



FINAL STUDY REPORT
East Texas Plant Materials Center
Nacogdoches, Texas

Assembly and Evaluation of *Echinacea* Species for Conservation in Eastern Texas

Melinda Brakie

ABSTRACT

Echinacea species are native perennial forbs which grow in tall grass prairies, savannas, and open woodlands. Due to its high value to pollinator insects the USDA-Natural Resources Conservation Service (NRCS) began making collections of *Echinacea* to increase diversity of conservation plantings and for food and cover for pollinators. The objective of this study was to evaluate the performance of forty-two wild collected accessions of *Echinacea* species to identify germplasm for use in a cultivar or pre-varietal development program. *Echinacea* species were planted in replicated plots on a fine sandy loam soil at the USDA-NRCS, East Texas Plant Materials Center and evaluated for percent seed germination, percent seedling survival and vigor, and percent transplant survival from 2011-2012. The average percent seed germination was 50%, average percent seedling transplant survival 70%, and vigor rating of 5. Eleven accessions were chosen for further testing based upon their performance in seed germination, seedling transplant vigor, and seedling transplant survival. No additional evaluations of the eleven accessions are planned.



INTRODUCTION

Echinacea species are native, perennial forbs. Although this genus is a C₃ (cool season) plant, it is adapted to summer heat and dry periods (Kindscher, 2006). All *Echinacea* species (except *E. purpurea*) have a taproot system that may extend to depths of eight feet (Weaver, 1958). In contrast, *E. purpurea* has a spreading fibrous root system (McKeown, 1999). *Echinacea* has a wide range of adaptation extending from southern Saskatchewan and Manitoba, Canada south through the US Great Plains, Midwest, Southeast, to the east coast (USDA NRCS, 2014).

This plant is found in dry prairies, meadows, and roadsides (Shirley, 1994). *Echinacea* species prefer sites in full sun with well drained soils. Most species prefer a pH range of 6 to 7 (Cech, 2002), although *E. angustifolia* and *E. pallida* tolerate more alkaline soils (Kindscher, 2006). Following are plant descriptions of the three main species in the assembly. (*The measurements mentioned in the descriptions have been converted from metric to English units.*)

Eastern purple coneflower (*E. purpurea*) plants grow up to forty-eight inches tall with brownish–green stems. The basal leaves are up to 5 inches wide and 12 inches in length with coarsely pointed to saw toothed margins. The flower petals vary from pink to purple and grow up to 3.2” long and 0.76” wide. The conical seedhead is up to 1.8” by 1.6”. The off white seed vary from 0.14” to 0.20” in length (Flora of North America, 2014).

Pale purple coneflower (*E. pallida*) grows up to fifty-five inches tall with green to purplish stems which are rarely branched. The basal leaves are up to 1.6” wide and 15.7” in length with smooth margins. The drooping flower petals vary from pink to reddish purple and grow up to 3.6” long and 0.16” wide. The conical to rounded seedhead is up to 1.6” by 1.48”. The seeds are tan or bicolored and vary from 0.10” to 0.20” in length (Flora of North America, 2014a).

Narrow leaved purple coneflower (*E. angustifolia*) plants grow up to 27.5” tall with green to purplish stems. The basal leaves are up to 1.0” wide and 11.8” in length with smooth margins. The drooping flower petals vary from pink to purplish and grow up to 1.6” long and 0.32” wide. The conical to hemispheric seedhead is up to 1.2” by 1.4”. The tan seeds have a dark brown band around one end and vary from 0.16” to 0.20” in length (Flora of North America, 2014b).

This forb is also an important plant species for wildlife and is utilized by many species of hummingbirds and butterflies (Steiner, 2010). Long tongued bees such as bumblebees, honeybees, and leaf cutting bees pollinate purple coneflower blooms. Caterpillars of the Silvery Checkerspot (*Chlosyne nycteis*) butterfly feed on the foliage and caterpillars of the Wavy-Lined Emerald (*Synchlora aerata*) and Common Eupithecia (*Eupithecia miserulata*) feed on the flowerheads of pale purple coneflower (Illinois Wildflowers, 2014).

The objective of this study was to assemble and evaluate purple coneflower germplasm and identify superior ecotypes for cultivar or pre-varietal development as part of the USDA-NRCS pollinator emphasis.

MATERIALS AND METHODS

Seed from forty-two accessions of *Echinacea* species were prechilled for 28 days at 36⁰F (Pinto, 2009) (Table 2). After prechilling, the seeds were placed in clear plastic germination boxes with form fitting lids (Pioneer Plastics, Dixon, KY) and placed in a germinator (Hoffman Manufacturing Comp., Albany, OR) set at alternating temperatures of 20⁰C (68⁰F) and 30⁰C (86⁰F) with 8 hrs light and 16 hrs dark (AOSA, 2001). Empty paper plant bands (Monarch Manufacturing, Salida, CO.) were filled with potting mix (Scotts Miracle-Gro Products, Inc., Marysville, OH) and the germinated seedlings transplanted into the media when they exhibited two leaves and a developed root. Total percent seed germination (number of transplants + germinated seedlings remaining in germination box) was recorded at 28 days. The transplanted seedlings were visually rated for vigor and counted for survival 14 days after transplanting. Visual ratings were on a scale of 1 = excellent, 5 = average, 10 = dead. The seedlings were grown in the planting bands and then transplanted in December 2011 to half gallon pots filled with a mix of 50%/50% Sunshine #3 (Sun Gro Horticulture Canada Ltd) and Redi-earth (Sun Gro Horticulture Canada CM Ltd) for additional growth prior to transplanting in the field. The plants were fertilized with Osmocote® Indoor and Outdoor Plant Food (19-6-12) (slow release granules) (Scotts Miracle-Gro Products, Inc., Marysville, OH).

On 3 and 5 April 2012 the plants were transplanted to the initial evaluation nursery at the USDA-NRCS East Texas Plant Materials Center near Nacogdoches, Texas. The plot design was a randomized complete block design with three replications on an Attoyac fine sandy loam (thermic typic Paleudalf). Each replication included five plants per accession on 1.5 ft. spacing. The study was irrigated to aid establishment the first year.

The plants were visually counted on 7 May 2012 thirty days after transplanting to the nursery to determine transplant survival. No other evaluations were taken in 2012. On 29 April 2013 a final survival count was taken.

RESULTS AND DISCUSSION

Of the forty-two accessions (Table 2), eleven were not included in the field evaluation because of low seed germination (<10%) or poor seedling vigor in the greenhouse evaluation (data not shown). Several factors could have contributed to poor germination and seedling vigor (i.e. immature seed collection; damage during shipping and processing).

During the field evaluation, the transplants declined in vigor beginning in June 2012 as determined by visual observations (no data taken). By September 2012, most of the transplants had died and no further data was collected from the plots other than the 30 day survival count on 7 May 2012. In the spring of 2013, a final survival count was completed. Average transplant percent survival had declined from 97% on 7 May 2012 to 21% on 29 April 2013. There was evidence of wildlife activity in the evaluation nursery within two weeks after transplanting. Observations by the PMC staff included deer tracks in the plot, browsing on transplant stems, and some plants were heavily damaged. We anticipate the decline in survival was due to deer activity, although this activity is in contrast to a checklist by Moreland (2005) which does not include *Echinacea* species as an herbaceous plant browsed by white-tailed deer.

The accessions listed in Table 1 were chosen for further testing because they exhibited at or above average performance for percent seed germination, percent seedling transplant survival and vigor. The twenty remaining accessions in the evaluation were eliminated because they performed below average in at least one of these performance criteria.

CONCLUSIONS

- From an assembly of forty-two *Echinacea* species wild seed collections, thirty-one were eliminated from further testing because of low seed germination, poor seedling vigor, or below average performance in the evaluation criteria. Eleven accessions were chosen for further testing because of satisfactory seed germination, seedling transplant vigor, and seedling transplant survival.
- No additional activity is planned for this study. The *Echinacea* species seed collections will be stored in a controlled environment at the East Texas Plant Materials Center.

LITERATURE CITED

- AOSA. 2001. Rules for Testing Seeds. Association of Official Seed Analysts, Inc. Washington, DC.
- Cech, R. 2002. Growing at risk medicinal herbs-cultivation, conservation and ecology. Horizon Herbs Pub., Williams, OR.
- Flora of North America. 2014. Taxonomic description of *Echinacea purpurea*. Accessed online 8 July 2014 http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=220004561
- Flora of North America. 2014a. Taxonomic description of *Echinacea pallida*. Accessed online 8 July 2014 http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=242416464
- Flora of North America. 2014b. Taxonomic description of *Echinacea angustifolia*. Accessed online 8 July 2014 http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=242416463
- Illinois Wildflowers. 2014. Description of pale purple coneflower (*Echinacea pallida*). Accessed online 8 July 2014 http://www.illinoiswildflowers.info/prairie/plantx/pale_coneflowerx.htm
- Kindscher, K. 2006. The Conservation Status of *Echinacea* Species. Kansas Biological Survey, Univ. of Kansas. Lawrence, KS.
- McKeown, K.A. 1999. A review of the taxonomy of the genus *Echinacea*. Perspectives on new crops and new uses. ASHS Press p. 482-489.

- Moreland, D. 2005. Checklist of Woody and Herbaceous Deer Food Plants of Louisiana. Louisiana Department of Wildlife and Fisheries. Baton Rouge, LA.
- Pinto, J.R., R.K. Dumroese, and R. Chandler. 2009. Propagation protocol for production of container *Echinacea pallida* (Nutt.) Nutt. Plants (90, 105, and 340 ml (5.5, 6.4, and 21 cu. In. respectively) Styrofoam containers); USDA Forest Service, Southern Research Station, Moscow, Idaho. In: Native Plant Network. Moscow (ID): University of Idaho, College of Natural Resources, Forest Research Nursery.
- Shirley, S. 1994. Restoring the Tallgrass Prairie An Illustrated Manual for Iowa and the Upper Midwest. Univ. of Iowa Press. Iowa City, IA.
- Steiner, L. 2010. Prairie-style Gardens. Timber Press, Inc. Portland, OR.
- USDA, NRCS. 2014. The PLANTS Database (<http://plants.usda.gov>, 7 July 2014). National Plant Data Team, Greensboro, NC 27401-4901 USA
- Weaver, J.E. 1958. Classification of root systems of forbs of grassland and a consideration of their significance. *Ecology* 39 (3):393-401.

Table 1. *Echinacea* species Accessions Chosen for Further Testing at the USDA-NRCS East Texas Plant Materials Center, Nacogdoches, TX 2011-2012.

Accession Number	Percent Seed Germination ^{1/}	Percent Seedling Transplant Survival (14d) ^{2/ 3/}	Seedling Transplant Vigor Rating (14 d) ^{2/ 4/}	30 Day Average Percent Transplant Survival in Evaluation Nursery ^{5/}
9067368	80	98	1	100
9094892	85	89	3	100
9094921	55	100	5	93
9094360	53	98	1	100
9094918	71	66	5	100
9067357	59	76	5	100
9094862	55	76	5	100
9094866	51	68	5	100
9094888	77	90	1	**
9094893	75	100	3	**
9094872	56	92	3	**
Study Average	50	70	5	97

1/ = Percent seed germination was a 28 day count. Seed was germinated at alternating temperatures of 20⁰C (68⁰F) and 30⁰C (86⁰F) with alternating 8 hrs light and 16 hrs dark.

2/ = Percent seedling transplant survival and seedling transplant vigor ratings were completed 14 days after germinated seedlings were transplanted to plant bands.

3/ = Percent seedling transplant survival was a direct visual count.

4/ = Seedling transplant vigor rating was visual assessment on a scale of 1-10 (1=excellent, 10=dead).

5/ = 30 day average percent transplant survival was a direct count taken on 7 May 2012.

** Although these accessions were not represented in the field evaluation nursery, they were included for further testing because of their above average percent seed germination, high seedling transplant survival and excellent or very good seedling transplant vigor rating.

Table 2. *Echinacea* sp. Assembly Evaluated at the USDA-NRCS East Texas Plant Materials Center, Nacogdoches, TX from 2011-2012.

Accession Number	County of Origin	Species (as noted on collection packet)
9094892	Gray, TX	<i>E. atrorubens</i>
9067368	Donley, TX	<i>E. angustifolia</i>
9094888	Shackelford, TX	<i>E. purpurea</i>
9094893	Parmer, TX	<i>E. purpurea</i>
9094918	Polk, TX	<i>E. purpurea</i>
9094835	Grimes, TX	<i>E. purpurea</i>
9067357	Nacogdoches, TX	<i>E. purpurea</i>
9094923	Nacogdoches, TX	<i>E. purpurea</i>
9094919	Lipscomb, TX	<i>E. purpurea</i>
9094872	Parker, TX	<i>Echinacea</i> sp. **
9094862	Freestone, TX	<i>E. angustifolia</i>
9094917	Dickens, TX	<i>E. angustifolia</i>
9094921	Donley, TX	<i>E. purpurea</i>
9067360	Randall, TX	<i>E. purpurea</i>
9094863	Hardin, TX	<i>E. angustifolia</i>
9094900*	Hopkins, TX	<i>E. angustifolia</i>
9094866	Nacogdoches, TX	<i>E. angustifolia</i>
9067358	Nacogdoches, TX	<i>E. purpurea</i>
9094852	Angelina, TX	<i>Echinacea</i> sp. **
9067366	Nacogdoches, TX	<i>E. purpurea</i>
9094832	Moore, TX	<i>E. angustifolia</i>
9094812	Armstrong, TX	<i>E. angustifolia</i>
9094891	Collingsworth, TX	<i>E. angustifolia</i>
9094945	Freestone, TX	<i>E. purpurea</i>
9094915*	Montgomery, TX	<i>E. purpurea</i>
9094875	Leon, TX	<i>E. pallida</i>
9094868	Nacogdoches, TX	<i>E. angustifolia</i>
9094858	Houston, TX	<i>E. angustifolia</i>
9094860	Polk, TX	<i>E. angustifolia</i>
9094836	Nacogdoches, TX	<i>E. pallida</i>
9094938	Hartley, TX	<i>E. purpurea</i>
9093052*	Deaf Smith, TX	<i>E. angustifolia</i>
9094838	Nacogdoches, TX	<i>E. pallida</i>
9094870*	Nacogdoches, TX	<i>E. angustifolia</i>
9094837	Nacogdoches, TX	<i>E. pallida</i>
9094925	Nacogdoches, TX	<i>E. purpurea</i>
9094877*	Leon, TX	<i>E. pallida</i>
9094869*	Nacogdoches, TX	<i>E. angustifolia</i>
9094924*	Nacogdoches, TX	<i>E. purpurea</i>
9094922*	Nacogdoches, TX	<i>E. purpurea</i>
9067356*	Nacogdoches, TX	<i>E. purpurea</i>
9094920*	Hansford, TX	<i>E. angustifolia</i>

* These accessions had low seed germination of less than 10% or a low seedling transplant vigor rating of 7. Percent seed germination is a 28 day count. Seed was germinated at alternating temperatures of 20°C (68°F) and 30°C (86°F) with alternating 8 hrs light and 16 hrs dark. Seedling transplant vigor rating was a visual assessment on a scale of 1-10 (1=excellent, 10=dead).

** Accession was not identified as to species on the original seed collection packet.