

INTRASPECIFIC COMPETITION AND THE DRY WEIGHT OF *ROMANOMERMIS CULICIVORAX*

Robin M. Giblin* (1), and Edward G. Platzer*

Romanomermis culicivorax is an obligatory endoparasite of the larvae of mosquitoes. The parasite sequesters all of its nutritional requirements for the forthcoming freeliving stage from its host. Female parasites are inherently larger and heavier than males (Womersley & Platzer, 1982) but the effects of parasite density and sexual composition of the burdens on parasite dry weights have not yet been examined. We therefore measured the pooled mean dry weights of total parasite burdens and individual parasites as a function of sexual composition and density to further elucidate this aspect of intraspecific competition.

Culex pipiens host larvae were reared in dechlorinated tap water under neutral conditions at 27° and infected with *R. culicivorax* as described by Platzer and Stirling (1978) and modified by Giblin and Platzer (1985). *C. pipiens* larvae were infected with *R. culicivorax* parasites at different inoculum levels (2, 4, and 7 nematodes : mosquito) to obtain varied numbers of parasites per host. Parasitized *C. pipiens* larvae were individually confined to wells of a multiwell tissue culture plate at day 6 post-infection (PI) and parasites were allowed to emerge. At day 10 PI newly emerged nematodes from a given trial were sexed and pooled separately according to the type of parasitic burden. Pooled groups for dry weight determinations always contained four or more nematodes (range = 4-60) and represented 1-30 worm burdens. Only the specific parasite types where three or more replicates were obtained are presented. The groups of nematodes were placed in marked microfuge tubes, frozen with dry ice, and lyophilized for 24 h. Nematodes were removed from the microfuge tube onto tared aluminum foil beakers and weighed on a Perkin-Elmer AD-2 microbalance. The average dry weight of a male or female parasite per burden type, and the average total weight per burden was calculated.

In general, the mean dry weight of total nematode burdens for a particular sexual composition type (i. e., males only) increased with parasite number (Tab. 1). The slopes from regression lines of each sexual composition type were not significantly different with an

analysis of covariance. The regression lines intercepted the y-axis at significantly different points ($p < 0.05$) suggesting that sexual composition was an important criterion in the competitiveness of a nematode burden with a specific number of parasites. Data presented here suggests that the percentage dry weight contributed by the parasite burden to the overall dry weight of a parasitized host was dependent upon the total number and sex of the nematodes per parasitic burden.

C. pipiens is an integrative host for *R. culicivorax* and was well fed in these experiments. We would expect that in poorly integrative or malnourished hosts that the dry weight dynamics of the parasite-host association might change. The predatory mosquito, *Toxorhynchites amboinensis*, was a poorly integrative host for *R. culicivorax* (Giblin & Platzer, 1985). Dry weight data from *R. culicivorax* burdens collected as above from *ad libitum* fed *T. amboinensis* showed that female parasites were rare and that the nematode burden and individual female and male mean weights were 1/3 to 1/2 the weight for equivalent nematode burdens or individuals from well fed *C. pipiens* hosts. Interestingly, a linear relationship existed between the weight of the nematode burden and the number of parasites/burden for males only burdens in *ad libitum* fed *T. amboinensis*, whereas a bell-shaped curvilinear relationship existed when the number of *C. pipiens* prey larvae/*T. amboinensis* predator was restricted to fifteen per day (Giblin, unpub.). Thus, parasite biomass was dependent upon host species and host nutrition. Gordon *et al.* (1981) reported that *A. aegypti* host larvae fed on a low protein restricted diet produced *R. culicivorax* with increased developmental asynchrony and larger size discrepancies at parasite emergence.

Although *R. culicivorax* burdens with greater numbers of parasites may alter the carrying capacity of the host as reflected in greater parasite burden dry weights and host pathology, it was obvious from the negative slopes of mean individual male and female parasites (Tab. 2) that there was increased intraspecific competition as well.

* Department of Nematology, University of California, Riverside, Ca 92521, USA.

(1) Present address : University of Florida, IFAS, 3205 College Avenue, Fort Lauderdale, Fl 33314, USA.

Table 1
 Mean dry weight of *Romanomermis culicivorax* postparasitic (a)
 burdens with different sexual compositions and numbers.

Number Parasites/ Burden	Dry weight of nematode burden		
	1 Female + X Males (b)	2 Females + X Males (b)	Males only
1	227.5 ± 25.3 (4) (c)	.....	.....
2	252.5 ± 17.1 (4)	285.7 ± 30.2 (4)	185.6 ± 7.0 (4)
3	244.8 ± 21.6 (6)	327.3 ± 36.6 (4)	221.8 ± 11.2 (6)
4	289.9 ± 32.2 (6)	.....	250.1 ± 19.4 (5)
5	.....	.....	236.1 ± 26.6 (3)
6	.....	381.7 ± 40.9 (3)	279.2 ± 36.8 (5)
LRE (d) r (e)	y = 206 + 18.5 X 0.36	y = 248 + 22.9 X 0.53	y = 146 + 23.3 X 0.66

- (a) = *R. culicivorax* postparasites harvested at 10 day postinfection.
 (b) = X varies from 0-4 according to the total number of parasites/burden.
 (c) = mean dry weight (µg/burden) ± S.E. (N.).
 (d) = linear regression equation, LRE.
 (e) = correlation coefficient, r.

ACKNOWLEDGMENT

We thank Ms Lin Duan for general assistance. This project was supported in part by Research Grant AI-15717 from NIAID, US Public Health Service, National Institute of Health.

REFERENCES

- GIBLIN, R. M. & PLATZER, E. G. (1985). *Romanomermis culicivorax* parasitism and the development, growth, and feeding rates of two mosquito species. *J. invertebr. Pathol.*, 46 : 11-19.
- GORDON, R., SQUIRES, J. M., BABIE, S. J. & BURFORD, I. R. (1981). Effects of host diet on *Romanomermis culicivorax*, a mermithid parasite of mosquitoes. *J. Nematol.*, 13 : 285-290.
- PLATZER, E. G. & STIRLING, A. M. (1978). Improved rearing procedures for *Romanomermis culicivorax*. *Proc. Calif. Mosq. Vector Control Assoc.*, 46 : 87-88.
- WOMERSLEY, C. & PLATZER, E. G. (1982). The effect of parasitism by the mermithid *Romanomermis culicivorax* on the dry weight and hemolymph soluble protein content of three species of mosquitoes. *J. Invertebr. Pathol.*, 40 : 406-412.

Accepté pour publication le 13 janvier 1986.

Table 2

Mean dry weight of individual males or females of *Romanomermis culicivorax* (a) from nematode burdens with different sexual compositions and numbers.

<i>Dry weight of nematode burden</i>			
Number Parasites/ Burden	1 Female + X Males (b)	2 Females + X Males (b)	Males only
MALES			
1	.....	.....	.....
2	73.3 ± 2.8 (4) (c)	.....	92.8 ± 3.5 (4)
3	62.8 ± 4.1 (6)	57.3 ± 9.7 (3)	73.9 ± 3.7 (6)
4	52.1 ± 6.6 (6)	.....	65.3 ± 5.1 (4)
5	.....	.....	47.2 ± 5.7 (3)
6	.....	42.3 ± 0.9 (3)	49.0 ± 3.4 (6)
7	.....	.....	45.6 ± 2.1 (4)
LRE (d)	$y = 94 - 10.6 X$	$y = 72 - 4.0 X$	$y = 104 - 9.2 X$
r (e)	- 0.60	- 0.61	- 0.87
FEMALES			
1	227.5 ± 25.3 (4)	.....
2	179.0 ± 14.7 (4)	142.9 ± 15.1 (4)	
3	143.1 ± 9.8 (5)	136.1 ± 21.0 (3)	
4	121.7 ± 17.0 (4)	.....
5	.....	.....
6	.....	106.2 ± 21.0 (3)	
LRE (d)	$y = 253 - 33.9 X$	$y = 172 - 9.3 X$	
r (e)	- 0.82	- 0.48	

Legend same as for Table 1, except (c) = mean dry weight (µg/individual male or female parasite) ± S.E. (N).