AgSense
(Agricultural Fungal Sensing)

From species to strains:
CRISPR-Cas-mediated detection of bioaerosol environmental DNA enables strain-level late blight monitoring

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EuroBlight workshop 19th May, 2026

Taighde Éireann Research Ireland

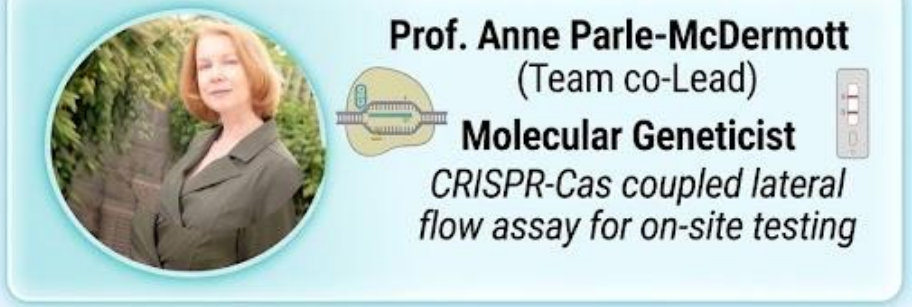
eagasc
AGRICULTURE AND FOOD DEVELOPMENT AUTHORITY

DCU
Ollscoil Chathair Bhaile Átha Cliath
Dublin City University

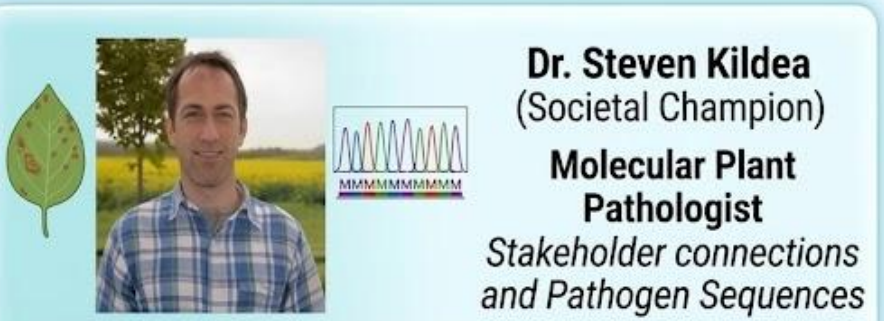
AgSense: Future Food Systems supported by National Challenge Fund

The Challenge: *lack of an effective system to* ***detect, monitor and forecast*** *the dispersal of late blight (P. infestans).*

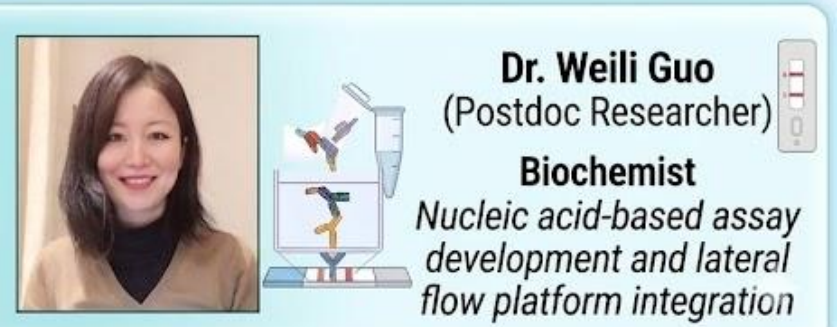
Dr. David O'Connor
(Team Lead)
Atmospheric Scientist
AI powered Real-time fungal monitoring and modeling



Prof. Anne Parle-McDermott
(Team co-Lead)
Molecular Geneticist
CRISPR-Cas coupled lateral flow assay for on-site testing



Dr. Steven Kildea
(Societal Champion)
Molecular Plant Pathologist
Stakeholder connections and Pathogen Sequences

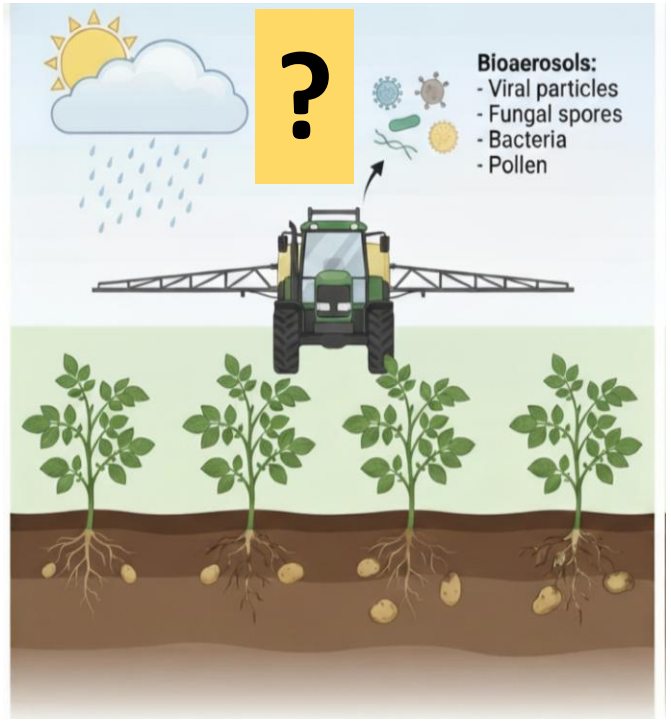


Dr. Weili Guo
(Postdoc Researcher)
Biochemist
Nucleic acid-based assay development and lateral flow platform integration

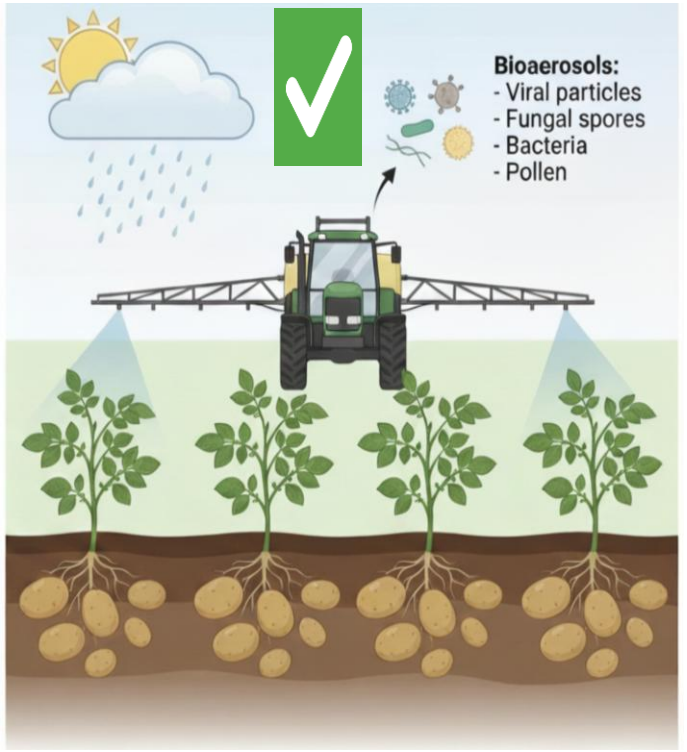
Aims: novel monitoring system to support blight management

1) **Real-time bioaerosol monitoring and machine learning models for late blight *(P. infestans)* forecasting**

2) **Rapid point-of-need test for identifying late blight *(P. infestans)* from eDNA in bioaerosols**



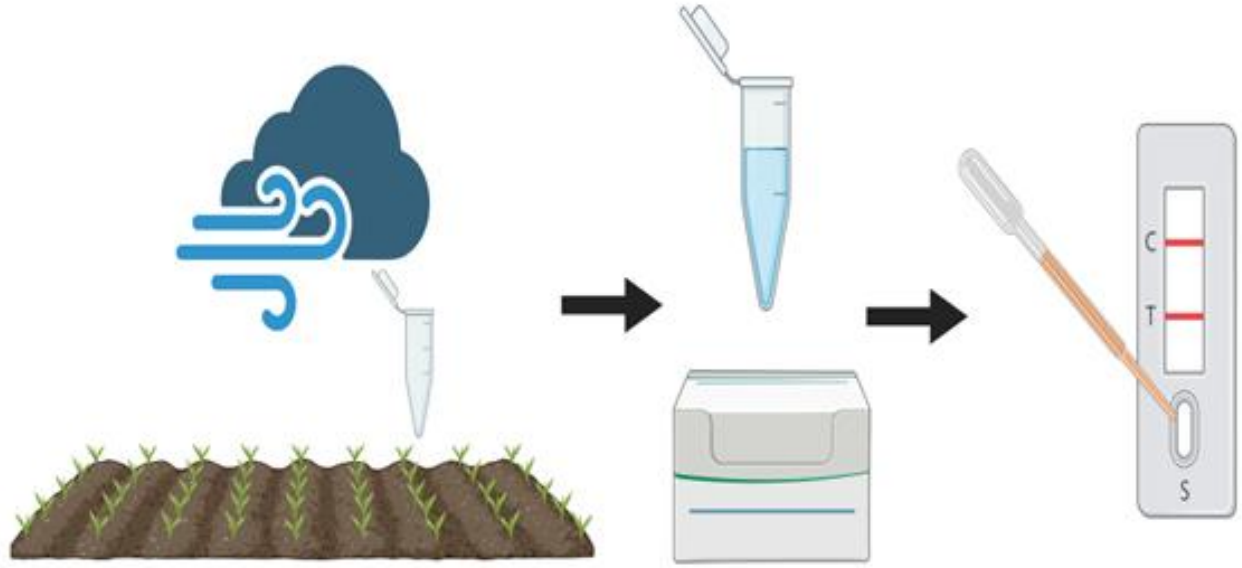
Blind Spray
Low yield and **high chemical use**



Targeted Spray
High yield and **low chemical use**

Vision: Lab to field biosensing

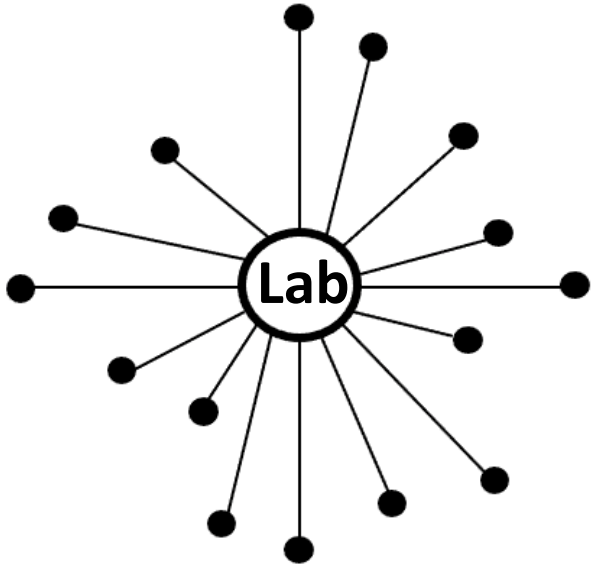
leaves
strains
resistant
fungicide



on-site testing for resistant strains in leaf/air

Challenges: current methods are unsuitable for rapid point-of-need testing

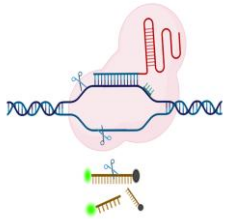
qPCR equipment

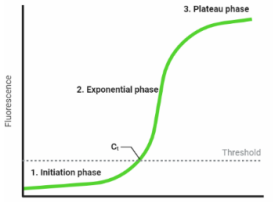


Centralised testing

Proposed solution: why CRISPR-Cas?

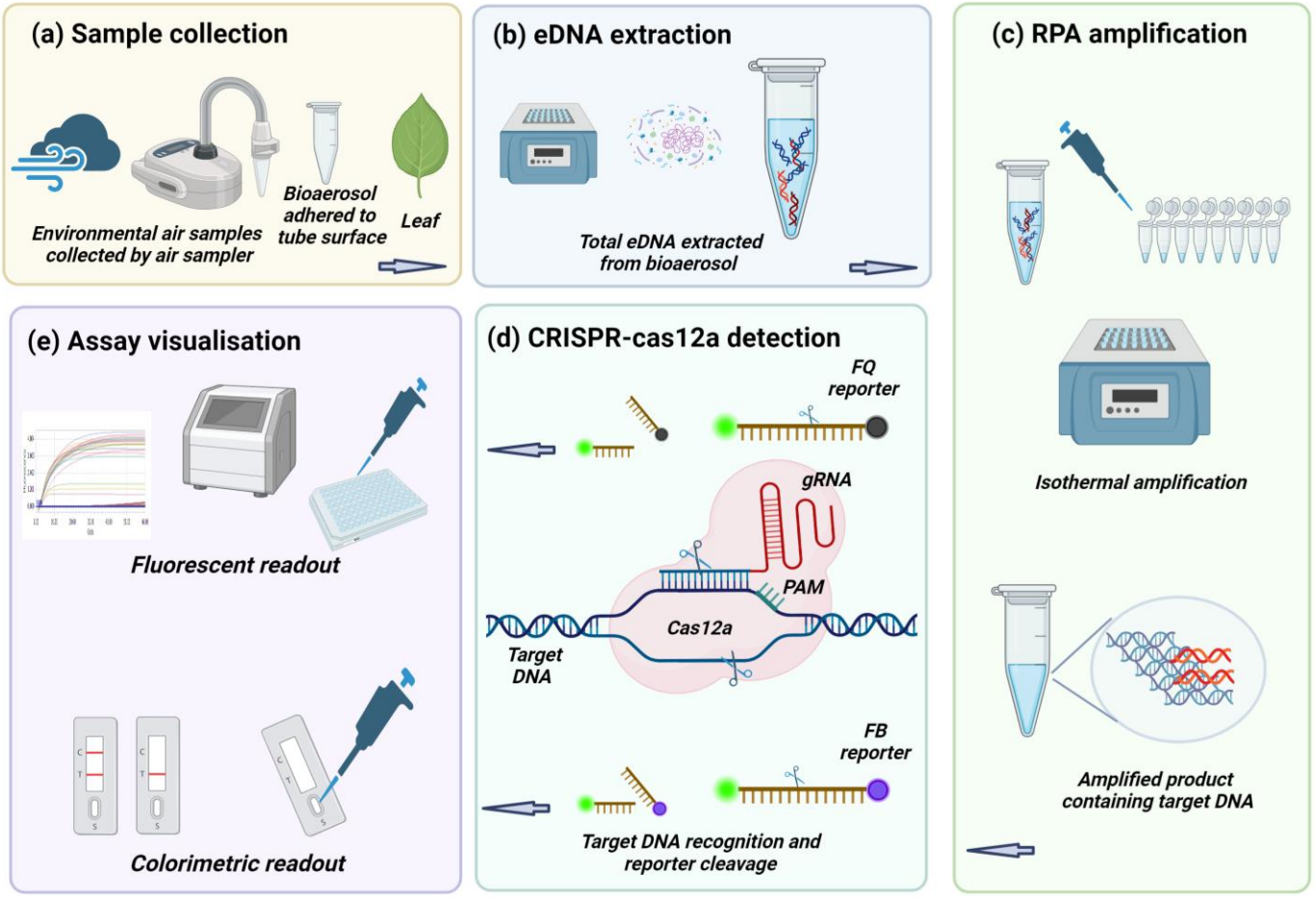
RPA/CRISPR-Cas integration with lateral flow or fluorescence for Environmental DNA (eDNA) detection





- *Highly **sensitive and specific**: distinguish lineages from 1 base difference*
- *Detection modes: **colorimetric or fluorescence***
- *Versatile: **multiple Cas** proteins available for assay design*
- *Basic equipment: reaction at **37°C** or room temperature*
- *Robust: reagents can be **freeze-dried** and rehydrated*
- ***Point-of-need potential** : suitable for on-site applications*

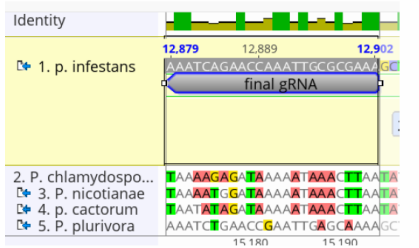
Workflow of RPA/CRISPR-Cas12a assay

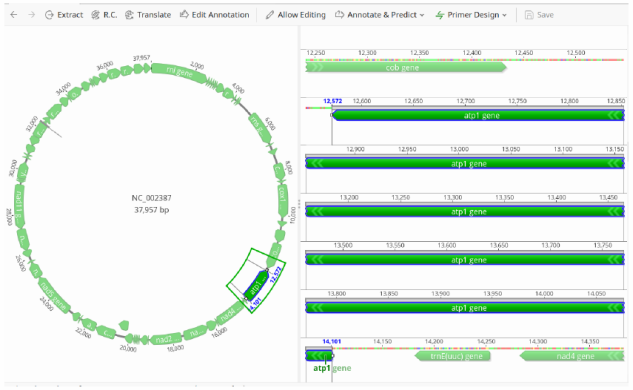


- **Entire reaction: 37°C**
- **Detection steps c-e: <1.5h**
- **Multiple readout methods**
- **Lateral flow (on-site)**

Late Blight species-level detection on lateral flow strips

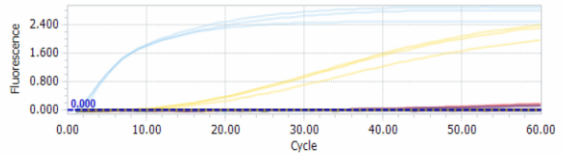
P.infestans: Assay gRNA1 designed to target ATP1 mitochondrial DNA.

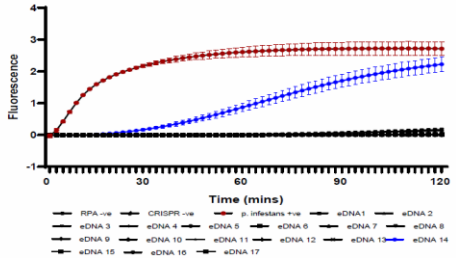


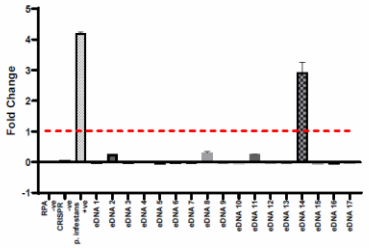


- Located on atp1 gene

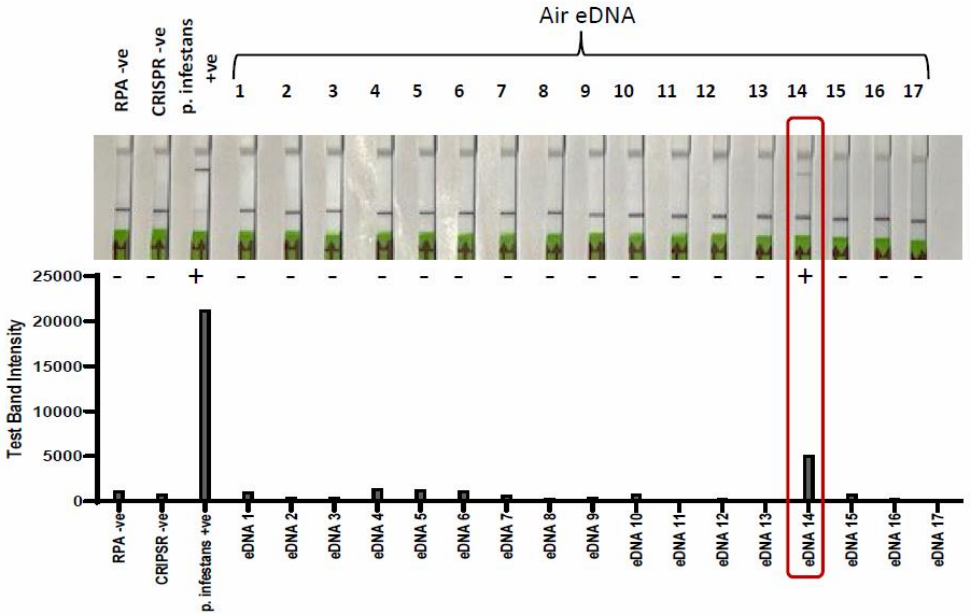
P. Infestans eDNA Fluorescent test: Positive in 2-4th October 2023 Air samples



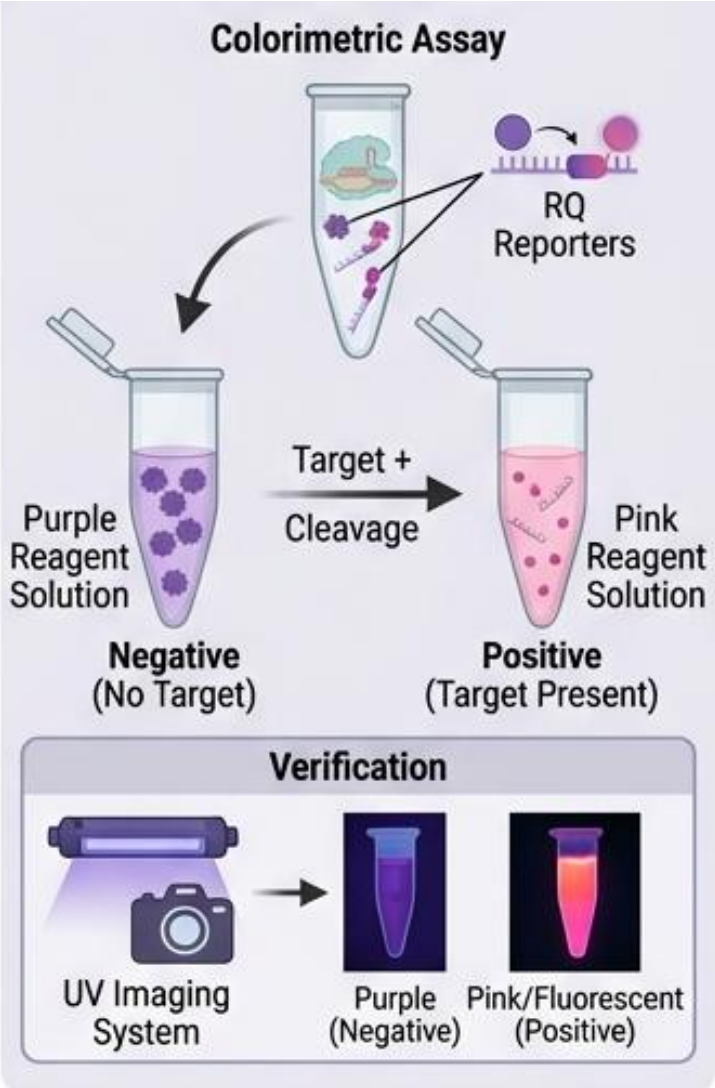




P. Infestans air eDNA lateral flow test correlates with fluorescent results

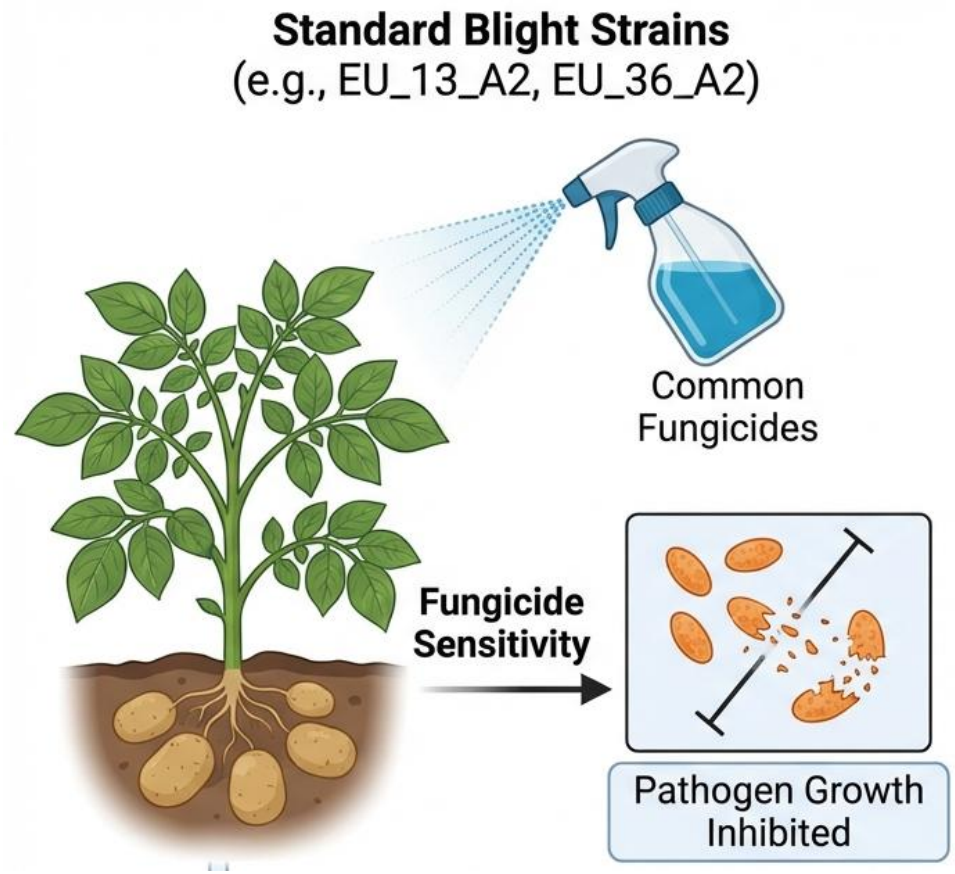


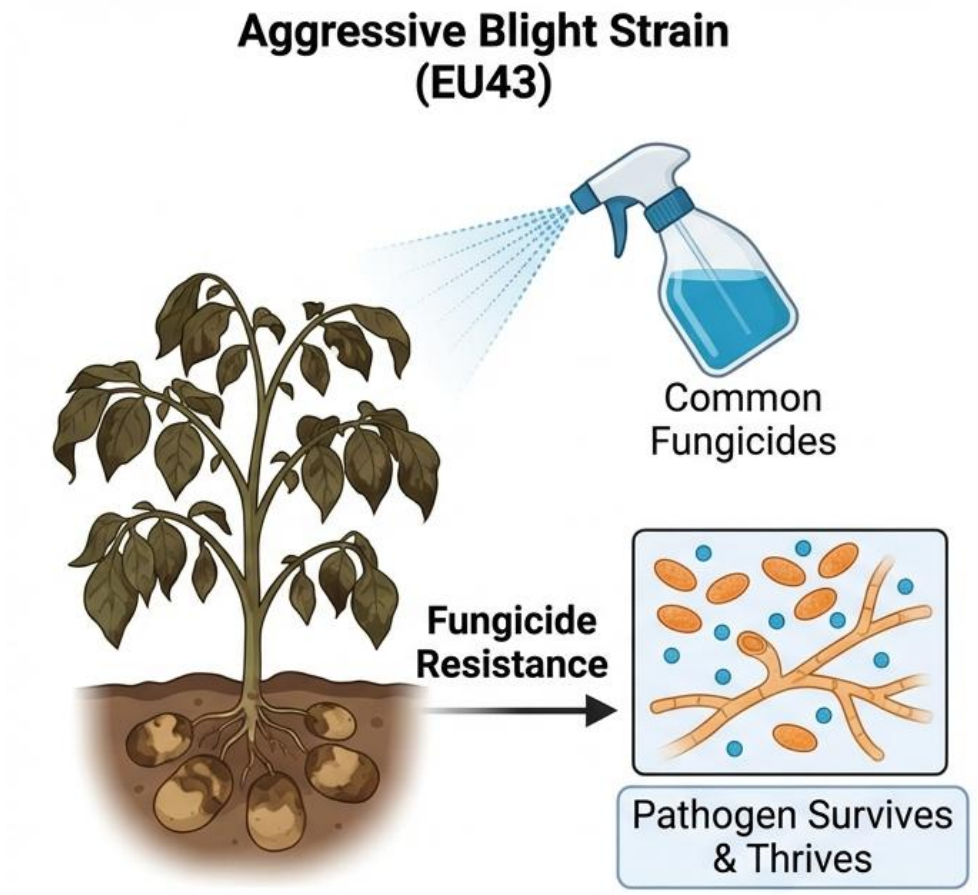
Single tube colorimetric assay: a simpler readout platform for on-site testing



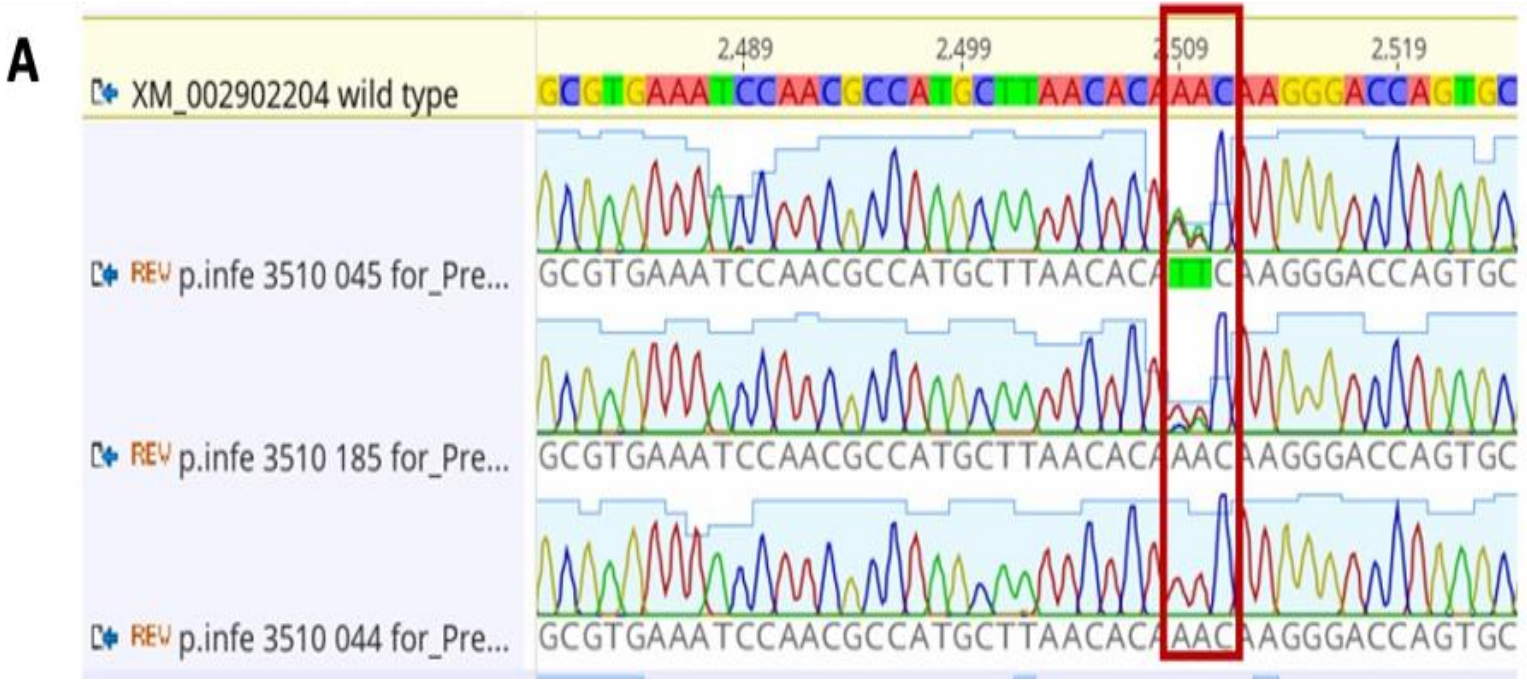
- **Reporter System:** RQ instead of FQ
- **Activation:** Cas collateral cleavage
- **Readout:** Colour shift from **purple** to **pink**.
- **Streamlined:** Simplified and highly efficient workflow
- **Cost-Effective:** Economical for scalable testing.

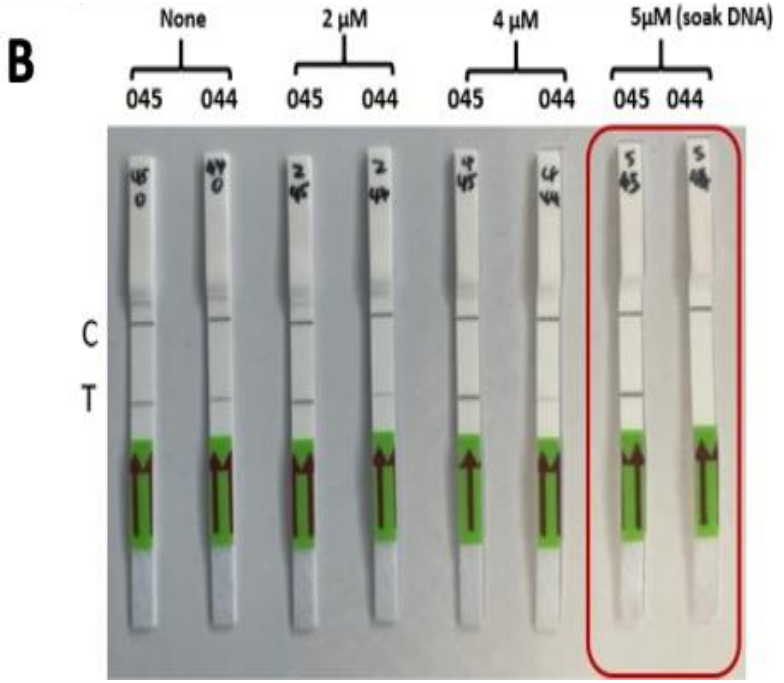
Can we distinguish resistant strains?





CRISPR-Cas blight strain-specific assay development: EU43_A1





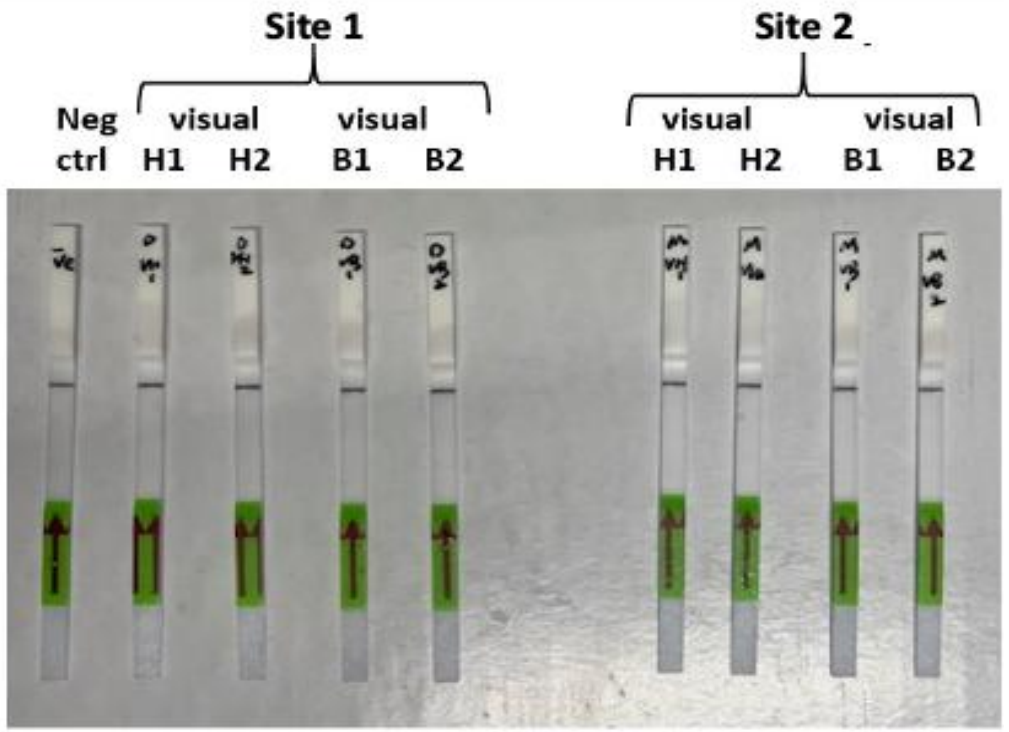
Samples provided by Mamadou Mboup in Corteva through Teagasc

Applying blight strain-specific assay on leaf samples

A

B

C



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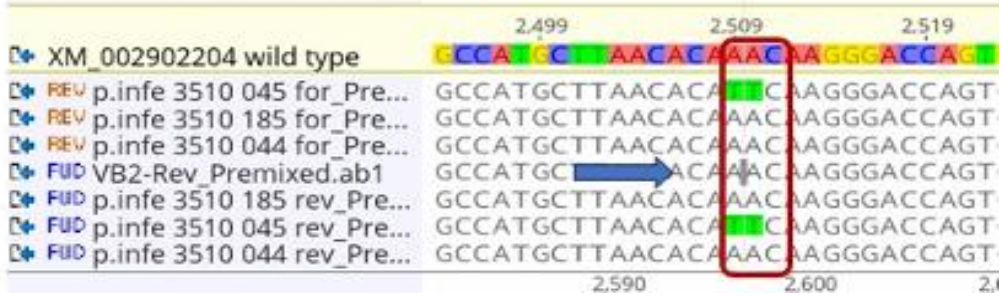
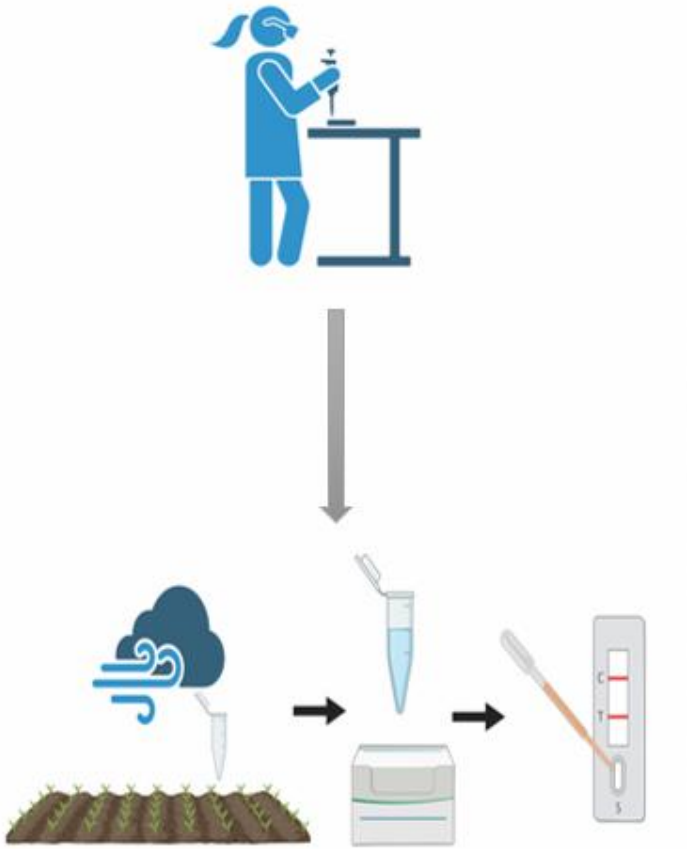


Current and Future work



- **Assay lab-to-field translation**
- **No lab-based equipment**
- **Prototype demonstration**

Acknowledgements

Temiloluwa Akinbola

Dr. Stephen Kildea

Dr. David O'Connor

Prof. Anne Parle-McDermott

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NATIONAL CHALLENGE FUND
Future Food Systems Challenge

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