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Research Update: Bud Bank Ecology for Understanding Perennial Grass Persistence

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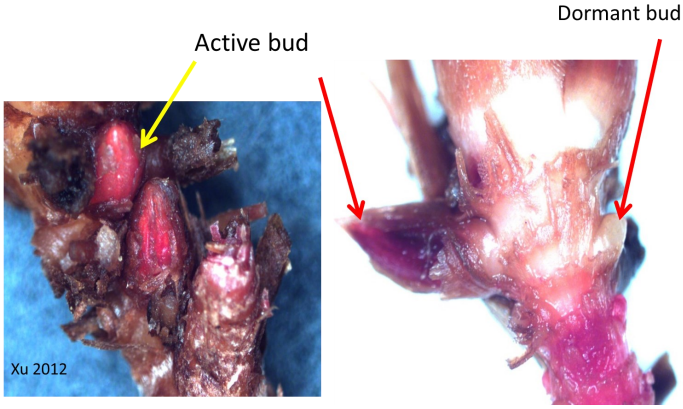
Grassland ecosystems often demonstrate very remarkable resiliency to severe natural and anthropogenic disturbances. Such resiliency following disturbances comes from either seed banks (germinable seeds in the soil) or bud banks (meristems or buds, such as bulbs, bulbils, and buds on rhizomes, corms, and tubers, that generate vegetative tissues). Although seeds are important for dispersal, initial colonization, and maintenance of genetic diversity; few grass seeds persist in the soil more than five years, plus seed production often is unreliable under grazing. Recent studies have demonstrated that >99% of aboveground stems in undisturbed tallgrass prairie were recruited from the bud bank while <1% were recruited from the seed bank. Even under grazed or disturbed sites in tallgrass prairie, belowground buds make a significantly larger contribution (80%) to plant recruitment than do seeds (20%).

Most grassland ecosystems, like the Great Plains, are dominated by vegetatively reproducing perennial grasses. The populations of perennial grasses are strongly driven by stem recruitment from the belowground bud banks. The maintenance of a healthy bud bank has important ecological and managerial implications of perennial grasses. The bud bank plays a critical role for maintaining populations, regulating vegetation dynamics and community assemblage, productivity, resilience to stress and responses to changing environments. The ecological benefits of the maintenance of a healthy bud banks include: 1) plants can respond rapidly to increased resource availability because bud activated stems are generally faster than from seeds, and are stronger than seedlings, 2) buds can increase growth through the production of a larger population of new stems because bud and stem production depend on each other, 3) buds provide capacity for high compensatory growth following disturbance such as grazing, fire, and haying, and 4) for native species, buds have the ability to rapidly colonize empty spaces and resources, limiting the opportunities for establishment by exotic invasive plant species. However, it also is true for the invasive species, if they have a large bud bank, which will provide them the advantage to occupy empty spaces and out-compete native species.

Recent studies reported vegetative reproduction through rhizome and new stem outgrowth from axillary buds is the primary means for the local spread, penetrating to adjacent prairie communities, neighborhood competition, and persistence of smooth bromegrass (Figure on the right). Since bud banks serve as reservoirs for recruitment of future aboveground stems, understanding the role of the belowground bud bank in regulating the persistence of invasive species in the response to management practices will provide the knowledge needed to develop adaptive management strategies that sustain long-term control effectiveness and preventing resurgence. A study was initiated in 2013 to examine smooth bromegrass belowground bud and rhizome production in response to different mowing (simulated grazing and haying) frequency treatments. We found defoliation at the most vulnerable growth stage can effectively hinder bud formation, stem recruitment, and reduce food reserve in the rhizome of perennial grasses. Our results from this study clearly demonstrated that repeated defoliation treatment reduced axillary bud production and rhizome biomass, suggesting they could form the basis for a long-term management plan.



Smooth bromegrass (*Bromus inermus*) crowns stained to reveal active and dormant buds (Photo by Lan Xu, 2012).

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