
Robert J. Reber

Observations on Recreating Prairie

Attempts at restoration of Eastern Tallgrass Prairie are relatively recent undertakings. In the 1930s, the Curtis Prairie was established near Madison, Wisconsin, with the assistance of Civilian Conservation Corps workers. There were other infrequent restoration projects; and in the 1960s, a restoration, later designated the Schulenberg Prairie, was started at the Morton Arboretum in Lisle, Illinois. Since then, there have been increasing numbers of restoration and reconstruction projects by organizations, government agencies, schools, and individuals. Due to the enduring nature of these efforts, various approaches and techniques have been tried and recommended.

Variations include a matrix-type approach, recommended by Robert Betz and others, in which pioneering native species are predominant in the initial seed application, with more conservative species added in later enrichment plantings, in an attempt to copy the observed successional changes occurring on disturbed native remnants. Another approach, suggested by Scott Weber, is to include few if any early successional native species such as wild bergamot, black-eyed Susan, and gray-headed coneflower in the seed mix and to proceed directly to plantings of conservative species, which could hasten the establishment of a high-quality prairie. Omitting early successional species may permit certain alien species to remain longer before being displaced, but this method is intriguing. What is interesting is that different people have used varying methods, yet all indicate some degree of success in achieving reasonably diverse prairies. It may imply either that prairie is very forgiving or that prairie restoration continues to be more art than science!

Conservative species such as prairie dropseed, shooting star, and hoary puccoon can be established with the help of a prairie nursery. Such a "garden," where these hard-to-establish plants are grown for the principle purpose of seed production, can greatly increase the amount of seed available to plant in the restoration proper. Once established, the nursery can also have the added benefit of providing root divisions or transplants.

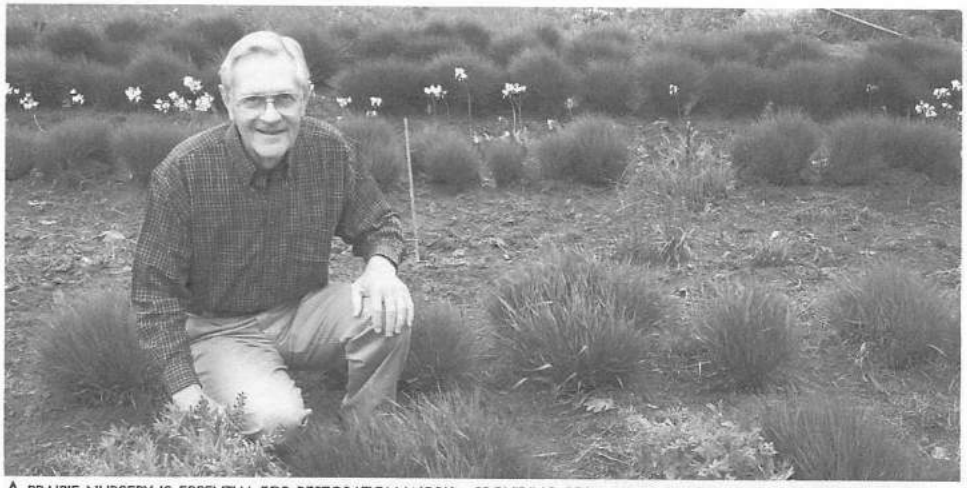
Although individuals working in the field, including myself, use the terms restoration and reconstruction freely, it should be understood that they are not quite accurately descriptive. Prairie restoration usually refers to the recovery and enrichment of prairie on a field where some prairie species continue to exist. Reconstruction refers to introducing prairie into an area where prairie species have been extirpated, such as a tilled field that has been growing corn or soybeans. Sometimes, as here, the terms are used interchangeably.

The problem with both terms is they imply that presettlement prairie will be recreated, which is unlikely for several reasons—including changes in soil hydrology, possible climate change, and the introduction of vast numbers of alien species. The last is especially daunting for prairie work on restorations and also on native remnants. These aliens are species that were introduced intentionally or inadvertently from such regions as Europe, Asia, or other parts of this continent. Originally, the native prairie did not have to contend with these species. Fortunately, a healthy prairie can displace, at least to a major extent, most of these. However, a few thrive in prairie conditions and present long-term challenges for prairie management. More accurately, what we are attempting to achieve with prairie plantings is to establish a healthy, reproducing mix of species that were likely present in a designated region in presettlement times.

My first prairie restoration work began on a 7-acre, clay loam mesic soil permanent pasture in 1974 (*see* The Illinois Steward, *Summer 2005*). From then until 1990, I used various methods to establish prairie plantings on plots, working progressively across the field. Now, over 30 years later, that field has more than 150 native species established, with a mix of spring, midsummer, and late-summer flowering species. Also, the field has been expanded to 15 acres. However, in 1993, I conducted a vegetation analysis on the core field that combined relative frequency and relative density numbers to assign an importance value (IV) to species encountered on the survey. At that time, five of the species with highest IV rankings were nonnatives. In 2004, the analysis was repeated. After that 12-year period, three nonnatives continued to rank among the top ten. Although this is an improvement, it also indicates the slowness of development of a prairie project, at least by methods I have used. What follows is a summary of some of these experiences.

Soil Preparation

One method to prepare for seeding was to use a moldboard plow in the fall, turning the soil 7 to 10 inches deep. The following spring, that area was disked and harrowed, thus producing a fine-particulate seedbed. The seed was hand-broadcast, as it was on all of these restoration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A PRAIRIE NURSERY IS ESSENTIAL FOR RESTORATION WORK—PROVIDING SEED, ROOT DIVISIONS, AND TRANSPLANTS OF SLOW- OR DIFFICULT-TO-ESTABLISH SPECIES.

plots, and then the area was rolled in order to gain better seed–soil contact. At times, the site was lightly harrowed after seeding; but this introduced the possibility of burying some seed too deeply.

The advantage of this approach was that it probably achieved the best seed–soil contact of any of the methods tried. However, by inverting a soil layer, it created more soil disturbance than was desired on a field that did not have a history of tillage. It also left the soil exposed over winter to possible erosion. Because weed seeds were brought to the surface, annual weeds may have increased the first year; but these appeared regardless of the method used. Given time, prairie species became well-established.

An alternative soil-preparation method was to use only a disk or a disk–chisel plow combination in the fall. This approach thoroughly agitated the soil and had the advantage of not inverting soil layers. Also, by leaving vegetative material on the surface, erosion was reduced. The area was harrowed in the spring, followed by hand-seeding and rolling. Seed–soil contact may have been somewhat poorer than with the prior method, due to more mulchlike surface material. However, prairie seed germinated and grew well with this method.

Yet another method was to use almost no tillage. In early May, a 2% glyphosate herbicide was sprayed on the designated area, which had been burned previously in late winter. Spraying was repeated 2 weeks later. The area was lightly harrowed, hand-seeded, and rolled. This method had the advantage of almost eliminating soil disturbance and possible erosion. It had the disadvantages of likely preventing optimum seed–soil contact and involved the use of a herbicide, although one that is considered relatively benign. This method also proved effective over time in establishing a prairie planting.

Techniques that proved unsuccessful included leaving an area fallow for an extra year in order to periodically till and destroy more weed seedlings. However, a large population of annual weeds continued following planting the second year, and the soil was left exposed to erosion for an extended time. This method was not repeated.

There was an attempt to start prairie by incorporating seed into individual 3-foot, hand-spaded quadrats. This proved unsuccessful on the pasture field because the cool-season alien pasture grasses rapidly encroached onto the quadrats, displacing most prairie seedlings.

Following these experiences, I now feel that—if a prairie planting is to be conducted on a field that has been in row crops—the better choice would be to till the soil and create a good seedbed. If following soybeans, minimal tillage is required, as existing surface vegetative material would not be great, and the soil has a relatively loose texture. Following corn, more tillage, such as with a disk-chisel plow combination, would be required to partially incorporate the often heavy accumulation of leaf and stem material, which if left on the surface could prevent adequate seed–soil contact or inhibit the emergence of germinating plants.

If the area to be seeded is currently in sod or a hay crop such as alfalfa, two sprayings with 2% glyphosate should be effective. In the case of alfalfa, the first spraying should be done in the fall. The field can be lightly disked or harrowed before seeding. As always following seeding, the site should be rolled.

An alternative to hand-broadcasting seed is to use a specialized no-till drill such as a Truax or Nisbit drill. These implements are used routinely and are effective, but I have not had experience with them.

Timing of Seeding

Most of my seeding has been during late May or early June—to permit elimination of the first flush of spring weeds either through tillage or herbicide treatment. However, the later the seeding date, the greater the possibility of encountering an extended period of dry, hot weather that could adversely effect seedlings or prevent germination of seed that first year.

It should be understood that the rapid growth of annual weeds is a natural response to soil disturbance and to the removal of existing vegetation. Providing the initial stage in healing the unstable site, the annual weeds stabilize the soil and create cover for the small, slower-growing perennials that are attempting to become established. These weeds compete for existing soil moisture, a problem that can be partially negated by mowing a couple of times during the growing season with the mower set 6- to 8-inches high to avoid small, emerging prairie species. The shorter weeds continue to provide a degree of cover. Fall or winter seeding has proved effective, thus timing of seeding may be of less concern.

After a prairie planting is becoming established, additional seed may be applied through enrichment seeding. Seed of most spring-flowering species ripens in late spring or early summer. This fresh seed may be applied in late summer by scratching it into small areas of exposed soil often found between tussocks of the tall grasses. For most species, an easier time to introduce the seed is in late winter or early spring following burning of the site. The absence of aboveground growth of plant material gives easier access to suitable areas where the seed can be incorporated into the soil. Another method of enrichment is to broadcast larger quantities of seed over the burned site and allow spring rains to mix the seed into the soil.

Seed Mixes

My seed was hand-collected and not fully cleaned. There was no debearding or removing of coverings on one-seeded fruits. Thus it was not possible to determine exact weights. More importantly, seed was applied generously; and as many species as possible were included.

Although difficult to quantify, on an expanse of native prairie on mesic soil, likely 200 or more vascular plant species were present. These species were part of a complex dynamic ecosystem of interactions and interdependencies, some of which enhanced the growth of other species, while others restricted population expansion. Factors involved included allelopathy, hemiparasitism, interactions with soil microorganisms, and different moisture and nutrient requirements. Many of these effects are poorly understood, so—to take advantage of them—it is important to introduce the greatest possible diversity of species that are ecologically compatible to the selected site.

One problem with some restorations has been the perceived overpopulation of native grasses. Thus the recommendation is to plant less grass seed. Although this is possibly true, the emphasis should be reversed: Plant a larger quantity and greater diversity of forb seed. Some prairie plantings may include 40 or 50 species, which seems to be a good diversity. However, it does not approach the diversity that likely existed on native prairie and thus may not benefit from the interactive characteristics that prevented overpopulation of certain species.

In my restoration work, seeding patterns varied. Sometimes, I applied more grass seed

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FOLLOWING HAND-COLLECTION OF RIPENED SEED DURING THE GROWING SEASON, ADDITIONAL SEED IS HARVESTED WITH A COMBINE IN THE FALL. THIS MATERIAL CONTAINS AN ASSORTMENT OF SEED AND EXTENSIVE AMOUNTS OF CHAFF AND LEAF PARTICLES.

to one area and more forb seed in another, in an attempt to copy the mosaic pattern that apparently was present on the native prairie. In areas where I did not introduce any grass seed, the site remained weedier for a longer time. A heavy population of native grasses is effective in displacing many of the alien weed species.

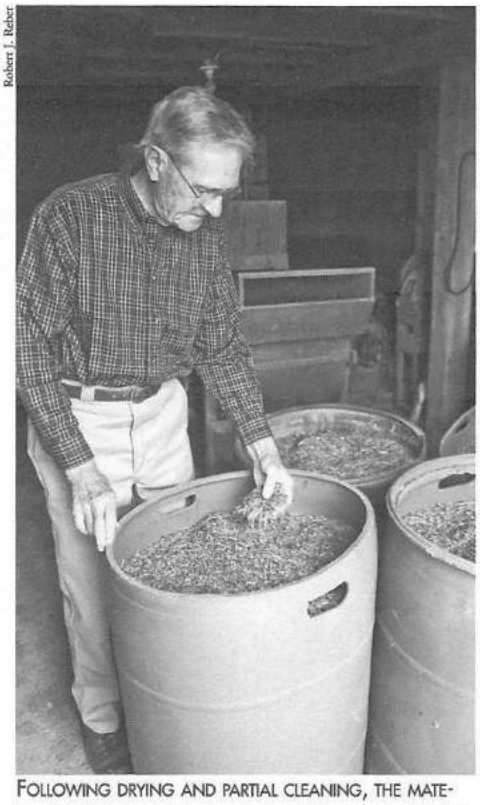
Seed Treatment

There are various methods of seed treatment. One is to scarify the seed to produce breaks in the seed coat to enhance earlier germination. Especially on some legumes, such as leadplant, cream wild indigo, and white wild indigo, I used a vibrating hand-sander to scratch the seed coat immediately before planting.

Most legumes establish a symbiotic relationship with rhizobial bacteria in the soil. Through this relationship, atmospheric nitrogen is fixed into a form that can be used by the host plant and later by other species in the area. During early years of the project, immediately prior to seeding, I coated the seed of various legume species with rhizobium inoculants acquired from Nitragin Corporation. These were specific for each species. As these species became established, I stopped applying the inoculants on new plantings.

Damp stratification is another seed treatment. The seed may be mixed with sand or vermiculite and lightly moistened, then refrigerated for about 6 weeks before planting. This technique often enhances early germination, but one possible disadvantage would be the occurrence of a prolonged dry period immediately after seeding: The germinating seed might not survive without supplemental watering. Most of my seed was stored dry over the winter in a cool basement or in an unheated building.

Genetic differences have been demonstrated between some species native to different regions. Thus, if there is to be an attempt to restore a site to some semblance of native prairie, insist on using regional ecotype seed, whether the seed is hand-collected or purchased from a seed nursery.



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FOLLOWING DRYING AND PARTIAL CLEANING, THE MATERIAL HARVESTED WITH THE COMBINE IS STORED IN BARRELS.

Fire

The plants that flourished on native prairie were adapted to periodic fires, which continue to be an important prairie-management tool. In the first year or two of a restoration project, the annual weed growth may consist of coarse stems and leaves that do not burn readily. Once more grasses become established, burns may be conducted every year for several years. Prairie species, especially spring ephemerals, seem to thrive following fire. There have been indications that the seed-germination rate of certain species improves in the presence of one or more active compounds in smoke (*see* The Illinois Steward, *Fall* 2007). Researchers in South Africa and at the University of Western Australia identified one of these compounds to be butenolide. Its positive effect on the germination of several native prairie species has been demonstrated at the Chicago Botanic Garden.

After the first few years, the burns can be conducted every 2 or 3 years. Spacing the fires at longer intervals may permit tree seedlings to become established to the extent that fire alone is not effective in removing them. On my sites, I burn every year but rotate, leaving about one-fourth unburned each year. The unburned area provides a refuge for insects and other arthropods that overwinter aboveground in leaves and stems.

I burn from February to mid-March, which leaves cover for wildlife for a longer time and reduces the possibility of erosion on burned-over soil. Later burning dates may be inadvisable if early-spring-emerging species such as shooting star and wood betony are present. They often emerge in late March.

Burns are planned a year ahead, with the mowing of fire lanes in areas where fire might escape. If possible, the burn is started on a day with a light breeze in an appropriate direction for the site. When there is little or no wind, the fire may drift unpredictably from one direction to another. Backfires are started along the firebreaks. Once these are secured, the head fire is started with often dramatic but controlled results.

Management

One of the hopeful opinions held by prairie enthusiasts, including myself, was that once a diverse prairie was becoming established the only management required would be an occasional burning. Unfortunately, that is not the case. Plans should be made at the outset to anticipate management tasks that may occur over time.

Quite likely, the major necessary management effort will be in controlling or extirpating exotic species. As suggested earlier, a vigorous healthy prairie will displace many of these aliens, to a great extent. However, a few thrive on prairie conditions and present a long-term challenge if native prairie is to be approximated. Species that can be especially troublesome include reed canary grass, teasel, crown vetch, *Phragmites*, sweet clover, and day lilies.

On my sites, yellow and white sweet clover present a continuing problem. If the issue is not addressed, an alien clover field with some native prairie species could evolve. After several ineffective attempts at control, a labor-intensive method has been implemented requiring repeated sweeps across a field from late April until mid-July, carefully spot-spraying small sweet clover plants, while removing any larger, seed-bearing plants from the site.

Different problem species require different approaches. However, the best solution is to remain vigilant and aggressively address a problem when it appears, before it becomes well-established on a site.

Conclusions

Given that various procedures in developing prairie can be successful, five factors are essential in my estimation.

1. Become informed. The first thing a person needs to do is learn about both native and non-native species—their identifying characteristics, their preferred habitats, their native ranges, and other species with which they grow. There should be an increasing awareness of interactions among plant species, as well as with soil organisms, insects, and other animal life.

Fortunately, there are many sources of information. These include Internet sites, published materials, and organizations. Becoming involved with one of the numerous organizations active in prairie work is an excellent method of learning about prairie from people who have extensive experience directly or indirectly associated with prairie.

Through becoming informed, a person can make a better judgment as to whether prairie restoration is an effort to undertake. The essence of native prairie was a sense of wildness. A goal of prairie restoration is to attempt

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to recapture some of that wildness. In spring and early summer, a prairie may have a meadowlike appearance. Later in the summer, the tall grasses and many of the sunflowers, *Silphiums*, and goldenrods make their major growth. The prairie then takes on an aspect of ruggedness, with rich textures and colors that can be very appealing. However, we must realize that we live in a society that places high value on carefully manicured, monocultured, and alien species lawns and agricultural fields. For some people, it requires both a cultural and an aesthetic adjustment to accept and appreciate prairie.

2. Proceed slowly and carefully with the development of a prairie project. That approach gives more time to control persistent alien species and is important if a high-quality site is to be established. One of the basic characteristics of native prairie is a sense of expanse. Thus it is understandable that we want to proceed as rapidly as possible to recreate that vista. However, the Eastern Tallgrass Prairie evolved over a period of several thousand years until it was essentially destroyed by agriculture and other development. If we can restore prairie to some semblance of that presettlement state in 100 years, it will be a remarkable achievement. The time frame should in no way discourage the effort. There are many opportunities for great satisfaction in the incremental improvements that develop during the process of establishing a diverse mix of prairie species.

3. Make heavy applications of seed. Establishing plantings progressively across a restoration site permits applying greater amounts of viable seed to any given area. The amount of seed produced and its viability can vary from year to year for the individual species. Using seed from multiple harvest years improves the chances of germinating and growing healthy native plants.

4. Introduce the greatest number of species suitable for the region in which the site is located. A further result of developing a restoration over an extended period is an increased opportunity to acquire more plant species. For instance, it will give time to permit establishment of a prairie nursery or garden, which can be used to start plants of species for which only small amounts of seed were available or that did not grow well when the seed was applied directly in the field. Also, over time a person becomes more familiar with the identity, growth characteristics, and requirements of additional native species that would be appropriate for the site.

5. Plan for long-term management. Early in the restoration project, clear plans and provisions should be made for management activities: such as establishing a schedule for periodic burning of the site; continuing vigilance for invading alien species and aggressive control efforts for those that become established; protection of the restoration from human encroachment, ranging from adjacent farming operations, to uncontrolled ATV use. Without management plans and their application, the results of the great effort involved in implementing the first four factors is likely to be placed in jeopardy.

So become informed, proceed slowly, make generous applications of seed, acquire the greatest number of regional ecotype species possible, and make firm plans for future management. By keeping in mind the limits of the sustainable effort and the resources that can be devoted to a project, there can be an emphasis on a methodical, incremental approach that has a much greater possibility of long-term success.

As Scott Weber states in a paper formulating a revised approach to prairie restoration, "...if we do not proceed slowly and try to do it right the first time, it is unlikely that many of these plantings will be adjusted later."

Prairie restoration can be characterized as being essentially a simple process. But sometimes, it is not easy. The most important characteristics necessary for successful prairie work are patience and persistence.

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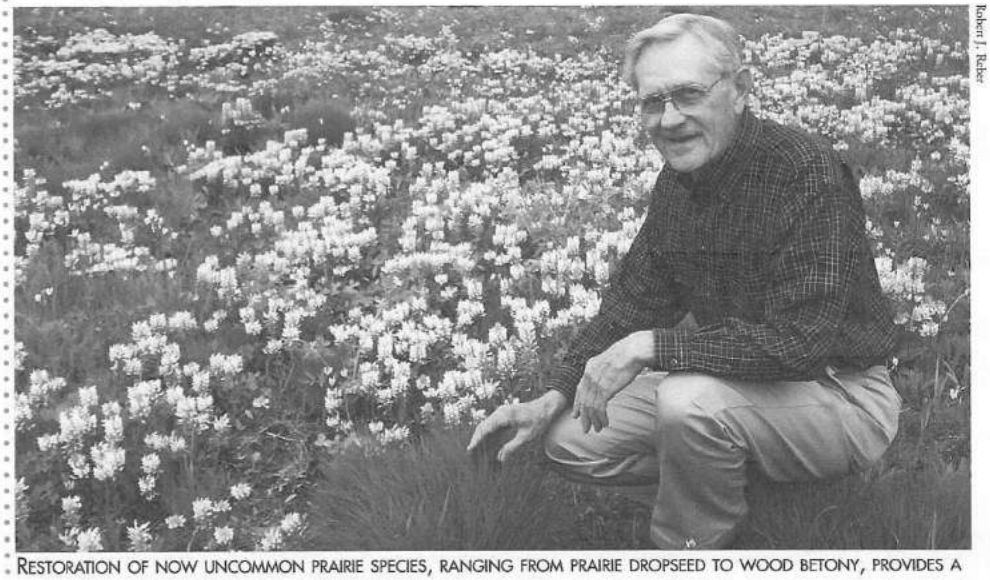

Robert J. Ricker

RESTORATION OF NOW UNCOMMON PRAIRIE SPECIES, RANGING FROM PRAIRIE DROPSEED TO WOOD BETONY, PROVIDES A CONTINUING SOURCE OF WONDER AND SATISFACTION.