

Introduction

Repeated use of a single weed control technique can shift the treated weed community to one in which species that are least affected by the control tactic are dominant. Shifts in weed community composition toward glyphosate-tolerant species have become important concerns in cropping systems that rely heavily on glyphosate for weed control (Benbrook, 2012; Brookes and Barfoot, 2013; Duke and Powles, 2009; Heap, 2017; Mortensen et al., 2012).

Materials and Methods

- Randomized Complete Block with Rotation (2-, 3- and 4-year sequences) as main-plot and Herbicide regimes (conventional and low plus cultivation i.e conv and low) as split-plot effects.
- Cropping systems:
- 2-year rotation: corn-soybean // 3-year rotation: corn-soybean-oat/red clover // 4-year rotation: corn-soybean-oat/alfalfa-alfalfa
- Data analysis:
 - Shannon's diversity and evenness: non-transformed data, by SAS® PROC MIXED
 - Species relative ranking: biomass value to the nearest integer and viable seed density, by R® BiodiversityR
 - Nonmetric MultiDimensional Scaling (NMDS) and Multi-Response Permutation Procedures (MRPP): comparison of biomass and (square-root transformed) viable seed density of all species, by PC-ORD® version 6.

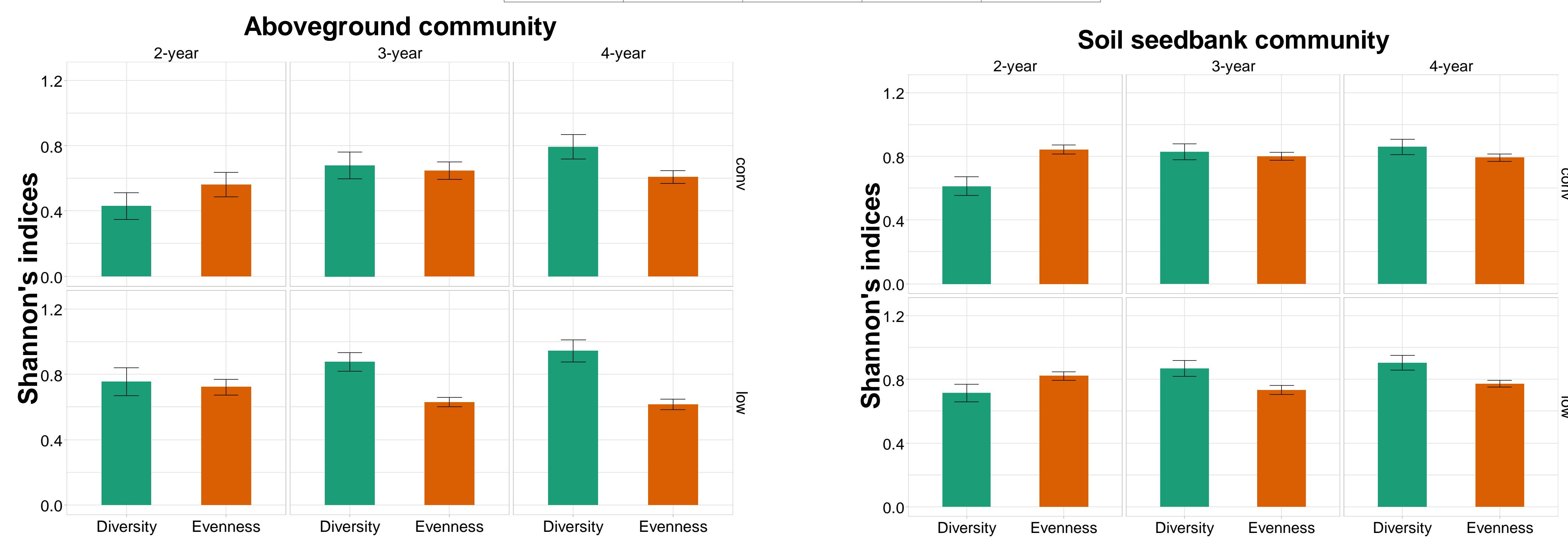
- Herbicide and cultivation management:
(*) applied in 2016 only

Management factor	Corn		Soybean	
	Low herbicide	Conventional herbicide	Low herbicide	Conventional herbicide
Herbicides	tembotrione	thiencarbazone methyl isoxaflutole nicosulfuron (*) mesotrione (*)	Imazamox lactofen	glyphosate as isopropylamine salt acifluorfen
Total (kg a.i./ha) 2014 – 2016 average	0.049	0.352	0.098	1.518
Application method	38-cm band	broadcast	38-cm band	broadcast
Mechanical control	interrow cultivation, once or twice	none	interrow cultivation, twice	none

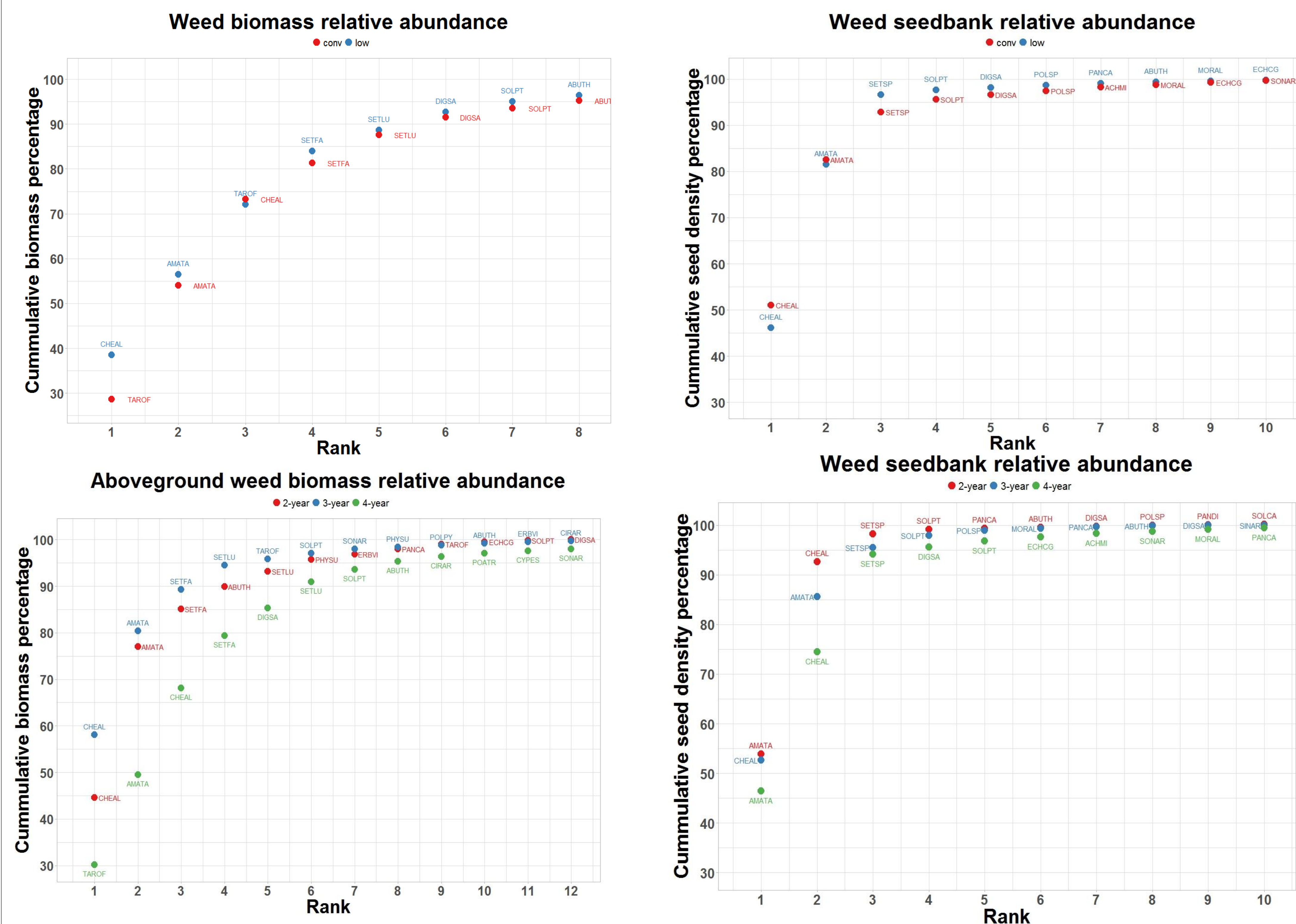
Results

Longer rotation promoted more diversity in aboveground and seedbank communities. Aboveground and seedbank evenness were comparable among three rotations.

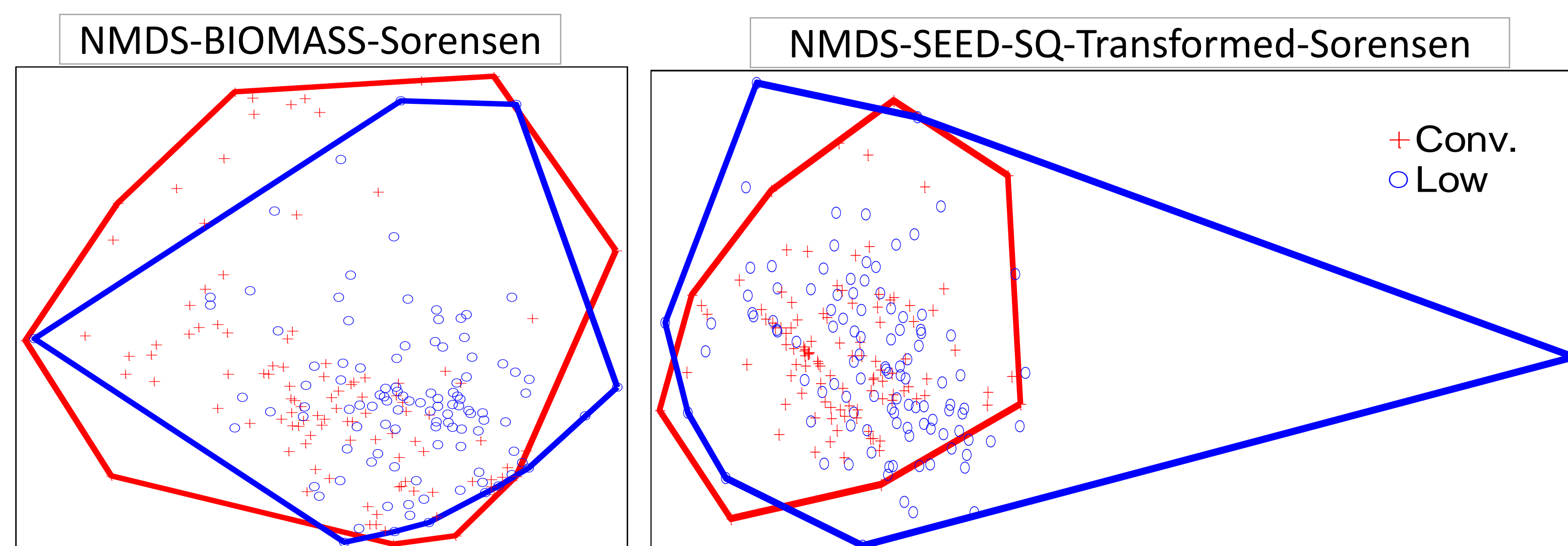
Effect	Aboveground biomass		Seedbank density	
	Diversity	Evenness	Diversity	Evenness
Herbicide (H)	0.0004	0.1680	0.1214	0.0746
Rotation (R)	0.0093	0.7648	0.0265	0.1129
R*H	0.5176	0.1490	0.7946	0.5370



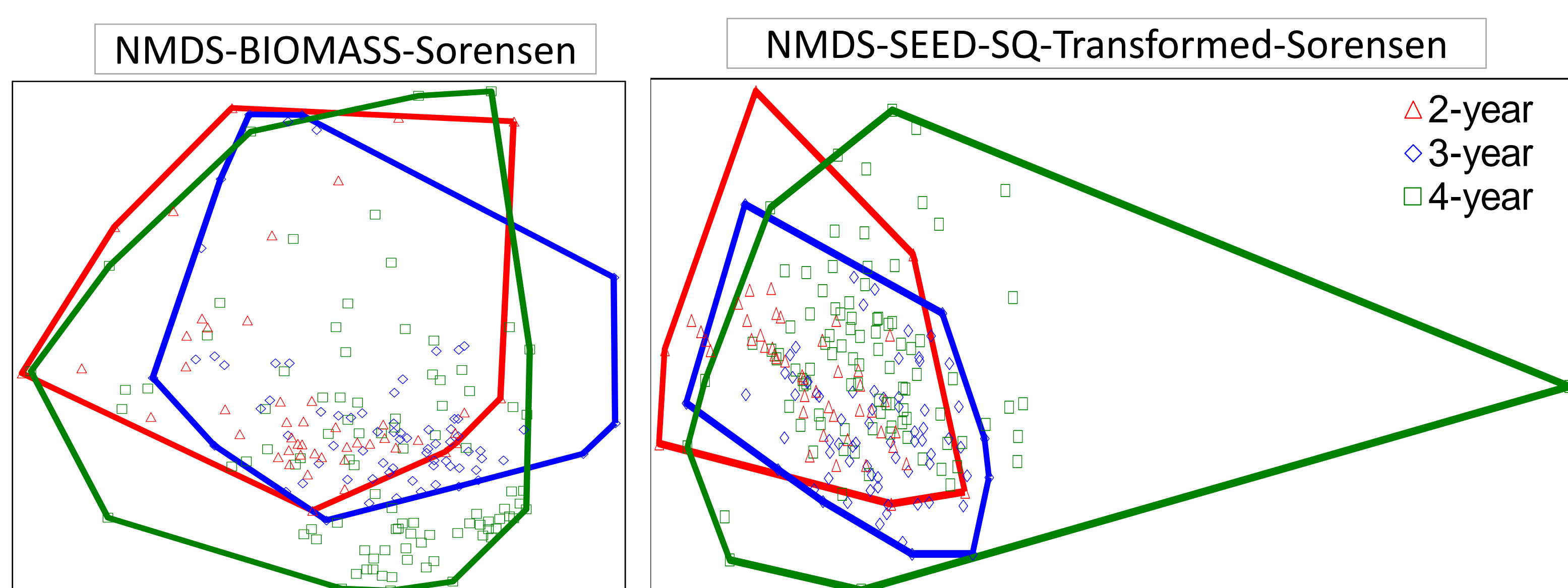
Weed community species tended to be more even under longer rotations.



Dissimilarity in community composition among rotations was readily apparent, compared to between herbicide regimes.



Pair-wise comparison p-values		
Rotation	Aboveground Biomass	Seedbank density
2-year vs. 3-year	0.002	< 0.0001
3-year vs. 4-year	< 0.0001	< 0.0001
2-year vs. 4-year	< 0.0001	< 0.0001
Herbicide	Biomass	Seedbank density
Conv. vs. Low	< 0.0001	< 0.0001



five-letter abbreviations are species names' Beyer codes

References

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- Brookes, G., and Barfoot, P. (2013). Key environmental impacts of global genetically modified (GM) crop use 1996-2011. *GM crops & food* 4, 109-119.
- Duke, S.O., and Powles, S.B. (2009). Glyphosate-Resistant Crops and Weeds: Now and in the Future. *AgBioForum* 12, 346-357.
- Heap, I. (2017). The International Survey of Herbicide Resistant Weeds (Online: Weed Science).
- Hunt, N.D., Hill, J.D., and Liebman, M. (2017). Reducing Freshwater Toxicity while Maintaining Weed Control, Profits, And Productivity: Effects of Increased Crop Rotation Diversity and Reduced Herbicide Usage. *Environmental Science & Technology* 51, 1707-1717.
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