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Host Choice in *Tetramesa petiolata* (Walker) (Hymenoptera: Eurytomidae)

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Abstract: This study was carried out to compare the host preference and oviposition behavior of *T. petiolata* in relation to different host plant species. Observations were made using stems of *D. caespitosa* contained in cages under laboratory conditions. Host plant preference was studied by introducing one adult *T. petiolata* female (4-5 days old) into a cylindrical cage containing four grass species including *D. caespitosa*, the natural host food plant. Female behavior was classified into five categories: grooming, resting, walking, searching, landing and oviposition. Walking and searching were distinguished by the attitude of the antennae. The mean time spent grooming and resting on each host food plant did not vary significantly between plants. In the oviposition choice experiments large number of larvae were reared from the host plant, but none were reared from other plants except for *D. setacea*, an unnatural host from which a few larvae were reared. This suggests that *T. petiolata* is at most potentially narrowly polyphagous and that females prefer one species much more than another. Since in the field, larvae of *T. petiolata* have never been recorded in the stems of *D. setacea*, the desposition of eggs in *D. setacea* can be regarded as a laboratory artifact and *T. petiolata* can be regarded as monophagous under natural conditions.

Key words: *Tetramesa petiolata*, Eurytomidae, host preference, oviposition behavior, host food plant, polyphagous, monophagous

Introduction

Insects of the genus *Tetramesa* Walker (*Isosoma* Walker; *Harmolita* Motsch.) (Hymenoptera: Eurytomidae) are small (2-3 mm in length), winged, generally black in color and feed on nectar as adult wasps. In the larval stage, they are phytophagous on cereals and grasses (Poaceae), the eggs being laid on the stems of their hosts (Claridge and Dawah, 1994). They are primarily a north temperate genus, comprising around 205 species world-wide (Burks, 1971; 1979). Sixty three species were recorded from America, north of Mexico (Peck, 1963) 61 species recorded from the former Soviet Union (Zerova, 1976, 1978) and 37 species from the British Isles (Claridge and Dawah, 1994; Fitton *et al.*, 1978; Claridge, 1961). They are sporadic serious pests of cereals and grasses in various countries around the world, especially North America, where they are known as joint worms or straw worms (Phillips, 1927; Spears, 1978; Spears and Barr, 1985). Because of their general economic importance globally, they have been intensively studied in terms of their biology, taxonomy and ecology.

Tetramesa are extremely host-specific and previous studies have shown that they normally attack plant hosts of only one genus (Claridge, 1961; Phillips 1936), although Dawah (1987) found *T. eximia* (Giraud) to attack hosts of two closely related genera, *Calamagrostis epigejos* L. Roth. and *Ammophila arenaria* L. Link.

Taxonomic difficulties as mentioned by Henneicke *et al.* (1992), based on the extremely uniform morphology of adult wasps, has stimulated taxonomists to look for other discriminating criteria. These include host plant preference, mate choice and mode of larval life (Claridge and Dawah, 1994; Dawah, 1987).

Host habitat location and host location are problems shared by most species of insects involved in seeking food or oviposition sites (Vinson, 1981). Insect herbivores can be described as monophagous, narrowly polyphagous and broadly polyphagous, according to the number of plants species they exploit. Monophagous insects are those whose diet is confined to host plants of only one species. In this study, narrowly polyphagous refers to insects whose host plants are confined to a few (1-3) species, while broadly polyphagous refers to many species.

Thompson (1981) defines host specificity as the hierarchical ordering of plants species by ovipositing females. This means that in a simultaneous host choice trial, an ovipositing female will restrict her choice of host to the preferred one, or the top two or three. Singer (1982) offered host plants sequentially to ovipositing females and defined host specificity as the rate at which an insect becomes less discriminating as it searches. Singer's definition of monophagy means that a truly monophagous insect, enclosed with a plant which is not its specific host, will not oviposit. An individual which spends a long time in the search phase in which only a single host is acceptable will be classified as highly host specific. In Singers view, there is no truly monophagous insect. What is often overlooked is that by specializing on a type of tissue, phytophages specialize upon a period in the phenology of the plant (Trong *et al.*, 1984).

According to Claridge (1961), Spears (1978) and Dawah (1987) *Tetramesa* species are very host specific but some (e.g., *T. hyalipennis*) are narrowly polyphagous i.e., feeding on small number of grass species belonging to a single genus or tribe. No previous studies have been done on host choice in *T. petiolata*. The aim of this present study was therefore to compare the oviposition behavior and preferences of *T. petiolata* in relation to different host plant species.

Materials and Methods

Observations were made using stems of *D. caespitosa* contained in cages under laboratory conditions. All females used in the experiments were reared in the laboratory and kept well supplied with food (a mixture of honey and water). All females used were 4-5 days old.

Host plant preferences were studied by introducing one adult *T. petiolata* female into a cylindrical cage containing four grass species including *D. caespitosa*, the natural host food plant. An open-ended tube containing the female was placed among the four plant stems and the female was allowed to climb out. The tube was then removed. The cages used in the experiment were kept well supplied with food in the form of 25% honey and water. The cages consisted of a cylinder of transparent plastic (height 800 mm, radius 250 mm). The cage was constructed using the base and lid of plastic cake container and cylinder of thin (0.16 mm) clear acetate sheet. Each cylinder included an 180 mm window, covered with nylon mesh to allow adequate ventilation. In addition, circular holes (120 mm dia.) were cut and fitted with sleeves of netting to enable access without allowing the insects to escape. In the experiment, a female was released into each cage and left for one hour. The time spent performing different activities was measured using a stop-watch.

All plants were at the same stage of development and stems were chosen in such a way that each had two pairs of fully expanded leaves and a compact shoot and which had similar leaf sizes and

internode distances. The experiments were carried out using a randomized arrangement of plants and a total of ten replicates were run. Female behavior was classified into five categories: grooming, resting, walking, searching, landing and oviposition. Walking and searching were distinguished by the attitude of the antennae. In walking the antennae are held parallel with one another or only slightly apart but parallel with the substrate, whereas in searching the antennae are continually tapped against the host plant surface. Recording of female behavior was started after a 5 min settling period, or when the test female first landed on a plant, whichever comes first. Recording ended after 4 h. Walking was not recorded because it often lasted for long periods. The experiments were carried out in an environmental chamber maintained at 18°C and with a 16 h light: 8 h dark photoperiod. Each female was left in the cage for 24 h. The observations were carried out between 12.30 h and 16.30 h.

The following plants were used; *Deschampsia caespitosa*, *Deschampsia setacea* (Huds) Hack. *Dactylis glomerata* (L.) and *Phleum pretense* (L.). All stems were dissected after 18 days and examined for the presence of larvae.

The dates on which insects were introduced into cage were coinciding with the flight period of *T. petiolata* (late May- mid June). This was done to ensure that the grasses used in the experiment were at the correct stage of development for possible selection by *T. petiolata*. Observations on oviposition behavior were made using stems of *D. caespitosa* contained in cages under the same condition. The results were analyzed statistically using a one-way analysis of variance (ANOVA).

Results and Discussion

From the collected data, the mean total time spent performing each behavior was calculated, including grooming, resting and searching on each host plant, by females in 10 replicates (Table 1). The number of landings and attempted ovipositions made by each female on each host plant was counted (Table 2).

The mean time spent grooming did not vary significantly between plants ($F = 1.63$; $df = 3$; $p > 0.05$); similarly the mean time spent resting on each host food plant did not vary significantly ($F = 1.80$; $df = 3; 36$; $p > 0.05$).

Phillips and Emery (1919) carried out breeding experiments on North American species of *Tetramesa* and showed that a high degree of host specificity exists amongst them. In the above oviposition choice experiments large number of larvae were reared from the host plant, but none were reared from other plants except for *D. setacea*, an unnatural host from which a few larvae were reared. This limited laboratory experiment suggests that *T. petiolata* is at most potentially narrowly polyphagous and that females prefer one species much more than another. Since in the field, larvae of *T. petiolata* have never been recorded in the stems of *D. setacea*, the deposition of eggs in *D. setacea* can be regarded as a laboratory artifact and *T. petiolata* can be regarded as monophagous under natural conditions.

The above results agree with those of Dawah (1987) who demonstrated the oviposition preferences in *T. hyalipennis* and *T. eximia*. He indicated that these species are narrowly polyphagous, but they are still highly host specific because they attack two closely related species of Gramineae.

Many phytophagous insects show a high degree of host specificity, being either monophagous or narrowly polyphagous (Hodkinson and Hughes, 1982). This certainly appears to be true for *Tetramesa* sp. Two of the thirty-nine species of *Tetramesa* studied by Spears (1978) were found to be monophagous. Other grass feeding *Tetramesa* were found to be even more host specific (Claridge, 1961).

Table 1: Mean time spent by *T. petiolata* grooming, searching and resting on different plant species

Plants	Grooming	Searching	Resting
<i>Deschampsia caespitosa</i>	6.4±0.7	12.3±3.03	7.4±1.80
<i>Deschampsia setacea</i>	5.9±0.64	7.0±1.96	6.7±1.69
<i>Dectylis glomerata</i>	5.3±0.65	6.7±1.56	6.10±1.14
<i>Phleum pretense</i>	4.5±0.56	2.0±0.67	3.2±0.38

Table 2: Mean number of landings and attempted ovipositions female of *T. petiolata* when given a choice between four plant species and number of larvae reared from each host plant.

Plants	No. of larvae	Attempted ovipositions	Landing
<i>Deschampsia caespitosa</i>	12	4.2±0.60	6.1±0.64
<i>Deschampsia setacea</i>	2	1.4±0.19	2.9±0.38
<i>Dectylis glomerata</i>	0	0.7±0.2	1.9±0.28
<i>Phleum pretense</i>	0	0.44±0.17	1.6±0.19

Oviposition preference in female insects involve sensory detection of the host plant or parts of the host plant. Dethier (1976) hypothesized that the process of finding a plant upon which to feed or oviposit is governed at each step by various arrays of sense organs of which chemoreceptors play an important role. Hawke *et al.* (1973), Van and Veen (1981) and Austin and Browing (1981) stated that sense organs on the tip of ovipositor are presumably used for assessing the suitability of the host, but that the sense organs involved in host finding are located on the antennae. The insects do not select host plants at random but by means of several criteria, probably plant volatiles, color and form or odors emanating from the host's habitat. Many parasitic Hymenoptera use olfactory cues to orient first towards a potential host habitat and second, towards the host itself (Vinson, 1981; Weseloh, 1981). Pinto and Stouthamer (1994) and Norlund (1994) noted that microhabitat preferences occur in many parasitoids such as Trichogrammatidae and Ichneumonidae, where in these species parasitization of a host egg depends on the crop plant it is laid on.

This study shows that adult females of *T. petiolata* are discriminating in their selection of plants in which to oviposit. Oviposition behavior in *T. petiolata* appears to be released only by highly specific stimuli. It may be suggested that the responses reported here are predictable because the insects become conditioned to feed and even oviposit on the same type of plant on which they themselves developed. Linn *et al.* (2003) and Thomas *et al.* (2003) hypothesized that preference for natal host plant odours and assortative mating due to host-specific sex pheromones may well drive host specialization. Al-Barrak *et al.* (2004) added that the morphologically similar host-adapted forms of *Tetramesa* may indeed be an example of sympatric speciation in action.

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