

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



DEVELOPED IN PARTNERSHIP WITH THE 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.



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

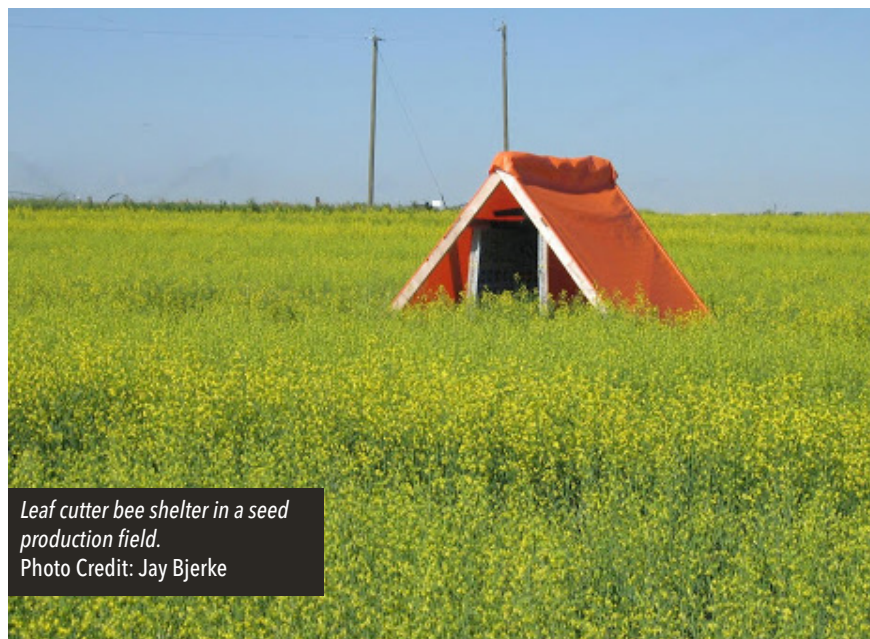
Further, bees may help to control canola diseases. Researchers are exploring the potential for honey bees to spread beneficial fungi for controlling insects like *Lygus* bugs.

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.

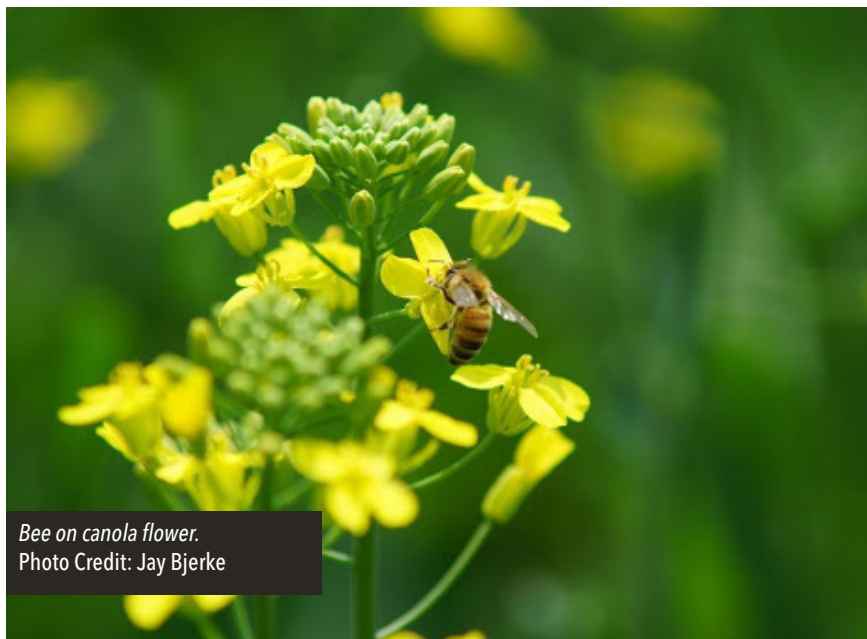
Most canola grown in the U.S. is hybrid spring canola which requires hybrid seed. To produce the seed required, seed growers (who typically do not grow production canola) plant female plants, (which do not produce pollen), in alternating bays with a male (pollen-producing) cultivar. Bees are required 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 forage and poor nutrition; incidental pesticide exposure; and hive management (<https://honeybeehealthcoalition.org/the-situation/>).



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 forage and clean water access. You can view agricultural land use around your apiary through 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.



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 Forage

One of the best ways that growers and landowners working in canola production can proactively improve honey bee health is by providing additional pollinator habitat and forage on land that they manage. Pollinator forage areas should be managed such that they provide pollen and nectar resources for as much of the season as possible. In relation to canola production, forage provided during canola planting and pollination can have the added benefit of drawing honey bees and other pollinators away from canola fields during these sensitive periods. Some best management practices for providing honey bee forage include:

- **Choose blends of plants that are well suited to your environment,** will not result in management issues (e.g., become weedy), and will result in an extended period of nectar and pollen forage. Refer to established resources on establishing and managing pollinator habitat (e.g., <https://honeybeehealthcoalition.org/focus-on-forage/>).
- **Include species that flower both before and during canola planting and pollination,** as bees are more likely to forage in areas where they have previously found sources of food.
- **Obtain seed from a high quality source** that is locally appropriate that does not include weedy species.
- **Locate pollinator habitat in areas that are at low risk of exposure to pesticide drift** (e.g., away from field margins and pesticide mixing areas).
- **Take advantage of programs** available through USDA, conservation organizations, and the agricultural industry that assist in providing pollinator habitat.

Effective 2019, USDA-NRCS has added an additional Conservation Enhancement Activity – Improved crop rotation to provide benefits to pollinators, E328136Z2 – to the Conservation Stewardship Program. Its purpose is to improve the existing crop rotation by adding pollinator friendly crops into the rotation adhering to the following criteria:

- **Crops will be grown in a planned sequence** over a five year rotation. The crop rotation shall include a minimum of three different crops in a minimum five year crop rotation.
- **The crop rotation must include at least one pollinator friendly.** For the purpose of these criteria, a pollinator friendly cover crop is considered a different crop. A pollinator friendly crop is defined as a crop, planted for harvest or as a cover crop, which provides nectar for pollinators and other beneficial insects. Examples of pollinator friendly crops are canola, sunflowers, clovers, and borage. To meet the purpose and definition of a pollinator friendly crop, these “flowering” crops must be allowed to bloom prior to harvest or termination.
- Each year the enhancement is planned, **the pollinator friendly crop will be planted on a minimum of 5% of cropland acres** contained within the agricultural operation. Plan/contract the actual acres planted to the pollinator friendly crop.
- Where applicable, **plan suitable crop substitutions** when the planned crop cannot be planted due to weather, soil conditions, or other local situations.
- **Foliar systemic insecticides may not be applied** to the pollinator friendly crop.
- **Insecticides may not be applied during crop bloom** period of the pollinator friendly crop.

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, North 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, North 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 Forage

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