

327A Conservation Cover, Pollinators: *Central Valley, Central Coast, Southern California*

Conservation Practice Specification



(Photo: Jessa Kay Cruz, The Xerces Society)

Specifications

These instructions provide in-depth guidance on how to install wildflower meadows for pollinators. To plan a specific project, use these *Specifications* to fill out the *Implementation Requirements* form. These requirements and considerations are in addition to those in the *Conservation Cover (327) Specifications* that are written for all purposes.

Definition and Purpose

Establishing and maintaining permanent vegetative cover to enhance habitat for pollinators.

Client Conservation Objectives

Depending on landowner objectives and project design, conservation cover for pollinators also will enhance wildlife habitat, may reduce soil erosion and sedimentation, improve soil, water or air quality, or help manage plant pests by removing weeds that harbor pest insects or by increasing habitat for predaceous and beneficial invertebrates as a component of an integrated pest management plan.



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). 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. For re-vegetating such sites, consider Critical Area Planting (342) or other suitable Practice Standards
- **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, and/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 or require a plant mix adapted to the site.
- **Soils and Habitat:** Most plants listed in the Appendices of this guide are tolerant of many soil conditions and types, however all plants establish better when matched with appropriate conditions.
- **Irrigation:** To establish plants from plugs, pots, or bare root will require irrigation. Irrigation is generally not needed for plantings established from seed if planted in the fall. Irrigation will also encourage weeds.
- **Other Functions:** The site may offer opportunities to serve other functions, such as run-off prevention, stream bank stabilization, or wildlife habitat. Those factors can influence plant choice and/or design.

Plant Selection

Plant species selection should be limited to plants providing pollen- and nectar-rich forage resources for bees. The inclusion of bunch grasses is appropriate at a low percentage of the mix by seed per square foot (e.g., 10% or less), but may limit options for use of grass-selective herbicides if grass weeds are a primary concern. The Appendices provide master lists of acceptable plants and specific seed mixes the California Central Valley region, the Central Coast region, and Southern California. Forbs may be plug planted rather than planted from seed when appropriate. Woody shrubs or sub-shrubs may also be added to conservation cover plantings. For more information on planting shrubs and sub-shrubs for pollinators, refer to *Specifications for (422A) Hedgerow Planting, Pollinators*.

If you are designing a custom plant list, individual species should be chosen so that **consistent and adequate** floral resources are available throughout the growing season. To achieve this goal, aim for nine or more species total, but have at least seven, with at least two or three blooming during each part of the growing season (early, mid, and late season).

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 nearby crops.

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. University of California research indicates that weedy borders harbor more pests than are found in diverse native plantings.



Mixed native and non-native wildflowers. (Photo: Claudia Street, Glenn County RCD.)

Requirements

Site Preparation

Site preparation is one of the most important and often inadequately addressed components of project success. It is also a process that may require more than one season of effort to reduce competition from invasive, noxious, or undesirable non-native plants prior to planting. In particular, site preparation should focus on the removal of perennial and aggressive weeds (there are more options to address less aggressive annual or biennial weeds after planting). Previously cropped lands (those that have been cultivated for several years) usually have fewer weeds, but weed pressure still needs to be addressed. 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 in **Table 1**.

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;
- Sites dominated by introduced sod-forming grasses and rhizomatous forbs (e.g. Canada thistle).

Figure 1 The site on the left was prepared with a single glyphosate treatment, leaving a significant stubble layer and persisting weedy grasses. It is not ready for planting.

The site on the right was treated for an entire growing season with repeated glyphosate treatments (applied whenever new weeds appeared). The stubble has been removed with a flail mower and it is ready for planting. Neither site has been cultivated.

(Photos: Brianna Borders, The Xerces Society)



Table 1. Site Preparation Methods

METHOD: NON-SELECTIVE (NON-PERSISTENT) HERBICIDE	
<p>Where to Use</p> <ul style="list-style-type: none"> • Conventional farms and organic farms* • Areas with a low risk of erosion • Areas accessible to sprayer 	<p>Timing</p> <ul style="list-style-type: none"> • Total time: 9+ months • Begin: late fall after the first flush of cool season weeds • Plant: fall (after one year of weed eradication)
<p>Basic Instructions:</p> <ol style="list-style-type: none"> 1. Clear away 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 after fall rains cause first flush of weed germination. 3. Repeat herbicide applications until the next fall, as needed (whenever emerging weed seedlings reach 4 - 6 inches). 4. If weeds are not responding to herbicide treatments, keep area mowed to prevent flowering and seed development or consider an alternative herbicide. 5. Plant pollinator seed mix (and any transplants) in the fall, waiting at least 72 hours after the last herbicide treatment. Refer to the Planting Methods section of this document for specific recommendations. <p>NOTE: <u>Do not till</u>. 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. Avoid use of herbicides that are bee-toxic (e.g. Paraquat and Gramoxone).</p> <p>*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.</p>	

Table 1. Site Preparation Methods (Cont.)

METHOD: SOLARIZATION	
<p>Where to Use</p> <ul style="list-style-type: none"> • Organic and conventional farms • Areas with a low risk of erosion • Areas accessible to mowing equipment • Locations with full sun 	<p>Timing</p> <ul style="list-style-type: none"> • Total time: 6+ months • Begin: spring • Plant: fall
<p>Basic Instructions:</p> <ol style="list-style-type: none"> 1. Mow, rake or lightly harrow and smooth the site in the spring (raking off debris, if necessary). 2. After smoothing the site, irrigate thoroughly and 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 of the plastic if necessary to prevent the wind from lifting it. Use greenhouse repair tape for any rips that occur during the season. 3. Remove the plastic in early-fall before the weather cools and the area beneath the plastic is recolonized by nearby rhizomatous weeds. 4. Immediately plant pollinator seed mix and/or install transplants. Refer to Planting Methods section of this document for specific bed preparation recommendations. <p>NOTE: <i>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.</i></p>	

Planting Methods

Recommended planting methods are site-specific. Pre-project site conditions, especially weed competition, may affect planting success and should be addressed prior to planting. Factors such as equipment availability, weed pressure, and cost should be taken into consideration when choosing a planting method. Installing and maintaining habitat should fit into general farm-management practices as much as possible.

Planting seeds, rather than plugs, can be a less expensive way to establish wildflowers. Seeding requires **excellent** site preparation to reduce weed pressure because weed control options are limited when the wildflowers start to germinate. **Seed of most native wildflowers are best planted in late fall in California**, when winter rains are just starting.

Seed should be ordered in individual lots, not as a mix. Individual lots help ensure that all species are accounted for and, because size of wildflower seed varies dramatically, seed separated by species gives you the greatest flexibility in planting method. For example, native seed drills have hoppers to accommodate seed of different sizes, and even when broadcasting seed it is useful to divide the seed into batches of small and large seed.

Grain drills, unlike native seed drills, are usually not designed to handle the wide variation in wildflower seed size. However, with simple modifications most types of grass-seed planters or granulated fertilizer spreaders can be used with good results, especially if you plant small seeds at one setting (gate opening) and large seeds at another. **Table 2** outlines several possible seeding methods, including broadcast seeding, drills and the use of transplants.

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

Table 2. Methods for Planting Wildflower Seed

METHOD: BROADCAST SEEDERS OR HAND BROADCASTING (THROWING SEED)	
<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 into the soil after planting • Difficult to calibrate • Some models of broadcast seeders cannot accommodate large seeds
<p>Basic Instructions:</p> <p>Remove as much stubble as possible prior to seeding, creating a smooth, lightly-packed seedbed clear of vegetation residue. 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).</p> <p>Seed of similar sizes can be mixed together and bulked up with an inert carrier ingredient such as sand, fine-grained vermiculite, clay-based kitty litter, gypsum, or polenta (fine cornmeal). Use at least two to three parts bulking agent for each part seed by volume. These inert carriers ensure even seed distribution in the mix, visual feedback on where seed has been thrown, and make calibration easier.</p> <p>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.</p> <p>For small sites (e.g. less than 2 acres), seed can 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, using at least two to three parts bulking agent for each part seed by volume. Sow each batch separately. To ensure that seed is evenly distributed, scatter the first batch over the site while walking in parallel passes across the site, and then walk in pass-es perpendicular to the previous passes to scatter the second batch.</p> <p>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.</p>	

Table 2. Methods for Planting Wildflower Seed (Cont.)

METHOD: DROP SEEDERS OR FERTILIZER SPREADERS (DROPPING SEED)	
<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 • Hand-powered models are time consuming for large areas (over ½ acre) • Calibration requires trial and error
<p>Basic Instructions:</p> <p>Remove as much stubble as possible prior to seeding, creating a smooth, lightly-packed seedbed clear of vegetation resi-due. 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).</p> <p>Seed of similar sizes can be mixed together and bulked up with an inert carrier ingredient such as sand, fine-grained vermiculite, clay-based kitty litter, gypsum, 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 dropped, 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.</p> <p>Do not cover the seed 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.</p>	
METHOD: NATIVE SEED DRILLS (DRILLING SEED)	
<p>Pros</p> <ul style="list-style-type: none"> • Convenient for planting large areas • 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 for small areas (less than 1 acre) • Requires a tractor and an experienced operator to set planting controls • Seed with a lot of chaff can clog delivery tubes
<p>Basic Instructions:</p> <p>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.</p> <p>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.</p> <p>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 inch (consult with the seed vendor for specific guide-lines on very sandy soils). Small wildflower seed should be planted on the soil surface. Stop periodically to check planting depth.</p>	

Table 2. Methods for Planting Wildflower Seed (Cont.)

Operate the drill at less than 5 mph, stopping to check periodically 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 native seed drill calibration, see NRCS publication:

<http://www.plant-materials.nrcs.usda.gov/pubs/mipmctn10591.pdf>

METHOD: TRANSPLANTING FORBS AND WOODY PLANTS

Pros

- 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 in weedy sites more easily with adequate mulching

Cons

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

Basic Instructions:

Regular shovels are usually 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.

Plant size at maturity should be considered when planting. Most woody shrubs can be spaced on 6' – 12' centers (depending upon size at maturity), with most herbaceous plants spaced closer on 3' – 5' 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.

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 however, the 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.

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.

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.**

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. rice straw), nut shells, grape-seed pumice, or other regionally appropriate mulch materials that contain **no** viable seeds. Mulch is intended to remain on the surface and not be incorporated into the soil. For more details on establishing woody plants, see Specifications for *422A-Hedgerow Planting, Pollinators*.

Planting Method Photos



(Photos: Brianna Borders and Jessa Kay Cruz, The Xerces Society)

Figure 2. For broadcast seeding, seed of **similar size** is mixed together (left). Polenta, sand or another inert carrier is added (at a ratio of at least 2:1) and then mixed (middle left), and the mix is divided into separate batches (middle right) for broadcasting in perpendicular passes over the planting site. When hand-broadcasting seed, walk in perpendicular passes over the entire planting area (right).



(Photos: Brianna Borders and Jessa Kay Cruz, The Xerces Society)

(Photo: Regina Hirsch, University of Wisconsin)

Figure 3. Native wildflower seed should be planted directly on the soil surface (left). After broadcasting, roll the site with a cultipacker (middle) or turf roller (right).



(Photo: New Hampshire NRCS)

(Photo: Cindy Lashbrook, Merced Resource Conservation District)

Figure 4. Hand-crank “belly grinder” type seeders (left) are low cost and can broadcast seed more evenly than hand-scattering on larger sites. Similarly, lawn fertilizer spreaders (right) 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 for planting together with the flow gate adjusted accordingly. 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 paths to ensure the most even seed distribution possible.



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

(Photo: Jessa Guisse, The Xerces Society)

Post Planting Establishment Requirements

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 (and possibly three) years 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:

- **Spot Spraying:** Spot spraying with herbicides can be effective, relatively inexpensive, and require minimal labor, even on larger project areas. Care should be taken that herbicides do not drift or drip onto desirable plant species. Spot spraying is usually performed with backpack sprayers, or occasionally with rope-wick implements (when weed growth is substantially taller than newly established wildflowers). Dye can be added to herbicide mixes to assist the applicator in keeping the herbicide on target plants.
- **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 when possible (through drip irrigation, for example) to avoid watering nearby weeds.
- **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 can be mowed occasionally (at 8 inches or higher) 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.

Operations and Maintenance (Long-Term)

Manage herbivores as needed. As soon as possible after establishment, remove tree guards or other materials that could impede plant growth. 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. On-going 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 Conservation Cover planting area is outside of the sprayed area and/or protected from application and drift.

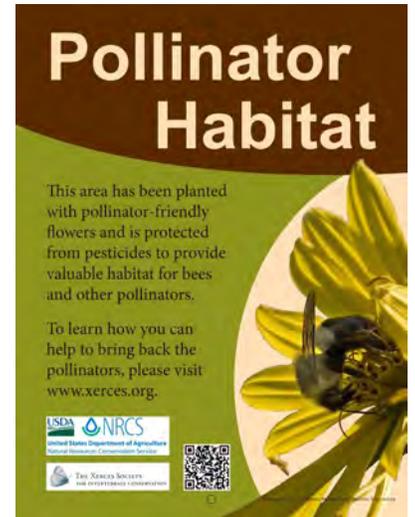


Figure 6. Newly planted areas should be clearly marked to protect them from herbicides or other disturbances. Using signs such as the one on the above can be a useful tool to designate protected pollinator habitat.

References & Resources

Xerces Society Seed Mix Calculator

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

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

Seedling Identification Guide for Pollinator Hedgerow Forbs of California's Central Valley

Many of the plant species recommended for Conservation Cover Practice 327A are also featured in this California NRCS Plant Materials Technical Note (no. 82, 2011), a downloadable resource with seedling photos.

www.plant-materials.nrcs.usda.gov/pubs/capmctn10340.pdf

Pollinator Biology and Habitat in California

This California NRCS Biology Technical Note (no. 19, 2009) describes the biology and habitat needs of native bees.

http://efotg.sc.gov.usda.gov/references/public/CA/TN/Biology_19_wAppendices_20090520.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

Pollinator Conservation Resource Center

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

www.xerces.org/pollinator-resource-center

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.

www.vric.ucdavis.edu/pdf/soil_solarization.pdf

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

Weed Identification and Management

California Invasive Plant Council

www.cal-ipc.org

Appendix A: Recommended Plants—California Central Valley Region

Recommended Native Wildflowers for Pollinators and Beneficial Insects

☀️	COMMON NAME	SCIENTIFIC NAME	💧	LIFE CYCLE ^①		MAX HEIGHT	NOTES
Early	Arroyo lupine	<i>Lupinus succulentus</i>	L	A	3'		
	Baby blue eyes	<i>Nemophila menziesii</i>	L	A	0.25'		
	Chinese houses	<i>Collinsia heterophylla</i>	M	A	0.5'		
	Common tidytops	<i>Layia platyglossa</i>	L	A	0.25'	Tolerates clay soils	
	Fivespot	<i>Nemophila maculata</i>	M	A	1'	Tolerates clay soils	
	Golden lupine	<i>Lupinus densiflorus</i> var. <i>aureus</i>	L	A	2.5'		
	Goldfields	<i>Lasthenia glabrata</i>	M-H	A	0.5'	Wetland-riparian	
	Great Valley phacelia	<i>Phacelia ciliata</i>	L	A	0.25'	Tolerates clay soils	
	Lacy phacelia	<i>Phacelia tanacetifolia</i>	L	A	3'	Can re-seed aggressively; tolerates clay soils	
Early-Mid	California poppy	<i>Eschscholzia californica</i>	L	A, P	0.5'	Tolerates clay soils	
	Elegant clarkia	<i>Clarkia unguiculata</i>	L	A	0.5'		
	Fort Miller clarkia	<i>Clarkia williamsonii</i>	L	A	1'		
	Globe gilia	<i>Gilia capitata</i>	M	A, P	1'		
	Showy penstemon 🌱	<i>Penstemon spectabilis</i>	L	P	3'		
Mid	California buckwheat 🌱	<i>Eriogonum fasciculatum</i>	L	P	2.5'	Can be extremely drought-tolerant	
	California phacelia	<i>Phacelia californica</i>	L	P	1'	Tolerates clay soil; can re-seed aggressively	
	Cleveland sage 🌱	<i>Salvia clevelandii</i>	L	P	5'		
	Common woolly sunflower	<i>Eriophyllum lanatum</i>	L	P	2'	Can be extremely drought-tolerant	
	Coyote mint 🌱	<i>Monardella villosa</i>	L	P	2'	Requires good drainage	
	Showy milkweed 🌱🦋②	<i>Asclepias speciosa</i>	M	P	5'	Tolerates clay soils; tolerates wet or dry conditions	
	Summer lupine	<i>Lupinus formosus</i>	L	P	1.5'		
Mid-Late	Bolander's sunflower ③	<i>Helianthus bolanderi</i>	M	A	5'	Tolerates clay soils	
	California fuchsia 🌱	<i>Epilobium canum</i>	L	P	3'		
	Common madia	<i>Madia elegans</i>	L	A	7'		
	Common sunflower ③	<i>Helianthus annuus</i>	M	A	5'	Tolerates clay soils	
	Gumplant	<i>Grindelia camporum</i>	L	P	4'	Tolerates clay soils; can re-seed aggressively; tolerates wet or dry conditions	
	Hooker's evening primrose	<i>Oenothera elata</i>	M-H	P	5'	Wetland-riparian	
	Narrowleaf milkweed 🌱🦋	<i>Asclepias fascicularis</i>	M	P	1.5'	Tolerates clay soils; tolerates wet or dry conditions	
	Nettleleaf giant hyssop 🌱	<i>Agastache urticifolia</i>	M	P	4'	Tolerates clay soils	
	Woollypod milkweed 🌱🦋	<i>Asclepias eriocarpa</i>	M	P	2'	Tolerates clay soils; tolerates wet or dry conditions	
Late	California aster 🌱	<i>Symphotrichum chilense</i>	L	P	5'	Tolerates clay soils	
	Canada goldenrod 🌱	<i>Solidago canadensis</i>	M	P	3'	Tolerates wet or dry conditions	
	Vinegarweed	<i>Trichostema lanceolatum</i>	L	A	1'	Does not do well in seed mixes; sow seed individually; can be extremely drought-tolerant	
	Western goldentop	<i>Euthamia occidentalis</i>	H	P	2'	Wetland-riparian	

Central Valley Region Recommended Native Wildflowers—Additional Notes:

- ① Life cycle: annual (A), perennial (P)
- ② Plant **ONLY** in Sacramento Valley, not in San Joaquin Valley
- ③ Do not plant within one mile of commercial sunflower fields

KEY	☀️ Bloom time	💧 Water needs: low (L), medium (M), high (H)	🌱 Establishes better from transplant than seed	🦋 Monarch butterfly host plant

Appendix B: Recommended Plants—California Central Coast Region

Recommended Native Wildflowers for Pollinators and Beneficial Insects

☼	COMMON NAME	SCIENTIFIC NAME	💧	LIFE CYCLE [Ⓢ]		NOTES
					MAX HEIGHT	
Early	Baby blue eyes	<i>Nemophila menziesii</i>	L	A	0.25'	
	Bicolor lupine	<i>Lupinus bicolor</i>	M	A	0.5'	
	Chinese houses	<i>Collinsia heterophylla</i>	M	A	0.5'	
	Common tidytips	<i>Layia platyglossa</i>	L	A	0.25'	Tolerates clay soils
	Golden lupine	<i>Lupinus densiflorus</i> var. <i>aureus</i>	L	A	2.5'	
Early–Mid	California poppy	<i>Eschscholzia californica</i>	L	A, P	0.5'	Tolerates clay soils
	Farewell-to-spring	<i>Clarkia amoena</i>	M	A	0.5'	
	Foothill penstemon 🌿	<i>Penstemon heterophyllus</i>	L	P	3'	
	Globe gilia	<i>Gilia capitata</i>	M	A, P	1'	
	Sticky monkey flower 🌿	<i>Mimulus aurantiacus</i>	M	P	2'	
Mid	Black sage 🌿	<i>Salvia mellifera</i>	L	P	2'	
	California phacelia	<i>Phacelia californica</i>	L	P	1'	
	Common deerweed	<i>Lotus scoparius</i>	L	P	3'	Very long-blooming; tolerates wet or dry conditions
	Coyote mint 🌿	<i>Monardella villosa</i>	L	P	2'	Requires good drainage
	Narrowleaf milkweed 🌿🦋	<i>Asclepias fascicularis</i>	M	P	1.5'	Tolerates clay soils; tolerates wet or dry conditions
	Nettleleaf giant hyssop 🌿	<i>Agastache urticifolia</i>	M	P	4'	Tolerates clay soil; tolerates wet conditions
	Purple sage 🌿	<i>Salvia leucophylla</i>	L	P	2'	
	Summer lupine	<i>Lupinus formosus</i>	L	P	1.5'	
Mid–Late	California fuchsia 🌿	<i>Epilobium canum</i>	L	P	3'	
	Common sunflower	<i>Helianthus annuus</i>	M	A	5'	Tolerates clay soils
	Golden-yarrow	<i>Eriophyllum confertiflorum</i>	M	P	3'	
	Gumplant	<i>Grindelia camporum</i>	L	P	4'	Tolerates clay soils; can re-seed aggressively; tolerates wet or dry conditions
	Seaside woolly sunflower	<i>Eriophyllum stoechadifolium</i>	L	P	3'	
Late	California aster 🌿	<i>Symphotrichum chilense</i>	L	P	5'	Tolerates clay soils; tolerates wet or dry conditions
	California buckwheat 🌿	<i>Eriogonum fasciculatum</i>	L	P	2.5'	Can be extremely drought-tolerant
	Canada goldenrod 🌿	<i>Solidago canadensis</i>	M	P	3'	Tolerates wet or dry conditions
	Marsh gumplant	<i>Grindelia stricta</i>	M	P	5'	



Monarch caterpillar on woollypod milkweed, left; monarch butterfly on narrowleaf milkweed, right. (Photos: Brianna Borders, The Xerces Society, left; Eric Eldredge, USDA–NRCS, right.)

Appendix C: Recommended Plants—Southern California

Recommended Native Wildflowers for Pollinators and Beneficial Insects

🌸	COMMON NAME	SCIENTIFIC NAME	💧	LIFE CYCLE ^❶		MAX HEIGHT	NOTES
Early	Baby blue byes	<i>Nemophila menziesii</i>	L	A	0.25'		
	Bicolor lupine	<i>Lupinus bicolor</i>	M	A	0.5'		
	Common tidytops	<i>Layia platyglossa</i>	L	A	0.25'	Tolerates clay soils	
	Golden lupine	<i>Lupinus densiflorus</i> var. <i>aureus</i>	L	A	2.5'		
Early–Mid	California brittlebush 🌱	<i>Encelia californica</i>	L–M	P	4'	Tolerates clay soil	
	California poppy	<i>Eschscholzia californica</i>	L	A, P	0.5'	Tolerates clay soils	
	Farewell-to-spring	<i>Clarkia amoena</i>	M	A	0.5'		
	Foothill penstemon 🌱	<i>Penstemon heterophyllus</i>	L	P	3'		
	Globe gilia	<i>Gilia capitata</i>	M	A, P	1'		
	Purple sage 🌱	<i>Salvia leucophylla</i>	L	P	2'		
	Showy penstemon 🌱	<i>Penstemon spectabilis</i>	L	P	3'		
Mid	California buckwheat 🌱	<i>Eriogonum fasciculatum</i>	L	P	2.5'	Extremely drought-tolerant	
	California phacelia	<i>Phacelia californica</i>	L	P	1'	Tolerates clay soil; can re-seed aggressively	
	Common deerweed	<i>Lotus scoparius</i>	L	P	3'	Drought-tolerant, also tolerates wetter conditions	
	Imbricate phacelia	<i>Phacelia imbricata</i>	L	P	2'		
	Island buckwheat 🌱	<i>Eriogonum arborescens</i>	L	P	2'		
	Narrowleaf milkweed 🌱🦋	<i>Asclepias fascicularis</i>	M	P	1.5'	Tolerates clay soils; tolerates wet or dry conditions	
	Summer lupine	<i>Lupinus formosus</i>	L	P	1.5'		
Mid–Late	Black sage 🌱	<i>Salvia mellifera</i>	L	P	2'		
	California goldenrod	<i>Solidago californica</i>	M	P	3'	Tolerates wet or dry conditions	
	Cleveland sage 🌱	<i>Salvia clevelandii</i>	L	P	3'		
	Common sunflower	<i>Helianthus annuus</i>	M	A	5'	Tolerates clay soils	
	Golden-yarrow	<i>Eriophyllum confertiflorum</i>	M	P	3'		
	Gumplant	<i>Grindelia camporum</i>	L	P	4'	Tolerates clay soils; can re-seed aggressively; tolerates wet or dry conditions	
	Woollypod milkweed 🌱🦋	<i>Asclepias eriocarpa</i>	M	P	2'	Tolerates clay soils; tolerates wet or dry conditions	
Late	St. Catherine's lace	<i>Eriogonum giganteum</i>	L	P	5'	Very long-blooming	
	California fuchsia 🌱	<i>Epilobium canum</i>	L	P	3'		
	Seaside woolly sunflower	<i>Eriophyllum stoechadifolium</i>	M	P	3'		

Central Coast Region & Southern California Recommended Native Wildflowers—Additional Notes:

❶ Life cycle: annual (A), perennial (P)

KEY	🌸 Bloom time	💧 Water needs: low (L), medium (M), high (H)	🌱 Establishes better from transplant than seed	🦋 Monarch butterfly host plant



Pollinator planting with California poppies, baby blue eyes, and common tidytops. (Photo: Jessa Kay Cruz, The Xerces Society.)

Appendix D: Example Seed Mixes, Native Seed and Native Plant Sources

Example Seed Mixes

These example seed mixes have been formulated for a one-acre area*, based on field trials and monitoring conducted by the Xerces Society, the NRCS, Hedgerow Farms, and the William's lab at UC–Davis, and are designed to provide permanent, high-quality foraging resources for a diversity of pollinators and other beneficial insects. None of the recommended species are known to serve as alternate hosts for any crop pests. In addition to pollinator attractiveness, species were selected for their ease of establishment, broad natural geographic range, and drought tolerance. For details on woody plants, see *Hedgerows for Pollinators 422A Specifications*.

*To use any of these mixes on larger or smaller areas, adjust rates accordingly. For more information on sourcing Xerces Society recommended seed mixes, please visit www.xerces.org/pollinator-seed/.

California Almond Orchard Understory Seed Mix

This seed mix is consists of early-blooming annual native and non-native wildflowers which provide excellent forage for honey bees, early season solitary bees and natural enemies of crop pests in almond orchards, but can also be used in other orchard types, such as apples and stone fruits. The species in this mix are low in stature and should be easy to clear away before harvest. For best results (i.e., re-seeding next year), mow after all species have finished blooming. Do **NOT** till.

COMMON NAME	SCIENTIFIC NAME	LIFE CYCLE ^①	SEEDS/ FT ²	% OF MIX	
				(by seed count)	(by weight)
Baby blue eyes	<i>Nemophila menziesii</i>	A	5.29	18%	27.4%
California poppy	<i>Eschscholzia californica</i>	A, P	4.7	16%	19.7%
Chinese houses	<i>Collinsia heterophylla</i>	A	6.76	23%	21.7%
Great Valley phacelia	<i>Phacelia ciliata</i>	A	6.47	22%	24.5%
Sweet alyssum ^②	<i>Lobularia maritima</i>	A	6.17	21%	6.7%
TOTAL			29.4	100%	

Pollinator and Beneficial Insect Seed Mix for the Central Valley

This mix is comprised of native wildflowers and is appropriate for habitat restoration throughout California's Central Valley region. Native bunch grasses that provide nesting habitat for bumble bees and other beneficial insects may also be included at a low rate.

COMMON NAME	SCIENTIFIC NAME	LIFE CYCLE ^①	SEEDS/ FT ²	% OF MIX	
				(by seed count)	(by weight)
Bolander's sunflower ^③	<i>Helianthus bolanderii</i>	A	0.85	2%	4.7%
California phacelia	<i>Phacelia californica</i>	P	3.19	7.5%	6.1%
California poppy	<i>Eschscholzia californica</i>	A, P	4.46	10.5%	8.8%
Elegant clarkia	<i>Clarkia unguiculata</i>	A	12.75	30%	4.4%
Fort Miller clarkia	<i>Clarkia williamsonii</i>	A	7.65	18%	3.4%
Golden lupine	<i>Lupinus densiflorus</i> var. <i>aureus</i>	A	0.85	2%	54.5%
Great Valley phacelia	<i>Phacelia ciliata</i>	A	5.31	12.5%	9.5%
Gumplant	<i>Grindelia camporum</i>	P	3.19	7.5%	7.8%
Yarrow ^②	<i>Achillea millifolium</i>	P	4.25	10%	0.9%
TOTAL:			42.5	100%	

Example Seed Mixes (All Regions)—Additional Notes:

- ① Life cycle: annual (A), perennial (P)
- ② Included for its high value to beneficial insects (not known to be particularly attractive to pollinators).
- ③ Do not plant within one mile of commercial sunflower fields. Seed mix is available from seed producer without sunflower upon request.

Pollinator and Beneficial Insect Seed Mix for the Central Coast Region and Southern California

This mix is comprised primarily of native wildflowers and is appropriate for habitat restoration throughout California's Central Coast region and most of Southern California. Native bunch grasses that provide nesting habitat for bumble bees and other beneficial insects may also be included at a low rate.

COMMON NAME	SCIENTIFIC NAME	LIFE CYCLE ^①	SEEDS/ FT ²	% OF MIX	
				(by seed count)	(by weight)
Baby blue eyes	<i>Nemophila menziesii</i>	A	5	10%	10.5%
California phacelia	<i>Phacelia californica</i>	P	3.5	7%	6.1%
California poppy	<i>Eschscholzia californica</i>	A, P	4	8%	6.3%
Common sunflower	<i>Helianthus annuus</i>	A	1	2%	2.9%
Farewell-to-spring	<i>Clarkia amoena</i>	A	12.6	25%	3.4%
Globe gilia	<i>Gilia capitata</i>	A, P	11.6	23%	7.4%
Golden lupine	<i>Lupinus densiflorus var. aureus</i>	A	0.8	1.5%	34.7%
Golden-yarrow	<i>Eriophyllum confertiflorum</i>	P	4.8	9.5%	3.1%
Gumplant	<i>Grindelia camporum</i>	P	3	6%	24.8%
Yarrow ^②	<i>Achillea millefolium</i>	P	4	8%	0.7%
TOTAL:			50.4	100%	

Native Seed Vendors and Native Plant Nurseries

Inclusion on this list does not constitute an endorsement or a recommendation. Other vendors not listed below may also have suitable plant materials. If you know of another source or if you are a vendor and would like to be included on this list, please contact Tom Moore, NRCS State Biologist (Tom.Moore@ca.usda.gov, 530-792-5652). For more information on sourcing recommended seed mixes, please visit www.xerces.org/pollinator-seed/.

⚠ Before ordering, ensure that all plants or seeds purchased for pollinator habitat have NOT been treated with systemic insecticides. ⚠

NATIVE SEED VENDORS & NATIVE PLANT NURSERIES				STOCK		REGION(S)		
NAME	LOCATION(S)	PHONE	WEBSITE	SEEDS	TRANSPLANTS	CENTRAL VALLEY	CENTRAL COAST	SOUTHERN CA
Central Coast Wilds	Santa Cruz	831-459-0656	www.centralcoastwilds.com	✓	✓	✓	✓	✓
Cornflower Farms	Elk Grove	916-689-1015	www.cornflowerfarms.com	✓	✓	✓	✓	✓
Elkhorn Slough Native Nursery	Moss Landing	831-763-1207	www.elkhornnursery.com	✓	✓	✓	✓	✓
Floral Native Nursery	Chico	530-892-2511	www.floralnativenursery.com	✓	✓	✓	✓	✓
Growing Solutions	Santa Barbara	805-452-7561	www.growingsolutions.org	✓	✓	✓	✓	✓
Hedgerow Farms	Winters	530-662-6847	www.hedgerowfarms.com	✓	✓	✓	✓	✓
Intermountain Nursery	Prather	559-855-3113	www.intermountainnursery.com	✓	✓	✓	✓	✓
Kamprath Seed, Inc.	Manteca	209-823-6242	www.kamprathseed.com	✓	✓	✓	✓	✓
Las Pilitas Nursery	Escondido, Santa Margarita	760-749-5930	www.laspilitas.com	✓	✓	✓	✓	✓
Native Here Nursery	Berkeley	501-549-0211	www.nativeherenursery.org	✓	✓	✓	✓	✓
Native Revival Nursery	Aptos	831-684-1811	www.nativerevival.com	✓	✓	✓	✓	✓
Pacific Coast Seeds	Livermore	925-373-4417	www.pcseed.com/index.asp	✓	✓	✓	✓	✓
S&S Seeds, Inc.	Carpinteria	805-684-0436	www.ssseeds.com	✓	✓	✓	✓	✓
Tree of Life Nursery	San Juan Capistrano	949-728-0685	www.californianativeplants.com	✓	✓	✓	✓	✓

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