Systematic and Applied Acarology (1997) 2, 115-120

Attachment sites of Allothrombium pulvinum larvae (Acari: Trombidiidae) ectoparasitic on aphid hosts

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Abstract

Attachment sites of larvae of *Allothrombium pulvinum* Ewing (Acari: Trombidiidae) on aphid hosts, *Liosomaphis berberidis* (Kaltenbach), *Macrosiphum rosae* L., *Myzus persicae* (Sulzer), *Periphyllus testudinaceus* (Fernie) and *Drepanosiphum platanoidis* (Schrank), were studied in the laboratory. Mites often came into contact with their host's by legs (or antennae) and climbed onto the body of the host via them. The host often shook its body and legs in defence, but the mites were often able to cling onto the host using the claws and claw-like empodia of their legs. They then searched on the surface of the host for an attachment site. Once attached, they usually did not move unless disturbed. The frequencies of attachment on the dorsal, lateral or ventral surfaces were similar on the head, thorax and abdomen of the five aphid species tested. On most host species, the thorax was the most preferred body segment (frequency of attachment 58-68 %) and the head was the least preferred site (frequency of attachment <5 %); an exception was *D. platanoidis*, on which the thorax and abdomen were equally preferred by mites. Frequencies of mite attachment were similar for the dorsal, lateral or ventral surfaces of the body on *P. testudinaceus* and *D. platanoidis*. On *L. berberidis* and *Macrosiphum rosae*, the ventral surface was most preferred (frequency of attachment 49-54%), whereas the dorsal and lateral surfaces were equally preferred (frequency of attachment 22-27%). The frequency of attachment for *Myzus persicae*, however, was highest on the ventral surface (45%) and lowest on the lateral surface (19%). The results of this study are discussed in light of a previous hypothesis on the behaviour underlying patterns of mite attachment on aphid hosts.

Key words: Searching behaviour, parasite-host relationships, mites, aphids

Introduction

Larvae of *Allothrombium* (Acari: Trombidiidae) are common ectoparasites of aphids (Zhang & Saboori 1996). Their role in the natural control of aphids has now been well established, especially against *Aphis gossypii* Glover in China (e.g. Zhang *et al.* 1993; Dong *et al.* 1996; Zhang & Li 1996). The author's personal observations show that these mites are quite common on aphid hosts, especially in relatively dry habitats. However, aphid specialists often fail to observe these mites in the field, although *Allothrombium* larvae are usually orange and are quite conspicuous. One reason for this might be that these ectoparasites prefer the ventral surface of the aphid host. This paper examines the distribution of attachment sites of larval *Allothrombium pulvinum* Ewing on several species of aphids.

Zhang (1991) examined experimentally the attachment of *A. pulvinum* larvae on *Acyrthosiphon pisum* (Harris) and noted that the host's thorax was the most prefered attachment site. He suggested that relatively fewer attachments occurred on the larger abdomen because of the defensive behaviour of the host - repulsion of intruding mites using its legs. This study tests these ideas by examining a wider range of host species.

Materials and methods

The larval mites of *A. pulvinum* tested in this study were reared from eggs laid by adult mites collected on 3 April 1995 in Kew, Surrey, England. Ten females of *A. pulvinum* were brought back to the laboratory in glass vials. The rearing methods were the same as described in Zhang (1996). Mite female individuals were allowed to lay eggs in each vial (Zhang 1996). Unfed larvae hatched from the eggs were used in various host attachment site tests. Some non-engorged mite larvae that had partially fed were first starved for 12-24 hours and then used in tests.

Five aphid species were studied as hosts for *A. pulvinum* larvae. Three species belong to the subfamily Aphidinae: *Liosomaphis berberidis* (Kaltenbach), *Macrosiphum rosae* L. [mixed with some *M. euphorbiae* (Thomas)], and *Myzus persicae*. One species belongs to the subfamily Chaitophorinae: *Periphyllus testudinaceus* (Fernie). Another species belongs to the subfamily Drepanosiphinae: *Drepanosiphum platanoidis* (Schrank). All the aphid species were collected from the garden of The Natural History Museum, London, with the exception of *Myzus persicae*, which came from a laboratory culture maintained in the Entomology Department of the Museum.

Attachment site was assessed by confining one larval mite and one aphid host in a glass vial (diameter 12 and length 30 mm). The aphids and mites were transferred to the vial using a fine hair brush (size 0000). The vial was then examined hourly (every 20 minutes for the first two hours for the three aphidine species) until the mite attached to the host. The site of attachment was then recorded as on either the dorsal, lateral or ventral surface of the head, thorax, or abdomen. Sometimes (fewer than 5 of the total observations) mites inserted their chelicera at the joints between body segments. They were considered to be on the thorax if they attached at the joint between the head and thorax or between the thorax and abdomen while most of the idiosoma lay over the thorax. There were 48 to 195 observations made per host species.

Frequencies of attachment of mites at different sites on aphid hosts were analyzed using chi-square tests. The 3 x 3 frequency tables were first analyzed to test the null hypothesis that attachment site distributions of mite parasites on the three surfaces of the host body (dorsal, lateral and ventral) were similar for the three body segments (head, thorax and abdomen). If this null hypothsis was accepted (which would indicate that there was no body surface by segment interaction), then data were pooled for body surfaces from all three segments and for body segments from all three surfaces. A one-way chi-square test was then used to test the null hypothesis that mites had equal distribution on all three body segments or surfaces.

Results

General description of mite behaviour

Mites came into contact with their aphid hosts via the legs. They climbed onto the body of the host via the legs and could do this within a second. The host often shook its body and legs in defence, and sometimes the mite was thrown off. However, mites were often able to cling onto the host using the claws and claw-like empodia of their legs. They then moved over the surface of the host and chose a site for attachment. They inserted their chelicerae into the host where the cuticle was weak (near joints between the body segments or between the legs and body). Once attached to a site, they usually did not move unless disturbed.

Most mites found and attached to their host within one hour in the vial. For example, 33.3% of the mites attached to *Myzus persicae* in 20 minutes, 50% of them in 40 minutes and 100% of them in two hours. When the host was *Macrosiphum rosae*, 66.7% of the mites found their host in 20 minutes and 91.7% in 40 minutes. Nearly half (45.8%) of the mites found *L. berberidis* hosts in 20 minutes and 91.7% in 40 minutes.

TABLE 1. Attachment site distributions of *Allothrombium pulvinum* larvae on five species of aphid hosts. Sample sizes for different species are: *Myzus persicae* 195, *Periphyllus testudinaceus* 91, *Liosomaphis berberidis* 107, *Macrosiphum rosae* 83, and *Drepauosiphum platanoidis* 48. Data in the table are frequencies (%).

	Head	Thorax	Abdomen	Total
Myzus persicae				
Dorsal surface	0	9.7	9.2	**18.9**
Lateral surface	0.5	22.6	12.8	**35.9**
Ventral surface	0.5	29.2	15.5	**45.2**
Total	**1.0**	**61.5**	**37.5**	**100.0**
Periphyllus testudinaceus				
Dorsal surface	1.1	15.4	9.9	**26.4**
Lateral surface	1.1	30.8	7.7	**39.6**
Ventral surface	0	22.0	12.0	**34.0**
Total	**2.2**	**68.2**	**29.6**	**100.0**
Liosomaphis berberidis				
Dorsal surface	0	13.1	10.3	**23.4**
Lateral surface	0	18.7	3.7	**22.4**
Ventral surface	0.9	34.6	18.7	**54.2**
Total	**0.9**	**66.4**	**32.7**	**100.0**
Macrosiphum rosae				
Dorsal surface	1.2	13.3	13.3	**27.8**
Lateral surface	0	14.4	8.4	**22.8**
Ventral surface	3.6	28.9	16.9	**49.4**
Total	**4.8**	**56.6**	**38.6**	**100.0**
Drepanosiphum platanoidis				
Dorsal surface	0	14.6	12.5	**27.1**
Lateral surface	2.1	16.7	10.4	**29.2**
Ventral surface	2.1	14.6	27.0	**43.7**
Total	**4.2**	**45.9**	**49.9**	**100.0**

Attachment sites on Myzus persicae

Attachment site distributions of mite parasites on three surfaces of the host body (dorsal, lateral and ventral) were similar for the three body segments (head, thorax and abdomen) (χ^2 = 2.885; df = 4; P = 0.5823; Table 1). Frequency of attachment varied significantly between the three body surfaces (χ^2 = 53.22; df = 2; P = 0.0001); the ventral surface was most preferred by mites (accounting for 45.2 % of the occurrence observed), whereas the dorsal surface was least preferred (18.9 %). Frequency of attachment also varied significantly between three body segments (χ^2 = 108.6; df = 2; P = 0.0001): the majority of the mites (61.5%) chose to attach to the thorax, whereas only 1% of the mites attached to the head.

Attachment sites on Periphyllus testudinaceus

Attachment site distributions of mite parasites on this species were similar to those on *M. persicae* except that frequencies of attachments were not significantly different between the dorsal, lateral and ventral surfaces (Tables 1 & 2).

TABLE 2. Statistical tests of variation of attachment site frequencies of *Allothrombium pulvinum* larvae parasitic on aphid hosts in relation to host body segments (head, thorax, and abdomen) and surfaces (dorsal, lateral and ventral)

Effects	χ^2	df	*P*
Myzus persicae			
Surface x segment	2.8	4	0.5832
Surface	53.2	2	0.0001
Segment	108.6	2	0.0001
Periphyllus testudinaceus			
Surface x segment	4.2	4	0.3839
Surface	2.4	2	0.3019
Segment	59.9	2	0.0001
Liosomaphis berberidis			
Surface x segment	5.3	4	0.2610
Surface	21.0	2	0.0001
Segment	68.7	2	0.0001
Macrosiphum rosae			
Surface x segment	2.7	4	0.6136
Surface	9.9	2	0.0007
Segment	34.4	2	0.0001
Drepauosiphum platanoidis			
Surface x segment	3.4	4	0.5009
Surface	2.4	2	0.3050
Segment	18.5	2	0.0005

Attachment sites on Liosomaphis berberidis

Attachment site distributions of mite parasites on this species were similar to those on *M. persicae* (Tables 1 & 2). One minor difference was that dorsal and lateral surfaces of this species were equally preferred.

Attachment sites on Macrosiphum rosae

Attachment site distributions of mite parasites on this aphid species were very similar to those on *L. berberidis* (Tables 1 & 2).

Attachment sites on Drepanosiphum platanoidis

Attachment site distributions of mite parasites on this species were similar to those on *L.*

berberidis (Tables 1 & 2). One minor difference was that the thorax and abdomen of this species were equally preferred.

Discussion

A general observation from this study is that the distribution of *A. pulvinum* larvae on dorsal, lateral and ventral surfaces of the host was consistent for the three body segments (i.e. head, thorax and abdomen). This is reflected in the non-significance of surface by segment interaction in Table 2.

Zhang (1991) examined the attachment sites of *A. pulvinum* larvae on *Acyrthosiphon pisum* and found that attachment occurred most often on the thorax. This behaviour was confirmed in this study on four additional aphid species. The only exception occurred on *D. platanoidis,* whose thorax and abdomen were equally preferred. Given the small size of the thorax in comparison with the abdomen, the thorax was preferentially parasitized whereas the abdomen was avoided. This is probably because aphid hosts are able to defend themselves by pushing away intruding mites using their legs (Zhang 1991). The legs could reach their head and abdomen but could not push away mites from the thorax. Thus, the thorax became a most preferable site for mites to attach successfully.

Zhang (1991) observed that *A. pulvinum* larvae preferred the ventral surface of *A. pisum* (an exception was in very large individuals, whose lateral surfaces were more often attacked). This study confirms that the ventral surface of the host species was more often attacked (an exception was in a very large species, *Periphyllus testudinaceus,* whose lateral surfaces were more often attacked). The ventral surface accounts for about 1/4 of the surface area but its probability of being attacked by mites (on average 45%) is much higher than expected by chance. This behavioural preference, due to both mite behaviour and aphid reactions, is perhaps adaptive for the mites because they are more likely to avoid the detection of natural enemies when they are on the ventral surface of their hosts. Given this behaviour, it is not surprising that it may be difficult to find these mites on aphid hosts in the field, especially for untrained eyes.

Acknowledgements

I thank Dr. Victor Eastop, Mr. Jon Martin, Miss Jenifer Spence (all of the Natural History Museum, London), and Dr. Gillian Watson (of the International Institute of Entomology, London) for their help in collecting, supplying, and/or identifying aphid species used in this study. Without their enthusiastic help and support, this study would not have been completed. I am also very grateful to Dr. Eastop for his interest in this project thoughout the study and to Dr. Gillian Watson for critical reviews of the manuscript. Space and facilities during this study were kindly provided by the Department of Entomology, The Natural History Museum, London.

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Accepted: 16 May 1997