Plant induced responses mediate interactions between herbivores from different feeding guilds

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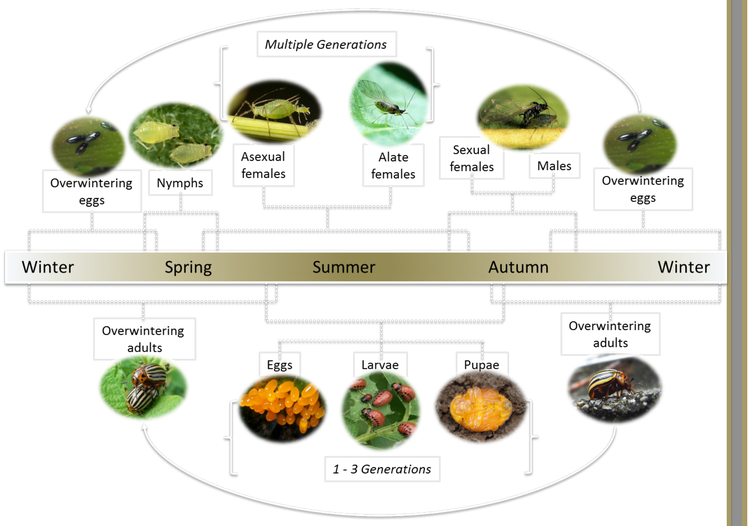
Overview:

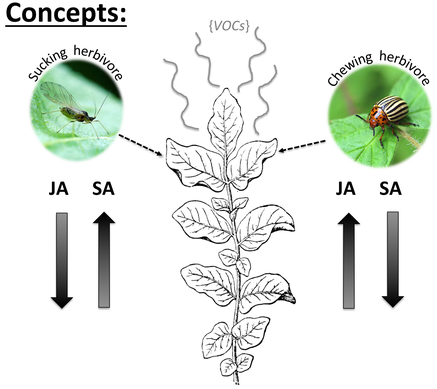
Plants use a variety of cues to detect attacking herbivores. Furthermore, signal transduction pathways notify the plant of the specific type of attacker and thus induce a specialized defense. Here we test how an induced response from an early colonizing foliage-feeder influences the performance and host-plant preference of a late-arriving phloem-feeder in order to reveal the underlying mechanisms of plant-insect interactions when herbivores co-occur in the field.

System:



Green peach aphid, *Myzus persicae* (Sulzer), and Colorado potato beetle, *Leptinotarsa decemlineata* (Say), are two major agricultural pests of potato, *Solanum tuberosum*. Green peach aphids use piercing and sucking mouthparts to feed on the phloem of their host plant, while Colorado potato beetles (CPB) are chewing herbivores that feed primarily on foliage.

Concepts:

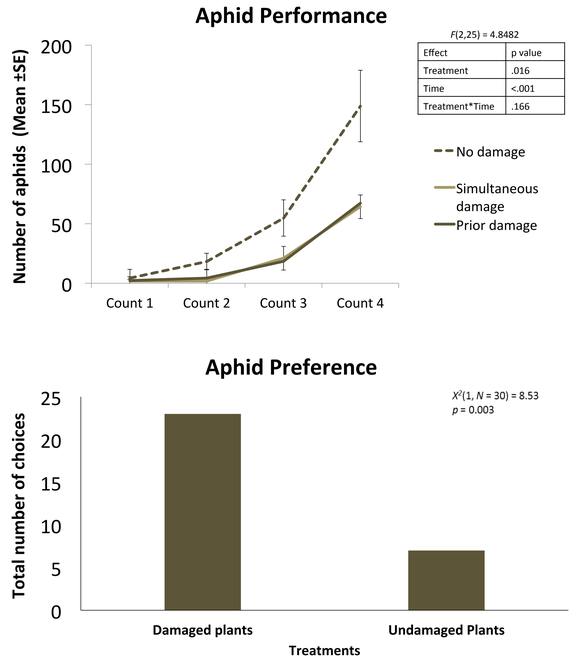


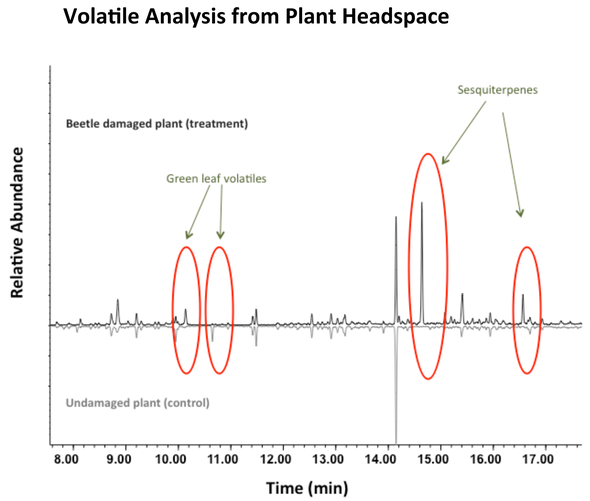
When attacked by herbivores, signaling molecules, such as salicylic acid (SA) and jasmonic acid (JA) trigger a plant response to wounding that generate plant defenses. In general, chewing herbivores elicit a response that upregulates JA, while sucking herbivores elicit a response that upregulates SA. However, what happens when these signal transduction pathways interact? Another artifact of these signaling molecules is the synthesis and emission of volatile organic compounds (VOCs), which can act as attractants or deterrents for herbivores.

Ideas:

Plants can differentiate between herbivores from different feeding guilds and customize their response to herbivory. However, defenses are costly and there may be tradeoffs between defense tactics for different enemy regimes. Therefore, we predict that a specialized plant response to one type of herbivore can indirectly impact the fitness and behavior of an herbivore from another feeding guild.

Preliminary Results:



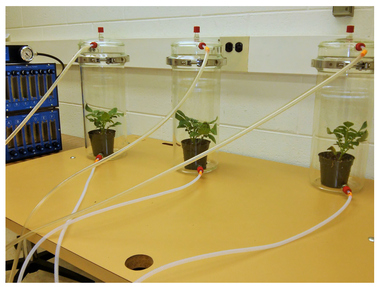


- Top left: Aphid performance on plants that were damaged by CPB (previously or simultaneously) and undamaged plants
- Bottom left: Aphid choice between CPB damaged and undamaged plants
- Top right: GC-MS profiles of volatiles collected from *S. tuberosum* plants with and without CPB damage.

Methods:

Aphid Performance Aphids were added to *S. tuberosum* plants under the following treatments: plants primed with prior CPB damage (CPB were added to plants but were removed after 3 days of feeding), plants with simultaneous CPB damage (CPB were added at the same time as aphids, but were removed after 3 days), and undamaged plants. Aphids were counted every 4 days to determine changes in aphid density over time.

Aphid Preference Alate aphids were added individually into the base of a two-choice olfactometer. One side of the olfactometer contained an undamaged *S. tuberosum* plant and the other side of the olfactometer contained a plant that had been damaged by CPB larvae. Aphid choice was recorded once the aphid had moved entirely into one arm of the y-tube and was oriented towards the chosen host plant.



Volatile Collection Volatiles were collected from *S. tuberosum* plants that were undamaged or that were damaged by CPB. Volatiles were collected using a push-pull system after 3 days of beetle damage. Samples were eluted with dichloromethane and then analyzed using Gas chromatography-mass spectrometry (GC-MS).

Conclusions:

- Aphids seemed to perform better on undamaged plants, and performed similarly on plants with previous CPB damage and simultaneous CPB damage
- However, when given a choice between CPB damaged plants and undamaged plants, aphids predominantly preferred CPB damaged plants over the undamaged plants
- The volatiles collected from plants damaged by CPB differ from those of undamaged plants

Future Research:

- Bioassay to include mechanical damage
- Bioassay concentrations of identified VOC compounds
- Analysis of alkaloids, protease inhibitor, JA, and SA content of undamaged and damaged plants
- CPB performance and preference on aphid damaged plants
- Tri-trophic interactions and natural enemy attraction