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PRAIRIE RESTORATION ON AN EAST-CENTRAL ILLINOIS FIELD

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ABSTRACT: A prairie restoration project was initiated in 1974 on mesic soil pasture land. Restoration of adjacent plots within the field continued annually; the final plot was seeded in 1990. Geological, climatological, and settlement histories are described briefly. Methods of soil preparation, seed treatment, nursery propagation, weed control, and the use of fire are discussed. The floristic composition and observations of successional changes are recorded. An inventory yielded 189 species of native and alien vascular plants. Voucher specimens were collected and placed in a herbarium.

INTRODUCTION

This is a report concerning a continuing prairie restoration project on a former pasture in northern Ford County. In the natural divisions of Illinois, it lies within the Grand Prairie Section of the Grand Prairie Division (Schwegman et al. 1973). It is located on the southeast side of the village of Kempton (in part of SW NW NE and SE NE NW S6) in Mona Township. The field shape is roughly trapezoidal, containing over seven acres. The long axis is east-west and is about 1000 feet. Width averages about 325 feet. Intense grazing for many years contributed to the extirpation of many native prairie species. The goal of the project has been to increase populations of remaining desirable native species and to introduce other native species that continue to survive on prairie remnants in central Illinois.

The project began in 1974. The years following provided time for comparisons of restoration methods and observations of species population changes. Although this represents more than twenty growing seasons, it is only a moment in the time span necessary for successional development of climax prairie. This report describes the brief and generally satisfying progress in what is anticipated to be a much longer-term project.

A survey of species established on the restoration was conducted, and voucher specimens were placed on file in the Illinois Natural History Survey herbarium (ILLS) at Champaign. All collections were made from 1991 to 1994.

GLACIATION AND TOPOGRAPHY

Bedrock under this area is the Carbondale formation of the Pennsylvanian system. It consists of thick shaly mudstones interbedded with thin coals, limestones, and sandstones. Above this bedrock are more than 200 feet of glacial till, a generally unstratified mixture of silt, clay, and sand, with inclusions ranging from pebbles to large boulders. It accounts for the principal features of the present topography of the region (Piskin and Bergstrom 1975). The project site lies near the south margin of the Ransom moraine. It has about 80 feet of elevation above a glacial lacustrine region to the southeast.

Rapid plant invasion followed the recession of the most recent glaciation, the Woodfordian phase of the Wisconsinan. Tundra vegetation with scattered spruce and fir forests was followed by a transition to deciduous tree species about 12,000 B.P. Beginning about 6500 B.P., grassland intruded from the west in response to a period of warm, dry climate (Geis and Boggess 1968; King 1981).

The variation of elevation within the restoration field reflects the gently rolling topography. From about 730 feet above sea level at the southwest corner, there is a gradual slope downward to a shallow watercourse passing diagonally through the central part of the field. Water is present in the ditch only during seasonal runoff. There is a difference of about 15 feet from the highest location to where the ditch exits the field (U.S.G.S. 1986).

The watershed draining through the restoration includes a major part of the village of Kempton and fields extending about one-half mile north of the village. Water flow is to the southeast where, in about three miles, it enters what was locally known as the Vermilion Swamp, a wetland that was drained early in the twentieth century. Water then enters the North Fork of the Vermilion River, which flows west and north, eventually entering the Illinois River near LaSalle.

SOILS

Soil types in the restoration are Swygert 91B2, particularly on the higher parts of the field, and Bryce 235 (fig. 1). Both are poorly drained fine-textured silty clay loam soils formed in loess, local outwash, and underlying glacial till. The surface layer is black to dark gray, friable, firm, and about 12 inches thick. Both soils are classified in hydrologic soil groups that have slow infiltration rates when wet, which causes potentially high runoff. These soils are used for cultivated crops, primarily corn and soybeans in the local area. Problems they present for cultivation are ponding in low areas and water erosion on slopes. Contributing to these effects is slow permeability and moderate available water capacity (Fehrenbacher 1990). The compact surface layer and low permeability of these soils cause severe and persistent clodding if cultivated when too wet. Thus, during springs of above average rainfall, timing of cultivation is critical.

A buried drainage tile passes through the restoration, causing localized alterations in soil hydrology. An 18-inch diameter drainage tile from the village enters the restoration site from the north and parallels the ditch to its exit from the restoration. This tile is nonperforated plastic and thus hydrologic modification of the soil is reduced. A 10-inch diameter perforated plastic tile connects to the larger tile after entering the site from the west. A 5-inch diameter clay tile line crosses the site from the southwest and connects to the 10-inch line (fig. 2).

CLIMATIC FACTORS

Marked year-to-year variations in climatic conditions significantly affect the accuracy of any characterization of a typical weather year over the short duration of the study, and the following statistics can be misleading for any brief period of years.

Ford County has a continental climate with cold winters and hot, humid summers. Precipitation is generally adequate. Data recorded in the period 1951–80 at Kankakee established that total annual precipitation averaged about 35 inches. Approximately 65 percent of this fell from April through September. Snowfall averaged 24.8 inches annually. Snow cover can be a protective factor on a restoration, especially for young plants. It provides insulation from the often intense subzero Fahrenheit temperatures and prevents the displacement of recently established plants that results from intermittent freezing and thawing of exposed soil. The number of winter days with a covering of snow varies greatly from year to year (Fehrenbacher 1990).

Established prairie forbs are well adapted to short-term moisture variations and use several protective mechanisms. During stressfully dry growing seasons leaf curling is apparent, growth is curtailed, and anthesis may not occur. During the drought years of 1988 and 1991 the tall warm-season native grasses grew to only about one-third of their usual height, and viable seed was not produced. Rainfall of 11.6 inches in July 1992 established a monthly high record;

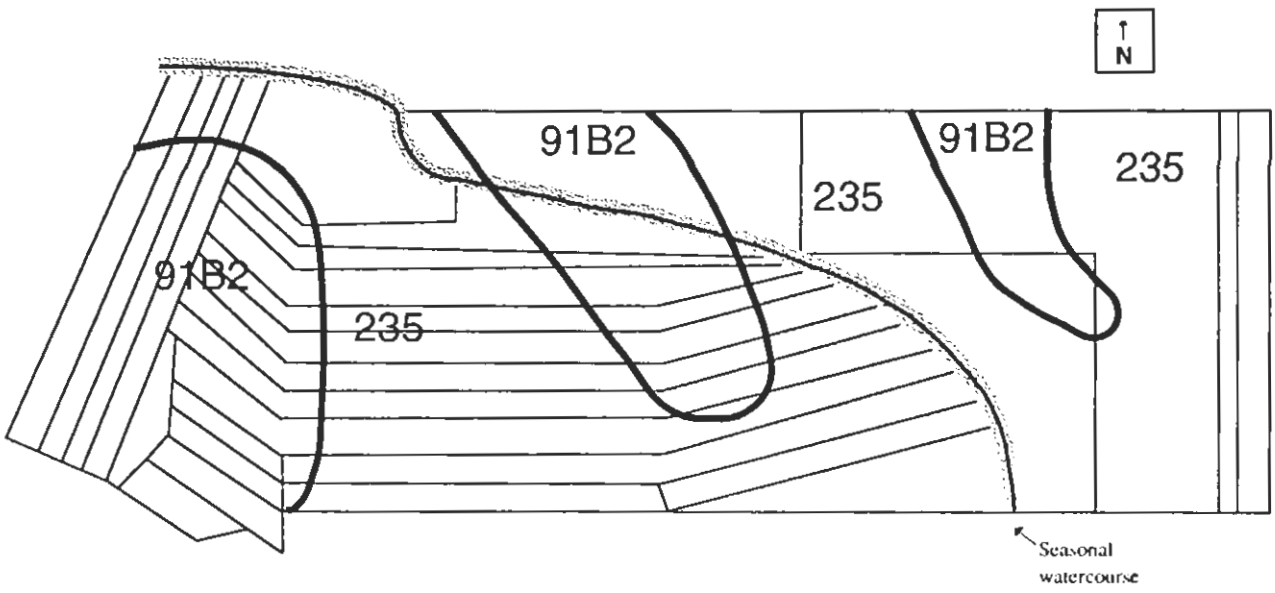

FIG. 1. Restoration site with designations of soil types, Swygert 91B2 and Bryce 235.

however, this was preceded by drought conditions during the spring, with 2.7 inches of precipitation from early April until 2 July. In spite of the wet summer, seed production by the tall native grasses was reduced. This suggests that anthesis is determined early, probably in June. In 1981, a year in which there was above average rainfall (39.7 inches from April through September), some plants of *Andropogon gerardii* (big bluestem) exceeded ten feet in height.

The growing season extends from about mid April until mid October. Two years in ten, killing frost (28°F or lower) occurs later than 20 April or earlier than 18 October (Fehrenbacher 1990). Early or late frost rarely was cause for problems on the restoration. Soon after freezing in the fall, seed falls readily from some grasses; prompt seed harvest is required. The remarkably prolonged resilience of the culms of these grasses was noted. Occasionally ice storms prostrated entire stands of previous season growth of the tall grasses, but following the melting of the ice, the culms rapidly regained their erect stature.

Settlement History

The first written records found for the immediate area in which the restoration is located are dated 27 April 1834. It was then that the United States public lands survey was conducted. The survey indicates that all of what is now Mona Township was prairie, with the marshland in the southeast portion described as the "Vermilion Swamp" (Illinois presettlement atlas 1840). Field notes (Ewing 1834) for the survey of Section 6, in which the restoration is located, describe it as "rich first rate prairie." The survey record notes that prairie covered all of Sullivan Township, adjacent on the west. Mona Township was organized in 1870, with a population of 342; major settlement had occurred from 1867 to 1870. Population growth was encouraged by construction of the Bloomington-Kankakee branch line of the Illinois Central Railroad, and the village of Kempton was developed on this newly established line in 1878.

Wright Kemp, who was instrumental in forming the village and owned land including the present prairie restoration, came from Morris in Grundy County to "Grand Prairie, Ford Co." in 1866. He described that journey, by way of Dwight, as traveling "across the unbroken prairie." The 1884 *Historical Atlas of Ford County, Illinois*, in which these comments appear, also describes northern Mona Township as "a fine body of undulating prairie land."

The two subsequent owners of the restoration site used the pasture land to graze dairy cattle throughout the early and mid portions of the twentieth century. Grazing ceased in 1965, and the pasture remained an old field with annual mowing until the start of the restoration work in 1974.

In past years, during conversations with the author, older residents of the community stated that the restoration had been permanent pastureland from at least 1900. It was their opinion that the field had never been tilled, but this could not be documented.

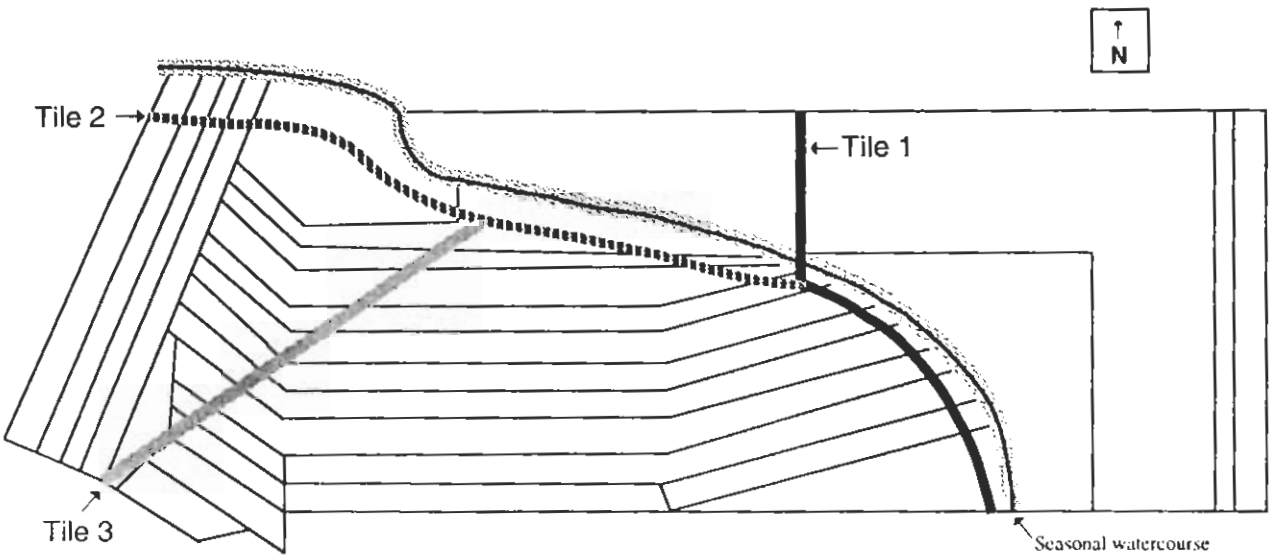

FIG. 2. Drainage tile locations. Tile 1, nonperforated plastic, 18-inch diameter. Tile 2, perforated plastic, 10-inch diameter. Tile 3, clay, 5-inch diameter.

METHODS

Plots

From 1974 through 1990, 28 plots were established in the approximately 7.3-acre restoration field (fig. 3). Plot size varied from about 0.044 acre to 1.375 acre (table 1) and was determined by the amount of hand-collected seed available each year. In some years two plots were delineated to test different soil preparation methods and different seed mixes, or to expand restoration into another part of the field. Generally the restoration started at the south side of the field and progressed northward in parallel plots. Most of the longer plots were curved in the hope of minimizing erosion of exposed soil on the slope and reducing the generally artificial appearance that is inevitable in the early years when adjacent restorations or reconstructions are being established. Pathway strips between most plots provided undisturbed areas for existing native species.

Plots were permanently marked using 1-inch diameter reinforcing bars cut to 24-inch lengths. A 1-inch brass tag with the plot number was bolted near the top end of each rebar. The rebar with the appropriate number was driven into the ground at the southwest corner of each plot (fig. 3). The tops of the steel markers were driven to ground level. Individual plots can be located using the prepared map and, if necessary, a metal detector.

Plot 19 remains as a control; there was no disturbance or direct seeding of this plot. Some native species from other plots are appearing there because of natural dispersal. Plot 20 is the part of the field containing the shallow ditch, and it remains largely undisturbed as well, although several wet-mesic species have been introduced. Nomenclature follows Mohlenbrock (1986).

Soil Preparation

Before restoration work started, the principal grasses in the field were *Poa pratensis* (Kentucky bluegrass), *Bromus inermis* (Hungarian brome), *Phleum pratense* (timothy), and *Agropyron repens* (quack grass). Frequent adventive forbs were *Daucus carota* (wild carrot), *Leucanthemum vulgare* (ox-eye daisy), *Asclepias syriaca* (common milkweed), *Aster pilosus* (hairy aster), *Achillea millefolium* (yarrow), and *Cirsium arvense* (Canada thistle). Surviving native species were often found in scattered, low-density populations.

Several preparation techniques were used, ranging from no soil disturbance to moldboard plowing. In the fall of 1973, Plot 1 (about 24 × 90 feet) was prepared by hand spading 48 3-foot square quadrats. Existing sod strips between the tilled quadrats were not disturbed. The following spring these quadrats were hand tilled several times and seeded on 20 June. The results were not satisfactory. Although germination was fair, the surrounding alien grasses, especially *Agropyron repens* and *Bromus inermis*, rapidly encroached. The introduced native species, including *Andropogon gerardii*, *Monarda fistulosa* (bergamot), and *Silphium*

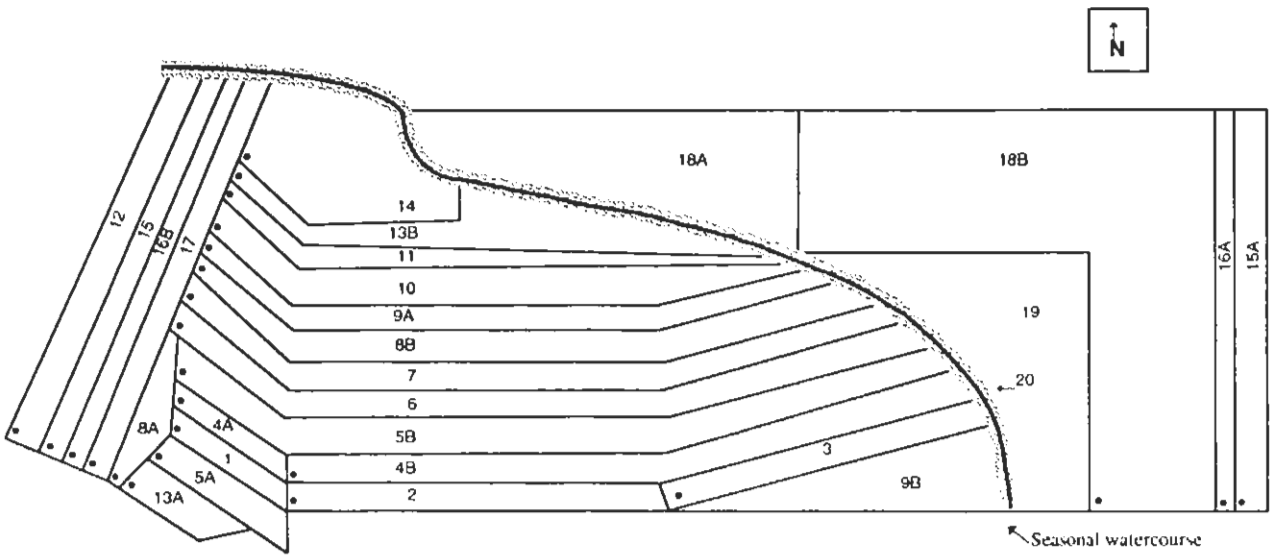

FIG. 3. Map of restoration area with individually numbered plots. • = Locations of buried steel identification markers.

terebinthinaceum (prairie dock), have gradually increased. However, even now, Plot 1 continues to have significant populations of alien species.

This method of soil preparation was not repeated, and for several years a moldboard plow was used. In the fall, the next plot would be plowed to a depth of seven to ten inches. During the following spring the plot was tilled several times with a disk and a spring-toothed harrow. Thus a fine particulate seedbed was prepared and the existing vegetation removed. Seeding was followed by light harrowing. A roller was then used to create a firm seedbed. Seeding dates ranged from 18 May to 20 June. In thirteen of the seventeen years in which new plots were established the planting date fell within the last ten days of May or the first ten days of June. In spite of repeated tillage and late planting, competition from annual weeds was invariably severe. Typical weed growth the first year included *Amaranthus hybridus* (green amaranth), *Chenopodium album* (lamb's quarters), *Erigeron annuus* (annual fleabane), and *Panicum capillare* (witch grass). One method of attempting to reduce competition was to leave a plot fallow for an extra growing season. It was fall plowed and then disked several times the following year. The second spring following plowing it was disked, harrowed, and seeded. This procedure was followed on two plots, 7 and 14. Weed competition continued to be intense. Although each tillage operation destroyed growing weeds, it also created conditions that encouraged germination of additional existing seed. Leaving the soil without a cover for an additional year increased the already existing risk of erosion associated with moldboard plowing. That is what occurred, especially on the 1980 Plot 7 where movement of soil was significant. With weed competition seemingly not diminished and erosion increased, this method of leaving a plot fallow was rejected.

TABLE 1. Planting years and individual plot sizes.

Plot #	Year	Area (sq. ft.)	Area (acres)
1	1974	1,925	0.044
2	1975	8,026	0.184
3	1976	6,256	0.144
4A	1977	2,230	0.051
4B	1977	12,166	0.279
5A	1978	3,384	0.078
5B	1978	18,222	0.418
6	1979	13,164	0.302
7	1980	12,520	0.287
8A	1981	3,524	0.081
8B	1981	13,678	0.314
9A	1981	10,194	0.234
9B	1981	1,243	0.258
10	1982	11,660	0.268
11	1983	7,266	0.167
12	1984	7,366	0.169
13A	1985	2,486	0.057
13B	1985	8,784	0.202
14	1986	2,729	0.292
15A	1987	9,415	0.216
15B	1987	6,311	0.145
16A	1988	4,519	0.104
16B	1988	6,095	0.140
17	1989	6,748	0.155
18A	1990	20,548	0.472
18B	1990	59,904	1.375
19	control	20,301	0.466
20	control	17,672	0.406
Total		318,338	7.308

Use of the moldboard plow was discontinued after 1982. Fall tillage on Plot 12 was with a Soil Saver farm implement, which is a combination of disk blades and chisel plow. This thoroughly agitates the soil but does not invert a layer as with the moldboard plow. The additional plant material remaining on the surface over the winter reduced soil erosion. Before spring seeding began, the plot was disked and harrowed. Weed competition was similar to previous years, but reduced erosion and other satisfactory results encouraged continued use of this procedure.

In 1986 another system was tried. There was no fall tillage and in May a 2% solution of the glyphosate herbicide Roundup was sprayed on the plot. Use of a hand sprayer permitted directing the spray to avoid any existing native species. Approximately two weeks later this procedure was repeated to destroy vegetation previously missed. Immediately before and after hand seeding, the plot was lightly harrowed and then rolled. This method delayed and seemed to reduce weed competition, and erosion was virtually eliminated. Germination and growth of native species occurred, with results similar to those achieved with other procedures. Although this method required application of a herbicide, it proved useful for establishing prairie.

Seed

Seed was used for plant propagation, with a few recorded exceptions. Collection sites were all Illinois locations within approximately 120 miles of the restoration field. Seed was sown on the restoration site by hand broadcasting.

Freshly collected seed was dried indoors by spreading it in a shallow layer that was regularly turned. No artificial heat or forced air drying was used. Storage of the dried seed was in a cool, dry basement. Seed of species for which there were small collections was frequently stored in refrigerators. Also, damp stratification was occasionally used, but insufficient refrigerated storage made this procedure impractical on any large scale.

Seed from spring-flowering taxa was often planted in late summer. After drying, the seed of species such as *Dodecatheon meadia* (shooting star), *Pedicularis canadensis* (wood betony), *Phlox pilosa* (prairie phlox), and *Sisyrinchium albidum* (common blue-eyed grass) was planted in established restoration plots. Small open areas were selected, and the soil was agitated with a pronged hand cultivator. Seed was scattered on the surface, the soil was agitated again, and then compressed. It was felt that this method was more conserving of seed than broadcast application when establishing a new plot in which heavy weed competition was assured. However, spring seeding on new sites with *D. meadia* proved successful on Plots 2, 3, 4A, and 5B. The same was true for *Pedicularis canadensis* on Plot 12.

For about the first ten years of the project, legume seeds of the genera *Amorpha*, *Baptisia*, and *Dalea* were treated immediately before planting with an appropriate *Rhizobium* inoculant from Nitragin Corp. Before inoculation, *Amorpha canescens* (lead plant), *Baptisia lactea* (white wild indigo), and *Baptisia leucophaea* (cream wild indigo) were scarified using a vibrating bench sander.

Dalea candida (white prairie clover), *Dalea purpurea* (purple prairie clover), and *Baptisia lactea* germinated well, usually appearing the first or second year after planting. *Amorpha canescens* often, though not always, required several years to appear. In Plot 12, established in 1984, *A. canescens* emerged the first year; seedlings also appeared in 1990.

In recent years scarification was continued, but legume seed was no longer treated with inoculant. The appearance of increasing numbers of native legumes may suggest that the required strains of *Rhizobium* are established in the soil. Other legumes such as *Astragalus canadensis* (Canadian milk vetch) and *Lespedeza capitata* (round-headed bush clover) were planted without inoculation or scarification. They have become established in several locations within the restoration.

Nursery

Cultivated nursery plots were in continuous use for the duration of the restoration project. They provided a source of additional seed and transplants for species for which small amounts of seed were collected or for species that proved difficult or slow to establish by direct seeding in the field. Short nursery rows were seeded, and resulting plants were increased primarily by division.

A typical example is *Dodecatheon meadia*. Although seed germination was often satisfactory, this plant required four or more years to reach anthesis in the restoration field. Plot 3 first produced flowering individuals in 1984, eight years after seeding. A nursery row was seeded to hasten the process. After about three years, the nursery plants were lifted in late summer. The root system of *D. meadia* consists of a central root crown from which project numerous radiating roots. These roots, each of which has a bud, may be detached separately from the central crown. These single roots were planted in additional rows. This reduced the time necessary to produce mature plants, saving probably two years over starting from seed.

With an increase in the length and number of nursery rows, some divided roots and mature plants were transplanted to the restoration. This provided older plants for recently established plots, and thus the opportunity for earlier appearance of seedling plants surrounding the parents. A useful indication of success on a restoration is the appearance of second-generation plants. This has occurred on several plots with *Dodecatheon meadia*. In addition, the nursery rows produced increasing amounts of readily collected seed. In 1991, 12 ounces of *D. meadia* seed were harvested from 147 feet of nursery rows.

Sporobolus heterolepis (prairie dropseed) is an example of a species for which only small amounts of hand-collected seed were available initially, and there was no success in establishing the species on the restoration by direct seeding. Seed planted in a nursery row in 1981 had poor germination, but did provide a few plants. After two years these plants were lifted before the start of spring growth. Tillers were divided and immediately planted in an extension of that row. This was repeated in subsequent years, and after several rows were established the tufts were divided, and some were planted in the field in early spring. Except in excessively dry years, these transplants grew well. During the same time, the rows of *S. heterolepis*

in the nursery provided increasing amounts of seed. In 1986 the collection was 1.25 pounds, but by 1990, 13.5 pounds were harvested from 410 feet of nursery rows. This seed was sown on the restoration, and *S. heterolepis* is now appearing on the most recent restoration plots. Previous lack of substantial amounts of seed may have been the principal reason for the early failure to establish this grass by direct seeding.

Asclepias tuberosa ssp. *interior* (butterfly milkweed) is an example where, after establishment in the nursery, it became possible to collect more seed and at an optimal time of maturity. In earlier years there were only isolated instances of success from direct seeding. However, many young plants are appearing in recent plots on which the greater amounts of fully ripened seed were applied from the nursery.

When moisture conditions were adequate, transplanting most species from the nursery was successful, and anthesis was achieved in the first or second year. With some species, though, the transplants had a shortened life span. This was true of at least some transplants of *Echinacea pallida* (pale purple coneflower), *Liatris pycnostachya* (prairie blazing star), and *Liatris spicata* (marsh blazing star). The transplants grew and produced seed, and seedling plants were often found in the area. However, the parent plants frequently diminished in size and disappeared after three to five years. Determination was not made whether this was due to the transplantation.

Since 1981 the nursery has been located in part of the restoration field (Plot 8A). When it is no longer required, tillage of rows will cease, and existing plants will remain as a part of the restoration.

Fire

Annual late winter burning of the restoration site is a principal management technique. The ground cover retained over winter aids in prevention of erosion and provides shelter for wildlife. Prescribed burning usually has taken place in March. However, the dates have ranged from 25 February to 19 April. The April dates were due to prolonged snow cover in 1978 and wet field conditions in 1979. In the latter year there was some damage to emerging *Dodecatheon meadia.*

Fire lanes are mowed in late summer on the east, southeast, and southwest sides of the restoration where there is a risk of escape. When possible, the burn takes place when there is a westerly wind. This diverts the considerable amount of smoke away from the village. Backfires are started on the east side. Then the fire is permitted to run downwind from the west. Following these precautions, problems were never encountered. However, the startling height of flames and noise of the fire caused local citizens to notify the fire department on three occasions.

Removal of surface plant material from the previous season is especially helpful when attempting to establish early spring forbs. Rotational burning of nearby railroad prairie remnants has repeatedly shown reduced flowering of species such as *Dodecatheon meadia* and *Pedicularis canadensis* in years when burning did not occur. The only year when burning of the restoration field did not take place was 1989, because of the stress of the previous drought year and the reduced amount of thatch. There followed a marked decrease in flowering of early spring species.

Burning was often incomplete on plots during the first two or three years because of the difficulty of starting the fire in the coarse annual weeds. *Chenopodium album, Erigeron annuus, Amaranthus hybridus, Ambrosia artemisiifolia* (common ragweed), and *Ambrosia trifida* (giant ragweed) produced heavy stems and small amounts of leaf material, which prevented clean burns. Some plots had a heavy first-year growth of *Panicum capillare* and *Panicum dichotomiflorum* (fall panicum), which provided excellent fuel. In these plots prairie species seemed to establish themselves more quickly.

Weed Control

Annual weedy species grew vigorously on all plots during their first year of restoration. Removal of existing vegetation, combined with soil disturbance, permitted pioneering taxa to thrive. Considering that perennial sod cover had been in place, one could not fail to be impressed with the opportunistic character of these species. Their seed was necessarily present in the soil for an extended time, remaining dormant until proper conditions for germination occurred. The predominant pioneering species varied with location. Plots toward the south side of the field had more *Chenopodium album, Amaranthus hybridus, Ambrosia* spp., and *Erigeron annuus.* Farther north the overwhelmingly dominant species the first year was *Panicum capillare.*

In some years a weed mower was used on new plots in midsummer, cutting to about six inches high. However, if growth was heavy, this could cause accumulation of cut plant material on the native

seedlings, with resultant losses. Unless the growth was light or raking was possible, mowing was counterproductive.

In spite of their rapid coverage of a new restoration plot, these annual weeds never proved to be an enduring problem. Another wave of unwanted taxa replaced them during the second and third years. These included *Daucus carota* (wild carrot). This biennial had invaded the entire field before restoration, and by midsummer it was the dominant forb cover. It was expected to be the cause of substantial difficulty in restoration management. At times it became so pervasive that intervention seemed necessary. After flowering, the plants were mowed. This was largely ineffective since secondary umbels developed and additional mowing was contraindicated because of the presence of young prairie taxa. However, the concern proved unnecessary. *D. carota* remains present in the field, in greatest numbers on more recently planted plots. In established areas only small scattered specimens can be found, and these do not flower. Given enough time, *D. carota* will probably be virtually extirpated from the site through successional replacement.

Other biennial aliens in this second wave of succession were *Melilotus alba* (white sweet clover) and *Melilotus officinalis* (yellow sweet clover). Their growth appears to respond favorably to burning, and they continue to persist even in some older plots. Their populations vary from year to year, but have not shown a significant increase. If they are not succeeded, some form of intervention will be required. Hand removal by hoeing before anthesis is one choice. Another possible treatment is use of a sponge or wick applicator to apply concentrated (50%) glyphosate herbicide.

The aggressive rhizomatous growth of *Agropyron repens* makes it a tenacious invader from border areas. There have been instances of it overwhelming and replacing seedling prairie forbs, and it continues to be a problem in limited areas. However, native species replace *A. repens* in the long term. This process could be hastened by using more native tall grasses in the seed mix in a problem area. *Andropogon gerardii* has shown that it will displace *Agropyron repens*.

Cirsium arvense has a long history as an aggressive and persistent perennial weed in our agricultural areas, and it was expected to be a continuing problem on the restoration. Herbicide was used on denser stands, but as the prairie grasses became established, *C. arvense* was displaced. None has been observed in the restoration for several years.

A neighboring field provides a continuing seed source for *Rosa multiflora* (multiflora rose). Fire is only a partially effective control. Spot treatment with a 2% Roundup spray in early summer or midsummer will destroy existing plants; however, an annual sweep of the field is necessary to treat newly established individuals.

The tree seedlings that occur are *Fraxinus* sp. (ash), *Crataegus* sp. (hawthorn), *Ulmus pumila* (Siberian elm), and *Morus alba* (white mulberry). They are primarily in evidence in recently established plots. Once the prairie develops to the extent that adequate fuel is produced, fire becomes an effective control. Although the nearby village and a wood lot act as continuing seed sources, these trees have not presented a problem on the restoration.

Successional Changes

Lack of understanding of species succession has caused unnecessary concern for the long-term species content of several plots. In 1975 the central portion of Plot 2 received a generous application of *Elymus canadensis* (Canada wild rye) in the seed mix. It flourished, and many individuals achieved anthesis the first year. For three years it continued to expand and dominate its range. Although it is a desirable prairie species, it is not a dominant in native prairie; thus, control of its range seemed necessary. Collection of *E. canadensis* seed was sharply curtailed and only small amounts were applied to subsequent plots. In Plot 2, thinly scattered *Andropogon gerardii* became more vigorous. By 1980 it had, to a large extent, displaced the *E. canadensis*. By 1990 only occasional plants of *E. canadensis* remained in the plot, which now also contains *Dodecatheon meadia*, *Eupatorium altissimum* (tall boneset), *Monarda fistulosa*, *Pycnanthemum pilosum* (hairy mountain mint), *Silphium laciniatum* (compass plant), and *Solidago juncea* (early goldenrod). *Elymus canadensis* proved to be a pioneering prairie species that creates a useful early cover and does not prevent later establishment of a diverse prairie community.

Rudbeckia hirta (black-eyed Susan) becomes established rapidly and often flowers the year it is seeded. Frequently it is used to provide some readily visible sense of success in otherwise weedy restorations or reconstructions. It also is an active participant in the mechanism of plant succession among prairie species. One of several examples where it became quickly dominant in the restoration was on the west end of Plot 2. It was replaced by even greater numbers of

Ratibida pinnata (yellow coneflower), another readily established species. By 1989 the *R. pinnata* population had decreased in that area, having been replaced by *Andropogon gerardii* and other native forbs.

Problems in establishing some species were predictable. *Lithospermum incisum* (fringed puccoon) and *Coreopsis lanceolata* (sand coreopsis) were readily grown in a nursery setting; however, after transplantation to the field, they disappeared within two years. These dry species were unable to survive the vigorous competition in a mesic soil environment. The same may be true of *Bouteloua curtipendula* (side-oats grama). Although it grows well when directly seeded onto plots, sometimes reaching anthesis the first year, it has disappeared in earlier plots, and population numbers are decreasing in recent seedings.

The drought of 1988 had prolonged effects on certain species. *Pedicularis canadensis* flowered normally that spring, but was decimated by the ensuing heat and drought. In 1989 there was no flowering, and no mature plants could be found. However, many seedling plants did appear. They increased in number and size the following year, but it was not until 1991 that flowering resumed in numbers comparable to those before the drought. A similar effect was noted with *Gentianella quinquefolia* ssp. *occidentalis* (stiff gentian), which did not flower between the years 1987 and 1993.

A warm-season grass that quickly became predominant in some plots was *Sorghastrum nutans* (Indian grass). One of several examples was in Plot 6, planted in 1979. In 1981 it was the dominant grass in that plot with only occasional *Andropogon gerardii* observed. Gradually there has been a population shift, so that ten years later the frequency of appearance of the two species has reversed. This may be a normal succession for this locality. Nearby railroad and cemetery prairie remnants have *A. gerardii* as the dominant tall grass with *S. nutans* scattered or absent. In high-quality prairie remnants, native forbs can partially displace *A. gerardii*. There are preliminary indications of that process occurring, and continued change in that direction is anticipated over time on the restoration.

Floristic Composition and Evaluation

In 1991 and 1992, a survey of the flowering plants growing on the site yielded 189 species. Of these, 138 species are considered native to central Illinois. The remaining 51 species are alien plants, generally common in the region. The native species comprise 71 previously existing on the site and 67 established during the restoration project. The total number of families recorded was 37. Those with the greatest native representations are Compositae with 35 species, Gramineae 19, Cyperaceae 14, and Leguminosae 12.

A plant list is included at the end of this paper, containing the following information: whether the species is considered native or alien; plots where the species has been observed growing (although not necessarily limited to those plots); whether the species existed on the site or was introduced as part of the restoration; and seed source locations.

An attempt was made to evaluate the restoration inventory. The Swink-Wilhelm method of floristic quality assessment revised by Swink and Wilhelm (1994) was used with revised numerical ratings (Taft et al. 1993).

A combination of recent species introductions and rapid successional change contributes to an artificiality of community structure in a restoration of short duration, and in such a diverse assemblage, some taxa negate the effects of others on the index. Thus high-quality marginally established prairie species are, to some extent, negated by alien species that are merely transitional. With a floristic quality index of 44, the restoration presents significant native character; however, the primary use of the evaluation here is to act as a guide for future species improvement of the site.

The last plots were added to the restoration in 1990. Further plans include enrichment of existing plots, a quantitative vegetation analysis, and continued observation of successional changes. In the past, lack of seed was a deterrent to increasing the size of the restoration. With an established seed source now on the site, the opportunity for enlargement is enhanced.

In September 1995 the restoration qualified for and was included in the Illinois Natural Areas Inventory as a Category V (natural community restoration site).

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GARDNER PRAIRIE RESTORATION KEMPTON, ILLINOIS (FORD COUNTY)

Native /Alien	Scientific name	Common name	Plots where species observed	Species added to restoration	Seed source locations[1]
A	Achillea millefolium	yarrow	various	N	
A	Agropyron repens	quack grass	various	N	
A	Agrostis alba	red top	18B,19,20	N	
N	Allium canadense	wild onion	20	N	
N	Allium cernuum	nodding wild onion	18A	Y	T,9
A	Amaranthus hybridus	green amaranth	8A,13A	N	
N	Ambrosia artemisiifolia	common ragweed	most	N	
N	Ambrosia trifida	giant ragweed	most	N	
N	Amorpha canescens	lead plant	3,4,5B,7,8B–12	Y	3,6,11,16
N	Andropogon gerardii	big bluestem	most	Y	2,6,11,12
N	Anemone canadensis	meadow anemone	1	Y	12
N	Anemone cylindrica	thimbleweed	613	Y	6,12,13
N	Antennaria neglecta	pussytoes	18B,19	N	
N	Apios americana	groundnut	8A	Y	T,6
A	Arctium minus	common burdock	20	N	
N	Aristida oligantha	prairie three-awn	19	N	
N	Asclepias sullivantii	prairie milkweed	16A,18B,19	N	
N	Asclepias syriaca	common milkweed	various	N	
N	Asclepias tuberosa ssp. interior	butterfly milkweed	2,6,8A,10–14	Y	1
N	Asclepias verticillata	whorled milkweed	various	N	
A	Asparagus officinalis	asparagus	12,19,20	N	
N	Aster ericoides	heath aster	various	N	
N	Aster laevis	smooth blue aster	10,12,17	Y	3
N	Aster novae-angliae	New England aster	7,9,8B,12,18B	Y	6,12
N	Aster pilosus	hairy aster	most	N	
N	Aster praealtus	willow aster	20	N	
N	Astragalus canadensis	Canadian milk vetch	10,13A,15	Y	14
N	Baptisia lactea	white wild indigo	various	Y	14
N	Baptisia leucophaea	cream wild indigo	8A	Y	1
N	Bidens frondosa	common beggar's ticks	20	N	
N	Bouteloua curtipendula	side-oats grama	15	Y	11
A	Brassica rapa	field mustard	various	N	
A	Bromus inermis	Hungarian brome	various	N	
N	Calamagrostis canadensis	blue joint grass	20	Y	6
N	Calystegia sepium	hedge bindweed	10,11,20	N	
N	Carex bebbii		15A	N	
N	Carex bicknellii	prairie sedge	16B	Y	T,9
N	Carex blanda		15A	N	
N	Carex brevior		17,20	N	
N	Carex gravida		15A	N	
A	Carex hirta *		12	N	
N	Carex meadii	Mead's sedge	1,12	N	
N	Carex molesta		15	N	
N	Carex muhlenbergii		15	N	
N	Carex vulpinoidea		15A	N	
N	Cassia fasciculata	partridge pea	18B,19	N	
A	Cerastium vulgatum	mouse-ear chickweed	20	N	
A	Chenopodium album	lamb's quarters	8A,13A	N	
A	Cichorium intybus	chicory	12,19,18B	N	
N	Cirsium discolor	pasture thistle	12,19,20	N	

[1] Listed at the end of this table.

Native /Alien	Scientific name	Common name	Plots where species observed	Species added to restoration	Seed source locations
N	Coreopsis palmata	prairie coreopsis	5B,6,11,12	Y	6,11,13
N	Coreopsis tripteris	tall coreopsis	8A,18A,18B	Y	13,16
N	Cyperus esculentus	nut grass	20	N	
A	Dactylis glomerata	orchard grass	various	N	
N	Dalea candida	white prairie clover	3,4,6,7,11–15	Y	3,6
N	Dalea purpurea	purple prairie clover	3,6–8,10–15	Y	3,6,12–14
A	Daucus carota	wild carrot	most	N	
N	Desmanthes illinoensis	Illinois mimosa	8A	Y	17
N	Desmodium canadense	showy tick trefoil	16A	Y	
N	Dichanthelium acuminatum	panic grass	19	N	
N	Dodecatheon meadia	shooting star	2–7,12	Y	6,11
N	Echinacea pallida	pale purple coneflower	7,10–13	Y	6,10,11
N	Echinacea purpurea	purple coneflower	11	Y	7
A	Echinochloa crus-galli	barnyard grass	15A,20	N	
N	Eleocharis elliptica compressa	flat-stemmed spike rush	19,20	N	
N	Eleocharis verrucosa	slender spike rush	18B,19	N	
N	Elymus canadensis	Canada wild rye	various	Y	Several
N	Elymus virginicus	Virginia wild rye	20	N	
N	Erigeron annuus	annual fleabane	various	N	
N	Eryngium yuccifolium	rattlesnake master	various	Y	6,12,13
A	Erysimum cheiranthoides	wormseed mustard	20	N	
N	Eupatorium altissimum	tall boneset	various	N	
A	Festuca pratensis	meadow fescue	20	N	
N	Filipendula rubra	queen-of-the-prairie	8A,20	Y	T,15
N	Fragaria virginiana	wild strawberry	various	N	
N	Galium aparine	cleavers	20	N	
N	Galium boreale	northern bedstraw	8A	Y	T,9
N	Gentiana andrewsii	closed gentian	8A,8B	Y	5
N	Gentiana puberulenta	downy gentian	10	Y	6,16
N	Gentianella quinquefolia ssp. occidentalis	stiff gentian	11	Y	6,11
N	Geum laciniatum	rough avens	20	N	
N	Helianthus grosseserratus	sawtooth sunflower	20	N	
N	Helianthus rigidus	prairie sunflower	10	N	
N	Heliopsis helianthoides	false sunflower	7	N	
N	Heuchera richardsonii var. grayana	prairie alum root	8A	Y	11
N	Hierochloë odorata	vanilla grass	8A,16B	Y	T,9
A	Hordeum jubatum	squirrel-tail grass	20	N	
A	Ipomoea hederacea	ivy-leaved morning glory	15A	N	
N	Iris shrevei	blue flag	20	Y	T,5
N	Juncus dudleyi	Dudley's rush	17	N	
N	Juncus interior	interior rush	19	N	
N	Koeleria macrantha	June grass	8A	Y	T,9
A	Lactuca serriola	prickly lettuce	19	N	
N	Leersia oryzoides	rice cutgrass	15A,20	N	
A	Leonurus cardiaca	motherwort	20	N	
A	Lepidium campestre	field cress	20	N	
N	Lespedeza capitata	round-headed bush clover	3,4,6,13A,14	Y	1,3,6,12
A	Leucanthemum vulgare	ox-eye daisy	various	N	
N	Liatris aspera	rough blazing star	9–14,19	Y	6,10–13
N	Liatris pycnostachya	prairie blazing star	10,13	Y	2,6,12,13
N	Liatris spicata	marsh blazing star	10,11,13A,19	Y	7
N	Lithospermum canescens	hoary puccoon	1,5A,8A	Y	6
A	Lychnis alba	white campion	15A	N	
N	Lysimachia lanceolata	lance-leaved loosestrife	8A	Y	T,6
A	Medicago lupulina	black medick	20	N	

Native /Alien	Scientific name	Common name	Plots where species observed	Species added to restoration	Seed source locations
A	Melilotus alba	white sweet clover	5B,6,12,18B,19	N	
A	Melilotus officinalis	yellow sweet clover	14	N	
A	Mollugo verticillatus	carpet weed	8A,13A	N	
N	Monarda fistulosa	wild bergamot	various	N	
N	Oenothera biennis	common evening primrose	various	N	
N	Oenothera pilosella	prairie sundrops	8A,12	Y	T,6
A	Ornithogalum umbellatum	star of Bethlehem	20	N	
N	Oxalis stricta	yellow wood sorrel	various	N	
N	Oxalis violacea	violet wood sorrel	16B	Y	T,14
N	Panicum capillare	witch grass	8A,18A	N	
N	Panicum dichotomiflorum	fall panicum	15A	N	
N	Panicum virgatum	switch grass	4A	Y	6
N	Parthenium integrifolium	wild quinine	various	Y	3,6,12,13
N	Parthenocissus inserta	Virginia creeper	19	N	
A	Pastinaca sativa	wild parsnip	various	N	
N	Pedicularis canadensis	wood betony	7,8,10–13	Y	6,11
N	Perideridia americana	perideridia	5B	N	
A	Phleum pratense	timothy	most	N	
N	Phlox pilosa	prairie phlox	12	Y	6
N	Physalis heterophylla	clammy ground cherry	11	N	
N	Physalis subglabrata	smooth ground cherry	18A	N	
N	Physostegia virginiana	false dragonhead	9,12,13A	Y	6,11,13
A	Plantago lanceolata	buckhorn	various	N	
A	Plantago rugelii	red-stalked plantain	various	N	
A	Poa compressa	Canada bluegrass	15A,20	N	
A	Poa pratensis	Kentucky bluegrass	most	N	
N	Polygala sanguinea	field milkwort	19	N	
N	Polygala verticillata	whorled milkwort	19	N	
A	Polygonum persicaria	lady's thumb	20	N	
A	Portulaca oleracea	purslane	8A	N	
A	Potentilla recta	sulfur cinquefoil	most	N	
N	Potentilla simplex	common cinquefoil	various	N	
N	Prunella vulgaris var. elongata	self-heal	18B,19	N	
N	Psoralea onobrychis	French grass	8A,20	Y	14
N	Pycnanthemum pilosum	hairy mountain mint	2,4B,10,11	Y	12
N	Pycnanthemum tenuifolium	slender mountain mint	18B	Y	
N	Pycnanthemum virginianum	common mountain mint	10	Y	3,6,11,12
N	Ranunculus abortivus	small-flowered buttercup	20	N	
N	Ratibida pinnata	yellow coneflower	various	N	
N	Rorippa islandica	marsh yellow cress	15A,20	N	
N	Rosa carolina	pasture rose	19	N	
A	Rosa multiflora	multiflora rose	16A,18B,19,20	N	
N	Rudbeckia hirta	black-eyed Susan	various	Y	6,12,13
N	Rudbeckia subtomentosa	fragrant coneflower	15A	N	
A	Rumex crispus	curly dock	various	N	
N	Schizachyrium scoparium	little bluestem	7,8B,9A,10,12	Y	3,6,10,12
N	Scirpus atrovirens	dark green rush	15A,20	N	
N	Scirpus pendulus	red bulrush	20	N	
N	Senecio plattensis	prairie ragwort	16B	N	
N	Silphium integrifolium	rosin weed	13	N	
N	Silphium laciniatum	compass plant	2,12,14–17	N	
N	Silphium perfoliatum	cup plant	8A,20	Y	T,4
N	Silphium terebinthinaceum	prairie dock	1,4A,4B	Y	12
N	Sisyrinchium albidum	common blue-eyed grass	8,10–13	Y	6,11
N	Smilacina stellata	starry false Solomon's seal	8A,20	Y	T,8
A	Solanum carolinense	horse nettle	various	N	

Native /Alien	Scientific name	Common name	Plots where species observed	Species added to restoration	Seed source locations
A	Solanum dulcamara	bittersweet nightshade	20	N	
N	Solidago canadensis	tall goldenrod	2,4B,6	N	
N	Solidago juncea	early goldenrod	2,15A	N	
N	Solidago ptarmicoides	stiff aster	10	Y	
N	Solidago rigida	rigid goldenrod	2,7,8B,9,10	N	
A	Sonchus oleraceus	common sow thistle	8A,20	N	
N	Sorghastrum nutans	Indian grass	various	Y	12,14
N	Spartina pectinata	prairie cord grass	220	Y	6
N	Sporobolus asper	rough dropseed	16A	N	
N	Sporobolus heterolepis	prairie dropseed	8A,16A,16B	Y	3
A	Stellaria media	common chickweed	20	N	
N	Stipa spartea	porcupine grass	16A	Y	6,12,13
A	Taraxacum officinale	common dandelion	various	N	
N	Thalictrum dasycarpum	purple meadowrue	8A,20	Y	T,6
A	Thlaspi arvense	penny cress	20	N	
N	Tradescantia ohiensis	common spiderwort	4A,12,20	N	
A	Tragopogon pratensis	common goat's beard	12	N	
A	Tridens flavus	purple-top	19	N	
A	Trifolium hybridum	alsike clover	17,20	N	
A	Trifolium pratense	red clover	various	N	
A	Trifolium repens	white clover	17	N	
N	Typha latifolia	common cat-tail	20	N	
N	Verbena urticifolia	white vervain	15A	N	
N	Veronicastrum virginicum	Culver's root	6,7,12,13A	Y	6,11,13
N	Viola pedatifida	prairie violet	6,8A	Y	6
N	Viola pratincola	common blue violet	20	N	
N	Vitis aestivalis	summer grape	12,18B,19,20	N	
N	Zizia aurea	golden Alexanders	8A,17	Y	6,13

* Gardner (1992)

SEED SOURCE LOCATIONS

Location #	Site	County
1	Bath Township, central part Section 14	Mason
2	Bath Township, central part Section 4	Mason
3	Broughton Township Cemetery, Section 14 Broughton Township	Livingston
4	Broughton Township, ditch, Section 14	Livingston
5	Havana Township, roadside ditch, Section 26	Mason
6	Kempton, railroad 2 miles north to 2 miles south	Ford, Livingston
7	Lincoln Memorial Garden, Springfield, probable Lee County source	Sangamon
8	Mona Township, north roadside, Section 9	Ford
9	Natural Garden Nursery, St. Charles	Kane
10	North Quiver Township, Section 6	Mason
11	Crane Creek Township, Sections 26 and 36	Mason
12	Railroads and roadsides	Mason
13	Sheldon to Donovan, railroad	Iroquois
14	Swing Grove Cemetery, Section 6 Mason City Township South	Mason
15	Lafayette Home Nursery, Lee County source	Lee
16	Weston Cemetery, Yates Township, Section 2	McLean
17	Illinois State Tree Nursery, Quiver Township SE Section 33	Mason
T	Indicates introduction was by transplant rather than seeding	