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Department for Environment Food & Rural Affairs

# Revolution in plant pest diagnostics since the last century Fiona Constable and Brendan Rodoni

**Agriculture Victoria Research** 



ECTING



London, 21 – 23 September 2022 | International Plant Health Conference

Saunders, et al. 2003. Nature 422, 831 (2003). https://doi.org/10.1038/422831a

# **Reproducing disease**

For many years scientists thought disease causing organisms, including insects, arose spontaneously from abnormalities in the host plants

Mid-1700's onwards: transmission experiments

1755: "Brown powder" from bunt of wheat (*Tilletia tritici*) could reproduce disease (du Tillet)

1847: Transmission of fireblight to a healthy pear tree (Gookins); Burrill proposed a bacteria 1879

1868: Transmission a bacteria from one plant to another and caused disease (Davaine)

1886: Transmission of tobacco mosaic disease from sap (Mayer)

1890: Koch – association and cause of disease

**Biological indexing** 









Fusarium oxysporum f.sp. cubense Manzo-Sánchez et al 2020



## A revolution in plant virus discovery

1898 - the infectious agent for tobacco mosaic disease was shown to pass through a bacterial filter (Beijernick 1898).

1935 – Crystallised TMV was still infective when used to infect plants (Stanley 1935).

1937 – TMV consisted of 5% RNA & 95% protein (Loring and Stanley 1937).

1940s and 50s – invention of the electron microscope allowed the visualisation of viruses.





# Serology: revolution in high throughput pathogen detection

1929: Differences in antisera from TMV infected and healthy Sap (Beale)

1941: First IEM observation of a virusantibody interaction with TMV (Anderson and Stanley)

1971: ELISA was developed (Engvall and Perlman)

1976: First application of ELISA for the detection of two plant viruses (Voller, Bartlett, Bidwell, Clark, Adams)

1977: Microplate ELISA method for plant viruses (Clarke and Adams)



https://www.moleculardevices.com/applications/ enzyme-linked-immunosorbent-assay-elisa#gref



# Molecular

1975: Electrophoresis for detection of PSTVd (Morris and Wright)

1981: Molecular hybridization for PSTVd (Owens and Deiner)

1983: Polymerase chain reaction (PCR)(Mullis et al)

2000's: Isothermal amplification for point of care testing – LAMP (2000), RPA (2006)



## Sequencing

1965: tRNA Saccharomyces cerevisiae (Holley)

1972: DNA of a bacteriophage coat protein gene

1977: Sanger chain termination

1987: Automation ABI 370 (Hood & Hunkapiller)

1996: High throughput sequencing

Metagenomic, Meta-transcriptomic HTS

Genome informed diagnostics

Targeted sequencing and enrichment

- Metabarcoding
- Amplicon sequencing including tiling
- Hybridization probes

### **Genomic epidemiology**

- Surveillance
- Pathogen discovery
- Pathogen diversity
- Improved understanding of biology



# Reflection

Technological advancements:

- Understanding of disease
- Disease management strategies
- Diagnostic accuracy
- Throughput

New technologies are underpinned by traditional approaches

• Trusted data

Trusted data

- Accurate diagnosis
- Decision making
  - Biosecurity, market access, etc









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# Thank you

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