



Houseplants

Proper Care and Management of Pest Problems

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Houseplant problems often arise when a new plant is brought into a home that previously was free of any problems. We Americans enjoy giving houseplants as gifts or we want to sustain one that was given to us by a beloved relative who recently passed on. Upon acquiring any new plants, whether it's one you purchased, a gift or one passed on from a relative, isolate that plant from others in the house for at least 30 days. During that time, inspect the plant carefully for insect or disease problems. If minor, take corrective action that is suggested in this publication and be sure the problem is under control or eliminated before placing it anywhere near your present healthy plant collection. If the problem is too far along, you really are better off discarding the plant.

Growing houseplants is a challenging and rewarding hobby that can be enjoyed by everyone and need not be difficult. Give plants what they need and they'll do well for you. Give them just about what they need and they hold their own. Deny too many of their needs and plants fail.

Take time to learn the cultural needs of a particular plant when you purchase it and keep a watchful eye out for possible disease and insect problems. If a plant has poor color or distorted leaves or flowers, or if the plant tends to droop, something is wrong. These distress signals tell you the plant is having problems and you need to take corrective steps.

The leading causes of houseplant failure are overwatering and/or too little light for the species. Check these conditions first before suspecting anything else.

Cultural Considerations

Soil

Plant roots must have air, nutrients and water. Potting soil must be porous enough to allow drainage of excess water and admit the oxygen (soil aeration) the roots need.

Garden soil may appear ideal for potting indoor plants, but it actually causes problems. This soil may be wonderful for outdoor gardening under natural conditions, but after a few months, garden soil becomes hard and almost rocklike in a plant pot. Plants in garden soil grow satisfactorily for a month or two, but soon the lower leaves turn yellow and the plants become weak. This problem is the result of poor drainage and the lack of soil aeration due to improper soil structure. Most garden soils become compacted with time and houseplants grow poorly in firm soil.

A proper soil mixture is of utmost importance to a houseplant because the roots are restricted by the pot. A good potting soil should have the capacity to retain some air and moisture and yet drain well and hold nutrients. Sand or perlite added to the soil will improve aeration and drainage. Clay or organic matter will help retain water. Organic matter plus commercial fertilizers will maintain adequate nutrient levels. Some "soiless" potting media do contain soil, so the addition of fertilizer may be required to provide all essential plant nutrients.

For general use, a good soil mix includes approximately equal parts of good garden loam, organic matter (preferably peat moss, although well-rotted manure or leaf mold will do) and sharp sand or perlite (Figure 1). When sandy soil is used in the mixture, reduce the amount of sand or perlite.

Always use pasteurized soil when repotting at home. This can be purchased at a local store or soil can be pasteurized at home.

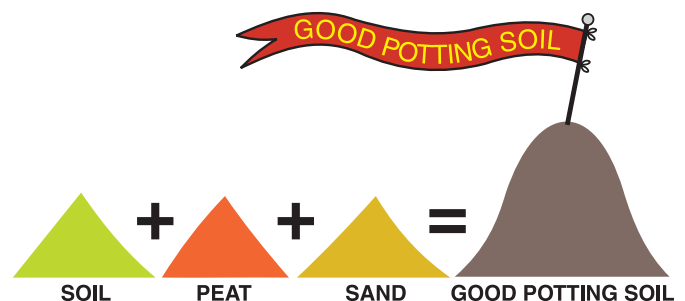


Figure 1

Methods for Pasteurizing Small Amounts of Soil With Heat

Conventional Oven

Place moist soil in a deep baking pan or roaster (aluminum, glass or iron). The soil should be level and not more than 4 inches deep. Bury a small potato (1½ inches in diameter) in the center. Then tightly cover the container with aluminum foil. Punch a small hole in the center of the soil but away from the potato and insert the bulb end of a meat or candy thermometer into the soil. Place the container in an oven on low heat (180 to 200 degrees Fahrenheit). Keep the soil in the oven for 30 minutes after the soil temperature has reached 180 F. Remove and cool the soil. The potato should be well-cooked, indicating sufficient heat penetration throughout the soil. Do not overcook the soil.

Microwave Oven

Place approximately 2 pounds of moist soil in a polypropylene bag. Leave the top open and place the bag in the center of a microwave oven. Heat it for 2½ minutes on full power - about 650 watts. After the heating is completed, close the top of the bag and allow the soil to cool before removing it.

Potting

Always use thoroughly cleaned potting containers with proper drainage holes. Before reusing any pots, they should be scrubbed clean and thoroughly rinsed in a solution of one part household bleach to nine parts water to kill disease organisms present.

Cover the drainage holes in the pot with pieces of broken clay pots or coarse gravel. Next add enough potting soil to bring the soil level of the finished planting to about ½ inch below the rim of the pot. This top space serves as a reservoir for watering.



Repotting

Symptoms of plants needing repotting include the following: wilting within a day or two after watering, very little or no new growth and a general lack of vigor, foliar discoloration, and water flushing out of the bottom of the pot as it is being watered. To confirm whether it needs repotting, hold the plant and soil ball with one hand, invert it and lightly tap the edge of the pot on a hard surface such as a table or countertop. If the soil mass is completely surrounded by a mass of roots, the plant needs to be repotted.

To begin the process of repotting, be sure the plant is watered thoroughly a day or two ahead of time and water again just before removing it from the pot. If the plant can be picked up, knock the pot against a table edge or other hard surface.

If the plant is too large to pick up, a couple of tactics have proven successful. Tip the pot and knock the high side with a rubber mallet or the heel of your hand. Roll the pot and repeat this process at least three more times in a different area of the pot. This should help loosen and break the adhesive character of the side of the pot. Then carefully grab the base of the plant and pull it loose.

On very large plants such as palms and fig trees, sit on the floor in front of the plant and place a foot on opposite sides of the pot, then tug the plant out. Another tactic if this doesn't seem to work (never damage the plant in trying to extract it from the container) is to strike or break the bottom of the container and push the plant out from the bottom. As you may have guessed, this could be a two-person job.

Now you need to make a choice: cut the roots or slice off four slabs of root mass. Slicing 1-inch-thick slabs with a sharp knife from the sides of the root mass is easier, so the result is a cube that easily can slip back into the same pot or, if desired, a slightly larger one. Using fresh, sterile or pasteurized potting soil and a piece of broken crockery, first cover the drain hole(s) with the crockery, then cover the bottom of the pot with about 1 inch of the soil. Adjust the thickness so that the plant will be at the same depth it grew in its previous container. Fill in the space between the edge of the roots and the sides of the container with potting soil, using fingers, a slender trowel or even a knife to get the soil in place.

Watering

Close observation and good judgment are essential for proper houseplant watering. Growing conditions vary from home to home and room to room due to variations in light, temperature (day and night) and humidity. Plants with roots in shallow containers may need daily watering, while plants in large tubs may go several weeks between waterings. Succulents such as aloe, jade plants and other dry-soil plants require less watering than moist-soil plants such as African violets and ferns.

Proper watering keeps the soil moist enough to supply the plants' needs without drowning the roots. Saturated soil drives out air, and roots can die from lack of oxygen. Proper pot drainage is critical. All the soil in a pot should be wetted thoroughly each time the plant is watered. Always empty the drainage water from the catch basin beneath your plant container after each watering. This will reduce the possibility of water-logged soil and prevent the dissolved salts in the water from being drawn back into the soil. Soil should dry to the point that the plant approaches moisture stress between watering intervals.

Do not use water that is unusually high in salts or has been run through a water softener to water plants. Rain or melted snow are good alternate sources of water for houseplants. Some plants are sensitive to the chlorine in city water systems. Letting a container of tap water sit overnight before use will allow most of the gas to escape.

Feeding

Many brands of fertilizers are designed for houseplants. Follow the manufacturer's directions and do not assume that twice the recommended amount is better than the recommended amount; overfeeding may damage your plants.

Plant injury can be reduced by leaching or rinsing out part of the dissolved fertilizer with clear water if overfertilization occurs. Use a container with holes in the bottom to allow thorough drainage. Place the pot in a sink and water liberally three to four times at half-hour intervals, allowing the water to flush out the dissolved fertilizer and other accumulated salts.

A white, flaky material on the soil surface of potted plants often is observed one to several months after potting. These are mineral salts that accumulate in the soil. Well water in North Dakota contains varying amounts of dissolved salts, as does the fertilizer you apply. With continuous watering, these dissolved salts accumulate in the soil and appear on the soil surface. The salts can be flushed out of the soil from time to time to prevent salt injury to your plants. Leaching (rinsing) the soil of most houseplants every three to six months is a good cultural practice and will reduce the accumulation of salts in the soil. Clay pots that have accumulated salts should be soaked in hot water for 24 hours before reuse.

Fertilizer will not cure all ills. It will not help a plant that is suffering from poor drainage, insect infestation, disease or overwatering. Fertilize only when new growth is evident.

Interstate Transportation of Plants

If plants are to be transported across state lines, determine the regulations of the states en route to avoid possible transportation of harmful plant pests to areas not previously infested. For more information on interstate transportation of plants, contact the North Dakota Department of Agriculture, 600 E. Boulevard Ave., Dept. 602, Bismarck, ND 58505-0020; Toll-free: (800) 242-7535; E-mail: ndda@nd.gov; Web site: www.agdepartment.com.



Houseplant Trouble Signs

Wilting or partial wilting often will be the result of improper watering. If sudden wilting is diagnosed, check the roots, pot or soil for the trouble. Some common causes are a lack of water, excess water, root rot, too much fertilizer and/or a salt buildup. Check the cause by pressing your finger, up to the first knuckle, into the soil. If the soil is dry to this depth, the plant needs water. If the soil is wet, too much water in the root area may be the problem. The roots may be saturated or rotting and incapable of absorbing water from the soil and supplying it to the leaves. Overwatered plants should be repotted into fresh soil. (Refer to the section on yellowing and death of all leaves and poor growth for more information on root rot.)

Sudden loss of leaves is frequently caused by a rapid temperature change. It also may be caused by such factors as prolonged hot or cold drafts, dry air, exposure to gas or furnace fumes or by changing the plant from a sunny to a dark location. *Ficus benjamina*, commonly called weeping fig, frequently has sudden leaf drop when moved to a location with lower light intensity.

Yellowing or death of leaves may indicate a nutrient deficiency, usually nitrogen or iron. First apply a nitrogen fertilizer. If the foliage does not appear greener after three to four days, do not add additional nitrogen. Instead apply a chelated iron product. Iron is essential to healthy, green leaves and may be present in the soil but in a form that the plant cannot use. Chelated iron is in a form that is readily available to the plant roots.

The yellowing and death of lower leaves may occur if plants become pot bound because of extensive root development. Rubber plant, *Dracena*, *Diffenbachia* and other woody plants are especially prone to this problem. When the lower leaves first start to yellow, apply extra nitrogen fertilizer or consider repotting. Occasional lower leaf drop may be normal. The length of time a plant will hold its leaves varies from species to species.

Yellowing of all leaves and poor growth may be due to excessive soil moisture and/or root rot. If the drainage hole in the pot or plant box is plugged or if the plants constantly stand in water, the soil will be waterlogged and lack sufficient oxygen.

If a root rot problem is suspected, remove the rootball and check the roots. Healthy roots and root tips will be white or cream-colored. Rotted roots are brown-black and may appear slimy. Severely rotted roots may be

hollow and easily broken between the thumb and index fingers.

Destruction of the roots by soil-borne fungi and nematodes may cause a yellowing of the entire plant. Severe infestations of mites, aphids and scale insects, fertilizer burn, improper light and temperature, or improper pH all may cause plant yellowing. Soil pH refers to the acidity or alkalinity of a soil measured on a scale of one to 14, with seven being neutral. Anything below seven is acidic and anything above seven is alkaline.

Some plants such as the Norfolk Island pine and Boston fern require an acidic soil medium. This can be achieved by using a potting mixture high in peat and an acidic fertilizer. Acidic fertilizers help reduce the pH of the soil. Most North Dakota well and river water is alkaline, so regular use of an acidifying fertilizer would be advantageous to plant growth.

Finely specked leaves with a faint mottled, lighter color indicate a spider mite infestation. When the mites are plentiful, the upper and sometimes the lower surfaces of the leaves may appear dusty due to their webbing. To check plants for spider mites, shake several suspect leaves or branches over a sheet of white paper. Look closely at the specks that have fallen on the paper. If they are moving, they are spider mites. More information on mites and their control is given in the chart on pages 9 and 12.

Bronzed or abnormally reddened leaves indicate cold temperature damage or a deficiency of phosphorus or potassium. Check the recommended temperature range for the plant. If a nutrient deficiency is suspected, fertilize with a complete fertilizer or repot in new soil.

Unnaturally small, pale leaves and spindly plants are most generally the result of insufficient light. This is especially common during the winter or when outdoor or greenhouse-grown plants are brought into the home. Small leaves also might indicate a need for fertilizer.



Brown leaf tips and margins can be caused by exposure to hot dry air, improper watering, insect feeding, salt accumulations (Figure 2), or objects rubbing against the leaves. Water that is chlorinated or contains added or natural amounts of fluoride can harm sensitive plants. Perlite (the white material in many potting mixes) and fertilizer products containing fluoride may release enough fluoride to harm sensitive plants. Spider plants, especially the variegated variety, are very sensitive to fluoride and often are seen with leaf-tip burn. Occasionally flushing the soil should help reduce a fluoride salt buildup.

Bleached or faded spots on leaves sometimes are caused by direct sunlight burning plants that require shade or are not yet accustomed to extended periods of direct sunlight. Chemicals and plant-cleaning products also can injure leaves.



Figure 2. Soluble salt injury on fern.

Courtesy of R.W. Stack

Other leaf spots, varying in appearance, may be caused by aerosol products, hot grease in the kitchen area, cold water (especially on African violets and gloxinias) or the sun shining on wet leaves. In rare cases, a pathogen may be involved. For more information on plant pathogens, see the table on pages 14-15.

Plant distortion (leaf thickening, curling, leaf and flower drop) accompanied by leaf yellowing and browning may be due to gas fumes or pesticides that are toxic to the plant. Plants are very sensitive to gases and will show symptoms before the gas concentration is at a level detectable to humans. Garden soil that is contaminated with agricultural chemicals and used for potting houseplants can result in chemical injury to houseplants.

White substances on the soil surface may indicate two things. If crusty or crystalline, it's probably an accumulation of salts. The crusty surface layer of soil can be removed and replaced with fresh soil between repottings. Refer to the previous section on "Feeding" for more information.

A white or light yellow moldlike growth may indicate the presence of a saprophytic soil fungus, a fungus that lives on dead or decaying matter. The fungus will not harm the plant but may indicate contaminated potting medium or an overwatered plant.

Light brown corky scablike lesions, usually occurring on the underside of leaves and along stems, are the result of excess water (Figure 3). This condition is known as oedema. Careful watering and good drainage will minimize this problem.







Figure 3. Oedema on geranium leaf.

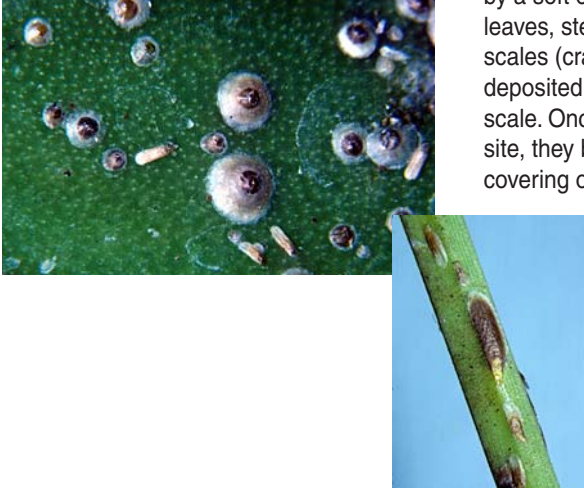


Courtesy of H.A. Lamey

Common Insects and Arthropod Pests of Houseplants



Here are some of the most common insect and arthropod pests of houseplants, their damage/symptoms and pest management strategies. See also Table 1 for specific insecticides available to homeowners and pests controlled.

Insect/ Arthropod Pest	Pest Description and Damage	Pest Management Strategy
<p>Aphids Order Hemiptera</p> 	<p>Aphids commonly are called “plant lice” and are minute (1/8 inch), soft-bodied insects with a pear-shaped body, long antennae and two short cornicles (tubes) at the posterior end of the body. Most species are green; however, some are brown, reddish or black. Adults may be winged or wingless. Aphids cluster on the undersides of leaves, buds and other tender plant parts. Damage is caused by piercing-sucking mouthparts. Aphids feed on plant sap and may transmit plant viruses in the process of feeding. Injury symptoms include reduced plant vigor, curled and distorted leaves and flowers. Aphids secrete honeydew (sugary waste product), which facilitates the growth of black sooty mold.</p>	<p>Dip or spray plant with insecticides. Also may use systemic insecticides applied as a granular or liquid to soil. Washing with warm, soapy water can help reduce pest infestations of aphids. For soapy water, use 1 to 2 teaspoons of a mild dishwashing liquid soap per gallon of water. Do not use laundry detergent or automatic dishwashing detergent.</p>
<p>Fungus gnats Order Diptera</p> 	<p>Adults (1/8 inch) often are seen running over the soil or flying around the pots, especially after watering. Adults do not cause damage but can be a nuisance. Adults are attracted to light and swarm around windows. Larvae (maggots) are white with a shiny, black-headed capsule and feed on organic matter. Under certain conditions, some species feed on root hairs or roots of seedlings, causing reduced plant growth and vigor.</p>	<p>Use a foliar spray for adults. Soil should be drenched with an insecticide for larval control.</p>
<p>Mealybugs Order Hemiptera</p>  	<p>Soft-bodied, scalelike insects (3/16 inch) covered by a white, cottony wax layer and with long, waxy filaments extending from the posterior end of the body. Damage is caused by sucking plant sap and injecting toxins into the plant, which causes yellowing, stunting and eventually plant death. Like aphids, mealybugs secrete honeydew on which sooty mold may develop.</p>	<p>Dip or spray plants. To ensure wetting of mealybugs, add mild household detergent at a rate of ½ teaspoon per gallon of water with solution. Also may use systemic insecticides applied as a granular or liquid to soil. Washing with warm, soapy water can help reduce pest infestations of mealybugs. For soapy water, use 1 to 2 teaspoons of a mild dishwashing liquid soap per gallon of water. Do not use laundry detergent or automatic dishwashing detergent.</p>

Common insects and arthropod pests of houseplants (continued)

Insect/ Arthropod Pest	Pest Description and Damage	Pest Management Strategy
<p>Scale insects Order Hemiptera</p> 	<p>Adult scale insects are 1/8 to 1/3 inch long black, gray, white or brown; and protected by a soft or armored covering. Scales are on leaves, stems, leaf axils or roots. Immature scales (crawlers) emerge from eggs deposited under the female's protective scale. Once crawlers establish a feeding site, they begin to secrete the protective covering over their body. Scale damage is caused by sucking plant sap, which greatly reduces growth and vigor and even causes leaf drop as populations build. Scale insects secrete honeydew on which black sooty mold may develop.</p>	<p>Similar control as for mealybugs. Dip or spray plants; repeat applications at two- to three-week interval as necessary. Target dip or spray control measures at the crawler stage before protective covering is formed. Also may use systemic insecticides applied as a granular or liquid to soil. Washing with warm, soapy water can help reduce pest infestations of scale insects. For soapy water, use 1 to 2 teaspoons of a mild dishwashing liquid soap per gallon of water. Do not use laundry detergent or automatic dishwashing detergent.</p>
<p>Springtails Order Collembola</p> 	<p>Very minute (1/16 to 3/16 inch), generally whitish, elongated or globular body shape and wingless. Springtails can jump with the aid of a forked furcula (tail-like structure) when disturbed. Most often seen after watering because this forces them to the surface. Attracted to moist high-organic soils and feed mainly on decaying organic matter. Some species may feed on the root system, causing wilting.</p>	<p>Drench soil with insecticide. On sensitive plants, water soil to bring insects to surface and then use a foliar spray to kill insects.</p>
<p>Thrips Order Thysanoptera</p> 	<p>Adults are very small (1/16 to 1/8 inch in length), cream to dark brown insects with narrow, long-fringed wings. Immature forms are wingless. If disturbed, adults fly readily and jump. Thrips feed on plant sap and also are known to vector plant viruses. Feeding damage results in the leaf surfaces becoming whitened or silvery and speckled. Leaf tips wither, curl up and die. Buds will fail to open normally.</p>	<p>Similar control as for aphids. Dip or spray plant with insecticides. Also may use systemic insecticides applied as a granular or liquid to soil. Washing with warm, soapy water can help reduce pest infestations of thrips. For soapy water, use 1 to 2 teaspoons of a mild dishwashing liquid soap per gallon of water. Do not use laundry detergent or automatic dishwashing detergent. Several Phytoseiid mites are known predators of thrips and commercially available.</p>

Common insects and arthropod pests of houseplants (continued)

Insect/ Arthropod Pest	Pest Description and Damage	Pest Management Strategy
<p data-bbox="126 275 300 338">Whiteflies Order Hemiptera</p> 	<p data-bbox="602 275 1036 705">Adults (1/16 inch) are snow-white with four wedge-shaped wings that are held rooflike over their body at rest. Whiteflies resemble small moths and swarm plants when disturbed. Nymphs (immature) are difficult to see and are pale green, flat and oval-shaped. Both adults and nymphs cause damage by sucking sap from the foliage and vectoring plant viruses. Infested plants are stunted and leaves turn yellow and may drop off. Whiteflies secrete honeydew on which sooty mold may develop.</p>	<p data-bbox="1073 275 1502 674">Similar control as for aphids. Dip or spray plant with insecticides. Also may use systemic insecticides applied as a granular or liquid to soil. Washing with warm, soapy water can help reduce pest infestations of whiteflies. For soapy water, use 1 to 2 teaspoons of a mild dishwashing liquid soap per gallon of water. Do not use laundry detergent or automatic dishwashing detergent. Several Phytoseiid mites are known predators of whiteflies and commercially available.</p>
<p data-bbox="126 856 267 919">Spider mites Order Acari</p> 	<p data-bbox="602 856 1045 1409">Very minute spider-like mites that barely can be seen with the naked eye. A common pest is the two-spotted spider mite, which can be recognized by two dark spots on the back. Warm and dry environmental conditions favor spider mite outbreaks. One of the injury symptoms of spider mite infestation is silky webbing on the underside of a leaf. Adult and nymph spider mites remove plant sap within plant cells, usually on the undersides of leaves. Feeding injury shows up first as pale, yellowish blotches on leaves which causes foliage to have a speckled appearance. Heavy infestations will cause leaf distortion, wilting, stunting of plants and even leaf drop.</p>	<p data-bbox="1073 856 1502 1255">Similar control as for aphids. Dip or spray plant with insecticides. Also may use systemic insecticides applied as a granular or liquid to soil. Washing with warm, soapy water can help reduce pest infestations of mites. For soapy water, use 1 to 2 teaspoons of a mild dishwashing liquid soap per gallon of water. Do not use laundry detergent or automatic dishwashing detergent. Several Phytoseiid mites are known predators of spider mites and commercially available.</p>
<p data-bbox="126 1514 300 1577">Cyclamen mites Order Acari</p>	<p data-bbox="602 1514 1045 1967">Cyclamen mites are primary pests of cyclamen, but also damage other plants such as African violets and ivy. Adult mites are too small to be seen with the naked eye. Adults are amber or tan and semitransparent, while the immature stages are white. Cyclamen mites are found mostly in protected places on young, tender leaves, buds or flowers. Damage, caused by removal of plant sap, causes leaves to become twisted, curled and brittle. Buds may become deformed, fail to open and have a streaked and blotchy appearance. Blackening of injured leaves, buds and flowers is common.</p>	<p data-bbox="1073 1514 1502 1864">Trim off badly injured leaves, stems and buds where practical. Lightly infested houseplants can be immersed pot and all for 15 minutes in water at 110 F. Similar control as for spider mites. Dip or spray plant with insecticides. Also may use systemic insecticides applied as a granular or liquid to soil, or soapy water. Several Phytoseiid mites are known predators of Cyclamen mites and commercially available.</p>

Pest Management Strategies for Control of Insect and Arthropod Pests of Houseplants

Early detection is important for proper pest management of insect and arthropod pest problems in houseplants. If an insect is detected before it has an opportunity to build or spread, pest management strategies generally can be applied in a timely and satisfactory manner.

Cultural Practices

Cultural practices often are effective in managing insect and arthropod pest problems in houseplants, especially when infestation levels are light or moderate. Some common cultural practices that are easy for the homeowner to use are:

Exclusion – New plants should be inspected closely for pests before purchase. Buy only pest-free plants. Any infested plant should be separated immediately from other plants. Keeping new plants isolated for three to four weeks is a good idea to prevent the spread of pests and allow time for eggs to develop if present at the time of purchase. Houseplants that are taken outside during warm weather can become infested with insects and should be examined closely before being brought back into the home in the fall. If a plant is heavily infested and damaged, simply disposing of it may be best.

Sanitation – Potting soil should be pasteurized to prevent soil-borne diseases and insect pests. Always use clean pots and potting materials. See section on soil pasteurization.

Avoid overwatering – Allowing the soil to dry can reduce infestation by fungus gnats and springtails that require moist soil condition to survive. Overwatering also can increase the incidence of fungal diseases that cause root rots. Proper pot drainage is important in preventing wet soil environment.

Mechanical Control

Mechanical control is feasible when few plants have low pest infestation levels. However, mechanical methods are time consuming for the homeowner and require a continued effort during a period of time.

Washing and spraying – Washing with warm, soapy water can help reduce pest infestations of aphids, mealybugs, scale insects, mites, thrips and whiteflies. For soapy water, use 1 to 2 teaspoons of a mild dishwashing liquid soap per gallon of water. Do not use laundry detergent or automatic dishwashing detergent. Routinely wash plants twice per year or every seven to 14 days during a heavy pest infestation. Spraying plants with a forceful stream of water also can be effective in removing and drowning insects, such as aphids, mealybugs, crawlers (scale insects) and spider mites. Focusing the stream of water on the undersides of leaves where most insect pests are found is important. This tactic may not be 100 percent effective in killing pests and some may crawl back onto plants.

Wiping – Washing or cleaning foliage and stems with a moist cotton ball or soft cloth with soapy water or an alcohol solution (one-half water and one-half rubbing alcohol) will remove most pests. The alcohol solution may burn sensitive plants, so try this on a small area of the plant first. This is an easy way to control a light infestation of aphids, mealybugs, crawlers (scale insects) and mites. This method should be repeated several times.

Hand Removal – If the pest infestation is light, insects such as aphids, mealybugs and scale insects may be controlled by removing them with a toothpick or tweezers. Hand removal generally is not effective against very small insects and mites. This method should be repeated several times.

Plant trimming – If the pest infestation is severe, the injured parts of the plants can be removed to permit



regrowth and recovery. This method works best when followed by repeated washing or chemical control.

Plant disposal – If the pest infestation is severe, the plant is heavily infested, disposing of it may be the best solution.

Chemical Control

Chemical control is used as the last resort for pest management. Pest identification is important when selecting a pesticide because some products are effective in controlling only certain pests. Using the wrong chemical is ineffective and a waste of time and money. Some pesticides are labeled for control of household insect pests, such as cockroaches and ants; however, these products may contain oils or other ingredients that can be phytotoxic (burn foliage) when applied to houseplants. Use products that are labeled for application on houseplants.

All insecticides are poisons and should be handled with care. Always read and follow the manufacturer's directions before using the product and always use the labeled rates. Treating plants outside or away from people, pets, fish, birds and other animals always is a good idea. Wear personal protective clothing, such as rubber gloves, dust mask, long-sleeved shirt, pants and shoes, to prevent pesticide poisoning. Keep pesticides in a separate storage area that is locked and labeled "Pesticides" and keep safe from children. After spraying, thoroughly wash yourself and triple rinse all spray equipment.

Insecticides are available in concentrated or ready-to-use spray formulations (aerosol, hand misters, hand atomizers). When spraying plants, covering all plant parts thoroughly is important, especially where insect pests are concentrated, such as the undersides of leaves or leaf axils.

To dip plants, make sure your container is large enough for the insecticide-water mixture and the whole plant to be submerged for a few seconds. Use a cardboard disk to fit around the plant stem to prevent the soil and plant from spilling when you turn the plant over. After dipping, hold the plant over the container to allow any excess pesticide mixture to drip off of the foliage.

Do not dispose of excess insecticide mixture in the sink or other drains that empty into the sewage system. It is best to dispose excess mixture on ground where runoff or other contamination is unlikely.

Dusting plants is effective in controlling common insect and arthropod pests but dust is not used commonly on houseplants because it is messy and difficult to apply efficiently. A thin visible coating of dust is all that is necessary to kill pests. Do not apply a heavy coat of dust on the foliage. If possible, dust plants outside.

Many trade names (or brand names) of insecticides are available for the homeowner. Brand or trade names, such as Ortho Rose & Flower Insect Killer, do not identify the insecticide in the container. The active ingredient that is listed on the label identifies the specific insecticide. In Table 1, some common insecticides that are available to homeowners for control of common insect and arthropod pests of houseplants are listed.



Table 1. Some insecticides available to homeowners for control of insect and arthropod pests of houseplants

Active Ingredient Insecticide Class	Trade Name(s)	Aphids	Fungus gnats	Mealybugs	Scale insects	Springtails	Thrips	Whiteflies	Spider mites	Cyclamen mites
Azadirachta indica Botanical insecticide from neem tree grown in India	Dyna-Gro Neem Oil, Bon Neem Insecticidal Soap (Neem often is combined with insecticidal soap to enhance its efficacy.)	X		X	X		X	X		
Bacillus thuringiensis subspecies <i>israelensis</i> Microbial insecticide	Gnatrol		X							
Bifenthrin Pyrethroid	Ortho Rose & Flower Insect Killer	X	X	X	X			X	X	X
Capsaicin Insect repellent Botanical insecticide	Bonide Hot Pepper Wax Concentrate	X					X		X	
Horticultural oil Petroleum or paraffin based oil	Bonide All Season Horticultural & Dormant Spray Oil, Sunspray Ultrafine Horticultural Oil	X		X	X			X	X	
Imidacloprid Neonicotinoid	Bayer Advanced Garden 2-in-1 Insect Control Plus Fertilizer Plant Spikes, All-In-One Rose & Flower Care Concentrate	X		X	X		X	X		
Imidacloprid Neonicotinoid	Bayer Advanced Garden 3-in-1 Disease & Mite Control Ready-to-Use /Concentrate	X	X	X	X		X	X	X	X
Imidacloprid and beta-cyfluthrin Neonicotinoid and pyrethroid	Bayer Advanced Dual-Action Rose & Flower Insect Killer Ready-to-Use	X	X	X	X		X	X		
Insecticidal soap Made of potassium salts of fatty acids	Concern Insecticidal Soap, Safer's Houseplant Insecticidal Soap, Schultz Garden Safe Insecticidal Soap	X	X	X	X	X	X	X	X	X
Malathion** Organophosphate	Malathion	X		X	X	X			X	
Permethrin Pyrethroid	Bonide Eight Garden & Home Insect Control, Spectracide Bug Stop Multipurpose Insect Control Concentrate	X	X	X	X		X	X	X	
Pyrethrin Made of extracts of chrysanthemum flowers	Schultz Expert Gardener Houseplant & Garden Insect Spray, Schultz Garden Safe Houseplant & Garden Insect Spray, Spectracide Houseplant & Garden Insect Spray	X		X	X		X	X	X	X

Note: Mention of any trade names does not imply endorsement of one product over another nor discrimination against any product by the North Dakota State University Extension Service or the authors.

**Potentially sensitive plants: Boston, Maidenhair and Pteris ferns, Crassula, Gloxinia, Saintpaulia (African violets), Begonias, Dieffenbachia (dumb cane), Schefflera



Diseases of Houseplants

Houseplants rarely suffer from infectious plant diseases because the indoor environment is typically too dry for plant diseases to develop. Cultural, environmental or insect problems are more common than disease problems in houseplants, and some symptoms that are caused by disease are similar to those caused by noninfectious disorders or insect injury. Disease problems can be prevented or minimized by purchasing healthy, vigorous, disease-free plants; using pasteurized potting soil or media when repotting; using clean pots sanitized in a 10 percent bleach solution; and avoiding overwatering.

Diseases of indoor houseplants are caused by plant pathogens, which are microscopic living organisms such as fungi, bacteria, nematodes and viruses. Plant pathogens can cause disease on indoor plants only if three conditions are met: 1) if the plant pathogen is present, 2) if the plant is susceptible to infection by a particular plant pathogen and 3) if the environment is favorable for disease development. Since indoor environments are typically too dry, diseases on houseplants rarely develop.

Root and Crown Rot Diseases

Symptoms of root rot or crown rot diseases are usually noticeable first on the foliage. Wilting of foliage, typically followed by yellowing or browning of the leaves, may indicate that a root or crown rot disease is present. These diseases are caused by various fungi, including

species of *Fusarium*, *Rhizoctonia*, *Phytophthora*, *Verticillium*, *Sclerotium* and *Pythium*.

Overwatering can lead to the development of root rot diseases, which can be worsened by heavy potting soils or poorly draining pots. Since several factors can cause wilting in houseplants, examine roots by carefully removing the plant from the pot while keeping the plant, roots and soil intact as much as possible. Healthy roots appear white to cream colored and are vigorous, while roots suffering from a root rot disease are typically discolored brown to dark brown. Many root rot diseases cause the roots or crown to become water-soaked, brown and mushy, and the outer sheath of the root may slip off the central root cortex easily in severe cases.

If the entire root system is brown and mushy, the plant cannot be saved, but propagating a new plant from cuttings may be possible for some species of houseplants (see publication H-1257, "Home Propagation Techniques"). If some of the roots are still white and vigorous, the plant possibly may be saved if the brown roots are cut out with a sharp, clean knife. The plant should be repotted in a new pot with clean, pasteurized potting medium.

Foliar Diseases

Diseases of the leaves of houseplants are rarer than root rots. However, if the foliage of an indoor plant is subjected to high humidity or frequent misting, disease problems on the foliage can occur. Symptoms of common foliar diseases can include leaf spots, lesions, blights or dieback, with or without water-soaking, yellowing, browning or defoliation of leaves. If detected early and diagnosed correctly, cultural practices of removing and destroying infected material often can lead to satisfactory management of the disease. Fungicides are available for some foliar diseases.

Leaf spots and lesions on indoor plants more often are caused by environmental factors, insect or arthropod injury, phytotoxic aerosols or other factors. They rarely are caused by pathogens in the indoor home environment. Table 2 summarizes a few foliar diseases that may be encountered in houseplants, along with their causes, symptoms, plants affected and corresponding management strategies.



Table 2. Common foliar diseases of houseplants and management strategies

Disease	Pathogen	Symptoms and Plants Affected	Management Strategies
Anthraxnose, Colletotrichum leaf spot	Fungi; species of <i>Colletotrichum</i>	<p>Symptoms of anthracnose vary from one host to another. On some hosts, circular lesions are tan to dark brown, sometimes in the shape of a bull's-eye; these lesions can coalesce to form larger areas of dead tissue on some hosts; on other hosts, lesions are angular and restricted to areas between leaf veins. Under wet conditions, a pinkish ooze might be visible in the lesions.</p> <p>Nearly all foliage plants are susceptible to infection by a fungus that causes an anthracnose disease</p>	Remove and discard diseased leaves. Reduce frequency of misting of leaves. Do not mist leaves when symptoms are present. Increase ventilation around plants. Chlorothalonil is reportedly an effective fungicide that can protect leaves from infection by anthracnose-causing fungi.
Other leaf spots: <ul style="list-style-type: none"> - Alternaria leaf spot - Cercospora - Fusarium - Ascochyta blight - Bipolaris leaf spot - many others 	Various fungi	Lesions vary by pathogen and host.	Remove and discard diseased leaves. Reduce frequency of misting of leaves. Do not mist leaves when symptoms are present. Increase ventilation around plants. Fungicides are available.
Powdery Mildew	<i>Oidium</i> species	White to grayish dusty growth that initially can rub off leaf surfaces is visible. Stems and buds also can be affected. Severe infections can cause shoot deformation. Indoor plants affected by this genus are primarily African violet and grape ivy.	Remove and discard diseased leaves in an enclosed plastic bag to minimize spread of the pathogen. Reduce frequency of misting of leaves. Do not mist leaves when symptoms are present. Increase ventilation and reduce relative humidity around plants. Fungicides are available.
Grey Mold, Botrytis Blight	Fungus, <i>Botrytis cinerea</i>	<p>Lesions are initially small and water-soaked, and they expand to cover large areas that later darken from light brown to nearly black. Under high humidity, characteristic fuzzy grayish-tan dusty growth of the fungus becomes apparent on the dead and dying plant tissue.</p> <p>Plants affected include Lipstick vine, grape ivy, Dracaena, ferns, English ivy, <i>Peperomia</i> species, African violet, many other foliage and flowering plants</p>	Since this disease develops only under high-moisture conditions, it typically is not observed in most indoor home environments. Prevention includes keeping foliage dry. Under favorable environmental conditions, fungicides are available to protect foliage from infection. Infected foliage should be removed and discarded immediately in an enclosed plastic bag to minimize the spread of the pathogen.





Table 2. Common foliar diseases of houseplants and management strategies (continued)

Disease	Pathogen	Symptoms and Plants Affected	Management Strategies
Bacterial Leaf Spots	Bacteria, such as <i>Erwinia carotovora</i> and <i>Xanthomonas campestris</i>	Symptoms vary by pathogen and host. Pin-point, water-soaked, irregularly shaped angular lesions that may or may not have a yellow margin can expand into larger blotches of rotting tissue.	Remove and discard diseased material. If infection is systemic, plant should be discarded. Keep foliage dry and avoid causing wounds. No chemical treatments are available for bacterial diseases of houseplants. Streptomycin usually does not offer satisfactory control for most bacterial diseases on houseplants, and phytotoxicity, when using streptomycin sulfate at 200 parts per million, has been reported on some hosts.
Nematode diseases of roots	Microscopic plant parasitic nematodes	Stunted, unthrifty appearance of foliage; wilting; discoloration resembling nutrient deficiency	Examine roots for small lesions or galls. Discard infected material. For some plant hosts, new plants free from root-infecting nematodes can be started from cuttings.
Virus diseases	Few viruses are serious problems in an indoor plant, if present, they are incurable and sometimes fatal	Symptoms are variable, depending on the virus, and they include ringspot, mosaic, stunting, leaf crinkling and color breaking. These diseases are rare on indoor houseplants. Some viruses, such as Tobacco Mosaic Virus (TMV), can be mechanically transmitted by contaminated hands and tools. Other viruses require an insect or arthropod vector to spread from one plant to another.	Purchase disease-free plant material. Virus diseases in plants cannot be cured, but they seldom cause serious harm on houseplants. To prevent potential spread, consider discarding symptomatic plants or quarantining them to see if the plant recovers. To prevent mechanical spread of certain viruses, wash hands and tools frequently and refrain from smoking when handling plants. Manage insect and arthropod pests.

Using Fungicides to Manage Plant Diseases Caused by Fungi

Several effective fungicides are available for managing diseases on indoor plants, but they differ in how they are used, where they can be used, on what plants they can be used safely and for which diseases they control. Most often, the cost of purchasing a fungicide is greater than replacing the plant itself. If choosing a fungicide, be sure it is labeled for the intended use and be sure to read, understand and follow the instructions on the label to avoid causing harm to the plant, the environment or yourself.

Compounds such as chlorothalonil (Fungonil), tebuconazole (for example, Bayer 3-in-1 Insect, Disease and Mite Control), neem oil (Triact 70), thiophanate methyl (Cleary's 3336), potassium bicarbonate (GreenCure) and fungicidal soap are available for use as fungicides on indoor houseplants.

Always read and follow the manufacturer's directions before using the product and always use the labeled rates. Mention of any trade names does not imply endorsement of one product over another nor discrimination against any product by North Dakota State University Extension Service or the authors.

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Stippling injury to leaves caused by spider mites (Whitney Cranshaw, Colorado State University, Bugwood.org)

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