



Department  
for Environment  
Food & Rural Affairs



# Track and trace toolbox; investigating the origins of plant pest interceptions

Rebecca Weekes (Fera, GB) & Aaron Hoyle (Defra, GB)

EPPO HoL Workshop, 6<sup>th</sup> March 2025

Saku, Estonia



# Outline of talk:

Fera Science Ltd. & Defra

Getting to track & trace - contingency plans

Outbreak process

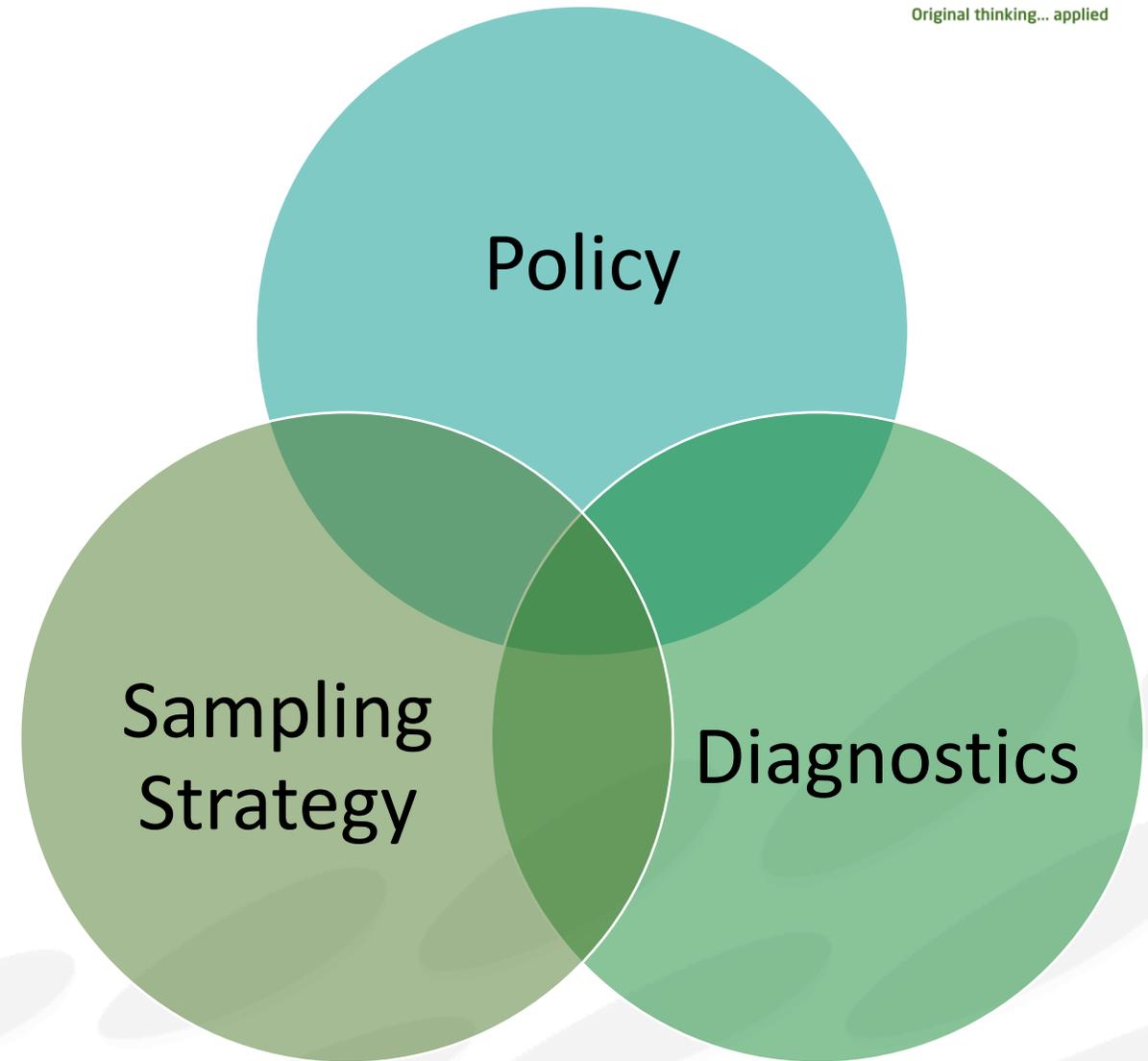
Questions arising from an outbreak

Diagnostic data interpretation

Access to information

Supporting data and bias

Examples





Department  
for Environment  
Food & Rural Affairs

# Fera Science Ltd. & Defra



‘To support and develop a sustainable food chain, a healthy natural environment, and to protect the global community from biological and chemical risks’

- The labs have a scientific heritage of over 100 years
- Long history across different sites, many mergers and governance
- Since 1996 at Sand Hutton, York
- Fera has been a joint venture between Bridgepoint & Defra, since 17<sup>th</sup> January 2024



Institute for Plant  
Pathology, 1914





# Contingency planning:



## Pest specific plant health response plan:

*Xylella fastidiosa* (2022)

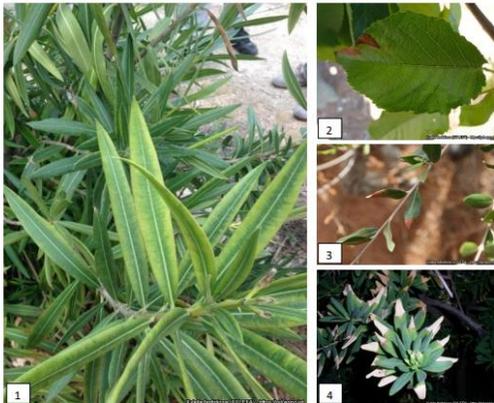


Figure 1: Early symptoms of *Xylella fastidiosa* on *Nerium oleander* in Italy. (Françoise Petter, EPPO)  
Figure 2: *Xylella fastidiosa* symptoms on cherry (Donato Boscia, Inst. Sustainable Plant Protection, Bari, Italy)  
Figure 3: Symptoms of *Xylella fastidiosa* on olive in Puglia, Italy (Donato Boscia)  
Figure 4: Symptoms of *Xylella fastidiosa* on *Polygala myrtifolia* (Bruno Legendre, Anses, France)



## Pest specific plant health response plan:

Outbreaks of tomato brown rugose fruit virus (ToBRFV)



Figure 1. Tomato infected with tomato brown rugose fruit virus (courtesy of Neil Giltrap).



## Pest specific plant health response plan:

Outbreaks of *Anoplophora glabripennis*



Figure 1. *Anoplophora glabripennis* adult. © Fera Science Ltd.

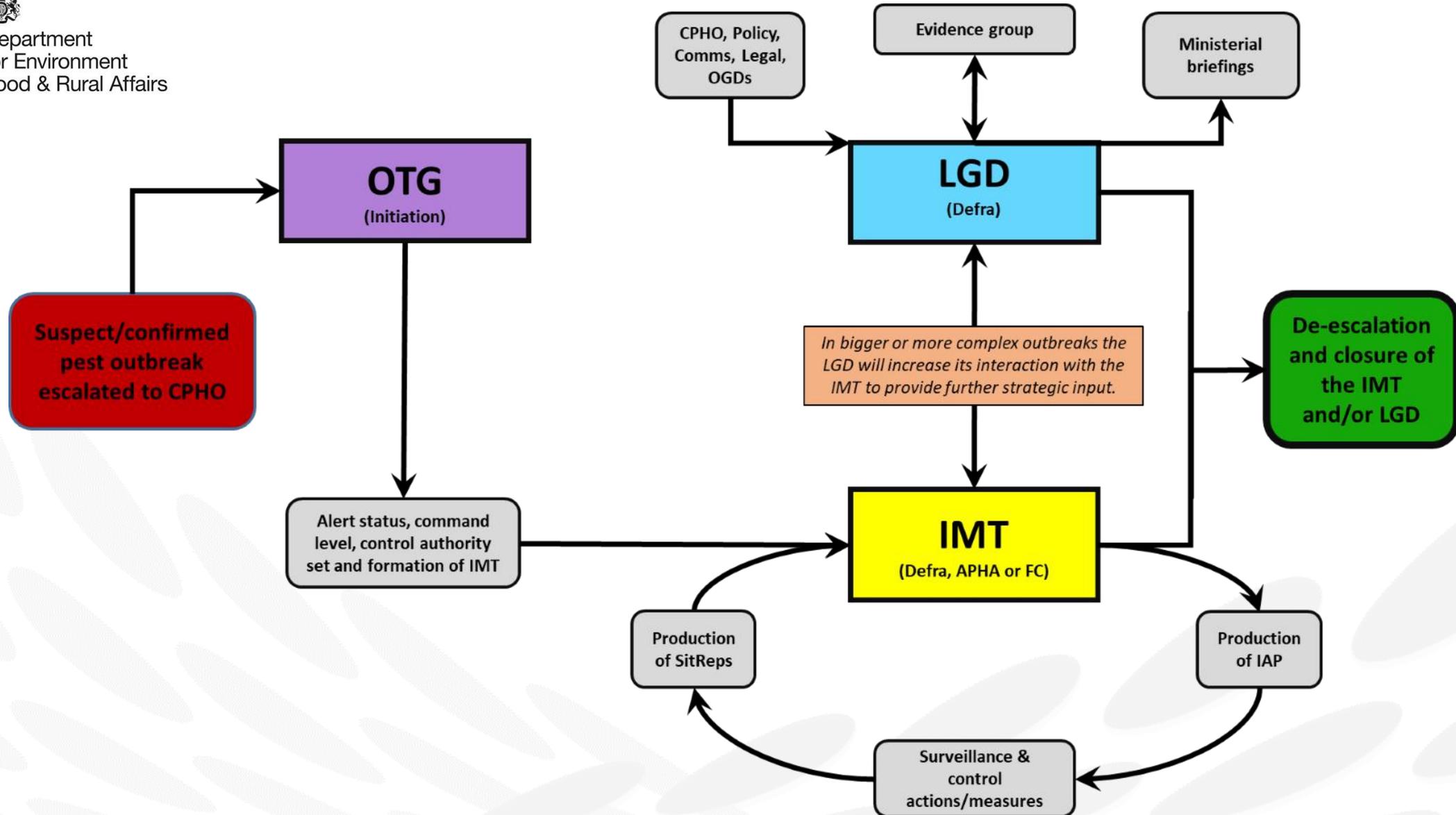


## Pest specific plant health response plan:

Outbreaks of *Leptinotarsa decemlineata* (Colorado beetle) on potato crops



Figure 1. Adult *Leptinotarsa decemlineata* feeding on a potato leaf. Image Courtesy of Fera-Science Limited © Copyright Fera-Science Limited 2016





# Questions arising from an outbreak:

What was the pathway for arrival?

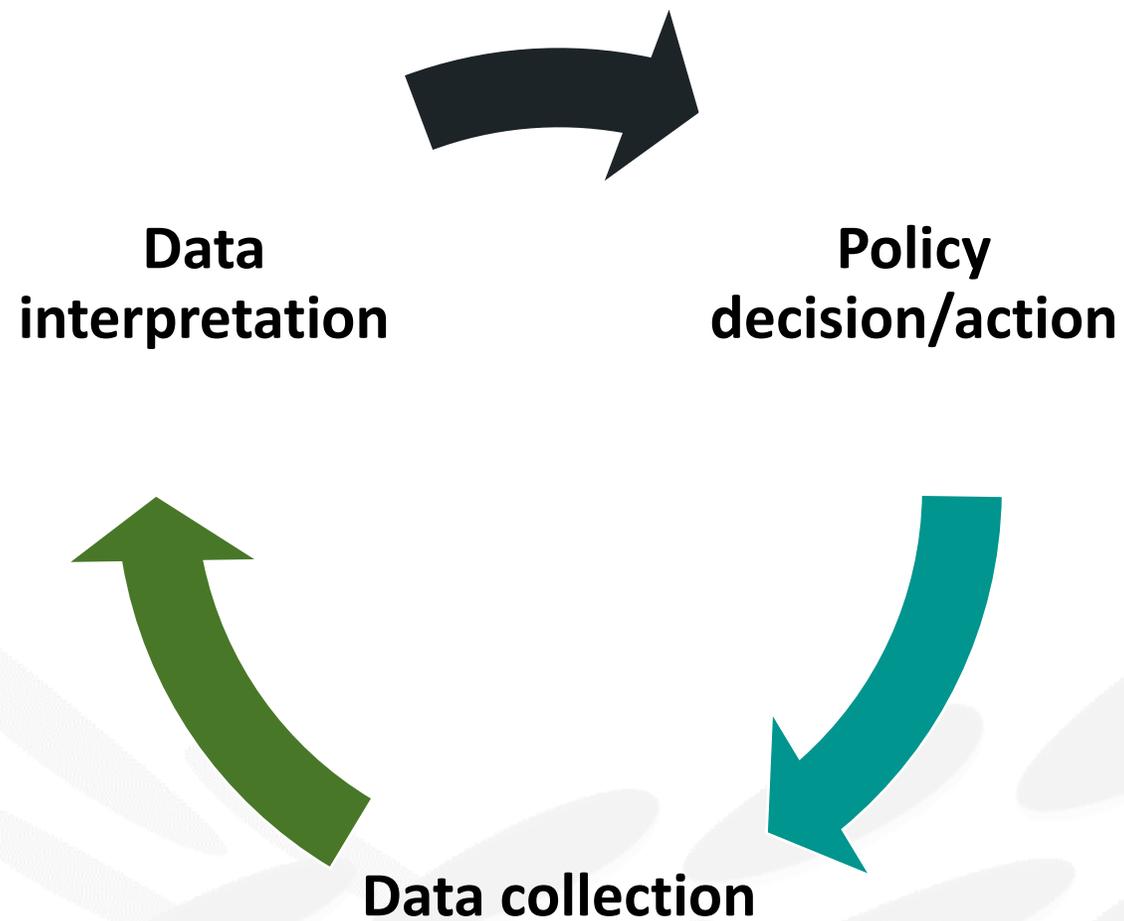
-produce, plants for planting etc

What country did the pest arrive from?

How long has the pest been present?

Two incursions have been identified, are they related?

# Track & trace information cycle:



# Considerations

- What information is out there?
- Expertise of the lab
- Bias due to existing data sets.
- What reference material is available – quantity and quality
- Mode of reproduction: clonal populations versus sexually recombining eukaryotes or polymorphic populations e.g. aphids

# Tools:

## DNA examples:

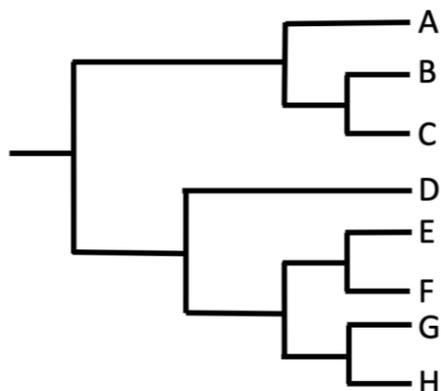
Microsatellite analysis

MLST

SNP

WGS – variable loci

WGS – phylogenetics



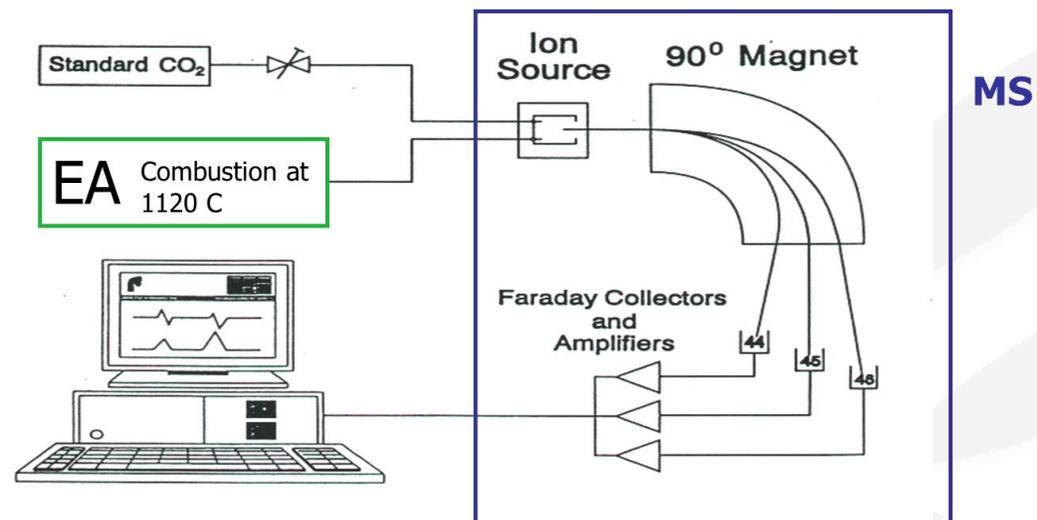
## Non-DNA examples:

Isotope analysis

Context

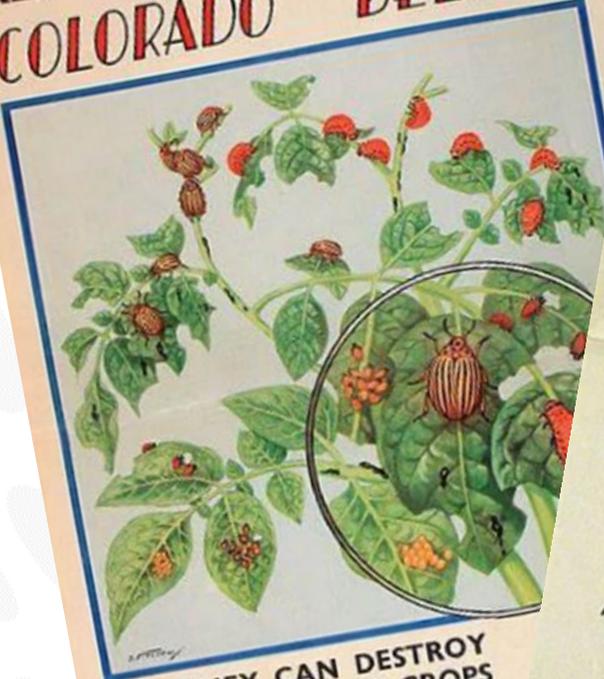
Trade Pathway

Previous crops grown on the land



# Colorado Beetle – linking findings

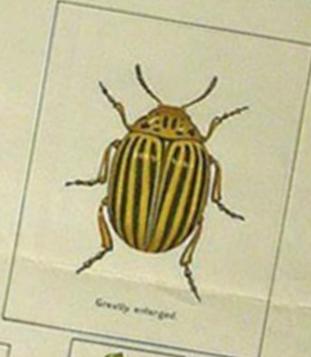
**KEEP CEASELESS WATCH FOR COLORADO BEETLE**



**THEY CAN DESTROY OUR POTATO CROPS**

If you find **Striped Beetles** about 1/2-inch long, or **Red Grubs**, eating the Potato foliage, send specimens to the Ministry of Agriculture Labor, Milton Road, Harpenden, Herts.

**THE COLORADO BEETLE.**



Greatly enlarged.



**A DANGEROUS FOREIGN POTATO PEST.**

**WATCH YOUR POTATO PLANTS.**

If you find Striped Beetles about 1/2 inch long, or red Grubs, eating the Potato Foliage, send specimens to the Ministry of Agriculture, 10, Whitehall Place, London, S.W.1.

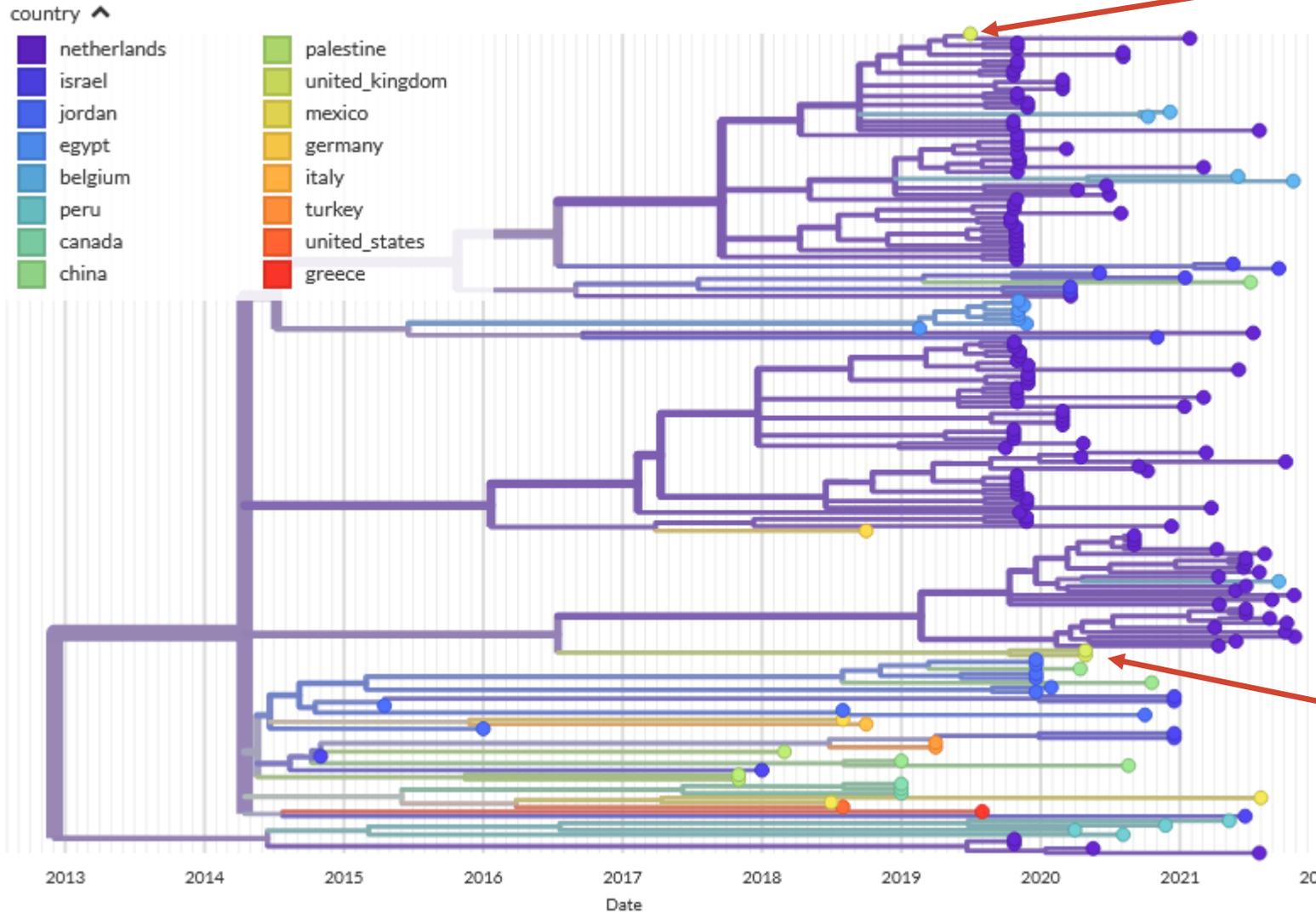


# Colorado Beetle – linking findings

- Single colony found in a field and a lone male found nearby shortly after
- Microsatellite analysis used to determine kinship
- Results indicated that the lone male was not directly related to the colony.
- But further validation needed on repeatability and robustness of the markers.
- Alternative approach in progress – whole mtDNA genome sequencing.



# Tracing the source of ToBRFV



UK first outbreak

“cross protection genotype”

UK recurrent outbreak

Peru “seed” detections

# Tracking UK outbreak sources by sequence?

“North” – Infection detected towards end of 2022 growing cycle.

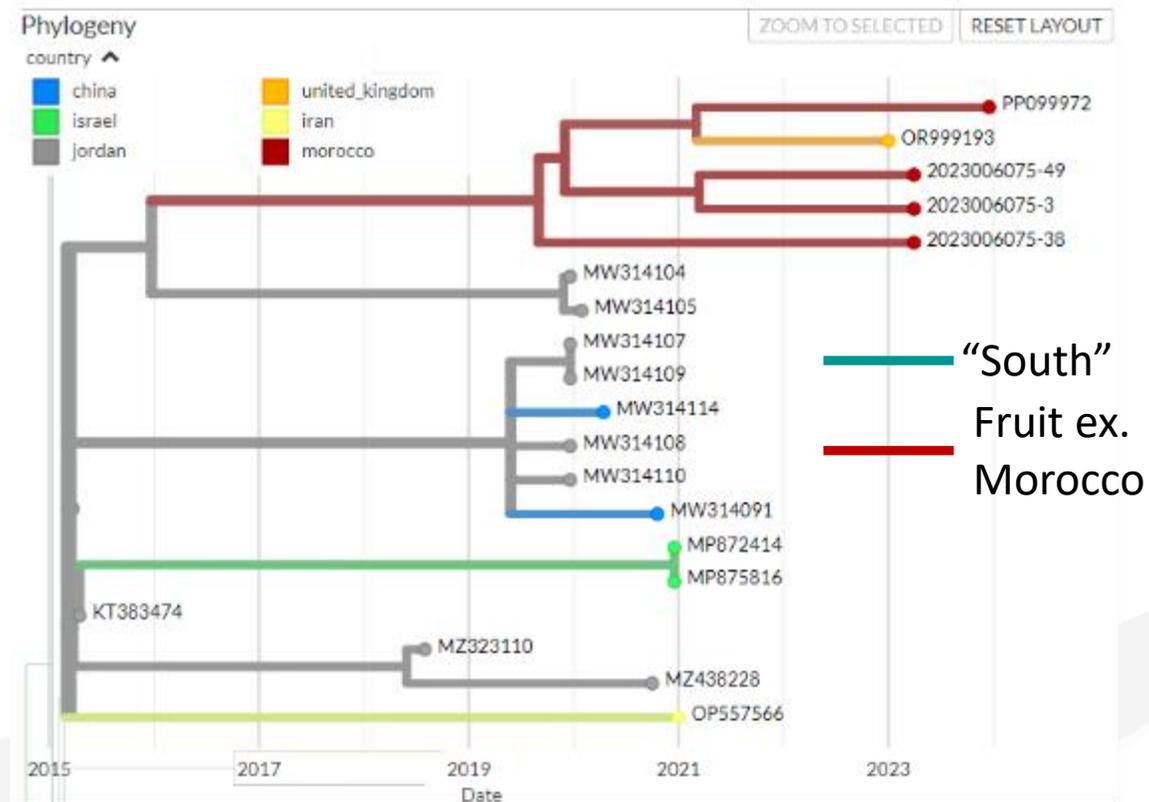
- **“cross protection” ToBRFV genotype**
  - (Not yet detected from seed)
  - Fruit origin?

“Midlands” - Ongoing re-infection since 2020.

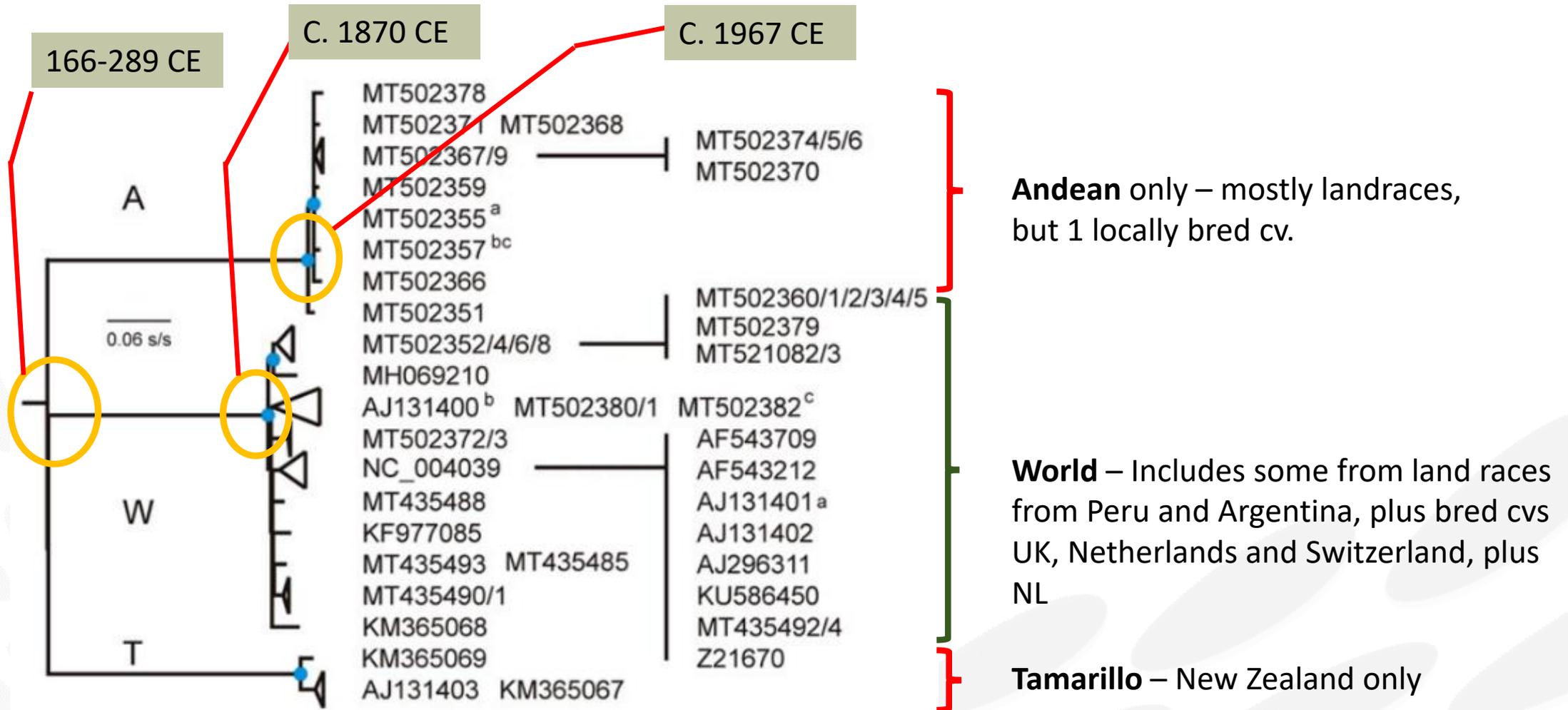
- **Grower identified packhouse staff moving to glasshouse as source of outbreak**
- Genotype in several European countries
- Fruit origin?

“South” – Infection early in 2023 growing cycle

- **Genotype similar to those from intercepted Fruit ex. Morocco**



# Potato virus A – European or non-European?



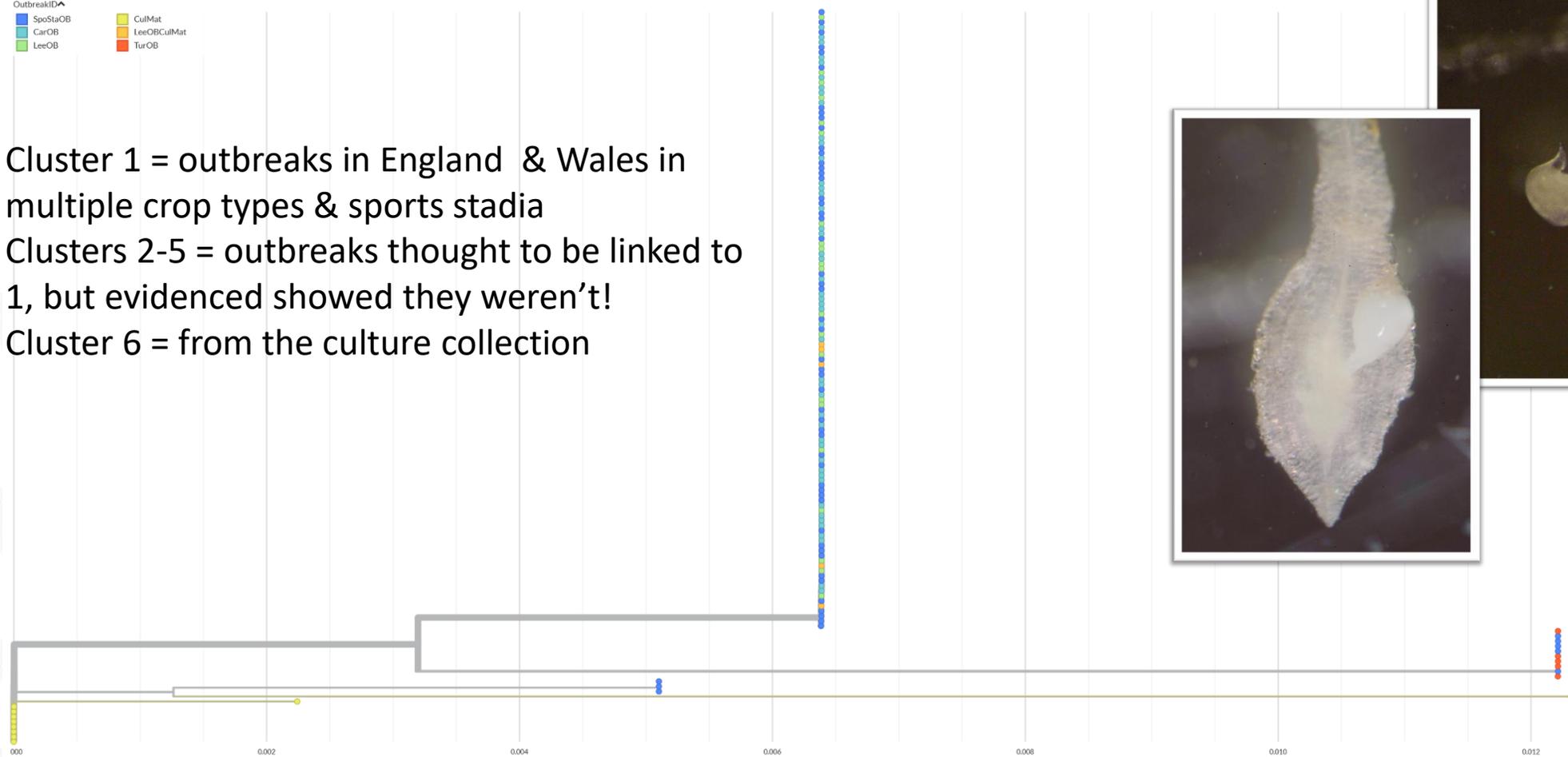
Fuentes S, Gibbs AJ, Adams IP, Wilson C, Botermans M, Fox A, Kreuze J, Boonham N, Kehoe MA, Jones RAC (2020) Potato virus A isolates from three continents: their biological properties, phylogenetics and prehistory, Phytopathology

# Meloidogyne fallax – associating outbreaks

OutbreakID▲

■ SpoStaOB	■ CulMat
■ CarOB	■ LeeOB
■ LeeOB	■ TurOB

Cluster 1 = outbreaks in England & Wales in multiple crop types & sports stadia  
 Clusters 2-5 = outbreaks thought to be linked to 1, but evidenced showed they weren't!  
 Cluster 6 = from the culture collection

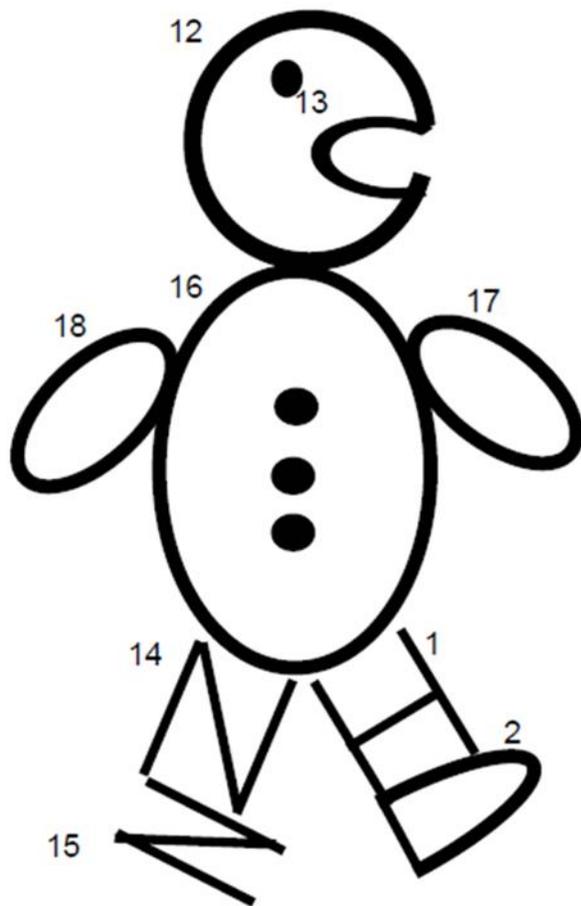


# Asian Longhorn Beetle – establishing origins

Proof of principle work to investigate whether stable isotope analysis could be used to provide reliable information on the origin of the pest.



# SIRA – stable isotope ratio analysis



Principal of SIRA\_1 “you are what you eat”

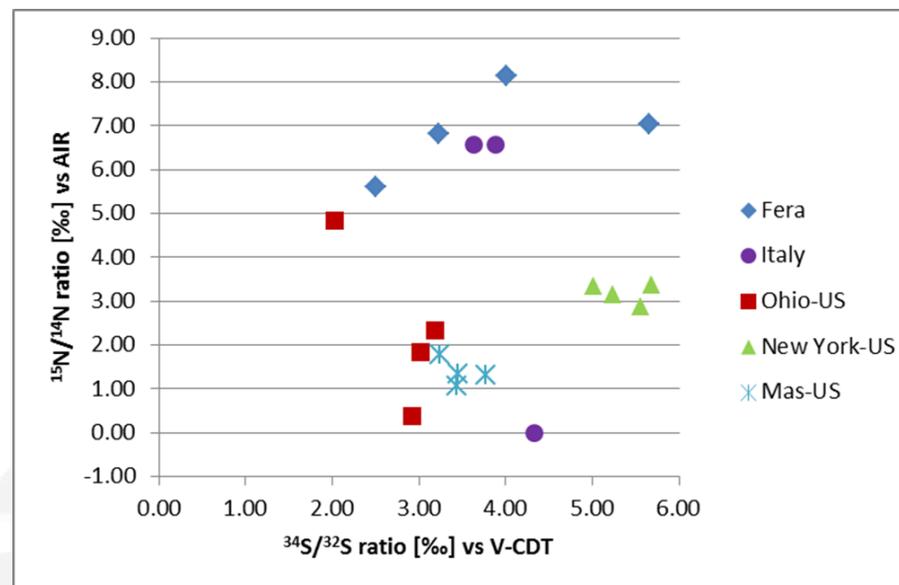
- Carbohydrates
- Lipids
- Proteins
- Water

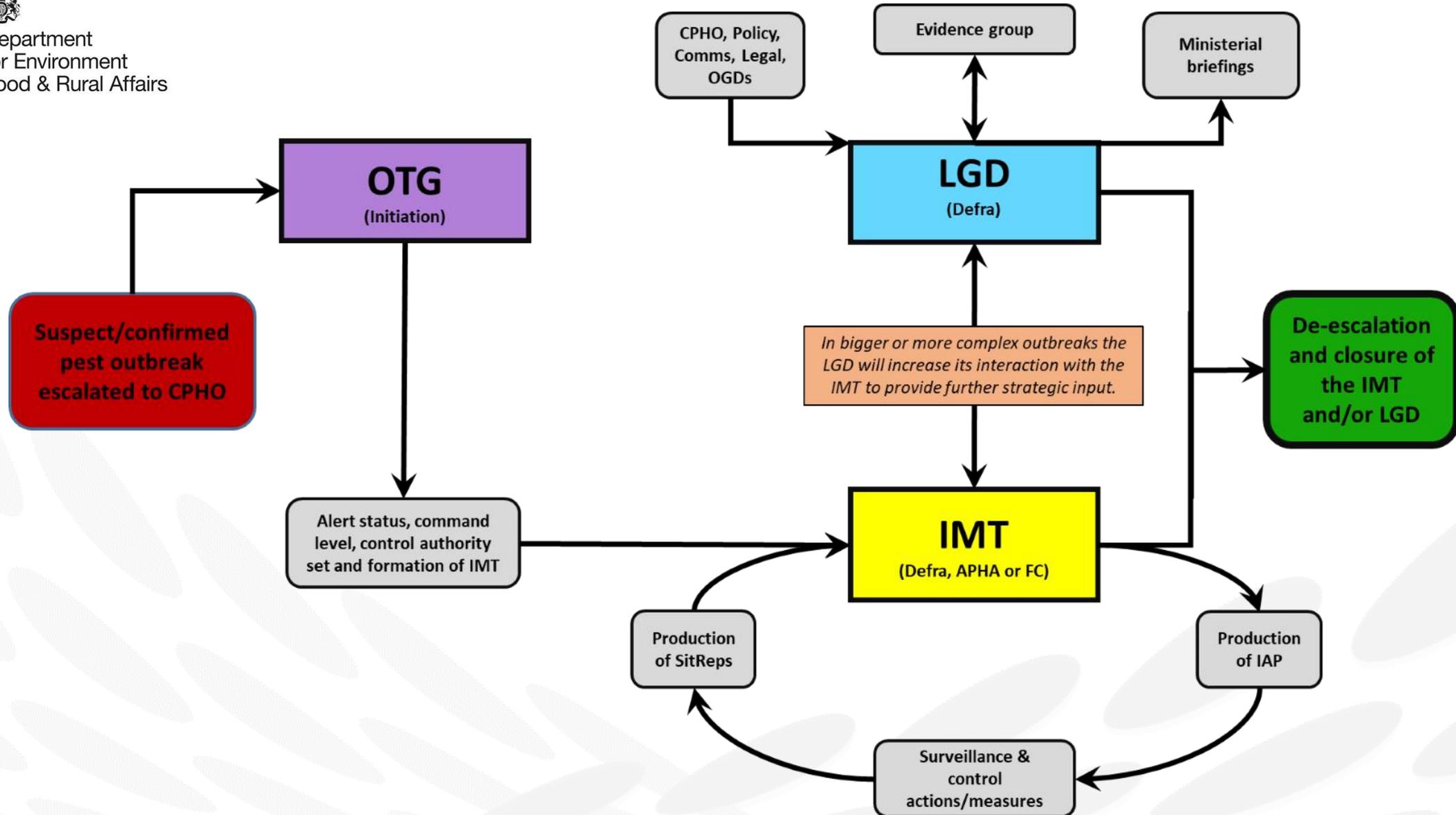
Stable bio elements:  $^1\text{H}$ ,  $^2\text{H}$ ,  $^{12}\text{C}$ ,  $^{13}\text{C}$ ,  $^{14}\text{N}$ ,  $^{15}\text{N}$ ,  $^{16}\text{O}$ ,  $^{17}\text{O}$ ,  $^{18}\text{O}$

# Asian Longhorn Beetle – establishing origins



- Beetle legs are representative body parts
- Proof of principle demonstrated
- Differentiation of locations possible
- Analysis of further ALB samples required







## In summary:

Every case is different  
Communication is key  
Asking the right questions  
Context is everything

## Thank you:

Eleanor Jones  
Katharina Heinrich  
Adrian Fox  
Thomas Prior  
David Crossley