



FINAL STUDY REPORT

East Texas Plant Materials Center
Nacogdoches, TX

Adaptation Demonstration of Commercial Wildflower Mixes for Creating Pollinator Habitat in East Texas

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ABSTRACT

The 2008 Farm Bill placed special emphasis on pollinators due to decreasing habitat and colony collapse disorder of honey bees. Desirable pollinator habitat consists of a mix of flowering plants for food and cover for pollinators. The USDA-NRCS East Texas Plant Materials Center planted and evaluated nine commercially available wildflower mixes from five seed sources in non-replicated demonstration plots near Nacogdoches, TX. Plots were planted February 2011 and evaluated for species present, and those persisting after three years. Seven of the nine plots had 75% or greater ground cover after three years. At the end of three years, most plots were dominated by four species, blanket flower (*Gaillardia* spp.), lemon mint (*Monarda citridora*), black eyed-Susan (*Rudbeckia hirta*), and Mexican hat (*Ratibida columnifera*).



Wildflower demonstration stop during the 2011 ETPMC field day, note the concentration of California poppy

INTRODUCTION

Pollinating insects are critical to the production of a vast array of the world's fruit and vegetable production. These crops provide the majority of the vitamins and minerals needed to sustain a healthy life. In 2003 it was estimated that in the United States alone, pollinating insects were responsible for \$18 to \$27 billion in revenue from agricultural crops (Mader et al. 2011). In the last two decades scientists have noticed an alarming trend in the decreasing number of pollinating insect numbers and species (Buchmann and Nabhan 1996; Allen-Wardell et al. 1998; Kearns et al. 1998; Cox and Elmqvist 2000; Steffan-Dewenter et al. 2005; Biesmeijer et al. 2006). The declines have been attributed to man-made causes such as destruction of habitat

through urbanization (Cane 2001), modern agricultural practices (Westrich 1989) and the use of broad spectrum insecticides (Johansen and Mayer 1990).

The United States Department of Agriculture (USDA) responded to pollinator decline in the Food, Energy, and Conservation Act of 2008, also known as the Farm Bill, by offering special incentive programs to landowners that developed enhanced pollinator habitat through the Environmental Quality Improvement Program (EQIP). In response to the 2008 Farm Bill and EQIP incentive program the USDA Natural Resources Conservation Service (NRCS) Plant Materials Program set out to develop technical information to assist NRCS field office staff and landowners in developing high quality, diverse habitat for pollinating insects. In support of this effort, the East Texas Plant Materials Center (ETPMC) in Nacogdoches, TX set up demonstration plots to evaluate commercially available wildflower mixes from seed companies. The mixes were mostly comprised of native wildflower species that were adapted to east Texas and surrounding areas. The demonstration plots were maintained for three years to monitor the species that were present after planting relative to the species in the mix and the species that persisted over the three year study.

MATERIALS AND METHODS

Nine commercial wildflower mixes were purchased from five seed sources and planted in non-replicated demonstration plots at the ETPMC from 2011-2013 (Table 1). The 40-ft x 80-ft plots were planted on 11 February 2011 into a clean, firm, prepared seed bed using a Hege 1000 research plot drill (Wintersteiger Salt Lake City, UT). The seedbed was prepared by disking the plot area in two directions in mid- January, culti-packing, and treating with glyphosate before planting to eliminate any weeds that had germinated. The February planting date was chosen to allow ample time for seed to stratify in cool soil to maximize germination when warmer temperatures arrived. Seeding specifications were adjusted for each plot based on recommendations provided by the seed companies. Plots were irrigated as needed for establishment during the first year using overhead sprinklers. Poast Plus[®] and Select Max[®] were applied at 1.5 pints/acre, and 12 oz. /acre, respectively to control competition from annual, warm season, grasses. One hundred pounds of 13-13-13 was applied to each plot in March 2012 and 2013 to stimulate growth and flowering. Plots were mowed annually in the fall after the majority of plants had mature seed. Alley ways between plots were maintained using a rotary tiller to prevent plots growing into one another. Species present in each plot were recorded during the first growing season and in year three to denote plants that emerged after planting and the plants that persisted in the plots. Plots were mowed in October 2013 to remove standing biomass. Percent cover was measured by randomly placing a 1 m² grid consisting of 25 cells in the plot at 4 locations and counting the number of cells within the grid that were occupied by a wildflower rosette. Percent cover was not measured during the first year due to



Planting wildflower mixes into a clean, prepared seedbed using a Hege 1000 research plot planter

the spacing of the planter's drilled rows, 8 inches between rows. Seed was not randomly distributed and an accurate measure would not have been obtained due to the size of the cells within the grid.

RESULTS AND DISCUSSION

There was a complete stand after planting except the Turner Starburst Fall Mix and Turner Texas Native Fall Mix plots (Table 1). These were the only fall mixes in the demonstration and were not planted at the optimum time for the plant species in the mixes. Plants remained weak throughout the three years producing 50 and 85 percent cover at year three. It should be noted that the demonstration was managed uniformly across seed mixes and the fall mix plots were mowed during the fall with the warm season mix plots. It is anticipated this operation resulted in low flower production, leading to less seed available for reseeding as was noted in the warm season plots. Native American Seed's Butterfly Retreat Mix and Bamert's American Magic Wildflower Mix produced 75 and 65 percent cover at year three, while the remaining mixes produced 85% cover or greater (Table 1).

Specie occurrence within a commercial mix was reported in 2011 and again in 2013 as an estimate of persistence over three years (Table 2a-2i). Species within a mix without asterisks were not present at either evaluation dates. Seed may have germinated and never emerged or emerged and the seedlings died or seed never initiated germination. There is no definitive reason for their lack of occurrence in the planted plots. Species persistence after 2011 may be attributed to lack of adaptability to growing conditions in east Texas, growth habit (e.g. annual, biannual), wildlife damage, or soil disturbance to encourage reseeding. Plots containing California poppy, *Eschscholzia californica*, in the seed mixes were dominated by this species in the first year, but its presence steadily decreased over time, and was only a minor component of the species present by year three. California poppy is shown to be found in Tarrant and Ellis Counties in Texas and Bossier and Lincoln Parishes in Louisiana (USDA NRCS 2014), though it was probably introduced to these areas by seed sources from commercial or residential plantings. It produced rapid establishment during the first year, and was one of the earliest blooming species in the demonstration plots. It has excellent potential as a pioneer species that provides an early nectar source and cover while perennial wildflowers establish. California poppy does not appear to be invasive in its growth or re-seeding habits in east Texas.



Complete stand of seedlings seen behind and adjacent to one of the fall mix plots that did not yield a complete stand after a spring planting



Close up view of a plot after planting showing typical stand and 8 inch spacing of a warm season seed mix during establishment of the demonstration.

Four wildflower species dominated the plots at the end of year three. *Gaillardia* spp. (blanket flower), *Monarda citridora*. (lemon mint), *Rudbeckia hirta*, (black-eyed Susan), and *Ratibida columnifera* (Mexican hat). These species were present in every plot by year three; whether they were part of the original seed mix or not. Their competitive nature and prolific seed production might be compensated by reducing their overall percentage in the seed mixes and increasing the seed percentage of species with wildlife value such as *Desmanthus illinoensis*, *Desmodium* spp, *Dalea* spp., *Helianthus* spp., and *Chamaecrista fasciculata*



There were multiple *Gaillardia* species in the seed mixes that dominated the plots the third year after planting.

Multiple species of butterflies, moths, bees, wasps, flies, and beetles were observed in the plots. General observations found ruby-throated hummingbirds (*Archilochus colubris*) utilizing some flower species as nectar sources, and morning doves (*Zenaida macroura*) and song birds utilized alley ways and mowed plots to forage for seed in late summer through mid-winter. White-tailed deer (*Odocoileus virginianus*) utilized the plots heavily in late winter and early spring, feeding on wildflower rosettes. Selective browsing may have contributed to the proliferation of less palatable species such as blanket flower, lemon mint, Mexican hat, and black-eyed Susan. It was noted in December 2012 that white-tailed deer created trails through cover crop fields planted to a mix of oats, wheat, triticale, radish, turnip, and kale to access the wildflower plots.

CONCLUSION

The use of commercially available wildflower seed mixes to rapidly develop pollinator habitat in east Texas is a feasible option for landowners. There are commercial wildflower mixes available from multiple sources, and most have specialty blends for specific geographic regions or desired pollinators. Adding wildflower mixes to native grass plantings will increase the diversity of the planting and increase wildlife use, both vertebrate and invertebrate. Properly managed plantings will last multiple years with adequate species diversity, though additional plantings or soil disturbance may be needed on 3 to 5 year intervals to increase species occurrence or maximize species diversity. Additional wildlife benefits for birds, small mammals, and deer may be obtained by focusing on palatable wildflower species, especially legumes, and those that produce seed utilized by wildlife.

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Mention of a seed company name does not indicate endorsement by NRCS, nor does NRCS guarantee availability or quantity of seeds produced by the seed company.

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Table 1. Wildflower demonstration seed sources and planting rates, USDA-NRCS East Texas Plant Materials Center, Nacogdoches, TX 2014.

Seed Source	Mix	Planting Rate	Percent Cover
		---lb/acre---	---3rd Year---
Native American Seed	Butterfly Retreat	20	75
Bamert	Bird and Butterfly Blend	8	100
Bamert	American Magic Wildflower Mix	8	65
Turner Seed	Starburst Spring Mix	10	100
Turner Seed	Starburst Fall Mix	10	85
Turner Seed	Texas Native Spring Mix	10	100
Turner Seed	Texas Native Fall Mix	10	50
Douglass King Co.	King's Wildflower Mix	30	100
Applewood Seed Co	Texas/Oklahoma Wildflower Mix	12	85

Table 2a. Wildflower species present in “Native American Seed Company Butterfly Retreat Mix” in year one and after year three. USDA-NRCS East Texas Plant Materials Center, Nacogdoches, TX.

Common Name	Scientific Name	Presence
Texas Bluebonnet	<i>Lupinus subcarnosus</i>	
Indian Blanket	<i>Gaillardia pulchella</i>	**
Lanceleaf Coreopsis	<i>Coreopsis lanceolata</i>	**
American Basketflower	<i>Centaurea americana</i>	*
Purple Coneflower	<i>Echinacea purpurea</i>	
Golden-Wave	<i>Coreopsis basilis</i>	**
Greenthread	<i>Thelesperma filifolium</i>	
Purple Prairie Clover	<i>Dalea purpurea</i>	
Cutleaf Daisy	<i>Erigeron compositus</i>	**
Partridge Pea	<i>Chamaecrista fasciculata</i>	**
Lemon Mint	<i>Monarda citridora</i>	**
Illinois Bundleflower	<i>Desmanthus illinoensis</i>	*
Drummond Phlox	<i>Phlox drummondii</i>	**
Tahoka Daisy	<i>Machaeranthera tanacetifolia</i>	
Prairie Verbena	<i>Glandularia bipinnatifida</i>	*
Standing Cypress	<i>Ipomopsis rubra</i>	**
Maximilian Sunflower	<i>Helianthus maximiliani</i>	**
Gayfeather	<i>Liatris punctata</i>	
Black-Eyed Susan	<i>Rudbeckia hirta</i>	**
Scarlet Sage	<i>Salvia coccinea</i>	*
Mealy Blue Sage	<i>Salvia farinacea</i>	
Butterfly Weed	<i>Asclepias tuberosa</i>	
Winecup	<i>Callirhoe digitata</i>	**
Foxglove	<i>Penstemon cobaea</i>	

* species present in 2011

** species present in 2013

Table 2b. Wildflower species present in “Applewood Seed Company Texas/Oklahoma Mix” in year one and after year three. USDA-NRCS East Texas Plant Materials Center, Nacogdoches, TX.

Common Name	Scientific Name	Presence
Baby's Breath	<i>Gypsophila muralis</i>	*
Texas Bluebonnet	<i>Lupinus subcarnosus</i>	**
Purple Coneflower	<i>Echinacea purpurea</i>	
Lance Leaved Coreopsis	<i>Coreopsis lanceolata</i>	**
Sulphur Cosmos	<i>Cosmos sulphureus</i>	
Annual Gaillardia	<i>Gaillardia</i> sp.	**
Annual Candytuft	<i>Iberis</i> sp.	
Corn Poppy	<i>Papaver rhoeas</i>	*
Red Phlox	<i>Phlox paniculata</i>	**
Purple Prairie Clover	<i>Dalea purpurea</i>	
Dwarf Blue Cornflower	<i>Centaurea cyanus</i>	*
'Polka Dot Mix' Cornflower	<i>Centaurea cyanus</i>	*
Golden Wave Tickseed	<i>Coreopsis basalis</i>	**
Dotted Gayfeather	<i>Liatris punctata</i>	
Lemon Mint	<i>Monarda citridora</i>	**
Dwarf Evening Primrose	<i>Oenothera</i> sp.	**
Clasping Coneflower	<i>Dracopis amplexicaulis</i>	
Prairie Coneflower	<i>Ratibida columnifera</i>	**
Scarlet Sage	<i>Salvia coccinea</i>	
Greenthread	<i>Thelesperma filifolium</i>	*
Black-eyed Susan	<i>Rudbeckia hirta</i>	**
Showy Evening Primrose	<i>Oenothera speciosa</i>	*

* species present in 2011

** species present in 2013

Table 2c. Wildflower species present in “Douglas King Seed Company King's Wildflower Mix” in year one and after year three. USDA-NRCS East Texas Plant Materials Center, Nacogdoches, TX.

Common Name	Scientific Name	Presence
Indian Blanket	<i>Gaillardia pulchella</i>	**
Clasping Coneflower	<i>Dracopis amplexicaulis</i>	
Showy Evening Primrose	<i>Oenothera speciosa</i>	*
Verbena	<i>Verbena</i> sp.	**
Drummond Phlox	<i>Phlox drummondii</i>	**
Blue Bonnet	<i>Lupinus subcarnosus</i>	**
Mexican Hat	<i>Ratibida columnifera</i>	**
Plains Coreopsis	<i>Coreopsis tinctoria</i>	**
Lemon Mint	<i>Monarda citridora</i>	**
Black-Eyed Susan	<i>Rudbeckia hirta</i>	**
Greenthread	<i>Thelesperma filifolium</i>	*

* species present in 2011

** species present in 2013

Table 2d. Wildflower species present in “Bamert Seed Company American Magic Wildflower Mix” in 2011 and 2013. USDA-NRCS East Texas Plant Materials Center, Nacogdoches, TX.

Common Name	Scientific Name	Presence
Bachelor Button	<i>Centaurea cyanus</i>	**
California Poppy	<i>Eschscholzia californica</i>	*
Blue Flax	<i>Linum perenne</i>	*
Annual Lupine	<i>Lupinus concinnus</i>	
Baby's Breath	<i>Gypsophila muralis</i>	*
Lance Leaved Coreopsis	<i>Coreopsis lanceolata</i>	**
Sensation Mix Cosmos	<i>Cosmos bipinnatus</i>	*
Chinese Forget-Me-Not	<i>Cynoglossum amabile</i>	
Sweet Alyssum	<i>Lobularia maritima</i>	
Scarlet Flax	<i>Linum grandiflorum</i>	*
Sweet William	<i>Phlox divaricata</i>	*
Bearded Dianthus	<i>Dianthus</i> sp.	
Indian Blanket	<i>Gaillardia pulchella</i>	**
Godetia	<i>Clarkia amoena</i>	*
Annual Mallow	<i>Lavatera trimestris</i>	*
Purple Coneflower	<i>Echinacea purpurea</i>	
Plains Coreopsis	<i>Coreopsis tinctoria</i>	*
Rocket Larkspur	<i>Consolida ajacis</i>	**
African Daisy	<i>Castalis tragus</i>	
Corn Poppy	<i>Papaver rhoeas</i>	*
Yellow Prairie Coneflower	<i>Ratibida columnifera</i>	**
Money Plant	<i>Lunaria annua</i>	
Clarkia	<i>Clarkia</i> sp.	*
Shasta Daisy	<i>Leucanthemum maximum</i>	
Black-Eyed Susan	<i>Rudbeckia hirta</i>	**
Columbine	<i>Aquilegia</i> sp.	
White Yarrow	<i>Achillea millefolium</i>	*
Strawflower	<i>Bracteantha bracteata</i>	*
Gayfeather	<i>Liatris</i> sp.	

* species present in 2011

** species present in 2013

Table 2e. Wildflower species present in “Bamert Seed Company Bird and Butterfly Blend Mix” in 2011 and 2013. USDA-NRCS East Texas Plant Materials Center, Nacogdoches, TX.

Common Name	Scientific Name	Presence
Perennial Lupine	<i>Lupinus perennis</i>	
Siberian Wallflower	<i>Erysimum x marshallii</i>	
California Poppy	<i>Eschscholzia californica</i>	*
Annual Candytuft	<i>Iberis</i> sp.	
Rocket Larkspur	<i>Consolida ajacis</i>	*
Purple Coneflower	<i>Echinacea purpurea</i>	
Perennial Gaillardia	<i>Gaillardia pulchella</i>	**
Black-eyed Susan	<i>Rudbeckia hirta</i>	**
Annual Gaillardia	<i>Gaillardia</i> sp.	**
Blue Flax	<i>Linum perenne</i>	*
Lemon Mint	<i>Monarda citridora</i>	**
Lance Leaved Coreopsis	<i>Coreopsis lanceolata</i>	**
Showy Milkweed	<i>Asclepias speciosa</i>	
Dwarf Godetia	<i>Clarkia amoena</i>	*
Dwarf Coneflower	<i>Echinacea</i> sp.	
Dwarf Plains Coreopsis	<i>Coreopsis tinctoria</i>	*
Sweet Alyssum	<i>Lobularia maritima</i>	
Scarlet Flax	<i>Linum grandiflorum</i>	
Gayfeather	<i>Liatris</i> sp.	
Dwarf Red Coneflower	<i>Ratibida columnifera</i>	**

* species present in 2011

** species present in 2013

Table 2f. Wildflower species present in “Turner Seed Company Starburst Fall Mix” in 2011 and 2013. USDA-NRCS East Texas Plant Materials Center, Nacogdoches, TX.

Common Name	Scientific Name	Presence
Black Sampson	<i>Echinacea angustifolia</i>	
Black-Eyed Susan	<i>Rudbeckia hirta</i>	**
Blue Flax	<i>Linum lewisii</i>	**
Blue Bonnet	<i>Lupinus sp.</i>	
California Poppy	<i>Eschscholzia californica</i>	*
Corn Poppy (red)	<i>Papaver rhoeas</i>	*
Drummond Phlox	<i>Phlox drummondii</i>	**
Huisache Daisy	<i>Amblyolepis setigera</i>	*
Indian Blanket	<i>Gaillardia pulchella</i>	**
Lemon Mint	<i>Monarda citridora</i>	**
Pitchers Sage	<i>Salvia azurea</i>	
Plains Coreopsis	<i>Coreopsis tinctoria</i>	**
Purple Coneflower	<i>Echinacea purpurea</i>	
Purple Prairie Clover	<i>Dalea purpurea</i>	
Scarlet Flax	<i>Linum grandiflorum</i>	
Showey Evening Primrose	<i>Oenothera speciosa</i>	*
White Yarrow	<i>Achillea millefolium</i>	*

* species present in 2011

** species present in 2013

Table 2g. Wildflower species present in “Turner Seed Co. Starburst Spring Mix” in 2011 and 2013. USDA-NRCS East Texas Plant Materials Center, Nacogdoches, TX.

Common Name	Scientific Name	Presence
Bachelor Button	<i>Centaurea cyanus</i>	**
Black-Eyed Susan	<i>Rudbeckia hirta</i>	**
Blue Flax	<i>Linum lewisii</i>	*
Butterfly Milkweed	<i>Asclepias tuberosa</i>	
California Poppy	<i>Eschscholzia californica</i>	**
Corn Poppy	<i>Papaver rhoeas</i>	*
Cosmos	<i>Cosmos</i> sp.	*
Drummond Phlox	<i>Phlox drummondii</i>	**
Gayfeather	<i>Liatris</i> sp.	
Indian Blanket	<i>Gaillardia pulchella</i>	**
Lance Leaf Coreopsis	<i>Coreopsis lanceolata</i>	**
Lemon Mint	<i>Monarda citridora</i>	**
Moss Verbena	<i>Glandularia pulchella</i>	
Purple Coneflower	<i>Echinacea purpurea</i>	
Purple Prairie Clover	<i>Dalea purpurea</i>	
Scarlet Flax	<i>Linum grandiflorum</i>	
Scarlet Sage	<i>Salvia coccinea</i>	
White Yarrow	<i>Achillea millefolium</i>	*

* species present in 2011

** species present in 2013

Table 2h. Wildflower species present in “Turner Seed Co. Native Spring Mix” in 2011 and 2013. USDA-NRCS East Texas Plant Materials Center, Nacogdoches, TX.

Common Name	Scientific Name	Presence
Black Samson	<i>Echinacea angustifolia</i>	
Black-Eyed Susan	<i>Rudbeckia hirta</i>	**
Clasping Coneflower	<i>Dracopis amplexicaulis</i>	
Gayfeather	<i>Liatris sp.</i>	
Huisache Daisy	<i>Amblyolepis setigera</i>	**
Indian Blanket	<i>Gaillardia pulchella</i>	**
Lead Plant	<i>Amorpha canescens</i>	
Lemon Mint	<i>Monarda citridora</i>	**
Mexican Hat	<i>Ratibida columnifera</i>	**
Plains Coreopsis	<i>Coreopsis tinctoria</i>	**
Prairie Verbena	<i>Glandularia bipinnatifida</i>	*
Cuero' Purple Prairie Clover	<i>Dalea purpurea</i>	
Sleepy Daisy	<i>Xanthisma texanum</i>	
Standing Cypress	<i>Ipomopsis rubra</i>	
Tahoka Daisy	<i>Machaeranthera tanacetifolia</i>	
White Prickley Poppy	<i>Argemone albiflora</i>	**

* species present in 2011

** species present in 2013

Table 2i. Wildflower species present in “Turner Seed Co. Native Fall Mix” in 2011 and 2013. USDA-NRCS East Texas Plant Materials Center, Nacogdoches, TX.

Common Name	Scientific Name	Presence
Black Sampson	<i>Echinacea angustifolia</i>	
Black-Eyed Susan	<i>Rudbeckia hirta</i>	**
Blue Bonnets	<i>Lupinus sp.</i>	
Clasping Coneflower	<i>Dracopis amplexicaulis</i>	
Cutleaf Primrose	<i>Oenothera laciniata</i>	**
Gayfeather	<i>Liatris sp.</i>	
Greenthread	<i>Thelesperma filifolium</i>	*
Huisache Daisy	<i>Amblyolepis setigera</i>	
Indian Blanket	<i>Gaillardia pulchella</i>	**
Lemon Mint	<i>Monarda citridora</i>	**
Mexican Hat	<i>Ratibida columnifera</i>	**
Pitcher Sage	<i>Salvia azurea</i>	
Plains Coreopsis	<i>Coreopsis tinctoria</i>	**
Purple Prairie Clover	<i>Dalea purpurea</i>	
Showy Evening Primrose	<i>Oenothera speciosa</i>	*
Sleepy Daisy	<i>Xanthisma texanum</i>	*
White Prickly Poppy	<i>Argemone albiflora</i>	**

* species present in 2011

** species present in 2013