The Role of Priority Effects on Host-Parasite Interactions
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Introduction
Parasitism is the practice of living in or on another organism for resources, usually causing harm to the host organism. To understand how parasitism impacts the host, experiments are typically done observing interactions between a single host and a single parasite species. However, in many real-world ecosystems, organisms have to defend from multiple parasites at once. This places unique constraints on the host to allocate immune resources and on the parasites who now face interspecific competition.

My research project investigated the host-parasite interactions between one host species, Galleria mellonella, and two of its natural parasites, Steinernema carpocapsae and Heterorhabditis indica, to see how the timing and order of infections affected host mortality and parasite success.

Galleria mellonella
- Also known as the Greater Wax Moth, Galleria mellonella is a moth species commonly studied in host-parasite systems.
- Galleria is also a major agricultural pest, acting as a parasite to honeybees and damaging hives by consuming wax and honey.

Parasitic Nematodes:
Steinernema carpocapsae and Heterorhabditis indica
- Parasitic nematodes reproduce by infecting a host organism and laying their eggs inside the cadaver. Once the eggs hatch, the juvenile nematodes will stay inside the host body growing and reproducing until it’s time to leave the cadaver and find another host.
- Competition between different species of parasitic nematodes, like S. carpocapsae and H. indica, shapes parasite virulence.

Methods
To investigate how the timing and order of infections alters host mortality and parasite virulence, I did a full factorial experiment using the two nematode species, S. carpocapsae and H. indica, plus a control treatment without nematodes.

Table 1 shows the all the treatment groups for the experiment.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Early Infection</th>
<th>Late Infection</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Species</td>
<td>Second Species</td>
<td>First Species</td>
</tr>
<tr>
<td>S. carpocapsae</td>
<td>H. indica</td>
<td>S. carpocapsae</td>
</tr>
<tr>
<td>H. indica</td>
<td>S. carpocapsae</td>
<td>H. indica</td>
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<tr>
<td>Control</td>
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<td>Control</td>
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</tbody>
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On day 10, all dead Galleria mellonella hosts were collected from each treatment and placed in water traps to recover the nematodes.

Results
- The probability of host mortality increases over time for across all treatment groups.

Discussion
The results of this experiment support the hypothesis that priority effects exist for the host-parasite system involving Galleria mellonella and two of its nematode parasites, Steinernema carpocapsae and Heterorhabditis indica.

This adds to the growing body of research considering the importance of the order and timing of infections in interactions involving more than one parasite species.

H. indica seems to be the more successful parasite of Galleria mellonella, as it increases the risk of host mortality and produces more infective juveniles. However, the H. indica produces fewer offspring when competing with S. carpocapsae, showing the negative impact competition has on parasite success and virulence.

Future Directions
- The control treatments of this project were found to have nematodes in them due to contamination. This experiment therefore needs to be replicated to prove significant differences in mortality caused by infection with just one species.
- Using genetic information from each parasite to identify them by species would help establish which parasite successfully colonizes the host and how priority effects impact the probability of colonization.
- Future experiments looking at the priority effects of infections on host species might benefit from investigating co-infection with more than two species of parasite or parasites of different genetic backgrounds to see how the competitive interactions play out.
- Understanding how the timing and order of infections impacts host mortality and parasite success will serve in future application of biopesticides to control populations of pests like the Greater Wax Moth.

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