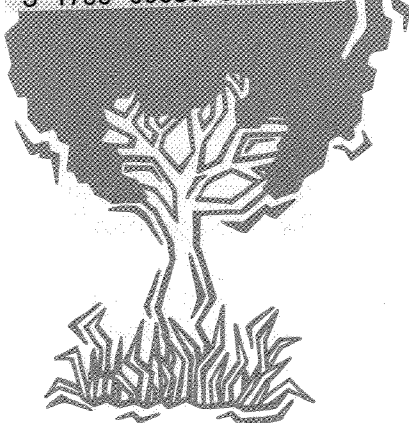


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Friendly Pesticides for Home Gardens no. 2,945

by L.P. Pottorff¹

Quick Facts...

Pesticides are substances or organisms that prevent, destroy, repel or mitigate a pest.

Sabadilla is considered among the least toxic of botanical insecticides. It can irritate eyes and produce sneezing if inhaled.

Pyrethrum is the most widely used botanical insecticide in the United States.

Pyrethroids are synthetic materials designed to imitate natural pyrethrum. They have the same basic chemistry but are modified to improve persistence, insecticidal activity, etc.

Sulfur is probably the oldest known pesticide in current use.

When we think of organic gardening, we often conjure up the image of a crop grown free of any pesticides. However, the concept of organic gardening is much more broad, and, believe it or not, many types of pesticides are permitted. These pesticides can be included in pest management programs in home landscapes.

Pesticides, as defined by the Colorado Organic Certification Act (COCA), are substances or organisms that prevent, destroy, repel or mitigate a pest. Normally when we think of pesticides, we think of synthetically produced pesticides (e.g., carbaryl/Sevin, Malathion and 2,4-D). These pesticides are prohibited on organically grown commodities. There is nothing wrong with them when used as needed and according to label directions. However, they also are the types of pesticides that have been misused and overused by urban gardeners. Alternative controls can be used in place of the more common synthetic pesticides. They can give the home gardener a satisfactory way to control pests while eliminating the potential for pesticide misuse.

The types of pesticides allowed in organic production under COCA include microorganisms, microbial products, and materials derived or extracted from plants, animals or mineral-bearing rocks. Exceptions also exist for certain synthetic pesticides such as soap, oil and lime sulfur.

As a general rule, pesticides approved for organic production break down rapidly and often are less destructive to natural enemies and other organisms. However, just because the materials are natural does not mean that they are always less toxic than the synthetic pesticides.

Botanical Pesticides

Sabadilla

Sabadilla is derived from the seeds of the sabadilla lily (*Schoenocaulon officinale*). The active ingredient is an alkaloid known as veratrine and most commonly sold under the trade names "Red Devil" or "Natural Guard." Sabadilla is considered among the least toxic of botanical insecticides, with an oral LD50 of 4,000 to 5,000 mg/kg. (LD50 is the dosage lethal to 50 percent of the test population. The larger the LD50, the safer the chemical.)

Sabadilla dust can be highly irritating to eyes and can produce sneezing if inhaled. No residue is left after application of sabadilla because it breaks down rapidly in sunlight. Sabadilla acts as a contact and stomach poison and has been effective against caterpillars, leaf hoppers, thrips, stink bugs and squash bugs. The insecticide is labeled for use on many vegetables.

Pyrethrum

Pyrethrum is the most widely used botanical insecticide in the United States. The active ingredient, pyrethrin, is extracted from the chrysanthemum



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plant, *Dendranthemum (Chrysanthemum) cinerariaefolium*, which is grown primarily in Kenya, Rwanda, Tanzania and Ecuador.

Most insects are highly susceptible to pyrethrum at low concentrations. The compound acts rapidly on insects, causing immediate “knockdown.” Flying insects drop almost immediately upon exposure. Pyrethrums also are highly irritating to insects, so they may be used as a “flushing agent” or irritant to make them come out of hiding.

Pyrethrum is nontoxic to most mammals, making it among the safest insecticides in use.

Fast knockdown and actual insect death don’t always go hand in hand, as many insects recover after the initial knockdown. For this reason, pyrethrums are mixed with a synergist such as piperonyl butoxide (PBO) to increase insect mortality. Pyrethrums are primarily effective as a contact poison. They affect the central nervous system of insects.

Pyrethrum is nontoxic to most mammals, making it among the safest insecticides in use. In fact, it has more approved EPA (Environmental Protection Agency) uses than any other insecticide. Trade names include Pyrenone and Pyrellin. One caution: Allergic skin reactions can be common when using pyrethrum or pyrethrins. Do not use products containing PBO when temperatures exceed 90 degrees F.

Pyrethroids

Pyrethroids are synthetic materials designed to imitate natural pyrethrum. Pyrethroids are not accepted by organic producer regulations. These synthetic materials have the basic chemistry of pyrethrins but are modified to improve persistence, insecticidal activity, etc. Pyrethroids are widely used in U.S. agriculture under trade names such as Asana, Capture, Astro, Mavrik, Pounce, resmethrin and sumithrin. Use caution when applying these products around water — they are toxic to fish.

Some synthetic pyrethroids are safer than natural pyrethrins. Oral LD50 of Pounce (pyrethroid) is 4,000 mg/kg, while oral LD50 of pyrethrin is 1,500 mg/kg.

Pyrethroids are toxic to fish.

Neem

Neem is a botanical pesticide derived from the seeds of the neem tree, a native of India. The neem tree supplies at least two compounds, azadirachtin and salannin, that have insecticidal activity, and other unknown compounds with fungicidal activity. Neem has been used for more than 4,000 years in India and Africa for medicinal as well as pest control purposes. It has low mammalian toxicity with an LD50 of 5,000 mg/kg.

Neem-based pesticides are sold under trade names such as Margosan-O, Azatin Rose Defense, Shield-All, Triact and Bio-neem. They have been shown to control gypsy moths, leafminers, sweet potato whiteflies, western flower thrips, loopers, caterpillars and mealybugs. The products are labeled for use on ornamentals, foliage plants, trees, shrubs and food crops. Neem works as an insect growth regulator. The treated insect usually cannot molt to its next life stage and dies. It also may deter egg laying. Do not expect a quick kill.

Research continues to look at the full activity of neem extracts against a wide range of pests and pathogens. Neem oil, sold under such trade names as Green Light Rose Defense, Shield-All and Triact, have been shown to give control against the disease powdery mildew.

Botanical Pesticides

- *Sabadilla*
- *Pyrethrum*
- *Pyrethroids*
- *Neem*

Mineral-Based Pesticides

- *Sulfur*
- *Lime sulfur*
- *Bordeaux mixture*

Other Alternatives

- *Horticultural oils*
- *Soaps*
- *Baking soda (experimental)*
- *Diatomaceous earth*

Mineral-Based Pesticides

Sulfur

Sulfur is probably the oldest known pesticide in current use. Homer described the benefits of “pest-averting sulfur” 3,000 years ago.

Sulfur can be used as a dust, wettable powder, paste or liquid. It primarily is used for disease control because it is effective against powdery mildews, certain rusts, leaf blights and fruit rots. However, spider mites, psyllids and thrips also are susceptible to sulfur. Most pesticidal sulfur is labeled for vegetables such as beans, potatoes, tomatoes and peas, and for fruit crops such as grapes, apples, pears, cherries, peaches, plums and prunes.

One of the drawbacks of sulfur is its potential to cause plant injury in hot (90 degrees and above), dry weather. It also is incompatible with other pesticides. Do not use sulfur within 20 to 30 days on plants where spray oils are applied; it reacts with the oils to make a more phytotoxic combination.

Sulfur is nontoxic to mammals but may be irritating to the skin and especially eyes. It has an LD50 of 5,000 mg/kg.

Lime Sulfur

Lime sulfur is made by boiling lime and sulfur together. This mixture is used as a dormant spray for fruit trees to control such diseases as blight, anthracnose and powdery mildew, and certain insects such as scales, eriophyid mites and spider mites.

Lime sulfur's drawbacks include smelling like rotten eggs, burning exposed skin and eyes, and causing plant injury if applied when temperatures exceed 80 degrees. Lime sulfur has an LD50 of 400 to 500 mg/kg.

Bordeaux Mixture

Bordeaux mixture is a product of the reaction between copper sulfate and calcium hydroxide (lime). It is not approved for use by organic growers. First used in Bordeaux, France, as a control for downy mildew, this mixture is primarily used as a fungicide to control bacterial leaf spots, blights, anthracnose, downy mildews and cankers. It also acts as a repellent to many insects and is labeled for use on many vegetable, tree fruit and nut crops.

Bordeaux mixture, like sulfur and lime sulfur, also can be phytotoxic to plants. It may cause burning of leaves or russetting (reddening) of fruit when applied in cool, wet weather. The LD50 is 472 mg/kg.

Other Alternatives

Horticultural Oils

Horticultural oils are highly refined so that compounds toxic to plants are removed. Considered effective and safe, they can be used to control insects as well as diseases. The types of oils available for pest control include dormant oils and summer oils. (See fact sheet 5.569, *Insect Control: Horticultural Oils*.)

Dormant oils are used during the winter season when plants are dormant to control overwintering stages of insects such as aphids, spider mites and scales. An oil applied during the dormant period suffocates the overwintering eggs of aphids and spider mites or suffocates the adult, in the case of scales.

Summer oils are a lighter version of dormant oil and can be applied to actively growing plants. Use summer oils to control aphids, mites, thrips, scales, mealybugs, and their eggs.

The use of oils to control fungal diseases is on the rise. Research is underway on the use of oils to control powdery mildew and rust diseases on a variety of ornamentals, including roses.

Oil phytotoxicity can occur if the product is not used properly. Plant damage can occur when: 1) too much is used, 2) plants are under water stress, 3) temperatures are over 90 degrees, and 4) when dormancy is mistaken (i.e., spraying too early in the fall). Apply dormant oils from December to February. Temperatures must be above 45 degrees. The LD50 of oil is 5,000 mg/kg.

One of the drawbacks of sulfur is its potential to cause plant injury in hot (90 degrees and above), dry weather.

Integrated Pest Management

The concept behind an integrated pest management program (IPM) is to incorporate many different tools to control pests, not to rely on just one product or method. All the pesticides described here, whether old or new, should be included in integrated control programs whenever possible.

Remember, these products are still pesticides, even though they are natural. Do not use them indiscriminately, but rather with care and certain precautions.

Bordeaux mixture, like sulfur and lime sulfur, also can be phytotoxic to plants.

Oil phytotoxicity can occur if the product is not used properly.

ALWAYS CAREFULLY READ AND FOLLOW LABEL INSTRUCTIONS.

Baking soda, or sodium bicarbonate is a natural substance and effective non-toxic control for certain fungi. It has been used for control of harmful fungi since at least early in the 20th century. Potassium bicarbonate is a synthesized byproduct of potassium hydroxide. Together these two substances are referred to as bicarbonates.

Although you can buy baking soda in the grocery store, the chemical is not legally registered for use as a fungicide. Until it is, Colorado State University cannot legally recommend the use of this chemical for disease control purposes. Applications must be treated as experimental on the part of the user.

¹ Colorado State University Cooperative Extension plant pathologist, Integrated Pest Management Program, Jefferson County.

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Soaps

Soaps have been used for 200 years or more and are effective against soft-bodied insects such as aphids, some scales, psyllids, whiteflies, thrips, mealybugs and spider mites. How soaps kill insects is poorly understood. It is thought that they remove the protective oils and waxy covering of the insect. They are strictly contact insecticides and must be applied directly to the insect to be effective.

Certain plants may be sensitive to soaps, resulting in leaf burn. To avoid phytotoxicity, always test a soap spray on a small area of the plant. Soaps can be purchased commercially, or you can make your own by mixing three to six tablespoons of dishwashing liquid with 1 gallon of water. Commercially produced insecticidal soaps have an LD50 of 16,900 mg/kg. For more information, see 5.547, *Insect Control: Soaps and Detergents*.

Bicarbonates

Sodium bicarbonate has the advantage that it is non-toxic, effective, readily available and very inexpensive. It has the disadvantage that it must be applied weekly to control powdery mildew, and a surfactant or liquid detergent must be added to the spray solution so that the sodium bicarbonate is spread evenly, preventing crystallization on rosebushes and other treated plants. Research at Cornell determined that a combination of baking soda and Sunspray horticultural oil applied to rose leaves infected with powdery mildew or black spot will significantly reduce the incidence of disease.

Timing and rates of baking soda application are important because leaf burning can occur if the level of sodium bicarbonate is too high. No phytotoxicity occurs on roses with rates as low as one percent sodium bicarbonate (one tablespoon baking soda plus 2.5 tablespoons Sunspray horticulture oil in one gallon of water). The chemicals were eradicated (i.e. disease incidence decreased upon application), whereas most fungicides on the market are protective in activity (they prevent further spread of the disease, do not erase, or eradicate what damage has already been done).

Potassium bicarbonate also controls powdery mildew on various plants and early blight on tomato. In fact disease control results with this type of bicarbonate have exceeded those of sodium bicarbonate. While sodium bicarbonate has some effect on the diseases mentioned above, it does not have enough of a control by itself to inspire product development on it. As a result potassium bicarbonate is legally labeled for disease control purposes and can be used for powdery mildew control on cucurbits, roses and grapes as well as early blight control on cucumber and tomato. Trade names include Kaligreen, Amicarb First Step and Remedy.

Diatomaceous Earth

Diatomaceous earth (DE) is a nontoxic insecticide mined from the fossilized silica shell remains of diatoms. Diatoms are single-celled or colonial algae in the class Bacillariophyceae.

DE absorbs the waxy layer on the surface of insect skins, causing the insect to dry out. It also can work as an abrasive, rupturing cuticle cells. The product is labeled to control slugs, grasshoppers, millipedes and sow bugs, as well as soft-bodied insects such as aphids.

DE is formulated as a dust, either alone or in combination with pyrethrin. With a low mammalian toxicity, the LD50 ranges from 3,160 to 8,000 mg/kg, depending on the formulation.

Another grade of DE is used as a filtering agent in swimming pools. Both swimming-pool grade and natural types of DE come from the same source but are processed differently. It is imperative that only the "natural" grades be used for insect control.