



Missouri Environment & Garden

Houseplant Problems *by David Trinklein*

“There are no houseplants in nature” is a quote used by a former colleague when talking about interior plant care. Over the years, horticulturalists have selected certain species of plants that are able to withstand the austere conditions characteristic of indoor settings and designated them as “houseplants.” Since the winter months force most of us to conduct our plant-growing activities indoors, January is a good time to review some of the problems houseplants can develop.

Occasionally, leaves of seemingly healthy houseplants begin to develop brown tips and margins, dead spots and yellowing. A common assumption is that a disease caused by a pathogen such as a fungus or bacterium might have infested the symptomatic plant. More often, however, these symptoms are the result of an unfavorable environment. Low relative humidity, insufficient light, over or under watering, or too much or too little fertilizer can lead to leaf damage that mimics disease symptoms. To make the problem even more difficult to diagnose, leaf problems often are due to a combination of these environmental factors.

How, then, can one determine the actual cause of leaf damage when there are so many possibilities? While an accurate diagnosis of a fungal or bacterial disease infestation is best made by a trained plant pathologist, there are a number of characteristics that can give any avid indoor gardener a clue to the possible cause.

First, we need to differentiate between plant problems that are biotic in nature (diseases) versus those that are abiotic (disorders). A disease can be transferred from a plant showing symptoms to a previously healthy plant. In time, the healthy plant will begin to show the same symptoms of the disease. Disorders, on the other hand, cannot be spread from one plant to another. Their symptoms are caused by non-living factors, most often environmental in nature.

If the plant showing symptoms has been indoors for several months (or years), the appearance of leaf damage is more likely the result in a change of environmental conditions rather than the development of a disease. In most indoor situations, diseases do not develop on leaves of established plants, since high humidity, wind or splashing water are not present. The former are conditions favorable for fungal disease infestation and are rarely encountered in the average home. Therefore,

if leaf diseases actually exist, they may have been present before the plant was brought into the home either from a retail outlet or from placing the plant outdoors for the summer.

The pattern of leaf damage also can provide clues relative to the cause. In the case of damage caused by a disease, the progression of symptoms often transitions from healthy (green) tissue, to chlorotic (yellow) and, finally, to necrotic (brown) tissue. Additionally, when true diseases attack leaves, the dead or dying spots often are scattered on the leaf and occur closer to the growing medium or in the center of the plant where relative humidity is higher or where water got on leaves when the plant was watered.

In the case of damage caused by abiotic factors, the yellow transition zone between healthy and dead tissue is greatly reduced or absent. Additionally, necrotic tissue often appears on leaf margins and tips.

Among those factors that lead to abiotic disorders in houseplants, excess fertilizer ranks high on the list. “If a little is good, more is better” certainly does not apply to fertilizing plants, especially if they are growing indoors. During the winter months when days are short and light is poor, most houseplants make little, if any, new growth. Attempting to encourage new growth by applying fertilizer is counterproductive.

Excess fertilizer salts applied to the growing medium are taken up by the plant, where they tend to accumulate along leaf margins and tips. This causes salt “burn” which can lead to marginal or tip necrosis. If fertilizer excesses are very high, root damage also may result which tends to worsen the problem.

The afore-mentioned symptoms also can appear (and for the same reason) if plants are watered with softened water. Most water softeners replace relatively insoluble salts (e.g. calcium carbonate) with highly soluble salts such as sodium or potassium chloride. This results in creating the same saline conditions in the root environment as applying too much fertilizer.

Another common abiotic cause of leaf edge and tip necrosis of many popular houseplants is fluoride in the water. The dracaenas as well as most members of the Lilaceae plant family are especially sensitive to the element fluorine (**right**). Upon being taken up by the plant, this toxic element is translocated to the edges and tips of it leaves where it soon reaches a lethal concentration, resulting in the death of the leaf tissue.

Additionally, temperatures too low for the houseplant species in question as well as excessively dry soil for extended periods of time also can cause leaf edge and tip necrosis.

Given the cause of leaf damage has been determined to be abiotic, the solution most often involves improvement of the environment. If the cause cannot be determined, then attempting to provide a more favorable environment can be helpful. This involves more uniform watering, better light, higher humidity and fertilizing properly.

Alternatively, leaf damage caused by disease organisms can be managed by removing symptomatic leaves, increasing air circulation around the plant and attempting to keep foliage dry when watering. Labeled fungicides can be used if the identity of the disease organism is known. Extra care should be taken when pesticides are applied to plants in the home. Should the use of fungicides be deemed necessary, it is advisable take the plant(s) outdoors (weather permitting) or into a garage or other structure away from living quarters when application is made. The REI listed on the pesticide label should indicate when it is safe to take the plants back into the home.

Even with the best conditions, recover of damaged plants may be slow. If the damage was severe, it may require the longer days and improved growing conditions of spring and summer to bring a plant back to its past state of attractiveness.



fluoride damage on a peace lily

Cone-Bearing Plants of Many Shapes, Sizes, and Species

by Michele Warmund

During the holiday season, pine cones are often used in decorations. Although those from conifers are common, other plants also produce cones or cone-like structures as part of their reproductive process (Table 1). In pines, pollen is produced in staminate (male) cones, which is wind-blown to young female cones. After fertilization, scales develop on the cone. Generally, two seeds develop on the upper surfaces of each scale of the female cone. The cone and a resin coating on its outer surface protects the naked seeds on conifers from erratic climatic conditions and herbivory. Some cones open and close multiple times while still attached to branches of the tree. When cones turn from green to a darker color, they open and seeds are released from their scales. Conifer seeds are a food source for birds and squirrels.

True pine cones are abundant as there are about 115 different species that are native to most temperate and subtropical regions of the world. Most pines produce small male cones (0.4 to 2 inches-long) in the spring, but after their pollen is shed, they soon drop. Fertilization occurs a year later with female cones maturing 1.5 to 3 years after pollination. The sugar pine (*Pinus lambertiana*) produces the longest seed cone (up to 25 inches) of any conifers and is the tallest of the pines, reaching 269 feet. Champion sugar pine trees can be found in Yosemite National Park and Umpqua or Siskiyou National Forests. Closer to Missouri, Scotch pine (*P. sylvestris*) seed cones are usually up to 3 inches long and may be found on trees sold as Christmas trees. Other cone-bearing species, such as Eastern white pine (*P. strobus*), limber pine (*P. flexilis*), and Japanese red pine (*P. densiflora*), are recommended for planting in Missouri. Because Austrian pine (*P. nigra*) is susceptible to *Diplodia* tip blight and Scotch pine often suffers from pine wilt fungus and nematodes, these trees are not recommended for planting.



Figure 1 Female cones at branch tips of a Norway spruce tree.

Table 1 Length of mature female cones produced by selected plants.

Plant	Cone length (inches)
Pines	
Austrian pine	2 to 4
Eastern white pine	3 to 6
Japanese red pine	1.5 to 2.5
Limber pine	3 to 6
Scotch pine	1.5 to 3
Sugar pine	10 to 25
Spruce	
Colorado	2 to 5
Norway	4 to 7.5
White	1.5 to 2.8
Firs	
Balsam	2 to 4
Frasier	1.5 to 2.5
Noble	4.5 to 10
White	3 to 6
Hemlock	
Eastern	0.5 to 1
Western	0.5 to 1
Other	
Bald cypress	0.5 to 1.5
Dawn redwood	0.75 to 1
Douglas fir	2 to 4
Eastern red cedar	0.1 to 0.3
European alder	0.3 to 0.7
Giant sequoia	1.5 to 2.8
Japanese larch	0.8 to 1.5
Redwood	0.5 to 1.5

Among the spruce (*Picea*) species, Norway spruce (*P. abies*) produces the longest cones (Figure 1). Even when young, Norway spruce trees produce cones. These trees are fast-growing (up to 3 feet per year for the first 25 years) when planted in deep, well drained soils, with good moisture. Branches are pendulous and will produce mature female cones 5 to 7 months after pollination. The slow-growing, Colorado spruce (*P. pungens*) typically doesn't bear seed cones until they are around 20 years-old. Colorado spruce cones are produced in the upper part of the tree and are smaller than those of Norway spruce. Several Colorado spruce cultivars are available with blue-colored needles. White spruce (*P. glauca*) bears pendulous cones about 1 to 2.5 inches-long at maturity. The scales of white spruce seed cones are thin, flexible, and have a rounded margin.

The cones of fir trees (*Abies* sp.) vary widely among species. Seed cones of fir trees can range from very small (1.5 inches-long) on Frasier fir (*A. fraseri*) to large (10 inches-long) on noble fir (*A. procera*). White fir (*A.*



Figure 2 A Douglas-fir seed cone with two types of bracts.

concolor) produces cylindrical female cones, up to 4.8 inches-long, on branches with soft needles. White fir is recommended for planting in Missouri, and is often sold at cut-your-own Christmas tree farms. Cone-bearing species, such as Balsam fir (*A. balsamea*), Frasier fir, noble fir, and white fir (*A. concolor*) are often already cut and sold at Christmas tree lots. Douglas-fir (*Pseudotsuga menziesii*) is not a true fir, but produces one of the most interesting cones. Mature cones have broad rounded scales separated by another elongated bract with three projections of varying lengths (Figure 2).

Eastern (Canadian) hemlock (*Tsuga canadensis*) is a conifer that produces a small cone, ranging from 0.5 to 1 inch-long. This hemlock was once recommended for planting due to its fine texture, graceful growth habit, and its reliability in the landscape. However, infestations of the Asian hemlock woolly adelgid have become severe in some parts of the eastern United States, causing tree mortality. Western hemlock (*T. heterophylla*), found on the Washington and Oregon coastal areas, has similar cones similar to those of the eastern species and is valued for timber and pulpwood.

Although Redwoods (*Sequoia sempervirens*) are towering evergreen trees (up to 321 feet tall) found in the Pacific coastal region, their cones are miniscule by comparison (0.5 to 1.5 inches-long). Likewise, giant sequoia or giant redwood (*Sequoiadendron giganteum*) grow to over 300 feet in the Sierra Nevada Mountains



Figure 3 A small seed cone (two-inches-long) from a giant sequoia tree.

of California and can produce over 11,000 small cones on a large tree at a time, dispersing up to 400,000 seeds per year (**Figure 3**).

Deciduous trees also produce cones. For example, dawn redwood (*Metasequoia glyptostroboides*) is a large conifer, ranging from 70 to 100 feet-tall, that bears solitary, small cones and sheds its reddish-brown leaves in the fall. The Missouri Botanical Garden has more than 20 of these stately trees that were planted as seedlings in 1952. Larch is another type of deciduous conifer. Although found mostly in the northern United States, Japanese larch (*Larix kaempferi*) trees produce small cones with scales that are reflexed at maturity (**Figure 4**). Cones mature in October, but persist on the tree until seeds are dispersed. Bald cypress (*Taxodium distichum*) is a cone-bearing, deciduous tree



Figure 4 A female Japanese larch cone with reflexed scales.

commonly planted in Missouri. Although these are beautiful trees with sage green foliage in summer, their round cones are less remarkable with compressed scales that open slightly at maturity. European or black alder (*Alnus glutinosa*) trees produce strobili, which are small cone-like structures. Strobili develop in the spring on branched stems (peduncles) and mature in the fall, but persist on the deciduous tree throughout winter.

Unlike other trees that bear woody cones, junipers produce female cones resembling berries and are used as a culinary spice or for flavoring in gin. Eastern red cedar (*Juniperus virginiana*), which is native to Missouri, is actually a juniper. Female trees produce small round cones, about a quarter inch in diameter that are dark blue with a waxy appearance. These cones are an important food source for birds (cedar waxwings, bluebirds, turkey) and several mammals during winter. Male cones are produced on separate trees at the tips of branches and are oval, about 0.1 inch-long. Some Eastern red cedars growing on Ozark bluffs in Missouri are over 1,000 years-old.

Plants that grow in subtropical and tropical regions, such as the cycads, produce showy cones. All cycads are dioecious, with seed cones on separate female plants, measuring more than 30 inches-long. The sago palm (*Cycas revoluta*) is perhaps one of the best known cycads. Unlike others, the sago palm male cone is more striking than female cone (**Figure 5**). Other cycads with spectacular cones include giant dioon (*Dioon spinulosum*), Kozi cycad (*Encephalartos ferox*), chigua (*Zamia roezlii*), Micholitz's cycad (*Cycas micholitzii*), which are housed indoors in the Climatron at the Missouri Botanical Gardens. Because cycads are endangered species, these plants are best viewed at public gardens. Fairchild Tropical Botanic Garden in Florida has a large collection, including more than 700 cycads.

Other interesting plants produce strobili, such as hop (*Humulus lupulus*) vines. Female hop plants produce papery cones used for brewing beer. Ornamental beehive ginger (*Zingiber spectabile*), pinecone ginger (*Z. zerumbet*), and jewel pagoda (*Z. neglectum*) develop colorful strobili (**Figure 6**). Club mosses, in the genera *Lycopodium* (ground pines), *Selaginella*, and *Phylloglossum* are primitive herbaceous plants that produce strobili. Other types of primitive herbaceous plants that produce strobili are the horsetails. Field horsetail (*Equisetum arvense*) and scouringrush (*E. hyemale*) are common perennial weeds found in wet soils (**Figure 7**).

While these are just a few of the cone-bearing plants, there are many others. So no matter what time of year, you can find plants that bear fascinating cones!



Figure 5 The rounded female cone and the elongated male cone on sago palm plants.



Figure 6 A red strobilus on a beehive ginger plant.



Figure 7 A strobilus on a field horsetail plant.

Holly for the Holidays *by David Trinklein*



As people decorate their homes for the holidays, most give little thought concerning why certain types of greenery find their way into wreaths, garlands, floral arrangements and other decorations. Most often, they simply carry on a tradition started generations ago associated with this festive time of the year. The history of that tradition often is overlooked.

The use of plants for indoor decoration at this time of the year can be traced back to pagan practices of the pre-Christian era associated with the winter solstice. The latter typically occurs December 21st/ 22nd. Although various cultures observed this event in different ways, the use of evergreens seems to be common among most celebrations.

Early civilizations considered evergreen plants to be symbolic of life. Using evergreens to adorn homes during the winter was believed to assure the survival of household members through what were often very harsh, austere conditions. Additionally, evergreens served to remind the members of the household that planting season was soon to come.

The first formal celebration of Christmas on December 25th occurred in 336 A.D. during the reign of the Roman Emperor Constantine (the first Christian Emperor). For many years thereafter, religious leaders considered decorating homes with evergreens to be a form of pagan idolatry and discouraged the practice. Slowly, however, the association of indoor décor using plants at this time of the year was transferred from paganism to Christianity.

One plant that has dominated holiday decorations over the ages is holly. Probably more superstitions surround holly than any other plant. A sacred plant of the Druids, holly was thought to be able to ward off evil spirits, protect against mad dogs, provide good luck, either prevent or trigger family arguments and, if discarded too soon, cause a death in the family. Holly also was associated

with Taranis, the Celtic god of thunder. Because of this it frequently was planted near homes to prevent lightning strikes.

“The Holly and the Ivy” is a popular Christmas carol that dates back to the 15th century. It took holly, a plant with deep pagan roots, and gave it Christian symbolism instead. The original version of the song published nearly 1000 years earlier was quite different and described a contest between the two plants for a favorite spot in the hall (home).

Other traditions associated holly with being a male plant. This is partially correct, since holly is dioecious. However, it is the female of the species that produces attractive red berries for which it is prized. Ivy, another evergreen plant used for winter decoration, was considered a female plant. Superstition maintained that whichever plant was brought into the house first at the holidays would determine whether the man or woman of the household would rule during the coming year. Additionally, “holly-boy” and “ivy-girl” effigies were often fashioned to be stolen by young members of the opposite sex and burned in effigy. The meaning behind the latter act remains unclear.

While there are more than 400 species of holly, English holly (*Ilex aquifolium*) is the one long associated with Christmas. Native to Europe, it was used by the Romans in their festival of Saturnalia. The latter was a period general merry making observed from December 17th through the 23rd in honor of the Roman god Saturn. Undoubtedly, early civilizations also enjoyed the contrast between holly’s bright red berries and glossy, evergreen foliage during a rather dull, dreary time of the year.

Until the 19th century, holly was much more popular than Christmas trees for interior decoration during the holiday season. In fact, in England during the pre-Victorian Era, the term “Christmas tree” usually made reference to holly shrubs instead of conifers, as it does today.

Holly’s popularity was bolstered by an event that dates back to the 17th century. At that time, Puritans led by Oliver Cromwell, Lord Protector of the British Commonwealth, enacted legislation banning traditional celebrations of Christmas. The Puritans deemed these celebrations wasteful and paganistic. In protest to this unpopular law, many people tied up “holly” boughs of mixed evergreens and hung them in their homes at Christmas. The “holly” gradually became “holly” and we still “deck the halls with boughs of holly” at this festive time of the year.

The magical powers attributed to holly by the ancients might have been due to certain chemical compounds the plant contains. Among these compounds is saponin, a known toxin. Holly berries contain saponin, whereas its leaves do not. Even though the literature reports that most cases of accidental ingestion of holly berries causes only mild distress (e.g. nausea, vomiting and abdominal cramping), they should be kept well out of the reach of children or pets. Additionally, make sure that any berries which might accidentally fall from decorations containing holly cannot be retrieved by a curious child.

The freshest and longest lived holly for decorative use is that trimmed from plants in your own yard. Although an attractive evergreen, growing English holly can be a bit challenging given it dislikes both hot and cold temperatures. Therefore, a sun to part-shade exposure that offers protection from winter winds is best. Additionally, holly will not tolerate poorly-drained soils. Its growth rate is slow.

Perhaps a better choice for our latitude is American holly (*Ilex opaca*). It, too, is evergreen and bears spiny green leaves and (on female plants) bright red berries. Native to eastern and central parts of the U.S., it slowly grow to a high of about 30 feet under cultivation. It tends to be a bit less demanding than English holly in its cultural needs, but still requires good drainage. Popular cultivars include ‘Jersey Princess’, ‘Saytr Hill’ and ‘Old Heavy Berry’.

Finally, Foster’s holly (*Ilex* $\tilde{\text{A}}$ — *attenuata* ‘Fosteri’) is an interspecific hybrid having American holly as its male parent. It is one of the few hollies whose female plants will produce red berries without a male plant in the general area for pollination. It has small glossy evergreen foliage with spiny margins and bears an abundance of red berries. Having a moderate rate of growth, it is easy to care for and makes a very attractive landscape plant. Because Foster’s holly is a bit less cold tolerant than its *Ilex opaca* male parent, planting it in a somewhat protect area is desirable.

Physiological Disorders of Apple Fruits

by Josephine Mgbechi-Ezeri

Certain conditions such as nutritional imbalance, production practices, cultivars and storage conditions can predispose apple fruits to different types of physiological disorders which can lead to significant losses in market value. This write up describes storage disorders of apple diagnosed at the MU Plant Diagnostic Clinic.

Bitter pit associated with calcium deficiency is a physiological disorder of apple fruits. Bitter pit begins in the orchard at harvest but symptom does not develop until storage. Depending on the cultivar, the symptoms appear as dark-brown sunken lesions (**Figure 1a**), approximately 2 to 10 mm in diameter on the surface of the fruit but most commonly at the calyx end. The flesh below the skin of infected area when peeled is dark and corky in appearance (**Figure 1b**). High nitrogen fertility, light crop load and premature fruit harvest are factors that may increase bitter pit incidence. Apple cultivars such as Honeycrisp, Jonagold, Golden Delicious and Granny Smith are more susceptible to bitter pit. Calcium spray in the orchard before harvest and drenching harvested fruits in a calcium solution before storage can help to minimize the incidence of this disorder.



Figure 1a Bitter pit symptoms on skin surface of an apple after storage.



Figure 1b Corky tissue underneath the apple peel caused by bitter pit.

Lenticel breakdown is a physiological disorder most often observed in stored apples. Symptom of lenticel breakdown can be inconspicuous at harvest but may become evident within few days of packing. Initial symptoms develop as small spots over the lenticel on apple skin (**Figure 2**). As the fruit firmness decreases in storage, these spots enlarge, become sunken, and turn dark brown. Unlike bitter pit, lenticel breakdown appears only on the skin with no corking of the flesh. Mineral imbalance, late fruit harvest, and longer fruit storage are conditions that can increase susceptibility of apple fruit to lenticel breakdown. There is limited information on the management of lenticel breakdown in apples.



Figure 2 Lenticel breakdown on apple fruit.

Senescent breakdown, another apple disorder that can cause fruit loss during storage, is most prevalent in apples harvested late and stored for long periods. Symptoms on the skin appear as brown patches while the interior of the fruit develop brown flesh and internal breakdown (**Figure 3**). Strategies that delay the occurrence of senescent breakdown include harvesting fruits at the right maturity stage, and using an optimum temperature in cold storage.

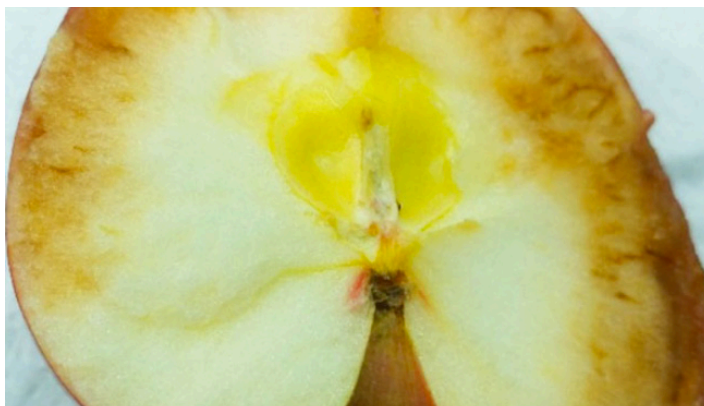


Figure 3 Apple fruit showing senescent breakdown after storage.

Physiological disorders of apples resulting from natural aging process could be confused with infection caused by disease pathogens. For accurate diagnosis submit sample to the MU Plant Diagnostic Clinic. For further information on sample collection, packaging and shipping, visit the MU Plant Diagnostic Clinic website: <http://plantclinic.missouri.edu/>.

Protecting Woody Plants from Vole Damage

by Michele Warmund

With snow on the ground and less abundant natural vegetation, voles begin feeding on the bark near the soil surface and roots of trees and shrubs. Voles, also known as meadow mice, cause serious damage to young apple trees, especially those on dwarfing rootstocks. Voles also feed on other fruit trees, blueberries, and some ornamentals, but usually do not feed on grapes, blackberries or raspberries. Although much of the feeding damage occurs during the winter months when voles girdle trunks of woody plants, it often goes unnoticed until drought stress occurs during the following growing season and the injured trees become weak or die.

Voles are not true mice, but are small gray or brown mammals that have plump bodies with short legs and tails about an inch long. Three species of voles are found in Missouri. Adult pine voles (*Microtus pinetorum*) are three to five inches-long and are found in fields in and around wooded areas. These voles inhabit extensive underground tunnels, spending little time aboveground. Adult meadow voles (*Microtus pennsylvanicus*), which tend to be larger than pine voles, are about four to seven inches-long (**Figure 1**). They are found in grassy or weedy areas in northern Missouri, especially where the vegetation is not mowed. Prairie voles (*Microtus ochrogaster*) are the most common species found in Missouri and are about the same size as meadow voles. As their common name implies, pine voles are found in sites with dense vegetation.

Voles reproduce quickly, resulting in cyclical increases in their populations. Female voles start reproducing 35 to 40 days after birth, with multiple litters every 21 days. Breeding peaks in the fall and the spring. Meadow and prairie

Although hawks, owls, foxes, and snakes feed on voles, tall vegetation beneath low tree limbs, brush piles, and leaves provide voles with protection from these predators. Vole colonies are also protected in their network of underground runways with several openings at the soil surface. Meadow and prairie vole runways often have small clippings in them.

To reduce the incidence of voles, do not use mulch around the base of fruit trees as it provides an excellent habitat. Hardware cloth (no larger than 0.25 inch mesh), about eighteen inches tall, with at least three inches underground, can be placed around the base of the trunk to protect it from vole damage. Vinyl tree guards can also prevent girdling when placed on trunks in the fall, but should be removed once growth begins in the spring as they can harbor insect pests during the growing season. Keep grass and weeds short by mowing, rake leaves as they accumulate, and eliminate brush. In orchards, remove limbs immediately after pruning.

For small populations of voles, mouse snap traps baited with a slice of apple or peanut butter and oatmeal can be used. Also, stake the trap down as voles can sometimes drag them away. With some excavation, traps can be placed end-to-end or perpendicular inside runs. Repellents are also available, but often these products wash away with precipitation and do not



Figure 1 A meadow vole, commonly found in or near tall vegetation in northern Missouri.

provide long-term vole control. Rodenticides in landscapes must be used with extreme care, out of reach of children, pets, domestic animals, and non-target wildlife, or in tamper-proof bait stations. Also, bait stations should be secured to prevent spillage from these units.

For commercial orchards, rodenticides are not applied until after all fruit is harvested in the fall. Also, some products may only be purchased and applied by licensed applicators. Multiple products and control strategies are needed to reduce vole populations in commercial plantings. These recommendations can be found in the Midwest Fruit Pest Management Guide at: <https://ag.purdue.edu/hla/hort/documents/id-465.pdf>.

Winter Squash for Thanksgiving *by David Trinklein*



As table fare for a typical Thanksgiving meal, squash pales in significance when compared with crops such as sweet potato, cranberry and pumpkin. It is recorded, however, that squash was served when the Pilgrims and the Wampanoag tribe gathered at Plymouth Colony in 1621 for the first Thanksgiving. Perhaps the time has arrived for this vegetable native to the Americas to be given a bit more attention as the menu for this year's Thanksgiving dinner is planned.

When the first Europeans arrived in America, they found Native Americans eating a food they had never seen before. Native Americans belonging to the Narragansett tribe called the food 'askutasquash'. Literally interpreted, the latter means 'eaten raw'. Today, we simply refer to it as squash; the name can be both singular and plural. Evidently, early settlers were not very impressed by squash, until they had to survive harsh colonial winters. It was then they adopted it as a food staple.

Squash is one of the oldest known food crops. Archeologists have found the remains of squash in cliff dwellings in the southwestern United States and Mexico, indicating that squash was being grown and used by early civilizations for at least 8,000 years.

Many of the types of squash we know as winter squash are thought to have originated near the Andes in what is now northern Argentina. They likely were spread to other locations by early civilizations. Some squash are native to Mexico and Central America. Their spread by early nomadic civilizations make the determination of their exact origin very difficult. Although squash has not become as popular in many parts of the world, as an American vegetable currently it ranks fifth in popularity. Only tomato, bean, cucumber and lettuce are consumed in greater quantities than squash.

Basically, two different types of squash exist: summer squash and the aforementioned winter squash. Both are members of the *Curcubitaceae* plant family making them closely akin to cucumber, gourds, musk melons and watermelon. The primary difference between the two is the state of maturity of the squash when it is best to eat. Summer squash are eaten when immature and small. They are picked frequently throughout the growing season. While they may be eaten when more mature, their quality is reduced with age, as they become more fibrous.

Winter squash, on the other hand, are harvested only after reaching full maturity and the outer rind is very hard. Because squash of this type develops a hard, protective rind, they can be stored throughout much of the winter (hence, the name 'winter' squash). In the days before modern transportation when there was little access to fresh vegetables during the winter, the winter squashes served as an excellent source of vitamin A, dietary fiber and other vitamins and minerals. Because winter squash can be grown easily and stored under normal household conditions, their contribution to the health and well-being of early families during long, cold winters was important.

Some of the better known types of winter squash include acorn, amber cup, banana, blue hubbard, butternut, buttercup, sweet dumpling and Turk's turban. A squash that has become popular in recent years is spaghetti squash, which also is a type of winter squash. In some areas, another name for winter squash is 'baking squash', because they are often prepared by baking in the oven.

In addition to being used for food, some of the more colorful winter squash often find their way into holiday décor, along with pumpkins and gourds. Turk's turban, amber cup, golden acorn and sweet dumpling are among the winter squashes popular for this purpose. Additionally, unless the squash are cut/carved in the decorating process, they ultimately can find their way to the dinner table after the holidays are over.

For maximum storage life, winter squash must be completely mature at harvest. They should be stored in a cool, dry place where temperatures remain between 50 and 55 degrees F. Ventilation around each squash is important to prevent surface (rind) diseases which can spread from squash to squash. They should be spread on open shelves or arranged loosely in baskets or boxes. If stored at higher temperatures, their flesh may become stringy and lose quality. As a rule, acorn squash is one of the first to decline in quality in storage, whereas butternut squash appears to have the longest storage life in conditions less than ideal.

Squash is a relatively easy vegetable to grow. It definitely is a warm-season vegetable and seeds should not be planted outdoors until May, after the soil has warmed. Squash enjoys a full sun exposure and well-drained garden soil. Fertilize prior to planting according to soil test results. Additional nitrogen is beneficial once squashes have set and begin to enlarge. While gardeners with little space once avoided squash, there now are many varieties available in bush, rather than vining, form.

Squash vine borer is an insect that can be very damaging and cause plants to collapse, often when they are starting to produce a crop. Typically, plants will suddenly wilt and die for no apparent reason. The wilting is due to the action of the larvae of the squash vine borer. The adult borer (a moth) deposits its eggs at the base of the plant just at the soil line. Upon hatching from the eggs, the larvae tunnel into the stem of the plant and live inside, consuming plant tissue as they develop. The appearance of a 'sawdust-like' material at the base of the plant is evidence that infestation has occurred. Insecticides should be applied to small plants several times during the growing season to prevent squash borer larvae from entering the stem.

Squash bug and cucumber beetle are two additional pests of squash. Both can be controlled through more conventional means. Squash bugs usually frequent the under sides of leaves and may go unnoticed until populations have built up to very large levels. Hand removal of egg clusters which appear shiny and look somewhat metallic is a good first step in squash bug management. Insecticides in the form of sprays or dusts also can also be used. Cucumber beetle is more noticeable than is the squash bug but usually less damaging. Many of the common garden insecticides that are stomach poisons are quite effective in its control.

Elusive 'Ice Flowers': A Natural Phenomenon

by Michele Warmund

Some may mourn the loss of colorful autumn flowers now that nighttime temperatures are falling below freezing. However, with this change of season, other types of beauty are visible in the early morning hours, such as "ice flowers" (Figure 1). These transient "flowers" are actually layers of ice crystals that form when moisture in certain herbaceous plants freezes and splits stems vertically. With adequate moisture and continuing sub-freezing temperatures crystallization continues, forming layers of ice form much like ribbon candy on the surface the plant stem. When temperatures begin to warm, the ribbon will curl inward and eventually melt.

Ice flowers are not a new phenomenon. In 1833, John F.W. Herschel published in *Philosophical Magazine* that ice "seemed to emanate in a kind of riband-or frill-shaped wavy excrescence-as if protruded in a soft state from the interior of the stem, from longitudinal fissures in its sides." In 1850, John LeConte observed that the "striking and beautiful" ice formation on plants, resembling "cotton-wool, varying from four to five inches in diameter." In 1892, William H. Gibson described "a flower of ice crystal of purest white which shoots from the stem, bursting the bark asunder, and fashioned into all sorts of whimsical feathery curls and flanges and ridges." He also speculated that the source of the moisture for these ice flowers was from the uptake of soil water by plant roots.

Other names for ice formation on plant stems are ice fringes, ice filaments, rabbit ice, and frost flowers. Although ice flowers can occur anywhere there are sub-freezing air temperatures and adequate soil moisture, not all herbaceous plant species produce them. Some of the native Missouri wildflowers on which spectacular ice flowers form, include *Verbesina alternifolia* (known as yellow ironweed or wingstem) (Figure 2) and *Verbesina virginica* (white crownbeard, frostweed, or tickweed). Yellow ironweed is found in 71 of the 114 counties in Missouri, whereas frostweed is found only in the southern half of the state. To find ice flowers, search at the base of plants in low-lying areas, weedy gardens or fencerows, and along streams at dawn or shortly thereafter, when temperatures are still in the lower 20's (°F). In Missouri, the most likely time for favorable conditions for ice flower formation is from October through early December.

Other types of ice formation occur on rocks and soil. Needle ice occurs on silty to clay-type soils with optimum porosity. Rods of ice, known as pebble ice, can form on porous sedimentary rocks that are contact with moist soil. Some types of pottery and brick are also known to form pebble ice. Both needle and pebble ice can increase in size over successive nights when sub-freezing temperatures occur. For more images of ice formation on rocks, soils, and plants, see <https://www.americanscientist.org/article/flowers-and-ribbons-of-ice>.



Figure 1 An "ice flower" formed at the base of a plant stem.



Figure 2 A common herbaceous plant, *Verbesina alternifolia*, on which spectacular, but elusive, ice flowers can form.

Spotlights: MU Plant Diagnostic Clinic

by Josephine Mgbечи-Ezeri

The following are highlights about samples and disease issues diagnosed at the Plant Diagnostic Clinic in the month of September.



Soft rot on cabbage caused by *Pectobacterium carotovorum* subsp. *Carotovorum*

Soft rot of cabbage

Soft rot, caused by *Pectobacterium carotovorum* subsp. *carotovorum* is a widespread destructive disease of vegetables worldwide. The bacteria infects succulent plant parts such as tubers, fruits, bulbs, corms, rhizomes, buds, petioles and leaf stalk tissues. Soft rot losses can occur during cultivation in the field and after harvest in storage. The bacteria attacks several vegetable crops including cabbage, broccoli, onion, potato, pepper, melon, cucumber, bean, and beet. Symptoms of infection appears as small, water-soaked areas that rapidly enlarge. Affected tissue becomes soft and mushy with foul odor. The affected plant part may decay and collapse within a few days.

The bacteria overwinters in soil and infected debris, and infect plants through wounds caused by frost damage, insect injuries, harvesting and handling. The bacteria is spread by affected plant tissue, irrigation water, rain, insects and infested pruning tools. Soft rot disease development is favored by warm [25-30°C (77-86°F)], humid conditions with prolonged periods of wet weather.

Control of soft rot involves multiple measures. Minimizing wounding during cultivation, harvesting and handling can help to reduce spread in the field or storage. Start plants with disease free seeds and transplants. Select well drained site for planting. Control frequency of irrigation, avoid overhead irrigation and using stagnant water source. Grow resistant crops in rotation with susceptible vegetables. Harvest crops during dry weather condition. Store and ship produce in clean and cool conditions.

Diseases of cucurbits

Anthracnose of Cucumber

Anthracnose is a widely distributed fungal disease of cucurbits. The MU Plant Diagnostic clinic received a sample of cucumber with leaf spots caused by the fungus *Colletotrichum orbiculare* (syn. *Colletotrichum lagenarium*). Anthracnose can cause serious losses of cucumbers, melon, watermelon and muskmelon whenever susceptible cultivars are grown but rarely infects pumpkin and squash. Warm, humid, and frequent rain favors disease development and spread. Infection can occur on seedlings, leaves, petioles, stems, and fruits.



Leaf spots on cucumber caused by *Colletotrichum orbiculare*

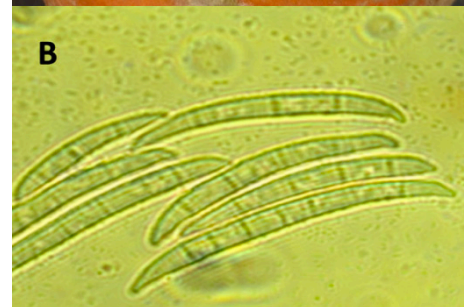
Leaf symptoms start as a small water soaked lesion with yellowish appearance. As the disease progresses, the lesion expands and turns into brown spots which may coalesce resulting in leaf blighting. Lesions on the leaf petiole and stem are shallow, elongate and tan. Severe infection of the petiole, stem, fruit and pedicel can cause extensive defoliation, lower fruit quality and yield loss. The fungus survives between crops on seeds, volunteer weeds and on infected crop residues. Spread of the fungus occurs by splashing rain, overhead irrigation, insects, field workers and tools.

Effective management of anthracnose disease involves an integrated pest management strategy. Start with certified clean seeds to reduce disease incidence on the field. When purchasing transplant seedling, carefully inspect plants for disease symptoms before transplanting. Scout plants regularly for signs of disease. Control volunteer cucurbit weeds and alternate host around the field. Plow down deeply all infected debris immediately after harvest. Practice crop rotation for at least two years with crops other than cucurbits. Regular fungicide application as soon as disease is detected can help to reduce disease severity. Information on chemicals registered for anthracnose disease on cucurbits is available in the Midwest Vegetable Production Guide for Commercial Growers.

Fusarium fruit rot

Fusarium fruit rot, a common pre and post-harvest disease of many cucurbits, can severely affect fruit quality. The disease is more destructive on pumpkin and squash. Fruit rot losses can occur in the field or in storage after harvest. Several *Fusarium* species including *F. equiseti*, *F. acuminatum*, *F. graminearum*, *F. avenaceum*, and *F. solani* are associated with fruit rot in cucurbits. The pathogen is seed borne and can survive as chlamydospores in the soil for 2-3 years.

Symptoms develop on fruit surfaces in contact with soil as firm, dry, sunken lesions of varying sizes covered with white or gray fungal growth. Disease symptoms can vary with host, plant age, environmental conditions, soil moisture, pathogen population in the soil, and the aggressiveness of the strain.



Fusarium fruit rot caused by *Fusarium* species. **A** Pumpkin fruit with lesion, **B** macroconidia of *Fusarium* species

Effective management of this disease involves an integrated pest management strategy. Plant resistant cultivars, start with disease free seeds and do not save seeds from the infected fruit. Practice rotation with non-cucurbits for 4 years. Avoid planting in fields with history of disease. Providing physical barrier between the fruit and the soil can help to minimize the disease and avoid wounding of the fruit during handling.

Brussels Sprouts Prolong Fall Harvest *by David Trinklein*

Brussels sprouts are part of the Gemmifera Group of *Brassica oleracea* (cabbage). This somewhat obscure garden vegetable is grown for its edible buds (sprouts) that are produced in its leaf axils. Unlike cabbage, however, Brussels sprouts can stand considerable freezing weather and, therefore, can be harvested late into the fall or early winter. The cool sunny days and crisp nights of fall result in Brussels sprouts of excellent quality from the standpoint of firmness and mild flavor.

Considered to be one of the newer members of the cabbage family, Brussels sprouts is thought to have first appeared in northern Europe during the fifth century. One of the first reliable references describing the plant is dated 1587. Later, it became popular in the cooler parts of Europe including the area now occupied by Belgium, which accounts for its common name. The latter often is misrepresented as Brussel sprouts or Brussels sprout. The correct version of its name is Brussels sprouts, which is both singular and plural.

As a rule, Brussels sprouts require a long growing period to develop edible sprouts. Because of this, hot weather often arrives too soon in Missouri to allow for successful production from an early spring planting. Sprouts that develop in hot weather tend to be loose and “fluffy”, and have an undesirable flavor. Even though hybrids have been developed with shorter maturities, this garden vegetable still is marginal as a spring crop in our climate.

In contrast, plants set into the garden in June will develop their sprouts in fall, when there normally is a much longer period of cool weather ideal for growth. Even a Brussels sprouts planting that did not have time to produce a good early summer crop can be kept growing and should produce a late fall crop that can be harvested through November.

If Brussels sprouts are not a part of your fall harvest this year, but you are considering adding them to your garden next season, remember they have approximately the same needs as cabbage, broccoli and cauliflower. They are heavy feeders and thrive in a rich,

well-drained soil high in organic matter. Side dressing with a fertilizer high in nitrogen several times during the summer is beneficial to keep plants growing vigorously until cool weather arrives.

Numerous varieties of Brussels sprouts are available. When selecting one for this area, pay close attention to the time needed for sprout development after planting. The latter may range from 80 to as many as 120 days, depending upon variety. The best chance for success in Missouri includes planting early-maturing varieties. Good choices include Jade Cross Hybrid (80 days), Royal Marvel (85 days) and Prince Marvel (90 days).

When planning the garden, remember that Brussels sprouts will occupy space for the entire summer and late into fall. Since their

harvested throughout the winter. Generally, when day temperatures no longer rise above 52 degrees F, plant growth ceases but the sprouts continue to survive. Flavor normally improves after frost in the fall.

To harvest Brussels sprouts, pick them from the bottom of the stem upward, as they develop in the leaf axils. When sprouts are harvested, the leaf at that point on the stem may be removed and discarded. If the outer leaves of the harvested sprouts are loose, they should be removed so that only the firm center of the sprout remains for consumption. Flavor is best when Brussels sprouts are consumed as soon after harvest as possible. Excess sprouts may be placed in a plastic bag and refrigerated. Brussels sprouts also freeze well, if blanched before placing them in a freezer.



Brussels sprouts are “nutritional powerhouses”. High in dietary fiber, they are especially rich in vitamins C and K. Additionally, they are a good source of essential minerals and a rich source of antioxidants such as kaempferol. Recent research indicates consuming the latter may reduce the risk of various cancers and also provide other health benefits. In short, including Brussels sprouts in a well-balanced diet is a sound way to promote one’s physical well-being.

Although most gardeners do not devote a large amount of space to this crop, Brussels sprouts is worth adding to the garden to extend harvest well beyond the end of the growing season. Now is a good time to make plans for next year’s crop.

leaves are relatively large, plants should be spaced 18 to 24 inches apart. They also tend to grow tall. Therefore, staking or some other form of support will prevent summer storms from toppling them over.

Because Brussels sprouts can tolerate temperatures as low as 0 degrees F, harvest is possible until late November, or beyond. In fact, in milder climates, this crop may be