Protecting pollinators from pesticides

WILD BLUEBERRY

POLLINATOR PARTNERSHIP CANADA

This guide is a joint project between Pollinator Partnership Canada and the Atlantic Tech Transfer Team for Apiculture. The original guide was authored by Lora Morandin, Ph.D., and Kathleen Law, M.A., Pollinator Partnership Canada to reflect the needs of highbush blueberry pollination. It has been revised and updated by Jeff Orr, Ph.D., to reflect research and practices of pollination of the wild blueberry.

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POLLINATOR PARTNERSHIP CANADA

ATTTA Atlantic Tech Transfer Team for Apiculture

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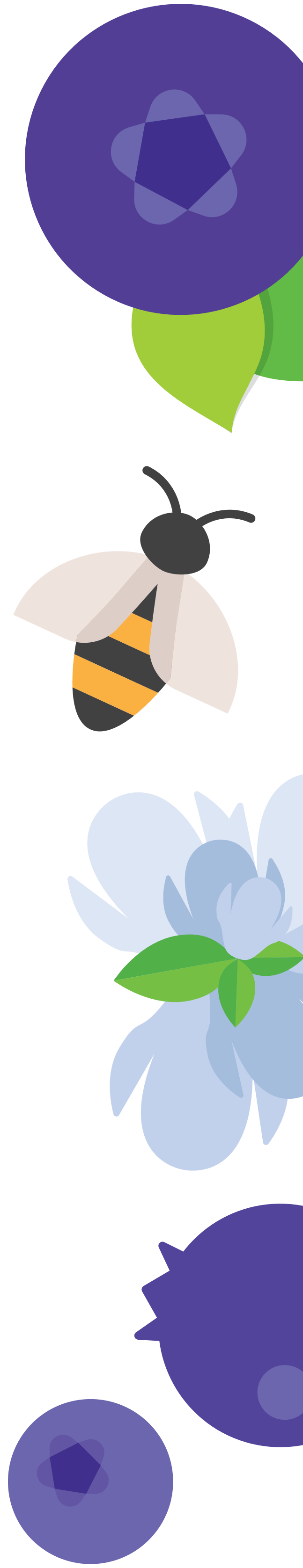


FOREWORD

Credit: Atlantic Tech Transfer Team for Apiculture

Bees play a crucial role in the pollination of wild blueberries and their health is important to the long-term sustainability of production as well as to the broader environment. Keeping managed and wild bees healthy requires involvement from all those participating in wild blueberry production, from beekeepers to growers, agronomists, crop consultants, and pesticide applicators.

The focus of this guide is on minimizing the impacts of pesticides on pollinators and is meant for all those involved in wild blueberry production. There are many factors that impact bee health in addition to pesticide exposure, including habitat loss, pests and diseases, and climate change. By reducing bees' exposure to pesticides, stakeholders can support bee populations in the face of multiple stressors.

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 minimize the impacts of pesticides on bees through informed decision-making, best management practices, and by maintaining good communication between beekeepers and wild blueberry growers.

The **first section** of this guide covers the relationship between managed and wild pollinators, and wild blueberries. The **second section** covers four important practices that help minimize the impacts of pesticides on pollinators: integrated pest management, communication, habitat, and pesticide product use and selection. The **third section** distills the information contained in sections 1 and 2 into action-oriented recommendations for growers, applicators, and beekeepers. The **resource section** includes more detailed information on the impacts of pesticides on bees and how to identify and report suspected bee poisoning.

In addition to this guide, readers can consult the supplemental document for pollinator precaution levels for products registered for use in wild blueberry, and for additional information on the pesticide risk characterization framework used by the Pesticide Management Regulatory Agency to designate precaution levels.

We hope this guide will help everyone involved in wild blueberry production learn more about the bees that pollinate this important crop and how we can maintain productive and healthy wild blueberry systems while protecting pollinators.

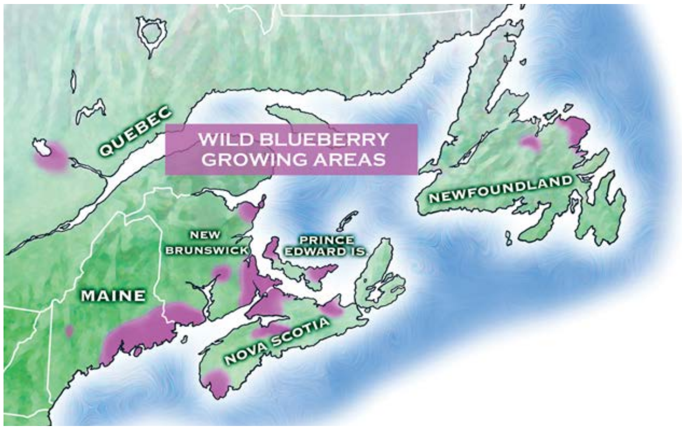
Credit: Atlantic Tech Transfer Team for Apiculture

1 WILD BLUEBERRY POLLINATION

BLUEBERRY PRODUCTION IN CANADA

The wild blueberry is native to Northeastern North America. In Canada, two main types of blueberry are grown, the cultivated highbush blueberry (*Vaccinium corymbosum*) and the wild blueberry which has two main species (*Vaccinium angustifolium* and *Vaccinium myrtilloides*). This document focuses on practices to protect pollinators in wild blueberries. Although the terms wild and lowbush may be used interchangeably, this guide will use the term wild blueberries.

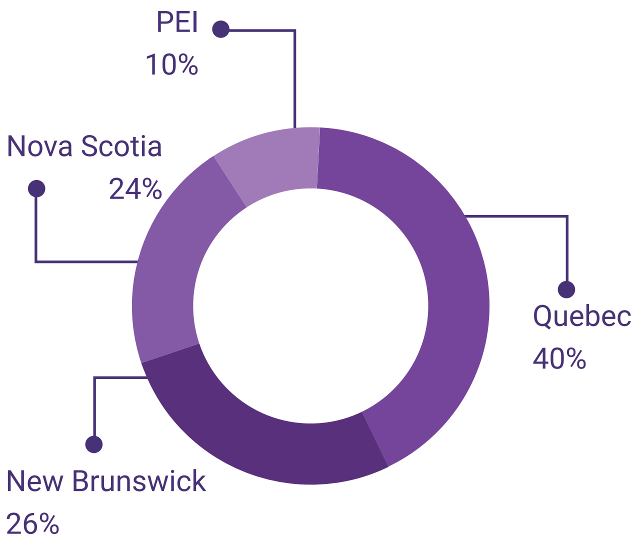
The wild blueberry is the most important fruit crop in Eastern Canada, with a farm gate value of approximately $112 million CAD and an export value in 2020 of over $300 million. Moreover, wild blueberry represents 50% of the total fruit area under cultivation in Canada[1]. The pollination services of bees, wild and managed, contribute to this value significantly.



Wild Blueberry Producers Association of Nova Scotia

The majority of North American commercial wild blueberry production occurs in Maine, Quebec, and the three Maritime provinces. Most of the wild blueberry crop is frozen and exported to Europe, the US, and Asia, though there is an increasing focus on the domestic Canadian market. It is important that growers can produce a marketable product for both domestic and export markets, which requires consideration of many factors, including pest control and pollination requirements.

WILD BLUEBERRY PRODUCTION IN CANADA *



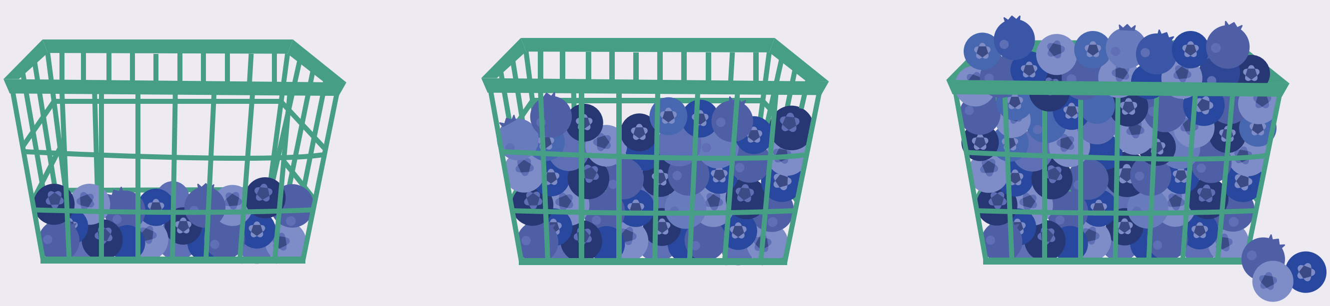
* Proportional production % as of 2021, based on rolling five year averages (over the last 15 years)

WILD BLUEBERRIES NEED POLLINATION

Wild blueberries, as an entomophilous plant, require insect pollinators for fruit production and optimum yields are produced with a combination of managed and native pollinators. Although wild blueberry yields are impacted by a number of factors, bee pollination is one of the most important. The greater the number of bee visitations resulting in pollen depositions to flowers, the more seeds are formed, resulting in larger fruit and higher yields[2, 3]. Additionally, wild blueberry production has been shown to be limited by insufficient pollination and increasing the number of wild and/or managed bees in blueberry fields can lead to increased fruit set[4]. Fruit set, seed numbers, and berry weight all contribute to the ultimate crop yield.

The presence of bumble bees and other native bees in wild blueberry fields result in less pollen limitation (which is the result of an insufficient quantity and/or quality of pollen) that contributes to greater fruit size and fruit set. However, many native bees nest on the edges of fields and can travel only short distances from their nests (however, bumble bees are long distance foragers). The range limitations of some native bees impact pollination in the centers of larger fields and therefore honey bees (which can travel upwards of 2km from hives) are often used in wild blueberry production[5]. This means that in many fields, especially those surrounded by forests, honey bees are of great economic importance to wild blueberry production[6]. While 100% pollination fruit set is not considered achievable under even ideal pollination, Jesson et al.[4] showed that increasing the number of wild and/or managed pollinators in a blueberry field can increase fruit set. Asare et al.[7] calculated that each percentage increase in fruit set will cause a 44.1 kg/ha increase in yield when averaged over all production systems across the years of their study. Furthermore, the benefits of placing pollinators in blueberries are also dependent upon effective pest and disease management in the crop to achieve the full benefits of good pollination[4].

WILD AND MANAGED POLLINATORS' IMPACT ON PRODUCTION



Low production: Ambient wild pollinators only

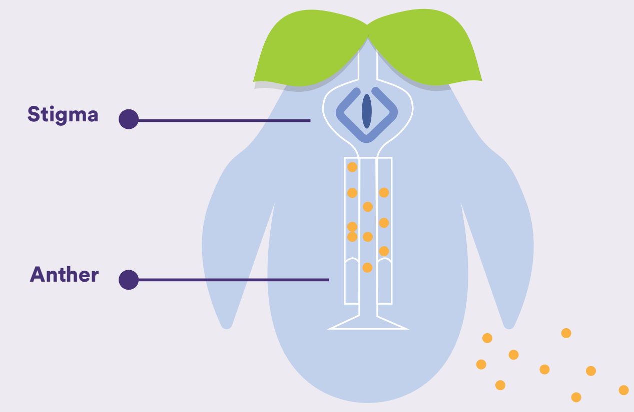
Typical production: Managed pollinators and ambient wild pollinators

Potential production: Optimal use of managed pollinators and increased wild bee presence from habitat management

THE POLLINATORS OF WILD BLUEBERRY

Wild blueberries are pollinated by many types of insects but the most important are bees. While most people are familiar with managed honey bees, a non-native insect species to North America, less well-known are wild bees that provide valuable pollination services to many crops. Wild bees, which have co-evolved with the plants of a given location are very important to agriculture. In contrast to most wild bees, honey bees are highly social species, living in colonies numbering in the tens of thousands. There are over 900 species of wild bees in Canada, ranging in size from a few mm up to 25 mm in length. Most wild bees are solitary, meaning that they build individual nests as opposed to colonies; they build these nests in the ground or in tunnels in old wood or vegetation. Bumble bees, however, are social and live in colonies. Throughout this guide the term 'wild' bees will be used to distinguish between wild, native species, and managed bees, which include not only honey bees but also some species of bumble bees and other bees.

Read below to find out more about managed honey bees and the fascinating wild bees that make blueberry production possible.



Poricidal anthers on a blueberry flower (figure adapted from University of Maine Fact Sheet No. 630, UMaine Exentsion No.2111)

Blueberry flowers have evolved for buzz pollination, also referred to as floral sonication. This is achieved when certain bee species move their flight muscles rapidly, causing the anthers to vibrate and release pollen[8]. Bumble bees, some miner and sweat bees, and large carpenter bees can buzz pollinate[9]. Honey bees are not able to buzz pollinate and are not very effective individual pollinators of blueberry[10]. However, because they can be brought to fields in large numbers, generally recommended between 5-10 colonies/ha and are able to drum on the anthers with their legs (among other pollination-aiding behaviours), they successfully benefit crop pollination[11, 12].

In bagging and cage studies, where insects are kept from accessing flowers, little or no blueberry fruit is produced[4, 13]. Research also shows that higher wild bee abundance and diversity, in addition to managed honey bees, can lead to more flowers setting fruit and larger berries. This and other studies show that both honey bees and wild pollinators, like bumble bees, are important, since the best pollination occurs when there is a diversity of species visiting the blueberry crop.

Credit: John MacDonald, Atlantic Tech Transfer Team for Apiculture

Credit: Atlantic Tech Transfer Team for Apiculture

HONEY BEES

Honey bees (*Apis mellifera*) are commonly rented from beekeepers for wild blueberry pollination and increasingly, blueberry growers are keeping colonies of their own. They are a managed species first brought to North America by early European settlers. Honey bees are social insects that live in large colonies with tens of thousands of individual bees. While honey bees are less efficient blueberry pollinators per visit than some wild bee species, they are easy to manage and transport, and can provide a large pollinating force that can adequately pollinate crops, especially when field sizes are large[5]. Hives are typically placed at a rate of 2-4 hives/acre (5-10 hives/ha) when the crop reaches 5-10% bloom and are usually removed from fields at petal fall.

Many beekeepers report higher disease incidence when returning from blueberry pollination. Suggested causes of the ill-health of honey bees linked to wild blueberry pollination are nutritive stress due to low floral species diversity in and around blueberry fields, hive transport, agrichemical exposure, increased exposure to pests and disease, or a combination of these factors. **Research shows that honey bees in blueberry fields are healthier if they have access to a diversity of non-crop pollen sources[14].** Causes of poor health in honey bees that are pollinating blueberries is the focus of ongoing research.

RESEARCH HIGHLIGHT

EXPLORING THE CONNECTION BETWEEN WILD BLUEBERRY POLLINATION AND HONEY BEE HEALTH

Credit: Atlantic Tech Transfer Team for Apiculture

Honey bee colonies make up most of the pollinator force in Maine for wild blueberry production and most are imported from other regions of the US. Drummond, Lund, & Eitzer[15] conducted a study to sample the health of honey bee colonies imported for pollination services in wild blueberry fields. They assessed the health of three colonies at each of nine locations in 2014 and five hives at nine locations in 2015 during wild blueberry bloom. They analyzed queen health, colony strength, the rate of colony population increase, as well as pesticide residues on honey bee workers, pollen and wax. Mite levels, viruses, and microsporidian, and Trypanosome pathogens were also monitored. Colony growth rates over both years were negatively affected by levels of varroa mite infestation and the pollen pesticide residues identified during bloom. There were many pesticide residues other than miticides identified but the study did not determine that these pesticides explained the amount of sealed brood. Studies of pesticide residues in other crops have been shown to have acute effects on honey bees and their colonies,[16] including the death of individual honey bees in the colony, reduced colony growth rate,[17] loss of queen productivity and increased queen mortality,[18] including a reduction in bee cognition[19]. However, in this study it was concluded that the levels of varroa mite were the main factor affecting the health of these colonies brought to Maine to pollinate wild blueberries.

WILD BEES

Wild pollinators are on-site 'natural resources' that are known to increase blueberry production; even in the presence of high densities of honey bees, having more wild bees will increase blueberry yield. Wild bees are present in and around fields all year, either as adults that can be seen flying and foraging; or as eggs, larvae, and pupae that are less visible but nonetheless present in nests in the ground, in twigs, and in cavities. In fact, many ground-nesting bees construct their nests on crop edges or in fields.

In the native range of wild blueberry (in Canada, from Manitoba east to Newfoundland), the diversity of wild bee species includes specialists on *Vaccinium* species (blueberry and related berries) such as mining bees, orchard bees, and bumble bees. Drummond[5] has identified 59 species of wild pollinators that have contributed to the pollination of wild blueberries in Maine. The relative contributions of these different groups to blueberry pollination are still unknown, though work by Javorek, MacKenzie, & Kloet[10] has shown significant differences among various species of wild bees visiting wild blueberry in Nova Scotia, with highest effectiveness in pollen deposition by mining bees (*Andrena*) and bumble bees (*Bombus*). Field size, proximity to other wild blueberry fields, and surrounding habitat such as forest all affect which pollinators are present. A Canadian Pollination Initiative (CANPOLIN) study in the Maritime provinces found that most of the pollination services in smaller wild blueberry fields were provided by wild bees. However, the numbers of these bees decline at distances further away from the forest edge because of lack of suitable nesting locations, highlighting the importance of preserving natural habitat around wild blueberry fields.

There is an increasing amount of research on the importance of wild, native bees to agricultural production and the risks pesticides pose to them. While there are documented declines of wild bees in North America,[20, 21] additional research is needed to fully understand the impacts of factors such as habitat loss, diseases, parasites, climate change, competition with managed bees, transmission of pests or pathogens from managed bees, and pesticide exposure[22–26].

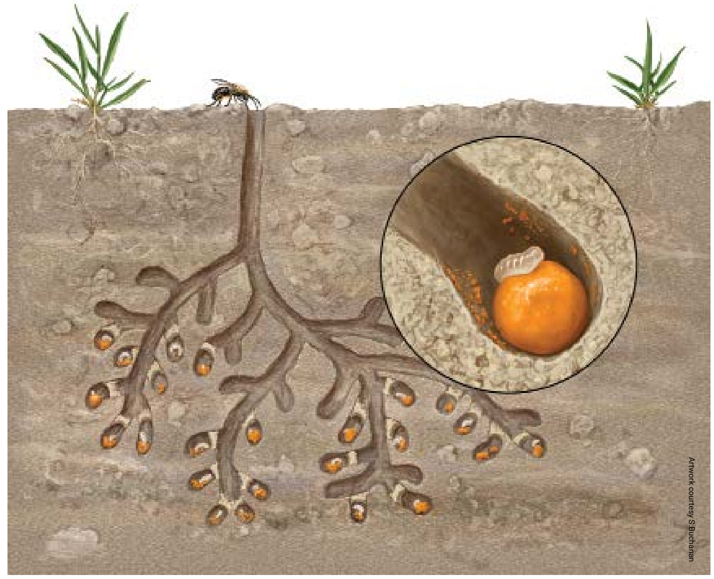
BUMBLE BEES

Bumble bees (*Bombus spp.*), like honey bees, are social insects, but they live in smaller colonies that number anywhere from 40 to 400 bees. Wild bumble bees are more abundant in fields that have natural areas nearby[27, 28]. When Maine wild blueberry producers increased their foraging force of commercial bumble bees, they achieved better fruit set comparable to stocking honey bees[29]. Bumble bees can forage in cooler weather than honey bees and most other wild bees, making them excellent pollinators of blueberries that bloom in the early spring when temperatures may be cool. **Bumble bees have the ability to "buzz" blueberry flowers to release pollen, making them more efficient per visit than honey bees**. Bumble bees can deposit about twice the amount of blueberry pollen and handle flowers 50% faster than honey bees[30].

Credit: Atlantic Tech Transfer Team for Apiculture

OTHER WILD BEES

There are several other kinds of wild bees that pollinate blueberry flowers, including sweat bees, mason bees, mining bees, and cellophane bees, but these are present in relatively small numbers compared to honey bees and bumble bees[27,28,31]. In contrast to the latter, most wild bees are solitary and only produce one or two generations per year. Some of these wild bees live in the soil, while others live in aboveground cavities and tunnels in plant stems and wood. See 'Wild pollinators of blueberry' on page 12 for more information and photos of common wild blueberry pollinators.



Ground nesting bee tunnels

Pollination of blueberry crops by wild bee pollinators can be encouraged in a number of ways, including:

- Creating or leaving adjacent habitat which can provide nesting and floral resources for wild bees and can also support honey bee health (p. 22).
- Field edges and marginal lands can be used for habitat (pp. 20-23).
- Reducing exposure to pesticides by following label recommendations and practicing Integrated Pest Management (p.14).

WILD POLLINATORS OF BLUEBERRY

These are some native bees that you may see in or around blueberry fields. They are docile and rarely sting people, and all of the ones shown here are known to pollinate wild blueberry. Use the iNaturalist App to help identify bees.

BUMBLE BEES

(genus *Bombus)* Bumble bees are great pollinators of blueberries and other 'buzz' pollinated flowers. They live in small colonies (40-400 individuals) in the ground or above ground in cavities and can fly in cool and inclement weather. There are about 40 different types of bumble bees across Canada and while it's easy to tell a bumble bee from most other bees, it can be pretty tricky to identify individual species of bumble bee.

SWEAT BEES

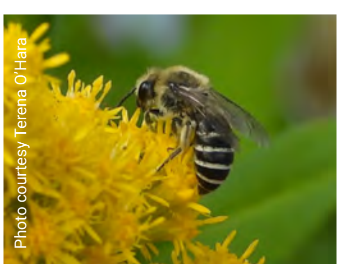
(family *Halictidae*) Sweat bees can be as tiny as 4 mm, like the one on the left, or up to about 11 mm. Some are metallic, others bright green, and some have stripes. They are good pollinators, and some can 'buzz' pollinate. They are solitary and nest in the ground. The little ones might land on a person and lick your sweat in the summer.

MASON BEES

(genus *Osmia*) Mason bees are tunnel nesters and some people put out bee boxes to give them places to nest. In nature, they nest in hollow stems or existing tunnels in trees or fallen logs. They fly early in the season and have been found to be efficient pollinators. They are small to medium sized and sometimes mistaken for flies.

MINER BEES

(family *Andrenidae*) Like the sweat bees, mining or miner bees nest in the soil. They all are solitary bees but sometimes will nest in large numbers in one area. They range in size from 7 mm to 18 mm. They can buzz pollinate and are good pollinators of blueberry. Look for them nesting within fields or in the soil, on banks or flat areas beside fields. Like all native bees, they are very docile and rarely sting people.



CELLOPHANE BEES

(family *Colletidae*) Cellophane bees are named after the cellophane-type material they use to line their nests. Most are solitary and nest in the ground, but some nest above ground.

Credit: Jeff Orr

2 PRACTICES TO PROTECT POLLINATORS

75% OF CROPS REQUIRE OR BENEFIT FROM INSECT POLLINATION

Growing crops in a productive and cost-effective manner is crucial, as is keeping pollinators healthy. Pollinators and agriculture are intimately tied together because approximately 75% of crops require or benefit from insect pollination[32]. The estimated economic benefit to Canada's agriculture industry by honey bee pollination is $7 billion[33]! Balancing the need for crop protection with pollinator health calls for employing several practices that together result in resilient and productive agricultural systems.

This guide covers four important practices that can help all stakeholders protect pollinators while maintaining production:

- Integrated pest management
- Communication between beekeepers and farmers
- Supporting pollinators through habitat
- Using pesticide products

INTEGRATED PEST MANAGEMENT (IPM)

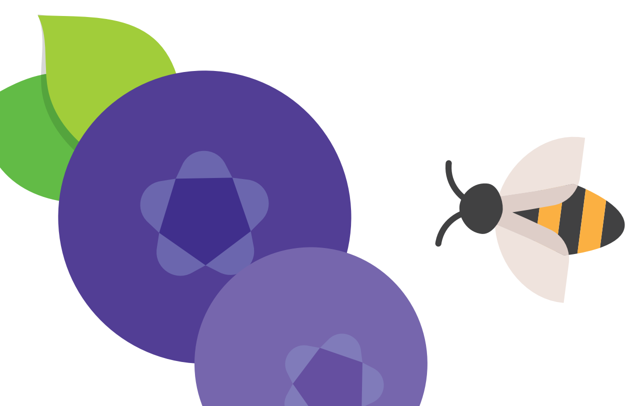
The United States Environmental Protection Agency defines Integrated Pest Management (IPM) as “an effective and environmentally sensitive approach to pest management that relies on a combination of common-sense practices. IPM programs use current, comprehensive information on the life cycles of pests and their interaction with the environment. This information, in combination with available pest control methods, is used to manage pest damage by the most economical means, and with the least possible hazard to people, property, and the environment”.

Using IPM can help producers save money and time, reduce pesticide use, reduce impacts to wild pollinators, and enhance crop pollination. IPM is a pest management strategy based on ecosystem function and long-term prevention of pest damage, and the term Integrated Pest and Pollinator Management is increasingly being used (IPPM). IPM combines techniques such as biological control, habitat manipulation, cultural practices, and the use of pesticides and pest-resistant plant varieties. Pest management materials are selected and applied in a manner that minimizes risks to human health, beneficial and nontarget organisms, and the environment[34]. For example, pesticides are used only when monitoring indicates they are needed according to established guidelines, and treatments are made with the goal of removing only the target organism. IPM plans help farmers meet their production and crop protection goals and protect pollinators, while minimizing impacts to the environment.

IPM PRINCIPLES:

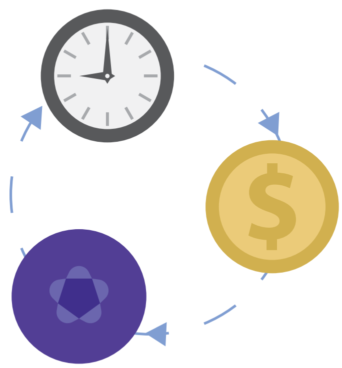
- A multi-faceted approach that combines chemical, physical, biological, and cultural pest control methods.
- Prevention of infestations.
- Monitoring and identifying pests at frequent intervals throughout the growing season.
- Decision-making based on monitoring and thresholds.
- Selection of pest control products that are the least toxic to non-target, beneficial insects.
- On-going evaluation and improvement of management strategies.

Careful consideration of pollinator health should be taken in each of these steps to support pollinators without limiting the effectiveness of pest management.



Credit: Wild Blueberry Producers Association of Nova Scotia

IPM strategies sometimes require more initial thought and investment, but they have large and long-term payoffs that include cost savings from using fewer inputs, less crop damage from a reduced need for equipment in fields, and better yields from healthier and larger pollinator and beneficial insect populations. Growers can learn about IPM and implement IPM strategies themselves, or contract with local IPM or tech transfer specialists. A recent initiative that will be explained below in the case studies adds pollinator management to IPM, emphasizing the need to consider pollinators within pest management plans.



AN IPM CONSULTANT CAN HELP YOU SAVE MONEY AND TIME, REDUCE PESTICIDE USE, REDUCE IMPACTS TO WILD POLLINATORS, AND ENHANCE CROP POLLINATION.

A study conducted with almond growers in California found that crop consultants who were independent from affiliation with chemical sellers communicated more frequently with growers than did those working for chemical sellers. This study also concluded that growers who used independent services felt more knowledgeable about IPM. They used more sophisticated pest monitoring and management strategies than those who relied on information from chemical sellers[35].

Learn more about IPM from the resources listed on page 40 and see https://extension.umaine.edu/blueberries/2009-ipm-tactics-to-reduce-pesticide-exposure-to-honey-and-native-bees/
Honey bee diseases and pests (3rd ed.) available here: https://capabees.com/capa-honey-bee-diseases-and-pests-3rd-edition/

CASE STUDY
WYMAN'S CANADA

FOCUS ON INTEGRATED PEST POLLINATOR MANAGEMENT (IPPM)

Case study written by Bruce Hall, adapted by Lora Morandin

Wyman's is one of North America's largest growers and processors of wild blueberries. Wyman's has recognized that wild blueberry agroecosystems are home to over 200 native bee species, which is a testament that agriculture and pollinators can thrive together. They believe that cultivating a healthy, robust, and thriving environment for pollinators is essential to a productive crop and sustainable pollination services. To support this, Wyman's began implementing an Integrated Pest and Pollinator Management (IPPM) program in 2017.

As part of their IPPM program, Wyman's has set a goal of protecting and enhancing the rich native bee ecosystem surrounding their wild blueberry fields and have implemented a strategy to protect 15% of the habitat surrounding their fields. They are focused on increasing the richness and abundance of native pollinators by building and preserving pollinator habitat. They also have found that there is a spin-off benefit with the habitat increasing the resilience of managed bees by providing more diverse food, helping improve honey bee health and increase hive strength. They have noted that higher plant diversity supports higher bee diversity, and reduces production variability. Wyman's created pollinator habitat management plans to enhance pollinator diversity and health, providing diverse floral resources across all seasons. They also ensured access to water (used by managed honey bees), and diverse nesting structures for wild bees, such as dead wood, uprooted trees, and broken ground. They aim for at least three flowering plant species each season, which includes at least one shrub and forb, from early spring to late summer. Alternating mowing of habitat areas every three to five years allows for staggering floral and habitat resources. They also strive for temporal flowering divergence between habitat and production areas to attract pollinators to crop fields and away from crop fields when not needed (although research in highbush blueberry indicates flowering habitat during blueberry bloom does not decrease pollinators in blueberry fields).

Wyman's IPPM program also has a focus on educating growers about applied pollinator ecology. They seek and use peer-reviewed scientific information from leading researchers worldwide and collaborate with the Center for Pollinator Research at Penn State University. They are committed to understanding how specific pesticide active ingredients affect pollinators, including short and long term, topical and ingested, neuro-growth regulation, and systemic affects. This helps managers assess the potential unintended consequences of current practices. They also seek to understand how the combined effect of pesticides applied by beekeepers and producers may impact pollinator health.

Part of Wyman's IPPM strategy focuses on effective communication between producers and beekeepers, recognizing that together they are responsible for reducing risk to commercial pollinators. An important part of this is sharing colony and crop management plans to ensure that both growers and beekeepers are aware of any pesticides applied to colonies or crops within 14 days of colony arrival to production fields. Wyman's also has developed, articulated, and ensured understanding of crop and habitat management plans across all operations members, including contractors. They use precision application equipment and technology such as automatic nozzle shutoff, drift-reducing nozzles, and automatic boom adjustment height to ensure pesticide applications hit only the target. Wyman's IPPM strategy aims to be sensitive to the impact of all its management practices on pollinators across the entirety of the two-year wild blueberry production cycle.


Credit: Wyman's Canada

CASE STUDY

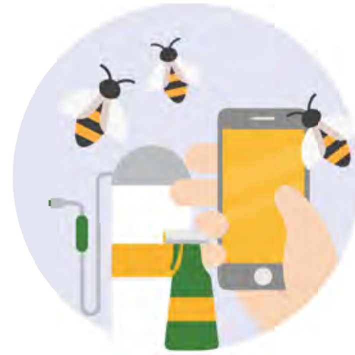
BABINEAU FARMS PARRSBORO, NS

FOCUS ON INTEGRATED PEST POLLINATOR MANAGEMENT (IPPM)

In 2018, Louis Babineau started planting pollinator plants along the edge of several of his wild blueberry fields to encourage wild pollinators. He began with bird's foot trefoil, then tried buckwheat, and currently is experiencing success with phacelia. He seeds three successive plantings beginning in early June with the last in the end of July. It takes about five weeks for phacelia to flower and he times it so that the bloom will occur after the wild blueberry bloom. This is so that the phacelia bloom does not compete with the blueberry bloom (although research shows that habitat areas contribute pollinators rather than pulling them away from blueberry bloom[38]) and, to help encourage the wild pollinators to stay and nest in the areas close to his fields after wild blueberry pollination. On one of his fields that is surrounded by woods, he pushed back the field about thirty feet from the field edge and excavated the strip for blueberry production. Instead of burning the brush piles, which is a common practice, he left them for nesting habitat for pollinators. Louis notes that during full bloom of the phacelia, he can stand most anywhere and count a dozen bumble bees. He has also begun experimenting with planting pollinator mixes available from local seed companies and he is finding this is attracting many wild pollinators as well. While he does not have conclusive proof of the impact of these practices on his overall wild blueberry yield, he is confident that his actions are providing an attractive habitat for wild pollinators. More research needs to be done to assess the impact of practices such as these on creating ecologically friendly and safe habitat for both wild and managed bees and to attempt to measure the affect these bee friendly flowers may have on pollinator health.

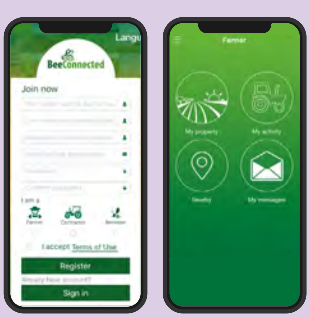
MAINTAINING CLEAR COMMUNICATIONS

Communication and cooperation between beekeepers and growers is the most effective way to reduce honey bee poisoning from exposure to pesticides and cannot be overstated. Both beekeepers and growers benefit from developing positive working relationships and familiarizing themselves with each other's management practices. Although the reasons for poor health in colonies after wild blueberry pollination are complex, open communication and coordination between beekeepers and blueberry growers can greatly reduce the risks to honey bees from pesticides.



DISCUSSIONS AND CONTRACTS BETWEEN GROWERS 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 grower'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 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 neighbouring growers and applicators of apiary locations.
- A description of possible pesticide use in adjacent crops.
- A diagram showing the location of honey bee colonies.



The BeeConnected app is an open platform between growers, beekeepers, and applicators for discussion and planning for bee protection in farmlands.

http://www.beeconnected.ca/

SUPPORTING POLLINATORS THROUGH HABITAT

Credit: Atlantic Tech Transfer Team for Apiculture

Maintaining or creating habitat around wild blueberry fields can go a long way toward supporting healthy honey bees, increasing the abundance of wild bees, and their resilience to other stressors[36]. There is now an abundance of evidence that leaving non-invasive weeds, wildflowers, and other habitat patches around pollinator-dependent crops such as wild blueberry increases pollination and crop production[37-40].

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 bee health by providing a diversity of pollen sources. Additionally, these areas support and attract wild bee populations rather than taking them away from the crops[14,38,41]. Research on honey bee behaviour indicates that 35% of the worker bees in a colony are nectar foragers and not seeking pollen. These nectar foragers are the bees which will be attracted to wild blueberry bloom and be responsible for pollination.

Having habitat to support honey bees and wild bees can be as simple as reducing unnecessary vegetation control. As such, it can involve no extra work and even some labour savings. Some considerations for producers:

- Delay flail or bush mowing areas surrounding blueberry fields until after pollination and after wildflowers have bloomed to increase forage for pollinator friendly species.
- Preserving and enhancing wildflower diversity in field margins adjacent to wild blueberry fields can lead to more yield due to the enhanced pollination from wild bees and healthier honey bees.
- Since the majority of wild blueberry fields are in wilderness areas, they are also surrounded by areas that can easily be kept as habitat for beneficial insects rather than cultivating these sections.

Enhancing and creating pollinator habitat can also help attract and sustain pollinator populations on your fields and enhance your crop yield through improved pollination:

- On fields that border cultivated land, growers can create floral strips or hedgerows, which can take little or no land out of production, on field edges.

Ideal habitat for bees includes the following elements, but 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, or ornamental plants) that bloom early in the season to support blueberry pollinators.
- Flowering plants that, in combination, bloom from early spring to fall to support honey bees and wild bees such as bumble bees that need forage from spring to fall.
- Undisturbed soil, piles of debris such as sticks, dead leaves or compost, standing plant material, old logs, etc., which provide nesting sites for ground nesting, twig (tunnel) nesting, and cavity nesting bees.
- Protection from pesticide application and drift through pesticide-free buffers and thoughtful management.
- Swamp and wetlands that provide natural water sources and habitat for nesting will support both managed and wild pollinators.

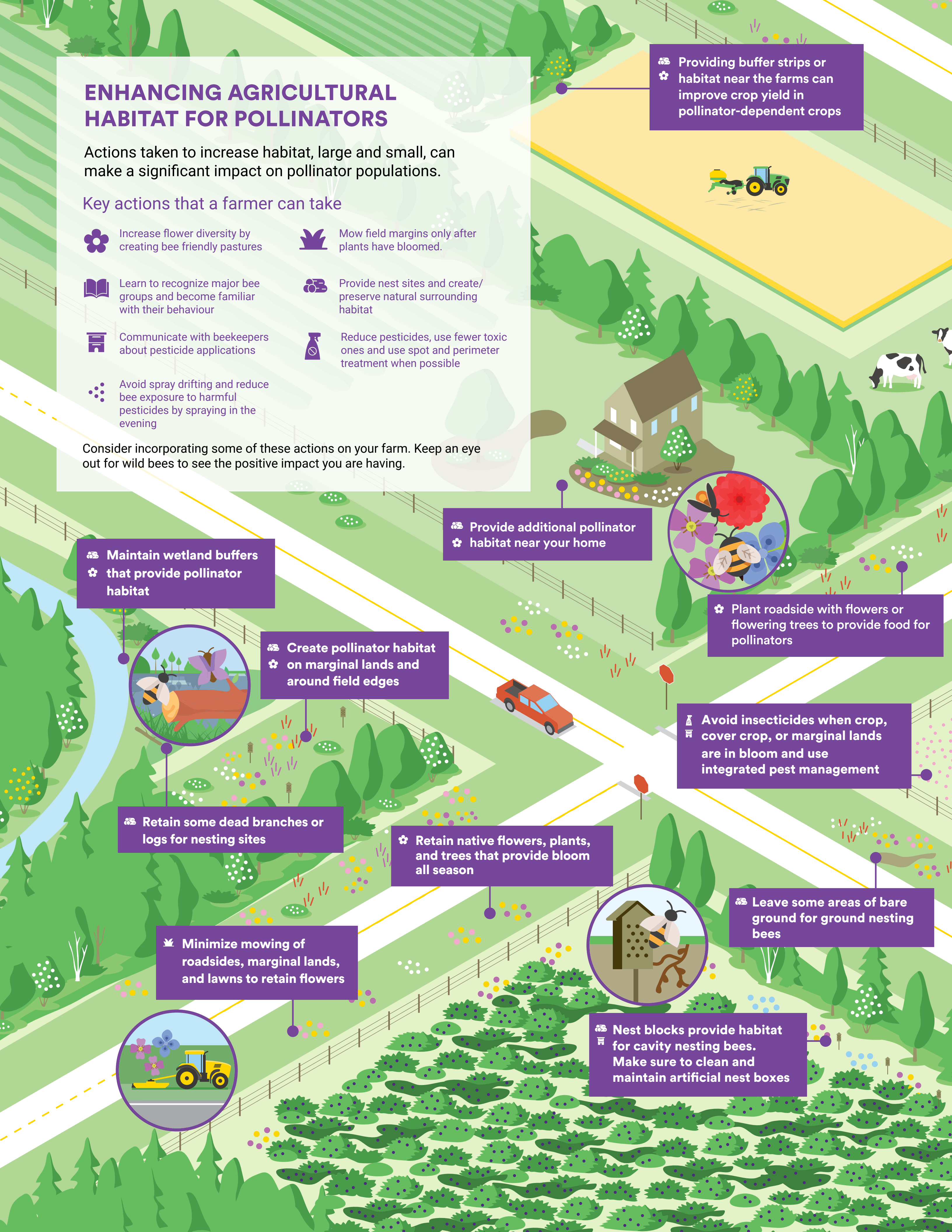
ENHANCING AGRICULTURAL HABITAT FOR POLLINATORS

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 by creating bee friendly pastures
- Mow field margins only after plants have bloomed.
- Learn to recognize major bee groups and become familiar with their behaviour
- Provide nest sites and create/ preserve natural surrounding habitat
- Communicate with beekeepers about pesticide applications
- Reduce pesticides, use fewer toxic ones and use spot and perimeter treatment when possible
- Avoid spray drifting and reduce bee exposure to harmful pesticides by spraying in the evening

Consider incorporating some of these actions on your farm. Keep an eye out for wild bees to see the positive impact you are having.



Unmowed areas provide habitat for managed and wild bees. Placing hives slightly away from the crop helps protect them from pesticides. *See page 24 Using Pesticide Products for more information.*

Preserving and creating habitat for bees is an achievable goal for large- and small-scale wild blueberry growers. Small actions taken by many growers and landowners can add up to large benefits for the agricultural community.

There are many other beneficial insects in and around blueberry fields. Minimizing use of pesticides and providing habitat will also help protect these biocontrol insects, possibly reducing future pest outbreaks. See https://fieldguide.bcblueberry.com/beneficial-insects/

Visit www.pollinatorpartnership.ca for the Ecoregional Pollinator Planting guide for your region for more information on conserving pollinators by maintaining and enhancing habitat.

USING PESTICIDE PRODUCTS

Pesticides are an integral part of agriculture. However, there are risks to pollinators associated with their use. The following practices outline ways to minimize these risks while maintaining crop production and quality. Bees can be impacted lethally or sublethally by exposure to pesticides. Health Canada's Pest Management Regulatory Agency (PMRA) uses a risk assessment framework to help eliminate unacceptable risks from pesticides. To learn more about this framework, see the supplemental document.

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 blueberry pollination, pollination of other crops, and natural ecosystems.

POTENTIAL PESTICIDE IMPACTS ON BEES

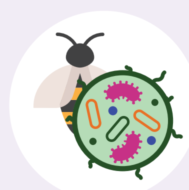
Bees can be impacted lethally or sublethally by pesticides. For more information, see Recognizing and Reporting a Bee Poisoning in the Resources section on p.35.

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

SELECTING LEAST TOXIC PESTICIDE PRODUCTS

Bee poisonings are related to both exposure and to the toxicity of a pesticide. The term, 'Pesticide' refers to all substances that are meant to control pests, including insecticides, fungicides, 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 or nectar of the crop where bees can be exposed to them, or are sprayed on the crop during bloom when the bees are present. Managed bees are potentially exposed to pesticides through many of these routes. Bees foraging on wild blueberry bloom can be directly exposed to insecticide and fungicide sprays or can be exposed indirectly through ingested pollen and nectar in the colony. Bees can also be exposed to chemicals in wax. Insecticides are generally more toxic to insects than other types of pesticides because they are formulated to kill insects. Fungicides can also present risks.

Some fungicides have been shown to increase honey bee larval mortality and create developmental deformations[42]. Boscalid, a common fungicide used to suppress botrytis blight has been shown to lead to cumulative toxicity in adult honey bees[43]. Fungicides are a necessary component of wild blueberry production (see below).

Some of the active ingredients in the following chemical families used in wild blueberry crops have residual toxicity longer than 8 hours:

- Organophosphates such as malathion
- Pyrethroids
- N-methyl carbamates such as carbaryl
- Neonicotinoids such as imidacloprid and thiamethoxam.

Growers can compare the toxicity of pesticides, especially insecticides and fungicides by using the tables in the supplemental document and choose those that are least toxic to bees while still being effective against target pests. Use Table 2: Pesticide toxicity to help you choose the lowest risk products. However, it is also important to use pesticides with different modes of action to avoid developing pest resistance, which means that only using the lowest toxicity product may not always be recommended. See Section 3: Action Guide (pp. 30-34) for resources on mode of action.

At the same time, herbicides can also be useful and necessary for the creation and management of pollinator habitat and for the elimination of weeds that will otherwise lead to reduced yields.

INSECTICIDES

Insecticides are designed to kill insects and therefore present a potentially higher risk to managed and wild bees than other pesticides. Insecticides are considered a major factor contributing to wild blueberry productivity, especially for control of the blueberry fruit fly and spotted wing drosophila, yet they can be toxic to humans and/or animals and accumulate in the environment. Use of insecticides within an Integrated Pest Management framework (p.14) and following label directions for application to wild blueberry will help minimize risk to bees and other beneficial insects.

HERBICIDES

Herbicides target unwanted plants by interrupting or modifying a biological process specific to plants. For that reason, they are generally considered to have negligible direct effects on bees. Wide use of broad-spectrum herbicides removes undesired weeds and flowers from wild blueberry fields; however, reduction of non-crop floral resources also reduces potentially important nectar and pollen sources for bees.

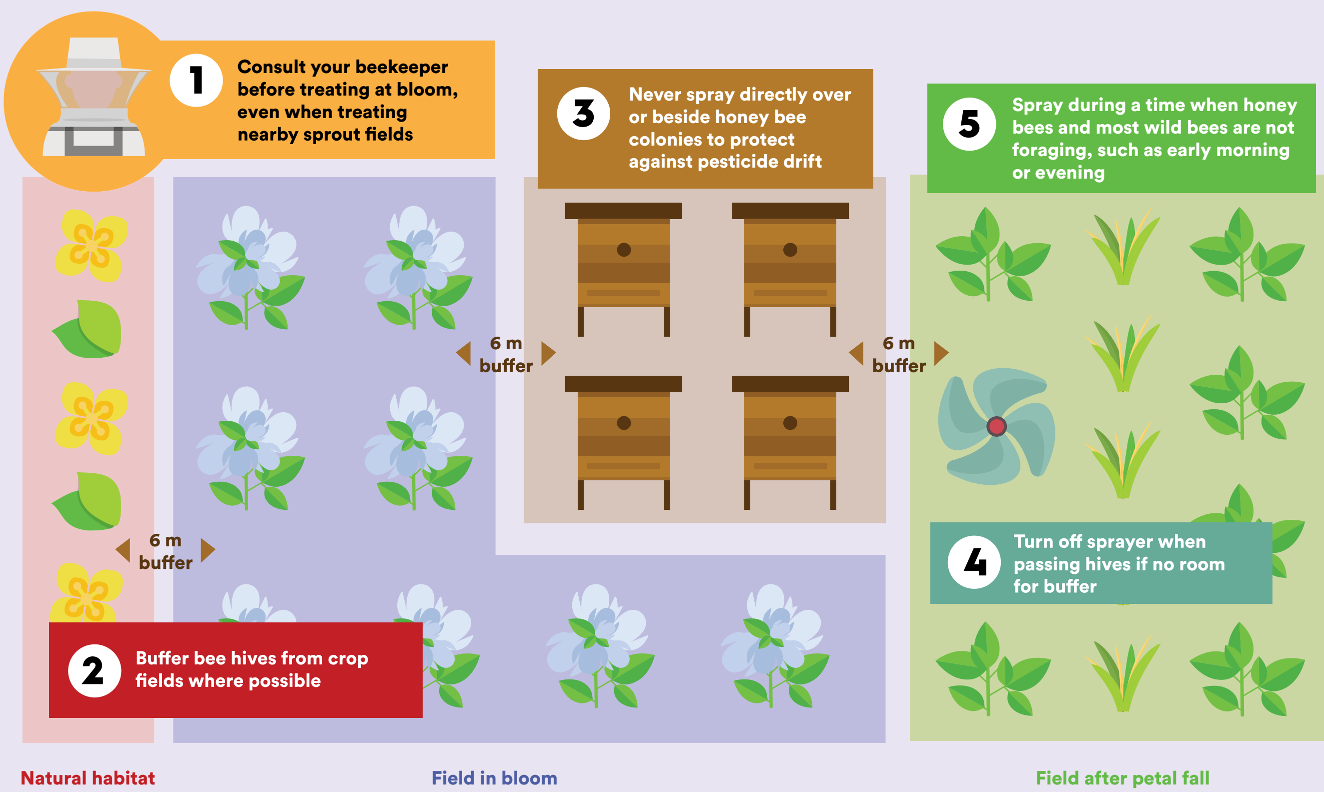
FUNGICIDES

Fungicides are necessary for wild blueberry production to prevent the development of leaf diseases during the sprout year and for controlling fruit rot diseases, such as monilinia, in the bud stage and botrytis blight when wet weather coincides with bloom. However, there is evidence that some fungicides can negatively impact bees on their own and in synergy with insecticides[44,46]. Following label directions, avoiding applying fungicides directly on or near honey bee colonies, and applying them when bees are not active, can help safeguard bee health.

SYNERGIES

Some products can have synergistic effects in the field; that is, they are more toxic in combination than individually. For example, the fungicides that use the active ingredients myclobutanil and propiconazole have each been found to synergize with some pyrethroids and neonicotinoids[45,47,48].

WAYS TO PROTECT BEES FROM PESTICIDE APPLICATION



Best management practices beekeepers and growers can use to reduce bee exposure to pesticides by creating buffers between treated fields, colonies, and bee forage areas. Diagram adapted from Iris Kormann, Oregon State University.

FOLLOW LABEL DIRECTIONS

Product registration, toxicity testing, and product regulation are in place to protect honey bees and other pollinators from the negative effects of pesticides. Pesticide labels are legal documents, and it is illegal to use a pesticide in any way other than for the purpose and in the manner stated on the label. Applying too much of one pesticide or applying it outside of label use because of inattention to label details could cost the grower more money and could increase risk of the product to visiting bees.

For the most current information on label restrictions, use the PMRA online label search or download the PMRA pesticide label app

Provincial information about pesticide toxicity is available from the following sources that are updated annually:
https://www.perennia.ca/?s=WILD+BLUEBERRY+MANAGEMENT+SCHEDULE+
https://www2.gnb.ca/content/dam/gnb/Departments/10/pdf/Agriculture/WildBlueberries-BleuetsSauvages/C161-E.pdf

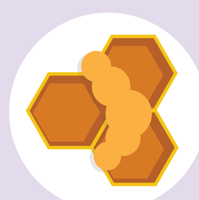
- The Environmental Precautions/Hazards section of the pesticide label contains information designed to protect bees.
- Review the entire label for precautionary and advisory statements. Look for “toxic to bees”.
- Crop-specific precautions may also be listed on the label.
- Although the bee precautions are based mainly on toxicity to honey bees, they are also relevant to other species of bees. Where differences in toxicity to other bee species are known, they are noted in Table 2 in the supplemental document.
- Residual toxicity to bees varies greatly between insecticides. When using insecticides with extended residual toxicity it is imperative that applicators carefully consider potential exposures to wild and managed bees and avoid applying insecticides to blooming plants (crops or weeds).
- Growers and other pesticide applicators are required to follow label restrictions. More PMRA information on pollinator protection can be found at: www.canada.ca/pollinators

ROUTES OF PESTICIDE EXPOSURE TO BEES


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.

Mow areas adjacent to wild blueberry fields to remove blooming flowers before applying pesticides that are toxic to bees.

Bee poisonings from exposure to pesticides can occur when:

- Beekeepers and growers do not adequately communicate.
- Pesticides are applied when bees are actively foraging.
- Pesticides are applied to the blueberry crops or weeds in the field or field margins during bloom.
- Pesticides are applied to other blooming plants in fields, field margins, or neighboring fields or to nearby sprout fields.
- Pesticides drift onto blooming plants adjacent to the blueberry crop.
- Systemic insecticides (like neonicotinoids) can be translocated into the nectar and pollen of non-crop flowering plants because of their movement through soil and water.
- Bees collect insecticide-contaminated nesting materials, such as leaf pieces collected by wild solitary bees.
- Honey bees collect insecticide-contaminated water in standing water near treated fields.
- Ground nesting or overwintering bees can be exposed through soil contaminated with pesticide[49].


Credit: Ben Cornect

REDUCING BEE EXPOSURE TO PESTICIDES

When using pesticides, in addition to following label directions and maintaining clear communications with beekeepers and other stakeholders (see p.19), other ways of minimizing managed and wild bee exposure include:

- Ensure that pesticide drift is minimized to reduce contact with adjacent habitat.
- Avoid applying pesticides during warm evenings when honey bees are clustered on the outside of their hives.
- Avoid applying pesticides (especially insecticides) to any blooming flowers including weeds; bees will be using these resources.
- Be aware that any pesticides applied to crops at any time of the year can be absorbed in soil, potentially impacting ground nesting bees or taken up by non-crop plants that bees forage on.
- Look for bees on crops, and for ground nests of solitary bees (e.g. long-horned bees, sweat bees, and mining bees) and bumble bees. Protect nest areas from insecticide spray.

Notes may be found in Table 2 of the supplemental document if it is currently known that greater precautions are needed for bumble bees or solitary bees than for honey bees.

Credit: Wild Blueberry Producers Association of Nova Scotia

3 ACTION GUIDE

GROWERS AND PESTICIDE APPLICATORS

COMMUNICATION

- Write and agree to a contract that defines expectations and responsibilities between beekeeper and grower, including protocol for suspected pesticide incidents involving pollinators.
- Share information about how to report bee pesticide poisoning.
- Establish a chain of communication between all parties, including crop consultants and pesticide applicators.
- Outline a pest management plan that specifies which products may be used during bloom and methods to protect bees during application.
- Give 48 hours notice to beekeepers when applications are necessary so that safety measures to protect the hives can be taken.

HIVE LOCATION

- When placing hives on your fields, where possible, provide a safe location that is out of the range of pesticide applications, including no-spray buffers.
- Be aware that there likely are more honey bee colonies than those you are currently aware of in any area because they have a foraging range of up to five kilometers.
- Check with your provincial beekeeper's association and/or any known local beekeepers and farmers for hives that might be in your area and use the BeeConnected app http://www.beeconnected.ca/

PRODUCT SELECTION AND USE

- Always read and follow pesticide label directions.
- Select pesticides that have the lowest pollinator precaution levels using Table 2 in the supplemental document. Provincial pesticides guides also have charts indicating the level of toxicity of each pesticide to bees, and these guides can be a helpful source for determining pesticide choices.
- Be careful to only apply pesticides to target crops and avoid spray drift onto hives, other blooming crops, or flowering weeds nearby. Note whether the pesticide has a bee caution on the label. 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, ditches, or wetlands), when making turns, and at the ends of fields.
- Do not spray in windy conditions to minimize drift.
- Never spray crop products onto hives, including low toxicity products such as herbicides and fungicides.
- Only apply pesticides with residual toxicity when bees are inactive or not present. Bees generally forage during daylight hours and when temperatures exceed 13°C for some wild bees and 15°C for honey bees. **When abnormally high temperatures result in foraging activity earlier or later in the day than normal, adjust application times accordingly to avoid bee exposure.**

PLANNING AND SCHEDULING

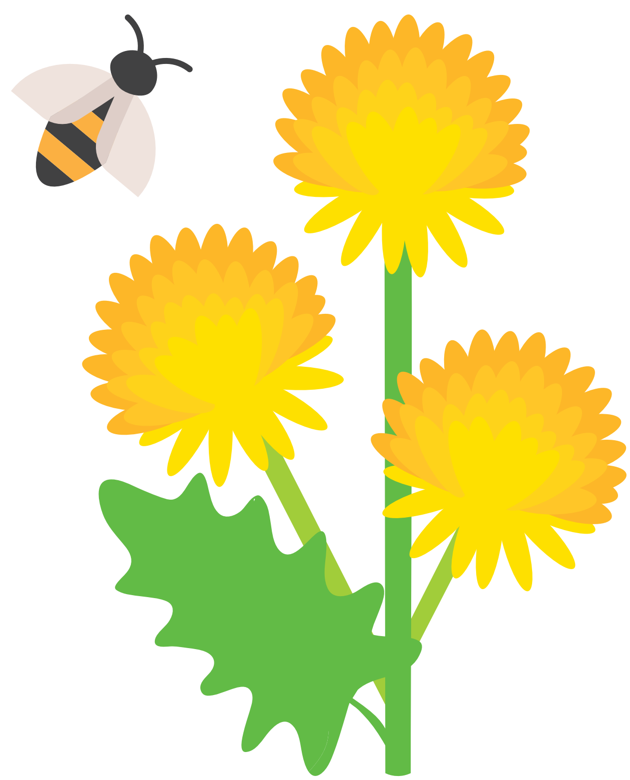
- Learn the pollination requirements of your wild blueberry crops and when they are attractive to bees. Plan your pesticide applications to occur well before and after bloom, when hives are not on location, and managed and wild bees are not active on the crop.
- Avoid spraying fields when bees are foraging during daylight hours, or when crops are in bloom.
- Keep track of weather patterns, including wind, precipitation, humidity, and daily temperatures to avoid any unintentional pesticide drift to nearby bee foraging areas.

CONSIDERATIONS

- Consider non-chemical pest control, such as beneficial insects, natural control products and other cultural practices, for long-term control of insect pests. Use insecticides with low to moderate toxicity when possible. It is important to be aware that some natural/organic products are also toxic to bees such as spinosad; natural is not always safer. Details of Integrated Pest Management (IPM) practices can be found at https://ipmcouncilcanada.org/ and https://agriculture.canada.ca/en/science/agriculture-and-agri-food-research-centres/pest-management-centre/pesticide-risk-reduction-pest-management-centre/integrated-pest-management-projects
- Plant habitat in areas near your fields for honey bees, other pollinators, and other beneficial insects such as is done by Operation Pollinator (https://www.syngenta.ca/commitments/operation-pollinator/), and Bees Matter (http://www.beesmatter.ca/), or build your own bee habitat using Pollinator Partnership's Ecoregional Planting Guides or the Canadian Honey Bee Forage Guide (https://www. pollinatorpartnership.ca/).

PEST AND WEED CONTROL

- Scout for pest insects and use economic thresholds for treatment decisions; you can learn the pests and beneficial insects and treatment thresholds yourself or hire an integrated pest management (IPM) consultant that can help you make decisions for pesticide, selection, applications, and timing by reducing unnecessary pesticide application. This can help save you time and money. Killing harmful insects on sprout and crop fields may unintentionally kill many more beneficial pollinators that outweighs the potential gain.
- Controlling as many weeds as possible that would otherwise flower within fields where you are applying insecticides minimizes the long residual toxicity to both wild and managed bees. Remember that managed bees will often fly several kilometers from their hives to find nectar and pollen.



BEEKEEPERS

COMMUNICATION AND REGISTRATION

- Write and agree to a contract that defines expectations and responsibilities between beekeeper and grower, including protocol and contact information for suspected pesticide poisoning incidents involving pollinators.
- Do not leave unmarked colonies near fields. Post your beekeeper’s bee code on apiaries, large enough to be read at a distance. Provincial apiarists can assist wild blueberry growers with contacting beekeepers to match them with their provincial bee codes.
- It is mandatory for beekeepers to register colonies with their Provincial bee inspectors in most provinces. You can notify pesticide applicators of the location of your apiaries using the BeeConnected app http://www.beeconnected.ca/.
- Communicate clearly to the grower and/or their pesticide applicator where your colonies are located, when they will arrive, and when you will remove them.
- Ask the grower what pesticides, if any, will be applied while bees are in the field, when they will be applied, and whether the label includes precautionary statements for bees. Ask them if they are familiar with strategies to minimize pesticide exposure to honeybees and if they are not, share this publication with them. Ask them to contact you if they decide on applying any new pesticides.
- Request 48 hours notice from growers when applications are necessary so that safety measures to protect the hives can be taken.

PEST MANAGEMENT

- Learn about pest problems and management programs to develop mutually beneficial agreements with growers concerning pollination services and prudent use of insecticides. Keep up to date with all major wild blueberry crop pests and treatment options for your province.
- Miticides, such as those used in hives for varroa control, are pesticides too. Use care when managing pests in and around bee hives, apiaries, and beekeeping storage facilities. Use pesticides for their intended use and follow all label directions carefully. Replace brood comb in every colony on a five-year rotation to reduce exposure to residual miticides.

Credit: Jeff Orr

Place hives at least 6 m away from the crop with a no spray buffer, rather than directly adjacent to the crop, if possible.

Credit: Jeff Orr

PROTECTING HONEY BEES FROM EXPOSURE

- When growers indicate their intention to spray pesticides during bloom, work with them to find a location for beehives that is not directly on the crop, encouraging no-spray buffers.
- Never leave bees on fields when being treated with insecticides that are highly toxic to bees. If it is not feasible to move your colonies prior to a fungicide application, protect honey bee colonies by covering them with wet cloth the night before a crop is treated. Keep these covers wet and in place for as long as feasible (depending on residual toxicity of pesticide) to protect bees.
- Do not return colonies to fields treated with insecticides that are highly toxic to bees until at least 48 to 72 hours after application. Bee deaths are most likely to occur during the first 24 hours following application. Pesticide labels also have directions on them identifying the time to re-entry into fields for humans and some of them also have directions for introduction of pollinators.
- Isolate apiaries from intensive insecticide applications and protect them from chemical drift. Establish holding yards for honey bee colonies at least 5 kms from crops being treated with insecticides that are highly toxic to bees.
- Place colonies on higher ground rather than in depressions because insecticides drift down into low-lying areas and flow with morning wind currents. Inversion conditions are particularly hazardous.
- Verify that a clean source of water is available for bees, and if there is not one available, provide one.
- Feed bees when nectar is scarce to prevent long-distance foraging to treated crops.
- In pesticide risk-prone areas, inspect bees often to recognize problems early.

RESOURCES

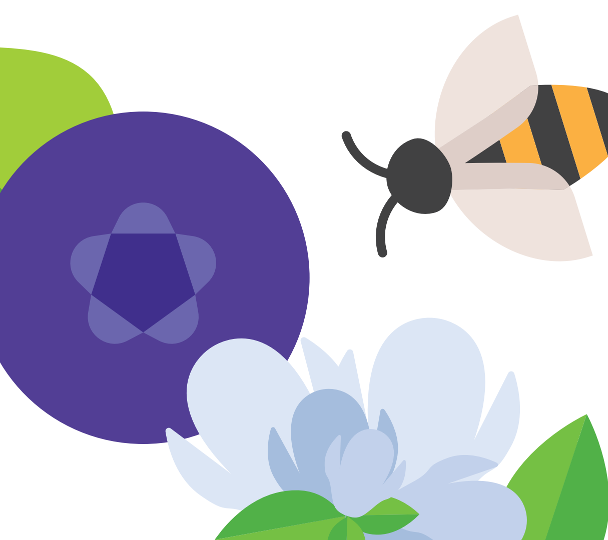
RECOGNIZING AND REPORTING BEE POISONING

Because of guidelines and regulation on product use, large-scale honey bee deaths are uncommon in Canada, especially in recent years. Nevertheless, incidents where large quantities of bees are killed by pesticides do occur and suggest a misuse of a product, system, or management protocol, or a possible result of a lack of communication.

Bee poisonings can be either lethal or sublethal. An example of lethal poisoning is when pesticide drift comes into direct contact with foraging honey bees, leading to large numbers of dead workers within or around the crop, or outside the hive entrance. In contrast, sublethal exposure does not kill bees outright but rather can lead to poor bee and hive health; reduced capacity to forage, orient, and learn; and many other symptoms[50,51].

Lethal and sublethal poisonings are harder to casually observe in wild bees than in managed honey bees but are nevertheless a risk. Without a marked hive or nesting site, they can easily go unobserved. Known sublethal impacts on wild bees include reduced longevity, body mass, colony size, and reproduction; impaired learning, navigation, and development; and increased susceptibility to pest and pathogens [50,52–58].

The signs and symptoms listed below can be the result of pesticide exposure, but some can also be a result of viruses or other diseases. Careful observation of individual honey bee and colony behavior, as well as preserving samples for testing (see instructions on p.38), can help determine the underlying causes. In some cases, pesticide poisoning can be worsened when hive health is initially poor, emphasizing the importance of nutrition, water supply, and proper management practices by beekeepers to maintain the health of their colonies. Healthy colonies reduces susceptibility to pest and pathogens [47,49–55]. If you see more than one dead bee in a location, this may be an indication that there has been lethal exposure to a toxic substance.



HONEY BEE POISONING

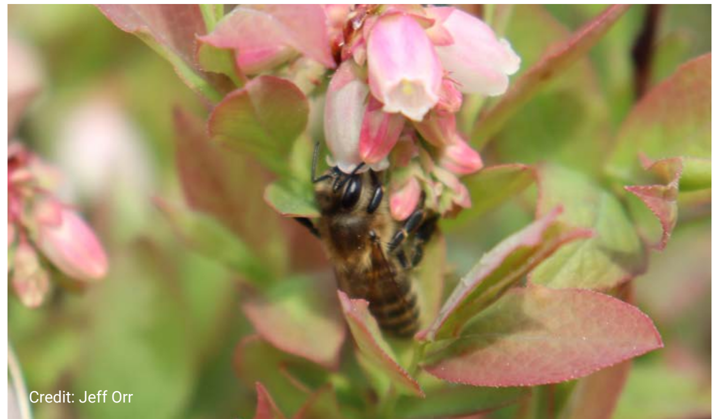
- Excessive numbers of dead and dying honey bees in front of hives.
- Severe colony imbalance, large brood size with few bees. Lack of foraging bees on normally attractive blooming crops.
- Stupefaction, paralysis, and abnormal jerky, wobbly, or rapid movements; spinning on the back.
- Forager disorientation and reduced foraging efficiency.
- Immobile, lethargic bees unable to leave flowers.
- Regurgitation of honey stomach contents and tongue extension.
- The appearance of "crawlers" (bees unable to fly). Bees move slowly as though they have been chilled.
- Dead brood, dead newly emerged workers, or abnormal queen behaviour, such as egg laying in a poor pattern.
- Queen-less hives.
- Poor queen development in colonies used to produce queens, with adult worker bees unaffected.

HONEY BEE RECOVERY FROM PESTICIDE POISONING

If a honey bee colony has lost many of its foragers but has sufficient brood and adequate stores of uncontaminated pollen and honey, it may be possible for it to recover with some intervention. Best practices include moving bees to a pesticide-free foraging area, if possible. If sufficient forage is unavailable, feed them with sugar syrup and pollen substitute, and provide clean water to aid their recovery. Protect them from extremes of heat and cold, and if needed combine weak colonies.

If pollen or nectar stores are contaminated, brood and workers may continue to die until the colony is lost. If you suspect contamination, contact your provincial apiarist who can assist you in having brood and/or wax tested at the National Bee Diagnostic Center. The Center offers chemical residue analysis services for honey bee, pollen and propolis samples through the chemistry laboratory of Agriculture and Rural Development, Government of Alberta.

Additionally, pesticides applied by beekeepers can accumulate in colonies. If there is a possibility that pesticides have transferred into the hive beeswax, consider replacing the comb with a new foundation, using comb from unaffected colonies, or shaking the bees into a new hive and destroying the old comb and woodenware. It is highly recommended that beekeepers replace all their brood comb on a regular schedule over 5 years to help reduce pesticide accumulation in brood comb wax and to manage disease accumulation in comb.



Credit: Jeff Orr

PESTICIDE POISONING IS NOT ALWAYS OBVIOUS AND MAY BE CONFUSED WITH OTHER FACTORS:

- Delayed and chronic effects, such as poor brood development, are difficult to link to specific agrochemicals, but are possible when stored pollen, nectar, or wax comb become contaminated with pesticides. Severely weakened or queenless colonies may not survive the winter.
- Viral paralysis disease, starvation, winter kill, and chilled brood can cause symptoms that may be confused with bee poisoning. Beekeepers may request a laboratory analysis of dead bees to determine the cause of an incident. Health Canada and provincial Departments of Agriculture or of the Environment (depending on the province) investigate suspected bee poisoning incidents (see p. 39 for contact information).


Credit: Jeff Orr

HOW TO REPORT A SUSPECTED BEE POISONING

If you suspect a bee poisoning incident, or have a question or concern regarding an incident, contact your provincial apiarist (see contact information on page 39). They will assist you by working with the National Bee Diagnostic Center to test for pesticide poisoning. Provide photos or videos of the incident, notes describing the previous health of the colony, prevailing winds, why you suspect the bees may have been exposed, pesticide treatments you or other applicators have applied to the hives, and any other pertinent details. If you know the brand name of the pesticide active ingredient this will be of great assistance. Growers and beekeepers should work together to compile this information.

Preserve at least 56 grams (1/4 cup) of adult bees, brood, pollen, or honey/nectar by immediately freezing in clearly labelled, clean containers, and ensure the samples stay dry and protected from light which can lead to the degradation of pesticides. This will be helpful for laboratory analysis. It is also a good idea to have a sample of the affected bees as well as a sample from an unaffected apiary. In the event of enforcement action, some provinces will need to collect their own samples. If this is the case, do not disturb the hives or site until the representative from your province 's lead office has finished collecting information.

It also is important that, if you suspect a bee poisoning incident, you communicate with nearby growers and/or beekeepers through their local associations and act quickly in order that the cause can be determined and prevented in the future.

PROVINCIAL RULES AND RESOURCES TO PROTECT POLLINATORS

The federal government is responsible for the registration of pest control products, and both federal and provincial governments play a role in regulating their sale and use. Ministries of each province provide rules intended to reduce the hazard of pesticide applications to bees, as well as guidance on bee management. The following provincial agriculture departments can assist growers and bee keepers in determining the specific regulations and policies for each province.

NEW BRUNSWICK (DEPARTMENT OF AGRICULTURE, AQUACULTURE AND FISHERIES)

https://www2.gnb.ca/content/gnb/en/departments/10/agriculture/content/bees.html

(506) 453 2108 – GENERAL INQUIRIES
(506) 470 3590 – PROVINCIAL APIARIST

NEWFOUNDLAND AND LABRADOR (DEPARTMENT OF FISHERIES, FARMING, NATURAL RESOURCES)

https://www.gov.nl.ca/ffa/programs-and-funding/programs/apiculture/

709-686-2702 EX 232 – GENERAL INQUIRIES
(709) 637 2662 – PROVINCIAL APIARIST

NOVA SCOTIA (DEPARTMENT OF AGRICULTURE)

https://novascotia.ca/agri/programs-and-services/farm-animal-welfare/

(902) 424 4560 – GENERAL INQUIRIES
(902) 956 9922 – PROVINCIAL APIARIST

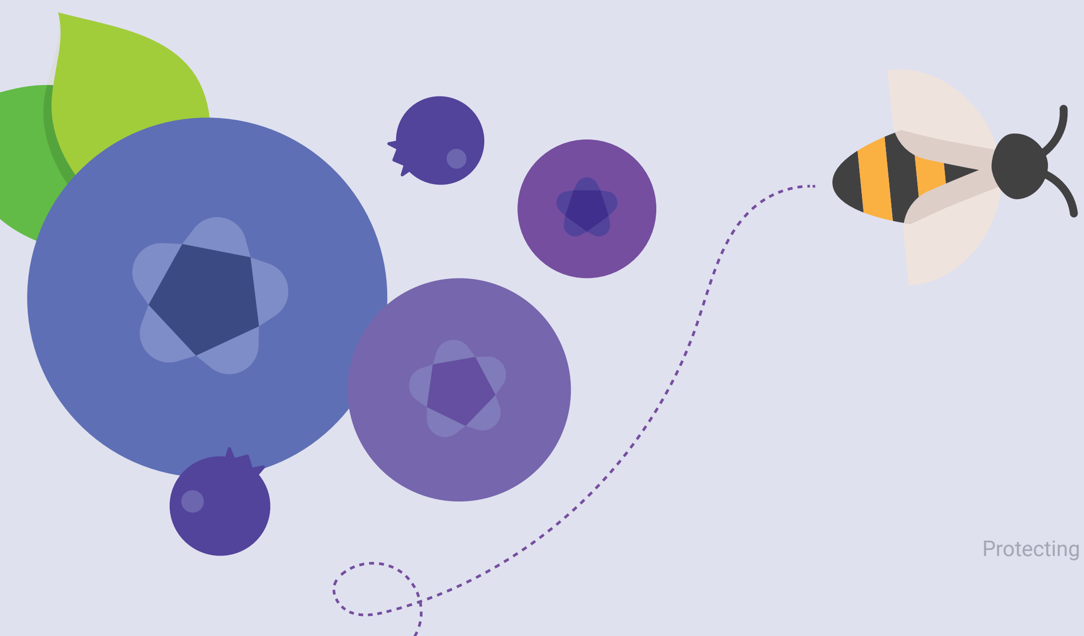
PRINCE EDWARD ISLAND (DEPARTMENT OF AGRICULTURE AND FORESTRY)

https://www.princeedwardisland.ca/sites/default/files/legislation/A%2611-1-2-Animal%20Health%20and%20Protection%20Act%20Bee%20Health%20Regulations.pdf

(902) 368 4880 – GENERAL INQUIRIES
(902) 314 0816 – PROVINCIAL APIARIST

REPORT A BEE INCIDENT TO HEALTH CANADA

Bee incidents can also be reported by contacting Health Canada's PMRA at 1-800-267-6315. If you know which product may have caused the bee poisoning, you can also notify the pesticide company, which is required by law to report adverse effects to Health Canada. See the Useful Links section below (pg. 40) for a link to report a bee incident to Health Canada.



USEFUL LINKS

UNIVERSITY OF MAINE

https://extension.umaine.edu/blueberries/integrated-pest-and-pollinator-management-ippm/

MICHIGAN STATE UNIVERSITY

https://pollinators.msu.edu/resources/pollinator-planting/native-bee-habitat/

THREE FORAGERS

https://threeforagers.com/blogs/threeforagersbeeblog/bee-species-in-canada?shpxid=7c0f0e61-a825-4379-a85c-4a822a3cd2e6

POLLINATOR PARTNERSHIP: TECHNICAL GUIDE FOR PRESERVING AND CREATING HABITAT FOR POLLINATORS ON ONTARIO'S FARMS

https://pollinatorpartnership.ca/en/land-manager-guides

CANADIAN WILDLIFE FEDERATION

https://cwf-fcf.org/en/resources/encyclopedias/fauna/explore-our-pollinators.html

WILD POLLINATOR PARTNERS ONTARIO EAST-OUTAOUAIS

https://wildpollinators-pollinisateurssauvages.ca/resources/

NATIVE POLLINATORS AND AGRICULTURE IN CANADA

https://publications.gc.ca/collections/collection_2014/aac-aafc/A59-12-2014-eng.pdf

ONTARIO BEEKEEPERS ASSOCIATION

https://www.ontariobee.com/outreach/honey-bee-pests-and-diseases#:~:text=American%20foulbrood%20(AFB)%20is%20the,kill%20a%20honey%20bee%20colony

WILD BLUEBERRY MANAGEMENT SCHEDULE

https://www.perennia.ca/wp-content/uploads/2018/06/Wild-Blueberry-Pest-Guide-2018.pdf

WILD BLUEBERRY PRODUCTION GUIDE

https://nbwildblue.ca/wp-content/uploads/Public/ResearchReports/Report_1300_QP6249_EN.pdf

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