ASSESSMENT OF PRAIRIE POT TRANSPLANTS AS A RESTORATION TOOL

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ABSTRACT

We assessed two transplanting methods as possible means for increasing diversity in a restored prairie at Pierce Cedar Creek Institute in Barry County, Michigan during the spring and summer of 2006. We compared the success of seedlings transplanted as individuals with those grown in ‘prairie pots’—15 cm diameter pots that contained one seedling each of four species. Each cell in which individual transplants were grown contained one quarter the amount of soil as a prairie pot. We utilized a replicated experimental design that incorporated four common prairie species, Big bluestem (Andropogon gerardii), Little bluestem (Schizachyrium scoparium), Stiff goldenrod (Solidago rigida) and Smooth blue aster (Aster laevis), as well as two less common prairie plants, Fringed brome (Bromus ciliatus) and Compass plant (Silphium laciniatum). The two uncommon species were used to assess the relative efficacy of these transplanting strategies for introducing under-represented species into prairie habitats. In general, we found that after one season of growth, seedlings raised and transplanted in prairie pots had greater survivorship and attained greater height than those transplanted individually. An exception to this trend was A. gerardii which exhibited greater survivorship when transplanted as individual seedlings. In addition, preparing and transplanting prairie pots required less than half the amount of time as individual transplants. Subsequent studies should track the success of transplants over multiple years to determine if this initial advantage is sustained as the plants mature. However, after one year of assessment, we conclude that prairie pots are a viable and advantageous transplant strategy for increasing species diversity in restored prairies.

KEY WORDS: Restoration, Prairie, Transplants, Seedlings

INTRODUCTION

Prairie restorations are typically initiated by broadcasting or drilling a seed mix comprised of a variety of common prairie species (Sauer 1998; Montalvo 2006). Usually the resulting prairie is not as diverse as native prairie remnants because species with low germination success, as well as less competitive species, have difficulty becoming established (Brown et al. 2001; Allison 2002). Also, rare species are seldom represented in seed mixes and even if desired diversity is attained initially, species richness has been shown to decline over time in re-created prairies (Sluis 2002). Therefore restored prairies are almost always lower in plant diversity than comparable native prairies (Sluis 2002). In this study we assess a new restoration method designed to improve species diversity in seed-initiated restored prairies. Our method involves transplanting target species into restored prairies using a vector we call a “prairie pot.” Prairie pots are 15 centimeter diameter pots that contain four seedlings, each of a different species (resembling a simplified miniature prairie) (Figure 1). We compared the
performance of plants transplanted as prairie pots with individual transplants to assess the efficacy of this transplant strategy.

We focused this study on transplants because it has been our experience that transplants are an underutilized but valuable restoration strategy that can yield multiple benefits. Transplants will reach maturity more quickly than plants emerging from seed, thereby discouraging weeds and providing a source of additional seed usually within the first year (Davies et al. 1999). Transplants can also include less common species, providing the restorationist a valuable tool to increase species diversity and to have a more direct influence over the final outcome of the project (Schramm, 1997; Sauer 1998).

METHODS

In this study we used four species typically represented in prairie restorations: two native prairie grasses: *Andropogon gerardii* Vitman (Big bluestem) and *Schizachyrium scoparium* Michaux (Little bluestem) and two native forbs, *Aster laevis* L. (Smooth blue aster) and *Solidago rigida* L. (Stiff goldenrod). We also included a less common grass, *Bromus ciliatus* L. (Fringed brome) and a rare forb, *Silphium laciniatum* L. (Compass plant) so that we could assess the use of prairie pots as a strategy for introducing under-represented species into restored prairies. The seeds for all these species were collected from natural local sites in Kent County, Michigan in late summer-fall 2005 and are all assumed
Seeds for *S. laciniatum*, a threatened species in Michigan (Herman et al. 2001), were taken from garden plantings at Calvin College that had been grown from seed originally collected under a Michigan Natural Features Inventory Permit #00-1036 in 2000. All seeds were stored in Hubco Soil Sample mesh bags and received a natural overwintering stratification treatment (December 1–March 1 2006) outside the Calvin College research greenhouse in an animal enclosure.

In March 2006, seeds were sown in a soil mixture (50% Sunshine promix, 25% sand, 25% perlite) in germination flats in the Calvin College greenhouse. Seedlings were allowed to grow for several weeks until their first true leaves emerged, after which they were either planted in prairie pots or into individual cells, each of which contained 1/4 the amount of soil as a prairie pot. A potentially important difference between these two procedures is that the depth of soil was greater in the prairie pots (approximately 15 cm) than in the individual cells (approximately 9 cm.). Two groups of prairie pots were prepared, each with two grasses and two forbs. Group A included *Silphium laciniatum*, *Aster laevis*, *Schizachyrium scoparium*, and *Andropogon gerardii*. Group B consisted of *Bromus ciliiatus*, *Solidago rigida*, *A. laevis*, and *S. scoparium*. Our transplanting efforts occurred during early May, 2006. All plants were kept in the greenhouse for approximately two weeks post transplanting, after which they were moved outside to an animal enclosure for hardening off.

When transplanting seedlings into prairie pots and individual cells we also performed a time trial to evaluate the amount of time required for these activities. The time involved to prepare pots and individual transplants was recorded for two different workers in the production of eight prairie pots and 32 individual transplants.

The site into which we outplanted the seedlings is a section of five year old recreated prairie located near the entrance road to Pierce Cedar Creek Institute in Barry County, Michigan (Figure 2). This section had been burned in the fall (2005), and is dominated by *Andropogon gerardii* and *Solidago canadensis* L. (Canada goldenrod). Other common species are *Panicum virgatum* L. (Switch grass), *Schizachyrium scoparium*, *Monarda fistulosa* L. (Bee balm) and *Heliopsis helianthoides* L. (Ox-eye sunflower).

At this site we marked off twelve 9 m × 9 m blocks. Within each block we located eight 1 m x 1 m quadrats (Figure 3). We randomly assigned four of these quadrats to receive five prairie pots, and the other four quadrats to receive 20 individual transplants (five seedlings from each of the four species). This design provided 6 large replicated areas for each group (A and B), each of which had 8 quadrats (4 with prairie pots, 4 with individual transplants). In total, 20 prairie pots as well as 80 individual transplants were introduced into each replicated site, for a total of 120 prairie pots and 480 individual transplants for each of the two groups (A and B). We assessed survivorship and measured seedling height on July 26–28, 2006. The data were analyzed with a two sample T-test (Statistix 2000).

**RESULTS**

Based on previous work (Warners 2002, unpublished), corroborated by time trial comparisons in this study, prairie pots were found to be a more time efficient method for introducing transplants into a prairie. When compared to individual transplants our informal tests revealed that prairie pots require approximately 36% the amount of preparation time in the greenhouse and from earlier records, approximately 50% of the outplanting time in the field.

Figure 4 displays survivorship data collected at the end of our study period in late July. Survivorship is expressed as the overall average of the six replicated blocks in each group (A or B) (n=6, except the two species used in both groups for which n=12). The trend in this graph is greater survivorship for the prairie pot seedlings compared to individually planted seedlings. The only species that had greater survivorship when transplanted as individuals was *Andropogon gerardii* (p ≤ 0.05).

Figure 5 illustrates the mean height for each of the seedlings that survived, as
recorded on the final day of data collection in July. The values on the graph represent the overall average for each species in the six replicated blocks. Species height shows a similar pattern as survivorship data, with seedlings in prairie pots generally growing taller than those transplanted as individuals. However, in this comparison only two species, *Aster laevis* and *Silphium laciniatum*, showed significantly taller seedlings when transplanted in prairie pots compared to those transplanted as individuals (p ≤ 0.05).

**DISCUSSION**

For introducing transplants into restored prairies, prairie pots were found to be a better strategy than transplanting seedlings individually. Prairie pots yielded better results in three ways: time required for preparing and transplanting, seedling survivorship, and seedling height. The trend in survivorship (Figure 4) illustrates an advantage for all species in prairie pots except *Andropogon gerardii*. 

FIGURE 3. Schematic diagram of experimental design in which six replicated blocks were established for each group of species (A or B).
As similar experiments with prairie pots occur, particular effort should be made to identify species like *A. gerardii* that grow significantly better when planted as individuals. This knowledge will benefit those who utilize transplants in restoration projects as they work to establish key elements in their restoration efforts.

For species that do exhibit greater survivorship in prairie pots, soil volume may be an important contributor to their success. Even though each prairie pot seedling has an equivalent portion of soil available as the individual seedlings, it appears that 4 seedlings sharing 4× amount of soil conveys an advantage over 1 seedling that is allocated 1× volume of the same soil. A potential mechanism is that the greater depth provided by 4× volume of prairie pot soil (approximately 15 cm compared to approximately 9 cm in the individual cells) helps protect the seedlings from complete desiccation during dry periods (Davies et al. 1999). The possibility for mutualistic interactions among these species is also present, although none of the species in this study are capable of fixing nitrogen (Reuters 1985; Weston 2000; Maestre 2005). Subsequent studies that incorporate native legumes (for example *Desmodium* spp. and *Lespedeza* spp.) would be valuable to further understand the potential for facilitative interactions (Rice 1968; Ashton et al. 1994).

We report data that were collected only in the first year of the study, and it is possible that as these plants get larger there will be increased competition between the four seedlings planted together in prairie pots (Huddleston et al. 2004). The increased competition could lead to negative interspecific interactions in the long term, potentially offsetting the benefits we describe here. Therefore, a study such as this needs to be monitored for several seasons so that the potential long term benefit of prairie pots can be more accurately understood.

Figure 5 illustrates a trend for greater height achieved by plants in prairie pots.
pots. However, when analyzing these data, only two of the six species, *Aster laevis* and *Silphium laciniatum*, grew significantly taller in prairie pots than the individual transplants. It is important to recognize that the tallest average end height was only 14 centimeters (for *Bromus ciliatus*). This behavior of first year seedlings remaining small has been documented in wet prairies after fire and may be a common phenomenon in communities dominated by herbaceous perennials (Warners 1997). It appears that once germination success has occurred, the typical behavior of many long-lived perennials is to build up below ground reserves before investing more energy in shoot biomass. Several long-lived prairie perennials are known to require multiple years before they will flower (Dickerson et al. 1976). This observation lends further support for the need to monitor studies like this for several seasons.

Time comparisons to maximize restoration efficiency are a common component of species eradication efforts (Reuters 1985; J. McGowan-Stinski and T. J. Gostomski, unpublished). However, such consideration of time investment for restoration planting is less widely assessed. We do feel this is an important factor to consider in the overall evaluation of restoration efforts. In an informal time trial, we found that on average, prairie pots (four species in one pot) required approximately 36% less time to prepare compared with individual plant preparations (four species, each in its own individual cell). Similarly, in a previous study (Warners 2002, unpublished) the time required for outplanting prairie pots was approximately 50% of the time needed for outplanting an equal number of individual seedlings. The consistent results of these informal time trials, which occurred four years apart from each other and utilized different species, validate the time-saving aspect of the prairie pot transplanting strategy.
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LITERATURE CITED


