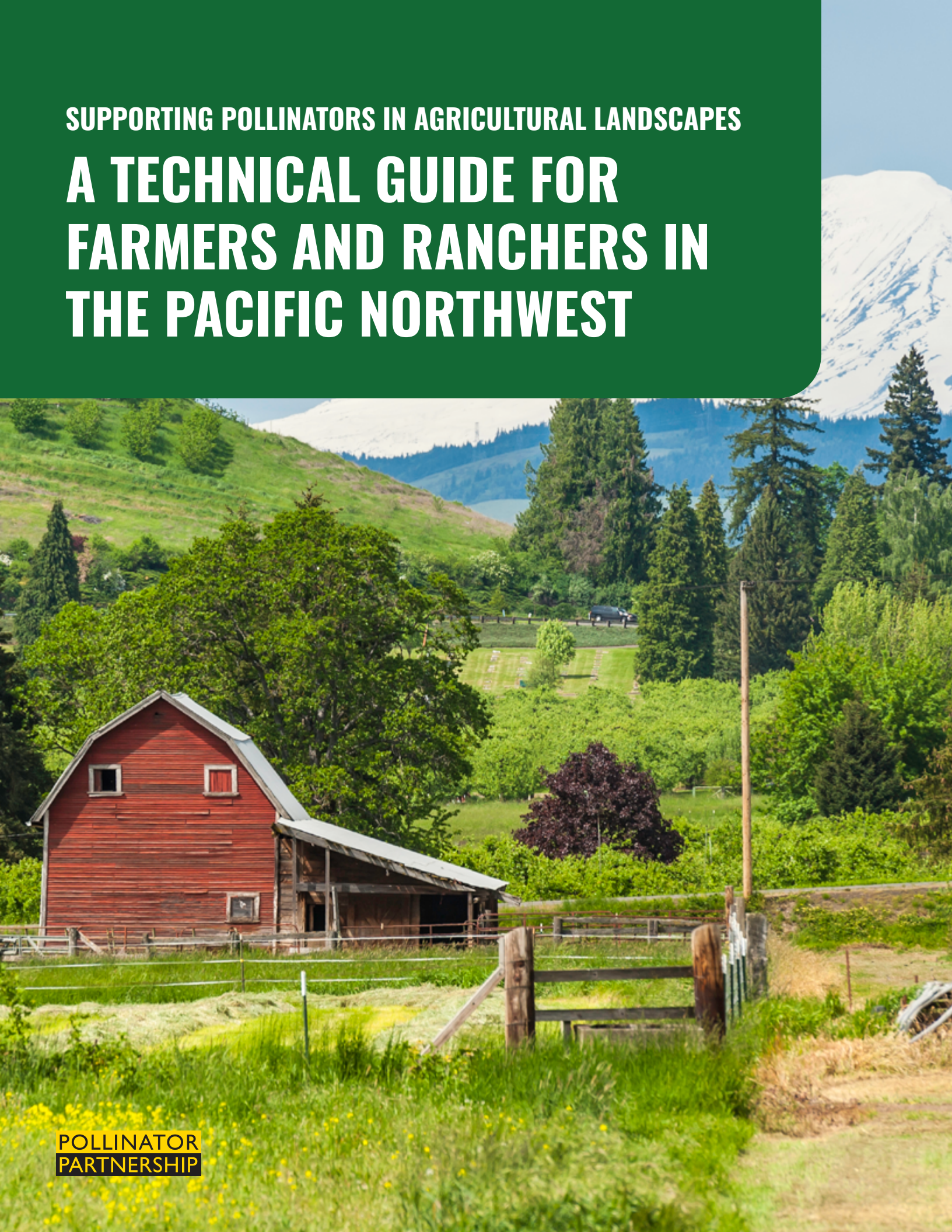
SUPPORTING POLLINATORS IN AGRICULTURAL LANDSCAPES

A TECHNICAL GUIDE FOR FARMERS AND RANCHERS IN THE PACIFIC NORTHWEST



POLLINATOR PARTNERSHIP

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POLLINATOR PARTNERSHIP

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SECTION 1:

INTRODUCTION

HOW TO USE THIS GUIDE

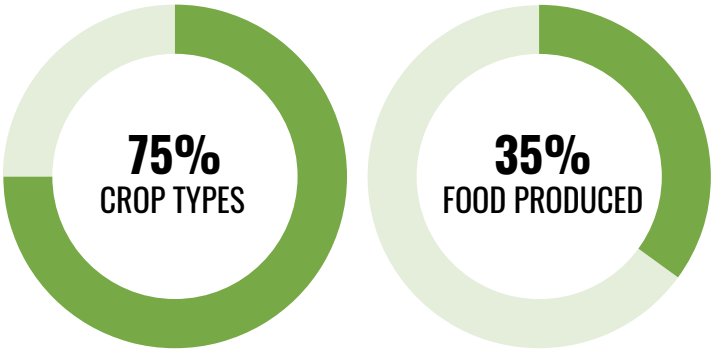
This guide has been created for farmers and ranchers who want to act to protect and promote pollinators on their land. Actions that support pollinators improve farm productivity as well as the resiliency of farm and ranch operation.

This guide can be used as a quick reference on individual topics or can be read in its entirety for a deeper dive into the subject. It provides guidance on how to support and protect pollinators and other beneficial organisms that are essential to resilient and productive farms in the Pacific Northwest. The guide covers four important activities that help support pollinators and minimize the negative impacts of pesticides: Integrated Pest Management (IPM); habitat creation and maintenance; communication between beekeepers and farmers and pesticide product selection and use. The resource section includes more information and important links that will help you support pollinators, minimize the impacts of pesticides, and have a productive and sustainable operation.

Photo courtesy Ben King

WHY SHOULD YOU SUPPORT POLLINATORS?

Pollinators, especially bees, play a crucial role in the pollination of crops around the world. About 75% of crop types and 35% of food produced relies on or benefits from the action of pollinators. Pollinator health is important to the long-term sustainability of crop production as well as to the broader environment. Attention to pollinators is more important than ever, as many pollinator populations are known to be in decline globally.

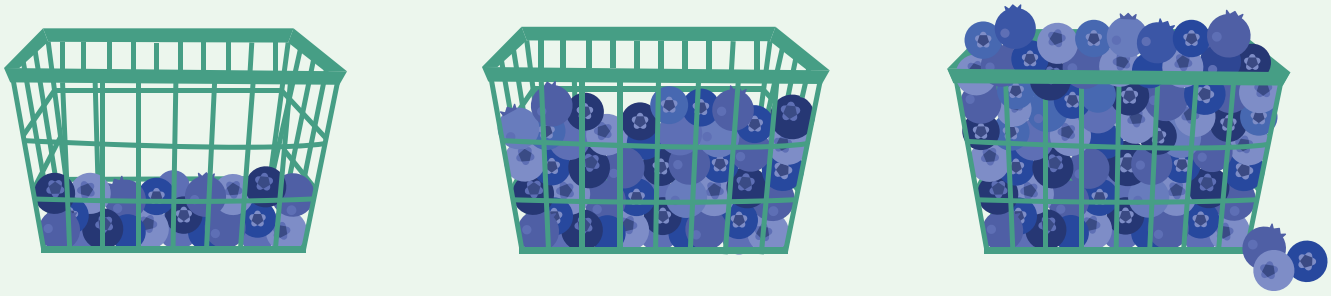


RELY OR BENEFIT FROM THE ACTION OF POLLINATORS

The US Pacific Northwest (in this guide, the Pacific Northwest includes Oregon, Washington, as well as Idaho) has rich soils and diverse climate resulting in an important and diverse agricultural economy. The region ranks among the top three producers of 40 different specialty crops, such as tree fruits, nuts, berries, and grapes. The primary crops are apple, wheat, and potato, and the region also produces cattle, milk, hops, hazelnuts, stone fruits, onions, and mint. Hay, grass seed, and specialty crops dominate the area west of the Cascade Mountains; west of the Rocky Mountains, cereal grains, beans and peas, tree fruits, berries, grapes, and hazelnuts dominate; and, throughout the region, livestock are an important contributor to the agricultural economy.

Many crops grown in the Pacific Northwest require or benefit from insect pollination. Approximately 70% of the nation's apples, which are pollinator-dependent, are grown in this region and other crops grown in the region also rely on pollinators, including blueberries, raspberries, cranberries, many stone fruits, and vegetable seed crops such as onions and squash. In Washington State alone, 3 of the top 10 crops require bees for pollination (apples, cherries, and pears).

WILD AND MANAGED POLLINATORS' IMPACT ON PRODUCTION

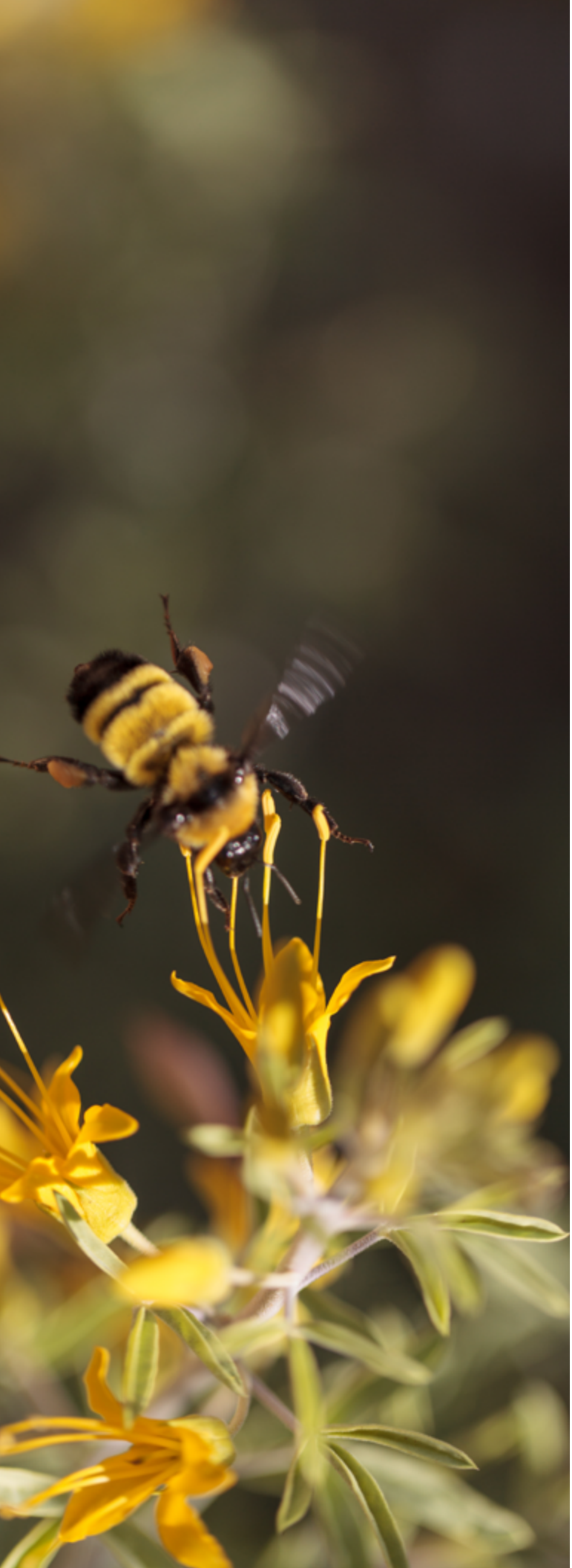


Low production:
No pollinators

Typical production:
Managed honey bees and typical ambient wild pollinators

Potential production:
Full pollination with managed honey bees and increased wild bee presence from habitat management. This can potentially increase revenue by $4,700-5,700/ac

To achieve sufficient levels of pollination in pollinator-dependent crops, many farmers rent honey bee hives. In addition to these managed bees, the Pacific Northwest contains a high diversity of native pollinators that provide important services to farmers. The Pacific Northwest is home to almost 900 species of native bees and hundreds of other species of pollinating insects. These beneficial insects are not managed commercially and require habitat in order to pollinate nearby crops. Providing this habitat can significantly benefit production in pollinator-dependent crops and can support conservation efforts.



In recent years there has been growing concern over both managed and wild pollinator populations. There have been documented declines in wild pollinators throughout the US, with some bumble bee (*Bombus*) species declining up to 96%. The threats faced by pollinators in the Pacific Northwest are similar to those in other agricultural areas. Some major stressors thought to contribute to decline include: land use change and loss of habitat; diseases and parasites; invasive species; and pesticide exposure. Studies have found that areas of intense agriculture are among the lowest areas of wild bee abundance in the US. Climate change and drought are leading to unpredictable temperatures and rainfall, further compounding other stressors. Research shows that increased biodiversity of adjacent habitat can improve pollinator resilience to climate change.

Keeping managed bees and other pollinators such as wild bees healthy amid potential threats requires involvement from all participating in crop production, from beekeepers to farmers, ranchers, agronomists, crop consultants, and pesticide applicators.

SECTION 2:

SUPPORTING AND PROTECTING POLLINATORS IN YOUR OPERATION

Balancing the need for crop protection with pollinator health calls for employing several activities that together result in robust and productive agricultural systems. **This guide covers four important activities that can help all stakeholders protect pollinators while maintaining production.**

- Integrated Pest Management
- Supporting pollinators through habitat
- Communication between beekeepers and farmers
- Selecting and using pesticide products

1. INTEGRATED PEST MANAGEMENT (IPM)

Using Integrated Pest Management (IPM) can help you save money and time, reduce pesticide use, reduce negative impacts to pollinators, and enhance crop pollination. IPM is a pest management strategy based on ecosystem function and long-term reduction of pest damage. It combines techniques such as habitat manipulation, use of pest resistant varieties, mechanical (e.g., chopping corn stalk with flail mower to destroy overwintering larvae), a range of cultural practices (e.g., crop rotation), biological control from beneficial insects, pest and damage monitoring, and as, pesticide application when pests exceed economic thresholds. The strength of IPM lies in the combination of all these methods.

Farmers and ranchers can educate themselves on using the many resources available (see resources section) or hire an IPM consultant. Although hiring an IPM consultant can cost more money up front, savings and production benefits from using IPM methods are substantial and can be realized within the first year of switching to IPM practices.

The Main Principles of IPM include:

1. Pest identification and monitoring
2. Decision making based on monitoring and thresholds
3. A multi-faceted approach based on monitoring, thresholds, observations, and predictive modeling
4. Prevention of pest infestations
5. Evaluation and improvement of management strategies
6. Resistance management
7. Manage pesticide risk

Implement cultural practices, like orchard and farm sanitation, to reduce the potential risk of pest outbreaks.

Use biocontrol methods, like mating disruption and natural enemies, whenever possible to reduce the need for chemicals.

Monitor using traps, sweep netting, and other methods to determine pest pressures. Use thresholds and/or models to determine the need for intervention.

Follow all label guidelines and only spray pesticides under ideal weather conditions. Avoid pesticide applications during periods of peak pollinator activity and select pesticides with the lowest risk to pollinators.

Only spray insecticides when pollinators are not present, under ideal weather conditions, and follow labels and expert guidelines.

Plant habitat to support beneficial insects including predators and parasites of pest species.

Evaluate yearly practices and implement improvements.

PRINCIPLES OF IPM

1. **Pest identification and monitoring:** Proper identification and monitoring of pests is vital in understanding the specific situation and potential mitigation of pest infestations. Scouting for pests, pest damage, and beneficial insects that may be controlling the pests is essential to a successful IPM strategy. Seek out crop-specific monitoring schedules and guides that include pest and damage identification, monitoring protocols, and thresholds for treatment. A good resource for these schedules and guides can be found at http://ipm.ucanr.edu/.

2. **Decision making based on monitoring, thresholds, observations, and predictive models:** Management decisions should be based on monitoring and assessing if economic threshold levels are met. Models are commonly used to help make decisions about the timing of management practices. Predictive models can consider pest biology, behavior, life cycles, and weather data to help farmers forecast pest emergence and improve timing of pesticides using science-based decisions. This is important because it ensures that farmers are applying management strategies at the proper time and avoiding any unnecessary applications, saving money and reducing pesticide exposure to pollinators and other beneficial insects.

3. **A multi-faceted approach that combines physical, biological, cultural control and chemical methods:** IPM benefits from a combination of management approaches that can use different modes of action and strategies, taking advantage of physiological, ecological, and behavioral characteristics of the target pests.These non-chemical approaches can reduce the use of pollinator-toxic pesticides. The application method also impacts how pollinators are potentially exposed to chemicals.

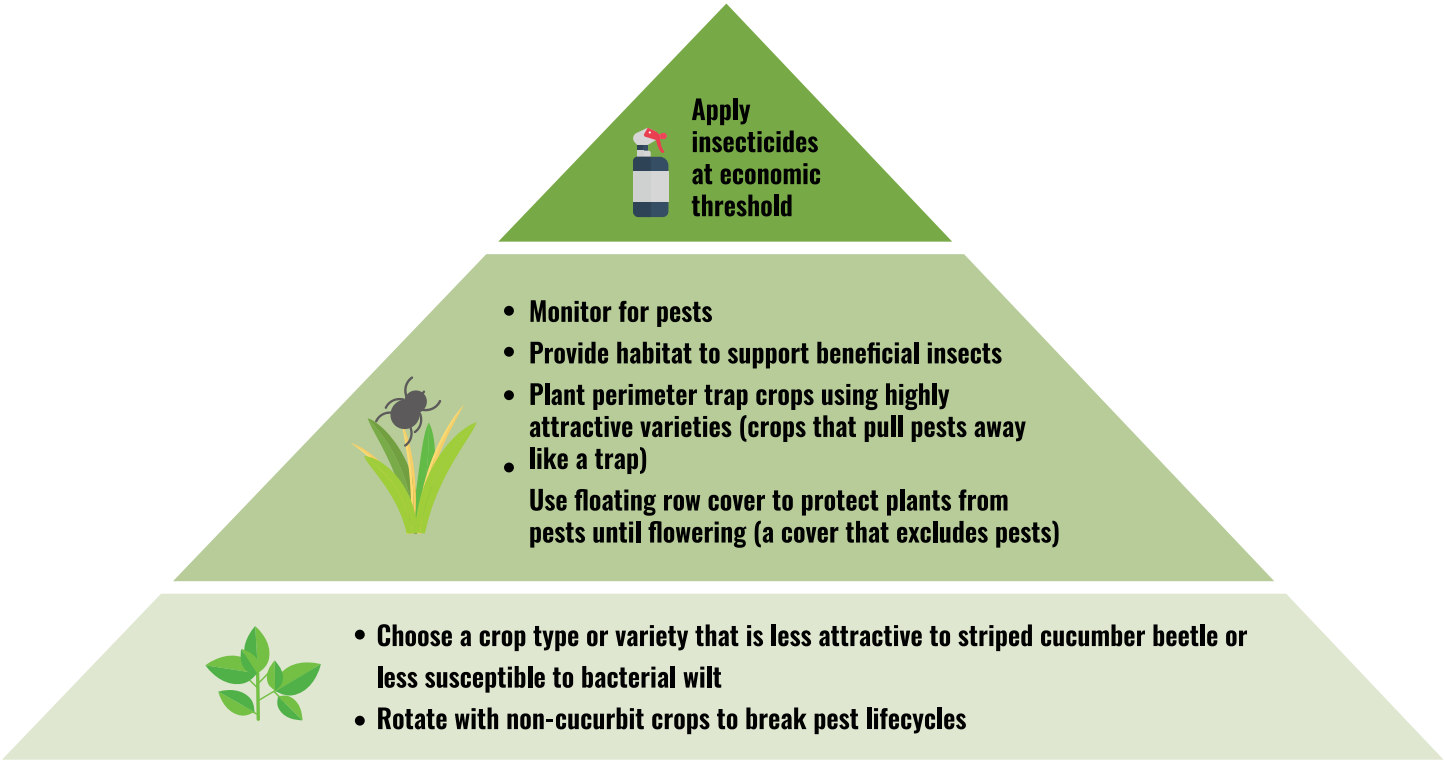
4. **Prevention and avoidance of infestations:** Prevention is the practice of keeping a pest population from infesting a field or site and should be the first line of defense. Avoidance may be practiced when pest populations exist in a field or site but the impact of the pest on the crop can be avoided through some cultural practice.

5. **Evaluation and improvement of management strategies:** Management strategies should be evaluated and adjusted throughout the year according to results from monitoring, damage assessments at harvest, yields, changes in the environment or new and emerging pests. Evaluation of IPM programs should also consider opportunities to incorporate new farming practices and methods into the IPM system, which are essential to developing impactful IPM programs. Lastly, while farms can adapt throughout the year, it is important to evaluate an IPM program year to year and make improvements every year. This is probably more common than adapting within the same year/growing season.

6. **Resistance management:** Pest populations can develop resistance to specific pesticides through continued use of the same Mode of Action (MoA). Alternating MoAs, applying at appropriate rates and timings, calibrating equipment, and many other techniques can all help prevent resistance evolution. Resistance management techniques can be found at the Insecticide Resistance Action Committee (IRAC), Fungicide Resistance Action Committee (FRAC), and Weed Science Society of America (WSSA).

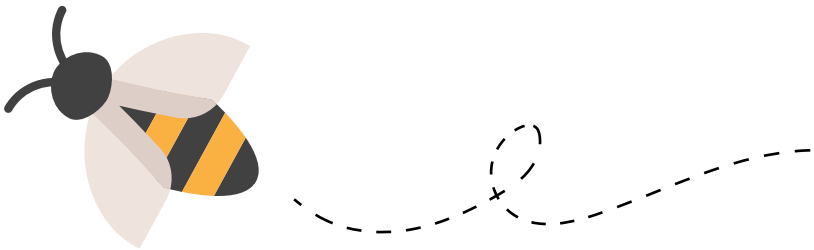
7. **Manage pesticide risk:** Manage pesticide risk and exposure to human and environmental health, including exposure to pollinators and other beneficial organisms.

SAMPLE IPM DECISION HEIRARCHY FOR CUCURBIT CROPS



An example of how IPM can be integrated into cucurbit production to manage striped cucumber beetle (SCB), the most economically damaging pest in cucurbit crops, and bacterial wilt, a disease spread by SCB in these crops. This example presents an IPM framework for actions to address pests. Begin at the bottom for foundational activities that should be the basis of pest control and proceed with options until you reach the economic threshold, after which insecticide application may be warranted.

IPM strategies often require more initial thought, planning, and investment, but they have large and long-term payoffs that include cost savings from using fewer inputs and better yields from stronger pollinator and beneficial insect populations.



RESEARCH HIGHLIGHT

TAKING AN IPM APPROACH REDUCES PESTICIDE USE AND INCREASES PROFITS

New published research done in Indiana, where watermelon is an important crop, compared standard insecticide use practices with an integrated pest management (IPM) approach on a seedless watermelon crop. The study was conducted over four years, at five sites, and measured pest pressure, the amount of insecticide used, the insecticide residue concentrations in nectar and pollen, yield, pollinator abundance, and profitability.

Under common practices in the watermelon system in the study region, prophylactic neonicotinoid insecticide treatments are followed by other foliar sprayed insecticides on a schedule. IPM avoids prophylactic use of insecticides and uses pest monitoring methods and established economic thresholds to trigger insecticide application to the crop.

The study found that pest pressure was higher in the watermelon crop in the IPM system but that pests rarely reached the economic threshold. As a result, the IPM system used 95% fewer insecticide treatments than the standard system, resulting in lower neonicotinoid residues in the nectar and pollen of the IPM system crop, and a 129% increase in the number of pollinators visiting the watermelon flowers. The greater wild pollinator populations resulted in a 26% increase in yield in the IPM system.

Because of the enhanced pollinator populations, higher yield, and lower insecticide input, the IPM system produced a $1,827 per acre increase in profit over the standard pest management system. Remarkably, the benefits of enhanced pollinator populations were realized within the first year of transition to an IPM strategy. Clearly, using an IPM approach in seedless watermelon in this study promoted pollinator health and was profitable.

Jacob R. Pecenka, Laura L. Ingwell, Rick E. Foster, Christian H. Krupke, Ian Kaplan. 2021. IPM reduces insecticide applications by 95% while maintaining or enhancing crop yields through wild pollinator conservation. Proceedings of the National Academy of Sciences Nov 2021, 118 (44) e2108429118; DOI: 10.1073/pnas.2108429118

CASE STUDY

INCORPORATING IPM

Stemilt Ag Services is a tree fruit orchard management service that farms apples, cherries, pears, and some stone fruits and wine grapes in Eastern Washington. Stemilt is currently farming over 6,000 acres of organic and conventional fruit that is shipped across North America and internationally. It began as a family operation in 1964 on Stemilt Hill in Wenatchee, Washington, and Stemilt continues to grow, pack, and market world-famous fruit. Stemilt believes in the responsible choice towards sustainability and in supporting pollinators. In 2021, Stemilt took it one step further and became Bee Friendly Farming Certified by planting over 400 acres of native wildflowers and bee forage to support pollinators, and continues to practice integrated pest management (IPM).

Using IPM strategies allows for an integrated approach of managing pests using measures such as close monitoring using scouting and traps, the release of beneficial insects, pheromones, and watching models that help determine when pest populations will be active and better time applications. Stemilt strategically applies chemical pest control applications before dawn and after dusk when there is little to no pollinator activity.

IPM strategies offer a long-term approach to controlling pests and can save money on chemical applications since other Integrated pest management measures help keep pest populations at a manageable level before a decision to apply insecticides. Using IPM supports pollinators and the surrounding farm areas ecosystem.

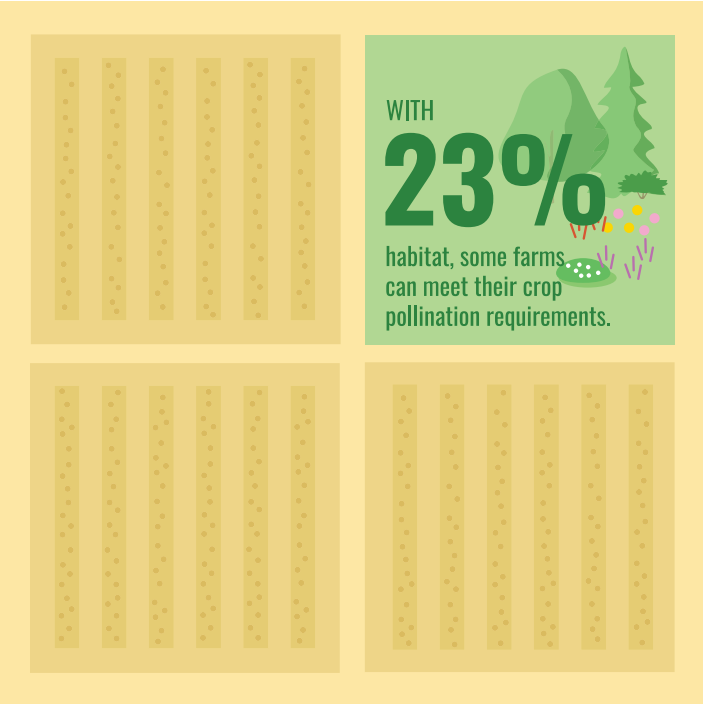
An IPM program requires attention to detail, beginning with scouting, looking for what kinds of insects and pests are out in the field, using Growing Degree Day models to monitor their growth cycles to time chemical applications correctly and efficiently. The use of biological control is used at Stemilt by releasing beneficial insects such as lady beetles or green lacewings that feed on pests. The modes of action of the insecticides used are rotated to avoid pests from developing resistance. An IPM plan takes time and effort to be effective, but if it is done correctly, it is beneficial to the farm and the pollinators.

Pollinator protection has been a priority at Stemilt for many years, beginning with our responsible choice mission to do what is right for the land and maintain sustainability. Stemilt has used IPM strategies to control pests for decades.

Contributed by Dianna Sanchez, Stemilt Growers

2. MAINTAINING AND CREATING HABITAT FOR POLLINATORS AND OTHER BENEFICIAL INSECTS

Maintaining or creating habitat on your farm can go a long way toward supporting healthy honey bees, increasing the abundance of wild bees, and their resilience to other stressors. Additionally, these habitat areas support other beneficial insects and can reduce the need for pesticide inputs. In the past, non-crop areas were not believed to contribute to farm production. However, there is now an abundance of evidence that leaving non-invasive weeds, wildflowers, and other habitat patches around pollinator-dependent crops increases pollination, pest control, and crop production.



Studies show that farms with 23% or more of their land managed as cover crops, permanent wildflower areas, or hedgerows on the farm or in the immediate surrounding landscape, can meet their crop pollination requirements entirely from wild pollinators. In some scenarios, less habitat can still result in full pollination, and generally any amount of habitat can improve pollinator visitation to the crop. Removing a feature such as a hedgerow can result in a loss in production.

There can be concern that non-crop floral resources will 'pull' honey bees or other bees away from the crop. However, research shows that non-crop floral resources can help honey bees by providing a diversity of pollen sources that they need to maintain health. Additionally, these areas support and enhance wild bee populations rather than taking them away from the crops

In this section, we cover two primary ways that you can provide habitat support for bees, other pollinators, and other beneficial insects on your farm or ranch: Maintaining existing habitat and creating new habitat.

ENHANCING AGRICULTURAL HABITAT FOR POLLINATORS

Loss of habitat in agricultural lands threatens pollination in crops. Actions taken to increase habitat, large and small, can make a significant impact on pollinator populations.

Key actions that a farmer can take:

- Increase flower diversity and aim for continuous bloom throughout the season
- Provide nest sites
- Reduce impact of mowing
- Communicate with beekeepers about pesticide applications
- Reduce pesticides use and follow IPM

Keep an eye out for native pollinators to see the positive impact you are having.

Providing buffer strips or habitat near the farms can improve crop yield in pollinator-dependent crops.

Maintain riparian buffers that provide pollinator habitat.

Create pollinator habitat on marginal lands and around field edges.

Retain some dead branches or logs for nesting sites.

Minimize mowing of roadsides, marginal lands, and lawns to retain flowers.

Plant cover crops in between rows or as a rotational crop.

Provide additional pollinator habitat near your home.

Plant roadside with flowers or flowering trees to provide food for pollinators.

Avoid insecticides when crop, cover crop, or marginal lands are in bloom and and use integrated pest management.

Retain native flowers, plants, and trees that provide bloom all season.

Leave some areas of bare ground for ground nesting bees.

Nest blocks provide habitat for cavity nesting bees. Make sure to clean and maintain artificial nest boxes.

Photo courtesy Anthony Colangelo

MAINTAINING EXISTING HABITAT

One of the best things you can do for pollinators is to maintain the food and shelter for bees and other pollinators that are already on your farm. This starts with recognizing existing areas that might be providing habitat. Pollinator resources are found in the semi-natural and natural areas on the farm and in the wider landscape. Conservation areas, wetlands, and woodlots are examples of natural areas that can provide valuable resources for pollinators. Fence lines, riparian buffers, unfarmed marginal lands, pastures, and roadsides are considered semi-natural areas, because they are often mowed or managed and contain mixes of native and non-native vegetation, yet they too are known to provide valuable pollinator resources. They can also present a risk to pollinators if they are sprayed without considering how pollinators might use them.

Having habitat to support honey bees and native pollinators can be as simple as reducing unnecessary vegetation control. It can involve no extra work and even some labor savings. Some ways to manage existing habitat areas that will help support pollinators include:

- Selective weed control to increase pollinator friendly species.
- Keeping 'scrubby' areas rather than farming every piece of land: this can lead to more yield on less land due to the enhanced pollination from native pollinators and healthier honey bees.
- Identify areas that are lower production and 'marginal'. Keep these as habitat for beneficial insects rather than cultivating these sections. This can save money and enhance production.

CREATING NEW HABITAT

Proactively enhancing and creating pollinator habitat can help attract and enhance pollinator populations on your farm and help increase your crop yield through improved pollination. Whether your goal is to ensure crop pollination or simply increase the stewardship value of your land, the principles for creating or enhancing habitat for pollinators and other wildlife are relatively simple: **Provide sources of food and shelter in the form of wildflowers, native grasses, trees, and shrubs, and protect these sites from pesticides.**

Ideal habitat for bees includes the following elements. Keep in mind that creating habitat with just some of these elements can significantly improve bee health and abundance:

- Flowering plants (native plants, cover crops, non-invasive weeds, shrubs, trees, or ornamental plants) that, in combination, bloom from early spring through fall.
- Undisturbed soil, including bare soil that is free of mulch or other ground cover provides access to nesting for ground nesting bees. Tunnel nesting species make use of standing plant material such as brambles, sticks, and twigs. Species such as bumble bees can make use of brush piles, compost, and existing cavities.
- Protection from pesticide application and drift through pesticide-free buffers and thoughtful management, especially around nesting aggregations.

Plants used to create habitat can be native plants that have evolved in your region, or non-native plants that are non-invasive, adapted to the climate, and provide pollinator resources. Though using native plants can involve higher up-front costs, in the long-term there are savings when compared to using non-native plants, mostly due to reduced maintenance needs. There are many other benefits to native plants, and their use in agricultural landscapes can serve multiple goals: financial, environmental, agricultural, and aesthetic.

Once established, habitat plants can displace many of the sources of undesirable weed seeds that were once growing in that location. Over time, the replacement of the weed seed bank will result in a decrease of time, resources, and chemicals used to maintain these areas. Leaving trees and snags along field edges not only provides valuable habitat for butterflies and tunnel nesting bees, they can also serve as perches and nesting sites for owls and other raptors. These residents can then help control rodent populations in crop fields.

Habitat enhancement has costs associated with both land and plant material. To minimize expense and effort, combine pollinator habitat with other farm stewardship projects. For example, include native flowering shrubs and flowers in a riparian buffer. Not only will the buffer help cut sediment runoff, but the deep root systems of native flowers and grasses will also take up excess nutrients while providing food and shelter to pollinators.

CASE STUDY

BEE FRIENDLY FARMING

Photo courtesy Ron Bitner


Photo courtesy Ron Bitne

I am an Idaho native and live in the southwest part of the state near the capital Boise. I have a master's degree from Purdue University (1970) focused on nesting habitats of native wasps and bees in Indiana. My PhD is from Utah State University (1976) focused on the management of the alfalfa leafcutting bee. From 1976 to 1982 I was the University of Idaho's first IPM specialist on alfalfa seed production. From 1976 to 2020 I managed the IPM program for Pioneer International, their pollination program on over 3000 acres (including Australia) and research.

Since 1981 I have farmed my own 15 acres of vineyards applying most of my background of IPM on these grapes. The vineyards are certified Bee Friendly Farming, Live, and Salmon Safe.
Since 2018 I have been on the Board of directors of Pollinator Partnership.

I have established pollinator friendly plants that bloom throughout the season, nesting blocks for cavity dwelling bees and wasps are placed throughout the vineyards, and bare ground areas are left for native ground nesting bees. The flowering areas also provide habitat for beneficial insects. The establishment of the pollinator strips has been managing weeds during establishment.

I sample for pests weekly throughout the season and apply soft chemicals only when needed. Weed control is done manually. For the last 10 years, I have only used 2 or less applications per year.

Because of my farming practices the certificate logos are allowed to use on the back wine label of my wines and have added increased value on their sales.
Contributed by Ron Bitner, Bitner Vineyards.

Photo courtesy Jordan Winery

SITE SELECTION

There are several considerations when selecting an appropriate site to install pollinator habitat, such as slope, existing vegetation, soil, and sunlight. Evaluating these criteria carefully when selecting a site will ensure you have the most success in our habitat planting.

Using the Site Evaluation Rubric at the end of the document, you can begin evaluating potential project sites. The rubric is intended to aid in objectively evaluating potential sites. No answer is 'wrong', they are just statements of facts to help you decide which site will be the best to work with for your habitat project.

Site selection can be influenced by the potential partnerships that may be formed at a specific site. For example, if a piece of land has an interested and engaged neighbor, or is in the jurisdiction of a conservation authority, these groups may work together to achieve a common goal. Additionally, on-farm pollinator habitat may be used for outreach and as a demonstration site to showcase the practice to your neighbors. If your farm is more accessible to the public or if you offer farm tours and Community Supported Agriculture there is an additional opportunity to showcase your sustainability practices.

If the site is known habitat for a sensitive species, review all laws, regulations, and guidelines. Consult with the U.S. Fish and Wildlife Service, or State and County officials for additional guidance. Even slight changes in sensitive habitat can have negative effects on the rare, threatened, and endangered species it supports. However, with careful planning, a habitat enhancement project could benefit both the species at risk and pollinators.

Photo courtesy Anthony Colangelo

SELECTING PLANTS

Plant diversity is a key element of successful pollinator habitat. Incorporating species with a variety of bloom times, colors, and forms will ensure there is a continuous source of food for pollinators between early spring and late fall. This will also help provide nesting and overwintering sites all year. The shape and size of mature plants should be considered when planning the spacing of plantings. It is important to choose plants that are well adapted to the conditions at the site.

When creating a pollinator habitat seed mix, the ideal ratio is 75% native forb (flower) seed to 25% native grass seed. A ratio closer to 70/30 can be used if cost is a defining factor. Native grasses and sedges are important for keeping costs down while keeping diversity high. Including annuals in your mix can be helpful in occupying the area and offering more immediate blooms while your perennials take time to establish below ground biomass. Reference Pollinator Partnership's ecoregional planting guide series, Selecting Plants for Pollinators, to find lists of native plants suitable for your location. Find out which ecoregion you live in and get your free guide by entering your zip code at www.pollinator.org/guides

You may want to take into consideration which pollinators you are aiming to support and attract to your landscape and what habitat type you are wanting to adopt (e.g., buffer strip, hedgerow, meadow etc.). Reach out to a local seed vendor, environmental consultant, or restorationist for assistance, and check out the Resources section of this guide for plant selection materials.

SITE PREPARATION

Proper site and seedbed preparation is a crucial step that is often overlooked but is necessary to create successful pollinator habitat. Before conducting any site preparation, it is essential to recognize the specific preparation needs of your site. Common sites for larger areas of pollinator habitat will be pasture, idle or brushy fields, lawn grass, and soybean or corn stubble. Field borders and nearby roadsides are ideal spots for hedgerow and buffer strip habitats. Sites with existing vegetation should have significant site preparation for one year before planting or seeding. If you are trying to remove invasive or noxious plant species, sites will require two years of site prep.

Weed removal is one of the most important steps to successful habitat creation. Whether there is heavy weed pressure on your site or simply turf grass, removing this vegetation is key to preparing your site for planting. Choose the method(s) below that best suits your needs.

Solarization: This process involves placing a clear, UV-stabilized plastic sheet over the site, with the soil wetted to a depth of 8-10 inches, in the spring or early summer, then removing it the following fall, just before seeding or planting. The heat generated from the sun will become trapped under the plastic sheet, and the high temperatures will kill the vegetation and dormant weed seeds. Solarization is an appropriate method for sites one acre in size or smaller.

Smothering: Similar to solarization, smothering is a non-chemical preparation method suitable for smaller sites such as hedgerows. Prior to the growing season, cover the area with a compostable material such as cardboard. Overlap the material to ensure the there is no open, bare ground. Cover the material with soil amendment, compost, or a similar material that will naturally break down. The area should be left to smother for an entire growing season before installing habitat.

Smothering Cropping: Smothering cropping is a method of site preparation using temporary cover crops such as clover, phacelia, and buckwheat to out compete existing weeds before the habitat is planted. Cover crops grow quickly and suppress unwanted weeds. This method of site preparation also provides pollinator forage while in bloom. Cover crops are then easy to remove from the site when it is ready for seeding or planting. Smother cropping may be used on larger areas with weed pressure that is low to moderate.

Tilling: Tilling the site is a good option when weed pressure is low or multiple tills are possible to eliminate the seedbed. Conduct a survey of existing plant material and consider past weed problems before tilling. Oftentimes, a till will work well in the short term but can bring weed seeds to the surface from the soil bed, creating a long-term weed problem. If you want to till, consider combining it with herbicide application. When tilling to exhaust the weed seedbank, first till, then irrigate to germinate the weed seeds, till to eliminate the plants, and repeat until the seedbed is exhausted.

Herbicide Application: Carefully time and repeat herbicide applications in preparation for seeding and planting. Begin by mowing the site. To be effective, herbicide usually needs to be applied a few times throughout the growing season as dormant seeds germinate. A fall application will be necessary if there is an abundance of cool season grasses and other, more aggressive, noxious weeds. To ensure adequate seed-to-soil contact, brown and dead vegetation should be removed by burning, mowing, or raking. When using a glyphosate herbicide, wait at least two weeks after the last treatment before planting or seeding. Other herbicides have different periods of time needed to wait before planting.

Photo courtesy Jordan Winery

SEEDING

A successful pollinator seed mix can be planted from fall to spring, timed with natural rains. The time of year that works best often varies with site conditions and regional climate. Before dispersing seeds, a site must have a clean seedbed and adequate bare soil. Options for planting include broadcast seeding, hydroseeding, and drill seeding.

It is important to remain patient with your planting as native perennial forbs and grasses planted from seed will usually not appear or be noticeable on your site the first year. It is helpful to remember the phrase “Sleep, creep, and leap!” when monitoring the growth and success of your planting. The process appears slow because native grass and forb species allocate the majority of their resources to below ground biomass and very little to above ground growth during establishment.

PLANTING FROM PLUGS AND POTS

Planting from plugs or containerized plants can be beneficial in that the plants have had time to grow before they go in the ground. This allows them to develop a robust root system and above ground growth so that when they are planted, they are less susceptible to pressures like excessive heat or low moisture that might kill newly-germinated seed. Potted plants also compete better against grasses and other encroaching vegetation.

Planning a hedgerow or other planting using mature plant materials requires proper spacing. Plants must be placed where they will have sufficient room to grow without becoming crowded. Large shrubs should be planted at a 15-20 foot spacing and smaller ones at a 7.5-foot spacing. Depending on the species, trees need 20-30 feet. In dry regions of the Pacific Northwest, it is best to plant containerized plants in the fall when cool, wet weather aids in establishment before the hotter, drier months. Spring plantings may be feasible in some geographies that have more precipitation in the hotter months or in sites that have assisted irrigation.

MAINTENANCE

HABITAT PLANTED FROM SEED

If establishing habitat from seed, remember that site preparation, maintenance, and patience are key. Unlike in the eastern regions of the U.S., in the Pacific Northwest your perennial forbs and grasses may flower in their first year and by the 3rd or 4th growing season, your habitat may experience high weed and grass pressure. Timing of natural rains and ability for supplemental watering will be contributing factors in the progression of your habitat. The diversity of your habitat will likely decrease over time, thus re-seeding or inter-seeding can be useful practices to keep your habitat thriving in the long-term.

In the first year of your planting, it is advisable to mow your site twice to set back any annual grasses or broadleaf weeds that may appear. Mow at a height of about 6-8 inches whenever weeds reach 10-12 inches in height for the first growing season and ensure that the last mow of the season in late summer or early fall maintains at least 6-8 inches of vegetation height during winter.

Weed competition and invasive species should be continually monitored for the first several years. Spot mowing or spot spraying should be conducted to control seed production and spread. Organize a team of farm hand employees or partner with a local non-profit to organize volunteers to hand pull weeds or target spray herbicides once a week or once a month during the first two years. Perfection is not necessary but prioritizing weeding of the most aggressive species is essential.

MAINTAINING HABITAT CREATED FROM POTTED PLANTS/PLUGS

When planting perennial plants from plugs or pots, it is important to water thoroughly the day of planting and as needed in the following days. Look for wilted leaves as a sign they need additional water. Water the plants at least once a week for 4-6 weeks post-planting. If conditions are particularly dry, supplemental watering may be necessary. After this initial planting period, watering every 1-2 weeks is optimal, especially if planting occurred later in the winter or early spring.

The most cost-effective method of controlling weeds in an area where potted plants were installed is to use a mulch like walnut shells. Weed mat or landscaping fabric can be used, but this removes habitat for ground-nesting bees. Preemergence herbicides such as Ronstar (oxadiazon) may be used to control weeds but doing so may reduce competition for weeds not affected by these chemicals, thereby replacing one weed with another. Roundup (glyphosate) offers better broad-spectrum weed control, but it is crucial that drift during spraying is prevented from reaching nearby beneficial plants. In general, potted plants will help shade out competing weed species once they become well-established.

This section provides a brief overview of how to maintain, enhance, and create habitat for pollinators. To properly create and maintain habitat that will be valuable to you and pollinators, consult technical guides for creating habitat on farms in the Pacific Northwest (see Resources section).

Preserving and creating habitat for pollinators is an achievable goal for large- and small-scale farmers alike. Small actions taken by many farmers and ranchers can add up to large benefits for the agricultural community.

3. COMMUNICATION WITH BEEKEEPERS, FARMERS, AND APPLICATORS: WHAT IS IMPORTANT TO DETERMINE IN CONTRACTS?

The need for communication and cooperation between beekeepers and farmers cannot be overstated and is the most effective way to reduce honey bee pesticide exposure risk in crops where managed honey bees are used for pollination. Both beekeepers and farmers benefit from developing positive working relationships and familiarizing themselves with each other's management practices.

DISCUSSIONS AND CONTRACTS BETWEEN FARMERS AND BEEKEEPERS SHOULD INCLUDE:

- ☑ Coordination of crop timing with dates of apiary arrival and departure.
- ☑ Details of the beekeeper's responsibility to provide strong and effective colonies for crop pollination.
- ☑ Details of the farmer's responsibility to safeguard bees from poisoning.
- ☑ A clear designation of responsibility for providing supplemental water and feed.
- ☑ A description of pest management practices in the cropping system before colonies are delivered.
- ☑ A description of possible pesticides to be used on a crop while bee colonies are present.
- ☑ A description of buffers to be placed between treated areas and apiaries.
- ☑ A communication plan for informing neighboring farmers and applicators of apiary locations.
- ☑ A description of possible pesticide use in adjacent crops.
- ☑ A diagram showing the location of honey bee colonies.
- ☑ Reference to state and regional information on crop pests and spraying schedule where available.

WORKING TOGETHER, BEEKEEPERS, FARMERS, AND APPLICATORS CAN HELP PROTECT HONEY BEES AND WILD BEES

Photo courtesy Anthony Colangelo.

What farmers and applicators can do:

- Learn the pollination requirements of your crops, and if (and when) they are attractive to bees. Plan your pest control operations with bee hazards in mind.
- Identify and confirm hive locations, and maintain appropriate buffers between treated areas and pollinator habitat.
- Check with your State Department of Agriculture for hives that might be located in your area.
- Be aware that there likely are more honey bee colonies than those you are currently aware of in any area. Honey bees have a large foraging range and bees can be present in the crop even if hives are located a few miles away.
- Consider your spray schedule and the establishment of no-spray buffers when coordinating apiary placement with beekeepers.
- Avoid spraying crops when bees are foraging during daylight hours, or when crops are flowering.
- Keep track of weather patterns including wind, precipitation, humidity, and daily temperatures to avoid any unintentional pesticide drift to bee foraging areas nearby.
- Use IPM methods to reduce need for chemical applications.
- Control blooming weeds such as dandelions in orchard cover crops before applying insecticides having a long residual hazard to bees.
- Select insecticides that have the lowest pollinator precaution levels whenever possible.
- Be aware of other blooming crops or flowering weeds in the immediate vicinity when applying insecticides to a crop.
- If possible, choose a product with a short residual toxicity.
- Do not apply insecticides with long residual toxicity to bees onto blooming plants.
- Do not apply insecticides when unusually low temperatures or dew are forecast following treatment, as these conditions can extend residual times.
- Apply pesticides with residual toxicity when bees are not present or inactive.
- Minimize spray drift. Verify that wind will not carry product in the direction of beehives, flowering weeds, adjacent habitat, or non-target crops. Turn off sprayers near water sources (ponds, irrigation ditches, or leaking irrigation pipes), when making turns, and at the ends of fields.
- Less drift occurs during ground application than aerial application. During aerial application, do not turn the aircraft or transport materials back and forth across hives, blooming fields, or water sources.
- Err on the side of caution and avoid spraying any pesticide near bee colonies and on flowering plants, whether or not the pesticide has a bee caution on the label.
- Inspect chemigation systems to verify that bees cannot access chemigation water.

Photo courtesy Cakebread Cellars

WHAT BEEKEEPERS CAN DO:

- Do not leave unmarked colonies of bees near orchards or fields. Post your name, address, and phone number on apiaries, large enough to be read at a distance.
- Register your colonies with your State Department of Agriculture. Non-agricultural applicators may also need to know the location of your apiaries (e.g. mosquito abatement programs).
- Communicate clearly to the farmer and/or applicator where your colonies are located, when they will arrive, and when you will remove them.
- Ask the farmer what pesticides, if any, will be applied while bees are in the field, and whether the label includes precautionary statements for bees.
- Learn about pest control problems and programs to develop mutually beneficial agreements with farmers concerning pollination services and prudent use of insecticides. Seek information on major crop pests and treatment options for your region.
- Miticides, such as those used for varroa control, are pesticides too. Use care when controlling pests in and around bee hives, apiaries, and beekeeping storage facilities. Use insecticides for their intended use and follow all label directions carefully. Regularly replacing brood comb to reduce exposure to residual miticides.

4. SELECTING AND USING PESTICIDES

Pesticides have become an integral part of most farm management systems. However, there can be risks to pollinators, other beneficial insects, the environment, and humans associated with their use, especially if label directions are not followed. Exposure to pesticides can kill bees or it can cause effects that do not kill them but negatively impact foraging, learning, reproduction, or the long-term health of populations. By using pesticides within an Integrated Pest Management (IPM) framework, following label directions, and selecting products that have low toxicity to bees, healthy bee populations can be maintained that will contribute to crop pollination and pollination in natural ecosystems.

POTENTIAL PESTICIDE IMPACTS ON BEES

Bees can be impacted lethally or sublethally by pesticides.

LETHAL

increased bee death

SUBLETHAL

increased susceptibility to pests and diseases

alteration of gut microbiome

decreased reproduction

learning and memory impairment

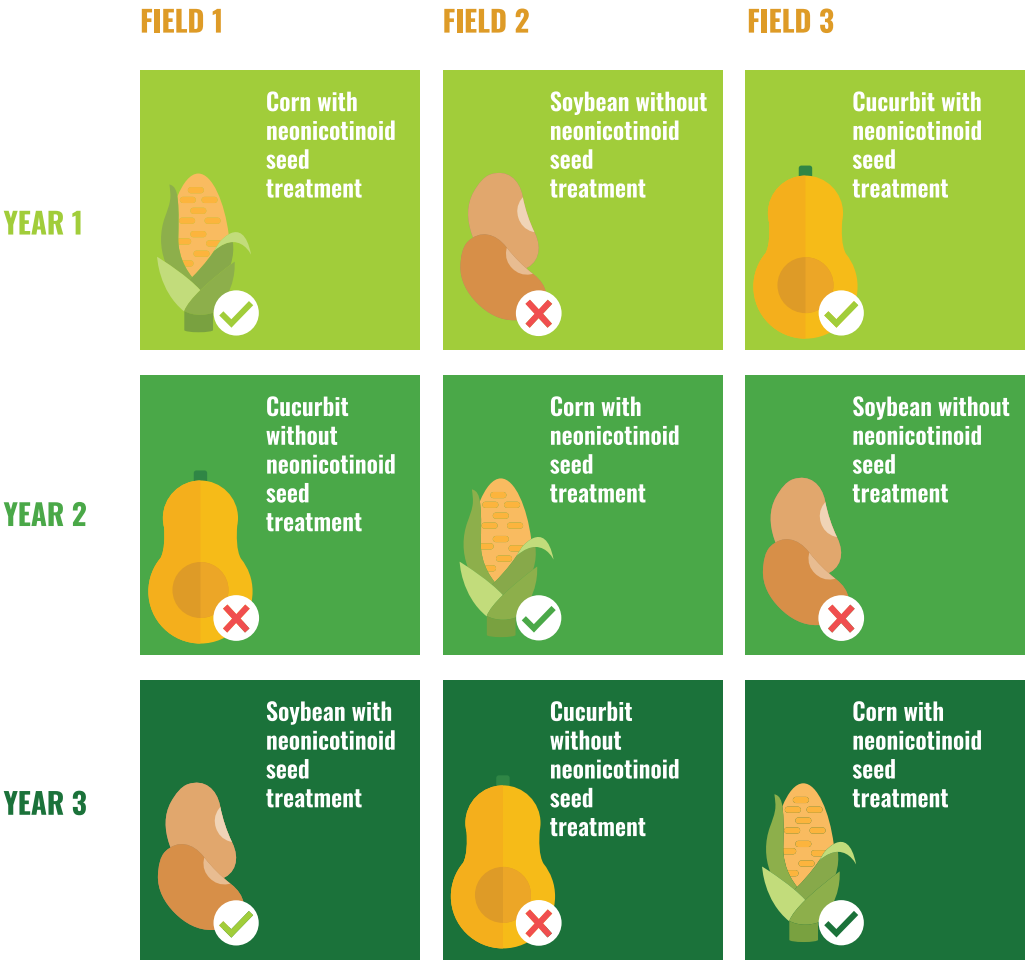
impaired orientation

reduced foraging

If insecticide treatments are needed to control insect pests in crops, farmers should rotate between pesticide classes treatments (a) from year to year in the same crop to avoid the development of pest resistance and (b) in the same location, even if a different crop is grown, to avoid accumulation of pesticide residues in the soil. It is important to remember that wild bees may be visiting crop flowers even if honey bees have been moved during pesticide application. The following practices outline ways to control exposure to pesticides, so the risk is acceptable to pollinators while maintaining crop production and quality.

SELECTING LEAST TOXIC PESTICIDE PRODUCTS: UNDERSTANDING PESTICIDE RISKS

Bee poisonings are related to exposure amount, exposure time, and the toxicity of a pesticide. The term, 'pesticide' refers to all substances that are meant to control pests, including insecticides, fungicides, nematicides, miticides, and herbicides. The highest risk to bees is from pesticide products that are highly toxic, have residual toxicity longer than 8 hours, can be found as residues in pollen, nectar, or soil where bees can be exposed to them, or are sprayed on the crop during bloom when the bees are present. **Risks are reduced by following pesticide labels closely and paying attention to changes in use restrictions.**



An example of an insecticide and crop rotation system that avoids buildup of pesticide residues in soil

Insecticides are generally more toxic to non-target insects than other types of pesticides because they are formulated to kill insects. Though herbicides and fungicides are generally less toxic than insecticides, they too can present risks. However, herbicides can be useful and necessary for the creation and management of pollinator habitat, and fungicides often are necessary components of commercial crop production. Further, it is also important to use pesticides with different modes of action to avoid developing chemical resistance in pest insects or pathogens. This means that only using the lowest toxicity product may not always be recommended.

FOLLOWING LABEL DIRECTIONS

Pesticide labels are legal documents. Product registration, toxicity testing, and product regulation are in place to protect honey bees and other pollinators from the negative effects of pesticides. **It is illegal to use a pesticide in any way other than for the purpose and in the manner stated on the label.**

In addition, properly following pesticide labels is important from an economic perspective for the farmer or rancher, from a human health perspective for the user, by-standers, and consumer, as well as from an environmental perspective for bees and other beneficial insects. Applying too much of one pesticide, applying it repeatedly in the same place, or applying it outside of label use could cost more money and could increase the risk of the product to visiting bees.

Bee exposure to pesticides can occur when:

- Beekeepers and farmers do not adequately communicate.
- Pesticides are applied when bees are actively foraging.
- Pesticides are applied to crops, weeds in the field or field margins during bloom or to neighboring fields.
- Pesticides drift onto blooming plants adjacent to the crop.
- Systemic insecticides (like neonicotinoids) are translocated into the nectar and pollen of crop and non-crop flowering plants because of their movement through soil and water.
- Bees collect insecticide-contaminated nesting materials, such as leaf pieces collected by alfalfa leafcutter bees, or are exposed to soil contaminated with pesticide residues as they build their ground nests.
- Honey bees collect insecticide-contaminated water in or near treated fields.
- Wild bees develop or overwinter in soil contaminated with pesticide.

REDUCING POLLINATOR EXPOSURE TO PESTICIDES

When using pesticides, in addition to following label directions and maintaining clear communications with beekeepers and other stakeholders (see p. 26), other ways of minimizing managed and wild bee exposure include:

- Ensuring that pesticide drift is minimized to reduce contact with adjacent habitat. A buffer area should be maintained between crops that will receive pesticide treatment and native habitat.
- Since fine droplets tend to drift farther, apply spray at lower pressures or choose low-drift nozzles that produce medium to coarse droplet size. Turn off sprayers near water sources (ponds, irrigation ditches, or leaking irrigation pipes), when making turns, and at the ends of fields.
- To minimize drift, do not spray in windy conditions or during temperature inversions.
- Avoiding applying pesticides during warm evenings when honey bees are clustered on the outside of their hives.
- Avoiding applying pesticides (especially insecticides that have toxicity to bees) to any flowers in bloom, even weeds; bees may be using these resources.
- Apply insecticides with residual toxicity when bees are inactive or not present. Bees generally forage during daylight hours and when temperatures exceed 63 degrees F for some wild bees and 55 degrees F for honey bees. When abnormally high temperatures result in foraging activity earlier or later in the day, adjust application times accordingly to avoid bee exposure. Note: Some important pollinator species such as squash bees and bumble bees forage at much lower temperatures and light levels and may be present on crop flowers in the early morning.
- Being aware that pesticides can be absorbed in soil, potentially impacting ground nesting bees or taken up by non-crop plants that bees forage on.
- Looking for bees on crops, and for ground nests of solitary bees like squash bees, long-horned bees, sweat bees, and mining bees within fields. Protect nesting areas from any exposure to insecticides wherever possible.

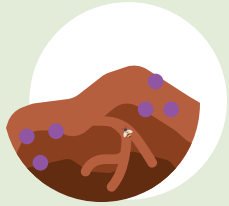
ROUTES OF EXPOSURE TO BEES & OTHER POLLINATORS

Directly sprayed on or through contact with recently sprayed leaves and flowers

Consumption of contaminated pollen and nectar

Contact with contaminated nesting materials

Effects on larvae through contaminated nectar, pollen, and cell materials



Contact with contaminated soil

Ways bees can be exposed to pesticide contaminants. Diagram adapted from Iris Kormann, Oregon State University.

SECTION 3:

RESOURCES

This guide is intended to be a broad and brief overview of the ways agricultural producers may support and protect pollinators on their landscapes. The topics included are complicated and have more details to be understood once you are ready to implement these actions. See the list of resources below for more information and reach out to technical assistance providers for on the ground support. There are many considerations to take into account when successfully adopting best management practices for pollinators, and we commend you for your interest in supporting pollinators on your agricultural landscape.

POLLINATOR PARTNERSHIP

https://www.pollinator.org/bff/bff-us/farming-resources

BEE FRIENDLY FARMING

https://www.pollinator.org/bff/bff-us

ECOREGIONAL PLANTING GUIDES

https://www.pollinator.org/guides

NATIVE POLLINATOR GARDEN RECIPE CARDS

https://www.pollinator.org/gardencards

CAFF CREATING HEDGEROWS FOR POLLINATORS

https://cdn-6138d0e4c1ac189674c0cdff.closte.com/wp-content/uploads/2020/08/CAFF_Hedgerow_Manual_2018.pdf

ENVIRONMENTAL DEFENSE FUND (EDF)

https://www.edf.org/sites/default/files/specialreport_summer2014.pdf/

FARMERS FOR MONARCHS

https://farmersformonarchs.org/state-resources/#CA

HONEY BEE HEALTH COALITION

https://honeybeehealthcoalition.org/resource_category/best-management-practices/

IDAHO STATE DEPARTMENT OF AGRICULTURE

https://agri.idaho.gov/main/

MONARCH JOINT VENTURE

https://monarchjointventure.org/get-involved/i-am-a/agriculture

OREGON BEE ATLAS

https://extension.oregonstate.edu/bee-atlas

OREGON DEPARTMENT OF AGRICULTURE

https://www.oregon.gov/ODA

OREGON STATE UNIVERSITY IPM

https://agsci.oregonstate.edu/oipmc

PROJECT APIS M.

https://www.projectapism.org/

UNIVERSITY OF IDAHO IPM

https://www.uidaho.edu/extension/ipm

UNITED STATES DEPARTMENT OF AGRICULTURE NATIONAL RESOURCE CONSERVATION SERVICE (USDA NRCS)

https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/plantsanimals/pollinate/farmers/

WASHINGTON AGRICULTURE

https://agr.wa.gov/washington-agriculture

WASHINGTON STATE UNIVERSITY

https://ipm.wsu.edu/

XERCES SOCIETY

https://xerces.org/pollinator-resource-center/

PESTICIDE RISK TOOL

https://pesticiderisk.org/

INSECTICIDES WITH ACUTE TOXICITY TO POLLINATORS

https://1bps6437gg8c169i0y1drtgz-wpengine.netdna-ssl.com/wp-content/uploads/2020/05/Pesticides-with-Pollinator-Toxicity_Final-4-2020.pdf

SECTION 3:
LANDOWNER QUESTION AND ANSWER

Q. HOW WILL MY ACTIONS BE AFFECTED IF POLLINATOR SPECIES ARE LISTED UNDER THE ENDANGERED SPECIES ACT OR OTHER STATE LISTINGS?

A. There are differences between species listed federally and those listed throughout the various states in the States. There are existing programs and agreements that can be utilized to help protect farmers who have adopted voluntary conservation measures prior to and/or after a species is listed. Some actions are designed in the hope of preventing listing, while others are designed to support the recovery of the species. For example, prior to federal listings you can engage in a Candidate Conservation Agreement with Assurances. After a species is listed, you may consider Safe Harbor Agreements, Habitat Conservation Plans, or Conservation Banks. More information is available at https://www.fws.gov/program/endangered-species and https://www.fws.gov/library/collections/tools-conservation-partnerships

Q. WILL MY WATER USE INCREASE WITH THE INSTALLATION OF HABITAT?

A. Native plants are adapted for each state's climate and are therefore adapted to the various environmental stresses of each region, including drought. As a result, installing native habitat can actually reduce water use. The addition of habitat elements such as cover crops can help retain moisture in soil, reducing the need for supplemental water. Additional water is usually needed when potted plants are used to create habitat, but after about 1-3 years, the plants will have formed a deep root system and will not require watering.

Q. SHOULD I CONSIDER ENROLLING IN CERTIFICATION PROGRAMS THAT RECOGNIZE MY POLLINATOR-FRIENDLY PRACTICES?

A. Certification programs can help show others what you are doing to support pollinators and conservation. Consumers are seeking out products that are produced in ways that help the environment and sustainability. Additionally, being part of a certification program gives you access to resources and community. Check out the Pollinator Partnership Bee Friendly Farming Program as one example. See a list of third-party certifications on Walmart's Sustainability Hub.

Q. WHERE CAN I SOURCE SEED AND PLANT MATERIAL FOR MY HABITAT PROJECTS?

A. https://www.pollinator.org/guides#vendors
https://calscape.org/plant_nursery.php
https://www.plantnative.org/
https://monarchjointventure.org/mjvprograms/habitat/milkweed-vendor-map
https://www.xerces.org/milkweed/milkweed-seed-finder#mwf_tool
https://rightofway.erc.uic.edu/resources/seed-expert-map/

Q. WHERE CAN I GET TECHNICAL ASSISTANCE AND FUNDING TO IMPLEMENT POLLINATOR-FRIENDLY PRACTICES?

A. In addition to the resources presented on the previous page, review the following links for support:

USDA NRCS Financial Assistance Programs
https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/

Pollinator Partnership Consulting
https://www.pollinator.org/consulting

National Association of Conservation Districts Technical Assistance Grants
https://www.nacdnet.org/technical-assistance-grants/

SECTION 4:
SITE EVALUATION RUBRIC

This rubric is intended to get you started on thinking about where there may be good areas on your farm to add habitat. The rubric is not intended to be a comprehensive assessment or address all possible habitat types or environments. Long-term maintenance is also necessary to a site for its continued value to pollinators. Choose sites where you can effectively reduce non-desirable plant species and maintain the habitat; look for detailed guides on site preparation and maintenance for your habitat type and region (see resources section of this guide).

Site Name:		Date:		Score:
Score	0 do not proceed with site	1	2	3
Value as Crop Land		Site has high economic value as crop land	Site has moderate economic value as crop land	Site has little to no economic value as crop land
Distance From Pollinator Benefited Crops*		Approximately 0.5 to 0.75 miles away	2,500 ft. to 650 ft.	Less than 650 ft*
Sunlight		Full Shade	Partial Sun	Full Sun
Water Availability (Needed for Establishment of containerized plants)		No water available	No water on site, but ability to bring it in	Accessible water sources on site
Slope	45-90° extreme slope (inaccessible)	11-45° steep slope	5-10° moderate slope	0-4° gentle slope
Soil Texture		Compacted	Gravel, clay, sandy	Well-drained loam to permeable clay
Soil pH	Alkaline soil, pH above 7.5 or Acidic soil, pH below 4	Acidic soil, pH between 4 and 5.5	Slightly acidic soil, pH between 6.5- 5.5	Neutral pH between 6.5-7
Accessibility	The site is inaccessible.	The site is difficult to access	The site is moderately accessible	The site is easily accessible
				Total Score:

*Habitat closer to a pollinator-benefited crop will help increase pollination more than distant habitat. However, habitat for pollinators should always be protected from pesticide applications. If the crop will be treated with pesticides, have at least a 20 ft buffer between the crop and habitat and use practices that help reduce pesticide drift (pg xx).

POLLINATOR
PARTNERSHIP

WWW.POLLINATOR.ORG