

SUPPLEMENT

to Protecting pollinators
from pesticides

HIGHBUSH BLUEBERRY



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Funding provided by the Pest Management Regulatory Agency (PMRA),
an agency of Health Canada.

The views herein do not necessarily reflect those of the PMRA or of other contributors.

Design and layout by Claudia Yuen.
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Cite as follows:

Morandin, L.A. and K. Law. 2021. Supplement To Protecting Pollinators From Pesticides
Highbush Blueberry. Pollinator Partnership Canada

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HOW TO USE THIS DOCUMENT

This supplement to *Protecting Pollinators From Pesticides Highbush Blueberry* contains information on the pesticide regulatory process of the Pest Management Regulatory Agency (PMRA) and precautionary levels for pesticide products used in highbush blueberry in Canada. It is meant to help stakeholders make more informed decisions when using pesticide products that may impact pollinators.

Use Table 1: Formulated products and their active ingredients to identify the active ingredient(s) in a given product.

Use Table 2: Active ingredient pollinator precaution levels to see the PMRA restriction levels (most, moderately, and least restrictive) for active ingredients.

Use Table 3: Pollinator precaution levels to learn how the PMRA determines precaution levels used in Table 2.

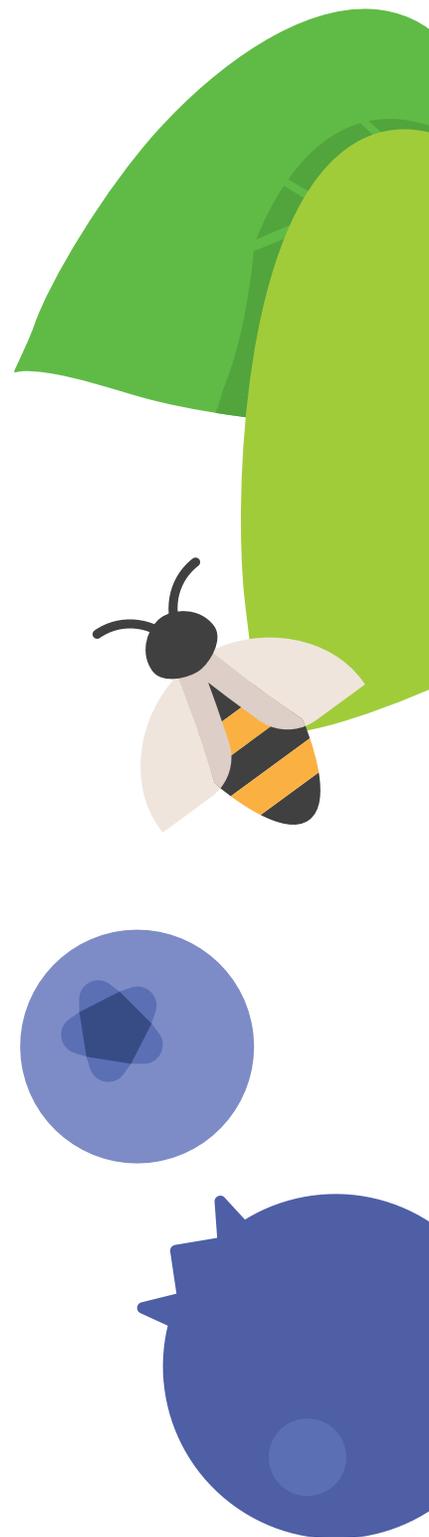
UNDERSTANDING POLLINATOR TOXICITY, EXPOSURE, AND RISK



Toxicity + **Exposure** = **Risk**

While the terms, risk and toxicity, are sometimes used interchangeably, they mean different things and should not be confused. **Toxicity** (sometimes referred to as 'hazard') of an active ingredient to bees refers to how much it will harm a bee if there is exposure. Toxicity can occur orally (ingestion) or from topical exposure, and is tested in both these ways, at different life stages, and with both single and repeated exposure on bees. **Exposure** refers to the likelihood of a pesticide coming into contact with a pollinator and the levels at which exposure may occur. Exposure considerations incorporate crop-specific information such as the attractiveness of the flowers to pollinators, time of bloom, whether managed pollinators are brought to the crop, and whether the crop is harvested before bloom. Exposure levels are estimated for different pesticide application types and rates, and may use models or actual residue levels in pollen and nectar if they are available.

It is the combination of toxicity and exposure that determine **risk** of a pesticide on a particular crop or crop group. Risk considers whether exposure is likely to occur at levels that will result in toxicity to pollinators. Risk also considers the residual toxicity, meaning how long the residues present may pose a risk to pollinators.



PMRA RISK CHARACTERIZATION FOR POLLINATORS

The Pest Management Regulatory Agency (PMRA), a part of Health Canada, is the branch of the Canadian federal government responsible for regulating pest control products under the authority of the Pest Control Products Act, including insecticides, herbicides, fungicides, and other products. The PMRA's primary mandate is to prevent unacceptable risks to Canadians and the environment from the use of these products. PMRA applies modern, evidence-based scientific approaches to assess whether the health and environmental risks of pesticides are acceptable. When there is potential exposure of bees to a crop protection product, the PMRA requires information to assess the risk to bees.

The PMRA characterizes the risk of a product (specific to formulation and application method) by using a tiered approach that assesses the information on toxicity and exposure. This tiered approach first establishes toxicity and exposure risks for honey bees at various life stages, and progresses to colony, semi-field, and field studies depending on the level of risk found in the first tier. The risk characterization also considers the risk to other bee species such as solitary bees and bumble bees. Honey bee information may be used as a surrogate for considering risk to other bee species, with information on toxicity and exposure for other bee species considered as available. Additionally, the attractiveness of crops to honey bees and other bees, and other agronomic considerations such as whether the crop is harvested before bloom, are considered. For more information, see *Guidance for Assessing Pesticides Risks to Bees*¹.

The risk characterization is used by the PMRA to determine **precaution levels** and the mitigation measures required to reduce harm to bees. Precaution levels in this document are categorized as

most restrictive, moderately restrictive, and least restrictive.

When used according to the label, the PMRA considers the risk to bees and other pollinators acceptable for pesticides registered for use in Canada. The PMRA reassesses risk as new scientific information becomes available and label precautions and registrations can change. **It is critical that users read and understand the current registrations and product label prior to use to minimize exposure and risk to pollinators.**

ASSESSING RISKS TO WILD BEES

Currently, PMRA pesticide toxicity testing requires testing only on honey bees, however studies on bumble bees, mason bees, and other species are increasingly received, reviewed, and incorporated into pollinator risk assessments for pesticides. Wild bees may be exposed to pesticides in ways different from honey bees (such as through nesting in the ground), and the toxicity effect of a pesticide can vary from one bee species to another (depending on life cycles, body size, nesting habits, etc.)². The PMRA takes into account new information on pesticide toxicity and exposure to pollinators other than honey bees as it emerges, however, it is important to note that at this time there are many unknowns around exposure and toxicity beyond honey bees.

¹ USEPA, PMRA. 2014. Guidance for assessing pesticide risks to bees. Office of Chemical Safety and Pollution Prevention Office of Pesticide Programs Environmental Fate and Effects Division, Environmental Protection Agency, Washington DC; Environmental Assessment Directorate, Pest Management Regulatory Agency, Health Canada, Ottawa, ON; California Department of Pesticide Regulation.

² Boyle, N. K., T. L. Pitts-Singer, J. Abbott, A. Alix, D. L. Cox-Foster, S. Hinarejos, D. M. Lehmann, L. Moradin, B. O'Neill, N. E. Raine, R. Singh, H. M. Thompson, N. M. Williams, and T. Steeger. 2019. Workshop on Pesticide Exposure Assessment Paradigm for Non-Apis Bees: Foundation and Summaries. *Environmental Entomology*. 48(1):4–11.

TABLE 1.

PESTICIDE PRODUCTS AND THEIR ACTIVE INGREDIENTS

Use Table 1 to look up specific products registered for use on highbush blueberry and determine their active ingredient(s). Then go to Table 2 to check the precaution level for that active ingredient. These products were registered for use in Canada in Highbush blueberry in January 2021. For the most current product registration, use the PMRA's label search.

Product Name	Active Name
Insecticide	
ACETA 70 WP	ACETAMIPRID
ACTARA 25WG INSECTICIDE	THIAMETHOXAM
ADMIRE 240 FLOWABLE SYSTEMIC INSECTICIDE	IMIDACLOPRID
ALIAS 240 SC SYSTEMIC INSECTICIDE	IMIDACLOPRID
ALTACOR INSECTICIDE	CHLORANTRANILIPROLE
AMBUSH 500EC INSECTICIDE	PERMETHRIN
ASSAIL 70 WP INSECTICIDE	ACETAMIPRID
BARTLETT SUPERIOR 70 OIL EMULSIFIABLE INSECTICIDE	MINERAL OIL
BIOPROTEC 3P DRY FLOWABLE BIOLOGICAL INSECTICIDE	BACILLUS THURINGIENSIS SUBSPECIES KURSTAKI (ALL STRAINS)
BIOPROTEC CAF	BACILLUS THURINGIENSIS SUBSPECIES KURSTAKI (ALL STRAINS)
BIOPROTEC ECO	BACILLUS THURINGIENSIS SUBSPECIES KURSTAKI (ALL STRAINS)
BIOPROTEC PLUS	BACILLUS THURINGIENSIS SUBSPECIES KURSTAKI (ALL STRAINS)
CAPTURE 240 EC	BIFENTHRIN
CONCEPT LIQUID INSECTICIDE	DELTAMETHRIN; IMIDACLOPRID
CONFIRM 240F AGRICULTURAL INSECTICIDE	TEBUFENOZIDE
CORMORAN	NOVALURON; ACETAMIPRID
CYCLANILIPROLE 50SL INSECTICIDE	CYCLANILIPROLE
CYGON 480 SYSTEMIC INSECTICIDE	DIMETHOATE
CYGON 480-AG SYSTEMIC INSECTICIDE	DIMETHOATE
DECIS 5 EC INSECTICIDE (EASTERN CANADA & BRITISH COLUMBIA)	DELTAMETHRIN
DECIS FLOWABLE INSECTICIDE (EASTERN CANADA AND B.C.)	DELTAMETHRIN
DELEGATE INSECTICIDE	SPINETORAM
DIPEL 2X DF BIOLOGICAL INSECTICIDE DRY FLOWABLE	BACILLUS THURINGIENSIS SUBSPECIES KURSTAKI (ALL STRAINS)

Product Name	Active Name
DOKTOR DOOM FORMULA 420 3-IN-1 CROP & PLANT RESCUE CONCENTRATE	CANOLA OIL
DOKTOR DOOM FORMULA 420 3-IN-1 CROP & PLANT RESCUE READY-TO-SPRAY	CANOLA OIL
DOKTOR DOOM FORMULA 420 PROFESSIONAL USE 3-IN-1 CROP & PLANT RESCUE CONCENTRATE	CANOLA OIL
DOKTOR DOOM PREMIUM 3 IN 1 CROP & PLANT RESCUE CONCENTRATE	CANOLA OIL
DOUBLE DOWN SPRAY OIL	MINERAL OIL
ENTRUST 80 INSECTICIDE	SPINOSAD
ENTRUST INSECTICIDE	SPINOSAD
ENVIDOR 240SC MITICIDE	SPIRODICLOFEN
EXIREL INSECTICIDE	CYANTRANILIPROLE
FORAY 48BA BIOLOGICAL INSECTICIDE AQUEOUS SUSPENSION	BACILLUS THURINGIENSIS SUBSPECIES KURSTAKI (ALL STRAINS)
FULFILL 50WG INSECTICIDE	PYMETROZINE
GENERAL HYDROPONICS EXILE	POTASSIUM SALTS OF FATTY ACIDS
GENERAL HYDROPONICS SUFFOCOAT	CANOLA OIL
GF-120 FRUIT FLY BAIT	SPINOSAD
GUARDSMAN DORMANT SPRAY OIL	MINERAL OIL
HARVANTA 50SL INSECTICIDE	CYCLANILIPROLE
IMIDAN 50-WP INSTAPAK	PHOSMET
IMIDAN WP INSECTICIDE	PHOSMET
INTREPID 240F INSECTICIDE	METHOXYFENOZIDE
ISOMATE DWB	(E,Z)-2,13-OCTADECADIEN-1-YL ACETATE; (E,Z)-2,13-OCTADECADIEN-1-OL; (Z,Z)-3,13-OCTADECADIEN-1-YL ACETATE; (Z,Z)-3,13-OCTADECADIEN-1-OL
KOPA INSECTICIDAL SOAP	POTASSIUM SALTS OF FATTY ACIDS
LAGON 480 E INSECTICIDE	DIMETHOATE
LIME SULPHUR INSECTICIDE MITICIDE FUNGICIDE	LIME SULPHUR OR CALCIUM POLYSULPHIDE
MAKO INSECTICIDE	CYPERMETHRIN
MALATHION 85E	MALATHION
MALATHION LIQUID INSECTICIDE-MITICIDE CONCENTRATE	MALATHION
MOVENTO 240 SC INSECTICIDE	SPIROTETRAMAT
NEUDORFF ANT AND INSECT BAIT	SPINOSAD
NEUDOSAN COMMERCIAL	POTASSIUM SALTS OF FATTY ACIDS
OPAL INSECTICIDAL SOAP	POTASSIUM SALTS OF FATTY ACIDS
PERM-UP EMULSIFIABLE CONCENTRATE INSECTICIDE	PERMETHRIN
POLECI 2.5 EC EASTERN INSECTICIDE	DELTAMETHRIN

Product Name / Insecticide Products	Active Name
POUNCE 384 EC INSECTICIDE	PERMETHRIN
PURESPRAY GREEN CONCENTRATE	MINERAL OIL
PURESPRAY GREEN SPRAY OIL 13E	MINERAL OIL
PYGANIC CROP PROTECTION EC 1.4 II	PYRETHRINS
RADIANT SC INSECTICIDE	SPINETORAM
RIMON 10 EC	NOVALURON
RIMON 10 EC INSECTICIDE	NOVALURON
RIPCORD 400EC AGRICULTURAL INSECTICIDE	CYPERMETHRIN
SCORPIO ANT AND INSECT BAIT	SPINOSAD
SEVIN XLR CARBARYL INSECTICIDE LIQUID SUSPENSION	CARBARYL
SIVANTO PRIME INSECTICIDE	FLUPYRADIFURONE
SUCCESS INSECTICIDE	SPINOSAD
SUFFOIL-X	MINERAL OIL
SUPERIOR 70 OIL	MINERAL OIL
VEGOL CROP OIL	CANOLA OIL
VEGOL INSECTICIDAL OIL	CANOLA OIL
VEGOL READY-TO-SPRAY	CANOLA OIL
VEGOL SINGLE DOSE INSECTICIDAL OIL	CANOLA OIL
Fungicides	
ACTINOVATE SP	STREPTOMYCES LYDICUS STRAIN WYEC108
ALIETTE SYSTEMIC FUNGICIDE WATER DISPERSIBLE GRANULE	FOSETYL-AL
ALIETTE WDG SYSTEMIC FUNGICIDE	FOSETYL-AL
ALLEGRO 500F AGRICULTURAL FUNGICIDE	FLUAZINAM
BOTECTOR	AUREOBASIDIUM PULLULANS DSM 14940 AND DSM 14941
BRAVO 500 AGRICULTURAL FUNGICIDE	CHLOROTHALONIL
BRAVO 720	CHLOROTHALONIL
BRAVO ULTREX	CHLOROTHALONIL
BRAVO WEATHERSTIK FUNGICIDE	CHLOROTHALONIL
BRAVO ZN AGRICULTURAL FUNGICIDE	CHLOROTHALONIL
BRAVO ZNC FUNGICIDE	CHLOROTHALONIL
BUMPER 418 EC	PROPICONAZOLE
BUMPER 432 EC	PROPICONAZOLE
CABRIO EG FUNGICIDE	PYRACLOSTROBIN
CANTUS WDG FUNGICIDE	BOSCALID
CAPTAN 50-WP FUNGICIDE	CAPTAN
CAPTAN 50-WP WETTABLE POWDER AGRICULTURAL FUNGICIDE	CAPTAN

Product Name	Active Name
CAPTAN 80 DF FUNGICIDE	CAPTAN
CAPTAN 80 WDG WATER DISPERSIBLE GRANULE	CAPTAN
CAPTAN 80 WSP FUNGICIDE	CAPTAN
CAPTAN 80-WP WETTABLE POWDER FUNGICIDE	CAPTAN
CONFINE EXTRA FUNGICIDE	MONO- AND DI-POTASSIUM SALT OF PHOSPHOROUS ACID
CO-OP PIVOT	PROPICONAZOLE
COPPER SPRAY FUNGICIDE	COPPER (PRESENT AS COPPER OXYCHLORIDE)
CUEVA COMMERCIAL	COPPER (PRESENT AS COPPER OCTANOATE)
CUEVA READY-TO-SPRAY	COPPER (PRESENT AS COPPER OCTANOATE)
CUEVA RTU	COPPER (PRESENT AS COPPER OCTANOATE)
CUEVA RTU WITH PULL'N SPRAY APPLICATOR	COPPER (PRESENT AS COPPER OCTANOATE)
CUEVA RTU WITH QUICK CONNECT SPRAYER	COPPER (PRESENT AS COPPER OCTANOATE)
CUEVA RTU WITH QUICKPUMP APPLICATOR	COPPER (PRESENT AS COPPER OCTANOATE)
CUEVA RTU WITH WAND APPLICATOR	COPPER (PRESENT AS COPPER OCTANOATE)
CYPROFLU FUNGICIDE	CYPRODINIL; FLUDIOXONIL
DIPLOMAT 5SC FUNGICIDE	POLYOXIN D ZINC SALT
DOKTOR DOOM FORMULA 420 3-IN-1 CROP & PLANT RESCUE CONCENTRATE	CANOLA OIL
DOKTOR DOOM FORMULA 420 3-IN-1 CROP & PLANT RESCUE READY-TO-SPRAY	CANOLA OIL
DOKTOR DOOM FORMULA 420 FUNGICIDE CONCENTRATE	COPPER (PRESENT AS COPPER OCTANOATE)
DOKTOR DOOM FORMULA 420 FUNGICIDE READY-TO-USE (RTU)	COPPER (PRESENT AS COPPER OCTANOATE)
DOKTOR DOOM FORMULA 420 PROFESSIONAL USE 3-IN-1 CROP & PLANT RESCUE CONCENTRATE	CANOLA OIL
DOKTOR DOOM PREMIUM 3 IN 1 CROP & PLANT RESCUE CONCENTRATE	CANOLA OIL
DOUBLE DOWN SPRAY OIL	MINERAL OIL
ECHO 720 AGRICULTURAL FUNGICIDE	CHLOROTHALONIL
ECHO 90DF AGRICULTURAL FUNGICIDE	CHLOROTHALONIL
ECHO 90WSP AGRICULTURAL FUNGICIDE	CHLOROTHALONIL
ECHO NP FUNGICIDE	CHLOROTHALONIL
FERBAM 76WDG AGRICULTURAL FUNGICIDE	FERBAM
FERBAM 76WDG FUNGICIDE	FERBAM
FITNESS FUNGICIDE	PROPICONAZOLE
FONTELIS FUNGICIDE	PENTHIOPYRAD
FUNGINEX DC FUNGICIDE	TRIFORINE
GENERAL HYDROPONICS SUFFOCOAT	CANOLA OIL

Product Name	Active Name
GUARDSMAN COPPER OXYCHLORIDE 50	COPPER (PRESENT AS COPPER OXYCHLORIDE)
HYDROWORXX DISEASE CONTROL CONCENTRATE	COPPER (PRESENT AS COPPER OCTANOATE)
INDAR FUNGICIDE	FENBUCONAZOLE
INSPIRE SUPER FUNGICIDE	CYPRODINIL; DIFENOCONAZOLE
IPCO PIVOT 418 EC	PROPICONAZOLE
JADE FUNGICIDE	PROPICONAZOLE
KENJA 400SC FUNGICIDE	ISOFETAMID
LIME SULPHUR INSECTICIDE MITICIDE FUNGICIDE	LIME SULPHUR OR CALCIUM POLYSULPHIDE
LUNA PRIVILEGE	FLUOPYRAM
LUNA TRANQUILITY FUNGICIDE	FLUOPYRAM; PYRIMETHANIL
MAESTRO 80 DF FUNGICIDE	CAPTAN
MAESTRO 80 WSP	CAPTAN
METCONAZOLE 50 WDG FUNGICIDE	METCONAZOLE
MIRACLE-GRO® GARDEN DEFENSE GARDEN DISEASE CONTROL READY-TO-USE WITH WAND APPLICATOR	COPPER (PRESENT AS COPPER OCTANOATE)
MIRACLE-GRO® GARDEN DEFENSE GARDEN DISEASE CONTROL CONCENTRATE	COPPER (PRESENT AS COPPER OCTANOATE)
MIRACLE-GRO® GARDEN DEFENSE GARDEN DISEASE CONTROL READY-TO-SPRAY	COPPER (PRESENT AS COPPER OCTANOATE)
MIRACLE-GRO® GARDEN DEFENSE GARDEN DISEASE CONTROL READY-TO-USE	COPPER (PRESENT AS COPPER OCTANOATE)
MISSION 418 EC	PROPICONAZOLE
MUSTGROW CROP BIOFUMIGANT	ORIENTAL MUSTARD SEED MEAL
NOVA FUNGICIDE	MYCLOBUTANIL
OXIDATE	HYDROGEN PEROXIDE; PEROXYACETIC ACID
OXIDATE 2.0	HYDROGEN PEROXIDE; PEROXYACETIC ACID
OXIDATE FC	HYDROGEN PEROXIDE; PEROXYACETIC ACID
PHOSTROL FUNGICIDE	MONO- AND DIBASIC SODIUM, POTASSIUM, AND AMMONIUM PHOSPHITES
POLYOXIN D ZINC SALT 5SC FUNGICIDE	POLYOXIN D ZINC SALT
PRISTINE WG FUNGICIDE	BOSCALID; PYRACLOSTROBIN
PROLINE 480 SC FOLIAR FUNGICIDE	PROTHIOCONAZOLE
PROPI EXPRESS FUNGICIDE	PROPICONAZOLE
PROPI SPEED FUNGICIDE	PROPICONAZOLE
PROPI SUPER 25 EC	PROPICONAZOLE
PROPICONAZOLE 250E FUNGICIDE	PROPICONAZOLE
PROPULSE FUNGICIDE	FLUOPYRAM; PROTHIOCONAZOLE
PROZOL FUNGICIDE	PROPICONAZOLE

Product Name	Active Name
PURESpray GREEN SPRAY OIL 13E	MINERAL OIL
QST713 LIQUID	BACILLUS SUBTILIS (STRAIN QST 713)
QUASH FUNGICIDE	METCONAZOLE
QUASH SC FUNGICIDE	METCONAZOLE
QUILT FUNGICIDE	AZOXYSTROBIN; PROPICONAZOLE
REGALIA LIQUID FUNGICIDE CONCENTRATE	EXTRACT OF REYNOUTRIA SACHALINENSIS
REGALIA LIQUID FUNGICIDE READY-TO-SPRAY	EXTRACT OF REYNOUTRIA SACHALINENSIS
REGALIA MAXX BIOFUNGICIDE LIQUID CONCENTRATE	EXTRACT OF REYNOUTRIA SACHALINENSIS
RIDOMIL GOLD 480EC FUNGICIDE	METALAXYL-M AND S-ISOMER
RIDOMIL GOLD 480SL FUNGICIDE	METALAXYL-M AND S-ISOMER
SCALA SC FUNGICIDE	PYRIMETHANIL
SERCADIS FUNGICIDE	FLUXAPYROXAD
SERENADE MAX	BACILLUS SUBTILIS (STRAIN QST 713)
SERENADE OPTI	BACILLUS SUBTILIS (STRAIN QST 713)
SHARDA CAPTAN 80 WDG	CAPTAN
SHARDA FUNGTION SC	AZOXYSTROBIN; PROPICONAZOLE
SUFFOIL-X	MINERAL OIL
SUPRA CAPTAN 80 WDG	CAPTAN
SUPRA CAPTAN 80 WSP	CAPTAN
SWITCH 62.5 WG FUNGICIDE	CYPRODINIL; FLUDIOXONIL
TAEGRO 2	BACILLUS SUBTILIS VAR. AMYLOLIQUEFACIENS STRAIN FZB24
TILT 250E FUNGICIDE	PROPICONAZOLE
TIMOREX GOLD	TEA TREE OIL
TOPAS FUNGICIDE	PROPICONAZOLE
VEGOL CROP OIL	CANOLA OIL
VEGOL INSECTICIDAL OIL	CANOLA OIL
VEGOL READY-TO-SPRAY	CANOLA OIL
VEGOL SINGLE DOSE INSECTICIDAL OIL	CANOLA OIL
WEEDAWAY PIVOT 418 EC	PROPICONAZOLE
WINFIELD PHOSPHITE EXTRA	MONO- AND DI-POTASSIUM SALT OF PHOSPHOROUS ACID
XEMIUM SC FOLIAR FUNGICIDE	FLUXAPYROXAD



TABLE 2.

ACTIVE INGREDIENT POLLINATOR PRECAUTION LEVELS

Table 2 lists active ingredients registered for use in highbush blueberry (as of January 2021) in Canada and their corresponding pollinator precaution levels based on the PMRA risk characterization framework: 'Most restrictive pollinator precaution', 'Moderately restrictive pollinator precaution', and 'Least restrictive pollinator precaution' (see Table 3). Pesticide active ingredients are listed alphabetically under the insecticide and fungicide sections of the table.

Active ingredient registrations frequently change and new information may change their precaution level.

In addition to formulation and application method, rate and timing, the actual risk to bees may be affected by other factors, as discussed in this guide. Further information, including special precautions for wild and native bee species, and pertinent research are included in the column titled "Additional Information (where available)". Also note that the pesticide mode of action (MoA) needs to be considered as part of an overall crop protection plan in order to avoid products becoming ineffective due to pest resistance. Information for MoA can be found at: <http://www.irac-online.org/modes-of-action/>

LABEL SEARCH

In addition to using this table to look up pollinator precaution levels, the PMRA has a tool called the 'Pesticide Label Search' which allows the user to either download an app to access product labels from their mobile device or to use the online [label search tool](#).

PRE-MIXES

Many pre-mixed products have entered the market containing multiple active ingredients. Refer to the pesticide label for pollinator precautions or use Table 1 to look up each active ingredient separately.

Disclaimer

The Pest Management Regulatory Agency and Pollinator Partnership Canada neither endorse these products nor intend to discriminate against products not mentioned. Some of the pesticides listed may not be registered for use in your province. It is the user's responsibility to check the registration status of any material and any provincial restrictions before use.

KEY TO ABBREVIATIONS USED IN TABLE 2

RT Residual Time. The length of time the residues of the product remain toxic to bees after application.

ERT Extended Residual Toxicity. Residues are expected to cause at least 25% mortality for longer than 8 hours after application.

Active Ingredient	Most Restrictive	Moderately Restrictive	Least Restrictive	Additional Information (Where Available)
Insecticides/Miticides				
Acetamiprid <i>Neonicotinoid insecticide</i>		X		2 day ERT to bumble bees ¹ . Cyano group neonicotinoids exhibit lower toxicity to bees than nitro group neonicotinoids ² .
Bacillus thuringiensis, var. kurstaki <i>Bt microbials, bio-insecticide</i>			X	
Bifenthrin <i>Pyrethroid insecticide</i>	X			
Canola oil <i>Horticultural oil</i>			X	Harmful effects are caused by smothering and suffocation making risks greatest for small arthropods. Larger size of some bees is thought to mitigate negative impacts ³ .
Carbaryl <i>Carbamate insecticide</i>	X			
Chlorantraniliprole <i>Diamide insecticide</i>			X	
Cyantraniliprole <i>Diamide insecticide</i>	X			
Cypermethrin <i>Pyrethroid insecticide</i>	X			
Cyclaniliprole	X			
Deltamethrin <i>Pyrethroid insecticide</i>		X		<8 hours RT for alfalfa leafcutting bees ⁴ . Formulated products may have a repellent effect lasting 2-3 hours ⁵ . 2 days ERT for bumble bees ¹ .
Dimethoate <i>Organophosphate insecticide</i>	X			ERT to alfalfa leafcutting bees ⁴ . Do not place alfalfa leafcutting bee nest shelters into fields until at least 1 week after treatment ¹ .
(E,Z)-2,13-OCTADECADIEN-1-YL ACETATE; (E,Z)-2,13-OCTADECADIEN-1-OL; (Z,Z)-3,13-OCTADECADIEN-1-YL ACETATE; (Z,Z)-3,13-OCTADECADIEN-1-OL <i>Sex Hormone</i>			X	
Flupyradifurone <i>Butenolide insecticide</i>		X		
Imidacloprid <i>Neonicotinoid insecticide</i>	X			Bumble bees may be more sensitive to imidacloprid than honey bees ⁶ .
Lime sulphur/calcium polysulphide <i>Sulphur fungicide</i>			X	Can repel bees if applied during bloom season ⁷ .

Active Ingredient	Most Restrictive	Moderately Restrictive	Least Restrictive	Additional Information (Where Available)
Malathion <i>Organophosphate insecticide</i>	X			Up to 7 days ERT for alfalfa leafcutting bees ⁴ .
Methoxyfenozide <i>Diacylhydrazine insecticide</i>			X	
Mineral oil <i>Horticultural oil</i>			X	Harmful effects are caused by smothering and suffocation.
Novaluron <i>Benzoylurea insecticide; insect growth regulator</i>		X		Effects on egg hatch and larval development in alfalfa leafcutting bees ⁸ . Effects on brood development and colony strength in honey bees ⁹ . Three days ERT for bumble bees ¹ .
Permethrin <i>Pyrethroid insecticide</i>	X			Up to 3 days ERT for alfalfa leafcutting bees. May be repellent in arid conditions ⁴ .
Phosmet <i>Organophosphate insecticide</i>	X			Up to 5 days ERT for alfalfa leafcutting bees ⁴ . 2-3 days ERT for bumble bees ¹ .
Pymetrozine <i>Pyridine azomethine derivative insecticide</i>		X		
Pyrethrins <i>Naturally occurring chemicals from chrysanthemums</i>	X			Commonly mixed with piperonyl butoxide (PBO) which acts as a synergist ⁴ .
Potassium salts of fatty acids <i>Soap salt</i>			X	Non-target insects in flightless stage are vulnerable ¹⁰ .
Spinetoram <i>Spinosyn insecticide, affects nerve action</i>	X			
Spinosad <i>Spinosyn insecticide</i>	X			>1 day ERT for alfalfa leafcutting bees ⁴ .
Spirodiclofen <i>Tetronic and Tetramic acid derivative; insect growth regulator</i>	X			Toxic to bee brood ¹¹ .
Spirotetramat <i>Tetronic and Tetramic acid derivative; insect growth regulator</i>	X			1 day ERT for bumble bees ¹ . Toxic to bee brood ¹¹ .
Tebufenozide <i>Insect growth regulator</i>			X	Honey bee learning and behavior can be affected ¹² .
Thiamethoxam <i>Neonicotinoid insecticide (nitro group)</i>	X			Thiamethoxam is often used as a systemic insecticide, and has been found in pollen and nectar of plants ^{2,13} . Documented incidents have demonstrated some degree of hazard with these treatments ^{13,14} . Bumble bees may be more sensitive to neonicotinoids than honey bees ⁶ .

Active Ingredient	Most Restrictive	Moderately Restrictive	Least Restrictive	Additional Information (Where Available)
Fungicides				
Aureobasidium pullulans <i>Bio-fungicide</i>			X	
Azoxystrobin <i>β-methoxyacrylate fungicide</i>			X	
Bacillus subtilis (Strain QST 713) <i>Microbial disruptor bio-fungicide derived from naturally occurring soil bacterium</i>			X	Laboratory tests suggest potential effects on bumble bees ¹⁵ .
Boscalid <i>Pyrazole-4-carboxamide fungicide</i>			X	Boscalid will also increase the toxicity of insecticide seed treatments to honey bees ¹⁶ .
Captan <i>Dicarboximide fungicide</i>			X	ERT lasting up to 7 days for mason bees ⁴ . Negative effects on honey bee brood observed in lab but not in field ¹⁷ .
Canola oil <i>Vegetable oil/natural pesticide/horticultural oil</i>			X	Harmful effects are caused by smothering and suffocation making risks greatest for small arthropods. Larger size of some bees is thought to mitigate negative impacts ³ .
Chlorothalonil <i>Chloronitrile fungicide</i>			X	Common contaminant of beeswax ¹⁸ .
Chloronitrile fungicide Copper octanoate <i>Inorganic fungicide/bactericide</i>			X	
Copper oxychloride <i>Inorganic fungicide/bactericide</i>			X	
Cyprodinil <i>Anilino-pyrimidine fungicide</i>			X	
Difenoconazole <i>Triazole fungicide</i>			X	Can synergize with cyprodinil to cause learning difficulties in honey bees ⁴ .
Extract of reynoutria sachalinensis <i>Plant extract, biofungicide</i>			X	
Fenbuconazole <i>Triazole fungicide</i>			X	
Ferbam <i>Dithio-carbamate fungicide</i>			X	
Fluazinam <i>2,6-dinitro-aniline fungicide</i>			X	
Fludioxonil <i>phenylpyrrole</i>			X	
Fluopyram <i>Pyridinyl-ethyl-benzamide fungicide</i>			X	

Active Ingredient	Most Restrictive	Moderately Restrictive	Least Restrictive	Additional Information (Where Available)
Fluxapyroxad <i>Pyrazole-4- carboxamide fungicide</i>			X	
Fosetyl-al <i>Ethyl phosphonate fungicide</i>			X	
Hydrogen peroxide <i>Part of a broad-spectrum fungicide</i>		X		
Isofetamid <i>Phenyl-oxo-ethyl thiophene amide fungicide</i>			X	
Lime sulphur or calcium polysulphide <i>Sulphur fungicide</i>			X	Can repel bees if applied during bloom season ⁷ .
Metalaxyl-m and s-isomer <i>Acylalanine fungicide</i>			X	
Metconazole <i>Triazole fungicide</i>			X	
Mineral oil <i>Horticultural oil</i>			X	Harmful effects are caused by smothering and suffocation.
Myclobutanil <i>Triazole fungicide</i>			X	
Oriental mustard seed meal (Brassica juncea) <i>Bio-fumigant</i>			X	
Penthiopyrad <i>Pyrazole-4-carboxamide fungicide</i>			X	
Peroxyacetic acid <i>Part of a broad-spectrum fungicide</i>		X		No information for bees. Very toxic to aquatic life. Low bioaccumulation potential ¹⁹ .
Phosphites; mono- and dibasic ammonium, sodium and potassium <i>Inorganic fungicide</i>			X	
Phosphorous acid, mono and di-potassium salts <i>Inorganic fungicide</i>			X	
Polyoxin D zinc salt <i>Peptidyl pyrimidine nucleoside broad spectrum fungicide</i>			X	
Propiconazole <i>Triazole fungicide</i>			X	Mason bees more sensitive than honey bees ²⁰ . If mixed with lambda-cyhalothrin, may increase toxicity ²¹ .

Active Ingredient	Most Restrictive	Moderately Restrictive	Least Restrictive	Additional Information (Where Available)
Prothioconazole <i>Triazolothione fungicide</i>			X	
Pyraclostrobin <i>Methoxy-carbamate fungicide</i>			X	
Pyrimethanil <i>Anilino-pyrimidine fungicide</i>			X	
Streptomyces lydicus strain WYEC108 <i>Bacteria</i>			X	Applied directly to soil, low risk for exposure ²² .
Tea tree oil <i>Melaleuca alternifolia</i>			X	
Triforine <i>Piperazine fungicide</i>			X	

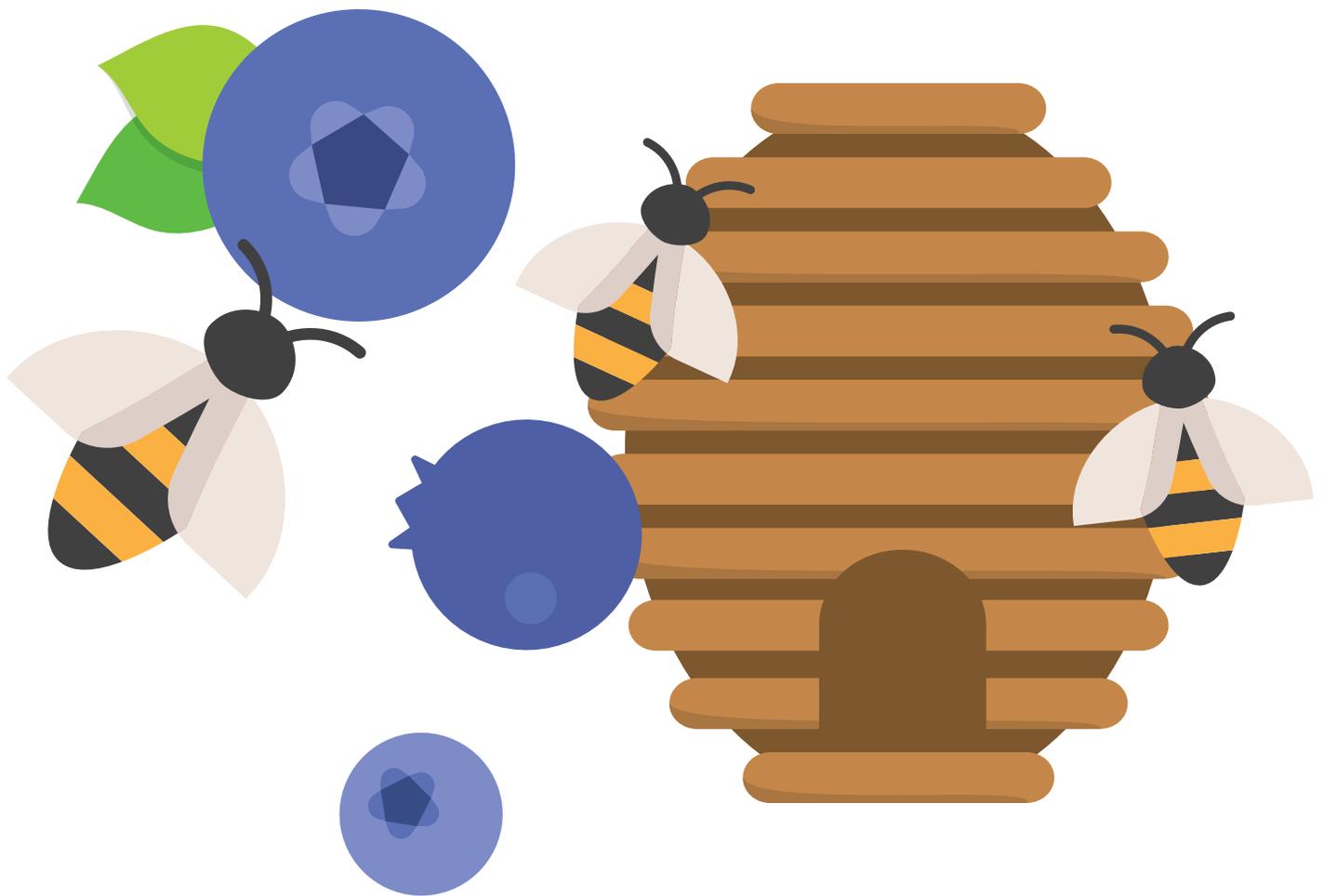


TABLE 3. POLLINATOR PRECAUTION LEVELS

Table 3 provides some of the considerations used by the PMRA to define the pollinator precaution levels.

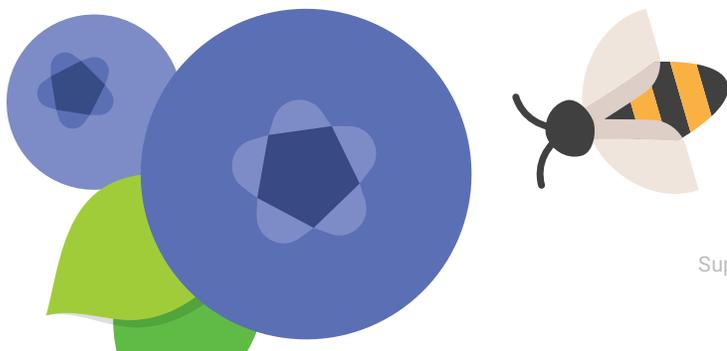
This table is not specific to highbush blueberry but rather shows how pesticide risk to pollinators is characterized for any active ingredient.

Three pollinator precaution levels are described here and correspond to the categories in Table 2 of this document. Always refer to label directions when applying pesticides as restrictions are specific to products and crops and are essential for minimizing harm to bees.

	MOST RESTRICTIVE	MODERATELY RESTRICTIVE	LEAST RESTRICTIVE
	Typically requires the most restrictive precautions, with greater restrictions for applications to highly bee-attractive crops	Typically requires some restrictions on application to bee-attractive crops	Typically requires minimal or no restrictions
Acute adult contact/oral toxicity	Typically highly toxic with an acute toxicity LD50 of < 2 µg/bee. Some pesticides may be highly toxic but have moderately restrictive labels due to short residual toxicity.	Typically moderately toxic with an acute toxicity LD50 of > 2 µg/bee to < 10.9 µg/bee. Note that some pesticides may be highly toxic but have moderately restrictive labels due to short residual toxicity.	Typically practically non-toxic with an acute toxicity LD50 of ≥ 11 µg/bee.
Larval toxicity	May have larval toxicity.	May have larval toxicity.	Typically none.
Chronic toxicity	May have chronic toxicity.	May have chronic toxicity.	Typically none.
Residual toxicity	Typically greater than 8 hours.	Typically 2 to 8 hours.	Typically no residual toxicity.



Higher tier studies	Available higher tier studies may indicate longer residual toxicity and a potential for effects even when exposure to residues occurs well after application (typically one to several days after application).	Available higher tier studies may indicate shorter residual toxicity and a potential for effects only when exposure to residues occurs shortly after application.	Higher tier studies are not typically required for low toxicity compounds; however, in some cases information may be available. Available higher tier studies would indicate a negligible potential for effects.
Crop pollinator attractiveness	Highly attractive crops require the most restrictive precautions, whereas crops with low or moderate attractiveness may require less restrictive statements.	Restrictions are similar for crops with high, moderate, and low crop attractiveness, and greater restrictions for highly attractive crops are not typically required.	No/minimal restrictions for crops with high, moderate, and low crop attractiveness.
Bloom in relation to harvest	Crops harvested after bloom would have restrictive statements.	Crops harvested after bloom may have restrictive statements.	Minimal or no restrictions whether crops harvested before or after bloom.
Examples of restrictions	<p>For highly bee-attractive crops, may not allow application during bloom.</p> <p>For moderately/low bee-attractive crops, avoid application during bloom but if necessary evening application may be allowed.</p> <p>May restrict pre-bloom application timing (i.e., certain systemic products; foliar or soil application methods).</p> <p>May be required to remove flowering weeds or groundcover prior to application (for example in orchards, or in turf lawns).</p> <p>Minimize spray drift.</p>	<p>For highly and moderately/low bee-attractive crops, avoid application during bloom but if necessary evening application may be allowed.</p> <p>Minimize spray drift.</p>	Typically requires minimal or no restrictions.



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