

IPM Series: Annuals and Perennials

Symptoms	Possible Causes	Controls/Comments
LEAVES/STEMS		
Leaf yellowing/ foliage fades, yellows browns or wilts	Aphids, scale insects, spider mites, mealybugs, whiteflies, borers, stem galls: examine lower leaf surfaces for presence of spider mites or whiteflies. Examine twigs and branches for scale covers or borer holes.	Light insect infestations do not require control. Consider replacement when annuals are severely damaged by insect or mite feeding. Pesticides can damage plants during hot, dry weather. For moderate mite infestations consider releasing predatory mites for biological control.
	Root rots, verticillium wilt, southern blight: scrape base of stem near soil line to look for evidence of vascular browning. Inspect for small round brown structures called sclerotia.	Remove diseased plants from the garden.
	Older leaf drop: often bottom leaves will yellow and drop as plant ages.	Remove older leaves as plants age.
	Excessive moisture: poorly drained soils cause root diseases.	Improve soil drainage by addition of organic materials.
	Insufficient sunlight: off-color shoots stretch towards light, becoming tall and spindly.	Prune overhead tree foliage to improve sunlight penetration or thin plants to maintain proper spacing.
	Nutrient deficiency: interveinal yellowing-potassium, iron, magnesium, manganese.	Follow soil test results.
Air pollution: speckled upper leaf surfaces. Undersides may appear silver.	Prune or remove affected plants	
Leaves eaten or chewed	Caterpillars, leaf-feeding beetles and weevils, grasshoppers, sawflies, slugs, earwigs: cause minor to severe defoliation.	Caterpillars should be controlled when larvae are small and before damage is extensive. The biological insecticide B.t. is effective on small caterpillars. Large caterpillars, sawflies and beetles can be hand-picked. Heavy insect infestations may require a residual insecticide spray. Inspect plants regularly for pests. Slugs may be controlled with diatomaceous earth, baits or by trapping.
Leaf stippling (fine to coarse spots)	Spider mites: cause very fine stippling on leaf surface.	Pesticide sprays during hot, dry weather can injure plants damaged by heavy mite feeding. For heavy to moderate mite infestations consider releasing predatory mites for biological control.
	Leafhoppers, plant bugs: nymphs and adults feed on lush spring growth causing yellow	Most plants will outgrow early damage. If necessary,

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stipples that may become necrotic black blotches. Stunting may occur.

replace severely damaged annuals.

Leaf spots/blotches

Various fungi (more symmetrical and can cross veins) or **bacteria** (more angular and bounded by veins)

Remove spotted leaves. Improve air circulation to promote faster drying of leaf surfaces. During growing season remove infected leaves. Rake up and destroy infected leaves in spring and fall to prevent overwintering of disease organisms.

Foliar nematodes: cause angular leaf-spotting, confined by the veins. On parallel veined plants, affected areas appear as streaks between veins.

During growing season remove infected leaves. Rake up and destroy affected leaves in spring and fall to prevent overwintering of the nematodes.

Plant bugs or **four-lined plant bug:** yellowish green, black stripes, a inch long. Nymphs are bright orange. Feeding causes perfectly circular spots. **Harlequin bugs:** red and black, shield-shaped. Feeding causes white and yellow blotches on leaves

Plants can tolerate severe plant bug feeding. If necessary, replace severely damaged annuals.

Frost or freeze damage: water-soaked blotches turn black.

Prune or remove affected foliage.

Herbicide or pesticide drift: off-colored spots or stunted, distorted growth.

Random pattern. Damage will occur on adjacent plants of different species.

Blights

Southern blight, Rhizoctonia web blight: foliage collapses and turns brown or black. Plants may be killed.

Improve soil drainage and air circulation. Pull mulch away from stems. Use a registered fungicide for severe outbreaks. Select resistant plants.

Leaf mottling

Viruses and phytoplasmas: foliage appears mottled green and yellow. Plants may be stunted.

Remove infected plants. Remove weeds that serve as reservoirs for infection.

Light-colored tunnels or blotches (mines) in leaves

Leafminers: larvae feed between the upper and lower leaf surfaces.

Pick off infested leaves.

Small blisters on lower leaf surfaces

Edema: on a variety of plants, especially begonias, geraniums, sedum, etc. Brown spots or rough areas on lower leaf surfaces. Occurs when warm days are followed by cool nights.

Maintain even soil moisture with mulch and increase air circulation around plants to promote fast drying.

Curling/distortion

Aphids: small, soft-bodied insects on young growth, stems and leaves.

Beneficial insects usually control aphids. Reduce heavy infestations of aphids and treehoppers with sprays of contact insecticides, such as insecticidal soaps, to conserve beneficials.

Treehoppers: common, small jumping insects, vary in shape. Some appear humpbacked or resemble thorns.

Viruses and phytoplasmas: foliage appears mottled green and yellow. Plants may be stunted.

There are no controls for viruses and phytoplasmas. Remove infected plants. Remove weeds that may serve as sources of infection.

General herbicide damage: includes glyphosate, dicamba and 2,4-D damage. New growth is especially sensitive from drift or contaminated sprayer. Leaves become narrow, twisted, crinkled and finely divided. Leaf yellowing, mottling, curling and cupping may also occur. Damage may follow leaf veins.

Avoid misapplication or improper timing of pesticides.

Leaf scorch or tipburn	<p>Heavy spider mite, whitefly and thrips feeding: symptoms can occur along leaf margins or between veins.</p> <p>Drought or heat stress: new growth wilts followed by marginal browning.</p> <p>Pesticide burn, including soaps and oils: random, irregular spots sometimes followed by entire leaf necrosis.</p> <p>Fertilizer burn, salt spray: leaf margin browning from excessive salt uptake by roots. Necrotic spots from direct foliar contact with fertilizer.</p> <p>Chloride toxicity: leaves yellow and brown at the tips. Typically from swimming pool drainage and de-icing salts.</p>	<p>Plants damaged by severe insect or mite feeding can be injured by insecticidal sprays during hot dry weather. For heavy to moderate mite infestations consider releasing predatory mites for biological control.</p> <p>Improve water management.</p> <p>Avoid misapplication or improper timing of pesticides.</p> <p>Irrigate to reduce levels of salt or fertilizer on foliage and in soil.</p> <p>Divert swimming pool water and ice melt runoff away from root zones. Irrigate to reduce salt levels.</p>
White powdery coating on leaves	<p>Powdery mildew fungi: white growth on leaf and stem surfaces.</p>	<p>Select resistant varieties. Spray with registered fungicides if disease is severe. Check horticultural oil labels for powdery mildew control listings.</p>
Orange/yellow spots on leaves and stems	<p>Rust fungi: orange or red colored spots on leaves and stems.</p>	<p>Select resistant varieties. Spray with registered fungicides if disease is severe.</p>
Entire plant wilts	<p>Various root rots, stem cankers, borers, aphids, plant hoppers, root feeding insects (i.e. Verticillium wilt, Phytophthora, Pythium, Rhizoctonia): rule out non-pest causes such as environmental, fertilizer or pesticide damage. Examine plants carefully for signs of boring activity such as frass and holes in the stem. Carefully dig up a specimen to observe root symptoms. Inspect plants for evidence of root diseases such as discolored roots or roots that easily pull off. Healthy plants can be replanted.</p> <p>Walnut wilt: affects many types of herbaceous plants in the vicinity of walnut trees.</p> <p>Drought/heat stress: newer growth wilts first, possibly followed by marginal leaf browning.</p> <p>Excessive water: poorly drained soils cause root diseases.</p>	<p>Remove diseased plants from the garden. Cut out insect infested or rotten portions of perennials and replant remaining healthy sections. Cut open stems/rhizomes to remove borers and replant. Treat plants with contact insecticides or release predators for biological control.</p> <p>Black walnut roots contain a chemical (juglone) that kills the roots and stunts the growth of other plants that come into contact with the walnut roots. Avoid planting near walnut trees.</p> <p>Improve water management.</p> <p>Improve drainage by addition of organic matter.</p>
Plants fall over/ branches break/ stems split	<p>Species characteristic: tall, unsupported plants may fall over.</p> <p>Wind, rain and hail damage: may beat plants down.</p> <p>Mature plants: may be overgrown.</p> <p>Insufficient sunlight: plants spaced too closely.</p>	<p>Pinch back or add plant supports</p> <p>Add plant supports if necessary.</p> <p>Keep plants pruned and supported.</p> <p>Maintain proper plant spacing, improve sunlight exposure.</p>

Excessive nitrogen: dark green, unusually tall, lush plants.
Excessive water, sudden changes in soil moisture: excessive growth due to sudden water availability.

Avoid overfertilization.

Use mulches to maintain even soil moisture.

FLOWERS

Failure to flower, malformed flowers, or blossom drop

Winter damage to perennials

Planted too late: season insufficiently long.

High and low temperatures

Drought stress, excessive water, Insufficient sunlight: off-color shoots stretch towards light, become tall and spindly

Excessive nitrogen: dark green, unusually tall, lush plants.

Thrips feeding: flowers fail to open, turn brown.

Gray mold (*Botrytis*): flowers become covered with a gray fuzzy growth.

Protect overwintering crowns with thick mulch. Plant earlier to ensure establishment.

Overhead watering will help cool plants and shading may help on very hot days. Frost damage may cause blackening or flower collapse.

Improve water management.

Prune overhead tree foliage to improve sunlight penetration or thin plants to maintain proper spacing.

Avoid overfertilization.

Remove infested blooms.

Remove infected blossoms, promote faster drying.

It is often easier to replace annuals and perennials than go through a lot of trouble and expense to control extensive pest or disease problems.

Life Cycles

Annual flowers complete their life cycle in one growing season, during which time they grow, flower, and produce seed. Although some varieties will self-sow, or naturally re-seed themselves, the parents of each seed are unknown and certain characteristics may be lost. Self-seeders such as alyssum, petunia and impatiens will scatter seed freely.

Biennials complete their life cycle in two growing seasons. During the first growing season they produce leaves, usually in rosettes. In the second growing season, after a cold period, they produce blooms and die. Popular biennials are sweet william, foxglove, and rose campion.

Perennials are plants that live year after year. This means the tops of the plants die back to the ground each fall with the first freeze. Every spring, new plant tops arise from the crown or roots, which persisted through the winter. Perennials are said to be hardy, because they live through the winter. Select perennial varieties hardy to your local hardiness zone.

CULTURE AND MAINTENANCE

Plant Selection Tips

In choosing a site, consider sunlight (full sun to heavy shade), slope of the site (which affects temperature and drainage),

and soil type. When selecting herbaceous plants, the important restrictions on any given plant will be environmental: tolerance to winter or summer temperature extremes, special soils, moisture or light needs.

For a good display, select a limited number of plants for a defined space. Observe the flowering times of perennials in your neighborhood. That way you will be able to choose plants that will flower together and plants that will be showy when little else is in bloom. To obtain details on particular plants or groups of plants consult plant societies, specialty books, nursery operators and local botanical gardens.

Select plants for texture, color, spread, flower form and height. Grow your own plants or purchase them from your local nursery. Choose plants that are compact and dark green. Avoid buying plants with thin, pale yellow stems and leaves. Buy named varieties of plants, as their disease resistance, heat and cold tolerance, growth habits and colors are known.

Soil Preparation

Preparing the soil is important for flowers, especially perennials. While some annuals can grow and flower in poorly prepared soil, few perennials survive beyond one year if the soil is not properly prepared.

1. Have the soil tested early in the season and adjust the pH if needed. Materials to adjust pH need time to work.

2. Check and adjust drainage. To test drainage, dig a hole about 10 inches deep and fill with water. The next day, fill hole with water again and see how long it remains. (It should drain within 8 hours). If drainage is poor, dig furrows along the sides of the bed and add soil from the furrows to the bed. This raises the level of the bed above the general level of the soil, allowing excess water to run off. Raised beds can be surrounded with wooden or masonry walls.
3. Dig the bed. Add 4 to 6 inches organic matter to improve soil texture. Dig to a depth of 12 or 18 inches.
4. Add fertilizer, working any phosphorous deeply into the soil for easy root uptake. Spade again, and rake surface smooth.

Before setting out transplants, harden them off by exposing them to gradually increasing time outside. The plants will receive more light and cooler temperatures, improving their vigor. Set out annual plants after the last frost date for your area.

Planting

Plant late summer or fall flowering perennials in the spring and spring flowering perennials in late summer or early fall. Regardless of the time of planting, allow perennials sufficient time to establish themselves before they bloom or endure the onset of cold weather.

1. For each plant, dig a hole large enough to accept its root system comfortably.
2. Remove transplants from flats by slicing the soil between the plants. Lift each plant from its flat with a block of soil. If the plant is in a fiber pot, remove the paper from the outside of the root mass and set the plant in a prepared planting hole. When setting out plants in peat pots, set the entire pot in the planting hole but remove the upper edges of the pot so that all of the peat pot is covered when you firm soil around the transplant.
3. Set the soil block in a planting hole and backfill it so the plant sits at the same level as it was as a seedling.
4. Irrigate each hole with a starter solution of water-soluble, high-phosphate fertilizer to stimulate root growth. Follow package directions.
5. Allow plenty of space between plants to give them room to develop.

Watering

- Moistening the entire bed thoroughly, but do not water so heavily that the soil becomes soggy. Allow the soil to dry moderately before watering again.
- A soaker hose or drip irrigation are excellent watering systems. They allow water to seep directly into the soil without waste and without splashing leaves and flowers.

- Hand-watering with a waterbreaker nozzle allows you to custom water plants. Direct water to the root systems of disease-susceptible plants. Give new transplants extra water.

Mulch

Mulches maintain uniform moisture and proper temperature conditions. They also prevent weed growth in the garden. Organic mulches add some nutrients and humus to the soil, improving tilth and moisture-holding capacity.

- Use mulches after the ground has warmed up.
- Excess grass clippings make a good mulch for annuals, thinly spread to prevent matting.
- Other organics for mulching include bark, pine needles, or shredded leaves.
- Spread inorganic mulches such as black plastic or paper before planting, when soil is damp.
- Apply organic mulches after plants are well-established, when soil is damp.

Weeding and Cultivating

- After plants are set out or thinned, cultivate only to break crusts on the surface of the soil.
- When the plants begin to grow, stop cultivating and pull weeds by hand. As annual plants grow, feeder roots spread between the plants. Cultivation is likely to injure these roots. In addition, cultivation stirs the soil and uncovers weed seeds that then germinate.

Deadheading (Removing Old “Spent” Flowers)

To maintain vigorous plant growth, ensure neatness and continuous bloom, remove spent flowers and seed pods. Late season seed heads can be left to provide winter interest and birdfood.

Staking

- Tall-growing annuals like larkspur, or tall varieties of marigold or cosmos, need support to protect them from strong winds and rain.
- Stakes can be made from wood, bamboo, plastic, metal, or reeds large enough to hold the plants upright but not large enough to be conspicuous. Make stakes 6 inches shorter than the mature plant so that their presence will not interfere with the beauty of the bloom.
- Begin staking when plants are about one-third their mature size by placing stakes close to the plant, taking care to minimize damage to the root system. Secure the stems of plants to stakes in several places with paper-covered wire, twine or other materials that will not cut into the stem.

- Plants with delicate stems (like cosmos) can be supported by a framework of stakes and strings in criss-crossing patterns or plastic mesh fencing.
- Tie the plant by making one loop around the plant and the other around the stake. Never loop the tie around both stake and plant. The plant will hang to one side and the wire may girdle the stem. Add ties as the plant grows.

Fertilizing

If you incorporate organic matter, such as compost or rotted manure into your soil on a regular basis, your plants may be adequately nourished. With less fertile soils, add fertilizer according to recommendations given by soil sample analysis. Apply slow-release fertilizers in the spring to promote better growth and flower production during the growing season. Follow the fertilizer rates on the product label. Water the bed after applying fertilizer to wash excess fertilizer off the foliage, prevent burn, and activate the fertilizer.

Your garden may need additional nitrogen if you use straw, raw sawdust or wood chip mulches because soil microorganisms decompose the mulch, taking up available nitrogen in the process.

If soil test results indicate a low soil pH, add lime. Use pulverized, granular or pelletized (dolomitic/calclitic)

limestone rather than hydrated lime, adding it in the fall so it will have time to raise the pH.

Fall Care

In the fall, after the foliage of perennials has died down, cut and remove dead leaves, stems, and spent flowers 2-inches above the crown. These materials often harbor insects and disease-causing organisms. All removed plant material should be put onto an active compost pile or removed off site to prevent reintroduction of pests and diseases into the garden. Apply winter mulch after the soil temperature has dropped.

Fall is a good time to plan the transplanting and separating of your perennials to give them more space. Increasing air movement between plants is an important method of preventing disease problems. If you are concerned about excessive bare space, fill in with annuals for the first few years.

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