UF IFAS Extension UNIVERSITY of FLORIDA

ENY-822

Natural Enemies and Biological Control[1]

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Good Bugs and Bad Bugs

Any organism that feeds on another organism is its **natural enemy**. Insects that are natural enemies of pests are **beneficial insects**. Other arthropods such as spiders and predatory mites, and some nematodes that parasite insects also are beneficial.

There are two main types of beneficial arthropods, **predators** and **parasitoids**. **Predators**, such as ladybugs and spiders, will attack different kinds of insect, and will consume several **prey** throughout their life cycle. **Parasitoids** are wasps or flies that lay their eggs on or inside other arthropods; they are also called parasites. The egg hatches and the immature parasitoid feeds on the victim, called a **host**, eventually killing it. Each developing parasitoid kills only one host in the course of its life cycle, but parasitoids are usually more specific in the insects they attack than predators. Some host can have more than one parasite, this is called **superparasitism**.

Insects also suffer from diseases. Bacteria, fungi or viruses infecting insect and causing diseases are called **entomopathogens.** With few exceptions, the diseases that attack arthropods do not afflict warm-blooded animals. Sometimes insects and plant disease agents are used to control weeds.

Controlling Pests Biologically

Biological control is an approach to reducing populations of harmful organisms with natural enemies. Organisms introduced from other parts of the world are called **exotic** or **nonindigenous**, as opposed to **native** or **indigenous** organisms. Pests may be introduced into the United States and become established without natural enemies to keep them in check. Biological control of nonindigenous organisms involves finding a pest's native complement of natural enemies and introducing these natural enemies into the new area where the pest has become established. Recent examples of successful introduction of introduced natural enemies include the Asian citrus psyllid's parasitoid *Tamarixia radiata*, or the Chrysomelid beetle *Lilioceris cheni* that feeds exclusively on the invasive air-potato weed. All nonindigenous natural enemies must be carefully studied prior to release in order to determine that they will not have an adverse environmental or economic impact.

The effectiveness of both introduced and native natural enemies can be enhanced through mass-rearing beneficial insects for release (**augmentation**) or by modifying the environment to favor predators and parasitoids (**conservation**). Many beneficial insects can be bought from commercial nurseries for augmentative release. Ladybird beetles, predatory mites, and lacewings are examples of predators that can be ordered through the mail to help control aphids, whiteflies, and other pests. Parasitoids of whiteflies, caterpillar eggs, and other pests may be purchased for release into a farm, garden, or greenhouse. In addition, some entomopathogens are available commercially in formulations which can be applied like a pesticide. The most common of these is *Bacillus thuringiensis* (Bt), a bacterium

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available in several strains that produce compounds toxic to distinct insect groups.

Conservation often involves establishing plants that provide alternate food sources such as nectar and pollen for beneficial insects, or selective use of insecticides so as not to impair the beneficial species. Many beneficial insects feed on the pollen of plants such as cilantro, fennel, bidens, and buckwheat. It may be possible to increase the numbers of beneficial insects by including such plants in a farm or garden. Pesticides such as Bt that kill caterpillars while causing minimal disruption to natural enemies allow agriculturalists and home-gardeners to benefit from naturally-occurring biological control.

IPM

Pest control is often most effective when used as a component of an **integrated pest management** (IPM) system. IPM involves using a variety of techniques to manage the pest in an economically viable and environmentally sound manner. IPM programs rely on the periodic examination of crops to determine if pest populations are reaching damaging levels. This is called **scouting**, which in addition provides information on the relative proportion of beneficial and harmful arthropods on a crop. Effective scouting programs can lead to significant reductions in pesticide use, because pesticides are applied only when necessary. Reduction of pesticide use is a central concern of most IPM programs, and is crucial for enhancing biological control, as most natural enemies are highly susceptible to pesticides, sometimes more than the pests themself. As pesticide use increases, populations of beneficial insects decrease, which may lead to secondary pest outbreaks. For instance, use of some pyrethroid-based insecticides are known to trigger spider mite infestations in vegetable and row crops. IPM programs which rely on the careful use of selective pesticides such as Bt, and non-insecticidal tools such as kaolin or insect pheromones may benefit from increased effectiveness of both native and introduced natural enemies.

Natural Enemies Commonly Seen in Florida

There are many insects that are beneficial, but only a few are really important natural enemies of pests. The commonly-encountered natural enemies are: lady beetles, lacewings, bigeyed bugs, minute pirate bugs, flower flies, predatory gall wasps, ants, parasitic wasps, parasitic flies, and predatory mites. The relative importance varies with insect pest, habitat, and season of the year.

Lady Beetles

Adult lady beetles (Figure 1) are among the most recognizable insects, but only when they are the "typical" beetles—orange or red with black spots. Most people do not realize that these beetles come in many colors including brown, or black, and often lack spots. Some of them can be extremely small, less than 1/10 inch length. The hemispherical shape of the adult is a helpful character, and the frantic searching behavior—they are always looking for a quick bite to eat—helps to identify lady beetles. Larvae are more difficult to recognize, and many gardeners have killed the beneficial immature stage due to inability to identify this stage. The larval stage is elongated and flattened, and usually blackish or bluish with orangish spots. In addition, some lady beetle species have larvae with white, waxy exudate on its back and resemble to a mealybug. If you see a white insect crawling amongst aphids, it very likely is a lady beetle larvae. The pupal stage is similar to the larva in color, though not capable of moving or feeding.

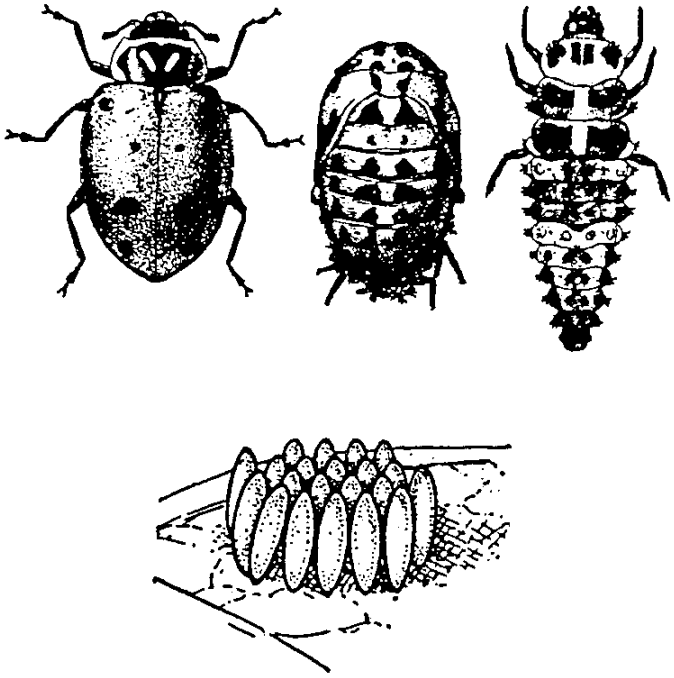

Figure 1. Adult, pupal, and larval stages of a common lady beetle (above). A lady egg cluster (below).
Credits: United States Department of Agriculture

The eggs are yellow and deposited on end in clusters. Lady beetles feed on numerous small insects and will attack any stage of prey that is small enough to be killed. They are most frequently found feeding among aphid colonies, but many also consume mites, scales, mealybugs, whiteflies, small caterpillars and beetle grubs, and all types of insect eggs.

Lacewings

Both green and brown lacewings (Figure 2) occur in Florida, and the pretty lacy-looking adults are quite recognizable. Like lady beetles, lacewings are often found associated with aphid colonies. However, unlike lady beetles, the adults sometimes do not feed on insects, with the larva being the beneficial stage. The large sickle-shaped mouthparts apparent in the larval stage are very effective for clamping onto prey and draining their body contents. The eggs of lacewings are placed on long thin stalks and placed in clusters. Lacewings feed on insect eggs, scales, mealybugs, and mites as well as aphids.

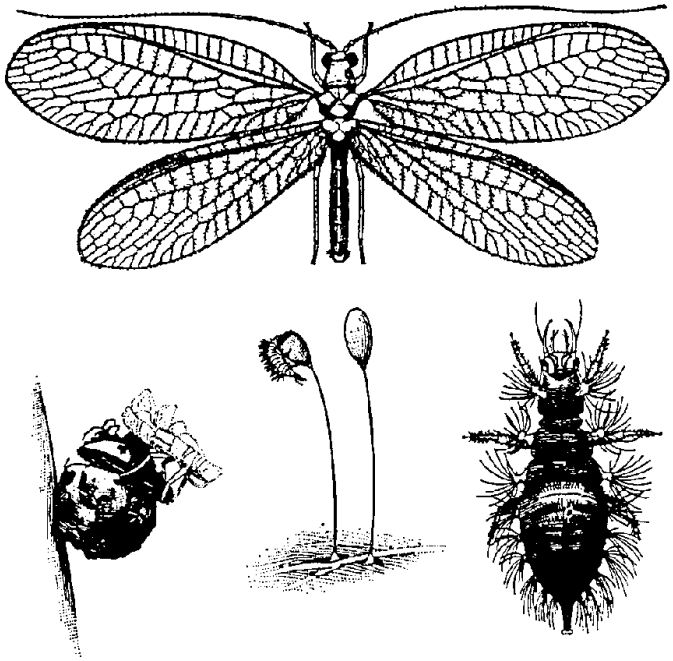

Figure 2. Lacewing adult (above). A lacewing emerging from a pupal case, emerging from an egg, and a larva (below).
Credits: United States Department of Agriculture

Flower Flies

Flower flies (Figure 3) are black and yellow insects which resemble honeybees. However, their bright colors are to deter predators, but they do not have sting. As the name suggests, they often are found hovering about, or feeding on, flowers. The larvae, however, are voracious predators, and especially fond of aphids (Figure 4). The larvae are maggot-like in appearance, with a thick body that tapers to a pointed head. They are yellowish, reddish, or greenish in color.

Figure 3. A typical flower fly, adult stage.
Credits: United States Department of Agriculture

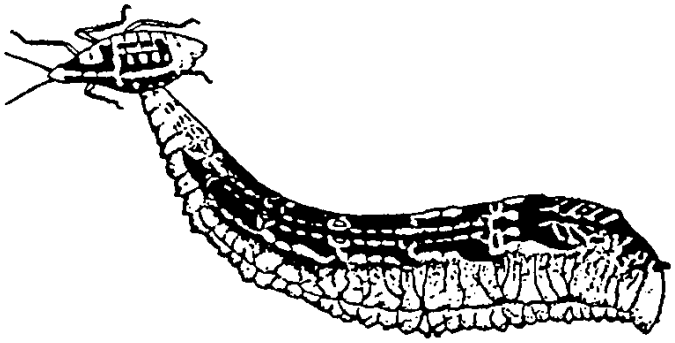

Figure 4. A flower fly larva feeding on an aphid.
Credits: United States Department of Agriculture

Predatory Gall Midges

Larvae of predatory gall midges (Figure 5) resemble flower flies, and often are overlooked because they are so small. Most people, if they do notice these larvae, think they are very young flower flies. They commonly are found within aphid colonies, but also feed on whiteflies, scales, thrips and mites. However, the adult is strikingly different. The adult gall midge, which is rarely observed because it is active at night, is small, pale, and bears long thin legs. It cannot be confused with adult flower flies!

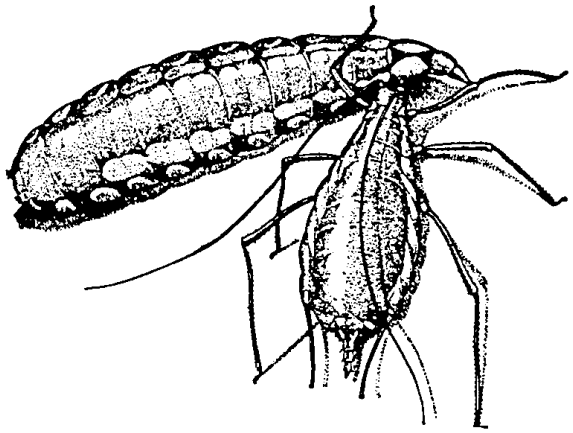

Figure 5. The larval stage of a predatory gall midge, *Aphidoletes*, feeding on an aphid.
Credits: United States Department of Agriculture

Bigeyed Bugs

This common predator (Figure 6) is frequently found in agricultural systems. Both the adult and immature stage are marked by oversized eyes, but are otherwise fairly nondescript, small, grayish insects. The piercing-sucking mouthparts are used to drain the fluids from moth eggs, caterpillars, thrips, and mites.

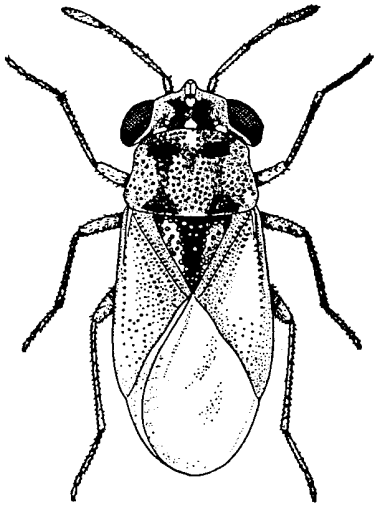

Figure 6. An adult bigeyed bug.
Credits: United States Department of Agriculture

Minute Pirate Bugs

These very small insects are easily overlooked, but their importance as beneficial insects cannot be overestimated. Like bigeyed bugs, they feed greedily on many small organisms such as psocids, leafhoppers, aphids, thrips, and mites by draining body fluids with their piercing-sucking mouthparts. Adults (Figure 7) are silvery-white and black in color. They occur everywhere, including within crops. They are highly attracted to flowers where they feed on pollen.

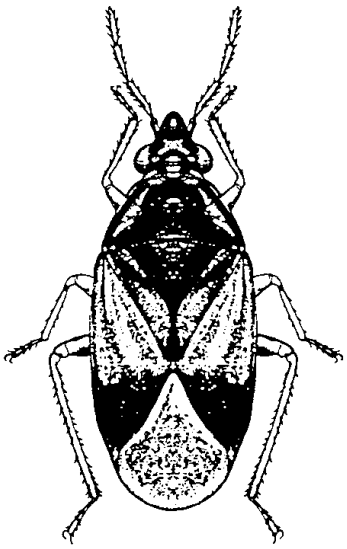

Figure 7. A minute pirate bug.
Credits: United States Department of Agriculture

Soldier Bugs or Stink Bugs

Soldier bugs, also known as stink bugs (Figure 8), are known as serious pests as well as useful predators because different species vary in their eating habits. The most common stink bug in Florida, the southern green stink bug, attacks blossoms and fruit, causing deformity and fruit drop. How can you distinguish between good and bad stink bugs? All stink bugs have long, thin, tubular piercing-sucking mouthparts. The good stink bugs use their mouthparts to extract fluid from other insects, particularly caterpillars and beetle grubs. The bad stink bugs use their mouthparts to extract plant sap. The mouthparts of good soldier bugs are relatively sturdy, whereas the mouthparts of pest species are relatively thin and frail. If in doubt, you might observe the bug's behavior before deciding whether it is good or bad.

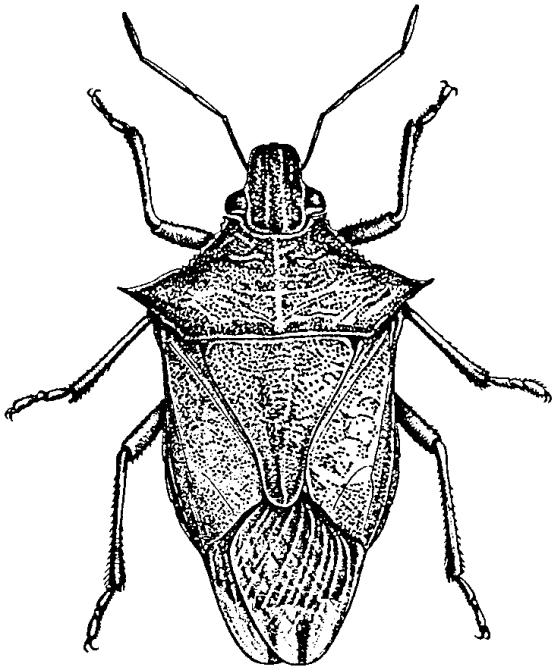

Figure 8. A predatory stink bug.
Credits: United States Department of Agriculture

Ants

People are often surprised to hear that some ants are important predators. Even fire ants (Figure 9) can be helpful in reducing numbers of pest insects. Farmers who have fire ant problems rarely have problems with caterpillars and other soft-bodied pests! Ants are not entirely beneficial, however, and in addition to their tendency to bite or sting, ants sometimes protect honeydew-producing insects such as aphids and scales from predation and parasitism. So, ants are a mixed blessing, depending on the type of plants and pests present.

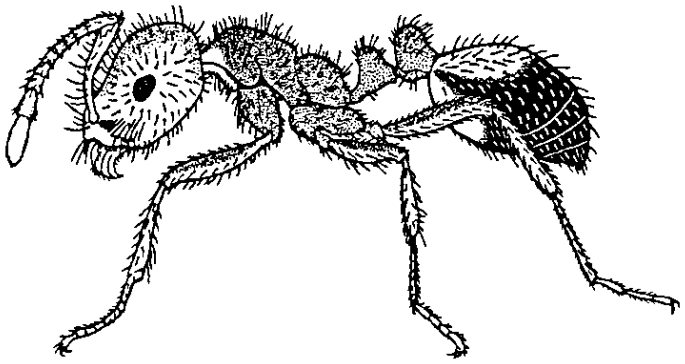

Figure 9. Red imported fire ant, a common predatory ant species.
Credits: United States Department of Agriculture

Parasitic Wasps

Most parasitic wasps are small and inconspicuous, but wasps that parasitize insect eggs are even smaller, almost microscopic in size. Growers and gardeners are therefore often unaware that parasitoids are helping control their insect pests. Sometimes these wasps can be seen walking quickly over a leaf and tapping its surface with their antennae in search of the "scent" of the host. Parasitic wasps deposit their egg with the host insect (Figure 10, Figure 11)—usually the host egg or larval stage. The young parasite develops within or on the host insect (Figure 12), eventually killing the host. The most common evidence of parasitism is often a sickly caterpillar from which parasitoid larvae are emerging, or a dead caterpillar on which a cocoon is hanging. Parasitic wasps are important natural enemies of caterpillars, grubs, whiteflies and aphids.

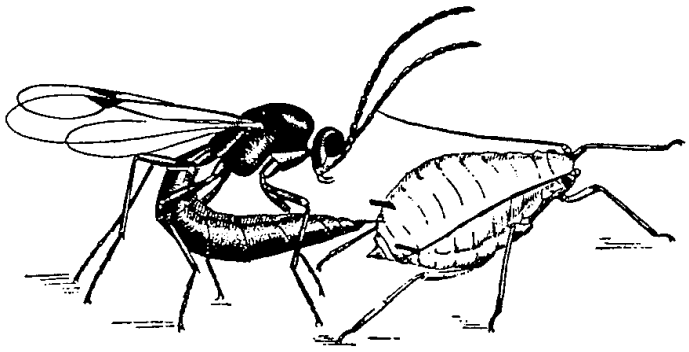

Figure 10. A parasitic wasp depositing its egg within an aphid.
Credits: United States Department of Agriculture

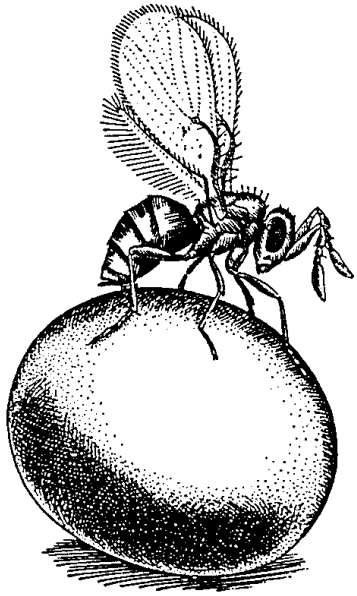

Figure 11. A *Trichogramma* wasp depositing its egg within a moth egg.
Credits: United States Department of Agriculture

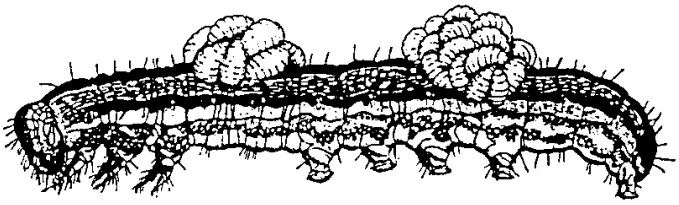

Figure 12. Clusters of parasitic wasp larvae developing externally on a caterpillar.
Credits: United States Department of Agriculture

Parasitic Flies

Several types of parasitic flies (Figure 13) attack pests. Many deposit their eggs on the surface of the pest; upon hatching the larva burrows in and eventually kills the host insect. Others deposit their larvae into host, with the same result. However, flies lack the long egg-depositing structure found in most wasps.

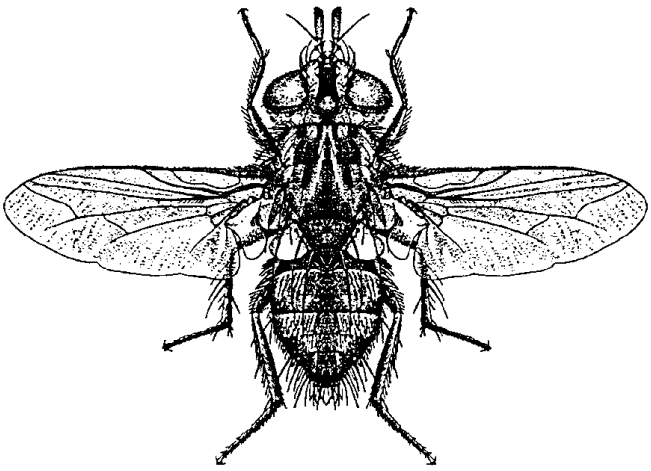

Figure 13. Adult of a parasitic fly.
Credits: United States Department of Agriculture

Predatory Mites

Although some mites, particularly spider mites, are known as serious plant pests, many mites are beneficial. Among beneficial mites, phytoseiid mites are especially important because they are predators of plant-feeding mites and other small organisms such as thrips or insect eggs. Predatory mites (Figure 14) tend to be larger than other mites, long-legged, and move actively in their search for prey.

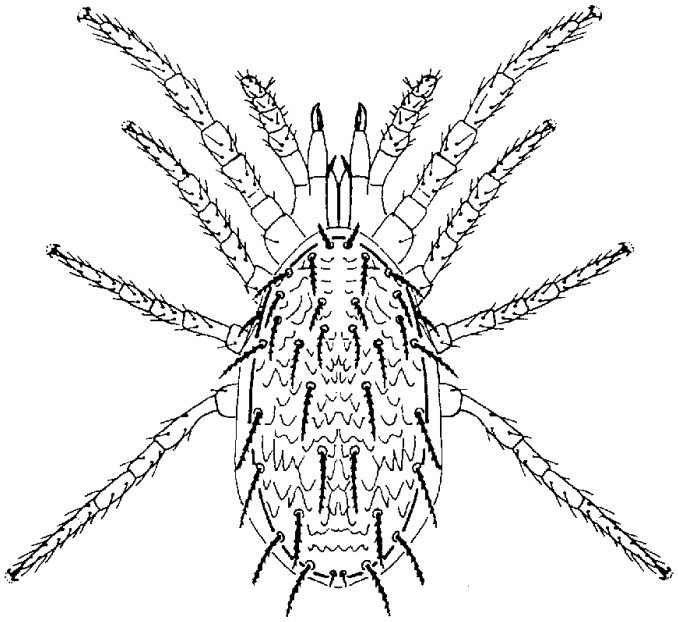

Figure 14. Phytoseiid mite.
Credits: United States Department of Agriculture

Purchasing Natural Enemies for Release

Producers of greenhouse-grown foliage, flower, and vegetable crops sometimes augment natural biological control through purchase of predators and parasitoids. Occasionally this is also done for field-grown crops in Florida. Strawberry production is an excellent example of a crop where this is often practiced successfully. Home gardeners frequently ask about supplementing the natural biological control in their garden and yard.

There are many commercial sources of natural enemies. Quality varies among producers, however, so the purchaser should consider suppliers who have been in business for at least several years. A comprehensive list of suppliers is found at a California Department of Food and Agriculture website on biological control: http://www.cdpr.ca.gov/docs/pestmgt/ipminov/bensuppl.htm

Selecting a natural enemy for purchase is most successful if the habits and habitats of the natural enemy match the characteristics of the pest. For example, *Trichogramma* egg parasitoids are often useful for moths, the predatory mite *Pytoseiulus* for spider mite pests; the predatory mite *Neoseiulus* (*Amblyseius)* for thrips and mites; *Cryptolaemus* lady beetles for mealybugs and scales; spined soldier bugs for caterpillars; and lacewings and the predatory gall midge *Aphidoletes* for aphids. Convergent lady beetles and praying mantids often are not successful. For commercial crop producers, it is best to purchase technical assistance along with product.

Other Sources of Information

Other excellent sources of information include such books as:

- Guidelines for Purchasing and Using Commercial Natural Enemies and Biopesticides in Florida and Other States, UF/IFAS EDIS https://edis.ifas.ufl.edu/IN849
- Natural Enemies Handbook, University of California Pub. 3386, 154 pp. (1998)
- Natural Enemies of Vegetable Insect Pests, Cornell Extension Pub., 48 pp. (1993)

Illustrations of some common natural enemies in Florida can be found at:

- https://edis.ifas.ufl.edu/TOPIC_Beneficial_Organisms_and_Beekeeping

Other useful websites include:

- A guide to natural enemies by Cornell University http://www.nysaes.cornell.edu/ent/biocontrol/
- Nematodes for biological control by University of Nebraska http://nematode.unl.edu/wormepns.htm
- Association of Biocontrol Producers http://www.anbp.org/
- Featured Creatures: profiles of pest and beneficial insects from University of Florida http://entomology.ifas.ufl.edu/creatures