Aphid parasitoids in organic and conventional farming systems

S. Pearce, R. Gibson, L. Raso, D. Sint, M. Traugott and J. Memmott

Parasitoid wasps are important natural enemies of some of our most devastating crop pests. The adults lay their eggs inside a host herbivore, and as the immature parasitoid develops, feeding and reproduction in the pest are slowed or halted. Eventually the adult parasitoid emerges from the host killing it in the process. Managing parasitoid-host interactions in agroecosystems for economic benefit is a difficult task. Most parasitoids are small and impossible for a non-specialist to identify, and visual evidence of parasitism may take some time to develop during which the host must be kept alive in the laboratory. Molecular techniques are increasingly being used to study and understand this complex group of insects. Whilst traditional rearing techniques require a minimal budget, and little training, molecular techniques are initially time-consuming and costly to develop for even a small group of parasitoids. However, once developed they offer an efficient and reliable technique for screening large numbers of hosts to determine parasitism rate and parasitoid species diversity.

Organic farmers, who cannot use chemical insecticides, rely heavily on the activities of naturally occurring predators and parasitoids to control pests such as aphids in their crops. However, for many growers this form of natural control may come too late to prevent crop losses. Currently we have a very limited understanding of the ecology of aphid-parasitoid interactions and the factors which structure these communities. This study aimed to determine how farming system (organic or conventional) effects the interaction between cereal aphids and their parasitoids. The objectives of the LESARS grant were to:

1. Collect aphids from cereal crops on replicate organic and conventional farms.
2. Use a molecular technique to identify the most abundant parasitoid species attacking aphid pests.
3. Determine if farming system has an impact on aphid parasitism rates and parasitoid community assemblage.

In summer 2007 aphids were collected from cereal fields on 10 organic and 10 conventional farms. Altogether 2159 field-collected aphids were screened for parasitoid DNA using a multiplex PCR assay developed by M. Traugott (University of Innsbruck, Austria). Using this approach, multiple parasitoid species can be detected within one reaction. The molecular technique was utilized to determine parasitism rate and parasitoid species diversity.

Aphid abundance was generally low in both systems, never getting up to one aphid per metre in cereal fields, however, organic cereal fields had significantly greater aphid abundance per metre ($Z = -2.292, P = 0.022$). There was no difference in mean parasitism rate of aphids between the two farming systems (Table 1). A total of 81 aphids (3.75% of all aphids) across all farms were parasitized by more than one primary parasitoid species. Despite the greater number of aphids present on organic farms, there was no increase in the mortality that could be attributed to naturally occurring parasitoids. This conclusion is supported by a similar study on these same farms which found no difference in parasitism rate of dipteran or lepidopteran hosts. The molecular protocol proved ideal for screening large numbers of field-collected aphids, leading to larger total aphid numbers from which to calculate parasitism rate, greater replication, and therefore a more robust data set. The parasitoid species level data is still being analysed. This research provides ideal pilot data for a much larger BBSRC grant to be submitted in the coming year, and forms the basis of a manuscript for submission to a scientific journal.

Table 1. Cereal aphid parasitism rates on organic and conventional farms during summer 2007.

<table>
<thead>
<tr>
<th>System</th>
<th>Mean % parasitism (SE)</th>
<th>No. farms</th>
<th>Z value</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organic</td>
<td>22.06 (3.37)</td>
<td>10</td>
<td>-0.227</td>
<td>0.853</td>
</tr>
<tr>
<td>Conventional</td>
<td>20.69 (3.31)</td>
<td>10</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

References