

COMPARATIVE OVERVIEW

Organic Pesticides



Organic farms can be an important asset in protecting pollinators and other insects beneficial to agriculture, such as predators and parasitoids of crop pests. Unfortunately, however, pesticides allowed for use in organic agriculture can cause harm to bees and beneficial insects.

While pest management programs should incorporate cultural, mechanical and other practices to prevent and manage pests, sometimes pesticides are the strategy of choice. There are many considerations when choosing between different pesticide options, including efficacy, specificity, cost, and risks to human health and the environment. This fact sheet is intended to be a quick reference to help you select and use organically-approved pesticides with the least impact on bees and other beneficial insects

Bees can be exposed to pesticides in different ways as they move through the landscape. In addition to direct exposures to adult bees out collecting pollen and nectar or seeking mates and nesting sites, pesticides may be carried back to nests in contaminated pollen or nectar or nest materials, where they may harm larval bees. For pesticides that break down quickly in the environment, applying in the evening or at night can reduce exposure and harm to pollinators.

Pesticide toxicity to bees is complex and difficult to measure. Effects of pesticides range from immediate mortality to sublethal effects such as changes in reproduction, foraging, navigation, and memory. The toxicity ratings in this fact sheet are based on the most readily available toxicity data for bees, acute lethality. Where available, we considered other peer-reviewed research studies to expand our understanding of toxicity.

For more detailed information on organic-approved pesticides, including discussion of managing pests while protecting pollinators, preventive pest management, modes of action, and current research on pesticide impacts on bees and other beneficial insects, download the full guidelines at: xerces.org/publications/guidelines/organic-pesticides.

TOP TO BOTTOM—Many crops, such as blueberries (*Vaccinium* spp.), require pollinators like bumble bees and mining bees to set fruit.

An Overview of Common Organic Pesticides

The table below provides a comparative overview of pesticides commonly permitted (or referenced) for U.S. organic agriculture. Use this table to determine which pesticide(s) is most appropriate for your situation as part of a new or existing Integrated Pest Management plan. See back for more information on how to download the complete guidelines, *Organic Pesticides: Minimizing Risks to Pollinators and Beneficial Insects*.

ACTIVE INGREDIENT (A.I.)	TYPE*						BEE TOXICITY		NOTES & SPECIAL PRECAUTIONS
Acetic acid (vinegar)				H		A	MEDIUM	X	Applications made with concentrations of acetic acid over 10% likely to be toxic to bees and other beneficials
Azadirachtin / neem oil	I	M					MEDIUM	X	Mixing with soap increases toxicity to bees
Bacillus amyloliquefaciens			F				LOW		
Bacillus subtilis			F				MEDIUM	X	Slow-acting MOA†—Impacts on bees likely to be delayed
Bacillus thuringiensis ssp. aizawai	I						MEDIUM – HIGH	X	Slow-acting MOA†—Impacts on bees likely to be delayed
Bacillus thuringiensis ssp. kurstaki / israelensis	I						LOW		Toxic to butterflies and other beneficials (Diptera)
Beauveria bassiana	I						MEDIUM-HIGH ^W	X	Slow-acting MOA†—Impacts on bees likely to be delayed; ▲ (see Coppers below); W—wet formulation
Bicarbonates (sodium / potassium)			F				LOW		
Boric acid	I						LOW		Uses for structural pest control are unlikely to affect bees; use caution if applying fertilizers that contain boric acid
Burkholderia spp. strain A396	I	M					LOW – MEDIUM	X	MOA† suggests that impacts could be delayed, but no data currently available
Cedar oil	I	M				R	LOW – MEDIUM	X	Repellent to bees and may disrupt pollination
Chromobacterium subtsugae	I	M					LOW – MEDIUM	X	Slow-acting MOA†—Impacts on bees likely to be delayed; repellent to bees and may disrupt pollination for up to a week
Cinnemaldehyde	I	M	F				LOW	X	Toxic to other beneficials (ground beetles, mites, nematodes)
Citrus oil (Limonene / D-limonene)	I			H			LOW	X	Repellent to bees and may disrupt pollination
Coppers			F				LOW – MEDIUM	X	Avoid heavy repeated use—copper can accumulate in soils and contaminated soils are difficult to remediate
↳ Copper sulfate (CuSO4)			F				LOW – MEDIUM	X	
↳ Copper sulfate + lime (Bordeaux mixture)			F				MEDIUM	X	▲Do not apply copper(s) within one week of Beauveria application
Corn gluten				H			LOW		
Cydia pomonella granulovirus	I						LOW		
Diatomaceous earth	I	M					MEDIUM	X	Slow-acting MOA†—Impacts on bees likely to be delayed
Garlic, cottonseed, or clove oil	I	M	F			R	LOW – MEDIUM	X	
Gibberellic acid						P	LOW – MEDIUM	X	
Gliocladium catenulatum			F				LOW	X	MOA† suggests that impacts could be delayed, but no data currently available
Horticultural oil / narrow range oil	I	M	F				MEDIUM	X	Only toxic to bees upon direct contact; if applying during bloom, apply at night to minimize risk to bees
Hydrogen dioxide, peroxyacetic acid			F				HIGH	X	
Insecticidal soap	I	M	F				LOW – MEDIUM	X	
Isaria fumosorosea	I	M					LOW – MEDIUM	X	Slow-acting MOA†—Impacts on bees likely to be delayed
Kaolin clay	I	M					LOW	X	Can disrupt foraging bees at time of application; if applying during bloom, apply at night
Lime sulfur	I	M	F				LOW – MEDIUM	X	Repellent to bees and may disrupt pollination
Pyrethrins	I	M					HIGH	X	
Pythium oligandrum			F				LOW	X	MOA† suggests that impacts could be delayed, but no data currently available
Reynoutria sachalinensis extract			F				LOW		
Rotenone	I	M					MEDIUM – HIGH	X	Highly toxic to honey bee larvae. PROHIBITED FOR USE IN U.S. ORGANIC AGRICULTURE.
Ryania/Ryanodine	I						LOW – MEDIUM	X	Slow-acting MOA†—Impacts on bees likely to be delayed. CANCELLED.
Sabadilla (Schoenocaulon officinale)	I						LOW – MEDIUM	X	
Spinosad	I	M					HIGH	X	Granular spinosad bait products generally have a much lower exposure risk for bees
Streptomyces spp.			F				LOW		Only registered for greenhouses / ornamentals
Sulfur	I	M	F				LOW	X	Repellent to bees and may disrupt pollination; may reduce pollen viability for some crops
Tea tree oil			F				LOW		
Trichoderma spp.			F				LOW	X	Slow-acting MOA†—Impacts on bees likely to be delayed

NOTES

- * TYPE—insecticide (I); miticide (M); fungicide (F); herbicide (H); repellent (R); adjuvant (A); plant growth regulator (P)
-  DO NOT APPLY directly to, or allow to drift onto, flowering plants
- † MOA—Mode of action (e.g., how a pesticide works, or the mechanism by which it causes physiological disruption at its target site[s])

This fact sheet on organic pesticides was produced by the Xerces® Society. For more information about pollinator conservation, please visit www.xerces.org.



DISCLAIMER: This document is provided only as a guide. It offers science-based information to help you make informed decisions to reduce the risk of pest management efforts to pollinators and other beneficial insects. It may also contain specific pest management suggestions, including pesticide uses, but does not guarantee the efficacy of these uses. While based on guidance, advice, research literature, or other documentation,

these recommendations are just that: recommendations for applicators and land managers to consider when developing or refining a specific pest management plan. In the event of a conflict between this guide and the pesticide label, the pesticide user has sole and complete responsibility to comply with the applicable laws and the pesticide label instructions.

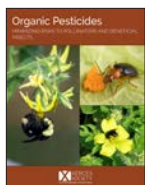
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Organic farms can support diverse and abundance pollinator and beneficial insect populations. Protecting these insects from pesticides is key to sustaining their populations and the important pollination and pest control services they provide.

Download the full guidelines at: xerces.org/publications/guidelines/organic-pesticides



Source

Adamson, N. L., E. May, A. Code, E. Lee-Mäder, S. Morris, and M. Vaughan. 2021 (2018). *Organic Pesticides: Minimizing Risks to Bees and Other Agriculturally Beneficial Insects*. 20 pp. Portland, OR: The Xerces Society for Invertebrate Conservation.

Additional Resources:

- ↪ *Guidance to Protect Habitat from Pesticide Contamination*: xerces.org/guidance-to-protect-habitat-from-pesticide-contamination/
- ↪ *How to Reduce Bee Poisoning from Pesticides*. Oregon State University. <https://ir.library.oregonstate.edu/concern/administrative-report-or-publications/vq27zn805>

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Photographs & Layout

PHOTO CREDITS: *Front cover*—bumble bee [top] and mining bees [middle] pollinating blueberries by the Xerces Society / Nancy Lee Adamson; lowbush blueberry harvest [bottom] by the Xerces Society / Eric Venturini. *Back cover*—male mining bees sleeping on apple blossoms, by Tom Potterfield ([flickr.com/tgpotterfield](https://www.flickr.com/photos/tgpotterfield/)). **LAYOUT:** Sara Morris, the Xerces Society.



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