Population dynamics of *Globodera pallida* in relation to temperature

V. Blok, K. McKenzie, H. Kettle and A. Kaczmarek
“Climate scientists agree: climate change is happening here and now. Based on well-established evidence, about 97% of climate scientists have concluded that human-caused climate change is happening.”

Report by the American Association for the Advancement of Science, 2014
Why has the year 2014 been so hot?

This year seems to be on track to be the hottest globally and in the UK. But what does this mean and what are the wider implications?
Meloidogyne spp. top pest for future spread!

UK annual average soil temperatures at 30cm in grassland
What is the relationship between soil temperature and PCN multiplication?
PCN life cycle
PCN hatching test on gradient table
Hatching of *G. pallida* and *G. rostochiensis* over a temperature gradient
Hatching of *G. pallida* and *G. rostochiensis* over a temperature gradient
Maximum number of hatched eggs and time delay as a function of temperature
Female development

**G. pallida**

- **Desiree 10°C**
- **Desiree 12°C**
- **Desiree 14°C**
- **Desiree 16°C**
- **Desiree 18°C**
- **Desiree 20°C**
- **Desiree 22°C**

**G. rostochiensis**

- **Desiree 10°C**
- **Desiree 12°C**
- **Desiree 14°C**
- **Desiree 16°C**
- **Desiree 18°C**
- **Desiree 20°C**
- **Desiree 22°C**

**Number of females vs. weeks at different temperatures.**
Juveniles and males of *G. rostochiensis* and *G. pallida* in the soil
Juveniles and males of *G. rostochiensis* and *G. pallida* in the soil
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Juveniles and males of *G. rostochiensis* and *G. pallida* in the soil

**G. rostochiensis**

- 11°C Desirée
- 14°C Desirée
- 18°C Desirée

**G. pallida**

- 14°C Desirée
- 17°C Desirée
- 14°C Morag
- 17°C Morag
Degree days

$$DD = \frac{T_{max} + T_{min} - T_{base}}{2}$$

- **G. pallida** - 450 DD4
- Average temperature 14ºC - 45 days
- Average temperature 17ºC - 35 days
- **G. rostochiensis** - 398 DD6
- Average temperature 14ºC - 50 days
- Average temperature 17ºC - 36 days
Development of *G. rostochiensis* and *G. pallida* at different temperatures

**Predicted DD**

**Actual DD**
Lincolnshire, England, September 4, 2014

Crop planted 11 April

Soil temperature at 20cm depth

Average 15.3°C

Females on roots - day 147
East Lothian, Scotland, 2014

Luffness: 11 April – 3 September

Lincolnshire: 4 April – 5 September

Average 15.3
Day degrees at different sites – 2014

*G. pallida* 450 DD4

<table>
<thead>
<tr>
<th>Location</th>
<th>DD4</th>
<th>Growing days</th>
<th>Average ºC</th>
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<tr>
<td>Holbeach, Lincolnshire</td>
<td>1639</td>
<td>145</td>
<td>15.3</td>
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<tr>
<td>Cambridge</td>
<td>1742</td>
<td>173</td>
<td>14.7</td>
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<tr>
<td>Ayr, Scotland</td>
<td>1358</td>
<td>120</td>
<td>15.3</td>
</tr>
<tr>
<td>East Lothian, Scotland</td>
<td>1742</td>
<td>163</td>
<td>14.7</td>
</tr>
</tbody>
</table>
Dynamic life stage model

To develop a model describing the relationship between the life cycles of PCN and temperatures

Evaluate risks from PCN in relation to temperature
Conclusions

• Current field temperatures in the UK are below the optimal temperatures for PCN hatching and development
• Increasing temperatures will likely increase PCN populations, though particular agronomic combinations could reduce final population levels
• Environmentally friendly and sustainable control methods for PCN are needed
1) RESAS workpackage 6.4.2: Risk assessment for new diseases and epidemiological modelling of the likely plant disease scenarios arising from climate change and reduced pesticide availability with BioSS

2) Potato Council: Potato Cyst nematodes: Research to support further development of the Potato Council PCN Model

3) ClimateXChange: Prioritising agricultural adaptation to future pest and pathogen threats in Scotland
Thank you