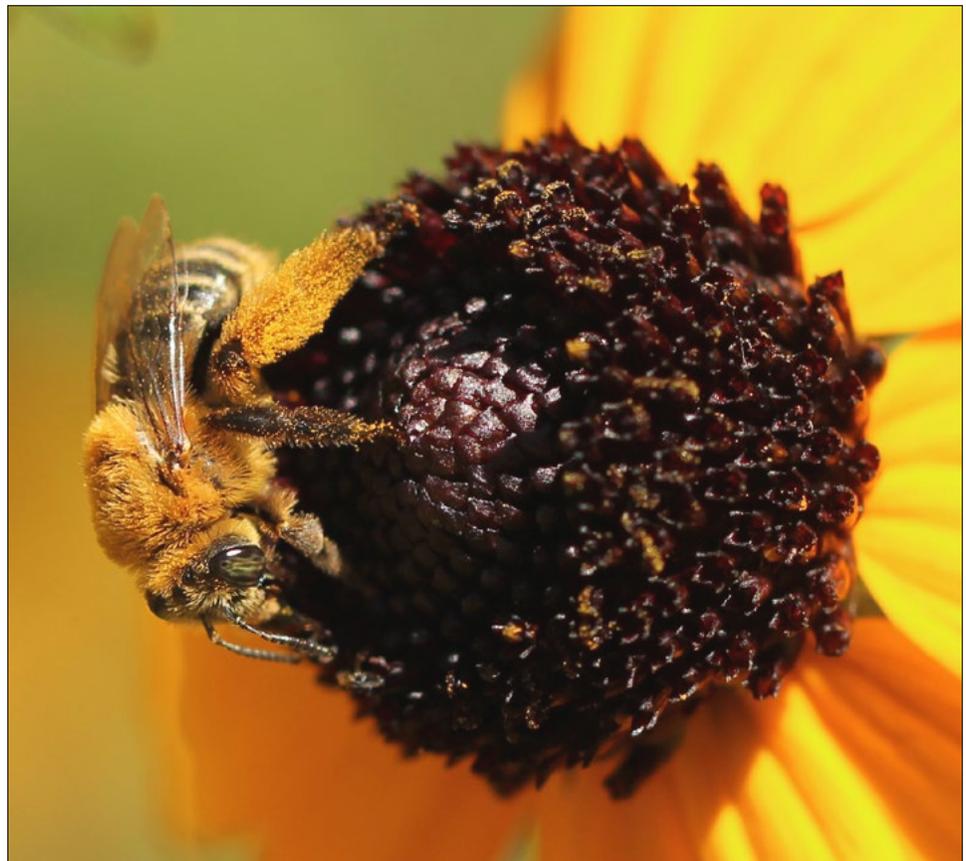




Establishing Pollinator and Beneficial Insect Habitat on Organic Farms in Idaho

An Installation Guide for Meadows and Hedgerows



September 2016

The Xerces Society for
Invertebrate Conservation

www.xerces.org

Acknowledgements

This material is based upon work supported by the Natural Resources Conservation Service, U.S. Department of Agriculture, under number 68-0211-13-075. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the views of the U.S. Department of Agriculture.

Financial support to the Xerces Society for the development of this guide was provided by Audrey & J.J. Martindale Foundation, Cascadian Farm, Ceres Trust, Cheerios, CS Fund, Disney Conservation Fund, The Dudley Foundation, The Edward Gorey Charitable Trust, Endangered Species Chocolate, LLC, General Mills, J.Crew, Madhava Natural Sweeteners, National Co-op Grocers, Nature Valley, Turner Foundation, Inc., The White Pine Fund, Whole Systems Foundation, and Xerces Society members.

Financial support to the Northwest Center for Alternatives to Pesticides was provided by CS Fund, Simply Organic 1%, Clif Bar, Ceres Trust, University of Idaho Extension.

The authors would like to thank Mike and Tim Sommer of Purple Sage Farms, Peter, Susan and Jonathan Dill of Saint John's Organic Farm, Beth Rasgorshek of Canyon Bounty Farm, and Mike Townsend and Joan Heath of Valley Pacific Farm.

Authors

This guide was written in September 2016 by Jennifer Hopwood, Jessa Kay Cruz, and Mace Vaughan of the Xerces Society for Invertebrate Conservation, and Jennifer Miller and Jade Florence of the Northwest Center for Alternatives to Pesticides. Eric Lee-Mäder, Sarah Foltz Jordan, Jolie Goldenetz-Dollar, and Brianna Borders of the Xerces Society contributed to an earlier version. Please contact Mace Vaughan (mace@xerces.org) to improve this publication.

Editing and layout

Sara Morris, the Xerces Society and Ashley Chesser, Northwest Center for Alternatives to Pesticides

Photographs

Cover: Long-horned bee on *Rudbeckia* (top), monarch butterfly (*Danaus plexippus*), minute pirate bug (*Anthocoris nemorum*) (Top photograph by Jennifer Hopwood, The Xerces Society; bottom left photograph by John Anderson; bottom right photograph by G. Bohne, flickr.com)

Below: An Idaho ranch provides habitat for pollinators (Jennifer Hopwood, The Xerces Society)

We thank the photographers who generously allowed use of their images. Copyright of all photographs remains with the photographers. None of the photographs may be reproduced without permission from the photographer. If you wish to contact a photographer, please



Copyright © 2016 The Xerces Society for Invertebrate Conservation

628 NE Broadway Ste. 200, Portland, OR 97232
tel 503.232.6639 • fax 503.233.6794 • www.xerces.org

Regional offices in California, Massachusetts, Minnesota, Nebraska, New Jersey, North Carolina, Oklahoma, Vermont, and Wisconsin.

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.

The Xerces Society is an equal opportunity employer and provider. Xerces® is a trademark registered in the U.S. Patent and Trademark Office.

Pollinator and Beneficial Insect Habitat Installation Guide

Idaho

Purpose

These instructions provide in-depth guidance on how to install habitat for pollinators and beneficial insects on organic farms in Idaho. This document focuses on meadows of native wildflowers and grasses, as well as hedgerows, linear plantings of shrubs and trees as well as herbaceous perennials. To plan a specific project, use this guide with the Checklist found at the end of this document.

Key Site Characteristics

There are many opportunities to install habitat on farms, including fence lines, field borders, non-irrigated land, pivot corners and centers, farm roadsides, and more. 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). Only sites with no to very low risk for pesticide drift should be established as new habitat. This includes some pesticides approved for use on organic farms.
- **Accessibility:** New habitat should 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 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

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.

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:** Irrigation is required to establish plants from plugs, pots, or bare root. Irrigation is not required 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.

Figure 1 Pollinator plantings can serve other functions, such as habitat for wildlife or beneficial insects. The diverse mix of native wildflowers, shrubs, and grasses in this native meadow planting (left) provides a variety of forage and nesting sites for native bees, beneficial insects (such as green lacewings, right), and more.



(Photographs by Eric Lee-Mäder (left), Sarah Foltz Jordan (right), The Xerces Society)

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 moths should also be included. Warm-season bunch grasses should be included at a low percentage of the mix (e.g., no more than 50%). The Appendix provides a master list of acceptable plants for various locations and environments in Idaho.

When designing a plant list, individual 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.

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.

Site preparation methods are provided below.

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 and 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: SHEET MULCHING (FIGURE 2)	
Where to Use <ul style="list-style-type: none"> • Conventional farms and organic farms* • Areas with a low risk of erosion • Areas accessible to equipment 	Timing <ul style="list-style-type: none"> • Total time: 5+ months • Begin: Early spring after the first weed growth • Plant: Early fall for transplants, anytime in the dormant season for seeds
Basic Instructions: <ol style="list-style-type: none"> 1. In the spring, mow, rake and/or lightly harrow and smooth the site, then irrigate the site to moisten the soil. 2. Layer and overlap a weed-barrier of corrugated cardboard. Water this layer. 3. Layer nitrogen-based materials (e.g., composted plant materials) to a depth of 1-3 inches, depending on weed pressure (the more weeds, the greater the depth). Water this layer. 4. Spread a layer of carbon-based materials (e.g., mulching materials, including natural wood bark, chips, straw, sawdust, or shavings) to retain moisture and prevent weed germination to a depth of 1-2 inches. 5. In the fall, install transplants by planting directly into the cardboard/mulched area. If seeding into the area, scrape off the top layer and seed directly into the next layer. 	
NOTES: Do not till. Avoid any ground disturbance that may bring up additional weed seed.	
* Choice of materials (e.g., cardboard, straw, etc) must be acceptable to OMRI for organic operations or, if not, used outside of certified ground AND approved by an organic certifier.	

METHOD: SOLARIZATION (FIGURE 3)

Where to Use

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

Timing

- Total time: 5+ months
- Begin: Spring
- Plant: Early fall or later in the dormant season

Basic Instructions:

1. Mow, rake, or cultivate the site in the spring to remove debris that could puncture the plastic. After smoothing the site, dig a trench around the perimeter in order to more easily bury the edges of the plastic (see below).
2. Lightly irrigate the site to moisten the soil, then lay UV-stabilized plastic (4 to 6 ml thick, 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. Repair any rips that occur during the season with greenhouse repair tape. If joining two or more pieces of plastic, create a trench for the seams and bury the edges of both pieces, rather than overlapping the pieces of plastic.
3. Remove the plastic in early fall before the weather cools and the area beneath the plastic is recolonized by nearby rhizomatous weeds. *Note: weeds under solarization plastic are not a concern, especially if they have not set seed.*
4. Immediately plant the pollinator seed mix or transplants. **Do not till after solarizing site. Avoid any ground disturbance that may bring up viable weed seed.**

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.

Figure 2 After the layer of cardboard is moistened, a thick layer of carbon, in this case straw, was layered on top (left). The thick layer of straw will help to suppress existing weeds and prevent weed seeds from germinating (right).



(Photographs by Susan Dill (left) Jennifer Miller (right))

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. Equipment, such as a trencher on a tractor, can be used to dig a trench around the perimeter (left). Next, lay UV-stabilized plastic (middle) and bury the edges (right), 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).



(Photographs by Susan Dill (left) and Sarah Foltz Jordan, The Xerces Society (center and right)).

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, with farmers selecting the methods with which they have the most experience or familiarity and access to equipment. Pre-project site conditions, especially weed competition, should be addressed prior to planting. **Table 2** (below) 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.

Figure 4 Many wildflower seeds are available as a lower-cost alternative to transplants or plugs, but establishing wildflowers from seed requires excellent site preparation to prevent weed encroachment.



(Photograph by Eric Lee-Mäder, The Xerces Society.)

Table 2 Methods for Planting Wildflower Seed

METHOD: BROADCAST SEEDERS OR HAND-BROADCASTING (THROWING SEED) (FIGURE 5)	
<p>Pros</p> <ul style="list-style-type: none"> • 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 	<p>Cons</p> <ul style="list-style-type: none"> • 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
<p>Basic Instructions:</p> <ol style="list-style-type: none"> 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). Choice of bulking agents must be acceptable to PMRI for organic operations or, if not, used outside of certified ground AND approved by an organic certifier. 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. 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. 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. 	

Opposite: Golden tickseed is an annual that will establish readily in areas of low precipitation. (Photograph by Jennifer Hopwood, The Xerces Society.)

METHOD: DROP SEEDERS OR FERTILIZER SPREADERS (DROPPING SEED) (FIGURE 6 AND 7)

<p>Pros</p> <ul style="list-style-type: none"> • 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) 	<p>Cons</p> <ul style="list-style-type: none"> • 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 ½ acre), tractor-powered models are more efficient on larger sites • Calibration requires trial and error
<p>Basic Instructions:</p> <ol style="list-style-type: none"> 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). Choice of bulking agents must be acceptable to PMRI for organic operations or, if not, used outside of certified ground AND approved by an organic certifier. 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. 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. 	

METHOD: NATIVE SEED DRILLS (DRILLING SEED) (FIGURE 8)

<p>Pros</p> <ul style="list-style-type: none"> • 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) 	<p>Cons</p> <ul style="list-style-type: none"> • 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
<p>Basic Instructions:</p> <ol style="list-style-type: none"> 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 1.5x 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. <p>For information on native seed drill calibration, see NRCS publication: www.plant-materials.nrcs.usda.gov/pubs/mipmctn10591.pdf</p>	



Table 3 **Methods for Transplanting**

METHOD: TRANSPLANTING FORBS AND WOODY PLANTS	
<p>Pros</p> <ul style="list-style-type: none"> • Provides mature nectar and pollen resources more quickly • Does not require specialized planting equipment (except for large trees) • Preferred for plants with limited seed availability, which are expensive or difficult to establish from seed • Transplants can be established more easily in weedy sites with adequate mulching 	<p>Cons</p> <ul style="list-style-type: none"> • Expensive and time consuming for large areas • Transplants typically require irrigation during establishment
<p>Basic Instructions:</p> <ol style="list-style-type: none"> 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. 	

Figure 5 For broadcast seeding, seed of **similar size** is mixed together (left). Sand or another inert carrier is added at a ratio of at least 2:1 (more for larger sites) and then mixed (middle). 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 (right).



(Photographs by Sarah Foltz Jordan, The Xerces Society.)

Figure 6 Hand-crank "belly grinder" type seeders (left) 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 (such as sand) and walk in at least two perpendicular passes to ensure the most even seed distribution possible. Similarly, lawn fertilizer spreaders (middle) 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 (right) for planting together with the flow gate adjusted accordingly.



(Photograph courtesy of the New Hampshire NRCS.)

(Photographs courtesy of Terry Best, North Carolina NRCS.)

Figure 7 When planting native wildflowers by hand-broadcasting or with a drop seeder, the seed should be planted directly on the soil surface (left). After broadcasting, roll the site with a turf roller (middle) or cultipacker (right)—unless planting in fall when the freeze-thaw cycle will adequately work seed into the ground.



(Photograph by Kelly Gill, The Xerces Society.)

(Photograph by Sarah Foltz Jordan, The Xerces Society.)

(Photograph by Jessa Kay Cruz, The Xerces Society.)

Figure 8 Tractor-powered spreaders (left) and native seed drills (middle) 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. For best results, seed should be divided into batches by size and mixed with an inert carrier. Alternately, typical native seed drills can plant in a light stubble layer (middle), have depth controls for optimal seed placement, and have separate seed boxes for different sizes of seed (right). Such drills need an experienced operator and careful calibration.



(Photographs by Kelly Gill, The Xerces Society.)

(Photographs by Sarah Foltz Jordan, The Xerces Society.)

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 organic 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 forb plots to eliminate broadleaf weeds during the first few seasons.
- **Spot-spraying:** There are a number of organic herbicide products on the market, most of which share the same suite of active ingredients: clove, cinnamon, or citrus-based oils, or acetic acid. All of these products work through direct contact with vegetative parts of the plants and are only effective upon direct contact, have no residual activity, and are not translocated through the plant. As such, these products function as 'burn-downs', and do not usually kill the plant after a single application. When applied repeatedly, however, they can prevent some weed species from setting seed. However, these products are generally not effective on grasses and may not be effective on certain broadleaf weeds. Spot-spraying is usually performed with backpack spraying, or occasionally with rope-wick implements (when weed growth is substantially taller than newly established wildflowers).
- **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 9 Short Term: 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 (right), which are generally unharmed by the occasional mowing.



(Photographs by Eric Lee-Mäder, The Xerces Society.)

Figure 10 Long Term: Flourishing wildflowers and pollinator habitat in the years after planting.



(Photograph by Jennifer Hopwood, The Xerces Society)

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. 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.

Note: using signs such as the one below 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 11 Grow tubes or trunk protectors may help during establishment to reduce browsing by herbivores and trunk damage from mowers or weeding operations (above), but should be removed as soon as possible to avoid impeding plant growth. Most transplants will benefit from 1" of water per week during the first two years of establishment, either from natural rainfall or irrigation, such as drip-irrigation (below).



(Photographs by Jessa Kay Cruz, The Xerces Society.)

Figure 12 Newly-planted areas should be clearly marked to protect them from herbicides or other disturbances.



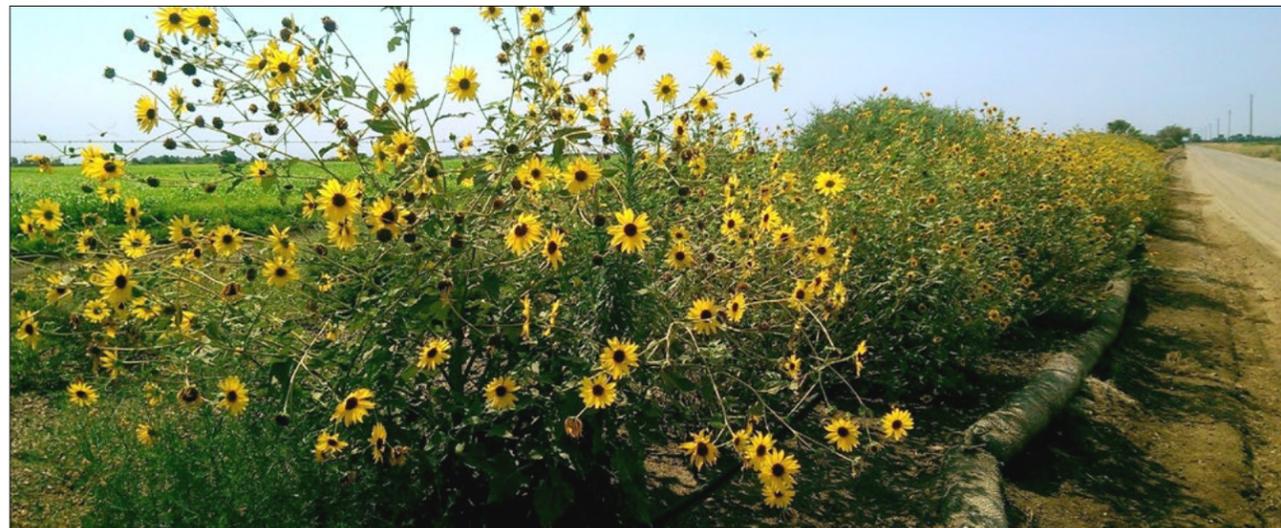
(Photograph by Kelly Gill, The Xerces Society.)

Appendix: Plant Lists, Sources of Plant Materials, and References

Plant Lists

Recommended native shrubs, subshrubs, and trees for pollinators. *Plants listed by first season of bloom, then alphabetically.*
Water needs: Low= 7"-12" annual precipitation, Moderate=12"-18", High=18"-25"

* COMMON NAME	SCIENTIFIC NAME	LIFE CYCLE ¹	MAX HT.	WATER NEEDS ²	NOTES
Bitterbrush	<i>Purshia tridentata</i>	P	6'	L	tolerates partial shade tolerates clay soil
Chokecherry	<i>Prunus virginiana</i>	P	10'	M	seeds and vegetative parts toxic, can be alternate host for tent caterpillar (<i>Malacosoma</i>)
Douglas' spirea	<i>Spiraea douglasii</i>	P	6'	M	tolerates partial shade, tolerates clay soils, tolerates wet soils
Golden currant	<i>Ribes aureum</i>	P	8'	M	tolerates partial shade
Oakleaf sumac	<i>Rhus trilobata</i>	P	8'	L	tolerates partial shade
Oregon grape	<i>Mahonia repens</i>	P	3'	M	tolerates partial shade
Serviceberry	<i>Amelanchier alnifolia</i>	P	15'	M	tolerates shade
Silver buffaloberry	<i>Shepherdia argentea</i>	P	20'	M	tolerates shade, tolerates clay soil and alkaline soil; edible fruit
Western sand cherry	<i>Prunus pumila var. besseyi</i>	P	6'	M	tolerates partial shade, tolerates clay soil
Fernbush	<i>Chamaebatiaria millefolium</i>	P	8'	L	tolerates partial shade, tolerates nutrient-poor soil
Mallow ninebark	<i>Physocarpus malvaceu</i>	P	6'	M	
Nootka rose	<i>Rosa nutkana</i>	P	10'	M	tolerates shade, larval host-plant for mourning cloak and grey hairstreak butterflies
Oceanspray	<i>Holodiscus discolor</i>	P	12'	H	tolerates shade, tolerates clay soil
Shrubby cinquefoil	<i>Dasiphora fruticosa</i>	P	4'	H	
Snowberry	<i>Symphoricarpos albus</i>	P	6'	M	tolerates shade, larval host plant for Vashti sphinx moth, toxic berries
Sulfur buckwheat	<i>Eriogonum umbellatum</i>	P	3'	L	tolerates clay soil
Whorled buckwheat	<i>Eriogonum heracleoides</i>	P	3'	L	
Wood's rose	<i>Rosa woodsii</i>	P	6'	M	tolerates shade
Fourwing saltbush	<i>Atriplex canescens</i>	P	8'	L	tolerates partial shade, tolerates alkaline and saline soils
Green rabbitbrush	<i>Chrysothamnus viscidiflorus</i>	P	6'	L	
Rubber rabbitbrush	<i>Ericameria nauseosa</i>	P	6'	L	



This hedgerow includes native shrubs as well as perennial wildflowers. (Photo by Jessa Cruz, The Xerces Society)

Plant Lists

Recommended Native Wildflowers for Pollinators

* COMMON NAME	SCIENTIFIC NAME	LIFE CYCLE ¹	MAX HT.	WATER NEEDS ²	NOTES
Arrowleaf Balsamroot	<i>Balsamorhiza sagittata</i>	P	2'	L	
Biscuitroot	<i>Lomatium triternatum</i>	P	3'	M	good habitat for sage grouse
Lewis flax	<i>Linum lewisii</i>	P	2'	M	
Mountain lupine ³	<i>Lupinus argenteus</i>	P	2'	L	shade tolerant
Northern sweetvetch	<i>Hedysarum boreale</i>	P	2'	L	tolerates alkaline soils
Palmer's penstemon	<i>Penstemon palmeri</i>	P	3'	L	
Rocky Mountain penstemon	<i>Penstemon strictus</i>	P	3'	M	tolerates partial shade
Sticky geranium	<i>Geranium viscosissimum</i>	P	3'	M	tolerates shade
Firecracker penstemon	<i>Penstemon eatonii</i>	P	2.5'	L	
Golden tickseed	<i>Coreopsis tinctoria</i>	A	4'	M	flowers on stems up to 4', rosettes 6"
Gooseberry globemallow	<i>Sphaeralcea grossulariifolia</i>	P	3'	L	
Mule's ears	<i>Wyethia amplexicaulis</i>	P	3'	M	
Scarlet globemallow	<i>Sphaeralcea coccinea</i>	P	2'	L	
Aspen fleabane	<i>Erigeron speciosus</i>	P	2'	L	
Basalt milkvetch ³	<i>Astragalus filipes</i>	P	3'	L	
Blanketflower	<i>Gaillardia aristata</i>	P	1.5'	L	
Blue mountain prairie clover	<i>Dalea ornata</i>	P	2'	M	
Hairy phacelia	<i>Phacelia hastata</i>	P	2'	L	tolerates shade
Prairie blazingstar	<i>Liatris pycnostachya</i>	P	4'	H	
Prairie coneflower	<i>Ratibida columnifera</i>	P	1.5'	M	tolerates clay soil
Rocky Mountain bee plant	<i>Cleome serrulata</i>	A	5'	L	tolerates partial shade
Showy milkweed	<i>Asclepias speciosa</i>	P	5'	M	larval host plant for Monarch butterfly; difficult to propagate from seed
False goldenaster	<i>Heterotheca villosa</i>	P	2'	L	
Hoary tansyaster	<i>Machaeranthera canescens</i>	P	3'	L	
Smooth blue aster	<i>Symphyotrichum laeve</i>	P	3'	M	
Woolly sunflower	<i>Eriophyllum lanatum</i>	P	1'	L	tolerates partial shade, tolerates clay soil
Blueleaf aster	<i>Eurybia glauca</i>	P	1.5'	M	
Broom snakeweed	<i>Gutierrezia sarothrae</i>	P	3'	L	tolerates partial shade
False aster	<i>Boltonia asteroides</i>	P	5'	M	tolerates clay soil, tolerates acidic soil
Maximilian sunflower	<i>Helianthus maximiliani</i>	P	6'	L	tolerates clay soil
Showy goldeneye	<i>Heliomeris multiflora</i>	P	3'	L	

Recommended Native Wildflowers for Pollinators Notes:

- * Bloom Time
- 1. Life Cycle abbreviations: P = perennial, A = annual, B = biennial
- 2. Water Needs abbreviations: L = low, M = medium, H = high
- 3. Legume—rich in nitrogen and attractive to a wide variety of wildlife.

Green sweat bee (*Agapostemon virescens*) on blanketflower (*Gaillardia aristata*). (Photograph courtesy of sankax, flickr.com.)



Native Grasses and Sedges for Pollinator Seed Mixes

Note: Grasses and sedges should ideally comprise no more than 25% of seed mixes on pollinator sites, but no more than 50%.

COMMON NAME	SCIENTIFIC NAME	LIFE CYCLE ¹	MAX HT.	WATER NEEDS ²	NOTES
Bluebunch wheatgrass	<i>Pseudoroegneria spicata</i>	P	4'	L	Tolerates clayey soils as well as thin, rocky sites
Sandberg bluegrass	<i>Poa secunda</i>	P	1.5'	L	
Idaho fescue	<i>Festuca idahoensis</i>	P	3.5'	M	Cool-season grass
Indian ricegrass	<i>Achnatherum hymenoides</i>	P	2.5'	L	Cool-season bunch grass; drought tolerant
Basin wildrye	<i>Leymus cinereus</i>	P	6'	L	Does well in saline/alkaline sites, riparian areas or swales
Sand dropseed	<i>Sporobolus cryptandrus</i>	P	3.5'	L	Very drought tolerant
Prairie junegrass	<i>Koeleria macrantha</i>	P	2'	M	Cool-season bunch grass
Slender wheatgrass	<i>Elymus trachycaulus</i>	P	4'	L	Establishes quickly from seed; not salt tolerant

Native Grasses for Pollinator Plantings Notes:

1. Life Cycle abbreviations: P = perennial, A = annual, B = biennial 2. Water Needs abbreviations: L = low, M = medium, H = high

Non-Native Plants for Insectary Meadows and Cover Crops

*	COMMON NAME	SCIENTIFIC NAME	LIFE CYCLE ¹	MAX HT.	WATER NEEDS ²	NOTES
Early	Crimson clover ³	<i>Trifolium incarnatum</i>	A	1.5'	M	Not freeze-tolerant, spring-seeded in cold climates ³
	Hairy vetch ³	<i>Vicia villosa</i>	A	1.5'	M	Fall-seeded; aggressive at high seeding rates ³
	Lacy phacelia	<i>Phacelia tanacetifolia</i>	A	2'	L	Not freeze-tolerant, spring-seeded in cold climates
Early-Mid	White clover ³	<i>Trifolium repens</i>	P	1'	M	Aggressive at high seeding rates ³
Mid	Alfalfa ³	<i>Medicago sativa</i>	P	2'	M	Susceptible to frost heaving ³
	Borage	<i>Borago officinalis</i>	A	1.5'	M	Not freeze-tolerant, spring-seeded in cold climates
	Buckwheat	<i>Fagopyrum esculentum</i>	A	2'	M	
	Sainfoin ³	<i>Onobrychis viciifolia</i>	P	5'	L	Attractive to honey bees in particular
Mid-Late	Cosmos	<i>Cosmos bipinnatus</i>	A	5'	M	Select single-petal varieties for pollinators

Non-Native Annual Plants for Insectary Meadows and Cover Crops Notes:

- * Bloom Time
1. Life Cycle abbreviations: P = perennial, A = annual, B = biennial
 2. Water Needs abbreviations: L = low, M = medium, H = high
 3. Legume—rich in nitrogen and attractive to a wide variety of wildlife.



Hunt's bumble bee (*Bombus huntii*) on lacy phacelia (*Phacelia tanacetifolia*) in a pollinator planting. (Photo by Jennifer Hopwood, The Xerces Society)

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.

Buffalo Berry Farm (S,T) • McCall, ID
208-634-3062 • buffaloberryfarm.com

Cadera Seeds Inc (S) • Swan Valley, ID
208-483-3683 • growseedsswanvalley.com/flower-seeds

Cedar Mountain Perennials (T) • Athol, ID
208-683-2387 • cedarmountainperennials.com

Center for Forestry, Nursery and Seeding Research
University of Idaho (T) • Moscow, ID
208-885-3888 • uidaho.edu/cnr/cfnr

Clifty View Nursery (T) • Bonners Ferry, ID
208-267-7129 • cliftyview.com

Draggin' Wing Farm (T) • Boise, ID
208-345-4199 • waterthriftyplants.com/

Idaho Grimm Growers Native Seed Foundation (S)
Blackfoot, ID • 208-785-0830 • idahogrimmgrowers.com/

Native and Xeric Plants, Inc. (T) • Emmett, ID
208.365.4331

North Fork Native Plants (T) • Rexburg, ID
208-354-3691 • northforknativeplants.com

Pineview Horticulture Services (S) • Hayden, ID
208-772-7294 • pineviewhorticulturalservices.com/

Plantasia Cactus Gardens (T) • Twin Falls, ID
208-734-7959 • plantasiacactusgardens.com

Sun Mountain Natives (S) • Moscow, ID
208-883-7611 • sunmountainnatives.com

Thorn Creek Native Seed Farm (S) • Genesee, ID
208-596-9122 • nativeseedfarm.com

Wildlife Habitat Nursery (T) • Princeton, ID
208-875-2500 • whn-online.com

Notes: Seeds Only (S), Transplants Only (T), Seeds & Transplants (S, T)

References & Resources

SEED MIX CALCULATOR & PLANT LISTS

Xerces Society Seed Mix Calculator

Develop your own pollinator conservation seed mix using this seed rate calculator.

www.xerces.org/xerces-seed-mix-calculator

Plants for Pollinators in the Inland Northwest

A technical note with information about plants that support pollinators in parts of Idaho, Oregon, and Washington.

http://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/idpmstn10799.pdf

Plants for Pollinators in the Intermountain West

A technical note with information about plants that support pollinators in parts of Idaho, Oregon, Nevada, and Utah.

http://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/idpmstn10798.pdf

SEEDLING IDENTIFICATION

USDA-NRCS Forb Seedling Identification Guide for the Inland Northwest

Many of the plant species recommended in this guide are featured in a series of seedling photos in this downloadable resource.

http://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/wapmcpu11331.pdf

WEED IDENTIFICATION & CONTROL

Idaho's Noxious Weeds

University of Idaho's Extension guide to identify common weeds of Idaho.
http://www.cals.uidaho.edu/weeds2/IWR/iwr-v6_website/files/Download/BUL816.pdf

Invasive Species of Idaho

From the Idaho State Department of Agriculture, this website has resources and guides for weed management

<http://invasivespecies.idaho.gov/control-strategies>

SITE PREPARATION & PLANTING GUIDELINES

Soil Solarization: A Nonpesticidal Method for Controlling Diseases, Nematodes, and Weeds

This fact sheet, produced by the University of California Cooperative Extension discusses the solarization process, including plastic selection, installation, removal, and underlying principles.

http://vric.ucdavis.edu/pdf/soil_solarization.pdf

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 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

Pollinator Conservation Resource Center

For additional information on pollinator plant lists, conservation guides, pesticide protection and more.

www.xerces.org/pollinator-resource-center

Site Preparation Method

Choose an option and note any adjustments.

- Sheet mulch Solarization
 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 Native seed drill
 Drop-seeding Transplants

Adjustments:

Maintenance During Establishment

Choose all options that apply and note any adjustments.

- Spot-spraying weeds with organic herbicide Mowing/ string-trimming
 Flame weeding 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). Organic herbicide spot-treatments and hand-weeding may be used to control noxious or invasive plants.