

Does mother know best?

Host plant selection by above-ground insect herbivores for below-ground offspring

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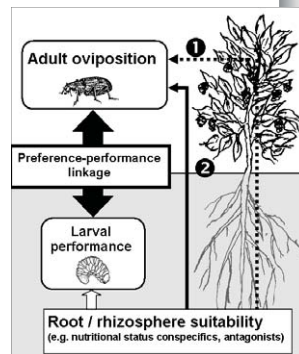
There is growing interest in how below-ground insect herbivores influence both their host plants and above-ground herbivores¹. However, the relationship between above-ground adult insects and their below-ground progeny is one that has generally been overlooked. Oviposition preferences of maternal adults may be critical in determining the survival of offspring, especially when the offspring have limited capacity to relocate. This preference-performance hypothesis has so far only been considered for above-ground insects, although there is evidence for including insects with below-ground life stages². We aim to investigate the relationship between maternal oviposition behaviour and larval performance using the vine weevil (*Otiorhynchus sulcatus*) (Fig 1) a generalist herbivore of raspberry (*Rubus* spp.) (Fig 2).



Aims and Hypotheses

My research aims to establish how root and rhizosphere suitability for below-ground offspring can influence an above-ground insect's oviposition behaviour, and determine the chemical mechanisms which drive this behaviour. It is hypothesised that:

1. maternal insects will choose to oviposit on *Rubus* that is moderately infested with conspecifics and has a low level of competitors;
2. the mechanisms driving the decisions of the maternal insect will be chemically mediated and thus can be induced, (such mechanisms could be from the soil or plant (Fig 3));



Vine weevil

The polyphagous vine weevil is a major pest for both horticultural nurseries and crop growers. The pathogenic adult weevil feeds on leaves leaving a characteristic notching pattern, reducing the aesthetic value of the plant. However, it is the root feeding larvae that cause the most significant damage to the host plant, with as few as three larvae on a rhododendron plant being lethal³. The weevil is univoltine, the adult oviposits eggs on or below the host plant at night. When the eggs hatch the larvae burrow into the soil. Young larvae initially feed on small roots, but as they mature they attack large roots and plant stems³. Vine weevils mainly overwinter as larvae, and increasing temperatures in spring trigger them to pupate and eventually emerge as adults.



Experimental Approach

How is oviposition behaviour influenced by below-ground plant status? Paired choice bioassays will examine oviposition preferences of vine weevils between control plants and plants inoculated with high, medium and low densities of (a) conspecifics larvae (b) entomopathogenic nematodes and plants with (c) mechanically damaged roots and (d) roots treated to mimic damage. Foliar and root nutritional quality as well as emissions from the soil and plants will also be investigated on plants under the same treatments (a-d), but with the removal of adult weevils. Eggs will be collected using a flotation method (currently under investigation).

Field based trials. A repeat of the greenhouse experiments will be conducted on an established raspberry plantation. Results from the greenhouse trials will indicate which treatments are likely to be most influential.

Behavioural responses of adult weevils and identity of the signal(s) influencing their behaviour. Experiment (i) will demonstrate the preferences of the adult weevils in choosing an oviposition site. The nature of the signals will be investigated using insect behaviour apparatus including EAG.

Identification of the signals will be determined using appropriate analytical techniques.

¹Blossey, B & Hunt-Joshi, T. R. Belowground herbivory by insects: influence on plants and aboveground herbivores. *Annual Review of Entomology* 48, 521-547 (2003)
²Johnson, S. N., Birch, A. N. E., Gregory, P. J. & Murray, P. J. The 'Mother knows best' principle: should soil insects be included in the preference-performance debate? *Ecological Entomology* 31 395-401 (2006)
³La Lone, R. S & Clarke, R. G. Larval development of *Otiorhynchus sulcatus* (Coleoptera: Curculionidae) and effects of larval mortality and injury to rhododendron. *Environmental Entomology* 10 190-191 (1981)