

Biotic resistance to plant invasion in grassland: Does seed predation increase with resident plant diversity?

Juliane Preukschas^{a,b,*}, Michaela Zeiter^{a,b}, Markus Fischer^{b,c},
Andreas Stampfli^{a,b}



^aSchool of Agricultural, Forest and Food Sciences, Bern University of Applied Sciences, Länggasse 85, CH-3052 Zollikofen, Switzerland

^bInstitute of Plant Sciences, University of Bern, Altenbergrain 21, CH-3013 Bern, Switzerland

^cBotanical Garden of the University of Bern, Altenbergrain 21, CH-3013 Bern, Switzerland

Received 8 August 2013; accepted 7 January 2014

Available online 15 January 2014

Abstract

Seed predation impacts heavily on plant populations and community composition in grasslands. In particular, generalist seed predators may contribute to biotic resistance, i.e. the ability of resident species in a community to reduce the success of non-indigenous plant invaders. However, little is known of predators' preferences for seeds of indigenous or non-indigenous plant species or how seed predation varies across communities. We hypothesize that seed predation does not differ between indigenous and non-indigenous plant species and that seed predation is positively related to plant species diversity in the resident community. The seed removal of 36 indigenous and non-indigenous grassland species in seven extensively or intensively managed hay meadows across Switzerland covering a species-richness gradient of 18–50 plant species per unit area (c. 2 m²) was studied. In mid-summer 2011, c. 24,000 seeds were exposed to predators in Petri dishes filled with sterilized soil, and the proportions of seeds removed were determined after three days' exposure. These proportions varied among species (9.2–62.5%) and hay meadows (17.8–48.6%). Seed removal was not related to seed size. Moreover, it did not differ between indigenous and non-indigenous species, suggesting that mainly generalist seed predators were active. However, seed predation was positively related to plant species richness across a gradient in the range of 18–38 species per unit area, representing common hay meadows in Switzerland. Our results suggest that generalist post-dispersal seed predation contributes to biotic resistance and may act as a filter to plant invasion by reducing the propagule pressure of non-local plant species.

Zusammenfassung

Samenprädatoren haben einen starken Einfluss auf Pflanzenpopulationen und die Artenzusammensetzung von Graslandökosystemen. Die Generalisten unter den Samenprädatoren können zur biotischen Resistenz beitragen, das heißt zur Fähigkeit der einheimischen Arten einer Gemeinschaft, den Invasionserfolg nicht-einheimischer Pflanzenarten zu vermindern. Es ist jedoch nicht bekannt, ob einheimische oder nicht-einheimische Pflanzenarten von Samenprädatoren bevorzugt werden, und wie stark die Samenprädatoren zwischen verschiedenen Pflanzengesellschaften variiert. Wir vermuten, dass Samen von einheimischen und nicht-einheimischen Pflanzenarten gleich häufig gefressen werden und dass die Samenprädatoren mit

*Corresponding author at: School of Agricultural, Forest and Food Sciences, Bern University of Applied Sciences, Länggasse 85, CH-3052 Zollikofen, Switzerland. Tel.: +41 31 910 21 98; fax: +41 31 910 22 88.

E-mail address: julianepreukschas@gmail.com (J. Preukschas).

zunehmender Artenvielfalt einer Pflanzengesellschaft zunimmt. In sieben extensiv oder intensiv bewirtschafteten Heuwiesen der Schweiz untersuchten wir die Samenprädation von 36 einheimischen und nicht-einheimischen Graslandarten über einen Gradienten von 18–50 Pflanzenarten je Flächeneinheit (ca. 2 m²). Im Hochsommer 2011 wurden ca. 24 000 Samen auf sterile Erde in Petrischalen in die verschiedenen Heuwiesen ausgebracht. Nach drei Tagen wurde der Anteil der fehlenden Samen bestimmt. Dieser Anteil variierte zwischen den einzelnen Arten (9.2–62.5%) und Heuwiesen (17.8–48.6%). Es konnte jedoch kein Zusammenhang zwischen Verlust und Größe der Samen festgestellt werden. Der Samenverlust unterschied sich nicht zwischen einheimischen und nicht-einheimischen Pflanzenarten, was darauf hinweist, dass hauptsächlich Generalisten unter den Samenprädatoren aktiv waren. Hingegen konnte über einen für Schweizer Heuwiesen repräsentativen Bereich von 18–38 Pflanzenarten je Flächeneinheit ein positiver Zusammenhang zwischen der Samenprädation und der Pflanzenartenvielfalt festgestellt werden. Unsere Ergebnisse lassen vermuten, dass Generalisten unter den Samenprädatoren zur biotischen Resistenz beitragen und als Filter gegen Pflanzeninvasion wirken, indem sie den Diasporendruck von nicht-einheimischen Pflanzenarten vermindern.

© 2014 Gesellschaft für Ökologie. Published by Elsevier GmbH. All rights reserved.

Keywords: Biotic filter; Community invasibility; Native non-native comparison; Propagule pressure; Seed availability; Seed provenance; Seed removal; Seed size; Semi-natural grassland; Species richness

Introduction

The number of non-indigenous plant species has increased in Europe (Hulme, Pysek, Nentwig, & Vilà 2009) and indeed around the world as a consequence of expanding transport and commerce. To be successful in a new habitat, non-indigenous species have to pass through various stages: being transported from the native range, colonizing the new habitat, surviving and reproducing. However, most non-indigenous species fail to establish or spread (Williamson & Fitter 1996). The failure of non-indigenous species in a new habitat may be explained by the biotic-resistance hypothesis, which states that resident species in a community reduce the success of exotic invasion (Levine, Adler, & Yelenik 2004). Biotic filters potentially impeding plant invasion include herbivores, pathogens and competition from indigenous species. While biotic resistance due to competition has often been studied, biotic resistance due to herbivores, including seed predators, has received less attention (Levine et al. 2004).

Propagule pressure, i.e. the number of propagules arriving at a site, has a well-documented influence on the success of species invasion (Lockwood, Cassey, & Blackburn 2005; Simberloff 2009). Therefore, the reduction of propagules of non-indigenous plant species by seed predators could be a potentially effective filter to invasion. In grasslands, and also in most other habitats, seed predators such as invertebrates and rodents have an important impact on the post-dispersal phase of seeds and thus affect plant population dynamics and community composition (Hulme 1993, 1996; Crawley 2000). Biotic resistance to plant invasion by means of seed predation would require that seed predators are generalists, i.e. they predate both indigenous and non-indigenous species. This requirement may not be fulfilled if non-indigenous species are released from seed predation as suggested by the enemy-release hypothesis, which states that invader species are successful in a new range either because they have lost some of the specialist enemies from their home range or suffer less from generalist enemies in the new range (Keane &

Crawley 2002). A second prerequisite for biotic resistance via seed predation is that resident communities do not show predator satiation, i.e. the supply of seeds does not outweigh the predator's ability to consume them. Predator satiation is a common explanation for mast seeding of woody species in forests (Janzen 1971; Kelly 1994; Kelly & Sork 2002). Hay meadows, however, are often seed limited (Zeiter, Stampfli, & Newbery 2006; Stein, Auge, Fischer, Weisser, & Prati 2008) and therefore probably only rarely predator satiated. So far, very few studies, mainly performed with few plant species, have compared the effects of seed predation between indigenous and non-indigenous plant species and they have found mixed results (Blaney & Kotanen 2001; Shahid, Garneau, & McCay 2009; Pearson, Callaway, & Maron 2011).

Invasion resistance has long been assumed to increase with resident plant diversity (Elton 1958). More recent studies have supported this idea (Fargione & Tilman 2005; Scherber et al. 2010; Cardinale et al. 2012), and competition from resident plants has often served as an initial explanation for biotic resistance. Yet, herbivory, including seed predation, may act as a parallel process because the abundance and species richness of herbivores is often positively related with plant species richness (Knops et al. 1999; Haddad et al. 2009; Scherber et al. 2010), and this higher abundance and diversity of herbivores might result in more extensive damage. So far, the relationship between seed predation and plant species richness has only been examined by a single study (Pufal & Klein 2013), which found no relationship probably because the seeds of only three plant species were examined. Studies which have examined leaf damage found mixed results (Mulder, Koricheva, Huss-Danell, Högberg, & Joshi 1999; Scherber et al. 2006; Fischer, Weyand, Rudmann-Maurer, & Stöcklin 2012).

We performed a seed-removal study across a gradient of plant species richness in Swiss hay meadows with seeds of 36 indigenous and non-indigenous grassland species in order to explore the potential of seed predation as a filter to plant invasion according to the biotic resistance hypothesis

Download English Version:

<https://daneshyari.com/en/article/4383994>

Download Persian Version:

<https://daneshyari.com/article/4383994>

[Daneshyari.com](https://daneshyari.com)