

Testing priority effects related to sowing high and low diversity and time of arrival of species on assembly and productivity of grasslands on marginal land: first experiments in field and greenhouse

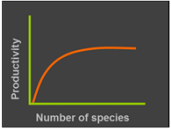


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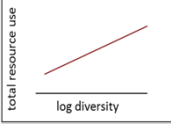
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Background on ecological theory:

Diversity-Productivity Relationship:

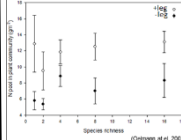


❖ Species richness & functional diversity play a key role in influencing productivity and nutrient cycling.

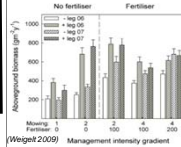


❖ **Complementarity effects** between a diverse range of species traits lead to higher total resource use. (Balvanera et al. 2006)

N Facilitation:

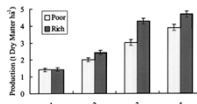


❖ Positive interactions between legumes (*Fabaceae*) and other species is known to have a promoting effect over time due to **enhanced N-availability**.

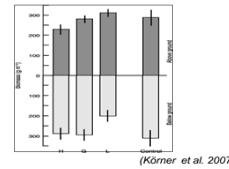


❖ This can result (in combination with the right management intensity) to a sustained, elevated biomass production.

Priority Effects:



❖ Successional experiments in field found large effects of starting diversity (sowing) on productivity & species composition (**Priority effects Type I**). (Bullock et al. 2001)



❖ There is evidence from a microcosm experiment that the order of arrival of different plant functional groups (PFTs i.e. legumes, grasses or forbs) can significantly affect the productivity and species composition of grasslands over Time (**Priority effects Type II**).

Hypothesis:

Sustained Bioproduction on marginal lands can be provided by:

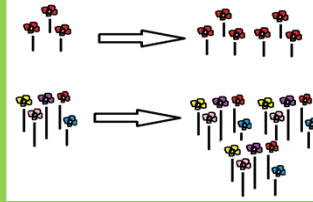
- varying the order of arrival of functional groups (**Priority Effects Type II**) and influencing starting diversity (**Priority Effects Type I**)
- the use of a high diversity mixture (**Diversity-Productivity-Relationship**)
- the use of positive plant-plant interactions (**N facilitation**)

We aim to test the effects of these different aspects of priority effects as well as the role of aspects of facilitation on sustained bioproduction both in the field and in controlled conditions.

Priority effects:

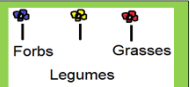
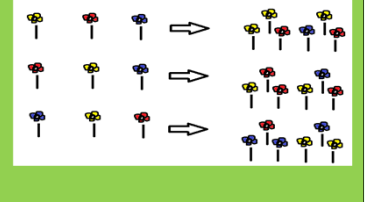
Type I:

Starting diversity:



Type II:

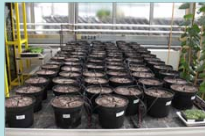
Sowing sequence:



A suite of assembly experiments in grasslands to test priority effects and how they are affected by intervals between sowing of different functional groups:

Together with the Anhalt University of Applied Sciences we conducted a suite of three experiments in the vegetation period of 2011 to test the effect size of priority effects under different conditions.

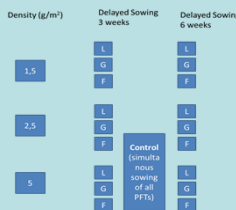
Sowing Interval x Density @ Greenhouse:



Apart from the factors this experiment varies in terms of selected species. Here we replaced some of the mesic grassland species by xerotherm species.

Exclusive Factors:

- Three sowing density levels: 1,5; 2,5; 5 g/m²
- Two levels of varying arrival time of PFTs: 3 and 6 weeks

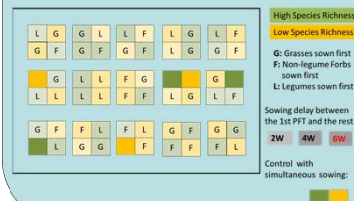


Sowing Interval x Diversity @ Crop Garden:



Exclusive Factors:

- Priority effects Type I: Species richness with two levels (high-SR: 28 species and low-SR: 8 species)
- Three levels of varying arrival time of PFTs: 2, 4 and 6 weeks



Mechanistic x Restoration @ Bernburg:



A field experiment under natural conditions had been established in Bernburg to test for a different sowing approach.

Exclusive Factors:

- Just one PFT (legume) is being tested here in terms of varying arrival time
- Priority effects type II are tested in two different approaches after the first PFT had been sown:
 - By adding the remaining PFTs afterwards
 - By adding all 3 PFTs on the subsequent sowing



Functional group	Sowing interval	SR	SR
L	2 weeks	1	1
G	4 weeks	1	1
F	6 weeks	1	1
L	2 weeks	1	1
G	4 weeks	1	1
F	6 weeks	1	1
L	2 weeks	1	1
G	4 weeks	1	1
F	6 weeks	1	1
L	2 weeks	1	1
G	4 weeks	1	1
F	6 weeks	1	1
L	2 weeks	1	1
G	4 weeks	1	1
F	6 weeks	1	1
L	2 weeks	1	1
G	4 weeks	1	1
F	6 weeks	1	1
L	2 weeks	1	1
G	4 weeks	1	1
F	6 weeks	1	1

Similarities between experiments:

- Same species pool
- Common factor: priority effect (type II)

Differences between experiments:

- Environmental conditions (field conditions, semi-natural conditions and controlled conditions)
- Different substrates ranging from sandy soil to ex-arable soil