

Less Toxic Insecticides

While a good pest management plan will start with preventative, cultural and other non-chemical methods, these are sometimes not completely effective on their own. In this case a pesticide may be considered. If pesticide use is deemed necessary for control of the pest problem, it is good practice to use the least toxic pesticide that will do the job effectively. Although all pesticides are by their nature toxic in some way to some organisms, there are now a number of "less toxic" pesticide options.

Insecticides may be considered less toxic for several reasons. Generally they should pose less risk to human and environmental health than conventional insecticides. Many break down rapidly and do not accumulate in the body or environment. Some are very pest specific and do little or no damage to other organisms. Still others, such as bait stations, minimize human exposure to the pesticide.

While "organic" insecticides are often less damaging to the environment than conventional insecticides, they are still pesticides. All pesticides should be evaluated before selection for level of toxicity, effectiveness, environmental impacts and costs. Some "organic" pesticides are as toxic, or even more toxic, than some synthetic pesticides.

Soaps & Oils

Insecticidal soaps and oils have a number of advantages for controlling insects. They are virtually non-toxic to humans and other mammals, and are relatively safe to beneficial insects in the landscape. They control a wide range of common soft-bodied pests including aphids, mealybugs, thrips, whiteflies, mites, and scales. It is difficult for pests to develop resistance to oils and soaps. Soaps and oils are now readily available and relatively inexpensive.

Both soaps and oils can cause damage to plants if applied when plants are water stressed, temperatures are above 90 °F, or high humidity prevents rapid drying. Some plants are sensitive to oil sprays. Read and follow the label.

Since soaps and oils work on contact, an effective application must coat both the upper and lower leaf surfaces as well as stems for best results. Repeated applications may be necessary.

Soaps: Insecticidal soaps damage the protective coat of soft-bodied insects causing them to dehydrate.

Homemade soap recipes are not recommended because they may be more likely to cause foliage burn. Commercial insecticidal soaps are tested on plants and are less likely to cause damage. Some common product names include Safer Insecticidal Soap and M-Pede.

Horticultural Oils: Oil products smother soft bodied insects on contact. Oils are formulated as either summer or dormant oils. Dormant oils are heavier oils used on dormant plants to control overwintering insects (e.g., aphids, spider mites, and scales). Dormant oils will damage plants if used during the growing season. Summer oils are lighter and more refined and can be applied to both actively growing and dormant plants. Do not apply summer oils when the temperature is above 90 °F.

Some readily available summer weight horticultural oils include Ortho Volck Oil Spray, Sunspray, Control Solutions Ultra Fine Oil, and Green Light Horticultural Oil. Ferti-Lome produces a Dormant Oil Spray.

Botanical Insecticides

Botanical insecticides are naturally occurring toxins extracted from plants. There are several advantages to using botanical rather than synthetic insecticides. Plant derived insecticides breakdown quickly in the environment, resulting in little risk of residues on food crops and less risk to beneficial insects. Some materials can be used shortly before harvest. Most botanicals are rapid acting and most, but not all botanicals are of low to moderate toxicity to mammals. Because most botanical insecticides must be eaten by the insect pest, they are primarily harmful to these pests and do little harm to beneficial insects.

There can also be disadvantages to using these products. Rapid break down, while less risky to health and environment, often creates a need for precise timing or more frequent applications. Several botanical insecticides are quite toxic and should be handled accordingly. Some botanical insecticides can be difficult to find in local stores.

Neem is a relatively new and promising botanical insecticide made from extracts of Neem tree seeds. It is used to control a wide variety of insects including leafminers, whiteflies, thrips, caterpillars, aphids, mealybugs, spider mites, scale crawlers, and beetles. Neem is most effective against actively growing immature insects.

Azadirachtin, the active ingredient in neem extracts, has a very low mammalian toxicity. It acts as an insect feeding deterrent and growth regulator. Neem does not produce a quick knockdown and kill, but stops insect feeding. The treated insect usually cannot molt into its next life stage and dies without reproducing.

Many commercial neem products exist, including Azatin XL, Neemix, SouthernAg Triple Action Neem Oil and Safer BioNeem. These products are labeled for use on ornamentals, foliage plants, trees, shrubs and food crops. Many neem products and formulations are also effective as a fungicide against powdery mildew.

Limonene (also known as d-Limonene) is produced from citrus oils extracted from oranges and other

citrus fruit peels. It is used as a contact insecticide against ants, roaches, palmetto bugs, fleas, silverfish and many other insects. Limonene has low oral and dermal toxicity to mammals, birds and fish, although it can cause skin irritation or sensitization in some people.

Pesticide products containing limonene are used for flea and tick control on pets, insecticide sprays, outdoor dog and cat repellents, mosquito larvicides, and insect repellents. Many products containing limonene are labeled as safe for use in areas near food. Limonene is the active ingredient in Ortho Home Defense Indoor Insect Killer, Concern Citrus Home Pest Control, and in products made by Orange Guard. Safer Fire Ant Killer and Citrex Fire Ant Killer also contain d-Limonene.

Capsaicin is the material that makes chili peppers hot. It can be used on ornamentals outdoors and indoors for control of aphids, spider mites, thrips, whitefly, lace bugs, leafhoppers, and other pests. It is important to note that capsaicin containing products are primarily used to repel insects, rather than to kill existing infestations.

To date there is limited research showing the effectiveness of capsaicin products as insecticides, although they appear to be effective at repelling certain animal pests such as rabbits, deer and squirrels.

Products containing capsaicin include Hot Pepper Wax Insect Repellent and Bonide Hot Pepper Wax.

Pyrethrum is made from the finely powdered flowers of a species of daisy. The word pyrethrum is the name for the crude flower dust itself, and the term pyrethrins refers to the insecticidal compounds that are extracted from pyrethrum. Pyrethroids are not botanical insecticides, but synthetic pesticides that are very similar in structure to the pyrethrins.

Pyrethrum is a contact insecticide and must be applied directly to the insect to be effective. Pyrethrum rapidly paralyzes pests, but may not kill them. Pyrethrum and pyrethrins are often formulated with another insecticide to ensure that paralyzed insects do not recover and once again become pests.

Because the pyrethrum mammalian toxicity is very low, it can be applied to food crops close to harvest. Pyrethrum has high contact toxicity for common beneficial insects.

Pyrethrum and pyrethrins are marketed under a wide variety of trade names, including Concern Multi-Purpose Insect Killer and Natural Guard Natural Insect Spray.

Garlic is marketed in several products intended to repel insects, much as capsaicin does. Products are labeled to repel a wide variety of pests on ornamental plants, but garlic may also repel beneficial insects. To date there is little research showing effectiveness of garlic insecticides.

Products containing garlic or garlic oil include Garlic Barrier and Mosquito Barrier.

Rotenone is one of the most toxic of the commonly-used botanical insecticides. Rotenone acts as a nervous system poison. It is highly toxic to fish and other aquatic life and is commonly used as a fish poison. Rotenone can be toxic to mammals through inhalation and may cause skin irritation. Rotenone will also kill many beneficial insects and should only be used to control severe insect infestations. In most cases, other, safer pesticides should be used in preference to rotenone.

Sabadilla & Ryania are older botanical insecticides that are rarely available. No sabadilla or ryania products could be found that are currently registered for use in South Carolina.

Nicotine derived from tobacco, is one of the most toxic botanicals. It is a fast-acting nerve toxin and is highly toxic to mammals. It is easily absorbed through the eyes, skin, and mucous membranes. Because of its high toxicity it is no longer registered for use as a pesticide. Home brewed nicotine preparations can also be quite toxic. Less harmful products will produce equal results.

Essential Oils

A variety of pesticides based on essential oils or components of essential oils have come on the market in the last few years. Essential oils are volatile, highly concentrated substances extracted from plant parts. In 1996 the EPA established that

certain ingredients that pose minimum risk to users no longer require EPA approval to be marketed as insecticides. A number of these ingredients are essential oils, including the oils of cedar, cinnamon, citronella, citrus, clove, eugenol (a component of clove oil), garlic, mints, rosemary, and several others. As insecticides, these work most commonly as contact killing agents only, so re-treatment may be needed. Most essential oils used as pesticides work by disrupting an insect neurotransmitter that is not present in people, pets, or other vertebrates.

Eugenol is a component of clove oil. It is a fast acting contact insecticide that is effective on a wide variety of household pests such as cockroaches, ants, dust mites, flies, wasps, spiders, crickets, and fleas. It is also used on some ornamental plant pests such as armyworms, thrips, aphids and mites.

Eugenol has little or no residual activity, although the scent of cloves will linger. Products based on eugenol are considered minimum risk pesticides with very low risk of damage to the environment or user.

Products that contain eugenol include Bioganic Brand's Flying Insect Killer and Bioganic Lawn and Garden Spray.

Microbial Insecticides

Microbial insecticides contain microorganisms (viruses, bacteria, fungi, protozoa, or nematodes) or their by-products. Microbial insecticides are especially valuable because their toxicity to nontarget animals and humans is extremely low.

Insecticidal products comprised of a single species of microorganism may be active against a wide variety of insects or group of related insects (such as caterpillars) or they may be effective against only one or a few species. Most are very specific. Since there is such a narrow range of insects killed, they spare the beneficial insects almost entirely.

Bacillus thuringiensis products are the most widely used microbial insecticides in the United States. They are commonly known as *Bt*. Different subspecies of *Bt* are effective against different groups of insects or their larvae.

You will achieve the best results with *Bt* products by following a few guidelines.

- Make sure the *Bt* product you have chosen lists the specific insect you want to control.
- Make sure the insect is at a stage where it is susceptible to control by *Bt*. In general, *Bt* products are effective against young larval stages but will not kill adults.
- Spray the parts of the plant on which insects are feeding thoroughly, including the underside of leaves. *Bt* products must be eaten in order to be effective.
- Treat with *Bt* in late afternoon or evening, or on a cloudy day as *Bt* breaks down in sunlight.
- Be aware that *Bt* does not kill immediately, but that poisoned insects will stop feeding almost immediately.

Bacillus thuringiensis var. kurstaki (Btk) products are toxic only to larvae of butterflies and moths. They are used to control many common leaf-feeding caterpillars, including caterpillar pests on vegetables, bagworms and tent caterpillars on trees and shrubs, and European corn borer larvae.

Some caterpillars are not effectively controlled by *Bt*, especially those that live in the soil or bore into plant tissues without consuming a significant amount of the *Bt* applied to plant surfaces.

Bacillus thuringiensis var. kurstaki products include Dipel, Javelin, Thuricide, Safer Caterpillar Killer, and several others.

Bacillus thuringiensis var. israelensis (Bti) formulations kill mosquito, black fly, and fungus gnat larvae. *Bti* is most effective for mosquito or black fly control when it is used on a community-wide basis. For most homeowners, eliminating standing water sources is more effective than applying *Bti* or other insecticides. Floating products sold as dunks or pellets can eliminate mosquito larvae in ornamental ponds and other areas that cannot be drained.

Bti products that are available commercially include Mosquito Dunks, Vectobac, Teknar, and Bactimos.

Bacillus thuringiensis var. tenebrionis (Btt) products are toxic to certain beetles. They are

commonly used to control Colorado potato beetle and elm leaf beetle adults and larvae, but are not pathogenic or toxic to some other key beetle pests. Bonide Colorado Potato Beetle Beater, and Novodor are products containing *Btt*.

Milky Spore products contain the bacteria *Bacillus popilliae* and *Bacillus lentimorbus*. Milky spore is applied to turf and watered into the soil below to control the larval (grub) stage of the Japanese beetle and, less effectively, some other beetle grubs. If a substantial grub population is present at the time of application, milky spore can survive beneath undisturbed sod for a period of 15 to 20 years. Consequently, lawn applications of milky spore bacteria might not have to be repeated each year.

Spinosad is an insect toxin derived from a soil-dwelling bacterium. It kills primarily by ingestion and is used against fire ants, caterpillars, thrips, whiteflies, aphids, leaf miners, scales and plant bugs. It is also used against borers of fruit trees. When applied at recommended rates, this product poses less risk than most insecticides to mammals, birds, fish, and beneficial insects. It is, however, toxic to bees, and should not be applied to plants in flower. Affected pests stop feeding within minutes, but may remain on the plant for up to two days.

Ferti-lome Borer, Bagworm, Leafminer & Tent Caterpillar Spray contains spinosad. Fire ant baits formulated with spinosad include Conserve Fire Ant Bait, Justice, Payback Spinosad Fire Ant Bait and Eliminator Fire Ant Killer Bait.

Beauveria bassiana is a fungus that attacks and kills a variety of immature and adult insects. Insects effected by various formulations include whiteflies, aphids, mites, caterpillars, leaf hoppers, grasshoppers, Colorado potato beetles, Mexican bean beetles, Japanese beetles, boll weevils, cutworms, sod webworms, bark beetles, chinch bugs, fire ants, European corn borers, and codling moths. Beneficial insects, such as lady beetles, are also susceptible.

Products containing *Beauveria* work best when applied at the onset of an infestation. It typically takes three to seven days after application for the spores to germinate, penetrate, and grow throughout the insect, thus killing them. Thorough spray

coverage is essential because fungal spores must contact the insect for infection to occur. Commercial products contain spores that germinate after application. New formulations do not require high humidity in order to provide effective control. Commercial products containing *Beauveria* include Naturalis H&G and Botanigard.

Beneficial Nematodes Nematodes are microscopic, worm-like parasites. While some species of nematodes are pests of turf grass and other plants, others are beneficial, being parasites of harmful insects. Since beneficial nematodes can not develop in vertebrate animals, they are very safe for use in pest control.

Beneficial nematodes can be used to control a variety of plant pests, including larvae of black vine weevil, clearwing borers, cutworms, sod webworms, mole crickets and white grubs. It is important to select the proper nematode species when trying to control a particular pest.

Nematodes can be difficult to use for most home gardeners. They must be shipped, stored and used under specific temperature and moisture conditions, and generally must be used very soon after shipping. For this reason, they are best ordered from suppliers immediately after a pest problem is observed.

A number of nematode products are available by mail order. Be sure the product you are ordering is specified for the pest you have and that you are able to provide proper environmental conditions for the nematodes. In general, nematodes require moist conditions, high humidity, and temperatures between 55 and 90 °F with little direct sunlight.

Minerals

Diatomaceous Earth is a nontoxic powder composed of fossilized, one-celled organisms called diatoms. It is used to control slugs, millipedes, sow bugs, cockroaches, ants and soft-bodied insects like aphids. It has low mammalian toxicity. Use the "natural grade," not the type used as a filtering agent in swimming pools.

Prolonged exposure to diatomaceous earth will irritate lungs and other tissues of people or pets. Because it also kills honeybees, avoid applying the product to crops in flower. Commercial products include Concern Diatomaceous Earth and Natural Guard Diatomaceous Earth.

Kaolin Clay products act as a barrier that irritates insects and disguises the host plant by coating it with a ghostly white film. Insects are apparently unable to recognize plants treated with kaolin. It is most commonly used against a wide variety of pests on apple and pear trees. Also, kaolin can be used to control Japanese beetles, tarnished plant bugs, thrips, leafhoppers, cucumber beetles and Colorado potato beetles on vegetable crops. Kaolin must be applied as a preventative to be effective and can not control a pest that is already established.

Kaolin clay can be applied up to the day of harvest and is non-toxic. Kaolin is sold as Surround Crop Protectant.

Sodium Fluoroaluminate is a mineral that forms sharp, glass-like particles that puncture insect gut cells if ingested. Since it only affects insects that have eaten treated leaves, it does not adversely affect beneficial predators and parasites. It is effectively used against leaf feeding caterpillars, sawflies and beetles. Sodium fluoroaluminate is sold as Kryocide.

Boric Acid is derived from boron, a naturally occurring mineral. It acts as a stomach poison and causes insects to die from starvation. Boric acid is available in powder, paste, aerosol, tablet, and liquid forms for use against cockroaches, ants, and other insects. Most boric acid products are available as ready-to-use products. Boric acid is sold under a number of brand names, including Roach Prufe, Terro Ant Killer II and Borid.

Silica Gel is an inert, nonabrasive material that is very effective in absorbing moisture. It absorbs the waxy coating on the insect's body and causes death by dehydration. Silica gel products are often used by professional pest control operators to control cockroaches, silverfish, and other pests.

Sulfur is probably the oldest known pesticide in current use. It can be used as a dust, wettable powder, paste or liquid, and is primarily for disease control. However, mites, psyllids and thrips are also controlled by sulfur. Sulfur is nontoxic to mammals, but may irritate skin or especially eyes. Sulfur is also used as a fungicide to control powdery mildew, rusts, brown rot and leaf spots on fruits, vegetables and ornamentals.

Sulfur has the potential to damage plants in hot, dry weather. It is also incompatible with other pesticides. Do not use sulfur within 20 to 30 days of applying spray oils to plants as it reacts with the oils and is more likely to cause damage to foliage. Do not apply sulfur when temperatures are above 80 °F.

Insect Growth Regulators

Insect growth regulators (IGRs) are juvenile insect hormone analogs. They interfere with egg development and molting of various insect life stages. Because of their mode of action, they are very safe for vertebrate animals. IGRs are among the safest pesticides for application in homes. They are primarily used in homes for flea control. More information is available in [EIS/HS-2, Flea Control](#).

Two commonly available IGRs are methoprene (Precor) and pyriproxyfen (Nylar).

Safer Formulations

Bait Stations deliver an insecticide through a sealed plastic or metal chamber that insects enter. This gives bait stations the advantage of decreasing both the amount of insecticide used and the

likelihood of exposure to it. Bait stations are particularly suitable for use in situations where the safety of children is a concern, or in areas where food is prepared or stored.

Numerous brands of bait stations are commonly available to control cockroaches and ants.

Pesticide Safety

Always read the pesticide label and follow its directions exactly. You may *only* use the pesticide on sites or crops listed on the label. Be sure to observe all special precautions that are listed on the label. Wear protective clothing or equipment as listed on the label when mixing or applying pesticides. Mix pesticides at the rate recommended for the target site as listed on the label. Never use more than the label says. Follow all label directions for safe pesticide storage and disposal. Always remember to read and heed the six most important words on the label: "**KEEP OUT OF REACH OF CHILDREN.**"

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