FIELD PARASITISM OF TWO SPECIES OF LOUISIANA RICE FIELD MOSQUITOES BY A MERMITHID NEMATODE[1]

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ABSTRACT. When first-instar larvae of *Psorophora confinnis* (Lynch-Arribálzaga) were exposed to preparasitic *Reesimermis nielseni* Tsai and Grundmann in a series of 20 x 45-foot rice field plots, mean parasitism ranged from 10 to 38 percent as rates of *R. nielseni* were increased from 180 to 1450 per square yard of surface area; an estimated 3900 preparasitic nematodes per square yard would therefore be required to produce 95+ percent parasitism of the species. Mean parasitism in first-instar larvae of *Anopheles quadrimaculatus* Say exposed in the same way ranged from 16 percent for 181 preparasitics per square yard to 61 percent for 725 preparasitics per square yard; an estimated 1300 preparasitic *R. nielseni* per square yard would therefore be required to produce 95+ percent parasitism in this species.

Recently the techniques developed for mass production of the preparasitic stage of the mermithid nematode *Reesimermis nielseni* Tsai and Grundmann, which has shown potential as a biological control agent for mosquitoes (Petersen and Willis 1971, 1972a, and Petersen *et al.* 1972), provided us with sufficient laboratory populations for preliminary field releases (Petersen and Willis 1972b). Thus in 1971, infective stages were released in 11 naturally occurring semipermanent to permanent mosquito breeding sites in southwestern Louisiana. Rates of 751–1000 preparasitic nematodes per square meter of surface area produced 94, 61, and 47 percent parasitism in 2nd-, 3rd-, and 4th-instar larvae of *Anopheles* spp. (principally *A. crucians*), respectively (Petersen and Willis 1972a). Also, a release of nematodes in a California rice field produced 80–85 percent parasitism in 1st- to 3rd-instar larvae of *Anopheles freeborni* Aitken when a rate of 1000 preparasitic nematodes per square yard of surface area was applied (Petersen *et al.* 1972).

The present study was similar but was conducted to evaluate the effectiveness of *R. nielseni* as a biological control agent against larvae of *Psorophora confinnis* (Lynch-Arribálzaga) and *Anopheles quadrimaculatus* Say, the principal mosquito species found in Louisiana rice fields.

METHODS AND MATERIALS. Two similar tests were conducted, one to evaluate the effectiveness of *R. nielseni* against *P. confinnis* and the other to evaluate its effectiveness against *A. quadrimaculatus*. Originally we planned to release the infective stage of the nematode against natural populations of the two mosquito species; however, after it became apparent that sufficient time was not available before the release for a buildup of populations of *A. quadrimaculatus*, the 12 test plots assigned to this test were artificially infested with 1st stage larval *A. quadrimaculatus* obtained from the laboratory colony.

A randomized complete block experimental design was employed in each test with treatments replicated 3 times. Individual plots were enclosed within levees, and each plot had an area of 20 x 45 feet (0.011 acre). The two tests were made in adjoining experimental areas in the same rice field.

On May 8, 1972, all plots were drill-seeded with rice (variety 'Della') at a rate of 100 pounds per acre and simultaneously fertilized with NKP (16–8–8) at a rate of 500 pounds per acre. Fourteen days after seeding, the plots were flushed with 2 inches of water to stimulate crop growth and to attract ovipositing *P. confinnis*. Seven days later, propanil was applied to all plots from an aircraft at a rate of 3 pounds per acre for control of weeds.

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Three days after this application, a permanent flood (6 inches of water) was applied to all plots.

The 12 contiguous plots (4 treatments x 3 replications) assigned to the test of *A. quadrimaculatus* were artifically infested with 1st stage larvae of *A. quadrimaculatus* at a rate of ca. 4,000 per plot. Treatments consisted of 4 rates of *R. nielseni;* 180, 365, 545, or 725 preparasitics per square yard of plot surface area.

Twenty-four contiguous plots (8 treatments x 3 replications) were assigned to the test of *P. confinnis* (natural populations). Treatments consisted of 8 rates of *R. nielseni;* 180, 365, 545, 725, 900, 1090, 1265, or 1450 preparasitics per square yard of plot surface. In both tests the preparasitics of *R. nielseni* were applied in water from a knapsack sprayer at a pressure of about 40 psi and at a rate of 1 gallon finished formulation per treatment.

All applications of nematodes in both tests were made 2 hours after flood. Then 24 hours later, 25 or more mosquito larvae were collected from each plot in each test and transported to the laboratory where they were held 2 days and then dissected. The number of parasitized mosquito larvae was determined for each mosquito species.

RESULTS AND DISCUSSION. The percentage parasitism of natural populations of *P. confinnis* obtained with the 8 rates of *R. nielseni* is reported in Table 1. A positive regression coefficient (b=0.025) was calculated for rate versus percentage parasitism. In the absence of evidence indicating otherwise, this regression was assumed to be essentially linear. Thus, in this test 100 preparasitics per square yard produced ca. 2.5 percent parasitism in *P. confinnis* larvae. Therefore, ca. 3,900 preparasitics per square yard would be required to produce 95+ percent parasitism in this species.

The percentage parasitism obtained with the 4 rates of *R. nielseni* in plots artificially infested with 1st stage larvae of *A. quadrimaculatus* is reported in Table 2. The positive regression coefficient for this study (b=0.081) was also assumed to be linear. Thus, parasitism increased ca. 8 percent for each additional increment of 100 preparasitic nematodes applied per square yard of plot surface, and 1300 preparasitics per square yard would be required to provide 95+ percent parasitism of the *A. quadrimaculatus* larval stages present in plots (artificial infestation plus whatever natural infestation was present in plots at the time of treatment).

These results indicate that *A. quadrimaculatus* larvae may be ca. three times more susceptible than *P. confinnis* larvae to parasitism by *R. nielseni.* (Unpublished laboratory data also indicate that anopheline species are generally more susceptible to invasion by this parasite than are culicine species.) Also, the test, though limited in scope, did demonstrate that mosquitoes can be killed in nature by

TABLE 1.—Incidence of parasitism of first-stage *Psorophora confinnis* larvae by *Reesimermis nielseni* in rice field plots. Louisiana State University Rice Experiment Station, Crowley, 1972.[1]

Rate of application (preparasitics/square yard of plot surface)	% parasitism in indicated replication			
	1	2	3	Mean
180	17	..	4	10
365	0	9	9	6
545	0	23	18	14
725	15	18	18	17
900	31	27	37	32
1090	36	30	23	30
1265	43	27	19	30
1450	41	50	24	38

[1] Values are based on examination of 25 larvae/plot.

TABLE 2.—Incidence of parasitism of first-stage *Anopheles quadrimaculatus* larvae by *Reesimermis nielseni* in rice field plots. Louisiana State University Rice Experiment Station, Crowley, 1972.[1]

Rate of application (preparasitics/square yard of plot surface)	% parasitism in indicated replication			
	1	2	3	Mean
180	14	20	15	16
365	12	20	35	22
545	50	40	12	34
725	55	45	84	61

[1] Values are based on examination of 25 larvae/plot.

using *R. nielseni* and that the incidence of parasitism can be increased proportionately by increasing the rates of the infective-stage parasites.

The concept of using parasitic nematodes in mosquito control programs is appealing because of the specificity of the agent plus the anticipated decrease in pesticides that may be achieved. However, much more information is needed concerning the effectiveness of *R. nielseni* against various densities of mosquitoes, the timing of applications, and the cost of applications plus the cost of rearing preparasitic nematodes.

Literature Cited

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