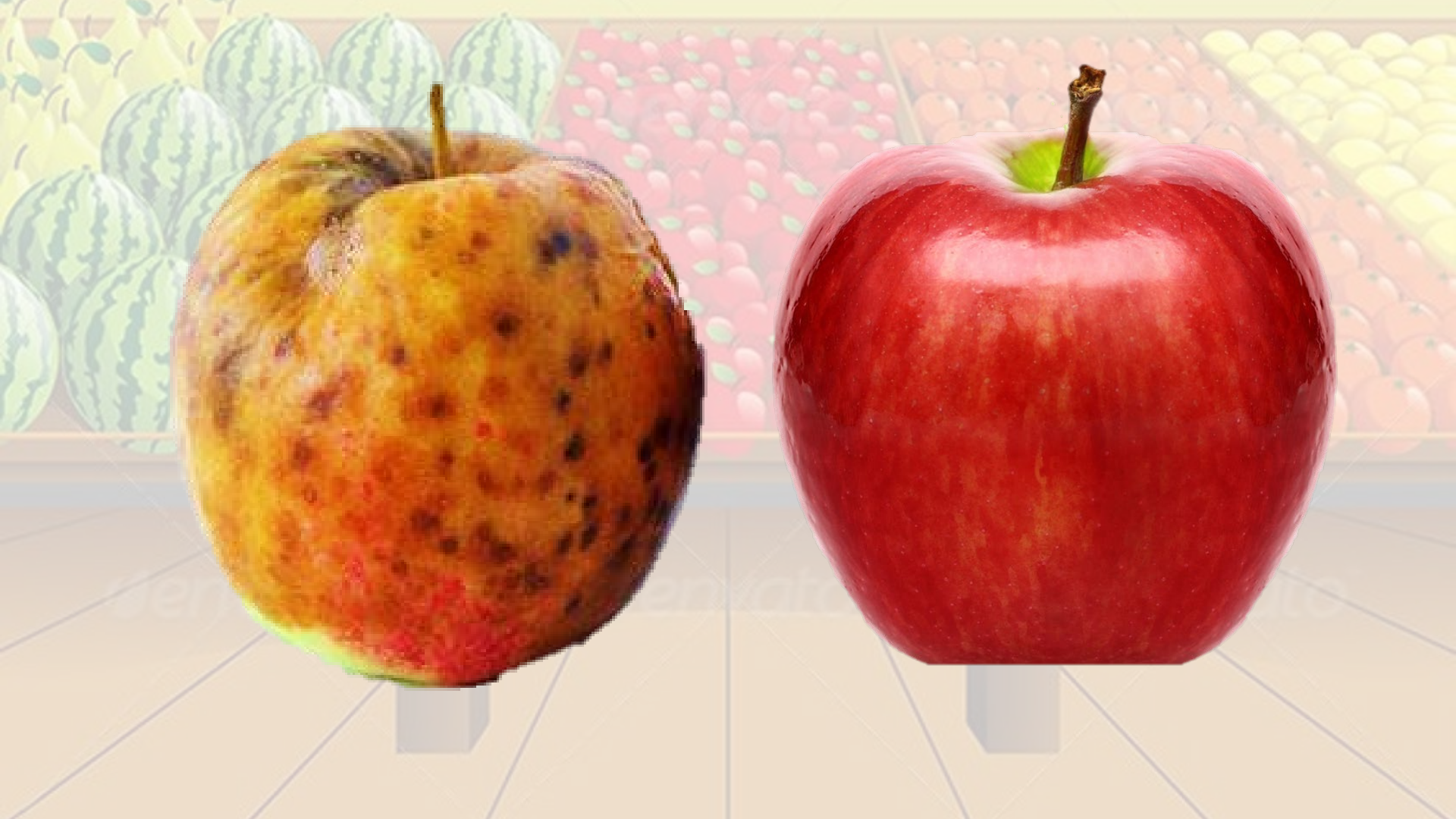










university of
 groningen



Natural Plant
 Defense



From Honey to High-Tech Adhesives

A Sticky Alternative to Pesticides

Abinaya Arunachalam

University of Groningen, The Netherlands

20-11-2025



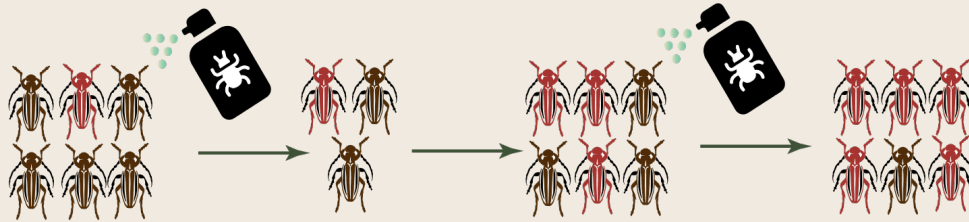
The Problem:



Harm to non-target organisms



Health risks



Development of pesticide resistance





Let's just ask the expert then?





Natural trichomes (*Drosera*)

In sundew (*Drosera*):
Stalked glands: secrete a sweet mucilage
to attract and capture the prey



ct



Design Principles



01

**Water -based
adhesive**

02

Biocompatible

03

**Tunable
properties**

04

Sprayable

05

Insect trapping

10

Natural deep eutectic solvents (NaDES)

- Mixture of solids at a specific molar ratio (eutectic point) forms a liquid at room temperature.
- Biobased
- Retains water



Glucose
(G)

Fructose
(F)

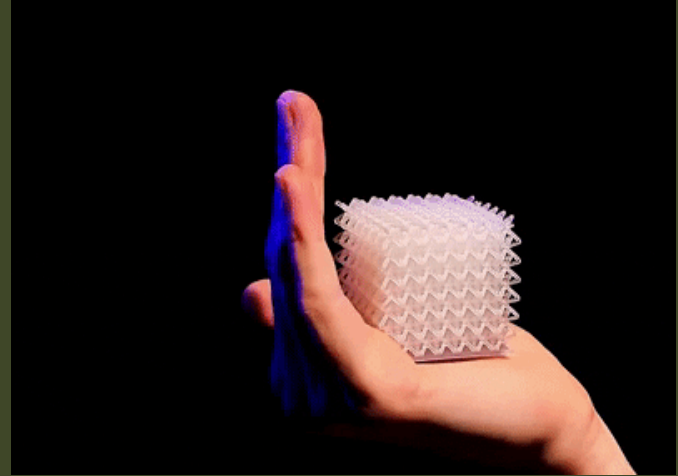
Sucrose
(S)

Water
(H)

GFSH
1:1:1:11



Viscous enough to establish good contact



Elastic enough to resist separation

Adhesive Properties

Tuning biopolymer content

Increasing hyaluronic acid content transitions from liquid-like to solid-like behavior.



Liquid-like

Solid-like

Increasing [biopolymer]

Design Principles



Water -based
adhesive



Biocompatible



Tunable
properties

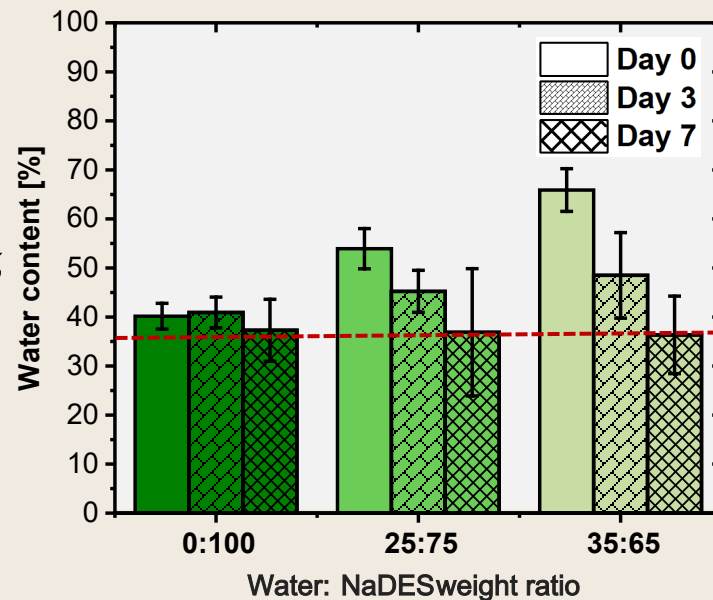
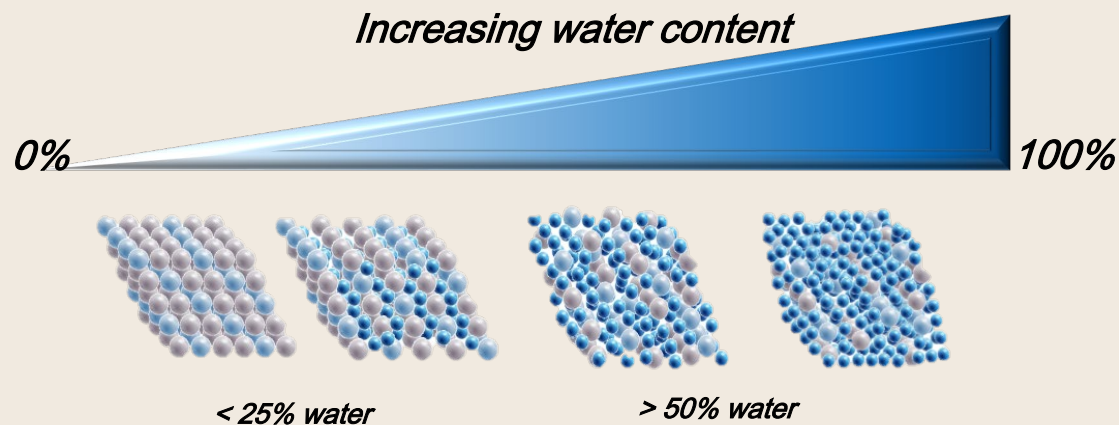
04

Sprayable

05

Insect trapping

Water addition



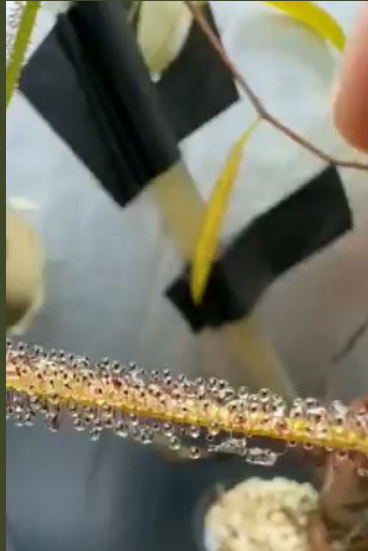
Sprayability





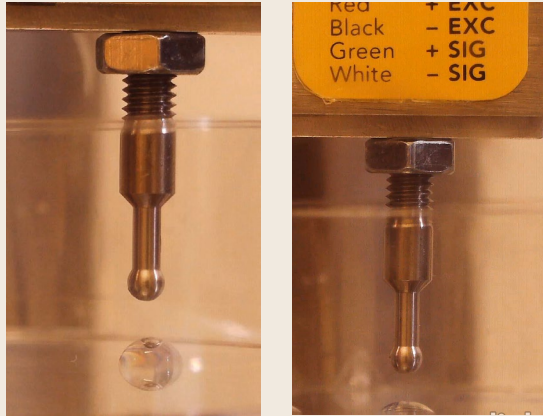
Trichome mimics
vs.
natural exudate

Does it work?

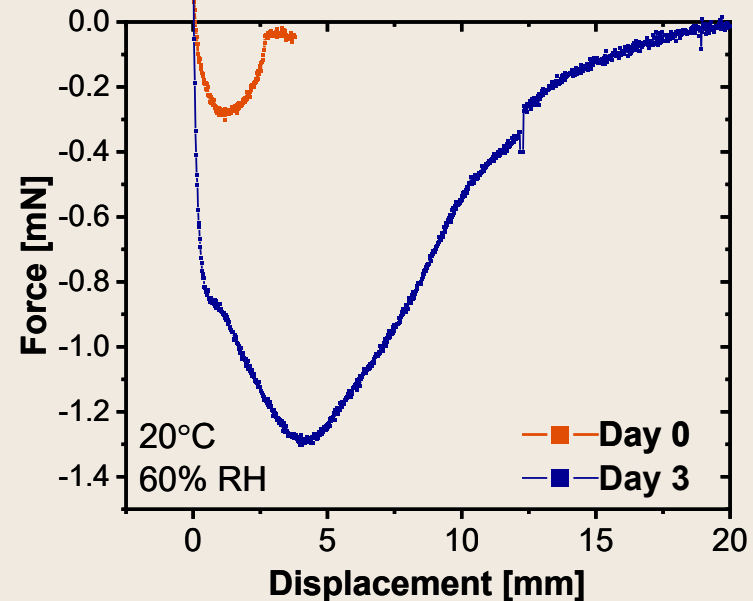


Adhesion testing

- 🌱 Adhesion energy increases significantly over time upon equilibration.
- 🌱 Formation of long fibrils which could potentially ensure that a trapped insect cannot escape easily.



8x speed







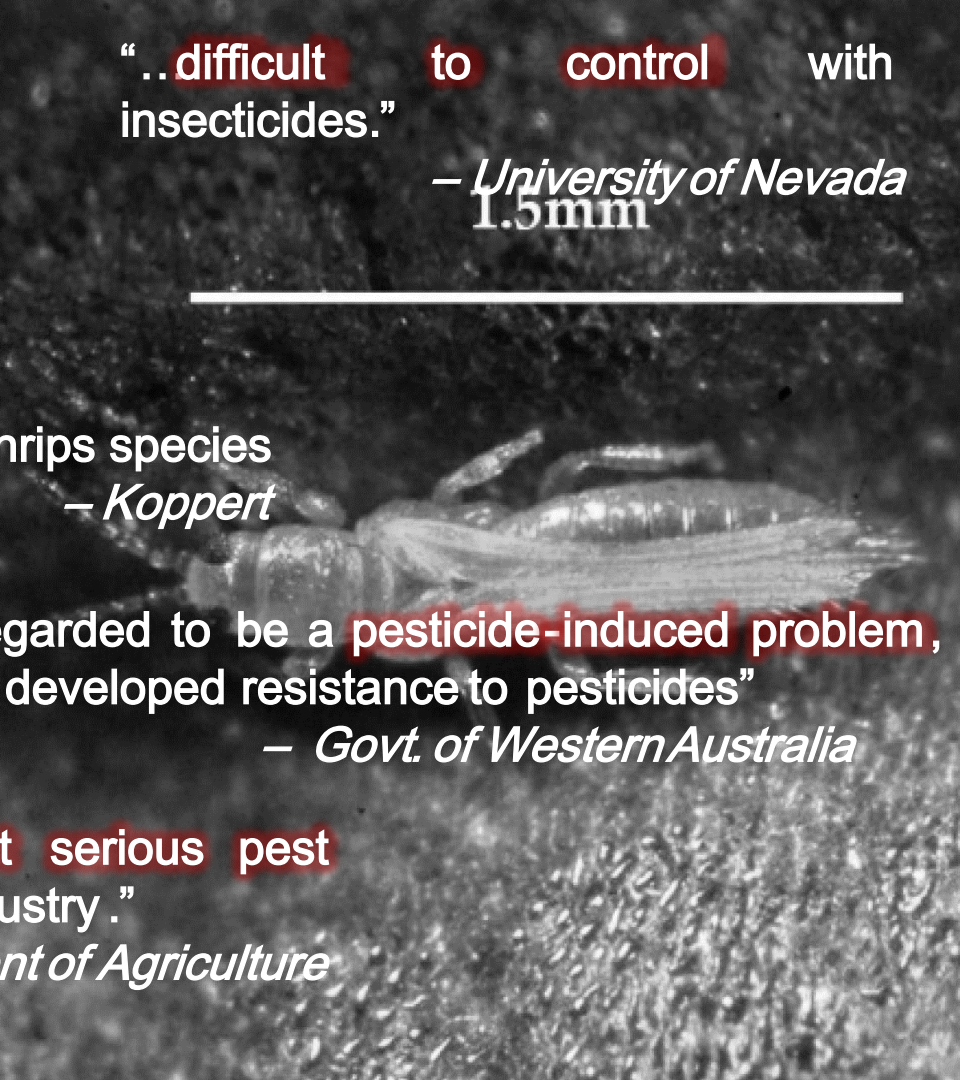
“..widespread and the most serious pest of greenhouse floricultural crops in much of the world.”
– *NCstate University*

“...currently the most damaging thrips species in many greenhouse crops.”
– *Koppert*

“...has become one of the most serious pest problems facing the ornamental industry.”
– *USDepartment of Agriculture*

“..difficult to control with insecticides.”

– *University of Nevada*
1.5mm



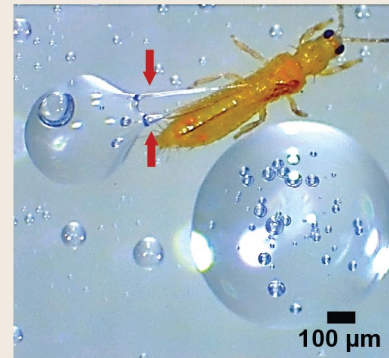
“..is regarded to be a pesticide-induced problem, having developed resistance to pesticides”

– *Govt. of Western Australia*

20 Thrips behavioural study

Thrips get trapped with legs in multiple droplets.

Long fibrils observed in many thrips trying to escape.



Design Principles



**Water -based
adhesive**



Biocompatible



**Tunable
properties**



Sprayable

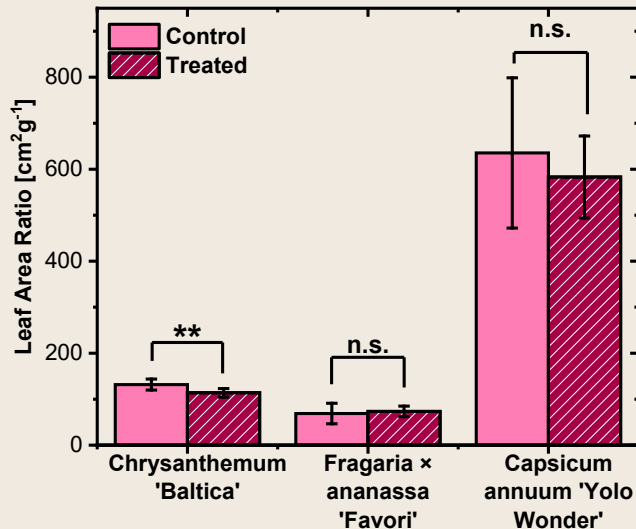


Insect trapping

Ongoing work

🌱 No phytotoxic effects observed for two weeks.

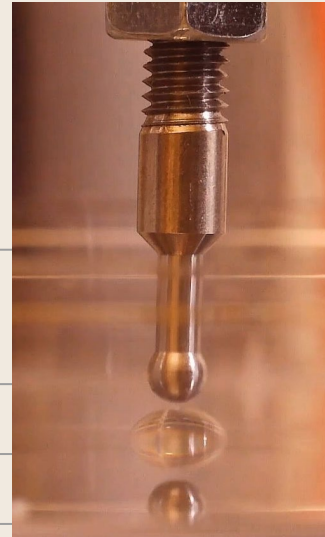
🌱 Optimization at high humidity.



Relative Growth Rate

Control

Treated

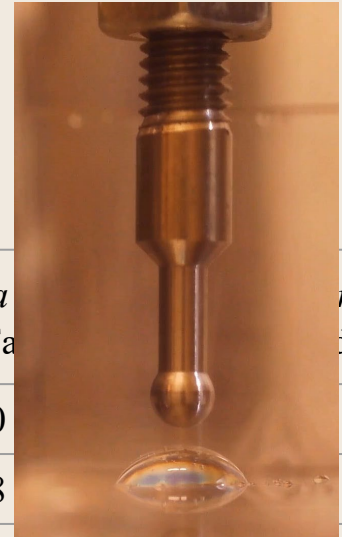


Viscous, liquid-like

Fragaria x ananassa 'Favori'

0.0090

0.0148



Viscoelastic



Prof. Marleen Kamperman (Supervisor)

Dr. Peter Dijkstra (Technician)

Aaltje van der Molen (Master student)

Elise LeCornec (Master student)

Dr. Mirka Macel (Aeres)

Dr. Bram Knegt (Aeres)

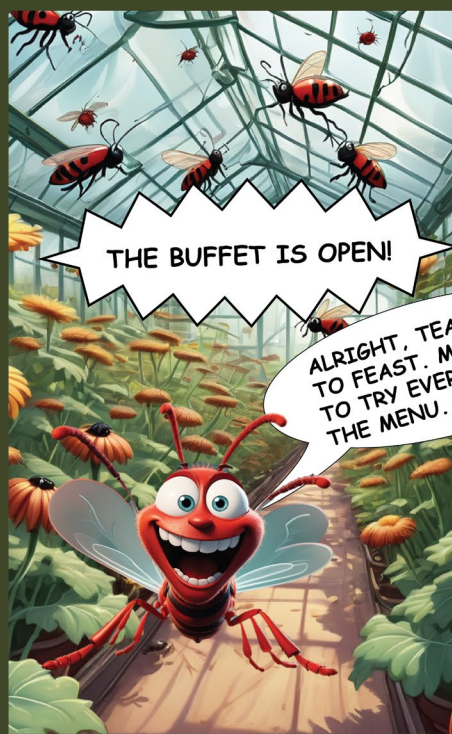
Tim Oosterhoff (Bachelor student, Aeres)

Isabel Breet (Bachelor student, Aeres)

Dr. Thomas Kodger
(Wageningen)



Natural Plant
Defense



Scan for more details!

Arunachalam, A. *et al.* (2025);
Communications Materials (1), 1-12.

Abinaya Arunachalam
a.arunachalam@rug.nl

Thank You!