LENScience CONNECT
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Bio-Protection
Bioprotection science for New Zealand

LENScience Senior Biology Seminar Series

Harnessing Biodiversity

Post Seminar Challenge Questions

Challenge 1: Improving parasitoid fitness in biological control

Biodiversity in an ecosystem is important for maintaining balance and providing natural pest control. Modern agricultural ecosystems are often monocultures, lacking biodiversity. By adding flowering plant species such as *Alyssum, Buckwheat,* and *Phacelia* scientists have been helping farmers to increase beneficial insects in the farm ecosystem, reducing the need for the application of pesticides. The four key factors that beneficial insects require from a habitat are **Shelter**, **Nectar**, **Alternative food** and **Pollen** (**SNAP**). It is important to find plants that will attract the right beneficial insects to control pests on the crop species. Nectar is a key factor that attracts beneficial insects to plants.

Evidence shows that different insects will visit different flower species depending on the quality of the nectar. Nectar is made of sugars including sucrose and hexose (fructose + glucose). Scientists have discovered that the sucrose to hexose ratio in the nectar varies between different plant species and that this ratio is important in determining which flowers beneficial insects will visit.

Successful planting to encourage beneficial insects is about (a) attracting insects that will feed on the pests and (b) ensuring that the beneficial insects live as long as possible.

A study was carried out to (a) find out what the hexose to sucrose ratio was in selected native and introduced New Zealand plant species and (b) find out whether the sucrose to hexose ratio in the nectar of the different plant species affected the longevity of the parasitoid wasp species *Diadegm semiclausum*.

Methods

1. **Measuring the plant nectar sugar ratios**
   Specimens of fourteen different plant species (native and introduced) were kept in a glasshouse under controlled conditions. Samples of nectar from each plant species were analysed to determine the quantity of sucrose, glucose and fructose in each.

2. **Determining the longevity of parasitoid wasps**

   a. Fourteen different solutions were made to represent different concentrations of sugars. They were pure sucrose, pure sucrose plus tap water, pure hexose, pure hexose plus tap water, tap water and sugar ratios (sucrose/(fructose : glucose)): 0.05, 0.1, 0.3, 0.5, 0.75, 1.5, 3.0, 5.0, 10.0.

   b. Newly emerged wasps were sexed and them placed individually in petri dishes containing one of the 14 treatment solutions. The petri dishes were kept in a controlled environment.

   c. The petri dishes were checked daily to measure how long the wasps lived for. This gave a measure of longevity in the different conditions.

Results

(A) Plant nectar sugar ratios

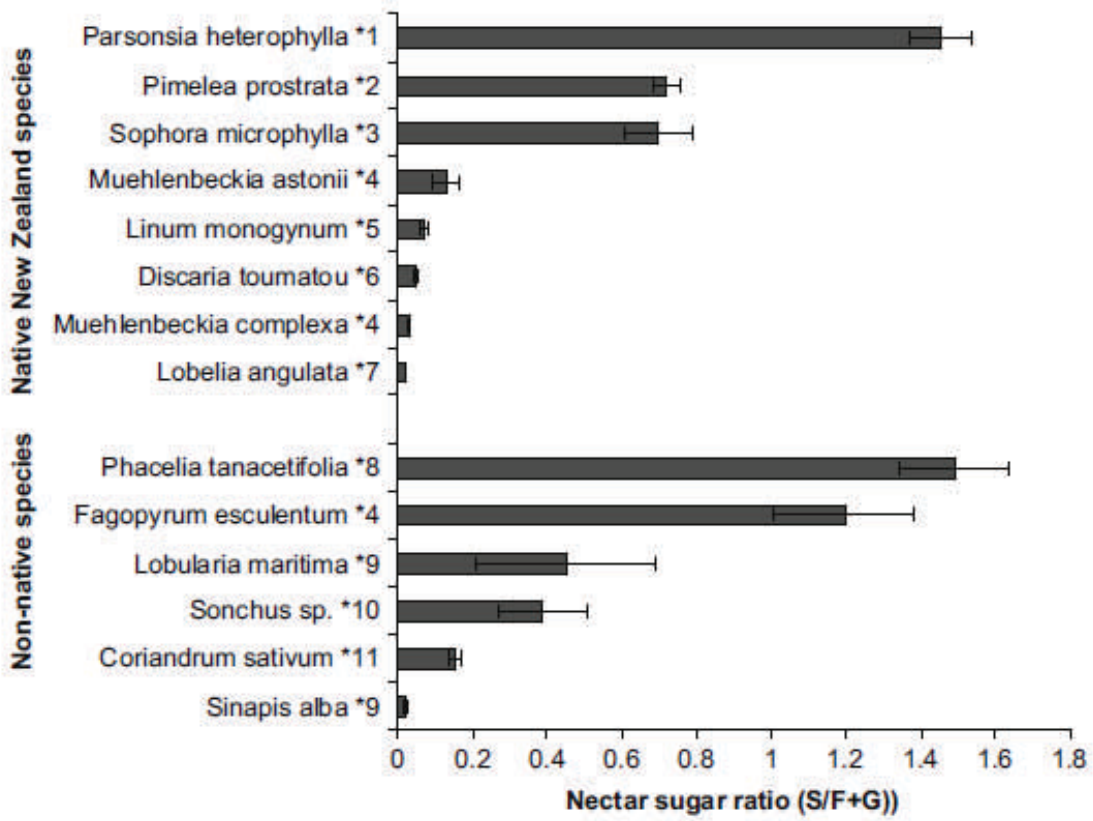

Figure 1. The sucrose to hexose ratio of various plant species as determined through the analysis of nectar samples.

Tompkins, J.M.L.,et al. Nectar to improve parasitoid fitness in biological control : Does the sucrose : hexose ratio matter? Basic and Applied Ecology (2010), doi:10.1016/j.baae.2009.12.010

Questions

1. What conclusion could the scientists draw from this data?

2. Why do you think the scientists wanted to look at native and non-native species in this investigation?

(B) Effect of sucrose to hexose ratio on longevity of parasitoid wasps

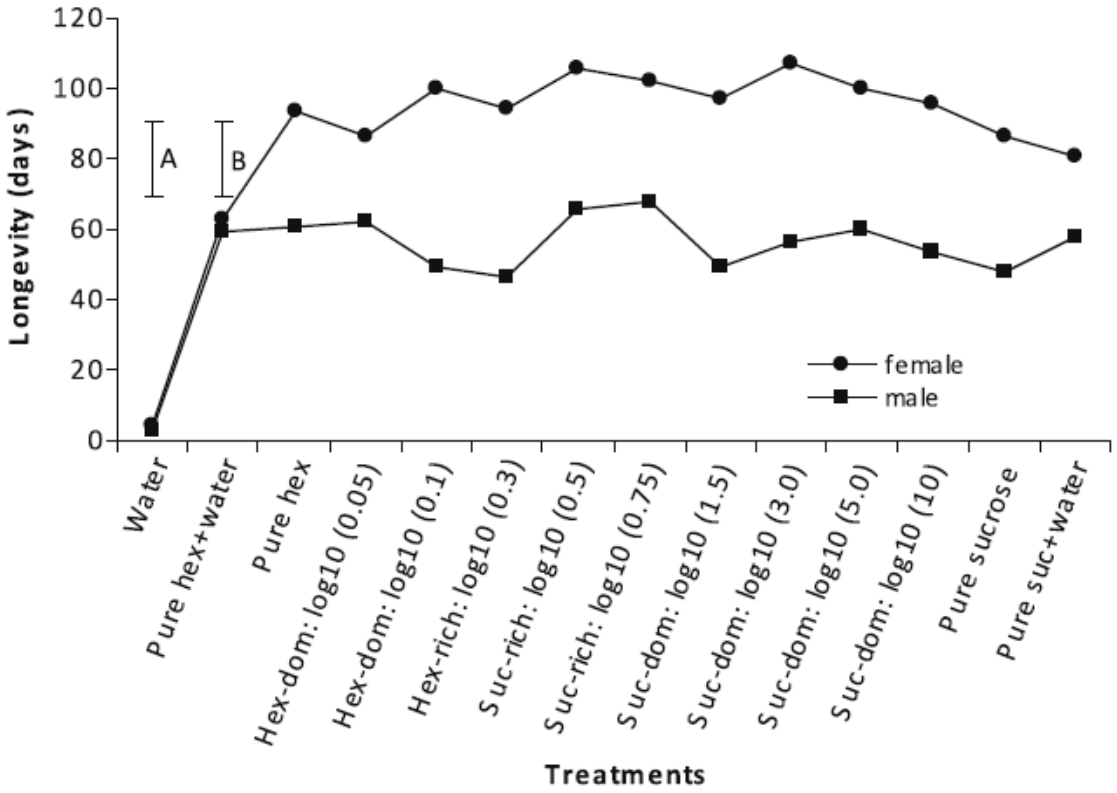

Figure 2: Longevity of female and male *D. semiclausum* with different treatments

Tompkins, J.M.L.,et al. Nectar to improve parasitoid fitness in biological control : Does the sucrose : hexose ratio matter? Basic and Applied Ecology (2010), doi:10.1016/j.baae.2009.12.010

3. What conclusion could the scientists draw from this data? Do you think that this data supports the hypothesis that sucrose to hexose ratio influences longevity?

4. What is the advantage of creating an environment where longevity of biocontrol insects is promoted?

5. What does the data in Figure 2 suggest about relative longevity in relation to sex? Discuss the potential significance of this in terms of the evolution of the wasp and the efficacy of the species as a biocontrol agent.

Challenge 2: The biological control of light brown apple moth

The graphs below are from a study looking at the potential of different ground-cover plant species that could be used to improve the performance of the egg parasitoid wasp *Trichogramma carverae* in controlling the vineyard leafroller pest *Epiphyas postvittana,* commonly known as the light brown apple moth.

The parasitoid *T. carverae* controls the light brown apple moth by laying its eggs in the eggs of the moth. The eggs of *T. carverae* hatch into larvae, which then consume the eggs of the moth, therefore killing them. The plant species tested were Alyssum, Mustard, Coriander, Buckwheat, and Borage.

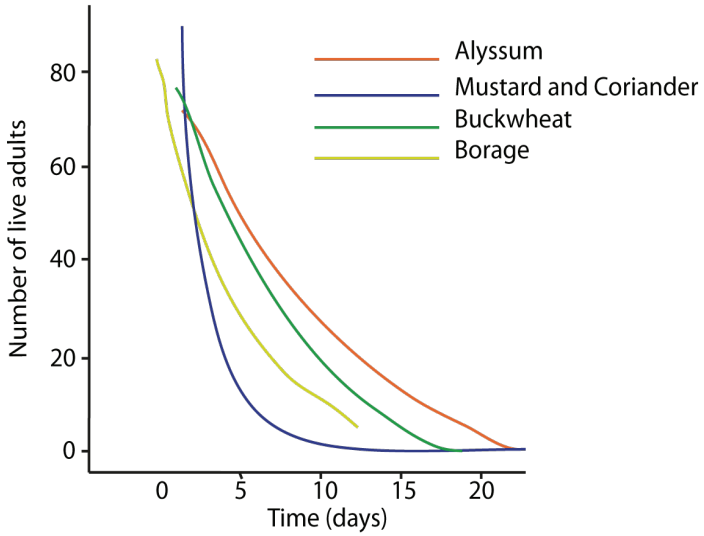

Figure 1: Mean longevity of the adult parasitoid *T.carverae,* with different ground-cover plant species.

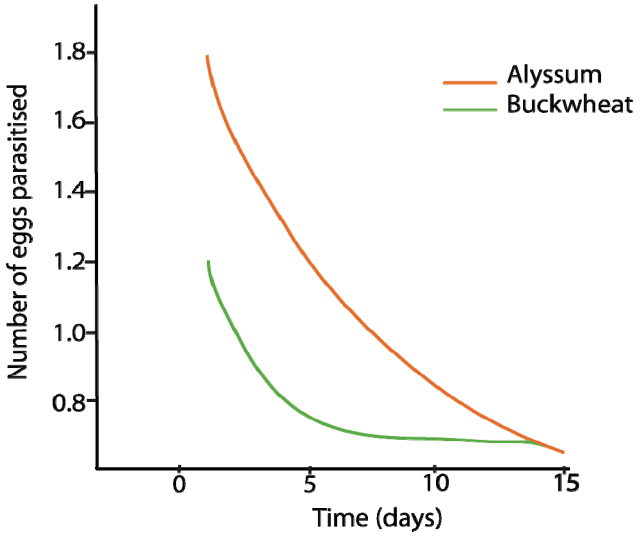

Figure 2: Mean daily fecundity (number of eggs) of the adult parasitoid *T.carverae,* with different ground-cover plant species.

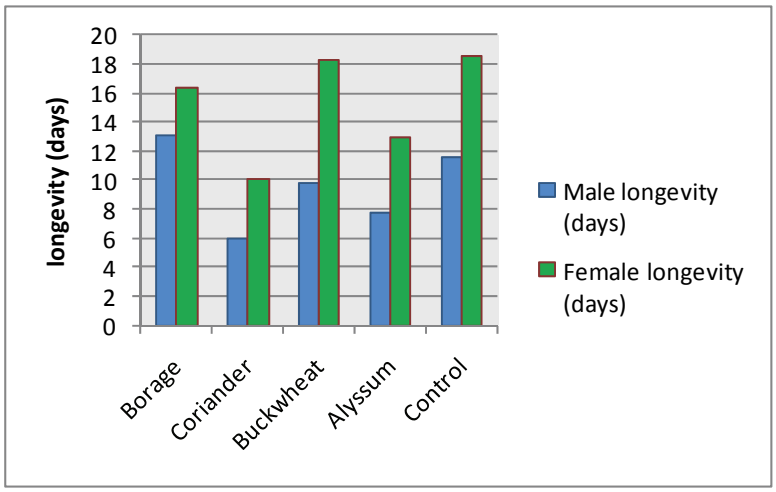

Figure 3: Mean longevity of *E. postvittana,* with different ground -cover plant species.

1. Using evidence from the data, explain which plant species enhanced the ability of the parasitoid *T. carverae* to control the light brown apple moth?

2. Using evidence from the data, explain which plant species benefitted the survival of the light brown apple moth *E. postvittana*?

3. What planting recommendations would you make for increasing the effectiveness of the biological control agent *T. carverae* in a vineyard where light brown apple moth (*E. Postvittana)* is a problem?