Alternatives to Using Chlorpyrifos

By Kagan Owens

Chlorpyrifos, the active ingredient in over 800 pesti cide products, is used to control numerous pest prob lems. When looking for alternatives to using this chemical you must remember that one chemical cannot be swiped out for another. In order to identify an alternative to using chlorpyrifos it is necessary to first identify the pest problem.

It is important to remember when controlling a pest problem to look for long-term solutions not just a temporary control. Instead of addressing the cause of pest problems, many pesticides only treat the symptoms, without changing the structural problems that create an environment conducive to their existence. Pesticides are often ineffective over the long term and the most common pests are now resistant to many insecticides.

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Simple changes in your environment can significantly reduce pest populations. Before reaching for a pesticide, monitor the pest population, make structural repairs, use proper sanitation inside and outside, and modify the pest's habitat. Any openings that pests are using to access the structure should be caulked, screened or repaired. Some outdoor pests are attracted to spilled greasy or sugary liquids, improperly stored garbage, untended pet foods or explosions of naturally-occurring food sources like aphids or scale infestations on nearby plants. Efforts to eliminate food sources may eliminate the pest problems.

Following is a brief description of some alternatives to using chlorpyrifos to control common pest problems. Use Table 1 to identify which alternatives can be used to eradicate a specific pest problem.

Non-Toxic Solutions

Heat treatments are effective in controlling pest populations for those pests that have minimum and maximum temperatures beyond which they cannot survive. Heat treatments require raising the temperature of a structure to 120 degrees F or more. Special equipment composed of a heating unit, blowers and ducts carries the heat to the locations in the structure where the pests are causing damage. Heat treatment field tests have killed insects inside wood without damaging the building or furnishings, although certain sensitive appliances should be removed as a precaution.

Cold treatments of liquid nitrogen can also eradicate pests that live in a narrow temperature range. Liquid nitrogen can be pumped into walls, which freezes the pest, killing them, then warms and evaporates. Because nitrogen is a natural part of our atmosphere, it does not have the dangers associated with the use of synthetic pesticides.

Electrical currents can be used to kill insects that nest in the walls of a structure. The Electorgun™ uses low wattage, high voltage, and high frequency to kill the insects. It does not emit microwaves, x-rays, ultraviolet rays or other potentially harmful radiation. Tests have shown the gun to be very effective. Existing pest holes and holes drilled into the nests by the operator are used as entry points for the electricity. Tests show that whereas some termites die immediately, others may take weeks to die, but that they all die eventually.

Fatty-acid soap and water can be used to control pests. The fatty acids in soaps serve as an insecticide killing pests on contact. Aphids, which attract ants, can be controlled by treating the aphids directly with insecticidal soaps. Direct action against individual fire ant nests include pouring boiling or soapy water directly into the hole.

Beneficial nematodes are microscopic soil-dwelling worms that actively search for insects like pre-adult fleas, fire ants, or termites in the yard. After invading the larvae or pupae, they release a bacterium that kills the host within 48 hours. The nematodes then feed on the pest's body, reproduce and seek out more pests. When all larvae and pupae are killed, the nematodes die off and biodegrade. Numerous pest problems can be controlled or eliminated by using biological controls that have a minimal impact on non-target species and offer long-term solutions.

Milky spore disease, ***Bacillus popilliae*** is a nontoxic way to control grubs. Commercial milky spore dust is made by inoculating beetle grubs with the disease and then extracting the spores, which resemble dust or powder when dry. The spores can be applied any time except when the ground is frozen or a strong wind is blowing. Grubs become infected when they feed on the thatch or roots of grass where the spores have been applied. As the infected grubs move about in the soil, then die and disintegrate, they release one or two billion spores back into the soil. This spreads the disease to succeeding generations of grubs. If the conditions are right, grub population high and feeding vigorously, and soil is at least 70 degrees F and very moist, the disease can spread through the grub population in a week or two. In general, however, the disease should not be thought of as a quick knockdown insecticide. It may take a season or two before it has a substantial impact.

Bacillus thuringiensis (B.t.) is a naturally occurring soil bacterium; it is a spore-forming rod and an insect pathogen. Different strains are toxic to particular kinds of insects. There are nearly 400 registered products that have been marketed in the country, providing effective control of such major insect pests as gypsy moths, mosquitoes, blackflies, and many others. These B.t. strains are only effective against insects in their larval feeding stages, since B.t. must be ingested to be effective. Depending on how much B.t. is ingested, insect larva soon stop feeding and are dead in a few days to a few weeks. B.t. is completely biodegradable, and does not persist in the digestive systems of birds or mammals. There is no evidence that B.t. goes on to reproduce in the wild. B.t.'s short biological half-life and high specificity makes the development of field resistance much more unlikely than with chemical pesticides if used in a targeted fashion.

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Least Toxic Pesticides

Because of the high toxicity of conventional pesticides and the high levels of exposure to people and pests that result from their use, it is wise to avoid them. Pesticides are products that are designed to kill living organisms and should be treated with caution. If pesticides are used, it is best to go with baits or crack and crevice spot treatments and use the least toxic pesticide available and only after non-toxic alternatives have been tried.

Boric Acid is a low-toxicity mineral with insecticidal properties. It does not evaporate or volatilize into the air or pose the considerable health concerns associated with synthetic pesticides; however it can still pose health hazards and should be used with care. Insects travel through the boric acid, which adheres to their legs. When the insects groom themselves, they then ingest the poison, which causes death three to ten days later of starvation and dehydration. As long as the material is not allowed to become wet, its continuous presence ensures that hatching insects, which sprays commonly spare, are exposed and die. Because boric acid is a stomach poison, don't expect immediate results – it may take weeks or even months to completely get rid of the pest problem. While boric acid is somewhat slower acting than the synthetic pesticides, like chlorpyrifos, diazinon, or pyrethrins, it is highly effective over a long period of time. At least one study has shown that the combination of heat, 110 degree F for two hours with boric acid, will increase the speed at which the German cockroach is killed. As with any pesticide, keep boric acid pesticide products out of reach of children and only use it in locations where it will not come in contact with people or animals, such as in cracks and crevices, behind counters, and in baseboards.

Diatomaceous earth and silica aerogels are insecticidal dusts that kill pests by breaking through their outer cuticle, which protects them from excess moisture loss. When the dust comes in contact with the pest, it abrades their outer shell, dehydrating and finally killing the pest. Because the dusts are inorganic, they can remain effective for a very long time. Although they are made of inert material and are relatively safe, care should be taken to avoid inhalation. Be aware that they have been combined with pyrethrin insecticides in various products; and there are serious health concerns associated with the use of pyrethrins. With diatomaceous earth, it is important that natural, not swimming pool grade, be used. Swimming pool grade has been refined in such a manner that makes it more harmful to human lungs. Silica aerogels are higher in acute toxicity and tend to kill insects more quickly than diatomaceous earth. Silica aerogels are toxic to fish, so they should not be applied where they could run off into a stream, pond or lake.

Botanical pesticides are derived from plants that are known to have insecticidal properties. It is important to remember that just because a pesticide is derived from a plant does not mean that it is safe for humans and other mammals or that it cannot kill a wide variety of other life. Many botanical insecticides are formulated with synergists. These have no insecticidal effect of their own, but serve to enhance the insecticidal effect of the botanicals. Carefully read the labels on all products before use to make sure that they do not also contain toxic pesticides. Some botanical pesticides can be quite toxic to humans and should not be used. Neem oil and garlic oil are two least-toxic botanical pesticides listed below. Others that can also be used as a last resort are citrus oils, mint oil, pine oil and herbal extracts.

Neem oil, extracted from the tropical neem tree, contains insecticidal properties that are composed of a complex mixture of biologically active compounds. It has a strong, unpleasant odor and a bitter taste. Its various active ingredients act as repellents, feeding inhibitors, egg-laying deterrents, growth retardants, sterilants and direct toxins. Neem has both contact and systemic action in plants. The active ingredients biodegrade rapidly in sunlight and within a few weeks in the soil.

Garlic oil exhibits antibacterial, antifungal, amebicidal and insecticidal qualities. Although garlic oils kill pest insects and some pathogens, it also kills beneficial insects and microbes. Thus, it is not recommend as an all-purpose spray for outdoor use.

If you have a pest problem, contact Beyond Pesticides/NCAMP for a detailed information packet on how to control the pest using non and least toxic methods.

Table 1. Non- and Least Toxic Alternatives to Using Chlorpyrifos

Ants
Heat treatment
Cold treatment
Electrical current
Fatty acid soap
Beneficial nematodes, *Steinernema* sp.
Spinosad
Diatomaceous earth
Boric acid
Botanical pesticides: d-limonene, mint oil, herbal extracts, orange oil, pine oil, garlic

Chinch Bug
Beneficial fungus, *Beauveria* spp.
Beneficial wasp, *Eumicrosoma beneficum*
Insecticidal soap
Silica aerogel

Cockroaches
Electrical currents
Heat treatment
Beneficial fungus: *Metarhiziumanisopliae*
Diatomaceous earth
Boric acid
Botanical pesticides: orange oil, mint oil, herbal oil, neem

Crickets
Beneficial fungal pathogen: *Beauveria bassiana*
Insecticidal soap
Diatomaceous earth
Boric acid
Botanical pesticides: neem

Fleas
Beneficial nematodes
Insecticidal soap
Boric acid
Diatomaceous earth
Silica aerogel
Botanical: limonene and herbal oil extract

Flies
Beneficial nematodes, parasitoids, parasitic mites
Botanical repellents
Diatomaceous earth
Silica aerogels

Gypsy moths
Microbial insecticide: Bacillus thuringiensis
Spinosad

Japanese beetles/grubs
Milky spore
Beneficial nematodes
Botanical pesticides: neem

Mosquitoes
Carbon dioxide traps
Bat houses
Purple martin houses
Microbial insecticides: *Bacillus thuringensis Israeliensis*, and *Bacillus sphaericus*
Mosquito fish, *Gambusia affinis*
Botanical pesticides: herbal extracts, neem

Termites
Heat treatment
Cold treatment
Termite shield
Electrical currents
Beneficial nematodes, *Steinernema carpocapsae*
Microbial termiticide: *Metarhizium anisopliae*
Spinosad
Diatomaceous earth
Silica gel
Boric acid
Botanical pesticides: neem

Wasp and Hornets
Physical traps
Insecticidal soap
Boric acid
Diatomaceous earth
Silica aerogels
Botanical oil: mint oil

Webworms/Cutworms/Caterpillars
Beneficial Nematodes
Microbial insecticide: *Bacillus thuringiensis*
Spinosad
Beneficial Endophytic fungi
Insecticidal soaps
Free roaming chickens