

Organic Pesticides

“Organic” does not automatically mean “pesticide-free” or “chemical-free”. Growers try to rely on non-chemical means whenever possible to control pests, but this is not always possible. Many different products and materials are allowed under USDA organic standards. The OMRI (Organic Materials Research Institute) maintains lists of pesticides approved under the USDA National Organic Program.



A pesticide is any material that will kill a pest. Synthetic chemical pesticides – what many people typically think of as a “pesticide” – are created in a laboratory from petrochemicals or other materials. But there are a number of materials which are derived from plants, minerals, bacteria, fungi or other natural sources that are registered as organic pesticides, which can be used by organic gardeners.

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Even organic pesticides that have no effect or are only slightly toxic to humans may be very toxic to other animals, such as bees or fish. So it is still important to be careful and read the label when using ANY pesticide, even those natural ones. Be sure the pesticide is labeled for use on the plant and against your pest, and follow the directions for application. All pesticides, both synthetic and natural, must have toxicity ratings on the container: CAUTION, WARNING or DANGER. “CAUTION” means low toxicity or relatively free from danger; “WARNING” means moderately toxic and “DANGER” means highly toxic.

Organic pesticides tend to be safer than synthetics; but just because a product is naturally-derived does not mean that it is not toxic – it does kill pests, after all. A few organic pesticides are as toxic, or more toxic, than some synthetic pesticides.



All pesticide labels — organic or synthetic — must state the toxicity rating.

Concern for the environment is another reason some people prefer natural or organic pesticides. Yet some organic pesticides have a potentially higher environmental impact than synthetic pesticides because they have to be used in large doses. Some of the new, low-risk synthetic pesticides may actually have a lower environmental impact, with greater efficacy against the pest and less effect on natural enemies which help control pests. So it is important to consider many factors when choosing to use pesticides of any type, rather than assuming natural is better.

Most of the organic pesticides available today are insecticides, although there are some fungicides and herbicides. These pesticides can be classified into three main categories based on their natural origins.

Botanicals

These materials are derived directly from plants or plant products. They tend to be short-lived in the environment, so most have little or no residual activity, and generally are broad-spectrum, so they kill beneficial as well as the target pests. They are often more costly than synthetics, and not all can be used in organic production. Some botanicals include the following:

- **Neem** is an extract from the neem tree, *Azadirachta indica*, which disrupts insect growth, development and feeding. It has low mammalian toxicity, but may be slow acting, taking 7-10 days to work. (CAUTION)



The neem tree, *Azadirachta indica*.

- **Nicotine**, extracted from tobacco or related *Nicotiana* species, is one of the oldest botanical insecticides, but it's also one of the most toxic to warm-blooded animals and therefore is NOT allowed under federal standards for organic production (and as of 2014 no nicotine products will be registered for use in the US). Nicotine sulfate is readily absorbed through the skin but breaks down quickly. (DANGER or WARNING, depending on formulation)

- **Oils** derived from plants, included citrus, garlic or hot pepper. Neem oil is also used primarily as an insect repellent.

- **Pyrethrins** are extracts from *Chrysanthemum cinerariaefolium* flowers. Do not confuse them with pyrethroids, which are synthetic chemicals that act in a similar manner. Pyrethrins are non-toxic to most mammals but cats can be poisoned by pyrethrins. They are fast acting, but have short persistence. They are often mixed with synergists, like piperonyl butoxide or n-octyl bicychoheptene dicarboximide (which are not labeled for organic use) because the pyrethrins often just knock down, but don't kill, the insects. (CAUTION)



Chrysanthemum cinerariaefolium, the source of pyrethrins.

- **Rotenone** is an extract from the roots of *Derris* or *Lonchocarpus* and related plants. It is moderately toxic to humans (pure rotenone is more toxic than pure carbaryl or malathion), and can be irritating to skin and mucous membranes. It is also very poisonous to fish and has been used by native cultures in South America for capturing fish. It is registered in the US as a piscicide and has been used in Wisconsin by the DNR to clear invasive fish from lakes. It is slow-acting, taking several days to kill insects. (CAUTION)

- **Ryania** is an extract of the roots and stems of *Ryania speciosa* that is moderately toxic to humans and very toxic to dogs. (CAUTION)

- **Sabadilla** is an extract from the seeds of *Schoenocaulon officinale*. It has low human toxicity (although the dust can irritate nasal tissue) but is toxic to honey bees. It breaks down rapidly in sunlight. (CAUTION)

Microbials

These products come from bacteria, fungi, viruses, algae or protozoans, or their products. The insecticides affect pest populations by causing disease that kills or debilitates the insect pest or produce a toxin that specifically kills only the pest. Microbial products for disease control often work though competition between the beneficial microbe and the pathogen. Some include:

- ***Bacillus thuringiensis***, or "Bt" is a naturally occurring soil bacterium that is toxic to the larvae of several species of insects but not toxic to nontarget organisms. The original type discovered is toxic just to the caterpillars (larvae) of moths and butterflies. Other strains of Bt were found and developed for control of fly larvae, including fungus gnats, mosquitoes and blackflies. Another type is effective against



One brand of the microbial insecticide Bt.

some beetles, including Colorado potato beetle.

- ***Beauveria bassiana*** is a cosmopolitan soil-borne fungus that infects a wide range of insects, eventually killing them in 3-7 days. Fungal spores must contact the insect for infection to occur, so spray coverage must be thorough.
- **Spinosad** is a fast-acting, somewhat broad-spectrum material derived from aerobic fermentation of the soil actinomycete *Saccharopolyspora spinosa*. Several commercial products are OMRI listed.

Inorganics

These materials are created from naturally-occurring minerals. Many of these products are useful against plant diseases.

- **Copper** is available in several formulations for killing fungi and bacteria. Bordeaux Mixture, first used in Bordeaux, France to control downy mildew, is produced by a reaction between copper sulfate and calcium hydroxide (lime). The addition of the lime helps reduce phytotoxicity, but it is still a concern, especially in hot or wet weather.
- **Cryolite** contains sodium fluoaluminate, a mined mineral, which works as a stomach poison against beetles and caterpillars. It is non-toxic to mammals, birds, and honey bees, and does not affect many beneficial insects, but is slightly toxic to fish. It is not OMRI approved.
- **Diatomaceous earth** is comprised of the fossil shells of microscopic marine algae called diatoms. When crushed, their very tiny silicon shells are very sharp and can abrade the insect exoskeleton, causing dessication. This product is most useful in stored grains or against indoor pests; outdoors it must be reapplied after every rain. Even with thorough coverage pest control is variable. The dust is non-toxic to humans, but it can irritate the lungs.
- **Kaolin clay** is a naturally mined mineral that acts as a feeding barrier against many insects and may reduce damage from some diseases. Enough has to be applied to leave a white residue on the leaves or fruit.
- **Lime sulfur** is made by boiling lime and sulfur together. The mixture is used as a dormant spray on fruit trees for disease and insect control. It can burn exposed skin and eyes and cause phytotoxicity if applied when temperatures are above 80°F. (DANGER)
- Ground elemental **sulfur** is used for powdery mildew, spider mite, and thrips control. One of the oldest known pesticides, sulfur is non-toxic to mammals but can irritate skin, eyes, and mucous membranes. Sulfur can also burn plants, especially when temperatures are above 90°F. (CAUTION)



Sulfur at a loading port.

Some synthetic products, such as insecticidal or herbicidal soap and horticultural petroleum oils, can also be used, but may not be allowed by all certification groups. You should be very cautious about using homemade pesticide recipes that have not been University tested.

– Susan Mahr, University of Wisconsin - Madison

Additional Information:

- Organic Materials Review Institute – an independent nonprofit organization at <https://www.omri.org/>
- Resource Guide for Organic insect and Disease Management – Cornell University at web.pppmb.cals.cornell.edu/resourceguide/
- USDA's National Organic Program – at www.ams.usda.gov/AMSV1.0/nop
- Using Organic Fungicides – Purdue University Disease Management Strategies for Horticultural Crops publication BP-69-W at www.extension.purdue.edu/extmedia/bp/bp-69-w.pdf