Belowground meristem populations as regulators of grassland dynamics

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Introduction Studies of plant populations are critical for linking organism to ecosystem-level phenomena and for understanding mechanisms driving responses to global change. In perennial grasslands, the below-ground population of meristems (the bud bank) plays a fundamental role in local plant population recruitment, persistence and dynamics. We explore two aspects of the bud bank in North American grasslands. It has been hypothesized that low variability in arid biomes is explained by meristem limitation, which constrains responses to pulses of high resource availability. Our research tests this hypothesis by comparing bud-bank populations across six sites in the United States that vary 3-fold in precipitation and 4.5-fold in productivity. In addition, we are examining the effects of management practices, such as fire and grazing, on bud-bank populations using replicated long-term treatments at Konza Prairie LTER site located in north-central Kansas.

Materials and methods At each of six study sites, stem densities, above-ground biomass and bud densities of grasses and forbs were measured within a 25 cm x 25 cm x 15 cm depth sample. We also sampled replicate watersheds in a factorial design at Konza Prairie that have been subjected to annual or four-year burning cycles and are either grazed by Bison (*Bos bison*) or are ungrazed.

Results Data from November 2003 and March 2004 support the hypothesis that bud densities increase from east to west along a precipitation/productivity gradient (Figure 1). Bud densities increased significantly at all sites between sampling dates (P=0.001). Letters indicate differences among sites in March at P<0.05 (LSD). Grass bud density increased from November 2003 to March 2004, but there were no significant treatment effects (grazing, P=0.215 and fire, P=0.339). There was a trend of higher grass bud density in the annually burned, ungrazed treatment compared to the four-year burning cycle. However, this trend disappears with the introduction of grazers. Forb bud density did not change from November 2003 to March 2004 and there was a significant treatment interaction (P=0.001, Figure 2). Annually burned and grazed tallgrass prairie had the highest bud density, but this difference disappeared in the absence of grazers.

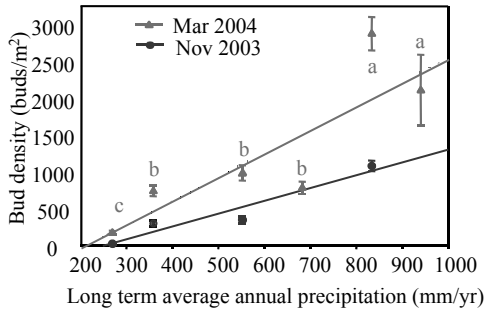

Figure 1 Bud density along a precipitation gradient in central North America

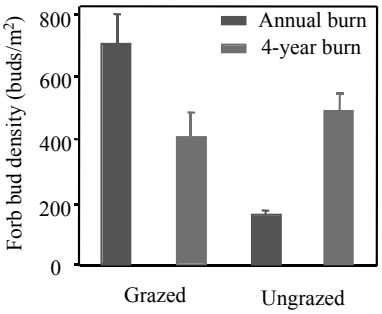

Figure 2 Effects of fire and grazing on forb bud populations

Conclusions Below-ground meristem (bud) density increased with increasing precipitation and productivity. Overall lower bud density in arid grasslands supported the hypothesis that meristem limitation constrains production variability in these grasslands. Grass and forb bud populations had different responses to fire and grazing in tallgrass prairie, with forb bud density increasing in grazed areas while grass bud density remained unchanged. Therefore, demographic mechanisms may be important for forbs in these grasslands.