BRIGIT
Vector Borne Disease of Plants

https://www.jic.ac.uk/brigit/
BRIGIT

Vector Borne Disease of Plants

• Celtic deity
• Brigit is derived from Brigantia (High One), patron goddess of the Brigantes
• Protector of the hearth and home
• Herbalist (dandelion is her favorite herb)

BRIGIT is pronounced as Bridge-It, as in making connection via laying down a bridge among:
• UK research organizations and research councils
• BRIGIT and European Horizon2020 programs
• Scientists, stakeholders and the general public
• The disease triangle: pathogen (Xylella), plants and insect vectors (and human vectors)
**P. myrtifolia**
>500 plant species

**P. spumarius**
±20 insects (UK)

**X. fastidiosa**
6 subsp; 81 genotypes

**AIM**
- 1B, 3ABC
- 2ABC, 4B
- 4ABC
- 2D, E, F
- 2A, 4C
- 1AB, 3A
- 1B, 3BC
Xylella fastidiosa – bacterial leaf scorch

Italy’s olive trees
Xylella fastidiosa presence in USA and Europe

Meadow froghopper/spittlebug (*P. spumarius*)

Distribution records as at May 2019
The BRIGIT project is funded by UK Research and Innovation through the Strategic Priorities Fund, by a grant from the Biotechnology and Biological Sciences Research Council with support from the Department for Environment, Food and Rural Affairs and the Scottish Government.
WP1: Co-design, crowdsourcing and knowledge exchange

Citizen scientists

Database: Insect vector guide

Database: Insect vector geography

Database: Open plant insects.org

Stakeholders

WP2: Xylella diagnostic capability

WP3: Insect vector biology

WP4: Epidemiology modelling

BRIGIT organogram - overview
Work package leaders

WP1
Ana Perez Sierra

WP2
John Elphinstone

WP3
Saskia Hogenhout

WP4
Steven White
WP1. Co-design, crowd sourcing and knowledge exchange

- Engage with key stakeholders, volunteers and the public
- Create databases that provide open-access information
- Work with social scientists to ensure databases are useful to end users
WP1. Website development
WP1. Training of volunteers & PHSI

Volunteer training – disease & vector
• 13 May, Llangddarog
• 22 May, Wisley
• 11 July, Edinburgh

PHSI training – plant host
• 3 July, Harlow Carr
• 10 July, Hyde Hall
WP1. Awareness raising & stakeholder engagement

- Information & advice to the public, e.g. RHS Cardiff Flower Show.
- Attending horticultural shows and related events to promote awareness, e.g. ARB Show, Fruit Focus, HTA National Plant Show.
- AHDB & HTA sector board presentations.
- Defra Xylella monthly preparedness board.
WP1. Reporting

• Possible *Xylella* symptoms to TreeAlert

  https://treealert.forestresearch.gov.uk

• Xylem fluid-feeding insects (potential vectors) to iRecord and Survey Monkey

  https://www.brc.ac.uk/irecord/xylem-feeding-insects
  https://www.surveymonkey.co.uk/r/spittlebug
WP1. Spittlebug survey & media

- BBC Breakfast & R4
- 1.24 million reads on BBC
- 67 media articles
- 10,000 reports
WP2. Enhancing diagnostics capabilities

- Standardisation of diagnostic methods
- Host colonisation & symptom expression
- Volatile signals of host infection
- Reliable detection in tree hosts
- Source tracing of infections
- Evaluation of new diagnostic methods
WP2. Validation and standardization of diagnostics

- SOP’s shared (Fera, FR, SASA, DARDNI)
- Interlaboratory proficiency testing planned
- Sensitivity of qPCR detection in 15 tree species (FR)
- MLST system for vector identification (SASA/EUPHRESCO)

- Six qPCR assays for *X. fastidiosa* subspecies identification (Fera)
- Core genome MLST system for *X. fastidiosa* source tracing (Fera/SASA)
WP2. Host infection and volatile detection

- Six key hosts selected for controlled-environment studies
  - Coffea arabica, Lavandula dentata, Nerium oleander, Olea europaea, Prunus dulcis, Polygala myrtifolia

- Host plants inoculated with 3
  X. fastidiosa subspp. (Fera)
  - X. f. subsp. multiplex
  - X. f. subsp. fastidiosa
  - X. f. subsp. pauca (CoDiRO)

- Volatile detection using MonoTrap™ technology
WP2. Evaluation and new diagnostics methods

- Digital droplet quantitative PCR (dd qPCR)
- Field test kits
- Optigene LAMP tests for *X. fastidiosa* and vectors
- Agdia RPA test (Amplify RP) for *X. fastidiosa*
WP3. Obtain a better understanding of *X. fastidiosa* insect vector biology

- Locate potential vectors in the environment
- Assess natural short-range dispersal potential of adult *P. spumarius* in the UK via mark-release-recapture experiments
- Generate genomics resources for insect vectors
- Population genetics structure analysis to assess vector distribution among habitats in the UK
Insect vector migration within, and to and from, the UK

Location of insect vector populations in UK

Possible insect migration routes

RAD-seq data of *P. spumarius* populations in Europe, Turkey, USA and New Zealand (data from Sofia Seabra)

BRIGIT: *P. spumarius*; generate genome sequence data to do population genetics of other insects in future
Philaenus spumarius (Xylella insect vector) distribution in Europe

Philaenus spumarius mitochondrial DNA sequences
Rodrigues et al. 2014 PLoS One (Sofia Seabra lab)
Use of databases by stakeholders and (citizen) scientists

- What is the insect species (e.g. on an oak tree)?
- Is the species and genotype of this species common in the UK?
- In which specific region(s) in the UK, Europe or elsewhere is the insect genotype commonly found?
- Has Xylella (or other pathogens) been reported in the region where this insect genotype is common?
WP4. Develop *X. fastidiosa* epidemiology models for the UK

- Assess human pathways of *X. fastidiosa* spread
- Model entry and spread within and from the UK horticultural trade
- Understand purchasing behaviours of consumers, and co-design of identification and detection tools
- Investigate stakeholder incentives
- Develop a multiscale model of *X. fastidiosa* dispersal: surveillance and control
Human pathways of *X. fastidiosa* spread

Goal: Determine the rationale behind and frequency of human interactions that can affect disease spread in the UK plant trade

Data collection *Semi-structured interviews*

- Participant identification
  - Stakeholder mapping of trade network
  - Building database of contacts across stakeholder map
  - Independent/multiple retailers, nurseries, landscape architects/contractors

- Building interview guide
  - Plant trade – origin, destination
  - *Xylella* – knowledge & perceptions
  - Control methods – responsibilities
  - Individual & cooperative biosecurity

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<tr>
<th>Interview questions</th>
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<td><strong>Plant trade</strong></td>
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<tr>
<td>What is your role in the business? For how long?</td>
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<tr>
<td>Which would best describe your business:</td>
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<tr>
<td>- Micro business (up to 10 employees)</td>
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<tr>
<td>- Small enterprise (up to 50 employees)</td>
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<tr>
<td>- Medium enterprise (up to 250 employees)</td>
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<tr>
<td>- Large enterprise (250+ employees)</td>
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Model entry and spread within and from the UK horticultural trade

- Trade network facilitates spread of infected plants
- Assess pattern of trade by using a combination of data, expert opinion, and computational methods.

Detection & control strategies
- Long asymptomatic period of Xylella-infected plants
- Xylella spreads before detection
- Optimize detection of Xylella in early infection stages to prevent spread (with WP2)

Table and chart showing different diseases with their symptomatic incidence.
Biosecurity preferences along the supply chain: What can choice experiments tell us?

1. Are consumers willing to pay more for bio-secure produce?

2. Can consumer preferences induce behavioural changes towards a more bio-secure supply chain?

**PLANT SUPPLY CHAIN**

**GROWERS**
- Nurseries

**INTERMEDIARIES**
- Retailers
- DIY stores
- Garden centres

**CONSUMERS**
- Retail
- Local authorities
- Landscapers
- Conservation orgs

<table>
<thead>
<tr>
<th>Option A</th>
<th>Option B</th>
<th>Option C</th>
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<tbody>
<tr>
<td>Biosecurity Certification</td>
<td>✗</td>
<td>📄</td>
</tr>
<tr>
<td>Source</td>
<td>🇬🇧</td>
<td>🌍</td>
</tr>
<tr>
<td>Appearance</td>
<td>🌸</td>
<td>🌿</td>
</tr>
<tr>
<td>Price</td>
<td>£</td>
<td>££</td>
</tr>
<tr>
<td>Your choice</td>
<td>A</td>
<td>B</td>
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Multiscale modelling of *X. fastidiosa* dispersal

**Epidemiology:**
- Host plants distribution
- Vector distribution
- Host/vector association
- Climate suitability

**WP2:** host plants and diagnostics

**WP3:** vector biology

**Potential entry points:**
- Nurseries
- Garden centres
- Retailers

**WP1, WP4a/d/e:** plant trade/human pathways, surveillance

**Feedback to stakeholders**

**Control/surveillance scenarios**

**Multiscale epidemiological model**

**Epidemiological scenarios**
Requests for handouts with further information about BRIGIT:

brigit@jic.ac.uk

Network, tools and knowledge developed within BRIGIT will be useful for other insect-transmitted plant pathogens that are threat to the UK, including for instance the Zebra chip pathogen (*Liberibacter* species transmitted by sap-feeding psyllids).
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