

## Developing Techniques to Produce Native Warm and Cool Season Grasses and Forbs in Missouri®

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### BACKGROUND

There is a vast source of native plants in prairies and other natural areas with landscaping potential that could be planted for beautification in backyards, land restoration projects, and roadsides. Native plants maintain biological diversity necessary to provide food and cover for wildlife. Diversity also increases tolerance to diseases, pests, and climate extremes.

Interest in including native plants in landscaping has increased during the last decade (Diboll, 1997); however, commercially available prairie mixes usually include wildflowers and warm-season grasses. Very few include native cool-season grasses. Ideally, a prairie seed mix should contain both cool- and warm-season grasses for soil protection and to provide adequate conditions for biological activity throughout the year. Also the addition of native cool-season grasses to a selected seed mix would extend the planting period of seed mixes from fall to spring (Shirley 1994).

Some warm-season grasses recommended for soil conservation plantings, pasture, or wildlife habitat are Indian grass (*Sorghastrum nutans* L. Nash), little bluestem (*Schizachyrium scoparium* Michx. Nash var. *scoparium*), and Eastern gamma grass (*Tripsacum dactyloides*). Some non-native cool-season grasses are timothy (*Phleum pratense* L.), reed canary grass (*Phalaris arundinacea* L.), Kentucky bluegrass (*Poa pratensis* L.), and tall fescue (*Festuca arundinacea* Schreb) (Missouri Department of Conservation, 2001; Pitts, 1999). Tall fescue is one of the most planted grasses in pastures because it establishes well and provides good forage; however, tall fescue can encroach native vegetation and could be toxic to cattle and horses when consumed in high quantities (Randall and Marinelli, 1996). The University of Missouri is presently searching for native cool-season grasses that can be offered to landowners as alternatives to this and other invasive introduced grasses.

Native cool-season grasses grow well under the shade found in woodlands or in moist and dry prairies (Yatskievych, 1999) and are easily propagated from seed and tillers that develop around the original plant (Navarrete-Tindall et al., 2002). Some North American cool-season grasses found in Missouri are river oats (*Chasmanthium latifolium*), an attractive shade-tolerant grass used in landscaping; Canada wild rye (*Elymus canadensis*) and Virginia wild rye (*E. virginicus*), which grow well under full sunlight or moderate shade; oatgrass (*Danthonia spicata*), a ground-hugging grass which grows well in poor, dry and well drained soils, but maintains its foliage in mesic conditions in the summer; and prairie junegrass (*Koeleria macrantha*), a grass with fine foliage that remains green in the summer in moist conditions also (Kucera, 1998).

Two other cool-season grasses with excellent potential for landscaping or forage in agroforestry practices are paradox and nodding grasses (*Festuca paradoxa* and *F. subverticillata*) (Navarrete-Tindall et al., 2002). For more information about these and other grasses see Tables 1 and 2. Paradox grass, also known as cluster fescue, is found in forest openings and prairies and nodding grass grows under heavy shade in woodlands (Aiken and Leptovitch, 1993; Kucera, 1998). Navarrete-Tindall et al. (2002) found that paradox grass grew well and produced seed under shade or full sunlight. Paradox grass maintains itself in natural prairies under some management. Mechlin (1999) reported that this grass responded better to summer burns than to spring burns in Tucker Prairie in Callaway County, Missouri.

**The Missouri Ecotype Program.** The Missouri Ecotype Program (MOEP) was created in 1997 to produce native grass and forbs seed for landowners wanting to establish natives for seed production in Missouri, and follows an approach similar to the Iowa Ecotype Program. The main objective of MOEP is to increase seed supplies of selected native forbs and grasses collected from three ecoregions in Missouri by establishing 1/10th acre seed production plots. The seed harvested from these plots will be distributed to landowners to establish plots for larger scale production. The seed harvested by private landowners will be used to fulfill Missouri's demand for future roadside plantings and habitat restoration.

**Opportunities for Native Seed Producers and Grow Native! in Missouri.**

There are several nurseries and landowners that grow exclusively native plants and are certified as providers of local ecotype seed; however, the demand is growing and the amount of ecotype seed still does not meet the demand. The Missouri Department of Transportation has an agreement with the Missouri Department of Conservation through the Grow Native! Program to plant native species on right-of-ways to reduce mowing and for beautification. Four seed mixes are now recommended for planting under different soil conditions in right-of-ways (Grow Native, 2002). Each mix contains a variety of cool- and warm-season forbs and grasses including paradox grass, wild ryes, and river oats. The Missouri Department of Conservation, University of Missouri, the Plant Material's Center at Elsberry, other institutions and private landowners are helping to meet this demand by establishing seed production plots.

**Ongoing Research on Native Plants.** Little is known about the best prairie seed combination of warm and cool season grasses and forbs for poor sites in roadside plantings. The University of Missouri in cooperation with the Missouri Department of Conservation, the Center for Agroforestry, and the USDA Forest Service, North Central Research Station, are presently evaluating the effect of different ecological conditions on seed yields and persistence of different combinations of native grasses and forbs. The results of these studies may determine the best combinations of natives to be grown in poor soil conditions like those encountered in right-of-ways and under different shade levels found in agroforestry practices or in savannas.

We are presenting a series of basic steps to propagate native grasses and forbs for seed production plots as follows:

## PROCEDURES TO ESTABLISH SEED PRODUCTION PLOTS OF NATIVE PLANTS

**Collecting and Storing Seed.** Seed is collected from prairies, prairie remnants, private areas, or forest openings by hand from July to December depending on the species. A list of six native cool-season grasses is included in Table 1. Seed is collected in paper bags and information about location and type of site is recorded. Seed is air dried and stored in cool and dry conditions at 5 to 10°C and cleaned manually or mechanically before treating the seed for germination.

**Seed Treatments.** Before planting seed may be stratified at 5°C at different time periods depending on the species. For example milkweed (*Asclepias* spp.) seed is planted in trays with moist growing medium with good water-holding capacity and good drainage, then trays are stored in coolers for up to 40 days, and covered with plastic to keep the growing medium moist.

Other seed, like *Baptisia* spp., is scarified manually or with hot water and planted directly in the soil. Most grasses do not require any seed treatment. Although some propagators recommend cold-dry or cold-moist stratification for some cool-season grasses like oatgrass, nodding, paradox, wild rye, and prairie june grasses, these grasses readily germinate without any seed treatment. Oatgrass germinates 2 to 4 days after planting and other grasses included in Table 1 germinate 10 to 25 days after planting at 20 to 25°C. Germination rates ranged from 80% to 95% for all grasses in Table 1.

**Seed Germination.** Seed can be started in the greenhouse at 20 to 25°C as early as February or March in small-plug trays (1 inch diameter by 2 inches deep) or in germination flats using a horticultural soil mix containing sphagnum moss, perlite, and vermiculite (7.5 : 1.5 : 1, by volume). Thirty or 40 days after germination, or when seedlings have a strong root system, seedlings are transferred to bigger plugs (2 inches diameter by 3 inches deep) and kept there for 2 to 4 months, depending on the species.

**Establishing Seed Production Plots.** Three- or four-month-old seedlings are established in tilled plots free of competing vegetation in the spring or fall. Plots are plowed and sprayed with glyphosate about a month before planting and seeded with perennial rye or other non-aggressive groundcover to avoid erosion. Seed production plots of different forbs and grasses are established at the Green Conservation Area of the Missouri Department of Conservation, the U.S.D.A.-N.R.C.S. Plant Materials Center in Elsberry, at the University of Missouri, Horticulture and Agroforestry Research Center in New Franklin, and at South Farm and by private landowners. The MOEP and its cooperators have established plots for 26 native species, including forbs and warm and cool season grasses. Information about seven out of these 26 is provided in Table 2.

**Maintaining Seed Production Plots.** Borders of plots are mowed two or three times a year and the area around seedlings is weeded manually or treated with selective herbicides twice a year. Seedlings are irrigated as needed soon after planting and forced to grow deeper roots by lengthening irrigation intervals later in the season.

Table 1. Characteristics of six perennial native cool-season grasses in the U.S.A.

| Species   | Habitat   | Flowering period | Collection period | Seed persistence in plant |
|---|---|------------------|-------------------|---------------------------|
| <i>Chasmanthium latifolium</i><br>(river oats)                  | Forests openings<br>part shade to sunny                           | June-August      | Sept.-Dec.        | thru winter               |
| <i>Danthonia spicata</i><br>(oatgrass)                          | Dry prairies, glades<br>moderate shade to sunny                   | June-July        | July              | short period              |
| <i>Elymus canadensis</i><br>(Canada wild rye)                   | Prairies, full sun or<br>draws, moderate shade<br>forest openings | May-June         | July-Oct.         | thru winter               |
| <i>Festuca paradoxa</i><br>(paradox grass or<br>cluster fescue) | Moist prairies<br>dry prairies in draws<br>forest openings        | May-June         | July-Dec.         | thru winter               |
| <i>Festuca subverticillata</i><br>(nodding grass)               | Deep shade-woodlands  | May-June         | June-July         | short period              |
| <i>Koeleria macrantha</i><br>(prairie junegrass)                | Prairies June<br>moderate shade                                   | July-August      | July-Sept.        | 1 or 2 months             |

References: Hitchcock, 1971; Kucera, 1998; Shirley, 1994; Yatskievych, 1999; and personal observations.

**Table 2.** Climatic adaptations and information about seed production, price, and yield for seven species grown by the Missouri Ecotype Program.

| Species   | Climatic adaptations                             | No. seed per g | Price range <sup>1</sup> (\$ per lbs) | Bulk seed/ acre <sup>2</sup> (lbs) |
|---|--|----------------|---------------------------------------|------------------------------------|
| <i>Asclepias tuberosa</i><br>(butterfly weed)         | Dry to mesic<br>(full sunlight)                  | 150            | 250-300                               | 20                                 |
| <i>Coreosis palmata</i><br>(prairie coreopsis)        | Dry to mesic<br>full sunlight-moderate shade)    | 350            | 320-1100                              | 220                                |
| <i>Dalea purpurea</i><br>(purple prairie clover)      | Dry to mesic<br>(full sunlight)                  | 650            | 25-110                                | 86                                 |
| <i>Echinacea pallida</i><br>(pale purple coneflower)  | Dry to mesic<br>full sunlight-moderate shade)    | 180            | 60-300                                | 70                                 |
| <i>Penstemon digitalis</i><br>(foxglove beard tongue) | Moist to mesic<br>(moderate shade)               | 4600           | 150-220                               | 43                                 |
| <i>Andropogon gerardii</i><br>(big bluestem)          | Dry to wet<br>(full sunlight)                    | 58             | 6-20                                  | 83                                 |
| <i>Elymus virginicus</i><br>(Virginia wild rye)       | Dry to moist<br>(Full sunlight – moderate shade) | 50             | 12-45                                 | 263                                |

<sup>1</sup>Price range is for bulk seed produced by seed producers across the United States.

<sup>2</sup>Germination rate varies from 60% to 100% depending on the species.

**Harvesting Seed from Seed Production Plots.** Seed collection can begin the same year or the next year after planting, depending on the species. For example, wild rye, river oats, and some legumes like purple prairie clover (*Dalea purpurea*) can produce seed the same year of planting. Other species like paradox grass and cream wild indigo (*Baptisia bracteata*) produce seed 2 and 3 years after planting, respectively. Information about number of seeds per gram, range of seed prices, and approximate amount of seed produced per acre is given for some selected species in Table 2.

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