

# How successful plants take the lead

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In greenhouse experiments, the characteristics of the different plant species are closely examined. Credit: Anne Kempel, Institute of Plant Sciences, University of Bern.

Why are some plant species rare, and others common? Why do certain exotic plant species become invasive – while others do not? Scientists from the University of Bern now identified the most important environmental and species characteristics for plants to colonize and establish in novel places.

Germinating quickly, growing fast, withstanding competitors and defending against herbivores - already since decades, ecologists have suggested that these are important characteristics of successful [plants](#). However, it has also been suggested that species characteristics are less important as determinants of plant establishment success than other factors such as seed availability or environmental characteristics, like dense vegetation.

In Bern, researchers of the Institute of Plant Sciences and the University of Konstanz carefully examined the importance of those species characteristics, and provide evidence that they affect – more strongly than has been anticipated – success or failure of species.

## **Field and greenhouse experiments combined**

Some unique features of the Bernese study are the high number of used [plant species](#) and the sophisticated combination of several independent experiments. In a comprehensive [field experiment](#), the scientists sowed more than 90 different native and exotic plant species into 16 grasslands with different vegetation densities in the Canton of Bern. They varied the introduced seed number and manipulated soil disturbance. Then, they observed carefully which of the sown plant species established in the field.

At the same time, the scientists conducted several greenhouse experiments to assess, as accurately as possible, the characteristics of each species – from seed mass and germination rate to the speed of growth, the competitive ability and the resistance against herbivores, like [caterpillars](#).

"Although it is known that herbivory and competition are relevant for plant establishment, the response of many plants to those factors is rarely measured due to the large amount of work", comments Markus Fischer,

professor of plant ecology at the University of Bern. By combining the results from the field and the greenhouse, the most important species traits and environmental characteristics for establishment success could be identified.

## **The winners are well defended against herbivores**

The Bernese plant scientists could show that at the beginning of the experiment mainly species with a high seed mass germinated in the [grasslands](#). In addition, a high number of seeds sown increased early establishment success. However, the importance of factors changed during the course of the study.

"Interestingly, at the end, mainly traits related to interactions between plants and plants or plants and animals were important", reports Anne Kempel, first author of the study. Accordingly, plants that were well defended against voracious insects were the most successful ones in the long run.

"Our results are in line with general theories on community assembly and invasion success", explains Mark van Kleunen, the leader of the project. First, the non-living environment, the so called "abiotic filter", constrains establishment of species without certain physiological adaptations.

The germinated species then have to pass the so-called "biotic filter" - which means that they have to withstand [herbivores](#), pathogens and competitors to persist in a community. "Our study shows that this second filter is of major importance, and is even gaining in importance with time" says van Kleunen.

The study, now published in "Proceedings of the National Academy of Sciences" helps to better understand the assembly of plant communities.

According to the researchers the results can also contribute to the early detection of potentially new invasive species – for instance when plant species introduced for horticultural purposes, prior to accreditation, are tested for their traits. "With such a screening, future plant invasions may eventually be prevented in Switzerland", says Kempel.

**More information:** Anne Kempel, Thomas Chrobock, Markus Fischer, Rudolf Philippe Rohr, Mark van Kleunen: Determinants of plant establishment success in a multispecies introduction experiment with native and alien plant species. *PNAS*, 15. Juli 2013, [doi:10.1073/pnas.1300481110](https://doi.org/10.1073/pnas.1300481110)

Provided by University of Bern

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