



Missouri Environment & Garden

Summer Color from Shrubs *by David Trinklein*

July is not a time of the year when gardeners can rely on spectacular displays of color from their shrubs and trees. The vibrant display of color from bright yellow forsythias, purple lilacs and pink magnolias are little more than a pleasant memory by midsummer. For those willing to accept a little less color, there are a few fairly durable shrubs that produce summer flowers in spite of the heat typical of July and August in Missouri.

Rose-of-Sharon (*Hybiscus syriacus*) is a very useful species for summer color in shrub borders or screens. Standard (tree-form) specimen are available for use as accent plants. Rose-of-Sharon is a hardy relative of tropical hibiscus and produces similar, but smaller, flowers. Flowers may be purple, violet, red, pink or white. Individual flowers last only one day, but a sequence of many flowers keeps this plant attractive during both July and August. Depending upon cultivar, Rose-of-Sharon may grow to a mature height of 10 feet.

One drawback of this plant is its prolific production of seeds which tend to invade nearby flower and vegetable gardens. Newer cultivars are available which do not produce seeds and eliminate the ability of the shrub to become weedy. 'Diana' (white), 'Aphrodite' (pink with a red eye), 'Minerva' (pale lavender), 'Helena' (white with a red eye) and 'Sugar Tip' (pale pink/variegated leaves) are examples of seedless cultivars that will not invade nearby plantings.

Japanese spirea (*Spiraea japonica*) and Bumald spirea (*Spiraea x bumalda*) are additional examples of very durable shrubs that flowers during the summer. As its scientific name indicates, Bumald is a cross between Japanese spirea and spirea species. One of the oldest and most widely planted cultivars of Bumald spirea is 'Anthony Waterer'. This cultivar produces pinkish-red flowers held atop reddish-purple foliage throughout the summer. There also are Bumald spirea cultivars with yellow foliage which contrasts dramatically with the pink flowers they bear. 'Gold Flame' and 'Gold Mound' are examples of the latter.

Attractive cultivars of Japanese spirea also are available. 'Shirobana' bears flowers that range from white to pink to deep purple on bright green, mounded plants from midsummer until fall. 'Little Princess' is another attractive cultivar with light-pink flowers over mint green foliage. 'Gold Flame', 'Gold Mound', 'Golden Princess' and 'Double-Play Gold' are examples of Japanese spirea with attractive yellow foliage.

Blue Mist spirea (*Caryopteris x clandonensis*) is not a spirea, but a hybrid Caryopteris. The latter is a genus of small to medium-sized shrubs prized for their blue flowers and attractive, aromatic foliage. Blue mist bears blue flowers over grey-green foliage in late summer. Plants are quite bushy and grow to a mature height of between two and three feet. Like most summer-flowering shrubs, Blue Mist bears flowers on new wood. Thus, even if a severe winter kills back its top growth, flowers still will be produced the following summer, given the roots and crown of the plant remain viable. This plant also is marketed as Bluebeard.

Another plant that bears blue flowers in late summer is Vitex (*Vitex agnus-castus*). Sometimes called chaste tree, we are its northern-most limit. While it frequently achieves a mature height of 15 feet in the south, at our latitude it is likely to remain shorter because of the

tendency of severe winters to kill it back to the ground. It produces terminal lavender-blue spikes on current-year's growth during July or August. It thrives in hot weather and full-sun exposures in many soil conditions. However, good drainage is a must. Its unique, palmately-compound foliage is quite aromatic but is known to cause some people contact dermatitis.

Butterfly Bush (*Buddleia davidii*) is yet another blue, summer-flowering shrub, although additional colors are available. Sometimes referred to a 'summer liliac', the species is a vigorous shrub which can grow to a mature height of 15 feet. 'Black Knight' is a very popular cultivar that achieves a mature height of about eight feet. It produces arching branches tipped with fragrant dark blue panicles up to eight inches long from June through September. 'Royal Red' and 'White Profusion' are additional popular cultivars. All Butterfly Bush cultivars enjoy abundant sunshine and a well-drained soil. Somewhat tender, Butterfly Bush often freezes back to the ground in severe winters.

The use of Butterfly Bush as a landscape plant is not without controversy, because of its ability to become invasive. Crossing *B. davidii* with other *Buddleia* species has resulted in the release of cultivars with improved horticultural merit and greatly reduced seed production. For example, 'Blue Chip' is a miniature cultivar that reaches a mature height of only two feet and bears almost no seeds. 'Asian Moon', 'Miss Molly', 'Miss Ruby' as well as all members of the Lo & Behold® and Flutterby Grande™ series are considered semi-sterile. 'Pugster® Blue' is a new hybrid that bears panicles nearly as large as the species on dwarf plants with improved cold tolerance.

For gardeners who want yellow flowers on durable plants, Bush or Shrubby Cinquefoil (*Potentilla fruticosa*) may be the answer. This plant boasts buttercup-yellow flowers borne on low, mounded plants which usually achieve a mature height of between two and four feet. It is an excellent choice for dry, sunny areas. Flowers normally begin to be produced in June and continue until frost. Cultivars with other than yellow flowers are available, but the yellow ones seem most characteristic of the species.

Finally, no discussion of summer-flowering shrubs would be complete without mentioning Crepe Myrtle (*Lagerstroemia indica*). Once relegated to the South, thanks to hybridization for cold tolerance with other Lagerstroemia species (e.g. *L. fauriei*), we now can grow this attractive shrub throughout plant hardiness zone six. Available in a myriad of colors, crepe myrtle produces large, showy panicles of crepe-like flowers from July through frost, depending on cultivar. It fares best in well-drained soil in a protected area that receives abundant sunlight. At temperatures of -5 degrees F, crepe myrtle often freezes back to its root system, which tends to keep this shrub shorter at our latitude than farther south. Inter-specific hybrids bred by the U. S. National Arboretum and named in honor of Native American tribes (e.g. 'Cherokee' and 'Hopi') tend to have greater cold tolerance than other cultivars.

Chinese cabbage: Good choice for fall gardens

by David Trinklein

The heat of July makes it difficult to realize that fall gardening activities are not too far away. The sunny, warm days and cool nights associated with a typical Missouri fall provide ideal growing conditions for cool-season vegetables native to areas where summers are less severe than those in the Midwest. Chinese cabbage is a good example of a vegetable that many gardeners find performs better in the fall in Missouri rather than when planted in the spring.

The word “cabbage” is an Anglicized form of *caboche*. The latter is an Old French word which, literally interpreted, means “head”. However, the term is often used for other plants with similar growth characteristics such as skunk cabbage, cabbage rose and Chinese cabbage.

As a food source, Chinese cabbage is one of our oldest vegetables. Native to eastern Asia, archeological records indicate it has been cultivated for over 6000 years. The common name “Chinese cabbage” is somewhat generic and refers to several sub-species of *Brassica campestris*, a member of the mustard plant family (*Brassicaceae*) to which cabbage, mustard, broccoli, cauliflower, kohlrabi and turnip belong.

Chinese cabbage is quite tolerant of cold temperatures but does not adapt to heat very well. When it develops primarily in hot weather, it is quick to form a flower stalk (bolt), oppose to forming a head. Therefore, planting this crop in the spring often results in disappointment when temperatures warm prematurely.

Seeds of Chinese cabbage sown now will make early growth during hot weather, but will not reach a size large enough to flower. After the cool temperatures of fall arrive and, as plants become larger, they will no longer be able to flower because of the cool weather and will form heads instead.

Sow Chinese cabbage seeds in flats or pots in a soilless germination medium. Place the containers in a protected location where they will get morning sun followed by afternoon shade. Seeds also may be sown directly in the garden in the location they are to grow, to avoid the need to transplant. However, seeds sown directly in the garden are subject to crusting of the soil from overhead irrigation or pelting rains. This usually leads

to poor germination. If possible, seeds sown directly in the garden should receive a light watering on a daily basis. This will help to keep the soil moist and cool, thus improving germination.

Plant vigor is important in the race against cold weather. Most Chinese cabbage varieties require about three to four weeks to produce plants large enough to transplant into the garden, and an additional 65 to 70 days until they are ready to harvest. Mature heads can endure light frosts in fall, but will be damaged by a severe freeze.



photo by A.Hennemann/CC

Soil considerations (fertility, pH, preparation, etc.) for Chinese cabbage are much the same as for regular cabbage. Soil with good structure, fertility and water-holding capacity is desirable. The ideal soil pH for Chinese cabbage is in the 6.0 to 6.2 range.

Nitrogen is an important nutrient for Chinese cabbage and timing its application is important. If a pre-plant application of fertilizer has been made, sidedressing with nitrogen at 10-day intervals after transplanting (or thinning) is recommended. However, excessive application of nitrogen leads to lush vegetative growth more prone to disease attack.

Chinese cabbage has been greatly improved in recent years, resulting in a number of new varieties. An excellent variety among the taller-headed (Michihli) types is ‘Jade Pagoda’. It is relatively heat tolerant and produces firm, cylindrical heads 16 inches long and about six inches in width. ‘Green Rocket’ is another good variety with long heads, crisp leaves and good storage life.

‘Blues’ and ‘China Gold’ are two relatively-new, barrel-shaped Napa types of Chinese cabbage. Both are early in maturity which makes them good choices for fall planting. Additionally, both are slow to bolt, form firm heads, and have good external and internal color and quality.

Another Asian vegetable that can be started now for the fall is Pak Choi or “Chinese celery cabbage”. A member of the mustard family, this vegetable is grown for its white stems (petioles) that somewhat resemble celery. Most Pak Choi varieties require about 50 days to mature from the time plants are placed in the garden until harvest. Because it grows rapidly, Pak Choi can be started later in the fall than Chinese cabbage. ‘Asian Delight’ and ‘Bopak’ are two new varieties that won the coveted All-American Selection award. Both form five-to-seven inch heads that have tender white stems and dark green, textured leaves.

Insect control on young Chinese cabbage or Pak Choi plants is important in late summer. Cabbage worms can quickly devour the young, tender plants if not controlled properly. Leaf damage at this early stage of growth also can slow growth. If excessive damage is done, young plants may not have time to recover and form heads before cold weather arrives.

Chinese cabbage is considered ready for harvest when its heads are firm and compact. It has a storage life of up to six weeks when placed in a plastic bag in the crisper compartment of a refrigerator.

Spider Mites

by David Trinklein



Spider mite populations increase under hot dry conditions and can cause economic damage in Missouri field crops. Several groups of insect predators effectively control spider mites. However, these natural enemies are more susceptible to insecticides, therefore, chemical control targeting early season pests such as Japanese beetles, may exasperate spider mite damage later in the season. Furthermore, imidacloprid applied as a systemic soil treatment or as a foliar spray can increase mite fecundity.

Spider mites are small (1/60 of an inch) and typically occur on the undersides of leaves making detection difficult. Identification can be accomplished using a 10-20 X hand lens. In soybean, chemical control is warranted when spider mites are present, and foliage yellowing reaches 20 % before pod set, or foliage yellowing reaches 10% after pod set. Most pesticides do not kill spider mite eggs, therefore additional applications are sometimes necessary 5 days after the initial treatment. Spider mites occur on numerous species of weeds along field borders. Weed control can reduce overwintering success and infestations in crops the following year.

Missouri State Approved Soil Testing Labs

by Manjula Nathan

The Missouri Soil Testing Association (MSTA) Approval Program is designed to assure that results provided by participating public and private labs serving the citizens of Missouri agree with allowable statistical limits. This is accomplished by evaluating the soil testing laboratories in their performance through inter-laboratory sample exchanges and a statistical evaluation of the analytical data. Based on this premise, soil test results from MSTA approved labs will be accepted by the U.S. Department of Agriculture, Farm Service Agency (FSA) and Department of Natural Resources and Conservation Services (NRCS) in federally assisted cost share programs and nutrient management plans in the state of Missouri.

In order to be approved by the Missouri State program, the participating labs should participate in all four quarter exchanges of the NAPT program and submit the MO State data release form each year to the NAPT coordinator. The NAPT coordinator in return sends soil test data from quarterly sample exchanges of the labs participating in MSTA program to the Missouri state coordinator. The MU Soil Testing Lab director serves as the state program coordinator and performs statistical analysis of the data as specified in the MSTA program. If a lab's results fall within the allowable limits, the lab will be placed on the Farm Service Agency's (FSA) list of approved labs. A lab that is not approved may re-apply after a year. An updated listing of Missouri State Approved Soil Testing lab list can be found at: <http://soilplantlab.missouri.edu/soil/msta.aspx>

List of Missouri State Approved Soil Testing Labs July 1, 2018 to June 30, 2019

MU Soil & Plant Testing Lab
University of Missouri
 23 Mumford Hall
 Columbia, MO 65211
 Telephone: 573-882-3250
 Fax: 573-884-4288

MU Delta Soil Testing Lab
 Univ. of Missouri, PO Box 160
 Portageville, MO 63873
 Telephone: 573-379-5431
 Fax: 573-379-3383

Custom Ag Labs
 PO Box 274
 Duenweg, MO 64841
 Telephone: 417-553-8510

Perry Agricultural Lab
 PO Box 418
 State Highway 54 East
 Bowling Green, MO 63334
 Telephone: 573-324-2931
 Fax: 573-324-5558

Ag Source Laboratories
 300 Speedway Circle #2
 Lincoln NE 68502
 Tel: 402-476-0300
 Fax: 402-476-0302

American Agricultural Lab
 700 W D St
 McCook, NE 69001
 Telephone: 308.345.3670
 Fax: 308-345-7880

Midwest Laboratories, Inc.
 13611 B St.
 Omaha, NE 68144-3693
 Telephone: 402-334-7770
 Fax: 402-334-9121

Ward Laboratories
 4007 Cherry Ave.
 PO Box 788, Kearney, NE 68848
 Telephone: 308-234-2418
 Fax: 308-234-1940

Ag Source Laboratories
 1532 Dewitt, Ellsworth, IA 50075
 Telephone: 515-836-4444
 Fax: 515-836-4541

Solum Lab Inc.
 615 S. Bell Avenue, Ames, IA 50010
 Telephone: 515-505-1036

Waypoint Analytical Iowa, Inc.
 111 Linn St., PO Box 455
 Atlantic, IA 50022
 Telephone: 901-213-2400
 Fax: 901-213-2440

Ingram's Soil Testing Center
 13343 Fitschen Road
 Athens, IL 62613
 Tel: 217-636-7500
 Fax: 217-636-7500

SGS-Toulon Labs
 117 East Main St.
 Toulon, IL 61483-0518
 Telephone: 309-286-2761
 Fax: 309-286-6251

Waypoint Analytical Illinois Inc.
 2906 Clark Road, Champaign, IL 61822
 Telephone: 217-359-7680

A&L Great Lakes Laboratory
 3505 Conestoga Drive
 Fort Wayne, IN 46808
 Telephone: 260-483-4759
 Fax: 260-483-5274

MVTL Laboratories-New Ulm
 1126 North Front St.
 New Ulm, MN 56073-0249
 Telephone: 507-354-8517
 Fax: 507-359-2890

Brookside Lab Inc.
 200 White Mountain Drive
 New Bremen OH 45869
 Telephone: 419-977-2766
 Fax: 419-977-2767

Spectrum Analytical
 1087 Jamison Road, PO Box 639
 Washington Court House, OH 43160
 Telephone: 740-335-1562
 Fax: 740-335-1104

Waters Agricultural Laboratories
 257 Newton Highway
 PO Box 382, Camilla, GA 31730
 Telephone: 229-336-7216
 Fax: 229-336-0977

Waters Agricultural Laboratories
 2101 Old Calhoun Road
 Owensboro, KY 42301
 Telephone: 270-685-4039
 Fax: 270-685-3989

Waypoint Analytical Inc.
 2790 Whitten Road
 Memphis, TN 38133
 Telephone: 901-213-2400
 Fax: 901-213-2440

Ag Source Cooperative Services
 106 N. Cecil St. PO Box 7
 Bonduel, WI 54107
 Telephone: 715-758-2178
 Fax: 715-758-2620

Note: Approval of soil analysis does not imply approval of fertilizer and limestone recommendations by the individual labs. The approval allows the clients to use the University of Missouri soil fertility recommendations as required by the federal and state agencies for cost share and nutrient management planning programs. In order to use the University of Missouri soil fertility recommendations and get meaningful results, it is recommended that the labs use the soil test procedures required by the MSTA program.

Sunflowers add color to summer landscapes

by David Trinklein

Late summer and early fall finds sunflowers at their full glory. Many roadsides and meadows are sprinkled with color because of the annual appearance of wild sunflowers. Fields of cultivated sunflowers are ablaze with gold at this time of the year as the large flowers bask in the sun. Garden sunflowers also are nice now because of their size and affinity for warm temperatures.

The name 'sunflower' normally is applied to any member of the plant genus *Helianthus*. The latter word is derived from the Greek words *helios* meaning 'sun' and *anthos* which means 'flower'. Taxonomists consider the genus somewhat bewildering because of the number and diversity of species it contains.

The genus *Helianthus*, in turn, is a member of the plant family *Asteraceae*. Members of this family bear a compound inflorescence known as a "head". The latter consists of a row(s) of petal-like ray florets that surround an inner tuft of disk florets. In the case of *Helianthus*, heads range in size from several inches to over one foot in diameter. In most cases, the colorful ray florets are yellow, gold or orange.

There are over 60 species of *Helianthus*. Two of them *H. annuus* (annual sunflower) and *H. tuberosa* (Jerusalem artichoke) bear the distinction of being the only two food crops domesticated centuries ago in what is now the United States. Interestingly, annual sunflower travelled to Russia where it was improved and commercialized. It later returned to the U.S. where it now is an important oil and seed crop.

Archeological findings suggest Native Americans began raising sunflowers for food and medicine as early as 2300 B.C. This predates the cultivation of important native crops such as corn, beans and squash, which is an indication of their importance. Sunflower seeds usually were roasted and ground into a fine meal for baking or thickening agent for stews. Alternatively, they were made into a butter-like substance which was used to form "seed balls". The latter were used a food source when traveling.

In addition, early Native Americans roasted sunflower hulls which were then made into a coffee-like beverage. Oil, extracted from sunflower seeds by boiling,

was used as cooking oil, hair tonic and a treatment for a range of ailments from snake bite to sunstroke.

As previously mentioned, sunflower still plays an important role in the U.S. economy as an oil and seed crop. However, it is the ornamental value of this plant that is of greater interest to gardeners. Recent improvements to sunflower have made it increasing popular in beds and border throughout the Midwest.

Ornamental sunflowers can be divided into one of two types: annual or perennial. Many of our annual sunflowers today are members of the species *H. annuus*; others are hybrids. Those considered more ornate usually are shorter in stature (three to five feet) and produce somewhat smaller, vividly-colored flowers in greater abundance than those grown for seed.

'Ring of Fire', 'Soraya', and 'Suntastic Yellow with Black Center' are three fairly recent introductions to the gardening world. All have received the coveted All American Selections award and typify today's annual sunflower. They are short in stature, free-blooming and have brightly colored flowers four to five inches in diameter suffused with yellow, gold and bronze.

Other popular cultivars include 'Teddy Bear' which bears fully double bright yellow flowers on plants that reach a mature height of only two feet, and 'Ballard'. The latter is perhaps the smallest sunflower available and has the added virtue of being pollen-free.

Perennial forms of sunflower also are available. Many are hybrids and go by the scientific name *H. x multiflorus*. They tend to be robust growers and typically bear an abundance of golden-yellow flowers two to three inches in diameter mid-summer through fall. Double and semi-double cultivars (e.g. 'Flore Pleno', 'Loddon Gold' and 'Meteor' and 'Sunshine Daydream') are very colorful and becoming increasingly popular.

Commonly grown non-hybrid (species) perennial sunflowers include *H. angustifolius* (swamp sunflower), *H. divaricatus* (woodland sunflower) *H. maximiliani* (Maximilian sunflower), *H. occidentalis* (western sunflower) and *H. salicifolius* (willowleaf sunflower).

Species sunflowers tend to be a bit taller than hybrid types and are good choices for the back of the perennial border. Named cultivars of *some* of the species sunflowers are available.

Heliopsis helianthoides (sunflower heliopsis) is a perennial very similar perennial in appearance to the perennial sunflowers and hence is often confused with them. There are several outstanding cultivars of this species, 'Summer Sun' being the most noteworthy.

Be they annuals or perennials, sunflowers are relatively easy to grow and do well under Missouri's environmental conditions. As their name implies, sunflowers love sun and need a minimum of six hours per day to thrive. Additionally, they prefer a well-drained, slightly acidic soil. They tolerate heat and dry conditions quite well but do appreciate adequate amounts of water, if it can be supplied. Avoid the temptation to fertilize sunflowers heavily (especially with nitrogen), since this leads to excessive vegetative growth and poor flowering. Sunflowers are not without disease and insect pests but the latter rarely warrant control.

Annual sunflower is propagated from seed which usually is directly sown in the garden after the soil warms in the spring. For a head start, consider planting seeds indoor in small pots about two weeks before the weather warms enough to set them out. Perennial types are propagated by division in the spring or fall.

Sunflowers, especially the newer, shorter cultivars are good choices for the border garden. The shorter cultivars can be novel additions to containers. Additionally, sunflowers can be used in the cut flower garden. Since the advent of the newer, brightly-colored cultivars commercial production of cut sunflowers has become a cottage industry for a number of gardeners.

Finally, sunflowers make ideal plants for children's gardening projects. Their large seeds are easy to handle and their rapid rate of growth and ability to handle adverse conditions make success almost guaranteed.

Cole crops harmed by hot weather *by David Trinklein*

For lovers of cole crops or those relying on their production for income, 2018 has been a disappointing year thus far. The combination of a late spring and early summer has resulted in reduced yield and quality or, in certain cases, no yield at all. Commercial growers and home gardeners alike have been left wondering what went wrong this spring.

The term “cole crop” is derived from *kobl*, the German word for cabbage, and given to a number of cultivar groups of *Brassica oleracea*. In its uncultivated form, the latter is commonly known as wild cabbage. Significant cultivar groups of *B. oleracea* include *Acephala* (kale and collard greens), *Botrytis* (cauliflower and Romanesco broccoli), *Capitata* (cabbage), *Gemmifera* (Brussel sprouts), *Gongyloides* (kohlrabi) and *Italica* (broccoli). All likely were derived by artificial (human) selection from phenotypic variations of *B. oleracea* that appeared throughout antiquity. Today, cabbage, broccoli and cauliflower represent the three most economically important cole crops in the United States.

The cole crops are classified as “cool season” vegetables which grow best under cool, moist conditions. For example, cabbage carries on the greatest amount of photosynthetic activity (growth) at temperatures in the 59–68 degree F range. Properly hardened, many of cole crops can withstand temperatures well below freezing for short periods of time. Young plants tend to be more cold tolerant than older plants.

Conversely, cole crops do not respond well to hot weather. For example, cabbage totally stops growth at temperatures above 77 degrees F. Broccoli and cauliflower are even more sensitive to high temperatures. Any condition that causes stress on cole crops during their period of active vegetative growth can lead to crop failure. At our latitude, temperature stress is a frequent cause.

Because of their ability to withstand frost but their aversion to hot weather, cole crops typically are planted (outdoors) in Missouri in March or early April. Exact planting date depends largely upon latitude and local conditions. The hope is for plants to have sufficient cool weather to make significant growth before warm weather ensues. Cool temperatures provide the plant with an environment conducive for growth that results in the formation of heads, spears or curds in cabbage, broccoli and cauliflower, respectively.

In most years, this production regime results in an adequate crop spring crop for Missouri growers. In 2018, it did not. Most of Missouri was subject to a combination of climatic events this past spring that rarely, if ever, were experienced before. Borrowing from a movie title, it was the “perfect storm” for cole crop failure.

Weather data collected at Sanborn Field on the University of Missouri campus revealed that April 2018 was the second coldest on record. The abnormally cold temperatures resulted in below average growth during a period when cole crops usually make significant growth.

April was followed by much warmer weather in May and June. Again at Sanborn Field, weather data revealed May to be the warmest on record with an average high of 84 degrees F. The latter is well beyond the point cole crops stop growth. Additionally, there was no respite to high temperature stress in May. Every day the recorded high daily temperature was above the historical average.



The abnormally warm temperatures continued into June when the average high temperature at Sanborn Field was 89 degrees F and the average low 69. The latter is significant, since warm night temperatures result in elevated rates of respiration which depletes the meager amount of food manufactured by plants during the day.

This transition from being somewhat “behind schedule” (growth-wise) at the end of April to the stifling temperatures of May and June resulted in widespread cole crop failure during spring 2018. At best, yields were greatly reduced and quality was poor.

Additional temperature-related disorders that can reduce cole crop value include “riciness” and curd bracts in cauliflower and knuckling in broccoli. Ricing occurs when cauliflower flower buds develop, elongate and separate. Curd bracts are leaves that develop between curd segments. Both are

caused by high temperatures. Knuckling, caused by fluctuating temperatures, occurs when broccoli makes uneven growth leading to a bumpy appearance.

The question arises then, “What can be done to improve the likelihood of a successful crop”? Cultural practices that allow for earlier planting in the spring so that cole crops can make significant growth before the advent of hot weather should be explored. These include the use of floating row covers, plastic mulch or high tunnels.

Depending upon thickness, row covers can provide from 4 to 8 degrees F of frost protection. At our latitude, this would allow cole crops to be planted three to four weeks earlier in the spring. The result would be longer exposure to cooler temperatures favored by cole crops before high temperatures slow growth.

Plastic mulch tends to warm the soil earlier in the spring. Research has demonstrated black plastic mulch increases soil temperature about 5 degrees F at a depth of two inches, when compared to bare soil. The combination of warmer roots along with favorable cool spring weather has been shown to hasten the maturity of cole crops from between one and three weeks. Thus, the crop has been harvested before temperatures get too warm. Clear plastic does an even better job of warming soil than black plastic, however, it does not suppress weed growth.

Finally, high tunnels are rudimentary, unheated greenhouses covered with a single layer of polyethylene plastic. Although they do represent an added production expense, their use has been demonstrated to increase day temperatures by 10 to 30 degrees F and offer up to four degrees of frost protection. The latter allows for the planting of most crops two to four weeks earlier than normal. Passively cooled, high tunnels provide ideal growing conditions for cole crops very early in the season. Once the crops have been harvested, warm weather vegetables can be planted to make additional use of the valuable space. For an extra early start, a combination of floating row covers placed over plants in a high tunnel has proven to be workable. Additional information about high tunnels can be found at <http://hightunnels.org/>.

Gummosis on Peach Fruit

by Michele Warmund

Gummosis is often apparent near harvest on the surface of peach fruit, especially in organically grown or minimally sprayed orchards. Gummosis appears as beads or a string of clear ooze after certain types of plant bugs (*Nezara viridula*, *Acrosternum hilare*, *Halyomorpha halys*) puncture the skin of the peach to feed (Figure 1). This year stink bugs have caused much of the gummosis observed at harvest in central Missouri. Dry, corky, sunken areas also occur just beneath the feeding site in the fruit flesh. Gummosis can be brushed off the fruit and the superficial damage in the flesh can be cut out. While stink bug feeding results in slight imperfections in the appearance of the peach, the fruit is safe to eat.



Figure 1 Gummosis on peach fruit surface caused by stink bug feeding. Photo credit: University of California IPM

Gummosis can also occur on developing peach fruitlets in the spring as a result of tarnished plant bug (*Lygus lineolaris*) or stink bug feeding. When peaches are about 1/2 to 3/4 inch in diameter, feeding by either type of plant bug causes not only gumming of the fruit, but also severe catfacing damage, fruit distortion, or fruit drop. Tarnished plant bugs are attracted to orchards where winter annuals are in bloom. Controlling broadleaved winter annual weeds and legumes, such as clover and vetch, in and surrounding orchards can reduce the incidence of plant bugs. Because these plant bugs are in orchards in early spring before peach trees bloom, scouting for these insects is recommended at the pink floral bud stage (before any flowers are open). Insecticide may be applied at the pink stage when tarnished plant bugs or stink bugs are found. Stink bugs feed throughout the growing season and may have one or two generations per year, depending on the species. Tarnished plant bugs have multiple generations each year. Thus, these insects require monitoring until harvest even though they may begin to leave peach trees for other hosts after petal fall.

Yet another insect that causes gummosis on peach fruit is the Oriental fruit moth. However, unlike the plant bugs, gummosis resulting from Oriental fruit moth feeding contains frass (excrement from larvae). In the spring, a larva bores into a terminal shoot, causing it to wilt. Later, a larva may bore into the peach fruit near the stem and burrow through the fruit. When it exits the peach, a hole with gumming and frass remains on the surface of the fruit. Monitoring for Oriental fruit moth also begins at the pink stage of flower development and continues through October since there are multiple generations of these insects during the growing season. Homeowner recommendations for controlling insect pests may be found at: extension.missouri.edu/publications/DisplayPrinterFriendlyPub.aspx?P=G6010 and those for commercial orchards are at: https://ag.purdue.edu/hla/Hort/Pages/sfg_sprayguide.aspx.

Cedar-Quince Rust

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What is cedar-quince rust?

Cedar-quince rust is a disease caused by a fungus called *Gymnosporangium clavipes*, which can infect about 480 species in the rose family, including apples, mountain ash, flowering quince, and hawthorn, and members of the Cupressaceae family such as the eastern red cedar (also known as red juniper). Cedar-quince rust causes flagging of leaves (Figure 1), decay and eventually death of the trees (Figure 2), particularly after repeated, untreated infections.



Figure 1 Eastern red cedar (*Juniperus virginiana*) trees severely affected by the cedar-quince rust. Circle shows a patch of dead leaves (flagging) on the tree. [Photo taken in Maryville, MO. May 2018]



Figure 2 Eastern red cedar trees killed by the cedar-quince rust. [Photo taken in Maryville, MO. May 2018]

Life cycle

The cedar-quince rust fungus requires two distinct plant hosts to complete its life cycle. One host is called the primary host and the other the alternate host. Primary hosts are often different species of evergreens, such as junipers (*Juniperus* spp.) and red cedars, whereas alternate hosts include the flowering quince, apple, hawthorn and crabapple, among others. On both types of hosts, the fungus produces at least four different types of microscopic spores in specialized structures or fruiting bodies. One type are the teliospores, which are formed in structures called telia and are responsible for the infections in the spring and summer on evergreen hosts (Figure 3).

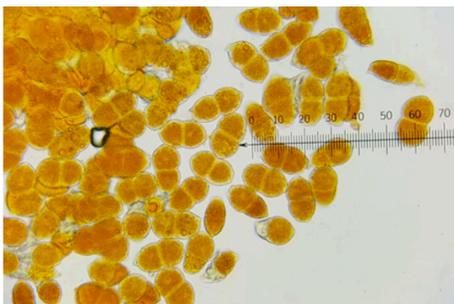


Figure 3 Teliospores of the cedar-quince rust pathogen (*G. claviceps*) observed under a compound microscope at 400x magnification. [Photo: Sautua and Perez-Hernandez]



Figure 4 Cedar-quince rust aecia on hawthorn (*Crataegus* spp.) fruit. [Photo by Dr. Alan Windham]

Infection on evergreen hosts occurs on needles, twigs and branches causing swellings that are the developing telia. Development of teliospores within the telia (Figure 3) is favored by moist and cool temperatures (around 76°F). Upon maturity, teliospores germinate in situ (where they are formed) and produce another type of spore called a basidiospore that can only infect plants in the Rosaceae family. Basidiospores are released and carried by wind and rain splash to newly emerging leaves of deciduous hosts. Infection occurs when these spores land on a susceptible plant host and penetrate host cells. Seven to ten days after infection, spots or swellings develop on the infected plant tissue followed by the formation of the next type of spores

called spermatia (pycniospores) in structures called pycnia (spermogonia). Spermatia are visible as tiny black dots within large spots. Four to seven weeks later, aeciospores are formed inside tubular protective sheaths called aecia (Figure 4). Aeciospores are released during rain, taken by wind currents over long distances and infect susceptible evergreen hosts during fall and late summer. After germinating on a *Juniperus* host, an overwintering latent mycelium is produced. The telial state appears on *Juniperus* in the spring to begin the life cycle again. Telia erupting from infected cedar tissue

Symptoms and Recognition

Cedar-quince rust symptoms vary according to the infected host plant. On primary hosts (evergreens such as junipers and red cedars), symptoms typically appear as elongated swellings on branches and twigs. Those swellings contain the teliospores that protrude from the plant surface as a bright orange gelatinized matrix (Figure 5). Then the swellings dry out after a few days (Figure 6), break through the surface and cause dieback (Figure 7). While some affected branches and twigs are killed, others can remain infectious for many years (perennial swellings).

On alternate hosts (deciduous hosts such as apples and hawthorn), the fungus infects leaves, petioles, young stems, branches and fruit. The main aecial host is quince (*Cydonia oblonga*), but apples (*Malus pumila*) and hawthorn (*Crataegus* spp.) also are infected. Young branches and fruit are infected more frequently than leaves. Pycnia and aecia may form in fruits in certain hosts. On hawthorn, the aecia look like pinkish tubes that occur mainly on branches, thorns, and fruit (Figure 8).

How can cedar-quince rust be recognized? The disease is generally easy to identify at the telial and aecial stages given the symptoms and signs that are produced. Follow the symptom description and photos provided in this publication to help you identify cedar-quince rust. To confirm the diagnosis, consult your regional agronomist at your local extension office, the Plant Pathology Extension Specialist at the University of Missouri or the MU Plant Diagnostic Clinic.

Management

Control of this disease is difficult and must be addressed with an integrated management plan that includes:

Cultural control: keep the trees healthy through proper nutrition and water supply, especially during months of dry weather. Avoid overhead irrigation in the early spring in the afternoons, as high moisture favors rust spore germination.



Figure 5 Telia erupting from infected cedar tissue immediately following a warm rain. [Photograph credit: Mike Boehm, Dept. Plant Pathology, The Ohio State University, published in APS Image Resources (<https://www.apsnet.org/publications/Imageresources/Pages/IW000013.aspx>)]



Figure 6 Closed up of a twig with orange dry blisters already passed the gelatinous stage of the fungus and covering the entire surface of the twig. [Photo: Sautua and Perez-Hernandez]



Figure 7 Close up of orange telial blisters of cedar-quince rust on an eastern red cedar branch. The orange areas are the dried out pustules of the fungus that had already broken through the surface. [Photo: Sautua and Perez-Hernandez]



Figure 8 Cedar-quince rust aecia on hawthorn (*Crataegus* spp.) fruit. [Photo by Damon Brunette (https://mushroomobserver.org/image/show_image/153998?obs=70212)].

Resistant varieties: There is limited information regarding resistant cultivars of eastern red cedar to cedar-quince rust, yet some apple cultivars are reported to have some level of resistance to this disease. Consider using resistant cultivars of the alternate hosts if they are planted near the primary host.

Sanitation: Eliminate infected plant material of alternative hosts in the fall. Pruning out branches and twigs with cedar-quince swellings and cankers in early spring helps reduce the amount of inoculum. It is recommended to remove as much of the infected twigs, branches, leaves and fruit as possible and destroy the residue. This practice is helpful, yet does not entirely solve the problem. If trees are severely infected or killed, then remove them and replace them with other ornamental trees that are adaptable in the region.

Fungicides: Fungicides can be applied as a preventive measure to protect developing twigs and branches from infection. On primary hosts, the best time to apply a fungicide is at the beginning of the spring, when plants start to grow actively. Treatments could still provide good results when applied before the swellings become gelatinous. Otherwise, applications when the swellings become dry and break through the bark are less effective. Fungicides registered for use include Captan, Chlorothalonil (Daconil), Mancozeb, Sulfur, Thiram, and Ziram. Refer to local university extension office, plant pathologist, or arborist for fungicide recommendations. Always read and follow the label directions before using a fungicide.

Additional information

A few rust diseases related to the cedar-quince rust occur in the Midwest: the cedar-apple rust and cedar-hawthorn rust. For information on these rust diseases visit the following sites:

- **Cedar-apple rust:**

<http://www.missouribotanicalgarden.org/gardens-gardening/your-garden/help-for-the-home-gardener/advice-tips-resources/pests-and-problems/diseases/rusts/cedar-apple-rust.aspx>

http://msue.anr.msu.edu/news/cedar_apple_rust_a_tale_of_a_fungal_disease_with_two_hosts

- **Cedar hawthorn rust:**

<http://www.missouribotanicalgarden.org/gardens-gardening/your-garden/help-for-the-home-gardener/advice-tips-resources/pests-and-problems/diseases/rusts/cedar-hawthorn-rust.aspx>

<http://extension.illinois.edu/focus/index.cfm?problem=cedar-hawthorn-rust>

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Himelick, E.B.; Neely, D. 1960. *Juniper hosts of cedar-apple and cedar-hawthorn rust. Plant Disease Reporter 44:109-112.*

<http://www.missouribotanicalgarden.org/gardens-gardening/your-garden/help-for-the-home-gardener/advice-tips-resources/pests-and-problems/diseases/rusts/cedar-quince-rust.aspx>. Retrieved on July 7, 2018.

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Kern F.D. 1973. *A revised taxonomic account of Gymnosporangium. University Park, PA: Pennsylvania State University Press. 134 p.*

Neely, D. 1983. *Chemical control of cedar-apple and cedar hawthorn rusts. Journal of Arboriculture 9:85-87.*

Rejuvenate Perennials in Fall by David Trinklein

Fall is a good time to dig, divide and (if necessary) move garden perennials, since the high temperatures of summer associated with water stress have subsided. The cooler weather of September and October causes renewed root growth and, in some cases, top growth. Both better enable perennials to survive the ensuing winter. Don't wait too long, however, since plants will need about six to eight weeks after rejuvenation to reestablish themselves before cold weather arrives.

Some perennials, such as peonies, rarely need to be replanted as long as they are flowering well. Failure to flower is more often the result of excessive shade, improper planting depth or poor growing conditions. Healthy, free-flowering peonies which have not been disturbed for over 20 years can often be found in gardens. However, if flowering has been poor due to inadequate light, now is the time to move them. Select a location that receives at least eight hours of direct sunlight and has soil that is well-drained. Dig the fleshy peony roots carefully and reset them one or two inches below the soil's surface. Avoid planting any deeper, since this can cause poor flowering.

Although iris normally are reworked earlier in the fall, it is still timely to replant them. However, later transplanting might result in reduced flowering next spring. This also is a good time to remove perennial weeds and grasses that may have invaded the iris bed. In fall, there is less chance for diseases to invade roots or rhizomes that might have been injured accidentally during the weeding process. Iris in the center of a clump become crowded and often fail to bloom. When this occurs, the clump needs to be divided. The sections around the outer perimeter of the clump have the most vigor and will redevelop most rapidly when divided and replanted.

Most daylily cultivars need to be replanted about every five years, although some can be left in one location longer. An exception would be reblooming daylilies such as 'Stella 'd Oro'. For maximum bloom production, clumps need to be divided more frequently to keep them young and actively growing. As with iris, if daylily plants are healthy and free-flowering replanting may not be necessary. Clumps can be divided into numerous sections before replanting. Larger plant sections (containing several fans) are better able to endure the rigors of winter. It is best to replant evergreen or semi-evergreen cultivars in summer, after the primary bloom period has ended.

While peonies, iris and daylilies are the "rock stars" among perennials, there are many others that can be dug, divided and replanted in the fall. Among them are astilbe, bleeding heart, butterfly weed, cone flower, hosta, perennial aster, Shasta daisy and yarrow.

When transplanting perennials in the fall, cut back top growth to within about six inches of the soil's surface. Making sure the soil is moist before digging, lift the clumps carefully. Try to move as much of the root system with the clump as possible. If division of the clump is warranted, do so with root preservation in mind. Species with spreading root systems most likely can be pulled apart by hand. Those having root systems that clump will likely need to be divided using a knife or other cutting instrument.

Common Quince, *Cydonia* versus Flowering Quince, *Chaenomeles* by Michele Warmund

After being divided or relocated, most perennials should continue root growth in the fall and become established before cold weather arrives. Some species may develop modest amounts of new top growth, depending on how long favorable growing conditions persist into late-fall or early winter. Water newly-divided plants well and continue to water if fall rainfall is not timely.

Nearly all of our popular perennials require well-drained soils. Most perennials that do not survive our winters die because of root problems associated with poorly drained soil, rather than cold temperatures. Incorporating organic matter into the soil is a good way to improve drainage. Peat moss, compost or well-rotted manure represent good sources of organic matter for gardeners. In settings where soil is tight and very poorly drained, raised beds or berms should be considered.

Fall-planted perennials benefit from mulch, at least for the first year. Mulch not only conserves soil moisture, but it helps to prevent alternate freezing and thawing of the soil during late fall and early spring. The latter tends to cause “frost heaving” in perennials with fleshy roots, such as hosta. Mulches do not keep plants warmer. Rather they function to protect them from rapid temperature changes and drying winter winds.

Many people consider perennials to be “care free” plants. Such is most often not the case. Neglected perennials bloom more poorly, become unthrifty and tend to be more prone to develop certain diseases. Properly done, rejuvenation by dividing or relocating the clump can keep perennials young, actively growing and floriferous.

Baffled by the quinces? If so, you are not the only one, as these genera have confused plant collectors for years. The jumble of names began in 1784 when botanist Carl P. Thunberg saw a flowering quince growing in Japan. Thinking it was a new type of pear tree, he named it *Pyrus japonica*. In 1807, Christiaan H. Persoon noticed that fruit of this plant had many seeds so it did not belong to the genus *Pyrus*. Thus, flowering quince became known as *Cydonia japonica* for a while. However, in 1822, John Lindley created the genus *Chaenomeles* to distinguish the flowering quince, which had stamens in two rows, from *Cydonia* with stamens in one row and also had different fruit anatomy. Perhaps, an easier way to distinguish these genera is that *Chaenomeles* is usually planted as an ornamental shrub with showy flowers (Figure 1) whereas *Cydonia oblonga* is grown for its fruit (Figure 2).

Today, *Cydonia oblonga* or the common quince is sold as a grafted tree, reaching about 15 to 20 feet-tall at maturity. Flowers are borne on the terminal portion of new growth and are usually self-pollinated. Trees are commonly trained to a vase shape and require little pruning when mature except for the removal of suckers. Because trees are susceptible to fire blight, they require light nitrogen fertilization to avoid excessive vegetative growth. The fruit is aromatic, yellow, and relatively large, about 3.5 to 4.5 inches long (Figure 1). Because of the fragrant fruit, these trees attract deer. The cultivar ‘Jumbo’ has white-fleshed fruit whereas ‘Orange’ has more rounded, orange-yellow flesh. ‘Pineapple’ has white flesh with a pineapple-like flavor, and ‘Smyrna’ has pink flowers and fruit with waxy, yellow skin. Raw quince fruit is bitter and acidic, but it sweetens and is more palatable when cooked, especially when poached. It is also used in jellies, tarts, or pies. Quince is also used to impart unique aromas, desirable bitter flavor, and astringency to fermented or hard cider.

Cydonia oblonga has also been used as a dwarfing rootstock for European pear planted at high density. ‘Comice’ pear trees grafted onto quince rootstock begin bearing fruit at a young age and have regular cropping with good fruit size and quality. However, quince rootstock has poor compatibility when grafted with ‘Bartlett’ or ‘Bosc’ pear.

Flowering quince, *Chaenomeles speciosa*, is a much more common shrub in the home landscape, ranging from three to five feet tall. These plants have tangled branches that produce showy flowers for about 10 to 14 days in early spring. Flowering quince shrubs are drought resistant and cultivars

with brightly colored blooms cultivars attract hummingbirds. Plants are often damaged by rabbit feeding, but are not particularly attractive to deer. Some of the more popular flowering quince cultivars are the Double Take series developed by Tom Ranney and his group in North Carolina, including ‘Scarlet Storm’, ‘Orange Storm’, ‘Pink Storm’, which have thornless branches, double flowers, and do not produce fruit. Cultivars with spines on branches, such as ‘Texas Scarlet’ with red flowers, ‘Toyo-Nishiki’ with white, pink, and reddish blossoms, and ‘Jet Trail’ with white flowers, usually produce small (1.5 inch-long), sparse fruit that may be used for jelly (Figure 3).



Figure 1 Flowering quince (*Chaenomeles speciosa*) shrub in full bloom.



Figure 2 Fruit of common quince (*Cydonia oblonga*) tree.



Figure 3 Fruit of flowering quince (*Chaenomeles speciosa*) shrub.