# Prairie Restoration Diversity – Planting and Seed Mixes

## Why is Diversity in Prairie Restorations Important?


Diversity gives rise to diversity is a foundational paradigm upon which ecology has been built. More diverse plant communities are resistant to invasions because they can more easily compete for resources. Highly diverse plant communities are also predicted to be more stable in the face of disturbance (Tilman and Downing 1994). In prairie restorations, as we think about diversity, we should expand our vision to include phenological (timing of flowering), structural (plant heights), spatial, and functional heterogeneity in addition to plant species richness. This expanded view of diversity will lead to a diverse system of wildlife that inhabit restored prairies. Diversity is important from an ecological perspective as it is the foundation upon which resilience in prairies is built (Helzer et al. 2010), and it is clearly a priority for many tallgrass prairie land managers (Rowe 2010). This fact sheet is a review of the current literature surrounding ways in which diverse tallgrass prairie restorations (i.e., prairie reconstructions) can be established.

## Factors that Increase Diversity in Restorations

Several interrelated factors affect diversity in restorations: planting method, density of seeding (seeds per sq ft), grass: forb ratio, density of dominant species, density of non-dominant species, and inclusion of plant functional guilds (cool-season grasses, warm-season grasses, sedges/rushes, legumes, and non-legume forbs).

### Planting Methods

Planting during dormancy by broadcasting seed resulted in the most cover of planted species (Larson et al. 2011) and greater resistance to invasion by exotic cool-season grasses (Norland et al. 2015). Dormant broadcasting appears to be the most preferred method by managers (Rowe 2010). However, planting method (dormant-season broadcasting, growing-season broadcasting, or growing-season drilled) may not affect the establishment and cover of those species that were included in the seed mix (Larson et al. 2017) if dormant broadcasting is not possible. Drill-seeded plantings may favor native, dominant warm-season grasses like big bluestem as well as non-native invasive species (Yurkonis et al. 2010). The spatial patterning of planted species and how they interact with each other at small scales (<1 square meter) can also impact diversity and invasibility. Grouping seeds of the same species during planting may increase the established diversity (Yurkonis and McKenna 2014). Similarly, diversity at small spatial scales better resists invasion (Yurkonis et al. 2011) and it is this scale where the diversity in restorations is significantly lower than in remnant prairies (Martin et al. 2005).

## Seed Mix Ratios and Seeding Density

A combination of high forb density, high forb:grass ratio, and high species richness are all important, often interrelated factors in achieving greater forb establishment. One study suggests that increasing the density (seeds per sq ft) of forbs will result in greater forb establishment and abundance (Dickson and Busby 2009). Another study suggests that forb establishment was greater in plantings where the ratio was heavily weighted towards forbs (~80%) (Williams and Smith 2007). However, seeding density may not be as important in resisting invasion as seed mix richness (Nemec et al. 2013). Seed mixes heavily weighted towards forbs (>70%) often have trouble carrying a prescribed fire (Diboll 1997). Knowing exactly which target ratios, seeds per sq ft by species, and number of species to plant to yield a diverse prairie community is an area that still needs more study.

## Dominant Native Species

The key is achieving the right balance in the seed mix to ensure that forbs and other less dominant species will persist in the restoration. Research has shown that over time there can be up to a 50% decline in species richness from the original prairie planting date, due to the dominance of big bluestem (Camill et al. 2004). Dominant grasses (Table 1) specifically decrease forb cover and species richness (Dickson and Busby 2009, McCain et al. 2010). Warm-season grasses such as big and little bluestem limit recruitment of other less dominant species such as forbs (Tilman 1997). Dominant warm-season grasses can even facilitate invasions due to increased instability in the low-diversity system (Smith et al. 2004). However, warm-season grasses resist invasions through competition for soil nitrogen and are an important component of restorations, especially in species diverse planting (Fargione and Tilman 2005). Short bunchgrasses such as little bluestem are the best warm-season grasses to enhance forb establishment (Wilsey 2010).

## Seed Mix Diversity


Photo by Phil Doll

### *Species diversity*

High seed mix diversity can successfully resist invasion by smooth brome (DiAllesandro et al. 2013) and Kentucky bluegrass (Norland et al. 2015). Of the main drivers of restoration success (seed mix, land use history, landscape context, management, and site characteristics) high seed mix species richness and high forb density are the dominant factors in determining established diversity (Grman et al. 2013).

### *Functional diversity*

Functionally rich (the number of functional groups) plantings are more resistant to invasion (Biondini 2007). Species and functionally rich plantings mimic the diversity in native prairies (Piper et al. 2007). Planted species are better competitors of invaders if they are functionally similar (Fargione and Tilman 2005). Native, cool-season grasses in particular are successful at resisting invasion to cool-season invasives (Symstad 2000). Cool-season forbs are an important guild to include in reconstructions because they begin using resources early in the spring (Losure et al. 2007). Increasing phylogenetic diversity (i.e., including species that are more distantly related evolutionarily) of seed mixes is a way to improve functional diversity of established restorations (Barak et al. 2017). Phenological diversity is another way to increase the functional diversity by providing nectar and pollen resources throughout the growing season for pollinators (Havens and Vitt 2016).

**These general rules of thumb can be used when developing seed mixes for prairie restorations to increase the established diversity:**

- Minimum total seeding rate of 40 seeds per sq ft*
- At least 40% of the total seeding rate should be composed of perennial forbs.
- 7 or more native grass or sedge species with at least 2 species of bunchgrass.
- Limit dominant species (Table 1)
- Fulfill the guilds: cool-season and warm-season grasses; sedges/rushes; legume and non-legume forbs.
- Include species from different families
- 20 or more native forbs with at least 5 species in each bloom period: early, middle, and late

*Site conditions, restoration goals, and budget constraints will ultimately determine seed mix composition.

**Table 1. Restoration competitive species.** Restoration competitive species are aggressive, easily established, and if planted at too high a rate of seeds per sq. ft. will dominate the planting after a few years, lowering the diversity and function of the restoration. Not all species on this list will be applicable to plant across the prairie region. This list is based on field observation and personal experiences of a variety of restoration professionals within and outside of the Minnesota Department of Natural Resources, and literature.

| | Latin Name | Common Name | Notes | Source |
|---|---|---|---|---|
| ***Forbs*** | *Galium boreale* | Northern bedstraw | Can create dense mats that out-compete other spp. | MNDNR |
| | *Monarda fistulosa* | Wild bergamot | | Helzer et al. 2010 |
| | *Ratibida pinnata* | Yellow coneflower | | Helzer et al. 2010 |
| | *Silphium perfoliatum* | Cup plant | Creates colonies from fibrous rhizomes that can crowd out other species. | MNDNR |
| ***Grasses*** | *Andropogon gerardii* | Big bluestem | | Losure et al. 2007 |
| | | | | McCain et al. 2010 |
| | *Panicum virgatum* | Switch grass | | McCain et al. 2010 |
| | *Sorghastrum nutans* | Indian grass | | McCain et al. 2010 |

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