Chapter Three

Your Beautiful Flower Garden

Introduction

Whether it's one planter next to your door, or a show-stopping floral garden, flowers are a bonus of color and texture we can all appreciate.

If you're an experienced green thumb, or have read up on basic gardening in Chapter Two, you'll know that, rather than insects and diseases, most plant problems are cultural—meaning that if you give plants what they need (proper soil, location and care), they'll be healthy most of the time. Keep an eye on your garden. Noticing problems and identifying them early are essential steps toward a satisfying result.

What follows are common cultural, disease, and insect problems, and their solutions. That's a lot to cover. We'll start with general concerns, then focus on specifics for annuals, tender perennials, biennials, and perennials. (Don't worry if you see a plant in both the Perennial and Annual charts. Some, like verbena and geranium, can be perennial in warmer climates.) Later we'll discuss hostas, roses, bulbs and peonies.

Perennial, biennial, or annual? Perennials tend to come back over repeated years and expand each season. They may live three or four years, thirty or a hundred. Biennials need two years to complete their life cycle but because of re-seeding, some may seem to be perennial when they re-appear in the same spot for years. Annuals can, but rarely, make it through more than one season depending on the climate, or come back from seed.

Gypsophila, also known as baby's breath, is hardy enough to be a perennial in much of the Northeast—if you can provide well-drained soil that is prepared deeply enough for the plant's taproot. Pansies (also known as violas) mums, and hollyhock all can be grown as annuals, biennials, or perennials.

Chrysanthemums are a special case. Whether pompoms, doubles, buttons, cushions, or daisies, mums are perfectly hardy if they are planted in spring like any other perennial and cared for over summer. But if bought in flower and left on the porch until Halloween, then planted … no, they won't come back.

Photo: Pixabay.

In this chapter:

Chelone, also known as Turtlehead, is a great native plant for wet areas with partial or full sun. Knowing the needs of your plants, the micro-environment of your property, and how much work you are willing to do will make for a satisfying gardening experience. Photo: Arend Vermazeren, c2.staticflickr.com/4/3871/14869452529_823548c6f9_b.jpg, CC BY 2.0

Some plants just aren't fussy. Few pests trouble them. If you have the right site for these plants—and that's easy enough to find out—give them a try. Below, you'll see a list of of some of them, but remember any plant can have problems if the environment isn't suitable. And that includes incorrect care. Some are so happy they take over, or become a monoculture ripe for insect or disease problems.

For cultural and abiotic problems: Note the vulnerable plants and what the symptoms look like.

For diseases and insects: Note key hosts, what the pests are and what they do to the plant. Once you've verified your diagnosis, find an IPM solution in the pages that follow.

Revisit the Basics: Plant Health Comes First

Prevent and avoid is the best defense. Let nature work for you. Match your plants to the site, to the soil, climate, drainage, air circulation, and water they need. Consider wind, winter road salt, reflected heat, traffic patterns, your kids, your pets. Scout early and often, carefully inspecting new plants to be sure you're not introducing new pests. Keep the garden clean, and allow for air flow. Rotate those annuals. Build a rich soil—unless your favorites prefer a low-nutrient soil. Invite natural enemies by growing plants that give them nectar and shelter both. Mix 'n' match plants to distract or repel pests.

Begin a garden journal. Note when you add fertilizer or compost, or divide plants or bring in new ones. Found some natural predators? Write down what you see. Scout for pests, and chart when you see them, on what, and how many there are.

Confused by Common Names? So Are We!

Have you noticed how many fungal and bacterial diseases fall under "leaf spot"? (What about herbicide drift or insect feeding?) That's why we urge you to correctly identify those spots before choosing your next move.

Knowlege is power, and saves you money along the way. Don't place a plant where it won't thrive. Photo: bhansmeyer, c1.staticflickr.com/5/4051/4651605820_b6d0cb998d_b.jpg, CC BY-NC-SA 2.0

Some Trouble-free Flowers	
Allegheny Foam Flower; *Tiarella*	Lambs' Ears; *Stachys*
Black-eyed Susan; *Rudbeckia*	*Lobelia*; Cardinal Flower
Blazing star; *Liatris*	Meadow Rue; *Thalictrum*
Brunnera; Heartleaf Brunnera	Meadowsweet; *Filipendula*
Coneflower; *Echinacea*; Purple Coneflower	Russian Sage; *Perovskia*
Daylily; *Hemerocallis*	*Sanguisorba*; Burnet
Goldenrod; *Solidago*	Sea Thrift; *Armeria*
Hosta	Siberian Iris
Lady's Mantle; *Alchemilla*	Shasta Daisy; *Leucanthemum*
Sedum Autumn Joy	Turtlehead; *Chelone*
Karl Foerster grass	*Pulmonaria*; Lungwort
Astilbe	Yarrow; *Achillea*

Common Cultural (Abiotic) Problems of Annuals, Perennials, Bulbs, and Groundcovers

Here are some common plant plights brought on by cultural (abiotic) conditions such as weather, soil nutrient availability, injury, and neglect. Yes, it's true. We all have busy lives! Unlike our disease or insect charts, we don't break this one according to perennials or annuals, let alone the names of flowers. These problems show up in all plants including vegetables, turf grasses and woody plants.

Possible Cultural (Abiotic) Problems of Annuals, Perennials, Bulbs, and Groundcovers	
Problem	**Cause**
Whole plant	
Leaves are many, flowers few	too much fertilizer
Older (lower) leaves die along edges first (marginal necrosis)	drought stress
	nutrient deficiency: potassium or phosphorus
	nutrient overload: iron, magnesium or manganese toxicity
Older (lower) leaves become purple	nutrient deficiency: phosphorus or zinc
	soil too wet; poorly drained or overwatered
Older (lower) leaves start yellowing, turn chlorotic (often at bottom or interior of plant)	"old age"
	crowded plants
	drought or heat stress
	nutrient deficiency
	nutrient deficiency: nitrogen, potassium, magnesium
	soil too wet; poorly drained or overwatered
Tiny blisters show on leaves	edema (oedema): too much water intake by plant
Tip damage	air pollution
Wilting, dropping	drought or heat stress
	salt damage
	too much sun or heat because a nearby shade-casting plant, fence, or building was removed, exposing plant to a new microclimate
Yellowing between leaf veins: not entire leaf	air pollution
	pH problem
Yellowing, mostly at tips	drought stress
Younger (upper) leaves curl up or down	ammonium toxicity (many nitrogen fertilizers are ammonium-based; depending on pH or other factors, can damage plants)
	nutrient deficiency: calcium, zinc or boron
Younger (upper) leaves distorted	herbicide damage from accidental exposure or misuse
	nutrient deficiency: calcium or boron
Younger (upper) leaves have necrotic spots: dying back	nutrient deficiency: calcium, copper or boron
Younger (upper) leaves yellowing, chlorotic	pH problem
	nutrient deficiency: iron, sulfur, calcium, manganese, zinc or copper
Roots brown or dying	nutrient deficiency: phosphorus, iron, calcium, boron
	soil too wet: overwatered or poor drainage

Possible Cultural (Abiotic) Problems of Annuals, Perennials, Bulbs, and Groundcovers	
Problem	**Cause**
Whole plant	
Stems, branches: witch's broom	nutrient deficiency: boron or zinc
Stems, branches: new shoots die back	improper planting
Tall, lanky growth	too much shade for a normally compact, sun-loving plant
Significant leaf damage or no leaves	(includes bulbs) vertebrate pests such as voles, mice, squirrel, rabbit or deer
Short stems	(includes bulbs) plant sprouted too early in season and became stunted in cooler weather
Plant doesn't show up in spring	drought conditions the previous year, or exceptionally hard winter. In bulbs this could mean voles, mice or squirrels made a meal of it
Plants grow poorly or don't establish well; could die	accidental poisoning: herbicide spill or drift; oil spill; toxins in water run-off
	crown damaged by extreme winter cold and temperature swings
	improper planting
	nutrient deficiency: calcium
	too much mulch, causing water runoff and dry roots
	planted without preparing soil or root ball properly
	compacted soil; dying roots
	soil too wet; overwatering or poor drainage
	doesn't transplant well (deep taproot)—for example, foxglove
Flowers	
Plants flower earlier than normal	drought stress
	too much fertilizer
	nutrient deficiency: nitrogen
Plants flower poorly or not at all (blindness in bulbs)	drought stress
	nutrient deficiency: phosphorus, copper, boron
	no buds could mean overcrowding, poor soil, shallow planting, or foliage was removed too quickly the prior year
	soil too wet; poorly drained or overwatered
Flowers drop early	(includes bulbs) temperature swings
Flowers buds damaged	frost injury
Leaves	
Turn black, rot	frost destroyed cells when water froze and crystallized
Bleach or turn bronze	salt damage
Brown on top or one side of plant	plant lacks water during times of too much sun or heat—or plant isn't hardy enough
Become cupped, curling up or down	drought stress
	herbicide damage from accidental exposure or misuse
	nutrient deficiency: phosphorus, magnesium, potassium, boron, copper
All leaves—no blossoms	(bulbs) overcrowding; not enough sun
Die in late spring: outer leaves turn brown	frost destroyed cells when water froze and crystallized
Outer leaves turn brown; die	too much mulch causes water runoff, dry roots
Scorch (brown edges) throughout	drought or heat stress

IPM Solutions for Cultural (Abiotic) Problems of Annuals, Perennials, Bulbs, and Groundcovers

Cultural problems arise from planting in the wrong site, improper care, or when elements beyond your control (drought or endless rain) can set up pest damage down the road. We address these cultural and abiotic conditions first.

Good drainage is critical against soil diseases. Consider raised beds in poorly drained sites, or choose plants that don't mind wet feet.

- Water early in the day, directing your hose at the base of plants. Or use drip irrigation. Don't overwater. Let leaves dry before working in the garden. This reduces the spread of disease.
- Track disease and insect damage in your garden journal.
- Seek disease-resistant species and cultivars.
- Don't trim back dying foliage of bulbs or spring plants—let them finish their jobs. Remove when completely dried.
- Inspect transplants for signs of disease before you buy them.
- Transplant during cool, cloudy weather or provide shade to new transplants (and plants taken off a windowsill and moved outdoors).
- Check proper plant depths for bulbs, and set perennials in to match crown of plant at soil surface.
- Divide perennials and bulbs when they begin to crowd—verify which perennials can be divided!
- Rotate annual flowers, moving them to different spots in your garden each year—just as you would vegetables.
- Be careful not to damage plants—nicks and scrapes, whether on stems or roots, are an open door to plant disease. Use sharp pruners (dull blades can tear stems); wield your shovel carefully.
- Provide the best mix of sun or shade for your plants.
- Water young plants during drought.
- Give plants some elbowroom—prune or thin as needed for healthy air circulation.
- Know which plants are frost or heat tolerant.
- Most plants grow stronger if well nourished. Amend soil as needed with organic matter—compost, well-aged manure, etc, but don't over-fertilize.
- Watch for root damage from suspicious liquids, such as from a dumped 'car wash' bucket or male dogs coming around. Leaf damage may occur from prolonged exposure to car exhaust.
- Remove diseased stems, leaves, flowers, or berries right away. Be careful—moving an ailing plant could just spread diseases around. We'll suggest when professional diagnostic help is best considered.
- Since some pathogens overwinter in plant debris, remove it in the fall—especially if you've had problems in the past. This includes deadheading during the season. Leave some plant material where possible for overwintering beneficials. Compost diseased plant debris as far from the rest of your garden as possible, and do not spread this compost on your garden.
- Consider pesticides as a last resort. The right diagnosis is key to choosing the right pesticide. Seek help from your county's cooperative extension specialists.

Water in the morning, rather than the evening, to reduce conditions conducive to fungal disease. Photo: A.Davey, farm5.staticflickr.com/4423/36446923972_0cbebd0bde_o.jpg, CC BY-NC-ND 2.0

Three pollutants to watch for:

Peroxyacyl nitrate, aka PAN: Leaves, especially new growth, show white or bronze spots on undersides; these turn silver. Resembles sunscald, thrips, or mite damage. PAN occurs when car exhaust and industrial smog meets sunlight. Typical where smog alerts are common.

Sulfur dioxide: Leaves become yellow or bleached-looking with white or tan streaks.

Ozone: Shows as speckles scattered over upper leaves; undersides sometimes silvery.

Monarda is susceptible to powdery mildew. The risk rises in shady areas or where overcrowding reduces air flow. Photo: eXtension.org: Gardens, Lawns and Landscapes, c2.staticflickr.com/4/3132/2863635283_7412092d2e_b.jpg, CC BY-NC-SA 2.0

Shade Lovers

Many plants tolerate some shade, but only a few annuals and tender perennials really thrive in it. Most true annuals require sun, since they need lots of energy to flower and set seed all season long. But these special plants say, "More shade please!"

Flowering plants: *Begonia* (wax and tuberous types), *Impatiens*, Wishbone flower/*Torenia*

Foliage plants: *Caladium*, *Senecio* (German ivy), and a few *Coleus*

If these plants are failing where they are, try giving them more shade.

Air Pollution

Vulnerable plants: Petunia, dahlia, tulip, violet

What it looks like: Leaves collapse, roll, or wither; become papery or brittle; spotted, streaked, or discolored. Stunted growth.

IPM solutions: Fencing or hedges may filter some pollution from highways or industry. But if high ozone is your problem, find plants that don't show symptoms and stick to them. Tolerant plants include California poppy, columbine/aquilegia, coral bells/heuchera, and lily.

Crowded Conditions, Poor Air Circulation

Vulnerable plants: Beebalm/monarda, hollyhock, lungwort/pulmonaria, phlox, rose.

What it looks like: Plant diseases are a major clue. Powdery mildew, rust, leaf spots—these and other diseases thrive where plants are crowded and the air is still.

IPM solutions: Thin out crowded plants. Prune nearby trees and shrubs. Replace fences that block the breeze with those that don't. Place vulnerable plants in sites that are in the open and have a breeze.

Damage While Pruning, Cultivating, Transplanting

Vulnerable plants: Delphinium, foxglove/digitalis, gas plant/dictamnus, lupine: all have deep taproots and don't transplant well—even as seedlings. Any stressed plant tolerates injury poorly.

What it looks like: Plants fail to thrive; roots or stems become diseased. Few flowers or small flowers.

IPM solutions: Cultivate carefully to keep from injuring plants when caring for nearby lawn, shrubs, or trees. Dig bulbs and divide plants carefully. Keep pruners sharp; don't break or snap stems. Prune at the right time so leaf and flower buds can grow right.

Drought, Heat Stress, Sunburn, Sunscald

Vulnerable plants: Astilbe, caladium, elephant's ear, fern, hosta, impatiens, ragwort/ligularia, Rodgersia, burnet/sanguisorba. Or any seedling or plants taken outside from inside a house or store, where light is less bright.

What it looks like: Leaf tips and edges, then whole leaves, wilt or look burnt. New leaves wilt first. If drought or heat continue, leaves brown and die. Flower buds or blossoms don't form or drop; flowers stay small; plant stops blooming. Plants with high moisture requirements are the first to suffer.

IPM solutions: Choose drought-tolerant plants. Water deeply (not daily) early in the day. Shade new or delicate plants with large pots, crates, or shade cloth during the hottest part of the day. Bring potted plants inside. Don't prune or thin in heat of summer.

Edema (Oedema)

Vulnerable plants: Begonia, ivy, geranium, sedum.

What it looks like: Leaves look blistered, especially on lower surface of leaves, when plants take up more moisture than they can lose. Worse during cloudy, humid or rainy spells when air is cool and soil is warm.

IPM solutions: Improve air circulation around plants to encourage quick drying. Don't pluck blistered leaves—plants need all their leaves to release moisture.

Fertilizer Excess

Vulnerable plants: Any if fertilized heavily or late in the season.

What it looks like: Stems become spindly and weak; break easily. Or lush, rank growth (too much nitrogen) attracts aphids, scales, mealybugs, leafhoppers, and more. Late in the season, new growth won't harden in time to endure harsh winter weather.

IPM solutions: Test your soil to find out what your plant's nutrient needs are; use fertilizers only as needed. As a rule of thumb, use compost liberally but fertilizer sparingly unless your plants have different requirements (or are container plants); choose slow-release fertilizers. Don't fertilize late in the season.

Frost or Ice Damage

Vulnerable plants: Container or basket annuals (typically fuschia, impatiens, sweet potato vine). Or any plant moved outdoors from house or greenhouse. Most seedlings (even hardy species) are vulnerable if suddenly frosted or frozen; their tender young tissue hasn't hardened off. And as autumn approaches, sudden freezes damage late-blooming plants.

What it looks like: Buds or leaves drop. Leaves blacken, wilt, and die. Stems break.

IPM solutions: Choose cold-hardy plants. Cover newly planted or sensitive plants when weather forecasts call for late spring or early fall frosts. Use oversized pots, crates, sheets draped over bamboo stakes, or row covers. Bring potted plants inside. Mulch well going into winter to protect roots from frost heave.

Good Soil is Foundational

Most plants thrive when well nourished (not over-nourished). Plan ahead: if your soil is poor; if whatever's growing there now isn't thriving, dig in organic matter or even renew the garden with cover crops and the like. You will be rewarded!

Annual flowers come from the nursery expecting a diet of fertilizer, and you'll have more flowers if you continue to supplement. But overfertilizing established perennials can lead to trouble. Test your garden soil. Aged compost is often the best choice for a perennial garden. Photo: Penn State University, Safe Earth: *The Downfall of Chemical Fertilizers.*

Spring frosts aren't surprises, but you may need to protect some of your garden plants later in the season. Photo: Zixii, c1.staticflickr.com/1/142/378172529_8e5c2554a8_b.jpg, CC BY-NC-SA 2.0)

A Rule of Thumb...

Try a plant in three sites. If it fails three times, choose a different plant!

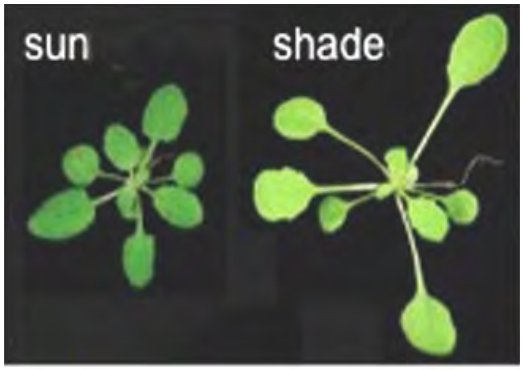
Herbicide drift on rose. Photo: University of Minnesota, www.extension.umn.edu/garden/diagnose/plant/annualperennial/roses/leavesmisshapen.html

Herbicide Drift or Burn

Vulnerable plants: Dahlia, petunia, tulip; many others.

What it looks like: Leaves suddenly look washed-out or scorched, or get irregular, discolored, or dead spots. Leaves die. Leaves curl, are distorted, twist, cup, and grow very irregular shapes. Leaves are thin or show random, off-colored spots. Often found on new growth, or along leaf veins. Twisted, curled flowers. Plants wilt or die. (Remember that herbicides are a type of pesticide.)

IPM solutions: If you must apply herbicides, do so on calm days—even a light breeze can disperse misty sprays where you don't want them. Read labels carefully. Know which plants you're targeting—and which to protect. Cover vulnerable plants with plastic while spraying. If herbicides drift in from neighboring yards, help neighbors understand how to use them correctly (and what the alternatives are).



Some plants remain alive but don't thrive when they don't receive the necessary hours of sunlight each day. Symptoms include lighter coloring and 'leggy' stems and shoots. Photo: Linda Chalker-Scott. Washington State University Puyallup Research and Extension Center, photobiology.info/Chalker-Scott.html

Not Enough Sun

Vulnerable plants: Many, including coneflower/echinacea, daisy, sunflower, gayfeather/liatris, black-eyed Susan/rudbeckia. Plants listed as "full sun" (six hours) do poorly in shade.

What it looks like: Plants are spindly, weak, floppy. Pale stems stretch toward light; bend easily. Few flowers—or none.

IPM solutions: Prune up or remove trees or fences that cast shade. Choose plants that like or tolerate shade. Cut back leggy plants and move to a sunnier site.

Iron deficiency is a common concern where soil pH is unbalanced. Here, on rose leaves, it's clear something isn't right! To find out, do a simple pH test on your soil. Photo: Government of Western Australia, www.agric.wa.gov.au/soil-ph-and-plant-health

Nutrient Deficiency

Typically in the northeast, soils are high in phosphorous, low in potassium, and sufficient in magnesium and sulfur. Iron, manganese and zinc can be inaccessible to plants if the soil pH is above 6.5. The value of pH can vary across the region depending on the parent rock—limestone areas tend to be basic/alkaline (high pH) while granite tends to be more acidic (low pH). Plants take hydrogen, carbon and oxygen from the air. They also need Cl (chlorine) and Ni (nickel). **See our chart, *Nutrient Deficiencies in Plants,* found in Chapter Two: Garden Basics.** Many nutrient problems are linked to soil pH, or soil texture.

Reverts to Parent Stock

Vulnerable plants: Bergenia, columbine, hosta, creeping phlox/moss phlox, many variegated cultivars.

What it looks like: Shape, leaves, or flowers look different in later seasons than they did the first year or so.

IPM solutions: Cut away unvariegated foliage or it will eventually take over. Where possible, follow green shoot to source and cut away entirely. In hostas, the source is the eye: gently carve it out of the crown. In roses, prune out shoots from below bud graft. Purchase cultivars known to reseed consistently. Our chart, *Nutrient Deficiencies in Plants,* can be found in Chapter Two.

Salt Drift or Accumulation

Vulnerable plants: Coneflower/echinacea, hosta, narcissus, rose—but most plants can be damaged.

What it looks like: Wilting, leaf scorch, color change. Dead spots on leaves; leaf edges and tips brown, especially on new leaves in spring. White crust at the soil level. If same plants show no damage when farther from the source—a road, driveway, or oceanfront—that's a strong clue.

IPM solutions: Keep vulnerable plants 50 to 100 feet from the road or shoreline. Look for salt-tolerance for roadside plantings—even if your town spreads sand, not salt. Policies could change! Use deicing products considered safer for plants, such as magnesium or calcium chloride, or a combination of deicers mixed with sand or kitty litter (granular, not sawdust blends). If you use sidewalk salt, try to shovel or plow snow piles away from sensitive plants. Water beds well in spring to help wash salt through the soil—it's the most vulnerable time for plants taking up moisture. Use fabric or solid (wooden or plastic) barriers to buffer salt spray, but don't let material touch plants. Don't wrap burlap around vulnerable plants.

Soil pH Extremes

Vulnerable plants: see callout box at right.

What it looks like: If soil is too acid (low pH) or too alkaline (high pH), plants can't take up certain nutrients. Iron deficiency is common among acid-requiring plants; note yellow or discolored leaf tissue between the veins. Other symptoms: plants sulk, growing poorly and failing to thrive. Leaves turn brown, yellow, or purple, or tips and edges look burnt.

IPM solutions: Test soil pH. Buy a kit at a garden center or call your county's Cooperative Extension office for information on getting your soil tested. Choose plants suited to your soil's natural pH. Follow directions based on test results. Sulfur lowers pH; lime raises it.

Cool beauties

Some annuals are cool beauties. Fuchsia, Marguerite daisy, nemesia, nigella and Swan River daisy just won't flower well when summer heat comes on strong. Plant them in organic-rich soil or the best potting mixture to retain moisture and water well to make their flowers last as long as possible.

Mix a few handfuls of soil from a particular area before testing for pH. Photo: Virginia Polytechnic Institute and State University, pubs.ext.vt.edu/452/452-129/452-129.html

Plants that prefer acidic soil (pH less than 7):

Hydrangea, Pachysandra, Begonia, Trillium, Azalea, Rhododendron, Fothergilla, Japanese iris

Plants that prefer alkaline soil (pH higher than 7):

Big leaf *Hydrangea,* Russian sage, lavender, thyme, *Achillea,* lilac, *Phlox, Salvia,* coneflower, daylily

Toughing Out Walnut Wilt

These plants seem to tolerate the juglone in walnut roots: ajuga, astilbe, beebalm, bellflower, bleeding heart, cranesbill, crocus, daylily, ferns, hollyhock, hosta, iris, Jacob's ladder/ polemonium, lungwort/pulmonaria, mums, pansy, phlox, primrose, stonecrop/sedum, spiderwort/ tradescantia, sweet woodruff.

Walnut Wilt

Vulnerable plants: Blue false indigo/baptisia, columbine, daffodil (some), lily, peony, petunia.

What it looks like: Plant doesn't thrive—and a black walnut tree is nearby. A chemical put out by black walnut roots, juglone, stunts or kills some plants. Plants often die quickly, within a few days of planting.

IPM solutions: Don't put susceptible plants nearby—juglone's effect is worse near the drip line. The toxic root zone is typically within 50 to 60 feet from the trunk of a mature tree. Pull out volunteer seedlings. Try shallow-rooted plants, since most walnut roots tend to grow deep. Use raised beds. Avoid mulch or compost made from black walnut chips; juglone remains in the woody parts. Cutting down the tree won't help, as decomposing roots stay toxic. Choose tolerant plants.

Wet Soil, Poor Drainage

Vulnerable plants: Beardtongue/penstemon, black-eyed Susan/ rudbeckia, coneflower/echinacea, coral bells/heuchera, daisy/ leucanthemum, gayfeather/liatris, lavender, salvia, many others.

Salt Tolerant Plants		
Maiden grass *Miscanthus sinensis*	Muhly grass *Muhlenbergia capillaris*	Panicum grass *Panicum amarum*
Panic grass *Panicum virgatum*	Little Bluestem *Schizachyrium scoparium*	Sand Cordgrass *Spartina bakeri*
Fountain Grass *Pennisetum alopecuriodes* (can be aggressive)	Lyme Grass *Leymus arenarius* (can be aggressive)	Daylily *Hemerocallis* spp./hybrids
Yarrow *Achillea*	Prickly Pear Cactus *Opuntia*	Seaside Goldenrod *Solidago sempervirens*
Butterfly weed *Asclepias tuberosa*	Lily of the Nile *Agapanthus*	Sea Thrift *Armeria*
Hens and chicks *Sempervirens tectorum*	Blanket flower *Gaillardia*	Candytuft *Iberis sempervirens*
Sea Holly *Eryngium planum*	Woody Aster *Xylrhiza glabriuscula*	Barren strawberry *Waldsteinia*
Lenten Rose *Helleborus*	Pinks *Dianthus*	Russian Sage *Perovskia*
Stone crop/ Autumn Joy *Sedum telephium*	Coral bells *Heuchera*	Evening primrose *Oenothera biennis*
Prairie mallow *Sildacea*		

What it looks like: Soil drains poorly after rain; stems are weak and too tall or long. Watch for rot diseases in the crown area. Water fills air spaces in soil; lacking oxygen, roots can't take up water—some symptoms resemble drought stress.

IPM solutions: Dig in lots of compost or organic matter. Plant in raised beds. Water sparingly. Choose plants that prefer constant moisture or even boggy soil: astilbe, ligularia, lobelia, primrose, rodgersia, sanguisorba.

Wind, Hail, Heavy Rain

Vulnerable plants: Any with thin or delicate stem, leaf, or flower tissue, or plants emerging just as a storm blows in—hosta in particular.

What it looks like: Buds drop. Stems and branches snap or split. Leaves rip or look tattered. Plants blow over.

IPM solutions: Your plants will grow stronger and hold up better against this type of damage if you take out competing plants, improve soil, and provide the appropriate amount of sun. Pinch plants early in season to develop thick stems. Bring potted plants inside. If the forecast calls for hail, cover vulnerable plants such as emerging hostas with sheets, plastic, or baskets.

Summing up ...

If your site is right and you've met your plant's needs but your plant still has a serious problem, seek professional help.

Drain Well—or Else!

Begonia, blanket flower/gaillardia, blue marguerite/Felicia, Gerbera daisy, helichrysum (strawflower, curry, or licorice plant), Madagascar periwinkle/catharanthus, Swan River daisy/brachycome—all could rot and die if their roots become waterlogged. Water in the morning. Let them dry out before you water again. Lighten up heavy soil and provide good drainage. If container-grown, use light potting mixes, not garden soil.

The mystery pest on this hosta was hail. Photo: Kyle Daniel via Purdue University Extension, ag.purdue.edu/hla/extension/nle/pages/weekly-thoughts.aspx

Plants That May Cause Skin Irritation	
Common Name	**Genus**
spurge	*Euphorbia*
daffodils, narcissus	*Narcissus*
buttercup	*Ranunculus*
cow parsnip	*Heracleum*
giant hogweed	*Heracleum*
wild parsnip	*Heracleum*
common rue	*Ruta*
gas plant	*Dictamnus*
stinging nettle	*Urtica*
monkshood	*Aconitum*
poison ivy	*Toxicodendron*
poison sumac (found only in swampy areas)	*Toxicodendron*

Read Up on Rashes

Got sensitive skin? Find out if that gorgeous new plant you're eying might give you a rash—or worse. If the answer is yes, wear gloves and long-sleeved shirts when you handle them. The annual plant, *Ammi majus* (Queen of Africa, bishop's weed, false Queen Anne's lace) is an example. To add to the problem, Bishop's weed is a common name for multiple plants, and *Ammi majus* looks like the very common Queen Anne's lace, *Daucus carota*! Know what you're handling before, rather than after you get that rash. The most dangerous of all? Giant hogweed. An impressive flowering weed with a very caustic sap!

Common Disease and Insect Problems of Annuals, Tender Perennials, and Non-Hardy Bulbs

Annuals don't need to tough it out year to year since you plant them fresh each spring. But providing the site that's right still makes the difference between a wow! garden and one that's not. You'll find tender perennials here too—plants that are perennials in warmer climes but we use them as annuals in the Northeast. If you're lucky, your tender perennials might return for a second year.

Common Disease and Insect Problems of Annuals, Tender Perennials, and Non-Hardy Bulbs		
Host	**Diseases**	**Insects, mites, slugs**
Ageratum; Flossflower	*Botrytis* gray mold, *Fusarium* root rot, powdery mildew, *Pythium* root rot, *Rhizoctonia* root rot	corn earworm, spider mite, tobacco budworm, whitefly
Alstromeria; Peruvian lily	Anthracnose leaf spot, INSV and mosaic viruses, *Pythium* root rot, Southern blight	slugs
Alyssum; Sweet Alyssum; *Lobularia*	clubroot, damping off, downy mildew, *Rhizoctonia* crown rot	
Amaranth; *Amaranthus*		aphid
Amaryllis		bulb fly
Angelica		slugs
Baby's Breath; *Gypsophila*	aster yellows, bacterial crown gall, *Botrytis* gray mold, gray mold, *Phytophthora* root rot, *Rhizoctonia* stem rot, rust	leafhopper
Begonia; Wax Begonia; Tuberous Begonia	bacterial leaf spot, *Botrytis* blight, foliar nematodes, powdery mildew, *Pythium* root/stem rot, tobacco ring-spot virus(TRSV), tomato spotted wilt virus(TSWV), *Xanthomonas* leaf spot	mealybug , thrips
Blanket Flower; *Gaillardia*; Blanketflower	aster yellows, *Pythium* root rot, *Rhizoctonia* root rot, white smut	four-lined plant bug
Bloodflower; *Asclepias*		aphids
Blue Marguerite; *Felicia*	*Botrytis* gray mold	aphids
Caladium	*Fusarium* root rot, *Pythium* root rot, *Xanthomonas* leaf spot	aphids
Calendula; Pot Marigold	*Cercospora* leaf spot, powdery mildew, *Sclerotinia* stem rot	blister beetle, thrips, slugs, aphid, tarnished plant bug
Canna (bulb)	rust, viruses including: BYMV, CaMV, CaYSV	Japanese beetle, corn earworm, leafhopper, spotted cucumber beetle

Common Disease and Insect Problems of Annuals, Tender Perennials, and Non-Hardy Bulbs		
Host	**Diseases**	**Insects, mites, slugs**
China aster; C*allistephus*	aster yellows, *Fusarium* wilt, *Rhizoctonia* root rot	aster leafhopper, aphids, spider mite
Cleome		harlequin bug, spider mite, aphids
Cineraria; Senecio	*Fusarium* wilt	aphids, cutworm
Cockscomb; *Celosia*	*Botrytis* gray mold, *Pythium* root or stem rot, root knot nematodes	spider mite
Coleus	downy mildew	mealybug, cyclamen mite
Cosmos	*Botrytis* gray mold, powdery mildew, white smut	European corn borer, spotted cucumber beetle, four-lined plant bug, aphids
Cupflower; *Nierembergia*	powdery mildew, tobacco mosaic virus (TMV)	slugs, thrips, two spotted spider mite
Dahlia (bulb)	bacterial stem rot (*Erwinia*), bacterial wilt, *Rhizoctonia* stem rot, *Verticillium* wilt, *Botrytis* blight, crown gall, CMV (cucumber mosaic virus (CMV), other virus: DMV, TSWV, powdery mildew, white smut, nematodes	aphids, spider mite, cutworm, blister beetle, corn earworm, European corn borer, four-lined plant bug, Japanese beetle, potato leafhopper, rose chafer beetle
Dusty Miller; *Senecio*	aster yellows, *Fusarium* stem rot, *Phytophthora* root rot, Southern blight	aphids
Elephant's Ear; *Taro; Colcasia*	*Phytophthora* root and stem rot, *Phytophthora* leaf blight	spider mites, (watch for voles as well)
Fairy Fan Flower; *Scaevola*		aphids, whitefliy
Forget-me-not; *Myosotis*	aster yellows, bacterial leaf spot, *Cercospora* leaf spot, powdery mildew, *Sclerotinia* stem and crown rot	aphids, flea beetle, Japanese beetle
Four o'clocks; *Mirabilis*		Japanese beetle
Fuschia	*Botrytis* gray mold, *Fuschia* rust, *Rhizoctonia* root rot	aphids
Geranium; Annual Geranium; *Pelargonium*; Zonal Geranium	*Alternaria* leaf spot, bacterial leaf spot, *Botrytis* gray mold, *Pelargonium* rust, *Pythium* root rot, *Xanthomonas* bacterial blight	aphids, budworm, corn earworm
Gerbera Daisy	*Alternaria* leaf spot, *Botrytis*, *Phytophthora* root rot, powdery mildew, *Pythium* root rot	aphids, leafminer, thrips
Gladiolus (bulb)	dry rot, *Fusarium* wilt, *Gladiolus* corm rot	aphids, bulb mites, corn earworm, European corn borer, *Gladiolus* thrips
Globeflower; *Gomphrena*	*Alternaria* leaf spot	aphids
Hyssop; Anise Hyssop; *Agastache*	powdery mildew	leafhopper
Impatiens	*Alternaria* leaf spot, *Botrytis* gray mold, damping off, *impatiens* necrotic spot virus (INSV), *Phytophthora* root rot, *Rhizoctonia* stem rot, tobacco ringspot virus (TRSV), tomato spotted wilt virus (TSWV), *Verticillium* wilt	aphids, spider mite, tarnished plant bug, thrips

Common Disease and Insect Problems of Annuals, Tender Perennials, and Non-Hardy Bulbs		
Host	**Diseases**	**Insects, mites, slugs**
Lantana		aphid, whitefly
Larkspur; *Consolida*	*Diaporthe* blight, powdery mildew, *Pseudomonas* leaf spot, *Pythium* root rot or stem rot, *Rhizoctonia* root or stem rot	leafminer
Lobelia; Annual Lobelia	*Botrytis* leaf spot, *Pythium* root rot	slugs
Marguerite Daisy; *Argyranthemum*	powdery mildew	aphids
Marigold; *Tagetes*	*Alternaria* leaf spot, aster yellows, *Botrytis* gray mold, *Fusarium* wilt	Japanese beetle, slugs, spider mite
Melampodium	powdery mildew	aphids, whitefly
Mexican Sunflower; *Tithonia*		Japanese beetle
Million Bells; *Calibrachoa*	*Phytophthora* root rot, *Pythium* root rot, root knot nematodes	aphids, budworm
Nasturtium; *Tropaeolum*	*Pseudomonas* bacterial wilt	aphids, cabbage looper, spider mite, serpentine leaf miner, tarnished plant bug
Nemesia	*Botrytis* gray mold, impatiens necrotic spot virus (INSV)	
Nicotiana; Flowering Tobacco	mosaic viruses such as TMV, *Pythium* root rot, *Rhizoctonia* root rot	aphids, cutworm, flea beetle, tobacco hornworm
Ornamental Kale; Ornamental Cabbage	*Alternaria* leaf spot, downy mildew, *Phoma* black rot, *Rhizoctonia* root or stem rot	aphid, cabbage worm, flea beetle
Pansy; *Viola*; Violet	Anthracnose, *Botrytis* leaf spot, downy mildew, *Thielaviopsis* and other root rots	aphids, slugs, spider mite
Paper Daisy; *Rhodanthe*		slugs, snails
Paper Daisy; *Bracteantha*; Strawflower	downy mildew	
Perilla; Beefsteak Plant	downy mildew	aphids, Japanese beetle
Periwinkle (annual vinca); Madagascar Periwinkle; Flowering Vinca; *Catharanthus*	*Alternaria* leaf spot, aster yellows, *Botrytis* leaf blight, *Phytophthora* root rot, *Verticillium* wilt	slugs
Petunia	*Botrytis* blight, *Phytophthora* late blight, powdery mildew, *Pythium* root rot, root knot nematodes, *Sclerotinia* stem rot. Many viruses including: TMV, INSV, TSWV	aphids, budworm, cutworm, flea beetle, spider mite, slugs, tomato hornworm
Pinks; *Dianthus*; Carnation	*Alternaria* leaf spot, bacterial wilt (*Erwinia*)	beet armyworm, two-spotted spider mite
Plectranthus; Indian Borage; Mexican Mint	impatiens necrotic spot virus (INSV), *Pythium* root rot, *Rhizoctonia* root rot, *Sclerotinia* blight	thrips
Pocketbook plant; *Calceolaria*	*Botrytis*, *Impatiens* necrotic spot virus (INSV), tomato spotted wilt virus (TSWV), *Phytophthora* root rot	aphids, thrips

Common Disease and Insect Problems of Annuals, Tender Perennials, and Non-Hardy Bulbs		
Host	**Diseases**	**Insects, mites, slugs**
Poppy; Corn Poppy; Shirley Poppy; *Papaver*	*Botrytis* gray mold, downy mildew, powdery mildew, *Rhizoctonia* root rot, *Xanthomonas* bacterial leaf spot	aphids, leafhopper, four-lined plant bug
Portulaca; Moss Rose	*Rhizoctonia* root rot, ringspot virus	spider mites
Rose Mallow; *Lavatera*	hollyhock rust (*Puccinia*)	Japanese beetle
Salvia	*Alternaria* leaf spot, powdery mildew, *Rhizoctonia* stem rot or root rots	Japanese beetle, red spider mite, whitefly, aphids
Snapdragon; *Antirrhinum*	*Botrytis* gray mold, downy mildew, powdery mildew, *Pythium* root rot, *Rhizoctonia* root and stem rot, rust	aphids, budworm and other caterpillars, spider mite
Statice; *Limonium*	*Pseudomonas* bacterial rot, *Rhizoctonia* root rot	
Stocks; *Matthiola*	downy mildew, *Xanthomonas* bacterial blight	aphids, flea beetle
Strawflower; *Helichrysum*	*Fusarium* root rot, *Verticillium* wilt	aphids, flea beetle
Sunflower; *Helianthus*	*Botrytis* gray mold, powdery mildew	various caterpillars
Swan River Daisy; *Brachycome*		aphids, slugs
Sweet pea; *Lathyrus*	mosaic viruses, powdery mildew, *Thielaviopsis* root rot	aphids, leafminer, thrips
Sweet Potato Vine; *Ipomoea*	Southern blight	aphids, flea beetle, leafminer
Verbena; Vervain	*Botrytis* gray mold, powdery mildew, ringspot viruses	aphids, leafminer, lygus plant bug, two-spotted spider mite, thrips
Wallflower; *Erysium*	clubroot, downy mildew	flea beetle, slugs
Wishbone Flower; *Torenia*; Mexican Sunflower	*Botrytis* gray mold, impatiens virus (INSV), powdery mildew	aphids, whitefly
Zinnia	*Alternaria* leaf spot, aster yellows, curly top virus & others, powdery mildew, *Xanthomonas* leaf spot	Japanese beetle, spider mite

Tender and Hardy Bulbs

Tender Bulbs: In the northeast, these bulbs generally need to be removed in fall and protected in cool, dry temperatures over the winter: gladiolus, dahlia, canna, tuberous begonia, calla, elephant ear, ranunculus.

Hardy Bulbs: With occasional feeding and good, well-draining soil, you won't have to remove and replant tulip, daffodil, narcissus, crocus, lily, hyacinth and allium. Plant once and enjoy!

Common Disease and Insect Problems of Perennials, Biennials, Hardy Bulbs, and Groundcovers

Nurseries carry thousands of perennials and biennials from all over the world, and their needs vary greatly. Because you plan to grow them for several years, they need a carefully selected, thoroughly prepared site even more than annuals do. (Biennials usually live only two years, but if they drop seeds, they may continue for years in the same spot.) One plant could get leaf spots in a crowded part of your garden but thrive in a less-crowded place where breezes waft through. Another could suffer during a dry summer but flourish in a wet year. If the plant doesn't thrive, try moving it in spring or fall. Give it a year or so to find out what it can do for you, and enjoy the experiment.

Common Disease and Insect Problems of Perennials, Biennials, Hardy Bulbs, and Groundcovers

Host	Diseases	Insects, Mites, Slugs
Ajuga; Bugleweed	Southern blight (*Sclerotinia* crown rot)	aphids
Anemone; Japanese anemone	downy mildew, foliar nematodes, powdery mildew, rust, *Septoria* leaf spot	black blister beetle, flea beetle, Japanese beetle
Aster	aster yellows, *Botrytis* blight, *Fusarium* blight, powdery mildew, rust, *Septoria* leaf spot	Japanese beetle, lacebug, leafhopper, slugs
Astilbe; False Spirea	foliar nematodes, *Fusarium* wilt, powdery mildew, *Rhizoctonia* root rot, root knot nematodes, Southern blight	aphids, Japanese beetle, leafhopper, slugs
Avens; *Geum*	downy mildew	
Baby's Breath; *Gypsophila*	aster yellows, *Botrytis*, *Erwinia* crown galls, *Sclerotinia* crown rot, Southern blight	leafhopper
Bachelor's Button; *Centaurea*	downy mildew, *Fusarium* wilt, *Phytophthora* stem rot, powdery mildew, rust	aphids
Balloon Flower; *Platycodon*	*Rhizoctonia* crown and root rots	slugs, snails
Beardtongue; *Penstemon*	*Cercospora* leaf spot, CMV and other viruses, *Phytophthora* root rot, powdery mildew, *Septoria* leaf spot, rust	aphids, Japanese beetle, rose chafer beetle
Bear's Breeches; *Acanthus*	powdery mildew, *Pseudomonas* leaf spot	aphids, slugs
Bee Balm; *Monarda*	*Cercospora* leaf spot, INSV, powdery mildew, rust	aphids, mites
Bellflower; *Campanula*	*Septoria* leaf spot, INSV, aster yellows, *Fusarium* crown rot, rusts, southern blight, powdery mildew	aphids, thrips, two-spotted spider mite
Black-eyed Susan; *Rudbeckia*	aster yellows, downy mildew, powdery mildew, *Pseudomonas* leaf spot, *Septoria* leaf spot, Southern blight, *Verticillium* wilt, white smut, *Xanthomonas* leaf spot	aphids, four-lined plant bug, slugs, snails, tarnished plant bug
Blanket Flower; *Gaillardia*	aster yellows, powdery mildew, *Pythium* root rot, *Rhizoctonia* leaf spot, *Septoria* leaf spot, white smut	aphids, leafhopper

Common Disease and Insect Problems of Perennials, Biennials, Hardy Bulbs, and Groundcovers		
Host	**Diseases**	**Insects, mites, slugs**
Bleeding Heart; *Dicentra*	*Fusarium* wilt, *Thielaviopsis* root rot	slugs
Blue False Indigo; *Baptisia*		blister beetle
Brunnera; Bugloss	foliar nematodes	
Bugbane; Black Cohosh; Snakeroot; *Cimicifuga*	*Ascochyta* leaf spot, CMV, root knot nematodes	slugs
Butterfly Weed; Milkweed; *Asclepias*	*Cercospora* leaf spot, CMV	aphids, milkweed bug, *monarch larvae
Candytuft; *Iberis*	downy mildew	
Cardinal Flower; *Lobelia*	rust, *Septoria* leaf spot	slugs
Catmint; Catnip; *Nepeta*	*Ascochyta* leaf spot, *Fusarium* wilt, powdery mildew	
Chrysanthemum; Mum	foliar nematodes, *Fusarium* wilt, INSV, *Rhizoctonia* stem canker, rust, *Septoria* leaf spot, powdery mildew, *Pseudomonas* leaf spot, TMV, TSWV	aphids, cabbage looper, cabbage worm, European corn borer, leafminer, slugs, two spotted spider mite
Clematis	aster yellows, *Phytophthora* leaf spot, *Septoria* leaf spot, ToRSV	
Columbine; *Aquilegia*	powdery mildew, *Septoria* leaf spot, Southern blight	leafminer, slugs
Coneflower; Purple Coneflower; *Echinacea*	*Alternaria* leaf spot, aster yellows, *Phytophthora* root rot, *Sclerotium* root rot, *Septoria* leaf spot, white smut	aphids, Japanese beetle, spider mite, stalk borer
Coral Bells; *Heuchera*	*Botrytis* gray mold, *Cercospora* leaf blight, downy mildew, *Phytophthora* root rot, powdery mildew, *Rhizoctonia* root rot, rust	black vine weevil
Corydalis	*Sclerotinia* crown rot	black vine weevil
Cranesbill; Fragrant Geranium	*Botrytis* gray mold, *Cercospora* leaf blight, downy mildew, foliar nematode, *Pseudomonas* leaf spot, powdery mildew, root knot nematode, *Xanthomonas* leaf blight	aphids, cyclamen mite, four-lined leaf bug, slugs
Crocus (bulb)	dry rot, *Fusarium* wilt, *Gladiolus* corm rot	aphids, bulb mites
Culver's Root; *Veronicastrum*	downy mildew, powdery mildew, *Septoria* leaf spot	aphids, Japanese beetle, lygus bug
Daffodil; *Narcissus*	basal rot, *Sclerotinia* crown rot, fire scorch, leaf scorch, nematodes, some viruses	bulb mite, *Narcissus* bulb fly, slugs, snails
Daylily; *Hemerocallis*	daylily rust, daylily leaf streak/ *Aureobasidium* leaf streak, root knot nematodes	aphids, blister beetle, daylily leaf miner, spider mite, thrips
Dead Nettle; *Lamium*	downy mildew	
Delphinium; Larkspur	aster yellows, bacterial leaf spot, CMV and other viruses, *Diaporthe* blight, *Fusarium* wilt, powdery mildew, root knot nematodes, *Sclerotinium* crown rot	aphids, cutworm, cyclamen mite
Fern, many spp	*Pythium* root rot	aphids, mealybug, scale
Flax	rust, *Fusarium* wilt	
Foxglove; *Digitalis*	Anthracnose, curly top virus, *Fusarium* fungal leaf spot, *Fusarium* wilt, Phytophora root rot, powdery mildew, Southern blight, TMV, *Verticillium* wilt	aphids, Japanese beetle, mealybug, slugs

Common Disease and Insect Problems of Perennials, Biennials, Hardy Bulbs, and Groundcovers		
Host	**Diseases**	**Insects, mites, slugs**
Fritillaria (bulb)		lily leaf beetle
Gasplant; *Dictamnus*	*Phoma* leaf spot	
Gaura; Whirling Butterflies	*Cercospora* leaf spot, powdery mildew, rust, *Septoria* leaf spot. Susceptible to root rots in wet soil	aphids, flea beetle, leaf miner
Gayfeather; *Liatris*	powdery mildew, rust, *Septoria* leaf spot, *Verticillium* wilt	flea beetle
Gentian	*Botrytis* blight, *Cercospora* leaf spot, rust	four-lined plant bug
Globe Thistle; *Echinops*	*Phytophthora* root rot, powdery mildew	
Goldenrod; *Solidago*	*Ascochyta* leaf spot, powdery mildew, rust, *Xanthomonas* leaf spot	gall fly
Hellebore: Christmas Rose; Lenten Rose	black death virus (*Helleborus* net necrosis virus)	aphids, black vine weevil
Hens and Chicks; *Sempervivum*		mealybug
Hollyhock; *Alcea*	Anthracnose, hollyhock rust	Japanese beetle, leafhopper, rose chafer, spider mite
Hosta	*Alternaria* leaf spot, Anthracnose, bacterial soft spot (*Erwinia*), *Cercospora* leaf spot, *Fusarium* root rot, Hosta Virus X and other viruses, *Phyllosticta* leaf spot, *Phytophthora* root rot, root knot nematodes, *Sclerotinia* root rot	cutworm, Oriental beetle, slugs,
Hyacinth (bulb)	bacterial soft rot, root knot nematodes, white mold, yellow rot (*Xanthomonas*)	bulb mite, narcissus bulb fly
Hyssop; *Agastache*	downy mildew	
Ice Plant; *Delosperma*	downy mildew	
Iris	bacterial soft rot *(Erwinia), Botrytis* leaf spot/gray mold, rusts, white mold, *Didymella* leaf spot, ringspot virus, Southern blight, *Xanthomonas* leaf spot	aphids, blister beetle, bulb mite, iris borer, lesser bulb fly, rose chafer beetle, slugs, thrips
Ivy; English Ivy	*Colletotrichum* leaf spot, *Xanthomonas* leaf spot	aphids, scale, spider mite
Lady's Mantle; *Alchemilla*	root rots online in consistently wet soil	four-lined plant bug
Lamb's Ear; *Stachys*	powdery mildew, root knot nematodes, *Septoria* leaf spot	spider mite, slugs
Lavender	*Phytophthora* root rot, *Rhizoctonia* root rot, *Septoria* leaf spot	four-lined plant bug
Lily; Asiatic Lily; Oriental Lily	basal bulb rot, *Botrytis* leaf spot, *Phytophthora* root rot, many viruses including CMV, LSV	bulb mite, lily leaf beetle, narcissus bulb fly
Lily of the Valley; *Convallaria*	Anthracnose, Southern blight	black vine weevil
Lily Turf; *Liriope*	Anthracnose, *Fusarium* root and crown rot, *Phytophthora* root rot, *Rhizoctonia* root rot, Southern blight	
Lungwort; *Pulmonaria*; Jerusalem Sage	root knot nematodes, Southern blight, tomato ringspot virus (ToRSV)	slugs
Lupine; Bluebonnet		aphids, blister beetle, four-lined plant bug, slugs

Common Disease and Insect Problems of Perennials, Biennials, Hardy Bulbs, and Groundcovers		
Host	**Diseases**	**Insects, mites, slugs**
Meadow Rue; *Thalictrum*	powdery mildew, ringspot virus, rust	aphids, leafminer
Meadowsweet; *Filipendula*	powdery mildew	
Monkshood; *Aconitum*	downy mildew, *Verticillium* wilt, *Pseudomonas* bacterial leaf spot, rust	four-lined plant bug, leafminer, two-spotted spider mite
Mullein; *Verbascum*	*Phoma* leaf spot, powdery mildew	mullein plant bug, western flower thrips
Musk Mallow; *Malva*	foliar nematodes, INSV, *Pythium* root rot, *Rhizoctonia* root rot, rust, stem canker	Japanese beetle, leaf hopper
Myrtle; *Vinca*: Woody Vinca	*Phoma* stem blight/dieback, *Botrytis* gray mold	scale
Obedient Plant; *Physostegia*	rust, Southern blight	
Ornamental Strawberry	*Cercospora* leaf spot, foliar nematodes, *Phytophthora* root rot, powdery mildew, *Rhizoctonia*, *Verticillium* wilt	strawberry mite
Pachysandra; Japanese pachysandra; Japanese Spurge	*Volutella* stem blight	
Pansy; *Viola*	*Ascochyta* leaf spot, aster yellows, *Botrytis* gray mold, *Cercospora* leaf spot, rust, *Sclerotinia* rot, *Thielaviopsis*	
Pasque Flower; *Pulsatilla*	root rots in wet soil	
Peony	*Botrytis* gray mold, *Phytophthora* root rot, powdery mildew, Southern blight	blister beetle, scale, stalk borer
Phlox; Tall Phlox; Moss Phlox; Creeping Phlox	*Ascochyta* leaf spot, aster yellows, powdery mildew, ringspot virus, *Sclerotinia* white mold, *Septoria* leaf spot, Southern blight, *Thielaviopsis* root rot	four-lined plant bug, Japanese beetle, Oriental beetle, phlox plant bug, tarnished plant bug, two-spotted spider mite
Pigsqueak; *Bergenia*	Anthracnose leaf spot, foliar nematodes	black vine weevil, slugs
Pincushion; *Scabiosa*	Anthracnose leaf spot, *Phytophthora* stem rot and root rot, powdery mildew	spider mite
Pinks; *Dianthus*	*Alternaria* leaf spot, bacterial wilt (*Erwinia*), *Botrytis* blight, *Fusarium* wilt, multiple viruses, *Pseudomonas* blight, *Rhizoctonia* stem rot	aphids, cutworms, slugs, two-spotted spider mite
Poppy; Icelandic Poppy	*Cercospora* leaf spot, downy mildew, *Pythium* root rot, root knot nematodes, *Verticillium* wilt, *Xanthomonas* leaf spot	aphids, aster leafhopper, four-lined plant bug, rose chafer beetle
Prickly Pear; *Opuntia*	root rots in wet soil	mealybug
Primrose; English Primrose	aster yellows, *Botrytis* gray mold, *Phytophthora* root rot, *Pseudomonas*, *Rhizoctonia* root rot	black vine weevil
Ragwort; *Ligularia*	foliar nematodes, *Phytophthora* root rot, root knot nematodes	Japanese beetle, leafhopper, leafminer, slugs
Red Hot Poker; Torch Lily; *Kniphofia*	*Sclerotinia* crown rot	two-spotted spider mite
Rodgersia		slugs
Rose	black spot (*Diplocarpon*), *Botrytis* blight, *Cercospora* leaf spot, crown gall, downy mildew, powdery mildew, stem canker, rust, rose mosaic virus	aphids, fall webworm, gall wasp, Japanese beetle, Oriental beetle, potato leafhopper, rose chafer beetle, rose curculio, rose midge, rose scale, rose slugs, spider mite, thrips

Common Disease and Insect Problems of Perennials, Biennials, Hardy Bulbs, and Groundcovers		
Host	**Diseases**	**Insects, mites, slugs**
Rose Campion; Silene; Maltese Cross; *Lychnis*		slugs
Rose Mallow; Hardy Hibiscus	*Botrytis* gray mold, *Pseudomonas* leaf spot, *Rhizoctonia* web blight, rust,	flea beetle, Japanese beetle, two spotted spider mite
Russian Sage; *Perovskia*	susceptible to fungal root, stem, and crown rots in wet ground	
Salvia; Flowering Sage	*Alternaria* leaf spot, aster yellows	aphids, grape leafhopper, two-spotted spider mite
Sea Kale; *Crambe*; Colewort	*Alternaria* blight	flea beetle
Sea Thrift; *Armeria*	root rots in wet soil	spider mite
Sedum; Stonecrop	*Phytophthora* blight, powdery mildew, *Rhizoctonia* stem rot, root knot nematodes, Southern blight	aphids
Shasta daisy: *Leucanthemum*	*Botrytis* gray mold, powdery mildew, *Septoria* leaf spot,	aphid, four-lined plant bug, rose chafer beetle, thrips
Sneezeweed; *Helenium*	powdery mildew	
Snowdrops (bulb)	narcissus leaf scorch	narcissus bulb fly
Speedwell; *Veronica*	*Septoria* leaf spot, downy mildew, powdery mildew, rust	borer, leafminer
Spiderwort; *Tradescantia*	rust	
Spurge; *Euphorbia*	*Phytophthora* root rot	aphids
St John's Wort; *Hypericum*	Anthracnose, *Cercospora* leaf spots, powdery mildew	
Sundrops; Evening Primrose; *Oenothera*	*Alternaria* leaf spots	aphids, flea beetle
Sunflower; *Helianthus*; Perennial Sunflower	*Botrytis* gray mold, *Pseudomonas* leaf spot, rust	aphids, cucumber beetle, leafhopper, lygus bug, spider mite
Tiarella; Foam Flower; Allegheny Foam Flower	*Phytophthora* root rot, bacterial leaf spot	slugs
Tickseed; *Coreopsis*	aster yellows, *Botrytis* rot, downy mildew, powdery mildew, *Rhizoctonia* crown rot, *Sclerotium* crown rot	aphids, aster leafhopper, four-lined plant bug, spotted cucumber beetle
Toad Lily; *Tricyrtis*	Anthracnose, CMV, foliar nematodes, INSV	slugs
Tulip	*Botrytis* blight/tulip fire, *Rhizoctonia* stem rot, Southern blight, bacterial soft rot	aphids, bulb mite, narcissus bulb fly, slugs, whitefly
Turtlehead; *Chelone*	powdery mildew, root knot nematode	slugs
Verbena	Anthracnose, *Botrytis* gray mold, *Cercospora* leaf spot, INSV, *Pseudomonas* leaf spot, powdery mildew, *Pythium* root rot	two-spotted spider mite
Vinca	Southern blight	
Yarrow; Achillea	botrytis gray mold, powdery mildew, rust	aphids, two-spotted spider mite

Vinca or Myrtle or Periwinkle?

Vinca is just one of the common names that confuses new gardeners. Annual vinca, *Catharanthus* spp., is also called Madagascar periwinkle or just periwinkle. *Vinca minor* is a perennial plant most often called creeping myrtle.

Focus on Roses

Roses—treasured plants, favorite cut flowers—are notoriously high-maintenance. IPM works in the rose garden too. Choosing the right cultivars and the right site, planting and tending them properly—these help keep your roses healthy, making them less vulnerable. Some basic care follows …

Choose the right site. Full sunlight—six hours per day—and well-drained soil of pH 6.0 to 6.5. Plenty of water. Dig lots of organic matter into the soil to hold water. Mulch well.

If your cultivars are borderline hardy, plant them where they'll be protected from the wind. But don't crowd them. Good air circulation helps prevent disease.

Nutrient-rich soil (compost is best). Or fertilize regularly but lightly until midsummer. Lush, over-fertilized growth attracts pests.

Choose the right time. Plant in late winter or spring when the soil is workable. Fall planting is great for many plants, giving them a head start over spring. With roses, trouble comes with unpredictable weather. Frosts and chilling soil could happen anytime from September through December. If planting roses in fall, be sure they are dormant and not bare-root. Mulch well for protection until spring.

Planting hybrids? Follow instructions that came with your rose on how deep to plant the bud union: the graft. If your winters are severe—in Zone 4, for example—you may be told to plant the bud union 2 inches below the soil surface. In milder zones, plant it at the surface.

Photo: Pixabay.

The Rose Chafer Trap

Put decaying fruit in an open jar. Add water so fruit is half-covered. Place under an infested plant to reduce captures of desirable moths and butterflies. Check the trap often. As beetles creep in, dump out and destroy.

Common Cultural and Abiotic Problems of Roses

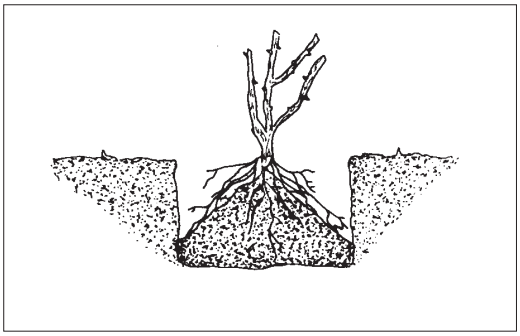
Problem	Cause
Canes blacken in fall	Early freeze
Flowers open only halfway	Cold nights
Inferior flowers; not what you bought	Shoots from rootstock

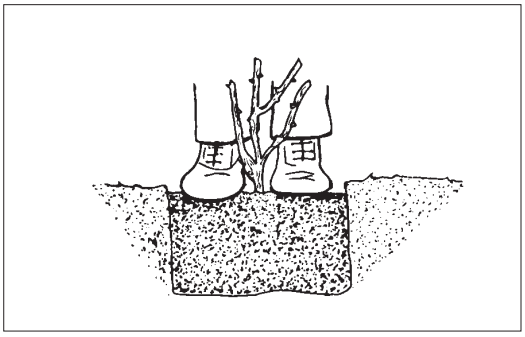
Common Disease and Insect Problems of Roses

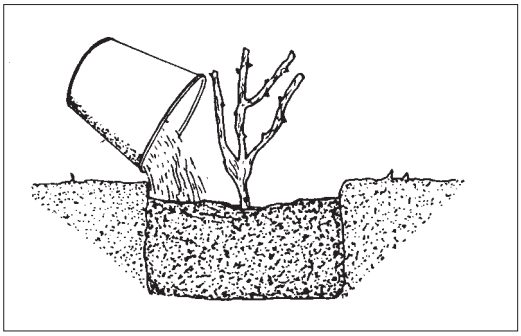
Diseases	Insects, Mites, and Slugs
Black spot	Aphids
Blight	Borers
Powdery mildew	Japanese beetle
Rust	Leafhopper
Sooty mold	Rose chafer beetle
	Rose curculio
	Rose midge
	Rose slug
	Spider mite
	Thrips

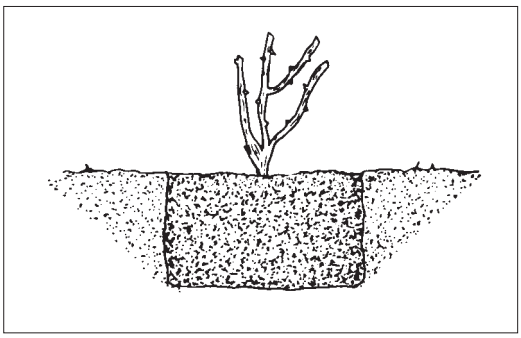
Cranesbill is an easy care companion to roses. Photo: Rhian vK, c2.staticflickr.com/4/3282/2599888559_e6774d9c2b_o.jpg, CC BY 2.0

Planting a Rose









Setting the plant crown at the correct level with the surrounding surface is vital to success. Fill in (use the soil from the hole you've dug and some matured compost), tamp down, water in. When the soil settles, top it up again. Photo: Division of Agricultural Sciences and Natural Resources, Oklahoma State University, Oklahoma Cooperative Extension Service, factsheets.okstate.edu/documents/hla-6403-roses-in-oklahoma/

In the Northeast,
old-time rose growers say:

Prune roses when the forsythia blooms.

Dig the hole three times as wide as the root ball and just deep enough to fit it. You want a solid foundation under the rose so it doesn't settle.

Backfill with the original soil or—if your soil is poor—soil amended with compost and some fertilizer.

Prune at the right time. Prune in the spring to remove dead wood down to the first living bud eye; a new shoot will emerge there. Since shoots grow in the direction the bud is pointing, cut to an outward-facing bud. Take out weak or damaged canes, or canes that rub against each other. And remove shoots that sprout straight from the ground—these could come from the root-stock below the graft, and you don't want that. Prune only after danger of frost has passed. Why? Pruning stimulates new growth, easily damaged by frost.

Fall is the time to remove long shoots that could whip around in the wind or break under heavy snows.

Exactly when to prune depends on your microclimate. Ask experienced gardeners or nursery owners, or find a rose forum online.

Give them friends. If you grow only roses, trust us—they'll be more prone to pests. Blur the signals with mixed plantings.

Prepare for winter. Where winters are typically mild, simply clean up foliage and damaged canes, cut back over-long canes, and mulch. But if temperatures often fall below zero or rise and fall in fits and starts, you need to do more. Before the ground freezes, mound some mulch or loose soil (borrow it from someplace other than your rose's root zone) at least 8 inches over the crown. Some growers cut canes by half and tie them together with twine before mounding with mulch.) Just don't use plastic twine.

Antitranspirants can help. These waxy films slow water loss from your plants. Otherwise stems could dry and die in winter, since roots can't take up water from frozen soil to replace what they lose. Find anti-transpirants at your garden center. Follow directions carefully.

In spring, gradually remove winter soil mounds or mulch. Recover crowns if predictions call for a late freeze.

Avoid some common cultural (abiotic) problems of roses by planting where roses will get enough sun, air circulation, and have decent soil. Don't plant a monoculture or use too much or too little fertilizer.

Roses that resist disease or insects? Take the time to research a particular rose if you're determined to grow them. But, remember even roses that are resistant to particular rose problems, will not be completely problem-free.

Focus on Bulbs

Tulips, daffodils and narcissus, dahlias, gladiolus—some of the most striking plants in Northeast gardens grow from bulbs, corms, rhizomes and tubers. Like other plants, keeping them healthy reduces disease and insect pests.

Many are planted in fall for spring bloom—but some in spring for summer bloom. Buy your bulbs at the proper planting time. Once planted, many are hardy enough to stay put for years.

Choosing and planting. Bulbs should be firm and unwrinkled, without soft spots or scabs. Buy only firm, undamaged corms and bulbs. To reduce chance of rot, handle bulbs carefully so they don't get nicked or bruised, or lose their papery sheath. Plant in rich, well-drained soil—sandy is good—and slightly acidic (pH 6.5). Alliums, though, like a neutral to alkaline soil. Plant hardy bulbs at least four weeks before the ground freezes in fall.

Plant bulbs pointy end facing up, about three and a half times as deep as the height of the bulb. If the bulb is two inches tall, plant it seven inches deep. Measure planting depth from the tip of the bulb to the soil surface. Are your winters really cold? Plant bulbs deeper yet, unless your soil is heavy with clay.

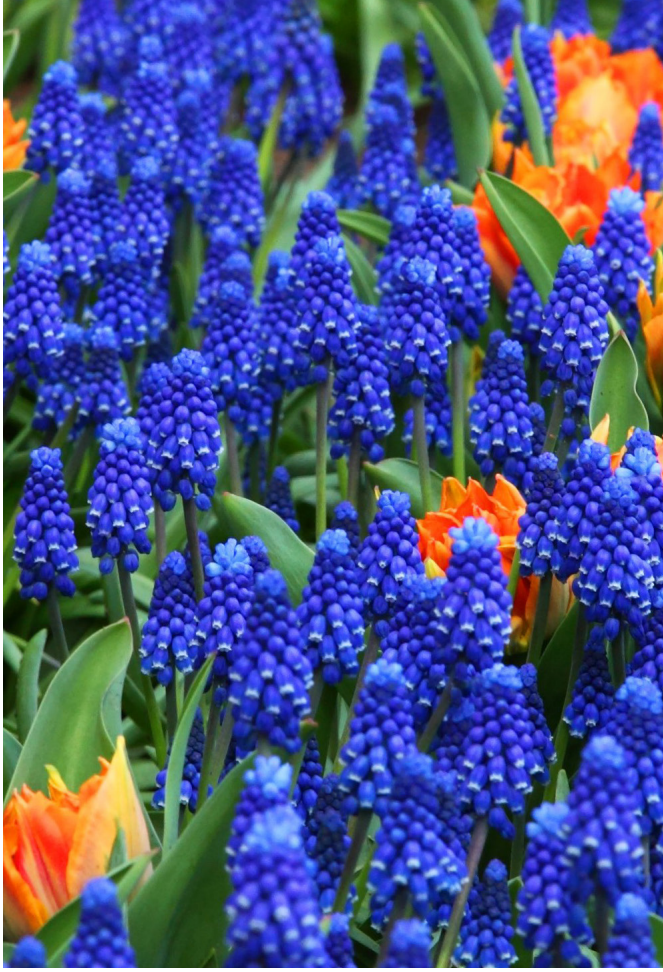
Space the bulbs as the package directs. Want a great show the first year? Plant them a little closer—but you'll need to divide them sooner.

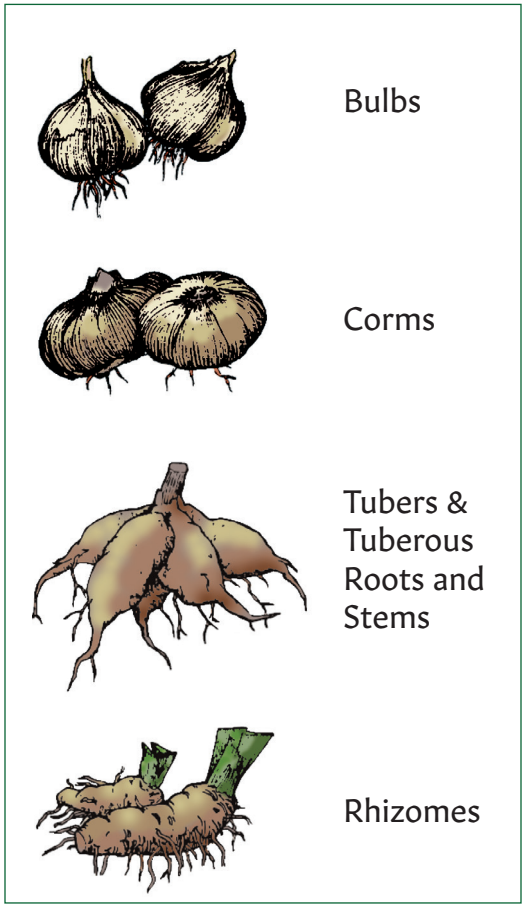
Note: planting depth for rhizomes and corms have different rules.

As for corms, rhizomes and tubers? Corms resemble bulbs enough that you'll recognize the roots versus pointed shoot. Rhizomes have an ugly root system, but obvious stems; prepare a good sized hole for the roots, but leave a part of the woody stem at soil's surface. Tubers are a little trickier. Don't make the mistake of thinking each tuber hanging on the main stem will start a new plant. Tubers are only energy storage for the stem.

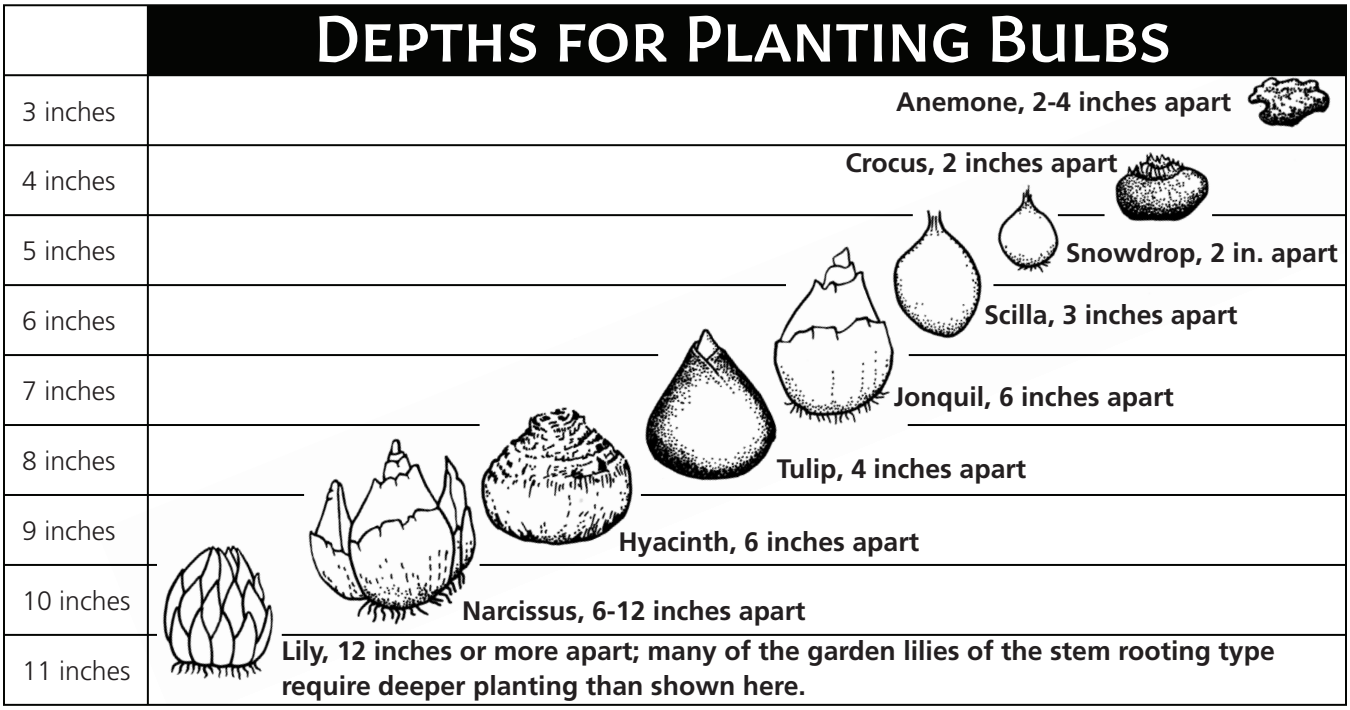
Bulbs, corms, tubers, and rhizomes?

And another question—are they tender or hardy? Most of these flowering plants get lumped together under the title of bulbs. If you can picture a bulb as an onion with layers, roots and stem, you'll better understand what a true bulb is. They include tulips, muscari, freesia, hyacinth and snowdrops. Bearded iris, canna lily, lily of the valley and calla lily are rhizomes—a sort of woody underground stem that spreads and starts new roots. Gladiolus and crocus are another type of 'bulb' called a corm; very similar to rhizomes. Tubers or tuberous roots include caladium, tuberous begonia, dahlia and ahem … potato. (yes, potatoes flower.) To further confuse things consider peony and daylily—they grow from thick, fleshy roots that can and should be easily divided.





Types of Fleshy-Rooted Plants, redrawn from Lesson 4 of the Afghan Agriculture educational materials. Illustration by E. Werner. Copyright 2000-2021 The Regents of the University of California, Davis campus.



This is a safe planting guide for the average gardener. Redrawn from *Depths for Planting Bulbs,* Cornell U. Cooperative Extension, Nassau County. ccenassau.org/resources/bulbs-depths-for-planting

Spring Flowering Bulbs

Early Spring (weeks 1-4)

Snowdrop *(Galanthus nivalis)*
Winter Aconite *(Eranthis hyemalis)*
Danford Iris *(Iris danfordiae)*
Crocus *(Crocus* spp.*)*
Glory-of-the-Snow *(Chionodoxa luciliae)*
Siberian Squill *(Scilla siberica)*
Striped Squill *(Puschkinia scilloides)*
Grecian Windflower *(Anemone blanda)*
Grape Hyacinth *(Muscari botryoides)*
Early Daffodils *(Narcissus* spp.*)*
Netted Iris *(Iris reticulata)*

Midspring (weeks 4-8)

Checkered Lily *(Fritillaria meleagris)*
Species Tulips *(Tulipa spp.)*
Early Tulips *(Tulipa spp.)*
Early Alliums *(Allium spp.)*
Hyacinths *(Hyacinthus orientalis)*
Summer Snowflake *(Leucojum aestivum)*
Medium-Cupped Daffodils *(N. spp.)*

Late Spring (weeks 8-12)

Dutch Hybrid Iris (Iris hybrids)
Midseason Tulips *(Tulipa spp.)*
Late Daffodils *(Narcissus spp.)*
Late Tulips *(Tulipa spp.)*
Alliums *(Allium spp.)*

Dahlias, for instance, will have one prominent stem with many tubers attached. To divide, cut down through the stub of the stem to ensure that there's an 'eye' on the stem with at least one of the tubers attached.

Care for bulbs. Fertilize bulbs at planting according to the package directions—or use less. Over fertilizing makes for rotten bulbs. Fertilize again when shoots emerge in the spring, and again after they flower. Don't cut back foliage after flowering. Let it yellow naturally. And don't braid or tie foliage. The leaves still need sunshine. Thin or divide when plantings get crowded or fail to flower.

Careful Storage Stops Disease

Hardy bulbs such as crocus, hyacinths, daffodils, and tulips usually stay healthy if they're stored right. Keep them in a cool, dry place, ideally with temperatures between 40°F to 45°F. Don't let them freeze—they'll be rot-prone. If they start sprouting, it's probably too light or too warm. Keep stored bulbs dry. The bacteria and fungi that attack them thrive where it's damp. Inspect stored bulbs and destroy moldy, crumbly, or dry ones.

Focus on Hostas

It's no wonder hostas are the most popular perennial in America. They're versatile—adaptable to shade or sun, wet sites (and dry, if you give them steady moisture). Their foliage is attractive from when it emerges in late spring until frost. They play many roles in the landscape—groundcovers, foils for flowering plants, and companions for bulbs. Large cultivars make good screens or borders. All make great container plants and most are trouble-free.

Abiotic problems. Some hostas, especially gold-leaved ones, love the sun. But they'll get sunburn and scorch if they don't get enough water and a break from the sun. Leaves turn papery and brown—especially around the edges. Some get stunted. Plant where there's shade during the hottest part of the day.

Hostas are **drought sensitive**, and need moisture, particularly the first season after planting or transplanting. Water often during dry spells. Work lots of compost into the soil to hold moisture. (On the other hand, poorly drained soil or extremely wet seasons can lead to rot diseases.)

Disease problems. Viruses are bad news, and the mysterious sounding HVX (Hosta Virus X) has spread through North America since the mid 1990s. Note pale leaves and mosaic patterns with dead spots. Leaves slowly wither and die. This is an extremely contagious disease—spreads easily on sap, hands, tools, pots, clothing, or insects.

INSV (Impatiens Necrotic Spot Virus) has small, bull's-eye spots with rings around them, pale green to white. Spots sometimes run together in patches. Spread by dividing diseased plants or by thrips.

Watch for the pale, beige or yellow spots with blurred margins characteristic of ToRSV (Tomato Ringspot Virus). This one can be spread by root-feeding nematodes and perhaps pollinators.

Buy healthy plants from reputable sources. Beware bargain-priced hostas! Inspect carefully before planting. Throw out diseased plants. Cope with insects that spread viruses: thrips, leafhoppers, and black vine weevils. Nematodes can spread viruses, too.

Hostas can be injured by fungal diseases. Anthracnose causes leaf spot. White mold occurs during wet spells, especially where mulch is against the stems. Check the crown area for Fusarium root and crown rot. If outer leaves pull away easily, your hosta may have this disease or another disease called Phytophthora.

Only one bacterial disease hits hostas. Erwinia causes soft rot. Leaves turn dark and mushy and give out a nasty smell. Erwinia thrives on damaged tissue, especially in severe hot or cold weather.

Hostas don't have many insect problems, but slugs are a major pest.

Hostas are available in hundreds of varieties. Learn more from the American Hosta Society, at hosta.org/. Photo: Pixabay

Hostas prefer cool, moist areas but can tolerate sun if protected from the worst of the afternoon heat. Hostas aren't drought-tolerant. Photo: Richard Buckley, Rutgers PDL.

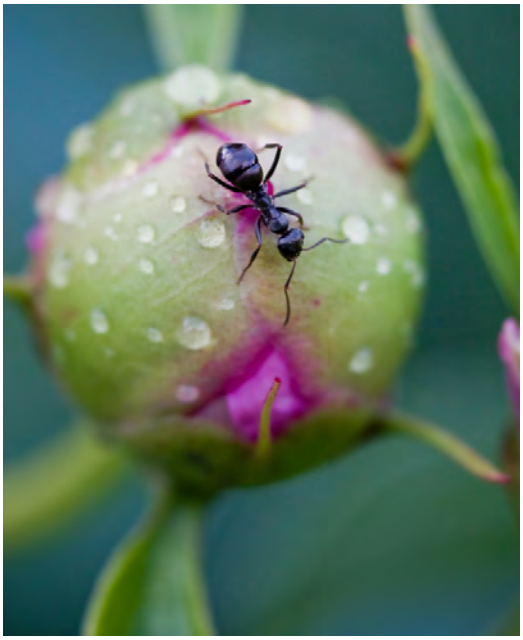
Sometimes it's hail. Usually it's slugs. Hostas and snails thrive in rich damp soil. Photo: Siaron James, c1.staticflickr.com/3/2893/9858233584_3d9d9cd565_b.jpg, CC BY 2.0

Focus on Peonies


Photo: Pixabay

Peonies

Divisions should have 3 to 5 well-developed eyes (buds for next year's growth). Plant peonies with the eyes no deeper than 1 inch below the surface.


Just when your peonies are their most beautiful, you're sure to get a heavy rainstorm. Ants love them too. Photo: Benson Kua, c2.staticflickr.com/4/3034/2591833020_ea5b9f7941_b.jpg, CC BY SA 2.0

Why don't your peonies flower? Most problems are cultural or abiotic.

- They're still too young. Cultivars mature at different speeds. Some take a few years.
- They're planted too deeply. Eyes (bumps) should show above the soil.
- Older clumps need to be divided. Leave three eyes per clump.
- Too much nitrogen fertilizer.
- They're stressed from being divided or transplanted too often.
- They're not getting enough sun. Prune or limb up trees that have overgrown the site.

If they bud but don't flower:

- A late frost zapped the buds.
- A hot spell zapped the buds.
- Too much rain waterlogged the buds.
- They need fertilizer.
- Partly opened buds turn brown and drop—they have thrips.
- They're diseased; possibly Botrytis.
- If diseases such as Botrytis persists year to year, consider fungicides—which you should probably apply before you see symptoms.

IPM Solutions for Flower Diseases of Annuals, Perennials, Bulbs and Groundcovers

So, you've followed the steps of IPM and you've done what you can to reduce the abiotic problems facing your plants. But when bad things happen to good plants, use this guide to identify IPM solutions for their pest problems.

Blight

Alternaria Leaf Blight (*Alternaria* spp.)

Key hosts—annual: Geranium, Gerbera daisy, globeflower, impatiens, marigold, ornamental kale, periwinkle, pinks, zinnia

Key hosts—perennial: Coneflower, hosta, pinks, salvia, sundrops

What it is and what it does: The alternaria fungus overwinters in plant debris, and can be carried short distances by wind. It thrives early in the season when warm, wet, or humid weather alternates with dry. Dew and frequent watering doesn't help! Watch lower leaves for small circular spots that enlarge into irregular lesions with a yellow halo. Spots eventually dry out and die. As with any disease, if you see mushy lesions on stems—act quickly. This disease is common in vegetable gardens.

IPM Solutions: Destroy infected plants; do not compost them near your garden. Because the fungus persists in soil, you may have to remove topsoil, or use a thick, absorbent mulch to reduce splashing. Keep plants well-spaced. Alternaria may require fungicide applications.

Meet the Blights

A severe, dramatic damage—that's a blight. *Alternaria, Botrytis, Rhizoctonia, Erwinia, Xanthomonas.* Leaves, stems, flowers, even entire plants suddenly blacken and wilt. Most blights are favored by cool, moist weather and are worse during wet weather or on stressed plants. Caused by fungus or bacteria, so don't assume a fungicide will work. What can you do? Refer back to our checklist, of course. Water carefully. Sometimes you must spray or dust before you see symptoms if a pathogen overwinters in soil or on plants and you had it last year. How many treatments are needed varies with the weather and the pathogen's life cycle.

Aureobasidium Leaf Streak, Daylily Leaf Streak *(Aureobasidium microstictum)*

Key hosts—perennial: Daylily

What it is and what it does: This fungal disease causes yellowing along leaf veins. They become brown or reddish and spread to appear as streaks. The disease drops spores that overwinter in leaf debris and become active in spring. Daylilies can survive unless leaf damage is significant.

IPM Solutions: Avoid overhead watering, and avoid working in wet gardens. Remove dead or damaged leaves and destroy. Do not compost.

Daylily leaf streak, anthracnose *(Aureobasidium microstictum).* Photo: David L. Clement, University of Maryland, Bugwood.org

Peony blight, a botrytis blight disease, is common and unsightly but rarely kills the plant. Be sure to sterlize pruners to reduce spread to other plants. Photo: Penn State Department of Plant Pathology & Environmental Microbiology Archives, Penn State University, Bugwood.org

Botrytis Gray Mold, Botrytis Blight, Botrytis Leaf Blight *(Botrytis cinerea)*

Key hosts—annual: Ageratum, baby's breath, begonia, blue marguerite, cockscomb, cosmos, dahlia, fuschia, geranium, Gerbera daisy, impatiens, lobelia, marigold, nemesia, pansy, periwinkle, petunia, pocketbook plant, poppy, snapdragon, sunflower, verbena, wishbone flower

Key hosts—perennial: Aster, baby's breath, coral bells, cranesbill, daffodil, lily, myrtle, narcissus, pinks, primrose, rose, rose mallow, salvia, Shasta daisy, tickseed, tulip, yarrow

What it is and what it does: As you can see by the list, botrytis is a very common fungal disease (likewise in the vegetable garden). It thrives in cool weather, and humidity, and spreads by wind or rain. Botrytis isn't shy about showing off with grayish or dirty white, fuzzy mold on leaves, flowers and stems. You'll see pale spots—gray or tan—and little black dots as well. Affected buds don't open.

IPM solutions: Avoid working in wet gardens, and remove plant debris each fall. Watch for early signs of disease when weather stays cool with long periods of high humidity. Petunias are extra susceptible and can give you a heads-up. Roughly handled transplants are particularly susceptible, including tulip bulbs—avoid nicking them. Promptly remove and destroy any diseased plant parts. In humid weather, this is going to spread fast. Consider fungicides.

No cure?

We know it sounds daunting. When you see this declaration of bad news, pay special attention to our advice on prevention, cleanup, sterilizing tools, seeking resistant plants, and not planting susceptible plants near each other.

Canna Bud Rot *(Xanthomonas* spp.*)*

Key hosts—annual: Canna

What it is and what it does: This bacterial disease enters through young buds before they even open; same for unfolding leaves. Spots are first white and then turn black, and buds may die before opening. On older leaves, spots are irregular, yellow and water-soaked. The bacterium lives on the root stock over the winter.

IPM solutions: Destroy overwintered bulbs that look suspicious. Avoid overwatering, and overcrowding your canna.

Early cercospora blight on coneflower. Photo: Penn State Department of Plant Pathology & Environmental Microbiology Archives, Penn State University, Bugwood.org

Cercospora Blight *(Cercospora* spp.*)*

Key hosts—annual: Calendula, forget-me-not, pansy

Key hosts—perennial: Beardtongue, beebalm, butterfly weed, coral bells, cranesbill, gaura, hosta, ornamental strawberry, poppy, rose, St. John's wort, verbena

What it is and what it does: This fungal disease overwinters in plant debris, and is carried short distances by wind from many susceptible plants (shrubs and trees included). It thrives

when dry weather alternates with warm, wet or humid weather (including dew and frequent watering). First small, irregular, purple or maroon spots turn brown and are usually on the older, lower leaves. Tiny black spores may be found inside each spot with use of hand-held magnifying lens; spots become tan or gray to brown with dead centers, and leaves yellow and fall.

IPM solutions: Remove infected plants and destroy (do not compost). Consider fungicides if necessary, and then reduce reinfection by improving drainage, and reducing weeds to increase airflow. Stay out of wet gardens. Water at the base of the plant. In roses, look for resistant varieties.

Diaporthe Blight *(Diaporthe arcii)*

Key hosts—annual: Larkspur

Key hosts—perennial: Delphinium

What it is and what it does: Watch for brown spots on lower leaves. Darker spots on both leaves and stems are pycnidia that produce spores. You may also see web-like mycelium as leaves and stems rot.

IPM solutions: Remove and destroy promptly. Protect against repeats with a fungicide and mulch.

Downy Mildew *(Peronospora* spp., *Bremia lactucae)*

Key hosts—annual: Alyssum, coleus, ornamental kale, pansy, paper daisy, perilla, poppy, snapdragon, stocks

Key hosts—perennial: Anemone, avens, bachelor's buttons, black-eyed Susan, candytuft, coral bells, cranesbill, culver's root, dead nettle, hyssop, monkshood, poppy, roses, speedwell, tickseed

What it is and what it does: Downy mildew is a humidity loving water mold acting like a fungal disease. It spreads by splashing water or from soil via roots. Watch for angular, pale green patches on upper leaf surfaces; they often go unnoticed or misdiagnosed. You'll need magnifcation to see fuzzy growth on downy white to gray-purple patches on the underside of leaves. When severe, lower leaves quickly brown and shrivel. (Don't confuse it with powdery mildew.) Downy mildew is host-specific.

IPM solutions: Seek disease-resistant cultivars. Air circulation is key; don't let plants get crowded. Site plants correctly—susceptible sun-loving plants will be at a great risk if planted in shade. Fungicides help if infected plants are removed first.

Downy mildew on poppy (underside). Photo: T. Smith, UMass, negreenhouseupdate.info/photos/poppy-downy-mildew University of Connecticut.


Downy mildew on impatiens. M.A. Hansen, Virginia Tech, www.extension.umn.edu/garden/yard-garden/flowers/managing-impatiens-downy-mildew-in-landscape/.


Downy mildew on black-eyed susan. Photo: www.ornamentalpathology.com/downy-mildews.

White rot fungus *(Stromatinia gladioli)* on gladiolis. Photo: Florida Division of Plant Industry , Florida Department of Agriculture and Consumer Services, Bugwood.org

Dry rot. Photo: Florida Division of Plant Industry , Florida Department of Agriculture and Consumer Services, Bugwood.org

Leaf scorch (shown on Amaryllis). Photo: Bruce Watt, University of Maine

Rhizoctonia stem blight on transplant. Photo: Gerald Holmes, California Polytechnic State University at San Luis Obispo, Bugwood.org

Dry Rot, White Rot *(Stromatinia gladioli, Sclerotinia gladioli)*

Key hosts—annual: Gladiolus

Key hosts—perennial: Crocus

What it is and what it does: Corms may appear unusually bumpy or shredded, and are dry, hard, and mummified if infected by this fungal disease. If you can scrape off a small reddish-brown spot, you may see sunken areas. This disease is sometimes called neck rot.

IPM solutions: Be careful of what you buy and plant. If you have any reason to suspect that the soil is infested, plant in a different spot. Fungicides can be used.

Leaf Scorch, Red Leaf Scorch, Narcissus Leaf Scorch *(Peyronellaea* spp., *Stagnospora* spp.*)*

Key hosts—perennial: Daffodil, narcissus, snowdrops

What it is and what it does: This fungal disease survives on bulbs in moist soil, and infects bulbs through injuries. Look for yellowish red or brown spots on the top 2 to 3 inches of leaves as they emerge. Symptoms include small, water-soaked spots, or discolored spots that look like frost injury. Raised brown spots hold pycnidia (fruiting bodies); around the brown spots, leaf tissue will turn a grayish-brown.

IPM solutions: Plant new bulbs away from existing sites if disease is present. Removing diseased leaves reduces next years' problems. Remove and destroy damaged plants, and dispose of all leaf debris. Do not compost.

Rhizoctonia Web Blight *(Rhizoctonia* spp.*)*

Key hosts—annual: Baby's breath, dahlia, impatiens, salvia, snapdragon

Key hosts—perennial: Blue false indigo, chrysanthemum, pinks, rose mallow, sedum, tulip

What it is and what it does: Rhizoctonia is a soil-borne fungus and common cause of root rots and damping off (death of young seedlings). However, it can cause stem and leaf cankers on broadleaved plants and grasses. At times, brown, web-like mycelium appears (commonly referred to as web blight). Leaf spots tend to be brown and irregular. Rhizoctonia is a problem in hot, humid weather.

IPM solutions: Reduce crowding. Thin to increase air circulation. Avoid overhead irrigation when possible. Remove diseased plants promptly, including plant debris, and destroy; do

not compost. Rhizoctonia generally requires treatment, such as microbial biological control products, or fungicides.

Southern Blight *(Sclerotium rolfsii)*

Key hosts—annual: Alstromeria, dusty miller, sweet potato vine, many more

Key hosts—perennial: Hosta, daylily, liriope, vinca, astilbe, peony, phlox, delphinium and others

What it is and what it does: Southern Blight is (not surprisingly) not a major fungal disease in the north, but it's worth noting because it can occur and it acts differently than other 'white mold' and 'crown rot' diseases. It prefers high humidity and high temperatures, 86° to 95°F, and peaty soil (3 to 6pH). This soil dweller causes infection at the soil line and stems fail. Look for yellowing and wilting of leaves, then white webbed mycelium at the crown. The fruiting bodies of this fungus are sclerotia that start white and darken with age. They resemble musard seeds and can also grow under the surface on roots.

IPM solutions: When it occurs, act fast to remove the plants (bag and destroy) and remove soil as well. Reduce weeds (they increase soil humidity), test your soil and consider treatments to raise soil pH. Don't track diesase around your garden or on tools and examine plant material before transplanting.

Dieback of hosta infected with Southern Blight. Photo: Michigan State University Diagnostic Services, Sclerotium of Southern Blight.

Tulip Fire *(Botrytis tulipae)*

Key hosts—annual: Ageratum, baby's breath, begonia, blue marguerite, cockscomb, cosmos, dahlia, fuschia, geranium, Gerbera daisy, impatiens, lobelia, marigold, nemesia, pansy, periwinkle, petunia, pocketbook plant, poppy, snapdragon, sunflower, verbena, wishbone flower

Key hosts—perennial: Aster, baby's breath, coral bells, cranesbill, daffodil, lily, myrtle, narcissus, pinks, primrose, rose, rose mallow, salvia, Shasta daisy, tickseed, tulip, yarrow

What it is and what it does: As you can see by the list, botrytis is a very common fungal disease (likewise in the vegetable garden). It thrives in cool weather, and humidity, and spreads by wind or rain. Botrytis isn't shy about showing off with grayish or dirty white, fuzzy mold on leaves, flowers and stems. You'll see pale spots—gray or tan—and little black dots as well. Affected buds don't open.

IPM solutions: Avoid working in wet gardens, and remove plant debris each fall. Watch for early signs of disease when weather stays cool with long periods of high humidity. Petunias are extra susceptible and can give you a heads-up. Roughly handled transplants are particularly susceptible, including tulip bulbs—avoid nicking them. Promptly remove and destroy any

Symptoms of *Botrytis tulipae,* Tulip Fire, on leaves and petioles of tulip. Photo: Sandra Jensen, Cornell University, Bugwood.org.

diseased plant parts. In humid weather, this is going to spread fast. Consider fungicides.

Cankers

Coniothyrium Canker of Rose (*Coniothyrium* spp.)

Stem canker, *Leptosphaeria coniothyrium,* of rose. Photo: Florida Division of Plant Industry , Florida Department of Agriculture and Consumer Services, Bugwood.org.

Key host—perennial: Rose

What it is and what it does: This fungal disease causes cankers by entering wounds in the stem or crown of roses. They begin as spots (reddish or yellow) that grow larger; the edges darken. As spots grow, disease kills the stem.

IPM solutions: Remove the stems affected by pruning them off below the canker—preferably in the spring. Always sterilize tools before and after any stem work, and keep them sharp to leave tidy cuts! Try 10% bleach solution, 70% alcohol solution, or purchase solutions made for sterilizing and disease reduction.

Damping off

Damping off (*Botrytis, Rhizoctonia, Fusarium, Pythium*)

Galls or Swellings

Clubroot (*Plasmodiophora brassicae*)

Clubroot is common in the Brassicae family. Alyssum is part of the family—think 'broccoli flowers' and you'll see the link. Photo: David B. Langston, University of Georgia, Bugwood.org

Key hosts—annual: Alyssum

What it is and what it does: This fungal-like disease lives in moist soil, where it makes plant roots swell. Above surface, plants will wilt, look stilted and appear less green (more blue or gray).

IPM solutions: Clubroot doesn't like alkaline soils, so adding lime slows the process. In new planting areas where clubroot has occurred, tilling soil during a hot, dry period may kill soil-based spores, just as adding raised beds lifts newer plants from diseased soil. Improving drainage also helps.

Crown Gall (*Agrobacterium* spp.)

Crown gall is a common bacterial disease of woody plants, characterized by odd corky growth. Photo: Melodie Putnam 2011, 2013 Oregon State University, www.science.oregonstate.edu/bpp/Plant_Clinic/agrobacterium/rose.htm

Key hosts—annual: Dahlia

Key hosts—perennial: Baby's breath, roses

What it is and what it does: These bacteria are in many soils but become a problem in wet or poorly drainied soil. Infection only occurs if there is a wound in the root or crown for entry. Odd, brown, corky globes show up at the soil surface and rot away by fall. Plants appear stunted, continue to weaken.

IPM solutions: Be careful to avoid root or crown injuries when you plant; later, deep freezes and soil insects may be the cause of root damage. Once active, these bacteria remain active for four or five years. Improve soil drainage, and use raised beds if you replant in the same spot.

Root Knot Nematodes

Key hosts—annual: Cockscomb, dahlia, million bells, petunia

Key hosts—perennial: Astilbe, bugbane, cranesbill, daffodil, daylily, delphinium, hosta, hyacinth, lamb's ear, lungwort, narcissus, poppy, ragwort, sedum and others

What it is and what it does: These prolific breeders are microscopic worms that spread easily when soil is wet. Symptoms vary widely; some plants turn yellow or bronze, but most often, they wilt, weaken, or die. Look for twisting. Sacrifice a dying plant and inspect roots, looking for stubby, stunted, decayed, swollen, or blackened roots, sometimes covered with galls, nodules, or knots. As for stem or bulb nematodes, look for discoloration in stem that doesn't move beyond the veins.

IPM solutions: No cure, so don't spread them accidentally with tools or rototiller tines (wash well, and away from your garden). Consider soil solarization if nematodes are widespread—damp, bare soil covered with clear plastic for the hottest six weeks of summer. Leaving an area fallow—no plants, no weeds—reduces food supply, but their numbers can rebound quickly the following year. Destroy infected plants when possible. Plant cover crops they don't like: annual ryegrass, rapeseed. French marigolds work too, but aren't effective on northern root knot nematode (and who knows which kind you have, right?). Adding compost increases other soil microorganisms that may reduce nematodes.

Root knot nematodes slowly weaken roots. Shown here on Tomato. Photo: Jonathan D. Eisenback, Virginia Polytechnic Institute and State University, Bugwood.org.

Here, juvenile Root Knot Nematodes have entered a tomato plant root. Photo: Jonathan D. Eisenback, Virginia Polytechnic Institute and State University, Bugwood.org

Leaf Spots and Anthracnoses

Alternaria Leaf Spot *(Alternaria* spp.*)*

Key hosts—annual: Geranium, Gerbera daisy, globeflower, impatiens, marigold, ornamental kale, periwinkle, pinks, zinnia

Key hosts—perennial: Coneflower, hosta, pinks, salvia, sundrops

What it is and what it does: The alternaria fungus overwinters in plant debris, and can be carried short distances by wind. It thrives early in the season when warm, wet or humid weather alternates with dry. Dew and frequent watering doesn't help! Watch lower leaves for small circular spots that enlarge into irregular lesions with a yellow halo. Spots eventually dry out and die. As with any disease, if you see mushy lesions on stems—act quickly. This disease is common in vegetable gardens.


Alternaria blight *(Alternaria zinniae)* of zinnia. Photo: Penn State Department of Plant Pathology & Environmental Microbiology Archives, Penn State University, Bugwood.org

Meet the Spots

Xanthomonas (bacterial): note reddish brown spots, distorted leaves

Pseudomonas (bacterial): note brown, angular spots with yellow halos encircling the spot

Cercospora (fungal): note light green sunken spots, turn gray

Alternaria (fungal): note water-soaked spots turn brown and sunken; later show yellow halos

Septoria (fungal): note small, round spots with light centers and dark borders (often appear purplish); vary by host

Anthracnose (fungal): irregular yellow or brown spots that expand, later sink

Ascochyta (fungal): small yellowish areas with white centers, and reddish ring which becomes gray

Anthracnose *(Colletotrichum sp.)* on peony. Dieback of flowers and stems. Photo: Paul Bachi, University of Kentucky Research and Education Center, Bugwood.org.

Ascochyta lesions (on bean leaf). Photo: CropPro Australia, www.croppro.com.au/crop_disease_manual/ch06s03.php.

IPM Solutions: Destroy infected plants; do not compost them near your garden. Because the fungus persists in soil, you may have to remove topsoil, or use a thick, absorbent mulch to reduce splashing. Keep plants well-spaced. Alternaria may require fungicide applications.

Anthracnose, Fungal Leaf Spot *(Collectrichum* spp.*)*

Key hosts—annual: Alstromeria, begonia, pansy

Key hosts—perennial: Foxglove, hollyhock, hosta, iris, lily of the valley, lily turf, lupine, pig squeak, St. John's wort, toad lily, verbena.

What it is and what it does: Anthracnose is a common fungal disease that thrives in rainy weather and affects all plants including shrubs and trees by surviving on plant debris and in soil for three or more years. Symptoms include irregular yellow or brown spots on stems and on the tops (upper surface) of leaves. Look on the under sides of those spots for pin-head sized dots. Anthracnose spots darken, expand, and often run together to cover entire leaves. Leaves may curl up along edges. On some hosts, dark lesions show along leaf veins; also look for sunken, stretched-out brown marks on leaves or other tissues. With magnification, you might see pinkish ooze (containing spore masses) in the center of the spot.

IPM solutions: Water at the base of the plants; don't use sprinklers. Be choosy about the health of plants you bring in to your garden. Promptly remove and destroy. Don't compost plants with signs of fungal disease or be prepared to choose a fungicide. Remove topsoil and replace, or consider a mulch (preferably not plastic) to stop disease from splashing onto plants during rain.

Ascochyta Leaf Spot *(Ascochyta* spp.*)*

Key hosts—annual: Pansy

Key hosts—perennial: Bugbane, catmint, phlox

What it is and what it does: Ascochyta (pronounced As-ko-kite-ah) is a fungal disease that overwinters in plant debris and shows up during cool, wet springs. Leaf symptoms vary from small, yellow-green areas to brownish-purple. (On stems the fungus is black). Spots are generally pale in the center and appear ringed with contrasting color. Leaves shrivel.

IPM solutions: Remove diseased plant material or entire plant and destroy (don't compost). Use raised beds for good drainage and reduce overhead irrigation. Fungicides should be considered for valuable plants.

Bacterial Leaf Spot *(Xanthomonas* spp.*)*

Key hosts—annual: Begonia, caladium, canna, dahlia, forget-me-not, geranium, larkspur, nasturtium, pinks, poppy, statice, stocks, zinnia

Key hosts—perennial: Bear's breeches, black-eyed Susan, chrysanthemum, cranesbill, delphinium, hosta, hyacinth, iris, ivy, monkshood, pinks, poppy, primrose, rose mallow, salvia, sunflower, tiarella, tulip, verbena

What it is and what it does: Bacterium overwinters on plant material and in seeds, and becomes active in temperatures of 75° to 82°F with high humidity. Though it is called leaf spot, it attacks all parts of the plant. Leaves show small, angular spots with a water-soaked appearance, which are clear when held to the light. (By comparison, fungal spots are generally round-edged). Spots later turn brown. In high humidity, spots appear milky—this is bacterial ooze which dries into a white crust. These spots can occur on stems as well; stems may fall over. In bulbs, look for rotting and softening, and a foul-smelling ooze.

IPM solutions: Avoid working in wet gardens, and don't water from overhead. Specific products containing copper have long been used to slow bacterial infections.

Ascochyta leaf spot on bugbane. Photo: Bruce Watr, University of Maine Extension, extension.umaine.edu/ipm/ipddl/plant-disease-images/bugbane-ascochyta-ss

Bacterial blight of geranium *Xanthomonas hortorum pv. pelargonii*. Photo: Penn State Department of Plant Pathology & Environmental Microbiology Archives, Penn State University, Bugwood.org

Black Spot *(Diplocaron rosae)*

Key hosts—perennial: Rose

What it is and what it does: Beware of black spots which become colonies of black spots, starting with new leaves. Foliage slowly yellows and falls off. This fungal disease thrives in warm, wet spells. Spores germinate in water and need leaves to be damp for seven hours. It overwinters in fallen leaves. Though not a killer, it weakens plants and mars their beauty. It spreads in splashing water—from a sprinkler or rain splashing leaf to leaf; or as you move among plants in the garden.

IPM solutions: Choose resistant roses. Water at the base of plants, early in the day. Mulch well. Clean up diseased or fallen foliage. Consider least-toxic fungicides such as anti-transpirant sprays, potassium bicarbonate-based products, or sulfur- or copper-based fungicides. Even compost tea can help. Use early when weather first favors black spot.

Black spot of rose, a common fungal disease. Photo: William Fountain, University of Kentucky, Bugwood.org.

Cercospora Leaf Spot *(Cercospora* spp.*)*

Key hosts—annual: Calendula, forget-me-not, pansy

Key hosts—perennial: Beardtongue, beebalm, butterfly weed, coral bells, cranesbill, gaura, hosta, ornamental strawberry, poppy, rose, St. John's wort, verbena

Cercosporta leaf spot on rose. Photo: Paul Bachi, University of Kentucky Research and Education Center, Bugwood.org CC BY -NC 3.0 US.

Leaf spots can be fungal, viral, bacterial, or caused by nutrient deficiency or herbicide drift.

Fungal, see: *Alternaria,* Anthracnose, *Fusarium, Ascochyta, Cercospora*

Bacterial, see: *Xanthomonas, Pseudomonas*

Less common: *Didymella, Phoma, Septoria, Botrytis*

What it is and what it does: This fungal disease overwinters in plant debris, and is carried short distances by wind from many susceptible plants (shrubs and trees included). It thrives when dry weather alternates with warm, humid or wet weather, including dew and frequent watering. First small, irregular, purple or maroon spots turn brown and are usually on the older, lower leaves. Tiny black spores may be found inside each spot with the use of hand-held magnifying lens; spots become tan or gray to brown with dead centers, and leaves yellow and fall.

IPM solutions: Remove infected plants and destroy (do not compost). Consider fungicides if necessary, and then reduce reinfection by improving drainage, and reducing weeds to increase airflow. Stay out of wet gardens. Water at the base of the plant. In roses, look for resistant varieties.

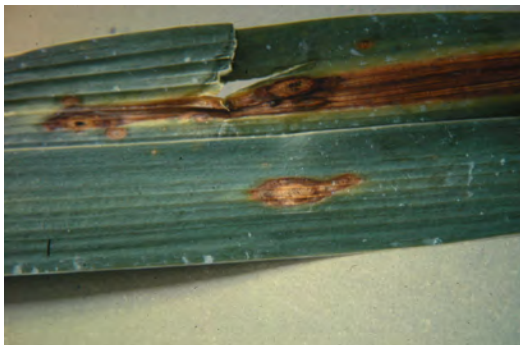
Colletotrichum leaf spot of ivy. Photo: Mike Munster, ncsupdicblog.blogspot.com/2012/03/bacterial-leaf-spot-on-english-ivy.html

Colletotrichum Leaf Spot, Ivy Anthracnose *(Colletotrichum trichellum)*

Key hosts—perennial: Ivy

What it is and what it does: This fungal disease causes large circular dead spots on leaves (usually the edges) and stems. Tiny black dots containing spore may be seen on dead tissue.

IPM solutions: Reduce overhead watering, thin plants, and remove diseased leaves promptly. Ivy can live with this disease. Fungicide is an option, but many gardeners would be happy with less ivy anyway.



Didymellina leaf spot on Iris. Photo: Penn State Department of Plant Pathology & Environmental Microbiology Archives, Penn State University, Bugwood.org.

Didymella Leaf Spot *(Didymellina macrospora)*

Key hosts—perennial: Iris

What it is and what it does: Didymella is a fungal disease you may fight in your vegetable garden as well. Tiny brown spots show up on leaves. Because they appear to have water-soaked borders, they may resemble a bacterial disease, but as they enlarge, they take on the common fungal "eye spot" appearance: gray centers with dark brown borders. Didymella worsens quickly in rainy weather and leaves may collapse.

IPM solutions: Destroy old leaves in the fall, and remove and destroy (do not compost) diseased ones as you find them during the season. If you choose a fungicide, apply after you cut away diseased leaves.

Foliar Nematodes (*Aphelenchoides* spp.)

Key hosts—annual: Begonia

Key hosts—perennial: Anemone, astilbe, chrysanthemum, cranesbill, musk mallow, ornamental strawberry, pigsqueak, ragwort, toad lily

What it is and what it does: Microscopic worms spread when weather or soil is wet, moving through films of water, and from leaf to leaf and plant to plant via splashing raindrops or sprinkler splash. Overwinter in dead leaves. Note twisted, curled, discolored leaves (brown, yellow, or purple splotches). Angular dead spots, outlined by leaf veins, show up dramatically in late summer. But infections on plants with small, narrow leaves won't have that characteristic angled lesion. Instead, random leaves turn brown and die. To observe, tear damaged leaf pieces into a dish of water. The next day, use magnification to see these tiny worms in the water.

IPM solutions: There is no cure. But since foliar nematodes are easily killed by heat, you could lift your most prized or hard-to-find plants just before they go dormant and submerge foliage in hot water: 120° to 140°F for four to ten minutes. Remove dead leaves first. You can, of course, kill crowns if water is too hot or plants are submerged too long. For insurance, divide plant and submerge one piece for four minutes; another for seven or ten—in other words, experiment! Monitor the temperature and watch the time carefully. Then plunge into a bucket of cold water—no more than five minutes—so tissue will cool. Drain and pot right away. This is not a long-term solution because nematodes endure in the soil as well.

Leaf of purple cone flower, *Echinacea* sp., infected with foliar nematode, *Aphelenchoides* sp. Photo: Jonathan D. Eisenback, Virginia Polytechnic Institute and State University, Bugwood.org.


Anemone leaf infected with foliar nematodes. Photo: Michigan State University Diagnostic Services, Foliar nematodes – *Aphelenchoides* spp.

Phoma Leaf Spot *(Phoma lingam)*

Key hosts—annual: Crocus, ornamental kale

Key hosts—perennial: Mullein, myrtle

What it is and what it does: Humid, rainy weather is a fungus' friend. Phoma can be carried on seed or transplants and spreads in many ways: splashing water from rain or sprinklers, wind, contaminated tools, diseased plant debris and visitors to the garden. Look for leaf spots that are pale brown, tan, or almost white with many tiny black fruiting bodies. Main stems could show large, sunken, brown-to-black cankers sporting black fruiting bodies.

IPM solutions: Reduce plant stress, such as too much or too little water. Remove soil and replace with soilless mix, or consider raised beds. Consider fungicides to reduce spread and loss of groundcover myrtle. Destroy rather than move diseased plant material.


Phoma Leaf Spot is most common on *Brassica* crops and a few ornamentals. Photo: Cynthia Ocamb, Oregon State University

Septoria Leaf Spot *(Septoria* spp.*)*

Key hosts—perennial: Anemone, beardtongue, bellflower, black-eyed Susan, blanket flower, blue false indigo, chrysanthemum, clematis, columbine, coneflower, culver's root, gaura, gayfeather, lamb's ear, lavender, phlox, Shasta daisy, speedwell


Septoria lesion with pycnidia on Heuchera leaf. Photo: Michigan State University Diagnostic Services, Septoria leaf spot.

White smut on *Gaillardia*. Photo: Michigan State University, pestid.msu.edu/plant-diseases/white-smut-entyloma-polysporum/

Viruses—the Original Hackers

Elusive and tricky to diagnose, viruses cause a wide range of symptoms. Insects—aphids, leafhoppers, thrips, whiteflies—spread some of them. Infected seeds or cuttings spread others, as do your hands, tools, and even your clothing as you move among plants. Some viruses, such as peony ringspot, are species-specific. Others infect a huge range of hosts. Don't plant virus-prone plants near each other or in beds where you've had virus before. Pull weeds; they harbor insects that carry viruses.

Aster yellows on marigold. Photo: Whitney Cranshaw, Colorado State University, Bugwood.org, (CC BY 3.0 US)

What it is and what it does: Septoria is a fungal disease that overwinters in plant debris and becomes active in cool weather, (temps in the 60s) and wet or humid conditions. Spores are carried by top watering, wind-blown rain, and by gardeners and animals moving among wet plants. Symptoms begin on lower leaves and work up the plant; leaf spots are irregular, tan to dark brown and may have yellowish borders. On some plants, spots are purple. Leaves yellow and die off.

IPM solutions: Weed often—it helps keep the microclimate less damp. Don't compost diseased plants. Consider mulch that will reduce splashing. Consider fungicides.

White Smut (*Entyloma* spp.)

Key hosts—annual: Blanket flower, cosmos, dahlia

Key hosts—perennial: Aster, black-eyed Susan, blanket flower, coneflower

What it is and what it does: This fungal disease reproduces inside leaf tissue and their resulting spores break through the leaf surface to appear as round white spots of powder. Eventually the white spots turn brown. The fungus stays on plant debris but is unlikely to survive northeast winters outside.

IPM solutions: Remove and destroy spotted leaves. Consider a fungicide if facing a major outbreak.

Mosaic, Leaf Discoloration and Distortion

Aster Yellows (a phytoplasma disease)

Key hosts—annual: Baby's breath, blanket flower, China aster, dusty miller, forget-me-not, marigold, pansy, periwinkle, zinnia

Key hosts—perennial: Aster, baby's breath, bellflower, black-eyed Susan, blanket flower, clematis, coneflower, delphinium, phlox, primrose, salvia, tickseed

What it is and what it does: A phytoplasma is like a bacterial disease or viral disease, but it is neither a bacterium or a virus. It is not at all like a fungal diseases. It is unaffected by weather but must be carried from plant to plant by damage such as insect feeding—in particular, leafhoppers whose mouthparts enter the plant's vascular system. Young leaves become yellow, flowers can be distorted, and plant growth is bushy. New leaves will often be much smaller than normal. Yellows can overwinter in living tissue of perennial plants.

IPM solutions: Keep garden weeded. Remove and destroy (don't compost) infected plants.

Note yellowing between leaf veins, mimicking herbicide damage; yellowing and stunting, malformed, greenish flowers, wilt, dieback. Many weeds or wildflowers host phytoplasmas—thistle, wild chicory, dandelion, field daisy, goldenrod, New England aster, plantain, and Queen Anne's lace among them. So keep your yard weed-free if you think you might have phytoplasmas. Inspect new plants for signs of disease. Pesticides won't cure the disease; plants can linger or die rapidly.

Distortion of leaves by Curly Top or Beet Curly Top. Photo: R. M. Harveson, The American Phytopathological Society.

Black Death Virus, Helleborus Net Necrosis Virus (HENNV)

Key hosts—perennial: Hellebore

What it is and what it does: What may first appear to be fungal spots on leaves quickly becomes long back streaks. The disease shows up on new growth of established plants: black leaf veins, stunted growth, blackening.

I**PM solutions:** Dig up and destroy (do not compost) the plant. If you have other hellebores nearby, watch carefully for aphid feeding which may vector this virus. There is no cure.

Curly top virus results in yellowing and stunting as show on these bean plants. Photo: Howard F. Schwartz, Colorado State University, Bugwood.org, (CC BY 3.0 US)

Curly Top Virus, Western Yellow Blight, Beet Curly Top Virus (BCTV)

Key hosts—annual: Zinnia

Key hosts—perennial: Foxglove

What it is and what it does: Curly top is a common virus spread by leafhoppers. Older leaves yellow and twist, but often on only one part of the plant. Leaves may appear thickened. Perennial plants can survive but not recover, and are stunted. Look for yellowing, and protuberances on the underside of the leaf.

IPM solutions: Remove diseased plants to reduce spread. They can be composted—the disease doesn't survive in dead plants. Water well to reduce heat stress. Consider reducing leafhoppers.

Viral diseases in plants often have similar symptoms: discoloration and mottling, or puckering as in Hosta Virus X (HVX Disease). Photo: Jody Fetzer, Maryland National Capital Park and Planning Commission, Bugwood.org

Hosta Virus X

Key hosts—perennial: Hosta

What it is and what it does: This virus makes interesting spots on hosta leaves. It also kills the plant. Viral diseases in plants spread by direct contact to plant fluids; generally this is by insect feeding but in the case of Hosta Virus X, can occur through rabbits or slugs moving from plant to plant, or by garden tools that break into plant cells.

IPM solutions: If you know the cultivar of the hosta, verify what its healthy appearance should be. If mottling has appeared, you likely have a virus. Remove and destroy the plant (don't compost). Sterilize the tools before working around other hosta plants.

Hosta virus X. Photo: Neil Mattson, Cornell University, www.greenhouse.cornell.edu/pests/gallery/hostagevirusx1.htm

INSV, Impatiens Necrotic Spot Virus, is a common virus disease, with varying symptoms depending on the host plant. Ringspots, puckering, discoloration. Viral diseases are often vectored by insects. Symptoms show up long after the pest has moved on. Photo: Penn State Department of Plant Pathology & Environmental Microbiology Archives, Penn State Univ., Bugwood.org

Rose mosaic virus. Photo: Penn State Department of Plant Pathology and Environmental Microbiology Archives, Penn State University, Bugwood.org

Tobacco mosaic virus on petunia. Many viral diseases are named for one particular plant species but affect many others as well. Photo: Anette Phibbs, WI Department of Agriculture, Trade & Consumer Protection, Bugwood.org

Impatiens Necrotic Spot Virus (INSV)

Key hosts—annual: Alstromeria, impatiens, Mexican sunflower, nemesia, plectranthus, pocketbook plant

Key hosts—perennial: Beebalm, bellflower, chrysanthemum, rose mallow, toad lily, verbena

What it is and what it does: This virus is most often spread by thrips on greenhouse-grown transplants, so it is rarely a problem in established gardens. Symptoms are brown or ringed leaf spots, lesions on stems, wilting, mottling, and distorted leaves. Mottled color is the primary symptom of virus.

IPM solutions: Proper indentification is important, and can be tricky because symptoms vary; you may think you have a fungal disease on a plant. Thrips aren't a big problem outside of greenhouses, but viruses are serious. If the plant has a virus, remove the entire plant, bag it up, and throw it out.

Mosaic Virus, including Tobacco Mosaic Virus (TMV), Tomato Mosaic Virus (TOMV), Cucumber Mosaic Virus (CMV), Bean Yellow Mosaic Virus (BYMV), Canna Mosaic Virus (CAMV), Dahlia Mosaic Virus (DMV), Rose Mosaic Virus (RMV)

Key hosts—annual: Alstromeria, canna, cupflower, dahlia, nicotiana, petunia, sweet pea, zinnia

Key hosts—perennial: Beardtongue, bugbane, butterfly weed, chrysanthemum, delphinium, foxglove, hosta, lily, lupine, pinks, rose

What it is and what it does: There are multiple viruses that affect plants. Just like human viruses, they spread by contact, and need a way to get "inside". In plants, that's any wound to the plant cell wall. Tobacco mosaic virus spreads by pest feeding (aphids, thrips, mites, nematodes) and by handling infected plants, especially if you smoked a cigarette or handled chewing tobacco—though most tobacco varieties are resistant, and the curing process usually used in making cigarettes inactivates most TMV. All virus symptoms are similar: mottled coloring, distortion of leaves, stems or flowers, odd colors and dead spots. Viruses are incurable in plants.

IPM solutions: Don't smoke or chew tobacco in the garden. Wash your hands if you've handled tobacco products. Reduce weeds that may shelter pest insects. Use good sanitation with tools, and avoid damaging stems and leaves. Dig out and destroy affected plants.

Narcissus Virus, Narcissus Yellow Stripe Virus (NYSV); Narcissus White Streak Virus (NWSV)

Key hosts—perennial: Daffodil, narcissus

What it is and what it does: Aphids are a natural vector for these viruses. Frost injury, water logging, and herbicide damage may be confused with virus diseases. However, virus-diseased plants will usually be scattered, while plants' abiotic (cultural) problems are in a more uniform area. NYSV-infected plants are characterized by light-green, grayish-green, or dull to bright-yellow stripes or mottles mostly confined to the upper two-thirds of the leaf. The surface of the discolored area is most often roughened near veins and may have a peculiar twist. White streaks or blotches may appear on flowers, which are reduced in size.

IPM solutions: Remove diseased plants and destroy, plant only large and health-looking bulbs. Don't risk spreading the disease by replanting susceptible bulbs in the same spots.

Virus, Ringspot Virus, Tomato Ringspot Virus (ToRSV); Tobacco Ringspot Virus (TRSV); Peony Ringspot Virus

Key hosts—annual: Begonia, impatiens, petunia, portulaca

Key hosts—perennial: Clematis, iris, lungwort, meadow rue, peony, phlox, verbena

What it is and what it does: Look for pale mottling, leaf distortion, yellow, ring-shaped spots. But symptoms come and go. The main mode of transmission is root feeding by nematodes. The pollen of virus-infected plants, moved by pollinators like bees, can also spread the disease.

IPM solutions: Remove diseased plants and destroy, but be warned, neighboring plants may be infected but not yet show symptoms. Let the soil go fallow (no plants, including weeds) for two years to reduce numbers of disease carrying nematodes.

Wilt Virus, Including Tomato Spotted Wilt Virus (TSWV)

Key hosts—annual: Begonia, dahlia, impatiens, pocketbook plant

Key hosts—perennial: Chrysanthemum

What it is and what it does: Wilt virus is vectored by thrips, and tends to be a greenhouse issue. (It can quickly take down a greenhouse crop.) Infected plants that come to your home garden will exhibit browning, stem streaks, leaf spots, and generally won't live long.

A note about viruses and their names …

Like NBC, CBS, ABC, and CNN, viruses often are known by their initials—sort of like a nickname. We describe four of the most common. (But we note some less common ones in our charts, too … like "tobacco rattle virus," or TRV. and in our narrative: example, iris yellow fleck, really yellow spot virus: YSV)

CMV (cucumber mosaic virus)

INSV (impatiens necrotic spot virus)

TMV (tobacco mosaic virus)

TSWV (tobacco spotted wilt virus)

TRSV (tobacco ringspot virus)

ToMV (tomato mosaic virus)

ToRSV (tomato ringspot virus)

To save room in our charts, we note only the nicknames.

Ringspot viruses have no cure. Photo: Sabrina Tirpak, Rutgers PDL

Tomato spotted wilt virus (TSWV) on begonia. Photo: Dr. Backhaus, Biologische Bundesanstalt für Land- und Forstwirtschaft, Bugwood.org.

IPM solutions: Destroy diseased plants promptly. Look plants over before you bring them home. Do they have thrips or whiteflies (tap flower heads over white paper)?

Rots (crown, stem, and root)

Bacterial Stem Rot (*Pectobacterium* spp., formerly *Erwinia*)

Bacterial black stalk, *Erwinia sp.,* on stonecrop. Photo: Mary Ann Hansen, Virginia Polytechnic Institute and State University, Bugwood.org.

Key hosts—annual: Begonia, caladium, canna, dahlia, forget-me-not, geranium, larkspur, nasturtium, pinks, poppy, statice, stocks, zinnia

Key hosts—perennial: Bear's breeches, black-eyed Susan, chrysanthemum, cranesbill, delphinium, hosta, hyacinth, iris, ivy, monkshood, pinks, poppy, primrose, rose mallow, salvia, sunflower, tiarella, tulip, verbena

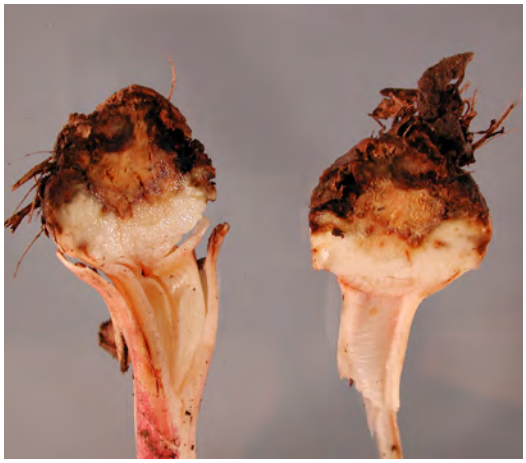
What it is and what it does: Bacterium overwinters on plant material and in seeds, and becomes active in temperatures of 75° to 82°F with high humidity. Though it is called leaf spot, it attacks all part of the plant. Leaves show small, angular spots with a water-soaked appearance, which are clear when held to the light. (By comparison, fungal spots are generally round-edged.) Spots later turn brown. In high humidity, spots appear milky—this is bacterial ooze which dries into a white crust. These spots can occur on stems as well; stems may fall over. In bulbs, look for rotting and softening, and a foul-smelling ooze.

IPM solutions: Avoid working in wet gardens, and don't water from overhead. Specific products containing copper have long been used to slow bacterial infections.

Corm Rot, Gladiolus Corm Rot, Fusarium Yellows (*Fusarium proliferatum*)

Key hosts—annual: Gladiolus

Key hosts—perennial: Crocus


Basal plate rot of Gladiolus due to Fusarium. Photo: Melodie Putnam at the Oregon State Univ. Plant Clinic

What it is and what it does: This fungus is soil-dwelling and thrives in wet, poorly drained sites. It shows up in cold, wet weather. Stored corms (similar to bulbs) show red specks with raised borders. These slowly darken and enlarge. Corms in the ground rot. Plants turn yellow. Roots have brown spots or general rot. Older leaves yellow. Flower size, shape and color may be abnormal. Flowers may not develop, while stalks are curved in an S-shape. Corms rot from the center outward. Oval, sunken spots on the corm surface are brown and may have concentric rings.

What you can do: Destroy (do not compost) infected corms. Buy only firm, undamaged corms and handle them gently. Plant in sunny, well-drained sites. Rotate beds each spring.

Fusarium Crown Rot, Fusarium Root Rot, Fusarium Bulb Rot, Basal Rot, or Wilt

Key hosts—annual: Ageratum, bush violet, caladium, China aster, cineraria, dusty miller, gladiolus, marigold, strawflower

Key hosts—perennial: Aster, astilbe, bachelor's button, bellflower, bleeding heart, catmint, chrysanthemum, crocus, daffodil, delphinium, foxglove, hosta, lily, lily turf, lupine, narcissus, pinks, tulip

What it is and what it does: Fusarium fungus is a soil-borne fungus that persists for years. Damage to seedlings or feeding by soil insects increases the chance of infection through roots. Plants become yellow and wilted, mostly on one side of the plant. Lower leaves turn yellow before the upper leaves; eventually turning brown and dry. Heat increases the disease's effects and you may see ooze on stems. On hot days, plants can suddenly collapse.

IPM solutions: Reduce plant stress, such as too much or too little water. Remove soil and replace with soilless mix, or consider raised beds. Fungicides are of little help. Take care to avoid root damage as you plant. Destroy (do not compost) rather than move diseased plant material. If replacing plants, look for lists of fusarium susceptible plants—besides aster—to avoid. Maintain a soil pH of 6.6 to 7.0 and use nitrate as the nitrogen source when fertilizing.

Fusarium Root Rot on Chrysanthemum. Photo: Penn State Department of Plant Pathology & Environmental Microbiology Archives, Penn State Univ., Bugwood.org

Fusarium Basal Rot on Daffodil. Remove failing daffodils to reduce disease in the soil. Photo: R.K. Jones, North Carolina State University, www.forestryimages.org/browse/detail.cfm?imgnum=1525466

Bulb and Stem Nematodes (*Ditylenchus* spp.)

Key hosts—annual: Cockscomb, dahlia, million bells, petunia

Key hosts—perennial: Astilbe, bugbane, cranesbill, daffodil, daylily, delphinium, hosta, hyacinth, lamb's ear, lungwort, narcissus, poppy, ragwort, sedum and others

What it is and what it does: These prolific breeders are microscopic worms that spread easily when soil is wet. Symptoms vary widely; some plants turn yellow or bronze, but most often, they wilt, weaken, or die. Look for twisting. Sacrifice a dying plant and inspect roots, looking for stubby, stunted, decayed, swollen, or blackened roots, sometimes covered with galls, nodules, or knots. As for stem or bulb nematodes, look for discoloration in stems that doesn't move beyond the veins.

IPM solutions: No cure, so don't spread them accidentally with tools or rototiller tines (wash well, and away from your garden).

Alfalfa stem nematode, *Ditylenchus dipsaci,* shown here on garlic. Photo: Bruce Watt, University of Maine, Bugwood.org.

Consider soil solarization if nematodes are widespread—damp, bare soil covered with clear plastic for the hottest six weeks of summer. Leaving an area fallow—no plants, no weeds—reduces food supply, but their numbers can rebound quickly the following year. Destroy infected plants when possible. Plant cover crops they don't like: annual ryegrass, rapeseed. French marigolds work too, but aren't effective on northern root knot nematode (and who knows which kind you have, right?). Adding compost increases other soil microorganisms that may reduce nematodes.

Sclerotinia, White Mold, Sclerotinia Stem Rot, Sclerotinia Blight or Wilt, Crown Rot (*Sclerotinia* spp.)

Note mycelial webbing on this poor petunia plant that had stem rot and dieback, caused by *Sclerotinia sclerotiorum.* Photo: Oregon State University Plant Clinic.

Baptisia plant infected with *Sclerotinia sclerotiorum.* Photo: Michigan State University, Diagnostic Services, pestid.msu.edu/plant-diseases/sclerotinia-sclerotiorum/

Key hosts—annual: Alstromeria, calendula, dusty miller, forget-me-not, pansy, petunia, plectranthus, sweet potato vine

Key hosts—perennial: Ajuga, baby's breath, beebalm, bellflower, black-eyed Susan, blue false indigo, columbine, coneflower, corydalis, daffodil, delphinium, foxglove, hosta, hyacinth, iris, lily of the valley, lungwort, narcissus, obedient plant, phlox, red-hot poker, sedum, tickseed, tulip

What it is and what it does: A serious fungal disease that survives in soil and moves in soil water (and rain), on transplants, and unsterilized tools. Infected plants turn yellow, and mushy, brown lesions appear at soil line. A white coarse webbing (mycelium) is a classic symptom. Sclerotia (spore producing bodies) resembling mustard seeds or small pebbles can also be seen in the crown. Plants wilt and die quickly. This disease thrives in high moisture and temperatures below 80° F. Overwinters in dead plant parts or in soil.

IPM solutions: Remove all moldy plants right away. Remove soil around roots—carefully! If you remove diseased plants, also remove the surrounding soil: 8 inches deep and 6 inches wider than where the plant sat. Pull nearby broadleaved weeds and remove damaged plants. Don't grow disease-prone plants there for four or more years. Try solarization. Cultivate around plants with a history of this disease but don't damage plant crowns. Sterilize tools and stay out of wet gardens. Consider fungicides.

Root Rots

Phytopthora Root Rot (*Phytophthora* spp.);

Key hosts—annual: Baby's breath, dusty miller, elephant's ear, impatiens, Gerbera daisy, million bells, periwinkle, pocketbook plant

Key hosts—perennial: Bachelor's button, beardtongue, coneflower, coral bells, foxglove, lavender, lily, lily turf, ornamental strawberry, ragwort, spurge

Pythium Root Rot (*Pythium* spp.);

Key hosts—annual: Ageratum, alstromeria, begonia (tuberous), blanket flower, caladium, cockscomb, geranium, Gerbera daisy, larkspur, lobelia, million bells, nicotiana, petunia, plectranthus, snapdragon

Key hosts—perennial: Blanket flower, dead nettle, fern, poppy, rose mallow, verbena

Rhizoctonia Crown Rot, Rhizoctonia Root Rot (*Rhizoctonia solani);*

Key hosts—annual: Ageratum, alyssum, blanket flower, China aster, dahlia, fuschia, larkspur, nicotiana, ornamental kale, plectranthus, poppy, portulaca, salvia, snapdragon, statice

Key hosts—perennial: Astilbe, balloon flower, blanket flower, blue false indigo, coral bells, lavender, lily turf, ornamental strawberry, primrose, rose mallow, tickseed, tulip

Thielaviopsis Root Rot, Black Root Rot (*Thielaviopsis basicola)*

Key hosts—annual: Pansy, sweet pea

Key hosts—perennial: Phlox

What it is and what it does: Root rots can occur early like damping off or, later, when a plant is established but besieged by waterlogged soil and soil-borne diseases. It usually strikes seedlings before first true leaves show, but plants can also succumb later when plants exhibit slow growth, yellowing leaves, or simply collapse. Phytophthora is particularly troublesome because it is a water-mold and remains persistent in soil. Root rots result in limp, thin roots with little evidence of tiny rootlets. In most plants, roots should be white or light brown, not dark brown or black. Thielaviopsis causes black spots on roots.

IPM solutions: Start seeds in disease-free, soilless potting mixtures or buy seedlings from trusted sources. Don't overwater plants, work in a wet garden, or over-fertilize. Disinfect tools, boots and gloves, and consider raised beds in problem areas.

Pythium and phytophthora root rots. Photo: The Ohio State University Ornamental Disease Fact Sheets, Pythium & Phytophthora Root Rots.

Pythium and phytophthora root rots. Photo: The Ohio State University Ornamental Disease Fact Sheets, Pythium & Phytophthora Root Rots.

Rhizoctonia crown rot on *Celosia*. Photo: Department of Plant Pathology, North Carolina State University, Bugwood.org

Thielaviopsis root rot on Viola., Photo: OSU Plant Clinic Collection

Rust is a complex, but manageable, fungal disease. Photo: Florida Division of Plant Industry , Florida Department of Agriculture and Consumer Services, Bugwood.org.

Rust on sunflower leaf; growth of pycnidia. Photo: North Dakota State University,www.ag.ndsu.edu/cpr/plant-pathology/sunflower-rust-found-in-nc-north-dakota-06-19-14.

Rust on aster. Photo: M. Grabowski, UMN Extension, blog-yard-garden-news.extension.umn.edu/2013/09/rust-fungi-infect-fall-blooming.html.

Daylily rust resembles drought damage until you look closely. Photo: Florida Division of Plant Industry, Florida Department of Agriculture and Consumer Services, Bugwood.org.

Note areas in your garden where you suspect soil-born fungus issues, and be sure to rotate out, or avoid placing susceptible plants in those areas. Root rots are difficult to deal with.

Rust

Common Rust, Fuschia Rust, Pelargonium Rust, Hollyhock Rust *(Puccinia* spp.*, Uromyces* spp.*)*

Key hosts—annual: Baby's breath, calendula, canna, fuschia, geranium, pansy, rose mallow, snapdragon

Key hosts—perennial: Anemone, aster, bachelor's button, beardtongue, beebalm, bellflower, blue false indigo, chrysanthemum, coral bells, daylily, gaura, gayfeather, goldenrod, iris, lupine, meadow rue, monkshood, musk mallow, obedient plant, roses, rose mallow, speedwell, sunflower, yarrow

What it is and what it does: Rust is a fungal disease with an odd life cycle—most reproduce by using two different plant hosts (called alternate hosts). Most can spread by wind and rain. Look for oval, cinnamon-colored bumps (pustules) scattered over tops and bottoms of leaves; these rupture, releasing dusty red spores. Spots turn brownish-black with spore masses. Rust progresses fast in humid weather with temperatures over 80° F.

IPM solutions: Do a thorough fall cleanup. Reduce alternate hosts: this means investigating the name of the rust species your plant carries and then searching for its alternate host and removing it where possible. As with any fungal disease, improving air flow and reducing humidity (thinning) is key.

Daylily Rust *(Puccinia hemerocallidis)*

Key hosts—perennial: Daylily

What it is and what it does: Rust is a type of fungal disease which typically needs an alternate host to survive. In other words, because of the way it reproduces, one type of its spores need one plant while another type of its spores need another. Watch for yellow or yellowish brown spots on leaves. They may begin to look like streaks. To avoid confusing this disease with Daylily Leaf Streak, look on the underside of the leaf for bright yellow or orange pustules. No pustules means it's not rust. Leaves will eventually become brown and dry up.

IPM solutions: Consider choosing puccinia-resistant daylilies next time or replace your current plants—though this is not a cure. Look around your garden for the alternate host plant, Patrinia, also known as Golden Lace. You might have to choose

one or the other to keep them from infesting each other. Remove all diseased daylily leaves promptly (they can be composted—the disease doesn't survive on dead plant material), and clean up debris in fall or early spring. Daylily rust can be slowed with early action.

Note: Removing all Patrinia plants doesn't mean this disease won't find a way to reproduce, but it certainly helps.

Surface Mold

Powdery Mildew

Key hosts—annual: Ageratum, begonia (tuberous), calendula, cosmos, cupflower, dahlia, forget-me-not, Gerbera daisy, hyssop, larkspur, marguerite daisy, melampodium, petunia, poppy, salvia, snapdragon, sunflower, sweet pea, wishbone flower, zinnia

Key hosts—perennial: Anemone, aster, astilbe, bachelor's button, beardtongue, bear's breeches, beebalm, bellflower, black-eyed Susan, blanket flower, blue false indigo, catmint, columbine, coral bells, cranesbill, culver's root, delphinium, foxglove, gaura, gayfeather, globe thistle, hyssop, lamb's ears, lupine, meadow rue, mullein, ornamental strawberry, phlox (tall phlox primarily), roses, salvia, sedum, Shasta daisy, speedwell, St. John's wort, sunflower, tickseed, turtlehead, verbena, yarrow

What it is and what it does: This very common fungus thrives in dry, moderated days with cool, humid nights (temps 50° to 80°F). Morning dew is its friend. Spores germinate in dew but grow only on dry leaves and primarily spread through air movement. New, tender leaves are most vulnerable. It doesn't spread among plant species unless they're closely related. (Example: mildew that infects lilacs won't infect roses.) First signs can be subtle: irregular patches, yellow or pale green, on upper leaf surfaces; usually starts lower on the plant where humidity is highest. Then note white or gray powdery patches on leaves, like a dusting of talcum powder. Badly infected leaves brown and drop; some pucker and get distorted. Severe cases block sunlight, weakening plants. Rarely kills.

IPM solutions: Difficult to control once established. Tolerant (although not completely resistant) varieties may be available for some hosts. If severe, consider horiticultural oils, bicarbonate- or sulfur-based products, or other fungicides at the first signs next year. Keeping records is part of IPM.

Don't confuse downy mildew with powdery mildew.

Both diseases are generally host-specific.

Powdery mildew on rose. "PM" is a virilent disease that is host specific, and dependant on overcrowding, air temperature and humidity, and lack of sunlight. Photo: Penn State Department of Plant Pathology & Environmental Microbiology Archives, Penn State University, Bugwood.org.

High humidity promotes the development of powdery mildew, as on this peony. Photo: University of Wisconsin Master Gardeners.

Sooty Mold (*Cladosporium* spp. and *Alternaria* spp.)

Key hosts—perennial: Rose

What it is and what it does: A fungus that grows on honeydew; honeydew is the sticky excrement of pests like aphids and lacebugs. Honeydew is often mistaken for tree sap and can coat a vehicle in as little as twelve hours in summer. Sooty mold fungus grows on the honeydew and becomes a black, sooty covering.

IPM Solutions: Hosing plants carefully can remove some of the honeydew. If plants are below aphid-hosting trees, there's not much you can do. If plants are filled with aphids, consider your garden hose. If the plant can take the pressure, hose the aphids off. Insecticides reduce beneficial insects and, instead of solving the problem, you'll often see a resurgence of aphids with few beneficial insects to keep them in check. Refer to the later Insect Pest section for advise on attracting natural enemies of aphids.

Wilt

Feeling wilted?

Seek expert help to identify bacterial wilts. Unfortunately your next step might be all-new beds or soil, and a switch to less wilt-prone plants.

Bacterial Wilt (*Pseudomonas* spp.)

Pseudomonas bacterial leaf spot on ivy. Photo: Michigan State Univeristy Diagnostic Lab, pestid.msu.edu/plant-diseases/bacterial-leaf-spot/

Symptoms of bacterial leaf spot *(Pseudomonas cichorii)* on mum plants. John Hartman, University of Kentucky, Bugwood.org

Key hosts—annual: Begonia, caladium, canna, dahlia, forget-me-not, geranium, larkspur, nasturtium, pinks, poppy, statice, stocks, zinnia

Key hosts—perennial: Bear's breeches, black-eyed Susan, chrysanthemum, cranesbill, delphinium, hosta, hyacinth, iris, ivy, monkshood, pinks, poppy, primrose, rose mallow, salvia, sunflower, tiarella, tulip, verbena

What it is and what it does: Bacterium overwinters on plant material and in seeds, and becomes active in temperatures of 75° to 82°F with high humidity. Though it is called leaf spot, it attacks all part of the plant. Leaves show small, angular spots with a water-soaked appearance, which are clear when held to the light. (By comparison, fungal spots are generally round-edged). Spots later turn brown. In high humidity, spots appear milky—this is bacterial ooze which dries into a white crust. These spots can occur on stems as well; stems may fall over. In bulbs, look for rotting and softening, and a foul-smelling ooze.

IPM solutions: Avoid working in wet gardens, and don't water from overhead. Specific products containing copper have long been used to slow bacterial infections.

Verticillium Wilt
(Verticillium albo-atrum)

Key hosts—annual: Dahlia, impatiens, strawflower

Key hosts—perennial: Black-eyed Susan, foxglove, gayfeather, monkshood, myrtle, ornamental strawberry, poppy, salvia

What it is and what it does: This fungal disease is in most soils, and will be inactive until soil temperature and moisture are ideal. On many hosts, lower leaves yellow first, then brown and fall off. Shoot tips wilt during the day; leaf tips curl inward. Infected plants tend to be smaller than their neighbors. Verticillium travels through the root hairs and into the plant up through stems. If you break open a stem, you'll see dark streats.

Note: It often affects one side of a leaf or plant first. Develops more slowly than Fusarium wilt (which can strike overnight). Leaf spots don't have a bulls-eye appearance like Alternaria.

IPM solutions: Choose resistant varieties—there are many. Keep plants healthy with adequate fertilization and light watering. Remove crop debris. Slow draining soil exacerbates it; consider a raised bed with clean soil. Remove and replace surrounding soil as a last resort.

Verticillium wilt typically affects only part of the plant. Photo: Texas A&M Horticulture, aggie-horticulture.tamu.edu/vegetable/problem-solvers/cucurbit-problem-solver/leaf-disorders/verticillium-wilt/.

Verticillium wilt on sunflower. Photo: French National Institute for Agricultural Research, www7.inra.fr/hyp3/pathogene/6veralb.htm.

Lupines. Photo: Pixabay.

IPM Solutions for Insect, Mite, and Slug Problems on Annuals, Perennials, Bulbs and Groundcovers

We've lumped some pests together since most pests attack a range of plants. Here's some general advice for avoiding problems:

- Note in your garden journal when you add fertilizer or compost, divide plants, or bring in new ones.
- Scout routinely for pests (for the good guys, too), and track what, how many, and when in your journal.
- Inspect potted plants before you buy them—tap the stems to see if tiny insects fly or fall off leaves.
- Use slow-release or organic fertilizer—or compost—to avoid the lush, quick growth (promoted by high-nitrogen fertilizers) so attractive to many pests.
- Compost can improve soil, making for healthier, more stress-resistant plants.
- Attract natural enemies with varied, pollen- and nectar-rich flowers; with water and shelter, too.
- Plant in mixed beds to confuse pests.
- Hose off small, delicate pests—aphids, mites, leafhoppers. Repeat as needed.
- Handpick or do the sheet or paper plate-beneath-the-plant trick. Knock or drop pests into a can or bucket of soapy water. Some insects, like Japanese beetles, come together in such large numbers that you can brush them en masse into a can of soapy water.
- Set out lures, traps or trap crops for insects—reviewing first our capture methods. Usually it's best to snag them early on a cool day, before they've revved up.
- Clean the garden well in fall. Some insects overwinter in damaged leaves and stems. But leave little piles of disease-free, undamaged leaves around to provide winter homes for natural enemies.

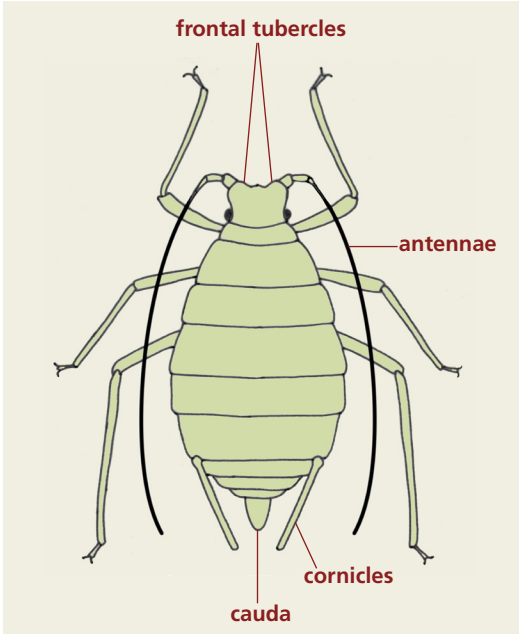
Good Garden Housekeeping

- Mulches provide homes for natural enemies.
- Till or turn over soil after annuals are done to destroy overwintering sites or expose larvae and pupae to weather and predators
- Consider pesticides if severe—there are many low-toxicity options. Use pesticides after sunset, when bees aren't active.
- Consider row covers over plants when local sources warn of high pest populations. Remember to hold covers down with stones or mulch. This doesn't work for pests that may have reproduced in the soil under your plants!

Aphids

Key hosts—annual: Amaranthus, caladium, China aster, cineraria, cleome, dahlia, dusty miller, fairy fan flower, forget-me-not, fuschia, geranium, Gerbera daisy, gladiolus, globeflower, impatiens, lantana, Marguerite daisy, melampodium, milkweed, million bells, nasturtium, nicotiana, ornamental kale or cabbage, pansy, perilla, petunia, pocketbook plant, poppy, salvia, snapdragon, stocks, strawflower, Swan River daisy, sweet pea, verbena, wishbone flower

Key hosts—perennial: Ajuga, astilbe, bachelor's button, beardtongue, bear's breeches, beebalm, bellflower, black-eyed Susan, blanket flower, bugleweed, butterfly weed, chrysanthemum, coneflower, cranesbill, crocus, culver's root, daylily, delphinium, fern, foxglove, gaura, hellebore, iris, ivy, lily, lupine, pinks, poppy, roses, salvia, sedum, Shasta daisy, stonecrop, sunflower, tulip, yarrow



Parts of the aphid, used for identification.

What they are and what they do: Few plants are exempt from aphids, because most aphid species are generalists (they like all plants). Some aphids are host-specific. These tiny (to 1/8 inch), pear-shaped insects come in many colors, yellow, green, dusty black, red) and some have a fluffy white coating. Look for two cornicles, looking like tiny stovepipes on their rear ends. They have sucking mouthparts that draw sap from leaves, buds, and flowers, especially on new, tender growth. Feeding can distort or stunt foliage. The sticky liquid (honeydew) they leave behind attracts ants and makes the perfect habitat for sooty mold. Aphids reproduce readily and can have overlapping generations on plants (adults, eggs, nymphs).

Mixed generations of aphids. Photo: Whitney Cranshaw, Colorado State University, Bugwood.org

IPM solutions: Use slow-release or organic fertilizers which slows the quick, lush growth aphids love. Hose them off three mornings in a row, and you'll get rid of most. Encourage beneficial insects (aphids parasitized by wasps turn into golden-brown aphid mummies).

Beetles

Blister Beetles

Key hosts—annual: Calendula, dahlia

Key hosts—perennial: Anemone, blue false indigo, daylily, iris, lupine, peony

What they are and what they do: Blister beetles are a generic term for a large family of beetles, most commonly long-shaped and black. There are four species common in the northeast; all have a 'neck' which makes them recognizable among most beetles. Adult feeding of nectar and pollen damages flowering plants, but larvae cause no harm; in fact, they often prey upon

Blister beetles. Photo: David Cappaert, Bugwood.org

Striped cucumber beetle. Photo: University of Maryland Extension, extension.umd.edu/growit/insects/cucumber-beetles-spotted-or-striped

Western spotted cucumber beetle *(Diabrotica undecimpunctata).* Photo: David Cappaert, Bugwood.org

Cucumber beetle eggs. Photo: Roots and Wisdom Blog, blogs.cornell.edu/rootsandwisdom/2012/12/10/bug-hunting-7242012/

Crucifer flea beetle *(Phyllotreta cruciferae)* on broccoli. Photo: Whitney Cranshaw, Colorado State University, Bugwood.org

other pests. While feeding damage may not be severe enough to treat for this beetle, be aware that the name blister beetle is a warning. These beetles can be trouble in two ways: secretions will cause blisters on your skin, and their presence in forage such as harvested hay can be detrimental, even poisonous, to grazing animals.

IPM solutions: Damage to plants is minimal. Learn what the blister beetle looks like, so you can avoid the discomfort when possible. If you are an owner of grazing animals, contact your cooperative extension agent for ways to reduce the chance of accidental poisoning.

Striped Cucumber Beetle *(Acalymma vittatum)*, Spotted Cucumber Beetle *(Diabrotica undecimpunctata)*

Key hosts—annual: Canna, cosmos

Key hosts—perennial: Sunflower, tickseed

What they are and what they do: Similar in appearance and with similar life cycles for the most part, we lump these two pests together; adults of both feed on leaves and fruit, while larvae of both feed on roots and stems. Much more common in the northeast, the striped cucumber beetle overwinters in topsoil under plant debris and comes out in early spring to feed on wild host plants. The spotted cucumber beetle generally doesn't overwinter but flies in later in the season and has a much wider variety of hosts. Both are long, pale beige or yellow, and 1/4 to 1/2 inches in length. Their size matters little because of quantity. Adults lay eggs at the crown, larvae enter soil to feed on roots and pupate. The next generation of adults and larvae may do more damage—the larvae may feed on plant stems or fruit as well. Their feeding can also spread bacterial diseases.

IPM solutions: Since cucumber beetles can spread bacterial disease, dealing with them is a high priority. Mulch slows larvae moving among plants but provides homes for adults—and helpful predators. They won't sit still for you, but you can knock them into a can of soapy water. Trap crops help—imagine the fun of growing one of those big blue Hubbard Squash with its big leaves at the edge of your garden.

Flea Beetles

Key hosts—annual: Forget-me-not, nicotiana, ornamental kale and cabbage, petunia, strawflower, sweet potato vine, wallflower

Key hosts—perennial: Anemone, colewort, gaura, gayfeather, hibiscus, monkshood, sundrops

What they are and what they do: Be glad these voracious, jumping beetles are so tiny. Adults are up to 1/16th inch long;

black, blue-black, brown, or bronze; some have stripes but the majority are solid colored and shiny. Adult feeding damage is easily identified by a shot-hole pattern; they prefer early, tender leaves but obviously feed all season long. Oh, and did we mention the jumping? Larval feeding on roots and stems can weaken or kill seedlings. Adults overwinter and emerge from soil to feed on early weeds until your garden plants are ready for them. Eggs are laid near the base of plants allowing larvae to enter the soil, pupate and start over with a second (or more) generation. This is one of those pests where both larvae and adults do damage, though it rarely kills plants.

IPM solutions: Seedlings are most vulnerable. Scout often for adults. Trap crops at the edge of the garden also help. Mulch slows down this pest. Purchasing and applying products containing the soil organism *Beauveria bassinia* is helpful if you're battling an infestation. Tricking adults to jump up onto yellow sticky cards can reduce their numbers.

Fuller rose beetle *(Pantomorus cervinus).* Photo: Russ Ottens, University of Georgia, Bugwood.org.

Fuller Rose Beetle *(Pantomorus cervinus)*

Key hosts—perennial: Rose

What they are and what they do: Adult beetles appear in July, chewing leaves and eating rose buds. They are gray-brown weevils (look for the long snout) just under a half inch long. Eggs are deposited on the soil surface; once hatched, the white larvae (~1/2 inch) dwell in the soil where they feed on turfgrass roots, or the roots of rose or berry bushes. They overwinter as pupae.

IPM solutions: The damage to roses is aesthetic but if you can confirm this tiny beetle is the culprit, you can remove them into soapy water (they don't fly), and, in spring or fall, try to stir up the soil near the base of the rose bush to expose pupae. In extreme situations, consider pesticides.

Fuller rose beetle on leaf. Photo: Agricultural and Natural Resources, University of California, ucanr.edu/blogs/blogcore/postdetail.cfm?postnum=5478

Japanese Beetle *(Popillia japonica)*

Key hosts—annual: Canna, dahlia, forget-me-not, four-o-clock, marigold, perilla, rose mallow, zinnia and others

Key hosts—perennial: Anemone, astilbe, beardtongue, canna, coneflower, culver's root, foxglove, hollyhock, musk mallow, phlox, ragwort, rose, hibiscus

What they are and what they do: These easily recognized metallic blue-green and coppery 1/2 inch beetles are sun lovers from July through September, massing and feeding on leaves of all kinds, and often leaving them skeletonized. Adult feeding by masses can rapidly defoliate a plant. Larvae are fat, pale gray, brown-headed, C-shaped grubs that can be as long as 1¼ inches. They feed in soil on roots, including turfgrass roots, overwintering and pupating there as well. Grubs often show up in the soft, moist soil of your garden; the adults are strong flyers.

Japanese beetle *(Popillia japonica).* Photo: Joseph Berger, Bugwood.org

Damage to rose by Japanese beetles. Adults feed on blossoms, leaves and tender stems. When feeding in mass, they can create major damage in a day. Photo: Whitney Cranshaw, Colorado State University, Bugwood.org

IPM solutions: In July, check your garden (vegetable, fruits and flowers) daily at dawn or dusk, and flick adults into soapy water buckets, or shake off onto a tarp (and then destroy). Handpicking is the most successful and safest option. Don't use beetle lure traps because these beetles are strong flyers. Lures can just attract more to your yard. Drought in July through September usually affects the following year's population.

Lily Leaf Beetle *(Lilioceris lilii)*

Lily leaf beetle *(Lilioceris lilii)* adults. Photo: Leslie J. Mehrhoff, University of Connecticut, Bugwood.org.

Key hosts—annual or perennial: Lily (Asiatic lily, Easter lily, Oriental lily, Turk's cap lily), frittilaria

Key hosts—perennial: Nicotiana, Solomon's seal

What they are and what they do: During a three week period in summer, hatched larvae feed on the underside of leaves and can defoliate plants in a matter of days. Adults are small, 1/2 inch bright red beetles with black legs and head. There can be three generations a year. You may easily see the adults, but the hatched larvae resemble brownish slugs with legs, and cover themselves with excrement. If you think you see walking bird poop on a lily leaf, you may be seeing the larvae. Larvae drop to the soil to pupate; pupae are bright orange. The overwintering larvae stay under leaf litter or in soil. Adult females can lay hundreds of yellowish-orange eggs on leaf undersides.

Red alert!

If you spot a tomato-red beetle or a fluorescent orange pupa when you're digging, it could mean danger to all the lilies in your area. Look twice. Get help with ID. Alert your county's cooperative extension or your state's department of agriculture.

IPM solutions: Keep an eye out for red. Adults show up in mid-April and will start laying their red eggs in May. Look on the undersides. Adults are strong fliers so they may come in from the neighbor's garden. Make sure you don't bring them in as eggs on the undersides of leaves from a nursery or gardening friend. The easiest treatment is scouting and knocking adults, larvae or eggs into a cup of soapy water. For heavy infestations, choose a biopesticide containing neem as it is effective on larvae. Releases of a natural enemy of this beetle have begun in some locations, and, if successful, may provide a long-term solution to this pest.

Oriental Beetle *(Anomala orientalis, Exomala orientalis)*

Oriental beetles. Photo: Doug Richmond, extension.entm.purdue.edu/CAPS/pestInfo/orientalBtl.htm.

Key hosts—annual: Dahlia, petunia

Key hosts—perennial: Hollyhock, phlox, rose

What they are and what they do: This scarab beetle is similar to Japanese beetle, but the adult does far less damage to plants—it's just not as voracious. Adults emerge in mid-June, mate and lay eggs. Larvae hatch and feed on plant and turfgrass roots before going deeper into the soil to overwinter. They pupate in spring. Larval feeding on turfgrass can be a problem, and can bring skunks, opossums, and racoons into your yard to dig for them at night.

IPM solutions: Scout for adults; they fly at night and during the day, but feed during the day. There is rarely a need to treat, but feel free to knock them into soapy water. If larvae (grubs) begin to destroy your lawn (this is less common than you think), consider a pest control company that specializes in biological controls such as *Beauveria bassiana*, or *Steinernema* nematodes.

Rose Chafer Beetles *(Macrodactylus subspinosus)*

Key hosts—annual: Dahlia

Key hosts—perennial: Beardtongue, hollyhock, iris, Shasta daisy, poppy, rose

What they are and what they do: These reddish-brown or tan beetles have long orange legs, and emerge in late May to begin heavy feeding on leaves, and massing in swarms. They lay eggs in soil in June or July, generally in grass or weedy areas. Larvae remain in the soil, feeding on roots (like other grubs) and pupating the following spring.

IPM solutions: Handpick and drop into soapy water. Consider temporary netting of cheesecloth or organic spray deterrents. Deep fall cultivation of garden beds (without damaging roots) may help expose larvae before they go deeper for the winter.

Rose chafer beetle adult, *(Macrodactylus subspinosus)*. Photo: Jim Baker, North Carolina State University, Bugwood.org.

Beetles that Sometimes Misbehave

Many beetles dine on plants in passing without major damage. Others cause big problems—occasionally:

Click Beetles and Wireworms: Larvae—wireworms—bore into bishop's flower, anemone, dianthus, chrysanthemum, dahlia, gladiolus, large bellwort, and primrose. Plants suddenly wilt. Larvae to 1½ inches, cylindrical, yellowish brown, and hard-skinned; look like a jointed piece of wire. Adult click beetles have a "click mechanism" on their undersides. When disturbed, it can propel them several inches into the air. Long, brown, flattened; to 1½ inches. Feed on nectar. Trap beetles early in the season by burying potato chunks on skewers; destroy chunks after the wireworms bore inside.

Coreopsis Beetles: Adult is brown and black striped, ¼ inch. Larvae are gold and black. Adults skeletonize a coreopsis quickly. Watch for them in summer and handpick.

Oriental Beetles: Larvae look like Japanese beetles grubs. Adults are ½ inch, mottled gray and black, or nearly all-gray or all-black; others are tan with brown patches; to ½ inch. Antennae are branched—striking if you take a close look. Adults are rarely seen but their feeding can shred rose petals. Grubs can destroy root systems of astilbe, dahlia, hosta, petunia, phlox, roses. For solutions, see Japanese beetles.

Mexican Bean and Colorado Potato Beetles: Both are orange adults, but Mexican bean beetles have black spots; potato beetles have stripes. Both emerge as adults in spring or summer and their larvae feed in masses. Mexican bean beetles damage legume plants; potato beetle larvae feed on the solanaceous family.

Grapevine Pelidnota or Grapevine Beetle: This 1 inch adult beetle shows up in June on wild and cultivated grapevines. Larvae feed on rotten wood. Besides size, you'll notice the pale orange color with three prominent small black spots along its elytra.

Rose curculio *(Merhynchites bicolor)* adult, and damage on rose. Photo: Kansas Department of Agriculture , Bugwood.org.

Rose Curculio *(Rhynchites bicolor)*

Key hosts—perennial: Rose

What they are and what they do: Rose curculio is a pretty little weevil—shiny red to black and 1/4 inch long, with black legs and snout. It prefers yellow or white roses, and may prefer feeding at night. (Unfortunately yellow roses tend to be more fungal resistant, so they are often recommended.) Adults lay eggs in hips and buds in May and June; larvae (legless, white, ~1/4 inch) emerge and feed inside buds through the summer, before dropping to pupate in the soil over the winter. One generation a year; both adults and larvae cause damage on buds, flowers.

IPM solutions: Scout throughout the season and look for shot-hole damage in petals and leaves. Buds may appear dried up, or have a broken stem just below the bud. Hand pick adults in May and June, or shake them out over a tray of soapy water, or a white sheet or newspapers on the ground—then destroy them. Remove and destroy damaged buds. For infestations, consider insecticidal soaps or products containing neem oil. Encourage your bird friends. Wrens are great allies.

Black vine weevil. Photo: Kent Loeffler, Cornell University, Bugwood.org.

Vine Weevils: Strawberry Root Weevil, Black Vine Weevil *(Otiorhynchus* spp.*)*

Key hosts—perennial: Coral bells, corydalis, hellebore, lily of the valley, pigsqueak, primrose

What they are and what they do: A double threat. The adult weevil emerges in May or early June to feed along the edges of foliage. Black vine weevil is almost 1/2 inch, strawberry root weevil is half that size. Both are small, black snout beetles, and a pest on many landscape flower, vegetable and fruit plants. Adults are walkers, not flyers, and leaf-feeding is minor (leaving tattered notches on leaf edges). One hundred to 200 eggs are laid at the base of the plant, allowing larvae to enter the soil throughout summer, and feed on roots first and then the crown, causing wilting and possible plant death. Larvae are white grubs with yellowish-brown heads; they overwinter to pupate in spring.

IPM solutions: Lay burlap or cardboard on ground. Weevils will hide under it during the day making it easy to capture and destroy them. To look for adults, scout at night with a flashlight. During the day, look for notching in leaves that shows activity. If you suspect root weevil activity, dig up a couple failing plants in spring when larvae are large. Support plant health, and consider adding parasitic nematodes from the genus *Heterorhabditis* to reduce infestation. Chemical treatments must be focused on adults, applied about two weeks after you've confirmed their activity (evening application is recommended).

Borers

European Corn Borer *(Ostrinia nubilalis)* and other Clear-Winged Moths

Key hosts—annual: Cosmos, dahlia, geranium, gladiolus

Key hosts—perennial: Aster

What they are and what they do: The European corn borer (ECB)overwinters as larvae in plant debris—often inside dead stalks. It pupates and emerges in late May as a yellowish-brown moth, ~1 inch wingspan, with faint zig-zag markings (diamond-shapes) on its wings. Pinhead sized eggs are laid on the undersides of leaves in a tight, overlapping mass. Pale gray larvae (sometimes appear pinkish) have brown head capsules and mature at about 3/4 inch. While corn is their first choice, ECB females will move to crops in a moister setting. Larvae feed on leaves before tunneling into the stem. Look for frass, which often collect in leaf axils.

IPM solutions: Good weed control is essential, and encouragement of beneficial insects helps. If you see a plant wilting or browning, examine the stems for evidence of a borer entrance. Once the borer is inside the stem, it is beyond most treatment; prune below the hole or rogue the entire plant to reduce the next generation.

European corn borer *(Ostrinia nubilalis).* Photo: Mariusz Sobieski, Bugwood.org.

Iris Borer *(Macronoctua* spp.*)* and Stalk Borer *(Papaipema* spp.*)*

Key hosts—perennial: Coneflower, iris, speedwell, peony

What they are and what they do: The adult borer has brownish forewings and yellowish-brown hindwings with a 2 inch wingspan. Females lay over 150 eggs on leaves, flower stalks and debris in fall. Eggs hatch in the spring; larvae crawl into the stalks through a tiny hole they create and then tunnel down to through the crown to the roots or rhizomes. On iris, look for browning of just one edge of the leaf, rather than the entire leaf. Stems or fans (iris leaves) turn brown and collapse. Look for frass—it may look like sawdust. Borer damage encourages bacterial disease. Matured larvae move into nearby soil in early fall, pupate, and adults emerge and reproduce before winter.

IPM solutions: Clean up old leaves in late fall or before April. Don't plant just irises. A garden of varied flowers helps keep moths from finding all your irises so borers don't destroy the beauty of your entire bed. Scout early and often for pinholes, fine silk threads, and frass. Shine a flashlight behind the leaf to see the shadows of borers inside. Pinch them dead, working up from the base of the leaf, or cut off damaged sections, even

Iris Borer *(Macronoctua onusta),* larva feeding. Photo: Bob Gutowski,c1.staticflickr.com/5/4139/5442881317_9a5a2312ba_b.jpg, CC BY-NC-SA 2.0.

Stalk borer, *Papaipema nebris.* Photo: Mike Boone, upload.wikimedia.org/wikipedia/commons/5/50/Papaipema_nebris1.jpg, CC BY-SA 2.5.

entire leaves; destroy. Kill larvae in rhizomes (remember, rhizomes lie halfway above the ground) by piercing them with a wire or sharp knife. Inspect and destroy infested rhizomes after flowers bloom. Move clean irises to borer-free beds. Save lightly infested rhizomes by cutting out soft areas. Found a hole but no larva? Check soil nearby for pupae and destroy. Divide crowded plantings. Pesticides are a last resort.

Caterpillars

Beet Armyworms (*Pseudaletia* and others)

Beet armyworm larva. Colors and striping change slightly at each instar cycle. Photo: Frank Peairs, Colorado State University, Bugwood.org

Beet armyworm larva late instar. Photo: Russ Ottens, University of Georgia, Bugwood.org

Key hosts—annual: Pinks

Key hosts—perennial: Baby's breath, chrysanthemum, cranesbill, pinks, rose

What they are and what they do: Adults are pale gray-brown moths, 1 inch long with a 1 1/2 inch wingspan; a white dot in each forewing. Armyworm moths move in from the south, looking for food. Round, white eggs are laid in clusters on the underside of leaves, wrapped with webbing for protection. Egg-laying adults prefer an area with dense vegetation. When hatched, larvae begin feeding (usually in June) and can leave large ratty holes in leaves that resemble hail damage. Larvae go from pale green to tan and greenish-brown with white side stripes and dark back stripes. Up to 1 1/2 inches long. Caterpillars move in masses—armies—in search of food, but their damage can be spotty, as it's localized near their hatch site. Large armies can do considerable damage overnight. Larvae drop to the soil to pupate but the second generation is usually not as much of a problem.

Coping With Caterpillars

You won't often need pesticides to deal with caterpillars. Try these methods first.

Handpick caterpillars you don't want and drop into a bucket of soapy water or move them elsewhere.

Rotate and Cultivate. Move caterpillar-prone annuals to different parts of the garden each year—it helps prevent pests from building up. Pull back mulch and cultivate soil in early spring and late fall. This exposes or kills overwintering pupae.

Cover your rows. Spread floating row covers over favorite and pest-prone flowers in early spring to prevent butterflies from laying eggs. Remove covers at flowering—or earlier if butterflies are gone.

Use Bt *(Bacillus thuringiensis)* that is labeled for caterpillars. This natural, soil-dwelling bacterium makes caterpillars sick, killing most—including those of butterflies you might want. But it doesn't harm other insects.

Attract natural enemies. Lady beetles eat small caterpillars and lacewings eat their eggs. Trichogramma and braconid wasps, tiny things that won't bother you, lay their eggs in or on eggs or caterpillars. The young wasps eat them inside-out. Birds, frogs, and salamanders eat caterpillars too.

Friendly fungi. Entomopathogenic fungi—fungi that live inside other things—kill some leaf-feeding caterpillars without harming other insects. Call your county's cooperative extension to learn more.

IPM solutions: Scout often for egg masses to stop them before they hatch. Contact your local cooperative extension and ask if armyworms have been seen by local farmers. Usually by the time you see damage, the larvae have been feeding for a couple of weeks. Bt is a good option unless the larvae are nearly mature.

Adult tobacco budworm—look for the fuzzy cape it wears. Photo: J. Michael Moore, University of Georgia, Bugwood.org

Budworms: Tobacco Budworm, Fall Budworm *(Heliothis* spp.*)*

Key hosts—annual: Ageratum, geranium, million bells, snapdragon

Key hosts—perennial: Rose

What they are and what they do: These moths' larvae are caterpillars that love to eat flower buds and petals. Larvae actually vary in color depending on what plant they are consuming. Adult moths lay single eggs on buds or leaves; two generations per year. Larvae overwinter. Adults have a 1 1/2 inch. wingspan with light green to light brown wings. To identify, look for wavy, cream-colored bands on wings.

IPM solutions: Scout buds and flowers early in the season and throughout. Look for holes in the buds or flowers, and for the caterpillars in evening, mostly at dusk (they tend to avoid sunlight). Handpick caterpillars and drop into soapy water. Re-pot containers with fresh soil if you've had geraniums or petunias, as larvae may be overwintering in the potting soil. The product Bt is not very effective on budworms, especially not on geraniums.

Examples of variation in tobacco budworm *(Heliothis virescens)* coloring and markings. Photo: (Above) Scott Bauer, USDA Agricultural Research Service, Bugwood.org; (Below), Joseph Berger, Bugwood.org

Cabbage Looper, Common Looper *(Trichoplusia ni)*

Key hosts—perennial: Chrysanthemum, cranesbill, pinks

What they are and what they do: The adult looper is a mottled brownish gray, nocturnal moth with a tiny silver figure eight on each forewing. Their wingspan is 1 1/2 inches. They lay small clusters of greenish-white eggs on the underside of leaves (their food source). Larvae are a solid green—the color of broccoli—with a faint yellow stripe along each side, and will grow to 1 1/2 inches. Loopers chew holes in leaves and stems, primarily between the leaf veins in mature plants. Feeding lasts two to four weeks before the larvae create cocoons for pupation; there can be multiple generations per season.

IPM solutions: Scout for eggs on the underside of leaves. Hand pick adults and larvae and drop into a can of soapy water. Another sign is dark green frass lower on the plant. Look for holes and you may find the culprits nearby. Loopers can do some damage, but you'll probably be more concerned with keeping them out of your vegetable garden.

Cabbage looper *(Trichoplusia ni)* larva. Photo: David Cappaert, Bugwood.org

Cabbage white *(Pieris rapae)* adult, on raspberry. Photo: Ansel Oommen, Bugwood.org.

Cabbage white *(Pieris rapae)* larvae, on kohlrabi. Photo: Ansel Oommen, Bugwood.org.

Butterflies—the bad and the beautiful

We love butterflies in our gardens, but the dining habits of some of their larvae—their caterpillars—can be a problem. Get a good butterfly guide to learn about caterpillars and the plants they like. If you want to attract butterflies, choose these plants, but place them where you won't mind some tattered leaves.

Corn Earworm larva markings are consistent, but color varies from green to brown. Photo: North Carolina State Extension, entomology.ces.ncsu.edu/field-corn-insect-corn-earworm/.

Cabbage Worm, Imported Cabbage Worm

Key hosts—perennial: Chrysanthemum

What they are and what they do: 1 1/2 inch larvae blend in nicely on green foliage, but the effects of their feeding do not. Look for ragged holes and green frass. Adults are the very common, nectar-feeding white butterflies (1 1/2 to 2 inches) flitting around in fields and gardens throughout the summer. Up close, you'll see a couple small black spots on the wings. It is thought cabbageworms overwinter as pupae; adults fly early in the season. Females lay one egg at a time on the underside of leaves, and after two to three weeks of feeding, the larva pupates by hanging from a thread from a leaf (no cocoon). With a possible three to five generations each year, you'll see cabbageworm and moth activity throughout the season. While young larvae eat leaves, mature larvae can damage growing heads.

IPM solutions: Scouting and removing by hand or water helps (the larvae are slow movers). Encourage their many natural enemies, and try a trap crop along the edge of your garden, such as a row of collards! Scout them for activity and you may keep cabbage worms off your mums (and cabbage).

Corn Earworm *(Helicoverpa zea)*

Key hosts—annual: Ageratum, dahlia, gladiolus

What they are and what they do: Adults moths are drab brown with dark spots in the centers of their wings, and a 1 1/2 inch wingspan. In mid-summer, they fly up from the south, and repeatedly lay single eggs (yellow and basically round) on leaves. Caterpillars are brown to tan or green with brown heads, micro-bristly bodies, and lengthwise stripes (also variable). Length to 1 3/4 inches. They feed on buds and flowers and can defoliate plants. Damage is more likely in fall, when their vegetable hosts are mature or harvested. Larvae drop to the soil to overwinter as pupae.

IPM solutions: Scout. Corn earworm act fast, so you may not see them until the plant is damaged. Because these are annuals, or tender perennials, there's little to do after the fact. Consider planting in a different spot the next year, or raking through the soil for pupae near the base of the plant. IPM for corn earworm on corn involves planting early, but this is not an option for glads and dahlia, as they are likely to be visited after the corn crop has matured and earworms are looking for tender plant material.

Cutworms (many species)

Black cutworm *(Agrotis ipsilon)* larva. Photo: Adam Sisson, Iowa State University, Bugwood.org.

Key hosts—annual: Cineraria, dahlia, nicotiana, petunia

Key hosts—perennial: Delphinium, hosta, pinks

What they are and what they do: Adults are dull brownish-gray moths and do no damage. Their wings are banded or striped with a 1 1/2 inch wingspan. They lay eggs on plant residue or live plants with low leaves. Larvae feed on leaves and roots until they are about a half inch long, at which time they prefer tender stems of young plants. Often, stems are severed and killed. Cutworms make their way to the next plant and are common in weedy settings. You may see them curled up on the soil surface. There are two to three generations per year but later cutworms do much less damage.

IPM Solutions: To protect young plants, push seedling collars around stems 1 inch into soil and sticking up 1 inch above soil. Or wrap stems loosely in tinfoil. Be sure foil doesn't choke growing plant. Time plantings carefully; wait till mid-June to set out transplants, since many cutworms pupate in early summer. (Not all species follow this pattern.) Or set out larger, stouter plants—cutworms find them less appealing. Weed often; move mulch away from young plants. Cultivate soil lightly in early morning to uncover resting larvae; destroy before they work through your plantings. Or scout at night with a flashlight; handpick! Focus on spots where you've had damage. Weed garden well in fall.

Tomato Hornworm *(Manduca quinquemaculata)*

Tomato hornworm larva. Photo: Whitney Cranshaw, Colorado State University, Bugwood.org.

Key hosts—annual: Nicotiana, petunia

What they are and what they do: A caterpillar this big must come from a large moth. It does. The adult hawk moth, also known as sphinx moth, is grayish-brown with a 4 to 5 inch wingspan. The adult female lays small, pale, yellow-green eggs under leaves. Caterpillars are few, big, noticeable; green (occasionally brown) with a black "horn". You'll see diagonal white stripes as well. At almost four inches in length, they make short work of your plants and leave gaping holes in leaves and dark green frass—huge dark frass. Mature plants usually survive, but seedlings don't.

IPM solutions: Scout in July and August. Handpick larvae (or eggs) and toss them into the bushes—it'll take them a long time to get back. If you see a hornworm with a bunch of little white tags attached—that's the work of a parasitic wasp; the hornworm will die soon. Fall tilling destroys many pupae. If you have been overwhelmed, consider insecticides such as Bt.

Narcissus bulb fly adult. Fly masquerading as a bee? Photo: Ken Gray Insect Image Collection, Oregon State University.

Narcissus bulb fly larva. Photo: Whitney Cranshaw, Bugwood.org.

Rose midge *(Dasineura rhodophaga)* damage. Photo: Bruce Watt, University of Maine, Bugwood.org.

Rose midge *(Dasineura rhodophaga)* pupae. Photo: Jim Baker, North Carolina State University, Bugwood.org.

Flies

Bulb Flies: Narcissus Bulb Fly *(Merodon equestris)*, Lesser Bulb Fly *(Eumerus tuberculatus)*

Key hosts—annual: Amaryllis

Key hosts—perennial: Daffodil, hyacinth, iris, lily, snowdrops, tulip

What they are and what they do: The "larger" bulb fly is still a small (1/3 to 1/2 inch), fuzzy, orange and black fly that is a fast flyer and likes to hover. The adult lays slender, white eggs on a plant near the ground. Hatched maggots crawl down the leaves into the crown of the bulb. In spring, they feed and grow from 1/16 to 3/4 inch, then exit the bulb and pupate in the soil inside a hard brown pupal case. The 'lesser bulb fly' adult is dark blue with a metallic sheen and up to 1/4 inch. It lays multiple eggs on each plant rather than a single egg. The plant may not show any sign of infestation until new growth, when there are multiple small leaves instead of the normal ones.

IPM solutions: Believe it or not, you can save your bulb if you act when you see the odd growth pattern of new leaves. You can dig out or squeeze out the larvae and replant the bulb. The stuff around the hole actually has an anti-fungal property which will help the bulb heal, unless bacteria has also entered the bulb. In that case the bulb will need to be destroyed to stop the spread of rots. If you scout, you may see this adult in spring. Mounding soil higher up around the stem and above normal soil level may reduce the number of successful eggs.

Rose Midge *(Dasineura rhodophaga)*

Key hosts—perennial: Rose

What they are and what they do: Rose midge makes up for size by its tenacity. There are many generations a year and an infestation can destroy your roses. In spring, adults emerge from the soil, mate, and females lay eggs in tender new shoots. In just two days, larvae hatch and feed for five to ten days before dropping to the soil to pupate in their white, cottony cocoons. All this activity and you won't see them, because adult midges are less than 1/16 inch while larvae are up to approximately 1/16 inch with a pinkish white color.

IPM solutions: Scout often. Use a loupe (magnifying lens) and check often and carefully. Larvae inside buds won't be seen but the buds will appear distorted or failing. Prune or remove failing buds daily. If you've had signs of an infestation, remove any mulch and about 1 to 2 inches of top soil from under the rose bush in the fall, and replace with fresh soil and mulch. This will

reduce the overwintering generation. Don't expect insecticides to do the trick. Only an application targeted at adults is effective (a small window of opportunity), and there are limited products labeled for rose midge.

Galls

Gall Fly *(Eurosta solidaginis)*

Key hosts—perennial: Goldenrod

What they are and what they do: This spotty brown fly, less than a 1/4 inch, isn't much of a flyer and spends its entire life on the goldenrod plant. After mating on the stem, females lay an egg inside the stem. Larvae hatch and feed, which causes a gall. A year of feeding and it's almost ready to leave but overwinters again, pupates in spring.

IPM solutions: Enjoy this interesting insect. Unless you are raising goldenrod for competition, there's nothing to worry about here. Survivalists eat the gall in the wild!

Two seasons of goldenrod gall. Photo: (Left) Scott Loarie, Flickr, c2.staticflickr.com/6/5198/7376155610_99a6d572ea_b.jpg, CC BY 2.0; (Right) U.S.Fish and Wildlife Service c1.staticflickr.com/1/758/22820018713_ee9303e3a1_b.jpg.

Gall Wasp of Rose *(Diplolepis rosae)*

Key hosts—perennial: Rose (less common on hybrid roses)

What they are and what they do: This small dark wasp, ~1/8 inch, lays tiny eggs inside leaf buds. The action causes distortion in the bud, producing fancy 'pin cushion' galls, also known as moss gall. Galls form in late summer to protect larvae—and can girdle canes in the process, killing them.

IPM solutions: This is more common on stressed plants, especially on lower branches. The galls are housing the next generation. Prune off the gall when possible to reduce the population.

Gall wasp of rose. Photo: Johnson Cameraface,c1.staticflickr.com/5/4474/37578532261_b69f7e516f_b.jpg, CC BY-NC-SA 2.0.

Leafhoppers

Aster Leafhopper *(Macrosteles quadrilineatus)*, Potato Leafhopper *(Empoasca fabae)*

Key hosts—annual: Baby's breath, China aster, dahlia, hyssop, poppy

Key hosts—perennial: Aster, astilbe, baby's breath, blanket flower, hollyhock, musk mallow, poppy, ragwort, rose, salvia, sunflower

What they are and what they do: Leafhopper adults fly in on windstorms from the south, ready to lay eggs. These tiny (1/8 inch) wedge-shaped insects vary in color and can blend in well: green, brown, or tan, sometimes with spots or stripes. No

Aster leafhopper. Photo: Michigan State University, www.ipm.msu.edu/green_industry/landscape/leafhoppers.

Potato leafhopper. Photo: Gail Hampshire, c2.staticflickr.com/4/3837/15184859876_a5f841ce85_b.jpg, CC BY 2.0.

Typical leafhopper damage: stippling often called 'hopper burn'. Photo: Whitney Cranshaw, Colorado State University, Bugwood.org.

Columbine leafminer *(Phytomyza aquilegivora),* feeding damage on columbine. Photo: Whitney Cranshaw, Colorado State University, Bugwood.org.

Azalea leafminer, *(Caloptilia azaleella),* feeding damage on columbine. Photo: Whitney Cranshaw, Colorado State University, Bugwood.org.

Mealybugs. Photo: Raymond Gill, California Department of Food and Agriculture, Bugwood.org CC BY-NC 3.0 US.

surprise—they jump, but pay attention and you'll see they run sideways. There are multiple generations each season, so you may find adults and the pale, wingless nymphs on the same plant. The potato leafhopper is an opportunist and eats over two hundred plant species, while others are more host-specific. Despite their tiny size, their sheer numbers and their method of feeding can distort, stunt or kill plants. Leafhoppers pierce plant tissue with their moutparts, and feed on juices. By doing so, they inject toxins into the leaves which may even contain plant diseases. Look for leaf curling, a leaf browning called hopper burn, or tiny white marks like stippling. They also leave honeydew on leaves.

IPM solutions: Leafhoppers are hard to control. A good hosing removes some. Try using a sticky card attached where they've been feeding—when you disturb them, you may catch a good many on the card. If your plants begin to show distortion, deformed leaves and yellowing, they may have a phytoplasma disease such as aster yellows and are spread by leafhopper feeding. They can't be cured, so removed them and destroy them promptly. Beneficial insects and insecticidal soap may help.

Leafminers

Serpentine Leafminer, Daylily Leafminer

Key hosts—annual: Gerbera daisy, larkspur, nasturtium, sweet pea, verbena

Key hosts—perennial: Blanket flower, chrysanthemum, columbine, daylily, gaura, meadow rue, monkshood, ragwort, speedwell

What they are and what they do: These tiny flies overwinter as pupae in the soil where they fed the previous season. Adult flies emerge in May; they are tiny, 1/4 inch long, dark and hairy. Eggs are attached to or inserted in the underside of leaves so hatched larvae can immediately begin tunneling through leaf tissue. Most leafminer larvae are pale green and barely noticeable at 1/16 to 1/8 inch. Unfortunately their feeding isn't and leaves pale, winding trails behind that enlarge into big, dry blotches. Mature larvae drop to the soil to pupate, which is why they show up to feed on your perennials the following year.

IPM solutions: Scout for damage, egg clusters, and active feeders, then remove and destroy. Keep weeds down, especially dock, lambsquarter, chickweed, nightshade, pigweed. Leafminer damage is mostly aesthetic.

Mealybugs, Scale & Whiteflies

Mealybugs

Key hosts—annual: Begonia, coleus

Key hosts—perennial: Foxglove, hens and chicks, prickly pear

What they are and what they do: Mealybugs are tiny oval, pinkish-white, and fuzzy insects who spend their lives surviving on plant juices. This makes for a lot of honeydew from adults and larvae—larvae are miniature adults. Honeydew leads to sooty mold, and the feeding weakens plants. Look for yellowing leaves and dropped leaves. The good news is that mealybugs don't overwinter unless they're in a greenhouse which is the major way they spread in the northeast.

IPM solutions: Be very careful what you take home to your garden. Check the health of those new plants and look for tell-tale signs of pests like mealybug. Their populations are often controlled outdoors by beneficial wasps. A strong stream of water can wash them off too; carefully adjust water pressure on the host plant—enough to wash away mealybugs but not the flowers!

Scale: Armored Scale, Soft Scale, Rose Scale

Key hosts—perennial: Fern, ivy, myrtle, peony, rose

What they are and what they do: Scale are an odd little insect. They are tiny, even microscopic, with no identifiable head, thorax or abdomen, and once they are mature, they don't have legs. Crawlers (immatures) creep along plant stems and attach to feed. They produce a coating, often waxy, for protection; this coating varies according to the species and may be white and fluffy or brown and hard. Scale feeding reduces plant vitality. Look for bumps in clusters, and yellowing of leaves. A scale infestation often causes leaf drop. Honeydew is another sign of scale (or mealybugs or aphids …).

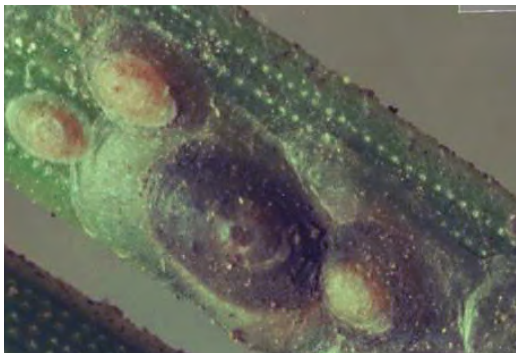
IPM Solutions: Encourage natural enemies. Don't fertilize with a rapid-release nitrogen. Some scales can be scraped off (try a soft toothbrush or a fingernail—damaging the stem won't help the problem!) Horticultural oils can reduce populations but only if timed exactly for the species. Removing the infested part of the plant will reduce the chances for problems the following year.

Whiteflies

Key hosts—annual: Ageratum, alyssum, begonia, coleus, dahlia, fuschia, geranium, lantana, salvia

Key hosts—perennial: Lupine, rose, tulip

Rose scale *(Aulacaspis rosae)* on cane fruit. Photo: United States National Collection of Scale Insects Photographs , USDA Agricultural Research Service, Bugwood.org.



Armored scale. Photo: Ken Gray Insect Image Collection, Oregon State University Special Collections & Archives Research Center.

Brown soft scale. Photo: Florida Division of Plant Industry , Florida Department of Agriculture and Consumer Services, Bugwood.org.

Whiteflies. Photo: M.J. Raupp, University of Maryland Extension.

Meet the mites

- Cyclamen mites damage *Antirrhinum* (snapdragon), chrysanthemum, daisy, geranium, ivy, larkspur, *Stachys* (lamb's-ear).
- Lewis mites damage *Euphorbia*.
- Acarid and bulb mites damage *Amaryllis, Crocus*, daffodil, Dutch Iris, Easter lily, *Freesia, Gladiolus*, hyacinth, *Narcissus*, tulip, tuberose.
- Strawberry mites damage ornamental strawberry, snapdragon, sunflower.
- Tarsonemid mites damage snapdragon, chrysanthemum, daisy, geranium, ivy, larkspur, *Stachys*, and strawberry.
- Two-spotted spider mites damage on *Aquilegia* (columbine), *Campanula, Dahlia, Dianthus* (carnation), hosta, *Kniphofia* (red hot poker, torch lily), *Lobelia, Phlox* subulata (moss phlox), *Salvia, Senecio, Tropaelum* (nasturtium).

Bulb mites. Photo: Ken Gray Insect Image Collection, Oregon State University Special Collections & Archives Research Center.

Two-spotted spider mites, *Tetranychus urticae.* Photo: David Cappaert, Bugwood.org

What they are and what they do: These sap-sucking insects aren't really flies; think of them more like aphids. The adults have powdery white wings, and are barely visible at 1/16 inch unless clustered together. Pinpoint-sized eggs are laid under leaves. Early nymphs crawl, later nymphs barely move. Whiteflies seem to rise up in a white cloud when disturbed, because they reproduce quickly. They don't overwinter outside, so it's a good chance they came into your garden on a transplant or seedling from a greenhouse. Their feeding causes yellowing spots and drying. For the most part, they don't cause many problems as they don't seem to last long outdoors.

IPM solutions: Inspect plants you're about to buy—a simple tap on the plant will reveal them. Don't buy infested plants. Natural enemies do most of the work. They are more likely to be a problem in hot, dry weather.

Mites

Note: Mites are arachnids, not insects.

Two-Spotted Spider Mite *(Tetranychus urticae)*, Cyclamen Mite *(Phytonemus pallidus)*

Key hosts—annual: Ageratum, China aster, cleome, cockscomb, cupflower, dahlia, elephant's ear, impatiens, marigold, nasturtium, pansy, petunia, portulaca, snapdragon, zinnia

Key hosts—perennial: Beebalm, bellflower, coneflower, cranesbill, daylily, delphinium, hibiscus, hollyhock, ivy, lamb's ear, monkshood, ornamental strawberry, phlox, pincushion, pinks, red hot poker, rose, salvia, seathrift, sunflower, verbena, yarrow

What they are and what they do: Mites are not insects because of that six-legged rule. Two-spotted mites go from egg to six-legged larvae, then to eight-legged nymph, but in general mites have eight legs, can be pale green, red, or yellow and can't fly. Adults overwinter and start laying eggs in warm weather. Both adults and nymphs feed on leaves, and on flowers and fruit, leaving stippling, speckling and sometimes webbing. They feed with sucking mouthparts and can cause leaves to curl, brown or die. Populations can boom in hot, dry weather; plants can weaken, produce stunted fruit/crops and even feel the effects the following year.

IPM solutions: Scout, especially during droughts—use a hand lens or loupe, and look on the underside of leaves. It helps to hold a piece of white, stiff paper under leaves and tap or shake the plant. Beneficial mites are bigger and faster, and prey on mites; they like damp soil, so water often to encourage them.

Hose off mites, repeat often. Other beneficial insects such as minute pirate bugs, lacewing larvae, and lady beetles (especially *Stethorus punctum*) will help you out.

Bulb Mites (*Rhyzoglyphus* spp.)

Key hosts—annual: Gladiolus

Key hosts—perennial: Crocus, daffodil, hyacinth, iris, lily, narcissus, tulip

What they are and what they do: These almost-invisible mites suck fluids from bulbs and transmit disease. You'll need a loupe/magnifier to even see them, much less their eight legs. They are almost translucent but have two brown spots on them. Plants will develop yellow, misshapen leaves. Bulbs show corky brown spots; become dry and crumbly. If the mites aren't in your soil, you're in good shape; they're much more likely to be a problem in production facilities. They likely come in on new bulbs and then multiply and move to other bulbs in the soil. Another sign is failing bulbs—fewer and fewer blossoms. Mite feeding also invites disease.

IPM solutions: Before planting, examine bulbs. If you see corky spots, you should suspect mites—if so, soak bulbs in 120°F water for three minutes. Dry well. Destroy badly infested bulbs. Keep stored bulbs dry to reduce mites. If an infestation begins to destroy your bulb gardens, you may want to use beneficial/predatory mites that feed on the pest mites.

Two-spotted spider mite *(Tetranychus urticae)* feeding damage on bean. Photo: Whitney Cranshaw, Colorado State University, Bugwood.org

Bristly rose slug *(Cladius difformis)* larva. Photo: Whitney Cranshaw, Colorado State University, Bugwood.org.

Bristly rose slug adult, *Cladius difformis*. Photo: Whitney Cranshaw, Colorado State University, Bugwood.org.

Sawflies

Roseslug Sawfly *(Endelomyia aethiops)*, Bristly Roseslug *(Cladius difformis)*, Curled Rose Sawfly *(Allantus cinctus)*

Key hosts—perennial: Rose

What they are and what they do: By the way, the larvae of rose sawfly are not slugs, but they are not caterpillars, either, although they resemble them. Adults emerge in spring after pupation in the soil, and lay eggs on the underside of leaves. Larvae are yellowish-green with orange-brown heads, tapered, soft; 1/2 to 3/4 inch. The bristly rose slug has fine, hairy-looking bristles; to 5/8 inch. These larvae chew holes between leaf veins, feeding on one tissue layer of the leaf—what's left turns dry and papery. From afar, rose leaves may appear to be white. Some feeding causes skeletonized leaves.

IPM solutions: Look on upper and lower sides of leaves. Handpick, or knock larvae into soapy water. Hose off with a strong jet of water. Although rose slug larvae look like caterpillars, Bt won't work on them.

Typical damage produced by a bristly rose slug, *Cladius difformis*. A larva is in the lower right. Photo: Whitney Cranshaw, Colorado State University, Bugwood.org.

Banded wood snail *(Cepaea nemoralis)*. Photo: David Cappaert, Bugwood.org.


Gray garden slug. Photo: Margaret Douglas, Penn State.


Slug eggs. Photo: Judy Kowalski, Oregon State Univ..

The Beer Trap

Sink cups—yogurt containers, old coffee mugs, or the like—a few inches into the soil. Let the top stick up 1 inch above the soil level so valuable ground beetles won't drown. Cups should have steep sides. Place every few feet—slugs need to be close by to sense the beer.

Fill cups with beer or a mixture of bread yeast, sugar, and water. The slugs crawl in, drink—and drown. Scoop the slugs out daily and refresh the beer after a rain or when it's empty. After all the joking about the beer is over, it works—if you care to go to all that trouble!

Slugs and Snails

Key hosts—annual: Alstromeria, angelica, calendula, cupflower, lobelia, marigold, paper daisy, petunia, Swan River daisy, wallflower

Key hosts—perennial: Aster, astilbe, balloon flower, bear's breeches, black-eyed Susan, bleeding heart, cardinal flower, chrysanthemum, columbine, cranesbill, daffodil, dead nettle, foxglove, lungwort, hosta, iris, lamb's ear, lupine, narcissus, pinks, ragwort, rose, rose campion, Rodgersia, sundrops, tiarella, toad lily, tulip, turtlehead

What they are and what they do: Slugs are soft and usually gray; sometimes tan, green, black, orangey-brown, or spotted; wide range of sizes. Snails carry coiled shells. Both are mollusks, sticky, and leave slimy mucus trails where they crawl. Both leave clear eggs, round or oval, in jellylike clumps in soil under plants or under mulch, stones, and debris. Both thrive in rainy weather and can demolish young plants. They prefer seedlings, smooth, or new leaves, but usually avoid plants with hairy leaves such as tomatoes and squash. Snails are far less damaging than slugs, but both are active at night or during cool, rainy weather. Adults go dormant to overwinter.

IPM solutions: Look for gaping holes in foliage. Clear mulch away from vulnerable plants in cool, wet weather, and then push it back when hot, dry weather comes. You want to reduce the moist, shady environment when you can. Carefully cultivating soil around roots may destroy eggs. Use a stick to flick slugs and snails off leaves and into a bucket of soapy water. To trap slugs, place boards, inverted pots, cabbage leaves, newspaper, or citrus or melon rinds near plants overnight. In the morning, drop your captives into that soapy water. Spare the helpers such as ground beetles, which eat slugs and snails. Encourage birds. Tuna cans, filled with beer or water and yeast, and set just below ground level, also make good traps. Diatomaceous earth is a great deterrent, but needs replacing often. Also consider wood ash, coal ash, or crushed eggshells. Some gardeners use copper barrier strips where slugs are relentless.

True Bugs

Brown Marmorated Stink Bug (BMSB) *(Halyomorpha halys)*

Key hosts: Blue wild indigo, snapdragon and many others

What they are and what they do: More and more people can recognize the BMSB because it's also a home invader during the winter months. They are spotty brown shield-shaped bugs, ~5/8 inch; look for white banding on antennae and legs. Nymphs

look similar but have red eyes and no wings. Adults generally overwinter in crevices of tree bark or buildings. They emerge in the spring to feed and reproduce one or more generations. Eggs (white or light green) are laid in masses, and early nymphs are brightly colored and stay close to the hatch site. They darken as they mature. Feeding continues all season as it moves from crop to crop (vegetables, fruits and ornamental plants). Adult females lay eggs all season. Adults and nymphs damage plants when they insert sucking mouthparts and cause distortions and marking. The effects can be missed unless a large group of them make a feeding stop on your plants.

IPM solutions: Reduce overwintering sites (crates, woodpiles, for instance), and encourage beneficials such as egg parasitoids. You can do this by growing dill and fennel around your flower and vegetable gardens. BMSB has become a major agricultural pest and new methods of control are being researched. Contact your local cooperative extension office for the latest news.

Brown marmorated stink bug *(Halyomorpha halys)* adult. Photo: David R. Lance, USDA APHIS PPQ, Bugwood.org.

Harlequin Bug *(Murgantia histrionica)*

Key hosts—annual: Cleome

What they are and what they do: The Harlequin Bug is bright red to orange and black; its nymphs are oval. The egg clusters look like little white and black barrels. After overwintering in nearby weeds, females begin egg-laying when the temperatures are in the 70s. Both adults and nymphs pierce leaves and suck sap, leaving distorted stems. They prefer vegetable crops like leafy greens, but like cleome enough that it's used as a trap crop!

IPM solutions: Reduce habitat for egg-laying and overwintering by keeping weeds down near the garden. Persistent scouting and removal of adults and nymphs into soapy water, and crushing eggs is very helpful. Like other stinkbugs, harlequins have many natural enemies: toads, birds, spiders, snakes and parasitic wasps and flies; if the predator doesn't mind the taste, they are an effective partner.


Harlequin bug *(Murgantia histrionica)* adult. Photo: Russ Ottens, University of Georgia, Bugwood.org.

Lace Bugs: Chrysanthemum Lace Bug, Andromeda Lace Bug (*Stephanitis* spp., *Corythuca* spp.)

Key hosts—perennial: Aster

What they are and what they do: This 'true bug' uses sucking mouthparts to feed on sap inside leaves. Adults are tiny, 1/8 inch, brownish, but often appear white after they molt because their lacey wings are held flat on their backs. In May, look for clumps of black eggs on the undersides of leaves. Nymph and adult feeding leaves brown or yellow stippling on leaves; eventually spots run together and leaves become deformed. Look also for small black resinous dots of excrement on leaf undersides.

Lace bug *(Corythucha sp.)* adult. Photo: David Cappaert, Bugwood.org.

Milkweed bug. Photo: Russ Ottens, University of Georgia, Bugwood.org


Four-lined plant bug *(Poecilocapsus lineatus)* adult. Photo: Johnny N. Dell, Bugwood.org


Tarnished plant bug; Lygus Plant Bug. Photo: North Carolina State University


Lygus (Tarnished) plant bug *(Lygus lineolaris)* nymph. Photo: Scott Bauer, USDA Agricultural Research Service, Bugwood.org

IPM solutions: Not a common pest and tend to be host-specific. Scout for eggs in May. Brush the leaves and watch for anything small to fly away. Like other sap feeders (aphids, for example), lace bug excrement can promote sooty mold. If the infestation is light; ignore it. If heavy, hose off plants, repeating for several days. Horticultural oil is another option.

Milkweed Bug *(Oncopeltus fasciatus)*

Key hosts—perennial: Milkweed

What they are and what they do: This 'true' bug has piercing, sucking mouthparts and is pretty selective in its feeding habitat. The handsome red and black adults (don't confuse them with boxelder bug) overwinters in leaf litter and lays eggs on plants in spring. The eggs are yellow and change to red. Nymphs resemble the adult but have black wing pads instead of wings. Both adults and nymphs feed on leaves and stems.

IPM solution: In most cases, simply ignore. They are a nuisance pest. Remove leaf litter and dead plant stems in fall to reduce overwintering. In extreme cases, consider insecticidal soaps.

Plant Bugs: Four-Lined Plant Bug *(Poecilocapsus lineatus),* Tarnished (Lygus) Plant Bug *(Lygus lineolaris),* Phlox Plant Bug *(Lopidea davisi),* Mullein Plant Bug *(Campylomma verbasci)*

Key hosts—annual: Blanket flower, cosmos, dahlia, poppy, verbena

Key hosts—perennial: Black-eyed Susan, cranesbill, culver's root, gentian, lady's mantle, lavender, lupine, obedient plant, phlox (creeping and tall), poppy, Shasta daisy, sunflower, tickseed

What they are and what they do: Four-lined nymphs are reddish with black wing pads; small, to 1/4 inch. Become yellow with black blotches; yellow stripes on wing pads. Adults are greenish-yellow; 1/4 to 3/8 inch. Four black stripes run lengthwise down the body.

Tarnished plant bug nymphs are greenish; the adults are mottled tans, browns and blacks (a tortoiseshell effect).

Lygus plant bug nymphs are pale green; later with spots. The adults are green to dark brown with reddish brown markings.

Most plant bug nymphs emerge by late spring. Both nymphs and adults suck plant juices, leaving rows or patches of pinhead-sized beige dots that may merge into brown patches. Look for symptoms in late May or early June. Damage can be moderate to severe, though many plants outlast early summer damage.

IPM solutions: Start monitoring susceptible plants in late May. Examine leaves and if you don't see any insects on them, look down to the ground below—they like to hide. Nymphs can be crushed if you can catch them, or knock them into soapy water. Most often, treatment is not needed. The leaves will look bad, but the plant will generally live. Prune back or remove damaged stems by fall to reduce the next generation. Destroy damaged plant material. Remove leaf litter in late fall as that's where tarnished plant bug can overwinter. Cut back plant stalks and remove to reduce overwintering eggs.

Mullein plant bug, *Campylomma verbasci.* Photo: Bradley Higbee, Paramount Farming, Bugwood.org.

Thrips

Key hosts—annual: Begonia, calendula, cupflower, gerbera daisy, impatiens, plectranthus, pocketbook plant, sweet pea, sweet potato vine, verbena

Key hosts—perennial: Bellflower, chrysanthemum, daylily, foxglove, gladiolus, iris, peony, rose, Shasta daisy, verbena

What they are and what they do: Even thrips adults are barely visible (around 1/16 inch), so you'd need a loupe or microscope to see the immatures. Adults range in color: white, pale yellow, brown or black. They have feathery wings, but are weak fliers without help from the wind. Nymphs are slender, pale, and red-eyed. Both adults and nymphs can overwinter in fields, and both feed on plants with raspy mouthparts that scrape tissue for sap. Females lay eggs on crops—the start of multiple generations each season. Thrips (remember, there is no such thing as one thrip—even one of these is called a thrips) are hot weather fiends and don't thrive in cool, wet summers. They barely move if temps are 65°F or below. A major pest of onions, so they also affect related plants like gladiolus and iris. Thrips feed between newly emerging leaves; hard to detect unless you part the leaves (look for silvery streaks and spots on leaves). Thrips damage on glads and iris and other flowering plants tends to be on flower buds—damage may produce a misshapen flower or prevent bloom. Opened flowers may have white streaked areas. Early on a cool morning when thrips are less active, put a white cloth, tissue, or frisbee under leaves or flowers and tap them. If you see lots of tiny moving critters on the cloth, you've got thrips. Thrips can bite people; it'll feel like a little prickle. Thrips can spread virus diseases.

IPM solutions: Water well; thrips thrive when it's hot and dry. Hose off as needed. Onion sets often have thrips, so inspect purchased set carefully with a magnifier before planting and destroy infested sets away. If you've had problems with them in the past (in flower or vegetable gardens), it pays to monitor with yellow sticky cards.

Adult thrips on rose leaf. Photo: Andrew Derksen, FDACS/DPI, Bugwood.org.

Gladiolus thrips *(Thrips simplex)* damage on gladiolus flower. Photo: Whitney Cranshaw, Colorado State University, Bugwood.org.

This is why a thrips is hard to see. Photo: University of Georgia, Thomas County Cooperative Extension.

The IPM Flower Garden

Chances are you'll never see most of the pests we've included here. But knowledge is power, and we want you well equipped to take them on. So we've given you an overview of how to grow beautiful, healthy flowers. We've reviewed a wide variety of the annuals, perennials, and bulb plants that make up your home flower garden. We've discussed the pests that bother them and the diseases that strike them. We've offered advice and stressed managing these problems in the least-toxic, most simple ways. Sometimes we've even suggested you not worry about a problem. We've mentioned pesticides, but we've urged you to be cautious about using them. Always read and follow label directions.

We hope this information is helpful and wish you a garden full of gorgeous flowers.

Iris. Photo: Pixabay.