A quantitative assessment of the likelihood of entry of the Lewis mite, *Eotetranychus lewisi*, into the continental EU

11th meeting of IPRRG, 29th August – 1st September 2017
Ottawa, Canada
WORKING GROUP MEMBERS

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\(^2\) EFSA ALPHA Unit
\(^3\) Visiting scientist EFSA – SLU
\(^4\) previous EFSA Plant Health Panel
1. Quantitative plant pest risk assessment method being developed by the EFSA Plant Health Panel
2. *Eotranynchus lewisi* (McGregor), Lewis mite, case study pest - biology & ecology
3. Entry pathways into EU
4. Results (comparison of scenarios)
5. The benefits of the new approach
6. Challenges
1. QUANTITATIVE METHOD

- EFSA Panel guidance from 2010* had to be reviewed
- Mechanism to link risk elements within each major step
- EFSA principles: transparency, uncertainty
- Quantitative system
  - Each risk element described in terms of a distribution
  - Monte Carlo simulation to combine distributions
- Outputs are distributions

2. PEST BIOLOGY & ECOLOGY

- *Eotetranychus lewisi* – Lewis spider mite
- Many hosts (69 spp)
  - Outdoors e.g. *Citrus, Prunus, Vitis*
  - Glasshouses e.g. poinsettia
- Mostly on leaves, stems, flowers
- Difficult to detect until high numbers (webbing & damage symptoms)
- Increasing concern in:
  - California - strawberry & raspberry
  - Mexico – peaches
  - Chile - grapes
- Already quarantine pest in EU
  - Revision of EU legislation – Commission need to check whether should remain listed: requested pest risk assessment

Source: Jean-Francois Germain, LNPV, Montpellier (FR)
2. PEST ECOLOGY: PLANT DAMAGE

- Feed on the underside of leaves
- Yellow/dark spots on topside
- Necrosis on underside

https://onfloriculture.files.wordpress.com/2015/08/lewismite-ohiosu.jpg?w=413&h=279

Illustrations Anna Howell, UC Davis
2. LEWIS MITE DISTRIBUTION

- UK = outbreak, now eradicated
- Portugal = only Madeira
3. ENTRY - PATHWAYS

- *E. lewisi* reported from 69 herbaceous and woody plant species belonging to 26 different families
- Focus on four pathways:
  1. poinsettia (*Euphorbia pulcherrima*) potted plants and cuttings
  2. strawberry (*Fragaria* spp.) plants for planting from US and Canada
  3. raspberry (*Rubus* sp.) plants for planting
  4. fruits of *Citrus* (*C. limon* and *C. sinensis*)
Evidence as a real pathway

- Interception of *E. lewisi* in Poland in poinsettia glasshouse
- One outbreak of *E. lewisi* in UK glasshouse growing poinsettia (2014, arrived from Guatemala, was eradicated from UK)

**Aim**

- to estimate the average (median) number of packs of poinsettia plants* arriving in the EU each year, infested with *E. lewisi*, over the next ten years

* un-rooted cuttings, rooted cuttings and young plants
## 3. ENTRY: CONCEPTUAL MODEL - POINSETTIA

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td><strong>Poinsettia demand</strong> - Average number of poinsettia plants marketed / consumed per year in the EU</td>
</tr>
<tr>
<td>2.</td>
<td>Percentage of poinsettias imported from third countries into the EU</td>
</tr>
<tr>
<td>3.</td>
<td>Percentage of poinsettia from third countries where <em>E lewisi</em> occurs</td>
</tr>
<tr>
<td>4.</td>
<td>Conversion of pieces of poinsettia into packs as a pathway unit (4a. rooted packs; 4b unrooted packs)</td>
</tr>
<tr>
<td>5.</td>
<td>Percentage of packs that are infested prior to export</td>
</tr>
<tr>
<td>6.</td>
<td>Percentage of infested packs surviving (remaining infested) following export checks</td>
</tr>
<tr>
<td>7.</td>
<td>Percentage of infested packs surviving (remaining infested) following transport, shipping &amp; storage (Assume transport and storage conditions are not affecting the number of packs infested by mites but could increase the density of mites within the packs) - fixed at 100%</td>
</tr>
<tr>
<td>8.</td>
<td>Percentage of infested packs that remain infested after EU Import checks - i.e. percentage of infested packs passing border inspection into the EU</td>
</tr>
<tr>
<td>9.</td>
<td><strong>Entry result</strong>: Average number of infested packs of poinsettia entering EU (per year)</td>
</tr>
</tbody>
</table>
3. ENTRY: EXPERT KNOWLEDGE ELICITATION

Followed EFSA guidance for knowledge elicitation*
For each model parameter:
• Agree specific question
• Collect information / data
• Conduct analysis (convert data to address question)
• Note uncertainties
• Collectively review information (& analysis) & uncertainties
• Individually estimate five quantiles (1\textsuperscript{st} 25\textsuperscript{th} 50\textsuperscript{th} 75\textsuperscript{th} 99\textsuperscript{th})
• Reveal individual values
• Discuss
• Agree five quantiles as a group

* Guidance on expert knowledge elicitation, EFSA Journal \textbf{12} (6), 3734
E₃ Question: What is the average annual percentage of poinsettia plants arriving in the EU over the next ten years, from countries where *E. lewisi* occurs?

Evidence, e.g.
- Countries where *E. lewisi* occurs
- Sources of all poinsettia
- Volumes from each country
- Trends (decline in imports from countries where *E. lewisi* occurs)

Uncertainties, e.g.
- Occurrence of *E. lewisi* (undetected spread)
- Data coverage (NL vs entire EU)
- Changes in sources & import volumes
3. ENTRY: IMPORT DATA FOR EU

- **AIPH: EU imports of cuttings & young plants (2015 data)**

### Table 6.2.1 Cuttings & Young plants

<table>
<thead>
<tr>
<th>Country</th>
<th>NL</th>
<th>BE-LU</th>
<th>IT</th>
<th>ES</th>
<th>DE</th>
<th>DK</th>
<th>GB</th>
<th>FR</th>
<th>CZ</th>
<th>PL</th>
<th>AT</th>
<th>FI</th>
<th>SE</th>
<th>HU</th>
<th>EU other</th>
<th>EU Total</th>
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<tbody>
<tr>
<td>Netherlands</td>
<td>-</td>
<td>2,049</td>
<td>4,799</td>
<td>829</td>
<td>10,825</td>
<td>2,264</td>
<td>4,040</td>
<td>2,347</td>
<td>222</td>
<td>2,073</td>
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<td>728</td>
<td>445</td>
<td>2,673</td>
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<td>137</td>
<td>455</td>
<td>55</td>
<td>332</td>
<td>786</td>
<td>712</td>
<td>181</td>
<td>3,057</td>
<td>2,057</td>
<td>262</td>
<td>163</td>
<td>261</td>
<td>563</td>
<td>11,402</td>
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<tr>
<td>Bel / Lux</td>
<td>85</td>
<td>115</td>
<td>129</td>
<td>554</td>
<td>192</td>
<td>83</td>
<td>243</td>
<td>766</td>
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<td>96</td>
<td>33</td>
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<td>-</td>
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<td>32</td>
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<td>153</td>
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<td>Denmark</td>
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<td>14</td>
<td>214</td>
<td>-</td>
<td>374</td>
<td>9</td>
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<td>48</td>
<td>84</td>
<td>194</td>
<td>472</td>
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<tr>
<td>EU others</td>
<td>21</td>
<td>182</td>
<td>127</td>
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<td>-</td>
<td>1</td>
<td>6</td>
<td>25</td>
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<td>3</td>
<td>1</td>
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<td>28</td>
<td>-</td>
<td>-</td>
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</tr>
<tr>
<td>Finland</td>
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<td>-</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>-</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>79</td>
</tr>
<tr>
<td>EU Total</td>
<td>2,740</td>
<td>2,545</td>
<td>6,183</td>
<td>1,539</td>
<td>12,632</td>
<td>3,877</td>
<td>6,151</td>
<td>4,595</td>
<td>545</td>
<td>6,029</td>
<td>3,446</td>
<td>1,552</td>
<td>1,452</td>
<td>1,051</td>
<td>6,324</td>
<td>60,661</td>
</tr>
</tbody>
</table>

**Majority of EU trade is internal**

**Countries where E. lewisi occurs**

- Costa Rica: 12,158, 1,325, 102, 86, 41, 11, 2, 2
- El Salvador: 784, 5, 4, 3, 3
- Guatemala: 3,461, 1, 152, 2, 5
- Honduras: 1,242
- All E. lewisi sources: 17,545, 1,331, 258, 91, 49, 11, 3, 3

**as % of EU:** 91.0%

- Rest of world: 9,557, 608, 426, 85, 995, 489, 306, 388, 16, 144, 25, 3, 0, 14
- World: 29,942, 4,484, 6,867, 1,715, 13,676, 4,377, 6,460, 4,986, 562, 5,173, 3,471, 1,555, 1,452, 1,065, 6,641, 93,426

**Import volumes (t):**
- 6.1 million t
- 1.9 million t
- 1.3 million t
- 9.3 million t
3. ENTRY: POINSETTIA DATA FROM NL

- NL data: Sources of NL poinsettia cuttings (2010)

<table>
<thead>
<tr>
<th>Country</th>
<th>No. Poinsettia cuttings</th>
<th>%</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uganda</td>
<td>15,695,883</td>
<td>47.88</td>
<td></td>
</tr>
<tr>
<td>Kenya</td>
<td>7,093,864</td>
<td>21.64</td>
<td></td>
</tr>
<tr>
<td>Ethiopia</td>
<td>6,646,691</td>
<td>20.27</td>
<td></td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>1,874,290</td>
<td>5.72</td>
<td></td>
</tr>
<tr>
<td>Indonesia</td>
<td>615,735</td>
<td>1.88</td>
<td></td>
</tr>
<tr>
<td>Brazil</td>
<td>254,381</td>
<td>0.78</td>
<td></td>
</tr>
<tr>
<td>Israel</td>
<td>73,322</td>
<td>0.22</td>
<td></td>
</tr>
<tr>
<td>Ecuador</td>
<td>31,010</td>
<td>0.09</td>
<td></td>
</tr>
<tr>
<td>Thailand</td>
<td>14</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td>Vietnam</td>
<td>2</td>
<td>0.00</td>
<td></td>
</tr>
</tbody>
</table>

Countries where *E. lewisi* occurs

<table>
<thead>
<tr>
<th>Country</th>
<th>No. Poinsettia cuttings</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Costa Rica</td>
<td>328,538</td>
<td>1.00</td>
</tr>
<tr>
<td>Guatemala</td>
<td>147,389</td>
<td>0.45</td>
</tr>
<tr>
<td>Mexico</td>
<td>15,100</td>
<td>0.05</td>
</tr>
<tr>
<td>Colombia</td>
<td>7,700</td>
<td>0.02</td>
</tr>
<tr>
<td>USA</td>
<td>366</td>
<td>0.00</td>
</tr>
</tbody>
</table>

499,093                                    1.52
32,784,285                                  100.00
E₃ Question: What is the average annual percentage of poinsettia plants arriving in the EU over the next ten years, from countries where *E. lewisi* occurs

<table>
<thead>
<tr>
<th>Percentile</th>
<th>1st</th>
<th>25th</th>
<th>50th</th>
<th>75th</th>
<th>99th</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimate (%)</td>
<td>0.0</td>
<td>0.8</td>
<td>1.5</td>
<td>3.0</td>
<td>6.0</td>
</tr>
</tbody>
</table>
E₄ Question: What is the average number of pieces of poinsettia in a pack* imported into the EU.

* A pack is a sealed unit within which a mite could spread to other individual pieces of poinsettia in the same pack.
3. ENTRY: POINSETTIA DATA FROM NL (PACK SIZE, $E_4$)

NL imports of Euphorbia cuttings (quantity of cuttings vs No. packs) to determine pack size

No. packs

Quantity of cuttings

0 100,000 200,000 300,000 400,000 500,000 600,000

0 50 100 150 200 250 300 350 400 450 500
3. ENTRY: POINSETTIA DATA FROM NL (PACK SIZE, $E_4$)

NL imports of Euphorbia cuttings (quantity of cuttings vs No. packs) to determine pack size

- 800 cuttings/pack
- 1,600 cuttings/pack
- Approx 3,200 cuttings/pack

Graph showing the relationship between the quantity of cuttings and the number of packs.
3. ENTRY: SPREADSHEET MODEL

- Excel @Risk add-in

1. Quantile estimates
2. Fitted distribution (red) based on quantile estimates (blue)
3. Result (distribution for one parameter)
4. RESULTS – POINSETTIA PATHWAY (@RISK OUTPUT)

- Sub-steps multiply together
4. RESULTS - POINSETTIA PATHWAY SCENARIO

• Expressed as cumulative descending probability

Approx 90% probability that the median is more than 1 infested pack per year

Approx 50% probability that the median is between 2 and 20 infested packs each year

< 5% probability that the median is more than 100 infested packs per year
4. RESULTS - POINSETTIA PATHWAY SCENARIO

- Expressed as cumulative descending probability

With risk management measures in place (pest free place of production) but residual likelihood that place is not pest free

Approx 95% probability that the median is less than 5 infested packs enter each year
5. BENEFITS OF NEW APPROACH

- Provides mechanism to combine risk elements in logical manner
  - Increased transparency
- Automatically updates with revised inputs
  - Mechanistic
  - Promulgates uncertainties
- Can compare distributions (between pathways, between scenarios)
  - Evaluate risk reduction options
- (Reveals steps which contribute greatest lack of knowledge)
6. THE CHALLENGES?

- Resource intense
- Lack of data
- Communicating results
6. THE ANSWERS TO THE CHALLENGES?

- Resource intense
  - EFSA panel members learning
    - will become more efficient
  - Worth the added transparency (awaiting feedback)
- Lack of data
  - Always lack of data
  - Now transparent how lack of data addressed
- Communicating results
  - First few times will require a degree of “educating” Commission until they get used to new approach
  - Focus for risk communication should be on distributions, more helpful than specific numbers
  - Provides an impression of risk
  - Guidance for panel being developed
ACKNOWLEDGEMENTS

- Olaf Mosbach-Schulz $^1$
- Anna D Howell $^2$

$^1$ EFSA AMU Support
$^2$ University of California, Davis
Questions?