

ORGANIC GARDENING

Wayne B. Jones

Retired Extension Educator,
Bonneville County

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ORGANIC GARDENING

Learning Objectives

- Understand the basic definitions of *organic* and organic pesticides
- Learn about organic soil fertility and amendments
- Understand the options for dealing with pests, including weeds, insects, and diseases
- Learn the organic options for controlling pests

Organic Gardening Overview

Over the past several decades, interest in organic farming has steadily increased. The rise in the popularity of growing produce organically has also influenced gardeners.

Organic growing is more of a mindset rather than rules and regulations to be followed, a striving to maintain a natural balance in the growing of plants. This natural balance involves soil, plants grown, water, insects, beneficial fungi, bacteria, wildlife, and other components that complete the natural equilibrium of living things. It is a holistic approach that includes using local materials as much as possible to replenish what is taken away from the total system.

Organic gardening does not involve the use of synthetic fertilizers or pesticides in the production system. It thus requires an added time commitment. Since one cannot rely on quick fixes through the use of synthetic materials, gardening organically often involves much greater hand labor, at least in the first few years, until the garden plot becomes more naturalized to the organic practices being used.

Weeding is generally the major effort of the first few years, but insect and disease pressures also take considerable time to control organically. Once the problems are recognized and methods developed to deal with them, the time commitment is reduced.

Organic gardening is similar to conventional gardening, yet there are important differences.

DEFINITIONS

Legal definitions of organically produced agricultural products must be met if the produce is intended for market. Find further information on growing plants and animals for the organic market at <https://agri.idaho.gov/main/about/about-isda/ag-inspections/organic-certification-program/>.

Because what qualifies as “organic” is legally complex and often confusing or contradictory, this chapter provides some of the basics about what growing in the organic tradition involves.

Basically, organic production entails growing crops and raising animals without the use of synthetically produced materials. In Idaho organically grown food means food products produced without the use of synthetically compounded fertilizers, pesticides, or growth regulators for a period of 36 months prior to harvest. To produce commodities and market them as organic, follow established rules. (See “Pest Control Strategies” for Idaho information.)

ORGANIC PESTICIDES

Organic pesticides can be used by the organic gardener, but many problems exist that are difficult to solve without synthetic pesticides. Because of these challenges, it becomes very important to follow good husbandry practices when gardening in the organic tradition.

SITE SELECTION

The simple step of choosing a gardening site becomes very important when growing organically. If a poor site is picked, the plants will be stressed and subject to insect and disease problems that may be very difficult to control. Weeds can also be a serious problem in an organic garden. Very few herbicides exist that are able to be used in organic production.

Pick a site with good soil, good drainage, and adequate sunlight. Try and find one with few weed problems, if possible, especially noxious weeds. If the soil is poor, add organic matter to help with the tilth, fertility, water-holding capacity, and organic content of the soil.

Soil Fertility and Amendments

Organic gardening begins with the soil. The healthier the soil the healthier the plants and the better success the gardener will have, be it an organic garden or otherwise. Given the limited resources to

deal with pest problems, maintaining the health of the plants becomes paramount.

Soil aspects of organic gardening need at least yearly attention. The addition of compost and other organic material is very important to replace nutrients lost in the production and harvesting of garden produce. The sources of this organic matter may be leaves from the trees, vegetables, kitchen scraps, lawn clippings, compost in its various forms, as well as other organic material that may be locally available.

Compost is organic matter that has been broken down by microbial action, insects, and other invertebrate animals. Composting is a natural process that can be easily accomplished by the home gardener. For detailed information on the art and science of composting, refer to chapter 8, Backyard Composting. The composting of material treated with synthetic pesticides is not allowed in organic gardening.

Both inorganic and organic fertilizers can cause plant burn, groundwater contamination, excessive buildup of toxic materials in the soil, and plant nutrient excesses and deficiencies. To avoid these problems, it is important to have an understanding of the types and amounts of nutrients you are applying to the soil when you add any type of material to your garden.

Organic matter is the main source of fertility in organic growing systems. Since synthetic fertilizers are not permitted in organic gardening, it sometimes becomes challenging to find and provide the necessary nutrients that plants need. Before planting a garden, fertilize it with needed components. Plants will get needed nutrients through the compost and other organic matter added yearly to the soil.

Usually plant nutrition consists of animal manures, plant manures, cover crops, compost, compost tea, and/or mixed organic fertilizer. Animal manures are generally the most complete source of nutrients for organic gardening but there are several other sources that can be utilized. Refer to Tables 1–3 to get a relative idea of which types of organic matter add what percentage of nutrients to the soil. There are mineral sources for certain nutrients for the organic gardener.

Green manures have been shown to benefit organic gardening. Not only do they add organic matter to the soil, many of them have the ability to reduce

Table 1. Average plant food content of natural and organic fertilizer materials. Percentage on a dry-weight basis.

Organic Materials	%N	%P	%K	Availability	Soil Reaction
Fish scrap	5.0	3.0	0	slowly	acid
Fish meal	10.0	4.0	0	slowly	acid
Guano, Peru	13.0	8.0	2.0	moderately	acid
Guano, bat	10.0	4.0	2.0	moderately	acid
Sewage sludge	2.0–6.0	1.0–2.5	0.0–0.4	slowly	acid
Dried blood	12.0	1.5	0.8	mod. slow	acid
Soybean meal	7.0	1.2	1.5	slowly	v. sl. acid
Tankage, animal	9.0	10.0	15.5	slowly	acid
Tankage, garbage	2.5	1.5	1.5	very slowly	alkaline
Tobacco stems	1.5	0.5	5.0	slowly	alkaline
Seaweed	1.0	---	4.0–10.0	slowly	---
Bonemeal, raw	3.5	22.0	---	slowly	alkaline
Urea*	45.0	---	---	quickly	acid
Castor pomace	6.0	1.2	0.5	slowly	acid
Wood ashes	---	2.0	4.0–10.0	quickly	alkaline
Cocoa shell meal	2.5	1.0	2.5	slowly	neutral
Cottonseed meal	6.0	2.5	1.5	slowly	acid
Ground rock phosphate	---	33.0	---	very slowly	alkaline
Green sand	---	1.0	6.0	very slowly	---
Basic slag	---	8.0	---	quickly	alkaline
Horn and hoof meal	12.0	2.0	---	---	---
Milorganite	6.0	2.5	---	---	---
Peat and muck	1.5–3.0	0.25–0.5	0.5–0.10	very slowly	acid
Spent mushroom compost	2.0	0.74	1.46	moderately	6.4

Urea is an organic compound, but since it is synthetic, it is doubtful that most organic gardeners would consider it acceptable.

Approximate nutrient content of soil amendment materials commercially available in bulk are listed in this table. It also gives information on the availability of nutrients to soil and plants. Slowly available material means nutrients last relatively longer and are available to plants longer in the soil compared to quickly released nutrients.

The soil reaction column indicates if the material will have an acidifying or alkaline impact on soil. For basic soils, adding acidifying material helps lower the pH. v. sl. = very slightly

Note: Tables 1–3 are slightly modified from CIR375 of the Horticultural Sciences Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Originally published in April 1993, it was updated in May 2003. Find it at <http://edis.ifas.ufl.edu>.

insect, disease, and weed problems. Members of the Brassica family, especially the oilseed radishes, contain natural chemicals that inhibit and kill soil-inhabiting pest problems.

The three tables that follow offer guidance on managing your compost piles to meet your soils' needs. Chapter 5, Soils and Fertilizers, in this book explains the significance of macronutrients N (nitrogen), P (phosphorous – designated P₂O₅ as phosphate in fertilizers), and K (potassium – designated K₂O or potash in fertilizers).

Dealing with Pests

The first approach to fighting pests is cultural control methods. In some cases this is the only option. For organic growing, the goal is to reach a stability or balance between pests and desirable plants. This balance comes about by maintaining diversity within the system. Reaching a good diversity level in a small garden plot is somewhat more difficult than in a large-scale operation, but it is a sound concept to strive for at any level of organic production.

Table 2. Composition of fresh manure with a normal quantity of water.

Kind of Manure	%Water	%N	%P	%K
Cow	86	.55	.15	.50
Duck	61	1.10	1.45	.50
Goose	67	1.10	.55	.50
Hen	73	1.10	.90	.50
Hog	87	.55	.30	.45
Horse	80	.65	.30	.45
Sheep	68	1.00	.75	.40
Steer or feed yard	75	.60	.35	.55
Turkey	74	1.30	.70	.50

This table gives an approximate amount of the noted nutrients that are added to the compost pile when composting fresh manure. The finished compost will vary in nutrient level depending on composting efficiency.

The initial cultural practice to adopt is crop rotation. Crop rotation is the habit of rotating different families of plants in the same area in the garden – for example, planting potatoes one year then tomatoes the next. This encourages both soilborne and aboveground pests that cause problems in this family to increase.

Table 3. Composition of various materials thrown into compost piles.

Compost Material	%N	%P	%K
Banana skins (ash)	---	3.25	41.76
Cantaloupe rinds (ash)	---	9.77	12.21
Castor bean pomace	5.00	2.00	1.00
Cattail reeds	2.00	0.81	3.43
Coffee grounds	2.08	0.32	0.28
Corncob ash	---	---	50.00
Cornstalks and leaves	0.30	0.13	0.33
Crabgrass, green	0.66	0.19	0.71
Eggs, rotten	2.25	0.19	0.15
Feathers	15.30	---	---
Fish scrap	2.00–7.50	1.50–6.00	---
Grapefruit skins (ash)	---	3.58	30.60
Oak leaves	0.80	0.35	0.15
Orange culls	0.20	0.13	0.21
Pine needles	0.46	0.12	0.03
Ragweed	0.76	0.26	---
Tea grounds	4.15	0.62	0.40
Wood ashes*	---	1.00	4.0–10.00

The composition of materials commonly found in or near the home are listed. If your soil is deficient in a certain nutrient, add material to the compost pile that is high in that nutrient to raise its level in the finished compost.

*Note: Do not compost wood ashes if you are going to apply the finished compost to alkaline soil.

However, following carrots, which tend to compact the soil, with corn, which tends to loosen it, helps soil tilth. Very few pests attack both of these crops.

- Higher crop yields — Through crop rotation, the garden area reaps several benefits. Higher crop yields have been demonstrated when crops are rotated.
- Microbial biomass — There is also an increase in soil microbial biomass, which helps ward off soilborne diseases and increases carbon dioxide generation.
- Nitrogen (N) increase — There is also an increase in N (related to the increased microbial biomass), which can decrease the need to add more N.
- Drainage and moisture holding — Crop rotation has also been demonstrated to increase drainage and moisture-holding capacity and reduce soil compaction.
- Weed suppression — Another great benefit of crop rotation is weed suppression. Different crops are prone to different types of weeds. For example, squash is considered a weed-suppressive crop because it shades the ground and inhibits weed seed germination, while corn is generally widely spaced and takes some time to grow sufficiently to shade out weeds.

Pest Control Strategies (Idaho Information)

One may think that any organic substance is allowable for use in organic production. This is not the case. For example, tobacco dust (nicotine sulfate) is not allowed in Idaho because of its extreme toxicity. Federal and state regulations list what materials may be used in organic food production. In Idaho, get detailed information by writing to Idaho State Department of Agriculture, Ag Inspections Division, PO Box 790, Boise, Idaho, 83701-0790.

Weed Control

Weed control is probably the most challenging part of organic gardening. Very few acceptable organic chemical controls are available for fighting weeds.

VINEGAR

One notable exception is vinegar, which has been shown to control many annual weeds when used at

10%–20% strength. Household vinegar is typically about 5%. In its concentrated state, vinegar can cause burns and eye damage. Availability is somewhat limited, but as the demand grows it will become more available in local nurseries. Sources can be found on the internet. As with any pesticide, care should be taken when using vinegar for controlling weeds.

CORN GLUTEN

Corn gluten is another herbicide that may be used in organic growing. Used as a preemergent, it has been shown to be effective against a large number of weeds. It reduces weed seed germination with no apparent effects on transplanted materials. It is also effective in lawns as a preemergent herbicide. Corn gluten can usually be found in well-stocked nurseries and also on the internet.

CULTIVATION

The most common way to control weeds is through cultivation. In small garden plots, the hoe becomes your best friend. In larger gardens, a rototiller can be used effectively, especially if crop rows are properly spaced. A drawback to the use of rototillers is that they can damage crop roots if you go too deep or too close to desirable plants. Another disadvantage is that you can create a hardpan in your soil through repeated use. As the tines go down into the soil and rotate they tend to compact the soil just below the depth of the cultivation. Overall, however, rototillers are a great asset in the battle against weeds.

MULCHING

Mulching is a very effective way to keep weeding to a minimum. Almost any material that will allow moisture to reach the soil but keep the light off the soil works as a mulch. Such things as compost, sawdust, grass clippings, leaves, weed matting, newspapers (noncolored inks), and black plastic with perforations to allow water to reach the soil, as well as many other items will greatly aid in the fight against weeds. Make sure the mulch is thick enough to keep sunlight from hitting the soil surface, but do not pile it so high as to reduce oxygen in the soil or to start the composting process, which could produce heating problems around the desirable vegetation. Probably 4 inches is a good maximum depth. Mulching can be done anytime of the year.

THERMAL WEEDING, FLAMING

Another technique that saves time in a large garden is thermal weeding or flaming. This method dehydrates weeds and is very effective. It can be used as a preplant, preemergent, postemergent, or preharvest treatment. A device such as a propane burner is lighted and passed over the tops of the offending weeds just before planting the desired crop. A good technique in preemergence crops, especially in carrots and beets, is to allow weeds to germinate and then plant crop seeds among weed seedlings. Wait about a week, then flame the weeds in the preplant state, thus allowing seeds to sprout in a weed-free environment. During postemergence and preharvest, keep the heat of the flame away from desirable vegetation, either by distance or use of heat-resistant shields, such as tin or other metal. Also use preharvest flaming to remove potato foliage prior to harvest.

SOIL SOLARIZATION

A method of controlling weeds, soil-dwelling insects, and soilborne diseases is soil solarization. Soil is more or less pasteurized through the heat of the sun. Benefits include reduction of pest problems and stimulation of beneficial organisms. First, till the soil to enhance the conduction of heat, moistening the ground to be treated to at least 1 foot deep.

Then place clear plastic over the soil. Anchor the ends securely to keep the plastic in place. This technique is mainly useful in United States Department of Agriculture Zones 5 and above. If you live in Plant Hardiness Zone 4 or less, the generated heat units will probably not be sufficient to heat the soil enough to kill very many weed seeds, insects, or disease organisms.

SOAP-BASED AND OIL-BASED HERBICIDES

Some soap-and oil-based herbicides are cleared for organic food production. They work by burning the foliage back and can be effective in certain situations. When using them, keep desired vegetation protected because they will burn the leaves of all plants. They generally are not effective in controlling perennial weeds.

OTHER METHODS

Other methods also may reduce weed pressure.

Weed-Free Manure/Mulch

Make sure manure and mulch sources are weed free, if possible.

Remove Weeds

Remove weeds from the garden before they go to seed.

Avoid Weed Hitchhikers

If you borrow equipment, check to see that you do not bring in weed seeds from soil or other matter adhering to the equipment. Vehicles, clothing, and animals may also transport weed seeds.

Composting

Composting weeds that have weed seed attached is not a good plan. If the composting process is done incorrectly, weed seeds may survive and become a problem.

Timing Your Planting

The timing of planting may prevent weed pressures. For example, mustards are generally an early spring problem. Delaying planting until the mustards have emerged and been removed may reduce weed problems.

Avoid Bare Soil, Green Manure

Maintain a crop cover instead of leaving bare soil to inhibit or prevent weed seed from germinating. To accomplish this, use green manures before or after the crop is put in. Green manures such as winter rye, buckwheat, mustards, oilseed, radishes, crimson clover, hairy vetch, or subterranean clover have all demonstrated the ability to suppress certain weeds.

Geese

Several species of geese have been used successfully to weed out grasses from crops and may be of some use in a garden.

Insect Control

The best control of insect pests is through maintaining healthy plants. Many insect pests are attracted to unthrifty plants. An ounce of prevention is indeed worth a pound of cure. Insects can pose serious problems in an organic garden. It is vital that you scout your garden for insects and try and control them before they have a chance to multiply. Three methods can be used to control insects organically: mechanical control, biological control, and insecticides (chemical control).

MECHANICAL CONTROL

Mechanical control is the first line of defense in combating insect pests.

Remove By Hand

Probably the most common way to control insects is to use the tried and true method of removing them physically from the plants. This method is very effective in a small garden. You can either pluck them from the surface or use a leaf to squash them. You will also be able to see egg clusters and remove them before they hatch.

Water Jet

Another easy way to remove certain insects from plants is to use a strong jet of water and wash them off the plant. This is especially effective with aphids. Once on the ground, aphids become prey for several ground-dwelling predators.

Floating Row Covers

A very effective defense against flying insects are floating row covers, available at well-stocked lawn and garden stores. They work by physically excluding flying insects access to the crop. Row covers are generally ineffective against soil-dwelling insects. They need to be in place before the insects have a chance to lay eggs on the plants. Floating row covers are effective in controlling lepidopteron larvae (caterpillars), flying pests of onions, carrots, and some leaf-mining insects, as well as other pests.

Sticky Traps

Sticky traps used in combination with insect attractants can be effective.

Bug Vacuums

Bug vacuums available commercially are very useful in removing large numbers of insect pests. However, they remove all insects, including beneficial ones. If you have beneficial insects helping you out, then this is a less attractive method.

Ultraviolet (UV) Bug Zapper

Should you be tempted to use a UV bug zapper to control insects, be aware that you will probably kill more beneficial insects than injurious ones.

BIOLOGICAL CONTROL

This method uses insect predators, parasites, and pathogens to help control pestiferous insects. When using this method of control, it is important to recognize and understand beneficial insects, their life cycles, and how to maintain them.

Strategies

Plant Diversity

Plant diversity is important in maintaining a viable beneficial insect population. Many helpful insects are nectar feeders so flowering plants are desirable. Many plants in the Apiaceae (formerly known as Umbelliferae) family — such as fennel, angelica, coriander, dill, parsley, and wild carrot — provide several tiny flowers needed by parasitoid wasps. Clovers, yarrow, and rue also attract parasitoid and predatory insects.

Low-Growing Plants

Ground-dwelling beneficial insects such as ground beetles seek low-growing plants for protection. Thyme, rosemary, or mint provide such shelter. Composite flowers, such as daisy and chamomile, and mints attract predatory wasps, hoverflies, and robber flies.

Safe Haven

If possible, dedicate a small area of the garden to plants that attract beneficial insects. Think of it as a safe haven. Insects will be able to maintain their populations by living off the deleterious insects in nearby untreated areas.

Helpful Beneficial Insects

The following is a partial list of organisms that can be used to your advantage in combating insect infestations.

Ladybird Beetles (Ladybugs)

These familiar insects are very beneficial in consuming soft-bodied insects, especially aphids and mealybugs. Both adults and larvae dine on these pests, but the larvae consume substantially more than do adults. The larvae somewhat resemble miniature alligators and many gardeners think they are harmful, so make sure you recognize them. Ladybird beetles may be purchased from several sources. Be sure to have some way to contain them, such as a fine-meshed net or a tent (be careful to ventilate to avoid heat buildup), for a few days when you release them to get them established in your backyard. When first released they have a tendency to disperse and mate.

Lacewings

These insects also prey on soft-bodied insects, eggs, and mites. Adults have delicate wings and the faint smell of mothballs. The larvae, as with ladybird beetles, are voracious eaters. Lacewing eggs are laid singly on a stalk and are fairly common in organic as well as conventional systems.

Wasps

Many wasp species parasitize several different orders of insects. They are generally very small and pose no threat to humans. They attack insect eggs, larvae, and adults.

Bacillus Thuringiensis (Bt)

Several strains of this bacterium have been very effective in controlling insect pests. They form a crystal that is toxic to certain insects but not to warm-blooded mammals.

The crystal dissolves in an insect's digestive system. When first discovered, these bacteria were found to be very useful in controlling lepidopteran pests (caterpillars), including codling moths and cabbage loopers. Since then, other Bt strains have been found that are effective against certain coleopteran pests (beetle family), including Colorado potato beetles. For this control method to work, the material has to be eaten by the insect. Several products on the market contain Bt. Make sure you purchase the type that is effective against pests you are trying to control. Unfortunately, some resistance to Bt has begun to show up in certain insect populations, especially the diamondback moth, a pest to cole crops, so caution is advised when using Bt as a control. Whenever there is a possibility of a pest species gaining resistance to a certain control strategy, it is very wise to rotate control methods.

In several crops, this toxin has been genetically engineered into the plant. Any genetically engineered plant or other organism is not acceptable in organic production.

Nematodes

These organisms are microscopic simple roundworms. Several nematodes are available that control several soilborne pests. Nematodes may be purchased at many well-stocked lawn and garden outlets. When purchasing them, be sure you know the targeted pests you wish to control because the nematodes have a fairly specific host range. They have been shown to be very successful in controlling certain insect pests when applied strictly according to label instructions. They are very sensitive to desiccation (extreme drying) and to UV radiation. Nematodes that are especially beneficial for Idaho pests include

- *Heterorhabditis bacteriophora* — for root weevils on ornamentals, billbugs, and scarabs (june bugs) in lawns and also for root weevils in berries

- *Steinernema feltiae* — for fungus gnats
- *S. carpocapsae* — for armyworms, cutworms webworms, girdlers, and wood borers.
- Other nematode species may also be effective. There are undoubtedly other nematodes that will be developed to control problem insects.

Beneficial Fungi

Specific fungi are commercially available that have shown control in aphids, whiteflies, leafhoppers, flies, beetles, caterpillars, thrips, mites, and some beetle larvae. These fungi may also attack beneficial insects. Under the right conditions they can be very effective, but as with most fungi, humid conditions are usually needed for efficacious control. *Beauveria bassiana* is the most common fungal insecticide used.

Beneficial Viruses

Certain viruses are effective in controlling insect pests, mainly in the Lepidoptera (moths) family. To be effective, viruses must be consumed by the insect. As with the other biological control methods previously mentioned, these viruses pose no threat to human health. They also do not directly cause problems for insect predators. Viruses are currently limited in their availability but through diligent searching one may find a source. Check the internet for leads or with universities or private companies to find out if they are involved in this line of research.

CHEMICAL CONTROL

Initially, the use of pesticides in organic gardening seems incompatible with the total concept of organic gardening, yet several pesticides are used in organic production. They are not synthetically made, however, and materials allowed in organic pest control are subject to close scrutiny. The fact that pesticides are considered okay to use in organic food production and are naturally derived does not mean that they are nontoxic. Some allowed substances are very toxic and it is vital to read and understand labels before using any pesticide. Just as common chemicals are given toxicity ratings, so are chemicals from botanical and mineral-bearing sources. **CAUTION** means low toxicity or fairly safe to use; **WARNING** means moderately toxic; and **DANGER** means highly toxic. To qualify as an organic pesticide, the product must be from natural

sources, cannot be genetically modified, and must be certified as a pesticide that is usable in organic food production.

The following insecticides are some of the more common ones currently registered in Idaho for use in organic production. This is not a complete list. New pesticides become available to the organic grower on a fairly regular basis.

Each state may recognize different chemicals as proper to use in organic production. If you are growing produce to sell organically, check the most current information. Contact information for Idaho is listed at the end of the chapter.

Pyrethrum/Pyrethrin

Extracted from chrysanthemums, this pesticide affects the nervous system of insects and is very effective against a wide variety of insect pests. Several formulations are available, some containing ingredients that are not allowed in organic production.

One common additive — piperonyl butoxide — is not permitted in organic production systems, so read the label carefully when purchasing pyrethrum-based insecticides. Several instances of allergic skin reactions have been reported, so take care to keep it off your skin.

Pyrethroids are synthetically made materials based on the chemistry of natural pyrethrins. Because they are synthetic, they are not allowed for use on organic crops.

Boric Acid

Boric acid has been used for a long time in controlling pests. It is allowable in organic production systems as long as it does not get on edible portions of the plant. There are various bait and dust formulations.

Diatomaceous Earth

This material is composed of the fossilized skeletons of microscopic water plants called diatoms. They extract silica from the water and incorporate it into their skeletal systems. When they die their skeletons form a diatomite deposit. After being ground, this material turns into very small glass-like particles able to cut the cuticle of insects and cause desiccation. It is fairly safe to use, but the dust can irritate lungs and eyes.

Sabadilla

Derived from seeds of the sabadilla lily, the active ingredient is an alkaloid known as veratrine. It is both a contact poison and a stomach poison. Sabadilla is one of the least toxic of the botanical pesticides. It can, however, be highly irritating to the eyes and can cause sneezing if inhaled. Sunlight quickly inactivates this material so applications in the evening are best.

Neem

Used in India and Africa for more than 4,000 years for medicinal and pest-control purposes, neem is derived from seeds of the neem tree, a native of India. Compounds derived from the seeds have both insecticidal and fungicidal properties. Neem blocks a molting hormone in insects and terminates the molting process. Effective against a wide range of insect pests, neem is an effective, but not a fast-acting insecticide, so do not expect quick results. It has a very low mammalian toxicity.

Rotenone

A compound produced by the roots of two members of the Leguminosae family, rotenone is effective on leaf-feeding insects such as caterpillars, beetles, aphids, and thrips. As with neem this is a slow-acting chemical. Insects stop feeding shortly after ingesting the material. This material is extremely toxic to fish but only moderately toxic to most mammals.

Horticultural, Summer, Dormant Oils

Oils, effective against a wide range of insects, are only to be used on woody plants. They can be very effective in controlling things like scale, mealybugs, and insect eggs, coating and smothering insects and their eggs. Oils are relatively more effective against active insects than dormant ones. Several different and sometimes confusing names are used for horticultural oils.

Heavier oils are used during the dormant period — late winter and early spring — on woody plant material, so they are called dormant oil. Summer oils or horticultural oils are lighter in consistency and relatively safe to use when plants are in leaf, but may cause leaf burn. Most horticultural oils are petroleum-based, but other types of oils — neem, vegetable, and fish — can also be effective.

Sulfur is sometimes a problem in horticultural oils and some oils have a “UR” (unsulfonated residue) rating. The higher the UR rating, the lower the sulfur content. Most horticultural oils have a UR rating of 90 or above. Oils are fairly safe around beneficial insects because most of them have the ability to escape. Some beneficials, such as predatory mites, succumb to oil applications since they cannot remove themselves from harm’s way.

Oils such as carrot and weed oils are not permitted for use in organic production. A few plant species are very sensitive to oil applications, among them Japanese and red maple, hickories and black walnut, plume cedar, and smoke tree. Other sensitive plants are redbud, juniper, cedar, spruce, and Douglas fir. If you apply oil to a blue spruce, the blue color will be lost.

Insecticidal Soaps

Insecticidal soaps are very safe and useful in controlling a wide variety of insects. Many gardeners are tempted to buy material that is labeled for insect control. All clothes detergents, however, cause harm to plants as do most other forms of dry soaps (burnt foliage). Insecticidal soaps are formulated with potassium salt of fatty acids. Commercially available insecticidal soaps are selected to control insects, to minimize potential plant injury, and are of consistent manufacture.

Sulfur

Sulfur is probably the oldest-known pesticide in use. The Greek poet Homer described the benefits of “pest-averting sulfur” 3,000 years ago. It can be used in several forms such as a dust, wettable powder, paste, or liquid. It can help control spider mites, psyllids, and thrips and can be used on a variety of crops, including beans, potatoes, tomatoes, and peas. It also is used on a number of fruit crops such as apples, cherries, grapes, peaches, pears, plums, and prunes. Sulfur is relatively safe to use, although it may cause eye and skin irritation, and, if applied when temperatures are above 90°F, it can burn the plant. Also, it reacts with other pesticides so it is best to apply it alone. If you use oils, be sure not to use sulfur within 20–30 days because sulfur and oil react together to cause phytotoxicity.

Other Products

Several other effective products are available to control insects and are certified for use in organic production, including garlic and herb preparations, lime sulfur, insect extracts, pheromones, etc. As you gain experience with organic gardening, you will become more familiar with these products. See the end of this chapter for several books and online resources to help you further resolve pest problems, along with additional reading material.

Disease Control

As with insect control, the best way to control diseases is to maintain healthy plants. Choosing the proper plants for the garden, matching the plant to the soil type, proper light levels and irrigation needs, correct sanitation, and proper fertilization and pruning go a long way to maintaining a healthy garden.

Prevention is extremely important when it comes to dealing with plant diseases. Once established, diseases are almost impossible to eradicate from stricken plants and they act as a reservoir for the infection of healthy plants. Don’t start out with a disease problem. Purchase disease-free stock. Generally, vegetatively propagated material has some type of certification stating it is either virus free or, at worst, that low levels of virus are present.

In fighting diseases, remember the disease triangle. The three components needed to have disease are a susceptible host, a pathogen capable of causing disease, and the proper environment for the disease to thrive.

Armed with this basic knowledge, approach disease control from several angles. For example, if you have problems with your tomatoes and *Verticillium* wilt, probably the easiest way to correct them would be to purchase *Verticillium*-resistant tomato plants. Many garden vegetables that are susceptible to *Verticillium* wilt have cultivars with resistance bred into them.

Another approach to minimizing disease is to remove diseased plant material, thus reducing the pathogen population. Such steps as removing fallen diseased leaves, pruning out diseased portions of a plant, or removing the entire diseased plant help to reduce disease pressure.

Most plant diseases are caused by fungi. Fungi like high humidity. By changing the environment through such things as drip irrigation and wider spacing of plants, the overall humidity is reduced thus decreasing the chances of fungi-causing problems.

Organic fungicides are available that are fairly effective against several disease problems faced by gardeners. As with herbicides and insecticides, fungicides should be used only after other controls have failed.

POPULAR FUNGICIDES

Below is a brief discussion on some of the more popular fungicides used by organic gardeners.

Sulfur

In addition to being an effective insecticide, sulphur has fungicidal properties and is effective in controlling and suppressing several plant diseases. First used some 2,000 years ago by the Greeks to control rust on wheat, sulfur is used as a preventive fungicide, which means to be effective it has to be on the plant surface before the disease gets inside the plant.

It is useful against powdery mildews, rose black spot, rusts, and other diseases. It works by inhibiting the germination of the fungal spores. It is available in several forms, including dusts, liquids, and wettable powders.

Keep in mind that sulfur can burn foliage if the temperatures are above 80°F and if oils have been used within the last 20–30 days. Plants sensitive to sulfur include apricots, some raspberries and blackberries, gooseberries, currants, and cucurbits.

Lime Sulfur

Lime sulfur is made by boiling lime and sulfur together. The lime helps the sulfur penetrate the plant tissue. The mixture has insecticidal properties as well as fungicidal ones. It helps control diseases such as anthracnose and powdery mildew when used as a dormant spray. It also aids in the control of scale insects, thrips, and eriophyid mites.

Drawbacks to using lime sulfur are its smell of rotten eggs and it can burn exposed skin and eyes. It will also injure plants if temperatures are above 80°F.

Bordeaux Mixture

This is a natural pesticide produced by a reaction between copper sulfate and calcium hydroxide

(hydrated lime). It was first used in Bordeaux, France, to control downy mildew on grapes, hence its name.

Like sulfur, Bordeaux is a preventive fungicide that needs to be in place before the disease shows up. It has a very long track record — more than 150 years. Fungicidal as well as bacterial properties extend its utility in organic production.

Bordeaux has the advantage of sticking to plants despite rain or irrigation. It controls bacterial leaf spots, blights, various types of anthracnose, downy mildews, and cankers. It also repels many insects.

Uses. Bordeaux is labeled for use on many vegetables, tree fruits, and nut crops.

Drawback. One drawback is that, like sulfur and lime sulfur, it can be phytotoxic to plants. It can burn leaves and cause russetting of fruits if applied in cool wet weather.

Formulations. There are various formulations of Bordeaux mixture, but perhaps the best all-around mix is 4-4-50 — four pounds of copper sulfate and four pounds of hydrated lime in fifty gallons of water. Generally a weaker solution of Bordeaux is recommended for foliage in early spring and a heavier solution for late-in-the-season applications for protection against serious diseases like late blight.

Copper caution. One caution to keep in mind with Bordeaux mix is that excessive use will cause a buildup of copper in the soil. Copper is toxic to fish and is a heavy metal. Bordeaux fungicide can be purchased premixed, but it is more effective if prepared just before use. Plants, including ornamental sorghum and corn, are sometimes sensitive to copper-based pesticides. Also, use caution when applying Bordeaux to tender leaves of apple, pear, plum, or rose as they may be burned. Geraniums, ivy, pansy, celery, strawberry, azaleas, dogwood, and juniper are also sensitive so use of dilute sprays is advised.

Other Fungicide Options

Neem oil has fungicidal properties. Hydrogen peroxide, dormant oils, the antibiotics streptomycin and tetracycline, as well as several mineral- and plant-based materials can be valuable in protecting your crop. See “Further Reading” at the end of the chapter and the online resources to aid your search for solutions to these problems.

Seek Reliable Data

When using compounds to control pests in an organic system, it is advisable to make sure reliable data supports its use and that it is registered for use on the intended plant species you wish to treat. Many homegrown recipes purportedly solve all sorts of problems. In some cases, they may be effective but may also cause unwanted side effects, such as the buildup of harmful compounds in the soil, unexpected detrimental effects on beneficial fauna and flora, and possible toxic-generated materials and side effects.

Summary

Gardening organically can be very rewarding. Through the process one will gain a much greater appreciation of natural checks and balances. By working within nature's parameters, we gain a deeper understanding of how natural processes work in our favor. Organic food production involves a certain state of mind, as well as a defined food production system. Organic growing involves a holistic approach to growing, instead of the more common approach of treating problems individually. There will certainly be a learning curve associated with this approach, but once a gardener understands how things interrelate, the process becomes much more manageable and enjoyable.

Further Reading

BOOKLETS AND PAMPHLETS

University of Idaho Extension

- BUL 775 *Planning an Idaho Vegetable Garden*
- CIS 993 *Management of Vegetable Diseases in Home Gardens*
- CIS 1066 *Composting at Home*
- EXT 726 *Weed Control in the Home Garden*
- PNW 328 *Using Horticultural Mineral Oils to Control Orchard Pests*
- PNW 533 *Fertilizing with Manure*
- PNW 550 *Encouraging Beneficial Insects in Your Garden*

Oregon State University Extension

EC 1247 *Gardening with Composts, Mulches, and Row Covers*

PNW Pest Management Handbooks: Insect Management, Plant Disease, and Weed Management, <https://pnwhandbooks.org/>

Utah State University Extension

HG-510 *Selecting and Using Organic Fertilizers*

Washington State University Extension

EBO 648 *Organic Gardening*

BOOKS

Ball, J. 1988. *Rodale's Garden Problem Solver; Vegetables, Fruits, and Herbs*. Emmaus, PA: Rodale Press. ISBN 0-87857-762-9.

Organic Gardening Magazine. 1978. *The Encyclopedia of Organic Gardening*. Emmaus, PA: Rodale Press. ISBN 0-87857-225-2.

Ware, W. W. 1988. *Complete Guide to Pest Control With and Without Chemicals*. Fresno, CA: Thomas Publications. ISBN 0913702-09-9.

WEBSITES

Organic certification information: <https://attra.ncat.org/topics/organic-certification/>

Idaho State Department of Agriculture Organic Program: <https://agri.idaho.gov/main/about/about-isda/ag-inspections/organic-certification-program/>

ALWAYS read and follow the instructions printed on the pesticide label. The pesticide recommendations in this UI publication do not substitute for instructions on the label. Pesticide laws and labels change frequently and may have changed since this publication was written. Some pesticides may have been withdrawn or had certain uses prohibited. Use pesticides with care. Do not use a pesticide unless the specific plant, animal, or other application site is specifically listed on the label. Store pesticides in their original containers and keep them out of the reach of children, pets, and livestock.

Trade Names — To simplify information, trade names have been used. No endorsement of named products is intended nor is criticism implied of similar products not mentioned.

Groundwater — To protect groundwater, when there is a choice of pesticides, the applicator should use the product least likely to leach.

