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**GOAL:** Grow a mini-ecosystem thriving with life

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## **AN INTERRELATED FOOD-RAISING SYSTEM: Creating and Caring for a Balanced Natural Ecosystem with Insect Life**

**I**nsects and people are only part of the complex, interrelated world of life. Both are important, integral parts of its living dynamism. Insects are an important part of the diet for many birds, toads, and frogs, and for some insects in nature's complex food chain. The GROW BIOINTENSIVE method reminds you that every time you relate to an insect you are relating to the whole system of life, and that if you choose to dominate the insect population, rather than work in harmony with it, part of the system dies. For example, we depend on insects to pollinate many of our vegetables, fruits, flowers, herbs, fibers, and cover crops. When we choose dominating, death-oriented control, then the scope and depth of our lives become narrower and smaller. We are actually detracting from our lives rather than adding to them. In trying to isolate an insect and deal with it separately out of relation to the ecosystem in which it lives, we work against nature, which in turn works against us in counterproductive results.

When an excess of insects appears in a garden, nature is indicating that a problem exists in the life of that garden. In each case, we need to become sensitive to the source of the imbalance. Observation and gentle action will produce the best results. In contrast,

when a heavy-handed approach is taken and poisons are used, beneficial predators are killed as well as the targeted harmful insects. Spraying trees to eliminate worms or beetles often results in a secondary outbreak of spider mites or aphids because ladybugs and other predators cannot reestablish themselves as quickly as the destructive species.

Paying attention to the soil and to plant health, planning a varied environment, and leaving a few wild spaces for unexpected benefactors minimize pest losses more effectively than the use of poison. Also, in order to have beneficial insects in your food-producing area, you must provide food for them—which may be some of the harmful insects! If there are no harmful insects to feed them, then there will be few, if any, beneficial insects around to act as friendly guardians for your garden. This seeming paradox—the need for both kinds of insects for the healthiest garden—is symbolic of nature’s balances. Not too much moisture, but enough. Not too much aeration, but enough. Not too many harmful insects, but enough. You find the need for these balances everywhere—in the compost pile, in the soil, in the mini-climate, and in the backyard microcosm as a whole.

In a small backyard garden ecosystem or mini-farm, it is especially important to welcome all life-forms as much as possible. Ants destroy fruit fly and housefly larvae and keep the garden cleared of rotting debris. Have you ever squashed a snail and watched how the ants come to whisk the remains away almost within a day? Earwigs are carnivorous and prey on other insects. Tachinid flies parasitize caterpillars, earwigs, tomato worms, and grasshoppers by laying their eggs in them. We’ve found cabbage worms immobilized and bristling with cottony white torpedoes the size of a pinhead—larvae of the braconid wasp, which will hatch and go in search of more cabbage worms. Toads eat earwigs, slugs, and other pests. Chickens control earwigs, sowbugs, and flies. Even the ancient and fascinating snails have a natural predator: humans!

The first step in insect control is to cultivate strong, vigorous plants by cultivating a healthy place where they can grow. Normally (about 90% of the time), insects only attack unhealthy plants. Just as a healthy person who eats good food is less susceptible to disease, so are healthy plants on a good diet less susceptible to plant disease and insect attack. The insect is not the source of the problem, but rather an unhealthy soil is. The soil needs your energy, not the insect. The uninterrupted growth that the GROW BIOINTENSIVE method stresses is also important to maintaining plant health. We are shepherds providing the conditions our plants need for healthy, vigorous growth.

Here are some elements to consider when caring for your garden's health:

- Did you dig the soil properly?
- Are the proper plant nutrients available in the soil?
- Did you use enough compost?
- Is the soil pH within reasonable limits for the plant being grown?
- Did you transplant the seedlings properly?
- Are you watering the plants properly?
- Are you weeding effectively?
- Are you maintaining the soil in a way that will enable it to retain moisture and nutrients?
- Are the plants receiving enough sun?
- Are you growing the plants in season?

Another factor that aids plant health and minimizes insect and disease problems is keeping a correct balance of phosphorus and potash in the soil in relation to the amount of nitrogen present. The optimal ratio among these elements is still to be determined. Research also needs to be completed to determine the minimum amounts of these elements (in pounds per 100 square feet) that should be in the soil. (Smaller amounts of organic fertilizer elements are required in comparison with soluble synthetic chemical fertilizers, since they break down more slowly and remain available to the plants for a longer period of time.)

Properly planning the garden can eliminate many insect and disease problems.

- Use seeds that grow well in your climate and soil.
- Use plant varieties that are weather hardy, insect resistant, and disease resistant. New strains, especially hybrids (whether developed for higher yields, disease resistance, or other reasons),

should usually be avoided. Some hybrids produce foods of lower nutritive value in comparison with older strains, and often use up nutrients from the soil at a more rapid rate than a living soil can sustain over time. Hybrids also tend to be very susceptible to a few diseases even when they are greatly resistant to many prevalent ones.

- Companion plant. Grow vegetables and flowers together that grow well with each other.
- Avoid putting the same vegetable in the same growing bed each year. This practice invites disease.
- Rotate your crops; follow heavy feeders with heavy givers and then light feeders.

## Natural Predators

Encourage natural insect control by enlisting the aid of Nature.

**Birds**—Some are vegetarians. Others are omnivorous. A bird that stops for a seed snack may remain for an insect dinner. A house wren feeds 500 spiders and caterpillars to her young in an afternoon; a brown thrasher consumes 6,000 insects a day; a chickadee eats 138,000 cankerworm eggs in 25 days; and a pair of flickers eats 5,000 ants as a snack. A Baltimore oriole can consume 17 hairy caterpillars in a minute. You can encourage the presence of birds with moving water, by planting bushes for their protection, by planting sour berry bushes for food, and by growing plants that have seeds they like to eat.

**Toads, snakes, and spiders**—They also eat insects and other garden pests. Toads eat as many as 10,000 insects in 3 months, including cutworms, slugs, crickets, ants, caterpillars, and squash bugs.

**Ladybugs**—These beetles are good predators in your garden since they eat a single particular pest, aphids, and do not eat beneficial insects. Ladybugs eat 40 to 50 insects per day, and their larvae eat even more.

**Praying mantids**—These predators should only be used in infestation emergencies, since they eat beneficial as well as harmful insects. They are not selective and even eat each other.

**Trichogramma wasps**—They lay their eggs in hosts, such as moth and butterfly larvae, that eat leaves. When they hatch, the wasp larvae parasitize the host larvae, which fail to reach maturity. Up to 98% of the hosts are rendered useless in this way.

**Tachinid flies**—These parasites help control caterpillars, Japanese beetles, earwigs, gypsy moths, brown-tail moths, tomato worms, and grasshoppers.

**Syrphid flies**—These parasites prey upon aphids and help pollinate crops.<sup>1</sup>

After you have done everything possible to provide a healthy, balanced garden for your plants, you may still have insect problems. If so, you should approach the unwanted insects with the idea of living control rather than elimination. If there is a problem, identify the pest and try to determine whether an *environmental change* can solve the problem. In our research garden, we have minimized (not eliminated, though) gophers by introducing gopher snakes.

The pocket Golden Guides *Insects and Insect Pests* are invaluable guides for getting to know the creatures that inhabit your garden. Out of the 86,000 species of insects in the United States, 76,000 are considered beneficial or friendly.<sup>2</sup> So, be careful! An insect that looks ugly or malicious may be a friend. If you can't seem to find an obvious culprit for your problem, try exploring at night with a flashlight. Many predators are active then.

Ask yourself whether the damage is extensive enough to warrant a policing effort. During 1972, we grew bush beans in one of our test beds. The primary leaves were almost entirely destroyed by the twelve-spotted cucumber beetle. But in most cases the damage was not so rapid as to prevent the development of healthy secondary leaves. The less tender secondary leaves were ultimately attacked and quite heavily eaten. About 80% of the secondary leaf area remained, however, and we harvested very tasty, unblemished beans. The yield in pounds was still 3.9 times the United States average! Recent tests have shown that leaf damage of up to 30% by insects can actually increase the yield in some crops. You may decide to sacrifice some yield for beauty; many destructive caterpillars become beautiful butterflies. To get the yield you want and/or

to encourage the presence of butterflies, you can plant extra plants of the crops they like.

We often underestimate the ability of plants to take care of themselves. The damage done by insects often affects only a very small percentage of the edible crop. Because of this, many GROW BIOINTENSIVE gardeners plant a little extra for the insect world to eat. This practice is beautiful, mellow, and in keeping with life-giving forms of insect control. Furthermore, extensive research has shown that beneficial organisms found in soil and ocean environments can withstand stress, in the form of temperature, pressure, pH, and nutrient fluctuations, to a much greater degree in an organically fertilized medium than in a synthetically fertilized medium. I suspect researchers will come to a similar conclusion about plant resistance to insect attack.

Any time an insect or other pest invades your garden, there is an opportunity to learn more about nature's cycles and balances. Learn why they are there and find a *living control*. Look for controls that will affect only the harmful insect. Protect new seedlings from birds and squirrels with netting or chicken wire, trap earwigs in dry dark places, wash aphids off with a strong spray of water, or block ants with a sticky barrier of Vaseline, Tanglefoot Pest Barrier, or a tack trap. While you are doing this, continue to strive for a long-term natural balance in your growing area.

At our Common Ground Research Garden, only 3 pest problems have taken a lot of our energy: snails, slugs, and gophers. The first few years we primarily trapped gophers. A lot of time was spent checking and resetting traps and worrying about them, yet the gophers probably only damaged about 5% of our crop. We later found that, in addition to gopher snakes, they really do not like certain things placed in their holes (sardines, garlic juice, fish heads, male urine, and dead gophers). The gophers may also be blocked with strips of daffodils. Daffodils contain arsenic in their bulbs and can discourage them. Gopher snakes, of course, prevent a population explosion. A combination of approaches and gentle persistence paid off.

We have a simple routine for snails and slugs. At the end of the spring rains we go out at night with flashlights and collect gallons of them. We drop the snails in buckets of soapy water, which kills them. If we use soap that is quick to degrade, we can dump them on the compost pile the next day. We catch most of them in the first 3 nights. Going out occasionally over the next 2 weeks, we can catch new ones that were too small to get in the first sweep or that have just hatched from eggs laid in the soil. Such a concentrated cleanup

can be effective for several months. The red-bellied snake eats large numbers of slugs. A sorghum mulch is reported to repel slugs as well.

Another kind of problem has been solved through observation. For example, one year a cherry tomato bed was wilting. Several people, including a graduate student studying insects, told us it was caused by nematodes. When we dug down into the soil to look for the damage, we discovered the real source. The soil was bone dry below the upper 8 inches. A good soaking took care of the problem, and we learned not to take gardening advice on faith, but to always check it out for ourselves—as we hope you will.

## Other Initiatives

Here are some other living control approaches to try:

**Hand-picking**—You can pick the insects from plants once you are certain the insect involved is harmful and is the source of the problem. Some insects are only harmful in one stage and can even be beneficial in other stages.

**Spraying**—In general, insects may be divided into two categories—those that chew and bite plants and those that suck juices from them.

- Chewing or biting insects include caterpillars, flea beetles, potato bugs, cankerworms, cutworms, and grasshoppers. Aromatic and distasteful substances such as garlic, onion, and pepper sprays can discourage them.
- Sucking insects include aphids, thrips, squash bug nymphs, flies, and scale insects. Soap solutions (not detergents, which would damage the plant and soil as well as the insects), clear miscible oil solutions, and other solutions that asphyxiate the insects by coating their tender bodies and preventing respiration through body spiracles or breathing holes help control these insects.

**Traps**—Some traps, such as shredded newspaper in clay pots turned upside down on sticks in the garden, will attract earwigs during daylight hours. Snails, slugs, sowbugs, and symphylans can be trapped under damp boards or sweet potatoes cut in half lengthways. They retreat to these places in the heat and light of the day.

**Barriers**—The sticky commercial Tanglefoot substance will catch some insects crawling along tree trunks during part of their life cycle. Catching insects in this manner often prevents infestation of the tree in a later season. (Tanglefoot barriers must be applied to apple tree trunks in July to catch codling moth larvae leaving the tree. This will minimize codling moth infestation the following spring. Plan ahead!) You can also use plant barriers and decoys. Grow a vegetable or flower preferred by a particular insect away from the garden to attract it to another location. Place repellent plants near a vegetable or flower that needs protection.

**Companion plants**—You may also wish to plant some herbs in your bed for insect control. The age and number of plants used per 100 square feet determine the herb's effectiveness. A young plant does not have an aroma or root exudate strong enough to discourage harmful insects or to attract beneficial ones. Similarly, too few herbs will not control a pest or attract a needed predator. But too many herbs may retard vegetable growth and yield. Composite flowers, such as pot marigolds (calendulas) and sunflowers, are excellent attractants for predatory insects because their large supplies of pollen serve as predator food sources. A few (2 to 4) plants per 100-square-foot bed will probably suffice. We have not done many experiments with them yet, since accurate testing can take 2 to 3 years for 1 herb grown with 1 food plant to control 1 insect. You may wish to try some of these biodynamic observations, though. It's a lot of fun to try to see for yourself!

Probably the most important form of insect control with plants is just diverse cropping. The GROW BIOINTENSIVE method we use utilizes diverse cropping, and we have only experienced 5% to 10% crop loss due to pests. Biodynamic gardeners and farmers also use diverse cropping and have suggested planting 10% more area to make up for crop losses. In contrast, the monocropped acreage of today's commercial agriculture provides an ideal uniform habitat for widespread attack by pests that favor a single crop. Pesticides have been used to counteract the problem inherent in monocropping. Yet the Environmental Protection Agency estimated that in 1940, "American farmers used 50 million pounds of pesticides and lost 7% of their crop before harvest," and that by 1970, 12 times more pesticides were used, "yet the percentage of crops lost before harvest has almost doubled."<sup>3</sup> Today, about 30 times more pesticides are used than in 1940, and the percentage of crops lost to insects has been estimated to be as high as 37%. In fact, many pesticides targeted for a single pest species actually cause increases in numbers of



nontargeted pests. By their action on the physiology of the plant, pesticides can make a plant more nutritionally favorable to insects, thereby increasing the fertility and longevity of feeding pests.<sup>4</sup>

Insect Pests and Plant Controls <sup>5</sup>	
INSECT PEST	PLANT CONTROL
Ants	Spearmint, tansy, pennyroyal
Aphids	Nasturtium, spearmint, stinging nettle, southernwood, garlic
Black flea beetle	Wormwood, mint
Blackfly	Intercropping, stinging nettle
Cabbageworm butterfly	Sage, rosemary, hyssop, thyme, mint, wormwood, southernwood
Colorado potato beetle	Eggplant, flax, green beans
Cutworm	Oak leaf mulch, tanbark
Flies	Nut trees, rue, tansy, spray of wormwood and/or tomato
Japanese beetle	White geranium, datura
June bug grub	Oak leaf mulch, tanbark
Malaria mosquito	Wormwood, southernwood, rosemary
Mexican bean beetle	Potatoes
Mosquito	Legumes
Moths	Sage, santolina, lavender, mint, stinging nettle, herbs
Plant lice	Castor bean, sassafras, pennyroyal
Potato bugs	Flax, eggplant
Slugs	Oak leaf mulch, tanbark
Squash bugs	Nasturtium
Striped cucumber beetle	Radish
Weevils	Garlic
Woolly aphids	Nasturtium
Worms in goats	Carrots
Worms in horses	Tansy leaves, mulberry leaves



Natural Ecosystem

It is evident that pesticides are not an effective solution for crop losses due to pests. Diverse cropping without pesticides may be able to reduce total pest losses more than monocropping with pesticides, even in large-scale agriculture. Using standard agricultural practices, Cornell University researchers, in a 5-year study completed in 1970, found that without pesticides the insect population could be cut in half when only 2 crops were grown together.<sup>6</sup> You can do this when you grow a diversity of plants in your backyard with life-giving techniques!

This introduction to insect control has emphasized philosophy and general approaches. Philbrick's *Companion Plants and How to Use Them*, Hunter's *Gardening Without Poisons*, and Philbrick's *The Bug Book* (see Insect Life and Balance section in online Bibliography at [www.growbiointensive.org](http://www.growbiointensive.org)) have already vigorously explored the spectrum of organic insect control in detail. These books provide companion planting combinations, recipes for insect control solutions, and addresses for buying predatory insects.

I hope each person who reads this book will plant at least one small, 3 by 3-foot grow biointensive bed. You will find the experience fun and exciting beyond your wildest expectations!

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#### ENDNOTES

- 1 Beatrice Trum Hunter, *Gardening Without Poisons* (New York: Berkeley Publishing Corp., 1971), pp. 31, 37, 42, 43, 48.
- 2 Ibid., p. 28.
- 3 James S. Turner, "A Chemical Feast: Report on the Food and Drug Administration" (Ralph Nader Study Group Reports) (New York: Grossman, 1970). Cited in Frances Moore Lappe and Joseph Collins, *Food First* (Boston: Houghton Mifflin Company, 1977), p. 49.
- 4 Francis Chaboussou, *Healthy Crops: A New Agricultural Revolution* (Charlbury, UK: John Carpenter Publishing for The Gaia Foundation, 2004).
- 5 Helen Philbrick and Richard B. Gregg, *Companion Plants and How to Use Them* (Old Greenwich, CT: Devon-Adair Company, 1966), pp. 52–53. This book and others should be consulted for the proper use and application rates of these plant remedies. Improper use or application can cause problems and could be harmful to you, your plants, and animals.
- 6 Jeff Cox, "The Technique That Halves Your Insect Population," *Organic Gardening and Farming*, May 1973, pp. 103–104.