Geophysical Research Abstracts
Vol. 18, EGU2016-7561, 2016
EGU General Assembly 2016

Responses of carbon isotope discrimination in C4 plant to variable N and water supply

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Understanding variations and underlying mechanisms of carbon isotope discrimination (Δ) in C4 species is critical for predicting the effects of change in C3/C4 ratio of plant community on ecosystem processes and functionning. However, little is known about the effects of soil resource gradients on Δ of C4 plants. To address Δ responses to drought and nitrogen supply, the leaf carbon isotope composition, bundle sheath leakiness (BLS), and leaf gas exchange (A, gs, Ci/Ca) were measured on Cleistogenes squarrosa, a dominant C4 species in the Inner Mongolia grassland. C. squarrosa were grown in controlled-environment pots from seed under a combination of water and N supply. High N availability and drought stimulated photosynthetic rate (A) and further decreased the ratio of internal and ambient CO_2 concentrations (Ci/Ca) through increasing leaf N content. BLS was higher under high N supply and was unchanged by drought. There was significant interaction between N and water supply to affect BLS and Ci/Ca. Δ was negatively related to Ci/Ca and was positively related to BLS. Tradeoff between the responses of BLS and Ci/Ca to changing environmental conditions kept leaf Δ relatively stable, which was also supported by a field N addition experiment. Our results suggested leaf Δ of C4 plant was unchanged under variable water and N environment conditions although the operating efficiency of C4 pathway and CO_2 concentration in photosynthesis were changed. Our findings have implications for predicting the change of C3/C4 ratio of plant community and understanding ecosystem processes and functionning.