Water use by dominant species in grazed and intact grassland ecosystems of Inner Mongolia, China

Hao Yang[1], *Yongfei Bai*[1], *Karl Auerswald*[2] *and Xingguo Han*[1]
[1] *Laboratory of Quantitative Vegetation Ecology, Institute of Botany, Chinese Academy of Sciences, Beijing 100093, China. E-mail: yfbai@ibcas.ac.cn,* [2] *Technische Universität München, Lehrstuhl für Grünlandlehre, Am Hochanger 1, D-85350 Freising-Weihenstephan.*

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Introduction Water is the most limiting factor for plant growth in arid and semi-arid grasslands. The water use of plant is sensitive to the degradation of grassland by heavy grazing. The hydrogen isotope ratios (δD) and leaf water potentials have widely been used to evaluate water sources of plants. The objectives of our study is to address if the dominant species differ in water use resulting from either winter or summer precipitation in relation to grazing among seasons and years and if the grazing-induced changes in water use of plant species explain the community structure shift.

Material and methods Community structure, plant available soil water, leaf water potential and hydrogen isotope ratios of plant water at the interface between the shoot and root systems of four dominant species were measured on long-term ungrazed and grazed plots to identify the contribution of winter moisture to water supply in May (early growing season) and August (late growing season) from 2005 (dry year) to 2006 (normal year).

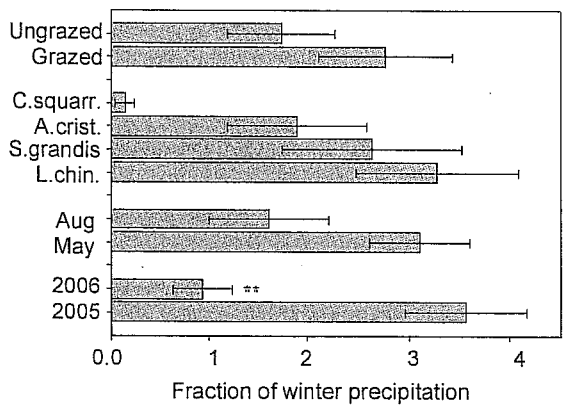

Figure 1 *Fraction of winter precipitation contributing to plant water uptake calculated from the deuterium signature of plant water in non-photosynthetic tissue. Error bars give standard error. Total sample number is 84.*

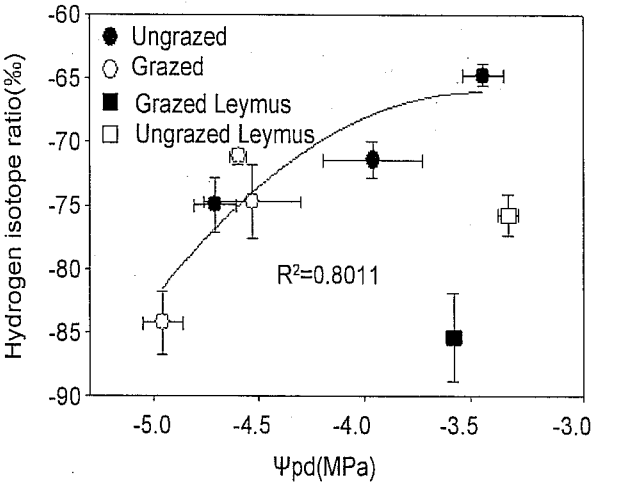

Figure 2 *Correlation of hydrogen isotope ratios of the non-photosynthesis tissues' water and predawn leaf water potential for different species in the ungrazed plot (solid circles) and the grazed plot (open circles) in August, 2005.* (L. chinensis *denoted by solid and open squares is shown but not included into the regression)*

Results and discussion *Leymus chinensis* was able to extract winter moisture even from below 60 cm depth and maintained a lower leaf water potential than all other species, while *Cleistogenes squarrosa* due to its late development as a C4 species and its shallow root system made least use of winter moisture. Winter precipitation stored within the soil after snowmelt was an important source of water contributing about 30% in the dry year and less than 10% in the normal year to total water supply (Figure 1). The δD value increased significantly with predawn leaf water potential ψ_{pd} and all species followed one relation except for *L. chinensis* (Figure 2). Both the relative biomass and relative abundance of the shallow rooted *C. squarrosa* and *A. cristatum* increased ($P<0.05$), whereas those of *L. chinensis* decreased significantly ($P<0.05$) by grazing.

Conclusions Grazing reduced the abundance of L. *chinensis* and promoted C. *squarrosa* and thus reduced the exploitation of winter moisture. This in turn will increase the severity of drought because winter moisture increases in importance for the plant water supply in years with rain below average.

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