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Conference Abstract

# Dynamics of biotic resistance to plant invasions

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## Abstract

Biotic resistance, the reduction in invasion success caused by native communities, plays an important role in the long-term dynamics of biological invasions. A large body of empirical research on biotic resistance has accumulated since the last comprehensive review on the subject 20 years ago, enabling us to achieve a refined understanding of biotic resistance and its dynamics. Here, we aim to reshape research on biotic resistance to alien plant invasions by:

- synthesizing existing evidence on biotic resistance and

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- exploring the so far rarely considered interplay between biotic resistance mechanisms (i.e. competition, aboveground and belowground antagonisms, and diversity-invasibility effects) and the potential eco-evolutionary changes in biotic resistance over time.

To address the first aspect, we conducted a global meta-analysis of 240 experimental studies to assess the mechanisms by which and the extent to which biotic resistance of native communities affects the performance of alien plant species. We show that competition with native plant species, aboveground antagonism (e.g. herbivores) and diversity-invasibility effects significantly reduced alien plant performance, whereas there was no evidence for consistent effects of belowground antagonism (e.g. soil pathogens). Competition exerted the strongest biotic resistance, followed by aboveground antagonism. However, the strength of biotic resistance also depended on the alien plant performance measure considered (vegetative performance, survival, reproductive performance, or population growth). From the small set of studies that considered more than one biotic resistance mechanism, we did not detect an overall synergistic effect of combined mechanisms. The meta-analysis results also revealed that biotic resistance first decreased with the residence time of the alien plant species but increased again after approximately 200 years. In a subset of studies directly comparing species of different origin, we did not detect a difference in biotic resistance to alien vs. native species.

To address the second aspect, we expanded the limited empirical evidence on temporal dynamics by presenting a conceptual causal network and an accompanying mathematical model to explore the eco-evolutionary dynamics of biotic resistance mechanisms. Our conceptual and mathematical models highlight that biotic resistance is determined by both the attributes of the alien species (i.e. invasiveness) and of the recipient community (i.e. invasibility). Both factors can change over time as inter- and/or intraspecific selection cause changes in the composition and overall density of the native community and the alien species. As invaders evolve and the successful ones persist, biotic resistance initially decreases, then increases again due to intra- and interspecific adaptation of the native community.

Using the findings from the comprehensive synthesis of empirical studies and our modelling approach, we highlight research avenues to better understand the temporal dynamics of biotic resistance to plant invasions, including how biotic resistance depends on multiple mechanisms and performance measures, how it may differently affect alien vs. native species and crucially, how it changes over time (Sheppard et al. 2026).

## Keywords

alien species; antagonism; biotic resistance; diversity-invasibility; herbivory; meta-analysis; plant competition; plant invasion; population dynamics

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## Conflicts of interest

The authors have declared that no competing interests exist.

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