chapter 5

Entomology

In a nutshell...

- 99% of insects are harmless or even beneficial! Learn to tolerate some damage in the garden.
- You need to be able to identify insects to know whether they should be managed and, if so, what the right stage is.
- Size does not influence the degree to which an insect damages plants.
- Check the resources at **hort.extension.wisc.edu** for issues not covered in this chapter.

MASTER GARDENER
UNIVERSITY OF WISCONSIN–MADISON
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Introduction

Insects are the most successful type of animal on earth. They have been around for at least 350 million years (which makes them much older than the dinosaurs) and are still the most diverse and numerous type of animal on earth. Probably over 1 million different species can be found in the world. An estimated 100,000 different kinds of insects live in North America; a typical backyard probably has hundreds of different species of insects living there.

While some insects can cause problems for horticultural plants in Wisconsin, the vast majority are either beneficial or harmless. Insects:

- Pollinate most flowers.
- Assist in breaking down organic materials.
- Feed upon other insects.
- Provide food for birds and fish.
- Provide useful products such as honey, wax, and silk.

This chapter addresses both the beneficial and problematic qualities of insects.

Spiders are not insects, but belong to the class Arachnida. They have two body regions: a modified thorax (cephalothorax) with four pairs of legs, eyes, and no wings or antennae. Mites and ticks are also arachnids, but have one body region.

Learning objectives

1. Understand how insects develop and why this is relevant to their management.
2. Describe how insects cause injury to plants.
3. Recognize that there are both beneficial and harmful insects.
4. Understand how integrated pest management plays a role in managing insect problems.

Focus on the orders that have significant pests or beneficial insects.

Insect classification

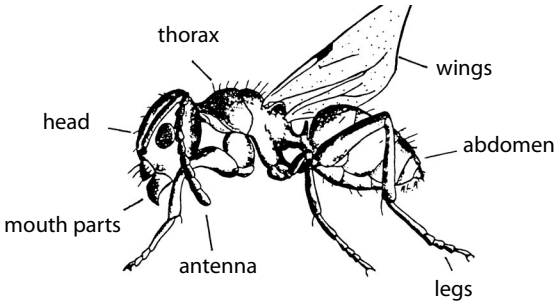
Insects belong to a larger group (**phylum**) of creatures in the animal kingdom called the **arthropods**. Spiders, ticks, mites, millipedes, and crayfish also belong to the arthropod group, but they are different from insects (see box). The class of Insects is subdivided into 26 to 30 different groups called **orders**. Criteria for assigning species to these orders include the type of mouthparts, type of metamorphosis, and wing characteristics (presence or absence, number, and form), among others. See tables 1 and 2 for the most common orders of insects. Knowing these larger groups of insects is a good first step in understanding insect diversity.

Insect anatomy

You need a basic knowledge of insect anatomy to understand how to identify them. Generally, insects in their adult forms—but not spiders, ticks, centipedes, and mites, which aren't true insects—have the following characteristics (figure 1):

- A body divided into three regions: head, thorax, and abdomen.
- One pair of antennae.
- Three pairs of jointed legs on the thorax.
- Wings on the thorax (only in the adult stage of most types of insects).

FIGURE 1. Insect anatomy



The main functions of the **head** are sensory, food intake, and information processing.

- An insect's compound eyes are made up of a number of facets (up to 50,000 facets in a large dragonfly eye), and each facet sees only part of the overall scene (like a pixel on a screen, but lower resolution). Insects can also see parts of the light spectrum that humans can't—such as ultraviolet.
- The two antennae are distinctive: they are segmented and have various sensing functions such as smelling, hearing, tasting, and feeling.
- Insect mouthparts are specialized structures used to obtain food. There are many types of mouthparts, including those for chewing, piercing-sucking, siphoning, rasping, and cutting. In fact, you can identify many insects from the type of damage their mouthparts leave on plants (or people).

The **thorax** is a fusion of three segments to make one distinct body part.

- One pair of legs are found on each of the three sections of the thorax. Legs differ in form and are used for running, walking, jumping, grasping, swimming, and digging.
- Wings are also attached to the thorax. Most adult insects have four wings, while true flies have only two or no wings. Beetles have one pair of membranous wings and a pair of hardened forewings called **elytra**. An insect's ability to fly is unique among the invertebrates and is one reason this group of animals has been so successful.

The **abdomen**'s functions are mainly digestive, respiratory, and reproductive, but in many insects the segments have also been modified for sensory or defensive purposes (such as stingers).

How insects are different

Insects differ from most animals that we are familiar with in many ways. An insect's skeleton is on the outside of its body. Called an **exoskeleton**, this hard outer shell helps prevent the insect from drying out, protects the animal from harmful things in the environment, and is where the muscles are attached. Insects must **molt** or shed this confining skin as they grow. Once they become an adult, they stop molting and growing.

Did you ever wonder why insects don't get as big as a car? While mammals can be as small as a mouse and as large as an elephant, insects are limited in size due to the physical constraints of the suit-of-armor-like exoskeleton and their unique internal physiology. In order to become larger, the exoskeleton has to be proportionately thicker to support the additional mass of body tissue. But a thicker exoskeleton is also heavier, requiring larger muscle volume in order to move. So there's a physical limit as to how large insects can become before they can't move themselves around any more, again limited by the physical limitations of surface-to-volume ratios.

Insects do not have a circulatory system like mammals and instead carry blood freely within their body cavity. Oxygen is delivered directly to the cells through a system of branching breathing tubes (trachea dividing into tracheoles at the ends) from openings through the exoskeleton called **spiracles**.

In addition, the nervous system is split between the three body cavities. The brain processes information in the head, but nerve centers in each section also process information—which is why, at least at first, a grasshopper may not notice when its head has gone missing!

Insects are cold-blooded animals, so their development and activities are influenced by temperature.

- The warmer the temperature, the faster things happen, up to a point. Many insects grow and develop very quickly under optimal conditions, with some going from egg to adult in a week or two.
- They can eat up to three times their weight in food per day and can grow to 50 to 100 times their beginning size in 3 to 4 weeks after hatching from an egg.
- Some species can go for long periods without food, slowing their metabolism down and going into a sort of hibernation called **torpor**.
- Because of their type of metabolism, many insects can tolerate freezing temperatures; when things warm up, they simply continue on with their lives.

Insect development

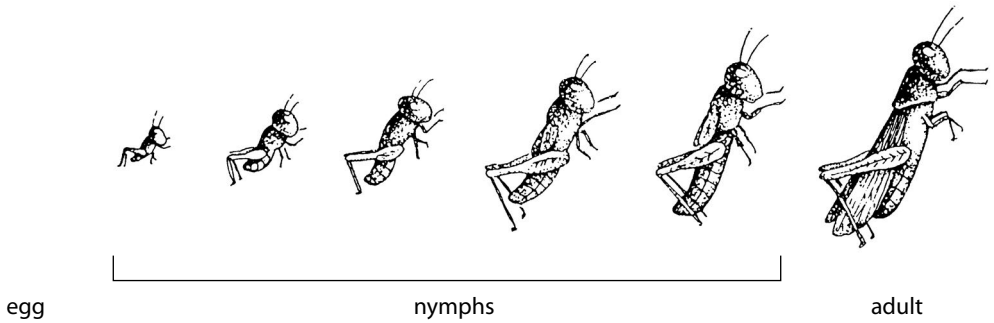
All insects go through significant changes from the time they hatch from eggs until they are full grown. The change in form, called **metamorphosis**, can be accomplished by a gradual change in size and structures or by a dramatic transformation in form and shape from young to adult.

Gradual metamorphosis

Insects that develop by **gradual metamorphosis**, also known as simple metamorphosis, hatch from the egg into the immature stage called a **nymph** (figure 2). Nymphs grow and shed their **exoskeleton**—in a process called **molting**—several times before their reach their final size.

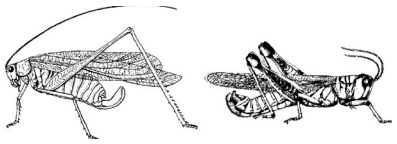
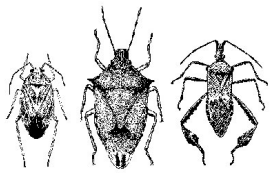
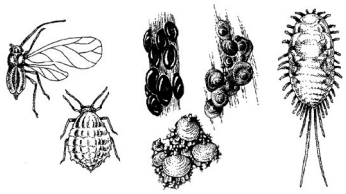
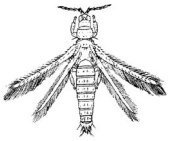
- The young look just like the adults but are smaller in size, lack fully developed wings, and are not sexually mature.
- Nymphs have the same types of mouth parts as adults, feed on the same foods, and live in the same environments.
- The final molt transforms the insect into the adult stage.

FIGURE 2. Gradual metamorphosis



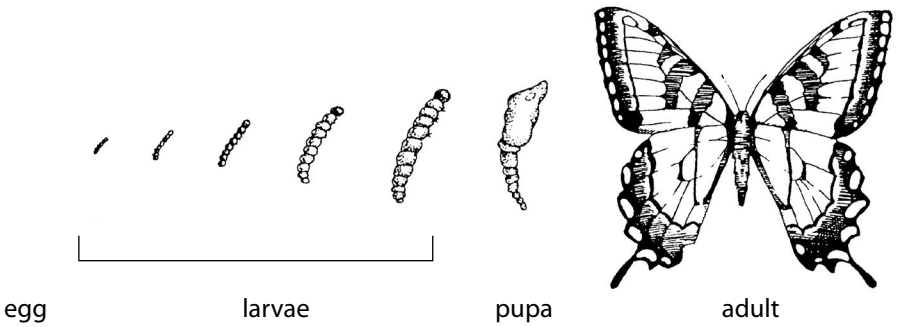
In the garden, both the adult and nymphs can be a problem and are often found feeding side by side. Common insects that have gradual metamorphosis include grasshoppers, aphids, true bugs (such as box elder bugs), leafhoppers, and cockroaches (see table 1).

TABLE 1. Insect orders with gradual metamorphosis

Order/Common name		Mouthparts	Wings
Orthoptera Grasshoppers Crickets		chewing	2 pair 1st leathery
Dermaptera Earwigs		chewing	2 pair 1st short wing cover
Hemiptera **Heteroptera** (suborder) True bugs		piercing-sucking	2 pair 1st halfwing
Homoptera (suborder) Aphids, scales mealybugs		piercing-sucking both membranous	2 pair (some without)
Thysanoptera* Thrips		rasping-sucking	2 pair fringed/feathery

*This order is regarded as an intermediate between gradual and complete metamorphosis, with egg, larva, prepupa, pupa, and adult stages.

FIGURE 3. Complete metamorphosis



Complete metamorphosis

The second type of development is called **complete metamorphosis** and involves major reorganization as the insect develops (figure 3).

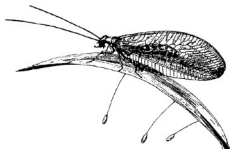
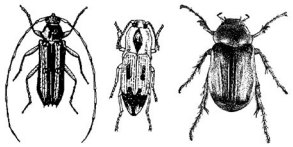
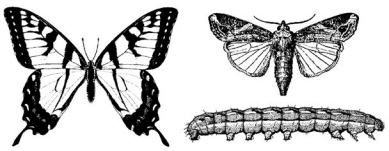
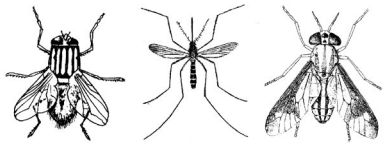
- Insects hatch from an egg into a worm-like stage called a **larva** (plural = larvae).
- After a series of molts, the insect pupates. The **pupa** (plural = pupae) is a non-mobile stage in which the larval structures are disintegrated and reconstructed into a very different looking adult.

The adults will often live in a very different environment from the immature insects and often require different food. Insects that develop in this way have evolved to take advantage of different resources to eliminate feeding competition between the feeding stages. An extreme example of this divergence in habitat and food is the mosquito, which feeds on algae in an aquatic habitat as larvae and on animal blood (females) or nectar (males) as adults.

For most insects with complete metamorphosis (see table 2), the larva will be the most damaging stage; the adults infrequently cause feeding damage on the same plants as the immatures. (There are always exceptions—the Colorado potato beetle is a prime example.)

For gardeners, this difference between adult and immature requirements will affect management strategies.

TABLE 2. Insect orders with complete metamorphosis

Order/Common name		Mouthparts	Wings
Neuroptera Lacewings Antlions		adult: chewing larva: chewing	2 pair net-like veins
Coleoptera Beetles		adult: chewing larva (grub): chewing	2 pair 1st hardened wingcover (= elytra)
Lepidoptera Butterflies Moths		adult: siphoning larva (caterpillar): chewing	2 pair scales on wings
Diptera Flies		adult: sucking, sponging, etc. larva (maggot): chewing	1 pair
Hymenoptera Bees, ants, wasps sawflies		adult: chewing larva (grub): chewing	2 pair both membranous

Beneficial insects

Don't just think about insects as pests. Only about 1% of insect species spread disease or cause serious injury to crops, animals, stored products, or structures. In fact, beneficial insects contribute an estimated $20 billion of value in the United States every year.

- Insects provide useful products including honey, beeswax, silk, and shellac.
- They play a key role in plant pollination of many plant species.
- Some insects destroy harmful insects, either by developing in the bodies of others (**parasitoids**) or by capturing and devouring their neighbors (**predators**). See "Biological Control" in chapter 4, Pest Management.
- Other insects help destroy weeds and unwanted plants.
- Insects living and tunneling in the ground help improve and enrich the soil's physical properties.
- Many insects function as scavengers—devouring dead animals and plants—or help recycle nutrients by breaking down wood and other plant matter.
- They are a food source; some fish and birds use insects as a large part of their diet.
- Other insects have contributed to medicine. Many historical and homeopathic uses of insects have been described over the centuries, and many contemporary uses remain. An understanding of blood-feeding insects led to medicines such as anticoagulants, vasodilators, vasoconstrictors, and antihistamines. Another example is allantoin, the protein associated with the curative effects of myiasis (maggot therapy) and often used to prevent infection and induce healing.

Lastly, many insects, such as butterflies and dragonflies, are appreciated for their beauty. Purposeful selection, placement, and management of plants will create a better habitat for attracting insect species that you might be interested in viewing.

Encouraging insects in the garden

You might think that all we need to do to attract hundreds upon thousands of insects to our gardens and plantings is simply try to grow something. However, the insects that are attracted are not always the most desirable. Most people would rather see a variety of glamorous insects such as moths, butterflies, and dragonflies. Or maybe you would like to encourage helpful ones such as pollinators (bees, moths, flies, wasps) or those that help control insect pests: predatory insects (beetles, many true bugs, and others) and parasitic insects (wasps primarily). To consistently lure in these preferred species, our plantings and/or management schemes must meet the needs of those species.

In general, the more homogeneous a planting is, the fewer insect species it will attract. Different plants provide different resources throughout the season. They may vary in flower color, size, or shape; blooming period; plant height; leaf type or color; canopy thickness; and many other characteristics to provide a diversity of foods and habitats for different insects. There are many insect species that are around as adults for only a short time period, are attracted to only certain color flowers, or are attracted to certain heights of plants.

Most of the insects we'd like to see are nectar- or pollen-feeding as adults. The higher the degree of flower diversity you have present in your landscape, the higher the likelihood that you will see a large number of butterfly, moth, bee, and beneficial wasp species. For example, a mass planting of forsythia will be a dramatic early spring attraction, but will attract far fewer types of insects than a mixed planting of forsythia, double-flowering plum, lilac, viburnums, and spireas over the course of the year. In some cases, flower shape is very important. For example, white-lined sphinx moths and hummingbirds are attracted primarily to long, trumpet-like flowers, while swallowtail butterflies need a flat flower on which to perch. Although many nectar-feeding insects are attracted to flowers for food, they can also be lured in by host plants on which they will lay their eggs.

Providing a large number of plant species in your landscape instead of monoculture plantings is beneficial not only for attracting a wide variety of insect species, but the variety actually decreases the chance of insect pest problems. Many predatory and parasitic insects that can play a major role in keeping insect pest species at tolerable levels are attracted to plant species other than those on which their prey develops. The likelihood of beneficial insects taking up residence and protecting your plants increases dramatically as your plant diversity increases. There are also certain insects that will be more consistently attracted to low-growing, mid-height, or taller species.

Plant spacing also affects use by insects and other wildlife. Plants spaced closely together develop differently than those that are grown alone. The microenvironment in and around them also will be quite different. The subtle differences in growth characteristics of the same plant in different spacings (the way the plant grows) may actually attract different types of insects. This is particularly true for certain types of plant pests, as well as their predators and parasites. It may not seem logical, but it is just as common to have pest problems on specimen plants as on group plantings. Most predator and parasitic insects do not like being out in the open, and are less likely to be found on a single plant that is set off from others, rather than in a clump with many other plants. The plant-feeding insects are less concerned about being in the open, so they will attack the specimen plant just as they would a clump. Microenvironmental conditions found on specimen plants, rather than clumps, favor the development of the soft-bodied plant pests such as aphids. Diseases are more severe in the higher humidity conditions found in plant clumps, and play a major role in naturally controlling these pests.

The more plant species you have, the more insect species you will see. Just remember many of them may not be beneficial. This is okay if you're interested in having the highest number of species possible, whether they are pests or beneficial, ugly or beautiful. Your child/grandchild may have an insect collection project for school, Scouts or 4-H, or you may be doing your own informal research to better understand the range of insect life you can find in your area.

There are many insect species that feed and develop only on particular plants. To view these insects more consistently or through their life cycles, you need to provide the key plants the immatures feed on, as well as the adults. The classic example is monarch butterflies. If you provide milkweed species, you will see more monarchs, because they are the only plants on which their larvae feed; you will also likely see the dozen or so other species that are fairly specific feeders of milkweeds. Do your homework and find out the preferred food sources for target insect species, and you may be rewarded with a new species sighting.

Providing specific plants is also important in helping threatened or endangered species. One of the best examples in Wisconsin is the Karner blue butterfly. This federally endangered species is actually relatively common in the central and northwestern portions of Wisconsin, because that area is very good habitat for its only food source, the wild lupine (*Lupinus perennis*). Planting clumps of wild lupine in those areas will increase your chances of seeing and assisting this delicate species.

Careful plant selection can alter micro-environmental characteristics in the landscape. One of the most significant of these characteristics for attracting or viewing insects is airflow. Wide open spaces with very good airflow will increase the number of certain butterflies and other flying insects native to prairies. Hedgerows or tree rows will create variable wind speed layers, including calm air. These differential airflow zones attract both strong and weak flying insect species. Where there are large numbers of small flying insects, you will also find the larger flying predators, particularly dragonflies and damselflies. A secondary benefit of the air pockets is being able to watch the magnificent aerial acrobatics that some insects, particularly the dragonflies perform. Watching a dragonfly single-handedly eradicate a small swarm of midges or mosquitoes is one of the true marvels of the natural world.

Another way of attracting insects is by providing a water feature. Although we cannot create an entire stream or river that is necessary for certain aquatic insects, small ponds with or without moving water can be added to the landscape to encourage other insects. Small water sources are breeding sites for a multitude of insects, as well as season-long attractants for flying insects. The immediate reaction may be that all these areas are good for is breeding more mosquitoes, but a healthy water feature, especially one with flowing water, is not going to significantly contribute to your need for insect repellents.

There is an entire subset of aquatic insects that you will have the chance to observe and interact with by adding water to your landscape. For many people, simply being able to observe water striders skate across the water surface makes the work of adding water well worth it. For others, it is the opportunity to watch a dragonfly emerge from its underwater nymphal stage to the magnificent adult, or the chance to see giant water bugs catching prey with their powerful front legs.

Insects as pests

A number of characteristics allow insects to be so successful. They are highly adaptable and diverse. Because of their small size, insects are widely distributed worldwide and can occupy almost any niche. Some insects spend their whole life inside an acorn; others, on the surface of snow pack in the arctic.

To many biologists, the most amazing fact about insects is their high reproductive capacity. For example, a fruit fly can complete a generation (from egg to adult) in 2 weeks at average room temperatures. Each female lays an average of 100 eggs after mating. If we start with one male and one female, allow them to mate on the first of the year, and all of their offspring survive and mate, by the end of the year we would have a ball of fruit flies that would be 96 million miles in diameter!

Of course, there are not enough overly ripe bananas in the world to breed that many flies, but at any time, insects are ready to leverage their advantage. Shortages of food or water, diseases, insect predators, exposure, and other weather conditions prevent 100% survival. In most situations 95% or more of any insect population die before they can reproduce, but that remaining 5% can cause a lot of problems. Losses due to insects have been estimated in the United States to exceed $5 billion yearly.

Types of insect injury

The more we understand the needs of a pest insect, the more educated decisions we can make to recommend management options to reduce their populations and limit their impact on our plants.

Chewing injury

Chewing is the easiest insect injury to identify. Beetles, crickets, grasshoppers, caterpillars, sawflies, webworms, and maggots are common examples of insects that cause injury by chewing mouthparts. These insects eat leaves, damage fruit, prune plant roots, or bore into plant stems or wood.

- **Defoliation** is the removal of any leaf tissue and encompasses many degrees, from the removal of little circular holes ("shotholes" caused by flea beetles) to the consumption of entire leaves.
- Sometimes only the upper or lower surface of the leaf is scraped off, leaving the leaf veins intact. This type of feeding is called **skeletonizing**.
- **Leafmining** occurs when an insect feeds between the upper and lower leaf surface, leaving a discolored serpentine trail or blotch visible on the leaf.
- Stem and wood borers feed internally and damage woody plants by **girdling** (cutting off) the vascular system of the plant. Emerald ash borers damage and ultimately kill ash trees in this way.

Plants and insects have evolved together, so plants normally have more leaves than they need to survive and can tolerate a fair amount of foliar damage. For example, birch leaf miners can cause a birch tree to drop up to 70% of its leaves (known as **leaf drop**) before the tree's health is affected. Insects such as the Eastern tent caterpillar or gypsy moth can eat every leaf on a well-established tree during the spring, and the tree will recover with a new set of leaves in 2 to 3 weeks. The energy put into the new growth will weaken the tree, however, and reduce fruit production; repeated defoliations can become life-threatening.

Any chewing injury in newly formed fruit will result in major damage by harvest time either by deformities or providing an entry point for disease. A few types of chewing insects may also carry pathogens from one plant to another.

Sucking injury

Other insects feed with needle-like mouthparts and suck the juices out of plants or animals. Major groups of pests that have this type of feeding include aphids, scale insects, plant bugs, mealybugs, and mosquitoes.

- Many beneficial insects (including assassin bugs, damsel bugs, and minute pirate bugs) have this type of mouthpart, but suck insect body fluids instead of plant sap.
- Damage from piercing-sucking feeding is much different from chewing damage. Symptoms may be very subtle—almost unnoticeable—or can include deformed fruit or foliage, burned or speckled tissue, aborted development, stunting, yellowing, or wilting.
- Most plant diseases transmitted by insects are associated with insects with this type of mouthpart.

A small number of insects don't fit neatly into the categories of chewing or piercing-sucking feeders. Thrips and spider mites feed by rasping off plant tissue or puncturing cells and then feeding on the juice released from the cells. This results in a stippled appearance on the affected leaves referred to as **stippling**.

Galls

Galls are abnormal growths that can occur on any plant part, particularly on woody plants. Galls are most frequently caused by insects, but mites and some plant pathogens can also induce gall formation. Gall-forming insects include aphids, phylloxerans, psyllids, midges (gall gnats), and tiny cynipid wasps (gall wasps).

- Galls vary widely in size, shape, texture, and color, and it is not uncommon to find several different types on the same plant.
- Galls are formed in response to the insect's egg-laying or feeding by the immatures. After a brief period of cell growth, gall development stops and the insect becomes enclosed by the gall, feeding only on gall tissue during its development. If galls are cut open, nymphs or larvae can sometimes be seen in a cell or cells within the gall.
- Small holes on the outside of the gall indicate that the adult insects have emerged.
- In general, galls do not seriously harm the plant.
- Small bumps on maple leaves, sometimes called "bladder galls," are a common kind of gall caused by tiny mites.

Insect management

Most insect populations remain at relatively stable levels (regulated by weather, food supplies, natural enemies, and/or other factors) without causing problems for humans. In cases where populations are higher than we can tolerate, insects become pests. Measures must be taken to reduce their numbers and the subsequent damage they would cause.

As simple as it may seem, knowing what type of mouthparts an insect has can be very important in deciding on a management tactic. Understanding the structure and function of the insect exoskeleton has proven critical in developing insecticide formulations that are able to penetrate this multi-layered protective covering.

Understanding an insect's biology and life cycle is important in determining which management options are most likely to succeed against a given pest, and when to implement management techniques. This can reduce unintended consequences to beneficial insects that would occur from just using non-selective insecticides.

- Insects with chewing mouthparts can be selectively controlled by some insecticides that are applied directly to plant surfaces and are only effective if ingested; contact alone will not result in death of the insect. For example, components of the microbial insecticide *Bacillus thuringiensis* enter the digestive system and break down the gut lining.
- Since insects obtain oxygen through openings in their exoskeleton, plugging these openings causes death. This is how insecticidal soap and oils kill insects—by suffocating them.
- Studies of insect communication (e.g., pheromones) have led to the discovery of chemical compounds used by insects to locate each other or host plants, and a few of these have now been identified and produced synthetically. These can be used in traps to eliminate insects, keep track of their presence and numbers in order to decide when to control them, or disrupt their mating.
- Insect growth regulators are chemical analogues of an insect's hormones. In insect development, hormones regulate the molting process and development through the pupal stages to reach adulthood. By applying these chemical analogues, insects will not develop normally.

Other forms of insect control could include:

- Cultural controls (e.g., crop rotation, trap crops, exclusion, varietal selection).
- Mechanical controls (e.g., picking them off of plants or shaking them onto drop cloths).
- Biological controls (e.g., parasites, predators).

Use integrated pest management principles to help you select the best combination of practices to maintain insect populations at, or below, levels you can tolerate. See chapter 4, Pest Management and chapter 17, Organic Gardening for a discussion of management strategies and table 3 for an overview of common insect pests in Wisconsin.

TABLE 3. Common insect pests in Wisconsin

Pest	Description	Damage	Control
CONIFERS			
Bark beetles	tiny beetles	galleries in trunk only on stressed trees	maintain tree health; remove infested trees
European pine shoot moth	sap oozing from shoots	bores in shoots, kills or deforms shoot; stunts growth	insecticides in spring when larvae moving; shearing removes larvae
Needleminers	esp. spruce; mainly cosmetic	lightly infested trees recover	
PIne needle scale	brown bumps on twigs or needles	yellowing of needles	target crawlers
Pine tussock moth	hairy caterpillar	complete defoliation of trees possible	Bt in August for larvae; insecticides in spring for large larvae
Sawflies	caterpillar-like worms in large groups	larval colonies eat needles	sprays or hand picking
Spruce spider mite	nearly microscopic mite produces white speckles on needles	needle discoloration, drop	worse in dry years; insecticidal soap; predatory mites
Spruce gall adelgid	tiny pineapple-like growths on terminals	galls are cosmetic on large trees; may kill young trees	eliminate Douglas fir (alternate host); early sprays
Zimmerman pine moth	sap oozing from holes in trunk or shoots	bores in trunk or shoots; weakens trunk or kills shoots	target adults in midsummer or larvae in spring
DECIDUOUS TREES: ASH			
Ash borer	clear-winged moth	larvae bore in trunk	pheromone traps to time sprays; resistant varieties
Ash plant bug	small green bug	injects toxins to cause burning; deformed leaves	mainly early; tree will recover
Ash flower gall	disfiguring galls	removes energy	treat based on history
Emerald ash borer	metallic green torpedo-shaped beetle	larvae bore in trunk	soil or trunk applied systemic insecticides
DECIDUOUS TREES: BIRCH			
Bronze birch borer	dark torpedo-shaped beetle	larvae bore in trunks of stressed trees	maintain tree vigor; only use resistant varieties
Birch leafminer	tan blotches on leaves	larvae mine leaves of paper and gray birch	mainly cosmetic; maintain tree vigor
DECIDUOUS TREES: HONEYLOCUST			
Honeylocust plant bug/leafhoppers	little green things	feeding deforms new leaves; leaf drop	early; tree will make new flush of leaves
DECIDUOUS TREES: MAPLE			
Cottony maple scale	fluffy white globs	looks bad	outbreaks when natural enemies killed
Galls (caused by mites)	funny bumps or patches on leaves	cosmetic only	worst in cool, slow springs
DECIDUOUS TREES: OAK			
Galls (caused by cynipid wasps)	woody balls on stems or leaves	mainly cosmetic	cut off bags
Two-lined chestnut borer	brown torpedo-shaped beetle	larvae bore in trunk of stressed trees only	maintain tree vigor

TABLE 3. Common insect pests in Wisconsin, *continued*

Pest	Description	Damage	Control
GENERAL TREE FEEDERS			
Eastern tent caterpillar	ugly brown caterpillars in white silk tent in tree crotches	defoliates flowering fruit trees	prune out/destroy nests
Gypsy moth	colorful, hairy caterpillars	defoliation; nuisance	community sprays; banding; natural enemies
FRUIT: APPLE			
Aphids	various types; in colonies on leaves	curls leaves	native natural enemies usually adequate
Apple maggot (railroad worm)	fly with banded wings; small maggot in fruit	larvae tunnel through fruit; brown trails, rot	primarily July–August trapping, insecticides
Codling moth	small moth; ½-inch cream-to-pink caterpillar	larvael tunnel in core causing kernal rot	2 generations; insecticides 1 week after petal fall; again in July
Leafrollers (various species)	small caterpillars in spring, summer	defoliation and surface scarring of fruit	damage cosmetic Bt or insecticides
Spider mites	tiny red or pale yellow specks on leaves	feeding dries out leaves, weakens tree	predators and water, dormant oil or summer oil
FRUIT: RASPBERRIES			
Cane and crown borers	various types of fly, beetle, or moth larvae	bores in canes, crown causing wilting, death	pruning; insecticides
Picnic beetles (sap beetles)	small black beetles with yellow/orange spots	infests ripe fruit	harvest frequently; remove over-ripe fruit; trapping; insecticides
FRUIT: STONE FRUITS			
Cherry fruit flies	small flies with banded wings; maggots in fruit	larvae tunnel through cherries, causing rot	remove wild hosts; insecticides; trapping
Plum curculio	adult is bumpy brown weevil; legless grub in fruit	adults make crescent-shaped slits in fruit, resulting in lumpy fruit	insecticides at petal fall and 2 weeks later
Woodborers	pale caterpillars	bores in trunk/branches causing stress/death	insecticides sprays of trunk during summer
FRUIT: STRAWBERRY			
Cyclamen mite	microscopic mites	severe stunting	replant (certified stock)
Leafrollers	worms in folded leaves	defoliation	Bt, insecticides
Spittle bug	green bug in froth	high numbers stunt fruit	insecticides if necessary
Strawberry bud weevil (clipper)	very small brown weevil with long snout	clips unopened buds, reducing yield flower	insecticides before bloom
Tarnished plant bug	small green-to-black bug	feeds on developing fruit, causing "button berries"	insecticides before and after bloom

TABLE 3. Common insect pests in Wisconsin, *continued*

Pest	Description	Damage	Control
HERBACEOUS PLANTS			
Aphids	green or black blobs with legs, in groups on leaves or stems	removes sap; stunting; honeydew/sooty mold; virus vectors (few plants)	water rinse; insecticidal soap; release predators; native natural enemies
Caterpillars	loopers, leafrollers, woolly bears	defoliation	tolerate some damage; hand pick; Bt; insecticides
Common stalk borer	caterpillar in stem	larvae bore in stems	native prairie insect
Iris borer	fat caterpillar in rhizome	plant decline; bacterial infection	remove weeds; insecticides
Japanese beetle	green/copper scarab	skeltonlized foliage	hand pick; traps are not recommended; insecticides
Leafhoppers	skinny, triangular	removes sap; stunting; hopperburn (potato) aster yellows (asters)	insecticides; no cure for aster yellows, so remove infected plants
Plant bugs	brown or striped bugs	toxins cause bud/ flower drop or small black spots on leaves	insecticides
Rose chafer	tan-brown beetle in mid-June	skeletonized foliage	hand pick
Rose slug	slimy green sawfly larva blends in well with leaves, hard to see	windowpane or skeletonizeing defoliation "overnight"	insecticides; monitor/ calendar; sprays for problem areas
Scales	bumps on stems or leaves	removes sap; stunting; honeydew/sooty mold	wash plant off; remove scales; insecticidal soap for crawlers; insecticides
Spider mites	tiny specks on leaf (generally underside)	speckling/stippling of foliage; leafdrop; webbing	insecticidal soap; predatory mites
Thrips	small "pollen grains" that move quickly	speckling of foliage	difficult to control; insecticides
HOUSEPLANTS			
Aphids	green or black blobs with legs, in groups	removes sap; stunting; honeydew/sooty mold; on leaves or stems	water rinse; insecticidal soap; release predators (green lacewings)
Fungus gnats	tiny, weak flies	mainly nuisance or cosmetic	don't overwater; Bt israelensis
Mealybugs	fluffy white bits	removes sap; stunting or malformation of leaves	insecticides; predator (mealybug destroyer)
Scales	bumps on stems or leaves	removes sap; stunting; honeydew/sooty mold	wash plant off/remove scales; insecticidal soap for crawlers; systemic insecticides
Spider mites	tiny specks on foliage (generally underside)	leaf speckling/stippling; leaf drop; webbing	insecticidal soap; predatory mites
Thrips	small "pollen grains" that move quickly	speckling of foliage	difficult to control; insecticides
Whiteflies	tiny white adults; clear or white bumps on underside of leaves	remove sap; stunting; honeydew/sooty mold	insecticidal soap; yellow sticky traps; systemic insecticides

TABLE 3. Common insect pests in Wisconsin, *continued*

Pest	Description	Damage	Control
TURF			
Chinch bug	little black and white bug	sucks sap; yellowing of leaves; large areas of dead or dying grass	monitor with flotation; don't kill native predator (bigeyed bug)
Greenbug	yellow aphid	sucks sap; yellowing of leaves, especially in shady spots	insecticidal soap; native natural enemies
Sod webworm	tan moths with zig-zag flight when disturbed	nocturnal caterpillars eat leaves; small yellow patches grow in size; in sunny areas	birds eat moths, larvae; monitor with flotation; insecticides if bad
White grubs	white grubs in soil	larvae feed on roots, loosens turf or dries out; skunks, moles, birds dig up grass to eat grubs	maintain grass vigor; water in drought; insecticides if bad
Japanese beetle	green/copper diurnal beetle	may be numerous	milky spore disease (not very effective)
June beetles	brown nocturnal beetle	larvae live in soil for 2–3 years; 2nd year worst damage	many native predators
VEGETABLES: CABBAGE AND OTHER CRUCIFERS			
Cabbage aphids	woolly, grey-green colonies	stunt or kill small plants, contaminate harvested crop	many natural enemies, insecticidal soap
Cabbage maggot	bristly, house fly-like adult; white maggot	maggots feed on roots, plants wilt	timing of planting; insecticides at planting
Caterpillars	green worms	defoliation	monitor by inspection; hand pick; Bt when small; insecticides; floating row cover
Imported cabbageworm	diurnal white butterfly fuzzy larva up to 1"		
Diamondback moth	small, brown moth pointed caterpillar to ½"		
Cabbage looper	large brown moth large looper larva to 1½"		
Flea beetles	dark-colored, jumpy	chews tiny "shotholes" in leaves	mainly cosmetic damage
VEGETABLES: ONIONS			
Onion thrips	tiny "pollen grains" that move quickly	white speckling/streaks on leaves	insecticidal soap
VEGETABLES: POTATO			
Aphids	green or pink blobs with legs, in groups on stems and leaves	sucks sap; transmit virus diseases	insecticidal soap; native natural enemies
Colorado potato beetle	fat orange larvae; yellow and black striped adults	defoliation	hand pick; insecticides
Flea beetles	dark-colored, jumpy	chews tiny "shotholes" in leaves	mainly cosmetic damage
Potato leafhopper	light green, triangular	injects toxins to cause hopperburn	insecticides
VEGETABLES: POTATO VINE CROPS			
Squash bug	clustering white nymphs, black adults	sucks sap; wilting plants	hand pick; trap
Squash vine borer	diurnal wasp-like adult	larvae bore in stems; plants wilt	cover plants to prevent moths from laying eggs
Striped cucumber beetle	yellow with black stripes	chews on leaves; vector of bacterial wilt	floating row cover; insecticides

Conclusion

Insects do more good than harm over all, but the ones that are pests in your garden can really drive you buggy. Due to their life cycle, an insect species may go from beneficial to benevolent to bothersome—all in the course of a single season!

Appropriately identifying the species, its life stage, and plant being tormented are the first steps to creating a management plan. And any management plan including chemicals should be conscious of the impact they have on the helpful insects in the garden and on any plants you may want to eat later on. Chemical-free options are often more work, but they may be the better choice in the long run.

Resources

Wisconsin Horticulture publications are available at hort.extension.wisc.edu.

FAQs

Is this a Japanese beetle or an Asian lady beetle?

If it's orange, red, or yellowish with black spots, it's a multicolored Asian lady beetle. If it's metallic brownish green, with white spots on the sides, it's a Japanese beetle. If it's hanging out in your house over winter, it's likely a multicolored Asian lady beetle. Japanese beetles overwinter in the soil.

How can I tell if I have emerald ash borer on my ash tree?

First, are you sure you have an ash tree? If so, look for several signs of the pest. Are there D-shaped exit holes and splintering bark with larval tunnels underneath? Are there any of the following symptoms: epicormic shoots (trunk sprouts), canopy die-back, or the removal of bark by woodpeckers? If you live in an area that hasn't been quarantined with EAB, then call your local DNR office to verify infestation.

There's something eating my plant—what can I spray on it?

First, identify the insect so you will know how to treat it. Note the specific damage to the plant. What's been chewed? When did you notice the damage? How big are the holes? Take pictures of the plant and any insects to help in identification.

This insect is huge, so it must be harming my plants, right?

Not all insects will harm your plants! Consider the humble bumble bee, a beneficial pollinator that any gardener would welcome. Identify any insect before treating for plant damage to make sure you're not harming beneficial insects.

Entomology, practice exam questions

(Answers below)

1. **Insects with gradual metamorphosis**
   a. Are likely to have adults and juveniles on the same plant
   b. Have a distinct pupa stage
   c. Have piercing-chewing mouthparts
   d. All of the above
2. **Which is FALSE about insects?**
   a. Wings are only found on adults
   b. Insect growth and activity is temperature dependent
   c. All insects undergo metamorphosis
   d. Spiders have distinct head, thorax and abdomen
3. **The insecticide BtK targets lepidopterans. Which larvae does it kill?**
   a. Caterpillars
   b. Grasshoppers
   c. Sawflies
   d. Mites
4. **Insecticidal soaps are most effective against**
   a. Large adult insects
   b. Small, soft bodied insects
   c. Insects with chewing mouthparts
   d. Insects with piercing-sucking mouthparts
5. **Plant damage associated with insect feeding includes:**
   a. Defoliation
   b. Skeletonizing
   c. Girdling
   d. All of the above
6. **Possible signs of insect activity on your plant include:**
   a. Feeding damage
   b. Molted skins
   c. Frass
   d. All of the above
7. **Which of the following is true?**
   a. Insects can move pollen from plant to plant
   b. Insects can move diseases from plant to plant
   c. Only a small percentage of insects cause problems to plants
   d. All of the above
8. **Which of the following is FALSE about Japanese beetles?**
   a. Japanese beetle adults emerge in June or July
   b. Both the adults and grubs cause damage on plants
   c. Turf is primarily damaged by adult feeding
   d. Large trees are best protected using a system insecticide applied in the spring
9. **An example to conserve beneficial insects in the garden would be:**
   a. Purchase and release beneficial insects from the store
   b. Mowing the lawn at 3" height
   c. Using only narrow-spectrum (selective) insecticides
   d. Watering plants at night
10. **Spinosad is most effective against chewing insects. Which is most likely to be affected by this product?**
    a. Aphids
    b. Caterpillars
    c. Butterflies
    d. Squash bugs

Answer key
1. (a) 2. (d) 3. (a) 4. (b) 5. (d) 6. (d) 7. (d) 8. (c) 9. (c) 10. (b)