Interactive effects of UV radiation and water deficit on production characteristics in upland grassland and their estimation by proximity sensing

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Abstract

Since water deficit (WD) and ultraviolet radiation (UV) trigger similar protective mechanisms in plants, we tested the hypothesis that UV modulates grassland acclimation to WD, mainly through changes in the root/shoot (R/S) ratio, enhances the ability of grassland to acquire water from the soil and hence affects its productivity. We also tested the potential of spectral reflectance and thermal imaging for monitoring the impacts of WD and UV on grassland production parameters. The experimental plots were manipulated by lamellar shelters allowing precipitation to pass through or to exclude it. The lamellas were either transmitting or blocking the UV. The results show that WD resulted in a significant decrease in above-gound biomass (AB). In contrast, below-ground biomass (BB), R/S ratio and total biomass (TB) increased significantly in response to WD, especially in UV exclusion treatment. UV exposure had a significant effect on AB and BB, but only in the last year of the experiment. The differences in the effect of WD between years show that the effect of precipitation removal is largely influenced by the potential evapotranspiration (PET) in a given year and hence mainly by air temperatures, while the resulting effect on production parameters is best correlated with the water balance given by the difference between precipitation and PET. Canopy temperature and selected spectral reflectance indices showed a significant response to WD and also significant relationships with morphological (AB, R/S) and biochemical (C/N ratio) parameters. In particular, the vegetation indices NDVI and RDVI provided the best correlations of biomass changes caused by WD and thus the highest potential to remotely sens drought effects on terrestrial vegetation.

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