

The Research Group  
WILD

has the honor to invite you to the public defence of the PhD thesis of

## Elias Goossens

to obtain the degree of Doctor of Sciences

Title of the PhD thesis:

**Impact of plant soil feedbacks on invasive plants  
and co-existence in grassland communities**

Supervisor:

**Prof. dr. Harry Olde Venterink (VUB)**

Co-supervisors:

**Dr. Vanessa Minden**

**The defence will take place on**

**24 April 2026 at 16h00**

**VUB Etterbeek campus, Pleinlaan 2,  
Elsene, Gebouw I, i0.02.**

### Members of the jury

Prof. dr. Luc Leyns (VUB, voorzitter)

Prof. dr. Franky Bossuyt (VUB)

Prof. dr. Thomas Merckx (VUB)

Prof. dr. Gerlinde De Deyn (Wageningen  
University and Research, NL)

Prof. dr. Marina Semchenko (University of  
Tartu, EST)

### Curriculum vitae

Elias Goossens obtained a Master's degree in Industrial Sciences: Landscape and Green Management at Ghent University in 2019.

He subsequently started as an Assistant Botany at the VUB under Prof. Harry Olde Venterink.

He investigated the influence of plant-soil interactions in grasslands and invasive alien species. He published five articles in international peer-reviewed journals.

He has also presented his results at international conferences.

Furthermore, he has supervised 18 bachelor and master students and established scientific collaborations with KU Leuven, UAntwerp, and Natuurpunt.

### Abstract of the PhD research

Plants modify soil chemistry, structure, and microbial communities, which in turn influence plant growth. These interactions, known as plant-soil feedbacks (PSFs), play a role in shaping plant diversity, invasion dynamics, and successional patterns. Although PSFs have been widely studied, gaps remain in empirical evidence and experimental design. Support for negative PSFs promoting coexistence by suppressing dominant species is theoretical, as most experiments rely on single-plant pots or simplified competition setups that poorly represent natural communities. It therefore remains unclear whether PSFs measured in monocultures translate to field conditions. Additionally, evidence for the Enemy Release Hypothesis (ERH), which predicts reduced negative PSFs for invasive species due to the absence of co-evolved pathogens, is inconsistent. Finally, the effect of nutrient availability on PSFs has been largely overlooked. To address these knowledge gaps, I performed a series of greenhouse and field experiments.

Results demonstrate that PSFs measured in monocultures are not correlated with PSFs in communities, indicating that monoculture experiments are unsuitable for assessing community-level PSFs. Instead, community-level PSFs can be predicted from community structure: dominant species experience negative PSFs, whereas rare species may receive positive PSFs, thereby facilitating coexistence. PSFs measured in monocultures were more negative for natives than those measured in communities. Contrary to expectations under the ERH, invasive species did not benefit from reduced negative PSFs in species-rich communities. Additional experiments showed that as PSFs for natives become more negative in species-poorer communities, invasive species may benefit more from the ERH, thereby facilitating invasion.

Nutrient availability was found to influence PSFs, with both nutrient levels and ratios affecting feedback strength. These effects varied among species and could not be explained by stoichiometric niches observed in the field. Consequently, stabilizing PSFs in plant communities may be disrupted by changes in nutrient availability, e.g. through anthropogenic nutrient inputs or invasive species. For example, *Solidago gigantea* was shown to increase nitrogen availability, at least partly through accelerated decomposition of organic matter.

These findings indicate that species diversity promotes stable grassland communities by diluting species-specific pathogens affecting rare species and suppressing dominant species through negative PSFs. Reduced negative PSFs in species-rich communities also increase invasion resistance by intensifying competition and diminishing the importance of the ERH. Disturbances that reduce species richness may therefore have long-lasting effects by destabilizing plant-soil feedbacks, facilitating dominance by a few species and invasion by exotic plants, which may further alter nutrient availability and reinforce these feedbacks over time.