Mechanisms of virus-vector interactions mediating disease transmission

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Do plant viruses perceive the presence of aphid vectors?

**Model**
- Aphid punctures trigger instant calcium elevations at the puncture site. They might be the first step in establishment of plant defense responses against these predators (see model above).
- Many viruses are transmitted by aphids. There is evidence that viruses modify plant defenses, for example to modify interactions of plants with virus-transmitting aphids.
- Such modifications could effect the very first steps in virus-aphid interactions (transmission).

Therefore, we tested whether virus infection interferes with local calcium elevations.

**Experimental system**
- Plant leaf expressing the calcium sensor YC3.6
- Probing aphid
- Visible
- Excitation 440 nm
- Fluorescence
- CCD Camera

**Method:**
- Recording of aphid activity by bright field microscopy
- Recording of calcium concentration by fluorescence imagining
- Temporal-spatial analysis

**Results**
- Time lapse video
- Analysis of calcium signal
- Bimodal distribution for CaMV and TuMV, unimodal for TuYV and healthy

⇒ Viruses alter calcium signaling differently

Can a plant virus perceive the presence of a plant while being retained in its insect vector?

**Model**
- Viruses that retain in the foreguts of whitefly vectors must be released and inoculated into the plant in order to achieve transmission.
- Many whitefly-transmitted viruses are emerging viral pathogens of important food and fiber plants.
- Although whitefly feeding (on plants) contributes to the inoculation of foregut borne viruses, nothing is yet known about the role(s) that plants play, if at all, in virus inoculation.

Therefore, we conducted studies to test the hypothesis that the inoculation of a foregut borne virus can be mediated by a plant trigger.

**Experimental system**
- Whole-mount, widefield fluorescence microscopy of whitefly heads (heads)

**Results**
- Establish virus host (B. rapa) and non-host (B. napus)
- Plant to plant transmission of lettuce infectious yellows virus (LIYV) to B. rapa or B. napus

**Virus Retention Assays**

<table>
<thead>
<tr>
<th>B. rapa</th>
<th>B. napus</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIYV (+) control</td>
<td>LIYV (+) control</td>
</tr>
<tr>
<td>LIYV virion purified from B. rapa</td>
<td>LIYV virion purified from B. rapa</td>
</tr>
<tr>
<td>Establish whitefly colonies</td>
<td>Establish whitefly colonies</td>
</tr>
<tr>
<td>Western blot</td>
<td>Western blot</td>
</tr>
<tr>
<td>TEM Analysis</td>
<td>TEM Analysis</td>
</tr>
</tbody>
</table>

**Fluorescence**
- Fluorescence
- % of leaves with fluorescent signals
- % of leaves with fluorescent signals

**Table**

<table>
<thead>
<tr>
<th>Fluorescence</th>
<th>Number of leaves with fluorescent signals</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIYV (+) control</td>
<td>100</td>
</tr>
<tr>
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**Acknowledgments**