

# Insectary Cover Cropping in California



**Figure 1:** A cover crop of profusely flowering broadleaf herbaceous plants brings many benefits for crop production, including supporting pollinators and other beneficial insects that attack crop pests. Good management and careful choice of plant species are needed to achieve the greatest benefits.

## A Guide to Insectary Cover Cropping in California

Insectary cover cropping is the practice of growing single species or diverse mixes of broadleaf herbaceous plants and allowing them to bloom to provide pollen and nectar resources that support populations of native bees, honey bees, and the insects that attack crop pests.

Worldwide pollinator declines are widely documented. Since 2006, honey beekeepers have lost an average of 30% of their hives per year, and at least 25% of North American bumble bee species are at risk of extinction. The western population of the iconic monarch butterfly has declined by over 99% since the 1980s, and it is becoming increasingly clear that insect populations, in general, are declining worldwide. The negative impacts of insect declines are likely to affect humans in a variety of ways, including reducing our food security and agricultural productivity. We rely on pollinators to produce over 30% of the food we consume, and the estimated value of pest control by wild natural enemies of crop pests is \$4.5–12 billion annually for U.S. crops, and \$100 billion worldwide. Collectively, pollinators and natural enemies—hereafter referred to as “beneficial insects”—provide critical ecosystems services for nearly all agricultural systems.

### What is insectary cover cropping?

The goal of insectary cover cropping is to provide an abundance of floral resources that are protected from pesticide exposure when the cover crop is in bloom, and that support important beneficial insects when they are active. Pollinators such as bees rely on pollen and nectar as their only source of food, while many natural enemies that attack crop pests rely on floral resources at specific life stages or to supplement their diets. Because different groups of beneficial insects are active at different times, it is ideal to provide consistent floral resources from early in the spring through the fall. However, insectary cover crops also can be designed to support beneficial insects that are important for a specific purpose (e.g., spring-flying native bees that require pollen and nectar before and after orchard bloom). It is important that insectary cover crops fit well into overall farm management, and targeting specific, shorter bloom times can help.

Selecting the appropriate species is an important component of insectary cover cropping. Not all flowering plants





provide resources for beneficial insects, so researching which plants to use or selecting insectary seed mixes from a trusted source is recommended. Diverse seed mixes that combine brassicas, clovers/legumes, and native wildflowers provide optimal resources for beneficial insects. Brassicas provide very early-season resources, while clovers and other legumes are generally inexpensive and attractive to beneficial insects. The inclusion of cost-effective native wildflowers is highly recommended, as they comprise some of the most important species for pollinators, and are often the only plants sufficiently drought tolerant to persist through the summer in non-irrigated or minimally irrigated areas. More information on recommended seed mixes for California can be found in the appendix of this document.

Cover cropping can address multiple natural resource concerns simultaneously, although some trade-offs may be necessary. The primary goal of insectary cover cropping is to attract and support beneficial insects; therefore, the cover crop should be allowed to bloom and remain on the ground for as long as possible. Other goals that can be achieved at the same time include improved soil health, increased soil organic matter, improved water infiltration and adjacent water quality, increased soil nutrients and nitrogen fixation, reduced weed pressure, reduced erosion from wind and water, and reduced soil compaction. The level of these other benefits depends upon the cover crop species chosen and how they are managed.

### Seedbed Preparation

As with any vegetation establishment practice, adequate site preparation is critical to success, particularly if weeds or other plant cover have been allowed to grow in the area to be cover cropped. A minimum of one year of weed eradication is recommended before planting cover crops in areas with existing plant cover. Areas with heavy weed pressure may require additional time. Recommended weed eradication methods for cover cropping include regular mowing, regular herbicide applications, grazing, and burning / steaming. The key strategy for any of these methods is to flush weed seeds out of the top several inches of the soil, kill existing

**Figure 2:** The method used to seed cover crops can be adapted to the site and the equipment available.

*Top:* Broadcast seeder mounted onto ATV

*Upper middle:* Broadcast seeder mounted onto ATV with improvised seed deflectors

*Lower middle:* Seed drill used to plant cover crops

*Bottom:* For smaller areas, an ATV mounted roller can be used to push seed into soil after broadcasting



weeds, and prevent unwanted species from going to seed. Repeated tillage is not recommended as a site preparation method because it tends to exacerbate weed problems.

### Method of Seeding

Proper equipment for cover crop planting is a key element of successful establishment and is often one of the most challenging aspects of successful planting, as many growers do not possess the appropriate equipment. No-till drills, especially native seed drills, can work very well for cover crop seeding projects. Drills should be set on a shallow setting or have hydraulics disabled as most insectary species do best planted at less than 1-inch depth. A variety of different styles of seed broadcasters can be mounted to small tractors or ATVs and calibrated accordingly. Models with an interior agitator and seed deflectors to control the broadcast area are best. Ant-bait spreaders or fertilizer spreaders can be cleaned out and used as seed broadcasters.

Insectary cover-crop seeding often has the added complication of including a diversity of species with seeds of different sizes. Many species used in insectary mixes have very small seeds, which can make selecting and calibrating equipment difficult. If there are grasses in your seed mix, sow these separately from the forbs. The shape and density differences make it very difficult to sow grasses and forbs together with most equipment. If seed sizes vary substantially, ask to purchase them as single species rather than pre-mixed. Sow differently sized seeds separately.

Here are a few other seeding tips:

- ☞ Do NOT till an area prior to seeding unless you can do so at a very shallow depth (e.g., less than 1 inch). Tillage will exacerbate weed problems and can result in burying cover crop seed too deep.
- ☞ Cover crops can be broadcast seeded if the seedbed is clear of stubble or other plant residue. Soil should be prepared for broadcast seeding by dragging with a harrow or similar implement that will scratch the soil surface and break the crust.
- ☞ If broadcast seeding, immediately follow up with a light harrow, ring-roller, cultipacker, irrigation, or other technique that will push the seed firmly into the soil.

### Timing of Seeding and Irrigation Requirements

Fall is the ideal time for planting cover crops in California. If irrigation is unavailable, wait until there has been adequate rainfall to moisten the top 2–4 inches of soil before planting. If possible, allow for a flush of weed growth after the first seasonal rain, remove the weeds, and then plant. If irrigation is available on-site, planting should still occur in the fall, but can be done as early as October. The site should be irrigated before and after planting if natural rainfall is absent. Avoid planting in very wet soil, as wet soil is fragile and compacts easily.

### Timing and Method of Termination

Termination of the cover crop may be necessary for farm management activities such as planting a seasonal crop or clearing an orchard floor for harvest. Since the goal of insectary cover cropping is to provide floral resources, it is important to allow the cover crop to bloom for as long as possible before terminating. Where reseeding (self-sowing) is desired, allow cover crop to set seed and mature prior to termination (seed usually takes a couple weeks to mature once plant is done blooming). If reseeding is not desired, cover crop can be terminated immediately at the end of bloom.

The recommended cover-crop termination method for insectary cover cropping is mowing. Mowing minimizes disturbance to ground dwelling beneficial insects such as ground beetles and ground-nesting bees, which can take up residence in cover-cropped areas during the growing season. Mowing also maximizes the likelihood that the cover crop will reseed on its own the



**Figure 3:** Cover crop six years after planting with no-replanting, using a flail mower to terminate. Native wildflower *Layia platyglossa* (tidy tips) self-sows prolifically, even in this non-irrigated orchard cover crop.





**Figure 4:** Early emerging species such as mustard (here blooming in early March) help out-compete common cool season weeds.

following year, a characteristic particularly common for native wildflowers. Most of the soil health benefits of cover cropping will be maintained if mowing is used to terminate. Some debris may be left behind on the soil surface after mowing, which can have soil health benefits. In cropping systems where debris is undesirable, choosing plants with residue that breaks down quickly and using a flail mower can minimize the amount of debris left behind.

### **Other Considerations**




**Frost:** In cases where cover crops are planted in the understory of perennial cropping systems (e.g., almond orchards or vineyards), frost risk can be of concern. Data on how cover crops affect frost risk is mixed and limited, but it is possible that cover crops can increase the risk of frost to adjacent crops by impeding airflow. In order to mitigate this risk, cover crops can be mowed at a high setting (approximately 1-foot high) ahead of anticipated frost. In most cases, this will minimize the risk while still allowing the cover crop to regrow and bloom later in the season.

**Weed management:** Managing weeds in cover-cropped areas is an important component of successful establishment. Methods for managing weeds depend on the cover crop composition, timing, and species of weed. Including very early germinating species in cover crop seed mixes, such as brassicas, can help outcompete common cool season weeds. Mowing can be a very effective and simple weed management strategy. Early in the season, cool season weeds such as *Malva* often grow above the height of the cover crop species and can be managed through a high mow. This allows the cover crop species to be relatively unharmed while knocking back undesirable species. Later season spot mowing / weedwacking can target denser patches of weeds such as maretail or prickly lettuce without sacrificing the entire cover crop. Depending on the species composition of the cover crop mix, selective herbicide applications can be a viable weed management option. Because insectary plantings are comprised primarily or exclusively of forbs, grass-selective herbicides can be an effective way to manage common grass weeds.

**Pesticide exposure:** Mitigating pesticide exposure is a key component of functional insectary habitat. It can be an added challenge in cover crop areas, especially those planted between crop rows or as an understory in perennial cropping systems. Beneficial insects foraging in cover crop areas can be negatively impacted by pesticides applied

### Bee Precaution Ratings

The University of California's Bee Precaution website (<https://www2.ipm.ucanr.edu/bee precaution/>) assesses the risk of pesticides to bees using a three-tier red–yellow–green rating.

-  Do not apply or allow to drift to plants that are flowering including weeds. Do not allow pesticide to contaminate water accessible to bees including puddles.
-  Do not apply or allow to drift to plants that are flowering including weeds, except when the application is made between sunset and midnight if allowed by the pesticide label and regulations. Do not allow pesticide to contaminate water accessible to bees including puddles.
-  No bee precaution, except when required by the pesticide label or regulations.

in the area. In order to preserve the functionality of insectary habitat, use the pesticide ratings on the University of California's Bee Precaution website (see box and link in the appendix) to determine the appropriate action if pesticides are used near the habitat area. We recommend only applying pesticides in adjacent cropped areas that are rated on Bee Precaution as a III (green), “no bee precaution.” If you determine that pest pressure necessitates the use of a pesticide rated as I (red) or II (yellow) in the area, mow the cover crop so there are no blooms remaining, and wait 24 hours before spraying. This will help reduce the number of beneficial insects in the area, and thus the nontarget impact of spraying.

When mowing to protect from pesticide exposure, there are a couple of important additional considerations. Depending on the time of year and growth stage of the cover crop species, mowing could decrease the likelihood that the cover crop will regrow and bloom within in the same growing season, or reseed the following year. It is also important to consider the likely dispersal patterns of beneficial insects. If there is appropriate nearby habitat with pollen and nectar resources, beneficial insects will have somewhere to go, but still stay in the area. That may increase the likelihood they will repopulate quickly. However, in the absence of such habitat resources, populations may disperse away from the area or perish. Therefore, it is recommended that in addition to insectary cover crops, farms also include some nearby permanent, protected insectary habitat. It is also important to note that using an integrated pest management (IPM) approach that focuses on long-term prevention of pests will reduce pest pressure and could reduce pesticide use. Additional information on pesticide risk mitigation and IPM can be found in the appendix of this document.

### Additional Support

There are a few companies that rent out equipment and / or that can be contracted to plant cover crops in California. A list of current companies can be found in the appendix of this document.

The Natural Resources Conservation Service (NRCS) provides both technical and financial support for cover cropping and pollinator habitat projects through Farm Bill Programs such as the Environmental Quality Incentives Program (EQIP). More information on those programs can be found at <https://www.nrcs.usda.gov/wps/portal/nrcs/main/ca/programs/farmbill/>.

The California Department of Food and Agriculture (CDFA) also offers technical and financial assistance for cover cropping and related practices through their Healthy Soils Program. More information on that program can be found at <https://www.cdfa.ca.gov/oefi/healthysouls/>.

# Appendix

## Cover Crop Seed Mixes

Recommended insectary cover crop seed mixes can be found on the Xerces Society website:  
[xerces.org/pollinator-conservation-resources/california](http://xerces.org/pollinator-conservation-resources/california)

## Cover Crop Planting Companies

*Please note that these companies are listed for informational purposes only. Listing these companies does not constitute an endorsement.*

- ↪ Miller Cover Crop Planting, Modesto, CA. (209) 526-2111 (equipment and planting)
- ↪ Joe Muller and Sons Farming, Woodland, CA. (530) 662-0105 (equipment only)
- ↪ Paul Strojan, Farmington, CA. (209) 573-1656, [strojanp@velociter.net](mailto:strojanp@velociter.net)
- ↪ Kellogg's Ag Service, Paradise, CA. (530) 624-3045, [www.kelloggsagservice.com](http://www.kelloggsagservice.com)

Many Resource Conservation Districts provide equipment rental services. Check with your local RCD office for availability.

## Pesticide Mitigation Information

Recommended website for looking up pesticide toxicity ratings

- ↪ Bee Precaution: <https://www2.ipm.ucanr.edu/bee precaution/>

Resources with more information on mitigating harm from pesticides

- ↪ University of California Statewide Integrated Pest Management Program: <http://ipm.ucanr.edu/>
- ↪ How to Reduce Bee Poisoning from Pesticides: <https://catalog.extension.oregonstate.edu/sites/catalog/files/project/pdf/pnw591.pdf>
- ↪ Bee Better Certified Production Standards: [https://beebettercertified.org/sites/default/files/docs/BBC\\_2017-02\\_Production%20Standards\\_March2019\\_Updated.pdf](https://beebettercertified.org/sites/default/files/docs/BBC_2017-02_Production%20Standards_March2019_Updated.pdf)
- ↪ Mitigation Techniques to Protect Habitat: <https://xerces.org/publications/fact-sheets/guidance-to-protect-habitat-from-pesticide-contamination>
- ↪ Organic Pesticides and Pollinators: <https://xerces.org/publications/fact-sheets/common-organic-allowed-pesticides>
- ↪ Fungicides and Pollinators: <https://xerces.org/publications/fact-sheets/protecting-pollinators-from-pesticides-fungicide-impacts-on-pollinators>
- ↪ Neonicotinoids and Beneficial Insects: <https://xerces.org/publications/scientific-reports/how-neonicotinoids-can-kill-bees> and <https://xerces.org/publications/guidelines/beyond-birds-and-bees>

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