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Bacterial Spot on *Prunus* Unappealing But Not Noxious

Bacterial spot is a common disease of peach, nectarine, apricot, and plum. This disease is caused by the bacterium *Xanthomonas pruni*. Bacterial spot is most severe after a wet spring. Rainfall during the three-week period following petal fall generally results in early-season fruit infection and the establishment of inoculum on new foliage and twigs of susceptible cultivars.

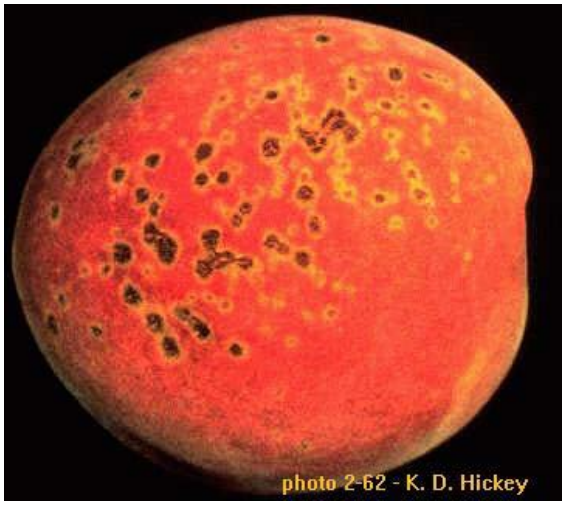

Figure 1. Bacterial Spot found on peach. (Courtesy of K.D. Hickey)

The first signs of bacterial leaf spot are water-soaked angular spots on the leaves, which may only be visible when viewed with a light source behind the foliage. These spots are generally found near the tips of the foliage, but they may also be present along the mid-vein or margin of the leaves. Within a few weeks, the spots darken. Eventually lesions drop out of the leaves, leaving a "shot hole" appearance. Severe infections may result in defoliation and a gradual tree decline.

Fruit infections appear as small purple or black flecks on the fruit surface of peaches and apricots, and as water-soaked spots on nectarines and plums. Later, pitting and cracking may occur around the spots. While infections adversely affect the appearance of the fruit, the flesh is safe to eat. Removing the peel will eliminate the lesions and make the fruit more attractive when serving it as a fresh dessert.

Spring infections develop into darkened blisters near the tips of the twigs of last season's growth. In some years, twig tip injury is so severe that that the terminal bud fails to open, resulting in dead shoot tips on the tree. Summer infections cause irregularly-shaped dark sunken lesions on the current season's shoots.

The best way to avoid this disease is to plant cultivars with the highest resistance. For peach, these cultivars include Belle of Georgia, Biscoe, Candor,

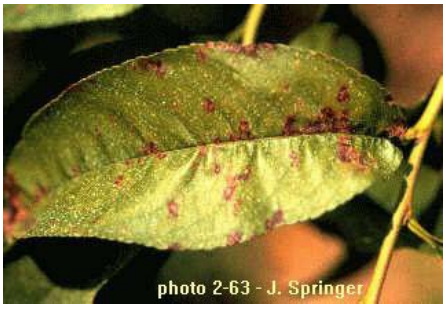

Figure 1. Bacterial Spot found along tips and vein of leaf. (Courtesy of J. Springer)

Comanche, Dixired, Earliglo, Encore, Garnet Beauty, Harbelle, Harbinger, Harbrite, Harken, Loring, Redhaven,

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In This Issue

Irrigating Home Lawns

Eighty percent of the water used around a home during the summer is for outside uses. Watering the lawn is the main outside water use. During dry summers, local water authorities may cut off water for outside use or only allow watering on certain days. Both measures are necessary and effective means to reduce water consumption and relieve the strain on city water supplies.

To avoid severe loss of turf and to conserve water, homeowners should manage their lawns each year in anticipation of water restrictions.

This guide offers cultural practices that will reduce the need for irrigation while improving the competitiveness and appearance of your lawn.

Learn to read a lawn and know when to water

Purple-blue wilting leaves, footprints that stay, and folded or rolled leaves are signs that lawns should be thoroughly watered if grasses are to remain green and actively growing.

Turf water use rates are high during sunny and windy days with low relative humidity. In situations where lawns are not watered and rainfall is limited, grasses first show symptoms of wilt and later turn completely brown.

When soil lacks moisture, grass blades first turn bluish-purple, indicating plant wilt.

Another early sign of insufficient water in the plant occurs when footprints remain in the lawn for several hours. Leaves with plenty of water quickly return to their rigid upright shape, while leaves lacking water will remain trampled for a period of time.

Leaves also may be folded or rolled lengthwise along the blade, indicating a lack of plant water.

If high temperatures and dry conditions continue without rain or irrigation, the above-ground portion of grasses will turn entirely brown and die. Grasses are said to be dormant during this browned-out stage, since the lower portion of the plant usually remains alive but not growing. Thorough watering will bring the lawn out of dormancy and new growth will resume from the below-ground base of grass plants.

Even though grasses are dormant, watering restrictions that result in extended dry periods can cause large ground cracks, severe soil drying, and excessive loss of turf cover even when watering is resumed later in the summer or early fall.

Summer dormancy of grasses is a mechanism that helps a lawn survive, but it does not guarantee that a lawn will fully recover from the browned-out stage.

Dormant lawns should receive at least 1 inch of water every two or three weeks during summer to prevent complete turf loss. Grasses may not show a noticeable greening, but that amount of irrigation should be sufficient to hydrate the lower plant portions and increase the recovery once adequate moisture is available.

Wet wilt is another type of wilt to look for. Wet wilt occurs when the soil is obviously wet, but the root system is not able to keep pace with the water demands from the atmosphere. The curling of leaves from wet wilt looks very similar to wilt caused by lack of soil moisture. Waterlogged lawns that have a shallow root system are susceptible to wet wilt. Do not add more water when lawns are wilting and soil moisture appears to be adequate; it will only aggravate the problem by starving the root zone of oxygen.

Select a sprinkler that best fits your needs

Automatic irrigation systems with pop-up sprinklers are often associated with excessive irrigation. This is not necessarily true, since properly designed and operated systems supply water uniformly over an entire area without wasted runoff.

Missouri soils generally have low water infiltration rates. Automatic controllers can be set to supply several short cycles so that the total amount of water desired is supplied without runoff.

The most common type of watering occurs with hose-end sprinklers. Some studies have shown that the average homeowner applies 2.5 times the amount of water that is required for turf growth when using hose-end sprinklers.

There are several types of hose-end sprinklers. Select one that best fits your size and shape of lawn and then operate it efficiently. All hose-end sprinklers can be attached to inexpensive timers that can be used to shut off unattended sprinklers and avoid over-irrigation.

How much water to apply

Once you have decided on the best sprinkler for your size and shape of lawn, you must decide how long to operate a sprinkler in a certain location. This is best achieved by knowing how many inches of water your system puts out in a certain amount of time. To do this, place shallow, straight-sided containers (tuna cans work well) or rain gauges in a grid pattern around the sprinkler. Operate the sprinklers (use overlapping patterns where needed) for a given amount of time and measure the amount of water captured.

Measure the depth of water in the cans with a ruler or read directly from the rain gauges. Then use the following example to determine your water application rate in inches per hour. For example, a sprinkler operated for 30 minutes that delivers a quarter-inch of water has a delivery rate of one-half of an inch per hour.

An alternative approach would be to measure the area that your sprinkler pattern covers and the length of time it takes to fill a one-gallon container

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directly from the sprinkler. For example, a sprinkler that covers 235 square feet and takes 1 minute and 15 seconds to discharge one gallon of water has a delivery rate of one-third of an inch per hour.

In the above examples, sprinklers should be operated approximately three hours in each location throughout the week to supply one inch of irrigation water per week.

Most soils in Missouri will take in only about ¼ to ½ inch of water per hour. If your sprinkler system delivers more than that amount, move it to a different location more frequently, after each time ¼ to ½ inch of water has been applied. Repeat the process until the full amount of water desired has been applied.

Rotary sprinklers that are set to deliver a quarter or half sprinkler pattern will discharge four or two times the amount of water on a given area. Operate rotary sprinklers with half patterns for half the amount of time and sprinklers with quarter patterns for one-quarter the amount of time.

The utility water meter connected to your home can also be used to check how effectively water is being applied. It accurately measures water in cubic feet. When no other water is being used in the home, water a known area for a set amount of time and use these conversion factors to determine your water application rate. Some helpful facts to have are:

- 624 gallons (83.3 cubic feet) of water are required to apply 1 inch of water on 1,000 square feet of lawn.
- 7.48 gallons = one cubic foot of water.

Once the decision has been made that a lawn has sufficiently wilted and irrigation is needed, supply enough water to last a week. Depending on the type of sprinkler and soil water infiltration rate, several sprinkler changes may be required over a two- or three-day period to supply the amount of water desired.

If no rainfall occurs, continue to irrigate on a weekly schedule. If rainfall occurs, delay the next irrigation until symptoms of wilt are present. Even though water application is discussed on a weekly basis, it is not crucial that water be applied every seven days. Keep the application schedule flexible and irrigate based on the determination of lawn wilting and soil moisture.

Table 1. Approximate Lawn Water Requirements

Lawn Type	Green Turf[1] inches of water per week	Dormant Turf[2] inches of water per week
Perennial ryegrass	1.5	1.0
Kentucky bluegrass	1.2	0.7
Tall fescue	0.8	0.5
Zoysia or bermuda	0.5	0.2
Buffalograss	0.3	0.2

[1]Lawn remains green and growing
[2]Lawn may turn brown, but will not die

Use the table above to determine the amount of irrigation that will be needed for your lawn situation.

Once the decision has been made to irrigate, use the above recommendations to guide irrigation scheduling and how much water to supply. Should puddles or runoff occur before the total amount of water is applied, stop irrigating and resume only after the ground has absorbed the free moisture. Lawn areas that are moist, firm and have no visible water are ready for a repeat irrigation cycle. Areas that are soft and produce squashy footprints when walked on are not ready to receive additional irrigation.

A day after watering, check a few different locations in the yard to determine how well your irrigation program is distributing water in the root zone. With a shovel, cut a slender 2-inch wedge 6 to 8 inches deep. This wedge of soil, roots and turf can be replaced easily without damage to the lawn after inspection.

Estimate the moisture content at different depths in the soil profile by pressing together a golf-ball-sized amount of soil. If drops of water can be squeezed from the soil ball, you may be irrigating too much or too often. Soils that hold together without crumbling and appear moist have been irrigated properly. Soils that appear dry, dusty and do not form a ball when squeezed have not received enough irrigation or the water is running off the surface of the lawn and not into the root zone.

Adequate soil moisture at 6 to 8 inches deep is sufficient to maintain grasses during the summer. A foot-long slender screwdriver pushed into the ground in several locations can also give a quick assessment of the moisture condition of the soil. The screwdriver will easily penetrate to the soil depth, which has received sufficient water. The screwdriver test can also be used to help determine where and when there is a need for irrigation.

Conserve water by knowing when to water

- The best time to water a lawn is from 6 to 8 a.m. During this time the water pressure is highest, disruption of the water pattern from wind is low, and water lost to the atmosphere by evaporation is negligible. Watering early in the morning also has the advantage of reducing the chance of turf diseases that require extended

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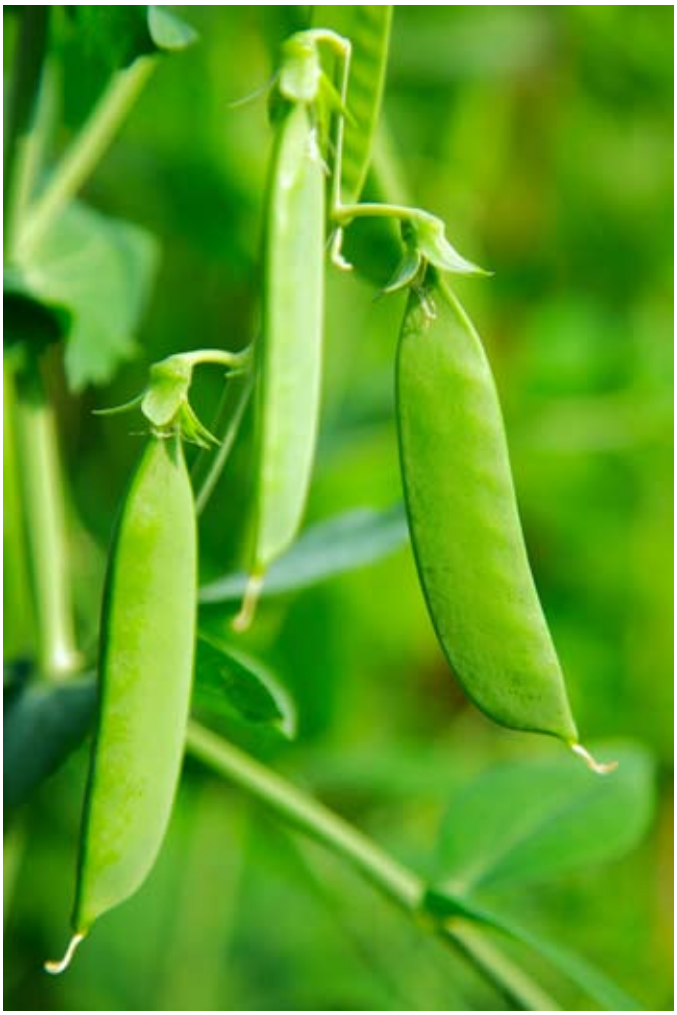
In Praise of Peas

Few things can match the eating pleasure of fresh peas from the family garden and June typically is the month this culinary delight is harvested. Peas represent an example of a food that requires a bit of work before it can be enjoyed, but for most "shelling peas" is a labor of love because of the ultimate results. In addition to being tasty, peas provide valuable vitamins and minerals to the human diet while being only modest in caloric content.

The word "pea" was derived from the Latin word *pisum* which (later) was introduced into the English language as *pease*. The nursery rhyme "pease porridge hot " makes reference to what we would call pea today. Since people often associated a word ending with "s" as being plural, pea gradually became the singular notation. The term is somewhat generic and can refer to different species in the *Fabaceae* family depending on country or region. Black-eyed pea, pigeon pea and cow pea are examples of species that commonly are referred to as pea in the areas they are popular. For most, however, pea refers to *Pisum sativum*, or English (garden) pea. Snap pea and snow (sugar) pea represent biotypes of the species whose entire pod can be consumed when harvested at an early stage of maturity.

Middle Asia, from northwest India through Afghanistan, is believed to be the primary center of origin for pea. Cultivation of peas dates back 5000 years to the Bronze Age. It probably was first grown for its dried seed and used as pulse crops are used today. It is known that the Greeks and Romans grew peas before the Christian era but writings indicate the crop held no special favor. Ancient types of peas probably were much smaller, darker colored and differed otherwise from modern garden types.

The first mention of "green peas" in the literature came after the Norman Conquest of England. By the 12th century peas were listed among the food crops stored in a nunnery near London. It was not until the 16th century that peas were described more fully in French literature. By that time, peas differed in type such as tall or dwarf; green, yellow or white seed colors; and smooth, pitted or wrinkled seeds. By the end of the 17th century peas were a rare delicacy and handsome prices were reportedly paid for them in France. The obsession people of that era had for peas is reflected in the writing of Madame de Maintenon (second wife of King Louis XIV) who noted, "Some ladies, even after having supped at the Royal Table, and well supped too, returning to their own homes, at the risk of suffering from indigestion, will again eat peas before going to bed. It is both a fashion and a madness".



Garden pea is a cool-season crop that tolerates light frosts and has the ability to germinate in relatively cool soil temperatures. Since warm summer temperatures adversely affect both yield and quality, planting is done early in the spring as soon as the soil can be worked. Peas prefer a well-drained garden loam with a pH of between 6.0 and 6.5. Sow seeds directly in the soil about one inch deep and two inches apart in rows spaced between 18 and 24 inches apart. Taller varieties will need three feet between rows as well as some method of trellising or support.

Fertilizer application should be based on soil tests and done before seeds are planted. Consistent with other legumes, peas (with the aid of symbiotic bacteria) have the ability to fix atmospheric nitrogen. However, if plants appear chlorotic after pods begin to set, a side dressing of nitrogen may be necessary. Peas prefer soil that is kept uniformly moist but not wet.

Although peas are relatively pest free, aphids, leafhoppers, and seed corn maggot can be problematic. Diseases that can occur include fusarium wilt, powdery mildew as well as root and seed rot. The latter can be especially troublesome in poorly drained soil or during wet springs. Rotating planting location in the garden from year-to-year

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is helpful in the disease management of peas.

Since peas do not compete well with weeds the latter must be controlled. Hand weeding and cultivation probably are the most logical way to control weeds in home garden plantings. However, herbicides such as trifluralin (Treflan®) and pendimethalin (Prowl®) are labeled for weed control in peas.

Depending on cultivar, planting date and seasonal temperatures, peas usually are ready for harvest about the middle of June and harvest lasts for about two weeks. Timing the harvest of peas is critical for top eating quality. Pick the pods as soon as they have swollen (appear round) since peas allowed to mature on the plant too long tend to convert sugars to starch thus reducing their sweetness. As with sweet corn, peas are tastiest immediately after being picked.

There are several cultivars of garden pea that do well in our area. Popular choices include Spring (57 days; 22 inches tall), Sparkle (60 days; 18 inches tall), Little Marvel (63 days; 18 inches tall), Lincoln (67 days; 30 inches tall), Green Arrow (68 days; 28 inches tall), Bolero (69 days; 28 inches tall), and Wando (70 days; 30 inches tall). Taller cultivars will require trellising while shorter one (18 inches tall) can be grown without.

As mentioned above peas are a good source of certain vitamins and minerals as well as insoluble dietary fiber. The latter has been shown to reduce cholesterol. One-half cup of cooked peas contains the following nutrients: 67 calories, 2.4 grams dietary fiber, 4.3 grams protein, 12.5 grams carbohydrates, 478 IU vitamin A, 11.4 mg. vitamin C, 50.7 micrograms folic acid, 1.2 mg iron, 217 mg potassium and 31 mg magnesium.

Peas from the garden freeze exceptionally well but must be blanched in order to keep enzymes and bacteria from destroying nutrients and changing color, flavor and texture. Blanching is accomplished by immersing peas in boiling water for about two minutes followed by cooling them in ice water.

Fresh or frozen, peas may be prepared in a number of different ways or combined with a variety of dishes. Simply put, (lightly) buttered peas fresh from the garden is one of life's unique pleasures.

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periods of leaf moisture. Avoid irrigation during mid-day and windy conditions.

- Move sprinklers frequently enough to avoid puddles and runoff. Difficult-to-wet areas such as slopes, thatched turf and hard soils may benefit from application of a wetting agent to improve surface penetration of water.
- Water only when the plant tells you to. Become familiar with areas of the lawn that wilt first (blue/purple leaves, rolled leaves, foot printing). Water within a day of observing these symptoms.
- Water problem areas by hand to postpone the need for irrigation of the entire lawn. Some areas of a lawn usually wilt before others. These areas, or "hot spots," may be caused by hard soils that take up water slowly, slopes, southern exposures and warmer areas next to drives and walks. Lawns that have unusual shapes also may require some hand watering to avoid unnecessary watering of paved surfaces, mulched beds and buildings. Soaker hoses that have a narrow pattern and supply water at a slow rate may be useful in these areas.

Summary

Good lawn care practices save water and harden turf in preparation for dry periods or local lawn watering restrictions. Taller mowing and fall nitrogen fertilization develop a hardy and efficient root system that reduces the need for supplemental irrigation.

Irrigation schedules should be kept flexible and associated with identification of lawn wilting. Choose a sprinkler that best fits your lawn size and shape. The amount of water a sprinkler applies should be determined to accurately water lawns. Newly seeded or sodded lawns require daily irrigation during establishment.

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Clinic Update: May Samples at the Diagnostic Clinic

We have had a number of plant sample submissions to the diagnostic clinic in May. Many of the sample submissions have been fungal diseases. Cool wet weather conditions across much of the state in May seem to have been favorable for plant disease development.

Anthracnose is common on shade trees during the spring, and we have had several sample submissions, particularly from ash trees this year. Other foliar fungal diseases including Microstoma leaf spot on hickory and crown rust on Carolina buckthorn. Two pines had pine needle rust. Other tree issues include some root rot issues on ornamental pears, one from a poorly draining location was serologically positive for Phytophthora. Some insect issues include granulate ambrosia beetle in several tree species in central and southwestern Missouri including peach, black walnut and plum. Several tree samples have been submitted with foliar galls including hackberry nipple gall and a Phylloxera gall on hickory.

An issue we have received several emails and phone calls about his spring, but few samples, is dieback of death of eastern red cedar. Samples submitted to the plant diagnostic clinic have had numerous issues including cedar apple rust, cedar quince rust, Kabatina tip blight, Phomopsis tip blight, spruce spider mite, bagworm and scale. While these issues can cause some dieback none of these appear to be likely to cause death of submitted samples. Certainly, rot issues may be present as well where entire plants are dying. In the past we have diagnosed a Phytophthora root rot on this species. Annosum root rot has also recently been identified by the Missouri Department of Conservation. More samples where severe damage is noted may result in additional information about the issue. It is important to try and collect material from trees with damage, but that have not been dead for several months. Root and crown material in addition to branch material would be useful for a complete diagnosis.

We have also had a number of tomato submissions. From high tunnels we have had a couple samples with bacterial canker, a Fusarium crown rot, and Rhizoctonia canker. Additional samples had walnut wilt and Pythium root rot. A pepper sample had bacterial leaf spot. Stevia was submitted with a broad mite infestation. Grape samples have been submitted with grape vine tomato gall and black rot. Peach and cherry samples have been submitted with brown rot, additional peach samples with peach leaf curl.

A few ornamental samples have also been submitted. English ivy had anthracnose, and several bedding plants had a Pythium root rot. Turf submissions include Zoysia with large patch and some recent fescue samples with brown patch.

Submission of samples to the plant diagnostic clinic can help prevent serious damage to your plantings. In addition to providing a diagnosis, management information is also provided. Your sample submissions also help provide a comprehensive update on plant problems for this newsletter and other resources. Additional information on sample submission is available at http://soilplantlab.missouri.edu/plant/

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Redkist, Redskin, and Sunhaven. Some of the most susceptible peach cultivars are Autumnglo, Elberta, Halehaven, July Elberta, Jersey Queen, Kalhaven, Redcrest, Rio-Oso-Gem, Suncrest, and Sweet Sue. Most apricot and many nectarine cultivars are susceptible to bacterial spot. However, Harcot and Harglow apricots and Flamin' Fury PF-11, Stark Summer Beaut, and Hardired nectarines have good resistance to this disease. Foliar sprays of zinc sulfate plus lime, or fall applications of copper with or without lime do not provide reliable control, and can sometimes cause foliar and twig damage. Antibiotic products are available for commercial producers.

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Guttation: A Pressure Relief for Plants

Have you ever noticed tiny water droplets uniformly spaced around the margins of a leaf on a dewy morning? If so, you might have wondered what would cause dew drops to form in such a regular pattern. In fact, you have observed a phenomenon called "guttation", by which plants exude water from structures called 'hydathodes" on margins or tips of leaf blades. In a sense, guttation is Mother Nature's way of allowing plants to relieve water pressure that can build up in their tissues under certain conditions.

Figure 1. Guttation droplets on blades of fescue.

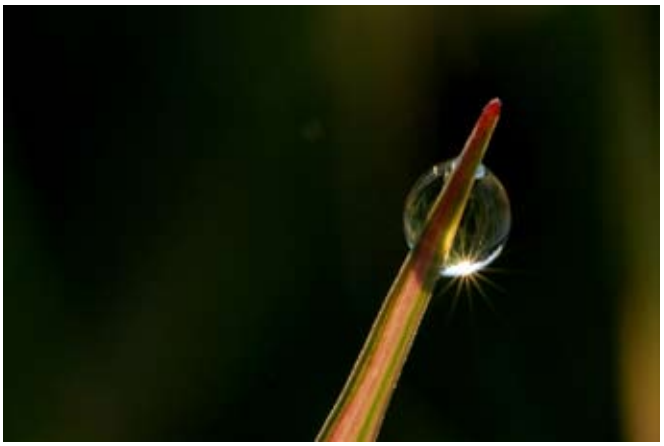

Figure 2. Guttation droplet on 'Strawberries and Cream' ribbon grass.

The processes by which plants take up water from the soil are fairly straight forward. Assuming that there is ample water stored in capillary pores in the soil, a plant pulls most of its water from the ground through suction created by transpiration (evaporation from stomata on the lower leaf surfaces). Over 90 percent of water used by most temperate zone plants is lost to the atmosphere through transpiration. While this may seem inefficient, transpiration is necessary for two main reasons; cooling of the leaf surface and pulling minerals from the soil into the plant.

Thinking back to high school biology, you may remember that roots have a layer of cells surrounding their central vascular tissues (xylem and phloem) called an endodermis. Water can not move through the endodermis without going through cellular membranes because the cell walls perpendicular to water flow are sealed with suberin (remember the casparian strip?). As roots take up fertilizer and other solutes from the soil, these can accumulate in cells inside the endodermis. Then, when transpiration stops at night, pressure may build up as water moves through the endodermis by osmosis. This is when guttation comes into play.

Under night time conditions of high humidity, cool air and warm soil, root pressure can move water to the leaves. Since the stomata are closed at night, transpiration can not remove water from the leaf as it does during the day. Hydathodes, located on leaf margins near the ends of tiny veins, exuded droplets of water to relieve the pressure. Even though water lost to guttation contains minerals and sugars, the losses are inconsequential. In rare cases, bacteria can grow in guttation droplets and be pulled back into the leaf when the sun comes up, leading to disease infection. In other cases, guttation may reduce the incidence of a non-infectious disorder called edema, in which tiny blisters appear on leaves during long periods of high humidity and excess soil moisture. Edema can be a problem when growing geraniums in the greenhouse. Regardless of its effects on plants, guttation provides entertainment to plant lovers. Check it out on your next dewy garden walk.

Figure 3. Guttation droplets on a tomato leaf in a greenhouse.

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July Gardening Calendar

Ornamentals

- **Weeks 1–4:** Remove infected leaves from roses. Pick up fallen leaves. Continue fungicidal sprays as needed.
- **Weeks 1–4:** While spraying roses with fungicides, mix extra and spray hardy phlox to prevent powdery mildew.
- **Weeks 1–4:** Newly planted trees and shrubs should continue to be watered thoroughly once a week.
- **Weeks 1–4:** Fertilize container plants every 2 weeks with a water soluble solution.
- **Weeks 1–4:** Keep weeds from making seeds now. This will mean less weeding next year.
- **Weeks 1–4:** Perennials that have finished blooming should be deadheaded. Cut back the foliage some to encourage tidier appearance.
- **Weeks 1–2:** Spray hollies for leaf miner control.
- **Weeks 1–2:** Apply final treatment for borers on hardwood trees.
- **Weeks 2–3:** Fall webworms begin nest building near the ends of branches of infested trees. Prune off webs. Spray with B.T. if defoliation becomes severe.
- **Weeks 3–4:** Semi–hardwood cuttings of spring flowering shrubs can be made now.
- **Weeks 3–4:** Summer pruning of shade trees can be done now.
- **Week 4:** Divide bearded iris now.
- **Weeks 3–4:** Don't pinch mums after mid–July or you may delay flowering.
- **Week 1:** Apply no fertilizers to trees and shrubs after July 4th. Fertilizing late may cause lush growth that is apt to winter kill

Lawns

- **Weeks 1–4:** Water frequently enough to prevent wilting. Early morning irrigation allows turf to dry before nightfall and will reduce the chance of disease.
- **Weeks 3–4:** Monitor lawns for newly hatched white grubs. If damage is occurring, apply appropriate controls, following product label directions.

Vegetables

- **Weeks 1–4:** Blossom–end rot of tomato and peppers occurs when soil moisture is uneven. Water when soils begin to dry; maintain a 2–3 inch layer of mulch.
- **Week 1:** To minimize insect damage to squash and cucumber plants, try covering them with lightweight floating row covers. Remove covers once plants flower.
- **Week 2:** Dig potatoes when the tops die. Plant fall potatoes by the 15th.
- **Weeks 3–4:** For the fall garden, sow seeds of collards, kale, sweet corn and summer squash as earlier crops are harvested.
- **Weeks 3–4:** Set out broccoli, cabbage, and cauliflower transplants for the fall garden.
- **Week 3:** Sweet corn is ripe when the silks turn brown.
- **Week 3:** Keep cukes well watered. Drought conditions will cause bitter fruit.
- **Week 3:** Harvest onions and garlic when tops turn brown.
- **Weeks 1–4:** Sow seeds of carrots, beets, turnips, and winter radish for fall harvest.

Fruits

- **Weeks 1–4:** Cover grape clusters loosely with paper sacks to provide some protection from marauding birds.
- **Week 1:** Prune out and destroy old fruiting canes of raspberries after harvest is complete.
- **Week 1:** Blackberries are ripening down.
- **Weeks 2–3:** Apply second spray to trunks of peach trees for peach borers.
- **Weeks 3–4:** Early peach varieties ripen now.
- **Week 4:** Thornless blackberries ripen now.