Effects of Ovipositional Experience and Length of Intervals after Previous Parasitism on Host Discrimination in *Gryon japonicum* (ASHMEAD) (Hymenoptera: Scelionidae)¹

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Females of many parasitoid species have an ability to discriminate between unparasitized hosts and hosts parasitized by conspecifics, and avoid laying eggs in the latter (van Lenteren, 1981). This discrimination, however, is not always complete. van Lenteren and Bakker (1975) showed that *Leptopilina heterotoma* (= *Pseudeucoila bochii*) females which had not yet oviposited ("inexperienced") accepted parasitized hosts as easily as unparasitized hosts. They concluded that these inexperienced females had to learn discrimination.

*Gryon japonicum* (ASHMEAD) is a solitary egg parasitoid of the bean bug, *Riptortus clavatus* (Thunberg). Females of this parasitoid exhibit a behavior of scraping the host surface with the tip of the ovipositor after oviposition (Hirose and Noda, unpublished). Such a marking behavior indicates the ability to discriminate between parasitized and unparasitized hosts, but there have been no tests of this mechanism. In this paper I report the results of laboratory tests on host discrimination as affected by ovipositional experience of females and length of intervals since previous host parasitism.

MATERIALS AND METHODS

*R. clavatus* adults were collected from a soybean field in Tsukuba, Ibaraki in August 1984. *G. japonicum* were obtained from host eggs which had been artificially placed (for a week in August 1984) in the same field that the host adults had been collected. Rearing and maintenance of hosts and parasitoids were carried out as in Noda and Hirose (1989). All females were allowed to oviposit in an unparasitized host 1 hr before all the tests in order to become "experienced."

To determine the effect of ovipositional experience of females on host discrimination, 0-day-old host egg that had been parasitized within 1 hr before the test or 0-day-old unparasitized host eggs were presented to 2-day-old experienced or inexperienced females in test tubes (2 × 10 cm). Each host egg presented was adhered to a piece of paper (3 × 1.5 cm) with vinyl-acetate. Behavior of each female was recorded with a video tape recorder. Oviposition of the female was identified by its marking behavior.

To determine if the number of days after previous parasitism of hosts have an effect on host discrimination, host eggs 0 to 7 and 14 days after conspecific parasitism were all presented to 2-day-old inexperienced females. Methods of recording behavior and identifying oviposition were the same as described above.

<table>
<thead>
<tr>
<th>Type of females</th>
<th>Type of hosts</th>
<th>No. of females tested</th>
<th>% Acceptance of hosts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inexperienced</td>
<td>Unparasitized</td>
<td>21</td>
<td>100 a</td>
</tr>
<tr>
<td></td>
<td>Parasitized</td>
<td>23</td>
<td>78.3 b</td>
</tr>
<tr>
<td>Experienced</td>
<td>Unparasitized</td>
<td>25</td>
<td>100 a</td>
</tr>
<tr>
<td></td>
<td>Parasitized</td>
<td>25</td>
<td>0 b</td>
</tr>
</tbody>
</table>

* Values followed by different letters in the same column differed significantly at $p<0.05$ (Fisher's exact probability test).

RESULTS AND DISCUSSION

In the test on the effect of ovipositional experience of *G. japonicum* on host discrimination, experienced females discriminated parasitized and unparasitized host eggs and never oviposited in the former (Table 1). Although most of the inexperienced females accepted parasitized host eggs, percent acceptance by inexperienced females was significantly higher in unparasitized hosts (Fisher's exact probability test, $p<0.05$). The test result of experienced females shows that they have the ability to discriminate hosts and is consistent with phenomena reported in many other parasitoids including scelionids (e.g. Rabb and Bradley, 1970; van Lenteren, 1976, 1981; Bosque and Rabinovich, 1979; Ables et al., 1981; Okuda and Yeargan, 1988), but the result of inexperienced females is not. Mean time required for each of the behavioral events of ovipositing inexperienced females (Table 2) showed that time of antennae drumming was significantly longer on parasitized host eggs than on unparasitized host eggs ($t$-test, $p<0.01$). Such a difference of parasitoid behavior suggests that inexperienced females of *G. japonicum* recognize parasitized host eggs. van Alphen et al. (1987) also revealed some differences in the oviposition behavior of inexperienced *L. heterotoma* and *Trichogramma evanescens* females toward unparasitized and parasitized hosts, claiming that host discrimination does not need to be learnt in these 2 species. In *G. japonicum*, nevertheless, ca. 78% of inexperienced females superparasitized (Table 1). This might be explained in terms of "conspecific superparasitism" (van Dijken and Waage, 1987). For a solitary parasitoid, conspecific superparasitism is not always wasting an egg if her offspring has a chance of winning the competition for the host (van Alphen et al., 1987).

Figure 1 shows the effect of number of days after previous parasitism of hosts on host discrimination in *G. japonicum*. Although inexperienced females inserted their ovipositors into hosts parasitized 14 days earlier, they did not oviposit in hosts parasitized 7 or 14 days earlier. A possible explanation for this is that some internal marking exists in these parasitized hosts. Strand (1986) showed a host rejection of *Telenomus helenoides* 21 hr after parasitism by a conspecific at 27°C in response to internal markers, suggesting that host necrosis can be responsible for the internal discrimination. It is unknown when necrosis begins in *R. clavatus* eggs parasitized by *G. japonicum*, but 6 or 7 days after parasitism at 25°C would be too late for its occurrence. In the hosts, *G. japonicum* larvac develop up to the size of the host egg shell 3 days after parasitism at 25°C and pupate on the 7th day (Noda, unpublished). Rather than host necrosis,

Table 2. Oviposition sequence durations by inexperienced *G. japonicum* females on unparasitized and parasitized host eggs

<table>
<thead>
<tr>
<th>Type of hosts</th>
<th>No. of females tested</th>
<th>Mean time (sec) for behavioral event*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Drumming</td>
</tr>
<tr>
<td>Unparasitized</td>
<td>21</td>
<td>33.7 a</td>
</tr>
<tr>
<td>Parasitized</td>
<td>23</td>
<td>45.9 b</td>
</tr>
</tbody>
</table>

* Values followed by different letters in the same column differed significantly at $p<0.01$ ($t$-test).

Fig. 1. Percent probe and oviposition of inexperienced females of *G. japonicum* when they attacked *R. clavatus* eggs at different times after parasitism. Each column indicates percent probe. Shaded part of the column represents percent oviposition calculated from the data of 25 females.
it may be internal discrimination in *G. japonicum* ovipositing parasitized *R. clevatus* eggs that is responsible for parasitoid pupation.

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**REFERENCES**


Preadaptation of a Wild Bean Weevil, *Kytorhinus sharpianus* Bridwell
(Coleoptera: Bruchidae), for Infesting the Storage Green Gram, *Vigna radiata* (L.) Wilczek (Leguminosae).

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Bruchids have been ecologically classified into 2 groups, the field and cross (or storage) types (Kiritani, 1956; Southgate, 1979; Umeya, 1981). The cross-type bruchids are recognized as distinct from the field-type in ecological habits such as ovipositing without feeding after adult emergence and laying eggs and developing in dry mature beans (Kiritani, 1956). These habits should be indispensable for the cross-type bruchids infesting dry beans in storage. However, Watanabe (1985) found that Sulochbruchus sauteri (Pic.), which is not a pest and not classified as a cross-type bruchid, could oviposit and develop in dry mature beans of its host. Shimada (1988) also reported the same ecological habits in a wild multivoltine bruchid, *Kytorhinus sharpianus* Bridwell, attacking the seeds of *Sophora flavescens* Arnot (Leguminosae) in the field. Furthermore, he found that *K. sharpianus* could lay vital eggs without adult feeding. The oviposition and feeding habits in dry beans might make *K. sharpianus* a potential Stored bean pest. Shimada (1988) emphasized preadaptation of a wild bruchid to infest dry stored beans of its host.

The cross-type bruchid as a stored bean pest has another distinct ecological habit. Its larvae can develop in beans of wide-ranging species. Almost all of the field-type bruchids are entirely or mostly monophagous (Watanabe and Sugimoto, 1988). If a wild bruchid can develop in beans of commercial legumes which are not related to its wild host plant, we can consider that it has acquired an infesting ability on beans of the secondary hosts as preadaptation in the field. Therefore conducted an experiment to examine if *K. sharpianus* can infest some commercial legumes. In this study I show that *K. sharpianus* larvae can develop into adults in dry beans of the commercial green gram, *Vigna radiata*.


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