Biomass production of different grassland communities under artificially modified amount of rainfall

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INTRODUCTION

Extreme drought events are predicted to increase under the global climate change (Trenberth et al. 2003, Dai 2011, Cook et al. 2015). Such changes affect numerous soil, plant, and ecosystem properties of grasslands, and ultimately influence their productivity and biological diversity (Knapp et al. 2002, Fay et al. 2008, Kreyling et al. 2008). Hui and Jackson (2006) estimated broad range of the root primary production (40 to 87% of total production) in grassland ecosystems occurring over large geographical and temporal scales, pointing to a significant role in the global carbon (C) cycle and the potential to enhance climate warming through positive feedbacks. Thus, it is important to understand how such habitat variability affects soil C pools and fluxes, as these ecosystems store up to 30% of the world below-ground C (see Risch et al. 2007).

Root turnover is a strong nutrient sink for most terrestrial ecosystems. However, plants growing in nutrient-poor environments are able to increase the root lifespan in order to avoid nutrients loss (Schläpfer and Rysér 1996). Relationships between vegetation productivity and climatic properties, mainly precipitation, and temperature, and their interaction with soil features, have been examined by several authors. For example, above-ground net primary productivity was positively correlated with mean annual precipitation in grasslands (e.g. Köchy and Wilson 2004, Yahdjian and Sala 2006, Fay et al. 2008).

Global climate change is predicted to alter growing season rainfall patterns, potentially reducing total amounts of growing season precipitation and redistributing rainfall into fewer but larger individual events. Such changes may affect numerous soil, plant, and ecosystem properties in grasslands and ultimately impact their productivity and biological diversity. A five-year field study with regulated amount of precipitation was executed in different types of temperate grasslands (dry Festuca, wet Cirsium and Nardus grasslands) in three different regions (in lowland, highland and mountain, respectively) in the Czech Republic. Three simulated rainfall treatments were applied: reduced rainfall by 50% (dry), increased rainfall by 50% (wet), and natural rainfall of the current growing season (ambient). The addition of supplemental resources of water exhibited slightly positive relation with the above-ground production (AP), but statistically significant only in the lowland grassland. At all grasslands, both root biomass (RB) and total below-ground biomass (TBB) were significantly higher in wet compared to dry treatments. Significantly increased values of the TBB/AP ratios occurred only in the highland grassland due to enhanced rainfall. The opposite relations were found in lowland grassland where the TBB/AP ratio decreased in response to enhanced rainfall, though not significantly. In the mountain grassland, values of the TBB/AP ratios have shown less variability. The highland wet Cirsium grassland was more sensitive to altered rainfall regimes forming rather lower proportion of below-ground plant production.