

Temperature dependent development of *Heterodera schachtii* in a changing climate in Southwest Germany

Möglicher Einfluss des Klimawandels auf die Vermehrung des Rübenzystennematodens in Südwestdeutschland

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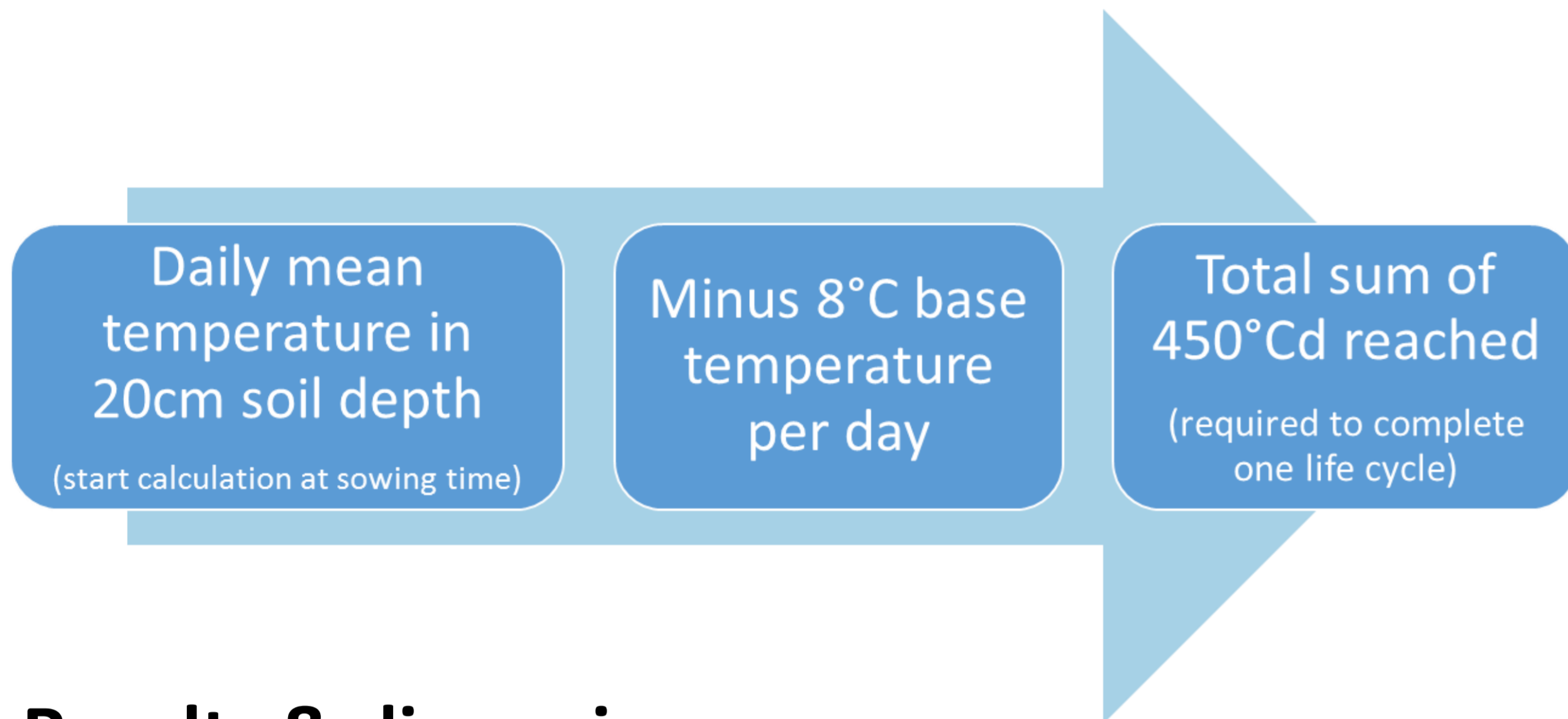
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Introduction

The beet cyst nematode (*Heterodera schachtii*) is the most yield relevant soil born pest in Southwest Germany. The life cycle and number of generations of *H. schachtii* depends of the soil temperature mainly. According to KOCHS (2014) respectively CURI & ZMORAY (1965) 450-465°Cd to base temperature of 8°C

are required to complete one generation. The study area is characterized as a relatively warm and dry climate due to its location in the Upper Rhine Valley. This research was conducted to estimate the recent and future impact of global warming on population dynamics of *H. schachtii*.

Materials and methods



First the potential number of completed life cycles per year were analyzed for the 2010-2015 time frame. Therefore the daily mean temperatures in 20cm soil depth were taken from agrometeorological stations in the study area. The sum of temperatures above 8°C (required for activity of *H. schachtii*) during vegetation time was divided by 450 to calculate the potential number of life cycles of *H. schachtii* a year.

For future time frames, the potential number of life cycles were estimated by using REMO Run 1, data stream 2 for Germany, daily resolution, without bias correction and 10x10 km raster (n = 150). Between the 1st of march and the 31th of October the daily mean temperature was summed up for three time frames: a baseline period 'B' (1971-2000), a medium time period 'K' (2021-2050) and a long time period 'L' (2071-2100). Potential numbers of life cycles were calculated as described above.

Results & discussion

Like given in Fig. 1 the base temperature of 8° C is given with the beginning of the blue column a year. The blue, green, yellow and red columns end when 450°Cd are reached and theoretically one life cycle is completed. The grey column just shows how long soil temperature is still above 8° C but not sufficient for another life cycle.

In the case of 2010, there is no red column. This indicates temperature is not high enough to complete the fourth life cycle. In opposite, in the past five years sugar beet nematodes could reach four generations a year potentially.

So what will happen next? Recording to the blue-green color in Fig. 2 two to four life cycles were possible in the past (B: 1971-2000). In nearly future (K: 2021-2050) more often four life cycles of *H. schachtii* will be completed in the study area. This could lead to a huge increase of nematode infestation in sugar beet growing areas.

In distant future the projected dimensions of temperature increase caused by climate change are particularly clear. Especially the Rhine-Main region and Upper Rhine Valley tend to become warmer. In future (L: 2071-2100) five or more life cycles will be expected per year.

In intensively used sugar beet growing areas crop rotation and intercropping of resistant catch crops (resistant oilseed radish and mustard) are tools of nematode management. Because the study area is a relatively warm and dry region, intercropping is mainly limited by the lack of water during seed germination. Consequently, nematode-management relies on the availability and use of sugar beet variety.

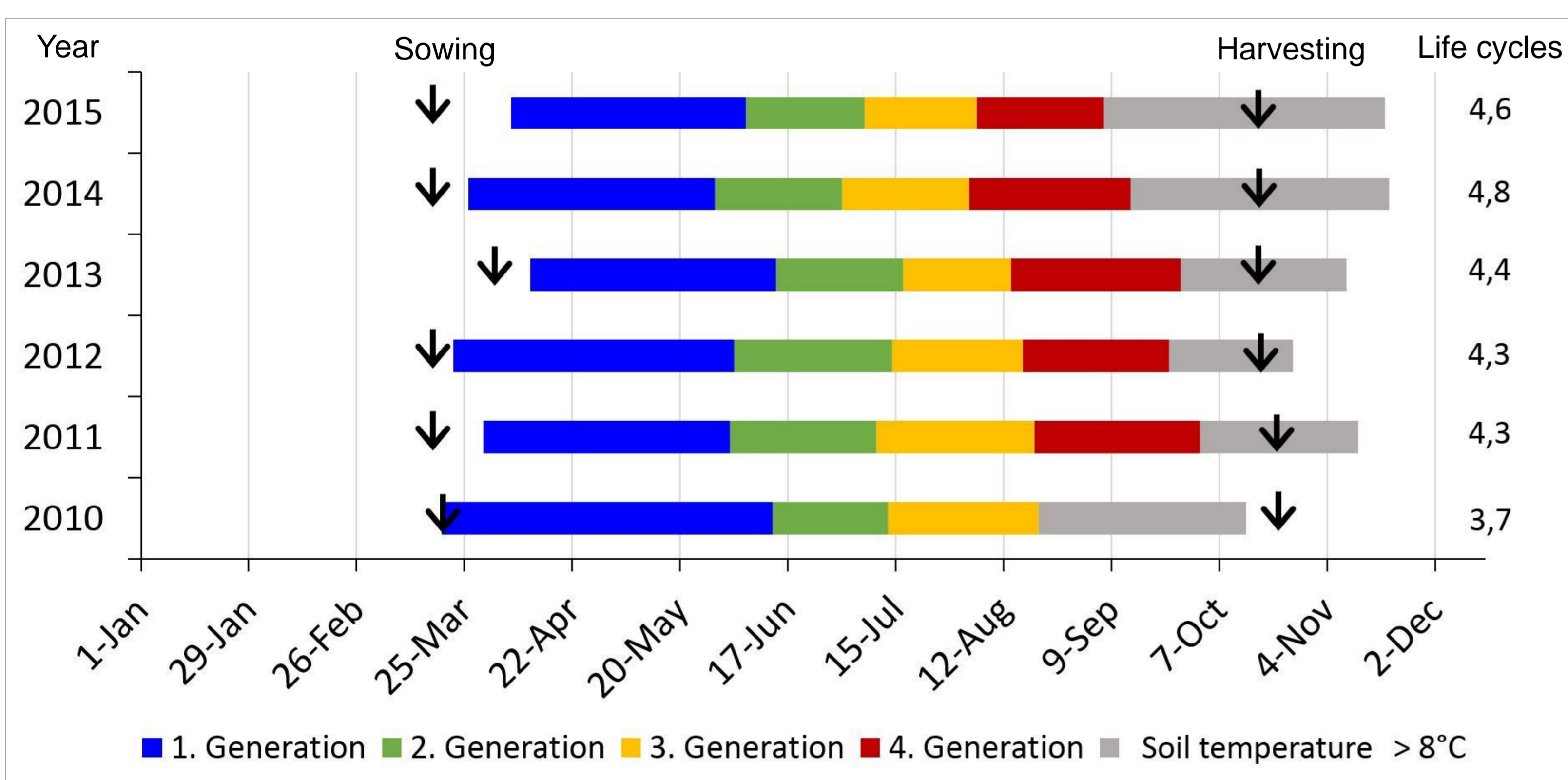


Figure 1: Days theoretically needed to complete a life cycle of beet cyst nematodes in the past six years calculated from data of the agrometeorological station Mainz, Germany.

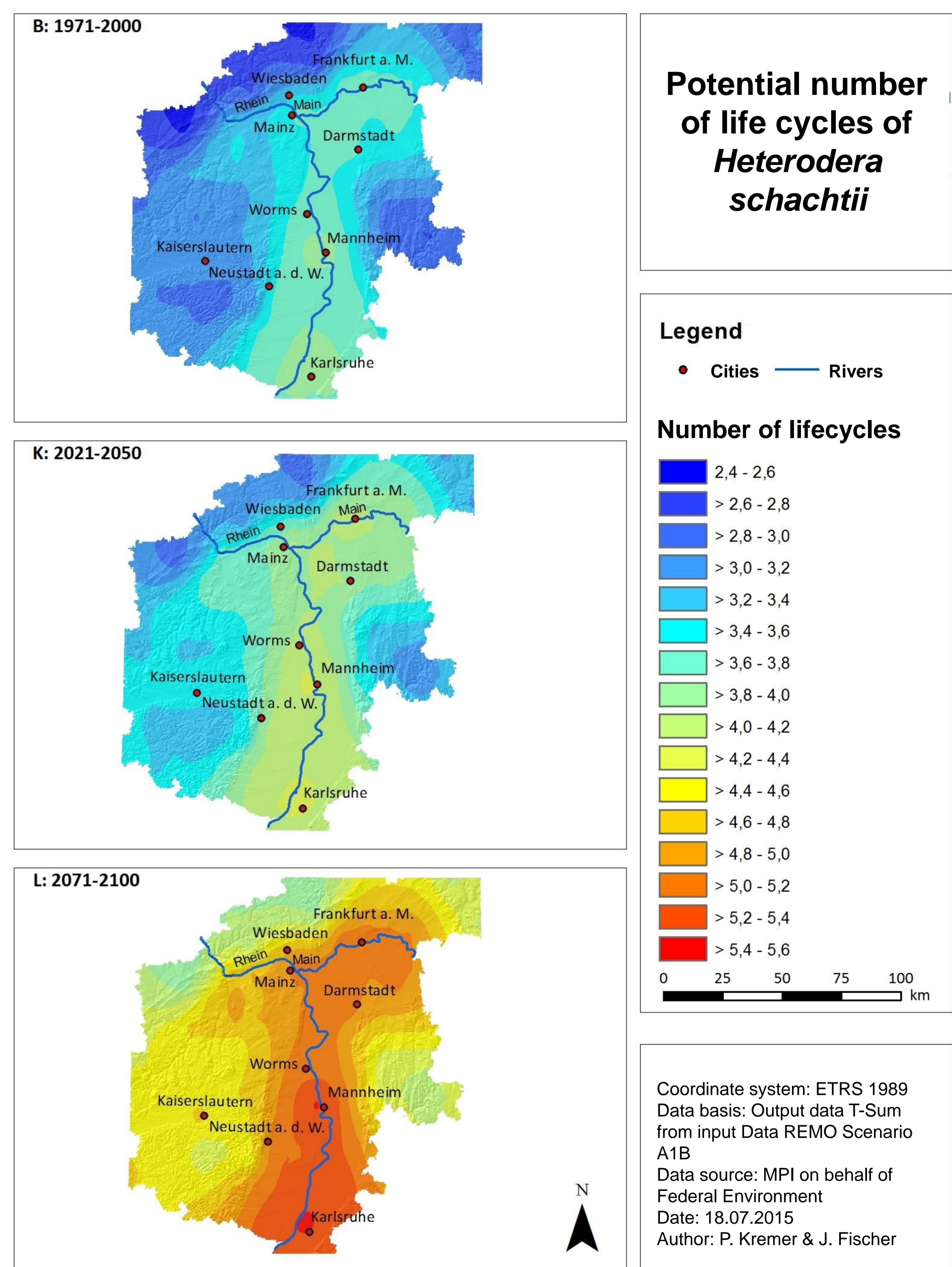


Figure 2: Climate model based calculation of number of potential life cycles of beet cyst nematodes in the study area for the past (B) and near (K) and distant (L) future.

Conclusion

- Serious increase of nematode infestation, especially when susceptible sugar beet varieties are used
- Importance of nematode-management will increase
- Already 4 life cycles of *H. schachtii* are possible per year, in future even 5!
- More influences next to soil temperature are crucial for the increase of beet cyst nematode infestation → more research is needed

Literature

CURI, J. & ZMORAY, I. (1966): Beziehung klimatischer Faktoren zur Entwicklungsdauer von *Heterodera schachtii* in der Slowakei (CSSR). – Helminthologia 7: 49-63. Berlin, Heidelberg, New York.
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