Plant mediated interactions with the large raspberry aphid

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The large raspberry aphid, *Amphorophora idaei*, is a major pest of red raspberry in the U.K. as the principle vector of several viruses. Past control strategies relied heavily on breeding aphid resistant cultivars but *A. idaei* have now largely overcome this resistance. New control strategies are therefore urgently needed.

Raspberry plants are subject to simultaneous attack by a range of organisms, including insect herbivores such as the vine weevil, *Otiorynchus sulcatus*, and viral pathogens such as BRNV and RLSV. This can lead to induced changes to host-plant chemistry which alter the plant's suitability as a host, ultimately giving rise to plant mediated interactions between such organisms. Understanding the chemical basis of these interactions could provide a novel basis for the development of new control strategies.

Identifying interactions with the large raspberry aphid

(a) Aphid interactions with viral pathogens

Choice experiments were conducted in a controlled environment laboratory (19 ± 1°C). Three adult aphids were released equidistant from two plants, one healthy and one infected with BRNV and RLSV. Initial aphid choice was recorded and replicated 20 times with different aphids and plant sets. Plant virus status was verified by RNA extraction and RT-PCR.

(b) Aphid interactions with competing herbivores

Three adult aphids were released between two plants, one healthy and one that had been inoculated with vine weevil eggs. The initial plant choice was recorded and the experiment was replicated 18 times with different aphids and plants.

Results

(a) Aphid interactions with viral pathogens

A significantly higher number of aphids chose to settle on plants infected with virus (Fig. 1.). Data was analysed using a binomial generalised linear model on aphid totals. The probability of an individual choosing a healthy host = 36.4% (95% C.I. = 0.24 -0.5). Figure 1 shows the mean number of aphids choosing each plant type ± standard error.

Figure 1.
Mean number of aphids on healthy and infected raspberry plants ± standard error.

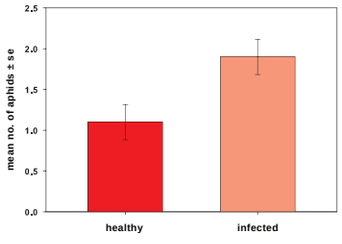
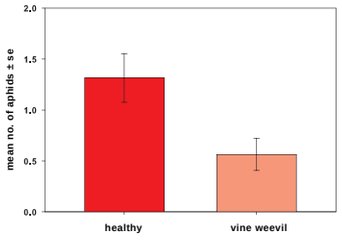


Figure 2.
Mean number of aphids on healthy plants and plants with vine weevil present.



(b) Aphid interactions with competing herbivores

Significantly more aphids chose healthy plants over hosts infested with vine weevil larvae (Fig. 2.). The probability of an individual aphid choosing a host with the competing herbivore present was 29.0% (95% C.I. = 0.141 0.498).

Conclusions and Future Work

Aphid choice experiments have provided encouraging evidence to suggest that BRNV and RLSV act to attract *Amphorophora idaei*, while the aphid shows an avoidance of plants with a competing herbivore present. Further experiments are underway using 4-arm olfactometer apparatus (Fig. 3.) and solid phase microextraction gas chromatography-mass spectrometry (SPME-GC-MS) to investigate the potential role of green leaf volatiles as the aphid attractant/deterrent (e.g. Fig. 4.).

Figure 3.
4-arm olfactometer apparatus.

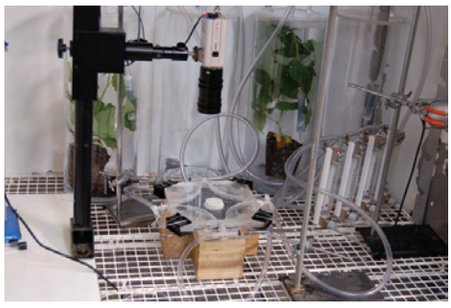


Figure 4.
Example of GC trace from healthy raspberry (top) and infected (bottom).