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*.

ACTIVE INGREDIENT (A.I.)	TYPE*							BEE TOXICITY	
Acetic acid (vinegar)				H		A		MEDIUM	✘
Azadirachtin / neem oil	I	M						MEDIUM	✘
Bacillus amyloliquefaciens			F					LOW	
Bacillus subtilis			F					MEDIUM	✘
Bacillus thuringiensis ssp. *aizawai*	I							MEDIUM – HIGH	✘
Bacillus thuringiensis ssp. *kurstaki / israelensis*	I							LOW	
Beauveria bassiana	I							MEDIUM–HIGH[W]	✘
Bicarbonates (sodium / potassium)			F					LOW	
Boric acid	I							LOW	
Burkholderia spp. strain A396	I	M						LOW – MEDIUM	✘
Cedar oil	I	M			R			LOW – MEDIUM	✘
Chromobacterium subtsugae	I	M						LOW – MEDIUM	✘
Cinnemaldehyde	I	M	F					LOW	✘
Citrus oil (Limonene / D-limonene)	I			H				LOW	✘
Coppers			F					LOW – MEDIUM	✘
↳ Copper sulfate ($CuSO_4$)			F					LOW – MEDIUM	✘
↳ Copper sulfate + lime (Bordeaux mixture)			F					MEDIUM	✘
Corn gluten				H				LOW	
Cydia pomonella granulovirus	I							LOW	
Diatomaceous earth	I	M						MEDIUM	✘
Garlic, cottonseed, or clove oil	I	M	F		R			LOW – MEDIUM	✘
Gibberellic acid							P	LOW – MEDIUM	✘
Gliocladium catenulatum			F					LOW	✘
Horticultural oil / narrow range oil	I	M	F					MEDIUM	✘
Hydrogen dioxide, peroxyacetic acid			F					HIGH	✘
Insecticidal soap	I	M	F					LOW – MEDIUM	✘
Isaria fumosorosea	I	M						LOW – MEDIUM	✘
Kaolin clay	I	M						LOW	✘
Lime sulfur	I	M	F					LOW – MEDIUM	✘
Pyrethrins	I	M						HIGH	✘
Pythium oligandrum			F					LOW	✘
Reynoutria sachalinensis extract			F					LOW	
Rotenone	I	M						MEDIUM – HIGH	
Ryania/Ryanodine	I							LOW – MEDIUM	
Sabadilla (*Schoenocaulon officinale*)	I							LOW – MEDIUM	✘
Spinosad	I	M						HIGH	✘
Streptomyces spp.			F					LOW	
Sulfur	I	M	F					LOW	✘
Tea tree oil			F					LOW	
Trichoderma spp.			F					LOW	✘

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.

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.

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	NOTES & SPECIAL PRECAUTIONS
	Applications made with concentrations of acetic acid over 10% likely to be toxic to bees and other beneficials
	Mixing with soap increases toxicity to bees
	Slow-acting MOA†—Impacts on bees likely to be delayed
	Slow-acting MOA†—Impacts on bees likely to be delayed
	Toxic to butterflies and other beneficials (Diptera)
	Slow-acting MOA†—Impacts on bees likely to be delayed; ⚠ (see Coppers below); W—wet formulation
	Uses for structural pest control are unlikely to affect bees; use caution if applying fertilizers that contain boric acid
	MOA† suggests that impacts could be delayed, but no data currently available
	Repellent to bees and may disrupt pollination
	Slow-acting MOA†—Impacts on bees likely to be delayed; repellent to bees and may disrupt pollination for up to a week
	Toxic to other beneficials (ground beetles, mites, nematodes)
	Repellent to bees and may disrupt pollination
	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**
	Slow-acting MOA†—Impacts on bees likely to be delayed
	MOA† suggests that impacts could be delayed, but no data currently available
	Only toxic to bees upon direct contact; if applying during bloom, apply at night to minimize risk to bees
	Slow-acting MOA†—Impacts on bees likely to be delayed
	Can disrupt foraging bees at time of application; if applying during bloom, apply at night
	Repellent to bees and may disrupt pollination
	MOA† suggests that impacts could be delayed, but no data currently available
	Highly toxic to honey bee larvae. PROHIBITED FOR USE IN U.S. ORGANIC AGRICULTURE.
	Slow-acting MOA†—Impacts on bees likely to be delayed. CANCELLED.
	Granular spinosad bait products generally have a much lower exposure risk for bees
	Only registered for greenhouses / ornamentals
	Repellent to bees and may disrupt pollination; may reduce pollen viability for some crops
	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. 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

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