens quinquefasciatus* Say and *Culiseta inornata* (Williston) are not known natural hosts of the parasite, they were used as the control species because both are susceptible to the nematode and are readily available from laboratory colonies.

The tests were made as follows: Whenever possible, 200 first instar larvae of both the test and the control species were placed in a common container with 50 ml. of water and an unknown quantity of pre-

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arasitic juveniles of *Romanomermis* sp. rom a laboratory culture were added. The larvae were fed lightly and after 16 ours were removed to rearing pans. The wo species were separated after 7 days, nd the parasitized larvae were counted.

RESULTS AND DISCUSSION. Fifty-one tests ere made with 15 species of mosquitoes, *triseriatus*, and *Psorophora ferox* were highly resistant to either the attack or development of *Romanomermis* and the last two exhibited host resistance to the developing parasites.

Aedes aegypti, *A. sierrensis*, *Culex salinarius*, *P. varipes*, and *Aedes thibaulti* had rates of parasitism that about equalled that

TABLE 1.—Susceptibility of *Culiseta inornata* and other mosquito species to *Romanomermis* sp. nematode.

Mosquito species	Number of tests	Total no. of surviving larvae	Percentage of survivors infected	Rating[a]
Psorophora confinnis (Lynch-Arribálzaga)	2	183	92.3	1.4
Culiseta inornata		217	64.5	(1.0)
Culex salinarius Coquillett	2	241	42.7	1.0
Culiseta inornata		200	43.5	
Aedes taeniorhynchus (Wiedemann)	3	419	19.8	0.6
Culiseta inornata		380	30.8	
Psorophora varipes (Coquillett)	3	120	34.2	0.6
Culiseta inornata		339	56.3	
Aedes aegypti (L.)	3	580	26.0	0.5
Culiseta inornata		341	49.8	
Culex restuans Theobald	2	253	32.8	0.4
Culiseta inornata		221	73.7	
Aedes sollicitans	3	291	20.3	0.4
Culiseta inornata		337	48.7	
Culex p. quinquefasciatus	3	570	16.8	0.2
Culiseta inornata		342	75.1	
Aedes tormentor Dyar & Knab	2	118	2.5	0.1
Culiseta inornata		382	54.4	
Aedes triseriatus (Say)	2	302	1.3	0.02
Culiseta inornata		207	70.0	
Psorophora ferox (Humboldt)	3	332	1.5	0.02
Culiseta inornata		467	85.6	

[a] Rating = $\frac{\text{Percentage parasitism of test species}}{\text{Percentage parasitism of control species}}$.

1 (including *C. p. quinquefasciatus*) with *C. inornata* as the control (Table 1) and 3 with *C. p. quinquefasciatus* as the control (Table 2).

Aedes aegypti, *A. sollicitans*, *A. taeniorhynchus*, *Culex restuans*, and *Psorophora varipes* were about one half as susceptible to the invasion and development of the parasite as *C. inornata* (Table 1), and *Culex salinarius* and *Culiseta inornata* were about equally susceptible. Of the 11 species tested against *C. inornata* only *Psorophora confinnis* was more susceptible to the nematode. *Aedes tormentor*, *A.* of the control *C. p. quinquefasciatus* (Table 2). *Culiseta inornata* and *P. confinnis* were several times more susceptible, and *Aedes tormentor*, *A. triseriatus*, *Culex territans*, and *P. ferox* were considerably more resistant than the control. Also, *P. confinnis* was the most susceptible of the 15 mosquito species tested. *P. confinnis* and *Culex restuans* were the only species tested that are known natural hosts. *Culiseta inornata* was the second most susceptible species. The nematode developed well in *C. inornata* but the slow rate of larval development of the mosquito species

caused the parasites to mature before the mosquito reached the fourth instar; the result was small postparasitic nematodes.

The host resistance to the nematodes observed in *Culex territans, P. ferox,* and *Aedes triseriatus* and reported by Petersen *et al.* (1968) was expressed by encapsulation and melanization of the developing parasite. *Romanomermis* did successfully complete its parasitic development in a few larvae of *P. ferox,* but development was never completed in *Culex territans* or *Aedes triseriatus.* When host resistance was observed in *P. ferox* and *Culex territans,* it occurred at a very early stage, and no parasitism was evident by the time the mosquitoes reached the third instar. With *Aedes triseriatus,* host resistance occurred a little later, and the melanized nematodes could occasionally be observed in fourth instar larvae (Fig. 1).

All mosquito species tested except thes three seemed capable of serving as host for the *Romanomermis* sp. However, mos of them have disadvantages that woul discourage their use as hosts in laborator tests or would make them poor hosts i maintaining the nematode culture. Fo example, *Aedes sollicitans, Culex restuans Aedes thibaulti,* and *P. confinnis* have no been colonized, and a continuous sourc of eggs would be a problem. Also, th larvae of *Culiseta inornata* develop s slowly and the larvae of *Aedes sierrensi* are generally so small that they usuall produced small, low productive nema todes. In contrast, although eggs of *Aede tormentor, P. varipes,* and *Aedes taenio rhynchus* are available from our laborator colonies, these species are not good labora tory hosts for tests because it is sometime difficult to obtain a good percentage o

TABLE 2.—Susceptibility of *Culex p. quinquefasciatus* and other mosquito species to *Romanomermi* sp. nematode.

Mosquito species	Number of tests	Total no. of surviving larvae	Percentage of survivors infected	Rating[1]
Psorophora confinnis	2	156	84.0	5.6
Culex p. quinquefasciatus		357	15.1	(1.0)
Culiseta inornata	3	342	75.1	4.5
Culex p. quinquefasciatus		570	16.8	
Aedes taeniorhynchus	3	162	48.8	3.1
Culex p. quinquefasciatus		482	15.6	
Aedes thibaulti Dyar & Knab	1	61	80.3	1.5
Culex p. quinquefasciatus		49	55.1	
Aedes sollicitans	4	223	50.2	1.1
Culex p. quinquefasciatus		758	46.0	
Psorophora varipes	2	161	80.1	1.1
Culex p. quinquefasciatus		345	75.1	
Aedes aegypti	2	350	98.9	1.0
Culex p. quinquefasciatus		394	97.5	
Aedes sierrensis (Ludlow)	2	56	53.5	0.9
Culex p. quinquefasciatus		335	56.4	
Culex salinarius	2	256	55.8	0.9
Culex p. quinquefasciatus		368	62.8	
Aedes tormentor	3	339	18.0	0.6
Culex p. quinquefasciatus		569	29.9	
Aedes triseriatus	3	387	2.5	0.2
Culex p. quinquefasciatus		583	11.1	
Psorophora ferox	3	127	0.8	0.02
Culex p. quinquefasciatus		522	41.6	
Culex territans Walker	1	122	0	0.00
Culex p. quinquefasciatus		92	28.3	

[1] Rating = $\frac{\text{Percentage parasitism of test species}}{\text{Percentage parasitism of control species}}$.

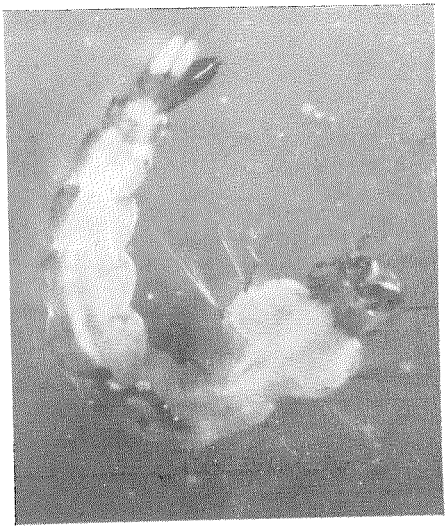

Fig. 1—*Aedes triseriatus* exhibiting host resistance by encapsulation and melanization of the *Romanomermis* sp. nematode.

survivors to the fourth instar, and *Culex salinarius* which is also available, occasionally exhibited some host resistance in the fourth instar and has somewhat slower larval development than many other species.

Aedes aegypti and *Culex p. quinquefasciatus* thus proved to be the most satisfactory hosts of *Romanomermis* sp. They are easily reared and colonized, and they produce large healthy postparasitic nematodes. However, extreme care is required to prevent the escape of *Aedes aegypti*. Thus *Culex p. quinquefasciatus*, which is also much easier to observe because it is less active, is the preferred host.

Romanomermis sp. is therefore a promising potential biological control agent because of its wide range of hosts and the ease with which it is cultured in the laboratory. However, much information is still needed about factors that will affect the establishment of the parasite in a new environment.

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