



Influence of drought stress and fertilisation on carbon isotopes as indicators of water use of grassland differing in diversity

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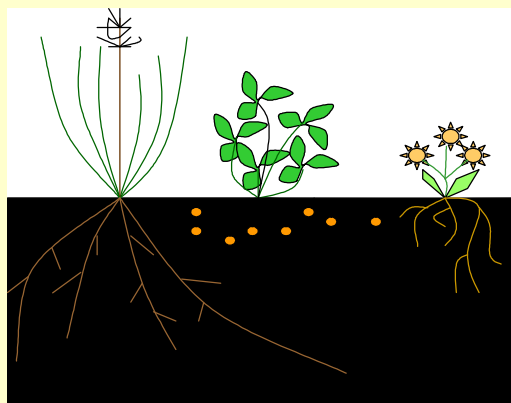


Fig. 1: Diverse systems may use soil resources like water more effectively than monocultures due to e.g. different rooting depths of coexisting species.



Fig. 2: Main plots differing in diversity (2007).

Introduction

From experimental (sown) grassland, there is evidence of less vulnerability to drought stress of diverse swards, probably due to complementary use of resources (Fig. 1). Is this also true for established permanent grassland?

Hypotheses

Diverse grassland

- experiences less drought stress (is more depleted in $\delta^{13}\text{C}$)
- produces more biomass than less diverse grassland.
- N-fertilisation increases biomass production and thus effects of drought stress.

Methods

- Permanent grassland (> 14 years old), Relliehausen, Solling, Germany (Fig. 2)
- Hierarchical design: diversity = main plot, fertilisation and drought stress on subplots, $n = 4$
- Different diversity: herbicide treatment against dicots in autumn 2006 (‘non diverse’; untreated: ‘diverse’)
- Drought: rainout shelters established for five weeks from beginning of May 2009
- Fertilisation: 90 kg N/ha, calcium ammonium nitrate, in April 2009
- Sampling: diversity, soil water content at harvest, biomass, $\delta^{13}\text{C}$

Results

Significant results (see also Tab. 1):

- More diverse: no significant effect on water content, biomass, $\delta^{13}\text{C}$
- With drought: smaller soil water content, less biomass, enriched in $\delta^{13}\text{C}$
- With fertilisation: smaller soil water content, more biomass, enriched in $\delta^{13}\text{C}$

Tab. 1: Main results (means, $n = 4$). The first two parameters are shown for species with a percentage cover larger than 2%.

	diverse				non diverse			
	no drought		drought		no drought		drought	
	0 N	90 N	0 N	90 N	0 N	90 N	0 N	90 N
Yield percentage main dicots [%]	24,5	17,8	31,3	8,8	1,5	4,5	2,3	2,3
Water content 0-10 cm [%]	17,8	15,0	10,7	10,2	19,8	17,0	9,8	9,4
Biomass [g/m ²]	451	582	288	458	437	565	361	435
$\delta^{13}\text{C}$ [‰]	-28,1	-27,7	-27,4	-26,2	-28,2	-27,8	-27,4	-26,6

Conclusions

- No diversity effect: maybe due to universal occurrence of *Taraxacum* sp. or due to similar species numbers (6 to 8 main species on all plots)?
- Fertilisation effect: more produced biomass requires more water; due to this and probably increased CO_2 fixation capacity (more Rubisco): ^{13}C -enrichment in fertilised plots (more drought stress)

