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Mechanisms of virus-vector interactions mediating disease transmission

Christiane Then, Fanny Bellegarde, Geoffrey Schivre, Tou Cheu Xiong, Martin Drucker, Stoyan Yordanov, Kaloian Koynov, Hans-Jürgen Butt, Jaclyn S Zhou, James C. K. Ng

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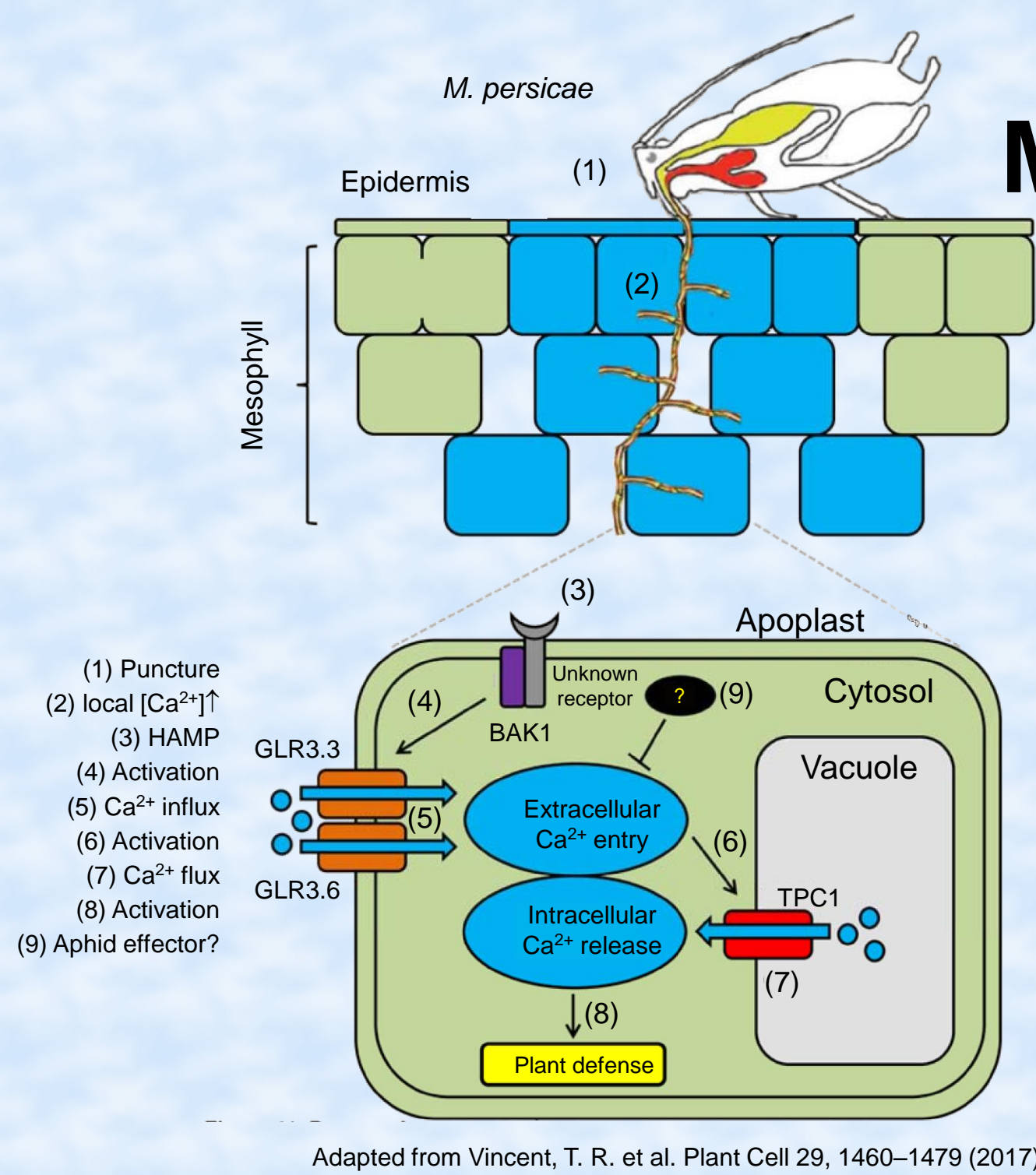
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Mechanisms of virus-vector interactions mediating disease transmission

INRA Colmar (France): Christiane Then, Fanny Bellegarde, Géoffrey Schivre, Tou-Cheu Xiong, Martin Drucker
 MPI Mainz (Germany): Stoyan Yordanov, Kaloian Koynov, Hans-Jürgen Butt
 UC Riverside (USA): Jaclyn S. Zhou, James C.K. Ng

Do plant viruses perceive the presence of aphid vectors?

Model



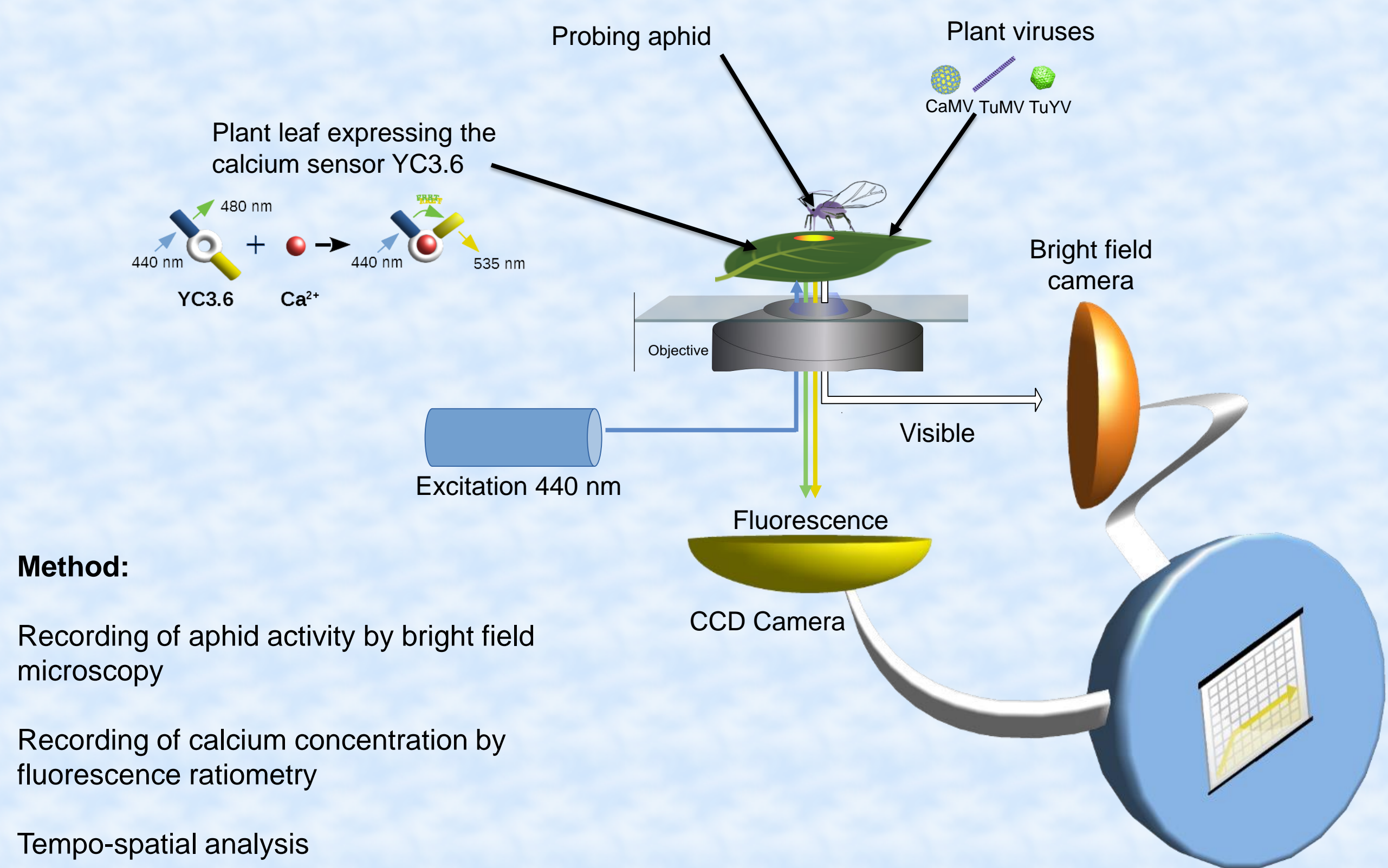
Aphid punctures trigger instant calcium elevations at the puncture site. They might be the first step in establishment of plant defense responses against these predators (see model above).

Many plant 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).

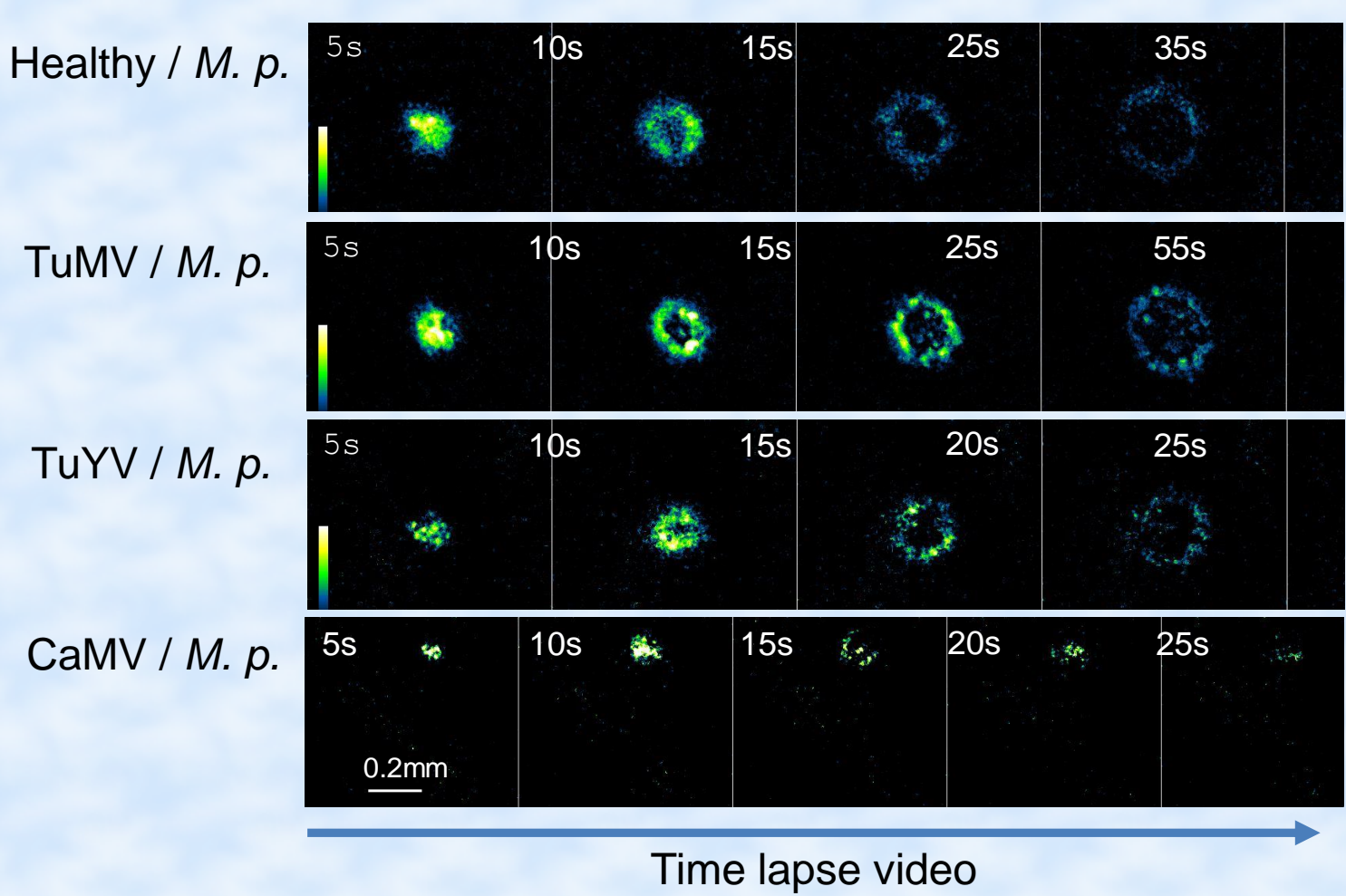
Therefore, we tested whether virus infection interferes with local calcium elevations.

Experimental system

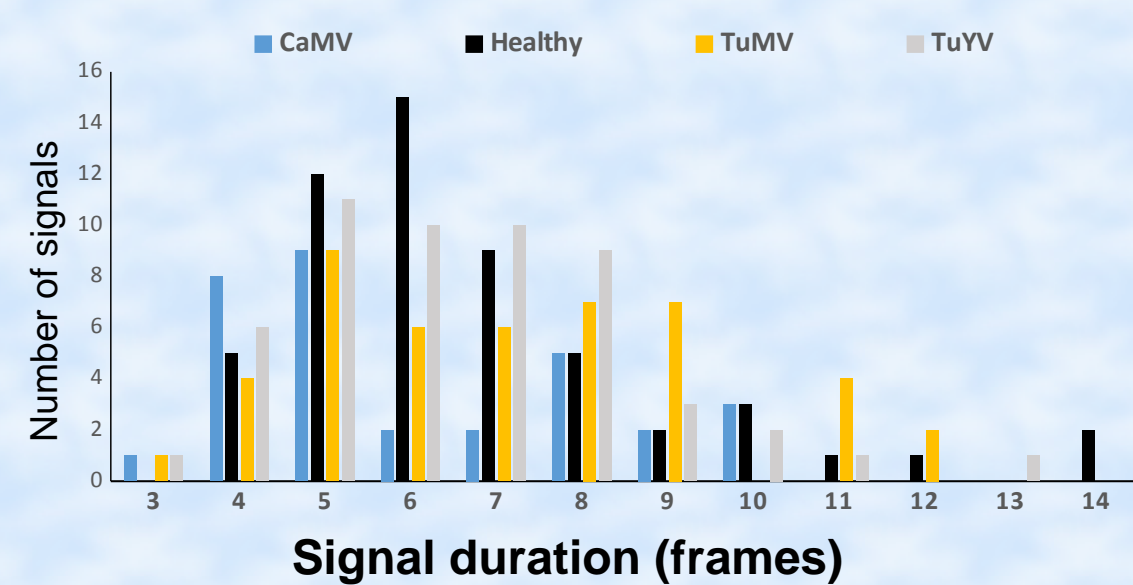


Method:
 Recording of aphid activity by bright field microscopy
 Recording of calcium concentration by fluorescence ratiometry
 Tempo-spatial analysis

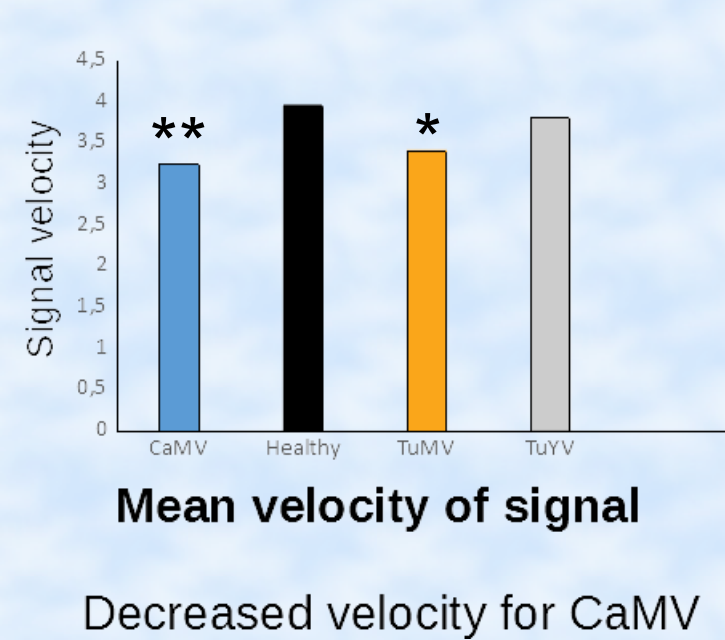
Results



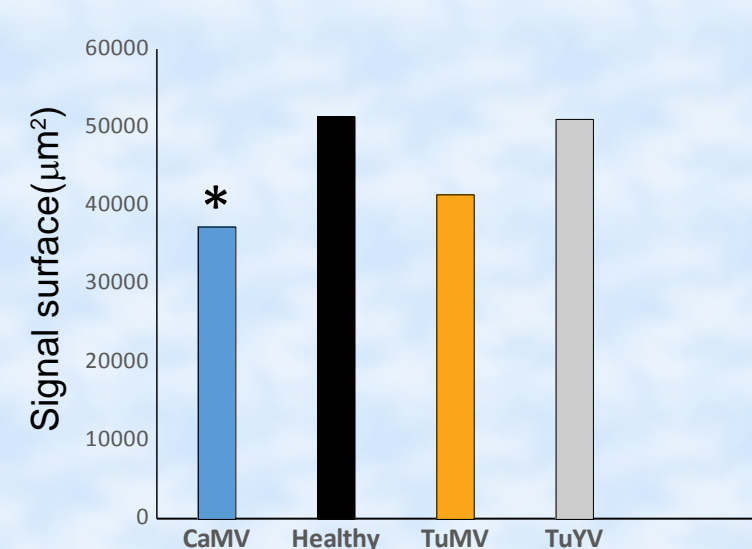
Analysis of calcium signal



Bimodal distribution for CaMV and TuMV, unimodal for TuYV and healthy



Decreased velocity for CaMV



Decreased surface for CaMV

⇒ Viruses alter calcium signaling differently

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

Model

Virus Inoculation by whitefly vector

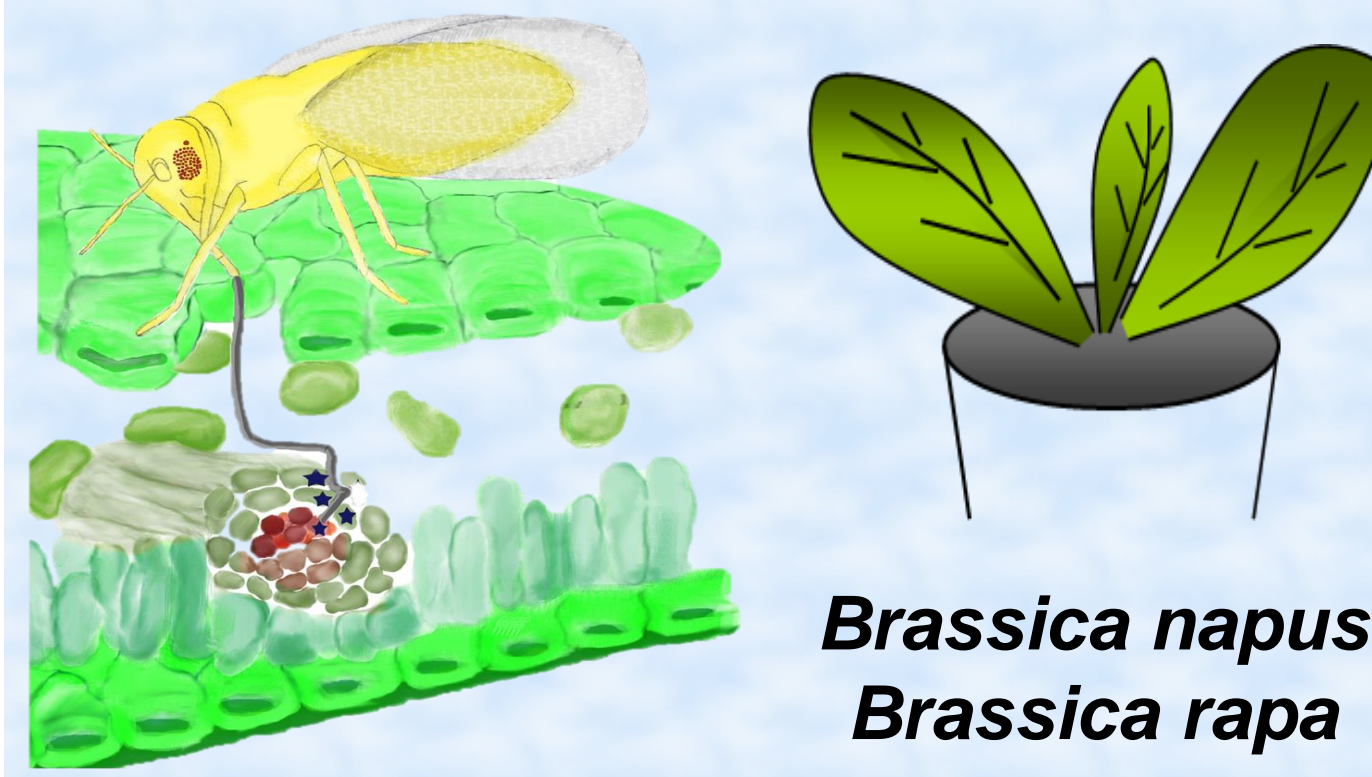
Plant hosts of whiteflies

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.

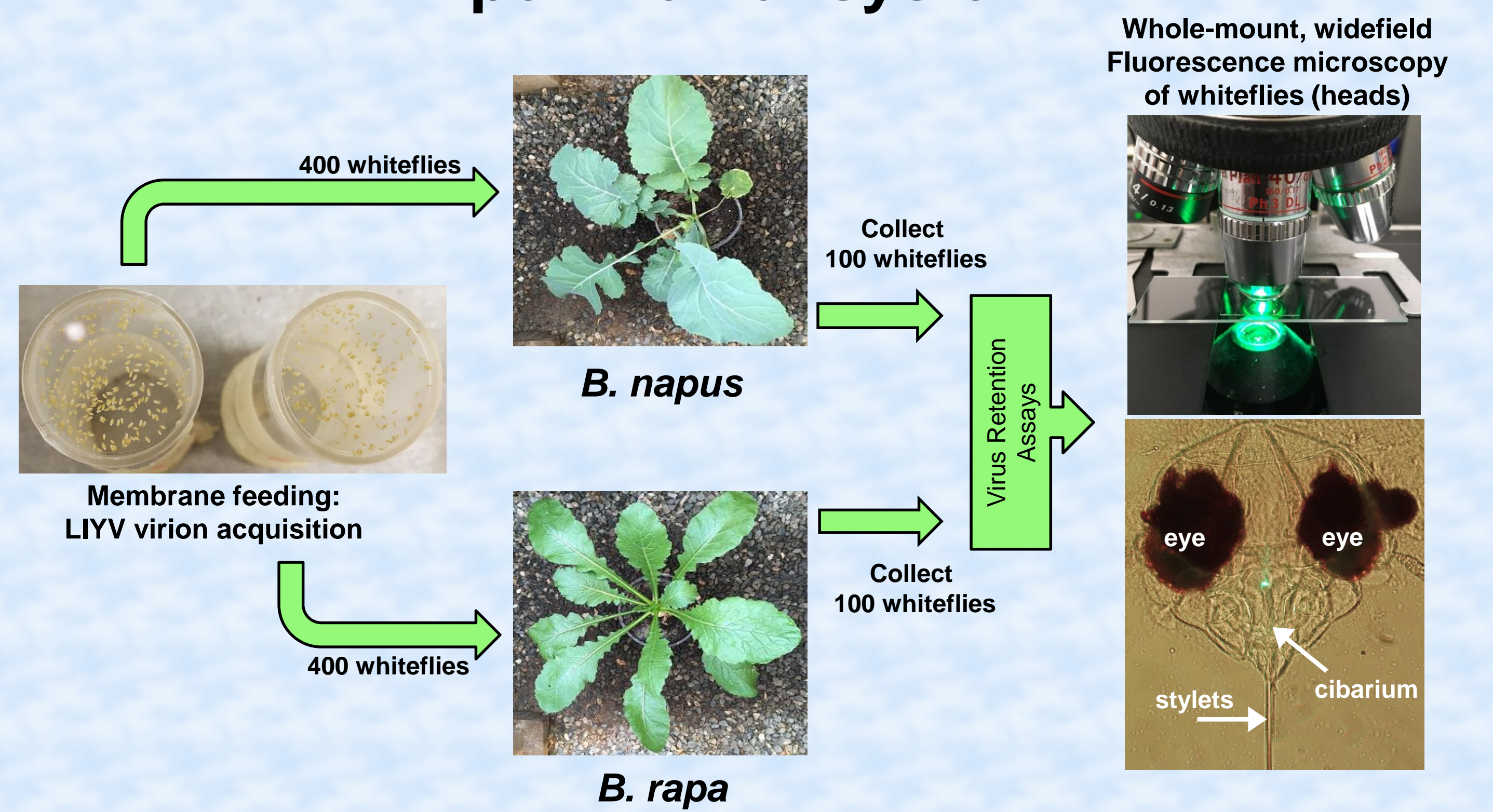
Although whitefly feeding (on plants) contributes to the inoculation of foregut borne viruses, nothing is yet known about the role(s) that plants play, if at all, in virus inoculation.

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



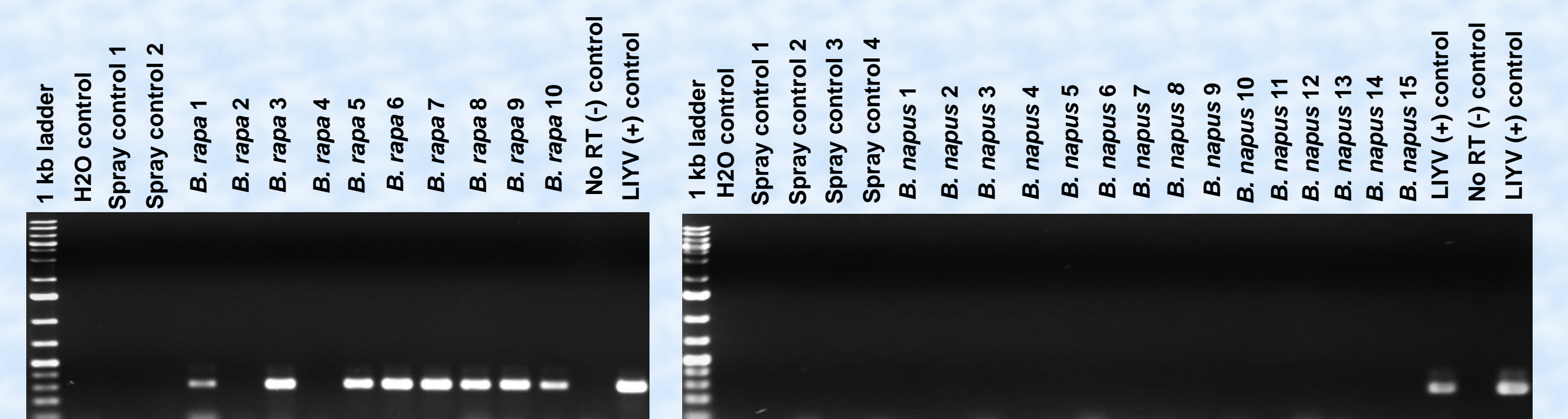
Brassica napus
Brassica rapa

Experimental system

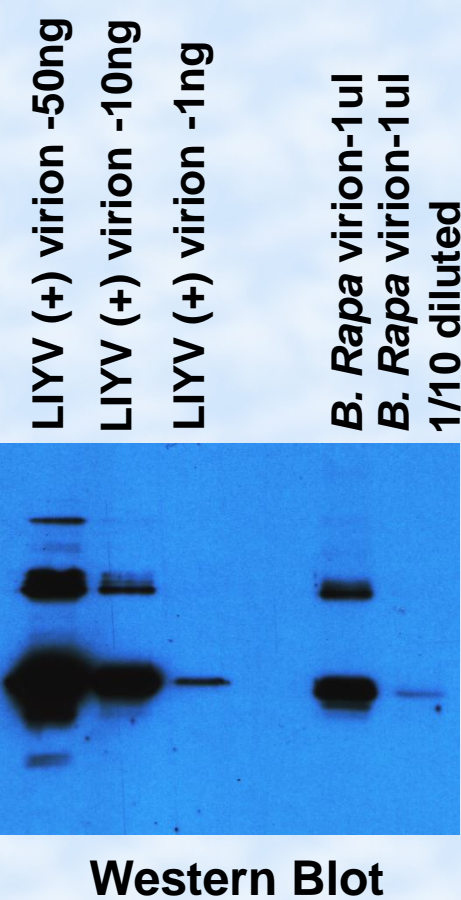


Results

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*

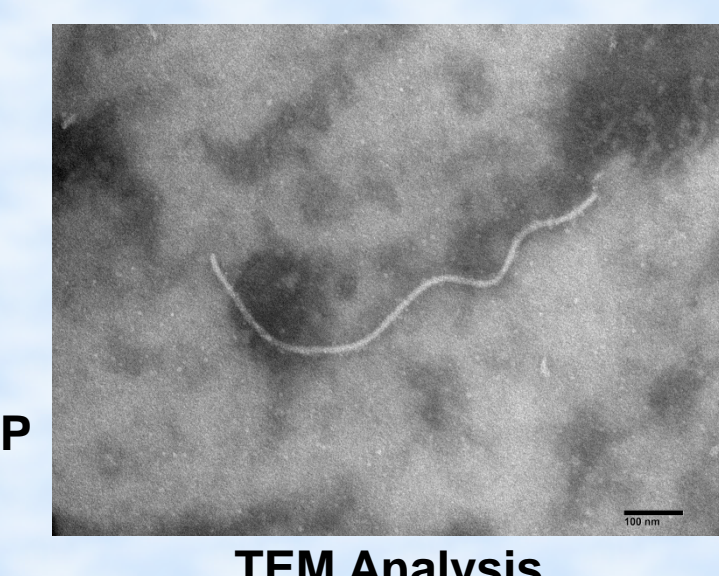


Reverse transcription (RT) - PCR



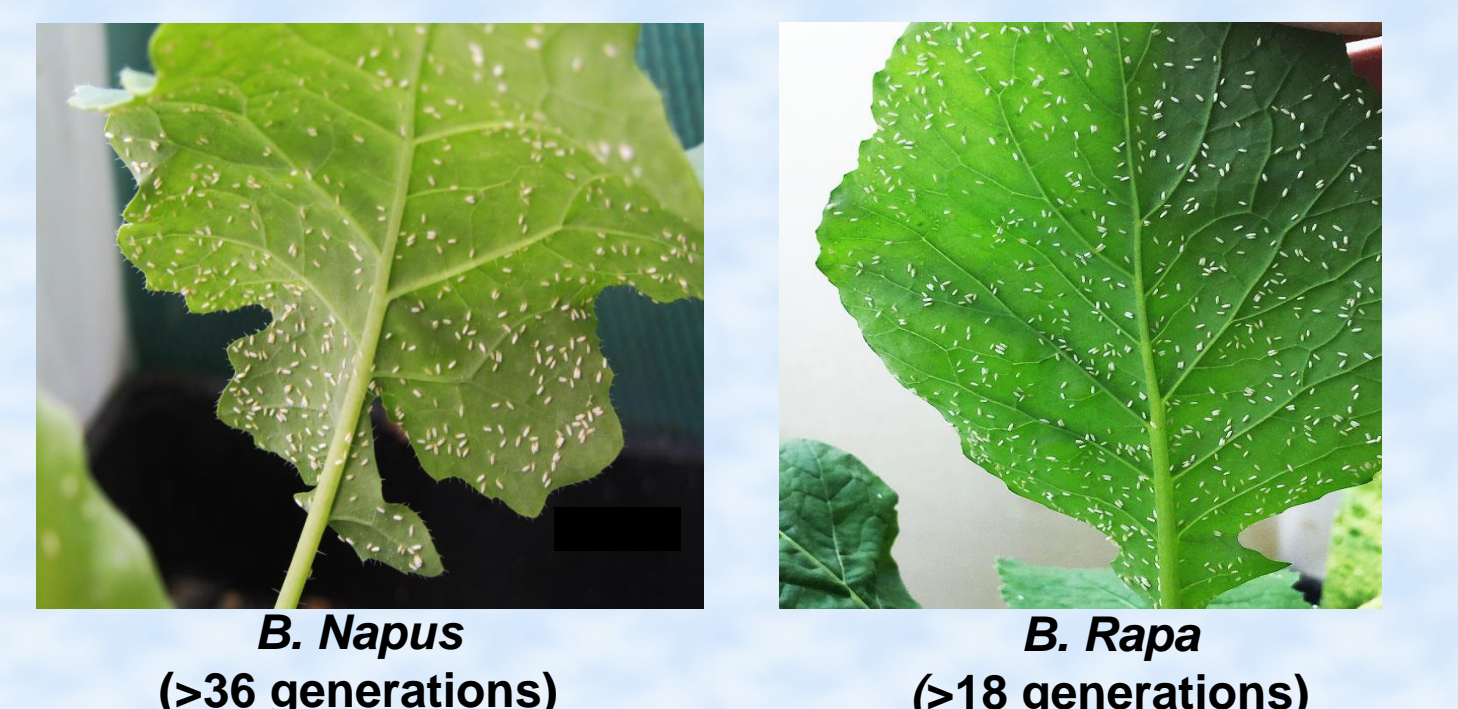
Western Blot

LIYV virion purified from *B. rapa*



TEM Analysis

Establish whitefly colonies



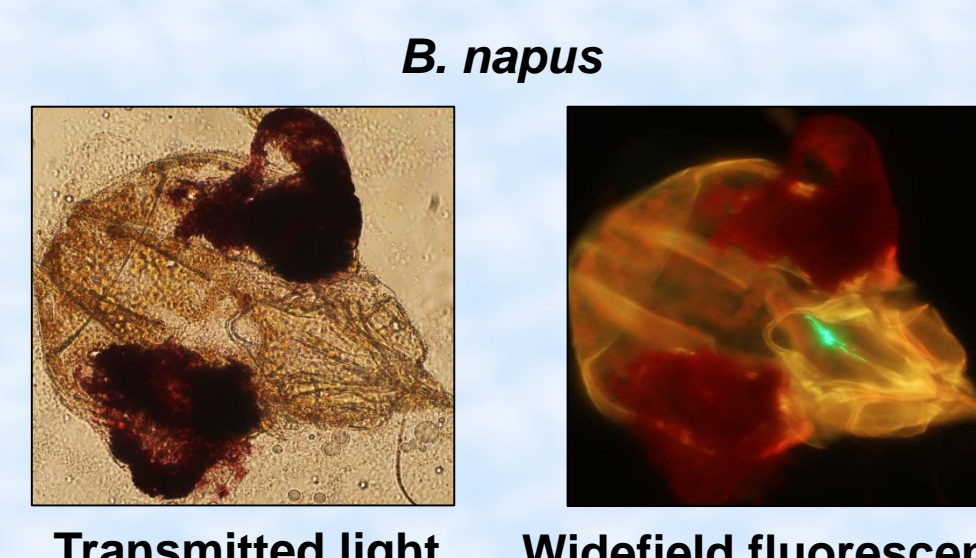
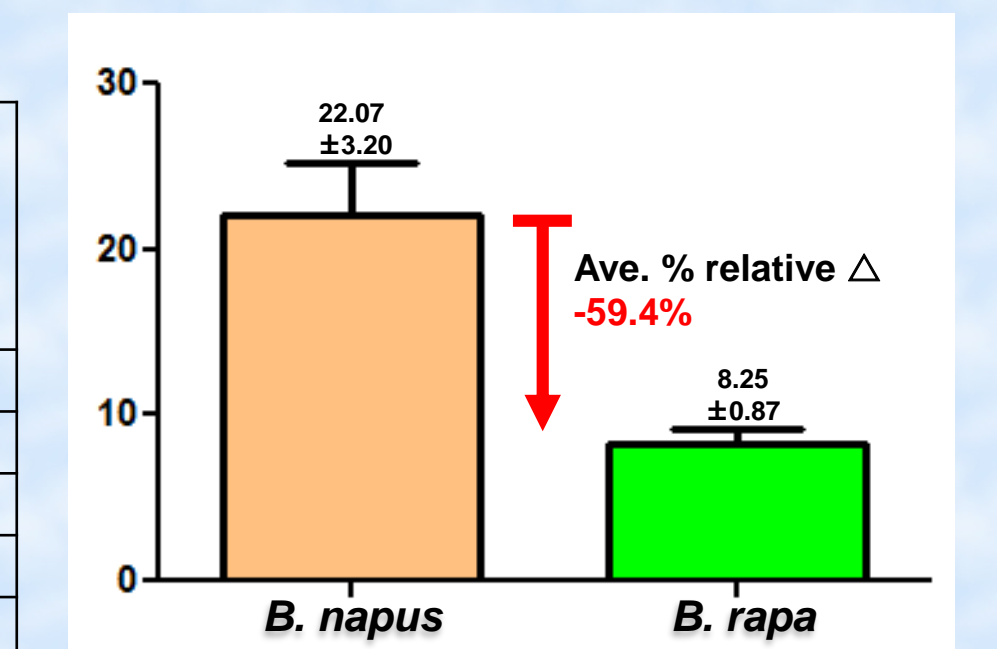
B. napus (>36 generations)

B. rapa (>18 generations)

Virus Retention Assays

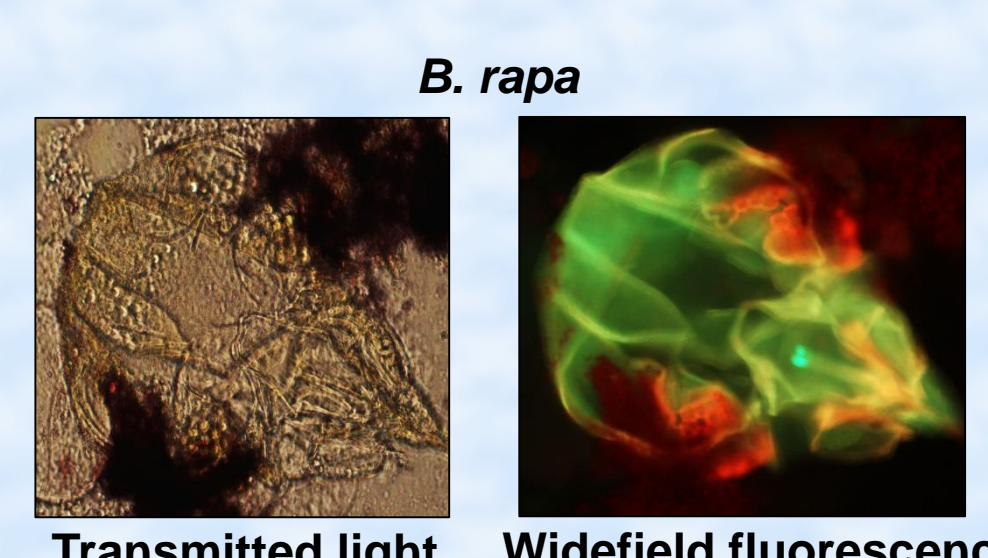
Experiment	<i>B. napus</i>			<i>B. rapa</i>		
	Total number of whitefly heads viewed	Number of whitefly heads with fluorescent signal	% of whitefly heads with fluorescent signal	Total number of whitefly heads viewed	Number of whitefly heads with fluorescent signal	% of whitefly heads with fluorescent signal
1	124	19	15.32%	149	11	7.38%
2	81	19	23.46%	79	7	8.86%
3	86	29	33.72%	94	6	6.38%
4	84	15	17.86%	96	7	7.29%
5	100	20	20.00%	97	11	11.3%

% foreguts with fluorescent signals & relative Δ



Transmitted light

Widefield fluorescence



Transmitted light

Widefield fluorescence

Acknowledgments:

