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Bulletin

PEST MANAGEMENT FOR TREES, SHRUBS, AND FLOWERS ON HOME GROUNDS

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NOTE:

In some instances we have found it advisable to use trade names in order to avoid using long and complicated chemical names. No endorsement of named products is intended, nor is criticism implied of similar products that are not mentioned.

PEST MANAGEMENT FOR TREES, SHRUBS, AND FLOWERS ON HOMEGROUNDS

The Rutgers Cooperative Research & Extension "**Pest Management Trees, Shrubs, and Flowers on Homegrounds**" has been prepared for **home gardeners** who wish to protect ornamental plants from injury due to insects, mites, and plant diseases.

CONCEPTS OF IPM

Optimum plant health can be maintained using a common-sense approach to pest management called **Integrated Pest Management** or "**IPM**." Use an IPM approach for the most effective and environmentally sound management of pests. The key to IPM is to first utilize **sound horticultural practices** so that pest outbreaks are prevented. Use of disease or pest-resistant species, such as native plants, is helpful. Planting "the right plant in the right place" is also important. Specifically, use plants rated for your locale or hardiness zone. Further, locate your plants in desirable soils/drainage or sun/shade conditions as recommended. It is also good practice to plant your trees, shrubs, flowers, or bulbs when it is optimal. See the section on "Impact of Environmental Conditions on Plant Health" for more details.

Monitoring for pest presence is really important in the practice of IPM so you can anticipate potential pest problems and employ a less-toxic mode of control when pest numbers are fewer. Becoming familiar with the life cycle of pests can be helpful so that you can recognize and remove, for example, grubs or eggs. Be sure to check the lower surface of leaves and in surrounding soil. It is important to check for not only the pests themselves, but for signs that they may be present. Look for plant damage (chewed leaves, holes, tunnels within leaves, borer holes in woody plants, discoloration), fecal droppings, pupal cases, or for example, slime trails in the case of slugs.

Another key concept in IPM is **cultural control**. This means taking care of the habit and conditions of the plant by watering and fertilizing appropriately, weeding, mulching, or cultivating the surrounding soil. Some difficulties may be avoided by keeping the area free of plant debris that might harbor pests, and pruning or dead-heading judiciously. Cultural control can be as simple as hand-picking insect or mite pests off the plant. See the section entitled "Insect and Disease Management" for cultural recommendations by host plant in alphabetical order. Each recommendation first provides a discussion of optimum growing conditions by plant so that you can minimize pest outbreaks.

A fourth key concept in IPM is **physical/mechanical control**. In the home landscape, this means the use of traps and barriers for pests. It can also mean simply using a stream of water from a hose to wash off pests. Tilling the soil to prepare your planting beds is considered a mechanical control. It disrupts pest life cycles both by burying them and by exposing them to harsh weather conditions and predators.

A fifth IPM concept is **biological control**. In the home landscape, this means planting plants that are attractive and good food sources to beneficial predators and parasites as well as pollinators. Another option for home gardeners is augmenting existing beneficials with mass-produced beneficials. Another type of biological control is the use of microbial pesticides. See the discussion that follows on pesticides below.

In the event that mechanical, biological, or cultural controls do not suppress a given pest outbreak on a specific host plant, the section entitled "Insect and Disease Management" of this guide provides pesticide controls by pesticide "**active ingredient**." The active ingredient is the material in the formulation that has pesticidal activity. To locate the appropriate pesticide product in the store, you must read the pesticide label for the list of active ingredients. See the section "The Pesticide Label" for more details on how to read and use the label.

You will notice that the recommendations are pest-specific. So, you will need to identify (or have identified) the pest to follow the pesticide recommendations. Rutgers Cooperative Research & Extension program staff and volunteers in each County can help you diagnose plant problems, including pests. They will also help you define the least toxic mode of control for the pest and may be able to diagnose your problem over the phone. If not, they may direct you to more in-depth Rutgers Cooperative Extension plant diagnostic services. Check the blue pages of your local telephone book under County Government (or visit http://www.rcre.rutgers.edu/county). NOTE: Selected counties have telephone "Master Gardener Helplines" staffed by certified Master Gardeners (see http://www.rcre.rutgers.edu/mastergardeners/helplines.asp).

Pesticides listed in this guide include **conventional chemical controls** that are broad-spectrum; i.e., they kill a wide range of organisms. In the home garden, these materials will affect the pests you wish to eliminate as well as non-target organisms, including beneficial ones. Consider using conventional pesticides in the home garden only when plant damage is imminent, beneficial activity is limited, or other control tactics have not been successful. Make sure that you follow the label strictly in the use of these pesticides in particular.

Botanicals are pesticides derived from plants and can be as toxic as conventional pesticides. Just because they are naturally derived does not mean that they are benign. They are, however, often less persistent in the environment, making them environmentally more friendly and a good IPM option.

These recommendations include botanical pyrethrum-based products such as pyrethrins, neem (oil and extract), and rotenone. It is important to read the pesticide label for any pesticide, even botanicals, since each pesticide is unique and may present potential hazards to non-target organisms such as honey bees. Rotenone, for example, is extremely toxic to fish.

Pyrethrins have chemical analogs that are chemically synthetic versions of the botanical and are called pyrethroids as a group. Pyrethroids included in this guide are bifenthrin, cyfluthrin, esfenvalerate, permethrin, resmethrin, and sumithrin. The advantage from a pest control standpoint is that the effects of these synthetic analogs are typically longer lasting in the environment and less prone to break down with exposure to ultraviolet light. Although this is of value in commercial crop production, the risk versus benefits for home landscape use should be considered. This should come into consideration when choosing a botanical pyrethrin versus one of the synthetic pyrethroid products. In the practice of IPM in the home landscape, pyrethrin would be a preferred choice over pyrethroids.

Microbial pesticides include microbes or their by-products. These pesticides tend to be extremely host specific and are often derived from organisms found naturally in the environment. Microbials are considered "reduced risk" pesticides by EPA and are a good option for home landscape IPM. Microbials listed in these recommendations include several varieties of *Bacillus thuringiensis* (*Bt*). Varieties of *Bt* are host-specific, specifically *Bt israelensis* (for gnats, mosquitoes, and black flies), *Bt kurstaki* (for caterpillars of moths and butterflies), and *Bt tenebionisis* (for leaf-feeding beetles such as Colorado potato beetle).

Insecticidal soaps are pesticides composed of the potassium salts of fatty acids. They are a very good option for homeowner use in an IPM program for the uses they are labeled and recommended in this guide. Soaps must directly contact the insect to be effective. So good spray coverage is essential. Once applied, the soap salts are degraded quickly in soil by microbes and do not persist in the environment. Although relatively low in toxicity to humans, they can be irritating to the eyes. The soap salts pose minimal risks to birds and are only slightly toxic to fish. They are highly toxic to aquatic invertebrates; there is no reason for application to aquatic environments. Note that insecticidal soap can be phytotoxic to some sensitive plants so only use them as recommended. It is a good practice to test a small leaf before applying to the whole plant if you are unsure.

Sulfur is a good homegrounds IPM option. It is a naturally-occurring elemental pesticide that has both fungicidal as well as insecticidal and acaricidal properties. Although relatively nontoxic, it can be irritating to both the eyes and skin. Sulfur can be phytotoxic in hot (in excess of 90°F) dry weather. It is also phytotoxic when mixed with oils. So do not apply sulfur within 20 to 30 days (or as specified on the product label) of an oil application.

These recommendations also include a variety of **oil-based products** that work well within a homegrounds IPM program. Specifically, oil sprays of superior miscible oils at the manufacturer's recommendations are effective against a wide variety of insects and mites. Some are also labeled for powdery mildew and black spot of rose. Be cautious with oil sprays. A drought during the previous year may have weakened the plants. Sugar maple, Japanese maple, beech, hickory, walnut, and butternut may be injured by sprays. Some injury may also occur to hemlock, cryptomeria, Douglas fir, junipers, and retinospora.

The best time to apply dormant sprays is in late March or early April after danger of freezing nights is past and before buds break OR in September or October. Spray in the morning or early afternoon on a clear, mild day.

Foliar oil spray recommendations are provided on many dormant oil labels. Follow the directions as stated. Foliar oil sprays are applied during the summer to control aphids, adelgids, mites, lacebugs, some leafbeetle larvae, mealybugs, sawfly larvae, and immature stages of plant bugs, psyllids, scales, and white flies.

PESTICIDES ON GLOSSY-LEAVED PLANTS

Sprays to be used on glossy-leaved plants such as rhododendron, ivy, laurel, pine, and spruce should have a commercial "spreader-sticker" added according to the manufacturers recommendations so that the spray material will cover the foliage completely. For disease control it is important to spray or dust the underside as well as the upper surface of the leaves.

INSECT AND DISEASE MANAGEMENT
TREES, FLOWERS, AND SHRUBS

The growing conditions listed after each host plant are those that favor plant health and an attractive appearance. A discussion of the impact of the environment in landscape plantings is found on page 29. Although the common name of pesticides (see page 42) has been used for most diseases and insects listed below, trade names are occasionally used for some products (such as those with two or more active ingredients).

AFRICAN VIOLET

African violet grows well at 60°F (16°C). Place African violet in good light but not in direct sun, which causes leaves and flowers to burn. A lack of blooms is often due to inadequate light. The plant requires moderate fertility and a well draining soil mix. If the plant is watered from the top, do not pour the water into the middle of the plant. Do not allow water to remain in the saucer under the pot for more than 30 minutes. Excess watering causes the leaves and flowers to decay. When repotting, the new pot should be just one size larger than the old pot.

Leaf spot.—Apply *Bacillus subtilis*, copper octanoate, neem oil, OR potassium bicarbonate and repeat (see label) until conditions no longer favor disease development.

AGERATUM

Although **ageratum** grows in full sun, shaded plants better tolerate heat. The plant prefers fertile, moist, but well drained soil. Blue flowered plants grow best at a soil pH of 6.0 to 7.5, and white flowered plants grow best at pH 5.0 to 6.0. Shear plants to remove old blooms.

Caterpillar—Apply carbaryl, *Bacillus thuringiensis*, cyfluthrin, OR spinosad in mid-August.

Powdery mildew—At the first sign of disease (repeat as per label directions), apply: acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, *Bacillus subtilis*, jojoba oil, myclobutanil, neem oil, neem oil + pyrethrin, potassium bicarbonate (shorten the interval during rainy weather), sulfur, tebuconazole, triadimefon, OR triforine.

Root rot—Apply thiophanate-methyl OR *Trichoderma harzianum* as needed and repeat (see label).

Spider mite—When mites appear, apply acephate + resmethrin + triforine, horticultural oil, insecticidal soap, OR malathion.

Tobacco budworm—Apply acephate, acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, *Bacillus thuringiensis*, bifenthrin, permethrin, OR spinosad.

Whitefly—Apply acephate, acephate + resmethrin + triforine, cyfluthrin, cyfluthrin + imidacloprid, esfenvalerate, OR insecticidal soap and repeat 3 times at 5- to 7-day intervals (see label).

ANDROMEDA (*Pieris*)

Andromeda is shade loving and prefers moist, light soils that are high in organic matter and that have a pH of 5.0 to 6.0. Mulch plantings and protect from winter sun and wind to prevent desiccation.

Lacebug—Spray acephate, carbaryl, cyfluthrin, cyfluthrin + imidacloprid, imidacloprid (once per year), OR insecticidal soap in May to June or when pest appears. Spray lower surface of leaves.

Spider mite—Use dormant oil in late March. When mites appear, apply horticultural oil, insecticidal soap, OR malathion.

ARBORVITAE

Plant **arborvitae** in full sun and in fertile, moist soil with a pH of 6.0 to 7.5. Mulch plantings.

Bagworm—Apply acephate, *Bacillus thuringiensis*, carbaryl, cyfluthrin, cyfluthrin + imidacloprid, OR spinosad in mid-June and late June. Hand remove bags before June.

Juniper scale—Apply dormant oil in late March; for crawlers, apply cyfluthrin, cyfluthrin + imidacloprid, horticultural oil, OR malathion in mid-June and repeat after 5 days; OR imidacloprid (once per year).

Leaf miner—May and August: acephate, carbaryl, cyfluthrin, imidacloprid, permethrin, OR spinosad

Spider mite—Use dormant oil in late March. When mites appear, apply horticultural oil, insecticidal soap, OR malathion.

AMELANCHIER

(Shadbush, Serviceberry, Juneberry)

Amelanchier grows best in moist, well-drained, acid soils, although somewhat tolerant of drier soils. Full sun or partial shade.

Juniper broom rust—Apply acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, myclobutanil, neem oil, neem oil + pyrethrin, sulfur, tebuconazole, triadimefon, OR triforine. Repeat as per directions on label.

ASH

Ash grows best in full sun and in deep, fertile, moist soil (pH of 6.0 to 7.5). Green ash (*Fraxinus pennsylvanica*) is more site tolerant than white ash (*F. americana*).

Anthracnose—Apply chlorothalonil, myclobutanil, neem oil, neem oil + pyrethrin, tebuconazole, OR thiophanate-methyl at budbreak and repeat according to label recommendations.

Ash/lilac clearwing borer—Spray trunk and large branches in mid- to late May with permethrin.

Banded ash clearwing borer—Spray trunk and large branches in late July to early August with permethrin.

Emerald ash borer—Drench tree base from late April to mid-May with products containing imidacloprid. Use acephate implant capsules in late May to mid-June.

Flower gall—Use malathion in spring after buds swell and before new growth appears.

Rust—Apply acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, myclobutanil, neem oil, neem oil + pyrethrin, sulfur, tebuconazole, triadimefon, OR triforine at budbreak and repeat intervals stated on label.

ASTER

Aster grows best in full sun and in moist, but well drained soil with a pH of 6.0 to 7.5. Rotate planting area to avoid disease problems.

Powdery mildew—At the first sign of disease (repeat as per label directions), apply: acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, *Bacillus subtilis*, copper (ammonium complex), jojoba oil, myclobutanil, neem oil, neem oil + pyrethrin, paraffinic oil, potassium bicarbonate (shorten the interval during rainy weather), sulfur, tebuconazole, triadimefon, OR triforine.

Rust—Apply acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, myclobutanil, myclobutanil + permethrin, neem oil, neem oil + pyrethrin, potassium bicarbonate, sulfur, tebuconazole, triadimefon, OR triforine and repeat at intervals stated on label.

AZALEA

Azaleas are shade loving. Plant in soils that are well drained, high in organic matter, and have a pH of 5.0 to 6.0. Mulch plantings and protect from winter sun and wind to prevent desiccation.

Bark scale—Apply 2% dormant oil in April; use acephate, carbaryl, insecticidal soap; OR malathion in late May and late June; OR cyfluthrin (crawlers) (see label), cyfluthrin + imidacloprid, OR imidacloprid (once per year).

Black vine weevil—Use acephate for adults, which are active June through September; OR cyfluthrin + imidacloprid, imidacloprid (once per year). May require landscape maintenance service.

Flower and leaf gall (Exobasidium, or pinkster gall)—copper (ammonium complex). Remove galls when seen.

Flower or petal blight (Ovulinia)—When flowers begin to show color, apply chlorothalonil, mancozeb, myclobutanil + permethrin, potassium bicarbonate (shorten the interval during rainy weather), tebuconazole, thiophanate-methyl, OR triforine and repeat as per label directions; OR apply PCNB to ground beneath bushes and immediate surrounding area prior to opening of buds and repeat every 3 to 4 weeks through bloom.

Lacebug—Spray acephate, acephate + resmethrin + triforine, bifenthrin, carbaryl, cyfluthrin, cyfluthrin + imidacloprid, deltamethrin, disulfoton, esfenvalerate, horticultural oil, imidacloprid (once per year), insecticidal soap, malathion, neem oil, OR permethrin in late May and mid-June or when first seen. Note: azaleas planted in the sun are more likely to develop lacebug infestations because beneficial insects that feed on lacebugs are less active on azaleas growing in the sun.

Leafroller (leaf miner)—Apply acephate, cyfluthrin + imidacloprid, disulfoton, imidacloprid, neem oil, permethrin, OR spinosad (see label).

Leaf spot—Apply *Bacillus subtilis*, copper (ammonium complex, salts, sulfate), copper + rotenone, mancozeb, neem oil, potassium bicarbonate (shorten the interval during rainy weather), tebuconazole, OR thiophanate-methyl at budbreak and repeat as per label directions.

Powdery mildew—At the first sign of disease (repeat as per label directions), apply: acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, *Bacillus subtilis*, copper (ammonium complex, salts), jojoba oil, myclobutanil, myclobutanil + permethrin, neem oil, neem oil + pyrethrin, paraffinic oil, potassium bicarbonate (shorten the interval during rainy weather), sulfur, tebuconazole, triadimefon, OR triforine. Exbury hybrid azaleas are especially sensitive to powdery mildew.

Rust (deciduous azalea)—Apply acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, mancozeb, neem oil, neem oil + pyrethrin, potassium bicarbonate, sulfur, tebuconazole, triadimefon, triforine in mid-August and repeat as per label directions.

Spider mite—Use dormant oil in late March. In early June or when mites first appear, apply acephate + resmethrin + triforine, disulfoton, horticultural oil, insecticidal soap, OR malathion.

Stem borer—Prune out and destroy dead and dying tips.

BEE BALM

Bee balm grows best in moist soils with high organic matter. The species tolerates partial shade but plantings in full sun will have fewer problems with mildew. Mulch plantings, especially those on drier soils. Also called Oswego Tea or Bergamot, bee balm (*Monarda didyma*) spreads by rhizomes and can be invasive. Remove old blooms.

Powdery Mildew—At the first sign of disease (repeat as per label directions), apply: acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, *Bacillus subtilis*, jojoba oil, lime-sulfur, myclobutanil, neem oil, neem oil + pyrethrin, paraffinic oil, potassium bicarbonate, sulfur, tebuconazole, triadimefon, OR triforine. Maintain good air circulation around plants.

BIRCH

All **birches** require full sun. Paper or white birch (*Betula papyrifera*) grows best in the cooler regions of New Jersey and prefers well drained soils that have a pH of 5.0 to 6.5. Sweet or cherry birch (*B. lenta*) grows best at pH 5.0 to 6.0. European white birch (*B. pendula*) grows best at pH 5.0 to 6.5 and is very susceptible to bronze birch borer, which can kill the tree. River or red birch (*B. nigra*) grows best at pH 5.5 to 6.5 and tolerates wet sites. The Heritage river birch is resistant to birch leaf miner and bronze birch borer. Gray or old field birch (*B. populifolia*) grows in clumps with 3 to 5 trunks and tolerates sandy, acidic, and low fertility soils.

Aphid—Use dormant oil in late March. Apply acephate, acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, bifenthrin, carbaryl, cyfluthrin, cyfluthrin + imidacloprid, dimethoate, disulfoton, esfenvalerate, horticultural oil, imidacloprid, insecticidal soap, malathion, neem oil, permethrin, OR rotenone when aphids are first noticed.

Bagworm—Apply acephate, acephate + resmethrin + triforine, *Bacillus thuringiensis*, bifenthrin, carbaryl, cyfluthrin, cyfluthrin + imidacloprid, malathion, permethrin, OR spinosad in mid-June and late June. Hand remove bags before June.

Bronze birch borer—Apply imidacloprid (see label). Keep trees in good vigor by feeding and watering.

Japanese beetle—Apply acephate, bifenthrin, carbaryl, cyfluthrin (adult), cyfluthrin + imidacloprid, deltamethrin, esfenvalerate, imidacloprid, malathion, methoxychlor, permethrin, OR rotenone in late June and July.

Leaf miner—Apply acephate, acephate + resmethrin + triforine, carbaryl, dimethoate, disulfoton, imidacloprid, malathion, OR spinosad in mid-May (leaf expansion) and mid-June when mines begin to show.

Powdery mildew—At the first sign of disease (repeat as per label directions), apply: acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, *Bacillus subtilis*, jojoba oil, myclobutanil, neem oil, neem oil + pyrethrin, sulfur, tebuconazole, triadimefon, OR triforine.

BOXWOOD

Plant **boxwood** in full sun or partial shade; prefers well drained soil with a pH of 6.0 to 7.0. Mulch plantings, and protect English boxwood (*Buxus sempervirens*) from winter sun and wind to prevent desiccation.

Canker—Apply Bordeaux OR copper (ammonium complex, sulfate) at budbreak and repeat as per label directions.

Leaf miner—Use carbaryl, dimethoate, imidacloprid, malathion, methoxychlor, OR spinosad in mid-May.

Psylla—Apply acephate, bifenthrin, carbaryl, OR cyfluthrin + imidacloprid when young psyllids appear (April to mid-May) and repeat in 2 weeks; OR imidacloprid (once per year).

Spider mite—Use dormant oil in late March. When mites first appear, apply dimethoate, horticultural oil, insecticidal soap, OR malathion.

BUTTERFLYBUSH

Butterflybush (*Buddleia* sp.) grows best in full sun and in well-drained, moist, and fertile soil. The plant is vigorous, reseeds itself prolifically, and is easily transplanted. Prune before growth begins in the spring: cut back stems to 12 to 18 inches from the ground so that next year's blooms will be at "eye level." Flowers form on new growth.

Aphids—Apply acephate, acephate + triforine + fenbutatin-oxide, bifenthrin, carbaryl, cyfluthrin, cyfluthrin + imidacloprid, disulfoton, esfenvalerate, horticultural oil, imidacloprid, insecticidal soap, malathion, neem oil, permethrin, OR pyrethrins when aphids appear.

NOTE: Sixty species of aphids are known to transmit *Cucumber mosaic virus* (CMV). The virus causes light green, linear patterns in the foliage. Butterflybush is usually so vigorous that the virus causes no real problem, but the virus can be transmitted to other plants, such as butterflyweed, delphinium, dahlia, and Michaelmas daisy. Dahlias may be infected and not show symptoms. CMV is also spread by

movement of plant sap during pruning and handling. Disinfect pruning shears, and control aphids and weeds to reduce incidence of virus. Weeds such as pigweed and pokeberry may harbor CMV.

BUTTERFLYWEED

Butterflyweed grows best in full sun in sandy soils, but tolerates heavier soils if drainage is good. A deep taproot makes butterflyweed (*Asclepias tuberosa*) drought tolerant, but also difficult to transplant.

Aphids—Apply acephate, acephate + triforine + fenbutatin-oxide, bifenthrin, canola oil, cyfluthrin, cyfluthrin + imidacloprid, disulfoton, esfenvalerate, insecticidal soap, malathion, neem oil, OR pyrethrins when aphids appear.

CALENDULA

Plant **calendula** in full sun and in moist, but well drained, fertile soil that has a pH of 6.0 to 7.5. Calendula prefers cooler temperatures.

Powdery mildew—At the first sign of disease (repeat as per label directions), apply: acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, *Bacillus subtilis*, jojoba oil, myclobutanil, neem oil, neem oil + pyrethrin, potassium bicarbonate (shorten the interval during rainy weather), propiconazole, sulfur, tebuconazole, triadimefon, OR triforine. Space plants to enhance air circulation and reduce humidity.

CAMELLIA (Japanese)

Japanese camellia (*Camellia japonica*) is marginally hardy in southern New Jersey and requires moist, well drained soil with a pH of 4.5 to 5.5. Grow camellias in protected, shady areas where the plant is not exposed to the late afternoon sun in the winter.

Powdery mildew—At the first sign of disease (repeat as per label directions), apply: acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, *Bacillus subtilis*, copper (ammonium complex), jojoba oil, neem oil, neem oil + pyrethrin, sulfur, tebuconazole, triadimefon, OR triforine.

CANNA

Plant **canna** in full sun and in moist, but well-drained, fertile soil with a pH of 6.0 to 7.5. Remove old blooms. Fertilizers that are high in nitrogen stimulate leaf and stem growth at the expense of flowers. Over-watering can be a problem with cannas in containers.

Japanese beetle—Handpick insects. Apply acephate, carbaryl, cyfluthrin (adult), cyfluthrin + imidacloprid, esfenvalerate, malathion, methoxychlor, neem oil, OR spinosad in June, July, and August.

CATALPA

Grow **catalpa** in full sun or partial shade. Catalpa tolerates a wide range of soil and moisture conditions, but grows best at a soil pH of 6.0 to 7.5.

Powdery mildew—At the first sign of disease (repeat as per label directions), apply: acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, *Bacillus subtilis*, jojoba oil, myclobutanil, neem oil, neem oil + pyrethrin, sulfur, tebuconazole, triadimefon, OR triforine.

CHERRY (Flowering)

Plant **flowering cherry** in full sun or partial shade. The tree prefers moist but well drained soil with a pH of 6.0 to 7.5. The bark on the trunk will be damaged if exposed to late afternoon sun in the winter. Transplant in the spring.

Black knot—Remove galls before spring.

Eastern tent caterpillar—Apply *Bacillus thuringiensis*, carbaryl, cyfluthrin, esfenvalerate, malathion, methoxychlor, OR spinosad in early May. Remove egg masses in fall and winter.

Fall webworm—Apply *Bacillus thuringiensis*, esfenvalerate, OR spinosad when webs first appear.

Leaf spot—Use *Bacillus subtilis*, captan, chlorothalonil, myclobutanil + permethrin, neem oil, potassium bicarbonate, OR tebuconazole. Repeat as per label directions.

White prunicola (peach) scale—Use 3% dormant oil in April. Apply carbaryl, cyfluthrin, cyfluthrin + imidacloprid, OR malathion in early and mid-June, late July, and early August; OR use imidacloprid (once per year).

CHERRY-LAUREL

Cherry-laurel grows best in partial or full shade. Plant in moist but well drained soils of moderate fertility with a pH of 5.0 to 7.0. Cherry-laurel is not reliably hardy north of Trenton, New Jersey and needs protection from winter wind and sun to prevent desiccation.

Leaf spot—Use *Bacillus subtilis*, chlorothalonil, neem oil, sulfur, OR tebuconazole as per label directions.

CHRYSANTHEM

Chrysanthemum grows best in full sun and in moderately fertile, moist, but well drained soil that has a pH of 6.0 to 7.5. Painted daisies (*Pyrethrum roseum* or *Dendranthrema coccineum*) grow best at a soil pH of 5.5 to 6.5. Feverfew (*D. parthenium*) tolerates partial shade.

NOTE: chlorothalonil may damage flowers, so avoid its use during bloom.

Aphid—When aphids first appear, apply acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, cyfluthrin, cyfluthrin + imidacloprid, esfenvalerate, insecticidal soap, malathion, neem oil, OR rotenone.

Flower blight (Botrytis)—Spray *Bacillus subtilis*, captan, captan + malathion + carbaryl, chlorothalonil, copper (ammonium complex, salts, sulfate), copper + rotenone, neem oil, potassium bicarbonate, OR thiophanate-methyl as per label directions. (See Note on *Botrytis*).

Lacebug—Apply acephate + resmethrin + triforine, cyfluthrin, cyfluthrin + imidacloprid, insecticidal soap, malathion, OR rotenone when lacebugs appear.

Leafminer—Use acephate + triforine + fenbutatin-oxide, cyfluthrin + imidacloprid, malathion, OR spinosad when mines appear.

Leaf spot—Use *Bacillus subtilis*, chlorothalonil, copper (salts, sulfate), mancozeb, neem oil, OR tebuconazole June through August (see label). Potassium bicarbonate may also be applied every 7 to 14 days until conditions no longer favor disease development (shorten the interval during rainy weather).

Powdery mildew—At the first sign of disease (repeat as per label directions), apply: acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, *Bacillus subtilis*, jojoba oil, myclobutanil, neem oil, neem oil + pyrethrin, potassium bicarbonate (shorten the interval during rainy weather), sulfur, tebuconazole, triadimefon, OR triforine.

Plant bug—Apply cyfluthrin + imidacloprid OR methoxychlor when plant bugs appear.

Spider mite—When mites first appear, apply acephate + resmethrin + triforine, horticultural oil, insecticidal soap, malathion, OR rotenone.

CLEMATIS

The **Clematis** genus includes large flowered vines as well as herbaceous perennials that don't climb. Showy flowers are followed by decorative seedheads. The foliage of all clematis plants does best in full sun, while the roots need the cool temperatures and moist soils provided by a 2-inch layer of mulch. Vine types include *C. montana* and tolerate shade enough to grow into trees. Solitary clematis (*C. integrifolia*) grows best in full sun; the species tolerates partial shade but stems will be thinner and it flowers less.

Blister beetle—Spray acephate, carbaryl, imidacloprid, neem oil, pyrethrins, rotenone, OR spinosad when beetles appear.

COLUMBINE

Plant **columbine** in full sun or part shade. The plant prefers moist, well drained soil that is high in organic matter. Soil pH requirement varies, but is generally best between 6.0 and 7.5.

Aphid—When aphids first appear, apply acephate + triforine + fenbutatin-oxide, cyfluthrin, cyfluthrin + imidacloprid, esfenvalerate, insecticidal soap, horticultural oil, malathion, OR neem oil.

Leafminer—Apply acephate + triforine + fenbutatin-oxide, cyfluthrin + imidacloprid, malathion, OR spinosad in the spring when mines begin to show. As mines begin to form, squeeze the leaf between thumb and forefinger to kill developing larvae.

COTONEASTER

Cotoneaster requires full sun and a well drained soil that has a pH of 6.0 to 7.5. The plant is drought tolerant but is susceptible to fireblight, a bacterial disease (see "Firethorn" for more information).

Aphid—Apply dormant oil in late March. When aphids first appear, apply acephate, acephate + triforine + fenbutatin-oxide, bifenthrin, carbaryl, cyfluthrin, cyfluthrin + imidacloprid, esfenvalerate, horticultural oil, imidacloprid, insecticidal soap, OR malathion.

Fireblight—See "firethorn."

Lacebug—Use acephate, bifenthrin, carbaryl, cyfluthrin, cyfluthrin + imidacloprid, deltamethrin, disulfoton, esfenvalerate, horticultural oil, imidacloprid (once per year), insecticidal soap, malathion, neem oil, OR permethrin when lacebugs appear.

Leaf spot—Use *Bacillus subtilis,* neem oil, OR tebuconazole at budbreak. Repeat as per label directions.

Spider mite—Apply dormant oil in late March. When mites first appear, apply disulfoton, horticultural oil, insecticidal soap, OR malathion.

CRABAPPLE (Flowering)

Crabapple grows in full sun; prefers deep, moist, but well drained soils that have a pH of 6.0 to 7.5. The tree tolerates infertile soil and is susceptible to fireblight, a bacterial disease (see "Firethorn" for more information).

Eastern tent caterpillar—In early May, apply acephate, *Bacillus thuringiensis,* bifenthrin, carbaryl, cyfluthrin, esfenvalerate, horticultural oil, insecticidal soap, malathion, neem oil, permethrin, OR spinosad. Remove egg masses in the fall and winter.

Powdery mildew—At the first sign of disease (repeat as per label directions), apply: acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, *Bacillus subtilis,* jojoba oil, myclobutanil, myclobutanil + permethrin, neem oil, neem oil + pyrethrin, propiconazole, sulfur, tebuconazole, triadimefon, OR triforine. Choose resistant varieties, and rake leaves to reduce inoculum.

Rust—Apply acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, chlorothalonil, myclobutanil, myclobutanil + permethrin, neem oil, neem oil + pyrethrin, propiconazole, sulfur, tebuconazole, triadimefon, OR triforine from pink-bud stage until two weeks after petal fall and repeat at intervals on label. Choose resistant varieties.

Scab—Apply *Bacillus subtilis,* captan, chlorothalonil, lime-sulfur, myclobutanil, myclobutanil + permethrin, neem oil, propiconazole, OR tebuconazole from budbreak until two weeks after petal fall and repeat at intervals on label. Choose resistant varieties.

CRAPE MYRTLE

Crape myrtle grows in full sun and in moist but well drained soil with a pH of 5.0 to 7.5. Crape myrtle is hardy to zone 7, but will grow in zone 6 with protection.

Powdery mildew—At the first sign of disease (repeat as per label directions), apply: acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, *Bacillus subtilis,* jojoba oil, myclobutanil, neem oil, neem oil + pyrethrin, potassium bicarbonate (shorten the interval during rainy weather), propiconazole, sulfur, tebuconazole, triadimefon, OR triforine.

DAHLIA

Dahlias grow in full sun or partial shade and prefer moist, fertile soil high in organic matter and with a pH of 6.0 to 7.5. Remove old blooms.

Aphid—When aphids first appear, apply acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, cyfluthrin, cyfluthrin + imidacloprid, esfenvalerate, horticultural oil, insecticidal soap, malathion, neem oil, OR rotenone.

Flower blight—Apply copper (ammonium complex, salts, sulfate) OR thiophanate-methyl as flowers open and repeat as per label directions. Remove old flowers. (See Note on *Botrytis*).

Leafhopper—Use acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, cyfluthrin, cyfluthrin + imidacloprid, OR malathion when leafhoppers appear.

Powdery mildew—At the first sign of disease (repeat as per label directions), apply: acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, *Bacillus subtilis,* copper (ammonium complex), jojoba oil, myclobutanil, neem oil, neem oil + pyrethrin, potassium bicarbonate (shorten the interval during rainy weather), sulfur, tebuconazole, triadimefon, OR triforine.

Spider mite—When mites first appear, apply horticultural oil, insecticidal soap, malathion, OR rotenone.

Thrips—Use acephate + resmethrin + triforine, acephate, acephate + triforine + fenbutatin-oxide, carbaryl, cyfluthrin, cyfluthrin + imidacloprid, disulfoton, imidacloprid, malathion, neem oil, rotenone, OR spinosad when flowers begin to open.

DAYLILY

Daylily grows well in full sun if soil moisture is plentiful. Adequate water is essential during bloom. Cultivars with red and purple flowers, however, hold their colors better with partial shade from the afternoon sun. Evergreen types are less hardy than deciduous types. Diminished flowering in a clump indicates that it needs to be divided.

Aphids—When aphids appear, apply acephate, acephate + triforine + fenbutatin-oxide, cyfluthrin, cyfluthrin + imidacloprid, dimethoate, esfenvalerate, insecticidal soap, malathion, neem oil, pyrethrins, OR rotenone.

Thrips—When damage appears, apply acephate, acephate + triforine + fenbutatin-oxide, carbaryl, cyfluthrin, cyfluthrin + imidacloprid, dimethoate, disulfoton, imidacloprid, insecticidal soap, malathion, neem oil, pyrethrins, rotenone, OR spinosad. For optimal control, thoroughly cover lower leaf surfaces, and penetrate dense foliage with product.

DELPHINIUM

Delphinium prefers full sun, cool growing conditions, and fertile soil with a pH of 6.0 to 7.5. Remove old blooms and don't mulch close to the crown of the plant. May need staking even with wind protection.

Powdery mildew—At the first sign of disease (repeat as per label directions), apply: acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, *Bacillus subtilis,* copper (ammonium complex), jojoba oil, myclobutanil, neem oil, neem oil + pyrethrin, potassium bicarbonate (shorten the interval during rainy weather), propiconazole, sulfur, tebuconazole, triadimefon, OR triforine.

DIANTHUS

(Pinks, Carnation)

Pinks grow best in full sun and in moist, but well drained soil with a pH of 6.0 to 7.5. Remove old blooms. Some carnation varieties are sensitive to neem oil.

Crown rot—Remove infected plants. To help prevent this disease, DO NOT mulch over the crown of the plant.

Leaf spot—Apply *Bacillus subtilis,* captan, captan + malathion + carbaryl, chlorothalonil, copper (salts), neem oil (use with caution on some varieties), potassium bicarbonate, OR tebuconazole as per label directions.

Powdery mildew—At the first sign of disease (repeat as per label directions), apply: acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, *Bacillus subtilis,* copper (ammonium complex), jojoba oil, myclobutanil, myclobutanil + permethrin, neem oil, neem oil + pyrethrin (use neem oil with caution on some varieties), potassium bicarbonate (shorten the interval during rainy weather), sulfur, tebuconazole, triadimefon, OR triforine.

Rust—Apply acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, captan, captan + malathion + carbaryl, myclobutanil, myclobutanil + permethrin, neem oil, neem oil + pyrethrin, potassium bicarbonate, sulfur, tebuconazole, triadimefon, OR triforine at intervals stated on label.

DOGWOOD

Dogwoods prefer moist, but well drained soils high in organic matter. Most dogwoods do well at a soil pH of 5.0 to 6.5, but yellow twig dogwood (*Cornus sericea* 'Flaviramea') requires a pH of 6.0 to 7.0. Flowering dogwood (*C. florida*) grows in partial shade as an understory tree, but performs better in full sunlight if there is adequate moisture available. Kousa dogwood (*C. kousa*) grows in full sun or partial shade, but does not tolerate shade as well as flowering dogwood. Hybrids of kousa dogwood and flowering dogwood (*C. kousa* x *C. florida*) are Aurora, Celestial, Constellation, Ruth Ellen, Stardust, and Stellar Pink. Red twig (*C. sericea*) and yellow twig dogwoods are shrubs that do best in moist sites. Keep turfgrass away from the trunk to avoid damage by lawn mowers and line trimmers.

Discula anthracnose—Apply chlorothalonil, copper (salts), iprodione, myclobutanil, propiconazole, OR tebuconazole at budbreak and repeat at intervals stated on label.

Borer—Spray permethrin to bark of trunk and larger branches May 15 and June 15.

Calico scale—Apply acephate, cyfluthrin, cyfluthrin + imidacloprid, horticultural oil, imidacloprid (once per year), OR malathion in mid-June when crawlers are active.

Flower blight—Apply copper (ammonium complex), potassium bicarbonate (shorten the interval during rainy weather), OR thiophanate-methyl. Repeat as per label directions. (See Note on *Botrytis*).

Leaf spot—When leaf buds open, spray *Bacillus subtilis,* chlorothalonil, copper (ammonium complex), neem oil, potassium bicarbonate, OR tebuconazole and repeat as per label directions.

Spot anthracnose—Spray copper (salts), myclobutanil, OR tebuconazole at budbreak and repeat as per label directions.

DOUGLAS-FIR

Douglas-fir grows best in full sun and in moist, but well drained soils with a pH of 6.0 to 7.0. Avoid planting in dry, windy sites.

Cooley spruce gall adelgid—Late May to mid-May: carbaryl, 1% horticultural oil (see individual label for timing and rates), imidacloprid, OR insecticidal soap.

Needlecast—Spray chlorothalonil when candles are 1/2 inch long and then repeat 1, 3, and 6 weeks later OR use copper (salts).

DRACENA

Most **dracenas** need high light intensity (especially variegated forms) but not full sun, which causes wilting and sunburned leaves. During the active growth period (spring, summer, and fall), *Dracaena deremensis* 'Janet Craig' and 'Warneckii' grow best at 64 to 75°F (18 to 24°C). Keep soil moist, but do not allow water to remain in the saucer for more than 30 minutes after watering. Requires moderate fertility. During the winter rest period, maintain plants around 53°F (12°C), water less often, and allow the growing medium to become almost dry between waterings. No fertilization is needed.

Leaf spot—Apply *Bacillus subtilis*, chlorothalonil, copper (salts), neem oil, OR tebuconazole, and repeat as per label directions.

ELM

Elms prefer moist soil that is high in organic matter and has a pH of 6.0 to 7.5 for lacebark elm (*Ulmus parvifolia*) and American elm (*U. americana*). Elm is salt tolerant. For new plantings, only lacebark elm is recommended.

Aphid—Use dormant oil in late March. When aphids first appear, apply acephate, acephate + triforine + fenbutatin-oxide, bifenthrin, carbaryl, cyfluthrin, cyfluthrin + imidacloprid, disulfoton, esfenvalerate, horticultural oil, imidacloprid, insecticidal soap, malathion, neem oil, permethrin, OR rotenone.

Cankerworm—Apply *Bacillus thuringiensis*, carbaryl, methoxychlor, OR spinosad in early to mid-May.

Dutch elm disease—Use a professional landscape maintenance service for elm bark beetle and disease control. See below.

Elm leaf beetle—Apply acephate, *Bacillus thuringiensis* subsp. *tenebrionis*, carbaryl, cyfluthrin, cyfluthrin + imidacloprid, horticultural oil, imidacloprid (once per year), insecticidal soap, methoxychlor, neem oil, rotenone, OR spinosad in mid-May, or late July, early August.

Japanese beetle—Apply acephate, carbaryl, cyfluthrin (adult), cyfluthrin + imidacloprid, esfenvalerate, imidacloprid, methoxychlor, permethrin, rotenone, OR spinosad in July and/or August.

ELM BARK BEETLE CONTROL

Use a professional landscape maintenance service for elm bark beetle control. Spray applications may be made when weather conditions are favorable and temperatures are above freezing. The best results have been obtained when applications are made between March 1st and budbreak.

Thorough spray coverage is absolutely necessary to obtain protection. Be certain that smaller twigs in the tops of trees receive adequate coverage. Mist blower applications should be attempted only when there is little or no wind. Do not allow the insecticide spray to drip onto automobiles because spotting or pitting may result. Some damage to lawn areas may result under trees.

Compounds labeled for professional control of elm bark beetle include azadirachtin, bifenthrin, carbaryl, chlorpyrifos, methoxychlor, and permethrin.

FUNGICIDE AND CULTURAL CONTROL

Remove all dead or dying elms to eliminate potential breeding sites for the bark beetle vector.

Have a landscape maintenance service inject valuable trees on a preventive basis with propiconazole (Alamo, Propiconazole G-Pro, Quali-Pro 14.3, Savvi), thiabendazole (Arbotect 20S), Mauget Fungisol, Mauget Abasol, Mauget Imisol, Mauget Tebuject (tebuconazole), or Phyton 27 per manufacturer's labeling. Once symptoms develop, fungicide treatments should be combined with drastic eradicative pruning (removing 10 feet of branch tissue below yellow symptomatic foliage). When trees exhibit more than 5% crown symptoms, fungicide injection may be ineffective.

To prevent root graft transmission of dutch elm disease, dig a trench (3 feet deep) midway between diseased and healthy elms, or apply Vapam per manufacturer's recommendations.

EUONYMUS

Euonymus grows in full sun or partial shade in soil with a pH of 6.0 to 7.5. Burning bush euonymus (*Euonymus alatus* and *E. alatus* 'Compactus') tolerates shade but has better red fall color in full sun. Spreading euonymus (*E. kiautschovicus*) can be evergreen, which means it will require protection from the late afternoon winter sun. Also an evergreen, wintercreeper euonymus (*E. fortunei*) is a variable plant that can grow as a ground cover, clinging vine, or shrub. Variegated forms of wintercreeper euonymus will be more susceptible to scale insects and will require more maintenance.

Powdery mildew—At the first sign of disease (repeat as per label directions), apply: acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, *Bacillus subtilis*, jojoba oil, lime-sulfur, myclobutanil, neem oil, neem oil + pyrethrin, potassium bicarbonate, sulfur, tebuconazole, triadimefon, OR triforine.

Scale—Apply 2% dormant oil in April. Use acephate, acephate + resmethrin + triforine, cyfluthrin, cyfluthrin + imidacloprid, dimethoate, horticultural oil, imidacloprid (once per year), OR malathion in early June, and mid-August.

FIRETHORN (Pyracantha)

Firethorn grows well in full sun and in well drained soil with a pH of 6.0 to 7.5. When selecting plant material, choose varieties that are resistant to fireblight and scab.

Aphid—Use dormant oil in late March. When aphids first appear, apply acephate, acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, bifenthrin, carbaryl, cyfluthrin, cyfluthrin + imidacloprid, disulfoton, esfenvalerate, horticultural oil, imidacloprid, insecticidal soap, malathion, neem oil, OR permethrin.

Fireblight—Apply *Bacillus subtilis,* copper (salts) during early, mid-, and late flowering; OR use streptomycin sulfate at the start of bloom and repeat every 3 to 4 days during bloom. Continue sprays every 5 to 7 days after bloom if weather is warm and over 60% relative humidity. Fireblight progresses most rapidly if daytime temperatures are between 81 and 87°F (27 to 29°C). High fertility and severe pruning stimulate succulent growth, which is susceptible to the disease. In late winter, remove blighted growth at least 8 inches into healthy wood during dry weather with pruning tools that are disinfested between cuts.

Lacebug—When lacebugs appear, apply acephate, acephate + resmethrin + triforine, bifenthrin, carbaryl, cyfluthrin, cyfluthrin + imidacloprid, deltamethrin, disulfoton, esfenvalerate, horticultural oil, imidacloprid (once per year), insecticidal soap, malathion, neem oil, OR permethrin.

Scab—Apply *Bacillus subtilis,* chlorothalonil, myclobutanil, neem oil, potassium bicarbonate, OR tebuconazole at budbreak and repeat as per label directions.

FUCHSIA

For **fuchsia**, provide good light outdoors in summer, but avoid direct sunlight. Fuchsia does best in cooler summer weather (60°F or 15°C) and at 46 to 50°F (8 to 10°C) during the winter. Water freely and fertilize once per week in the summer. During the winter, allow soil to dry between waterings, and feed once per month when the plant grows more slowly. Leaves turn yellow and fall if the plant is overwatered. Fuchsia flowers are sensitive to neem oil.

Powdery mildew—At the first sign of disease (repeat as per label directions), apply: acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, *Bacillus subtilis,* jojoba oil, myclobutanil, neem oil, neem oil + pyrethrin (use neem oil with caution on flowers), Phyton 27, sulfur, tebuconazole, triadimefon, OR triforine.

Whitefly—Apply acephate + resmethrin + triforine, cyfluthrin, cyfluthrin + imidacloprid, esfenvalerate, imidacloprid, insecticidal soap, malathion, neem oil, permethrin, OR pyrethrins.

GERANIUM

(Zonal or Florists) (*Pelargonium* x *Hortorum*)

Geranium grows in full sun or partial shade and in fertile, moist, but well drained soil that is high in organic matter. Zonal geranium (*Pelargonium* x *hortorum*) does best at a pH of 6.0 to 7.5, and wild geranium or cranesbill (*Geranium maculatum*) grows at a pH of 5.0 to 6.5.

NOTE: chlorothalonil may damage flowers, so avoid its use during bloom.

Flower and leaf spot—Spray *Bacillus subtilis,* chlorothalonil, copper (ammonium complex, salts, sulfate), Phyton 27, potassium bicarbonate, OR thiophanate-methyl when flowers open and continue as per label directions.

Rust—Apply acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, *Bacillus subtilis,* chlorothalonil, mancozeb, myclobutanil, neem oil, neem oil + pyrethrin, Phyton 27, potassium bicarbonate, sulfur, tebuconazole, triadimefon, OR triforine when disease appears and repeat at intervals stated on label.

Tobacco budworm—Apply acephate, acephate + triforine + fenbutatin-oxide, *Bacillus thuringiensis*, bifenthrin, OR spinosad as per label recommendations.

GLADIOLUS

Plant **gladiolus** in full sun and in fertile, well drained, sandy loam or loam soil with a pH of 6.0 to 7.0. These plants are not drought tolerant.

NOTE: chlorothalonil may damage flowers, so avoid its use during bloom.

Aphid—When aphids first appear, apply acephate + triforine + fenbutatin-oxide, cyfluthrin, cyfluthrin + imidacloprid, dimethoate, esfenvalerate, insecticidal soap, neem oil, OR rotenone.

Leaf and flower spot—When plants are 8 to 10 inches tall, spray *Bacillus subtilis,* chlorothalonil, copper (ammonium complex, salts, sulfate), potassium bicarbonate (shorten the interval during rainy weather), OR thiophanate-methyl and repeat (see label) until conditions no longer favor disease development. (See Note on *Botrytis*).

Thrips—Use acephate + triforine + fenbutatin-oxide, carbaryl, cyfluthrin, cyfluthrin + imidacloprid, dimethoate, disulfoton, imidacloprid, malathion, methoxychlor, neem oil, pyrethrins, rotenone, OR spinosad. Store corms at 40 to 45°F (5 to 7°C).

HAWTHORN

Hawthorn grows well in sun and in deep, moist soil that has a pH of 6.0 to 7.5. Transplant these trees in the spring. Hawthorn can develop fireblight, a bacterial disease (see "Firethorn" for more information).

Aphid—Use dormant oil in late March. When aphids first appear, apply acephate, acephate + triforine + fenbutatin-oxide, bifenthrin, carbaryl, cyfluthrin, cyfluthrin + imidacloprid, disulfoton, esfenvalerate, horticultural oil, imidacloprid, insecticidal soap, malathion, neem oil, OR permethrin. Repeat when necessary.

Japanese beetle—Apply acephate, bifenthrin, carbaryl, cyfluthrin (adult), cyfluthrin + imidacloprid, deltamethrin, esfenvalerate, imidacloprid (once per year), malathion, methoxychlor, neem oil, permethrin, OR spinosad in July and August.

Lacebug—When lacebugs appear, use acephate, bifenthrin, carbaryl, cyfluthrin, cyfluthrin + imidacloprid, deltamethrin, disulfoton, esfenvalerate, horticultural oil, imidacloprid (once per year), insecticidal soap, malathion, neem oil, OR permethrin as per label recommendations.

Leaf blight or spot—Spray *Bacillus subtilis,* chlorothalonil, copper (ammonium complex, sulfate), copper + rotenone, potassium bicarbonate (shorten the interval during rainy weather), tebuconazole, OR thiophanate-methyl at budbreak and repeat at intervals on label.

Rust—Apply acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, chlorothalonil, copper ammonium complex, myclobutanil, neem oil, neem oil + pyrethrin, potassium bicarbonate, sulfur, tebuconazole, triadimefon, triforine at budbreak and repeat at intervals on label. Choose resistant varieties.

HEMLOCK

Hemlocks grow best in partial sun or shade and prefer deep, moist soil with a pH of 5.0 to 6.0. Hemlocks are not drought tolerant but also do not tolerate "wet feet."

Hemlock fiorinia scale—Apply 2% dormant oil in April. Use cyfluthrin, cyfluthrin + imidacloprid, dimethoate, imidacloprid (once per year), malathion in early June and late August when crawlers are active.

Rust—Apply acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, neem oil, neem oil + pyrethrin, sulfur, tebuconazole, triadimefon, OR triforine at budbreak and repeat (see label).

Scale—Apply 2% dormant oil in April. Use cyfluthrin, cyfluthrin + imidacloprid, dimethoate, horticultural oil, imidacloprid (once per year), OR malathion in late July when crawlers are active.

Spider mite—Use dormant oil in late March. In mid-May, apply dimethoate, horticultural oil, malathion, OR rotenone.

Woolly adelgid—Apply 2% dormant oil in late April and late September. Use 1% horticultural oil OR insecticidal soap in June through August, OR use cyfluthrin + imidacloprid, imidacloprid (see label). For more information, refer to the Rutgers Cooperative Research & Extension fact sheet FS751 "The Hemlock Woolly Adelgid."

HICKORY

Hickory grows best in deep, well drained soils that are high in organic matter and have a pH of 6.0 to 7.0.

Leaf spot—Apply *Bacillus subtilis,* neem oil, OR tebuconazole at budbreak and repeat as per label directions.

Leaf stem gall aphid—Use 3% dormant oil in April. Apply malathion in early May.

HOLLY

Plant **holly** in partial shade or full sun and in moist but well drained soils that have a pH as follows: American holly (*Ilex opaca*), 5.0 to 6.5; Chinese holly (*I. cornuta*), 5.5 to 6.5; Japanese holly (*I. crenata*), 5.0 to 6.5; and Inkberry (*I. glabra*), 5.0 to 6.5. Inkberry and winterberry (*I. verticillata*) tolerate wet soils.

Berry midge—Apply cyfluthrin + imidacloprid in late May.

Leaf miner—Apply carbaryl, cyfluthrin + imidacloprid, dimethoate, imidacloprid, OR spinosad in mid-May.

Leaf spot—Spray *Bacillus subtilis,* chlorothalonil, copper (salts), neem oil, potassium bicarbonate (shorten the interval during rainy weather), OR tebuconazole at budbreak and repeat at intervals stated on label.

Spider mite—Spray delayed 2% dormant oil, horticultural oil, insecticidal soap, OR malathion in late April or early May.

HOLLYHOCK

Hollyhock grows in full sun and in moist but well

NOTE: chlorothalonil may damage flowers, so avoid its use during bloom.

Earwig—For information, refer to Rutgers Cooperative Research & Extension fact sheet FS211, "All about the European Earwig."

Japanese beetle—Apply acephate, carbaryl, cyfluthrin (adult), cyfluthrin + imidacloprid, esfenvalerate, malathion, methoxy-

chlor, neem oil, OR spinosad in June, July, and August. Handpick insects.

Rust—Apply acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, chlorothalonil, myclobutanil, neem oil, neem oil + pyrethrin, Phyton 27, sulfur, tebuconazole, triadimefon, OR triforine at budbreak and repeat (see label). Maintain good air movement; some annual cultivars are more resistant to rust than others.

Spider mite—When pest appears, apply horticultural oil, insecticidal soap, OR malathion.

HONEY LOCUST

Honey locust grows well in full sun and prefers moist soils with a pH of 6.0 to 7.5. Honey locust is drought and salt tolerant. The cultivar Sunburst is especially susceptible to infestations of pod gall midge.

Bagworm—Apply acephate, *Bacillus thuringiensis*, bifenthrin, carbaryl, cyfluthrin, cyfluthrin + imidacloprid, malathion, permethrin, OR spinosad in mid- and late June. Hand remove bags before June.

Locust borer—Use chlorpyrifos in late August.

Mimosa webworm—Apply acephate, *Bacillus thuringiensis*, carbaryl, OR spinosad in mid-June, mid-July, and mid-August.

Pod gall midge—Apply bifenthrin, carbaryl, cyfluthrin + imidacloprid, OR spinosad in May at intervals stated on label until August, or until no further injury is noted.

HONEYSUCKLE (Goldflame)

Honeysuckle (*Lonicera* x *heckrottii*), a climbing vine, grows best when transplanted as a small container plant. It will grow in shade, but flowers more in full sun. Prune within two or three weeks of flowering or the flower buds for the following year will be lost.

Aphids—Apply acephate, acephate + triforine + fenbutatin-oxide, carbaryl, cyfluthrin, cyfluthrin + imidacloprid, esfenvalerate, imidacloprid, insecticidal soap, malathion, neem oil, permethrin, OR pyrethrins when aphids appear.

Fall webworm—Apply acephate, *Bacillus thuringiensis*, carbaryl, neem oil, permethrin, OR pyrethrins in early July or August.

HORSE CHESTNUT

Horse chestnut grows best in full sun or partial shade and in moist, but well drained soil with a pH of 6.0 to 7.5.

Leaf blotch/leaf spot—Spray chlorothalonil OR neem oil at budbreak and repeat (see label). Once at early flowering will give fairly good control unless spring rainfall is above normal.

HOSTA (Plantain lily)

Hosta prefers partial or full shade and constantly moist but well drained soil that is high in organic matter. With adequate soil moisture, many hosta cultivars will grow in full sun, especially in cooler weather. Cultivars with gold tones in their foliage must have some direct sun for development of full color. Leaf edges that turn brown and dry indicate too much sun or lack of sufficient soil moisture for the plant.

Slugs—To reduce slug problems, keep the area free of weeds, remove older leaves, and keep mulch away from the crown of the plants. Hostas that are "vase-shaped" are less prone to slug damage because the leaves don't touch the ground. Also, cultivars with heavier, thicker leaves will be less damaged. Refer to Rutgers Cooperative Research & Extension fact sheet FS397 "Slugs and Snails in the Vegetable Garden" for more information.

HYDRANGEA

Hydrangeas prefer full sun or partial shade and fertile, moist, but well drained soils with a pH of 6.0 to 7.5. Florist's hydrangea (*Hydrangea macrophylla*) normally has pink flowers, but will produce blue flowers if the plant is grown in soils at the lower end of the above pH range. Flower buds may winter kill. Hydrangea tolerates heat, drought, and salt.

NOTE: chlorothalonil may damage flowers, so avoid its use during bloom.

Bud blight (Botrytis)—Spray *Bacillus subtilis*, neem oil, potassium bicarbonate, sulfur, OR thiophanate-methyl until conditions no longer favor disease development (repeat as per label directions). (See Note on *Botrytis*).

Leaf spot—Early in propagation (and repeat as per label directions), spray: *Bacillus subtilis*, chlorothalonil (foliage only), copper (salts), myclobutanil, neem oil, potassium bicarbonate (shorten the interval during rainy weather), sulfur, OR tebuconazole.

Powdery mildew—At the first sign of disease (repeat as per label directions), apply: acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, *Bacillus subtilis*, copper salts, jojoba oil, myclobutanil, neem oil, neem oil + pyrethrin, potassium bicarbonate (shorten the interval during rainy weather), sulfur, tebuconazole, triadimefon, OR triforine.

IMPATIENS

Impatiens requires moist, well drained soil that is high in organic matter. Plantings in full sun will require extra water and fertilizer. Garden balsam (*Impatiens balsamina*) grows in full sun or partial shade; impatiens (*I. walleriana*), also called buzy lizzie, grows in partial shade; New Guinea hybrid impatiens grows well in full sun (which brings out color variegations in the foliage), but will also grow in partial shade. Impatiens flowers are sensitive to potassium bicarbonate and neem oil.

Thrips—Apply acephate + triforine + fenbutatin-oxide, carbaryl, cyfluthrin, cyfluthrin + imidacloprid, disulfoton, imidacloprid, malathion, neem oil, pyrethrins, resmethrin, rotenone, OR spinosad. Before spraying an entire bed, check for phytotoxicity by applying the insecticide to a small portion of a plant. Thrips are vectors of the genus *Tospovirus* (*Tomato spotted wilt virus* and *Impatiens necrotic spot virus*), which means they carry the viruses from infected plants to healthy plants as they feed. There is no direct control for virus diseases.

IRIS

Iris prefers full sun. Remove old blooms. Bearded types (*Iris* x *germanica*) grow well in moderately fertile, moist, and well drained soil with a pH of 6.0 to 7.5; blue flag (*I. versicolor*) prefers a pH of 5.0 to 7.5; Japanese (*I. ensata* or *kaempferi*) and Siberian (*I. sibirica*) types require constantly moist soil with a pH of 5.0 to 6.0; and yellow flag (*I. pseudacorus*) prefers a moist soil near water or an average soil with regular irrigation. Pest problems listed below apply primarily to bearded irises.

Aphid—As soon as aphids appear, spray acephate + triforine + fenbutatin-oxide, cyfluthrin, cyfluthrin + imidacloprid, esfenvalerate, insecticidal soap, malathion, OR neem oil.

Borer—Begin malathion sprays when leaves are 4 to 6 inches long and repeat every 10 days. Crush larvae in leaves between thumb and forefinger. Clean up old plant material by early April.

Leaf spot—When plants are 8 inches high or when spots appear, use *Bacillus subtilis*, chlorothalonil, copper (salts, sulfate), neem oil, potassium bicarbonate (shorten the interval during rainy weather), OR tebuconazole. Repeat as per label directions until conditions no longer favor disease development.

IVY (English)

English ivy prefers partial shade and needs protection from wind and late afternoon sun during the winter to prevent desiccation of foliage. Ivy is moderately drought tolerant and prefers a well drained soil with a pH of 6.0 to 7.5.

Leaf spot—Apply *Bacillus subtilis*, copper (octanoate, salts, sulfate), neem oil, potassium bicarbonate (shorten the interval during rainy weather), sulfur, OR tebuconazole at intervals stated on label until conditions no longer favor disease development.

Japanese beetle—Apply acephate, carbaryl, cyfluthrin (adult), cyfluthrin + imidacloprid, esfenvalerate, malathion, methoxychlor, neem oil, OR spinosad in late June and July.

Spider mite—Use dormant oil in late March. Apply acephate, acephate + resmethrin + triforine, dimethoate, horticultural oil, insecticidal soap, OR malathion when mites appear.

JUNIPER

Juniper grows well in full sun and in well drained soils. Tolerates heat, drought, and salt.

Aphid—Use a dormant oil in late March. When mites appear (May), apply acephate, acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, bifenthrin, carbaryl, cyfluthrin, cyfluthrin + imidacloprid, dimethoate, disulfoton, esfenvalerate, horticultural oil, imidacloprid, insecticidal soap, malathion, neem oil, OR permethrin.

Bagworm—Apply acephate, *Bacillus thuringiensis*, bifenthrin, carbaryl, cyfluthrin, cyfluthrin + imidacloprid, malathion, permethrin, OR spinosad in mid-June and repeat after 10 to 14 days. Hand remove bags before June.

Juniper tip midge—Mid-May, mid-June, and early August: neem oil OR dimethoate. Prune out dead tips by April.

Rust—Apply acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, copper (ammonium complex, salts), neem oil, neem oil + pyrethrin, potassium bicarbonate, sulfur, tebuconazole, triadimefon, OR triforine. Choose resistant varieties. Do not plant juniperous species near crabapple, hawthorn, or quince.

Scale—Use 2% dormant oil in April. In mid-June when crawlers are active, apply acephate, acephate + resmethrin + triforine, carbaryl, cyfluthrin, cyfluthrin + imidacloprid, OR malathion and repeat after 5 days; OR use imidacloprid (once per year).

Spider mite—Apply 2% dormant oil in early April before new growth begins. When mites appear, spray acephate + resmethrin + triforine, horticultural oil, insecticidal soap, OR malathion.

Tip blight—Spray copper (salts, sulfate), neem oil, OR potassium bicarbonate at budbreak and repeat, as per label directions, until conditions no longer favor disease development. Choose resistant varieties.

Webworm—In early May and late July, apply acephate, *Bacillus thuringiensis*, carbaryl, OR spinosad.

LARCH

(European, *Larix decidua*, or Eastern, *L. larcinia*)

Larches are large, cone-bearing trees that are not evergreen. Larch needles turn deep yellow in the fall. European larch grows best in moist, well-drained soils in full sun, while the eastern larch is well adapted to wet soils.

Bagworm—Mid-June: acephate, *Bacillus thuringiensis*, carbaryl, malathion, neem oil, permethrin, pyrethrin, OR spinosad.

Casebearer—Early May and mid-May: *Bacillus thuringiensis* OR spinosad.

LAUREL (Mountain)

Mountain laurel is shade loving and prefers moist but well drained soil that has a pH of 5.0 to 6.0. Mulch plantings and protect from winter sun and wind to prevent desiccation.

Lacebug—Apply acephate, bifenthrin, carbaryl, cyfluthrin, cyfluthrin + imidacloprid, deltamethrin, disulfoton, esfenvalerate, horticultural oil, imidacloprid (once per year), insecticidal soap, malathion, neem oil, OR permethrin in May to June.

Leaf spot—Spray *Bacillus subtilis,* chlorothalonil, copper (sulfate), neem oil, potassium bicarbonate, OR tebuconazole at budbreak and repeat as per label directions.

LAVENDER

Lavender grows best in well drained soils and in full sun. Most are perennial, but Spanish lavender (*Lavendula stoechas*) is a tender perennial or an annual.

Gray mold—Apply *Bacillus subtilis,* potassium bicarbonate, OR thiophanate-methyl when symptoms appear. (See Note on *Botrytis*).

Powdery Mildew—At the first sign of disease (repeat as per label directions), apply: acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, *Bacillus subtilis,* jojoba oil, neem oil, neem oil + pyrethrin, potassium bicarbonate, sulfur, tebuconazole, triadimefon, OR triforine. Maintain good air circulation around the plant to reduce humidity.

Root rot—Do not mulch over the crown of the plant, and avoid planting in low areas where water settles around the crown. Apply *Trichoderma harzianum* OR thiophanate-methyl as per label instructions.

LICORICE PLANT

Also called cudweed or trailing dusty miller, **Licorice plant** (*Helichrysum petiolatum*, also sold as *H. lanatum* or *Gnaphalium lanatum*) is an annual, often used in containers and hanging baskets. The larva (or caterpillar) of a butterfly (the American Painted Lady, *Vanessa virginiensis*) attracted to butterflybush (*Buddleia* sp.) webs the licorice plant foliage and feeds from inside the web.

Caterpillar—When caterpillars appear, apply acephate, bifenthrin, *Bacillus thuringiensis*, carbaryl, cyfluthrin, cyfluthrin + imidacloprid, neem oil, pyrethrins, OR Rotenone.

LILAC

Lilac grows well in full sun and in light, fertile, well drained soil that has a pH of 6.0 to 7.5. Remove old blooms.

Borer—Apply permethrin in early May and mid-June. Prune out branches with swollen areas and cracked bark.

Giant hornet—In late June and late July, apply carbaryl to the bark. Include a spreader-sticker.

Powdery mildew—At the first sign of disease (repeat as per label directions), apply: acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, *Bacillus subtilis,* copper (ammonium complex), jojoba oil, lime-sulfur, myclobutanil, neem oil, neem oil + pyrethrin, paraffinic oil, sulfur, tebuconazole, triadimefon, OR triforine. Use resistant varieties.

Oystershell scale—Use dormant oil in early April. Prune out badly infested branches. In late may and early June (when crawlers are active), spray acephate, cyfluthrin, cyfluthrin + imidacloprid, horticultural oil, insecticidal soap, OR malathion; OR use imidacloprid (once per year).

LILY

Lily grows in full sun, but partial shade keeps colors from fading. The plant prefers fertile, moist, well drained soil. Asiatic lilies tolerate lower fertility. Martagon or Turk's Cap lilies and madonna lilies grow best at pH 5.0 to 6.0, whereas other lilies do best at pH 6.5 to 7.0. Lily bulbs do not have a dormant period. Keep new bulbs in damp peat moss before planting and plant as soon as possible. Tiger lily (*Lilium tigrinum*; in the Asiatic group) carries the lily mosaic virus without showing its effects. Aphids transmit the virus to other lilies. Remove old blooms and mulch plantings.

NOTE: chlorothalonil may damage flowers, so avoid its use during bloom.

Leaf and flower spot—When spots appear, apply *Bacillus subtilis*, chlorothalonil, copper (ammonium complex, salts, sulfate), mancozeb, neem oil, tebuconazole, OR thiophanate-methyl and repeat as per label directions.

LINDEN

Linden grows best in sun or partial shade and in deep, fertile, and moist but well drained soil with a pH of 6.0 to 7.5. Littleleaf linden (*Tilia cordata*) grows well at a soil pH of 5.5 to 7.5. Silver linden (*T. tomentosa*) tolerates heat and drought better than other lindens. The soft hairs on silver linden foliage make this tree less prone to problems with foliar insects, such as aphids, compared to other lindens.

Aphid—When aphids first appear, apply acephate, acephate + triforine + fenbutatin-oxide, bifenthrin, carbaryl, cyfluthrin, cyfluthrin + imidacloprid, disulfoton, esfenvalerate, horticultural oil, imidacloprid, insecticidal soap, malathion, neem oil, permethrin, OR rotenone.

Bagworm—Apply acephate, *Bacillus thuringiensis*, bifenthrin, carbaryl, cyfluthrin, cyfluthrin + imidacloprid, malathion, methoxychlor, permethrin, OR spinosad in mid- and late June. Hand remove bags before June.

Cankerworm—In early to mid-May, apply acephate, *Bacillus thuringiensis*, methoxychlor, OR spinosad.

Fall webworm—Spray acephate, *Bacillus thuringiensis*, esfenvalerate, methoxychlor, OR spinosad when webworms are present.

Japanese beetle—Apply acephate, bifenthrin, carbaryl, cyfluthrin (adult), cyfluthrin + imidacloprid, deltamethrin, esfenvalerate, imidacloprid, malathion, methoxychlor, neem oil, permethrin, rotenone, OR spinosad in late June and July.

LONDON PLANE (see "Sycamore")

MAGNOLIA

Magnolia grows best in full sun and in fertile, moist but well drained soil which is high in organic matter and has a pH of 5.0 to 6.0. Early blooming magnolias are subject to frost injury, especially when planted in low-lying areas. Sweetbay magnolia (*Magnolia virginiana*) requires a pH of 4.0 to 5.0 and tolerates wet soils.

Leaf spot—Apply *Bacillus subtilis*, chlorothalonil, copper (salts), neem oil, PCNB (*M. grandiflora* only), OR tebuconazole; repeat at intervals on label.

Magnolia scale—Use dormant oil in April. In mid-August and early September (when crawlers are active), spray acephate, carbaryl, cyfluthrin, cyfluthrin + imidacloprid, horticultural oil, insecticidal soap, OR malathion; OR use imidacloprid (once per year).

Tuliptree scale—Use dormant oil in April. In early September (when crawlers are active), spray acephate, carbaryl, cyfluthrin, cyfluthrin + imidacloprid, horticultural oil, insecticidal soap, malathion; OR use imidacloprid (once per year).

MAPLE

Maple grows best in full sun, moist soils, and will tolerate a variable soil pH (pH 6.0 to 7.5 is optimal). Red maple (*Acer rubrum*) and silver maple (*A. saccharinum*) tolerate wet sites. Sugar maple (*A. saccharum*) needs deep, well drained soils and does not tolerate soils contaminated with road salt. Japanese maple (*A. palmatum*) does best in light shade and in moist soils high in organic matter. Norway maple (*A. platanoides*) is soil and pH tolerant but tends to produce girdling roots that can eventually kill the tree. Norway and silver maples have disadvantages for residential properties. Silver maple is weak wooded and breaks up easily in storms. The surface root system of Norway and silver maple eventually lifts the pavement of sidewalks, curbs, and patios. Norway maple casts such a dense shade that it is difficult to grow and maintain a healthy lawn.

Anthracnose—Apply chlorothalonil, copper (ammonium complex, salts, sulfate), neem oil, neem oil + pyrethrin, myclobutanil, OR tebuconazole at budbreak, then repeat as stated on label.

Bladder gall mite—In spring when buds turn green, apply malathion and repeat in 2 weeks.

Calico scale—Use dormant oil in late March. Apply acephate, acephate + resmethrin + triforine (red maple only), cyfluthrin, cyfluthrin + imidacloprid, imidacloprid (once per year), OR malathion in mid-June when crawlers are active.

Cankerworm—Apply acephate, *Bacillus thuringiensis*, carbaryl, malathion, methoxychlor, OR spinosad in early to mid-May.

Cottony maple scale—Late June and early July: acephate, acephate + resmethrin + triforine (red maple only), carbaryl, cyfluthrin, cyfluthrin + imidacloprid, dormant oil, horticultural oil, imidacloprid, insecticidal soap, malathion, OR permethrin.

Japanese beetle—In late June and July, apply acephate, bifenthrin, carbaryl, cyfluthrin (adult), cyfluthrin + imidacloprid, deltamethrin, esfenvalerate, imidacloprid, malathion, methoxychlor, neem oil, permethrin, rotenone, OR spinosad.

Leafhopper—Apply acephate + resmethrin + triforine (red maple only), acephate + triforine + fenbutatin-oxide, carbaryl, cyfluthrin, cyfluthrin + imidacloprid, esfenvalerate,

imidacloprid (once per year), methoxychlor, OR rotenone in May when leaves are 1/2 to 3/4 grown.

Leaf spot—Apply *Bacillus subtilis,* chlorothalonil, copper (salts, sulfate), copper + rotenone, neem oil, tebuconazole at bud break and repeat as per label directions.

Norway maple aphid—When aphids appear, apply acephate + triforine + fenbutatin-oxide, cyfluthrin, cyfluthrin + imidacloprid, imidacloprid, insecticidal soap, malathion, OR rotenone.

Powdery mildew—At the first sign of disease (repeat as per label directions), apply: acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, *Bacillus subtilis,* copper (ammonium complex), jojoba oil, myclobutanil, myclobutanil + permethrin, neem oil, neem oil + pyrethrin, sulfur, tebuconazole, triadimefon, OR triforine.

MARIGOLD

Plant **marigolds** in full sun and in fertile soil with a pH of 5.5 to 7.0. Marigold is drought tolerant; remove old blooms.

Botrytis blight—Spray *Bacillus subtilis,* chlorothalonil, copper (salts), neem oil, potassium bicarbonate, OR thiophanate-methyl at intervals on label. (See Note on *Botrytis*).

Powdery mildew—At the first sign of disease (repeat as per label directions), apply: acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, *Bacillus subtilis,* copper (ammonium complex), jojoba oil, myclobutanil, neem oil, neem oil + pyrethrin, potassium bicarbonate (shorten the interval during rainy weather), sulfur, tebuconazole, triadimefon, OR triforine.

Spider mite—When mites appear, use acephate + resmethrin + triforine, horticultural oil, insecticidal soap, malathion, OR rotenone.

MAYAPPLE

Mayapple (*Podophyllum peltatum*) is a native, herbaceous, perennial groundcover suited to moist, shaded, or partially shaded sites. Mayapple grows in colonies, spreading by rhizomes.

Rust—Apply acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, *Bacillus subtilis,* myclobutanil, neem oil, neem oil + pyrethrin, sulfur, tebuconazole, triadimefon, OR triforine when symptoms appear and repeat according to label directions.

MIMOSA

Mimosa (*Albizzia julibrissin*), also called silk tree, grows in full sun or partial shade. Prefers well drained soils, but will tolerate infertile, gravelly soils and drought. Short-lived. This tree is susceptible to a soilborne wilt disease caused by the fungus Fusarium, for which there is no effective control. Choose varieties resistant to this disease.

Mimosa webworm—In mid-June, apply acephate, *Bacillus thuringiensis,* carbaryl, OR spinosad. Repeat twice every 4 to 5 weeks.

MOUNTAIN ASH

Mountain ash grows best in full sun and in moist but well drained soils with a pH of 4.0 to 5.0. Mountain ash grows best in the cooler regions of New Jersey. Weakened trees frequently die from borer injury. Mountain ash can develop fireblight, a bacterial disease (see "Firethorn" for more information).

Aphid—Use dormant oil in late March. When aphids appear, use acephate, acephate + triforine + fenbutatin-oxide, bifenthrin, carbaryl, cyfluthrin, cyfluthrin + imidacloprid, disulfoton, esfenvalerate, horticultural oil, imidacloprid, insecticidal soap, malathion, neem oil, OR permethrin.

Borer—Apply permethrin in mid-May, mid-June, and mid-August.

Japanese beetle—Apply acephate, bifenthrin, carbaryl, cyfluthrin (adult), cyfluthrin + imidacloprid, deltamethrin, esfenvalerate, imidacloprid, malathion, methoxychlor, neem oil, permethrin, OR spinosad in late June and July.

MYRTLE

Also known as periwinkle, **myrtle** grows well in sun or shade and prefers moist, well drained soil that is high in organic matter and has a pH of 6.0 to 7.0. The plant is moderately drought tolerant. Annual vinca (also known as Madagascar periwinkle) is heat tolerant, but does not do well in shade.

Powdery mildew—At the first sign of disease (repeat as per label directions), apply: acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, *Bacillus subtilis,* jojoba oil, neem oil, neem oil + pyrethrin, potassium bicarbonate (shorten the interval during rainy weather), sulfur, tebuconazole, triadimefon, OR triforine.

NARCISSUS

Narcissus grows in full sun or partial shade. The plant tolerates wet soils during the growing season, but in the winter, excess moisture can cause the bulbs to rot.

Bud blast—Buds that look normal fail to open due to drought during bloom. Double flowered cultivars are more susceptible to bud blast.

Narcissus bulb fly maggot—Infests old plantings that need division. Remove old foliage when completely yellow. Dig up the bulb mass and pull off bulbs that separate easily. Replant these immediately. Discard bulbs that are rotting, or ones that have pinhead-sized holes near the base of the bulb.

NEPHTHYTIS (Syngonium)

Nephthytis requires bright but indirect light; if the plant becomes straggly, it needs more light. Nephthytis grows vigorously, so it often needs repotting. Place container over pebble tray to increase relative humidity. Temperatures optimal during periods of active growth range from 64 to 70°F (17 to 21°C); during the resting period in winter, temperatures should drop no lower than 60°F (15°C). In the summer, do not let the plant dry out completely and fertilize once per month. Water less in the winter, allowing the soil to dry more between waterings.

Leaf spot—Apply *Bacillus subtilis*, chlorothalonil, copper (octanoate, salts), neem oil, OR tebuconazole and repeat (see label) when conditions are warm and moist.

NICOTIANA (Flowering)

Nicotiana grows best in full sun or partial shade and moist but well drained soil with a pH of 7.0 to 7.5.

Tobacco budworm—Apply acephate, acephate + triforine + fenbutatin-oxide, *Bacillus thuringiensis*, bifenthrin (see label), OR spinosad.

OAK

Oak does well in full sun and in deep, moist, well drained soils. Most species require a soil pH of 5.5 to 6.5 and become chlorotic if the pH is too high (lime-induced chlorosis). Pin oak (*Quercus palustris*) requires a pH of 5.0 to 6.0 and tolerates wet soils. Willow oak (*Q. phellos*), which is not hardy north of Trenton, requires a pH of 5.0 to 6.0. Scarlet oak (*Q. coccinea*) requires a pH of 6.0 to 7.0 and, with red (*Q. rubra*), white (*Q. alba*), and bur (*Q. macrocarpa*) oaks, must be planted as small trees for best results. Pin oak has downward growing branches and will normally retain some old leaves all winter, meaning that fallen leaves will have to be raked in spring as well as fall.

Anthracnose—Spray chlorothalonil (red-black oak group only), copper (ammonium complex, salts, sulfate), myclobutanil, neem oil, neem oil + pyrethrin, OR tebuconazole at budbreak and repeat (see label).

Bacterial leaf scorch (*Xylella fastidiosa)*—Water during drought and remove branches and trees as they become hazardous. For specimen trees, yearly injections of oxytetracycline may be applied as a bacteriostatic treatment. Consult an arborist for application.

Cankerworm—Apply acephate, *Bacillus thuringiensis*, carbaryl, methoxychlor, OR spinosad in early to mid-May.

Fall webworm—When webs first appear, apply acephate, *Bacillus thuringiensis*, carbaryl, esfenvalerate, OR spinosad.

Gypsy moth—Apply acephate, *Bacillus thuringiensis*, bifenthrin, carbaryl, cyfluthrin (larvae), cyfluthrin + imidacloprid, esfenvalerate, horticultural oil, insecticidal soap, neem oil, permethrin, OR spinosad in mid- to late May.

Japanese beetle—In late June and July, use acephate, bifenthrin, carbaryl, cyfluthrin (adult), cyfluthrin + imidacloprid, deltamethrin, esfenvalerate, imidacloprid, malathion, methoxychlor, neem oil, permethrin, rotenone, OR spinosad.

Lacebug—Apply acephate, acephate + resmethrin + triforine, bifenthrin, carbaryl, cyfluthrin, cyfluthrin + imidacloprid, deltamethrin, disulfoton, esfenvalerate, horticultural oil, imidacloprid (once per year), insecticidal soap, malathion, neem oil, permethrin, OR rotenone when the pest appears.

Leaf blister—Spray chlorothalonil (red-black oak group only), copper (ammonium complex, sulfate), OR copper + rotenone at budbreak and repeat (see label).

Leaf miner—Use acephate, acephate + resmethrin + triforine, carbaryl, malathion, OR spinosad in early June.

Leafroller— Apply carbaryl, methoxychlor, OR spinosad in early May.

Leaf spot—Spray *Bacillus subtilis*, chlorothalonil (red-black oak group only), neem oil, OR tebuconazole at budbreak and repeat (see label).

Oak skeletonizer—Use carbaryl, methoxychlor, OR spinosad in mid-June and mid-August.

Obscure scale—Dormant oil in April. Apply cyfluthrin, cyfluthrin + imidacloprid, malathion in mid-June when crawlers are active and repeat three times every 10 days; OR use imidacloprid (once per year).

Pin oak sawfly—Use carbaryl, horticultural oil (for young larvae), OR cyfluthrin + imidacloprid, spinosad in June and August; OR use imidacloprid (once per year).

Powdery mildew—At the first sign of disease (repeat as per label directions), apply: acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, *Bacillus subtilis*, copper (ammonium complex), jojoba oil, myclobutanil, neem oil, neem oil + pyrethrin, sulfur, tebuconazole, triadimefon, OR triforine and repeat (see label).

Spider mite—Use dormant oil in late March. When pest appears, apply acephate + resmethrin + triforine, horticultural oil, malathion, OR rotenone.

Twig pruner—Pick up fallen twigs in May and destroy.

PACHYSANDRA

Pachysandra is shade loving and prefers moist, but well drained soil with a pH of 5.0 to 7.5. The plant needs protection from winter sun and wind to prevent desiccation.

Canker—Use chlorothalonil, copper (salts), OR Phyton 27. Repeat 3 times as per label.

Mite—Disulfoton, malathion, OR pyrethrins.

Scale—See "Euonymus."

PANSY

(Viola and perennial violet)

Pansy prefers full sun, but plants in partial shade are more heat tolerant. Although all pansies prefer fertile, moist soils with a pH of 5.5 to 6.5, they are moderately adaptable to other soils. Except for bird's foot violet (*Viola pedata*), most perennial violets prefer soils high in organic matter. Labrador violet (*V. labradorica*) retains the purple color of the foliage better with some exposure to sun. In New Jersey summers, even "heat resistant" plants may produce fewer flowers. Water and remove old blooms with hedge or pruning shears to maintain flower production. Pansies can be planted in the fall to provide both fall and early spring blooms. Cut plants back in late winter.

NOTE: chlorothalonil may damage flowers, so avoid its use during bloom. Do not use potassium bicarbonate at early stages of growth.

Anthracnose and scab—Apply chlorothalonil, myclobutanil, neem oil, neem oil + pyrethrin, potassium bicarbonate, OR tebuconazole when disease appears and repeat as stated on label.

Aphid—When aphids appear, use acephate + triforine + fenbutatin-oxide, cyfluthrin, cyfluthrin + imidacloprid, esfenvalerate, insecticidal soap, malathion, neem oil, OR rotenone.

Leaf spot—Apply *Bacillus subtilis*, chlorothalonil, copper (ammonium complex), neem oil, Phyton 27, potassium bicarbonate, OR tebuconazole at budbreak and repeat at intervals on label or until conditions no longer favor disease development.

Slugs—Refer to Rutgers Cooperative Research & Extension fact sheet FS397, "Slugs and Snails in the Vegetable Garden."

Spider mite—When mites appear, apply horticultural oil, insecticidal soap, malathion, OR rotenone.

PEAR (Flowering)

Callery pear (*Pyrus calleryana*), a medium size shade tree native to China, bears white flowers in the spring. Because of its flowers, great fall color, and the fact that it has relatively few insect and disease problems, it is overused in the landscape. The original USDA introduction, with the cultivar name Bradford, is still available commercially but no longer recommended. It's lateral branches are too closely spaced on the main trunk making it susceptible to storm damage as it becomes mature. Redspire, Chanticleer, and Whitehouse are newer cultivars that don't have this problem, but property owners who plant this tree should look for and eliminate branches that cross and rub against each other.

Pear leaf blister mite—Calcium polysulfide (dormant spray), canola oil, horticultural oil, OR neem oil (see individual labels for timing and rates).

PEONY

Peonies grow best in full sun and in well drained soil that is high in organic matter and that has a pH of 6.0 to 7.5. The easily damaged growing points (called "eyes") on the roots should be planted no deeper than 1 to 2 inches below the soil surface.

Flower blight (Botrytis)—When flowers are "pea size," spray *Bacillus subtilis*, copper (ammonium complex, salts, sulfate), mancozeb, neem oil, OR thiophanate-methyl and repeat (see label); continue until plants bloom. (See Note on *Botrytis*).

Rose chafer—Apply methoxychlor OR spinosad in late May and June. Hand pick insects.

PETUNIA

Petunia grows best in full sun and fertile, moist, well drained soil with a pH of 6.0 to 7.5. Remove old blooms.

Gray mold (Botrytis)—Spray *Bacillus subtilis,* chlorothalonil, neem oil, OR thiophanate-methyl (pre-bloom only) and repeat as per label directions. (See Note on *Botrytis*).

Powdery mildew—At the first sign of disease (repeat as per label directions), apply: acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, *Bacillus subtilis,* jojoba oil, myclobutanil, myclobutanil + permethrin, neem oil, neem oil + pyrethrin, sulfur, tebuconazole, triadimefon, OR triforine.

Tobacco budworm—Apply acephate, acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, *Bacillus thuringiensis*, bifenthrin, permethrin, OR spinosad (see label).

PHILODENDRON

Most **philodendrons** prefer bright light; some tolerate low light, but none do well in direct, strong sunlight. For best growth, do not subject plants in summer to temperatures greater than 75°F (24°C). Optimal winter temperatures range from 55 to 64°F (12 to 18°C). Place plant on a tray of wet pebbles to increase relative humidity. More water is needed during the summer when the plant is in active growth. Water less often during the winter rest period. If the lower, older leaves turn yellow and fall, the plant may be over-watered. Fertilize once per month during the summer.

Leaf spot—Under moist conditions, apply *Bacillus subtilis,* chlorothalonil, copper (octanoate, salts), neem oil, potassium bicarbonate, OR tebuconazole and repeat (see label) until conditions no longer favor disease development.

PHLOX

Phlox grows well in moist, well drained soils high in organic matter. Woodland phlox (*Phlox divaricata*) grows best in partial or full shade and in moist soils high in organic matter and with a pH of 6.5. Remove old blooms, unless reseeding is desired. Creeping phlox (*P. stolonifera*) grows best in partial shade and a soil pH of 5.0 to 6.0. This phlox does not get powdery mildew and is not drought tolerant. Garden or border phlox (*P. paniculata*) grows best in full sun. Soils should be fertile, moist but well drained, and have a pH of 6.0 to 7.5. Select cultivars that are less susceptible or resistant to powdery mildew. Ground or moss phlox (*P. subulata*) grows best in full sun and in well-drained soils. Remove old blooms by shearing plants to half their height after flowering. This prevents reseeding of plants that are not true to type.

Powdery mildew—At the first sign of disease (repeat as per label directions), apply: acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, *Bacillus subtilis,* copper (ammonium complex), jojoba oil, myclobutanil, neem oil, neem oil + pyrethrin, paraffinic oil, potassium bicarbonate (shorten the interval during rainy weather), sulfur, tebuconazole, triadimefon, OR triforine. To reduce problems with powdery mildew, maintain good air circulation through proper spacing and division of large plants.

Root rot (non water molds)—Apply thiophanate-methyl OR *Trichoderma harzianum* as a soil drench and repeat (see label).

PHOTINIA

Photinia grows well in full sun or partial shade and in well drained soils with a pH of 6.0 to 6.5. The evergreen photinias, Chinese (*Photinia serrulata*) and Japanese (*P. glabra*), will need protection from winter wind and the late afternoon sun to prevent desiccation. Oriental photinia (*P. villosa*) is deciduous and more susceptible to fireblight (a bacterial disease with no practical chemical control) than are Chinese and Japanese photinia. Red tip or Fraser photinia (*Photinia* x *fraseri*), also evergreen, is hardy in southern New Jersey (zone 7 to 9) and has some resistance to mildew. Fraser and Oriental photinia develop yellow foliage when growing in soils deficient in nitrogen.

Powdery mildew—At the first sign of disease (repeat as per label directions), apply: acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, *Bacillus subtilis,* jojoba oil, myclobutanil, neem oil, neem oil + pyrethrin, potassium bicarbonate, sulfur, tebuconazole, triadimefon, OR triforine.

PINE

Pines prefer full sun and dry, sandy, deep, and well drained soils. They will tolerate a variable soil pH, but generally do best between pH 5.0 to 6.0. Eastern white pine (*Pinus strobus*) grows best at a soil pH of 4.5 to 6.0. Since Japanese black pine (*P. thunbergii*) tolerates heat, drought, and salt, it is the classic seashore plant. It is, however, short-lived due in part to increasing problems with Maskell scale and pinewood nematode.

Aphid—When aphids appear, apply acephate, acephate + triforine + fenbutatin-oxide, bifenthrin, carbaryl, cyfluthrin, cyfluthrin + imidacloprid, disulfoton, esfenvalerate, horticultural oil, imidacloprid, insecticidal soap, malathion, neem oil, permethrin, OR rotenone.

Bagworm—Apply acephate, *Bacillus thuringiensis*, carbaryl, cyfluthrin, cyfluthrin + imidacloprid, in mid- and late June, OR spinosad (see label). Hand remove bags before June.

Eastern pine looper—This insect feeds on two needle pines, especially pitch pine in southern New Jersey. When larvae are smaller than ½ inch in length (usually late July to early August), apply *Bacillus thuringiensis* with a spreader sticker. After mid-August, apply carbaryl plus a spreader sticker.

European pine shoot moth—Apply carbaryl in mid-April and late June or early July, OR cyfluthrin + imidacloprid, dimethoate, malathion, spinosad (see label).

Maskell scale—Use cyfluthrin, cyfluthrin + imidacloprid, dimethoate, malathion in mid-June and August; OR use imidacloprid (once per year).

Nantucket pine tip moth—In late April, mid-May, and mid-July, apply acephate; OR use cyfluthrin + imidacloprid, dimethoate, imidacloprid (once per year), OR spinosad (see label).

Needlecast—Spray chlorothalonil in early June, and repeat 3 and 6 weeks later OR use copper (ammonium complex) (see label).

Pine bark adelgid—Early April: 2% dormant oil. Mid-May: cyfluthrin, cyfluthrin + imidacloprid, esfenvalerate, horticultural oil, imidacloprid, insecticidal soap, OR malathion.

Pine needle miner—Apply permethrin in mid-June and late June.

Pine needle scale—Apply cyfluthrin, cyfluthrin + imidacloprid, dimethoate, malathion, OR permethrin in late May, early June, and mid-August; OR use imidacloprid (once per year).

Sawfly—When sawflies appear (May), use carbaryl, cyfluthrin + imidacloprid, esfenvalerate, imidacloprid (larvae) (once per year), methoxychlor, OR spinosad.

Soft scale—Use 2% dormant oil in March or April. In late June to early July when crawlers are active, apply carbaryl, cyfluthrin, cyfluthrin + imidacloprid, 1% horticultural oil, imidacloprid (once per year), insecticidal soap, OR malathion.

White pine weevil—Spray permethrin once in early to mid-April, OR cyfluthrin + imidacloprid. Cut off infested shoots when damage is noticed in early summer.

PLANETREE (see "Sycamore")

PLUM

Plums grow well in full sun and in well drained soils with a pH of 6.0 to 7.5. They are short lived trees (20 years), especially purple leaf plums. Eliminate crossing or rubbing branches to prevent wounds in the bark which become egg-laying sites for borers. Beach plum (*Prunus maritima*) tolerates heat, drought, and salt.

Aphids—Apply acephate, acephate + triforine + fenbutatin-oxide, bifenthrin, carbaryl, cyfluthrin, cyfluthrin + imidacloprid, disulfoton, esfenvalerate, imidacloprid, insecticidal soap, malathion, neem oil, OR permethrin.

Black knot—In winter or spring before buds swell, prune infected branches 6 to 8 inches below the fungal growths.

Plum curculio—For pest management information, see the Rutgers Cooperative Extension fact sheet FS116, "Plum Spray Schedule for New Jersey Home Orchards."

POPLAR

Poplars grow best in full sun and in soil with a pH of 6.0 to 7.5. Poplars, although short lived, are tolerant of salt spray. They are weak-wooded trees with a surface root system that makes it difficult to grow and maintain a healthy lawn.

Leaf spot—Apply *Bacillus subtilis,* chlorothalonil, neem oil, OR tebuconazole at budbreak and repeat (see label).

Powdery mildew—At the first sign of disease (repeat as per label directions), apply: acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, *Bacillus subtilis,* jojoba oil, neem oil, neem oil + pyrethrin, sulfur, tebuconazole, triadimefon, OR triforine.

PRIVET

Privets are somewhat adaptable plants that grow best in sun or partial shade and in well drained soils with a pH of 6.0 to 7.5.

Leaf blight—Apply *Bacillus subtilis,* chlorothalonil, OR potassium bicarbonate at budbreak and repeat (see label) or until conditions no longer favor disease development.

Spider mite—Use dormant oil in late March. Inspect lower leaf surface. When mites appear apply horticultural oil, insecticidal soap, OR malathion.

Thrips—Inspect lower leaf surface. When thrips appear apply acephate, acephate + triforine + fenbutatin-oxide, carbaryl, cyfluthrin, cyfluthrin + imidacloprid (once per year), insecticidal soap, malathion, neem oil, OR spinosad.

PYRACANTHA (See "Firethorn")

QUINCE (flowering)
(*Chaenomeles* sp.)

Quince grows best in full sun or partial shade. Quince can adapt to many soil types, but prefers a soil pH of 6.0 to 7.0. The plant becomes chlorotic in overly limed soils. Early blooms are often damaged by frost; avoid planting quince in low areas in the landscape where cold air settles. Quince flowers best in full sun, but tolerates partial shade.

Leaf spot and scab—Apply *Bacillus subtilis,* chlorothalonil, myclobutanil, neem oil, OR tebuconazole at budbreak and then repeat at intervals on label through 2 weeks after petal fall.

RHODODENDRON

Rhododendrons prefer in moist, well drained soils that are high in organic matter. Soil pH requirement varies, but rhododendrons do best in the 5.0 to 6.0 range. Evergreen types are shade loving, but tolerate morning sun. Mulch plantings, and protect plants from winter wind and sun to prevent desiccation.

Borer—Spray trunk and branches with permethrin in May.

Black vine weevil—Use acephate, bifenthrin, neem oil, permethrin, for adults OR cyfluthrin + imidacloprid, imidacloprid (once per year), spinosad; may require landscape maintenance service.

Dieback (Botryosphaeria)—Apply copper (sulfate) at budbreak and repeat (see label).

Dieback (Phytophthora)—Apply chlorothalonil at 7- to 14-day intervals, beginning at budbreak; shorten the interval when weather favors disease development; copper (ammonium complex, salts), fosetyl-Al (once every 30 days), OR phosphite (see label).

Flower or petal blight (Ovulinia)—Apply chlorothalonil, mancozeb, myclobutanil, potassium bicarbonate, tebuconazole, OR triforine (start when flowers begin to show color and repeat as per label directions) until conditions no longer favor disease development; OR apply PCNB to ground prior to opening of buds and repeat every 3 to 4 weeks through bloom. Remove old blooms to reduce severity of the disease.

Lacebug—Apply acephate, bifenthrin, carbaryl, cyfluthrin, cyfluthrin + imidacloprid, deltamethrin, disulfoton, esfenvalerate, horticultural oil, imidacloprid (once per year), insecticidal soap, malathion, neem oil, OR permethrin in May or early June when lacebugs are active.

Leaf spot—Apply *Bacillus subtilis,* copper (ammonium complex, salts, sulfate), copper + rotenone, mancozeb, neem oil, potassium bicarbonate, OR tebuconazole at at budbreak and repeat (see label) until conditions no longer favor disease development.

Phytophthora root and crown rot—Avoid poorly drained soils; fosetyl-Al is labeled for use once every 30 days, OR use phosphite (see label).

Powdery mildew—At the first sign of disease (repeat as per label directions), apply: acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, *Bacillus subtilis,* copper (ammonium complex), jojoba oil, myclobutanil, neem oil, neem oil + pyrethrin, potassium bicarbonate, sulfur, tebuconazole, triadimefon, OR triforine.

Rhododendron midge—Apply carbaryl, neem oil, OR spinosad in May when new growth begins, and early August.

Root rot (non-water molds)—Drench plants with PCNB, thiophanate-methyl, OR *Trichoderma harzianum* and repeat as per label instructions.

Scale—Use dormant oil in late March. Apply cyfluthrin, cyfluthrin + imidacloprid, horticultural oil, OR malathion on June 1, July 1, and September 1; OR use imidacloprid (once per year).

ROSE

Roses grow best in full sun and in deep, well drained soils that are high in organic matter. Roses tolerate a variable pH, but grow optimally within the 6.0 to 7.5 range. Remove old blooms; grafted varieties may need winter protection. Saltspray rose (*Rosa rugosa*) requires a soil pH of 6.0 to 7.5 and tolerates drought, heat, and salt.

NOTE: Check for toxicity before large-scale use of any fungicide, particularly neem oil. Avoid chlorothalonil and copper just prior to bloom.

All rose pests—A weekly spray or dust program. Use a combination insecticide-fungicide material. Start in late May.

Aphid—When aphids appear, apply acephate, acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, bifenthrin, carbaryl, cyfluthrin, cyfluthrin + imidacloprid, dimethoate, disulfoton, esfenvalerate, horticultural oil, imidacloprid, insecticidal soap, malathion, neem oil, permethrin, OR rotenone.

Black spot—Apply acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, *Bacillus subtilis,* captan, captan + malathion + carbaryl, chlorothalonil, copper (ammonium complex, octanoate, salts, sulfate), copper + rotenone, mancozeb, myclobutanil, myclobutanil + permethrin, neem oil, neem oil + pyrethrin, Phyton 27, potassium bicarbonate, propiconazole, sulfur, tebuconazole, OR triforine and repeat (see label) beginning during mid-May until conditions no longer favor disease development. Use oil + lime sulfur as a dormant spray, or lime-sulfur as a dormant spray or apply every 7 to 14 days during the growing season. Red or pink roses are less susceptible than yellow or gold types; especially susceptible are Austrian Brier roses, Pernetians, Polyanthas, Tea roses, and Hybrid Teas.

Canker—Prune and spray as for "black spot."

Japanese beetle—Apply acephate, bifenthrin, carbaryl, carbaryl + malathion, cyfluthrin (adult), cyfluthrin + imidacloprid, deltamethrin, esfenvalerate, imidacloprid, malathion, methoxychlor, neem oil, permethrin, rotenone in June, July, August, OR spinosad. Hand pick insects.

Leafhopper—When leafhoppers appear, apply acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, cyfluthrin, cyfluthrin + imidacloprid, dimethoate, disulfoton, esfenvalerate, imidacloprid (once per year), malathion, OR rotenone.

Mite—When mites appear, apply acephate + resmethrin + triforine, horticultural oil, insecticidal soap, malathion, OR rotenone.

Powdery mildew—At the first sign of disease (repeat as per label directions), apply: acephate + resmethrin + triforine,

acephate + triforine + fenbutatin-oxide, *Bacillus subtilis,* copper (ammonium complex, octanoate, salts, sulfate), copper + rotenone, jojoba oil, myclobutanil, myclobutanil + permethrin, neem oil, neem oil + pyrethrin, potassium bicarbonate, propiconazole, sulfur, tebuconazole, triadimefon, OR triforine and repeat until conditions no longer favor disease development. Use lime-sulfur as a dormant spray or apply every 7 to 14 days during the growing season.

Rose chafer—Use methoxychlor OR spinosad, or hand pick in late May and June.

Rose slugs—Apply carbaryl, cyfluthrin + imidacloprid, malathion, OR spinosad when slugs appear.

Rust—Use oil + lime sulfur as a dormant spray, or lime-sulfur as a dormant spray or apply every 7 to 14 days during the growing season; apply acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, copper (octanoate), mancozeb, myclobutanil, myclobutanil + permethrin, neem oil, neem oil + pyrethrin, potassium bicarbonate, propiconazole, sulfur, tebuconazole, triadimefon, OR triforine.

Stem borer—Cut out injured portions when first noticed. Treat new cuts with melted paraffin or wax, or insert a thumb-tack.

Thrips—Apply acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, carbaryl, cyfluthrin, cyfluthrin + imidacloprid, dimethoate, disulfoton, imidacloprid (once per year), malathion, neem oil, permethrin, pyrethrins, resmethrin (spray a small portion of a plant to test for possible phytotoxicity), rotenone, OR spinosad. For optimal control, thoroughly cover lower leaf surfaces and penetrate dense foliage with product.

SALVIA

Salvia is heat tolerant and grows best in moist but well drained soils that are high in organic matter and that have a pH of 6.0 to 7.5. Blue sage (*Salvia farinacea*) grows best in full sun. Scarlet sage (*S. splendens*) grows in full sun or partial shade. Cultivars of scarlet sage with light colored flowers may fade in full sun.

Powdery mildew—At the first sign of disease (repeat as per label directions), apply: acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, *Bacillus subtilis,* jojoba oil, myclobutanil, myclobutanil + permethrin, neem oil, neem oil + pyrethrin, sulfur, tebuconazole, triadimefon, OR triforine.

SEA LAVENDER

(Notch-leaf, or Statice)

Sea lavender (*Limonium latifolium*) grows best in full sun and in sand or deep, well drained sandy loam soils of low fertility. This perennial tolerates heat, drought, and salt. It is difficult to transplant unless plants are small; established plants should not be divided and, instead, propagate by seed. German statice (*Goniolimon tataricum,* also sold as *Limonium sinuatum, L. dumosum,* or *L. tataricum*) is an annual.

Leaf spot (German statice)—Spray *Bacillus subtilis,* chlorothalonil, neem oil, potassium bicarbonate (shorten the interval during rainy weather), OR tebuconazole at budbreak and repeat (see label).

SNAPDRAGON

Plant **snapdragons** in full sun and in fertile soil with a pH of 7.0 to 7.5. Remove old blooms. Flower buds may not develop when summer night temperatures are above 50°F (10°C). The Rocket series may be more heat tolerant.

Anthracnose—Apply copper (salts), neem oil, neem oil + pyrethrin, potassium bicarbonate, OR tebuconazole and repeat (see label) until conditions no longer favor disease development.

Aphid—When aphids appear, apply acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, cyfluthrin, cyfluthrin + imidacloprid, esfenvalerate, insecticidal soap, malathion, neem oil, OR rotenone.

Caterpillar—When caterpillars begin to feed, apply *Bacillus thuringiensis,* carbaryl, cyfluthrin, OR spinosad.

Powdery mildew—At the first sign of disease (repeat as per label directions), apply: acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, *Bacillus subtilis,* copper (ammonium complex), jojoba oil, myclobutanil, myclobutanil + permethrin, neem oil, neem oil + pyrethrin, potassium bicarbonate, sulfur, tebuconazole, triadimefon, OR triforine.

Rust—Apply acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, *Bacillus subtilis,* myclobutanil, myclobutanil + permethrin, neem oil, neem oil + pyrethrin, Phyton 27, potassium bicarbonate, propiconazole, sulfur, tebuconazole, triadimefon, OR triforine and repeat (see label). Choose resistant varieties.

Spider mite—When mites appear apply acephate + resmethrin + triforine, insecticidal soap, OR rotenone; repeat spray 3 times every 7 to 10 days.

Tobacco budworm—Apply acephate, acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, *Bacillus thuringiensis,* bifenthrin, permethrin (see label), OR spinosad when holes appear in buds or flower petals.

SPIREA

Spirea grows best in full sun or partial shade and in well drained soils that have a pH of 6.0 to 7.5. Anthony Waterer (*Spiraea* x *bumalda*) is a genetically variable plant which is both heat and drought tolerant. Several forms are available commercially. For example, the diameter of the flower cluster may range from 2 to 6 inches; flowers may be cerise-red to carmine-pink. Some forms normally have yellow-green foliage, whereas the more desirable forms have new leaves that are brownish-red, maturing to a bluish-green.

Aphid—When aphids appear, apply acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, cyfluthrin, cyfluthrin + imidacloprid, esfenvalerate, horticultural oil, imidacloprid, insecticidal soap, malathion, OR neem.

Leaf spot—Spray *Bacillus subtilis*, chlorothalonil, neem oil, OR tebuconazole at budbreak and repeat (see label).

Powdery mildew—At the first sign of disease (repeat as per label directions), apply: acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, *Bacillus subtilis*, jojoba oil, myclobutanil, myclobutanil + permethrin, neem oil, neem oil + pyrethrin, sulfur, tebuconazole, triadimefon, OR triforine.

SPRUCE

Spruces prefer full sun and moist, but well drained soil. Optimum soil pH varies with species, but generally ranges from 5.0 to 6.0. Colorado blue spruce (*P. pungens glauca*) is more adaptable than other spruces, but prefers moist soil that is high in organic matter and that has a pH of 6.0 to 7.0. While this spruce survives periods of drought, even 10 days without adequate rain makes these trees more susceptible to Cytospora canker, a fungal disease with no chemical control. Norway spruce (*P. abies*) tolerates a wet site better than other spruces. Serbian spruce (*P. omorika*) is pH adaptable, grows well with protection from winter winds, but is short lived in New Jersey. Like blue and Serbian spruce, Oriental spruce (*P. orientalis*) will grow in drier soils.

NOTE: oil sprays will discolor needles on blue spruce trees.

Aphid—When aphids appear, apply acephate + triforine + fenbutatin-oxide, bifenthrin, carbaryl, cyfluthrin, cyfluthrin + imidacloprid, disulfoton, esfenvalerate, horticultural oil, imidacloprid, insecticidal soap, malathion, neem oil, permethrin, OR rotenone.

Bagworm—Apply acephate OR *Bacillus thuringiensis* in mid- and late June; OR bifenthrin, carbaryl, cyfluthrin, cyfluthrin + imidacloprid, malathion, permethrin, OR spinosad. Add a spreader-sticker. Hand remove bags before June.

Canker—Prune cankers during dry weather. No chemical offers adequate control.

Gall adelgid—Spray carbaryl OR insecticidal soap during late April or early May just before growth appears. Remove and destroy galls by August. Repeat spray during early fall. Add spreader-sticker to spray tank.

Needlecast—Spray chlorothalonil in early June and 3 and 6 weeks later OR use copper (ammonium complex, salts) (see label).

Spruce mite—When pest first appears in May, apply horticultural oil, insecticidal soap, malathion, OR rotenone. Repeat in September.

White pine weevil—In early to mid-April, spray cyfluthrin + imidacloprid or permethrin once (include a spreader-sticker) only on the leaders. Prune out infested leaders when injury is noted (usually in June or July).

STOCK

Stock grows in full sun, but plants in partial shade better tolerate heat. Plant stock in fertile, moist soil with a pH of 6.0 to 7.5. Common stock (*Matthiola incana*) does not flower well in hot weather.

Gray mold (Botrytis)—Spray *Bacillus subtilis*, copper (ammonium complex), neem oil, OR thiophanate-methyl and repeat (see label) until conditions are no longer favorable for disease development. (See Note on *Botrytis*).

SYCAMORE

Sycamore grows well in full sun or partial shade and prefers deep soils with a pH of 6.0 to 7.0. The tree is tolerant of wet sites. London planetree (*Platanus* x *acerifolia*) is easily transplanted and tolerates high pH soils, heat, drought, and soil compaction. London planetree is the result of a cross between the Oriental planetree (*P. orientalis*), which is resistant to anthracnose, and the American planetree (*P. occidentalis*), also called sycamore or buttonwood, which is susceptible to anthracnose. Commercially available London planetrees have varying degrees of resistance to anthracnose because the trees may have grown from seed produced by a cross between a London planetree and a sycamore, thus reducing the disease resistance of the offspring.

Anthracnose—Apply chlorothalonil, copper (ammonium complex, salts, sulfate), myclobutanil, neem oil, neem oil + pyrethrin, OR tebuconazole at budbreak and repeat (see label).

Aphid—When aphids appear, apply acephate, acephate + resmethrin + triforine, acephate, acephate + triforine + fenbutatin-oxide, bifenthrin, carbaryl, cyfluthrin, cyfluthrin + imidacloprid, disulfoton, esfenvalerate, imidacloprid, insecticidal soap, malathion, neem oil, OR permethrin.

Powdery mildew—At the first sign of disease (repeat as per label directions), apply: acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, *Bacillus subtilis*, copper (ammonium complex), jojoba oil, myclobutanil, neem oil, neem oil + pyrethrin, sulfur, tebuconazole, triadimefon, OR triforine.

Sycamore lacebug—When the pest appears in late May, mid-July, and mid-August, spray with acephate, acephate + resmethrin + triforine, carbaryl, cyfluthrin, cyfluthrin + imidacloprid, horticultural oil, imidacloprid (once per year), insecticidal soap, malathion, neem oil, OR permethrin.

Sycamore tussock moth—Apply *Bacillus thuringiensis*, carbaryl, OR spinosad in early to mid-July.

TULIP

Plant **tulips** in full sun and in fertile, moist, but well drained soils with a pH of 6.0 to 7.5. Flower quality normally declines the year after planting due to splitting of the flower bulb. (The undersized daughter bulbs do not bloom until their foliage produces enough starch and carbohydrates to increase the size of the bulb.) Plant bulbs deep to prevent splitting (6 inches in clay soils and 8 inches in sandy soils). If bulbs will be left to flower the following year, remove old blooms. The species tulips (*Tulipa kaufmanniana*, *T. fosteriana*, and *T. greigii*) are longer lived.

NOTE: chlorothalonil may damage flowers, so avoid its use during bloom.

Fire (Botrytis)—When flowers bud, spray until flowering begins (see label for spray interval) with *Bacillus subtilis*, chlorothalonil, copper (ammonium complex, salts, sulfate), neem oil, OR thiophanate-methyl. (See Note on *Botrytis*).

TULIP TREE

Tulip tree, also called tulip poplar, grows best in full sun and in deep, moist, but well drained soil that is high in organic matter and has a pH of 6.0 to 7.0. Transplant in the spring.

Aphid—When aphids appear, apply acephate, acephate + triforine + fenbutatin-oxide, bifenthrin, carbaryl, cyfluthrin, cyfluthrin + imidacloprid, disulfoton, esfenvalerate, horticultural oil, imidacloprid, insecticidal soap, malathion, neem oil, OR permethrin.

Tulip tree scale—Use dormant oil in April. Apply acephate, carbaryl, cyfluthrin, cyfluthrin + imidacloprid, imidacloprid (once per year), OR malathion in late August when crawlers are active.

VIOLET, perennial (See "Pansy")

VIBURNUM

Viburnum can grow in sun or shade. The plant prefers moist or wet but well drained soils as most are not drought tolerant, especially doublefile viburnum (*V. plicatum* var. *tomentosum*). Blackhaw viburnum (*V. prunifolium*) tolerates drier soil, and arrowwood (*V. dentatum*) is shade tolerant. Foliage of these two species give off a foul odor when in contact with the soil. This can be avoided by mulching or planting a ground cover under the branches. Optimal soil pH for leatherleaf viburnum (*V. rhytidophyllum*) is pH 5.5 to 6.5; Koreanspice viburnum (*V. carlesii*) is pH 6.0 to 7.5; burkwood viburnum (*V.* x *burkwoodii*) is pH 6.0 to 7.5; and mapleleaf viburnum (*V. acerifolium*) is pH 4.0 to 5.0.

Aphid—When aphids appear, apply acephate, acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, bifenthrin, carbaryl, cyfluthrin, cyfluthrin + imidacloprid, disulfoton, esfenvalerate, imidacloprid, horticultural oil, insecticidal soap, malathion, neem oil, OR permethrin.

Powdery mildew—At the first sign of disease (repeat as per label directions), apply: acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, *Bacillus subtilis*, chlorothalonil, jojoba oil, myclobutanil, neem oil, neem oil + pyrethrin, potassium bicarbonate (shorten the interval during rainy weather), sulfur, tebuconazole, triadimefon, OR triforine.

Spider mite—When mites appear (in May) apply acephate + resmethrin + triforine, horticultural oil, OR insecticidal soap and repeat 10 days later.

WALNUT (Black)

Black walnut grows best in deep, moist soils that are high in organic matter and have a pH of 6.0 to 7.5. Persian, common, or English walnut (*Juglans regia*) tolerate drier soils. Black walnut (*J. nigra*) roots, leaves, branches, and the mulches made from these plant materials secrete a phenolic compound called juglone which suppresses the growth of other plants. For more information, see "allelopathy" on page 33.

Anthracnose—When leaves are half size, apply chlorothalonil, myclobutanil, neem oil, neem oil + pyrethrin, OR tebuconazole and repeat as per label directions.

WILD CHERRY

Wild cherry tolerates a wide range of soil and moisture conditions.

Black knot—Remove swellings before spring.

Eastern tent caterpillar—Shortly after leaves appear, apply acephate, *Bacillus thuringiensis*, bifenthrin, carbaryl, cyfluthrin, esfenvalerate, horticultural oil, insecticidal soap, malathion, neem oil, permethrin, OR spinosad. Remove egg masses in winter.

WILLOW

Willow grows well in full sun and in wet soils. Although the tree tolerates a variable soil pH, it grows optimally at pH 6.0 to 7.5.

Aphid—When aphids appear, apply acephate, acephate + resmethrin + triforine, acephate, acephate + triforine + fenbutatin-oxide, bifenthrin, carbaryl, cyfluthrin, cyfluthrin + imidacloprid, disulfoton, esfenvalerate, horticultural oil, imidacloprid, insecticidal soap, malathion, neem oil, permethrin, OR rotenone.

Blight—Apply copper (sulfate).

Canker—Apply mancozeb at budbreak and then repeat 3 times (see label) OR use copper sulfate.

Giant aphid—When aphids appear, apply acephate, cyfluthrin, cyfluthrin + imidacloprid, imidacloprid, insecticidal soap, malathion, OR rotenone.

Rust—Apply acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, myclobutanil, neem oil, neem oil + pyrethrin, sulfur, tebuconazole, triadimefon, OR triforine in mid-May to mid-August and repeat (see label).

Scab—Apply *Bacillus subtilis*, myclobutanil, neem oil, OR tebuconazole at budbreak and then repeat (see label).

Willow leaf beetle—Apply carbaryl, cyfluthrin, cyfluthrin + imidacloprid, imidacloprid (once per year), OR spinosad in late May and early August.

YEW (*Taxus*)

Although full sun is best, **yews** are also tolerant of shade, especially English yew (*Taxus baccata*). Yews are intolerant of poorly drained soils. Anglojap yew (*T.* x *media*) tolerates a more acid soil, but most yews grow well in deep soils with a pH of 6.0 to 7.0.

Black vine weevil—Use acephate, bifenthrin, neem oil, permethrin for adult insects; OR use cyfluthrin + imidacloprid, imidacloprid (once per year), OR spinosad. May require professional landscape maintenance services.

Mealybug—Use 2% dormant oil in April. Spray acephate, carbaryl, cyfluthrin, cyfluthrin + imidacloprid, dimethoate, imidacloprid (once per year), insecticidal soap, OR malathion in late May and early June.

ZELKOVA (Japanese)

Zelkova is adaptable to soil pH, is drought tolerant, and has good resistance to elm leaf beetle and Japanese beetle. The bark on the trunk is frequently damaged due to exposure to late afternoon sun in the winter.

Canker—Prune affected branches during dry weather. There is no effective chemical control for canker.

ZINNIA

Plant **zinnias** in full sun and in moist, fertile soils that have a pH of 5.5 to 7.5. Zinnias are heat tolerant, and the ground cover species (*Zinnia angustifolia*) tolerates dry soil. Remove old blooms.

NOTE: chlorothalonil may damage flowers, so avoid its use during bloom.

Japanese beetle—Apply acephate, carbaryl, cyfluthrin (adult), cyfluthrin + imidacloprid, esfenvalerate, malathion, methoxychlor, neem oil, OR rotenone in late June and July. Hand pick insects.

Leaf spot—When plants are 6 inches tall, apply *Bacillus subtilis*, myclobutanil, neem oil , potassium bicarbonate, OR tebuconazole and repeat (see label) until conditions no longer favor disease development. Maintain good air circulation to reduce humidity.

Powdery mildew—At the first sign of disease (repeat as per label directions), apply: acephate + resmethrin + triforine, acephate + triforine + fenbutatin-oxide, *Bacillus subtilis*, chlorothalonil, copper (ammonium complex), jojoba oil, lime-sulfur, myclobutanil, myclobutanil + permethrin, neem oil, neem oil + pyrethrin, paraffinic oil, Phyton 27, potassium bicarbonate (shorten the interval during rainy weather), sulfur, tebuconazole, triadimefon, OR triforine. Maintain good air circulation to reduce humidity. (See Note on *Botrytis*).

PEST MANAGEMENT IN ORNAMENTAL GRASSES

JAPANESE SILVER GRASS

Most cultivars of **Japanese silver grass** grow best in full sun. Some of the larger cultivars of the clump-forming *Miscanthus sinensis* need staking when grown in the shade or in soil that is too moist or overfertilized. Cultivars bred for early flowering, such as Arabesque and Goldfelder, will be more likely to self-sow in the landscape than cultivars that flower in the fall (Morning Light or Gracillimus) or not at all.

Anthracnose. Apply neem oil, thiophanate-methyl, OR triadimefon according to the label.

Mealybug. Apply dormant oil before new growth appears in the spring. Apply carbaryl OR neem oil when mealybugs appear, OR use disulfoton as a soil treatment according to directions on the label. Inspect plants before purchasing. Mealybugs can infest all parts of the plant, even the roots, and are often found at the shoot base inside the leaf sheath.

RIBBON GRASS

Ribbon grass, a cultivar of variegated Reed canary grass (*Phalaris arundinacea* var. *picta*), is adaptable to soils of different texture, but needs a constant supply of moisture. Grows well in sun or partial shade. The grass does not self sow, but spreads aggressively by rhizomes. As a cool-season grass, it often declines in mid-season due to heat stress. Cut the grass back to 8 inches to stimulate new growth.

Stripe smut. Apply thiophanate-methyl OR triadimefon in mid-October, OR in mid-May and repeat 8 and 16 days later.

ZEBRA GRASS

Zebra grass (*Miscanthus sinensis* 'Zebrina') grows best in moist soils in full sun or light shade, but is somewhat site tolerant. The grass, also known by the cultivar names Zebrinus and Zebrina, often requires staking and is susceptible to anthracnose.

Anthracnose. When disease first appears, apply neem oil, thiophanate-methyl, OR triadimefon according to the label.

PEST MANAGEMENT NOTES

ROOT ROT AND WILT DISEASES OF FLOWERS

Planting the same crop in the same area for a number of years may result in the build-up of root rot or wilt-causing fungi. This is one of the reasons that we recommend "crop rotation." Some flower crops that are particularly susceptible to the common soilborne fungi are chrysanthemum, delphinium, snapdragon, calendula, carnation, moss pinks, and geranium. In addition, excessive moisture in the root zone is especially favorable to fungi that attack roots. Planting in well-drained soil or avoiding overwatering are two more excellent ways to help manage root diseases in flower beds.

NEMATODE CONTROL

If nematodes are known to be a problem, contact a commercial pesticide applicator since nematicides are not available for homeowner use once plants are established.

FUNGICIDE RESISTANCE IN *BOTRYTIS*

Although compounds containing thiophanate-methyl are registered for control of Botrytis blight or gray mold, isolates of *Botrytis* that are resistant to these compounds may be present. If a treatment applied as per label recommendations is not effective, shortening the interval between applications or increasing the rate will not improve disease control. As a result, another fungicide should be used.

IMPACT OF ENVIRONMENTAL CONDITIONS ON PLANT HEALTH

EFFECT OF TEMPERATURE: ACCLIMATIZATION, HARDINESS, AND MICROCLIMATE

Plants become **acclimated** to winter weather in autumn when the days are short and the weather is cool. Loss of winter hardiness due to warm winter weather is called deacclimatization. Most winter injury occurs after plants have lost hardiness due to unseasonably warm weather. Once deacclimated, plants can be injured by temperatures they would have easily tolerated had they been hardy. For example, the weather was unseasonably warm during January and early February of 1999. This caused a loss of winter hardiness in many landscape plants throughout New Jersey, which then sustained winter injury in late February when the weather returned to normally cold temperatures. Winter injury also occurs when plants are pruned between mid-July and mid-October. Pruning this late in the growing season stimulates new growth that will not be hardy by the time normal fall and winter weather arrives.

A **hardiness zone** corresponds to the lowest winter temperature normal for that area. Hardiness zones in New Jersey are zone 5 (low winter temperatures of -10 to -15°F) in northwestern New Jersey, zone 7 (5 to 0°F) in the shore areas of southern New Jersey, and zone 6 (0 to -10°F) in all the areas in between. Gardeners can check with their local garden center or the Rutgers Cooperative Extension office in their county to determine the hardiness zone for their area. Choosing plants appropriate for a particular hardiness zone is not a guarantee of plant survival; gardeners must be aware of **microclimates**. These small environments may differ in temperature, soil moisture, and the quantity or quality of light compared to the area as a whole. Microclimates are due to the influence of features such as nearby buildings, walls or fences, paved areas, land formations, and bodies of water. An example of a microclimate is a region in a landscape that is warmed by the heat reflected from white siding on a home or by large expanses of window glass on an office building.

Many microclimates may exist in the average landscape. Planting sites that are dry due to large roof overhangs will require drip irrigation systems unless landscape plants tolerant of dry soils are chosen. Low areas in the landscape where cold air settles are difficult microclimates for plants that bloom in early spring, such as magnolias. Plants placed on south facing slopes will start to grow earlier in the spring than the same plants placed on north-facing slopes. The tender growth of plants facing south is often injured by normal early spring temperatures. Temperatures are usually milder, however, by the time plants facing north begin to develop, so this type of early spring frost injury may not occur. The effects of microclimates are subtle but significant. For example, because of the heat generated by paved areas, a population of spider mites will increase much more quickly in a ground cover juniper planted near a sidewalk or driveway compared to similar junipers growing in the center of the planting.

Some damage from cold winter temperatures doesn't appear until the following spring or summer when twig dieback may occur or buds fail to develop. For example, buds may appear to develop normally early in the growing season, but then die during the first dry period of the spring or summer. In such cases, the sapwood in the trunks and branches of affected trees and shrubs was injured or killed due to cold winter temperatures. These plants are thus unable to deliver sufficient water to the canopy. Some landscape plants, such as balsam fir, don't do well in New Jersey; even though they tolerate our winters, summers in the state are too hot.

Points to keep in mind regarding temperature and landscape plantings include:

- Compared to rural areas, urban environments have greater temperature fluctuations due to shelter from winds and re-radiated heat.
- Choose plants that are hardy in your zone or the next lower zone.
- Plants that are hardy in the ground in your area may not be hardy in containers. The roots in containers, even large ones, are exposed to ambient temperatures without the insulating effects of soil.

MOISTURE EXTREMES

Drought Stress

Drought stress occurs when plants lose more water from the foliage than can be taken up by the roots. All trees and shrubs in New Jersey landscapes can be affected by moisture deficits, and it can take 5 to 10 years for a plant to recover from the impact of a severe drought. Drought-stressed trees lose foliage, grow slowly, and become more susceptible to attack by insects and diseases (Table 1) and to injury by severe winter weather. This is especially true of younger trees. A severe drought may kill trees. In New Jersey, drought periods occurred in 1983 and late in the summer of 1988, 1995, and 1997 to 2002.

Causes. Native plants in a given area are adapted to variations in water supply and show symptoms of drought stress only under unusually dry conditions. Planted trees and shrubs, however, can be more susceptible to water deficit. Water deficit is a normal phenomenon that occurs in plants during the daytime when loss of water from the leaves exceeds water uptake in the roots. This deficit is made up at night and during periods of rain or dew formation. Under dry soil conditions, however, roots fail to extract as much water as has been lost, and physiological stress develops. Under severe drought stress, tissues lose turgor, degenerate, and die.

Table 1. Diseases and insects common on plants stressed by drought.

- Armillaria root rot
- Borers on birch, oak, and dogwood
- Cankers:
  - Botryosphaeria canker (all trees, especially rhododendron and redbud)
  - Cytospora canker (*Prunus* spp., poplar, willow, maple, and spruce and other conifers)
  - Hypoxylon canker (oak)
  - Nectria canker (hardwoods)
  - Thyronectria canker (honeylocust)
- Dogwood anthracnose
- Pine wilt nematode
- Verticillium wilt on maple

Water deficit may also occur in dormant plants (especially evergreens) during warm weather in winter or early spring when water evaporates from leaves and stems while the soil is cold or frozen. Roots extract insufficient water from cold soil and none from frozen soil. This is called winter desiccation. Drought stress also predisposes plants to sun scald, frost cracks, winter burn, and dieback.

Plants vary in ability to tolerate moisture stress. Some stress tolerant species are listed in Table 2. Seedlings are very susceptible to drought stress because their root systems are shallow and underdeveloped. Newly transplanted trees are similarly affected because they have lost many absorbing roots during the transplant process. In some situations, highly porous rooting media present within the root ball dries rapidly, so that water shortage occurs even though surrounding soil may contain sufficient water.

Symptoms. Plants affected by drought stress cope with the moisture deficit in various ways. Stomates may close to prevent moisture loss from leaves, and photosynthesis may slow or cease, resulting in the development of yellow leaf color. Green leaves, stems, roots, and fruit may shrink, and shrunken sapwood may develop radial cracks. Roots in drying soil become less permeable to water, and root tips may be damaged by drying.

Leaves on drought-stressed plant material may droop, wilt, curl, turn yellow, turn brown at the tips and margins, or drop prematurely. Older leaves usually succumb first. Severe water deficit in pines causes needles to lose turgor and droop near the needle base. Needles then fade and turn brown or remain green and permanently bent. Symptoms may not appear until a year or more after trees have been stressed by drought. Dead tree tops, shortened needles, and sparse foliage indicate a general decline in vigor that becomes evident in the years following severe drought stress.

Monitoring and management. When faced with a drought situation, keep the following points in mind:

- Inspect stressed trees of all ages for injury by invading pests during and after periods of drought.
- Control weeds and grasses in and around stock to reduce competition for water during dry periods.
- If drought persists, irrigate to replace soil moisture in the root zone. This is especially important for young and newly transplanted trees.
- Remove all dead trees as soon as possible; they may harbor bark beetles.
- Do not plant shallow-rooted species in areas of low rainfall or on drought-prone sites.
- To increase moisture retention in dry, sandy, or gravelly soils, add organic matter when planting. Application of

Table 2. Stress tolerant trees and shrubs.

Deciduous Trees and Shrubs		Evergreens
Amur cork tree	Glossy abelia	Adam's-needle yucca
Amur privet	Golden raintree	Atlas cedar
Anthony water spirea	Hackberry	Concolor fir
Ash: green, white	Holly: American, Japanese	Dense yew
Barberry: Japanese, wintergreen	Ironwood	Douglas fir
Bayberry	Japanese pagodatree	Eastern red cedar
Bearberry	Japanese tree lilac	Juniper: Pfitzer, shore
Birch (gray)	Japanese zelkova	Pine: Japanese white, Japanese black, mugo, Scotch, white
Blackhaw viburnum	Maple: Amur, red, tatarian, trident	Spruce: Norway, Colorado, Colorado blue
Bush cinquefoil	Mimosa	White fir
Chaste tree	Oak: pin, red, scarlet, white	
Common witchhazel	Saltspray rose	
Crabapple: *Malus* sp., tea, Zumi, Katherine	Spirea 'Anthony Waterer'	
Ginkgo	Shadblow serviceberry	
	Turkish filbert	

mulch (no more than 3 inches) reduces soil moisture loss and soil temperature.
- To help alleviate winter injury, make sure plants go into the cold winter months with adequate soil moisture. For example, broadleaf evergreens growing in planting sites with adequate soil moisture in the fall will be better able to withstand drying winter winds without desiccation. Such plants should be watered again during periods in the winter when the soil is not frozen.

Excessive Soil Moisture

Even when soils contain sufficient water for plant growth, the volume of soil in which the roots are growing is still 25% air. When the root zone is flooded (as in May 1998 when parts of New Jersey had 13 days of rain), the air spaces fill up with water. The normal life processes of healthy roots stop in the absence of air, and the roots begin to rot. Trees that can tolerate flooding for a few days with no adverse effects are flood plain plants such as sycamore, elm, sweet gum, and red maple. For most plants, however, root systems injured by water-logged soils will cease to function. Since they can't deliver water to the branches and leaves, drought symptoms develop in the upper portions of the plant. Even after the soil drains, a plant that survived flooding may die due to drought stress because the injured, diminished root system can't supply the top growth with enough water.

In general, most deciduous plants tolerate flooding better than most evergreens. Also, dormant plants can tolerate flooding better than those in active growth, in part because roots in cold soil need less oxygen.

Proper Watering Practices

New Jersey lawns, gardens, and landscapes need 1 to 1-1/2 inches of rainfall or water from irrigation each week to maintain healthy growth. In planting beds and gardens, soaker hoses or drip irrigation systems will conserve water and keep plant foliage dry, which reduces problems with fungus diseases such as powdery mildew. The irrigation water should be applied slowly enough so that it sinks into the soil, rather than running off.

Even mature shade trees need watering during a drought. Shade trees have root systems shaped like a pancake, with the great majority of roots within 10 to 18 inches of the soil surface. (Only nut trees that are growing naturally in landscapes or wooded areas will have taproot systems. As these trees age, their taproots become less important and lateral roots become a more important part of the tree's root system.) Shade trees can be watered with deep root feeders or with soaker hoses placed on the soil surface. The hoses should be laid in concentric circles around the tree at the dripline or even farther from the trunk. The irrigation of mature shade trees should continue until the soil under the dripline is moistened at least 12 inches below the surface. It takes a long time to water large trees with soaker hoses, although the total amount of water used is smaller than if the tree was watered with a lawn sprinkler. Soaker hoses will be even more efficient if they are spread on the soil surface and then covered with a layer of mulch.

Use of Mulch

Mulches conserve moisture and prevent weed growth. Compared to the temperature of bare soil exposed to full sun on a hot summer day, mulches reduce soil temperatures as much as 10 degrees, thereby permitting continued root growth during warm periods. A mulch layer should be 2 or 3 inches thick and should not be placed against the trunk where it could rot the bark and eventually cause the death of the tree.

For more information on moisture use in landscapes, refer to the following fact sheets:

- FS595 Low Water Use Landscaping
- FS596 Principles of Low Water Use Landscaping I: Water Only When and Where Needed
- FS597 Principles of Low Water Use Landscaping II: Improve Your Soil
- FS598 Principles of Low Water Use Landscaping III: Low Water Demanding Plants
- FS599 Principles of Low Water Use Landscaping IV: Apply Mulches
- E080 Landscaping for Water Conservation

SUN AND SHADE

Many flowering plants, such as roses, require full sun (defined as 6 or more hours of direct sun per day) for their best growth and flower display. Experienced gardeners select landscape plants while keeping in mind the expressions "don't fight the site" and "right plant, right place." Although planting sites can be modified to some extent, choosing a plant to match the site results in a healthy, attractive plant that requires less care.

For example, flowering dogwood (*Cornus florida*) is a native tree that is commonly found in the understory layer of a forest. The tree can do well in the sun, however, if it is placed in well-drained soil with adequate moisture. If soil moisture is limited due to drought or competition from turf or ground covers, the tree is more susceptible to the dogwood borer, a serious pest. Many native flowering dogwoods in New Jersey eventually die of borer damage because they are stressed by unfavorable growing conditions. Other small flowering trees such as Kousa dogwood (*C. Kousa*), Kousa hybrids, crabapples, flowering cherries, magnolias, hawthorns, Carolina silverbell, and tree lilac are also suitable choices for sunny planting sites.

Trees that require full sun will be stressed when grown in a shady planting site. Since their leaves are not exposed to enough sunlight to make the food they need (carbohydrates or starch), their resistance to insect and disease problems declines. Bark beetles, browsing mammals, fungal pathogens, and defoliating insects will be more likely to attack such plants.

Gardeners can take advantage of the varying qualities and effects of sunlight throughout the day. Morning sun will dry plant foliage that may have been covered with dew during the night. If a gardener has no planting sites with full sun for roses, for example, morning sun is the next best choice. Keeping foliage as dry as possible helps reduce problems with black spot, a fungal disease of roses. Also, afternoon sun is more stressful than morning sun for many plants.

SOIL CHARACTERISTICS

A good quality topsoil contains 40 to 50% sand, 25 to 60% silt, and 5 to 20% clay. Sandy loam, loam, and silty loam soils differ in the amounts of sand, silt, and clay they contain, but since all three soil types fall into the above ranges, they are all topsoils that would support healthy plant growth.

Soil pH

Soil pH is measured on a scale of zero to fourteen, where zero to seven is acidic and seven to fourteen is basic. A pH of seven is neutral. Turfgrasses and most landscape plants require a soil that is slightly acidic (i.e., pH 6.0 to 6.5). Liming soils that are more acidic to raise their pH to this range has many benefits, including:

- Lime makes soil nutrients available for plant growth, reducing the need for additional fertilizer.
- Lime replaces the calcium lost when, for example, the leaves of a shade tree are removed rather than left to decay on the soil surface under the branches of the tree. (Had the leaves been left to decay, calcium and other minerals in the leaf tissue would have been returned to the soil and taken up by the tree for future use.)
- Lime makes some toxins that are naturally present in our soils (e.g., cadmium and aluminum) unavailable for plant growth.
- By improving soil conditions for plant growth, liming encourages deeper root systems, making many plants more drought tolerant.
- Liming encourages the activity of the microorganisms, insects, and earthworms that are characteristic of a healthy soil.

There are some ornamental plants that prefer more acidic soil (pH 4.5 to 5.5). If the pH is above 5.5, sulfur and aluminum sulfate can be used to reduce the pH of planting sites for acid-loving plants. Sulfur is often the preferred product since high levels of aluminum from aluminum sulfate can be a problem. Since the pH can only be reduced by one-half unit per growing season (for example, from 6.3 to 5.8), acidifying soil for established plantings is a slow process. For new plantings, soil pH can also be reduced by incorporating a small amount of peat moss into the planting hole.

Soil Fertility

The application of fertilizer and lime to planting beds should be based on the results of a soil test conducted every three or four years. The improper application of lime and fertilizer can have adverse affects on soil and plant health. For example, high pH levels and phosphorus combine to make the nutrients boron, chlorine, copper, iron, manganese, molybdenum, and zinc unavailable for plant growth. These elements, called **micronutrients** because they are needed in small quantities, are essential for plant growth. When the pH and phosphorus levels are high, micro-nutrients cannot be taken up by plant roots because they are chemically bound to soil particles. Many common fertilizer products contain micro-nutrients.

Improper fertilization also causes water pollution and predisposes lawns and landscape plants to disease and insect problems. For example, crabapples, cotoneasters, and mountain ash that are fertilized with too much nitrogen produce soft, lush growth that is susceptible to fireblight, a bacterial disease that is difficult to control. When an excessive amount of nitrogen fertilizer is applied during hot summer weather, turfgrass becomes susceptible to a fungal disease called brown patch. On the other hand, turfgrasses are susceptible to red thread and dollar spot, two other fungal diseases, when the soil is deficient in nitrogen. Scale insects, aphids, and hemlock woolly adelgid are examples of insects that thrive on over-fertilized plants. The sap in such plants contains more nutrients than the sap of unfertilized plants, so the insects that feed on them grow to be larger adults and lay more eggs.

For more information on soils and fertilizers, see the following Rutgers Cooperative Research & Extension fact sheets:

- FS656 Lead in Urban Garden Soils
- FS719 Soil Fertility Test Interpretation - Phosphorus, Potassium, Magnesium, and Calcium
- FS797 Soil Testing for Home Lawns and Gardens
- FS871 Understanding Fertilizer Labels
- FS901 Topsoil Suitable for Landscape Use

Organic Matter and Compost

Organic matter is the carbon-rich, partially decayed remains of plants. Organic matter improves soil water-holding capacity and acts as a reservoir for nutrients that are released slowly as the plant needs them for growth. Organic matter also serves as a food source for populations of microbes and earthworms. Indeed, an abundance of earthworms is one sign that the level of organic matter in the soil is sufficient. In soils high in clay, decaying organic matter acts as the “glue” that causes individual particles to clump together into aggregates. The spaces between the aggregates permit infiltration of air to the roots and good drainage. In addition to these benefits, certain composts reduce the incidence of soilborne diseases.

To increase the organic matter content of soils, add commercial “humus,” manure, or peat moss, or use a homemade soil amendment of composted yard waste and kitchen scraps that do not contain meat or animal fat. Although it is difficult to incorporate organic matter to the entire root system of a mature shade tree, it is possible to amend the soil used for annuals, perennials, bulbs, and shrubs that need better drainage or more organic matter than is present in the existing soil. Many new references in

horticulture do not recommend adding organic matter to the existing soil when planting shade trees and small ornamental trees. Thus, the amount and type of organic matter added, if any, should be based on the requirements of the plant and the characteristics of the existing soil.

Organic matter is most conveniently added to garden or planting bed soil before planting. The addition of organic matter in the fall, however, hastens the process of decomposition due to the freezing and thawing of the soil during the winter. When preparing soil for garden or landscape plants, incorporate a 1 to 3 inch layer of organic matter into the soil to a depth of 12 inches. The characteristics of the organic matter to be used must be taken into account. If peat moss is used, the soil in the root zone will become more acidic. If composted leaves are used, the soil in the root zone will become more neutral and less acidic. The size and shape of the planting hole is at least as important, or even more important, than the use of soil amendments.

Filling the planting hole with soil amended with large amounts of organic matter can create a situation in which the hole fills with water rather than draining away from the roots into the surrounding soil. Adding organic matter does gradually improve soil quality, drainage, and plant growth. Overcompensating in the planting hole for a poor soil that lacks sufficient organic matter does not, however, ensure tree survival. If composted organic matter is added it should be no more than 25% of the volume of the soil in the root zone (for example, 3 inches of organic matter in the upper 12 inches of soil).

For more information on composting, refer to the following fact sheets:

- FS074 Backyard Leaf Composting
- FS117 Using Leaf Compost
- FS826 Sources for Home Compost Bins

Soil Drainage

Sandy soils have large spaces between the particles of sand. These soils require frequent watering because drainage in the larger pores is very fast and complete. The spaces between clay particles are extremely small, which slow the flow of water through the root zone. In addition, the surface of the clay particles retains more water than the surface of sand particles. If puddles linger for a day or two after a rain, or if the soil seems wet or muddy all the time, the clay content may be relatively high.

To estimate the ability of the soil to drain, dig a hole 12 inches deep and fill it with water. Let it drain and fill it again, noting the time. After 15 minutes, measure the depth of the water to calculate the drainage in inches per hour. For example, if the water level decreases from 12 inches deep to 10 inches in 15 minutes, the amount of water that drained from the hole equals 2 inches. If 2 inches drained in 15 minutes, the rate per hour would be 8 inches. In poorly drained soils, water will leave the hole at a rate of less than 1 inch per hour. In moderately drained soils the water drains from the hole at a rate of 1 to 6 inches per hour. If the rate is greater than six inches per hour, the soil is excessively drained.

Variations in the color of the soil, called gray mottling, is also a good indication of poor drainage. The gardener can check for mottling by digging a hole about 12 inches deep and examining chunks of soil for a distinct gray color (in contrast to the orange or brown color of soil that drains well). Poorly drained soils often smell fermented due to acids and alcohols that accumulate in soils lacking sufficient oxygen for normal root growth.

Soils can be poorly drained due to high clay content, compacted soil structure, or grading of an area so that surface water does not run off. Some planting sites may have a high water table. If soils are poorly drained due to high clay content, adding organic matter is the long-term solution. In the short-term, consider constructing raised planting beds in areas that are high in clay or with a high water table, or choose plants that are tolerant of wet soils. Re-grading may be needed to solve problems with accumulating surface water.

Heavy equipment or constant foot traffic can cause soils to become compacted. The normal arrangement of soil particles with nearby air spaces is destroyed. Water and air are unable to penetrate deeply into the soil. Prevent compaction by not working the soil when it is wet, incorporating organic matter regularly, and restricting foot or vehicle traffic to areas that are not to be planted.

ALLELOPATHY

Allelopathy is the term that describes the positive and negative effects that some plants have on other plants. It is defined as the biochemical modification of the environment by a plant to enhance its chances for survival and reproduction. The most commonly known allelopathic plant is black walnut, although other ornamental plants and turfgrasses also have negative allelopathic effects.

Black walnut exudes a substance called juglone from its roots, stems, and leaves. Mulches made from these plant tissues also release juglone into the soil. Juglone inhibits cell respiration, thus reducing plant growth, in species such as pines, chrysanthemums, peonies, apple, lilac, white birch, and acid-loving plants. Soil moisture, microorganisms, the availability of light, and soil texture all affect the activity of juglone. For example, white and red pines are affected negatively by juglone when the soil is wet, but not when the soil is dry.

SPRING AND FALL PLANTING

Fall is an optimum time to plant many trees, shrubs, ground covers, perennials, and bulbs because rainfall is generally more uniform in the fall compared to the spring and summer. Perennials and bulbs are best planted in early to mid-fall; planting at this time permits sufficient root growth so the plants are not heaved out of the ground during winter cycles of soil freezing and thawing.

Certain trees such as oaks and beeches generate new roots primarily in the spring. They can be planted in the landscape in the fall, but are most likely to survive if they have been container-grown or if the plant was dug from the nursery row the previous spring. Other plants that generate roots primarily in the spring are the true firs (Douglas fir is not a true fir), birch, yellowwood, flowering dogwood, beech, gingko, American holly, sweetgum, tuliptree, magnolia, sourwood, oak, and hemlock.

DEADHEADING

Referred to as "**deadheading**," the removal of old blooms prevents seed development and improves the appearance or health of many annuals and herbaceous perennials. Deadheading:

- prolongs the bloom period in plants that flower over a period of several weeks
- stimulates a second period of blooms in plants that flower heavily in a short period (the second burst of blooms will be shorter, the flowers smaller, and there will be fewer of them)
- prevents self-seeding in plants where this is a problem, such as border phlox (*Phlox paniculata*)
- causes some biennials such as sweet William (*Dianthus barbatus*) to behave as perennials
- improves the general appearance of the plant, first because the aging plant parts are removed, and second because the energy that would have gone into seed production goes into leaf, stem, and root growth instead.

FOR MORE INFORMATION

Other Rutgers Cooperative Research & Extension fact sheets and bulletins which may prove helpful include:

- FS121 Herbicide Injury to Trees
- FS191 Pest Resistant Trees and Shrubs
- FS316 Preventing Pests in the Home Landscape
- FS432 Wildlife and Homeowners: New Jersey White-Tailed Deer
- EB433 Landscaping at the Seashore
- FS631 Plant Disease Control: Sphaeropsis (Diplodia) Shoot Blight and Canker of Pines
- FS663 Plant Disease Control: The Impact of De-icing Salt on Roadside Vegetation
- FS786 Six Ways to Keep Your Newly Planted Tree Alive and Healthy
- FS866 Using Horticultural Oils

Limited copies of publications listed are free unless a price is specified. Contact your county office of Rutgers Cooperative Research & Extension, found in the blue pages of telephone book under County Government (or visit http://www.rcre.rutgers.edu/county/default.asp), to obtain copies of these publications, or visit the Publications Pages at the Rutgers Cooperative Extension Web site: http://www.rcre.rutgers.edu.

NOTES

HELPING INDOOR PLANTS RETURN TO FLOWER

AMARYLLIS

Remove any dead roots on a newly purchased bulb. Select a pot with about 1 to 2 inches of space between the bulb and the wall of the pot. Plant so that about half of the bulb is above the soil line. Three to five bulbs can be planted in a large pot for a mass of color and to prevent top-heavy flower stalks from falling over.

Water thoroughly when the bulb is potted, but not much after that until the flower stalk appears. Provide good light and begin watering, keeping the soil evenly moist. The plant will be in bloom within 6 to 8 weeks. Remove old flowers and stalks as they age.

Foliage develops after flowering stops. Keep the plant in a warm, sunny place and water weekly with a dilute solution of fertilizer (one quarter of the label rate). Flower buds may not develop on hybrid amaryllis bulbs if the growing conditions are not good enough for the plant to produce 4 to 6 leaves before dormancy. Remove old foliage as it turns yellow.

To bring a bulb into flower again, it must have a dormant period during which it is not watered. (Amaryllis is a tropical plant, which means that dormancy is induced by drought rather than by cold temperatures as with tulips and hyacinths.) In September, water less so that the bulb gradually becomes dry. Stop watering completely and store the bulb in its pot, at 50°F, for 6 to 8 weeks of dormancy. Then bring the plant into good light and begin watering for another flowering cycle.

CHRISTMAS CACTUS

This succulent plant grows at average household temperatures, but it does prefer bright light and moist soil with a high level of organic matter. As with many indoor plants, Christmas cactus does well when it's placed outdoors in a sunny area in the summer. Fertilize it monthly from March through August with a water soluble fertilizer at one-quarter of the rate recommended on the label.

Starting October 1, provide 16 hours of total darkness to initiate flower buds. Even a short burst of light during the dark period will delay bud formation. During this period, the plant should receive good light during the daytime. The temperature should be between 60 and 70°F. In early December, bring the plant into ordinary light and blooms will develop.

GARDENIA

Gardenia leaves and flowers drop if the air is dry, if the growing area is too dark, and if the soil is not acidic enough.

To increase humidity in the air around the plant, group plants together, or place plants on trays of pebbles to which water has been added. Add water to the tray as it evaporates, always making certain that the pots are resting on pebbles above the level of the water.

Gardenias grow best in sunny locations and outdoors in the summer, and often require artificial light to supplement low light levels during the winter. The potting mixture should be well-drained and acidic, consisting of one part fine pine bark, one part perlite, and one part sphagnum peat moss.

When the growing mix is dry to the touch, often 1 week after watering, water thoroughly using a dilute solution of water-soluble fertilizer (mixed at one–quarter of the rate recommended on the label).

Cool winter night temperatures are important. Sunny, unheated rooms often have night temperatures of approximately 50°F during the winter, which is good for gardenias.

EASTER LILY

After purchasing an Easter lily, check to see that the drainage hole is unobstructed in the bottom of the pot. If the soil is dry to the touch, water thoroughly. After 30 minutes, remove any water that remains in the saucer under the pot. Bright light, without direct sun, is best. A cool location prolongs the life of the blossoms. Remove blooms as they fade. Gradually dry off the plant, when the flowering is over, and the foliage turns yellow. When the flower stalk is completely yellow, pull it out with a slight twisting motion.

Place the plant in a cool, dark place. After the danger of frost has past, remove the plant from the pot, and plant in a perennial bed. The bulb should be covered with 6 to 8 inches of sandy soil, to which organic matter has been added. The plant may flower the same year, or certainly the next year.

Easter lilies are not recommended for indoor forcing a second time.

POINSETTIA

While flowering, keep the soil evenly moist. Keep the plant away from drafts that cause rapid evaporation of moisture from the foliage, causing it to wilt. Placing the plant on a tray of pebbles and water prolongs the life of the colorful leaves ("bracts") that we think of as flowers. Blooming Poinsettias require at least 2 to 3 hours of good light per day, and a temperature between 70 and
75°F.

From mid-winter until the danger of frost is past in the spring, keep the plant exposed to moderate light with a temperature above 60°F at night. The plant needs less water after flowering than it does during bloom.

Before planting outdoors, replace the soil in the pot. The best soil mix is equal parts of loam soil, sand and peat moss or compost. Select a planting site where the plant will have morning sun and protection from strong winds. Sink the plant, still in the pot, up to its rim and cover the soil with two inches of fine-textured mulch.

In early summer cut the stems back to 12 inches to stimulate new growth. Pinch the growing tips of new shoots until mid-July to produce even more growing points that eventually produce blooms.

In early September lift the poinsettia, still in its pot, from the garden and remove any roots that grew below the pot. Bring the plant indoors, water as described above, and provide good light during the day. Beginning in early October, place the plant in a darkened room for 14 hours every night for one month. Another way to shield the plant from the light is to place a large cardboard box over the plant for the 14-hour period. The month-long treatment of short days with good light and long nights of complete darkness induces flower buds to set in poinsettia.

SAFE USE OF PESTICIDES AROUND THE HOME

How safe are pesticides? This is a very important question, particularly for the applicator and for those persons who may come in contact with the chemicals before, during, or immediately after application. Generally, home pesticide products are safe if handled properly and according to the instructions on the product label. To avoid pesticide dangers, you must know your materials and how to use them. Pesticides are effective and efficient if used properly and safely. ALWAYS READ THE LABEL BEFORE USING ANY PESTICIDE PRODUCT! If you do not understand the directions on the label, check with the Rutgers Cooperative Extension Agent in your county.

THE PESTICIDE LABEL

The instructions on the label are like a prescription: they state how much pesticide to mix; how, where, and when to apply it; and precautions to be observed. The label is a legal document that states specifically what uses (host plant, target pest, site of application) have been approved by the Environmental Protection Agency (EPA). If the intended use is not on the label, the product should not be used! Pesticide users are forbidden to use a pesticide in a way contrary to its labeling. Certain formulations of a particular pesticide may be intended for a specific use only, for example, on certain ornamentals, even though the pesticide is also registered for other uses.

It is also illegal for consultants or sales persons to recommend a pesticide be used contrary to its label. The information found on the label has passed strict government requirements. The label itself, not just the pesticide product, must be registered by the EPA before it is used. The EPA reviews and approves each statement which is on the label.

PARTS OF THE LABEL

1. **Brand, Trade, or Product Names**. A specific brand name, usually registered as a trademark, will identify a product as produced by a particular manufacturer. Different manufacturers may use different brand names for the same pesticide active ingredient. For example:

   Tersan LSR = zinc and maneb
   Tersan SP = chloroneb
   Tersan 1991 = benomyl
   Tersan = thiram

2. **Classification**. Every use of every pesticide will be classified by the EPA as either "general" or "restricted." All homeowner products are general use pesticides. Restricted use pesticides must carry the following statement in a prominent place at the top of the front panel of the pesticide label:

   "RESTRICTED USE PESTICIDE. For retail sale to and use only by certified applicators (or persons under their direct supervision) and only for those uses covered by the certified applicator's certification."

   No one, specifically homeowners, can use a restricted use product unless they are certified and licensed as an applicator or registered as a pesticide operator by the New Jersey Department of Environmental Protection (NJDEP) Pesticide Control Program. The absence of a RESTRICTED USE statement does not necessarily indicate that the product has a low hazard level. Use the signal word (see below) and the precautionary statements (see below) to judge the acute toxicity hazard of a pesticide product.

3. **Ingredient Statement**. Lists the amount (by percent) of each active ingredient and the total amount of inert ingredients. The active ingredient is the material in the formulation that has the pesticidal activity. There may be more than one active ingredient in a given formulation. The ingredient statement must list the official chemical names and/or common names for the active ingredients. Inert ingredients need not be named, but the label must show the percent composition of inerts.

   - **Chemical Name**. The chemical name is a complex name that identifies the chemical components and structure of the pesticide. This name is almost always listed in the ingredient statement on the label. For example, the chemical name of Sevin 50% WP is 1-naphthyl methyl carbamate.
   - **Common Name**. Because pesticides have complex chemical names, many are given a shorter, "common" name. Only common names that are officially accepted by the EPA may be used in the ingredient statement on the label. The official common name may be followed by the chemical name in the list of active ingredients. For example, a label with the trade name Sevin 50% WP would read:

     Active ingredient:
     carbaryl (1-naphthyl methyl carbamate) 50%
     Inert ingredients 50%

4. **Net Contents**. The front panel of the pesticide label tells you how much is in the container. This can be expressed as pounds or ounces for dry formulations; and as gallons, quarts, pints, or fluid ounces for liquids.

5. **Name and Address of the Manufacturer**. The law requires the maker or distributor of a product to put the name and address of the company on the label. Many companies now voluntarily provide '800' numbers for homeowner products.

6. **EPA Registration and Establishment Numbers**. The registration number identifies a specific product and signifies that the product has met federal registration requirements. An EPA registration number is also proof the label was approved by EPA before sale in the market place. The establishment number (for example, EPA Est. No. 5840-NJ-1) identifies the facility that produced the product.

7. **Directions for Use**. The use instructions will specify:

   - the pests that the manufacturer claims the product will control (Federal and New Jersey law legally allows you to apply a pesticide against a pest not specified on the labeling if the application is to a crop/plant, animal, or site which the labeling approves)
   - the plant, animal, or site the product is intended to protect
   - where the material should be applied
   - what form the product should be applied
   - when it should be applied
   - the proper equipment to be used
   - mixing directions
   - how much to use
   - compatibility with other often-used products
   - phytotoxicity and other possible injury, or staining problems

8. **Signal Words and Symbols**. The pesticide label will contain a signal word that will tell you how acutely toxic the product is to humans. There are three signal words: DANGER, WARNING, or CAUTION.

   - **DANGER** - Any product which is **highly toxic** via oral, dermal, or inhalation exposure. As little as a taste to a teaspoonful taken by mouth could kill an average-sized adult. These materials will also carry the word POISON printed in red and the "skull and crossbones" symbol. The signal word DANGER alone is sufficient if the highly toxic rating is due to severe, corrosive damage to skin or eyes.
   - **WARNING** - Any product which is **moderately toxic** via oral, dermal, or inhalation exposure, or causes moderate eye and skin irritation will be labeled WARNING. A teaspoonful to a tablespoonful by mouth could kill the average-sized adult.
   - **CAUTION** - Any product which is **slightly toxic** to **relatively non-toxic** via oral, dermal, or inhalation exposure, or causes slight eye and skin irritation will be labeled CAUTION. An ounce to more than a pint taken by mouth could kill the average-sized adult.

9. **Routes of Entry Statements**. The statements which immediately follow the signal word, either on the front or side of the pesticide label, indicate which route(s) of entry (mouth, skin, lungs) you must particularly protect. Many pesticide products are hazardous by more than one route and may include several route of entry statements.

   Typical DANGER label route of entry statements include:

   - Fatal if swallowed
   - Poisonous if inhaled
   - Extremely hazardous by skin contact -rapidly absorbed through skin
   - Corrosive - Causes eye damage and severe skin burns

   Typical WARNING label route of entry statements include:

   - Harmful or fatal if swallowed
   - Harmful or fatal if absorbed through the skin
   - Causes skin and eye irritation

   Typical CAUTION label route of entry statements include:

   - Harmful if swallowed
   - May be harmful if absorbed through the skin
   - May be harmful if inhaled
   - May irritate eyes, nose, throat, and skin

10. **Specific Action Statements**. These statements usually follow the route of entry statements. They recommend the **specific action needed to prevent poisoning accidents**. These statements are directly related to the acute toxicity of the pesticide product (signal word) and route(s) of entry.

    DANGER labels typically contain action statements such as:

    - Do not breathe vapors or spray mist
    - Do not get on skin or clothing
    - Do not get in eyes

    CAUTION labels generally contain specific action statements which are much milder than those on the DANGER label:

    - Avoid contact with skin or clothing,
    - Avoid breathing dust, vapors, or spray mists,
    - Avoid getting in eyes.

    The specific action statements help you to prevent pesticide poisoning by taking the necessary precautions and wearing the correct protective clothing and equipment.

11. **Protective Clothing and Equipment Statements**. Pesticide labels vary in the type of protective clothing and equipment statement they contain. You should strictly follow all advice on protective or equipment which appears on the label. However, the lack of any statement or the mention of only one piece of equipment does not rule out the need for additional protection; use common sense and always wear gloves, long sleeves, and long pants.

12. **First Aid or Statement of Practical Treatment**. These statements tell you the first aid treatments recommended in case of poisoning. Typical statements include:

    - In case of contact with skin, wash immediately with plenty of soap and water
    - In case of contact with eyes, flush with water for 15 minutes and get medical attention

- In case of inhalation exposure, move from contaminated area and give artificial respiration, if necessary,
- If swallowed, drink large quantities of milk, egg white, or water - do not induce vomiting
- If swallowed, induce vomiting

All pesticides with DANGER signal words and some WARNING and CAUTION signal words have a section on First Aid Treatment, "Poison Signs or Symptoms," "Note to Physicians," or "Antidote" and an "Emergency Assistance Call telephone number." WARNING and CAUTION labels usually do not provide this information, although some may provide an "Emergency Assistance Call telephone number" near the signal word or precautionary statements.

13. **Precautionary Statements**. All pesticide labels contain additional statements to help you decide the proper precautions to take to protect yourself and other persons (or domestic animals such as pets) which may be exposed.

14. **Other Precautionary Statements**. Labels often list other precautions to take while handling the product. These are self-explanatory:

    - Do not contaminate food or feed
    - Remove and wash contaminated clothing before reuse
    - Wash thoroughly after handling and before eating or smoking
    - Wash clothes daily
    - Not for use or storage in and around a house
    - Do not allow children or domestic animals into the treated area

15. **Environmental Hazards**. Pesticides may be harmful to the environment. Some products are classified RESTRICTED USE because of environmental hazards alone. Label warnings may include groundwater advisories and protection information. Watch for special warning statements on the label concerning hazards to the environment.

16. **General Environmental Statements**. These statements appear on nearly every pesticide label. They are reminders of common sense actions to follow to avoid contaminating the environment. The absence of any or all of these statements does not indicate that you do not have to take adequate precautions. Sometimes these statements follow a "specific toxicity statement" and provide practical steps to avoid harm to wildlife. Examples of general environmental statements include:

    - Do not apply when runoff is likely to occur
    - Do not apply when weather conditions favor drift from treated areas
    - Do not contaminate water by cleaning of equipment or disposal of wastes
    - Keep out of any body of water
    - Do not allow drift on desirable plants or trees
    - Do not apply when bees are likely to be in the area

17. **Hazards to Wildlife**. The label may indicate that the product causes undesirable effects in the environment. In this case, the precautionary statement may tell you what to avoid doing. Some labels indicate toxicity to bees, birds, fish, and crustaceans. Labeling may indicate limitations imposed to protect endangered species. These limitations may include reduced rates, restrictions on types of application, or a ban on the use of the pesticide within the species range. The label may also tell you where additional information can be obtained.

18. **Special Toxicity Statements**. If a particular pesticide is especially hazardous to wildlife, it will be stated on the label. For example:

    - This product is highly toxic to bees
    - This product is toxic to fish
    - This product is toxic to birds and other wildlife

    They should also help you choose the safest product for a particular job and remind you to take extra precautions.

19. **Physical or Chemical Hazards**. This section of the label will tell you of any special fire, explosion, or chemical hazards the product may pose. For homeowner use, foggers use a flammable propellant and should always be used according to the label directions.

20. **Storage and Disposal**. All pesticide labels contain general instructions for the appropriate storage and disposal of the pesticide and its container.

PROTECTIVE CLOTHING AND SAFETY EQUIPMENT

The type of protective clothing and equipment needed depends on the job being done and the type of pesticide being used. Read the label on the pesticide container carefully and follow all directions concerning necessary protective clothing and equipment.

As a minimum precaution, the home gardener should have the following protective items available when handling pesticides:

(1) Clean clothing - long sleeved shirt, long trousers, or coveralls made of tightly woven fabric or a water-repellent material. Cotton T-shirts and shorts do not provide adequate protection when applying pesticides.
(2) Chemical resistant gloves, unlined and without a fabric wrist band. Shirt sleeves should be worn over gloves in most instances, not tucked inside, to prevent spills from running down inside the glove.
(3) If needed, chemical resistant boots and hat.
(4) Eye protection and respirator (if needed). Keep all of your protective equipment clean and in good condition.

MIX PESTICIDES SAFELY

Rubber gloves should always be used when mixing pesticides. When mixing pesticides, fill the spray tank about half full of water before adding the chemical. Be sure to measure accurately the proper amount of chemical according to instructions on the label. All measuring utensils (spoons, cups, etc.) should be kept in the areas where pesticides are stored. These utensils should be thoroughly washed after each use and should never be used for any other purposes.

Do not spill or splash when filling the tank. Carefully fill the spray tank with the correct amount of water. Make sure the garden hose does not come in contact with the spray preparation.

APPLY PESTICIDES SAFELY

First, READ THE LABEL carefully before applying any pesticide. Know something about the product you intend to use. Be sure that you have properly identified the insect, weed, disease, or other pest that you want to control.

Most important, use chemicals only on the plants for which they are recommended. An entire garden can be destroyed by spraying it with the wrong chemical.

Never eat, drink, or smoke when applying pesticides. Guard against drift of sprays or dusts. Drift can be reduced or controlled by making the application when there is no wind. Cover all bird feeders and baths when spraying or dusting around your home.

Do not allow persons to come in contact with treated surfaces or plants until the spray has dried or the dust has settled.

Immediately following application and cleaning of equipment, the applicator should wash thoroughly and change to all clean clothing. The spray residue must be removed from contact with the skin.

DISPOSE OF PESTICIDES SAFELY

Avoid disposal problems with excess pesticides by purchasing only the amount of material you will need for one growing season. DON'T STOCKPILE! Mix only as much pesticide as you will need for a particular treatment.

Homeowners may dispose of small empty pesticide containers through a municipal solid-waste collection service. Wrap the containers in several layers of newspaper before placing in a trash receptacle. Never attempt to burn or puncture aerosol containers; they can explode like a bomb. Never reuse empty pesticide containers for any other purpose!

Do not dump excess pesticides into toilets or other drainage systems. Such disposal methods can contaminate water supplies.

If a leak or spill occurs, clean it up immediately. Scatter sawdust, pet litter, or some other absorbent material over spilled pesticide, then sweep this up.

In New Jersey, many counties have special "Household Hazardous Waste" disposal facilities or "amnesty days" where you can bring in old pesticides for safe disposal. You can find more information about County-sponsored programs at the "Association of Household Hazardous Waste Coordinators" Web site at http://www.njhazwaste.com/ or check the phonebook for "Municipal Authority" or "Utility Authority" for your specific county of residence.

STORE PESTICIDES SAFELY

Always store pesticides in their original containers with the label attached and the lid closed tightly. Do not use soda bottles, fruit jars, or other types of nonpesticide containers; this can have serious consequences!

Keep all chemicals out of the reach of children and pets. Lock all chemicals in a building or cabinet. The lock should keep everyone away from the chemicals except those who are qualified to use them properly. Also, be sure to identify the storage facility with a sign which clearly indicates that pesticides are stored inside.

IF A POISONING OCCURS

By observing the commonsense safety procedures already discussed and by carefully following the information on the product label, pesticide-related accidents can usually be avoided. However, no matter how carefully a person handles pesticides, accidents do happen occasionally. You should, therefore, be aware of a few fundamental first aid techniques in the event of a pesticide poisoning. Above all, you must recognize the symptoms of pesticide poisoning. These may appear either immediately after exposure or not for several hours. They include headache, sweating, blurred vision, cramps, nausea, vomiting, general muscle weakness, difficulty in breathing, pinpoint pupils, as well as others.

Know the general symptoms of poisoning for the pesticide you are using. If at any time after exposure to a pesticide you do not feel well, call the New Jersey Poison Information and Education System at 1-800-222-1222.

SMALL QUANTITIES

FLUID MEASURES	DRY MEASURES	DRY WEIGHT
3 teaspoons = 1 tablespoon 2 tablespoons = 1 fluid ounce 8 fluid ounces = 1 pint 2 cups = 1 pint 2 pints = 1 quart 4 quarts = 1 gallon	3 teaspoons (level) = 1 tablespoon 16 tablespoons (level) = 1 cup 2 cups = 1 pint 2 pints = 1 quart	2 tablespoons = appx. 1 ounce dry weight

HELPFUL HINTS

1. If you use a liquid concentrate, add an equal amount of water and shake or stir thoroughly. Add this mixture to the full amount of water and stir until completely mixed.

2. If you use a wettable powder, stir it vigorously in a small amount of water to make a smooth paste or slurry. Add this to the full amount of water and stir until completely mixed. Shake spray tank frequently to prevent pesticide from settling.

3. Mix a fresh batch of spray for each application.

WEB SITES for MANUFACTURERS OF PESTICIDES USED ON HOME GROUNDS

Agway: www.agway.com

Bonide and RoseRx Products: www.bonideproducts.com

Ortho: www.ortho.com

Garden Tech: www.gardentech.com

Bayer: www.bayeradvanced.com

Green Light: www.greenlightco.com

Gardeb Safe, Schultz, Spectracide: www.schultz.com

Safer and Concern: www.woodstream.com

Cleary: www.clearychemical.com

Summit Chemical: www.summitchemical.com

Gardens Alive: www.gardensalive.com

Chemtura: www.chemtura.com

Loveland Products: www.dynagroseed.com/uap

COMMON AND TRADE NAMES OF INSECTICIDES AND FUNGICIDES

The following table lists the common name of the active ingredient and the trade name containing the active ingredient of some pesticides available for use on homegrounds. No endorsement of named products is intended, nor is criticism implied of similar products which are not mentioned. Before applying any pesticide, read and follow label directions.

COMMON NAME	TRADE NAME
Insecticides and Miticides:	
acephate	Ortho Bug-B-Gon Garden & Landscape Insect Killer Ortho RosePride Orthenex Insect & Disease Control[1,2]
acephate + fenbutatin oxide	Ortho Systemic Insect Killer
Bacillus thuringiensis	Bonide Thuricide *Bacillus Thuringinensis* (B.t.) Liquid
Bacillus thuringiensis subsp. *tenebrionis*	Bonide Colorado Potato Beetle Beater
Bacillus thuringiensis subsp. *kurstaki*	Safer Caterpillar Killer Concentrate
bifenthrin[3]	Ortho Rose & Flower Insect Killer
carbaryl	Bonide Bug Beater Yard & Garden Insect Control Granules GardenTech Sevin Ready-To-Use Bug Killer GardenTech Sevin-5 Ready-To-Use 5% Dust Bug Killer GardenTech Sevin-10 Ready-To-Use 10% Dust Bug Killer Ortho Bug-B-Gon Garden & Landscape Insect Killer
cyfluthrin[3]	Bayer Advanced Garden PowerForce Multi-Insect Killer
cyfluthrin + imidacloprid	Bayer Advanced Garden Rose & Flower Insect Killer
dimethoate	Ferti-Lome Systemic Ornamental & Evergreen Spray
disulfoton	Bayer Advanced Garden 2-in-1 Rose & Flower Care Bonide Systemic 2% Granules Ready-To-Use Bonide Systemic Rose & Flower Care 1% Granules Ready To Use[4]
esfenvalerate[3]	Ortho Bug-B-Gon Garden & Landscape Insect Killer Ortho Bug-B-Gon Garden & Landscape Insect Killer Ready-to-Use Bonide Bug Beater Yard & Garden Insect Control Ready To Spray Bonide Bug Beater Yard & Garden Insect Control Ready To Use
imidacloprid	Bayer Advanced Garden Tree & Shrub Insect Control Bayer Advanced Garden All-in-One Potting Mix[4] Bayer Advanced Garden All-in-One Rose & Flower Potting Mix[4]
lambda-cyhalothrin	Spectracide Triazicide Soil & Turf Insect Killer Concentrates
malathion	Bonide Malathion Insect Control Concentrate Dragon 50% Malathion Insect Spray Concentrate Ortho Malathion Plus Insect Spray Concentrate Spectracide Malathion Insect Spray Concentrate
methoxychlor	Dragon Methoxychlor Insect Spray

COMMON NAME	TRADE NAME
Insecticides and Miticides (continued):	
permethrin[3]	Bonide Borer-Miner Killer Bonide Bug Beater Yard & Garden Insect Control Concentrate Bonide Bug Beater Yard & Garden Insect Control Dust Bonide Mite Beater Ortho Bug-B-Gon Garden & Landscape Insect Killer Ortho Bug-B-Gon Garden & Landscape Insect Killer Ready Spray Schultz Houseplant & Gardens Insect Spray
piperonyl butoxide	Bonide Japanese Beetle Killer
potassium salts of fatty acids (insecticidal soap)	Bonide Insecticidal Soap[1,2] Concern Insect Killing Soap Garden Safe Insecticidal Soap Safer Houseplant Insecticidal Soap[1,2] Safer Houseplant Insect Killer Safer Rose & Flower Insect Killer Safer Yard & Garden Insect Killer[1]
pyrethrins	Agway EZ Insect Control Yard & Garden Concern Multi-Purpose Insect Killer Concern Rose & Flower Insect Killer Garden Safe Rose & Flower Insect Spray Prescription Treatment 1600 X-clude Timed Release Pyrethrum Safer Houseplant Insect Killer Safer Yard & Garden Insect Killer[1,2] Schultz Houseplants & Gardens Insect Spray Schultz Expert Gardener Roses & Flowers Insect Spray Schultz Fruits & Vegetable Insect Spray Security Spider Mite & Mealybug Control
pyrethrins + piperonyl butoxide	Spectracide Bug Stop Insect Killer Schultz Expert Gardener Houseplants and Gardens Insect Spray Schultz Expert Gardener R-T-U Houseplants and Gardens Insect Spray Schultz Insect Killer for House & Garden Plants
resmethrin[3]	Bonide Houseplant Helper Insect Spray Bonide Whitefly and Mealybug Spray
rotenone	Agway Rotenone Dust Bonide Rotenone 1% Dust Bonide Rotenone Pyrethrin Concentrate
spinosad	Bulls-Eye Bioinsecticide (Gardens Alive)
Oils (Disease and/or Insect Management Products):	
canola oil	Concern Pesticidal Spray Oil (Woodstream, Corp.)
cottonseed oil	Bonide Mite-X
horticultural spray oil	Bonide Oil & Lime Sulfur Spray Concentrate
jojoba oil	Monterey E-Rase[1,2]
neem oil	Bonide Bon-Neem Insecticidal Soap[1,2] Bonide Rose Rx 3-in-1[1,2] Concern Garden Defense Multi-Purpose Spray[1,2]

COMMON NAME	TRADE NAME
Oils (continued):	
Neem oils (continued):	Garden Safe Fungicide 3[1,2] Green Light Rose Defense[1] Safer 3-in-1 Garden Spray Concentrate with Neem Oil Safer BioNEEM Insecticide and Repellent
neem oil + pyrethrin	Green Light Neem II[1] Green Light Rose Defense II[1]
paraffinic oil	Bonide All Seasons Horticultural and Dormant Spray Oil[1,2] Bonide All Seasons Horticultural Spray Oil[1] Ortho Volck Oil Spray Concentrate Summit Year-Round Spray Oil
Disease Management Products:	
Bacillus subtilis QST 7l3 strain	Serenade Garden Disease Control[1,2]
calcium polysulfide (lime sulfur)	Bonide Lime Sulfur Spray
calcium polysulfide + horticultural oil	Bonide Oil & Lime Sulfur Spray[2]
captan	Bonide Captan – 50%WP Fruit & Ornamental[6] Gordon's Liquid Fruit Tree Spray
chlorothalonil	Bonide Fung-onil Multi-Purpose Fungicide[1,2] GardenTech Daconil Fungicide[1,2] Monterey Fruit Tree, Vegetable & Ornamental Fungicide Ortho Garden Disease Control
copper ammonium complex	Lilly Miller Kop-R-Spray[2] (8% copper) Monterey Liqui-Cop Copper Fungicidal Garden Spray (8% copper)
copper octanoate (copper soap)	Concern Copper Soap Fungicide Gardens Alive! Soap-Shield
copper salts of fatty rosin acids	Bonide Liquid Copper Fungicide[2] (4% copper) Prescription Treatment Camelot (Whitmire Micro-Gen) (5% copper)
copper sulfate	Bonide Copper Spray or Dust[1] (7% copper)
copper sulfate pentahydrate	Phyton 27
fosetyl-Al (Aluminum tris)	Monterey Aliette
mancozeb	Bonide Mancozeb Flowable with Zinc[2]
myclobutanil	Spectracide Immunox Multi-Purpose Fungicide Spray Concentrate
PCNB	Terraclor 75W (Chemtura)
phosphite (mono- and di-potassium salts of phosphorous acid)	Monterey Agri-Fos Systemic Fungicide
propiconazole	Bonide Infuse Systemic Disease Control Gordon's Systemic Fungicide

COMMON NAME	TRADE NAME
Disease Management Products (continued):	
potassium bicarbonate	BioWorks MilStop Bonide Remedy Monterey Bi-Carb Old Fashioned Fungicide
streptomycin sulfate	Bonide Fire Blight Spray
sulfur	Bonide Sulfur Plant Fungicide Spray or Dust[1] Dragon Garden Sulphur Lilly Miller Multi-Purpose Fungicide[1] Safer Garden Fungicide[1,2]
tebuconazole	Bayer Advanced Disease Control for Roses, Flowers, & Shrubs
thiram	Bonide Bulb Saver[2]
thiophanate-methyl	Cleary 3336G Green Light Systemic Fungicide
triadimefon	Green Light Fung-Away Fungicide
Trichoderma harzianum Rifai strain KRL-AG2	RootShield Home and Garden (T-22 WP)
triforine	Ortho RosePride Rose & Shrub Disease Control[2]
Insecticide/Fungicide Combination Products:	
acephate + resmethrin + triforine	Ortho Orthenex Insect & Disease Control[3]
acephate + triforine + fenbutatin-oxide	Ortho Orthenex Garden Insect & Disease Control[2]
captan + malathion + carbaryl	Bonide Fruit Tree Spray[1,2] Bonide Rose Rx Insect & Disease Control Dust or Spray[1]
captan + carbaryl + methoxychlor	Bonide Rose Spray II Rose Rx
copper + rotenone	Bonide Garden Dust[1] (7% copper)
myclobutanil + permethrin	Schultz Fungicide Plus[2,3] Spectracide Immunox Plus Insect & Disease Control[2,3] Spectracide Immunox 3-in-1 Insect & Disease Control Plus Fertilizer[5]
sulfur + potassium salts of fatty acids	Safer 3-in-1 Garden Spray[1,2]

[1] Ready to use
[2] Concentrate
[3] Aerosol
[4] Pyrethroid
[5] Product contains fertilizer
[6] Wettable powder

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