THE "DO'S AND DON'TS" OF PRAIRIE RESTORATION

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ABSTRACT

Based on ten years of prairie restoration efforts on the Knox College Biological Field Station located in Knox County, west central Illinois, this paper reviews the various procedures used to plant and establish prairie. The two most important variables affecting restoration are weed seeds present, and prompt germination of a high percentage of the grass and forb seeds planted. Suggestions on how to control these variables are presented. A variety of successful planting methods may be used. There is no such thing as instant prairie; therefore, the installment plan is recommended, trying different kinds of plantings over several years. Forb enrichment of existing stands, and the ecotype problem are discussed. Quality prairie plants are defined, and a list of grasses and forbs is presented indicating quality, competitive ability, ease of restoration, seed conditioning, habitat preference, time of blooming and showiness.

INTRODUCTION

During the First Midwest Prairie Conference held in 1968, it became obvious there was much we did not know about prairie restoration. Many eager new prairie enthusiasts wanted to know the best way to get prairie started, but only a few could offer concrete suggestions on how to propagate the various species and achieve some semblance of a prairie community. In the years that followed there was much trial, error, and variable success in prairie restoration. New people and projects were trying to establish prairie, going about it in their own way, and not profiting from the mistakes of others. The same method tried in two different places or in two different years, or by two different persons yielded different results. The problem became one of determining the most important variables and controlling them to achieve a successful planting.

Based on ten years of restoration efforts on the Knox College Biological Field Station located in Knox County, west central Illinois, this paper will attempt to pinpoint and emphasize the major variables in prairie restoration, point out the "Do's and Don'ts" of planting prairie, review the various procedures and methods that have worked, and list the various prairie species with regard to their quality, ease of establishment and competitive abilities. It will also attempt to up-date previous papers by this author based on the Knox project (Schramm 1970; 1972).

THE TWO MAJOR VARIABLES IN PRAIRIE RESTORATION

There are two major variables in prairie restoration that will influence the success of the planting; weed seed present in the planting site, and degree of prompt germination of both grass and forb seed.

The first variable, that of weed seed, is very unpredictable and more difficult to deal with if a real weed problem exists. The second variable, that of germination and viability of seed, can be determined prior to planting. Prompt germination can be enhanced by cold-damp conditioning (or stratification), scarification, and other kinds of treatments which condition seed and break dormancy or prevent the seed from ever becoming dormant.

These two variables, and how to deal with them, will be discussed separately in some detail.

The Weed Seed Variable and Weed Competition

The amount of weed seed present in the planting site is perhaps the most variable and unpredictable factor in prairie restoration. There is no way to predict with certainty the amount of weed competition that will be present during the first few years of restoration. One can generalize, however, and state that fallow fields and recently farmed fields result in weedier plantings than the field of perennial pasture grass sod. But again, this may not always be the case. A plot of bluegrass sod (Poa pratensis) on the Knox Field Station, Fall-plowed and planted late the following Spring, resulted in a remarkably weed-free planting. Another nearby site of orchard grass sod (Dactylis glomerata) Fall-plowed and late Spring planted was very weedy with a heavy growth of the annuals velvet-leaf (Abutilon theophrasti) and witch grass (Panicum capillare). Very much depends on the weed seeds that are lying dormant in a particular site irregardless of the kind of plant cover present.

Solutions to the Weed Problem

There are four things that can be done to alleviate or reduce the weed problem:

1. Late Planting. Plant as late as possible, but before the mid-part of the growing season. In western Illinois the ideal time is the first two weeks in June. This late planting date allows time for the site to be lightly and shallowly cultivated to eliminate weeds as they germinate. Weed seeds begin to germinate as soon as the soil warms up in March. Late planting allows two to three months of weed germination, shallow cultivation, and weed removal. Do not deep cultivate as this only brings up more weed seed. Usually a thorough discing in March levels the Fall-plowed site, and then shallow discing or harrowing at two to three-week intervals eliminates much of the problem.

The only danger to late planting is that in a particularly dry season the project might not get the necessary precipitation to germinate the seeds. However, if the seeds have been handled correctly, they will be on the verge of germination and it will take very little soil moisture to get things going. Prairie plants are remarkable in that they "grow down" the first year not up (Wilson 1970), and the seedlings quickly send down roots to considerable soil depths during the first few weeks of growth.

The one exception to a later planting date is in certain kinds of strip-mine sites of heavy and water impervious substrates. Here an earlier planting is necessary to utilize the more abundant Spring precipitation. The lighter mid-summer rains may germinate the late planting but not be adequate enough

to penetrate and sustain the important early growth and root penetration. Fresh stripmine sites are usually devoid of weed seed and no weed problem occurs that first season.

Fall plantings have been tried by other projects with varying degrees of success and results, but this author, along with others, recommends against such procedures because of possible Fall germination and frost-heave, loss of seed to rodents and other wildlife over the Winter, and especially because of the early starts the weeds will get over the germinating prairie plants the following Spring (Schulenberg 1970).

2. Mowing. If there is a real weed problem the first season, particularly of broad-leafed forbs such as velvet leaf or lamb's quarter, these should be mowed in late July with a rotary-type mower to prevent heavy shading of the prairie plants and reduce the competitive vigor of the weeds. This should be done when the weeds are two to three feet in height, setting the mower at about twelve inches so as not to mow off the tops of the shorter prairie plants. If the season is particularly wet, a second mowing may be called for, but one usually suffices. A weed growth of annual grasses such as foxtail (Setaria sp.) or witchgrass is usually not too serious and will provide needed fuel for the first burn the following Spring. The prairie plants remaining small the first season do not provide much fuel.

3. Fire. Burning is a third procedure that can be carried out to reduce weeds and increase prairie plant growth. As mentioned above, first year weed cover may provide the necessary fuel, or the prairie grasses themselves may contribute to a burn. Burning is best done in the Spring even in mature prairies so that cover for wildlife is available during the Fall and Winter. The best time to burn in Illinois is from mid-March to the second week in April. In some years an earlier burn may be possible, but burning after mid-April may disrupt nesting birds and cause mortality to reptiles. The important point on burning is that one must be poised and ready to burn at the proper moment as usually there is only one chance for a good burn during this early Spring period.

Fire reduces the vigor of the cool-season weedy forbs and grasses such as bluegrass, if such perennials persist or show up in the site. In the later stages of restoration, fire prevents or reduces the invasion of woody plants into the prairie site. As for true prairie plants, they thrive under a burning regime. Grassland communities have evolved with fire as an omnipresent factor, and prairie seedlings of all kinds, both grasses and forbs, respond remarkably to regular annual Spring burning during the first few years of restoration. In small sites dry straw may be scattered on the planting to achieve fuel for a first year burn. In the ensuing years, the prairie plants themselves provide all the fuel that is needed.

4. Patience. The final approach to weeds in a restoration project is one of wait and have patience regardless of how weedy the project appears the first few years. Never plow up a planting. Even the weediest sites improve with age. It is difficult and sometimes impossible to find the prairie plants amongst the weed growth, but they do show up in time. Some of our weediest plantings on the Field Station have turned out to be quite impressive patches of prairie with new forbs showing up even eight to ten years after the initial planting. These forbs have not necessarily germinated later but, rather, have finally become evident from their size and flowering -- on the other hand, unscarified seed such as the legumes may lie dormant for several years before germinating.

Seed Conditioning, Viability and Germination

The other major variable in prairie restoration, and perhaps the most importnat factor for a successful prairie planting is the viability and rapid germination of grass and forb seed. Two factors influence seed viability. The seed may not maturate properly due to poor conditions during the growing season or during the final ripening time, or, what may happen more frequently, insects may damage the seed prior to or even after harvest. The field conditions for ripening and the insect damage prior to harvest cannot be controlled. Insect damage after harvest can be controlled by brief fumagation with chloroform, paradichlorobenzene, or other suitable fumigants. This is necessary mainly with forb seed and, particularly, with species of Liatris, Ceanothus, Eryngium and Baptisia.

Proper handling and conditioning of the seed after harvest is the most important factor determining a successful planting. Some seeds such as the legumes need no dampening, but may be stored dry until planting time. They must be scarified, however, for prompt germination and inoculated for proper growth. This scarification is best accomplished by placing small amounts of seed on a sheet of fine-to-medium sandpaper or on a concrete floor and very lightly sanding with a sanding block. Other seeds such as the grasses and many of the forbs should be cold-damp conditioned.

Grass Seed Conditioning

Prairie grass seed, at least the Illinois ecotypes, must have cold-damp conditioning for maximum and rapid germination. Seed harvested and left dry even though subjected to cold or freezing temperatures may, in six to eight months (September to May), lose 90% of its viability. In contrast, grass seed harvested in September and immediately stored just above freezing with its own moisture content, or with slight additional dampening, will yield 90% germination the following Spring. The best procedure is to dampen slightly (2 quarts H_2O per 20 lbs. seed) and store immediately at just above freezing temperatures (34°F) in covered plastic containers or bags. Seed should be aerated once every month or so to reduce mold in the closed containers. This is easily done by emptying seed from one container to another or by opening bags briefly and turning contents. Just before planting time, the seed is removed from cold storage, spread out on a dry floor in a 2"-3" layer and dried for a day or so. Use of a large window fan moving air above the seed, plus occasional raking and turning, will hasten drying. Drying is necessary if a drill is to be used for planting and will also facilitate broadcasting the seed by hand or by small mechanical seeder. Drying should not be prolonged or else a deep dormancy may set in.

Forb Seed Conditioning

Most forbs, including the Spring-blooming species

(Zimmerman 1972, Threfall 1972) should be dampened immediately after harvest, stored in plastic bags and placed in cold storage at the same just-above-freezing temperature. No additional material such as vermiculite or sand is necessary. This simplifies the process and the chaff associated with most seeds is sufficient to hold moisture and separate the seed. Like the grass seed the forbs are brought out of cold storage just before they are planted. If they are to be mixed in with the grass seed, it is not necessary to dry the forbs. Just stir them into the dried, fluffy grass seed. We do this right in the drill hoppers after they are loaded with dry grass seed. Dry grass and forb seed may be held for one to two months without too much loss of viability, but the sooner they go into cold-damp storage the better.

PLANTING METHOD

Prairie may be planted in any of a number of ways with reasonably good results. As we have emphasized above, reduced weed competition and prompt seed germination determines the success of a planting far more than the planting methods used. Prairie may be drilled (Schramm 1972, Wilson 1970), hand broadcast (Schramm 1970) or run through small seeders or any mechanical device which will give an even scattering of seed over the planting site. Methods that do not drill the seed into the ground call for raking or harrowing followed by rolling or tamping to set the seed into the ground. If properly raked or harrowed, follow-up rains may be enough to set the seed into the ground surface for proper seedling establishment. The whole process for both grass and forbs is not unlike planting a lawn. Hydroseeding is another method that has been proven successful in prairie establishment (Brakeman 1975), reinforcing the notion that any of a number of planting methods will work. Drilled prairies have an initial row appearance to them but this becomes less noticeable in just a few years. In the smaller projects the hand-planting of seedlings at evenly spaced intervals facilitates hand weeding and hoeing (Schulenberg 1970) and the results of such labor may be spectacular. The layout and planting of spaced seedlings is greatly facilitated by the use of a planting board with evenly spaced bolts protruding at the chosen interval to mark the holes that receive the hand-planted seedlings. In the absence of competition from surrounding weeds or other prairie species the grasses and forbs will put on remarkable growth the first season and may even bloom in the first or second year. Such projects are labors of love. Persistent weeding for up to two years is very much worth the effort but can only be done on a small scale. Hand planting is one of the best ways to establish the very competition-sensitive species such as butterfly weed, (Asclepias tuberosa), prairie dropseed (Sporobolus heterolepis) and Culver's root (Veronicastrum virginicum).

THE INSTALLMENT PLAN IN PRAIRIE RESTORATION

One of the major considerations in planning a prairie restoration project is the timetable involved and the size of the area to be planted in any given year. Some key points need to be mentioned here.

There is no such thing as instant prairie. I have observed too often the rushed project results in failure or at most a very poor stand. It takes time to prepare a site, gather seed, condition it properly, arrange for equipment and plan the details that ensure success. Also, there is nothing like experience to enhance results. Therefore, we recommend the installment plan approach to planting prairie. Plans for a restoration project should start a year in advance of the first planting. The total site should be divided into several years plantings. The reasons for this are manifold: weed seed variability from year to year and site to site; seed viability from year to year; seed availability from year to year (we obtain some species one year and others another year; rarely do we get all the species we want for a particular year's planting), and finally, there is no substitute for experience. The experience gained in the initial plantings increases the probability of the success of later plantings and the overall project. With the installment approach one can try several different methods, and a more interesting and diverse prairie will result.

COMPOSITION, DENSITY AND COMPETITION

There is a definite relationship between competition and the resultant degree of seedling establishment and the composition and density of the species planted. In other words, the prairie plants are competing with themselves as well as the weeds. There are different kinds of restored prairies that can be achieved depending on what is planted with what, and at what seeding rate or density.

We all know there are different kinds of prairies represented in the few remaining remnants that we have as models. Some are very grass-dominated with forbs present but less evident. Others are amazing in their forb diversity and abundance, with the grasses present, but presenting a much lower profile resulting from competition from the numerous forbs. There is still much debate as to which model truly represents the pristine, original prairie. Perhaps the true picture is one of a mosaic of the two types depending on local heavy use by the larger grazing ungulates. Be that as it may, the restorationist must decide what the end product is to be like and plant accordingly.

The Grass Planting

Some projects want a grass-dominated prairie quickly established for a grassland effect for public viewing or erosion control. Such a prairie can be achieved with a denser seeding rate of species such as Big Bluestem (Andropogon gerardi) or Indian Grass (Sorghastrum nutans) or a mix of the two, at from 25 to as high as 50 pounds per acre seeding rate. Some of the more competitive forbs such as the Silphiums, coneflowers, goldenrods, and sunflowers can be planted at the same time and will also establish in spite of the dense grass stand. The result is an impressive grass stand in two to three years, with large, prominent composite forbs blooming a year or so later than the grasses. Such stands can be enriched at a later time, at least with some species of prairie legumes (see forb enrichment). With burning management the grass prairie quickly becomes remarkably free of weeds.

The Forb Planting

Still another approach is that of the forb planting. This involves a very dense planting (as much seed as you can get your hands on, no rate is

too high) of high quality prairie forbs (legumes, less weedy composites, etc.) all planted in a small area. A light sprinkling of grasses may be planted at the same time or scratched in, a year or so later. The result is usually a rather weedy plot for several years. Then the dense forbs come into their own and give the appearance of an impressive and showy stand more like some of our truly quality remnants.

The Compromise or Mixed Planting

The third approach is one of compromise between the above two extremes: eight to twenty pounds of grass seed per acre with forb seed spread over a larger area and seeded directly with the grasses. This compromise is typical of many restoration projects. The installment approach allows for all three methods to be tried.

Reemphasizing a final point - the denser the grass, the less weeds, the quicker visual results, but sometimes the fewer the forbs due to competition with the prairie grasses. Of course the hand planting of spaced seedlings, discussed earlier, allows complete control of composition and density.

FORB ENRICHMENT

Can an established stand of prairie be enriched by more forbs at a later time? Much work still needs to be done in this area, but some preliminary results are emerging. One initial experiment on the Knox Field Station indicated positive results with some legume species.

During late April 1969, after a burn had eliminated all litter and standing dead, a harrow was dragged round and round over the same circular swath in a well established, 14-year old stand dominated by Big Bluestem. Some Indian Grass and Little Bluestem (Andropogon scoparius) were present in spots, as was the weedy composite Solidago altissima. After numerous passes over the circular swath, the surface of the soil between the grass plants showed some pulverizing effect and a kind of very shallow seedbed was established. Beneath the surface was a dense, wirelike network of grass roots. Into this harrowed area a legume seed mixture of Petalostemum purpureum, P. candidum, Baptisia leucantha and Amorpha canescens was densely hand broadcast and rolled in with a large lawn roller. Some of these legumes bloomed three years later, and at the present time, this area presents some well established and persisting legumes, adding great improvement to this stand of prairie. The prairie clovers are particularly evident. Such a procedure would not work with the more competition-sensitive species and would be merely a waste of seed.

Another forb-enrichment process that has been tried with variable success in the Knox project consists of setting out seedlings of various forbs species in planting holes cut into existing prairie grass sod. Various tools such as trowels, narrow spades, and bulb-planting tools have been used. These seedlings experience considerable mortality from deer and rabbits attracted to the disturbed site, or from drought conditions caused by moisture competition with the massive amounts of grass roots the seedlings are surrounded by. For successful establishment this procedure calls for fencing protection and watering the seedlings for several weeks, until establishment is assured.

Much work still needs to be done in the area of forb enrichment.

THE ECOTYPE PROBLEM

There has been much discussion and voiced concern in recent years among prairie people about the use of non-native ecotypes of prairie grasses and forbs. This author was himself involved in a planting of commercial strains of grass species obtained from Nebraska in 1970 (Schramm 1972). The concern about this practice began to emerge at the time of the Second Midwest Prairie Conference at Madison, Wisconsin, and flourished during the third conference at Manhattan, Kansas in 1972 (Schwarzmeier 1973). Since that time there has been a steadily increasing effort on the part of prairie restorationists to obtain local seeds of grasses and forbs, rather than send away for commercially available strains from distant points of origin. Most of these commercial strains of prairie grass originated in the west-central and southern portions of the great plains and were developed at plant materials centers in response to the need of reseeding range land deteriorated by overgrazing and drought years.

There are several important reasons for using locally adapted ecotypes. The meaning of the word restoration implies bringing back what was originally present. In many areas of the Middlewest the local ecotypes of native grasses and prairie forbs are extinct. One of the responsibilities of restoration projects is, where possible, to search out local seed sources and reestablish these small gene pools in the sanctuary of the restoration site. This is what we mean by restoration. The preservation of the diversity of organic evolution and the complete ecosystem is one of the issues involved.

It is well documented in many plant species including a number of prairie species that various ecotypes differ from one another in a variety of ways including adaptive abilities, flowering time, growth responses, and physical characteristics such as height at maturity. It makes common sense that if one is attempting to restore a big bluestem prairie in central Illinois, a shorter ecotype from western Kansas would be rather inappropriate.

It has been suggested by some that "wild-type" strains of grasses are not as vigorous or not vigorous enough to establish good persisting stands, compared to the commercial strains. This is not in accord with the results of numerous restorations including the Knox project where local ecotypes, if handled and planted properly, establish excellent stands.

Finally, there is the problem of the too vigorous commercial ecotype. Blackwell Switchgrass (Panicum virgatum) is the case in point. This variety was used in a drilled planting mixed with other grass species and a variety of forbs (Schramm 1972). In follow-up studies on this planting it was determined that the other grass species and forbs germinated and established for a short period but were totally overwhelmed and out-competed by the Switchgrass early the second year.

All of the above points are ample reason for being purist when it comes to seed sources. Midwest ecotypes are becoming increasingly available now from several Illinois sources.

How far away should one go for seed? As a rule of thumb 200 miles north (or south) and 150 miles east (or west), but one has to use judgment here in relation to transition across areas of significant climatic change. As an example, a central Illinois project could use eastern Iowa seed but should hesitate to use seed from western Iowa.

The most discouraging aspect to the ecotype problem is the continuing practice of large-scale commercial plantings on roadways and industrial sites that must have large amounts of prairie grass seed here and now and end up sending off to the western producers for the commerical varieties.

FIELD OCCURRENCE OF QUALITY FORBS

Most of us have observed at one time or another the occurrence of a quality prairie species in abundance in some gravelly or poor soil area along a country road, a railroad embankment, or on some remote and eroded hillside. The occurrence of butterfly weed (Asclepias tuberosa), prairie dock (Silphium terebinthinaceum), and cream false indigo (Baptisia leucophea) along gravelly roadside banks in the Missouri Ozarks and species of Liatris in poor soil areas along railroad right-of-ways, are examples of this. Such occurrences are best explained by the remarkable ability of prairie plants to send down deep roots to obtain required moisture and nutrients. They get established in the absence of competition from the common Eurasian weeds which simply cannot do well in such a harsh site. This points up the fact that many of our prairie species are admirably suited to establishment in deteriorated sites that need reclamation and plant cover. It also points up the role of competition in the establishment of some of the more "difficult" prairie forbs.

QUALITY PRAIRIE PLANTS

As one visits various prairie remnants and studies the composition of prairie species one begins to get an impression of what constitutes a high grade prairie remnant and what constitutes a degraded one. From the various assemblages of prairie forbs certain species emerge as high quality plants.

How can we determine what species are really high quality? By studying and comparing the least disturbed prairie remnants with the more disturbed prairie sites one can get a comparative basis on which to judge the quality of a particular prairie species. A high quality prairie plant can be defined by the following characteristics:

1. Found in abundance in the least disturbed sites.
2. Found only in low numbers or absent in degraded and disturbed prairies.
3. Is not weedy or aggressive; does not readily invade new sites.
4. Appears to be climax, or, stated another way, is an important self-reproducing component of a mature, well developed and diverse prairie community.
5. May be recognized by the company it keeps; that is; it is found in association with other high quality species.
6. May be difficult to restore, indicating perhaps the need for the special condition of the mature prairie community for establishment.

It is probably evident from the above that the term "quality" is closely associated with the climax, mature and well developed prairie.

Our studies in restoration have not addressed themselves to gathering quantitative data to document just what species are high quality, but we are ready to indicate by the following list, based on our experience and the above mentioned criteria, just what we think are high quality and lower quality species. We are doing this because we have observed and are concerned with a lack of discretion with regards to forbs which are referred to as prairie species or quality prairie species. Not all forbs in a prairie remnant can necessarily be pegged with a high or low quality designation, but certainly some of them can. And certain forbs do not belong in a prairie at all and should not be planted or even considered if we are really talking about prairie restoration.

Another key point to be considered in choice of species is geographical distribution. The restorationist should become familiar with the composition of local remnants and the recorded distributions of the species to be used. For example, two very well known species, pasque flower (Anemone patens) and prairie smoke (Geum triflorum) are highly desirable in restorations in Iowa, Wisconsin and northern Illinois but are completely out of place and do not belong in restorations located in central Illinois. True prairie restoration calls for an informed approach and a great deal of discretion.

PROBLEM SPECIES

Certain species can cause real problems and simply should not be planted in prairie restorations. Helianthus mollis, Downy (Ashy) Sunflower: A number of the species of Helianthus are known to be allelopathic (Rice 1967, Wilson 1970) and H. mollis has turned out to be extremely so. In several restoration sites on the Knox Field Station this species is spreading rapidly, developing sterile clones six to twelve feet in diameter and in the older clones is killing itself out in the center, forming a kind of toxic fairy ring with the center becoming devoid of any plant life. Helianthus grosseserratus, Sawtooth Sunflower: Large, coarse sunflower, very aggressively spreading by rhizomes and also forming sterile clones. Solidago altissima - canadensis complex, Tall Goldenrod: Very weedy composite that will persist in a restored prairie for a number of years even when regularly burned. After fifteen years it will gradually decrease as burning continues and the restored prairie develops. This species should be eliminated from the site by plowing prior to any initial planting.

SPECIES APPROPRIATE FOR MIDWESTERN RESTORATION

The following list does not pretend to be complete with regard to all prairie species that occur in the tall-grass area, but it does include those species that are considered to be important in prairie restoration. It is presented as an effort at making qualitative distinctions between the more frequently encountered species. In addition, competitive ability, ease of restoration, seed conditioning, habitat with regard to moisture, flowering time, and showiness are also indicated. Restoration notes are offered as a general guide. For additional details on propagation see Rock (1974).

The grasses are discussed separately in a little greater detail with regard to the above points.

Prairie grasses

Andropogon gerardi, Big Bluestem: This is the high quality, showy dominant grass of the upland mesic, medium moist prairie. Competitive, but not aggressively so, it is easy to restore, with cold-damp treatment soon after harvest. Blooms mid to late summer, ripens by September.

Sorghastrum nutans, Indian Grass: The other important and showy co-dominant of the upland mesic prairie but grades into slightly dryer sites including lower portions of hill prairies. Easy to restore with all methods. Handle the same as Big Bluestem. Same flowering and ripening time.

Andropogon scoparius, Little Bluestem: A lower profile, very showy (maroon in Fall) bunch-grass dominant of hill prairies and the dominant grass of midwestern sand prairies. Restores easily and does well in any kind of restoration sites. Handle same as the above.

Sporobolus heterolepis, Prairie Dropseed: A super-high quality prairie grass of great beauty, bunch-grass in character, highly desirable in any prairie planting but very difficult to restore in the mixed, drilled or broadcast planting. Best established by setting out seedlings. Seasonal aspect like the above. This species ranges from medium moist to dryer swells of mesic uplands. Apparently very competition-sensitive at the germination to tiny seedling stage, but will persist forever once established. Moderate height.

The above mentioned species I consider the Big 4 of midwestern prairie restoration.

Panicum virgatum, Prairie Switch Grass: a handsome species of mid-height, but a little of this species goes a long way; tends to grow in pure, forbless stands. It was definitely part of the original mesic to lowland prairies occurring naturally in the swales and edges of Spartina bottomland prairie. However, will grow almost anywhere it is planted, is very competitive and will persist. Go easy! (Recall the discussion of the commercial strain, Blackwell Switch Grass.)

Spartina pectinata, Prairie Cord Grass: The tall profile, dominant grass of the bottomland prairie and wet swales of the upland mesic. Tends to grow in pure, forbless stands. In the proper sites will spread aggressively by rhizomes. Restoration by seed unpredictable but easy from plugs of sod. Of limited use in restoration because of its competitive nature and rhizomaceous spreading.

Bouteloua curtipendula, Side Oats Grama: A hill prairie species found occasionally in sandy loam but not important in the true sand prairie. More of a cool season species, this low profile grass lends interest to a dry prairie planting and is easily restored in a variety of sites.

Stipa spartea, Porcupine Grass: Occurs naturally on dryer swells of the mesic prairie, and, like the above, adds interest to the diverse prairie planting. Different in that it matures and ripens in early summer.

Less important species of grasses that have high fidelity with regard to their occurrence in prairies, and which should be included in the planting of the purist in the Illinois area include: Panicum leibergii, Prairie Panic Grass: A high quality species of mesic to dryer sites; low in profile but adds interest to the more complete restoration planting. Panicum oligosanthes schribnerianum, Schribner's Panic Grass: Another panic grass species found in sand prairies and occasionally in black-soil mesic prairie. Koeleria cristata, June Grass: A sand prairie associate of Andropogon scoparius, of medium quality and medium profile.

The short-grass species that occur commonly further west, are not included here for the midwest restoration but are quite appropriate in the great plains regions of lower rainfall.

Prairie Forbs	Quality	Competitive Ability	Ease of Conditioning	Seed Conditioning	Habitat	Flowering	Showiness
**Allium cernuum Nodding Wild Onion	High	Moderate	Medium	Cold-damp	Mesic	Mid to Late Summer	Low-attractive
**Amorpha canescens Lead Plant	Very high!	Moderate	Forb planting or by seedlings	Scarify	Mesic to Dry	Mid-Summer	Very Showy
Anemone cylindrica Prairie Anemone	Very high!	Moderate	Forb planting or by seedlings	Cold-damp	Mesic to Dry	Early Summer	Moderate
Anemone patens Pasque Flower	High	Moderate	Forb planting or by seedlings	Brief cold-damp	Dry	Late Spring	Low Showy
Asclepias hirtella Tall Green Milkweed	High	Low	Set out seedlings	Short cold-damp	Mesic to Moist	Summer	Subtle-taller
Asclepias sullivantii Sullivant's Milkweed	High	Low	Set out seedlings	Short cold-damp	Moist	Summer	Subtle-taller
***Asclepias tuberosa Butterfly Weed	High!	Low	Set out seedlings	Short cold-damp	Mesic to Dry	Summer	Very showy
Asclepias viridiflora Short Green Milkweed	Very high!	Low	Set out seedlings	Short cold-damp	Mesic to Dry	Summer	Subtle-shorter
**Aster azureus Sky-blue Aster	High	Moderate	Forb planting or by seedlings	Cold-damp	Mesic to Dry	Fall	Showy
*Aster ericoides Many Flowered or Heath Aster	Medium	Good	Easy	Cold-damp	Mesic to Dry	Fall	Moderate
**Aster laevis Smooth Blue ASter	High	Moderate	Forb planting or by seedlings	Cold-damp	Mesic to Dry	Fall	Showy
*Aster novae-angliae New England Aster	Low	Very good	Easy	Cold-damp	Mesic to Moist	Early Fall	Showy
Aster sericeus Silky Aster	High	Moderate	Forb planting or by seedlings	Cold-damp	Dry; Hill and Sand Prairies	Fall	Medium
*Baptisia leucantha White False Indigo	Medium	Good	Medium	Scarify	Mesic	Early Summer	Showy
Baptisia leucophaea Cream False Indigo	Very high!	Moderate	Forb planting or by seedlings	Scarify	Mesic to Dry	Late Spring	Showy
Callirhoe triangulata Clustered Poppy Mallow	High	Moderate	Forb planting or by seedlings	Cold-damp	Dry, Sand Prairie	Summer	Very showy
**Camassia scilloides Wild Hyacinth	High	Moderate	Forb planting or by seedlings	Cold-damp	Mesic to Moist	Late Spring	Low showy
Castilleja coccinea Indian Paintbrush	High!	Parasitic Sow seed densely in established prairie	Difficult	Plant immediately	Mesic to Dry	Late Spring	Very showy

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Prairie Forbs	Quality	Competitive Ability	Ease of Restoration	Seed Conditioning	Habitat	Flowering	Showiness
Ceanothus americanus New Jersey Tea	High!	Moderate	Best by seedlings	Boiling H_2O-2 min.	Mesic	Early Summer	Showy
***Cirsium hillii Hill's Thistle Problematical species; occurred perhaps in grazed prairies originally	High	Low	By seedlings short-lived; needs to re-seed inself	Cold-damp?	Mesic to Dry	Early Summer	Showy
Comandra richardsiana False Toadflax	Medium	Parasitic	By seedlings with other species	Cold-damp?	Mesic to Dry	Early Summer	Inconspicuous
**Coreopsis palmata Prairie Coreopsis	High	Good (May be allelopathic as clones develop)	Medium	Cold-damp	Mesic to Dry	Early Summer	Showy
*Coreopsis tripteris Tall Coreopsis	Low	Good	Easy	Cold-damp	Mesic	Summer	Tall but not showy
Delphinium virescens Prairie Larkspur (Note; Does not belong in Illinois prairies)	Medium	Moderate	Forb planting	Cold-damp	Mesic to Dry	Early Summer	Attractive
Desmodium canadense Showy Tick Trefoil	Medium	Aggressive (Do not plant too much)	Easy	Scarify	Mesic	Summer	Very showy
Desmodium illinoense Illinois Tick Trefoil	Medium	Good	Easy	Scarify	Mesic	Summer	Not showy
**Dodecatheon meadia Shooting Star	High	Moderate	Mixed, Forb planting or seedlings	Short, Cold-damp	Mesic to Dry	Spring	Very showy
*Echinacea pallida Pale Purple Coneflower	High	Excellent	Easy	Cold-damp	Mesic to Dry	Early Summer	Very showy
*Eryngium yuccifolium Rattlesnake Master	Medium	Excellent	Easy	Cold-damp	Mesic	Summer	Showy-unusual
Euphorbia corollata Flowering Spurge	Moderate	Good	Mixed or Forb planting	Cold-damp	Mesic	Summer	Moderate
Filipendula rubra Queen-of-the-Prairie	Very high	Moderate	Seedlings Cuttings (will grow in the garden prairie)	Cold-damp?	Specialized; Low, Wet, Calcareous	Summer	Tall; Very showy
**Gentiana andrewsii Bottle Gentian	High	Moderate	Forb or seedlings	Cold-damp	Moist	Fall	Showy
Gentiana flavida Yellow Gentian	High	Good	Easy in forb planting	Cold-damp	Mesic	Early Fall	Attractive

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Prairie Forbs	Quality	Competitive Ability	Ease of Restoration	Seed Conditioning	Habitat	Flowering	Showiness
***Gentiana puberula Prairie Gentian	Very high!	Very low	Very difficult; Seedlings in established prairie	Cold-damp	Mesic	Fall	Low; Very showy
Geum triflorum Prairie Smoke	High	Moderate	Forb or seedlings	Cold-damp Plant soon	Mesic to Dry	Late Spring	Showy
***Habenaria leucophaea Prairie White Fringed Orchid	High	Low	Specialized; Difficult	Cold-damp?	Moist-Wet (Acid)	Mid-Summer	Low; Showy
*Helianthus rigidus Stiff Sunflower	Low	Aggressive (do not plant much)	Easy	Cold-damp	Mesic to Dry	Late Summer	Showy
*Helianthus occidentalis Western Sunflower	Medium	Aggressive	Easy	Cold-damp	Dry; Hill and Sand Prairie	Late Summer	Moderate
*Heliopsis helianthoides False Sunflower	Low	Good	Easy	Cold-damp	Mesic	Summer	Showy
*Heuchera richardsonii Alum Root	High	Medium	Mixed, Forb or seedlings	Cold-damp	Mesic	Late Spring	Subtle
***Hypoxis hirsuta Yellow Star Grass	Very high	Moderate	Forb or seedlings	Cold-damp	Mesic to Dry	Late Spring	Low-showy
***Krigia biflora False Dandelion	Very high	Low	Seedlings	Cold-damp	Mesic	Late Spring	Low-attractive
*Lespedeza capitata Round-headed Bush Clover	Low	Very good	Easy	Scarify	Mesic to Dry including Sand	Summer	Not showy, but adds interest
**Liatris aspera Rough or Button Blazing Star	Medium	Moderate	Mixed, but best in Forb planting	Cold-damp	Dry-Mesic, Hill and Sand	Late-Summer	Showy
**Liatris cylindracea Cylindrical Blazing Star	High	Moderate	Mixed, but best in Forb planting	Cold-damp	Hill Prairies, occasionally sand	Late-Summer	Showy
**Laitris pycnostachya Prairie Blazing Star	High	Moderate	Mixed, but best in Forb planting	Cold-damp	Mesic, Rich Soil	Mid-Summer	Very showy
***Lilium michiganene Turk's Cap Lily	High	Low	Seedlings, Special Handling	?	Moist Edge of Mesic Prairie	Mid-Summer	Very showy
***Lilium philadelphicum Prairie Lily (true prairie species)	Very high!	Low	Seedlings, Special Handling	?	Mesic Prairie	Mid-Summer	Very showy
***Lithospermum canescens Hoary Puccoon	Very high!	Low	Difficult: Needs Special Handling	Cold-damp Plant soon ?	Mesic	Spring	Very showy

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***Lithospermum croceum Sand Puccoon	High	Low	Difficult; Needs Special Handling	Cold-damp Plant soon ?	Sand Prairies	Spring	Very showy
***Lithospermum incisum Fringed Puccoon	High	Low	Difficult; Needs Special Handling	Cold-damp and occasionally sand	Hill Prairies	Spring	Very showy
**Lobelia spicata Pale Spiked Lobelia	Medium	Moderate	Forb planting or seedlings	Cold-damp	Mesic to Dry	Late Spring Early Summer	Low profile, subtle
Oxalis violacea Violet Prairie Sorrel	Medium	Low	Bulbs and Runners; Seeds ?	Cold-damp ?	Mesic	Early Summer	Low-attractive
**Parthenium integrifolium Wild Quinine	High	Good	Mixed and Forb	Cold-damp	Mesic	Summer	Prominent, showy
Pedicularis canadensis Parasitic Wood Betony	Very high	Low	Parasitic; Easy from seed; plant with other species	Short cold-damp	Mesic	Late Spring Early Summer	Unusual, low-showy
**Petalostemum candidum White Prairie Clover	Very high	Medium	Mixed and Forb planting	Scarify	Mesic to Dry	Mid-Summer	Very showy
**Petalostemum purpureum Purple Prairie Clover	Very high	Medium	Mixed and Forb planting	Scarify	Mesic to Dry; Hill Prairies	Mid-Summer	Very showy
**Phlox pilosa Prairie Phlox	Very high!	Moderate	Forb planting and seedlings	Short Cold-damp	Mesic to Dry	Late Spring	Very showy
**Physostegia virginiana False Dragonhead	Very high	Moderate	Forb planting	Cold-damp	Mesic	Late Summer	Very showy
Polygala senega Seneca Snakeroot	High	Low	Forb planting or seedlings	Cold-damp	Mesic to Dry, Gravelly Prairies	Summer	Not showy
**Potentilla arguta Prairie Cinquefoil	High	Moderate	Forb planting	Cold-damp	Mesic to Dry	Mid-Summer	Tall; Interesting not showy
**Prenanthes aspera Rough White Lettuce	High	Medium	Mixed or Forb planting	Cold-damp	Mesic to Dry	Late Summer	Tall, not showy
**Prenanthes racemosa Smooth White Lettuce	Medium	Medium	Mixed or Forb planting	Cold-damp	Moist to Wet	Late Summer	Moderate
***Psoralea tenuiflora Scurfy Pea	High	Low	Forb or seedlings; difficult	Scarify	Dry Hill Prairies	Early Summer	Delicate-showy
**Pycnanthemum virginianum Mountain Mint	Medium	Medium	Mixed or Forb planting	Cold-damp	Mesic	Mid-Summer	Showy
*Ratibida pinnata Yellow Coneflower	Low	Aggressive! (Do not plant too much!)	Easy	Cold-damp	Mesic	Mid-Summer	Showy

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Prairie Forbs	Quality	Competitive Ability	Ease of Restoration	Seed Conditioning	Habitat	Flowering	Showiness
Rosa carolina Prairie Rose	Low	Medium	Mixed planting	Cold-damp	Mesic	Early Summer	Low-showy
**Rudbeckia hirta* Black-eyed Susan	Low	Aggressive Go easy!	Easy	Cold-damp	Mesic to Dry	Summer	Showy
**Rudbeckia subtomentosa* Sweet Black-eyed Susan	Medium	Aggressive	Easy	Cold-damp	Mesic	Summer	Showy
Ruellia humilis Hairy ruellia	Low	Moderate	Mixed or Forb planting	Cold-damp	Dry and Hill Prairies	Summer	Moderate
Salix humilis Prairie Willow	Medium	Moderate	?	?	Mesic to Moist	Spring	Not showy
**Silphium integrifolium* Rosinweed	Low	Good	Easy	Cold-damp	Mesic	Mid-Summer	Moderately
**Silphium laciniatum* Compass Plant	High	Excellent	Easy	Cold-damp	Mesic	Mid-Summer	Showy
**Silphium perfoliatum* Cup Plant	Low	Good	Easy	Cold-damp	Low Moist	Mid-Summer	Moderately showy
**Silphium terebinthinaceum* Prairie Dock	High	Excellent	Easy	Cold-damp	Mesic to Dry	Mid-Summer	Showy
***Sisyrinchium albidum* Blue-eyed Grass	High	Moderate	Forb or seedlings	Short Cold-damp	Mesic to Dry	Late Spring	Low-attractive
***Solidago riddellii* Riddell's Goldenrod	High	Medium	Mixed and Forb	Cold-damp	Moist-Wet	Late Summer	Showy
**Solidago rigida* Stiff Goldenrod	Medium	Good	Easy	Cold-damp	Mesic to Dry	Late Summer	Showy
**Solidago speciosa* Showy Goldenrod	Medium	Good	Easy	Cold-damp	Mesic to Dry	Late Summer	Very showy
Spiranthes cernua Nodding Ladies Tresses	High	Low	Special Handling	Cold-damp?	Occasionally Moist to Wet Prairies	Late Summer	Low-showy
**Thalictrum dasycarpum* Meadow Rue	Medium	Good	Mixed planting	Cold-damp	Mesic to Moist	Mid-Summer	Tall, moderately showy
***Tradescantia ohiensis* Spiderwort	Low	Good	Mixed or Forb	Cold-damp	Mesic to Dry	Early Summer	Showy
***Veronicastrum virginicum* Culver's Root	High	Low	Forb planting or seedlings	Cold-damp	Mesic	Mid-Summer	Very showy
***Viola pedata* Birdsfoot Violet	Medium	Low	Forbs or seedlings	Short Cold-damp	Dry to Sandy	Late Spring	Low-showy

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***Viola pedatifida Prairie Violet	Very high!	Low	Seedlings	Short cold-damp	Mesic	Late Spring	Low-showy
Zizia aptera Heart-leaved Meadow Parsnip	Very high!	Low	Forb planting or seedlings	Cold-damp	Mesic	Late Spring	Moderate
**Zizia aurea Golden Alexanders	Medium	Good	Mixed planting	Cold-damp	Moist-Wet	Late Spring	Attractive

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