Response of chrysopids (Neuroptera) to larval tracks of aphidophagous coccinellids (Coleoptera)

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Abstract. Choice tests showed that tracks left by coccinellid larvae have generally little effect on oviposition site selection by phagous chrysopids. Oviposition-deterring tracks are considered more aggressive and predatory species can help to bring about a better understanding of oviposition-deterring tracks. In tests with a single pair of coccinellid species, the response of chrysopid females to tracks of conspecific or heterospecific coccinellid larvae was transversely folded every 10 mm to 13 cm. Two strips were exposed to unfed first instar larvae on the bottom of a glass dish, 18 cm in diameter. Fluon on the wall of the glass dish kept the larvae inside. Choice test with females. Experiments were made in cylindrical cages 10 cm high, 18 cm in diameter. The bottom and the top were covered by glass, the side was tough netting (Růžička, 1997b). Chrysopid females were provided with drinking water, aphids Acyrthosiphum pisum Harris in a higher number than the females were able to kill during the test, and a supplementary liquid diet consisting of yeast hydrolysate, sucrose and water. Tests were done at 24 ± 2°C, under light from white-light fluorescent tubes, the photoperiod was 18L : 6D.

One paper strip with larval tracks and one clean paper strip were offered simultaneously to 10 chrysopid females. Both par-
allel strips were fixed to the lower side of the lid 50 mm apart. Experiments started within 15 minutes after the contamination of paper substrates by the coccinellid larvae. Besides the numbers of eggs laid by females on each paper strip, the numbers of eggs on the semicircular area of the glass around clean strip and on the opposite area around the contaminated strip were recorded. Each choice test lasted 20 hours and had ten replicates. Numbers of eggs laid on contaminated and uncontaminated paper strips were compared with a Wilcoxon paired sample test. The same test was used to analyse the numbers of eggs laid on glass semicircle areas of the lid around each strip.

RESULTS

The females of both chrysopid species mostly laid eggs on the folded paper strips and on the glass lid of the cylindrical cages. In four different choice tests and one blank test, C. oculata oviposited 856-1320 eggs on paper strips and 501-880 eggs on the glass around strips, C. perla laid 303-526 eggs on paper strips and 947-2316 eggs on the glass.

In blank tests, both chrysopid species laid similar numbers of eggs on two clean paper substrates. Females of C. oculata laid similar numbers of eggs on clean substrates and on substrates with larval tracks of each of the four coccinellid species tested (Table 1). Females of C. perla laid more eggs on the clean substrate only in one case, i.e. when the other substrate was previously exposed to L. dimidiata larvae (P < 0.0488). In all choice tests, females of both chrysopid species laid similar numbers of eggs on the semicircular area of the glass lid with contaminated paper strips and on the opposite glass area with clean strips (Table 1).

DISCUSSION

Females of some insects respond to oviposition-deterring heterospecific semiochemicals of species that might compete for food at the larval stage. The interspecific effects were reported less frequently than intraspecific effects in phytophagous species (Birch et al., 1980; Byers & Wood, 1980; Byers et al., 1984), pyralids (Thiery & Gabel, 1992) and in parasitoids (Janssen et al., 1995a,b). For predators, interspecific effects were recently described between chrysopids (Růžička, 1996; 1998) and coccinellids (Růžička, 2001). Females of Aphidoletes aphidimyza Rondani laid fewer eggs on aphid infested plants that were previously exposed to first instar larvae of C. oculata, C. perla or C. septempunctata than on plants with aphids non-exposed to larvae (Růžička & Havlíčka 1998).

Although strong oviposition-deterring effects were recorded for C. septempunctata females on sites with larval tracks of C. oculata, females of C. oculata laid on sites with tracks of C. septempunctata larvae only slightly lower numbers of eggs than on clean sites (Růžička, 1997b). The choice tests of the present study indicate that chrysopid females respond only in exceptional cases to tracks of coccinellid larvae: C. oculata laid similar numbers of eggs on clean substrates and on those with tracks of larvae of each of four coccinellid species, and females of C. perla decreased oviposition only on substrates previously exposed to L. dimidiata larvae.

It has been shown in laboratory experiments that a volatile cue from fresh tracks of C. oculata larva can contaminate clean substrates. When clean papers were enclosed in a Petri dish for four hours near the glass with fresh tracks of starved first instar larvae, they became deterrent to conspecific females, however, clean substrates did not become deterrent when enclosed with glass contaminated in the same way, but then kept for ten days in the open air (Růžička, 1997a). In this study, females of C. perla laid similar number of eggs on semicircle area of the clean glass lid around the strip with fresh tracks of L. dimidiata larvae and on the opposite half of the lid with the clean strip. This indicates a limited distant deterrent

<table>
<thead>
<tr>
<th>Females tested</th>
<th>Coccinellid larvae tested</th>
<th>Blank test</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>C. limbifer</td>
<td>S. undecimnotata</td>
</tr>
<tr>
<td>C. oculata</td>
<td></td>
<td></td>
</tr>
<tr>
<td>eggs on substrate (SE)</td>
<td>61(13) ns</td>
<td>50(8) ns</td>
</tr>
<tr>
<td>% eggs on substrate</td>
<td>52</td>
<td>48</td>
</tr>
<tr>
<td>eggs on glass area (SE)</td>
<td>41(6) ns</td>
<td>47(6) ns</td>
</tr>
<tr>
<td>% eggs on glass area</td>
<td>47</td>
<td>53</td>
</tr>
<tr>
<td>C. perla</td>
<td></td>
<td></td>
</tr>
<tr>
<td>eggs on substrate (SE)</td>
<td>19(9) ns</td>
<td>17(9) ns</td>
</tr>
<tr>
<td>% eggs on substrate</td>
<td>51</td>
<td>49</td>
</tr>
<tr>
<td>eggs on glass area (SE)</td>
<td>51(1) ns</td>
<td>44(3) ns</td>
</tr>
<tr>
<td>% eggs on glass area</td>
<td>52</td>
<td>48</td>
</tr>
</tbody>
</table>

TABLE 1. Mean number (per replicate; SE in brackets) and mean percentage of eggs laid by females of two chrysopid species (Chrysopa oculata and Chrysope perla) on clean substrates (-) and on substrates with tracks (+) of first instar larvae of four coccinellid species (Cyclocephala limbifer, Semiadalia undecimnotata, Coccinella septempunctata, Leis dimidiata) and on clean glass areas around substrates without (-) and with (+) larval tracks in choice tests. 10 females of each species were tested in ten replicates. Numbers of eggs on substrates and glass areas were compared with Wilcoxon paired sample test, * = P<0.05; ns = not significantly different (P≥0.05).
effect of tracks left by L. dimidiata larvae on C. perla females.

The comparison of strong and frequent oviposition-deterring interspecific effects between chrysopid species (Růžička, 1996; 1998) with the rare response of coccinellid females to chrysopid larvae (Růžička, 1997b; 2001) and the low occurrence of the oviposition-deterring response of chrysopids to coccinellid larvae in this study may show that coccinellid larvae leave in their tracks additional oviposition-deterring semiochemical cues compared to the larvae of chrysopids. In summary, this study indicates that the deterrent effect of tracks of coccinellid larvae on egg deposition by chrysopid females is low.

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