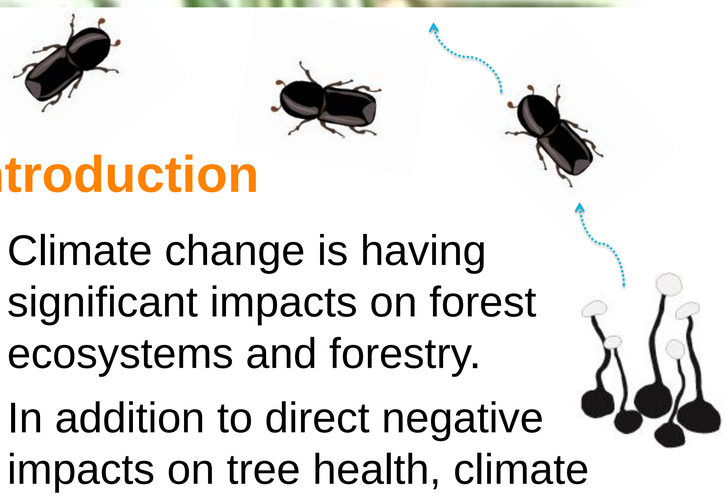
Climate change alters disease severity in the *Endoconidiophora polonica*-Norway spruce pathosystem

Riikka Linnakoski[1,2], Junko Sugano[3], Samuli Junttila[2], Michael J. Wingfield[4], Fred O. Asiegbu[2], Pertti Pulkkinen[5], Kristian M. Forbes[6]

[1]Natural Resources Institute Finland (Luke), Helsinki, Finland; [2]Department of Forest Sciences, University of Helsinki, Finland; [3]Department of Microbiology , University of Helsinki, Finland, [4]Forestry and Agricultural Biotechnology Institute (FABI), University of Pretoria, South Africa; [5]Natural Resources Institute Finland (Luke), Läyliäinen, Finland; [6]Department of Virology, University of Helsinki, Finland



Introduction

- Climate change is having significant impacts on forest ecosystems and forestry.
- In addition to direct negative impacts on tree health, climate change has the potential to impair plant responses to other environmental stressors, such as pathogens and pests.
- Few rigorous experimental studies have focused on interactions between biotic agents and climate change-associated environmental perturbations.
- To shed light into these implications, we conducted two powerful inoculation experiments[1,2] to test *in vivo* the effects of changed growing environment on Norway spruces seedlings infected with *Endoconidiophora polonica*, a pathogenic fungus commonly vectored by *Ips typographus*, a major forest pest insect in Europe.

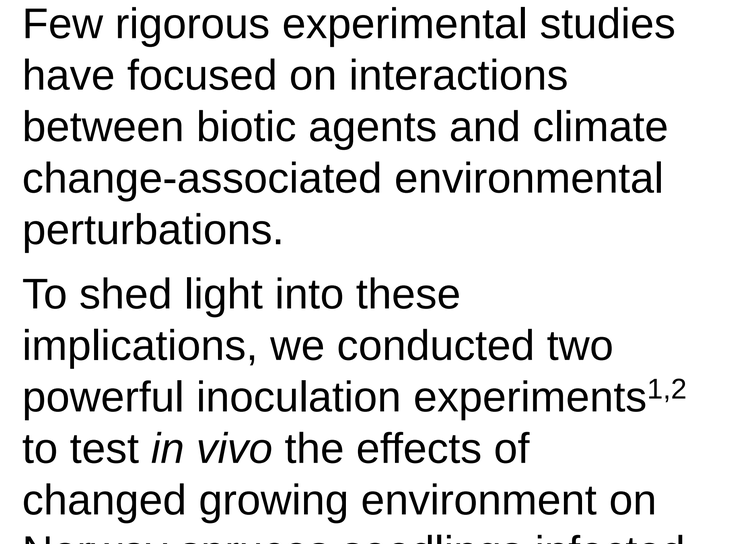


Fig. 1. Norway spruce (*Picea abies*) seedlings infected by an ophiostomatoid fungus *Endoconidiophora polonica*. The majority of seedling mortality occurred during the initial two months of the experiments.

Materials and methods

- 2-year-old Norway spruce (*Picea abies*) seedlings were inoculated with different strains of *E. polonica* isolated from *I. typographus* or mock-inoculated (control).
- In the first experiment[1], seedling performance was compared under ambient temperatures and CO_2 levels with those predicted for the years 2030 and 2100 in Finland.
- The second experiment[2] compared seedling performance under high and low water availability treatments.
- In total 450 (the first experiment) and 737 (the second experiment) seedlings were inoculated.
- Seedling mortality was monitored at monthly intervals, and seedling growth and lesion length indices were measured at the end of the experiments.

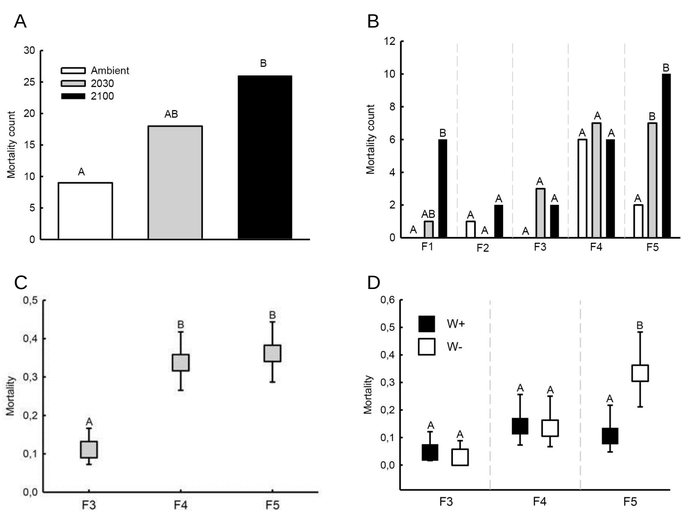


Fig. 2. Seedling mortality counts when (A) all fungal strains combined and (B) between the fungal strains under different climate change scenarios, and under high (W+) and low (W-) water availability treatments during the first (C) and second (D) month of the experiment.

Results

- Increased temperatures coupled with elevated CO_2 concentration[1], and reduced water availability[2] can both enhance disease severity in *P. abies*.
- Higher temperature increases are likely to be most detrimental to tree health.
- Disease severity was not universally greater under the most distant climate change expectations or for water restricted seedlings, but varied markedly among the fungal strains (Fig. 2b-d).

Conclusions

- We show that predicted climate changes have the potential to alter the damage caused to Norway spruce by *E. polonica*.
- Our results highlight the importance for a strain-specific level of understanding of the disease agents.
- There is an urgent need for systems-based research to better understand the impacts of interactions between biotic agents and climate change.
- For more information, visit our special issue in *Frontiers in Plant Science* for outstanding research addressing the multifaceted effects of climate changes on forest pests and pathogens and their interactions.

Acknowledgements

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References

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Contact information: riikka.linnakoski@luke.fi