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

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3 December 2014 Last updated at 16:54

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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?

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News from:
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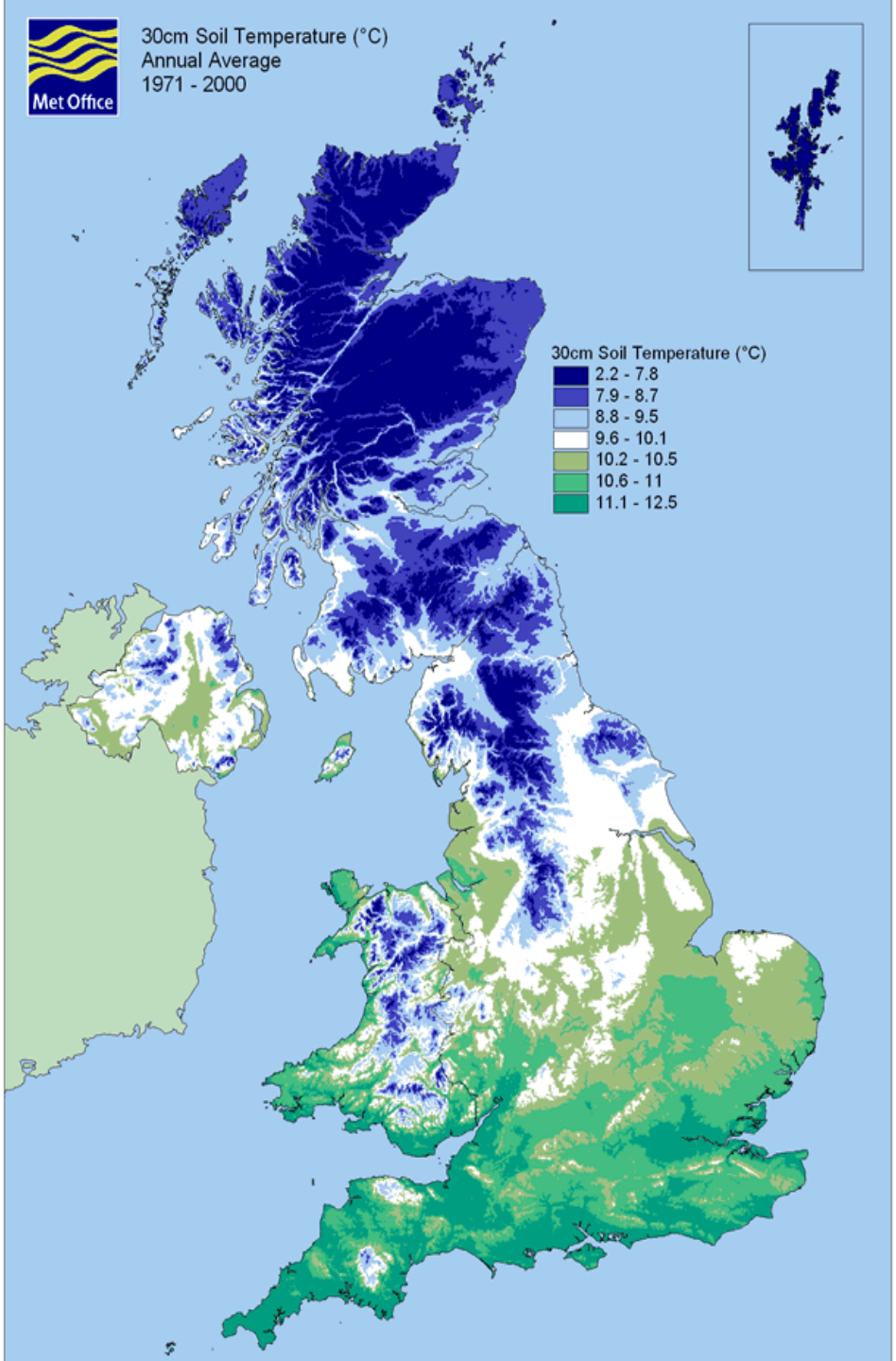
Bebber, Holmes and Gurr (2014) The global spread of crop pests and pathogens. *Global Ecology and Biogeography*



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UK annual average soil temperatures at 30cm in grassland

What is the relationship between soil temperature and PCN multiplication?

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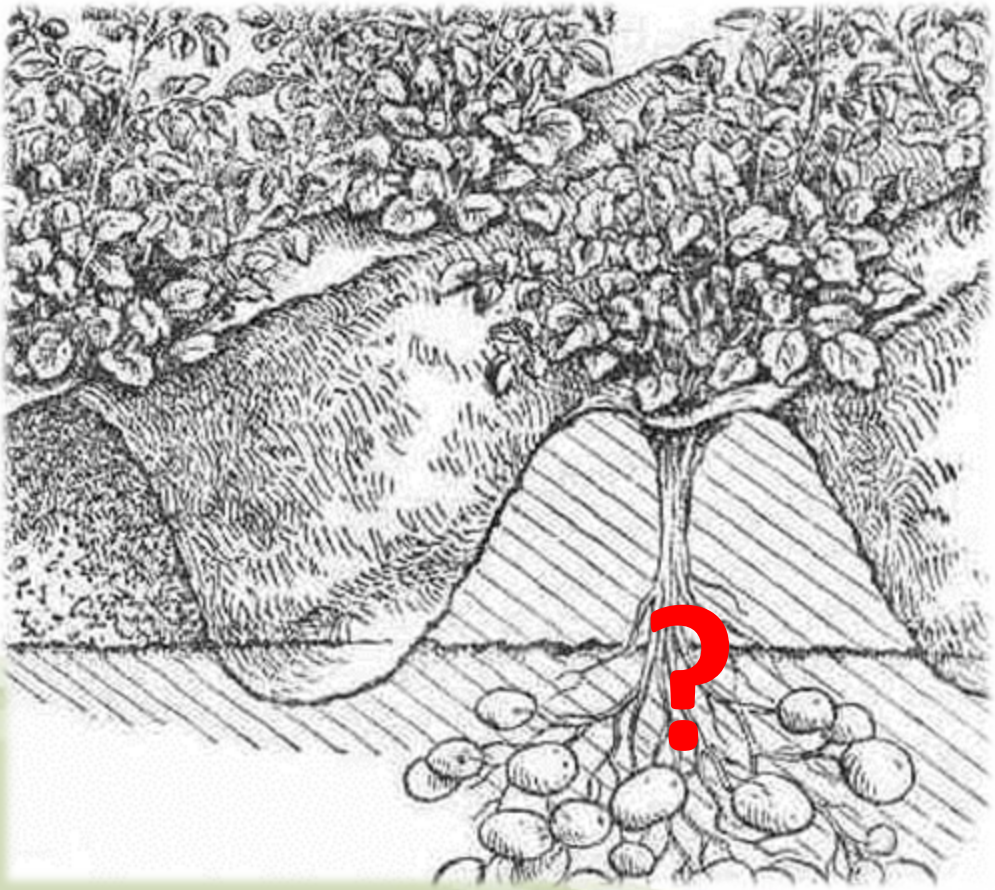
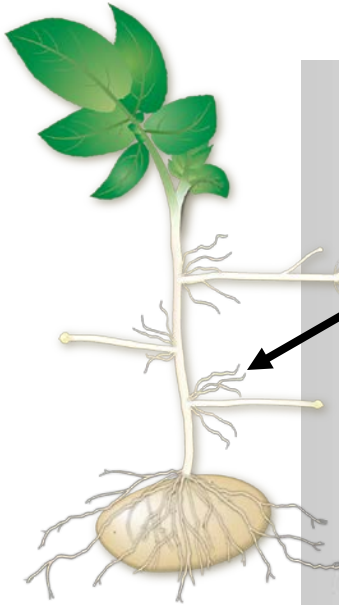
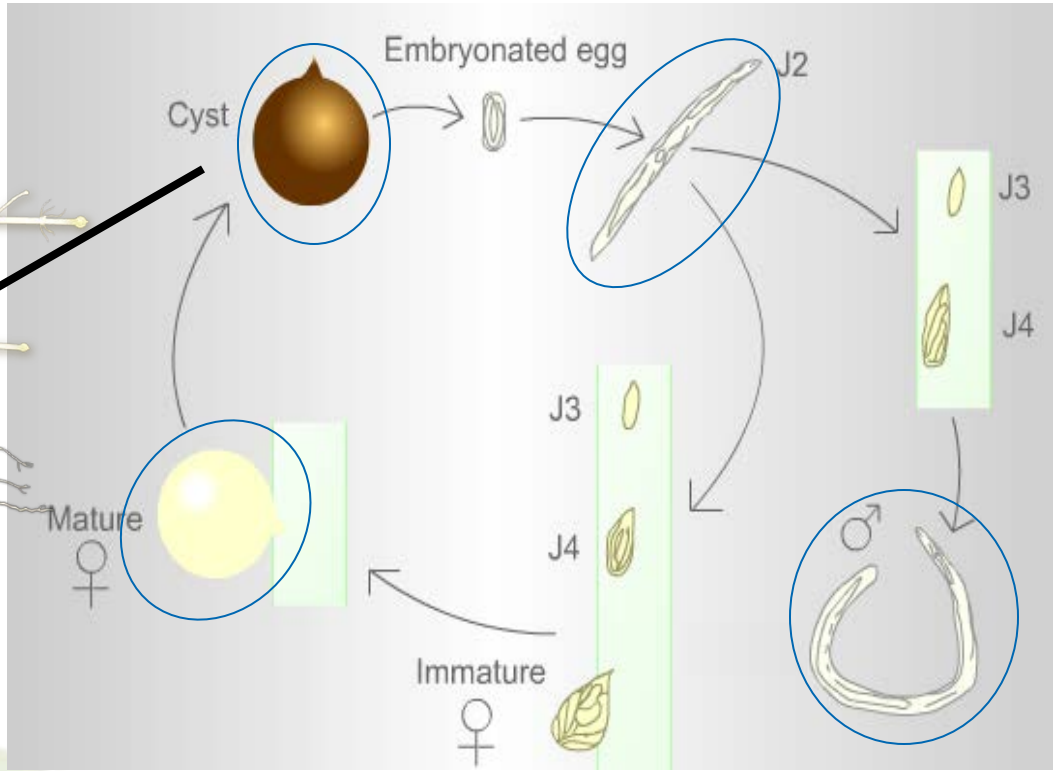
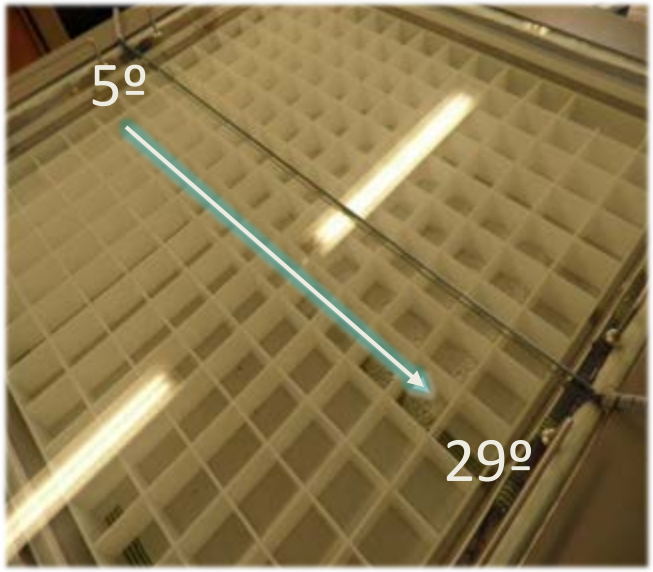


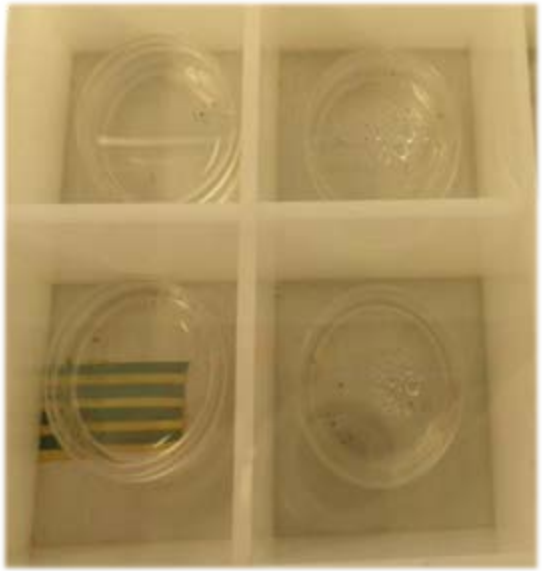
PCN life cycle



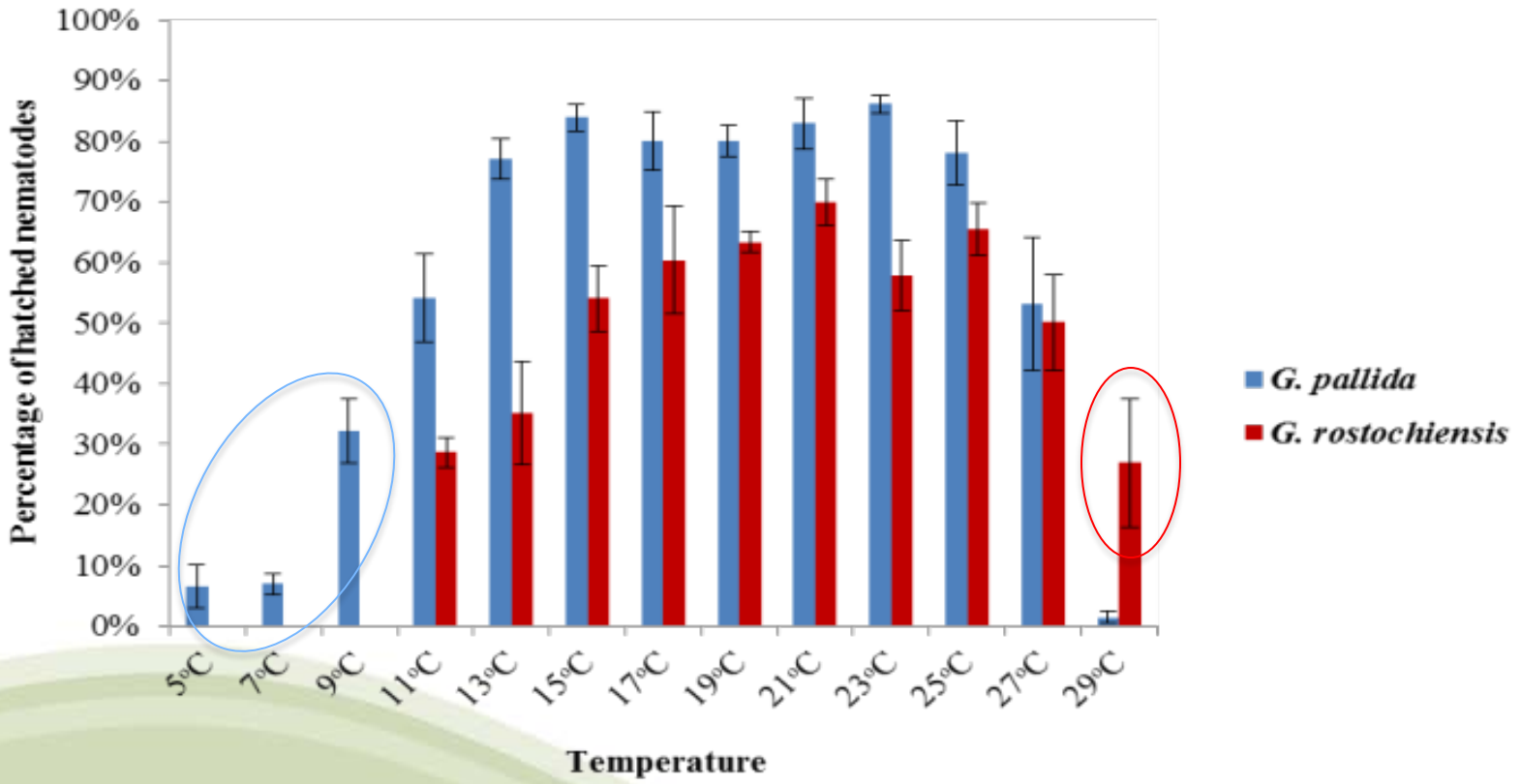


PCN hatching test on gradient table





Hatching of *G. pallida* and *G. rostochiensis* over a temperature gradient



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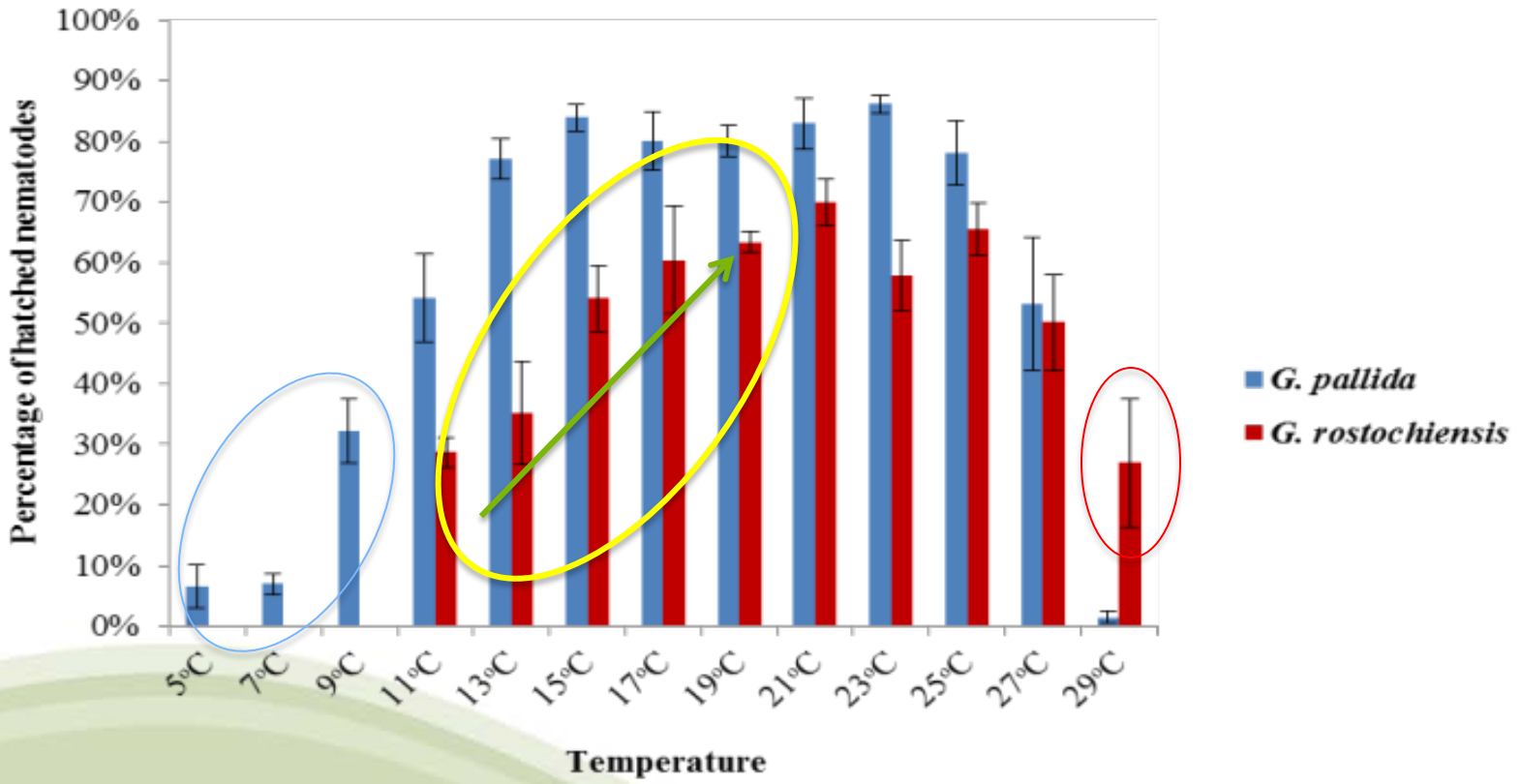
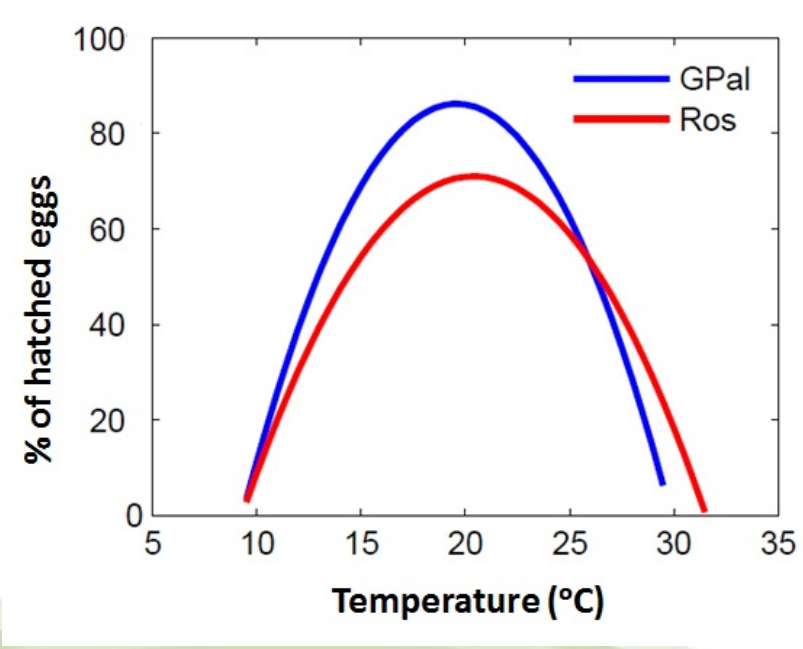
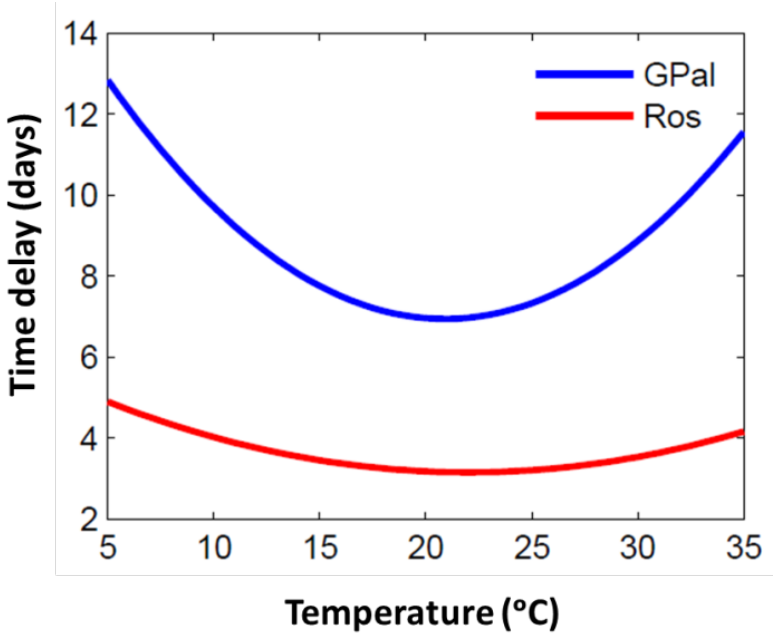
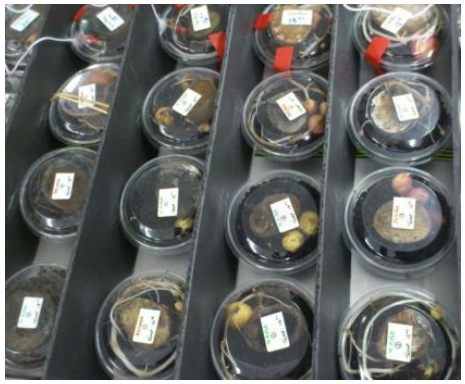


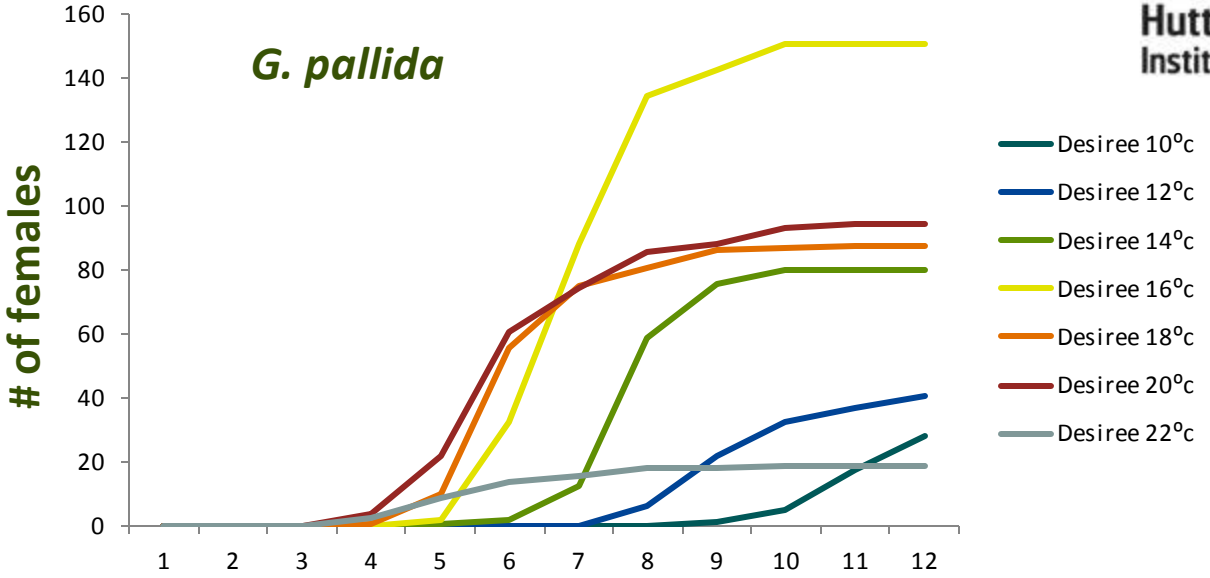
Maximum number of hatched eggs and time delay as a function of temperature

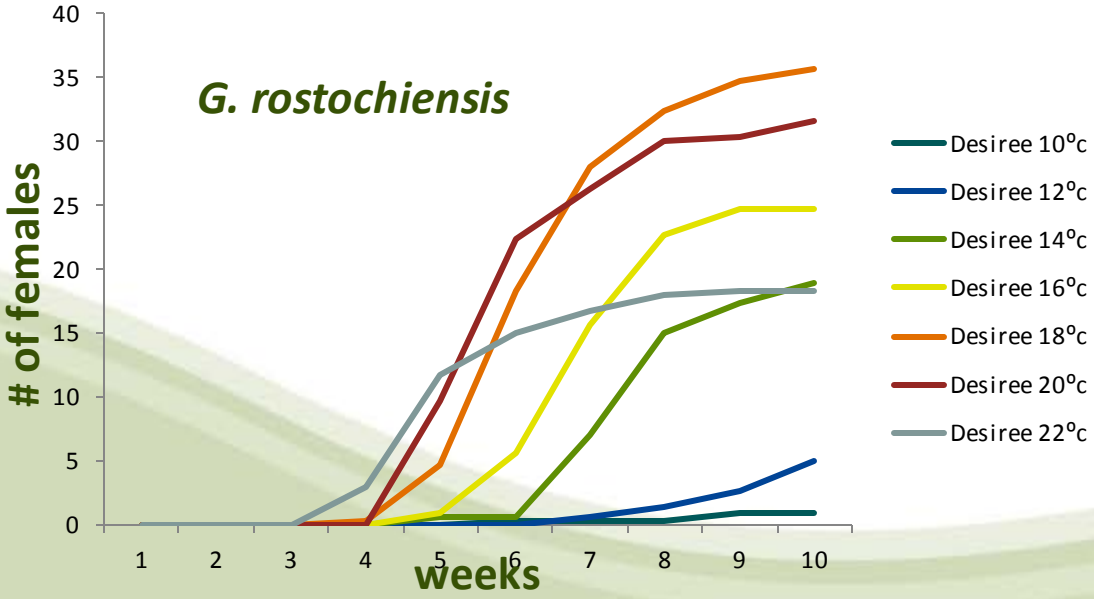




Female development







Juveniles and males of *G. rostochiensis* and *G. pallida* in the soil

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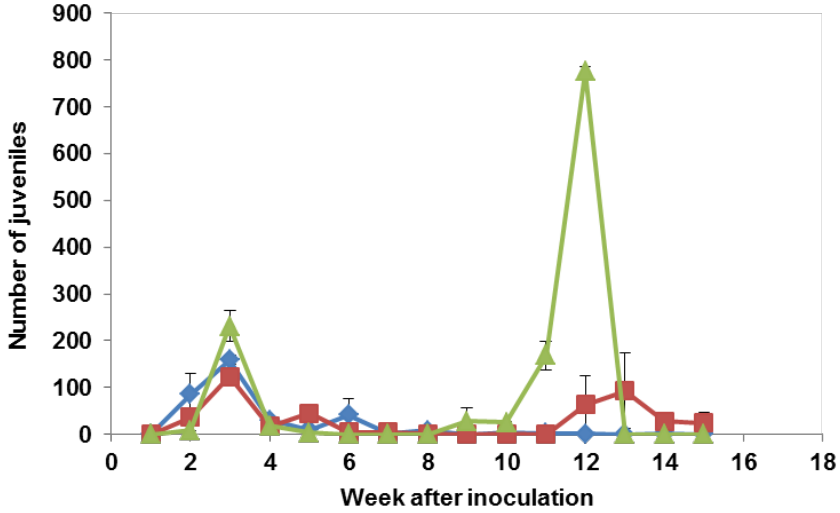
Juveniles and males of *G. rostochiensis* and *G. pallida* in the soil



G. rostochiensis

11°C Desirée

14°C Desirée

18°C Desirée

Juveniles and males of *G. rostochiensis* and *G. pallida* in the soil

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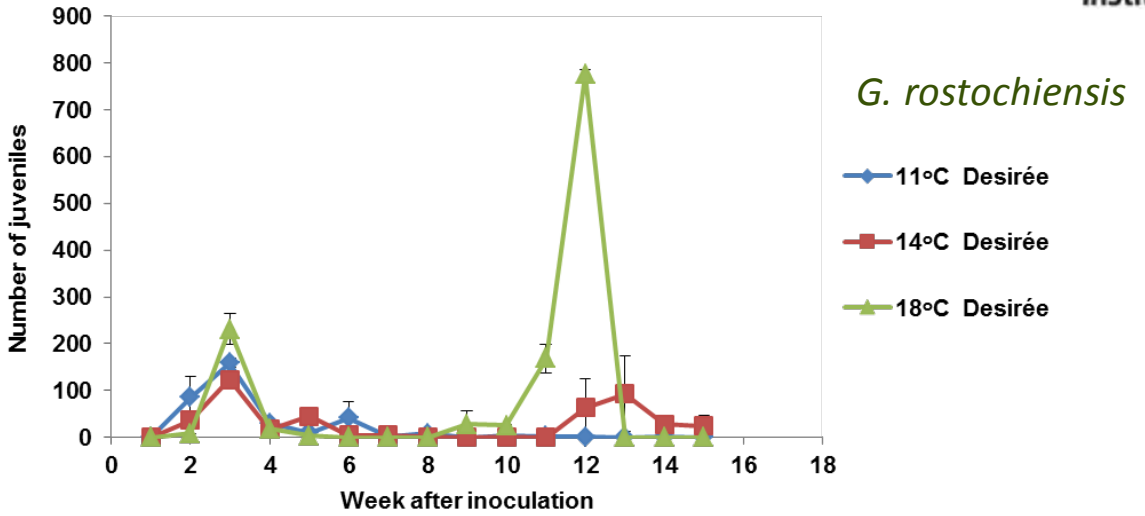
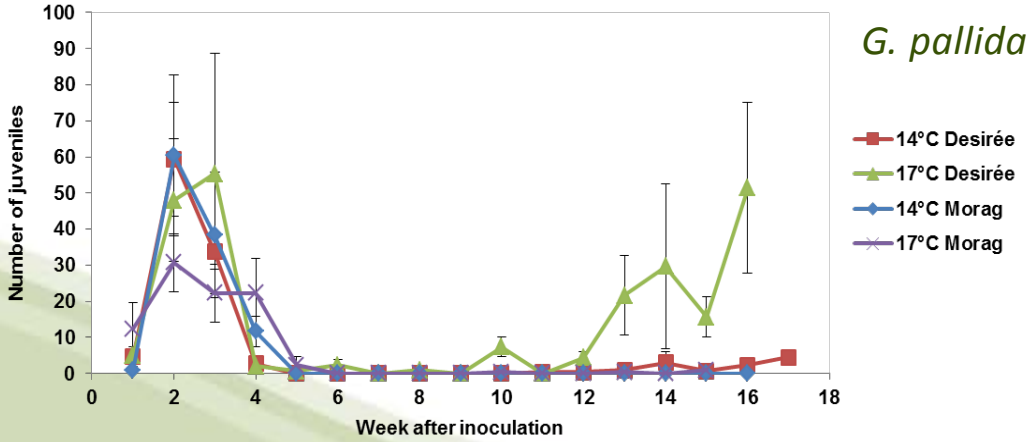
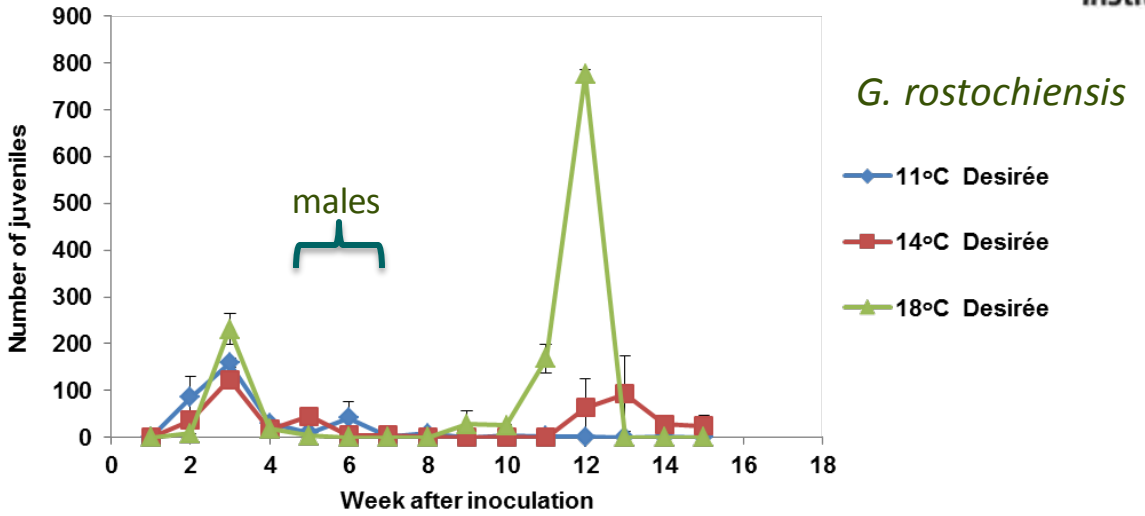
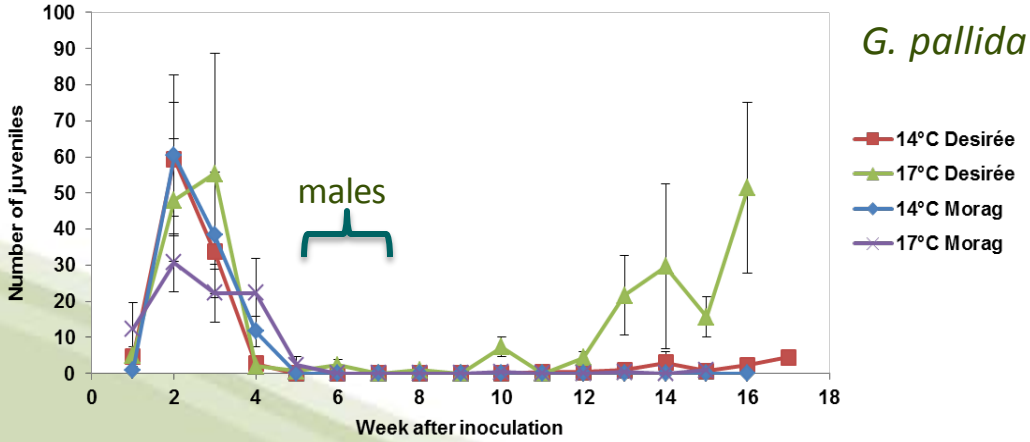




Juveniles and males of *G. rostochiensis* and *G. pallida* in the soil

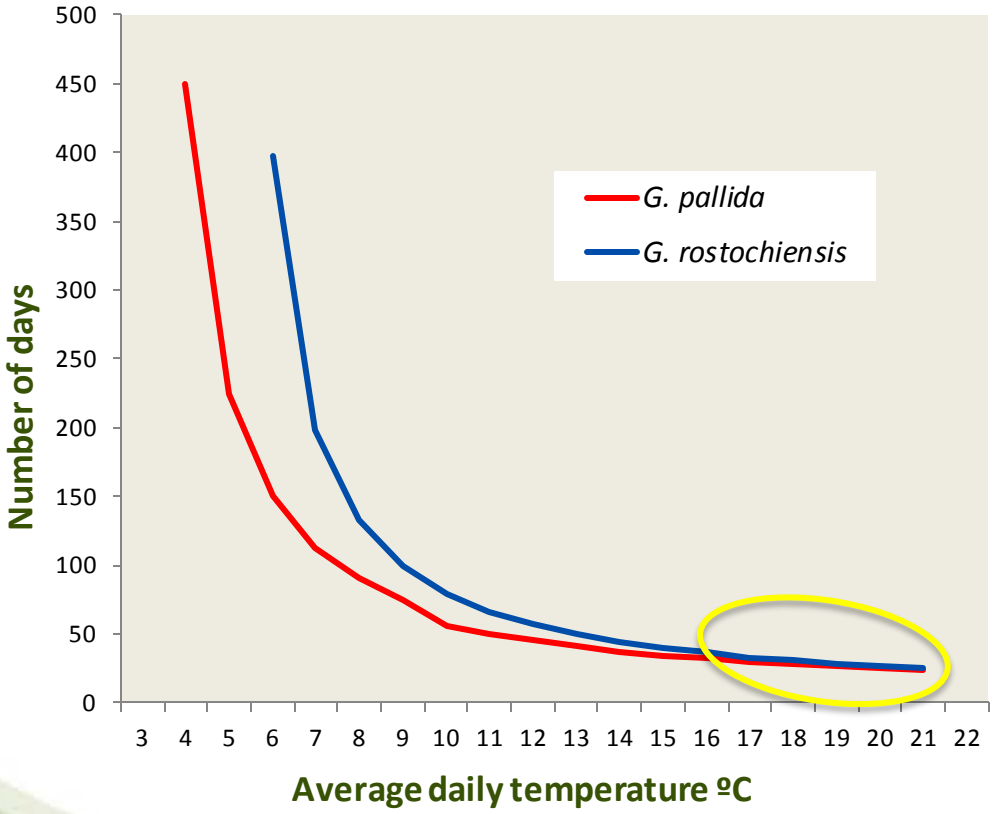




Degree days

$$DD = \frac{Tmax + Tmin}{2} - Tbase$$

- *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

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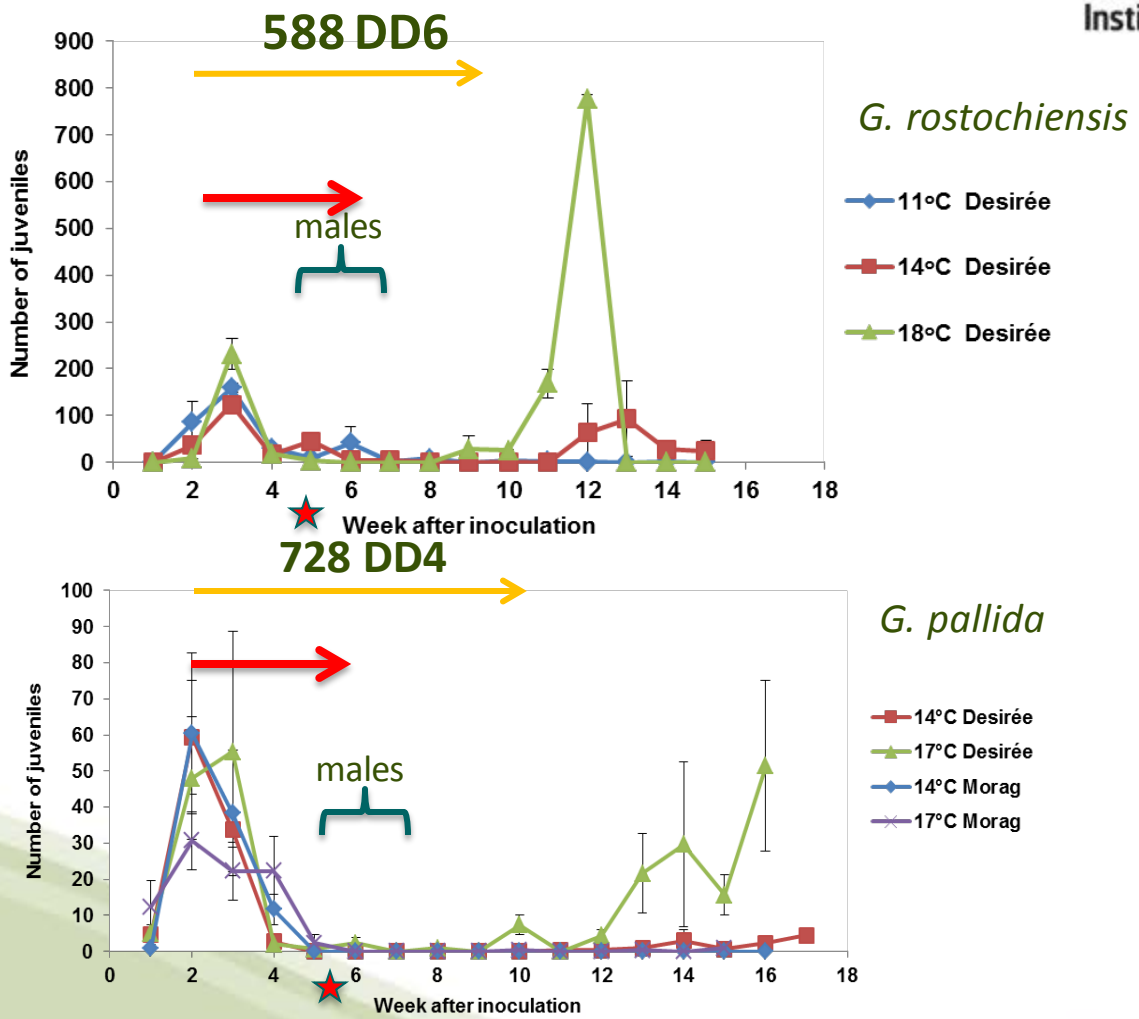
Predicted DD →

Actual DD →



Lincolnshire, England, September 4, 2014

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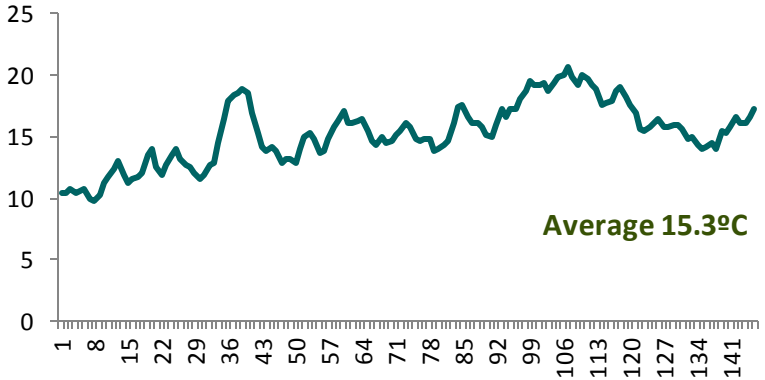
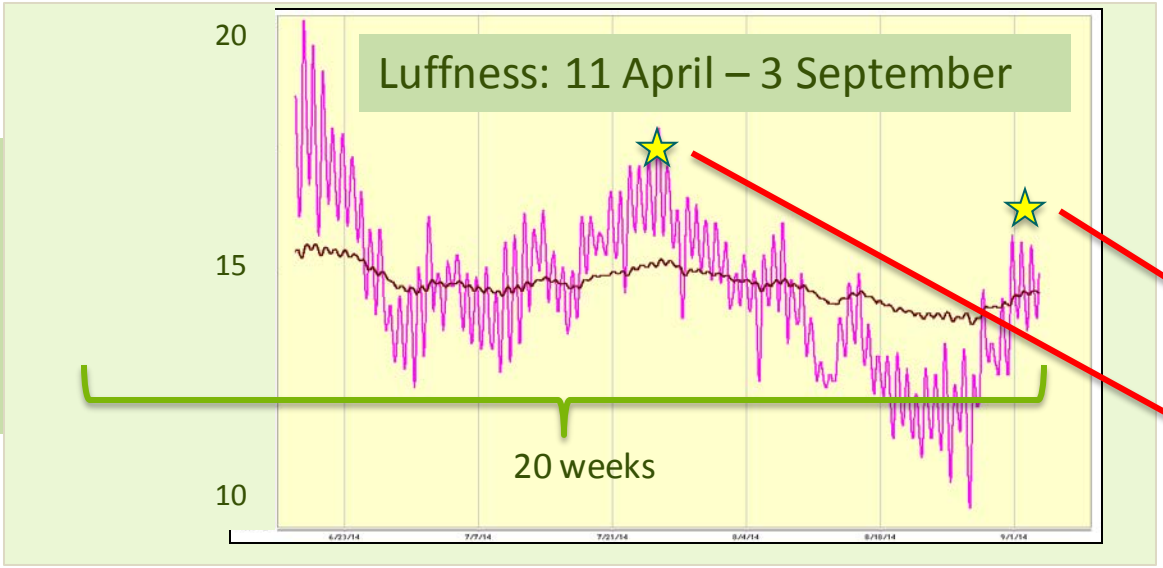
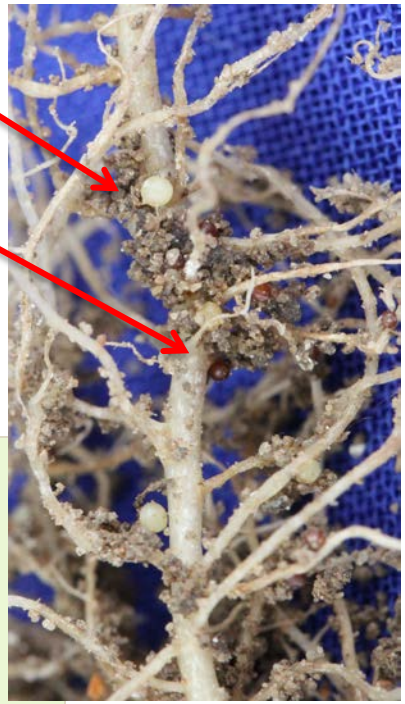
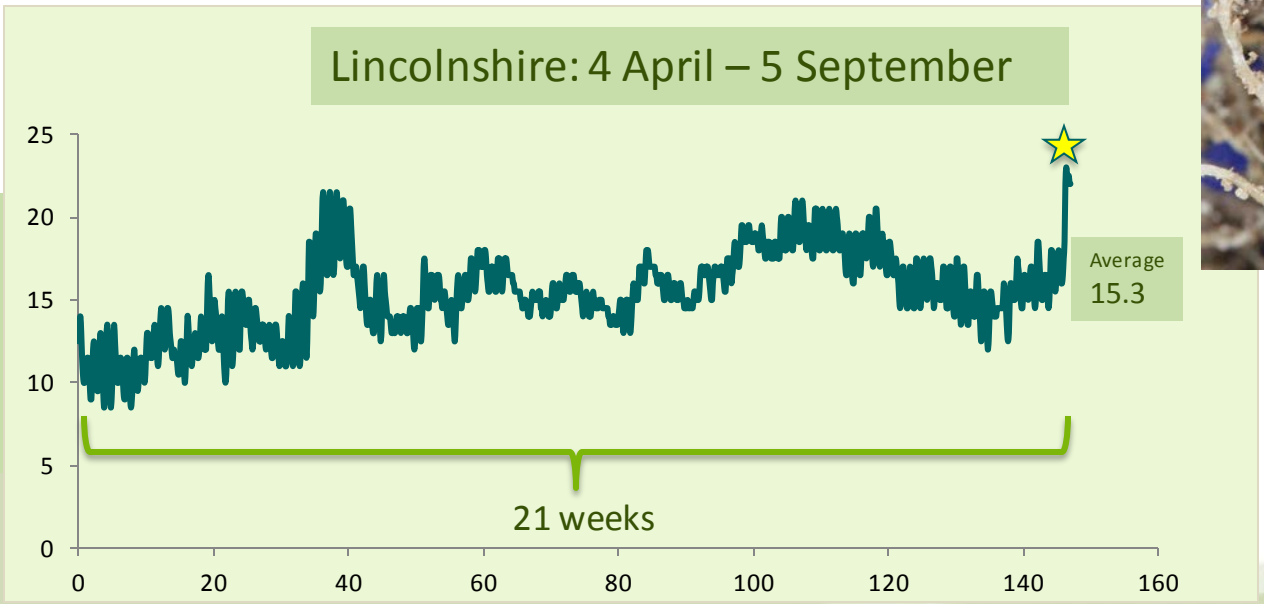
Soil temperature at 20cm depth



East Lothian, Scotland, 2014







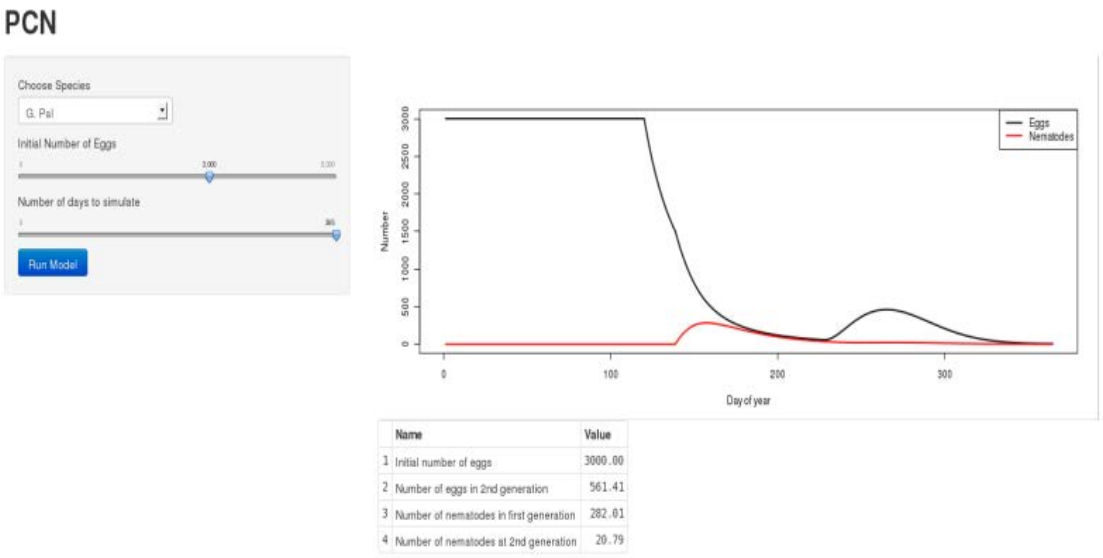
Day degrees at different sites – 2014
G. pallida 450 DD4

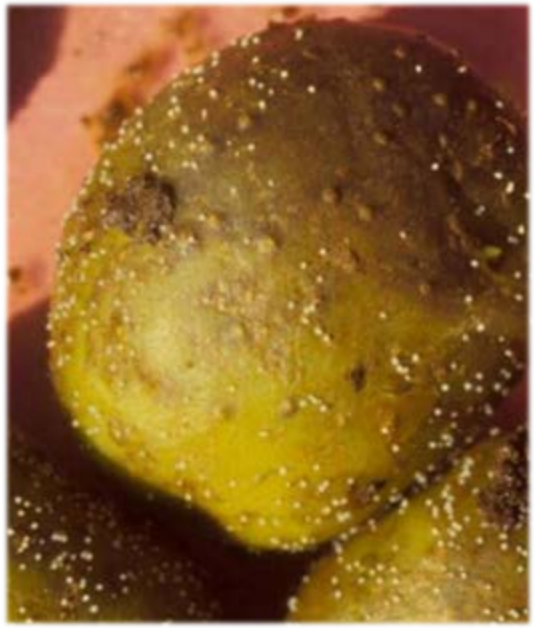
Location	DD4	Growing days	Average ºC
Holbeach, Lincolnshire	1639	145	15.3
Cambridge	1742	173	14.7
Ayr, Scotland	1358	120	15.3
East Lothian, Scotland	1742	163	14.7

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





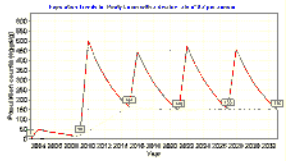
Conclusions

- 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

Funding

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

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Thank you