KU LEUVEN

Towards Automatic Insect Identification in Flanders: some recent research results brought closer to the field

MeBioS

smart protect
IPM THEMATIC NETWORK

AGENTSCHAP INNOVEREN & ONDERNEMEN

Vlaanderen is ondernemen

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Our research group in Leuven (Belgium)

- Developing new **sensing technologies** and **advanced data analytics**
- Focus on agrofood applications
- Active research in **automatic insect recognition**
  - **Image analysis** and **wingbeat data** are key areas of focus

- Presenting: **Overview** of the current status of both areas

Manual monitoring is inefficient

- Time consuming
- Low resolution in time and space

Towards automated insect monitoring

Many researchers and companies are working towards solutions to automate the process

Essentially, there are **three main lines of techniques**:

1. Imaging systems
2. Wingbeat analysis
3. Remote sensing (weather/UAV/satellite data)

Besides these three there are some alternatives of which one bio-impedance technique is commercially available

Towards automated insect monitoring

Focus of presentation = research into:

1. Imaging systems
2. Wingbeat analysis

… and their status and use in Flanders

Pests specific to our region may have lower priority for international commercial companies.

- Academic research and commercial activities can collaborate in this field.

1. Imaging systems

Very helpful for the analysis of **sticky plates**.

Especially helpful for somewhat **larger insects** (such as moths), but **more challenging for smaller insects** such as flies.

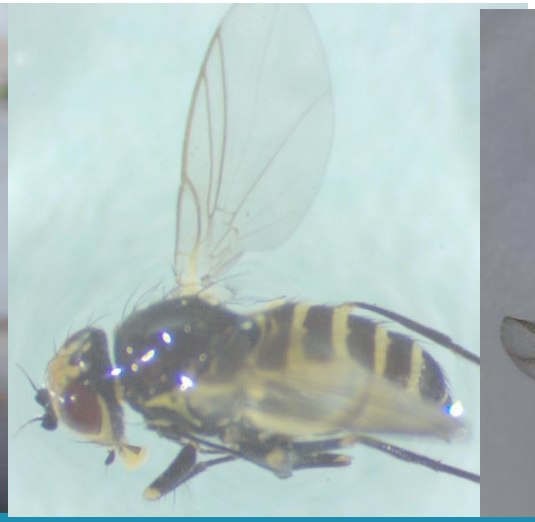
We aim to use affordable camera technologies and state-of-the-art **Artificial Intelligence** to be able to also include these smaller insects.

Automatic image analysis – case study in Flanders

Witloof **chicory** (endive) – rather local crop

Miner flies and **wooly aphids** as two imortant pest insects – both are very small

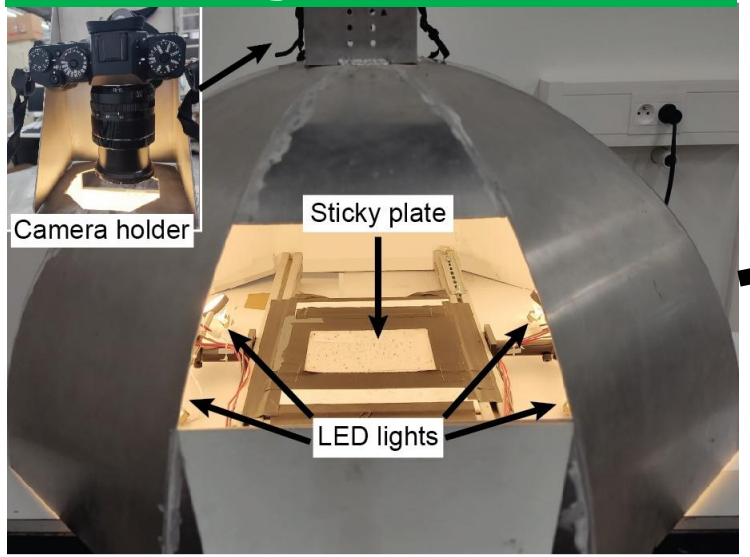




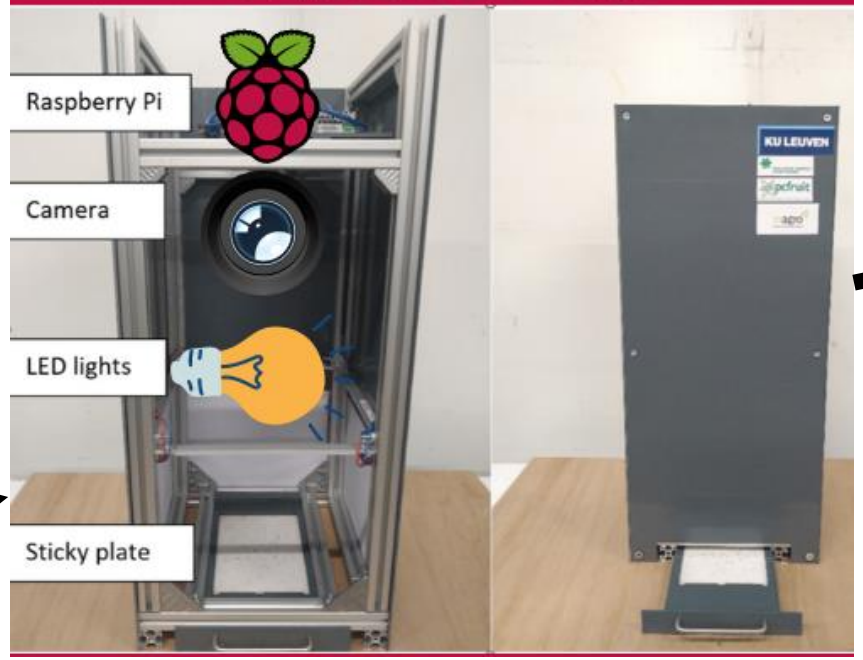

From lab to field

✓ inexpensive & portable

Fuji-Dome



PhotoBox



PhoneBox

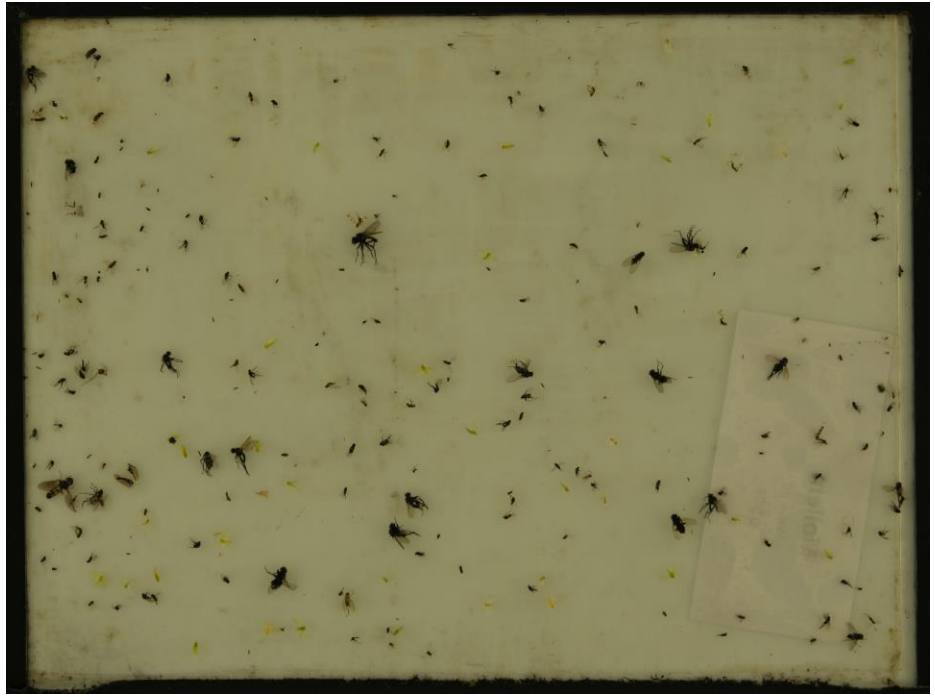
PRAKTIJKPUNT LANDBOUW VLAAMS-BRABANT

used by research stations

inagro

From lab to field

Sticky (colored) plates placed in the field are not selective: one has to cope with many species

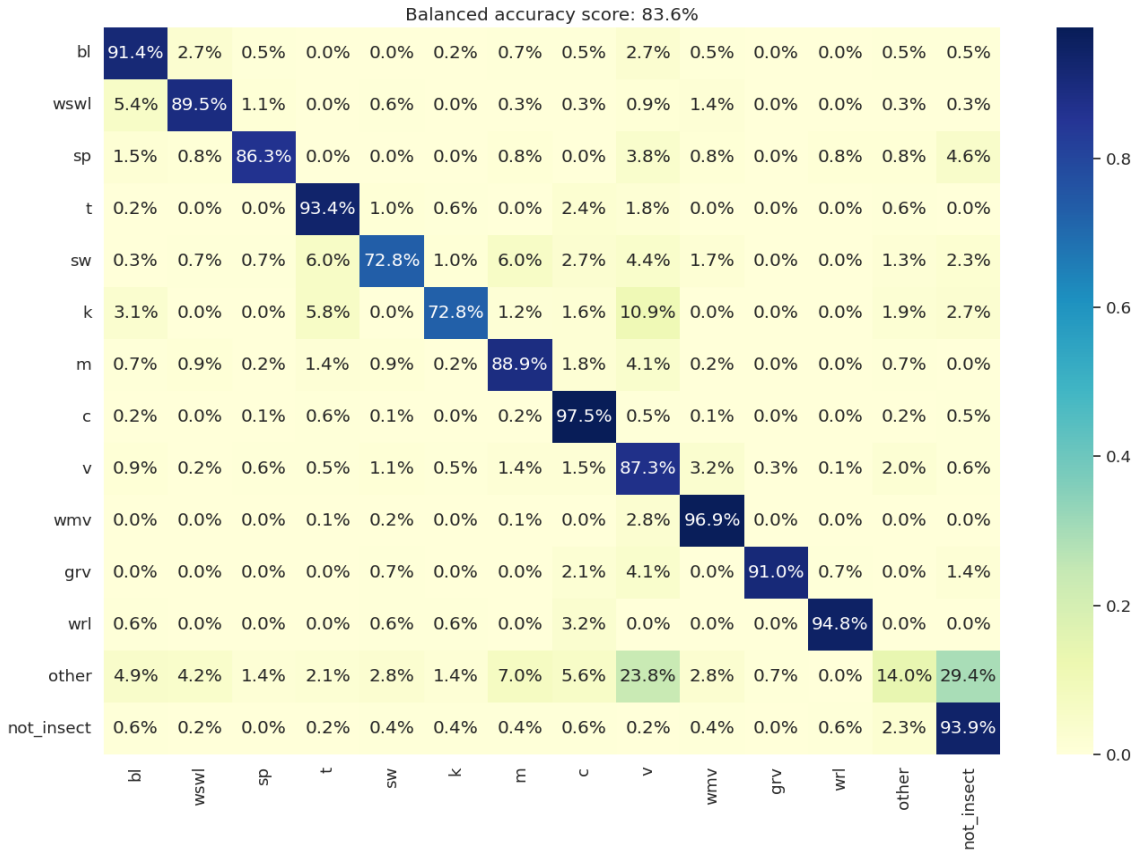


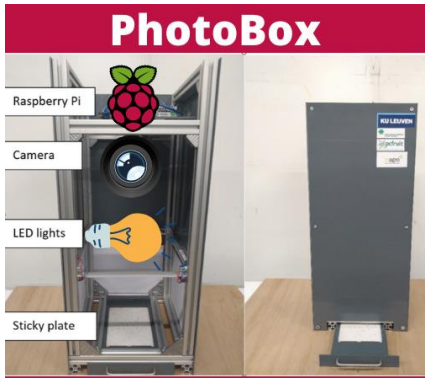
Source: Kalfas, Ioannis, et al. "Towards automatic insect monitoring on witloof chicory fields using stickyplate image analysis." Ecological Informatics 75 (2023): 102037.

Large difference with selective traps using pheromones (e.g. *Delia*)

From lab to field

Multi-class model accuracy based on 34k images in total



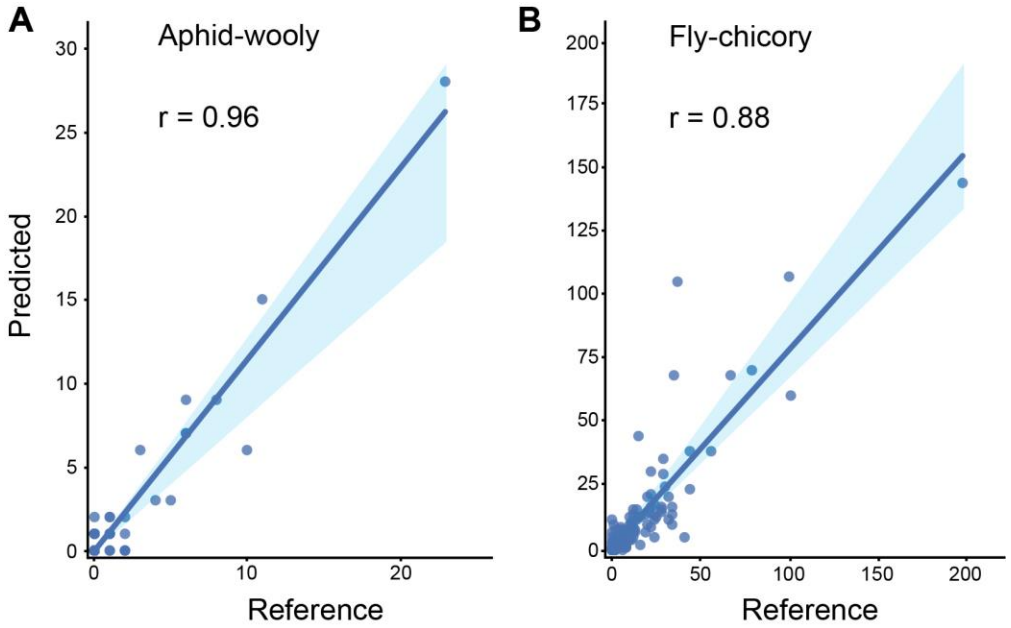


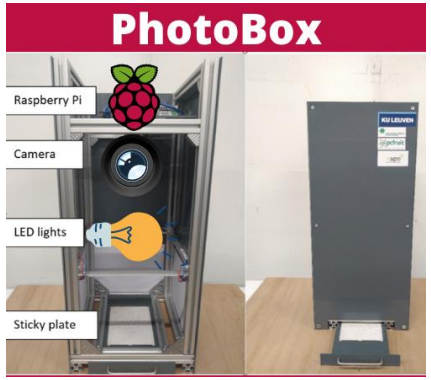
Legend for main target insects:

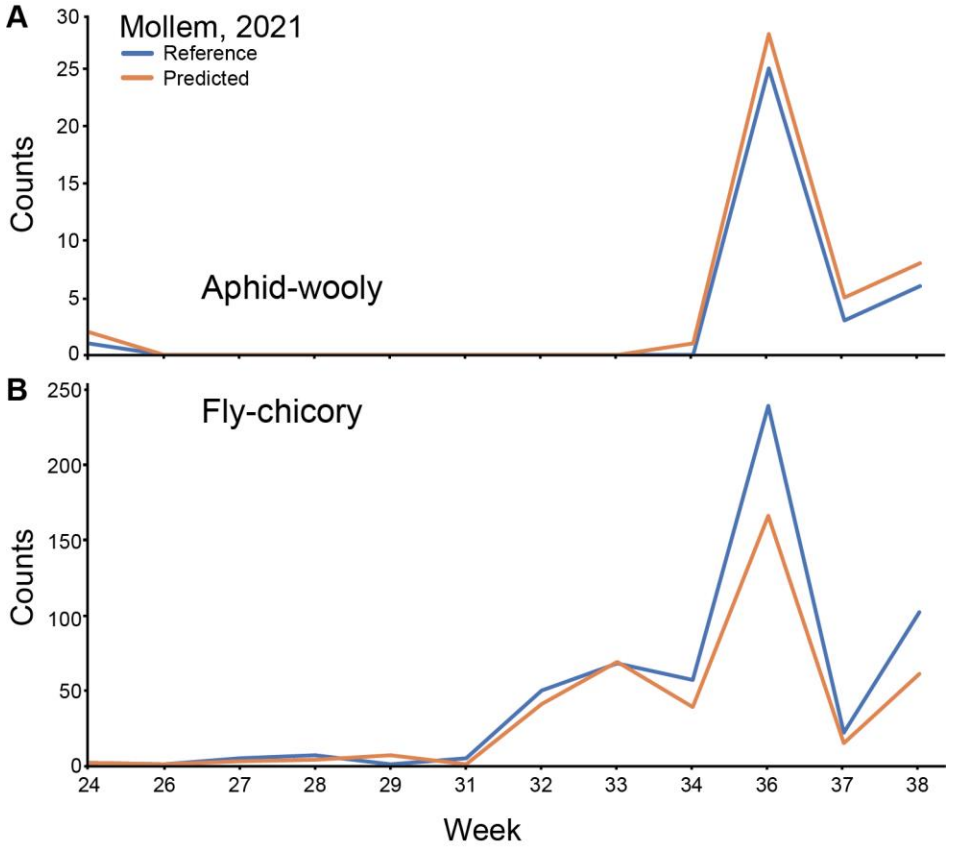
Code name	Full name	Accuracy
wswl	wooly aphid	**89.5%**
sw	parasitic wasp	**72.8%**
wmv	chicory miner fly	**96.9%**
wrl	carrot fly	**94.8%**

Results using the photobox

Works well for monitoring the pests



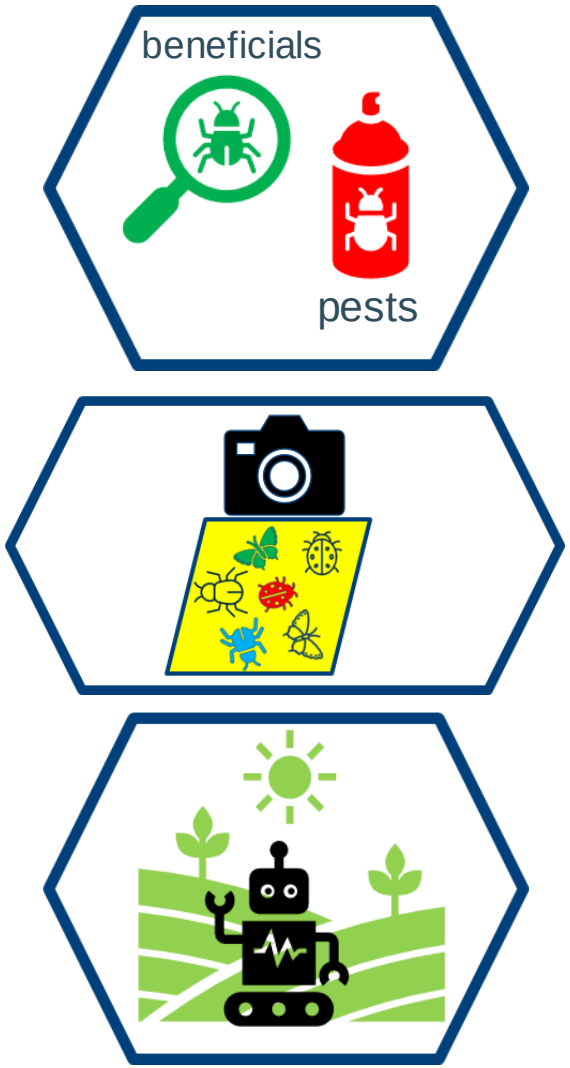




From lab to field – ongoing research

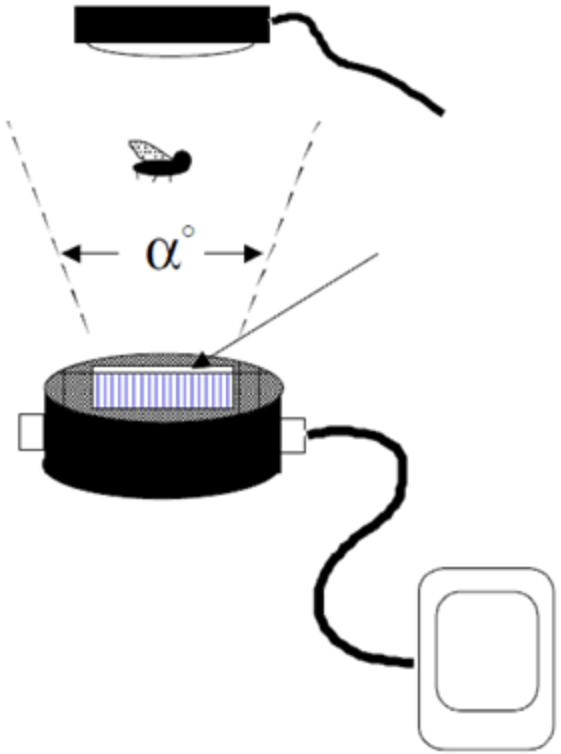
We are currently partnering in several projects bringing the technology closer to practice:

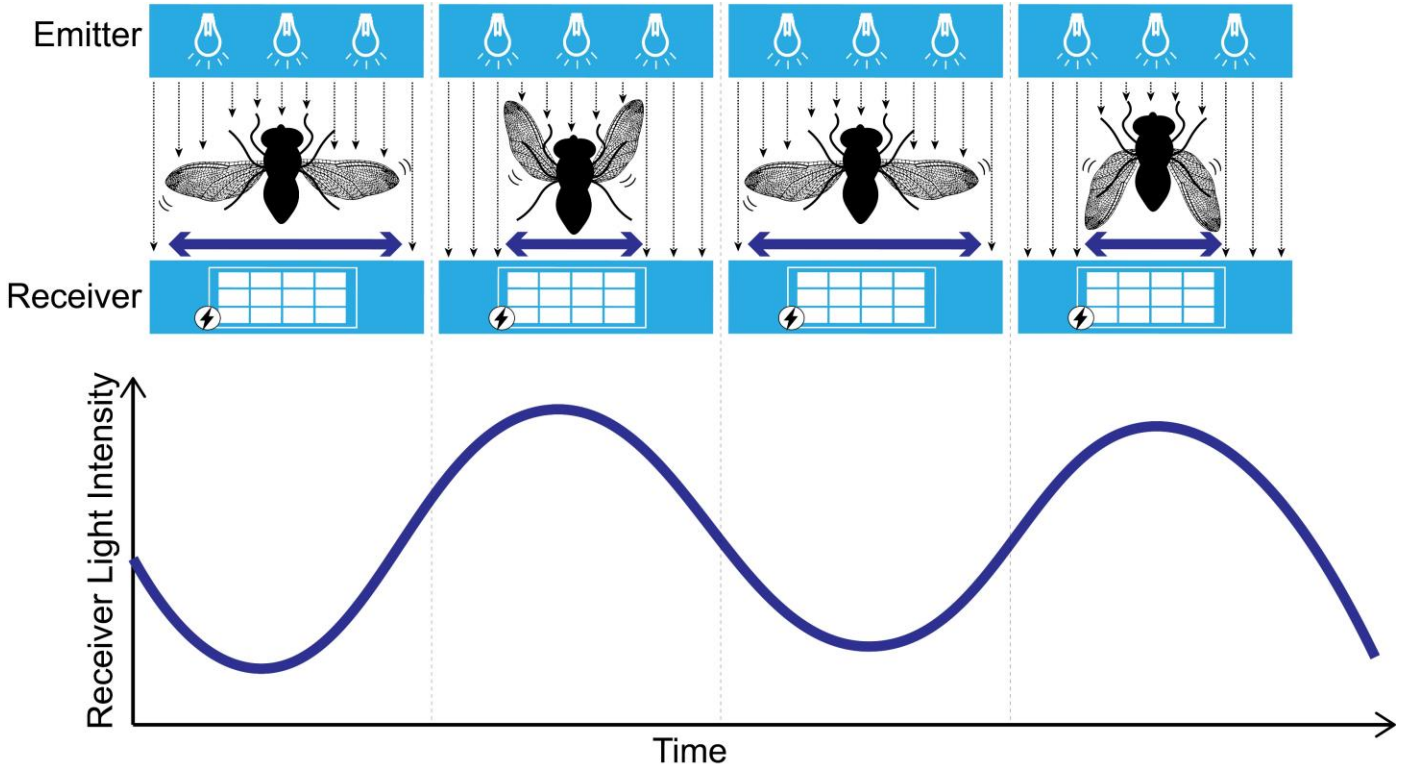
- Involved in action labs with various partners to address important pest insects for Flemish growers.
- Collaborating with grower platforms to develop demonstrators and keep growers up-to-date.
- Investing heavily in Artificial Intelligence for robust and accurate models with minimal labeling effort.



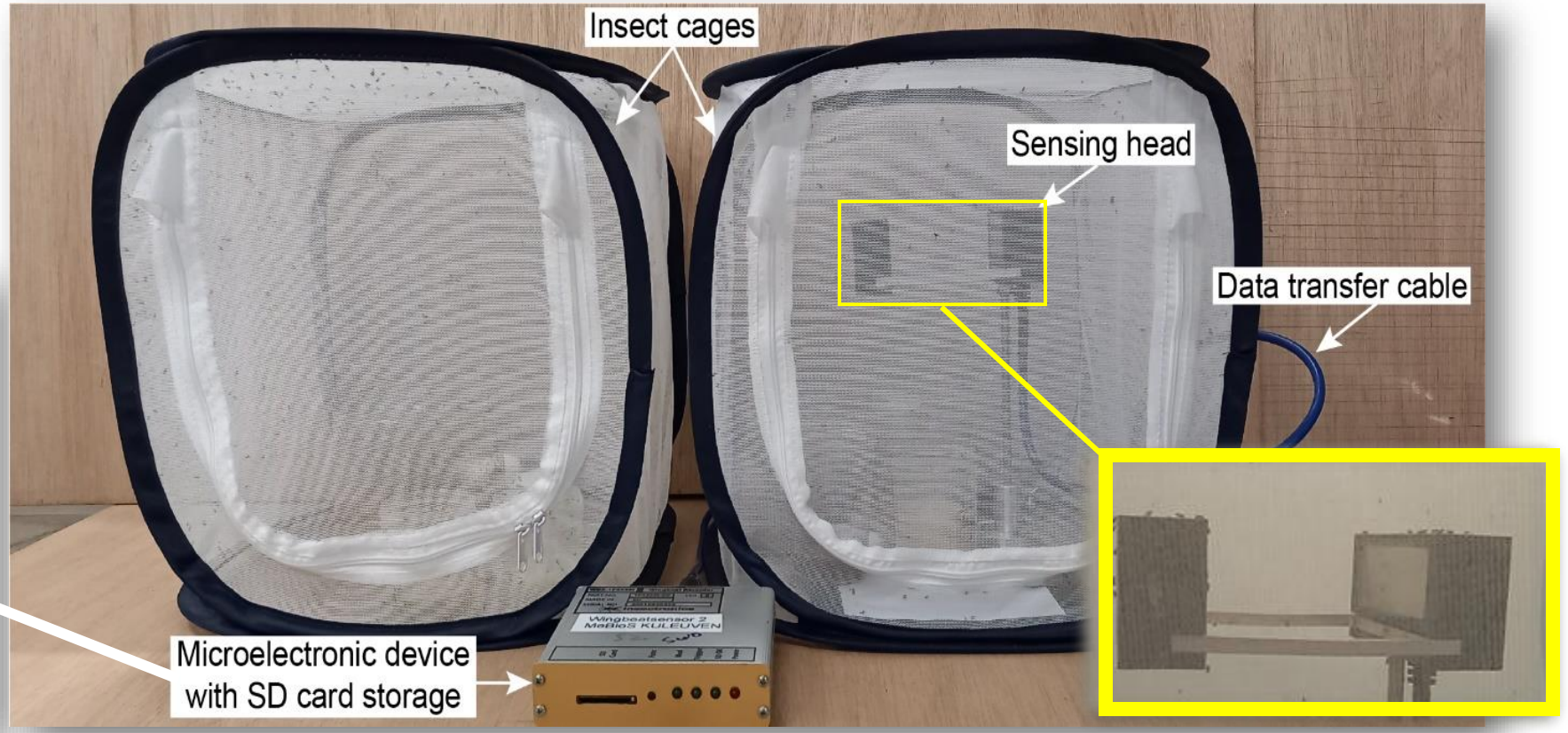
2. Wingbeat analysis

Simple principle – sensitive to small insects





Wingbeat analysis sensor in the lab



Wingbeat analysis sensor in the lab

Case → classifying *Drosophila melanogaster* vs *Drosophila suzukii*

- Measured during two seasons
- Ca 75 000 signals measured

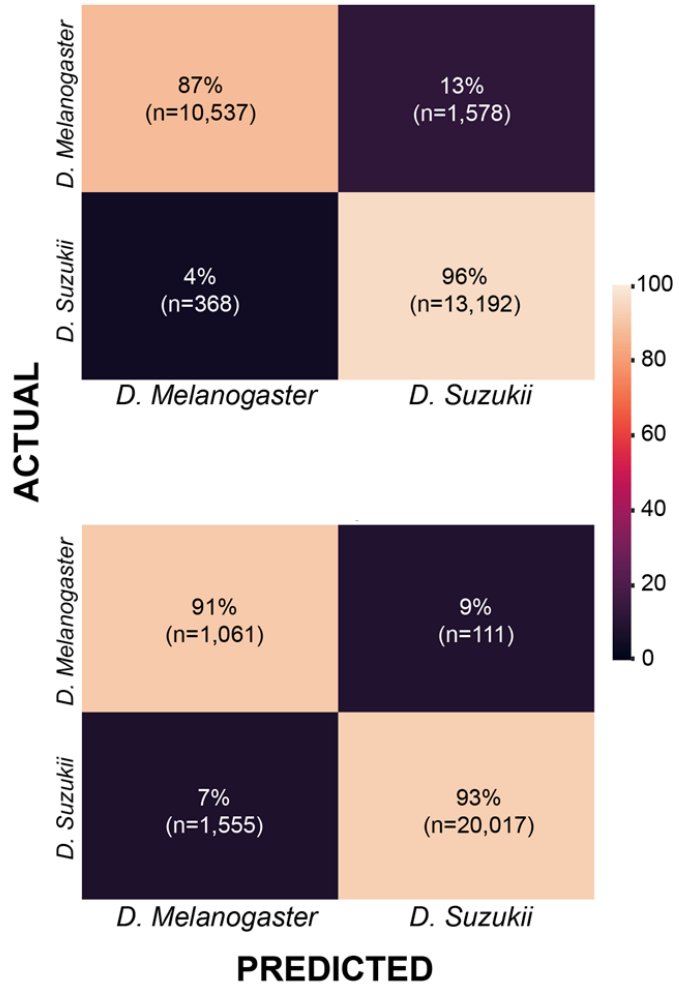
Wingbeat analysis sensor results

InceptionFly
(trained on wingbeats)

- High accuracy: ~92% correct classification
- From lab to field → trials ongoing

Controlled (test)
Balanced Accuracy: **92.4%**

Remote Uncontrolled
Balanced Accuracy: **91.6%**



pcfruit
PROEFCENTRUM FRUITTEELT VZW

✓ 4G
✓ 3D printed

Conclusions

- Significant progress is made in automatic insect recognition
- Both image based recognition and wingbeat analysis provide added value to growers
- Advances in sensor technology and data analysis will further improve the systems that are currently in the market

Thank you!

Our recent research:

Towards automatic insect monitoring on witloof chicory fields using sticky plate image analysis
Optical Identification of Fruitfly Species Based on Their Wingbeats Using Convolutional Neural Networks
Towards in-field insect monitoring based on wingbeat signals: The importance of practice oriented validation strategies

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