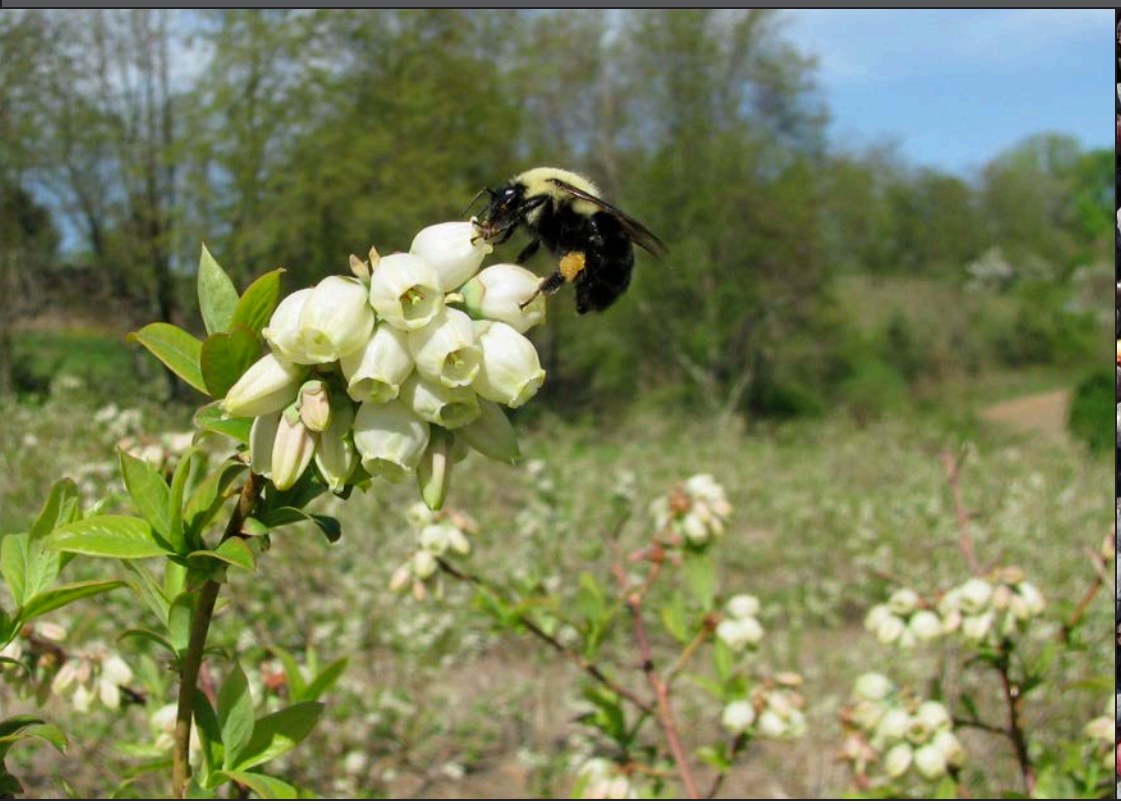
COMPARATIVE OVERVIEW

Organic Pesticides



*Many crops, like blueberries (*Vaccinium *spp.), require pollinators to set fruit.*

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: www.xerces.org/guidelines-organic-pesticides.

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An Overview of Common Organic Pesticides

The table below provides a comparative overview of pesticides commonly permitted (or referrenced) 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*.

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)

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

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ACTIVE INGREDIENT (A.I.)	TYPE*							EXAMPLE PRODUCT NAMES	BEE TOXICITY		NOTES & SPECIAL PRECAUTIONS
Acetic acid (vinegar)				H		A		Weed Pharm	MEDIUM	✘	Applications made with concentrations of acetic acid over 10% likely to be toxic to bees and other beneficials
Azadirachtin / neem oil	I	M						Neemix, Trilogy, Azatrol, Debug, Neem Pro	MEDIUM	✘	Mixing with soap increases toxicity to bees
Bacillus amyloliquefaciens			F					Stargus	LOW		
Bacillus subtilis			F					Serenade	MEDIUM	✘	Slow-acting MOA†—Impacts on bees likely to be delayed
Bacillus thuringiensis ssp. *aizawai*	I							Xentari, Agree	MEDIUM–HIGH	✘	Slow-acting MOA†—Impacts on bees likely to be delayed
Bacillus thuringiensis ssp. *kurstaki / israelensis*	I							DiPel, Javelin, Biobit	LOW		Toxic to butterflies and other beneficials (Diptera)
Beauveria bassiana	I							BotaniGard	MEDIUM–HIGH[W]	✘	Slow-acting MOA†—Impacts on bees likely to be delayed; ⚠ (see Coppers below); W—wet formulation
Bicarbonates (sodium / potassium)			F					Armicarb, Kaligreen, Remedy	LOW		
Boric acid	I							Boric acid, Borax	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						Venerate, Majestene	LOW–MEDIUM	✘	MOA† suggests that impacts could be delayed, but no data currently available
Cedar oil	I	M			R			CedarCide	LOW–MEDIUM	✘	Repellent to bees and may disrupt pollination
Chromobacterium subtsugae	I	M						Grandevo	LOW–MEDIUM	✘	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					Cinnacure, Cinnerate, Bravado	LOW	✘	Toxic to other beneficials (ground beetles, mites, nematodes)
Citrus oil (Limonene / D-limonene)	I			H				GreenMatch, Orange Guard, Avenger	LOW	✘	Repellent to bees and may disrupt pollination
Coppers			F					Badge, Champ, Nu-Cop, Cuprocaffaro	LOW–MEDIUM	✘	Avoid heavy repeated use—copper can accumulate in soils and contaminated soils are difficult to remediate ⚠ Do not apply copper(s) within one week of *Beauveria* application
↳Copper sulfate ($CuSO_4$)			F					Copper sulfate, $CuSO_4$	LOW–MEDIUM	✘	
↳Copper sulfate + lime (Bordeaux mixture)			F					Bordeaux	MEDIUM	✘	
Corn gluten				H				Corn gluten	LOW		
Cydia pomonella granulovirus	I							Cyd-X	LOW		
Diatomaceous earth	I	M						Diatomaceous earth	MEDIUM	✘	Slow-acting MOA†—Impacts on bees likely to be delayed
Garlic, cottonseed, or clove oil	I	M	F		R			GC-Mite, Matratec, Scary Garlic Plus	LOW–MEDIUM	✘	
Gibberellic acid							P	ProGibb	LOW–MEDIUM	✘	
Gliocladium catenulatum			F					Prestop	LOW	✘	MOA† suggests that impacts could be delayed, but no data currently available
Horticultural oil / narrow range oil	I	M	F					JMS Stylet Oil, Ecotrol, Leaf Life Gavicide Green	MEDIUM	✘	Only toxic to bees upon direct contact; *if applying during bloom*, apply at night to minimize risk to bees
Hydrogen dioxide, peroxyacetic acid			F					Oxidate 2.0	HIGH	✘	
Insecticidal soap	I	M	F					M-Pede	LOW–MEDIUM	✘	
Isaria fumosorosea	I	M						Preferal, NoFly	LOW–MEDIUM	✘	Slow-acting MOA†—Impacts on bees likely to be delayed
Kaolin clay	I	M						Surround	LOW	✘	Can disrupt foraging bees at time of application; *if applying during bloom*, apply at night
Lime sulfur	I	M	F					Lime sulfur, Sulforix	LOW–MEDIUM	✘	Repellent to bees and may disrupt pollination
Pyrethrins	I	M						PyGanic, Azera	HIGH	✘	
Pythium oligandrum			F					Polyversum	LOW	✘	MOA† suggests that impacts could be delayed, but no data currently available
Reynoutria sachalinensis extract			F					Regalia	LOW		
Rotenone	I	M						PROHIBITED FOR USE IN U.S. ORGANIC AGRICULTURE	MEDIUM–HIGH		Highly toxic to honey bee larvae
Ryania/Ryanodine	I							CANCELLED	LOW–MEDIUM		Slow-acting MOA†—Impacts on bees likely to be delayed
Sabadilla (*Schoenocaulon officinale*)	I							Veratran-D	MEDIUM	✘	
Spinosad	I	M						Entrust, Success, Regard	HIGH	✘	Granular spinosad bait products generally have a much lower exposure risk for bees
Streptomyces spp.			F					Actinovate, MycoStop	LOW		Only registered for greenhouses / ornamentals
Sulfur	I	M	F					Sulfur, Microthiol	LOW	✘	Repellent to bees and may disrupt pollination; may reduce pollen viability for some crops
Tea tree oil			F					Timorex	LOW		
Trichoderma spp.			F					Bio-Tam 2.0	LOW	✘	Slow-acting MOA†—Impacts on bees likely to be delayed

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: http://xerces.org/guidelines-organic-pesticides

Source

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

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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. http://bit.ly/OSU_ReduceBeePoisoning

Photographs & Layout

PHOTO CREDITS: ***Front cover***—bumble bee pollinating blueberries [left], © the Xerces Society / Nancy Lee Adamson; lowbush bluberry harvest [right] © the Xerces Society / Eric Venturini. ***Back cover***—male mining bees sleeping on apple blossoms, by Tom Potterfield (flickr.com/tgpotterfield). Formatted by Sara Morris, the Xerces Society.

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