Back to the Future: Achieving Resilient, Sustainable Grasslands through Restoration of Ecological Norms

Productive grasslands – The role of adapted species to increase ecosystems resilience

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Abstract: Producers are interested in diversifying grazing systems with native warm-season grasses. Climate variations may result in extreme weather events. For instance, recent studies show strong evidence pointing to an increasing frequency of flooding in the central US, due to changes in both seasonal rainfall and temperature across this region. In a constantly changing climate, adapted species play a crucial role in increasing ecosystems resilience and resistance to extreme weather events. Native grasses may be well adapted to the future changes on climatic conditions, with wide ecological amplitude and resistance under different conditions. Use of adapted warm season grasses, associated with appropriate management practices may enhance pasture ecosystem resilience, and ultimately productivity.

Introduction

Recent rainfall and weather projections indicate changes in both seasonal rainfall and temperature across the central U.S. Evidence points out to increased frequency and magnitude of soil inundation events, as well as longer and more severe periods of drought (Mallakpour and Villarini 2016; Zhang and Villarini 2020). Areas prone to recurring short-term soil inundation make up an important part of the productive area for farms (Turner 2017; Starr 2019). The increased recurrence of soil inundation, associated with severe periods of drought, challenges farm productivity in the State. Native, adapted forage species add resilience, longevity, and adaptability to grasslands. Producers are interested in diversifying grazing systems with native warm-season grasses. However, concerns with low nutritional value and quality are also commonly present. Strategic grazing management focused on reduced leave-to-stem ratio is a promising tool to overcome quality concerns and allow successful NWSG introduction and production. Strategic grazing of warm season grasses can potentially maximize leaf production, promote animal intake, and increase animal yield (Da Silva et al 2015). As a consequence, Ohio farmers could rely on high-quality herbage in the summer, when the commonly used cool-season plants have compromised nutritive value and productivity.

Resilience of native species

Native species are originated and developed in its surroundings habitat, being adapted to that particular environment. Each native plant species has a natural range of growing conditions. Some species will evolve in response to changing climate, allowing them to maintain or even expand their natural ranges. Switchgrass, for example, is a native forage species from North America with a wide adaptative characteristic, that grows well in both dry and moist soil conditions. Native-warm season grasses are characterized by a C_4 photosynthetic pathway. Therefore, they are adapted to warmer temperatures and have considerably elevated yield potential compared with cool-season grasses. NWSG are commonly bunch grasses that form tussocks and are well adapted to soil with poor fertilization. Species such as Indiangrass, Big bluestem, Switchgrass and Eastern gamagrass have well-developed root systems, which provide doughty hardness. Deeper roots and relationships with mycorrhizal fungi makes native species less impacted by extreme weather events, also demonstrating faster recovery. Eastern gamagrass is widely adapted to drought and flooding (Collins et al. 2018). Studies suggest Eastern gamagrass being able to tolerate up to 40 days of repeated inundations. Native species are more easily adaptable to changes in climate and could be associated with greater resilience that translates into productivity, especially when associated with strategic grazing management.

Resilience optimized by strategic grazing management

Grazing management is an important aspect of pasture systems. Strategic defoliation is central to ideal manipulating of both animal and plant responses (Hodgson, 1990). Compared to cool-season grasses, native warm-season grasses are more sensitive to grazing management because of their accelerated growth rate in warmer conditions. If optimal frequency and intensity of defoliation are not implemented, over or under-grazing might compromise herbage production and pasture perenniality. In C4 species regrowth is a function of canopy LI and leaf area index (LAI) with accumulation of herbage fitted to a sigmoid curve with three distinct phases as proposed for temperate swards by Brougham (1955). During the early stages of regrowth, leaves are the main morphological component accumulated. As LAI increases, canopy light intra-competition increases, and plants change their growth pattern as a means of optimizing light capture through stem elongation. Grazing management should prioritize leaf production, which is often challenging for warm-season grasses. If leaves are prioritized, regrowth is fast, yield is high and root death is controlled (Da Silva et al, 2015; Chapman and Lemaire, 1996). Warm-season grasses could have high leaf production if a sward structure is maintained at conditions that limit excessive shading between plants. If grazing management is optimized, native-warm season grasses will have increased ground cover, vigor and perenniality, which often relates to the capacity of pasture to endure environmental disturbances. By keeping NWSG pastures highly productive and always growing, resilience is increased, and productivity remains even under extreme weather events.

Conclusions

NWSG are an important alternative to increase resilience of pasture systems. Native species are well adapted to different weather conditions and have faster recovery under extreme weather events. Resilience of NWSG is optimized by strategic grazing management that prioritizes leaves as the main morphological component accumulated. Under grazing management that constantly allows regrowth and leaf accumulation, native species thrive even with extreme and changing weather conditions.

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