Laboratory studies on *Hydrotaea aenescens* as predator of house fly larvae (Diptera: Muscidae)

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ABSTRACT. The aim of this work was to determine how the density and age of immature stages of *Hydrotaea aenescens* and *Musca domestica* influenced the predation rate during development in pig manure. If eggs or first instar larvae of both species were put together into a larval medium no predation of *Hydrotaea aenescens* was observed. However, when second and third instar *Hydrotaea* larvae were used, no house fly emerged from the samples. It was found that one *Hydrotaea* larva is capable of destroying at least 5 *Musca* larvae during its larval development. The results confirm earlier reports on the ability of *Hydrotaea aenescens* larvae to kill house fly larvae in pig manure, thus showing a biolarvicidal potential.

KEY WORDS: *Hydrotaea aenescens*, *Musca domestica*, biolarvicide, pig manure.

Filth-breeding flies, mainly the house fly, are among the livestock and poultry pests most difficult to control. In order to keep the flies at an acceptably low level, means other than chemical control must be sought because of the increased resistance of flies to chemical insecticides. The so-called integrated fly management programs offer good control results. They involve a combination of mechanical, chemical and biological methods of which the biological component has been investigated very intensively worldwide. Over the past two decades numerous surveys, laboratory and field trials have been conducted with several species of predators, parasites and various pathogens of manure-breeding flies (PECK 1969; PECK and ANDERSON 1969; PFEIFFER and AXTELL 1980; AXTELL and RUTZ 1986; AXTELL 1986). Among the potential agents some *Ophyra* species - the genus has recently been amalgamated with *Hydrotaea* (PONT 1986) - also seem to be suitable candidates for biological control of the house fly (THOMSEN and HAMMER 1936; DERBENEVA-UKHOVA 1940; LEIKINA 1942; ANDERSON and POORBAUGH 1964; CONWAY 1973; SCHUMANN 1982; OLCKERS and HULLEY 1984; NOLAN and KISSAM 1987). One of these species is *Hydrotaea aenescens* (Wiedemann, 1830), which is also known as the black dump fly. It was accidentally introduced from the United States into Europe in the mid 1960s and spread very quickly. Nowadays it can be found in several countries of this continent

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(SACCA 1964; SICK 1971; STEIN et al. 1977; BAUERMEISTER and SCHUMANN 1980; ADAMS 1984) including Hungary (MIHÁLYI 1975). The imagoes are a little smaller than the adults of *M. domestica* and are bronze-black with red palpi. The larvae occupy the same milieu in the manure as the house fly larvae and they can actively prey on other fly larvae. Despite the fact that *Hydrotaea aenescens* has already been used as a biocontrol agent against the house fly on pig farms (RIBBECK et al. 1987) and in poultry houses (RUSZLER 1989), we still lack sufficient detailed data on important aspects of the predation effect of their larvae. In laboratory trials some scientists have observed that the larvae of *Hydrotaea aenescens* destroy the immature stages of *Musca domestica*; however, they used artificial medium instead of animal manure or their trials were not overall (HOGSETTE 1979; MÜLLER 1982; GEDEN et al. 1988; FARKAS and PAPP 1990).

Our laboratory work presents an attempt to determine how the numbers and ages of the immature stages of both fly species influence the predation rate using pig manure.

MATERIALS AND METHODS

The colony of *Hydrotaea aenescens* was derived from flies collected on a poultry farm outside Budapest. The *Musca domestica* strain has been maintained in our laboratory for a few years. The imagoes were fed on sugar and whole milk powder. Water was provided separately. Pig manure was used as larval medium. It was frozen at -20 °C for 24 hours before the trials in order to kill the living organisms. 100 g of manure was put into each of small plastic jars. Replicate groups of same (20-20) or different (30 to 150) numbers of predator and prey immatures (eggs and/or larvae) were placed together into the medium. The samples were put in a bigger jar with ca. 2 cm sawdust for fly pupation. All jars were covered with cloth and tightly sealed at the top with a rubber band to prevent larvae from escaping. The samples were kept at 25±2 °C and 60±10 % relative humidity. Three replicates were done for each predator-prey combination. In order to determine the mortality due to factors other than predation control cups were used with only the predator omitted. After 14 days the developed imagoes were identified and counted. If control mortality was between 5 % and 20 %, the mortality data were corrected for control mortality using Abbott's formula.

RESULTS AND DISCUSSION

It is known that the larvae of *Hydrotaea aenescens* become carnivorous during a period of their development as well as the larvae of *H. ignava* (=*O. leucostoma*) and *H. capensis* (SÉGUY 1923; ANDERSON and POORBAUGH 1964; MÜLLER 1982; OLCKERS and HULLEY 1984). During this time the larvae attack, kill and eat larvae of other fly species including the house fly. KEILIN and TATE (1930) reported that *Hydrotaea* larvae are carnivorous only in later stages of their life, earlier they are saprophagous. This behaviour is related to the structure of their oral sclerites. The obtained data (Table 1) confirm that larvae of *H. aenescens* can destroy house fly maggots before they could reach the pupal stage but in pig manure the predation rate also varies by the age and size of both predator and prey at the time when the experimental jar was set up. In the first part of the study, when the same immature stages were reared together, the mortality

Table 1. Effect of *Hydrotaea aenescens* as a biolarvicide against *Musca domestica* in pig manure

Number of immature stages/sample[1]		Mortality[3] of M. domestica
H. aenescens	M. domestica	
20 E[2]	20 E	15
20 L_1[2]	20 L_1	30
20 L_2	20 L_2	100
20 L_3	20 L_3	100
20 L_2	20 E	100
20 L_2	20 L_1	99
20 L_3	20 E	100
20 L_3	20 L_1	100
20 L_3	20 L_2	100
30 L_2	90 E	99
30 L_2	120 E	98[4]
30 L_2	150 E	100
30 L_2	90 L_1	99[4]
30 L_2	120 L_1	86[4]
30 L_2	150 L_1	99[4]
30 L_3	90 E	93[4]
30 L_3	120 E	95[4]
30 L_3	150 E	99[4]
30 L_3	90 L_1	99[4]
30 L_3	120 L_1	99[4]
30 L_3	150 L_1	100

[1] 100 grams of pig manure/sample

[2] E - egg; L_{1-3} - first, second or early third (4-day-old) larvae

[3] the mean of three replicates

[4] corrected for control mortality by Abbott's formula

rates were between 15 and 100 %. This result shows that if eggs or first instar larvae of both species are seeded in pig manure, despite the long period of joint development, the dump fly larvae will not be able to prey on *Musca* larvae. This can probably be explained by the fact that *Musca domestica* develops faster in pig manure - which is its most favoured larval medium - than *Hydrotaea aenescens*. For this reason *Hydrotaea* larvae can kill only a few, or none, of the bigger prey ones. ANDERSON and POORBAUGH (1964) obtained a similar result when studying *Ophyra leucostoma*. MÜLLER (1982) also found that if the females of both species laid their eggs at the same time no predation was observed but 90-100 % of

the house fly larvae were killed by *Hydrotaea* larvae when first instar larvae were used in artificial material. Probably *Musca* immatures could not develop so fast in this medium as in pig manure. If second and third instar larvae of both fly species were developed together, no house fly emerged from the samples. In these cases the voracious *Hydrotaea* larvae immediately attack the prey larvae and are able to kill all of them.

An almost total mortality of house fly was observed when the same number but older *Hydrotaea* larvae were in the samples with immature stages of *Musca* (see Table 1). Similar data were obtained by other researchers who emphasized that the predaceous nature of *Hydrotaea* larvae is more evident if *Musca* larvae are younger than the predators (MÜLLER 1982; OLCKERS and HULLEY 1984).

In the third part of our laboratory study we investigated whether *Hydrotaea* larvae could kill more house fly larvae than they were in pig manure. The mortality rates of *Musca domestica* were between 86 and 100 % when 30 predators and 90 to 150 preys were developed together in a sample. This means that one larva of *Hydrotaea aenescens* can destroy at least 5 *Musca* larvae during its development in pig manure despite it offers alternative food. This investigation should be continued with more prey larvae because it was reported that one larva could kill 17-20 house fly larvae/day in artificial medium or chicken manure (HOGSETTE 1979; GEDEN et al. 1988).

The data presented here suggest that *Hydrotaea aenescens* can develop in pig manure and the use of its larvae as a biolarvicide offers a good biocontrol possibility of *Musca domestica*. The predation rate of this species is influenced by the age of the house fly larvae which develop faster. These investigations with pig manure are intended to be continued in order to get more information about the life and predaceous nature of this species.

Farkas R. és Jantyik T.: A *H. aenescens* lárváknak, mint a házi légy lárvák ragadozóinak laboratóriumi vizsgálata.

A szerzők arra kerestek választ, hogy a hazánkban is előforduló *Hydrotaea aenescens* légyfaj sertésbélsárban fejlődő lárváinak a házi légy lárvákkal szembeni ragadozó képességét hogyan befolyásolja a két faj fejlődési alakjainak kora és száma. A kapott eredmények azt mutatják, hogy ha egyidejűleg petéket, illetve első stádiumú lárvákat teszünk a bélsárba, úgy nem figyelhető meg ragadozás. Ez valószínűleg azzal magyarázható, hogy a házi légy az általa legkedveltebb tenyészőanyagban gyorsabban fejlődik, mint a másik faj. Abban az esetben, ha azonos korú második, illetve harmadik lárvastádiumok kerülnek egymás mellé vagy ha a házi légy lárvái fiatalabbak, úgy a lárvicid hatás 100 %-os, azaz egyetlen *Musca domestica* lárva sem éri el a bábstádiumot. Az eddigi részeredmények alapján egy *Hydrotaea* lárva öt *Musca* lárvát képes elpusztítani a fejlődése során.

Összefoglalóan megállapítható, hogy a szintetikus táptalajokkal végzett külföldi vizsgálatok tapasztalataihoz hasonlóan a *Hydrotaea aenescens* lárvája sertésbélsárban is képes felkeresni és elpusztítani a házi légy lárváit, de ennek mértékét a két faj fejlődési alakjainak egymáshoz viszonyított kora és száma határozza meg. További vizsgálatokra van szükség a biológiai védekezés egyik lehetőségét kínáló légyfaj ragadozó tulajdonságának a jobb megismerése érdekében.

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