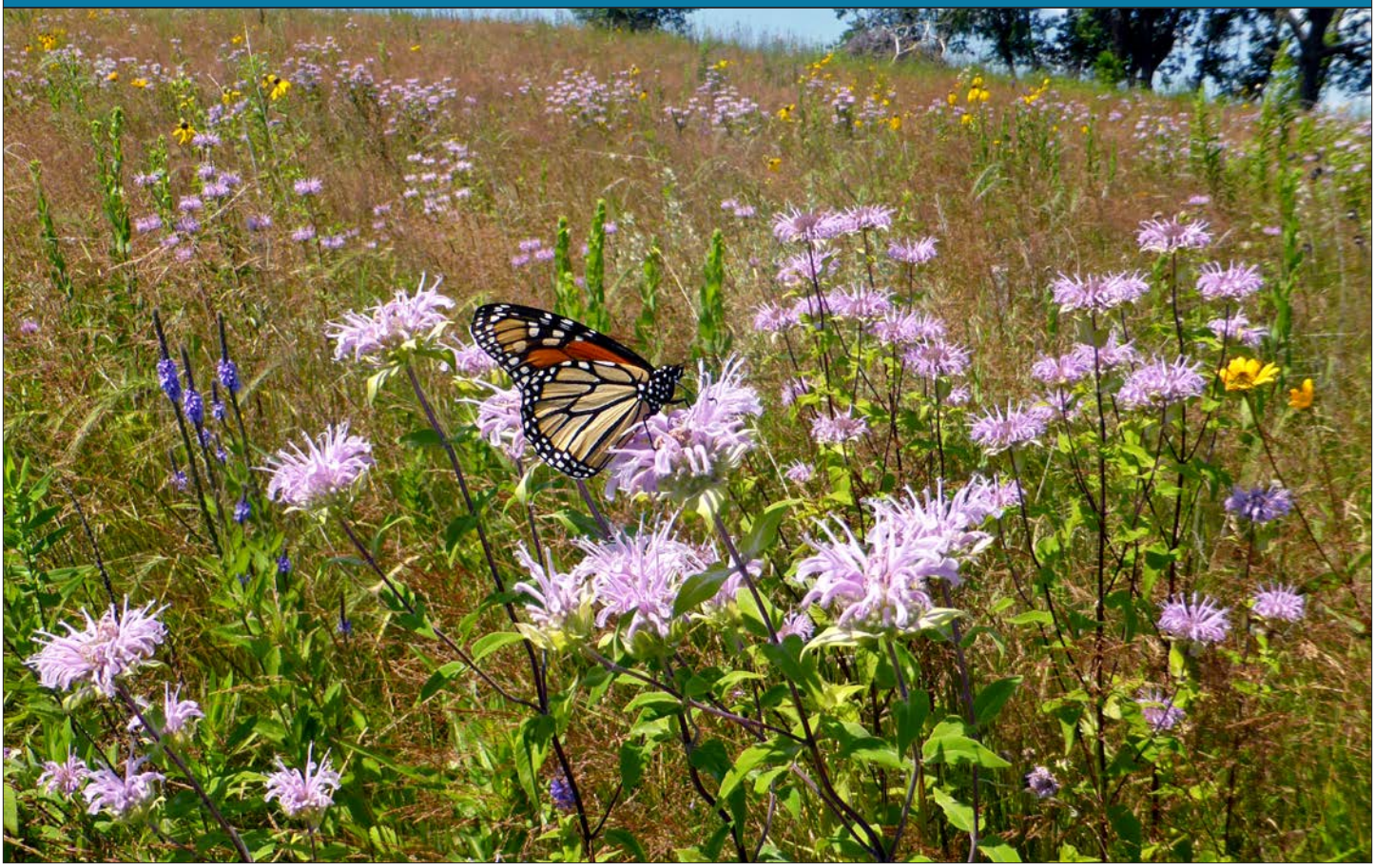
Habitat Installation Guide

Upper Midwest

NATIVE WILDFLOWER MEADOWS
for Pollinators & Beneficial Insects

Guidelines & Job Sheet



Purpose

These instructions provide in-depth guidance on how to install pollinator habitat for bees in the form of native wildflower meadows in the Upper Midwest (Illinois, Indiana, Iowa, Michigan, Minnesota, and Wisconsin). To plan a specific project, use this guide along with the checklist found at the end of this document.

Conservation Objectives

Depending on conservation objectives and project design, pollinator habitat may also provide food and cover for other wildlife, reduce soil erosion, protect water quality, and attract other beneficial insects such as predators and parasitoids of crop pests.

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The Xerces Society for Invertebrate Conservation

www.xerces.org

XERCES SOCIETY for Invertebrate Conservation

Center for Integrated Agricultural Systems (CIAS)

THE UNIVERSITY of WISCONSIN MADISON

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Revised edition

Updated in January 2018 by Sarah Foltz Jordan and Eric Lee-Mäder of the Xerces Society. Earlier edits were applied in February 2015 and October 2015 by Mace Vaughan, Eric Lee-Mäder, Sarah Foltz Jordan, Emily Krafft, and Sara Morris. Please contact Mace Vaughan (mace@xerces.org) to improve this publication .

Editing and layout

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Photographs

Cover: monarch butterfly (*Danaus plexippus*) on wild bergamot (*Monarda fistulosa*), by Sarah Foltz Jordan. We thank the photographers who generously allowed use of their images. Copyright of all photographs remains with the photographers.

- **Jim Cairns, USDA–NRCS: Figure 12A.**
- **Minnesota Department of Natural Resources [flickr.com/minnesota_snas/]: Figure 13A.**
- **Kenneth Cole Schneider [flickr.com/rosyfinch/]: Figure 13C.**
- **Claudia Street, Glenn Co. RCD: Figure 13B.**
- **U.S. National Park Service: Figure** 12C.
- **The Xerces Society/Nancy Lee Adamson:** Figures 22B–E.
- **The Xerces Society/Brianna Borders:** Figure 2A.
- **The Xerces Society/Jessa Kay Cruz:** Figures 6A–B; 9B–C.; 12B
- **The Xerces Society/James Eckberg:** Figures 2B–C.
- **The Xerces Society/Sarah Foltz Jordan:** Cover; Figures 1; 3A–C; 4A–C; 5E–F; 6C; 7D–F; 8A–D; 9A; 10; 15A–D; 16A; 17A–C; 18A–B; 19; 20A–C; 21A–B; 22F.
- **The Xerces Society/Kelly Gill:** Figures 5D; 16B; 20C; 22A.
- **The Xerces Society/Eric Lee-Mäder:** Figure 11.

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The Xerces Society for Invertebrate Conservation is a nonprofit organization that protects wildlife through the conservation of invertebrates and their habitat. Established in 1971, the Society is at the forefront of invertebrate protection, harnessing the knowledge of scientists and enthusiasm of citizens to implement conservation programs worldwide. The Society uses advocacy, education, and applied research to promote invertebrate conservation.

Planning Considerations

Key Site Characteristics

Site selection for pollinator habitat should take the following into consideration:

- **Pesticide Drift:** Habitat must be protected from pesticides (especially insecticides and bee-toxic fungicides and herbicides). This includes some pesticides approved for use on organic farms. Only sites with no to very low risk for pesticide drift should be established as new habitat. For more information, see the References & Resources (page 18).
- **Accessibility:** New habitat should generally be accessible to equipment for planting and maintenance operations.
- **Sunlight:** Most wildflowers and native shrubs grow best in full sunlight.
- **Slope:** Steep or highly erodible sites should generally not be disturbed.
- **Weed Pressure:** Areas with high weed pressure will take more time and effort to prepare for planting. It is also important to note the primary weed composition. Knowing the most abundant weed species on site, their reproductive methods, and whether they are grass or broadleaf, perennial or annual, and woody or herbaceous, will help significantly in planning for site preparation and follow-up weed management during establishment.
- **Site History:** Factors such as past plant cover (e.g., weeds, crops, grass sod, or native plants), use of pre-emergent herbicides or other chemicals, and soil compaction can affect plant establishment. It is also important to know if sites may have poor drainage or may flood, as such conditions make habitat establishment more difficult and require a plant mix adapted for the site.
- **Soils and Habitat:** Most plants listed in the Appendix of this guide are tolerant of many soil conditions and types, however all plants establish better when matched with appropriate conditions.
- **Irrigation:** Establishing plants from plugs, pots, or bare root will likely require irrigation. Irrigation is generally not needed for plantings established from seed.
- **Other Functions:** The site may offer opportunities to serve other functions, such as run-off prevention, stream bank stabilization, wildlife habitat, or windbreaks. Those factors can influence plant choice or design.

Plant Selection

Native Plants: Flower species selection should emphasize plants that provide pollen- and nectar-rich forage resources for bees and other flower-visiting insects. Important larval food plants for butterflies and moth should also be included. Warm-season bunch grasses should be included at a low percentage of the mix (e.g., 50% or less). The Appendix provides specific seed mixes for dry and wetland sites, and a master list of acceptable plants for various locations and environments in the Upper Midwest.

If you are designing a custom plant list, the combination of species should be chosen to provide **consistent and adequate** floral resources throughout the seasons. In order to achieve this goal, a minimum of three species from each blooming period (early, mid, and late season), should be included. Plant mix composition (i.e., percent of each species) can be designed to complement adjacent crop bloom time or other abundant species in the landscape, with more plants blooming immediately before and after adjacent crops.

Non-Native Plants: Plant selection should focus on pollen- and nectar-rich native plants, but non-invasive, non-native plants may be used when cost or availability are limiting factors. Please see the Appendix for acceptable non-native plants. Non-native plants such as buckwheat or clover may be planted as part of a crop rotation or in a perennial crop understory, to increase the value of crop fields to pollinators.

Alternate Pest or Disease Hosts: In most cases, native pollinator plants do not serve as alternate hosts for crop pests or diseases, but selected plants should be cross-referenced for specific crop pest or disease associations. Research indicates that diverse native plantings harbor fewer pests than unmanaged weedy borders.

Figure 1: Native wildflower meadows can help support important native pollinators, like bumble bees.

Requirements

Site Preparation

Site preparation is **one of the most important** and often inadequately addressed components for project success. It is also a process that may require more than one season of effort to reduce competition from invasive, noxious, or undesirable plants prior to planting. *In particular, site preparation should focus on the removal of perennial weeds* (there are more options to address annual or biennial weeds after planting). Regardless of whether the objective is to establish herbaceous or woody vegetation, more effort and time spent eradicating undesirable plants prior to planting will result in higher success rates in establishing the targeted plant community.

Two site preparation methods are provided below. For additional organic (non-herbicide) site preparation methods, see our guidelines *Organic Site Preparation for Wildflower Establishment*, (see References and Resources on page 17).

NOTE: If weed pressure is high, then the weed abatement strategies detailed in **Table 1** should be repeated for an additional growing season.

High weed pressure conditions are characterized by:

- Persistent, year-round cover of undesirable plants (covering the entire surface of the site);
- Sites where weeds have been actively growing (and producing seed) for multiple years (e.g., burdock);
- Sites dominated by introduced sod-forming grasses or rhizomatous forbs (e.g., Canada thistle).

Previously cropped lands—those that have been cultivated or in sod for several years—are generally lower in weed pressure.

Table 1: Site Preparation Methods

METHOD: Non-Selective (Non-Persistent) Herbicide (Figure 2)

Where to Use:

- Conventional farms and organic farms*
- Areas with a low risk of erosion
- Areas accessible to sprayer

Timing:

- Total time: 6+ months
- Begin: Early spring after the first weed growth
- Plant: Late fall after hard frost

Basic Instructions:

1. Mow existing thatch as needed before beginning herbicide treatments to expose new weed growth to the herbicide spray.
2. Apply a non-selective, non-persistent herbicide as per label as soon as weeds are actively growing in the early spring.
3. Repeat herbicide applications throughout the spring, summer, and early fall as needed (whenever emerging weed seedlings reach 4–6").
4. For any herbicide-resistant weeds, mow the area to prevent flowering and seed development as necessary.
5. Plant pollinator seed mix (and any transplants) in the late fall after a hard frost, waiting at least 72 hours after the last herbicide treatment. Refer to the Planting Methods section of this document for specific recommendations.

NOTE: *Do not till. Avoid any ground disturbance that may bring up additional weed seed. An additional year of site preparation is recommended if weed pressure is particularly high (e.g., herbicide is applied more than five times during preparation season but new growth covering more than 30% of area is still present in the fall, or stands of white or red clover covering more than 30% of site remain). Avoid use of herbicides that are bee-toxic (e.g., Paraquat and Gramoxone).*

** Choice of herbicide must be acceptable to OMRI for organic operations or, if not, used outside of certified ground AND approved by an organic certifier.*

Figure 2: The site on the left (A) was prepared with a single glyphosate treatment, leaving a significant stubble layer and persisting weedy grasses. It is not ready for planting. The center photo (B) shows a site that was treated for an entire growing season with repeated glyphosate treatments (applied whenever new weeds appeared). Following these treatments, the stubble was removed with a flail mower and was ready for planting (C). Neither site was cultivated.

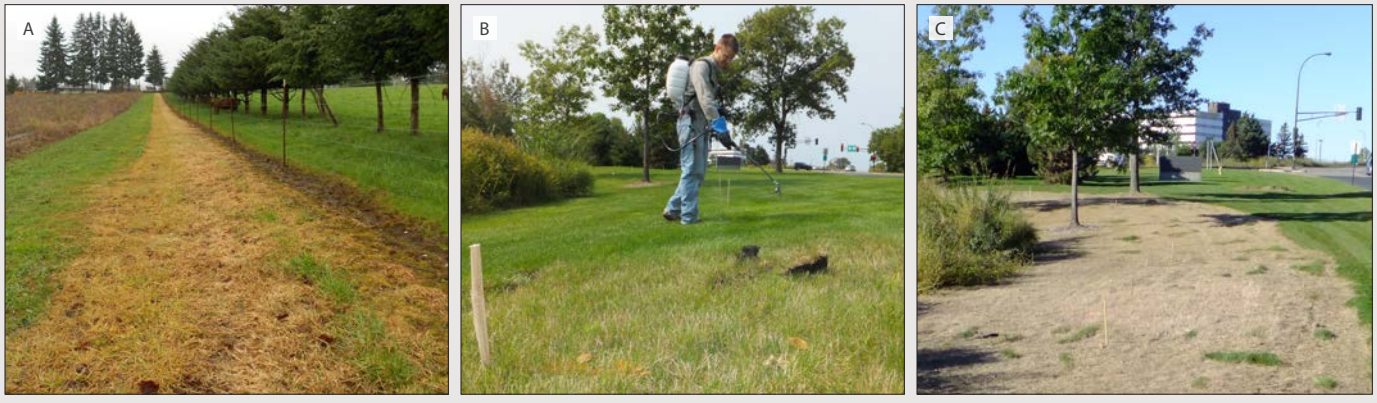


Table 1: Site Preparation Methods *continued*

METHOD: Solarization ⓘ (Figure 3)

Where to Use:x

- Conventional and organic farms
- Areas with a low risk of erosion
- Areas accessible to mowing equipment
- Locations with full sun

Timing:

- Total time: 5+ months
- Begin: Spring
- Plant: Late fall after hard frost

Basic Instructions:

1. Mow or cultivate the site in the spring (raking or burning off debris, if necessary, to avoid puncturing the plastic). After smoothing the site, create a trench around the perimeter in order to more easily bury the edges of the plastic (see below).
2. Lay UV-stabilized plastic (such as high tunnel plastic), burying the edges to prevent airflow between the plastic and the ground. Weigh down the center with rocks or old tires, if necessary, to prevent the wind from lifting it. (Note: weights will have a cooling effect in the immediate areas where they are located, so should be kept to a minimum). Repair any rips that occur during the season with greenhouse repair tape.
3. Remove the plastic in early fall before the weather cools and the area beneath the plastic is recolonized by nearby rhizomatous weeds. Note: annual weeds under solarization plastic are not a huge concern, especially if they have not set seed.
4. Immediately plant the pollinator seed mix. Do not till after solarizing site. Avoid any ground disturbance that may bring up viable weed seed. Refer to Planting Methods section of this document for specific seed bed preparation recommendations.

NOTE: *Solarization may not be as effective in years when summer sun or high temperatures are limited. An additional year of site preparation is recommended if weed pressure is particularly high.*

ⓘ For additional details on solarization, see our guidelines, *Organic Site Preparation for Wildflower Establishment*.

Figure 3: Solarization is an effective method to prepare a site for future planting. For optimal results, the site should get full sun and be accessible to equipment. Begin by cultivating and smoothing the site in early spring. Mowing (instead of cultivating) is also an option, and is preferred if there are weeds present that respond positively to cultivation. Equipment, such as a trencher on a tractor, can be used to dig a trench around the perimeter (A). Next, lay UV-stabilized plastic (B) and bury the edges (C), weighing down the center with rocks if necessary to prevent airflow between the plastic and the ground. Throughout the season, repair any holes in the plastic with high-tunnel repair tape, to keep the temperature high. Remove the plastic in early fall and immediately plant the pollinator seed mix without tilling the site (see Table 2 Methods for Planting Wildflower Seed for instructions).

Planting Methods

Recommended planting methods are site-specific. Factors such as equipment availability and site size should be taken into consideration. Installing and maintaining habitat should fit into general farm management practices as much as possible. Pre-project site conditions, especially weed competition, should be addressed prior to planting. **Table 2** (p. 6–9) covers several planting options.

Seeding Wildflowers: Planting from seed can be a lower-cost way to establish wildflowers. Seeding requires **excellent site preparation** to reduce weed pressure since weed control options are limited when the wildflowers start to germinate. **Most native wildflowers are best planted in the late fall.**

Hand-broadcasting is an excellent method for small sites. Drop-seeders or fertilizer spreaders, with simple modifications, can be used for larger sites. Native seed drills can also be used for larger sites, although they are often more challenging to operate effectively. **Table 2** outlines several possible seeding methods.

Newly-planted areas should be clearly marked to protect them from herbicides or other disturbances.

Table 2: Methods for Planting Wildflower Seed

METHOD: Broadcasting Seeders or Hand-Broadcasting (Throwing Seed) (Figures 4 & 5)

Pros:

- Inexpensive
- Easy to use
- Can often accommodate poorly-cleaned seed
- Many models and sizes of broadcasters are commonly available, including hand-held crank and larger tractor- or ATV-mounted models

Cons:

- Requires a smooth seed bed
- Seed should be pressed firmly into the soil after planting (unless fall planting, in which case this step can be skipped)
- Difficult to calibrate
- Some models of broadcast seeders cannot accommodate large seeds

Basic Instructions:

1. Remove as much stubble as possible prior to seeding, creating a smooth, lightly-packed seed bed. The soil surface can be lightly hand-raked or harrowed to break up crusted surfaces, but do not cultivate the site (cultivation will bring up additional weed seed).
2. Seeds of similar sizes can be mixed together and bulked up with an inert carrier ingredient such as peat moss, sawdust, gypsum, clean sand, pelletized lime, or polenta (fine cornmeal). Use two to three parts bulking agent for each part seed by volume. These inert carriers ensure even seed distribution in the mix, provide visual feedback on where seed has been thrown, and make calibration easier.
3. The broadcast-seeding equipment used should have a flow gate that closes down small enough to provide a slow, steady flow of your smallest wildflower seed. Models with an internal agitator are also preferred. Planting should begin with the flow gate set to the narrowest opening, to allow at least two perpendicular passes over the seed bed for even distribution. Very large seed can be planted separately with the flow gate set to a wider opening.
4. For small sites (e.g., less than one to two acres), seed can also be hand broadcast (similar to scattering poultry feed). When hand-broadcasting, divide the seed into at least two batches, bulk the seed mix with an inert carrier, and sow each batch separately (scatter the first batch evenly over the site while walking in parallel passes across the site, and then walk in passes perpendicular to the previous passes to scatter the second batch) to ensure seed is evenly distributed.
5. Regardless of how it is broadcast, do not cover the seed with soil after planting. A water-filled turf grass roller (available for rent at most hardware stores) or a cultipacker should be used to press the seed into the soil surface. Natural precipitation or light overhead irrigation can also help ensure good seed-soil contact. Floating row-cover can be used, if necessary, to protect seeds and small seedlings against predation. A very light covering of weed free straw may be necessary on sites where water flows through and there is the potential for rains to wash the seeds away.

Figure 4: For broadcast seeding, seed of similar size is mixed together (A). Sawdust, peatmoss, or another inert carrier is added at a ratio of at least 2:1 (more for larger sites) and then mixed (B). The mix is divided into separate batches for broadcasting in more than one pass (to ensure adequate coverage). When hand-broadcasting seed, walk in perpendicular passes over the entire planting area (C).

Figure 5: When planting native wildflowers by hand-broadcasting or with a drop seeder, the seed should be planted directly on the soil surface (D). After broadcasting, roll the site with a turf roller (E) or cultipacker (F).

Table 2: Methods for Planting Wildflower Seed *continued*

METHOD: Drop Seeders (Dropping Seed) (Figures 6 & 7)

Pros:

- Inexpensive
- Easy to use
- Even seed dispersal
- Can accommodate both large and small seed
- Many models and sizes are commonly available (hand-powered turf grass seeders are most common, but larger tractor-drawn "pasture-seeder" models also exist)

Cons:

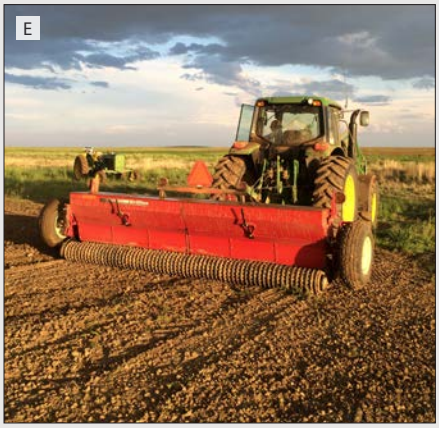
- Requires a smooth, level seed bed
- Seed should be pressed into the soil after planting (unless fall planting)
- Hand-powered models are time consuming for large areas (over 1/2 acre), tractor-powered models are more efficient on larger sites
- Calibration requires trial and error

Basic Instructions:

1. Remove as much stubble as possible prior to seeding, creating a smooth, lightly-packed seed bed. The soil surface can be lightly hand-raked or harrowed to break up crusted surfaces, but do not cultivate the site (cultivation will bring up additional weed seed).
2. Seed of similar sizes can be mixed together and bulked up with an inert carrier ingredient such as peat moss, sawdust, gypsum, clean sand, pelletized lime, or polenta (fine cornmeal). Use two to three parts bulking agent for each part seed by volume. These inert carriers ensure even seed distribution in the mix, provide visual feedback on where seed has been thrown, and make calibration easier. Planting should begin with the drop gate set to the narrowest opening, to allow at least two perpendicular passes over the seed bed for even distribution. Very large seed can be planted separately with the drop gate set to a wider opening.
3. Do not cover the seed after planting. Unless fall planting, a water-filled turf grass roller (available for rent at most hardware stores) or a cultipacker should be used to press the seed into the soil surface (See Figure 5). Natural precipitation or light overhead irrigation can also help ensure good seed-soil contact. Floating row-cover can be used, if necessary, to protect seeds and small seedlings against predation.

Figure 6: Hand-crank "belly grinder" type seeders (A) are inexpensive and can broadcast seed more evenly than hand-scattering on larger sites. ***Note:*** It can be difficult to plant very large and very small seed together in a single seed mix using mechanical broadcasters. Use an inert carrier and walk in at least two perpendicular passes to ensure the most even seed distribution possible. Similarly, lawn fertilizer spreaders (B) are another commonly available tool for broadcasting seed. In both cases, models with internal agitators are preferred to prevent clogging. For best results, divide the seed into separate batches, grouping seed of similar sizes (C) for planting together with the flow gate adjusted accordingly.

Figure 7: **Alternately**, tractor-powered spreaders (D), dropseeders (E), and native seed drills (Figure 8) are ideal for large planting sites (5+ acres). Tractor-powered spreaders can broadcast over larger areas, have motorized agitators to prevent clogging, and only require a tractor to operate (F).



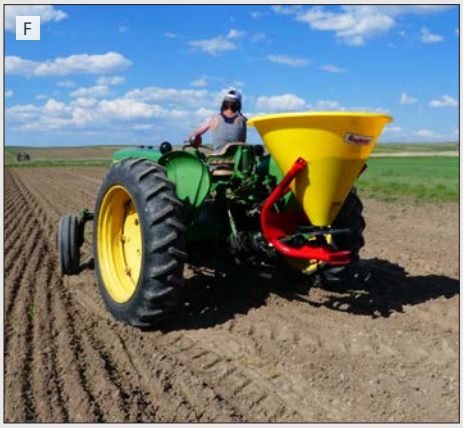


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Table 2: Methods for Planting Wildflower Seed *continued*

METHOD: Native Seed Drills (Drilling Seed) (Figure 8)

Pros:

- Convenient for planting large areas (note: do not use grain drills, which are not equipped to handle small seed)
- Seed box agitators and depth controls are designed specifically for planting small and fluffy native seeds at optimal rate and depth
- Can plant into a light stubble layer
- Seeds are planted in even rows, allowing for easier seedling recognition
- Does not require seed to be pressed into soil surface after planting (e.g., cultipacking)

Cons:

- Expensive and not readily available in some areas
- Difficult to calibrate, especially for small areas (less than one acre)
- Requires a tractor and an experienced operator to set planting controls
- Abrupt turns or bumps can spill large quantities of seed
- Seed with a lot of chaff can clog delivery tubes

Basic Instructions:

1. Plant only when the soil is dry enough to prevent sticking to the coulters. Under wet conditions, small seed is likely to stick to mud-caked parts of the drill, rather than the ground.
2. Keep seed separated by species until ready to plant. Prior to planting, seed should be organized into batches of large smooth seed, small smooth seed, and tufted seed that does not flow easily. Loosely fill seed boxes (do not compact seed into them) with the appropriate seed batch for each box. Seed quantities that do not cover the agitator should be planted using some other method, since the drill is difficult to calibrate for small volumes of seed.
3. As a general rule, the planting depth for a particular seed should be no more than 1.5× its diameter. To achieve this for most wildflower seed, set the depth controls to plant no deeper than ¼" (consult with the seed vendor for specific guidelines on very sandy soils). Small wildflower seed should be planted on the soil surface. Stop periodically to check planting depth.
4. Operate the drill at less than 5 mph, stopping periodically to check for any clogging of planting tubes (usually observed as a seedbox that is remaining full). Clogging is most common with fluffy seed, or seed with a lot of chaff. Avoid backing up the drill as it will likely cause clogging.

For information on the calibration of native seed drills (shown: Truax™ Flex II no-till drill), see the Michigan NRCS Field Office Technical Guide, *Agronomy Technical Note #63 "Calibration of Truax No-Till Grain Drill (Model FLX 1188RD)".* Available at: https://efotg.sc.egov.usda.gov/references/public/MI/AG_TN63_Calibration_of_Truax_Grain_Drill.pdf. [Accessed January 2018.]

Figure 8: Native seed drills (A) are the ideal tool for large planting sites (5+ acres). Typical models can plant in a light stubble layer (B), have depth controls for optimal seed placement, and have separate seed boxes for different sizes of seed (C, D). **Such drills need an experienced operator and careful calibration.**

Table 2: Methods for Planting Wildflower Seed *continued*

METHOD: Transplanting Forbs and Woody Plants (Figure 9)

Pros:

- Provides mature nectar and pollen resources more quickly
- Does not require specialized planting equipment (except for large trees)
- Preferred for plants that are expensive or difficult to establish from seed
- Transplants can be established more easily in weedy sites with adequate mulching

Cons:

- Expensive and time consuming for large areas
- Transplants typically require irrigation during establishment

Basic Instructions:

1. Regular shovels are adequate for transplanting most container stock. However, dibble sticks or mechanical transplanters are sometimes helpful for plug-planting. Power augers and mechanical tree spades can be helpful for larger plants.
2. Plant size at maturity should be considered when planting. Most woody shrubs can be spaced on 4' to 10' centers (depending upon size at maturity), with most herbaceous plants spaced closer on 2' to 3' centers. It is helpful to measure the planting areas prior to purchasing transplants, and to stage the transplants in the planting area prior to installing them in the ground.
3. Transplanting can occur any time the ground can be worked, but should be timed to avoid prolonged periods of hot, dry, or windy weather. Regardless of when planting occurs, transplants should be irrigated thoroughly immediately after planting. Holes for plants can be dug and pre-irrigated prior to planting as well. Follow-up irrigation is dependent upon weather and specific site conditions, but generally even native and drought tolerant plants should be irrigated with at least 1" of water per week (except during natural rain events), for the first two years after establishment. Long, deep watering is best to encourage deep root system development and shallow irrigation should be avoided. Drip irrigation is useful, and other methods that allow for deep watering can be successful. It is advisable to irrigate at the base of plants and avoid overhead irrigation that would encourage weed growth. Once plants are established, irrigation should be removed or greatly decreased. Non-native plants may require more frequent irrigation, and may still require supplemental irrigation once established.
4. Most of the plants in the Appendix are adapted to a variety of soil conditions and do not need any specific amendments. However, in areas where the soil is compacted, degraded, or depleted, compost should be used during planting. Compost should be free from weed seeds, aged properly, and mixed thoroughly with soil in the holes during planting.
5. In cases where rodent damage may occur, below-ground wire cages are recommended. Similarly, plant guards may be needed to protect plants from above ground browsing or antler damage by deer. Newly-planted areas should be clearly marked to protect them from herbicides or other disturbances.
6. Mulching is recommended to reduce weed competition and to retain moisture during the establishment phase. Recommended materials include wood chips, bark dust, weed-free straw (e.g., oat straw), or other regionally appropriate mulch materials that do not contain viable weed seeds. Mulch is intended to remain on the surface and not be incorporated into the soil.

Figure 9: Grow tubes (A), trunk protectors (B), and below ground wire cages (C) can protect transplants during establishment by reducing browsing by herbivores and trunk damage from mowers or weeding operations. Protective materials should be removed as soon as possible to avoid impeding plant growth.

Maintenance During Establishment (Short-Term)

Weed control is critical in the first and second years after planting. If the site is well prepared, then less effort will be required for weeding after project installation. Maintenance practices must be adequate to control noxious and invasive species and may involve tools such as mowing, burning, hand-hoeing, or spot-spraying with herbicides.

Weeds should be prevented from going to seed in, or adjacent to, the project area during the first two years (and possibly three) after planting to help ensure long-term success. Familiarity with the life cycle of weeds will facilitate appropriate timing of management activities. Since young wildflower and weed seedlings may look alike, care should be taken to properly identify weeds before removal.

Common weed-management strategies include:

- **Mowing/String-trimming:** Mowing or string-trimming can be utilized to keep weedy species from shading out other plants and to prevent them from going to seed. Mowing is especially useful when establishing wildflower plots of perennial species. When planted with perennial seed mixes, sites should be mowed occasionally—ideally as high as mower settings allow—during the first year after planting to prevent annual and biennial weeds from flowering and producing seed. Perennial wildflowers are slow to establish from seed, and are usually not harmed by incidental mowing in the first year after planting. Mowing can also be used on plots of re-seeding annuals at the end of the growing season to help shatter wildflower seedpods, and to reduce woody plant encroachment. Mowing and string-trimming can also be useful around woody transplants to manage nearby weeds.
- **Hand-weeding:** Hand-weeding (including hoeing) can be effective in small areas with moderate weed pressure. Hand-weeding will likely be necessary in wildflower plots to eliminate broadleaf weeds during the first few seasons.
- **Spot-spraying:** Spot-spraying with herbicides can be effective, relatively inexpensive approach to dealing with highly problematic perennial weeds (e.g., Canada thistle). Care should be taken so that herbicides do not drift or drip onto desirable plant species. Spot-spraying is usually performed with backpack spraying, or occasionally with rope-wick implements (when weed growth is substantially taller than newly established wildflowers).
- **Selective Herbicides:** Grass-selective herbicides can be used to control weedy grasses in broadleaf plantings. Contact a local crop advisor or Extension specialist for appropriate herbicide selection and timing.
- **Managing Irrigation:** Most wildflowers established from seed thrive with little or no supplemental irrigation. Keeping irrigation to a minimum helps native wildflowers out-compete non-native weedy species that sometimes have higher soil moisture requirements. Similarly, when irrigation is needed for transplants, it should be supplied at the base of the transplant whenever possible—through drip irrigation, for example—to avoid watering nearby weeds.

Figure 10: ***Short Term (2015):*** In the first spring after seeding the previous fall, this site is dominated by annual and biennial weeds. Mowing the site periodically during the first year (ideally as high as mower settings allow) will prevent these short-lived weeds from producing more seed, and allow sunlight to reach the slower-growing natives (outlined), which are generally unharmed by the occasional mowing. ***Long Term (2016):*** Flourishing wildflowers and pollinator habitat in the second year after planting.

Operations and Maintenance (Long-Term)

Control herbivores as needed, but remove tree guards or other materials that could impede plant growth as soon as possible after establishment. In most cases, irrigation can be removed from transplants by the end of the second year after planting. Continue to protect habitat from pesticides and herbicides except when necessary to control noxious or invasive plants. Ongoing herbicide use (spot-treatment) or occasional hand-weeding may be necessary to control noxious weeds. Maintain the long-term plant diversity of pollinator habitat by re-seeding or re-planting as necessary.

Wildflower plantings generally need to be managed over time to maintain open, early successional characteristics. The actual management will depend on the size and location of the habitat. Possible management tools/ techniques include mowing or burning. If mowing is used, be sure all equipment is clean and free of weed seed. Do not mow or burn during critical wildlife nesting seasons (consult your state wildlife biologist for specific guidance). After establishment, no more than 30% of the habitat area should be mowed or burned in any one year to ensure sufficient undisturbed refuge areas for pollinators and other wildlife.

Finally, note that some common farm management practices can cause harm to bees and other beneficial insects. Insecticides are especially problematic, including some insecticides approved for organic farms. Therefore, if insecticide spraying is to occur on the farm, it is critical that the pollinator meadow is outside of the sprayed area or protected from application and drift.

Figure 11: Newly-planted areas should be clearly marked to protect them from herbicides or other disturbances.

Note: *using signs such as the one above can be a useful tool to designate protected pollinator habitat. Due to wildlife safety concerns, we recommend attaching habitat signs to the top hole of the fence post or plugging the top hole with a bolt and nut. Alternatively, posts which do not have holes—such as solid wood stakes—should be used.*

Figure 12: Targeted weed management techniques like hand-weeding (A), spot-spraying (B), or spot-mowing (C), are often the most effective ways to remove weeds without harming desirable species, although they can be time-consuming on large sites.

Figure 13: Long-term site management techniques, like prescribed fire (A) or mowing (B), can be highly effective for managing native plant populations to favor wildflowers over aggressive grasses and woody species. In order to avoid disturbing ground-nesting wildlife—like these killdeer (C) that were displaced after mowing destroyed their nests—management should be timed to avoid peak nesting dates and limited to no more than 30% of a habitat area in a given year.

Appendix: Seed Mixes, Plant Lists, and References

Sample Seed Mixes

The following sample seed mixes are formulated for a one-acre planting area. For larger areas, increase the rate accordingly. To create custom seed mixes, see recommended species master list on page 14 or the references section for vendors. *Plants are listed by first season of bloom, then alphabetically by scientific name.* ***Note:*** *"% of mix" is by seed count, not seed weight.*

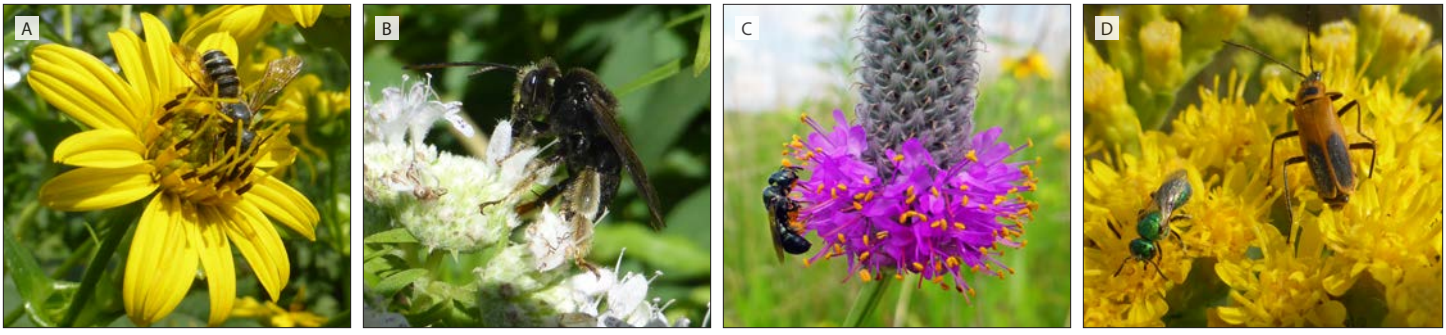
Mesic Site Pollinator Seed Mix

The mix is designed to provide season-long pollen and nectar resources on any sunny mesic to slightly dry upland site.

	SCIENTIFIC NAME	COMMON NAME	% OF MIX†	SEEDS/ FT²	LBS/AC.
EARLY	*Baptisia alba*	White wild indigo	0.2%	0.12	0.19
	Lupinus perennis	Wild lupine	0.3%	0.18	0.45
	Zizia aurea	Golden Alexanders	6%	3.6	0.89
EARLY–MID	*Penstemon grandiflorus*	Large-flowered penstemon	5.5%	3.3	0.64
	Tradescantia ohiensis	Ohio spiderwort	5.5%	3.3	1.12
MID	*Agastache foeniculum*	Anise hyssop	7%	4.2	0.13
	Asclepias syriaca	Common milkweed	1%	0.6	0.41
	Asclepias tuberosa	Butterfly milkweed	0.4%	0.24	0.08
	Dalea purpurea	Purple prairie clover	5%	3	0.54
	Echinacea purpurea	Purple coneflower	2%	1.2	0.5
	Monarda fistulosa	Wild bergamot	12%	7.2	0.28
	M. punctata	Dotted mint	7%	4.2	0.13
	Pycnanthemum virginianum	Virginia mountain mint	5%	3	0.04
	Ratibida pinnata	Yellow coneflower	4%	2.4	0.22
	Silphium laciniatum	Compass plant	0.1%	0.06	0.25
MID–LATE	*Helianthus maximiliani*	Maximilian sunflower	4%	2.4	0.5
	Liatris ligulistylis	Meadow blazing star	2%	1.2	0.33
LATE	*Eryngium yuccifolium*	Rattlesnake master	1%	0.6	0.22
	Solidago speciosa	Showy goldenrod	7%	4.2	0.12
	Symphyotrichum laeve	Smooth blue aster	3%	1.8	0.09
	Sym. novae-angliae	New England aster	3%	1.8	0.07
—	*Andropogon gerardii*	Big bluestem	5%	3	0.82
	Koeleria macrantha	Prairie junegrass	3%	1.8	0.02
	Schizachyrium scoparium	Little bluestem	10%	6	1.09
	Sporobolus heterolepis	Prairie dropseed	1%	0.6	0.1
		TOTALS	**100%**	**60**	**9.22**

Figure 14: Meadow blazing star (A), showy goldenrod (B), and new england aster (C), are very attractive to monarch butterflies.

Figure 15: Cup plant (A), Virginia mountain mint (B), purple prairie clover (C), and stiff goldenrod (D) attract diverse species of native pollinators and beneficial insects.



SAMPLE SEED MIXES KEY	BLOOM TIME	†	% OF MIX is calculated by seed count, not by weight	LEGUME	MONARCH NECTAR PLANT (see p. 18)	LARVAL HOST PLANT (butterfly/moth; see *Master Plant Lists* on page 15)

Wetland to Mesic Pollinator Seed Mix

The mix is designed to provide season-long pollen and nectar resources in a wetland or semi-reparian site, including along irrigation ditches, streams, flood-prone areas, and rain gardens.

BLOOM TIME	SCIENTIFIC NAME	COMMON NAME	% OF MIX†	SEEDS/ FT²	LBS/AC.
EARLY	*Zizia aurea*	Golden Alexanders	2%	1.2	0.3
EARLY–MID	*Tradescantia ohiensis*	Ohio spiderwort	0.5%	0.3	0.1
MID	*Asclepias incarnata*	Swamp milkweed	0.5%	0.3	0.17
	Echinacea purpurea	Purple coneflower	10%	6	2.48
	Eutrochium purpureum	Sweet Joe Pye weed	5%	3	0.19
	Lobelia siphilitica	Great blue lobelia	20%	12	0.07
	Monarda fistulosa	Wild bergamot	10%	6	0.23
	Silphium perfoliatum	Cup plant	1%	0.6	1.17
MID–LATE	*Eupatorium perfoliatum*	Boneset	10%	6	0.1
LATE	*Eryngium yuccifolium*	Rattlesnake master	1%	0.6	0.22
	Helenium autumnale	Sneezeweed	10%	6	0.13
	Solidago speciosa	Showy goldenrod	5%	3	0.09
	Symphyotrichum novae-angliae	New England aster	5%	3	0.12
—	*Andropogon gerardii*	Big bluestem	10%	6	1.63
	Carex stricta	Tussock sedge	5%	3	0.15
	Carex vulpinoidea	Fox sedge	5%	3	0.08
		TOTALS	100%	60	7.23

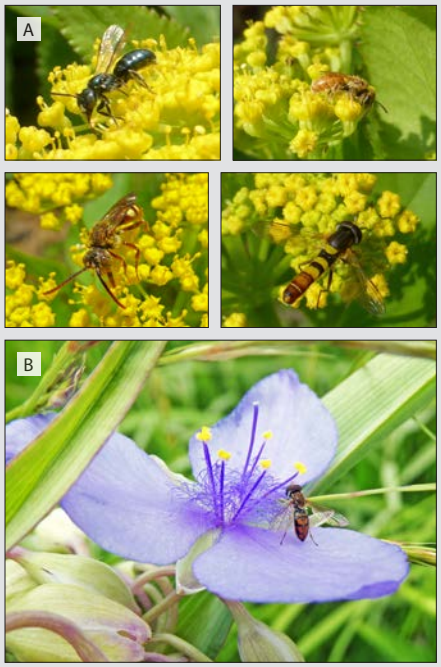
Figure 16: Sweet Joe Pye weed (A) and swamp milkweed (B) do well in moist to wet soils.

Dry Pollinator Seed Mix

The mix is designed to provide season-long pollen and nectar resources in a sunny dry site where drought-tolerant native prairie plants are required.

BLOOM TIME	SCIENTIFIC NAME	COMMON NAME	% OF MIX†	SEEDS/ FT²	LBS/AC.
EARLY	*Zizia aurea*	Golden Alexanders	2%	1.2	0.3
	Lupinus perennis	Wild lupine	3%	1.8	4.46
EARLY–MID	*Coreopsis lanceolata*	Lanceleaf coreopsis	11%	6.6	0.9
	Tradescantia ohiensis	Ohio spiderwort	1%	0.6	0.2
MID	*Asclepias tuberosa*	Butterfly milkweed	1%	0.6	0.19
	Dalea purpurea	Purple prairie clover	10%	6	1.09
	Monarda fistulosa	Wild bergamot	10%	6	0.23
	M. punctata	Dotted mint	10%	6	0.18
	Pycnanthemum virginianum	Virginia mountain mint	10%	6	0.07
	Verbena stricta	Hoary vervain	9%	5.4	0.53
MID–LATE	*Liatris ligulistylis*	Meadow blazing star	1%	0.6	0.16
LATE	*Oligoneuron rigidum*	Stiff goldenrod	5%	3	0.2
	Symphyotrichum laeve	Smooth blue aster	5%	3	0.15
	Sym. oolentangiense	Skyblue aster	3%	1.8	0.06
—	*Koeleria macrantha*	Prairie junegrass	3%	1.8	0.02
	Schizachyrium scoparium	Little bluestem	10%	6	1.09
	Sorghastrum nutans	Indian grass	5%	3	0.68
	Sporobolus heterolepis	Prairie dropseed	1%	0.6	0.1
		TOTALS	100%	60	10.62

Figure 17: Early blooming species, like golden Alexanders (A) and Ohio spiderwort (B), are vital resources for pollinators and beneficial insects.



Low Cost Pollinator Seed Mix

This low cost mix provides fewer season-long pollen and nectar benefits, and may be less resistant to weed encroachment. For extremely large sites, however—especially where financial resources are limited—it may be a preferred option.

❀	SCIENTIFIC NAME	COMMON NAME	% OF MIX†	SEEDS/ FT²	LBS/AC.
EARLY–MID	*Coreopsis lanceolata*	Lanceleaf coreopsis	8%	4.8	0.65
	Penstemon grandiflorus	Large-flowered penstemon	5%	3	0.58
MID	*Achillea millefolium*	Yarrow	8%	4.8	0.07
	Chamaecrista fasciculata	Partridge pea	2%	1.2	1.21
	Dalea purpurea	Purple prairie clover	7%	4.2	0.76
	Echinacea purpurea	Purple coneflower	4%	2.4	0.99
	Gaillardia aristata	Blanketflower	6%	3.6	0.84
	Monarda fistulosa	Wild bergamot	6%	3.6	0.14
	M. punctata	Dotted mint	8%	4.8	0.15
	Ratibida pinnata	Yellow coneflower	7%	4.2	0.38
MID–LATE	*Helianthus maximiliani*	Maximilian sunflower	8%	4.8	1.01
LATE	*Solidago nemoralis*	Old field goldenrod	4%	2.4	0.02
—	*Andropogon gerardii*	Big bluestem	8%	4.8	1.31
	Koeleria macrantha	Prairie junegrass	3%	1.8	0.02
	Schizachyrium scoparium	Little bluestem	8%	4.8	0.87
	Sorghastrum nutans	Indian grass	8%	4.8	1.09
		TOTALS	**100%**	**60**	**10.10**

Figure 18: Many pollinator plants, like dotted mint (A) and yellow coneflower (B) are also very attractive to a variety of beneficial insects.

Figure 19: Plant selection should focus on pollen- and nectar-rich native plants as much as possible, with enough plant diversity to ensure consistent and adequate floral resources through the seasons, as demonstrated by this pollinator planting in Minnesota.

Figure 20: Late-blooming species of wildflowers, like showy goldenrod (A), field thistle (B), and sneezeweed (C), are especially important to include in any pollinator planting because they provide essential resources for migrating monarchs and bumble bee queens preparing to overwinter.

Master Plant Lists

Recommended Native Wildflowers for Pollinators

	SCIENTIFIC NAME	COMMON NAME				NOTES
Early	*Baptisia alba*	White wild indigo	P	4'	L	[Wild indigo duskywing]; slow to establish
	Lupinus perennis	Wild lupine	P	2'	L	[11 spp., incl. Karner's blue & frosted elfin]; prefers sandy soil
	Zizia aurea	Golden Alexanders	P	3'	H	[Black swallowtail]; adapted to disturbance
Early–Mid	*Coreopsis lanceolata*	Lanceleaf coreopsis	P	2'	L	Establishes quickly
	Penstemon grandiflorus	Large-flowered penstemon	P	2'	L	Very showy; prefers sandy soil; requires dry soil
	Tradescantia ohiensis	Ohio spiderwort	P	3'	M	Can tolerate partial shade
Mid	*Achillea millefolium*	Yarrow	P	2'	L	[Painted lady]; very aggressive
	Agastache foeniculum	Anise hyssop	P	5'	M	Establishes quickly
	Asclepias incarnata	Swamp milkweed	P	5'	M–H	[Monarch; delicate cycnia]; prefers wetter soils
	A. syriaca	Common milkweed	P	6'	M	[Monarch; cecropia silkmoth; several tiger moths]
	A. tuberosa	Butterfly milkweed	P	3'	L	[Monarch]; prefers sandy soil
	Chamaecrista fasciculata	Partridge pea	A	2'	L	[Io moth; sleepy orange, cloudless sulphur, little yellow]; favors disturbed sites; self-seeding annual
	Dalea purpurea	Purple prairie clover	P	2'	L	[Reakirt's & marine blues; southern dogface]; does not tolerate grazing well
	Echinacea purpurea	Purple coneflower	P	4'	M	Establishes quickly
	Eutrochium purpureum	Sweet Joe Pye weed	P	7'	H	Prefers part-shade and fertile soil
	Lobelia siphilitica	Great blue lobelia	P	3'	H	Prefers part-shade and fertile soil
	Monarda fistulosa	Wild bergamot	P	4'	M	[Hermit sphinx]; rhizomatous; establishes quickly
	M. punctata	Dotted mint	A, B, P	3'	M	Prefers sandy soil; establishes quickly
	Pycnanthemum virginianum	Virginia mountain mint	P	3'	M	[Hermit sphinx]
	Ratibida pinnata	Yellow coneflower	P	4'	M	Tends to grow tall and spindly on fertile sites
	Silphium laciniatum	Compass plant	P	12'	M	Large-statured plant
	Sil. perfoliatum	Cup plant	P	8'	M	Occasionally aggressive; stems provide nest sites
	Verbena stricta	Hoary vervain	P	3'	L–M	Does well in dry soil
Mid–Late	*Eupatorium perfoliatum*	Boneset	P	5'	H	[Numerous blues]; prefers fertile soil
	Helianthus maximiliani	Maximilian sunflower	P	7'	L	[Bordered patch]; tends to grow tall & spindly on fertile sites
	Liatris ligulistylis	Meadow blazing star	P	5'	L	*Liatris* spp. excellent monarch nectar plants
	L. pycnostachya	Prairie blazing star	P	5'	M	*L. aspera* also recommended
	Vernonia fasciculata	Prairie ironweed	P	5'	H	[Painted lady; yellow-spotted tiger moth]; butterfly magnet
Late	*Cirsium discolor*	Field thistle	A, B, P	6'	M	[Painted lady]; short-lived **native**; not aggressive
	C. flodmanii	Flodman's thistle	B	2'	H	Short-statured **native** for rain gardens or other moist soils
	Eryngium yuccifolium	Rattlesnake master	P	6'	M	[Rattlesnake-master borer moth]
	Gentiana andrewsii	Bottle gentian	P	2'	M	Not drought tolerant
	Helenium autumnale	Sneezeweed	P	2'	H	[Dainty sulphur]; prefers fertile soil; toxic to livestock
	Oligoneuron rigidum	Stiff goldenrod	P	5'	L	Will grow in acidic, poor soil
	Solidago nemoralis	Old field goldenrod	P	2'	M	Tolerates a variety of soil conditions
	Sol. speciosa	Showy goldenrod	P	5'	M	Blooms even later than most goldenrods and asters
	Symphyotrichum laeve	Smooth blue aster	P	3'	L	Lovely blooms from August through October
	Sym. lateriflorum	Calico aster	P	3'	M	Prefers part-shade
	Sym. novae-angliae	New England aster	P	6'	M	Tolerates a wide range of soil moisture
	Sym. oolentangiense	Skyblue aster	P	3'	L–M	Thrives in almost any soil

KEY

- **BLOOM TIME**
- **LIFECYCLE:** annual (A), biennial (b), perennial (P).
- **MAX HEIGHT** (in feet).
- **WATER NEEDS:** low (L), medium (M) and high (H).
- Difficult to establish from seed, establish from transplants
- Legume
- Monarch nectar plant (see p. 18)
- Larval host plant (butterfly/moth)
- Very attractive to bumble bees (see p. 18)
- Very attractive to beneficial insects (see p. 18)
- Can be aggressive at high seeding rates

Native Grasses and Sedges for Pollinator Seed Mixes

Note: Grasses and sedges should ideally comprise no more than 25–35% of seed mixes on pollinator sites.

	SCIENTIFIC NAME	COMMON NAME				NOTES
Cool	*Koeleria macrantha*	Prairie junegrass	L	P	2'	Cool-season bunch grass
Warm	*Andropogon gerardii*	Big bluestem	M	P	8'	[Argos, byssus, cobweb, Delaware, dusted, Ottoe skippers]
	Bouteloua curtipendula	Side oats grama	L–M	P	2'	[Numerous skippers and giant silk moths]; warm season grass with unique flowers
	Carex brevior	Plains oval sedge	L–H	P	1'	Beautiful seed heads
	C. stricta	Tussock sedge	H	P	4'	[Mitchell's satyr; Appalachian, marsh-eyed browns; mulberry wing, black dash skippers]; tolerates occasional flooding
	C. vulpinoidea	Fox sedge	H	P	3'	Tolerates occasional flooding
	Schizachyrium scoparium	Little bluestem	L	P	3'	[10 skipper species]; considered a weed in cranberry bogs
	Sorghastrum nutans	Indian grass	M	P	7'	[Georgia satyr; pepper-and-salt skipper]
	Sporobolus heterolepis	Prairie dropseed	L	P	3'	[Leonard's skipper, Powershiek skipperling]; long-lived but slow to establish from seed

Non-Native Annual Plants for Insectary Meadows and Cover Crops

	SCIENTIFIC NAME	COMMON NAME				NOTES
Early	*Trifolium incarnatum*	Crimson clover	M	A	1.5'	[Grey hairstreak]; not freeze-tolerant, spring-seeded in cold climates
	Vicia villosa	Hairy vetch	M	A	1.5'	[Silvery, eastern-tailed blues; orange sulphur]; fall-seeded
	Phacelia tanacetifolia	Lacy phacelia	L	A	2'	Not freeze-tolerant, spring-seeded in cold climates
Early–Mid	*Trifolium repens*	White clover	M	P	1'	[21 spp., incl. Io moth & Reakirt's blue]
Mid	*Medicago sativa*	Alfalfa	M	P	2'	[38 spp., incl. blues & sulphurs]; susceptible to frost heaving
	Gaillardia aristata	Blanketflower	L	P	2'	[Bordered patch]; North American native
	Borago officinalis	Borage	M	A	1.5'	[Painted lady; polka-dot wasp moth]; not freeze-tolerant, spring-seeded in cold climates
	Fagopyrum esculentum	Buckwheat	M	A	2'	[White-lined sphynx]; quick growing; blooms attract honey bees and other insects
Mid–Late	*Helianthus annuus*	Common sunflower	M	A	9'	[30+ spp., incl. bordered patch & silvery checkerspot]; excellent forage for long-horned bees & bumble bees
	Cosmos bipinnatus	Cosmos	M	A	5'	[Old World swallowtail]; select single-petal varieties; blooms until frost

KEY

- **BLOOM TIME**
- **LIFECYCLE:** annual (A), biennial (b), perennial (P).
- **MAX HEIGHT** (in feet).
- **WATER NEEDS:** low (L), medium (M) and high (H).
- Difficult to establish from seed, establish from transplants
- Legume
- Monarch nectar plant (see p. 18)
- Larval host plant (butterfly/moth)
- Very attractive to bumble bees (see p. 18)
- Very attractive to beneficial insects (see p. 18)
- Can be aggressive at high seeding rates

Figure 21: Native grass species can be included in pollinator meadow seed mixes at a low rate (e.g., 25–35%) and provide important resources for pollinators and beneficial insects that nest or overwinter in native bunch grasses. Native grasses also help the planting resist invasion by weedy grasses.

Regional Native Seed Vendors and Native Plant Nurseries

Inclusion on this list does not constitute an endorsement. Other vendors not listed below may also have suitable plant materials. **Before ordering, ensure that all plants or seeds purchased for pollinator habitat have NOT been treated with systemic insecticides.**

Agrecol (+) • Madison, WI
608-223-3571 • www.agrecol.com

Allendan Seed () • Winterset, IA
515-462-1241 • www.allendanseed.com

Cardno JFNew (+) • Walkerton, IN
574-586-2412 • www.cardnojfnew.com

Hidden Savanna Nursery () • Kalamazoo, MI
269-352-3876 • www.hiddensavanna.com

Hoksey Native Seeds () • Lynnville, IA
641-780-1539 • www.hokseynativeseeds.com

Ion Exchange Native Seed Nursery (+) • Harpers Ferry, IA
800-291-2143 • www.ionxchange.com

Michigan Wildflower Farm () • Portland, MI
517-647-6010 • www.michiganwildflowerfarm.com

Minnesota Native Landscapes (+) • Otsego, MN
763-295-0010 • www.mnnativelandscapes.com

Native Connections () • Three Rivers, MI
269-580-4765 • www.nativeconnections.net

Osenbaugh's Prairie Seed Farm () • Lucas, IA
800-582-2788 • www.prairieseedfarms.com

Prairie Nursery (+) • Westfield, WI
800-476-9453 • www.prairienursery.com

Prairie Moon Nursery (+) • Winona, MN
866-417-8156 • www.prairiemoon.com

Prairie Restorations, Inc. (+) • Princeton, MN
800-837-5986 • www.prairieresto.com

Shooting Star Native Seeds (+) • Spring Grove, MN
507-498-3944 • www.shootingstarnativeseed.com

Taylor Creek Restoration Nurseries (+) • Brodhead, WI
608-897-8641 • www.restorationnurseries.com

The Prairie Flower (+) • Spencer, IA
712-262-5864 • www.theprairieflower.com

Wildtype (* +) • Mason, MI
517-244-1140 • www.wildtypeplants.com

Notes: Seeds Only (), Transplants Only (), Seeds & Transplants (+), * available by request

Figure 22: Certain pollen- and nectar-rich non-native plants, such as crimson clover (A), blanketflower (B), borage (C), buckwheat (D), common sunflower (E), or cosmos (F), can be included in pollinator plantings when native plants are unavailable or cost-prohibitive. Always check your state's list of invasive plant species before including any non-native plants in pollinator habitat (see References & Resources on page 18 for more information).

References & Resources

Site Preparation & Planting Guidelines

Organic Site Preparation for Wildflower Establishment
These guidelines provide instructions for preparing a site using seven different organic methods, including solarization.
www.xerces.org/guidelines-organic-site-preparation

Creating and Maintaining Healthy Pollinator Habitat: Guidance to Protect Habitat from Pesticide Contamination
This guidedance document was designed to help growers, land managers, and others safeguard pollinator habitat from harmful pesticide contamination.
www.xerces.org/guidance-to-protect-habitat-from-pesticide-contamination

Seed Quality, Seed Technology, and Drill Calibration
This Washington NRCS Plant Materials Technical Note (no. 7. 2005) features extensive information on calibrating native seed drills, and the use of inert carriers.
www.plant-materials.nrcs.usda.gov/pubs/wapmctn6331.pdf

Seeding Pollinator Plots (NRCS Technical Note)
This NRCS Plant Materials Center guide includes detailed information about the use of various types of seeders, and how seed size influences planting method, and planting success.
https://prod.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_023218.pdf

Comprehensive Guides

Attracting Native Pollinators: Protecting North America's Bees and Butterflies
This comprehensive book on pollinator conservation highlights the role of native pollinators in natural ecosystems, gardens, and farms. It includes information about pollinator ecology, guides for identifying common bees, and habitat designs for multiple landscapes.
www.xerces.org/announcing-the-publication-of-attracting-native-pollinators

Wisconsin Pollinator Biology and Habitat (NRCS Technical Note)
The NRCS Tech Note No. 8 provides an in-depth guide to native bee ecology and conservation for natural areas and farms in Wisconsin. An extensive and detailed list of plant species is included on pages 18–24, as well as color photos of common regional bees and sample seeding mixes for habitat restoration efforts.
https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_020421.pdf

Additional Pollinator Resources

Pollinator Plant Lists
Recommended native plants that are highly attractive to pollinators and are well-suited for small-scale plantings.
www.xerces.org/pollinator-conservation/plant-lists

Monarch Nectar Plant Guides
The plant species included in these guides have been chosen based on monarch nectaring observations compiled from numerous sources.
www.xerces.org/monarch-nectar-plant-guides

Pollinator Conservation Resource Center
For additional information on pollinator plant lists, conservation guides, pesticide protection and more.
www.xerces.org/pollinator-resource-center

Conserving Bumble Bees
Highlights the important role that bumble bees play in plant pollination, details the threats they face, and provides information on how land managers can create, restore, and enhance high quality habitat.
www.xerces.org/bumblebeeguidelines

Habitat Planning for Beneficial Insects
This publication outlines the ecology of many native beneficial insect groups and highlights recommended strategies for conservation biological control—the practice of providing habitat for insects that attack crop pests.
www.xerces.org/habitat-planning-for-beneficial-insects

Seedling Identification

USDA-NRCS Central Region Seedling Identification Guide for Native Prairie Plants
Many of the plant species recommended in this Habitat Installation Guide are featured in a series of seedling photos in this downloadable resource from the USDA–NRCS.
www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/mopmcpu6313.pdf

Bonestroo Prairie Seedling and Seeding Evaluation Guide
Many of the plant species recommended in this Habitat Installation Guide are featured in a series of seedling photos in this resource. The publication also includes guidelines for assessing establishment success of seeded native grass and wildflower plots.
www.prairiemoon.com/books/identification-guides/prairie-seedling-and-seeding-evaluation-guide.html

Weed Identification & Control

Midwest Invasive Plant Network
A comprehensive list of resources to identify and control common weeds of the Upper Midwest. Extensive links to other resources.
http://mipn.org/control.html

University of Wisconsin–Extension Weed Science
The UW–Extension Weed Science website provides identification resources and management fact sheets for common weeds of the Upper Midwest.
http://fyi.uwex.edu/weedsci

Upper Midwest

POLLINATOR MEADOW INSTALLATION CHECKLIST

LANDOWNER/ MANAGER: _____ **LOCATION:** _____

PLANNED BY: _____ **DATE:** _____

CONSERVATION OBJECTIVES:

AERIAL SITE MAP OR PHOTOGRAPH:

Purpose

This Pollinator Meadow Installation Checklist documents the process of establishing nectar and pollen habitat for bees in the form of wildflower meadow plantings. Other natural resources may also benefit, depending on your conservation objectives and the integration of this habitat with other conservation practices. For detailed instructions on each step in this Installation Checklist, please see the *Pollinator Meadow Installation Guide: Upper Midwest*.

Key Site Characteristics

Risk of pesticide drift on site? **Low to high** **Very low to none**

Weeds: weed pressure, and primary weed species of concern:

Site history: historic and current plant cover, past use of land, pre-emergent herbicide use, compaction, etc.:

Soils and habitat: soil texture (coarse to fine), drainage, and moisture level:

Irrigation: availability and method (necessary if transplants are to be used):

Other concerns or conservation goals that may affect plant choice or site preparation and planting:

Plant Selection: Wildflower Seed Mix

See the Appendix in the Installation Guide

Mesic Site Pollinator Seed Mix | Wet to Mesic Pollinator Seed Mix | Dry Site Pollinator Seed Mix

Low Cost Pollinator Seed Mix | Custom Seed Mix

Note any species substitutions here or attach copy of custom seed mix:

Transplants may be preferred when seed is not available, weed pressure is high, or when a particular species is difficult to establish by seed. Transplanting can involve the use of plug plants or bare root plants. Pollinator meadows can also include woody plants. See *Wisconsin Pollinator Biology and Habitat (NRCS Technical Note No. 8)* for suggested woody plants.

Note any woody or herbaceous species established from transplants here:

Site Preparation Method

Choose an option and note any adjustments.

Herbicide | Solarization | Other: _____

Severe weed pressure?
(If so, an additional year of site prep or the use of transplants should be considered. See the *Installation Guide*.)

Adjustments:

Planting Method

Choose all options that apply and note any adjustments.

Broadcasting: by machine or hand | Drop-seeding | Native seed drill

Transplants

Adjustments:

Maintenance During Establishment

Choose all options that apply and note any adjustments.

Spot-spraying weeds with herbicide | Mowing/ string-trimming | Grass- or other selective herbicide

Hand-weeding and/ or hoeing | Managing irrigation | Other: _____

Adjustments:

Long Term Site Operations and Maintenance

Control herbivores as needed, but remove plant guards or other materials that could impede plant growth as soon as possible after establishment. In most cases, irrigation of transplants is no longer required by the end of the second growing season after planting. Maintain the long-term plant diversity of pollinator habitat by re-seeding or re-planting as necessary.

Finally, after establishment, no more than 30% of the habitat area should be mowed, grazed, or burned in any one year to ensure sufficient undisturbed areas for pollinators and other wildlife. Do not mow or burn during critical wildlife nesting seasons (consult your state wildlife biologist for specific guidance). Continue to protect habitat from pesticide applications and drift (especially insecticides and bee-toxic fungicides). Herbicide spot-treatments and hand-weeding may be used to control noxious or invasive plants.