Aims
To model and analyse the spatio-temporal dynamics of a plant-apid-parasitoid-plants-virus system and explore whether aphid endosymbionts affect trophic dynamics in these systems.

Model
The IBM that I am developing is based on partial differential equations that have been discretized:
\[
\frac{\partial A}{\partial t} = DA \nabla^2 A
\]
\[
\frac{\partial W}{\partial t} = DW \nabla^2 W
\]

These equations are used to generate the movement probabilities for individual hosts and parasitoids. Birth and death terms are handled elsewhere in the model.

Focus will be on the evolution of population dynamics and disease transmission during the summer, when aphid populations reach peak densities. Individuals will move randomly or via chemotaxis on a 2-dimensional domain representing one or more plants. Aphids are assumed to have constant birth and natural mortality rates and can also suffer mortality from being parasitized. Each aphid will have a probability of transmitting disease to plants and will either be winged or wingless.

Parasitoid wasps are assumed to attack aphids given a probability of successfully discovering the aphid and a probability of successful attack. Parasitoid population growth is limited by availability of the host and by the search efficiency of the parasitoid. If there are no available hosts in a patch of area, the parasitoid moves to a random location on the domain after a certain amount of time has passed, called the ‘giving up time’.

Results from model
Simulating the model with aphids and parasitoids gives rise to a range of dynamics that include stable coexistence, instability (Figure 1a) and quasi-periodic oscillations (Figure 1b). These dynamics have been observed in other host-parasitoid models.

Future Work
I am planning lab experimental work to obtain parameter estimates for my model and to assess the effect of facultative endosymbionts on aphid fitness. This information will be used in the model to analyse whether endosymbionts affect trophic dynamics.

References