

# NATURE'S OWN PEST CONTROL: BENEFICIAL INSECTS

*Here's the inside story on how the right "bugs" can do battle  
with the bad guys in your garden.*

BY JACK COOK

To call the Trichogramma wasp "tiny" is like calling Mt. Everest "above average." Half a dozen Trichogrammas could perch comfortably on the head of a pin. The wasp's wingspread is about one-fiftieth of an inch.

Despite its size, the Trichogramma looks fierce when you magnify the little monster. Its eyes glow a dangerous red, and the yellow markings on its shiny black body give it the sleek look of a jet fighter. Luckily, this wasp is so tiny that it poses no threat to humans. In fact, it even lacks the "true stinger" that make its larger cousins such an outdoor worry.

It does, however, pose a great threat to many members of the insect world—especially one distinct type whose members are among the least welcome in our gardens. European corn borers, alfalfa caterpillars, cutworms, cabbage loopers, codling moths, tomato hornworms and wax moths are but a handful of the 200 species of destructive moths and butterflies whose eggs are the



*The Chinese praying mantis, introduced in the United States about 80 years ago, eats anything it can catch.*

Trichogramma's victims.

Upon finding such an egg, the adult female wasp deposits one of her own eggs. This little gift soon hatches into a wasp larva that consumes the pest egg surrounding it.

During the course of her brief life—nine to 11 days—the Trichogramma will parasitize some 50 eggs in this manner. And since many of those 50 offspring will themselves become females, this beneficial army can muster quite a few troops over a summer.

The Trichogramma is a prime example of what we call a beneficial insect. (Those that *don't* benefit us we call pests.) It's worth noting that of all the known species of insects, only about 1 percent are what we would consider pests. It's also worth noting that for every pest insect, there are several beneficials that will prey upon it.

Controlling pests with beneficials is an ancient practice. The Chinese put bugs to work for them centuries ago. Even in this country, the practice dates back more than 100 years—to 1883—when another tiny wasp, *Apanteles glomeratus*, was released in great numbers in California to control the imported cabbageworm. Six years after that, the first really spectacular success occurred. The hero was

an insect that looks a bit like a ladybug: the vedalia beetle.

By the mid-1880s, a sucking insect called the cottony cushion scale—it produces a cotton-like waxy residue on plant tissue—had virtually destroyed the California citrus industry. Trees were dying by the hundreds of thousands. Investigation revealed that the scale had come to California from Australia, where it existed in such small numbers it was scarcely noticed. Natural enemies there kept it in check.

In 1888, the U.S. Department of Agriculture sent Albert Koebele to Australia to search for those enemies and bring 'em back alive. On Oct. 15, 1888, he found the vedalia beetle feasting on the scale insects and sent several packages of live beetles back to California. They were released in two badly infested orange groves near Los Angeles.

The beetles proved both hungry and prolific, even though only 500 survived the journey. The scale had disappeared from entire trees in just a few weeks. The vedalia, dubbed by citrus growers "the miracle bug," was widely distributed and in less than a year, cottony cushion scale was no longer a problem in California. That success had an important side effect: establishment of the California Biological Control Services Program.

Enter the anti-hero of this tale: *dichlorodiphenyltrichloroethane*. DDT. In the 1940s, this notorious (and now vilified) pesticide was sprayed on orange groves to eliminate other bugs. Unfortunately, DDT killed off the vedalia beetle, but *not* the scale insect and, in two years, the orange groves were again being decimated by the cottony cushion scale. Growers voluntarily discontinued the lethal pesticide and reintroduced the beetle. Today, the scale and vedalia co-exist in small numbers, the scale is once again a non-threat and DDT is used only in conversation—as a reminder of the harm that chemicals can cause.

In the early 1960s, J. Everett "Deke" Dietrick, widely regarded as the granddaddy of the beneficial insect industry in this country, scored a similar victory against the cotton

bollworm, *Heliothis zea*. Dietrick, 70, president of California's Rincon-Vitova Insectaries Inc., the oldest and largest insectary in the United States, used Trichogrammas and a complex of other beneficials to beat the bollworm. "We took cotton out of spray (programs) in 1961, '62, and '63," he recalls. "We virtually proved that you didn't have to spray cotton."

The victory was short-lived, unfortunately—today cotton may be doused with more insecticides than any other crop. The cause is the pink bollworm, *Pectinophora gossypiella*, which arrived from points unknown in the mid-1960s. The beneficials that worked so well against the common bollworm were not effective against the pink, and the insecticides made a comeback, killing off the beneficials that had kept the common bollworm in check. So, in an escalation pattern that has become all too familiar, more insecticides were sprayed.

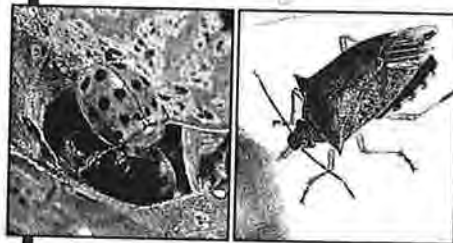
But a quarter of a century later, Dietrick says there's still beneficial hope. "We have another Trichogramma species from Australia that's being tried on the pink bollworm," he reports. "The problem we've had in getting these here is that they're from south of the equator, so you've changed the season on them. Ideally, you'd take them from a temperate region to another temperate region." Of course, that's not an option, so what they're trying to do instead is find a strain in the chillier mountains of northwestern Australia. The hope is that parasites there will be more cold tolerant and therefore more likely to survive the switch in seasons.

### BENEFICIAL BOOM

Driven by increasing pest (and human) resistance to insecticides, the beneficial insect business is booming. There has never been a wider variety of pest-eaters available—or more interest in using them, thanks to a public increasingly disenchanted with "better living through chemistry."

Most members of the general public associate beneficial insects with the ladybug (or the lady beetle

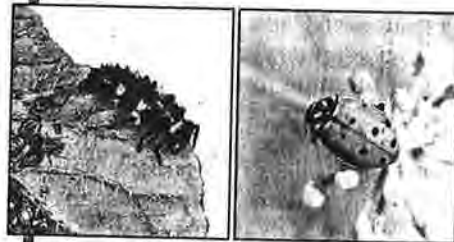
## When insects devour your garden crops, WHICH BUGS Will You Kill?



### Good bugs or bad bugs?

The critter on the left is a Mexican Bean Beetle—your garden is his own gourmet salad bar. He and his friends are so voracious, they can strip a row of beans in a few days. What's worse, they look so much like Ladybugs that many gardeners think they're good guys. They're not. The mean-looking dude on the right is a Spined Soldier Bug. His favorite dinner is Mexican Bean Beetle. These fierce soldiers can save your crop.

When you use broad-spectrum chemical insecticides, you kill them both—the good with the bad, friend with foe.



The ugly bug on the left is a Ladybug larva, which eats aphids the way other adolescents eat french fries. She'll grow up to be the cute little thing on the right, an adult Ladybug. Spray chemicals for aphids and you kill the Ladybugs, too.

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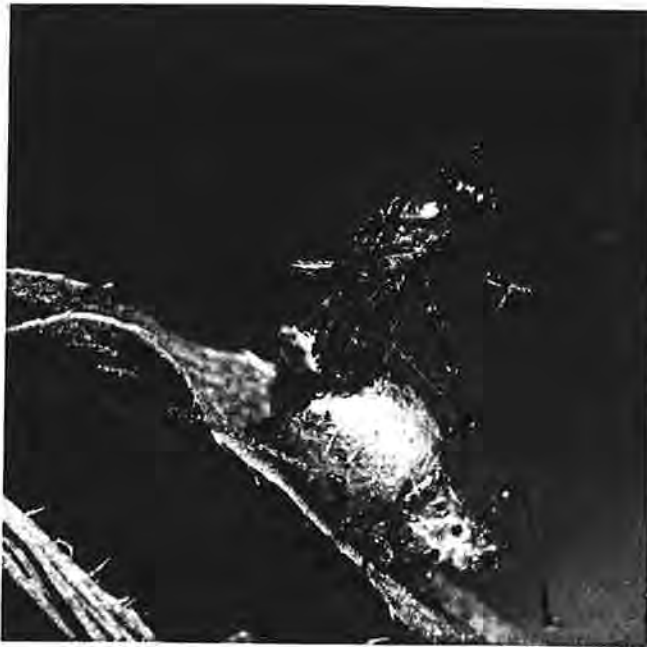
to you sticklers) and the praying mantis. But it's now generally agreed that the martial-arts mantis, fascinating critter though it may be, is not an effective pest predator, because it eats *any* insect its piously extended front legs can grab—including other beneficials (even other praying mantises!).

As for the familiar ladybug, there's no doubt that it does have an avid appetite for aphids. The problem is that once released, it often flies away. For that reason, it is the even *more* voracious *larva* of the ladybug that you want prowling around in your patch.

The ladybugs sold commercially (*Hippodamia convergens*) are collected mostly in the Sierra Nevada mountains of California during December, January and February—three of the nine months of the year they are "asleep." Upon awakening, they leave the mountains and fly down to the valleys to feed. If a gardener releases them in June or later, their instinct is to fly up to seek the air streams that would carry them back to the mountains to their long season's nap, says Kenneth S. Hagen, Ph.D., of the division of biological control at the University of California at Berkeley.

Niles Kinerk, who thinks "ladybugs have gotten an overly bad rap" on their propensity to fly away, has some astute suggestions for gardeners who want to welcome this favored bug into their lives. (He operates Gardens Alive!, Sunman, Ind., one of the country's fastest growing mail-order retailers of beneficials. It mailed 160,000 orders last year, compared to slightly more than 100,000 the year before. GA!'s most popular beneficial, in fact, is the ladybug.)

"They do disperse," he concedes, "but I have found that if you release them in the evening and spray the area with water ahead of time, and make sure there's an abundant supply of aphids or other food,



A braconid wasp (one of many beneficial species) emerges from the shell of a parasitized aphid.

you'll have ladybug larvae crawling all over the place within a very short time."

Nonetheless, Kinerk prefers green lacewings in *his* garden. Commonly found on almost any plant, adults are light green, about three-quarters-inch long, with beautifully filigreed wings that are larger than the insects themselves. "In their larval form, they're a much more aggressive predator than ladybugs," he believes. "They work so well on aphids that I would use them as a first line of attack every time." These larvae are known (for good reason) as "aphid lions"; they also prey on virtually any other soft-bodied insect they find.

The arsenal of beneficials available to gardeners and farmers currently includes:

- **Spined soldier bugs**, that go after cabbage loopers and cabbage worms.

- **Predatory mites** (there are many species); one mite can consume up to 20 pest mites, or their eggs, per day.

- **The little *Encarsia formosa***, which keeps greenhouse whiteflies in check.

- **Fly parasites**, also tiny wasps, which can dramatically reduce the flies that are a package deal when

you keep livestock.

- ***Cryptolaemus***, a member of the lady beetle family commonly called the "mealybug destroyer," after its favorite meal. It's also known as Australian lady beetle.

- **Beneficial nematodes** that, unlike their nasty cousins, do not harm plant roots but destroy insects that live at least part of their lives underground, including cutworms, root maggots, wireworms, Japanese beetles, June beetles and onion maggots (but not those friendly red earthworms).

- And in the near future, reports Dr. Hagen, another member of the lady beetle family, the **seven-spot beetle**, *Coc-*

*cinella septempunctata*, will be available if the cost of rearing can be brought down from the current \$1-plus per beetle. Unlike its kin, *Hippodamia convergens*, it does not have the unsettling habit of flying away when released as an adult.

### A THREE-PRONGED STRATEGY FOR BENEFICIAL SUCCESS

If you want to try to use beneficials to control garden pests, you should understand certain basics, advises Roy VanDriesche, Ph.D., of the University of Massachusetts' entomology department, a noted expert on biological pest control.

"There are three broad approaches to using beneficials," he explains. "Importation, conservation, and augmentation."

- **Importation** means that you bring an organism into an area where it does not naturally occur so that it becomes established in this nonnative land. Both the cottony cushion scale and the vedalia beetle are examples; the scale an unintentional import and the beetle intentional. Both became established and now exist in a sort of adversarial balance with each other.

- **Conservation**, on the other hand, means that you try to accommodate the needs of natural ene-

mies of pests in your environment, so that they prosper and perform the service. "This often works well if you're dealing with native pests," VanDriesche explains. "But it often does not work if you're dealing with introduced pests. So you can be doing all the right things to conserve and still have lots of pests."

"That's why, in addition to conservation, you often need importation to find the right natural enemies that are specific to the pest, and get them established if you can."

Conservation is the key to a remarkable success story in southern Georgia, where it had been widely believed that raising vegetable crops without insecticides was impossible. But three years of trials at the Georgia Coastal Plain Experiment Station have shown that vegetables can be raised successfully with no insecticides at all!

Sharad Phatak, Ph.D., professor of horticulture at the University of Georgia, explains that cover crops are planted in October and November, creating an environment that is attractive to native beneficial insects. (Among the most successful so far are crimson clover, subterranean clover and Vantage vetch.)

They have counted abundant numbers of 13 different species of beneficials in these covers, though 65 percent of the total population consists of "big-eyed bugs," *Geocoris punctipes*. (See chart, p. 46.) The result, Dr. Phatak says, "is that we have been able to control all of our major pests without insecticides." (In the spring, they remove half of

the cover crop and replace it with food crops. When the remaining cover crops die back, the beneficials naturally migrate over and protect the food crops.)

• **Augmentation** means releasing beneficial insects, such as predatory mites or whitefly parasites, purchased from a commercial source for the purpose of pest control.

Beneficial Insectary in Oak Run, Calif., is one of the half dozen or so major producers of beneficial insects in this country. Its owner, Sinhya Penn, has been involved in this field for 15 years. She agrees that for the average gardener it is difficult to make a realistic assessment of the effectiveness of a particular beneficial. And that is one reason, she says, for the recent establishment of the Association of Natural Biocontrol Producers, of which she is president.

"This is a difficult issue," she declares. "Quality control in this industry is not as simple as it sounds." ANBP is currently in the process of setting up minimum industry standards. One of the problems inherent to the industry, Deke Dietrick of Rincon-Vitova points out, is that most beneficials have virtually no "shelf life"—that is, they typically live from 12 days to three weeks after they're packaged. "If I don't sell them in three weeks," he says, "I've got to throw them away. The reason a lot of people aren't in this business is that it's been so hard to make any money at it."

### A GOLDEN AGE OF BIOLOGICAL CONTROL?

Indications are that the "powers that be" in the agricultural establishment are slowly beginning to agree that biological controls work. The wheels of officialdom grind very slowly, however, and California's Medfly battle and Buddy Maedgen's harrowing experience in Texas are good examples.

When the Medfly, a dire threat to the fruit industry, showed up once again in California, state authorities turned to malathion, a broad-spectrum insecticide.

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paign of 1980-82, millions of dollars were spent—including \$20 million for helicopters and \$3.7 million just to settle spraying-related lawsuits. And it may not have even worked! Some scientists believe the pest was brought under control only because it could not survive a colder-than-normal winter. And, Deke Dietrick adds, "there are no strategies for how we're going to deal with the inevitable evolution of strains of malathion-resistant Medflies."

Dietrick's answer, of course, is beneficials. He notes that state Agricultural Research Service entomologists have successfully mass-produced wasp parasites of the Medfly that, when combined with sterile flies, and released on an isolated island in Medfly-infested areas of Hawaii, were completely effective against the pest.

"Wide-area malathion spraying is not necessary," Dietrick says. "They've spent \$50 million just in this last go-around, and they still haven't gone and procured the Medfly's natural enemies, even though we *know* where to go and get them. The cost of the most recent proposal (for biological control research) is barely \$250,000 a year for five years; peanuts compared to the hundreds of millions spent on chemical-based solutions."

M.A. "Buddy" Maedgen Jr. owns Biofac Inc. in Mathis, Texas, one of two commercial insectaries in the state. In 1985, Biofac began to rear insects—including *Trichogramma* wasps—to control pests in stored grains. In April 1988, at the request of the Food and Drug Administration, a warrant was issued to seize a bin containing 300 bushels of rye at the Arrowhead Mills storage facility in Hereford, Texas. (Arrowhead is a well-known and highly respected supplier of organically grown grains.) The reason for the seizure was that insect parts were present in the grain. Some of those insects had come from Biofac.

This was grain straight from the field; it had not yet been cleaned. Grain at that stage almost *always* contains insect parts. (The cleaning process removes most of them.) But

the problem here, says the FDA, was that these bugs had not simply walked or flown into the grain under their own power. They had been *placed* there on purpose! It mattered not a whit to FDA that the purpose was to prevent real pests from damaging the grain.

Nope—to them the grain had simply been "contaminated."

News of the seizure traveled fast, and Biofac's business plummeted. Thanks to vigorous protests by Maedgen and Arrowhead, however, the 300 condemned bushels of rye were eventually released.





Officials of the FDA, the Environmental Protection Agency, and the USDA agreed in December of last year—almost three years after the seizure—that they were "not aware of any adverse health effects associated with the use of parasites and predators of insect pests of stored grain and commodities." Accordingly, in early January the EPA published (in the Federal Register) a proposed rule change that would officially allow beneficial bugs to be used in stored grain. This excerpt from the register caught our fancy:

"In the interests of . . . reduced dependence on chemical controls, researchers and the grain industry believe the use of biological control agents could be practical and have less adverse impact on human health and the environment than the use of chemical pest-control agents, such as commonly used grain fumigants. Furthermore, since the use of biological control agents would decrease the amount of chemical pest-control agents currently in use, applicator/worker exposure to highly toxic materials would be reduced."

The 60-day period for comment (before the rule change can attain the power of law) expired right at press time, and so far it appears that the change will stand. (We'll keep you posted.) If it does, Buddy Maedgen and others in the industry agree that it could mean that a golden age of biological controls might just be beginning. ☸

*Jack Cook writes and gardens among the ladybugs of Vermont's Northeast Kingdom.*

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# BENEFICIAL BORDERS

*Here's how to create the perfect environment for pest-eating insects.*

BY JOANNA PONCAVAGE

**B**y now, most of you know you can buy ladybugs, Trichogramma wasps or green lacewings and have them delivered to your garden by UPS. But your backyard is *already* home to many native beneficials

that show up for free. Getting more of these helpful bugs to stop by—and stay awhile—might be as simple as creating the right habitat.

The Rodale Institute Research Center has been working to identify the best plants for such insect at-

traction since 1987. They've examined nearly 150 so far, recording the kinds (and numbers) of helpful and harmful insects drawn to them.

Their recommendations take into consideration a plant's ornamental value, usefulness and flow-

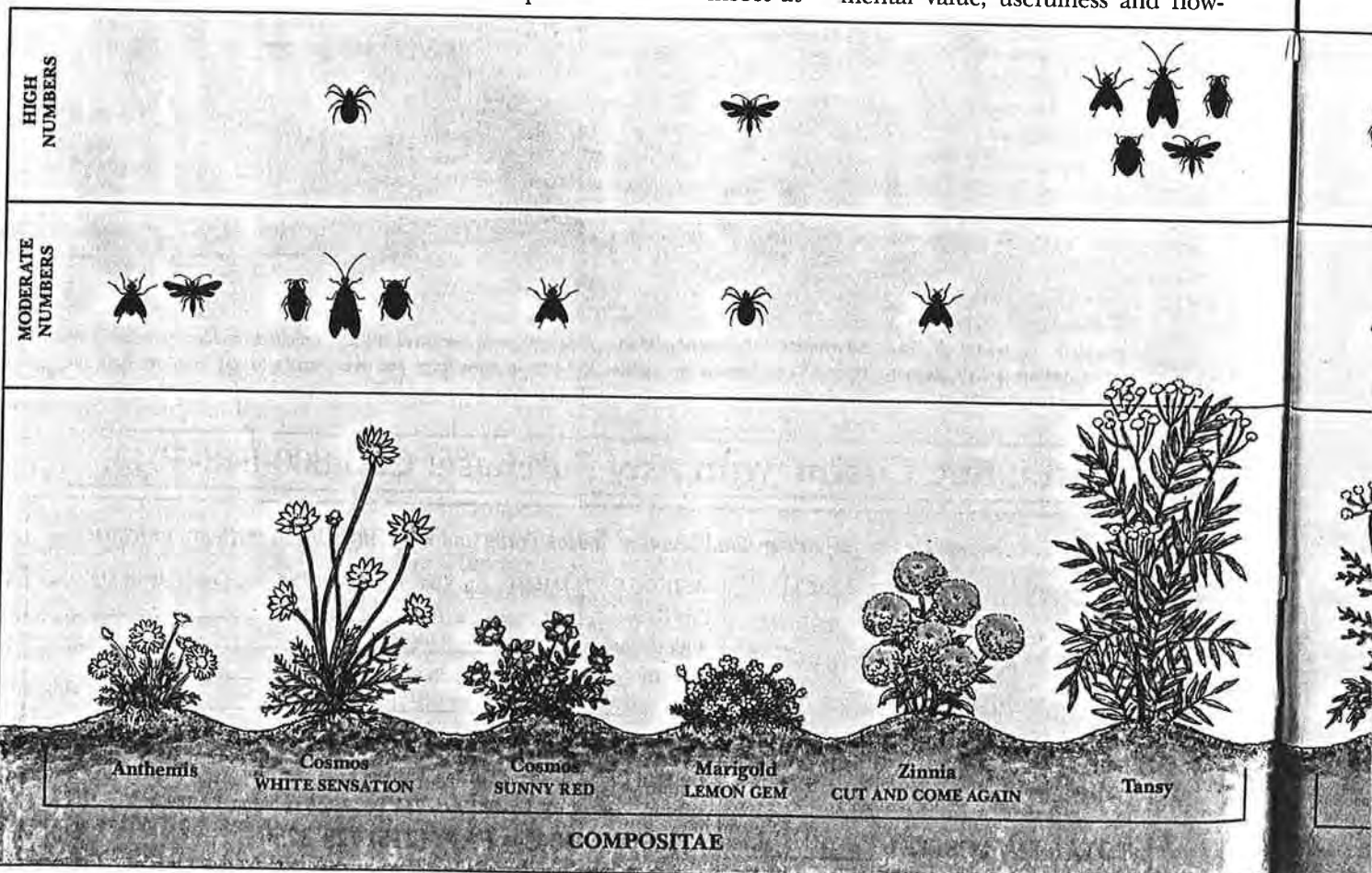


ILLUSTRATION BY BRIAN SWISHER

ering time, as well as the downside—their potential to become troublesome weeds.

“Preliminary” findings (research never ends!) will help you to make informed decisions about what you can plant to keep beneficial insects happy. And if you discover something we may have missed, please write and tell us—after all, every gardener is a scientist and every garden is a unique laboratory.

### RIRC METHODOLOGY

Plants were chosen for testing because they were mentioned in papers written by other scientists, or because staffers noticed they attracted beneficials. Some already had a reputation as “butterfly plants,” because butterflies visit them for nectar and pollen. Some were chosen because they are widely grown, showy ornamentals. All are easily available from seed catalogs and nurseries.

During the tests, plants were swept regularly with insect-catching

nets, and the insects were bagged and frozen for later identification and counting. Particular attention was paid to the following predators and parasites:

- **Syrphids**, also called hover flies. They attack many kinds of aphids.

- **Parasitic wasps**. There are many kinds, including Trichogramma. All lay their eggs in the egg, larva or adult forms of pests, killing them.

- **Ladybugs** (or lady beetles). They eat a wide variety of other insects, including aphids.

- **Lacewings**. Their larvae feed on aphids, mealybugs and scale, moth eggs and small caterpillars.

- **Flies**. Depending on the species, these can be pests or beneficials. Despite the bad reputation of the pests, the beneficial varieties, including tachinid flies, are extremely valuable biological controls.

- **Insidious flower bugs**. A type of pirate bugs, these feed on small larvae, insect eggs, mites and thrips.

- **Spiders**. These are not insects, but are fierce predators.

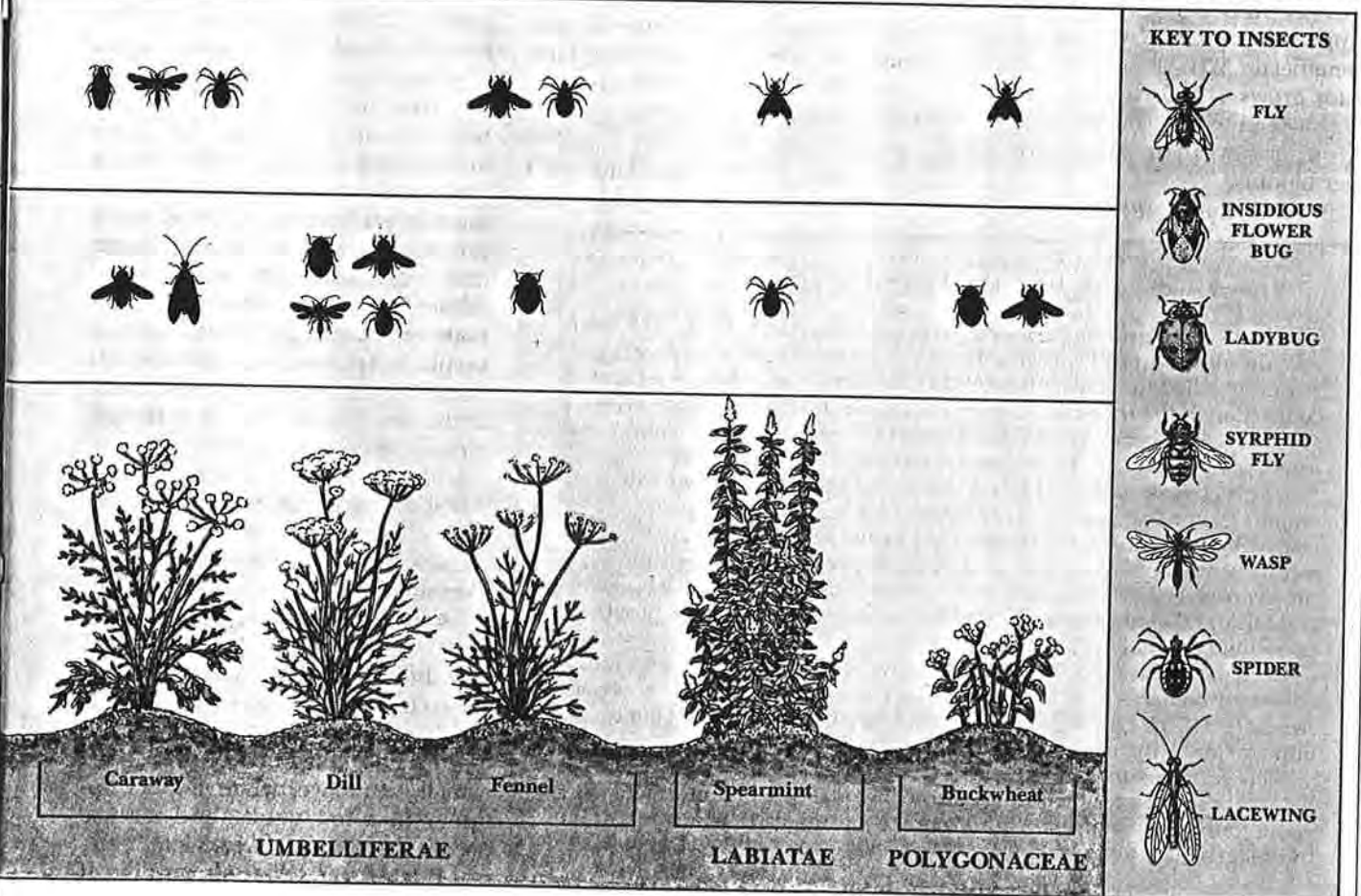
### THE PROMISING PLANTS

Based on the data they have to date, the RIRC researchers believe that the following plants are good candidates for creating habitats that attract and nurture beneficials.

**COMPOSITES:** These plants (Compositae) have flowers with a simple ray of petals around a center.

- **Tansy** (*Tanacetum vulgare* the herb, not *Senecio jacobaea*, or tansy ragwort, the noxious weed) is a large, attractive plant once used extensively in medicine and cooking. In the research center herbarium, tansy attracts a lot of beneficials—one day, there were 115 adults and larvae of two different ladybug species in a 3-by-3-foot plot. Tansy also attracts many insidious flower bugs, small wasps, lacewings and flies.

One reason for the plant's popularity might be that it's full of





food—specifically the tansy aphid, which feeds by sucking the plant's juices, and which tends to congregate in large numbers in the plant's serrated leaf margins.

If you do decide to grow tansy in your garden, position it carefully! This 4- to 5-foot-tall perennial is vigorous and spreading, and when conditions are moist and unventilated, the honeydew excreted by all those aphids gets moldy and can turn the plant's leaves black.

We hasten to add that tansy's benefits far outweigh these potential problems. A solution made from its leaves has even been found to repel Colorado potato beetles in the laboratory. Tansy can be grown from seed or propagated by division. Seeds are tiny, and germination is slow, but dependable.

● **WHITE SENSATION cosmos** (*Cosmos bipinnatus*) bears beautiful flowers that are attractive in garden or vase. They also attract lacewings, ladybugs, insidious flower bugs and spiders. Although visually showier, **SUNNY RED cosmos** (*C. sulphureus*) appears to attract fewer numbers of beneficials. **WHITE SENSATION cosmos** grows 4 to 5 feet tall. You can direct seed where you want them to grow, or start them indoors for earlier blooms.

● **Anthemis** (*Anthemis tinctoria*

*KELWAYI*) is a 2-foot perennial long valued as a dye plant that attracts beneficial wasps and flies. It makes a nice border plant, with many showy yellow flowers over a long period of time. It reseeds itself readily. Both seeds and plants are available.

● **LEMON GEM marigold** (*Tagetes tenuifolia*, also called Signet marigolds; sometimes called *T. signata*) attracts small wasps and spiders. An easy-to-grow annual that is more cold-sensitive than other marigolds, its 1-foot bushy mounds are covered with one-half-inch yellow flowers. For earliest blooms, start these indoors and transplant after danger of frost has passed.

**UMBELS:** Umbels are members of the Umbelliferae, or parsley, family. Many are food or herb plants, including angelica and lovage. Some are common wildflowers, such as Queen Anne's lace. They are highly regarded as attractors of beneficial insects, particularly tiny, parasitic wasps that have an easy time feeding on the nectar of their shallow flowers. The following family members are especially attractive to beneficials:

● **Caraway** (*Carum carvi* L.), 2 to 3 feet high, provides aromatic seeds for use in breads and pickles. An

annual with feathery leaves and fluffy white flower heads, it attracts insidious flower bugs, spiders, small wasps, syrphid flies and lacewings. You can start indoors or direct seed.

● **Dill** (*Anethum graveolens*) is an easy-to-grow annual that reseeds itself readily. It likes moderately rich, loose soil and full sun. Germination is easy; just sow seeds where you want the plants. They'll get 2 to 3



Ed Lachowski, RIRC horticulture technician, "sweeps" a plot of asters.

feet tall, then go to seed. Dill attracts ladybugs, syrphids, small wasps and spiders.

● **Sweet fennel** (*Foeniculum vulgare*) is an herb grown for its licorice-flavored seeds and leaves. (Florence fennel is very similar, but is grown for its edible stalks and bulb.) It can grow 3 feet high and, in mild climates, may behave like a perennial. Start indoors, or direct seed in early spring in moderately fertile soil with adequate calcium and much sun. After germination (about two weeks), allow to dry out between waterings. Fennel attracts syrphids, spiders and ladybugs. (At the New Alchemy Institute in Massachusetts, it also attracted 48 species of parasitic wasps.)

**MISCELLANEOUS:** A wide variety of other plants have interesting relationships with beneficials. Among them:

● **Buckwheat** (*Fagopyrum esculentum*) attracts flies, ladybugs and syrphids, plus pollinating bees. It's also an effective soil-builder that adds organic matter when turned in, and a good weed controller. Its small, attractive, white flowers appear in a few weeks, and mature seeds three to four weeks later.

Buckwheat self-seeds readily. If

## Out in the field

The Rodale Institute Research Center is located in rural Berks County (in southeastern Pennsylvania), about 10 miles west of OG's offices. Formerly called the Rodale Research Center (the name change reflects its connection to the nonprofit Rodale Institute, rather than Rodale Press), its goal has always been to develop, test and refine regenerative, natural-resource management techniques for farm and garden.

It's also one of the few places in the scientific community working to identify plants that provide good habitats for beneficial insects. Since 1987, researchers involved in the project have included Diane Matthews-Gehringer, senior entomology project leader; Sarah Wolfgang, orchard project leader; Terry Schettini, horticulture coordinator; Ed Lachowski and Susan Edwards (now employed by the University of Massachusetts), horticulture technicians.

Recent emphasis has focused on finding beneficial-friendly ground covers for orchards. The best of these will be compared to sod as part of a five-state, USDA Low-Input Sustainable Agriculture grant seeking to improve low-input apple production for the Northeast.

This year, visitors to the research center can visit the herbarium where plants are studied for their insect-attracting qualities. For information about tours, or to contribute in support of this research, write to RIRC, 611 Siegfriedale Road, Kutztown, PA 19530.

you don't mow it after full flower, it may take over. But that same mowing might harm beneficials in their nymph stage, when they can't fly away. (For example, minute pirate bugs need 20 days to produce a new generation.) The best solution might be to have a permanent buckwheat patch near the garden—instead of in it.

● **Spearmint** (*Mentha spicata*), which makes a refreshing tea and flavoring, attracts various flies and spiders. This 3-foot plant with pretty spikes of purple flowers also has a tendency to take over, and should be planted in a container or given lots of space. Transplant (for truer flavors) or start from seed.

● Many kinds of **legumes**, such as crimson clover, white clover or vetch can also help you attract beneficials. They provide alternate prey, good shelter and moisture, and they're absolute champions at adding nitrogen to the soil.

(Note: While attractive, LEMON GEM marigold and CUT AND COME AGAIN zinnia harbored fewer beneficials than other composites or the umbels. They were tested because they are so extensively grown.)

## HABITAT HOW-TO

In addition to nectar and pollen, beneficial insects also need moisture, shelter from wind and rain, alternate prey to get them through the lean times, and places to spend the winter. Usually, the more diverse and varied habitat will better supply these needs.

First, evaluate what you already have. If you grow in containers, consider adding a few pots of spearmint or dill. If you have a big lawn, consider some long strips of fennel, caraway or buckwheat near your garden. You can create a border with perennial anemisis and tansy.

Insects are attracted to the shelter of windbreaks and hedgerows, and these can also serve to liven up an otherwise dull landscape. A thick stand of cosmos also makes a nice privacy fence. A small water garden will supply insects with moisture—as will an attractive shallow dish filled with pebbles and water.

If you are partial to flowers, be

## Bugs up close

We hope this special issue of OG will inspire you to start taking a closer look at the insects in your garden. To take a *really* close look, trap an insect in a clear glass or plastic vial with a snap-on top. (Be careful not to injure the insect when you place the vial around it and close the top.) Put the vial in a refrigerator for a short time—the cold will slow the insect—and then examine it with a magnifying glass. To identify your catch, refer to our chart on p. 46, or one of the identification guides listed below.

sure you are planting ones that beneficials like, too. Many flowers have been bred for showyness—size, petals and color—and may have lost the nectar and pollen characteristics that make them attractive to insects. Perhaps this is why insects seem to prefer wildflowers and herbs—no one's developed their appearance at the expense of their natural functions.

To ensure a full season of beneficial-friendly flowers, start with early

bloomers, such as buckwheat, and make succession plantings of dill. Sow cosmos and marigold now for midsummer blooms. Start growing tansy and anemisis for a long season of flowers year after year.

Of course, there are some rough edges to be smoothed out. "Tarnished plant bugs, seed-feeding bugs that can deform many kinds of fruits and vegetables, also like pollen and nectar." So if you think a beneficial planting might be attracting too many insect *pests*, try another plant.

Remember, as with all aspects of organic gardening, the goal in using beneficials is not complete eradication of pest populations, but control. You can achieve a natural balance between pests and predators by creating a habitat that's both useful *and* ornamental. 🍷

*Rodale's own insect expert, Diane Matthews-Gehring provided much of the information for this article and illustration. Now the senior entomology project leader, Diane has been with the Rodale Institute Research Center since 1976. She has a master's degree in entomology from the University of Delaware, and specializes in vegetable and fruit pest management.*

## SOURCES

### IDENTIFICATION GUIDES

● *A Field Guide to the Insects North of Mexico* by D.J. Borror & R. E. White (Houghton-Mifflin Co.). One of the Peterson Field Guide Series. An introduction to insect identification.

● *Rodale's Color Handbook of Garden Insects* by Anna Carr (Rodale Press). A classic; often referred to outside of OG as a "first choice."

### PLANTS AND SEEDS

**W. Atlee Burpee & Co.**  
300 Park Ave.  
Warminster, PA 18974

*Seeds of WHITE SENSATION cosmos, dill, LEMON GEM marigold, spearmint and tansy.*

### Gardens Alive!

Highway 48  
P.O. Box 149  
Sunman, IN 47041

*Seeds of caraway, dill and fennel; buckwheat, legume and other cover crops*

### Thompson & Morgan Inc.

P.O. Box 1308  
Jackson, NJ 08527  
*Seeds of anemisis, dill and LEMON GEM marigold.*

### Well Sweep Herb Farm

317 Mt. Bethel Road  
Port Murray, NJ 07865  
*Seeds and plants of dill, caraway, fennel and tansy; spearmint plants.*

### Whayes End Nursery

P.O. Box 310  
Burgess, VA 22432  
*Anemisis plants; "butterfly" plants that provide nectar and pollen.*

### SOCIETIES

#### Young Entomologists' Society Inc.

1915 Peggy Place  
Lansing, MI 48910  
(517) 887-0499  
*Information for all ages and interests. Publishes the Y.E.S. International Entomology Resource Guide, \$9 ppd.*

# THE ORGANIC GARDENING GUIDE TO IMPORTANT BENEFICIAL INSECTS AND MITES OF NORTH AMERICA

Compiled by Linda Gilkeson and Joel Grossman



Larva feeds on aphid

## APHID MIDGE (*Aphidoletes aphidimyza*)

### DESCRIPTION

Tiny ( $1/16''$ ) and delicate with long legs. Larvae are bright orange maggots ( $1/16$ - $1/8''$ ). Common throughout North America.

### PREYS ON

60 species of aphids (on vegetables, flowers, fruit and shade trees).

### LIFE CYCLE

Eggs are laid at night among the aphids, then hatch in 2-4 days. Larvae feed on aphids for 3-5 days, then drop to the soil and burrow  $1/2''$  deep to spin cocoons; pupate for 2 weeks, then adults emerge. The last generation in fall will overwinter (as larvae) in soil; adults emerge in the spring.

### HOW TO ATTRACT

Attract with dill, mustard, thyme, sweet clover, and other pollen and nectar plants; shelter garden from strong winds; provide water in a pan filled with gravel.

### HOW TO APPLY

Sold commercially. release 250 cocoons for small garden or greenhouse, 3-5 pupae per plant, or 5-10 cocoons per apple tree. Repeat in two weeks.



Adult *Aphidius ervi*

## APHID PARASITES (*Aphidius matricariae* and related species of braconid wasps)

### DESCRIPTION

Tiny ( $1/16''$  long), slender, black or brown, with characteristic "wasp-waist." Larvae are tiny white grubs that develop inside the pest "hosts." Widespread.

### PREYS ON

Several aphids, including green peach, melon and pea aphids.

### LIFE CYCLE

Eggs are laid in aphids; as larva develops (as parasite), aphid is killed. After 10-18 days of feeding, the wasp larvae pupate, turning the aphid into a rigid "mummy" (some species pupate beneath the aphid's corpse). Adult emerges in 8-10 days through a circular hole in back of mummy.

### HOW TO ATTRACT

Adults are drawn to nectar-rich plants with small flowers (anise, caraway, dill, parsley, mustard family, white clover, lemon balm, corn spurry, wild carrot, stinging nettle, yarrow). Do not use water traps or yellow sticky pest traps; these catch parasites.

### HOW TO APPLY

Move leaves with mummies to problem areas. Becoming available commercially; release 50-100 pupae in garden or small greenhouse when aphids appear in spring.



Newly hatched nymph



Assassin bug adult

## ASSASSIN BUGS (*Reduviidae* family)

### DESCRIPTION

Adults are flat with long, narrow heads and stout, curving beaks. Some have elaborate flared or sculptured crests on the thorax ( $1/4''$ ). Most can bite, some species squeak. Nymphs look like small adults without wings; some are brightly colored, others disguise themselves with dust or trash. Related species throughout North America.

### PREYS ON

Many insects, including flies, tomato hornworms and other large caterpillars.

### LIFE CYCLE

Eggs are laid (singly or in clusters) in crevices. Nymphs develop for awhile, then hibernate in a pre-adult stage, becoming adults the next June.

### HOW TO ATTRACT

Provide permanent plantings for shelter.

### HOW TO APPLY

Not available commercially.

# THE ORGANIC GARDENING GUIDE TO IMPORTANT BENEFICIAL INSECTS AND MITES OF NORTH AMERICA



Big-eyed bug on corn

## BIG-EYED BUGS (*Geocoris* spp.)

### DESCRIPTION

Bulging eyes, but otherwise nondescript; gray, brown, black or tan with tiny black spots,  $1/8$ - $1/4$ " long. Wingless nymphs are similar to adults. Found throughout North America.

### PREYS ON

Eggs and small larvae of armyworms, hornworms, loopers, corn earworms, lygus bugs, spider mites, aphids, leafhoppers, flea beetles, psyllids, mealybugs and thrips. One big-eyed bug can eat 12 small caterpillars or leafhoppers per day.

### LIFE CYCLE

Two generations each year. Some adults hibernate in garden trash, emerge in spring and lay eggs on plant stems and underside of leaves. Adults remain active into fall as long as there is a cover crop.

### HOW TO ATTRACT

Attracted by alfalfa, potatoes, beets and subterranean clover. Provide flower nectar when pests are scarce.

### HOW TO APPLY

Not available commercially



Braconid wasp adult



Cocoons of braconid wasp on tomato hornworm

## BRACONID WASPS (*Braconidae* family, e.g. *Apanteles glomeratus*)

### DESCRIPTION

Adults are tiny ( $1/10$ - $1/2$ " ), slender, black or brown, "wasp-waisted" with clear wings. Larvae are tiny, white grubs that live inside (or on) other insects. Numerous species common throughout North America.

### PREYS ON

Armyworm, cabbageworm, codling moth, gypsy moth, European corn borer and many other caterpillars, beetle larvae, flies, aphids and other insects (see aphid parasite).

### LIFE CYCLE

Females lay eggs in "host" insects; some species lay eggs that divide into many larvae once laid. Some develop inside the pest; others paralyze the host and wasp larvae develop as external parasites. After larvae develop, they spin cocoons, usually nearby or on a dead host, then pupate. Life cycles are usually short; several generations develop each year. Most species overwinter as newly hatched larvae inside a living host.

### HOW TO ATTRACT

Grow nectar plants with small flowers (dill, parsley, wild carrot, corn spurry, mustard, white clover, lemon balm, stinging nettle, yarrow). Crocuses supply early pollen.

### HOW TO APPLY

Some species available commercially for greenhouse use. Leave container open or sprinkle them around.



Damsel bug adult

## DAMSEL BUGS (*Nabidae* family, e.g. *Nabis americanoferus*)

### DESCRIPTION

Adults are slender, gray or brown, with long beaks tucked backwards under head ( $2/8$ - $1/2$ " ). They move rapidly; some species can fly long distances. Nymphs are slender, wingless, and smaller than adults.

### PREYS ON

Aphids, thrips, plant bugs, leafhoppers, treehoppers, small caterpillars.

### LIFE CYCLE

Eggs are laid in plant tissue and hatch in 1 week. Nymphs immediately begin feeding and develop for 3-4 weeks until their final molt to adults; adults overwinter. Two or more generations per season.

### HOW TO ATTRACT

Common throughout North America in orchards and fields, especially alfalfa.

### HOW TO APPLY

You can collect damsel bugs with a sweep net in alfalfa fields and release them around your garden or orchard.

## THE ORGANIC GARDENING GUIDE TO IMPORTANT BENEFICIAL INSECTS AND MITES OF NORTH AMERICA



Ground beetle larva



Ground beetle adult

### DESCRIPTION

Large, long-legged, blue-black or dark brown beetles, usually with iridescent sheen (1"). Swift. Hide under stones by day. Larvae are elongated, dark brown or black, with large head and six legs (rarely seen). More than 2,500 species common throughout North America.

### PREYS ON

Most species prey on slugs, snails, cutworms and cabbage-root maggots in soil; some pursue prey on plants or trees, such as Colorado potato beetle larvae, gypsy moth and tent caterpillars.

### LIFE CYCLE

Overwintering adults emerge from soil in spring and lay eggs. Larvae prey on soil-dwelling species for 2-4 weeks, then pupate in soil. Adults remain in the soil until they emerge the following spring. Usually 1 generation per year; individual beetles can live 2-3 years.

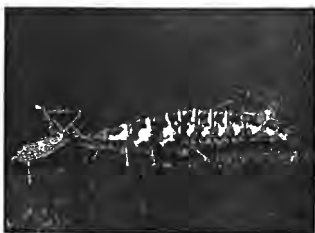
### HOW TO ATTRACT

Provide permanent beds, perennial plantings in garden and allow some weeds, especially amaranth; plant white clover as ground cover in orchards; make permanent stone, sod or clover pathways throughout garden to provide refuges.

### HOW TO APPLY

Collect them from rotting trees and release them in the garden.

### GROUND BEETLES (*Carabidae* family)



Lacewing larva



Brown lacewing

### DESCRIPTION

Adults are fragile, slender, green or brown, with small heads and large eyes; wings are longer than body, transparent, with fine network of veins, some covered with fine hairs ( $1/2$ - $3/4$ " long). Larvae are spindle-shaped, yellow to brown, mottled, with spines along sides and large curved mandibles. Common throughout North America.

### PREYS ON

Soft-bodied insects including aphids, thrips, mealybugs, some scales, moth eggs, small caterpillars and mites.

### LIFE CYCLE

Eggs are laid singly on the end of long, fine stalks, and hatch in 4-7 days. Larvae feed for about 3 weeks, then form cocoons and pupate for 5-7 days. Adults emerge from the top of the cocoon; last generation in fall hibernates as pupae or adults.

### HOW TO ATTRACT

Grow pollen and nectar plants (dill, angelica, corn, sunflowers). Allow some flowering weeds (dandelion, goldenrod). Provide water during dry spells.

### HOW TO APPLY

2 species sold commercially; scatter 500-1,000 eggs throughout average garden.

### LACEWINGS (*Chrysoperla* and *Chrysopa* spp.)



Hatching larvae (center); mature larva, pupa and adult ladybug (from top)

### DESCRIPTION

Shiny, round beetles, short legs and antennae. Wing covers are dark reddish orange to pale yellow, with or without black spots or irregular marks; some species are solid black or black with red spot ( $1/16$ - $3/8$ "). Larvae are alligator-like, segmented, usually with short spines on the body. Eggs are usually yellow ovals laid upright in clusters on undersides of leaves. Numerous species are common throughout North America.

### PREYS ON

Adults and larvae of many species feed on aphids; some only on mealybugs, spider mites or soft scales.

### LIFE CYCLE

In spring, overwintering adults seek food, then lay eggs in aphid colonies. Eggs hatch in 3-5 days and larvae feed on aphids or other insects for 2-3 weeks, then pupate on plant stems or the side of a pot. Adults emerge in 7-10 days. In fall, local species hibernate as adults in plant refuse and crevices; *H. convergens* migrates to the Sierra Mountains to overwinter in large groups.

### HOW TO ATTRACT

Grow pollen and nectar flowers (angelica, dill); grow grains; allow weeds (dandelion, wild carrot, yarrow). Protect egg clusters, larvae and pupae on plants.

### HOW TO APPLY

Purchased *H. convergens* often fly away from gardens, but are effective for a greenhouse if vents are screened. Collect native species from hay or grain fields.

### LADY BEETLES; LADYBUGS (*Hippodamia* spp., *Adalia bipunctata* and many others)

## THE ORGANIC GARDENING GUIDE TO IMPORTANT BENEFICIAL INSECTS AND MITES OF NORTH AMERICA



Larva eating mealybugs



Adult beetle

### MEALYBUG DESTROYER (*Cryptolaemus montrouzieri*)

#### DESCRIPTION

Oval, black beetles with coral-colored head and rear (1/8" long). Larvae are cream-colored with long, waxy hairs, similar to mealybugs. Native to Australia.

#### PREYS ON

Adults and larvae eat many species of mealybugs.

#### LIFE CYCLE

Eggs are laid singly among mealybug egg masses. Eggs hatch in 8-10 days and the larvae feed on eggs and young mealybugs for about 3 weeks. They pupate on plants and adults emerge in 2-3 weeks. (Generations continue year-round indoors, but this development may be too slow to control mealybugs in winter.)

#### HOW TO ATTRACT

Not native to North America.

#### HOW TO APPLY

Sold for use in citrus orchards, greenhouses and conservatories. Release 2-5 beetles per infested plant indoors, 1-2 times per year. For houseplants, confine 10-20 beetles per plant for 1 month (by draping sheer fabric over the plants and tying it closed at the base).



Minute pirate bug adult

### MINUTE PIRATE BUGS (*Orius* spp.)

#### DESCRIPTION

Black-and-white-patterned bugs (1/4") with beaks for sucking. Nymphs are shiny, wingless, and change color (yellow to orange to mahogany) as they grow. Found throughout North America.

#### PREYS ON

Will eat anything but prefer thrips, spider mites, eggs of many insects, small caterpillars, leafhopper nymphs, corn earworms.

#### LIFE CYCLE

Tiny eggs (less than 1/50") laid on alfalfa stems, green clover leaves and petals, and moist corn silks. Eggs hatch in 3-5 days into tiny voracious nymphs. Nymphs develop for 2-3 weeks, then molt into adults. Last generation in the fall spends winter as adults in crevices and trash.

#### HOW TO ATTRACT

Alfalfa, goldenrod, daisies, yarrow, corn (especially older, heavy-silk varieties such as COUNTRY GENTLEMAN), stinging nettles, clover, vetch; willows and other shrubs. Maintain permanent plantings or hedgerows for winter cover.

#### HOW TO APPLY

Collect them with a net in alfalfa fields and release 50-100 in a small garden. Sold to commercial growers for thrip control in greenhouses; release 1 bug per plant.



Mantis nymph



*Mantis religiosa* adult

### PRAYING MANTIS (e.g. European mantid, *Mantis religiosa*)

#### DESCRIPTION

Adults are very large and elongated, green or brown, with prominent eyes and enlarged grasping forelegs held poised for attack (2 1/2-3"). Nymphs are similar to adults, but smaller and without wings. Eggs are laid in grayish case of 50-400 glued to stems or twigs. Eastern and southern U.S., north into Ontario.

#### PREYS ON

Any insects they catch, including some beneficial species.

#### LIFE CYCLE

Eggs are glued in a sticky mass to plants where the covering hardens for winter protection; nymphs hatch in spring and develop over summer; one generation per year in northern areas.

#### HOW TO ATTRACT

Protect native species by urging pesticide avoidance in your area.

#### HOW TO APPLY

Eggs are not recommended for purchase (most do not survive and releasing nonnative species may displace local mantises).

## THE ORGANIC GARDENING GUIDE TO IMPORTANT BENEFICIAL INSECTS AND MITES OF NORTH AMERICA



Orange predatory mite adult

### PREDATORY MITE (*Phytoseiulus persimilis*)

#### DESCRIPTION

Minute ( $1/50''$ ), pear-shaped, reddish-orange and fast-moving; Sold widely for use in greenhouses and gardens.

#### PREYS ON

Spider mites, such as two-spotted mite, red mite, Pacific mite.

#### LIFE CYCLE

Eggs are laid among spider-mite webbing. Nymphs hatch in 1-2 days, molting several times until they reach the adult stage in 7-10 days. Not hardy; mites die outdoors in subfreezing temperatures.

#### HOW TO ATTRACT

Not native to North America. Live mites must be available when released.

#### HOW TO APPLY

Release 2 to 10 mites per plant on strawberries, garden or greenhouse plants at first sign of spider mites; does not work well on tomatoes; results should be obvious in 2 to 3 weeks; mist plants to encourage predators and slow spider mite reproduction.



Adult predatory thrips

### PREDATORY THRIPS (*Thripidae* family and others)

#### DESCRIPTION

Very tiny (under  $3/50''$ ). Includes six-spotted thrips (yellow with black spots on wings); black hunter thrips and banded-wing thrips (yellow to brown with dark cross bands on the wings). Found throughout North America.

#### PREYS ON

Eggs and larvae of spider mites, aphids, other thrips, Oriental fruit moth, codling moth, bud moth, peach twig borer, alfalfa weevil, whitefly, leafminer flies, and scales.

#### LIFE CYCLE

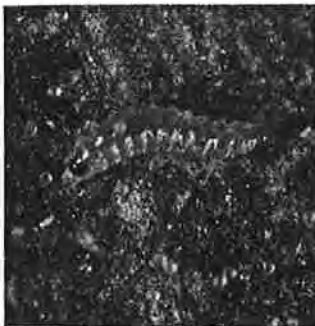
Eggs are laid in leaves and stems. 1-2 weeks later, nymphs emerge and feed. Some species drop to the ground, and emerge as adults. Several generations each year; most prevalent in late spring to midsummer.

#### HOW TO ATTRACT

They prefer insect prey, but will eat plant juices and pollen for survival. Provide pollen by planting flowers and corn.

#### HOW TO APPLY

Not available commercially.



Rove beetle larva



Rove beetle adult

### ROVE BEETLES (*Staphylinidae* family)

#### DESCRIPTION

Adults are brown or black, slender, and fast-moving with stubby top wings covering only the forward part of the abdomen; some resemble earwigs without pinchers. When disturbed they turn the tip of their abdomens up over their back. The larvae resemble adults. More than 3,100 species native to North America.

#### PREYS ON

Many are predators of aphids, springtails, nematodes, fly eggs and maggots in the soil; some are parasitic on cabbage-root maggots and larvae of other flies. Many species are scavengers on decaying material.

#### LIFE CYCLE

Little studied, these beetles live mostly in and on the soil, although adults can fly well; most species overwinter as adults, becoming active in the spring and laying their eggs in the soil. The larvae pass through 3 molts as they prey or scavenge, then pupate in the soil.

#### HOW TO ATTRACT

Maintain permanent beds and plantings to protect population; interplant strips of rye, other grains or cover crops; mulch planting beds; make stone or plank walkways in garden to provide refuges.

#### HOW TO APPLY

If you find them in your soil, put them in the garden.

# THE ORGANIC GARDENING GUIDE TO IMPORTANT BENEFICIAL INSECTS AND MITES OF NORTH AMERICA



Spider mite destroyer larva



Spider mite destroyer adult

## SPIDER MITE DESTROYER (*Stethorus* spp.)



### DESCRIPTION

Adults are small, very round, black, lady beetles ( $\frac{1}{16}$ ""); larvae are gray or black with black hairs and short spines. Similar species throughout North America.

### PREYS ON

Many species of spider mites, especially in unsprayed raspberry patches and avocado groves.

### LIFE CYCLE

Eggs are laid among spider mites; the larvae hatch in 1 week and begin eating mites. After 2 weeks, they pupate on leaf or stem. Adults overwinter.

### HOW TO ATTRACT

Adults probably feed on pollen and nectar in carrot and mustard family plants and weeds; watch for and protect beetles in spider mite colonies.

### HOW TO APPLY

Not available commercially.



Nymph with cabbage webworm



Adult (right) with pest pupa

## SPINED SOLDIER BUG (*Podisus maculiventris*)

### DESCRIPTION

Adults are shield-shaped, yellow to brown bugs ( $\frac{1}{2}$ "") covered with black specks and with sharp points on shoulders; the nymphs are similar, but more oval-shaped and wingless. Eggs are metallic bronze, laid in clusters of about 12. Native throughout North America.

### PREYS ON

Many species of hairless caterpillars and beetle larvae including fall armyworm, sawfly larvae, Colorado potato beetle and Mexican bean beetle larvae.

### LIFE CYCLE

Eggs are laid on leaves; nymphs hatch in a few days and feed for a short period on plant juices, then become predators. Adults live 5-8 weeks; one female can lay more than 500 eggs.

### HOW TO ATTRACT

Maintain permanent beds of perennials in garden to provide shelter.

### HOW TO APPLY

Sold commercially; release 2-5 bugs per square yard in potato or bean patch to control beetle larvae.



Larva with prey



Syrphid adult

## SYRPHID FLIES (*Syrphidae* family). Also called hover flies or flower flies.

### DESCRIPTION

Adults ( $\frac{1}{2}$ - $\frac{5}{8}$ "") resemble bees with striped black and yellow or black and white abdomens. They hover like hummingbirds over flowers. Larvae are grayish or greenish slug-like maggots with pointed heads. Common throughout North America.

### PREYS ON

Many species of aphids infesting vegetables, flowers, fruit trees.

### LIFE CYCLE

Eggs are laid among aphid colonies; the eggs hatch in 2-3 days and the larvae feed voraciously for 3-4 weeks, then drop to soil to pupate. Adults emerge after 2 weeks.

### HOW TO ATTRACT

Grow pollen and nectar flowers (dill, fennel, marigolds and parsley); weeds such as wild carrot or yarrow.

### HOW TO APPLY

Move any found maggots into the garden.



## THE ORGANIC GARDENING GUIDE TO IMPORTANT BENEFICIAL INSECTS AND MITES OF NORTH AMERICA



Tachnid larva



Tachnid adult

### TACHINID FLIES (family *Tachinidae*)

#### DESCRIPTION

Adults are  $\frac{1}{3}$ - $\frac{1}{2}$ " ; robust, gray, brown or black flies with light marks, similar to houseflies, some covered with bristles. Larvae are maggots that feed inside insect hosts. Hundreds of species throughout North America; extremely valuable as pest predators.

#### PREYS ON

Many species of caterpillars, including cutworms, armyworms, tent caterpillars, cabbage looper, gypsy moth; some attack sawflies, Japanese beetle, May beetle, squash bugs, green stink bug, sowbugs.

#### LIFE CYCLE

Eggs are laid near the pests or on their skin. The larvae are eaten by the host or burrow into it, eventually killing it. They pupate inside the dead host or in soil nearby. 1-2 generations per year.

#### HOW TO ATTRACT

Grow pollen and nectar plants (dill, parsley, sweet clover, *Phacelia* sp., fennel, buckwheat and herbs) throughout your garden. Allow weeds to grow, especially goldenrod, wild carrot, amaranth.

#### HOW TO APPLY

Don't kill caterpillars with white eggs stuck to them—they will produce more flies.



Tiger beetle adult

### TIGER BEETLES (*Cicindelidae* family)

#### DESCRIPTION

Adults ( $\frac{1}{2}$ - $\frac{3}{4}$ " ) are swift, long-legged, shiny, brightly colored and patterned (many are bright blue, green, bronze or other metallic colors). The larvae are S-shaped, segmented, with humpbacked appearance and a lump in the middle of their back with strong hooks to anchor them in soil burrows. Adults are often attracted to lights at night. Many species native throughout North America.

#### PREYS ON

Both adults and larvae prey on a wide variety of insects but are considered mostly beneficial.

#### LIFE CYCLE

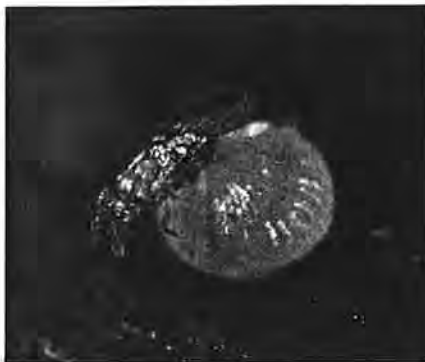
Eggs are laid singly in burrows dug in soil; larvae lie in burrows and wait for prey. Larvae develop for several years, digging deep into soil to hibernate each winter; adults also overwinter in burrows. Entire life cycle can take 2-3 years.

#### HOW TO ATTRACT

Maintain permanent beds and areas in garden to preserve populations from changes during cultivation and harvesting.

#### HOW TO APPLY

Don't leave outdoor lights on all night; this will coax them out of the garden.



*Trichogramma pretiosum* parasitizes egg

### TRICHOGRAMMA WASPS (*Trichogramma minutum* and related species)

#### DESCRIPTION

Adults are minute yellow parasitic wasps ( $\frac{1}{100}$ " long) with darker abdomens and bright red eyes. Larvae are tiny, white grubs that live inside host eggs. Found throughout North America.

#### PREYS ON

Eggs of over 200 species of moths, including spruce budworm, cotton bollworm, tomato hornworm, corn earworm, corn borers, codling moth.

#### LIFE CYCLE

Eggs are laid in moth eggs; larvae develop and consume the contents of the eggs, which turn black as the wasps mature. Adults chew their way out of the host egg; the entire life cycle takes only 8-10 days; there are 13-30 generations per season depending on climate.

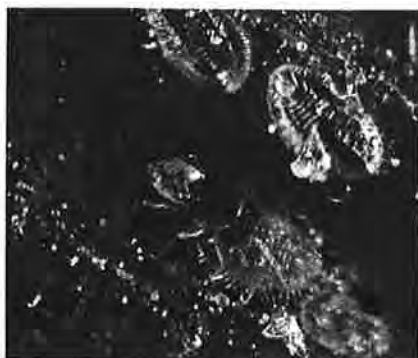
#### HOW TO ATTRACT

Maintain a diversity of plants, including dill, anise, caraway and fennel. Provide mixtures of clover and flowering weeds in orchard ground covers.

#### HOW TO APPLY

Sold commercially but buying wasps is only advisable for large plantings; they parasitize freshly laid eggs, so moth eggs must be present when wasps are first released.

## THE ORGANIC GARDENING GUIDE TO IMPORTANT BENEFICIAL INSECTS AND MITES OF NORTH AMERICA



*Encarsia formosa* adult with whitefly larvae

### WHITEFLY PARASITE (*Encarsia formosa*)



#### DESCRIPTION

Adults are minute ( $1/20''$ ) parasitic wasps with yellow abdomen, black thorax. Larvae are minute, creamy grubs concealed inside host. Not native to North America.

#### PREYS ON

Greenhouse whitefly, sweet potato whitefly.

#### LIFE CYCLE

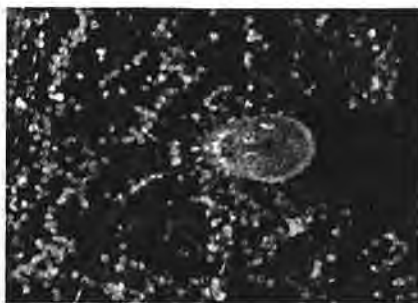
Nearly all wasps are females; one egg is laid inside each immature whitefly. Larva develops inside whitefly, eventually killing it. Whitefly turns black as the wasp pupates inside. Life cycle takes 3 weeks at room temperature. Adults emerge through a neat circular hole they chew in the top of the pupa.

#### HOW TO ATTRACT

Not native to North America.

#### HOW TO APPLY

Sold widely for use in greenhouses; can be used outdoors in warm, long-season areas. Release 2-5 parasites per tomato or cucumber plant when first whitefly is seen, repeat in 2 weeks. Minimum order of 1,000 is sufficient for most home gardens or greenhouses. Most successful in warm, bright conditions (not late fall or winter). Not hardy, but may overwinter outdoors in mild areas.



Adult mite

### WESTERN PREDATORY MITE (*Metaseiulus* (= *Typhlodromus*) *occidentalis*)



#### DESCRIPTION

Minute ( $1/50''$ ) reddish tan, fast-moving mites native to western North America.

#### PREYS ON

Spider mites, especially European red mite, citrus red mite.

#### LIFE CYCLE

Eggs are laid among spider mites; nymphs hatch in 3-4 days, molting several times until they reach the adult stage in 5 days. This is a hardy species, overwintering as adults in cracks and crevices under tree bark.

#### HOW TO ATTRACT

Grow pollen-producing plants.

#### HOW TO APPLY

Sold commercially for use in strawberries and orchards. Release 50 to 100 mites per apple tree in summer or early fall to establish permanent population; use 1,000 per tree to control pest outbreak in the same season.

Most of these insects progress from an egg to a larva (which is wingless and usually worm-like). In the next stage, pupa (sort of like being a teenager), the insect generally spins a cocoon inside which it changes into an adult. Some insects have a nymph stage instead of the larval and pupal stages; a nymph is a smaller, less developed adult. Molting occurs when the insect outgrows and casts off its coat.

Linda Gilkeson, Ph.D., is director of research at Applied Bio-Nomics, a company that specializes in research and commercial production of biological control agents near Victoria, B.C. She has a doctorate in entomology from McGill University, Montreal. Joel Grossman is an agricultural pest control specialist who writes for *The IPM Practitioner* and other journals.

Chart photographs by:

Max E. Badgley/Biological Photography—p.46 middle; p.48 middle right; p.49 top left, top right; p.50 bottom left; p.51 top left; p.52 bottom; p.53 middle.

Martin Dohrn/Science Photo Library/Photo Researchers—p.50 top.

Dwight Kuhn—p.46 bottom.

John A. Lynch—p.49 bottom right.

Charles W. Melton—p.46 top.

James H. Robinson—p.46 bottom left; p.47 middle right; p.48 bottom; p.49 bottom left.

Edward S. Ross—p.47 middle left, p.48 top right, middle left.

John Serrao—p.48 top left.

Ron West—p.47 top, bottom; p.49 middle; p.50 middle, bottom right; p.51 top right, middle left, middle right, bottom left, bottom right; p.52 top left, top right, middle; p.53 top.

indicates a "micro-beneficial" insect; one which is too small to be seen clearly with the naked eye.

**In all cases, remember to never apply pesticides; they not only kill bad bugs but also take out the good guys, too.**

## THE FOOL-YA BUGS!

### Can you recognize friend from foe?

You say you have a pretty good idea of who your friends are in the insect kingdom. Can you pick their “bug mugs” out in a crowd—especially a crowd of enemy bugs designed by nature to fool you? Here’s a glimpse of some of the major masters of disguise, and the beneficials they’re impersonating.

—Jill Jesiolowski



Ladybug



Mexican bean beetle

#### LADYBUGS AND MEXICAN BEAN BEETLES

Ladybugs range from white, yellow or orange to red and even black, and can vary in size and the number of spots they have on their back. But Mexican bean beetles *always* have 16 dots, and are yellowish-brown to coppery. (Ladybugs also are slimmer and faster than the plump, round Mexican bean beetles.)



Spined soldier bug



Stink bug

#### SPINED SOLDIER BUG AND STINK BUG

Spined soldier bugs are tough to distinguish from stink bugs by color, so look closely for the sharply pointed shoulders that identify the good soldier. The spined soldier bug actually takes its name from a conspicuous spine on the *underside* of each of its front legs.



Tachinid fly



Housefly

#### TACHINID FLY AND HOUSEFLY

The most obvious difference is the presence of large bristles on the abdomen of most tachinids. Houseflies have no prominent bristles. Tachinids also move around in a fast, jerky un-housefly-like manner. A housefly’s wings lay straight back when it’s resting; a tachinid’s lay at an angle to its body.



Ground beetle



Darkling beetle

#### GROUND BEETLE AND DARKLING BEETLE

Ground beetles (good—they eat slugs) are usually shiny, while darkling beetles (bad—they eat your plants) are dull. The tips of a darkling beetle’s antennae are slightly larger than the antennae segments at the base; ground beetle antennae tips are rarely enlarged. Some ground beetles also have patterns of lighter colors.

## Here's how to get your bugs off to a good start

**B**y now you probably have a better idea of which beneficial will be the most beneficial in *your* garden. But how many do you order? And how do you welcome your new guests once they arrive?

Since companies ship according to their *highly* specialized knowledge of climate and pest life cycles around the country, leave that part of the thinking to the experts and release your beneficials as soon as you receive them.

Quantities to order? Remember that the numbers will depend largely on how infested your garden is.

But here are a few rules of thumb you can follow: For ladybugs, 1 pint will cover about 5,000 square feet. Release them in early morning or late evening, *not* during the heat of the day when the sun is beating down on your garden.

"Their tendency to fly away upon release is exaggerated," emphasizes Niles Kinerk, manager of Gardens Alive!, who adds that you can do several things to *keep* them around. "Spray the area with water just before you release them. They are thirsty after their long journey." Also, ladybugs need to be released in an area where there is abundant food, especially aphids. "But they *will* disperse over a period of time," he says. "That's just a fact of life." If you're lucky and have provided enough food and water, they may leave some of their hungry (and wingless!) offspring behind to take care of business.

Use about 100 spined soldier bug nymphs per 20 feet of garden row, and three praying mantis egg cases (each case contains hundreds of eggs) per 5,000 square feet. Attach praying mantis egg cases to a plant or twig 1 to 2 feet off the ground, and be sure there is enough cover to protect the young when they hatch.

Try about 10 green lacewing eggs per plant or 1,000 eggs per 200 square feet for moderate infestations. Gardens Alive! recommends three such releases at two-week intervals. "You have a better chance of catching the pest in its life cycle with several releases," Kinerk says. Spread lacewing eggs, which are usually mixed with rice hulls, directly on infested plants. The eggs should hatch shortly after you receive them.



*There several things you can do to welcome your new ladybug guests.*

Trichogramma wasps should be released when you see the first sign of pest presence. For a small area, Gardens Alive! recommends three releases (of 4,000 wasps each) two weeks apart. Unique Insect Control in Citrus Heights, Calif., recommends a slightly different tactic. They suggest using the same total number, but to let more than half go in the first release, then reinforce with two more releases of equal amounts.

Use the Unique method when you are faced with heavy pest populations and the Gardens Alive! method for smaller attacks. Eggs of these tiny parasites are shipped within host eggs that are attached to squares of paper. Look for tiny moving brown specks when you receive a shipment. If the Trichogramma have not hatched yet, keep them at about 80° F and out of direct sun until most of them hatch. Release Trichogramma in early morning or evening when it is cool, by setting the opened cups in the garden.

To attract aphid eaters, such as ladybugs and lacewings, when nectar, pollen or prey are in short supply, try mixing up some bug food. Kenneth S. Hagen, Ph.D., of the division of

biological control at the University of California at Berkeley, recommends a ratio of one part whey yeast or brewer's yeast, one part sugar and about 10 parts water. Apply small amounts in spots about 5 or 10 feet apart.

The amount of water you use depends on whether you spray or spread the mixture. Whey yeast, a by-product of cottage-cheese making, is preferred, but sometimes difficult to obtain.

You also can try "take-out food for bugs." Necessary Trading Co.'s Bug Chow<sup>®</sup> is a mixture of yeast and sugar. Available by mail from Necessary and Gardener's Supply Co., you can make it into a spray or paste. Bug Pro<sup>®</sup> from Gardens Alive! is a similar product (it also contains whey).

To make your new guests want to stay, create a habitat that encourages them to stay around. Provide water, nectar and a haven of their favorite plants (see "Beneficial Borders," p. 42). Avoid all spraying or dusting—even if your bug killer is a purely organic substance—or you'll kill off your good bugs long before you hurt the bad ones.

—Jill Jesiolowski

## Beneficials on the move

Whenever I've planted alfalfa upwind and around the perimeter of crops needing protection, many big-eyed bugs, pirate bugs, lacewings and ladybugs have arrived. One USDA found study found 40 big-eyed bugs and 20 pirate bugs per 10 square feet in alfalfa interplanted with vegetables. Halving that alfalfa plot when predators are abundant forces beneficials into the vegetable crops under attack.

Meanwhile, a "breeding population" of beneficials remains behind in the uncut alfalfa. Big-eyed bugs breed exceptionally well in alfalfa, though potatoes, peas, beets, broccoli and orchard grass are also attractive. So, when the cut alfalfa grows back (it takes about a month during the summer), the other half can be cut for another beneficial insect release. (I've had a few spider mites and corn earworm moths move out of the alfalfa along with the beneficials, but the advantages of the predator release has far outweighed this tiny drawback.)

—Joel Grossman

## Chow time

Big-eyed bugs come from a family of seed eating bugs, and vestiges of this seed-eating habit can be used to increase your garden big-eyed bug population. The USDA ran an experiment in which a quarter-pound of chopped sunflower seeds was scattered on plots of beets twice during the growing season. This supplemental food doubled the number of big-eyed bugs (compared to plots without seeds.)

—Joel Grossman

## BENEFICIAL INSECT SUPPLIERS

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Delta, BC

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(800) 767-2847 (SOS-BUGS)

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(406) 587-5891

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### Buena Biosystems

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*Free catalog (\$50 minimum purchase)*

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Warminster, PA 18974

(215) 674-4900

*Free catalog*

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Shenandoah, IA 51601

(605) 665-4491

*Free catalog*

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Burlington, VT 05401

(802) 863-1700

*Free catalog*

### Gardens Alive! (Natural Gardening Research Center)

Highway 48

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Sunman, IN 47041

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In Calif.: (805) 643-5407

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### Unique Insect Control

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