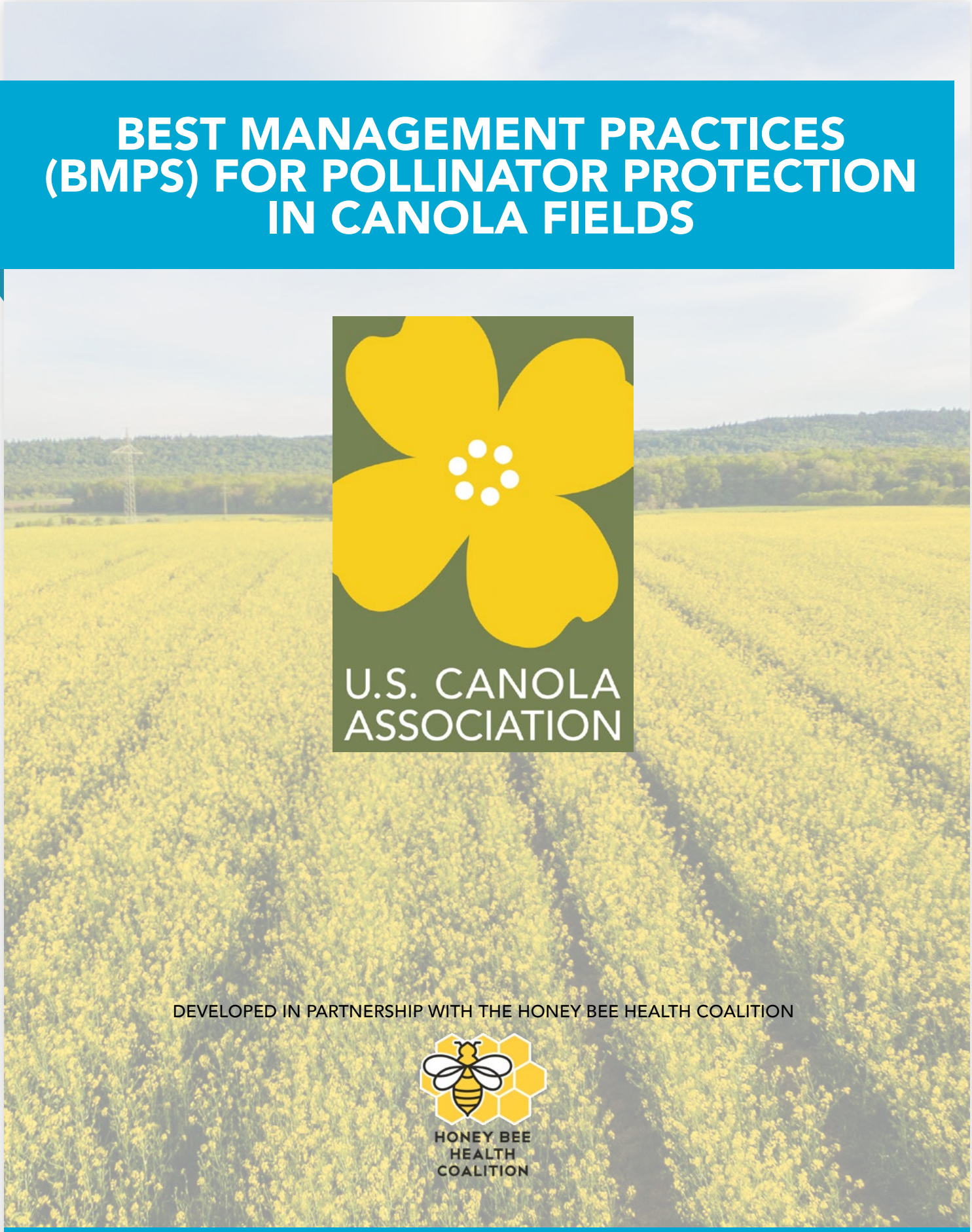
BEST MANAGEMENT PRACTICES (BMPS) FOR POLLINATOR PROTECTION IN CANOLA FIELDS



U.S. CANOLA ASSOCIATION

DEVELOPED IN PARTNERSHIP WITH THE HONEY BEE HEALTH COALITION

HONEY BEE HEALTH COALITION

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Please note that the recommendations contained herein are provided by U.S. Canola Association and the Technical Working Committee (listed above) and do not necessarily represent the views of Coalition members. For more information about the coalition visit: *https://honeybeehealthcoalition.org/about-the-coalition/*.

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INTRODUCTION

Canola (*Brassica* sp) is a crop that produces many small, bright yellow flowers that are highly attractive to bees. Canola provides an ideal food source for honey bees as the sugar profile of canola nectar is great for honey production, and the plentiful pollen offers a good balance of amino acids and proteins. With nearly 2 million acres of canola grown each year in the U.S., canola has become a crop that plays a key role in bee health and management.

Canola provides bees an ideal habitat and efficient means of feeding. Canola fields bloom for relatively long periods and provide bees with a good source of nectar for several weeks and up to a month. The nectar has a good sugar profile for honey production and canola's plentiful pollen offers a good balance of proteins and fats. Honey bees feeding on canola produce a light colored, mild tasting honey that is in high demand by consumers.

For the average U.S. canola grower, canola acres are typically less than one-quarter of the farm's acreage in any given year. Adopting farming practices in canola that are conducive to the survival of bees and other pollinators can benefit both the grower and beekeeper.

Bee on canola flower.
Photo Credit: Jay Bjerke

Canola Species and Growing Areas

Canola is an oil-seed crop comprised from three species (Brassica rapa, B. napus, and B. juncea) belonging to the mustard family, a family which also includes broccoli, Brussels sprouts and cauliflower. Canola seeds contain about 45 percent oil. In the U.S., the species B. napus is the most common canola, and is grown using spring and winter biotypes. Spring canola is the most widely grown and is planted primarily in the northern states of North Dakota (1,590,000 acres in 2017), Minnesota (36,000 acres), Montana (155,000 acres), Idaho (23,000 acres), and Washington (55,000 acres). Winter canola is grown in Oklahoma (160,000 acres) and Kansas (50,000 acres), with minor acreages planted in Texas and in the southeastern states. High erucic acid rapeseed, also B. napus, is grown both as a winter and spring crop in the Pacific Northwest and Great Plains. Of note, canola grown in the Southern U.S. experiences higher pest pressures than that grown elsewhere.

Canola is typically self-pollinating, meaning that bees are not required for the plant to set seed. However, the presence of bees can, under some circumstances, prove beneficial.

Studies have indicated that bee pollination:

- Encourages higher canola yields with better ripening
- Result in more uniform flowering and earlier pod-setting
- Increase the number of pods per plant, seeds per pod and seed weight
- Reduces the amount of time canola blooms by 17%
- Increases seed weight per plant from 13% to nearly 50%

Citation: Canola Council of Canada

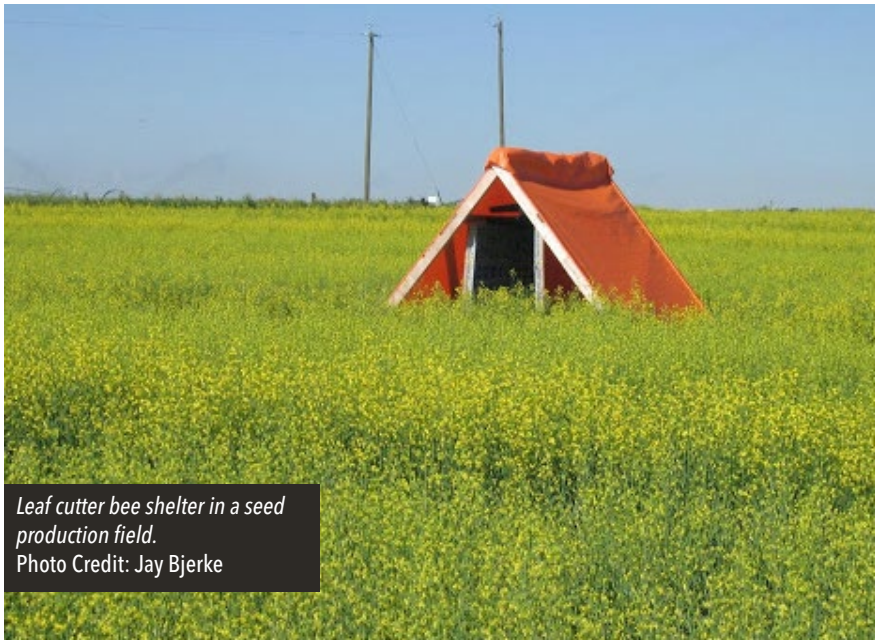
Further, bees may help to control canola diseases. Researchers are exploring the potential for honey bees to spread beneficial fungi for controlling insects like Lygus bugs.

Since bees are not required for pollination in commercially grown canola, most commercial growers do not contract with beekeepers for pollination services. Some beekeepers contract with growers for the rights to place hives on / near canola fields, but often these are more informal agreements with minimal or token payments.

Bee Species and Usage

The different canola agricultural areas enjoy both widely varying wild bee populations as well as managed bees in significant numbers. Many of the wild bees are solitary or social ground nesting species and/or nesters. Wild bees include bumble bees (*Bombus* spp), sweat-bees (*Halictidae*), leaf cutter bees (*Megachile rotundata*), large carpenter bees (*Xylocopa* spp.), and mason bees (*Osmia* spp.) among others. Wild bees are extremely important to the ecosystem, and many species are very efficient pollinators of crops and wild plants. It is a critical part of bee management to protect wild bees. Honey bees (*Apis mellifera*) and other managed bees are large economic contributors to agriculture.

Most canola grown in the U.S. is hybrid spring canola which requires hybrid seed. To produce the seed required, seed growers (who typically do not grow production canola) plant female plants, (which do not produce pollen), in alternating bays with a male (pollen-producing) cultivar. Bees are required to move the pollen from the male canola to the flowers on the female, thereby making the hybrid. Seed production companies use different methods, but in general, seed producers use about 50 percent honey bees and 50 percent leaf cutter bees for pollination. Stocking densities typically exceed one hive per acre. These commercially managed (typically contracted) bees are typically situated in the fields from a week before bloom to a week after bloom. Great care is taken to isolate canola hybrid seed production fields from commercial production fields as well as other seed production fields using a different male pollen donor. In general, seed production is the only use of contracted bees in canola.



Leaf cutter bee shelter in a seed production field.
Photo Credit: Jay Bjerke

Bee Health Impacts

Both managed and unmanaged bees face a variety of environmental conditions that can have a negative impact on their populations, including loss of habitat, parasites, diseases, and exposures to pesticides (Goulson et al. 2015). Since 2007, U.S. honey bee beekeepers have been surveyed to estimate overwintering losses and, since 2012, total colony losses by the Bee Informed Partnership (*https://bip2.beeinformed.org/loss-map/*). These losses vary dramatically by region and year, but are routinely self-reported by beekeepers as higher than the level of annual losses they would consider acceptable. Major reasons for these honey bee colony losses include Varroa mites and other pests, a variety of pathogens, and management issues. The Honey Bee Health Coalition recognizes four primary factors that affect bee health, which include: pests and disease; lack of habitat and poor nutrition; incidental pesticide exposure; and hive management (*https://honeybeehealthcoalition.org/the-situation/*).

Bee on canola flower.
Photo Credit: Jay Bjerke

This document seeks to organize Best Management Practices (BMPs) for protecting pollinators in canola production, ordered based on seasonal plant cycles, since there is a wide geographic and winter/spring variability in the U.S. season-long BMPs are practices that should be followed during the entire year, while BMPs for planting etc. are specific to that named activity.

BEST MANAGEMENT PRACTICES

Season-Long

Communication and cooperation between beekeepers, canola growers and their advisors (crop consultants, pesticide applicators, etc.) is the most effective way to protect pollinator health while in canola fields. There are times when growers need to manage pests. When this occurs, the choice of application time, which pesticide to use, costs, application method, etc. should be discussed with all stakeholders to minimize the damage to pollinators. The potential for accidental pesticide exposure to occur is heightened when there is a lack of communication and education by both growers and beekeepers. Beekeepers, consultants/applicators, and growers all benefit from close working relationships and familiarizing themselves with each other's practices.

GROWERS AND APPLICATORS

- ***Maintain open lines of communication with nearby beekeepers and local beekeeping associations*** to identify hive locations and inform potentially affected beekeepers of management plans. Resources to facilitate this communication include the website DriftWatch (*https://driftwatch.org/*) where growers and pesticide applicators can view the locations of registered bee hives and sensitive crops.
- Where available, growers should ***refer to their state-specific Managed Pollinator Protection Plan.*** A listing of state MP3's can be found at the following link under "Updated State MP3 Inventory" *https://aapco.org/2015/07/01/current-topics/*.
- ***Scout fields to determine whether a pesticide application is needed.*** Scouting and economic thresholds ensure that pesticides are used only when the benefits of the application outweigh the potential loss of no action. Use economic thresholds (when available), to determine control efforts for routine pests and diseases. Seek to avoid precautionary applications. Economic thresholds are well established for the most common insect pests of canola in North Dakota. Economic thresholds and approved insecticide rates can be found at *https://www.ag.ndsu.edu/publications/crops/north-dakota-field-crop-insect-management-guide*
- When insecticides are required, try to ***choose insecticides with low and/or short residual toxicity to bees*** (i.e., do not contain a bee toxicity advisory statement on the label), short residual toxicity time (i.e., pesticide residues are generally no longer toxic to bees <6 hrs following application).
- ***Follow label instructions every time a pesticide is used.*** Remember that label restrictions are legally binding. Many pesticide labels have instructions specific to honey bee and pollinator protection, which will be indicated in the Environmental Hazards Statement. Most labels of pesticide products that are highly toxic to bees prohibit applications when crops are blooming or if the pesticide will drift onto blooming crops, weeds or onto bee hives/shelters. Contact your state agriculture department with any questions regarding the pesticide label language.

- Whenever possible ***choose to make foliar applications within two hours of sunrise or sunset***. This is the time when bees are least active and likely in their hives.
- ***Follow best practices to manage drift*** when conducting foliar applications. Take steps to reduce or avoid pesticide drift, especially onto areas with flowering vegetation and actively foraging pollinators. In particular, avoid making applications during weather conditions (e.g., high winds) that make pesticide drift away from the target area more likely. Pesticide-specific instructions for reducing drift are often given in the pesticide label. Refer to guidance such as developed by CURES *https://www.curesworks.org/best-management-practices/*

  Specific steps to avoid drift include:

  - Select nozzles that adhere to label requirements for particle size
  - Use an appropriate boom height and ground speed
  - Use drift-reducing surfactants following label requirements
  - Turn off sprayers near water sources (ponds, irrigation ditches, and leaking irrigation pipes), when making turns, and at the ends of fields.
  - Note that tank mixing of pesticides can influence drift characteristics. Reference the mixing instructions on all pesticide labels before including more than one pesticide in the same application.
  - Be aware of temperature inversions when choosing the best time for applications. Temperature inversions allow pesticide droplets to remain suspended in the air and increase the chance of drift, often unpredictably. Temperature inversions often form in the evening hours, up to four or five hours before sunset, and can persist until one or two hours after sunrise.
- ***Consider avoiding tank mixing of insecticides during fungicide or herbicide application***. Here, we define tank mixing as the mixture of two or more, independently labelled, active ingredients in the same application (e.g., mixing an insecticide into a fungicide application). This is distinctly different from the use of a pre-mix (i.e., formulation), which is a singly-labelled mixture of multiple active ingredients (e.g., a formulation containing multiple herbicides). Growers or applicators usually use tank mixing to save money on fuel and labor, as it reduces the number of passes through a field by applying treatments at once. However, mixing active ingredients can change their toxicity and thereby could potentially make them more toxic to bees than they would be alone (ref. 31). Growers and applicators should check label information regarding the synergy between active ingredients and avoid mixing pesticides that will result in increased bee toxicity. Labels will sometimes, but not always explain what can be mixed during application. In all of these cases, our understanding of the complicated interplay of these chemicals is always evolving. It is not clear how much effect these chemicals and their combinations in real-world scenarios can have on bees. Growers and applicators should stay up to date through contact with advisors and extension agents and remain vigilant about developing changes in BMPs.

BEEKEEPERS

- ***Do not leave unmarked bee colonies near fields.*** Clearly post the beekeeper's name, address, and phone number on apiaries in lettering large enough to be read at a distance. Make sure the hives are readily visible from a distance so that applicators can spot them. Register hives with the appropriate state apiary agency provided that such a program exists in your state. Additionally, the "BeeCheck" website (*https://beecheck.org/*) can be used to report apiary locations to pesticide applicators.

- ***Obtain landowner and/or grower permission for hive placement*** every year and keep in contact. Seek to establish informal or formal agreements regarding responsibilities and practices for each party.

- Miticides, such as those used for varroa mite control, are also pesticides. ***Use care in controlling pests in and around beehives, apiaries, and beekeeping storage facilities.*** Use insecticides/miticides labeled for the intended use and follow all label directions carefully.

- ***Ask the grower what pesticides, if any, will be applied*** while bees are in the field and whether the label provides precautionary statements and/or restrictions for use around bees.

- ***Learn about the land use around your hives***, what crops are being grown, and what pesticide applications occur. Ensure adequate and healthy food sources and clean water access. You can view agricultural land use around your apiary though the USDA National Agricultural Statistics Service (NASS) CropScape website: *https://nassgeodata.gmu.edu/CropScape/*, and registries such as FieldWatch® *https://fieldwatch.com/*.

- In areas known for high exposure to pesticides, ***inspect behavior of bees often*** to recognize problems early.

- ***If acute pesticide exposure is suspected, consider contacting the grower or applicator.*** Growers and applicators do not want to harm beekeeping operations and are often willing to consider any impact. Additionally, contact the local state apiary agency or department of agriculture to report the loss. Provide a bulleted list/photos to indicate acute exposure and, if possible, remove and properly store several frames for residue sampling. For investigation purposes, a state official will also probably need to take samples. To learn more about factors considered during the investigation of a bee kill incident, refer to the USEPA *Guidance for Inspecting Alleged Cases of Pesticide-Related Bee Incidents* (*https://www.epa.gov/sites/production/files/2013-09/documents/bee-inspection-guide.pdf*)

  Beekeepers may wish to provide supplemental sugar and protein to potentially dilute any contaminated food reserves.

Hives adjacent to canola field.
Photo Credit: Chris Hiatt

Pre-Planting

Some regions and species of canola require tilling to prepare the fields during pre-planting of canola. This can impact wild bees. Some species of wild bees overwinter and nest in the ground. No-till systems are least hazardous to these bees and their nesting areas.

- If no-till is not possible, ***delaying tillage as late as possible*** and using minimal soil disturbance may minimize damage to these wild pollinators. Avoid mechanical tillage where possible to mitigate damage to ground nesting or overwintering bees.
- ***Leave untilled areas*** i.e. shelterbelts, grassed waterways, and roadside ditches to act as nesting habitat for ground nesting bees. Avoid spraying insecticides on untilled areas.
- ***Control flowering weeds*** in the field prior to planting so that bees are not attracted to the field for foraging.

Planting BMPs

Planting of winter canola typically occurs in the fall (September) in the High Plains and earlier in the Pacific Northwest. Spring canola planting typically occurs as soon as frost danger has passed in the spring.

Some canola varieties may be more attractive to bees and thus provide better nutrition for them.

Canola seedlings have many insect pests and diseases such as wireworms, cutworms, flea beetles, and damping off. Hence, seed treatments are considered essential by most growers. It should be noted that the canola industry has moved away from highly toxic in-furrow treatments, such as carbofuran and terbufos, replacing them with less toxic (frequently neonicotinoid) seed treatments.

Pesticide seed treatment may be harmful to bees through dust-off. As a result, treated seeds need to be handled with care, as per the information on the seed bag and/or tag.

- ***Select canola varieties that are most attractive to bees*** when possible, and check with extension agents about new developments as more science emerges.
- ***Check to ensure no managed bees have been placed in the area.*** Other bees may be present as well. Be aware of hive locations and wind direction. Dust containing abraded pesticide can drift onto flowering crops, trees, and other foliage or water sources putting foraging bees at risk.
- ***Communication between beekeeper and grower*** is critical for reducing exposure risks if hives are in place. Share hive locations and timing of agronomic operations.
- ***Avoid generating dust*** when handling or loading treated seed into the planter. Pour seeds carefully and do not shake dust or loose material from the bottom of the bag. Do not use areas near bee hives or bee foraging sites to load or clean planting equipment.
- ***Avoid fluency agents in general.*** When using a singular planter and there is a need for fluency agent, consider using a synthetic fluency agent to reduce dust (i.e., dust-off; fugitive dust) from abraded seed coatings.
- ***Practice good clean-up and disposal methods.*** Clean up or cover spilled or exposed seed with soil rather than leaving it exposed. Keep treated seed and abraded seed coat dust away from surface water. Properly dispose of empty seed bags in a timely manner and in accordance with local regulations.
- ***Speak to your equipment dealer or manufacturer*** to see if deflector kits are available for your vacuum (pneumatic) planter. If so, consider investing (installing) in these drift reduction technologies.

Further information can be found in The Guide to Seed Treatment Stewardship: *https://seed-treatment-guide.com/pollinators/*.

Pre-Bloom BMPs

For winter canola, this can encompass a large time period from emergence in the fall, through winter, and into bolting in April. During this period, canola can come under pressure from many insect pests which may necessitate control measures. These pests may include flea beetles, grasshoppers, cutworms, aphids, harlequin bug, diamondback moths, cabbage worm, and others. Be aware of the presence of flowering weeds in the field, which may attract bees to the crop at this stage; however, keep in mind that fields can serve as nesting habitats for a variety of social and solitary native bees.

For spring canola, this is a much shorter period, usually six to eight weeks of spring to early summer. Pests that need attention at this time are typically flea beetles and/or cutworms. Seed treatment typically keeps flea beetles in check however there are circumstances in this stage that can necessitate additional treatment for flea beetles. This is typically in the early stages of plant growth, when bees are not in the field, although fields may be serving as a nesting rather than foraging habitat for wild bees.

Most spring and winter canola are herbicide-tolerant, and weed control is usually done during the pre-bloom period. Herbicides are commonly applied prior to planting and in the first few weeks after crop emergence when canola is most susceptible to weed competition. Keeping canola fields free of flowering weeds during this time, through herbicide application or tillage, will discourage foraging bees that would be susceptible to possible insecticide applications also common at this period.

Bees may be present during this time. Seek to determine hive locations and communicate with beekeepers early and as necessary before making foliar treatments.

- ***Be aware of hive locations.*** Notify nearby beekeepers of plans to spray.
- ***Always read the pesticide label*** and follow the label instructions.
- ***Check the weather forecast*** before application and be mindful of changing weather conditions during application to minimize drift. Spray when temperatures are cool and/or humidity is high. Do not spray in situations where temperature inversions may occur. This is particularly important to check as temperature inversions are most likely to occur during the evening or early morning hours, when pesticide applications are advised.
- ***Spray when wind is blowing away from hives***; however, note that most pesticide labels have wind speed restrictions for applications.
- Whenever possible ***seek to make foliar applications within two hours of sunrise or sunset*** as this is when bees are least active.
- ***Follow best practices for minimizing drift*** such as:
    - Use a low-drift nozzle if possible and calibrate spray equipment regularly.
    - Use a medium-to-coarse droplet size if possible.
    - Install cones or shrouds on field sprayers to reduce off-field movement.

- For aerial applications, ensure maximum boom width does not exceed 75 percent of the wingspan.
- Incorporate spray drift reduction agents into spray mixes to ensure consistent droplet size and on-target application.
- Treat only the target area. Adhere to the buffer zone width specified on the pesticide label.
- Shut off sprayers when turning at field ends, near large puddles or water sources, or near other environmentally sensitive areas; turn off outward facing nozzles on field edges.
- Shut off nozzles if there are gaps in the crops.

- ***Avoid mixing herbicides and insecticides*** whenever possible.

Bee on tassels.
Photo Credit: Jay Bjerke

Bloom-Time BMPs

Blooming for winter canola typically takes place in March/April, and spring canola typically blooms in May/June. Bloom duration is heavily dependent on environmental factors such as air temperature and available soil moisture. As well, the presence of bees is known to shorten the bloom period, speed up the plant maturation, and promote more even ripening.

There is some risk during bloom-time of fungus, such as Sclerotinia. As well, there may be fungus issues in surrounding wheat fields. As such, fungicide application can occur during this time.

Other pest pressure is generally low at this time; however foliar and aerial spraying can happen at this stage.

Avoid spraying any pesticide during the bloom period if at all possible. If spraying is necessary to prevent economic losses, always follow the BMPs below.

- ***Grower, applicator, and beekeeper communication*** very important (refer to state MP3/ Pollinator Plan) throughout season.
- ***Communicate with nearby beekeepers*** as soon as possible before applying pesticides.
- ***Select crop pest products with pollinator health in mind*** (give examples, not brand specific, because brands change and don't want to endorse specific products).
- ***Apply pesticides conservatively*** (follow labels and apply only when truly needed and thresholds are met). When spraying fields, consider spot spraying, or only applying pesticides to infested areas.
- ***Always follow the pesticide label.*** Use the recommended rate and never exceed the maximum application rate, avoid drift of sprays and dusts, and do not apply in windy conditions above wind speeds specified on the label or when there is a danger of drift onto non-target areas. Use drift-reduction application equipment that is properly maintained and calibrated.
- ***Avoid mixing fungicide and insecticide treatments in a tank.*** Mixing active ingredients can change their toxicity and thereby could potentially make them more toxic to bees than they would be alone (ref. 31).
- ***Apply pesticides at night*** whenever possible, and when evening/night isn't possible, then early morning would be next best.

Remember that most commercial beekeepers can't move or cover their hives before a pesticide application.

Post-Bloom - Post-Harvest BMPs

After bloom, bees are typically foraging on other flowering plants around a canola crop, so impacts are fewer as bees are less present. Herbicide applications on surrounding plants (e.g., alfalfa, late-blooming clover) could negatively impact bees, so precautions, if possible, are warranted.

For winter canola, harvest occurs in late May/June. Spring canola harvest typically occurs late August/September, depending on weather conditions.

- ***Remove hives as soon as blooming is complete.*** If hives can't be removed on a timely basis, make sure water and food are available so that bees don't forage on other nearby crops that may have been treated with crop protection products.
- If spraying a pre-harvest desiccant to control flowering weeds in canola fields, ***contact hive owners prior to application***. Although registered desiccants are not typically highly toxic to bees, they may result in contamination of bees and honey with these pesticides. If possible, apply desiccants during early morning or evenings to minimize contact with foraging bees.
- If possible, ***avoid tillage*** so wild bee nests are not destroyed.

Providing Honey Bee Habitat

The practices that have been recommended thus far in this guide help protect bees. One of the best ways that growers and landowners working in canola production can proactively improve honey bee health is by providing pollinator food sources and forage nearby. Research shows that leaving and establishing flowering plants provides honey bees, native bees, and other pollinators with better nutrition — and healthy bees means a healthier agricultural landscape. An added benefit is that the food sources provided during canola planting and pollination may provide a buffer when pesticide applications are scheduled.

For canola production, pollinator plantings encourage bee pollination that has specific canola yield benefits (Canola Council of Canada, see more on Page 2).

Pollinator habitat can be integrated into existing sustainability efforts — such as field buffer strips and natural habitat restoration — by including pollinator-friendly seed mixes.

In this section, you can learn more about the benefits of pollinator habitat for canola growers, several types of habitat projects, and then how to get started. You'll also find a list of resources with links that can help you connect with resources and programs for your area.

HABITAT BENEFITS FOR CANOLA GROWERS

Growers and landowners may be eligible to earn payments from a variety of public sector and private sector programs. These include cost-share programs through the USDA Farm Service Agency (FSA) and the U.S. Fish and Wildlife Service (USFWS) as well as state and/or private programs offering seed, technical support, or other conservation incentives for creating and maintaining pollinator habitat. Programs include the Conservation Reserve Program (CRP) as well as local and regional programs with county-specific or temporary financial support. This is a great way to put marginal and non-production land (such as field borders, buffer strips, roadways, railways, and waterways) to use and get paid for conservation practices.

Beyond cost-sharing and potential financial compensation, growers who plant pollinator habitat may also benefit from reduced soil erosion, protected and improved soil and water quality, and enhanced food and cover for other wildlife, according to the USDA Natural Resources Conservation Service (NRCS). Michigan State University researchers note the potential for organic matter accumulation, compaction alleviation, and improved water filtration. Pollinator habitat may also store carbon in the soil and act as a carbon sink by encouraging deep-rooted plants and limiting soil disturbance.

Growers also may be able to earn recognition or a premium for sustainably produced crops and/or access to markets that require sustainability metrics (Muth, 2018; Wratten et al, 2012) such as established pollinator habitat. In addition, many consider pollinator habitat a beautiful addition to the landscape (Wratten et al, 2012).

TYPES OF HABITAT PROJECTS

- ***Enhance off-field areas with forage***
    - Plant diverse wildflower patches that bloom all season long
    - Install hedgerows with blooming shrubs, trees, and/or wildflowers
    - Establish non-crop buffer strips
    - Restore native plants in nearby natural areas
- ***Provide nesting habitat for ground bees***
    - Leave areas of grass or bare soil untilled for ground-nesting bees
    - Leave some tree snags or dead pithy stems for stem-nesting bees
- ***Provide access to clean water***
    - Bird baths
    - Irrigation, ditches, or natural ponds

BEST PRACTICES FOR HABITAT PLANTINGS

Because many pollinators and other wildlife have experienced extreme habitat declines, landowners should strive to make their pollinator habitat plantings as constructive as possible. Plantings can be designed to fit the goals, size, and appearance the grower desires. The best planting will depend on budget, size, soil type, climate, weed history, and other factors. A good first step is to speak with field staff at your county USDA office, your Conservation District biologist, the closest Farm Bill biologist, or any of the programs linked below. The following best management practices provide a general overview, and the federal or nonprofit expert you work with will likely provide recommendations specific to your site.

Site Selection and Preparation

To maximize success and minimize long-term maintenance, be sure to spend adequate time on site preparation. This means eliminating existing vegetation and reducing competition from weeds seeds in the soil. Many techniques can be used such as herbicides, grazing, and prescribed fire. A site with existing crop stubble is an ideal choice because of decreased competition from grasses. Consider any herbicides used the previous year that could have a residual effect and prevent pollinator-friendly species from growing. If the site has existing grass, it is recommended to plant soybeans and apply standard herbicide treatments for one growing season to address weeds and improve soil nitrogen. Depending on the techniques used and the season in which you start, proper site planning and preparation could take from six months to one or more years.

Seed Mix Selection

When choosing a seed mix, growers should consider which pollinators they want to attract as well as the soil type, geography, and any species restrictions mandated for conservation goals. Seed mixtures should include a high diversity of species with a variety of bloom periods that will provide pollen and nectar for the entire growing season. Also consider avoiding species that are especially attractive to deer. Talk to your local Farm Service Agency representative or seed dealer to determine the best seed mix for the site and its cost. You can also use a seed calculator that shows each species' planting rate, seeds per square foot, bloom period, and pollinator value.

Planting and Water Requirements

When planting, it's important to have great seed-to-soil contact. This can be done with broadcast seeding on roughened bare soil or in crop stubble, depending on the crop. In areas with heavier crop stubble or existing grass, a no-till drill should be used. Broadcast seeding into lighter crop stubble in the fall is preferred. Some conservation districts have rental tools available for establishing pollinator plantings. Be sure to use the appropriate planting depth for the size of the seeds. Aim for a planting depth of two times the diameter of the seed, and know that a planting depth greater than 1/8" will mean some species will not appear in the planting. When seeds are sown in the fall, they should germinate with normal precipitation in fall and early winter. Winter annuals may provide flowers in time for honey bee colonies in the spring. Monitor seedling growth to determine if supplemental irrigation is needed. Some available seed mixes have low moisture requirements.

Management

Landowners should plan for long-term maintenance and record-keeping, especially if the habitat is supported by an incentive program.

If allowed by the incentive program, mow in the first year when plants are about 24 inches tall to help the pollinator planting become established. Be sure to mow the vegetation no shorter than 10 to 12 inches tall. Mowing to this height removes seed-producing parts of many weeds while minimizing impacts to the pollinator-friendly plants. It's recommended to mow twice in the first year, once in the second, and then only at the end of the season in the following years.

Address any grass encroachment before the grass outcompetes wildflowers. Use an appropriate grass-selected herbicide so that it doesn't negatively impact the forage species. The herbicide is more effective combined with another method such as prescribed fire, grazing, or shredding. Prescribed fire (combined with green fire banks that allow rotation of fire treatments) and grazing also help with wildflower establishment. Combining fire and grazing provides better results. It is highly recommended to do some management of the planting every year.

Pollinator Habitat and Crop Pesticides

If habitat is planted next to crops or water sources, it is important to carefully read and follow pesticide label directions to avoid drift and reduce the risk of exposure to bees. Many pesticides can be used safely when pollinators are nearby as long as label directions are followed.

INCENTIVE AND COST-SHARING RESOURCES

Some websites can provide ideas and photos of successful projects, but they may not have the latest information or a complete list of available resources. It's best to call organizations directly and talk with someone at your closest office.

Don't limit your search to pollinator-specific projects. Some programs are designed for specific habitats, such as riparian restoration or deer habitat, but can still benefit pollinators by adding the right flowering plants.

- USDA Farm Service Agency (FSA):
  - *Conservation Reserve Program (CRP)*
  - *Conservation Reserve Enhancement Program (CREP)*
- USDA Natural Resources Conservation Service (NRCS):
  - Find your closest NRCS contact at: *https://offices.sc.egov.usda.gov/locator/app*
  - *Agricultural Conservation Easement Program (ACEP)*
  - *Conservation Stewardship Program (CSP)*
  - *Environmental Quality Incentives Program (EQIP)*

- Conservation District:
    - Find your district at: *https://www.nacdnet.org/general-resources/conservation-district-directory*
- U.S. Fish and Wildlife Service (USFWS):
    - Find contact info for your region and state at: *https://www.fws.gov/partners/contactUs.html*
    - *Partners for Fish and Wildlife*
- The Bee & Butterfly Habitat Fund
    - *Seed a Legacy Program:* The Seed A Legacy pollinator habitat program is available for private, public, and corporate lands in a 12-state region of the country critical to pollinator health and habitat needs. It offers access to documented, high-quality pollinator seed mixtures for free or at discounted rates to projects that are at least two acres.
- Pheasants Forever
    - Find a biologist: *https://www.pheasantsforever.org/Habitat/findBiologist.aspx*
- Quail Forever
    - Find a biologist: *https://quailforever.org/Habitat/findBiologist.aspx*
- Seeds for Bees
    - Project Apis m. program for California residents: *https://www.projectapism.org/seeds-for-bees-home.html*

SUMMARY OF BEST MANAGEMENT PRACTICES

1. **Communication among beekeepers and growers.** This is one of the most important factors in preventing acute poisoning of managed bee hives. When growers and beekeepers are aware of each other's locations, concerns, and management practices, they can take steps to avoid pesticide exposure to hives and foraging bees.

2. **Integrated Pest Management.** Growers should follow recommended economic thresholds and Extension recommendations to guide pest management decisions and consider multiple strategies for control that include non-chemical options (e.g., resistant varieties, cultural practices).

3. **Always follow label instructions.** When insecticides or other pesticides are used (either by growers, or by beekeepers when managing hive pests or forage), label instructions must be followed. Remember that label restrictions are legally binding.

4. **Practice good hive management.** Poorly managed hives are more susceptible to stresses from parasites, pathogens, other pests, and poor nutrition. Healthy hives with access to plentiful forage are more resilient when confronted with additional stresses, including pesticides, than are hives at risk from multiple stressors.

5. **Improve foraging areas for bees and other pollinators.** Where possible, include flowering plants in non-crop areas. Avoid pesticide drift onto non-crop areas that include floral resources. Leave areas that include these resources intact whenever possible.

RESOURCES

Communication Between Growers and Beekeepers

FieldWatch:
https://fieldwatch.com

DriftWatch:
https://driftwatch.org

BeeCheck:
https://beecheck.org

BMPs for Other Cropping Systems

Best Management Practices to Protect Honey Bees and Other Pollinators in Soybean Fields:
https://honeybeehealthcoalition.org/soybmps/

Honey Bee Best Management Practices for California Almonds:
www.almonds.com/pollination

How to Reduce Bee Poisoning from Pesticides:
http://catalog.extension.oregonstate.edu/pnw591

How to Protect and Increase Pollinators in Your Landscape:
https://www.canr.msu.edu/publications/how_to_protect_and_increase_pollinators_in_your_landscape

Minimizing Pesticide Risk to Bees in Fruit Crops:
https://www.canr.msu.edu/resources/minimizing_pesticide_risk_to_bees_in_fruit_crops

Protecting Honey Bees from Pesticides:
https://extension.entm.purdue.edu/publications/E-53.pdf

State Managed Pollinator Protection Plans

Inventory of state managed pollinator protection plans:
https://aapco.org/2015/07/01/current-topics/

Honey Bee Health

Honey Bee Health Coalition:
https://honeybeehealthcoalition.org

Bee Informed Partnership:
https://beeinformed.org

IPM in Canola

Radcliffe's IPM World Textbook, University of Minnesota
https://ipmworld.umn.edu/weiss-canola-pests

Integrated Pest Management of Flea Beetles in Canola, Noth Dakota State University
https://www.ag.ndsu.edu/publications/crops/integrated-pest-management-of-flea-beetles-in-canola

Diamondback Moth in Canola Biology and IPM, Noth Dakota State University
https://www.ag.ndsu.edu/publications/crops/diamondback-moth-in-canola-biology-and-integrated-pest-management

Identifying and Managing Insect Pests of Canola, Washington State University
http://css.wsu.edu/oilseeds/files/2018/03/2018-Canola-Pests-Hartline-Oilseed-Workshop-Whaley.pdf

Canola Management Options, Kansas State University
https://entomology.k-state.edu/extension/insect-information/crop-pests/canola/plant-bugs.html

Canola Insects, Oklahoma State University
http://canola.okstate.edu/cropproduction/insect

Seed Treatments

The Guide to Seed Treatment Stewardship:
http://seed-treatment-guide.com

Pollinator Habitat

Honey Bee Health Coalition Focus on Forage:
https://honeybeehealthcoalition.org/focus-on-forage/

The Bee and Butterfly Habitat Fund:
http://beeandbutterflyfund.org/

USDA Conservation Reserve Program (CRP):
https://www.fsa.usda.gov/programs-and-services/conservation-programs/conservation-reserve-program/

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APPENDIX I: SEED PRODUCTION BMPS

Canola grown for seed production represents less than 1 percent of the canola grown in North America. Canola seed production does require contract pollination services. As such, most practices are undertaken in the context of formal contracts drawn up between seed producers and beekeepers. A review of the BMP's contained here will be useful in advance of negotiating any formal agreements.

Generally, good communication and contracting are key to successful pollination in seed production fields. Details that should be discussed and coordinated between the beekeeper and the seed producer include:

- Coordination of crop timing with dates of apiary arrival and departure;
- Details of the beekeeper's responsibility to provide strong, effective colonies for crop pollination;
- Details of the grower's responsibility to safeguard bees from poisoning;
- Agreement on who is responsible for providing supplemental water and feed;
- Pest management practices in the cropping system that occurred before colonies are delivered;
- Any pesticides that are to be used on a crop while beehives are present;
- Buffers between treated areas and apiaries;
- Inform neighboring growers and applicators of apiary locations;
- Possible pesticides that may be used in adjacent crops;
- Location of honey bee colonies. Registering colonies with your state agriculture department or pesticide regulation department can provide the location of apiaries to pesticide applicators.
- It is generally not feasible to move bees from the field. Plan pest-control strategies early to avoid applying bee-toxic chemicals during the crop-pollination period and apply only those pesticides with low toxicity and short residual hazard to bees at twilight or at night after bees cease foraging.
- Alfalfa leaf cutter bee and mason bee shelters can be constructed so that they can be covered or closed for night applications of pesticides. When bees are not active, the developing bees inside the tubes are protected.

Bays of male and female plants in a canola seed production field.
Photo Credit: Jay Bjerke