Non-Toxic, Organic Lawn & Garden Care

The lawn and garden section of home improvement stores, department stores, and nurseries are filled with pesticides and chemical fertilizers. Pesticides poison the air, leach into soils, and contaminate groundwater, wetlands, streams, rivers, and coastal waters. Chemical fertilizers deplete soil over time, harm microorganisms vital to soil health, and can build up in waterways.

No doubt slugs and certain insects can wreak havoc in an Alaskan garden, and we've all encountered dandelions growing where we wish they wouldn't, but you don't have to use harmful pesticides to eliminate weeds or control pests. There are safer alternatives!

You can prevent or minimize pest damage and weed problems by developing an understanding of the relationships among living organisms in your home landscape and by caring for the ecosystem as a whole. If problems do arise, you can address these using safe, non-toxic methods.

(Over)

ACAT
Alaska Community Action on Toxics
(907) 222-7714 www.akaction.org

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Remember:

- **Healthy soils support healthy plants.** Healthy soils have adequate nutrients and organic matter and are alive with beneficial bacteria, microorganisms, fungi, nematodes, and earthworms.
- **Strong, healthy plants are more resistant** to weeds and pests than are weak, unhealthy ones.
- **Certain pests prefer some plant species** over others. Knowing which plants are vulnerable to which pests can help you implement effective pest prevention and control strategies. *Please see the blue pest sheets to learn about common pest species in Alaska, signs of infestation, and what you can do.*
- **Not all insects are harmful**; the majority of insects are actually beneficial to plants.
- **Chemical pesticides do not discern** between harmful and beneficial insects – they poison all of them, as well as other animals, and people. *Please see the yellow pesticide fact sheets for information on health effects that have been associated with exposure to common pesticides.*
- Botanical insecticides (such as neem), insecticidal soap, and other non-chemical pesticides may also have adverse effects and should be researched individually.

Natural Pest Control Tips-at-a-Glance

- Build healthy soils that contain plenty of organic matter (such as compost) to nurture the overall health of your plants. Be sure that you are providing your plants with organic sources of nitrogen, phosphorus, and potassium in sufficient amounts to cultivate strong, healthy plants.
- Plant a variety of herbs and flowers among your vegetables. Some plants are believed to repel pest insects and others are known to attract beneficial insects. This is one form of "companion planting" that can protect neighboring plants.
- Avoid planting too many of one kind of plant together. A monocrop will be more attractive to the pests that target that plant. Interplanting can confuse pests, preventing them from attacking one plant after another. Mixed plantings can also be beneficial in other ways. For example, legumes (such as peas) fix nitrogen from the atmosphere and lettuce requires abundant nitrogen, so why not plant them together! Look for companion planting in the index of any organic gardening book and you will find many helpful suggestions.

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Tips for Non-Toxic Prevention & Control of Weeds

Healthy Lawns

Remember, healthy turf will outcompete weeds. Sound cultural practices such as maintaining healthy soil, using varieties of turf grasses that are suitable for our climate, mowing high, avoiding compaction of turf and proper watering can all help your lawn ecosystem develop a natural resistance to weeds.

- To maintain the health of your soil: Have your soil tested to find out what nutrients may be needed and address any deficiencies using organic fertilizers. Apply ¼ inch of compost as a top dressing each spring. Apply compost tea a few times during the growing season.
- Reseed bare patches or thin areas of your lawn in spring. Remember, healthy turf will leave no habitat for weeds to take hold.
- Increase mowing height to 2.5 to 3 inches to develop drought resistance and allow for better photosynthesis.
- Be sure to remove excess thatch (the layer of grass stems, roots, clippings, and debris that build up on the surface of the soil). This will reduce grass susceptibility to insects, disease, and weather stress.
- Aerate your lawn to help water reach the turf roots.
- Heavy foot traffic will compact turf, making it more susceptible to weeds. A sensible landscape design should minimize stress to turf through the creation of pathways where needed.

If after following the above recommendations, you still have more weeds than you can tolerate:

- Hand-pull weeds. Make it a family affair!
- Apply natural pre-emergent herbicides such as corn gluten meal to weed prone areas (be patient as it can take a few years of application before you see results).
- A spot treatment of 50/50 mixture of household vinegar and hot water can be effective against dandelions, but be careful not to spray on other plants.

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▪ Flame weeding machines use a targeted flame to kill weeds. This is best done when the plant is young and only a few inches tall.

Tips for Non-Toxic Control of Weeds in Vegetable and Flower Beds

▪ Mulch to suppress weeds. Experiment with organic mulching materials that are readily available. Seasoned compost, straw (not hay which has seeds), chopped leaves, and grass clippings are some examples of organic mulch.

▪ Hand-pull weeds when they are small, so as to remove the entire root system and so less nutrients are lost to the weed plant.

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Organic Fertilizers vs. Chemical Fertilizers

All plants require adequate nitrogen (N), phosphorus (P), and potassium (K) for healthy growth. In addition to these three key nutrients, plants also need calcium, sulfur, magnesium and certain trace minerals to survive. You do not have to use chemical fertilizers to provide the necessary nutrients to grow strong, healthy plants. Chemical fertilizers will, in fact, deplete soil over time, kill important organisms that live in the soil and make nutrients available to plants, and can pollute our waterways harming fish and wildlife.

Key differences between organic fertilizers and chemical fertilizers:

- Organic fertilizers come from organic materials such as cottonseed meal, fish emulsion, manure, bone meal, kelp, etc. whereas chemical fertilizers are synthesized from inorganic materials.
- Organic nutrients can improve the long-term health of the soil whereas chemical fertilizers will gradually deplete and degrade the soil, eventually resulting in reduced productivity.
- Organic nutrients increase the abundance of microorganisms in the soil whereas chemical fertilizers will kill important living organisms in the soil. (The sulfuric and hydrochloric acids found in many chemical fertilizers destroy certain bacteria that make nitrogen available to plants.)
- Organic sources of nutrients replenish trace minerals taken up by plants, whereas chemical fertilizers do not.
- Over-fertilizing plants with chemical fertilizers will harm them; with the exception of certain manures, it is difficult to over-fertilize with organic fertilizers.
- Use of chemical fertilizers can lead to weakened plants that are more vulnerable to pests (leading gardeners to turn to pesticides) and prone to disease whereas use of organic

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fertilizers builds healthy soils that support strong plants with better natural resistance to pests and disease.

- Organic fertilizers release their nutrients more slowly than chemical fertilizers.

Of all the differences between organic and chemical fertilizers, the slow release of nutrients from organic sources is one that gives gardeners trouble, but it doesn't have to. If you add organic fertilizer in the fall, the nutrients will be available in the soil by the time you are ready to plant in the spring. You may also need to apply organic liquid fertilizers, such as compost tea and fish emulsion to give your plants nutrients throughout the growing season.

It's all about the soil!

While selecting the right plant varieties for Alaska and proper watering are important keys to successful gardening, it is also critical to feed the soil. In nature, most nutrients taken up by plants are returned to the soil through decomposition and nutrient cycling. For example, when trees and shrubs lose their leaves and plants die back in the fall, bacteria and fungi break them down into their constituent elements. When we grow vegetables and enjoy our harvest, we are taking up the nutrients in the plant that took up the nutrients from the soil. That's why it is so important to replenish the soil by adding back plenty of organic matter (such as compost) and by adding organic sources of macro (N-P-K) and micro nutrients in the form of natural and organic fertilizers.

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Aphids: *Family Aphididae*

Aphids are pear-shaped soft-bodied insects that are usually less than 1/8" long. While they are usually light green, they range in color and may be yellow, pink, black or purplish-brown. Adult aphids may be winged or wingless and young aphids (nymphs) resemble adults. Aphids injure the plant by sucking its sap with their needle-like mouth parts, causing leaf distortion and reduced plant growth and vigor. Aphids can also transmit plant diseases. Aphids excrete a greenish yellow sticky substance called "honeydew" on which a sooty black mold grows and may cover the plant or structure.

Target Plants
Aphids target all vegetables and many trees and shrubs.

Signs of Plant Infestation
Aphid damaged leaves are often puckered, twisted and full of little aphids. On flowers, aphids will be found on deformed flowers or hiding behind the flower. Aphids may also chew holes in roots or stems, and may usually be found near the damaged part of the plant.

What You Can Do
- Tolerate low numbers of aphids. Most plants can handle a low to moderate amount of aphids.[1]
- Plant a variety of flowering plants to attract beneficial insects that feed on aphids.[1]
- Use a high pressure spray of water frequently to dislodge the aphids.[2]
- Manually rub aphids off of plants with your fingers.
- Prune away heavily infested plant parts, but avoid excessive pruning.[1]
- A dilute spray of castile soap and water can be effective against aphids.
- Use slow release fertilizers like compost tea. Some aphids reproduce more quickly on plants with high levels of nitrogen in their leaves and buds.[1]
- Make sure your plant has enough water and light so that it can resist aphids.[3]
- Use row cover to exclude pests, but allow light and nutrients to reach the plants.[1]

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- Wash gardening tools and pruning shears before using them on another plant.[4]
- Consider buying lacewings and parasitic moths for use in greenhouses[1,5]
- Plant trees so that they are not close to houses or other structures where aphids can leave their "honeydew".[6]

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[1]Our Water, Our World. 2007. Controlling aphids in your garden. Available: http://www.panna.org/files/aphids101.pdf [Accessed 25 February 2010].
[2] Bettini, L. 2005. Identifying and Controlling Pests in Alaska Using Integrated Pest Management Techniques. University of Alaska Fairbanks Cooperative Extension Service.
[3] Oregon State Univ. Extension & Experiment Station Communications. Undated. Gardening information.
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[4] Univ. of Kentucky Entomology. 1994. Houseplant insect control. www.uky.edu/Agriculture/Entomology/entfacts/trees/ef406.htm
[5] Bradley FM, Ellis BW, & Martin DL (editors). 2009. The organic gardener's handbook of natural pest and disease control. New York: Rodale Inc., p. 251.
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Birch Leaf Rollers:

Lepidoptera order (various species)


Leaf rollers are caterpillars of small grey-brown moths. Their characteristic habit of webbing and rolling leaves as they feed causes temporary growth reduction to the host plant, occasional branch die-back, and rarely, tree death. Adult moths are usually seen on birch twigs or on surrounding ground plants in August.

Target Plants
Birch trees

Signs of Infestation
These caterpillars roll birch leaves into a cylinder and chew small holes into the edges of the leaves.

What You Can Do
- Maintain tree health and vigor by ensuring that the trees are properly irrigated.[1]
- Prevent bark, limb, and root injuries by keeping lawn-mowers and weed whackers away from trees.
- Avoid damaging the root system by driving on roots, putting excessive weight on roots, or removing soil above the roots.
- Properly prune heavily infested twigs.[2]

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Cutworms (*Family Noctuidae)*

Cutworms are soil-dwelling caterpillars of different species of night-flying moths. The large, robust, brownish or grey caterpillars characteristically curl into a "C" shape when disturbed. Cutworms generally feed at night on young seedlings and transplants, clipping the plant off at the soil level making it look like a lawnmower attacked your plants. Some cutworms climb mature plants and eat the leaves and fruit.

Target Plants
All garden vegetables and flowers, especially young seedlings and transplants.

Signs of Infestation
Cutworms chew the edges of flowers and may eat most of the petals. They may also chew tender seedlings off at the stem near the ground level. Look to see if C-shaped caterpillars are hiding near your plants.

What You Can Do
- Keep areas surrounding garden free of weeds and sod to decrease cutworm habitat.[1]
- Turn the soil in the spring and fall to expose them to weather and predators.[2]
- Make collars to protect young transplants. You can use cardboard, stiff paper, aluminum foil, plastic or tin cans with both ends removed to fashion a collar. The collar should extend 1-2" into the soil and 2-3" above the soil.[2]
- Putting a wooden stick next to your plant will stop cutworms from completely encircling your plant and biting it off at the stalk.[2]
- Monitoring your garden in early spring can make a big impact. If you find a plant that has been severed at the stalk, scratch the soil near the plant to find the cutworms. You will find more cutworms if you monitor your garden at night as this is the time when cutworms are most active.[2]
- Floating row covers can be placed around developing plants to keep cutworms out, but this will not prevent damage from cutworms that overwintered in the soil near your plant.[2] Reusable fabric row covers are recommended

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- Encourage the cutworms' natural enemies which include ground beetles, rove beetles, spiders, wasps, toads, parasitic nematodes and birds.[2]

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Fungus Gnats: *Bradysia spp.*

Fungus gnats are tiny black or dark brown flies often seen in large numbers flying near areas of high moisture. The larvae are clear with visible organs and a shiny black head. They live in the soil, especially soils high in organic matter. Damage caused by fungus gnat larvae occurs when they are feeding on or injuring tiny roots. The adults are considered bothersome due to their flying behavior and sheer numbers.

Target plants
All greenhouse plants and houseplants.

Signs of Infestation
Fungus gnats may frequently be detected on the underside of leaves or on the moist soil near plants. They leave slime trails on plants which turn dark brown or black and may spread diseases to plants that stunt their growth.

What You Can Do
- Hand vacuum visible pests off plants.[1]
- Use sticky traps for adult gnats.[1]
- Biological control organisms such as nematodes and soil-inhabiting predaceous mites *(Hypoaspis miles)*, have been effective.[1]
- Use raw potato cubes to monitor for fungus gnat larvae.[2] To determine whether the soil is infested, take a 1 inch cube or slice of raw potato and embed it 3/8" into the soil. Pick up and examine the potato and the soil just beneath it twice a week to determine if you have a fungus gnat infestation.

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Larch Sawfly: *Pristiphora erichsonil*

The larch sawfly was first recorded in Alaska in 1965 and has been considered by many to be a nuisance ever since. In south-central Alaska, it has voraciously attacked Siberian Larches in the Mat-Su Valley, Anchorage, and the Kenai Peninsula. Larch sawfly larvae have brown or black heads, cream colored bodies and are about ½" long. Adult females are about 3/8" long with a broad orange band around the abdomen, black bodies and black antennae. Adult males can be identified by their yellowish antennae and their orange abdominal band.

Target Plants
Siberian larches and tamarack (eastern larch).

Signs of Infestation
Attacks by larch sawflies can thin foliage, kill branches, and cause significant growth loss. The tops of trees may be notably defoliated.

What You Can Do
- To maintain your tree's natural defenses against sawfly infestation, ensure that they have the best possible growing conditions.[1]
- Protect the tree's roots! Avoid injuring roots mechanically by driving on them or chopping them.[1] Also, soil compaction or removing excess soil from above the roots can harm the health of your tree.
- Make sure that your tree is sufficiently watered.[1] Fertilizing your tree in the spring can also help.
- Trees can tolerate some defoliation.[2] Properly prune damaged branches.
- Do not use broad spectrum insecticides which will not only harm larch sawflies but also their predators (predacious mites, for example) [2]
- If the tree is small, handpicking larvae from trees can be effective.[1] For larger trees, spray the trees with a high pressure water spray to dislodge larvae.

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Root Maggots: *Family Anthomyiidae*

"Root maggots" is the name given to the larval stage of a group of very similar flies that look like a smaller version of the common housefly. These larvae are pale, legless and are usually ¼" in length. They feed on plant root tissue, which results in wilting, stunted growth, and potential death of the plant.

Host Plants
All crucifers such as cabbage, radish, broccoli, kohlrabi, and cauliflower.

Signs of Infestation
Root maggots chew on roots, leaving holes and chew marks which can split the roots. When they burrow into a root, they can leave slimy tunnels and brown lesions. They will often be present in or near roots that they have attacked.

What You Can Do
- Rotate crops and plant in ground that was free of root maggots and their host plant from the previous year.[1]
- Do not compost plants that were infested by root maggots as these may introduce root maggots into your soil when you use the compost.[1]
- Floating row covers and waterproof collars around the plant stem can reduce infestation.[1] Be sure to bury the edges of the row covers in the soil.[2]
- If possible, delay planting until soil warms to avoid planting during peak egg laying periods.[3]
- Introduce or encourage predation by beneficial nematodes.[1]

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Slugs: *Class Gastropoda*

Slugs have soft, oblong bodies and produce large quantities of slime which facilitates their travel from plant to plant. Although slugs serve a beneficial role as a food source to many mammals, some types are incredibly bothersome pests, chewing ragged holes in garden plants and ornamentals. They leave a slimy trail on plants and walkways, and are most active at night or on cloudy days. On sunny days, they find places to hide.

Host Plants
Most fruits, vegetables, and ornamental plants.

Signs of Infestation
Slugs leave slime trails on the plants that they infest. They also chew large holes in leaves, flower petals, and fruit. In roots, they will frequently chew a small entry hole which will lead to a large, hollowed out chamber.

What You Can Do
- Slugs like to hide in moist, shaded locations, underneath pots, boards, logs, cardboard boxes, weeds, and rocks. One of the first things you can try is eliminating these hiding places from your garden.[1]
- Place a ring of coffee grounds, finely ground egg shells or wood ash a few inches away from your seedlings to repel slugs.[2]
- Raise beneficial predators of slugs such as chickens, ducks, and geese.[1]
- Create your own hiding places to trap slugs. Turn a flower pot upside down or use pebbles to prop up a pot or board off the ground by 1 inch.[1] You can place beer or wilted weeds under the traps to attract slugs.[3] Check the trap once a day and, if you are comfortable doing so, kill the slugs that you find by placing them in soapy water or in a paper bag and then stepping on them.[1]
- Place shallow containers of beer near plants which will attract slugs and drown them.[2]
- Use kitchen tongs to take slugs directly off of plants and dispose of them as suggested above. Also, go slug hunting on cloudy days or at night using a flashlight.[1]

Slugs: *Class Gastropoda*

Slugs have soft, oblong bodies and produce large quantities of slime which facilitates their travel from plant to plant. Although slugs serve a beneficial role as a food source to many mammals, some types are incredibly bothersome pests, chewing ragged holes in garden plants and ornamentals. They leave a slimy trail on plants and walkways, and are most active at night or on cloudy days. On sunny days, they find places to hide.

Host Plants
Most fruits, vegetables, and ornamental plants.

Signs of Infestation
Slugs leave slime trails on the plants that they infest. They also chew large holes in leaves, flower petals, and fruit. In roots, they will frequently chew a small entry hole which will lead to a large, hollowed out chamber.

What You Can Do
- Slugs like to hide in moist, shaded locations, underneath pots, boards, logs, cardboard boxes, weeds, and rocks. One of the first things you can try is eliminating these hiding places from your garden.[1]
- Place a ring of coffee grounds, finely ground egg shells or wood ash a few inches away from your seedlings to repel slugs.[2]
- Raise beneficial predators of slugs such as chickens, ducks, and geese.[1]
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- After you have removed slugs from the area, put copper tape around the tree, planter box or pot. Slugs will not crawl across copper.[1]
- As a last resort, try using diatomaceous earth. This is a white, gritty powder that has the texture of ground glass and kills slugs when they crawl across it. It can be placed under slug traps. Be sure to use caution when applying DE because it is a fine powder that can irritate the lungs. Wear a face mask, gloves, a long sleeved shirt and pants.[1]

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Spruce Beetles: *Family Scolytidae*

Adult spruce beetles are small brown or black beetles about ¼" long. The larval stage is a small, legless white grub with a brown head. Spruce beetles kill live standing trees by consuming the living tissue underneath the bark. They prefer to attack mature, weakened, wind thrown, or damaged trees.

Target Plants
White, Lutz, Sitka, and rarely, black spruce.

Signs of Infestation
- On standing trees, the first sign of infestation are holes bored into the bark of trees. A reddish brown dust will also be found in these entrance holes, in the crevices of the bark and on the ground near the trunk of infested trees.
- During the winter after an infestation, look for areas on trees that have been debarked by woodpeckers looking for the beetles.
- The needles of infested trees may be green for one or two summers following an infestation. After a few summers, the needles will start to turn yellow or orange.

What You Can Do
- Damaged and wind-thrown spruce trees can serve as habitat for spruce beetles, so they should be used or burned after they are discovered.[1]
- Partially burned trees may also harbor spruce beetles, so these should also be used or burned after they are discovered.[1]
- Spruce beetle infested firewood should not be stored in areas near live trees.[1]
- Protect your spruce trees from mechanical damage from weed wackers, lawn mowers, cars, and anything else that can damage trees.[1]
- Protect spruce tree roots by not removing excess soil from or dumping excess soil on root zones.[1]

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What are Pesticides?

Pesticides are a group of chemicals made for the purpose of killing or otherwise deterring "pest" species. The word *pesticide* may refer to insecticides, herbicides, fungicides, or other pest control methods.[1] Because pesticides are made to be toxic, they inherently have adverse health effects on animals and humans—even at low levels—and can stay in the environment after the being applied. There are many different types of pesticides made for different results.

The Environmental Protection Agency (EPA) currently requires that pesticide labels disclose only the products "active" ingredients. Pesticide products also contain many other "inert" ingredients, which are intended to preserve or improve the effectiveness of the pesticides' active ingredients. Inert ingredients may be toxic themselves.

The following pesticides are commonly used in and around houses, gardens, and lawns in Alaska. Fortunately, there are many ways to prevent pest infestation and there are also ways to control pest populations without pesticides. The following information cards have a section which describes alternatives to using pesticides. Additional information about non-toxic alternatives can be found on our "Non-Toxic, Organic Lawn and Garden Care" and "Tips for Non-toxic Prevention and Control of Weeds" information card and the insect information cards.

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Glyphosate

AKA: Roundup, Rodeo, Accord.

Uses

- As a non-selective herbicide to eliminate broad-leaved plants, grass, and sedge species.
- On lawns, around houses, parks, playgrounds, and golf-courses.

Health & Environmental Impacts

- Roundup kills human placental, embryonic, and fetal cells *in vitro*.[1]
- Cancer, reproductive problems, ADD/ADHD, preterm birth, birth defects, and hormone disruption have been linked to exposure to glyphosate-based herbicides.[2,3,4,5,6,7]
- Brain cancer: In a recent study, herbicide use by parents before their child was born nearly doubled the risk that their child would have brain cancer.[8]
- Low levels of glyphosate can be harmful to fish potentially leading to gill damage, liver structure changes, decreased ability to respond to stress, and decreased olfactory ability which impacts their migration.[9,10,11,12]
- Glyphosate persists in the soil for a long time which means that it may impact human and environmental health long after it has been applied. In a Finnish study, the measured half-life of glyphosate was 249 days.[13]

Alternatives to Glyphosate

You can help prevent weeds from taking hold in your lawn by implementing sound cultural practices that create healthy turf. Weeds thrive where turf does not. Please see our "Tips for Non-Toxic Prevention and Control of Weeds" information card for information on preventive measures.

If you need to control weeds in your lawn, there are safer alternatives to the use of glyphosate and other herbicides[14]:

- Apply corn gluten meal, a highly effective deterrent to dandelions, to weed prone areas. It works on weeds before they have sprouted, but may take several years to take effect.
- Hand-pull weeds when the ground is moist. Be sure to remove vegetative parts and roots to prevent re-sprouting. Tools like a garden trowel make weed pulling easier.
- Flame weeding machines use a targeted flame to kill weeds. This is best done when the plant is young and only a few inches tall.
- Boiling water can be applied directly to weeds.

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- Horticultural vinegar, or acetic acid can be used to eliminate weeds, but you must be careful not to spray on your other plants.
- For flower beds, use compost or chopped (mowed) leaves around your plants to suppress weeds.

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[5] Sanborn, M. et.al. 2004. Systematic Review of Pesticide Human Health Effects. Publication of the Ontario College of Family Physicians, p 37.

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[8] Shim YK, Mlynarek SP, & van Wijngaarden E. 2009. Parental exposure to pesticides and childhood brain cancer: US Atlantic Coast childhood brain cancer study. Environ Health Perspect, 117(6): 1002-1006.

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[11] Cericato L, Neto JGM, Fagundes M, Kreutz LC, Quevado RM, Finco J, et al. 2008. Cortisol response to acute stress in jundia *Rhamdia quelen* acutely exposed to sub-lethal concentrations of agrichemicals. Comp Biochem Physiol C Toxicol Pharmacol, 148(3): 281-286.

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[13] Muller MM, Rosenberg C, Siltanen H, & Wartiovaara T. 1981. Fate of glyphosate and its influence on nitrogen cycling in two Finnish agricultural soils. Bull. Environ. Contam. Toxicol., 27: 724-730.

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2,4-D

AKA: Weedtrine-II, Aqua-Kleen, Barrage, Plantgard, Lawn-Keep, Planotox, Weed-B-Gon, and Malerbane

Uses

- This herbicide is used to kill broad leafed plants and will not usually kill grasses.[1]
- Commonly used on rangeland, pasture, in the production of wheat, and on lawns.[2]

Health & Environmental Impacts

- Insulin resistance and increased risk for heart disease: According to a new study, exposure to 2,4-D is associated with reduced high density lipoprotein (HDL) cholesterol ("good" cholesterol which helps to transport low density cholesterol to the liver and out of the body).[3]
- Reproductive toxicity: In animal studies 2,4-D has been shown to disrupt the development of egg cells, so it may have an impact on the fertility and development of humans.[4] Exposure to 2,4-D is also linked to significant changes in the sex ratio in future generations of fish, with more females being born after exposure.[5]
- Cancer: Risk for Non-Hodgkin's Lymphoma is significantly increased for farmers who use 2,4-D.[6] Dogs who are exposed to 2,4-D also have an increased risk of cancer.[7]
- Hormone disruption: Exposure to 2,4-D lowers levels of thyroid hormone T4 in animal studies.[8,9] Thyroid hormones are important in the regulation of metabolism, temperature, and brain development *in utero.*
- Brain development and behavior: Animal studies have demonstrated that 2,4-D may impact neurotransmitters, brain size, and the connections between neurons.[10,11,12] In a recent study, mother rats exposed to 2,4-D demonstrated less caring behavior toward their young.[13]
- 2,4-D is frequently found in rivers, streams, air, and in house dust.[14,15,16] In study that measured the exposure of pre-school aged children to pesticides, 2,4-D was found in the dust of over 80% of the homes.[17]

Alternatives to 2,4-D

Please see our "Tips for Non-toxic Prevention & Control of Weeds" information card to learn how to keep your lawn and garden healthy without pesticides.

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DEET (N,N'-Diethyl-m-toluamide)

AKA: Repel Sportsmen Max, 3M Ultrathon Lotion, Cutter All Family,Off! Sportsmen

Uses

- To repel mosquitoes.

Health & Environmental Impacts

DEET readily enters the body through the skin and may cause a variety of adverse health effects:[1]

- Immunosuppression: In a recent animal study, exposure to levels of DEET similar to those reported for occupational uses was correlated to decreased lymphocyte levels.[2]
- Reproductive and developmental toxicity: In a recently published study, mothers who reported using insecticides (including DEET) while pregnant were much more likely to have sons with hypospadias (displacement of the urethral meatus to the ventral surface of the penis).[3] Hypospadias are a sign of feminization in boys.
- Neurotoxicity: "DEET exposures have been associated with death, toxic encephalopathy, acute manic psychosis, seizure, and cardiovascular and dermal toxicities."[4] There is evidence that DEET exposure kills brain cells, and that DEET and malathion together may have greater effects regarding destruction of brain tissue.[5]
- DEET is a common contaminant in surface waters where it may impact wildlife and people.[6]

Alternatives to DEET

Fortunately, there are healthier ways to keep mosquitoes from disturbing you and your family:

- Screen or cover entrances to dwellings.[7] Repair any breaks in the screen.
- Get rid of buckets of standing, stagnant water that may be near your house.[7]
- Wear pants, long sleeved shirts, and head nets.[8]
- Avoid outdoor activities during high mosquito times.[9]
- Replace outdoor lights with yellow "bug lights" to distract mosquitoes and other insects.[9]
- Fix leaky outdoor faucets or sprinklers.[9]
- Store unused tires in the garage.[9]
- Replace water in bird-baths, watering troughs, fountains, and wading pools once a week.[9]
- Clean out rain gutters on a regular basis to ensure that they are draining properly.[9]
- Many plant based mosquito repellants are marketed as being "natural" or "healthy," but some of them are

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associated with adverse health effects ranging from skin irritation to genetic damage.[8] Carefully consider both the efficacy and the health effects associated with *any* repellant that you use**.**

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Carbamates

AKA: carbaryl, Sevin, Temik, Furadan Lannate, Ordram

Uses

- Used in homes and gardens to control fleas, fruit tree insects, lawn insects, garden insects, ornamental plant insects, slugs, snails, ants, and grasshoppers.
- Used agriculturally to control insects on fruit trees and on crops.

Health & Environmental Impacts

- Neurotoxicity: Carbamate pesticides work by targeting cholinesterase, the enzyme that breaks down acetylcholine, an important neural hormone for insects, animals, and humans.[1] Rats prenatally exposed to carbamates had impaired development of reflexes.[2] Also, when adult rats are exposed to carbamate insecticides, they show decreases in cognitive ability and motor responses.[3]
- Cancer: Carbamates seem to have negative effects on steroidal molecule metabolism, which may contribute to some cancers.[4,5] Carbaryl exposure has been linked to higher risk for non-Hodgkins lymphoma.[6] A significant increase in kidney and liver tumors was seen in rats exposed to carbaryl in the laboratory.[7]
- Skin cancer: Using carbamates may increase your risk for skin cancer. Farmers who used carbamates in a recent study were much more likely to have melanoma than farmers who had never used carbamates.[8]
- Reproductive toxicity: Men with higher levels of carbaryl metabolites in their urine were more likely to have a low sperm count and decreased sperm motility, factors that may negatively impact fertility.[9]
- Toxicity to fish: Carbaryl based pesticides are neurotoxic to trout, which reduces their swimming performance and makes them more likely to be consumed by predators.[10]
- Toxicity to bees: Carbaryl is highly toxic to bees and may play a role in Colony Collapse Disorder.[11]
- Environmental contamination: In a USGS study, carbaryl was found in 45% of urban streams and 10 percent of agricultural streams.[12]

Alternatives to Carbamates

Carbamates are used against many different types of insects. Please refer to our insect information cards to learn how to control insect pests without toxic chemicals.

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Organophosphates

AKA: Diazinon, Malathion, Monior, Dylox, Orthene

Uses

- In eradication programs against grasshoppers and fruit flies.
- As an insecticide on crops.
- In yards and gardens to kill mosquitoes and other insects.
- In head-lice shampoos.

Health & Environmental Impacts

Organophosphate pesticide exposure has been linked to serious acute and chronic health effects including:

- Brain development and behavior: In humans, prenatal exposure has been linked to abnormal reflexes,[1] delayed development, and an increase in attention deficits and hyperactivity.[2,3]
- Depression: Farmworkers who reported using organophosphate or organochlorine pesticides were significantly more likely to be diagnosed with depression.[4]
- Childhood cancer: In a recent study, children with acute lymphoblastic leukemia, a cancer of the white blood cells, were more likely to have higher levels of organophosphate pesticide residues in their urine.[5]
- Asthma: Women who live on farms where insecticides (including organophosphates, organochlorines, and pyrethroids) are used, are significantly more likely to have asthma.[6]
- Heart disease & diabetes: Current research suggests that the organophosphate pesticide malathion could contribute to the symptoms of both type 2 diabetes and atherosclerosis.[7]
- Reproductive toxicity: Malathion exposure was linked to the production of damaged sperm in mice.[8] Male agricultural workers with higher levels of organophosphate in their urine had lower levels of testosterone.[9]
- Thyroid hormone changes: Agricultural workers exposed to organophosphate pesticides showed reductions in T3 and increases in T4 and TSH one day after exposure. [10]
- There is evidence that organophosphates are potent inhibitors of the human metabolism of other toxic chemicals including carbaryl, carbofuran, DEET and fipronil, and jet fuel components.[11]
- Environmental contamination: Organophosphate pesticides are frequently found in the air, in rivers and streams.[12,13]
- Toxicity to wildlife: Organophosphates are highly toxic to fish, birds, and frogs.[14,15,16]

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Alternatives

Organophosphates are used against many different types of insects. Please refer to our insect information cards for suggested ways to control insect pests without toxic chemicals.

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Pyrethroids

AKA: Ambush, Scourge, Pyrethrin, Permethrin, Pertox

Uses

- Control of flying and crawling insects that bother humans, pets and livestock (i.e. mosquitoes, lice, fleas, and scabies).
- Control of larvae, crawling and flying insects that damage agricultural crops.
- To control insects in homes, businesses, schools and other facilities both indoors and outdoors.

Health & Environmental Impacts

Although pyrethroids are generally thought to be relatively low-toxicity pesticides, they are still toxic to humans and produce many adverse health effects:

- Excessive exposure may cause numbness, tingling, whole body tremor, hyperthermia, and even death.[1,2,3]
- Hormone disruption and cancer: One study found that permethrin had endocrine disrupting action on human endometrial cells and breast cancer cells.[4] A later study confirmed that permethrin, as well as three other pyrethroids, increased the growth of human breast carcinoma cells.[5] This suggests that pyrethroids may aid in the progression of some cancers.
- Decreased fertility: Exposure to permethrin and cypermethrin (another pyrethroid) as well as organophosphate pesticides reduced healthy sperm concentrations in exposed men.[6]
- Toxicity to aquatic organisms and beneficial insects: Low levels of pyrethroids are extremely toxic to fish, lobster, shrimp, zooplankton and honeybees.[7,8] Exposure to 1 part per billion of pyrethroid pesticide is lethal to 50% of exposed lake trout.

Alternatives to Pyrethroids

Control of lice:

- Inspect hair and scalp for nits and adults. This is best done by another person under a strong light source. Divide hair into small sections and examine each strand, pulling any nits off of the hair strand with your fingernails. Carefully collect and dispose of all nit eggs that are found. Repeat this process daily until no nits have been seen for several days.[9]
- Use a blow-dryer or hot air treatment to kill lice with heat.[10]
- Use wet-combing method which has been shown to be more effective than pesticidal treatment.[11]

Use 4% dimethecone lotion, mayonnaise, or olive oil as an

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alternative to pesticides.[12] These treatments smother the lice.

Control of fleas:

- Screen or restrict the access of squirrels to your home.
- Limit your pet's access to wild animals.
- Because flea larvae feed on organic matter, the best way to eliminate them is by keeping things clean. Vacuum and launder pet bedding and carpets frequently.[13]
- Bathe your pet in soapy water and use a flea comb by gently running it through your pet's coat. After each comb-through, take the fur off of the comb and submerge it in the soapy water to drown the fleas.[13]
- Use specially designed, non-chemical flea traps which attract fleas with incandescent light and trap them with sticky paper.[13]

For mosquito control alternatives, see "Alternatives to DEET".

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1 Thiebault JJ, Bost J, & Foulhoux P. 1985. Experimental intoxication by deltamethrin in the dog and its treatment, Collect Med Leg Toxicol Med, 131:47–62.

2 Ray DE. 1982. The contrasting actions of two pyrethroids (deltamethrin and cismethrin) in the rat. Neurobehav Toxicol Teratol, 4:801–804.

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4 Garey J, & Wolff MS. 1998. Estrogenic and antiprogestagenic activities of pyrethroid insecticides. Biochem. Biophys. Res. Commun, 251:855–859.

5 Go V, Garey J, Wolff MS, & Pogo BTG. 1999. Estrogenic potential of certain pyrethroid compounds in the MCF-7 human breast carcinoma cell line. Environ. Health Persp,107:173–177.

6 Perry MJ, Venners SA, Barr DB, & Xub X. 2007. Environmental pyrethroid and organophosphorus insecticide exposures and sperm concentration. Reproductive Toxicology, 23:113–118.

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Resources for more information

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- Teaming with Microbes: A Gardener's Guide to the Soil Food Web by Jeff Lowenfels & Wayne Lewis.
- Ask Mother Nature: A Conscious Gardener's Guide by Ellen Vande Visse.
- Identifying and Controlling Pests in Alaska Using Integrated Pest Management Techniques by Lois Bettini of the University of Alaska Fairbanks (UAF) Cooperative Extension.

Alaska Specific Websites

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The following publications are not specific to Alaska, but they may also provide good ideas for growing healthy plants and ways to avoid harmful pesticides:

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