Improving Native Seeding Strategies

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Summary

High seeding rates may fill niche space and combat weeds (Sheley et al., 2008; Carter and Blair 2012), but competition between seedlings increases with increased seed number. Some species will win, and other species- often subdominant forbs and small grasses- will lose when seedling competition is high (Dickson and Busby, 2008). This early competition results in a spatially homogeneous, low diversity plant community (Carter and Blair 2012). Here we discuss strategies we will use this fall and spring to stagger species arrangement in time and space to create more diverse communities. We seek to create a patchwork of spatially aggregated species and plant communities that take up niche space and use resources more efficiently than standard drill-seeding practices.

Background

Plants coexist when species fill a different above and/or belowground spatial or temporal niche. Standard rangeland drill seeding practices that spread a single seed mixture across the landscape can't account for variation in growth rates, rooting patterns, or phenology of species in native seed mixtures. Forcing species to interact in densely seeded rows maximizes competition between seedlings.

Aggregated Seeding

Rapid establishment of a competitive native community improves invasive species control. We will try staggering seeding times for different species to increase diversity by altering competitive relationships. Established plants are more difficult to displace than seedlings. Sowing weak competitors before aggressive species can facilitate coexistence by giving weak competitors time to establish (Young et al., 2001; James et al., 2012).

Spatial aggregation of seeds may present a way to reproduce natural plant co-occurrence patterns. Interactions such as facilitation and competition that display spatial heterogeneity on multiple scales maintain species diversity. Modeling studies and empirical work suggest that spatially aggregating seeds will facilitate weak competitors and increase diversity by giving weak competitors establishment priority (Potthoff et al., 2006; Turnbull et al., 2007; Wassmuth et al., 2009; Porensky et al., 2012; Houseman, 2013).

Aggregated seeding

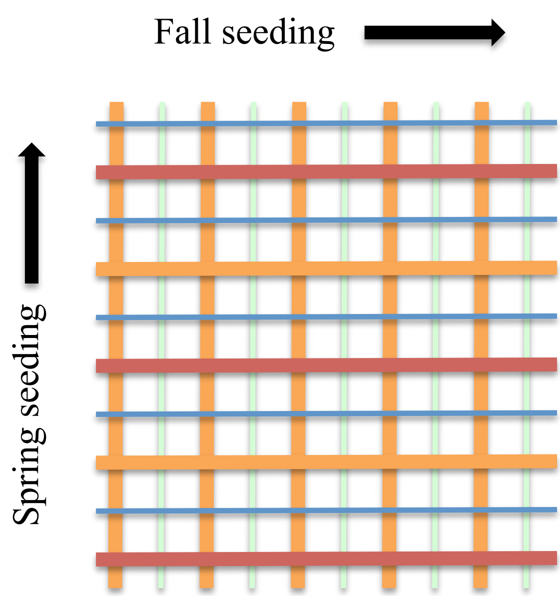
Species establish without heterospecific competition.

Random species mixture

Heterospecific competition is high. Weak competitors will be excluded.

Strategy #1

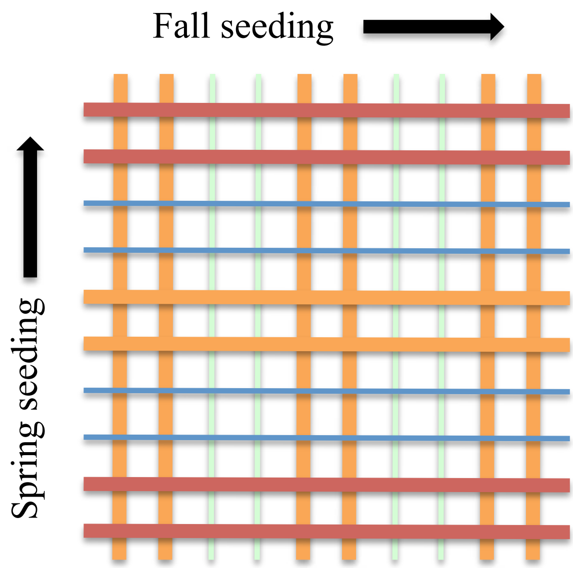
- Imprinters on alternate rows will facilitate broadcast seeding.
- We will seed each field twice, once in the fall and once in the spring.
- Large grasses will compose the first drill mix.
- Species that require cold stratification will compose the first broadcast mix.
- Small grasses and forbs will compose the second drill mix.
- Grasses and forbs the do not require cold stratification will compose the second broadcast mix.



Drilled Rows	Large grasses	Small grasses and forbs
Broadcast rows	Forbs	Forbs

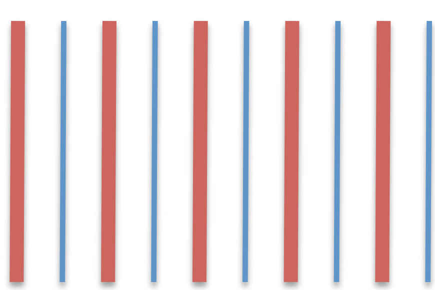
Strategy #2

- Paired broadcast imprinters and drilled rows will alter the spatial scale of species interactions compared with Strategy #1.
- Increased patch size will decrease heterospecific competition over larger areas.



Control: Single pass seeding (only a few areas)

- We will combine all broadcast species and all drilled species for comparison.
- Seeds will be sown in the fall and the spring in different areas.



Discussion

The proposed seeding strategies will increase the range of interactions between sown species compared with standard seed drilling practices. Seed density will vary at small scales within each row. Each seeded species will experience different amounts of competition or facilitation from other seeded species over multiple spatial scales. Niche space will be increased even for subordinate species. Spaces between seeded rows provide niches for weeds to establish and compete with natives (Bakker et al., 2003; Yurkomis et al., 2010). This strategy decreases unseeded areas between rows that could host weedy species.

There are advantages and disadvantages to both fall and spring seeding. Seedling establishment and survival hinges on unpredictable climate conditions. Dormant seeding in the fall allows plants to take advantage of early season conditions favorable for seedling growth, but not for seeding. Seeds experience natural cold stratification when sown in the fall.

If seeds germinate in the fall, they are susceptible to frost damage. Seeds sown in the fall are exposed to pathogens and predators longer than spring sown seeds. Planting fields in both the fall and spring is a way to hedge bets against unfavorable conditions. The advantages of each timing can be exploited and the potential for success increased.

Our seeding strategy will improve the aesthetics of seeded areas. The proposed strategy will "break up" rows and decrease the time it takes for restorations to look "natural".

A disadvantage to using this strategy is that seeding time and effort is more than doubled. However, the time and expense required to prepare sites and reseed after a failed seeding are greater.

Drill-seeded rows remain visible for years and leave space for weeds to establish without competition.

Evaluation- Do restorations mimic functional trait spatial stratification of natural communities?

Spatial analyses will be used to evaluate differences in spatial community assemblage over time. Vegetation survey crews will place permanent markers on blocks of rows within each treatment and treatment area. We will compare taxa diversity, richness, small-scale co-occurrence, spatial patterns between treatments, and plant functional trait indexes.

Species co-occurrences will be evaluated in 6 inch cells positioned down each row. Species co-occurrences that, after correction for species abundances, occur less often than expected by random chance will indicate competition. Co-occurrences that occur more often than expected by chance alone suggest facilitation. Neutral co-occurrences suggest that species occupy a different temporal or spatial niche space.

Most information about plant community structure is derived from analysis of adult plant communities. The proposed analyses will provide information about how restoration species interact at all growth stages and develop into adult communities.

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