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FEEDING TESTS OF GRASSLAND SOIL-INHABITING GAMASINE PREDATORS

BY M. A. SARDAR¹ and P. W. MURPHY²

SUMMARY: A series of experiments were conducted on nine gamasine mites, offering ten prey items in the laboratory. Hypoaspis aculeifer was the only mite with consumption recorded for each food. The remaining predators had intermediate prey spectra except Alliphis halleri which fed on nematodes only. These feeding categories of gamasine mites might have an influence on the prey occurring in the same habitat. The acceptability of the prey related to the morphological features of the predators has been discussed.

RÉSUMÉ: Une série d’expériences ont été conduites en laboratoire sur neuf espèces de gamases en leur offrant dix sortes de proies. Hypoaspis aculeifer est la seule espèce pour laquelle on ait observé la consommation de toutes les sortes de proies. Les autres prédateurs ont manifesté un spectre de proies intermédiaire, exception faite d’Alliphis halleri qui ne s’est nourri que de Nématodes. Ces caractéristiques de la nutrition des gamases devraient avoir une influence sur la présence de la proie dans leur habitat. Le choix de la proie en relation avec la morphologie du prédateur est discuté.

INTRODUCTION

Gamasina represent the major group of mites of the order Mesostigmata, which occur in many soil habitats (Haarlov, 1960; Wood, 1967; Curry, 1969; Usher, 1971; Wallwork 1976). In grassland, the majority of this mite group are hemiedaphic and some are truly euedaphic. Their distribution patterns indicate that they are spatially associated with the availability of food and other factors. Soil Gamasina are predominantly predatory, feeding on a number of prey ranging from Collembola, nematodes, enchytraeid worms and mites to the eggs and larvae of higher insects (Karg, 1961, 1971; Rodriguez et al., 1962; Sardar and Murphy, 1984). But information of foods and feeding of these mites is sparse. The present paper is concerned with the types of prey consumed by the soil gamasine mites and ecological relationships.

MATERIALS AND METHODS

Nine gamasine taxa were tested on ten types of prey consisting of Collembola spp., eggs and larvae of Tribolium spp., dipterous larvae, three astigmatic mites and immatures of Cryptostigmata and enchytraeid worms. The Collembola taxa were Onychiurus armatus group, Tullbergia spp. and Isotoma olivacea-violacea group.

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The gamasine predators for the tests were obtained from the soil extraction of a grazed grassland known as Froghole Paddock on the farm of the University of Nottingham, Sutton Bonington, England. Live individuals were collected from Haarlov funnel extractors about 24 hours before the trial, and freshly extracted mites were used for each prey except *Pergamasus diversus* and *P. runciger* predators. All but three of the prey taxa were provided from live extractions of the soil of Froghole Paddock. Eggs and first-instar larvae of *Tribolium* spp., and mixed postembryonic stages of the astigmatic mites *Acarus siro* and *Tyrophagus putrescentiae* were provided from laboratory cultures in the feeding tests. Nematodes were also tried in separate experiments later as a food source for the predators but the results are not reported here in detail.

Each test consisted of a 7-day period during which a predator taxon was cultured on a particular prey. Two cultures were prepared for each test using microcells, and two adult female predators placed in each. The cells were kept in a glass dish having a moistened plaster-charcoal floor, and maintained in an illuminated incubator at 15°C. They were examined daily at which time the prey items from the previous day were counted and removed, and fresh food added. The work was carried out between December, 1975 and October, 1976 in four periods ranging from less than two weeks to about a month. In most cases a particular prey was tested with each predator in a series of consecutive weekly tests.

**RESULTS AND DISCUSSION**

Seven prey items were tested on all predator taxa, and three others such as dipterous larvae, enchytraeid worms and *Schwiebea talpa* were offered to 4-6 of the predators (Table 1).

*Hypoaspis aculeifer*

This gamasine mite consumed not less then 48 % of all food items except *A. siro* and dipterous larvae where consumption was 32 and 14 % respectively (Table 1). It ate all the *Liebstadia similis* voraciously usually within a short period of their introduction to the culture. *T. putrescentiae* was also readily accepted; 97 % of the total were eaten being an average of 5 individuals per predator per day. It also had the highest consumption of *Ceratozetes gracilis* among the predators feeding on this species. *Onychiurus* spp. were the springtail prey of which on average 1.5 individuals were consumed per day. In later cultures *H. aculeifer* fed readily on the nematodes, *Rhabditis* spp. and *Pelodera (P.) strongyloides*.

*KARG* (1961) reported that it fed on five species of Colembola, *T. infestans* and *T. dimidiatus* and sciarid larvae. KEVAN and SHARMA (1964) found that *T. putrescentiae* was a suitable prey, and up to 10 adults were consumed per day by an adult predator. In contrast KARG (1961) stated that *Folsomia fimetaria* was more readily eaten than *Tyrophagus* spp. BARKER (1969) used *Glycyphagus domesticus* and *T. putrescentiae* as prey in a study of the fecundity and rate of increase of the predator. VAN DE BUNO (1972), in laboratory experiments, found that it fed on tylenchid nematodes. IGNATOWICZ (1974) reported that *H. aculeifer* was an extremely voracious predator and fed on a number of prey including insects, mites and enchytraeid worms. In view of these reports there seems little doubt that it is a polyphagous species. This mite has a somewhat stocky build with an idiosomal length of about 690 μm and gives the impression of considerable strength with powerful legs.

**Pergamasus (Paragamasus) spp.**

Both *P. (P.) diversus* and *P. (P.) runciger* group fed on eight prey items. *P. diversus*, a fairly large gamasine mite ca. 820 μm long and very active, consumed over two-thirds of the total of the prey except *Tribolium* eggs and larvae, and immatures of *C. gracilis* where the proportions eaten were 36-38 and 11 % respectively (Table 1). All the *Liebstadia* immatures were taken. This predator consumed 86 % of *A. siro* which was the largest proportion of this prey consumed among the predators. *P. runciger*, 715-840 μm long and also very active, consumed at least 64 % of the available prey except for
**Table 1:** Total number of prey offered and number consumed by gamasine mite predators in laboratory culture for 7 days at 15°C. (2 replicates/prey; 2 female predators/replicate; — : not tested)

<table>
<thead>
<tr>
<th>Species</th>
<th>Tyrophagus putrescentiae</th>
<th>Acarus siro</th>
<th>Collembola spp.</th>
<th>Tribolium spp.</th>
<th>Liebstadia similis</th>
<th>Ceratozetes gracilis</th>
<th>Schievingia talpa</th>
<th>Enchytraeidae</th>
<th>Diptera larva</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total prey offered</td>
<td>140</td>
<td>140</td>
<td>56</td>
<td>56</td>
<td>28</td>
<td>28</td>
<td>28</td>
<td>28</td>
<td>28</td>
</tr>
<tr>
<td>Gamasine mites:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alliphis haleri</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Arctosius cetratus</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>24</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Dendrosetus reticulatus</td>
<td>0</td>
<td>9</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Hyposapis aculeifer</td>
<td>135</td>
<td>44</td>
<td>42</td>
<td>28</td>
<td>27</td>
<td>28</td>
<td>23</td>
<td>19</td>
<td>14</td>
</tr>
<tr>
<td>Macrocheles glaber</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>18</td>
<td>20</td>
</tr>
<tr>
<td>Pergamasmus (P.) diversus</td>
<td>97</td>
<td>120</td>
<td>42</td>
<td>21</td>
<td>20</td>
<td>28</td>
<td>3</td>
<td>19</td>
<td>0</td>
</tr>
<tr>
<td>Pergamasmus (P.) runciger gr.</td>
<td>96</td>
<td>85</td>
<td>42</td>
<td>18</td>
<td>20</td>
<td>28</td>
<td>18</td>
<td>24</td>
<td>0</td>
</tr>
<tr>
<td>Rhodacarellus silesiacus</td>
<td>0</td>
<td>0</td>
<td>28</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Rhodacarus roseus</td>
<td>3</td>
<td>0</td>
<td>28</td>
<td>0</td>
<td>0</td>
<td>23</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

*Triobolium* eggs and larvae in which 32-36% were taken (Table 1). Apart from higher percentages of *C. gracilis* and *S. talpa* and a somewhat lower one for *A. siro*, the results for this predator were very similar to those for *P. diversus*.

KARG (1971) lists the prey preferences of five *Pergamasus* mites but the species referred to here are not included. He considered these mites to be springtail-mite predators and chose *Pergamasus* (*Paragamasus*) miselli as the type of this feeding group. The results reported here are in close agreement with those of KARG.

**Macrocheles glaber**

*M. glaber* with a length of about 860 μm was the largest predator cultured in this study. It differed markedly from the other predators, feeding on Enchytraeidae, Diptera larvae and to a lesser extent the eggs and larvae of *Triobolium* spp. (Table 1). Enchytraeid worms were readily eaten with a mean consumption of 4.5 per female per week as were dipterous larvae. These were the highest numbers eaten of these prey among the predators. Of the *Triobolium* food items 20-23% were eaten.

The prey consumption by four species of *Macrocheles* except *M. glaber* is reported by KARG (1971). No mites or Collembola were eaten by these species. Contrary to KARG's (1971) finding, AXTELL (1963) observed *M. muscaedomesticae* feeding on astigmatic mites in laboratory culture. The adults preferred house fly eggs to nematodes whereas protonymphs and deutonymphs favoured nematodes (RODRIGUEZ et al., 1962). Enchytraeid worms and dipterous larvae appeared to be suitable food for *M. glaber*. The morphological features of the chelicerae of the predator may be related to prey of this type.

**Rhodacarus roseus**

This species differs from those already considered in respect, of two important aspects, viz. its smaller size the idiosomal length being about 470 μm, and its markedly euedaphic habit living in the deeper layers of the soil. Of the nine food items, Collembola (*Tullbergia* spp.), *L. similis* and *T. putrescentiae* were the only prey taken by this predator (Table 1). Half the Collembola were eaten and 82% of *L. similis* but only 3 individuals of *T. putrescentiae* were consumed. In later cultures *Rhabditis* and *P. (P.) strongyloides* nematodes proved acceptable prey, and reproduction occurred with both.

*Tullbergia krausbaueri*, Cryptostigmata immatures,
Tyrophagus spp. and nematodes are listed as prey for *R. roseus* (KARG, 1961). VAN DE BUND (1972) also found that this predator fed on other mites, small Collembola and nematodes. It ate one large (*Rotylenchus*) or 3-4 small or moderately sized tylenchid nematodes per day. It consumed 2-3 small specimens of *O. armatus* in the same time period. The published records strongly support the results of the tests that nematodes, Collembola and mites are eaten by this predator.

**Dendroseius reticulatus**

This was the smallest gamasine mite its length being about 290 μm. Of the seven prey tested, this species fed on Collembola (*Tullbergia* spp.) and immatures of *L. similis* the proportions being 16 and 18 % respectively (Table 1). In later cultures it reproduced when *Rhabditis* was provided. SHEALS (1956) observed this species (*Digamasellus reticulatus*) feeding on small Collembola including *T. krausbaueri* and eggs of *Hypogastrura denticulata*.

**Arctoseius cetratus**

This gamasine mite with an idiosomal length of about 350 μm only fed on immatures of *L. similis*, 86 % of which were taken (Table 1). The Collembola *Onychiurus* spp. and *Isotoma olivacea-violacea* group particularly the latter are large for this size of predator. It may be that *A. cetratus* had difficulty in capturing and eating such large and active prey. A separate culture was maintained and reproduction occurred when *Rhabditis* spp. were supplied as food.

KARG (1961, 1971) refers to *T. krausbaueri*, *F. fimetaria*, immatures of Cryptostigmata and *Tyrophagus* spp. as acceptable prey and the possibility of eating nematodes. On the other hand, WEISFOGH (1948) states that this predator does not feed on astigmatic mites. BINNS (1972, 1974), found *A. cetratus* preying on the eggs and first-instar larvae of the mushroom sciarid fly, *Lycoriella auripila*, mushroom mites and small nematodes.

**Rhodacarellus silesiacus**

This was the second smallest gamasine predator being about 300 μm long. Out of nine prey, *Tullbergia* spp. were the only ones accepted and half the total were consumed representing an average of one individual per day. In later cultures *Rhabditis* spp. and *P. (P.) strongyloides* were taken and reproduction occurred with the latter prey. KARG (1971) reported that small nematodes and Collembola were eaten and the former were the preferred food. He (1961) listed Cryptostigmata immatures and *Tyrophagus* spp. as suitable prey. Present evidence suggests that nematodes and small springtails are readily accepted by this predator.

**Alliphis halleri**

This mite is about 460 μm long, about the same length as *R. roseus*. It was the only predator which did not feed on any of the seven food items offered. On one occasion it was observed attempting to attack a *Tullbergia* but retreated after the first contact. In later experiments it was readily cultured and reproduction occurred when the nematodes, *Nematospiroides dubius* and *P. (P.) strongyloides*, were used. No published information has been found on the food sources of this species but KARG (1971) gives information on *A. siculus* which is very similar if not the same as *A. halleri*. He regards *A. siculus* as a monophagous species, and has chosen it as his type representative of those gamasine predators with a strong preference for nematode prey. He considers that the structure of the chelicerae of this mite with short digits is an adaptation for this mode of feeding.

**REFERENCES**


