Research Summary
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Cost-effective pollinator seed mix design and first-year management

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Key Findings

- Diverse, site appropriate seed mixes (1:1 grass to forbs) established well and supported pollinator forage plants while remaining cost effective
- Pollinator seed mixes (1:3 grass to forbs) supported pollinator forage plants but established poorly and were not cost-effective
- Grass-dominated seed mixes (3:1 grass to forbs) were cost-effective but supported very few pollinator forage plants
- Frequent first year mowing greatly increased native plant establishment and cost-effectiveness for all seed mixes

Introduction

The decline of pollinators throughout the US has recently prompted the USDA to create a conservation program designed to promote pollinator habitat. For the popular CP-42 pollinator program, conservation practice specifications intend to create forb-dominated stands of native vegetation that support pollinator use. As part of these specifications, seed mixes are required to have an overall seeding rate of 40 seeds per square foot, with a grass-to-forb ratio of 1:3 (10 seeds per square foot grass/ 30 seeds per square foot forb). As interest in the CP-42 program has grown, seed vendors and other organizations have provided pre-packaged seed mixes that meet these program requirements, and practitioners have planted thousands of acres of such seed mixes over the past several years.

However, seed mixes based on the requirements and preferences of the pollinator program may not be sufficient to produce durable stands of native vegetation. For example, the preference for short-statured species to compose the grass component of mixes may result in poor establishment, since short prairie grasses are generally adapted only to dry soils. Additionally, the 1:3 grass-to-forb ratio may be too low to establish native stands capable of competing with weeds, especially if frequent first season management is not properly carried out. Ultimately, these factors may lead to poor cost effectiveness when considering high costs of seed and low potential stand establishment.

Our objective was to compare native plant density, canopy cover, and cost effectiveness with and without establishment mowing for three different seed mixes that differed in grass-to-forb ratio and soil type customization.

Materials and Methods

To assess cost effective seed mix design and establishment management, we installed a randomized complete block experiment with three replicates in May 2015. We established two 40 x 253 ft strips as blocks, each consisting of eighteen 20 x 28 ft plots. In each plot, we randomly assigned a combination of mowing and seed mix treatments. We manipulated mowing at two levels: 1) unmowed and 2) mowed, and seed mix treatments at three levels: 1) economy grass mix, 2) diversity mix, and 3) pollinator mix.

We varied seed mix treatments based on grass-to-forb ratio and soil type customization. The economy grass mix ($130/ac) included 21 species at a 3:1 grass-to-forb seeding ratio, the diversity mix ($291/ac) included 71 species at a 1:1 grass-to-forb seeding ratio, and the pollinator mix ($368/ac) included 38 species at a 1:3 grass-to-forb seeding ratio. We selected species for economy and pollinator mixes to mimic popular commercially available seed mixes, while we designed the diversity mix using species selected for mesic soil conditions

at the experiment site. We seeded each mix at an overall rate of 40 seeds per square foot to standardize the mixes. To increase the relevancy of this study to practitioners, we used a Truax no-till drill (commonly employed for large-scale seedings) to plant each mix.

For the mowing treatment, we mowed vegetation frequently throughout the 2015 growing season. We mowed plots to 4 in. when vegetation height reached 2 ft (4 total mowings). We did not mow plots in 2016.

We collected plot vegetation data in Sep 2016. To sample plant density and cover, we used six 1 ft^2 quadrats spaced every 3.3 ft along a 19.7 ft transect established randomly in each plot. In each quadrat, we counted and identified all stems, and recorded canopy cover values for each species. We assessed cost effectiveness by calculating the cost of seed per plot and dividing by the number of 1000 established native stems in each plot (cost per thousand stems).

To analyze the effects of seed mix and mowing on cost-effectiveness and native plant establishment, we used R to conduct analysis of variance (ANOVA) and *post-hoc* Tukey HSD tests to compare means within treatment groups ($P < .05$).

Results and Discussion

After two growing seasons, the pollinator mix generally established poorly while the diversity and economy grass mix established well. On average, the diversity and economy grass mixes produced 4 times as many native stems as the pollinator mix ($P < .0001$; $P < .0001$) (Fig. 1). Native cover was also greater in the diversity and economy grass mix compared to the pollinator mix ($P < .05$; $P < .01$). The economy grass mix produced the fewest forbs (0.5 plants/ft^2) ($P < .05$), and forb density in the diversity mix (1.4 plants/ft^2) was not significantly different from the pollinator mix (1.6 plants/ft^2) (Fig. 2).

Mowing throughout the first growing season greatly improved the performance of native plantings, even in the second year. Mowing more than doubled native stem density ($P < .0001$) (Fig. 1), and increased native cover by twofold ($P < .0001$). However, mowing did not affect forb density.

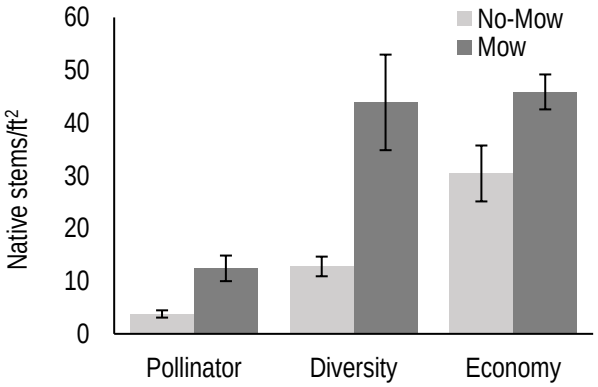

Fig. 1. Average native stem density per square foot after two years for three seed mixes with and without establishment mowing. Error bars represent standard error.

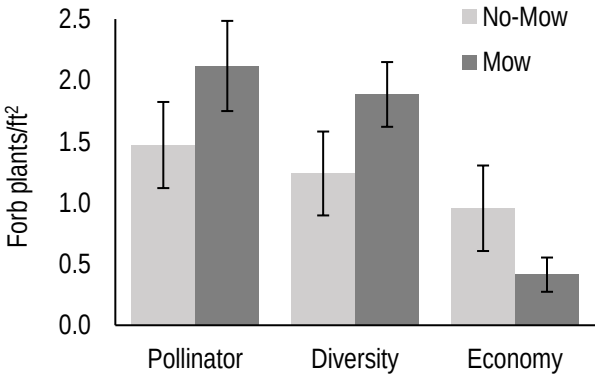

Fig. 2. Average native forb density per square foot after two years for three seed mixes with and without establishment mowing. Error bars represent standard error.

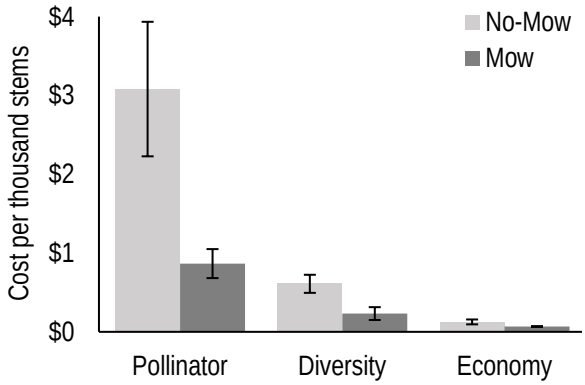

Fig. 3. Average cost to produce 1000 native stems after two years for three seed mixes with and without establishment mowing. Error bars represent standard error.

Both seed mix and first year mowing determined cost effectiveness in native plantings (Fig. 3). The pollinator mix was least cost effective; cost per thousand stems for this mix ($0.87 with mowing) was 4 times higher than the diversity mix ($0.23 with mowing) ($P < .001$) and over ten times higher than the economy grass mix ($0.07 with mowing) ($P < .0001$). Mowing greatly increased cost effectiveness, lowering cost per thousand stems on average by 350% ($P < .0001$).

Seed mix specifications designed to promote pollinator habitat do not necessarily result in successful stands of native vegetation. The pollinator mix (1:3 grass-to-forb ratio) established poorly, which led to low cost effectiveness. The economy grass mix (3:1 grass-to-forb ratio) established well, but resulted in forb densities likely insufficient to support pollinators. In contrast, the diversity mix (1:1 grass-to-forb ratio) established well, was cost effective, and produced forb density equivalent to the pollinator mix. Since the diversity mix maximized pollinator value, native plant density, and cover, specifications for pollinator seed mixes might be made more cost effective by emphasizing diverse site-appropriate mixes at a 1:1 grass-to-forb ratio.

Frequent first year mowing is also essential for establishing cost-effective, robust stands of native vegetation. The magnitude of the effect even in the second year suggests establishment mowing is likely to provide benefits into the future.

Acknowledgements

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