Rapid testing technologies- can they help plant health inspectors?

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From Newcastle. For the world.

Summary

- When or why we might use technology
- Technology readiness levels

1. In Field testing – identification
2. In Field testing – identification and detection
3. Remote imaging – detection / surveillance / monitoring tool
4. Sensing – detection
5. Smart surveillance – monitoring / surveillance

When might we use technology ?

1. Import inspection
2. Managing eradication of a disease post incursion into a new region
3. Mapping the spread of disease
4. Providing data on freedom from a disease in a region
5. Early detection of a new disease into a new region
6. Establishing containment strategies or buffer zones

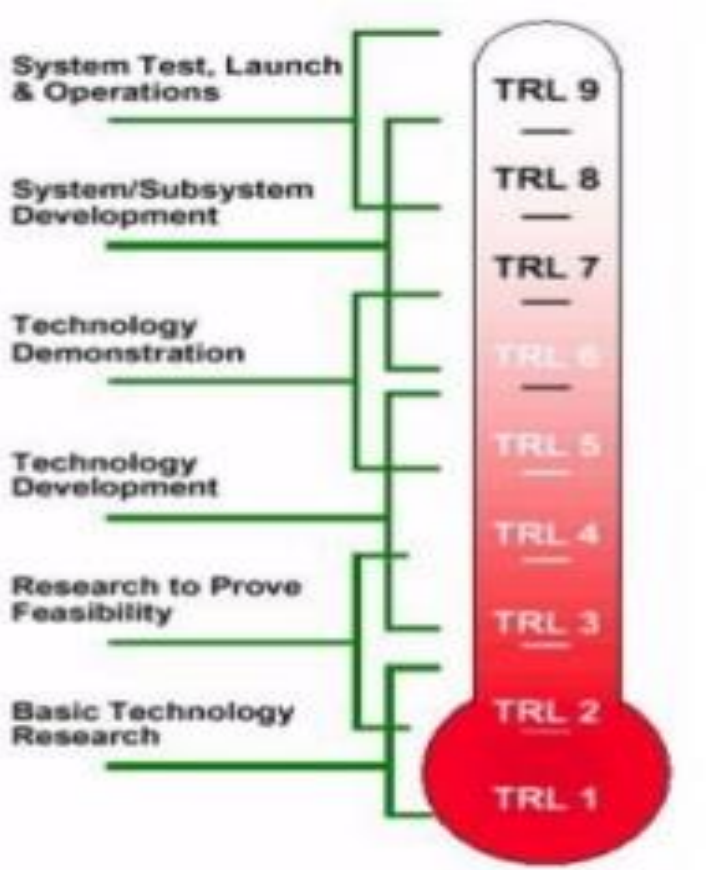
Why might we use technology ?

- Improve speed / accuracy of early identification
  - Reduce friction in trade
  - Benefits to the importers and other down-stream stakeholders
  - Early detection - increasing choice of actions
  - Slow the spread - reducing costs

Technology Readiness Levels

Originally developed by NASA in the 1980s

Level 1 : Basic principles observed and reported
Level 2 : Concept and/or application formulated
Level 3 : Concept demonstrated analytically or experimentally
Level 4 : Key elements demonstrated in laboratory environments
Level 5 : Key elements demonstrated in relevant environments
Level 6 : Representative of the deliverable demonstrated in relevant environments
Level 7 : Final development version of the deliverable demonstrated in operational
Level 8 : Actual deliverable qualified through test and demonstration
Level 9 : Operational use of deliverable

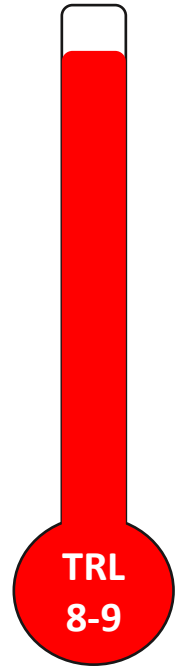


* Level 1: Basic, Level 2: Applied, Level 3: Prototype

http://en.wikipedia.org/wiki/Technology_readiness_level
http://www.nstda.or.th/nstda-km/92-km-knowledge/2770-technology-readiness-levels-

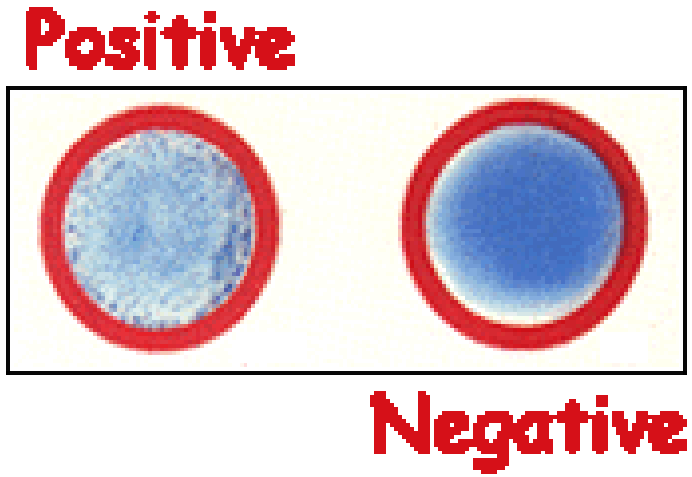
1 –In-Field testing - specific

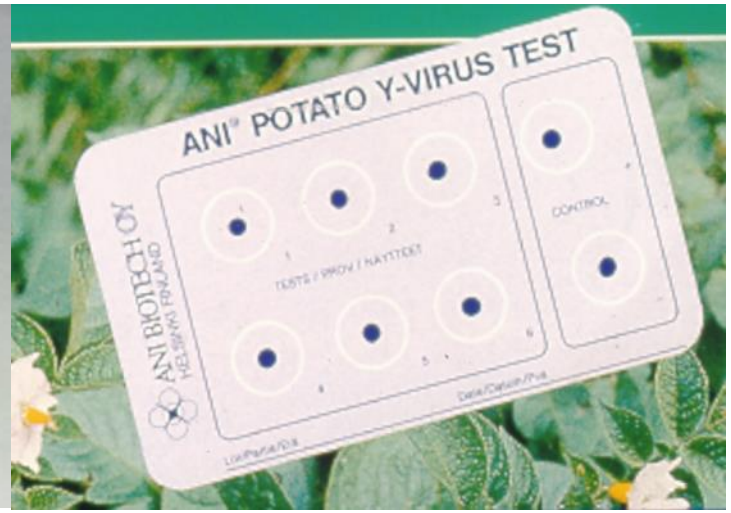
- Portable technologies that provide a yes/no answer enabling identification of a pest
  - Lateral flow devices (LFDs)
  - DNA technologies



Latex agglutination – 1980's

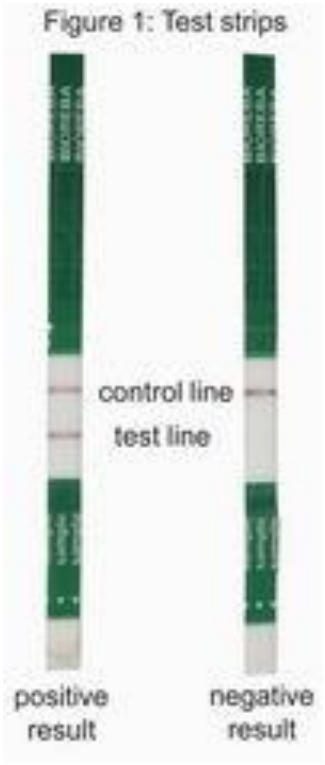
- Chemistry set
- Stored at 4°C
- Difficult to interpret
- Multiple steps





Lateral flow devices : 2000’s

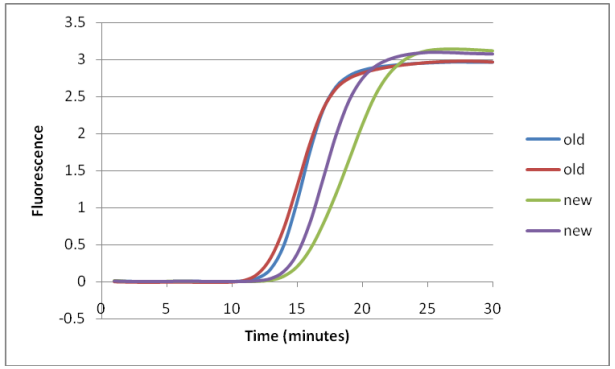
Bioreba : AgriStrip



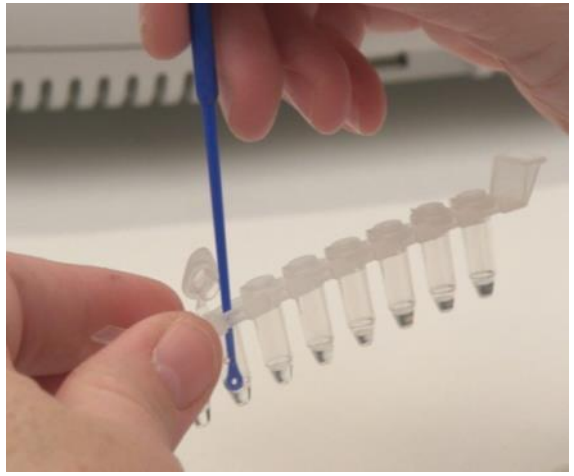
Agdia : Immunostrips

Forsite : Pocket Diagnostic

Guignardia citricarpa LAMP



Results in
10-15 mins



Trial of methods with inspectors

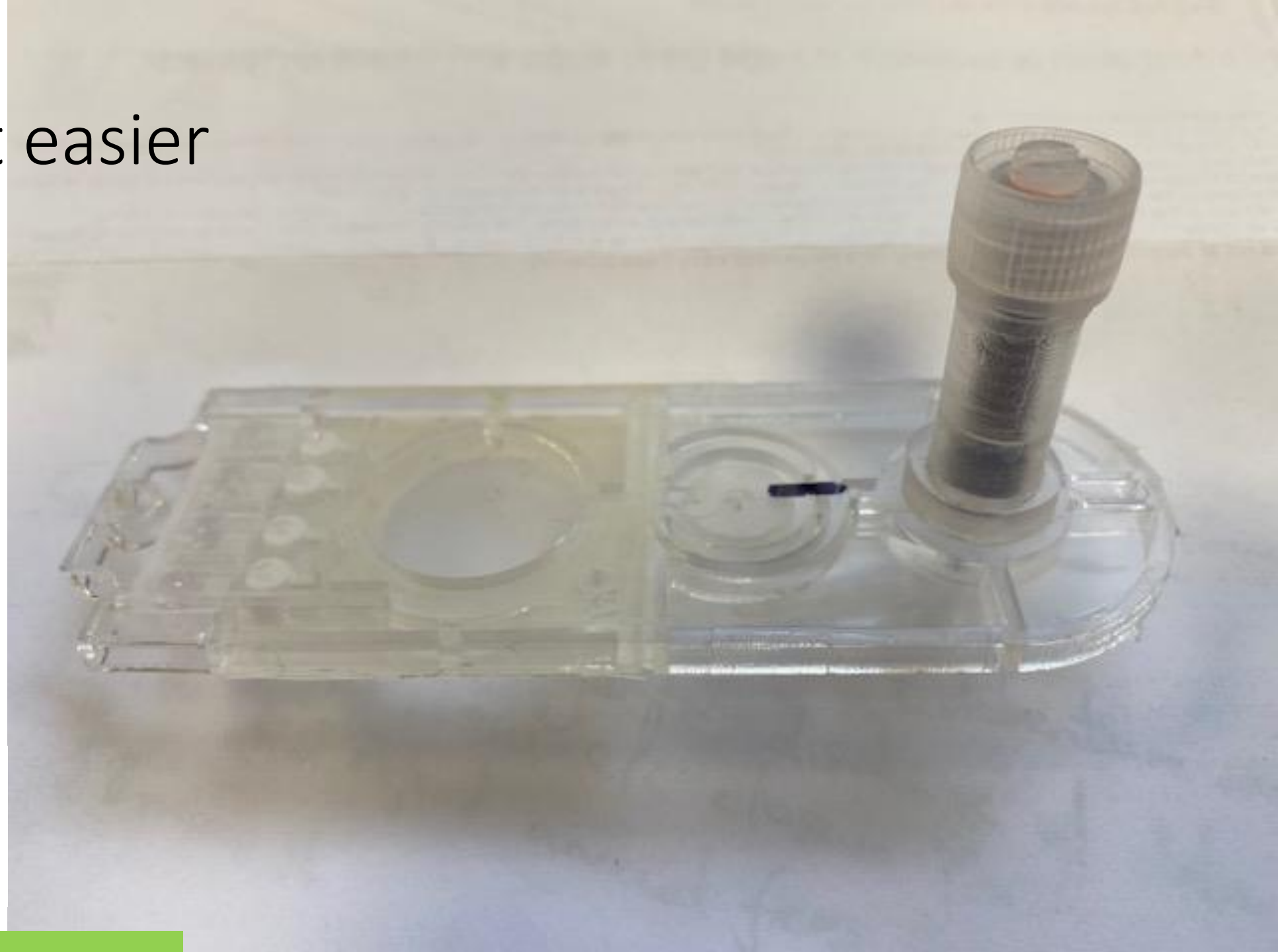
2013 – complete deployment for identification of 5 priority quarantine targets at Heathrow and Zurich airports

“...not much more involved than using a LFD kit...”

“The instrument itself also seemed very simple and easy to use.”

“It was impressive how quickly you could get a result...”

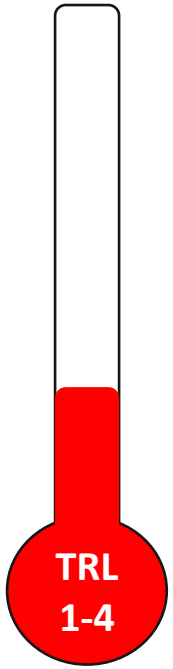
Making it easier



OptiSense

2 - In-field testing – non-specific

- Generic technologies that can be used to identify what organisms are present in a sample
  - High throughput sequencing
  - iKnife



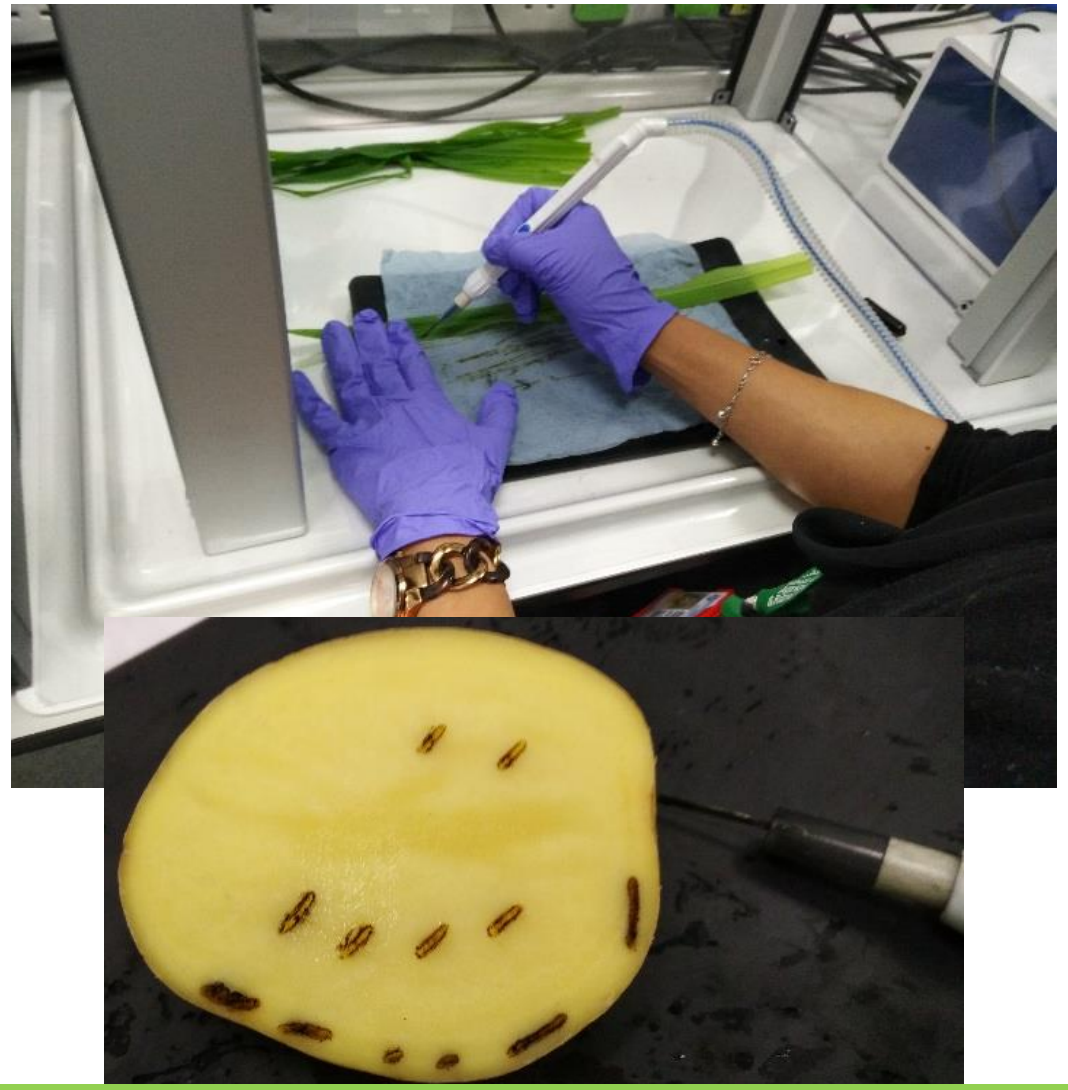
High-throughput sequencing

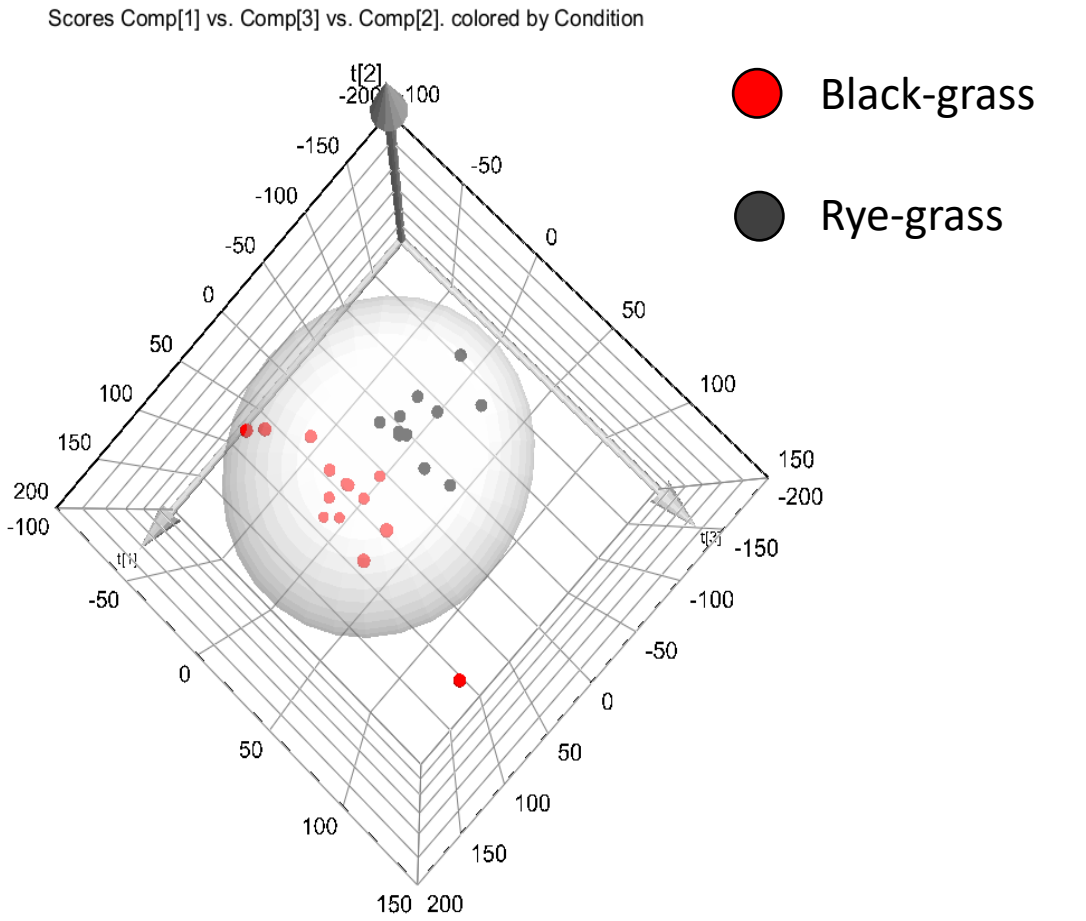
Illumina sequencing

MinIon Sequencing


http://www.lauraboykinresearch.com/blog

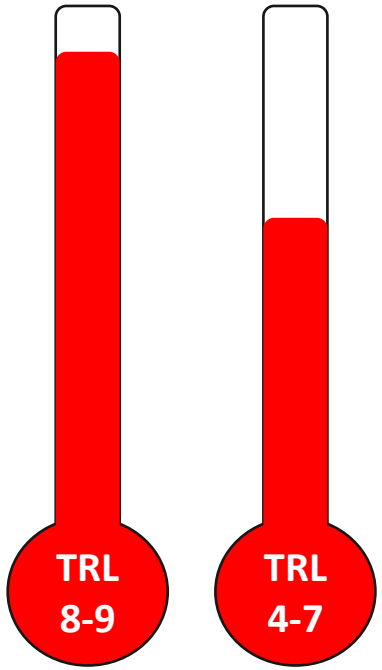
iKnife technology for grass species identification





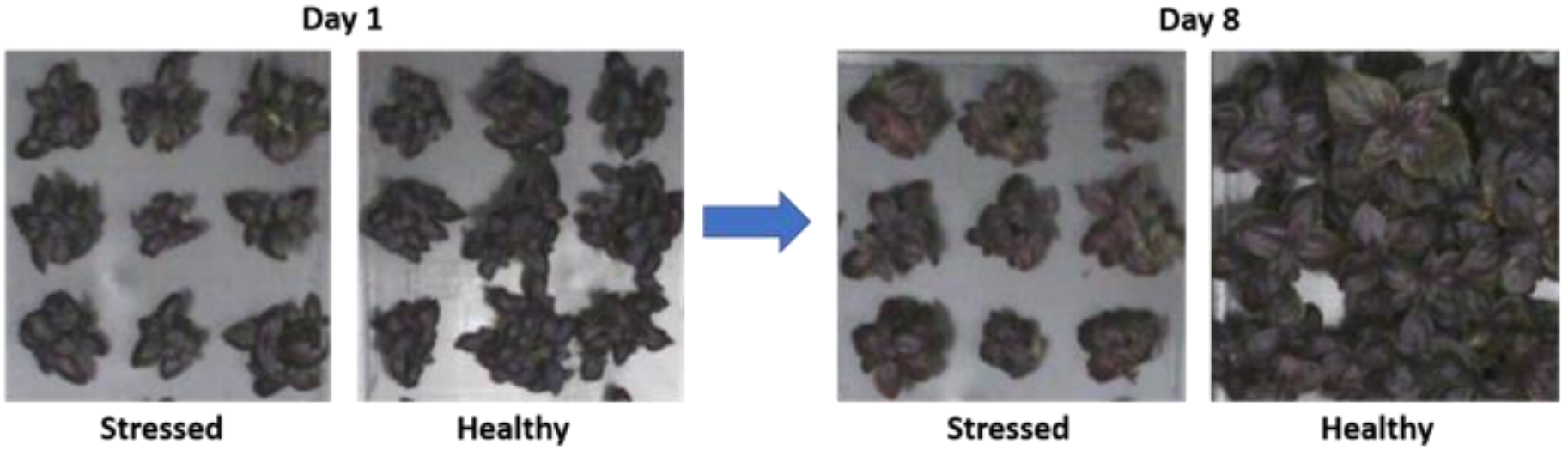
3 - Remote imaging

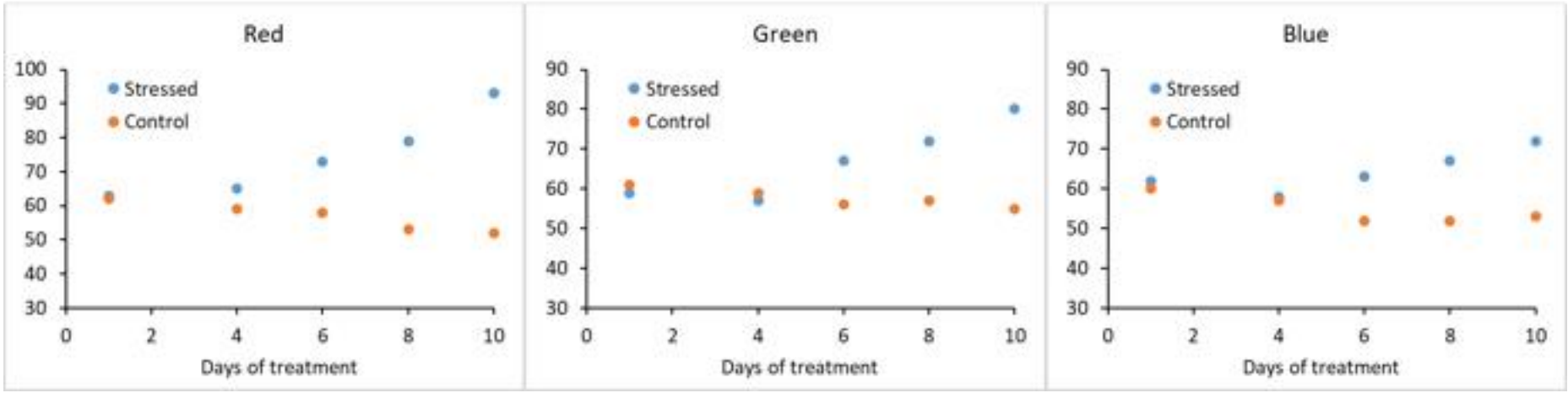
- Methods that can be used to see the presence or signs of a disease from a distance
  - Different spectra
  - Different deployment scales



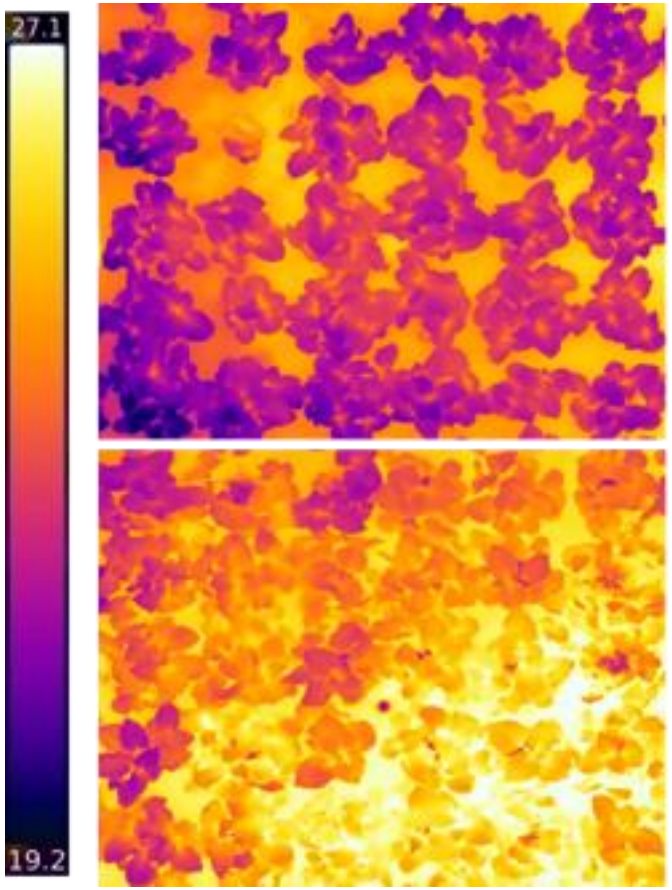
Visual assessment

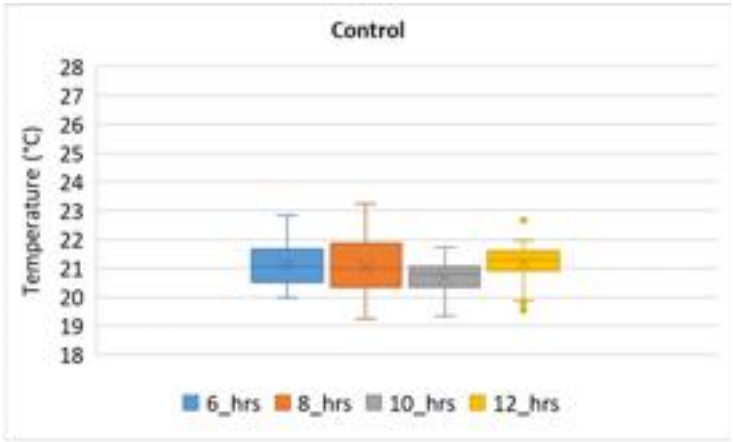
RGB analysis of stressed plants

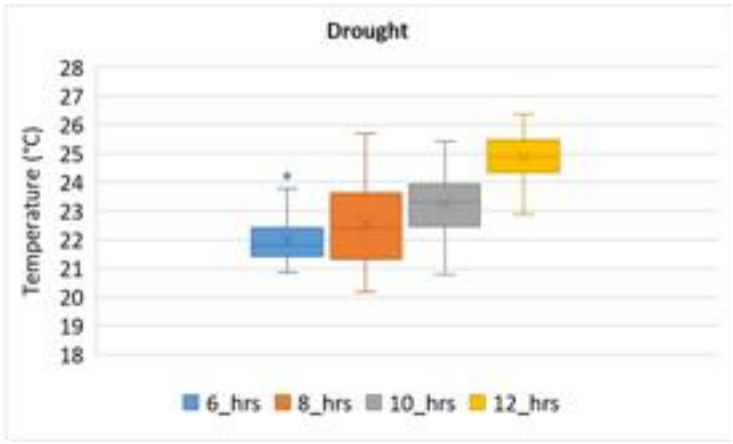




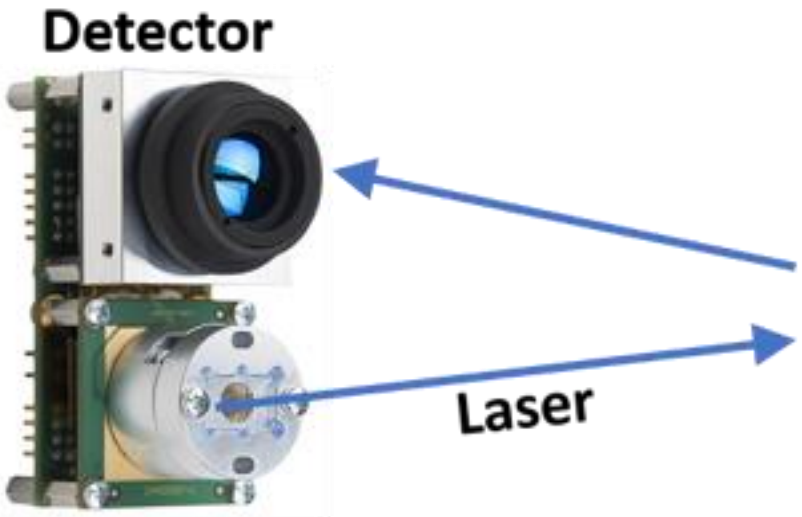
IR-thermography – abiotic stress

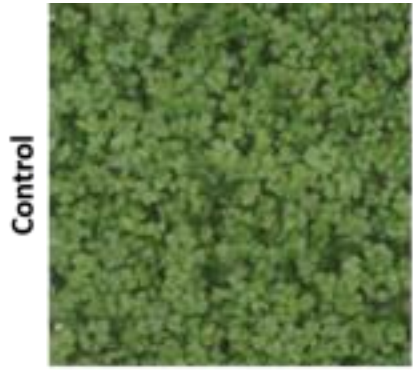


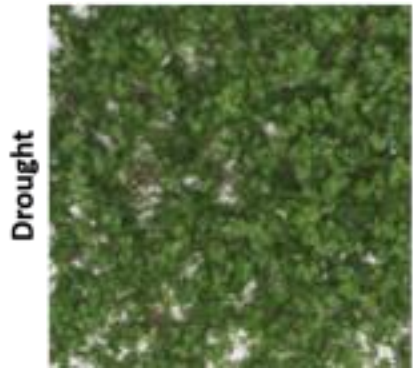


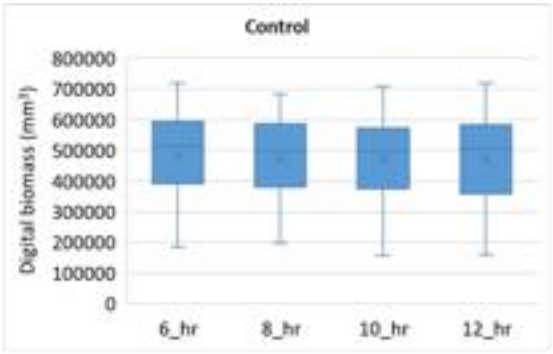


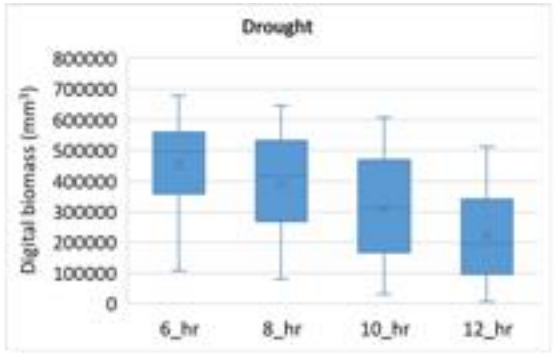
Laser scanning for canopy structure

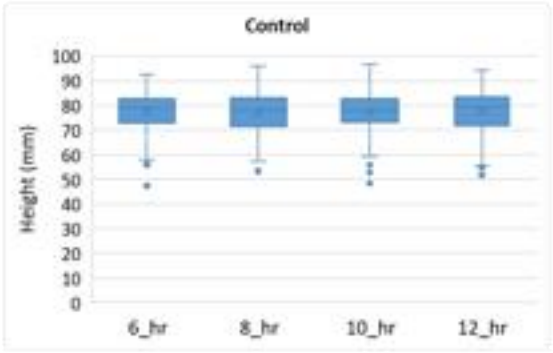












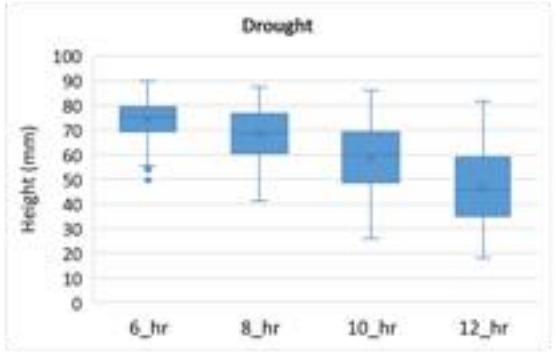
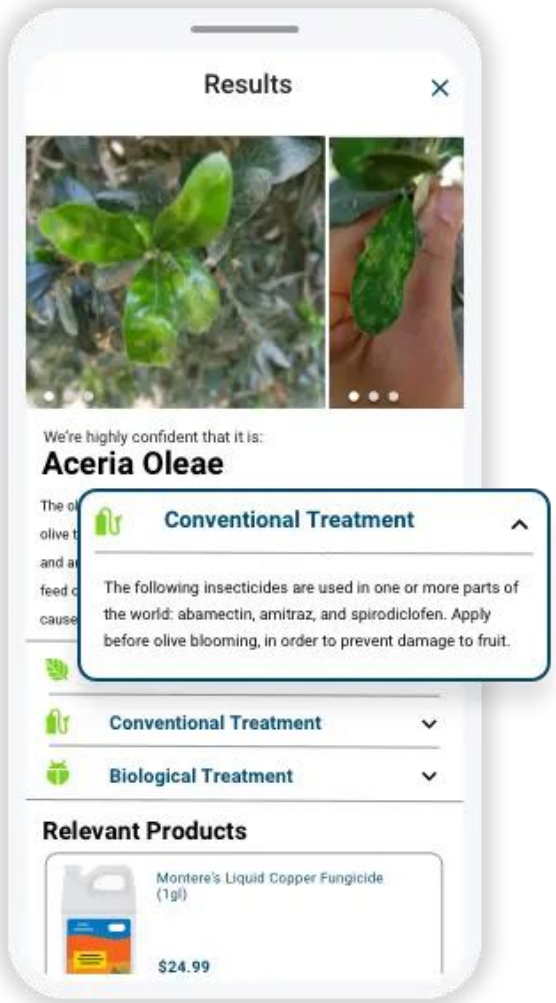
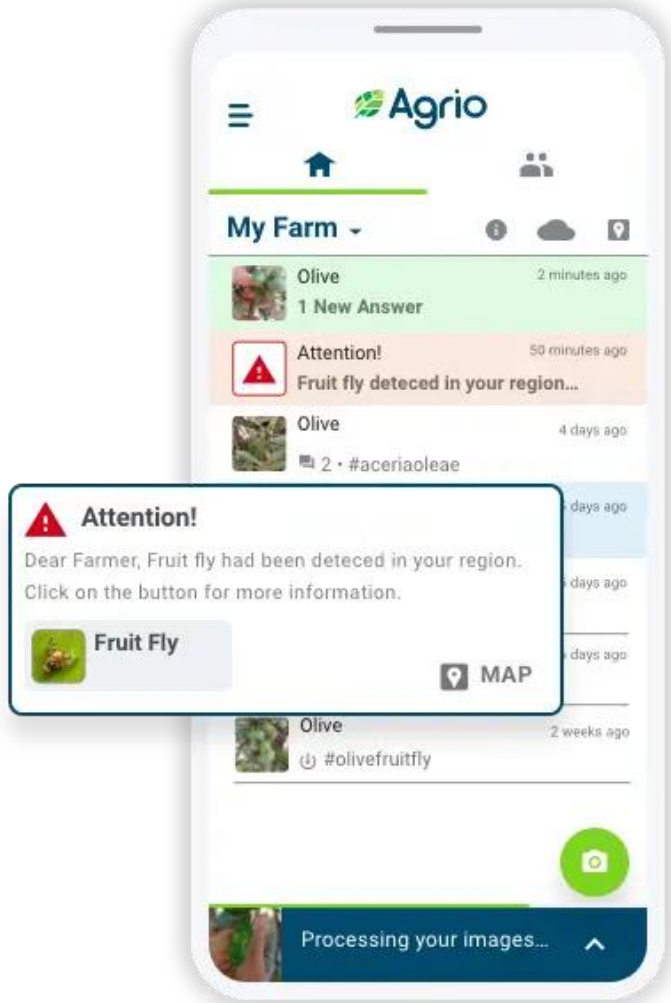


Image recognition and AI



- Identify symptoms
- Recommend actions
- Inform people of threats



Deployment at different spatial scales

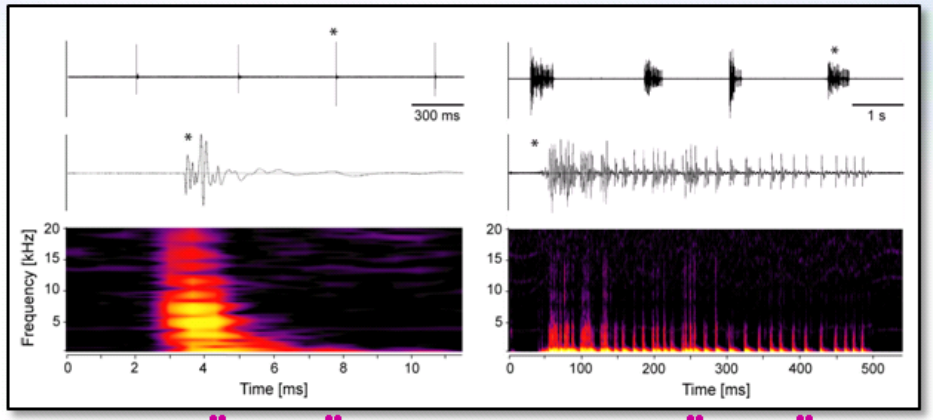
4 - Sensing

- Technologies that can be used to test for the presence of an organism in a location
  - Acoustics - sounds
  - Volatiles - smells

Acoustics – listening for pests

OUTCOMES SO FAR: - larval sounds of target wood boring insect pests were recorded with the laser vibrometer and the microphone – a **library of larval sounds** is established
- **protocols for detection methods** prepared for the WP2
- laser vibromety was tried and tested and its sensitivity and specificity were compared to the microphone method; the advantages/disadvantages of the **non-contact** laser technique in comparison to previosly used **contact** acoustic methods for detection of wood boring insects will be disscussed in the final project report and published in EPPO publications

	LASER VIBROMETER	MICROPHONE
SENSITIVITY	0.88 (0.75-1)	0.84 (0.70-0.95)
SPECIFICITY	0.88 (0.75-1)	0.66 (0.50-0.70)



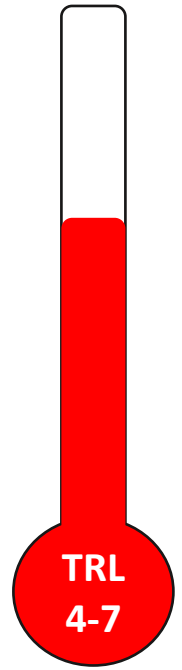
"CLICK" "RASP"

Cooperation with FP7 project Palm Protect on the RPW research

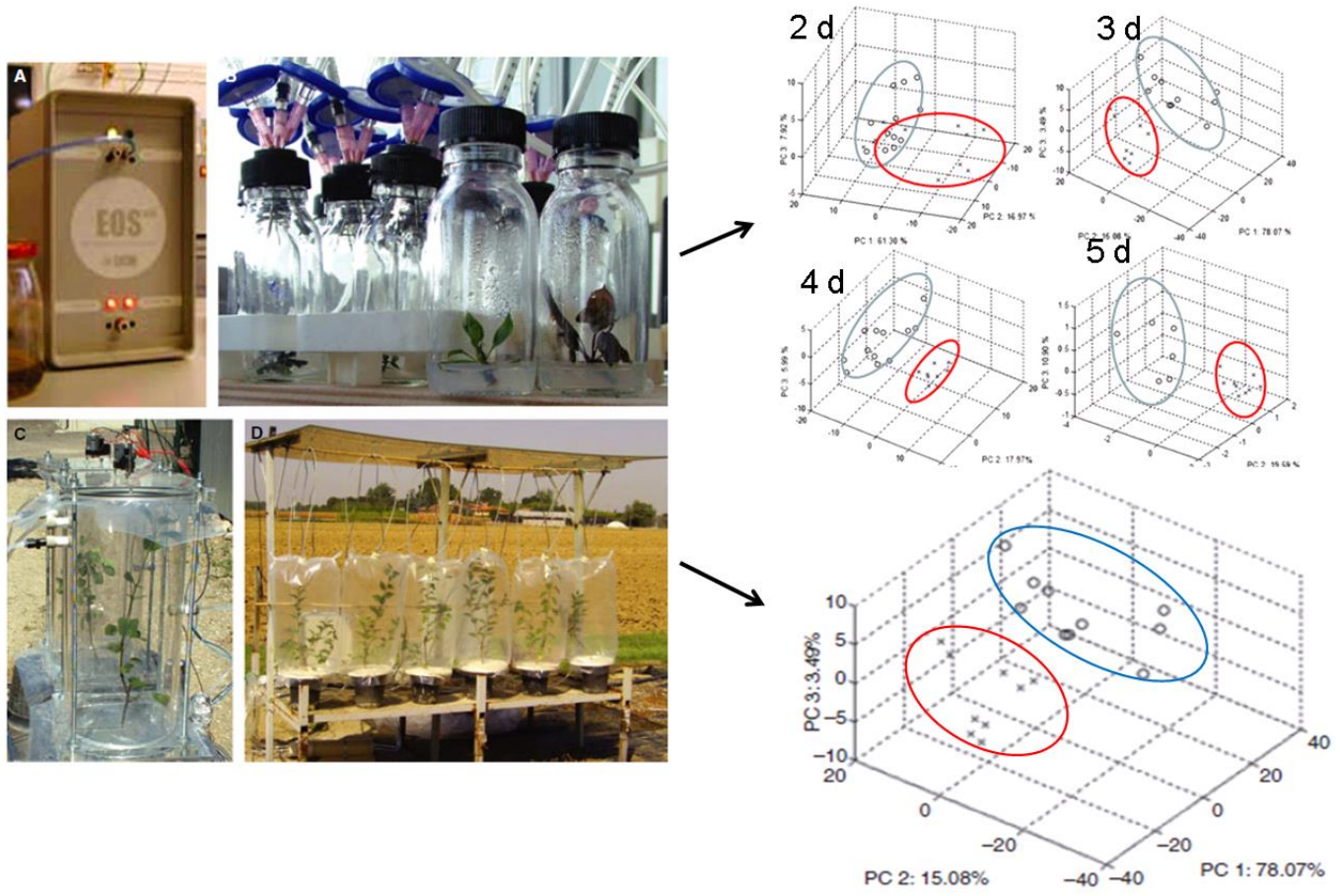
TRL 4-7

Volatiles – sniffing for pests

- Specific volatiles – laser spectroscopy
- Non-specific volatiles – e-nose / dogs / bees



E-Nose detection of fire blight



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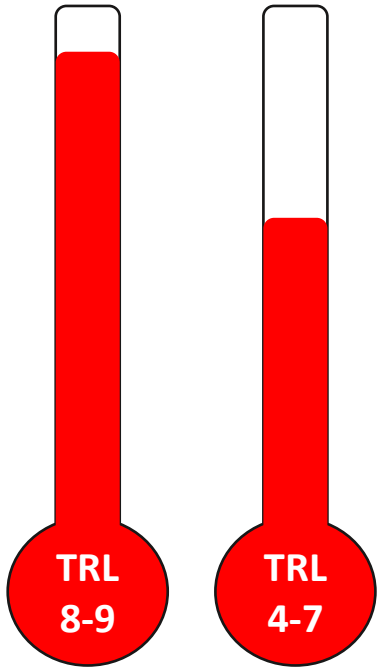
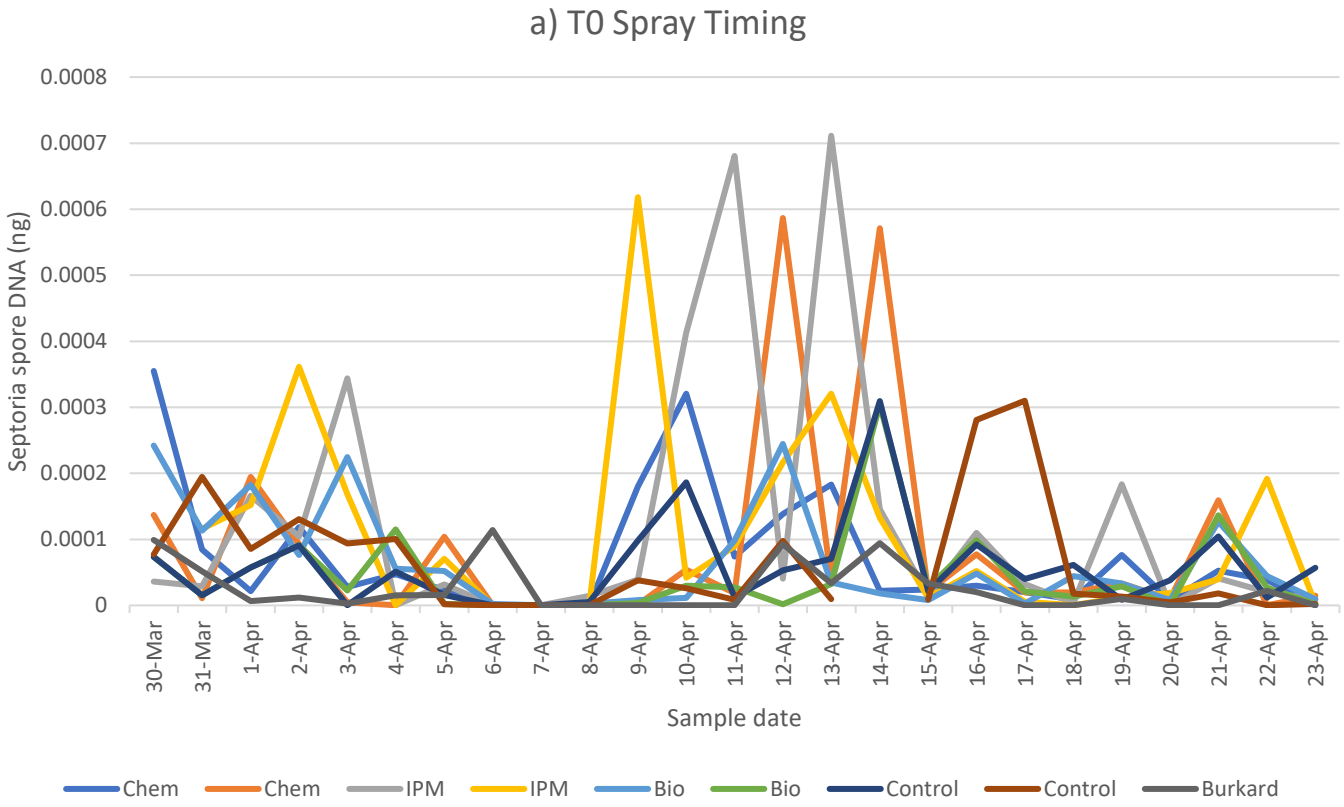
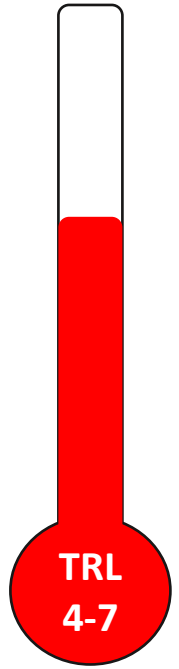
5 - Smart surveillance technologies

- Automated, landscape scale, broad spectrum surveillance techniques
  - Spore sensing
  - Insect trapping



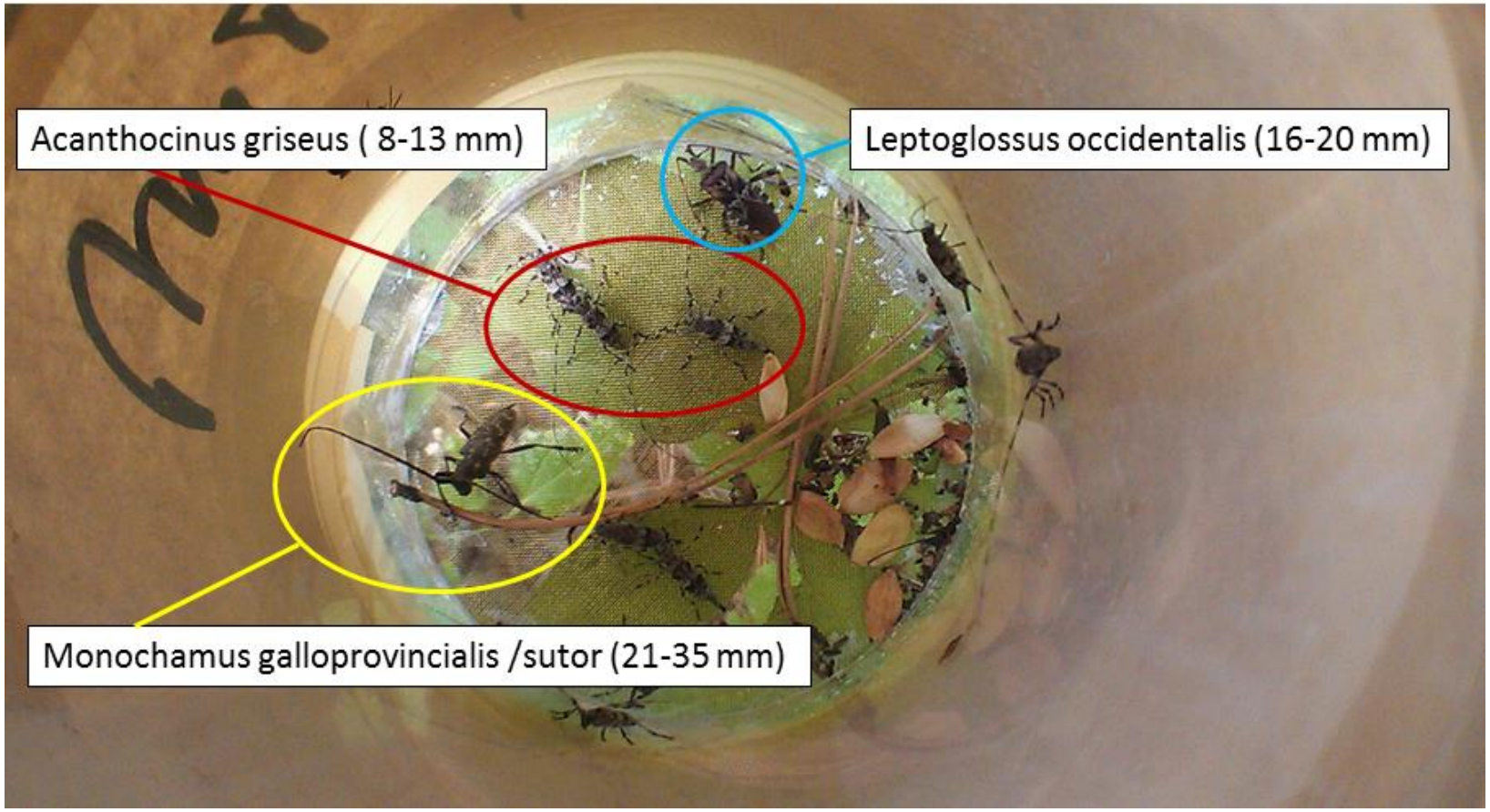
Automated detection of fungal spores





Internet connected camera traps

3MP Camera – Tregnago pine forest (August 2012)



-detect

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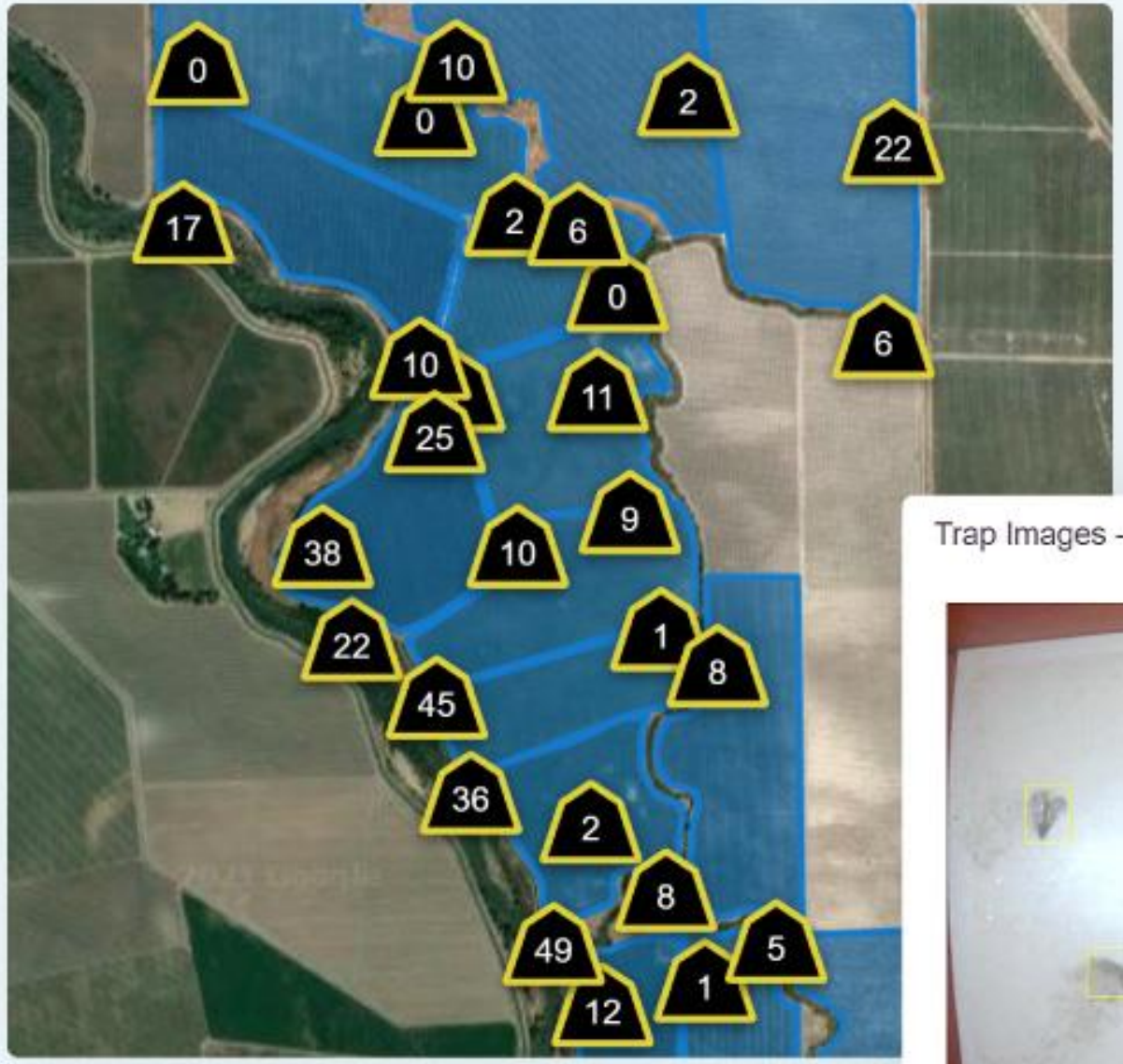

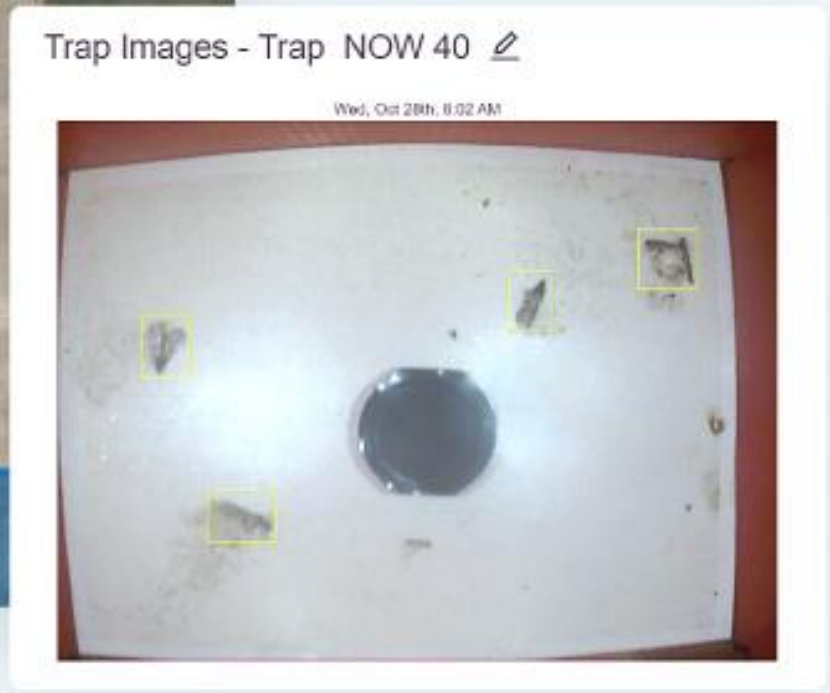

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Digital Inspector

HORIZON-CL6-2024-FARM2FORK-02-3-two-stage: Tools to increase the effectiveness of EU import controls for plant health

- Project results are expected to contribute to all of the following expected outcomes:

  - Enlarged availability and accessibility to cost-efficient and user-friendly tools and methods for the detection of plant pests to assist plant health inspectors during import controls;
  - Increased the effectiveness of detection of plant pests at import points, by decreasing time and overall costs;
  - Knowledge exchange and uptake of the innovative tools are promoted;
  - Support plant health inspections and import controls

Acknowledgments

People

Ankush Prashar
Avinash Agarwall
Filipe de Jesus Colwell
Sarah Sommer
Nawaporn Onkokesung
Lou Mallard
David George

Funding

Institute for Agri-Food Research Innovations (IAFRI)

Innovate UK

Northern Accelerator

UKRI Innovate UK

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