Campbell County Extension

Horticulture Newsletter

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Cooperative Extension Service

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How Dry Seasons Affect Woody Plants

Nicole Ward Gauthier, Plant Pathology, and Susan Fox and Kathy Wimberley, Horticulture

Pattern, frequency, and amounts of rainfall are important components to plant health. Water is an essential plant component, making up 70 percent to 90 percent of plant mass. Growth, photosynthesis (manufacture of food), nutrient transport, important chemical reactions, and the production of secondary metabolites are all dependent upon water uptake from roots. Water expands and enlarges new cells within stems and leaves, which holds them upright (turgor pressure).

During dry seasons and drought conditions, plants become stressed (Figure 1). Growth ceases, nutrient transport slows, and plants wilt as cells become water-deficient. Severe, long-term, or consecutive drought events may cause permanent damage.

Water Uptake in Plants

The driving force for transport of water throughout plants is transpiration. Evaporation from pores (stomata) on leaf surfaces creates a negative pressure that draws water up through plants. During periods when rainfall accumulation amounts are below average or when rainfall distribution is uneven, plant health declines. Thus, water is a vital resource for plant life.

Plant water and mineral uptake begins at delicate root hairs on feeder roots. Ninety percent of these root hairs are located on root tips that often occur in the top 12 to 15 inches of soil, and usually extend well beyond the driplines of trees. Thus, upper layers of soils require adequate moisture for optimum water and

Figure 1. *Water loss during drought reduces the amount of water and nutrients taken up by roots and, thereby, amounts reaching leaves and needles.*

mineral uptake, and plant health. Under hot, dry conditions, water availability may be reduced to feeder roots and they can become permanently damaged. Damaged roots are unable to absorb and transport water to upper plant parts.

The physical characteristics of soils largely govern water-holding capacity and availability. For example, clay and clay loam soils have

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How Dry Seasons Affect Woody Plants

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high water-holding capacities. Fine-textured clay soils hold much of their stored water for long periods of time. Conversely, course-textured soils (sands and sandy loams) have lower capacities to provide plant-available water. These coarse-textured soils cannot store enough water to last longer than a few days after rain or irrigation.

Compacted soils have lower water-holding capacities than non-compacted soils. When a given volume of soil is compacted, soil particles are crushed together and pore space reduced. Machinery, vehicular traffic, and even human or animal traffic can cause compaction, especially when soils are moist or wet. Plants in compacted soils often suffer from drought conditions.

Symptoms and Effects of Drought

Wilting—As leaves in some plant species lose water turgor, wilting is often the first visible effect. Lack of moisture usually affects all leaves on multiple branches or entire plants. Leaves that are exposed to afternoon sun and prevailing winds are usually affected first and most severely. During early stages of drought and soil drying, wilt may be temporary, and leaves will be turgid again by the next morning. In more severe drought conditions, plants wilt permanently and do not recover overnight. Extent of wilt may also depend upon physical properties of leaves. While most plants lose leaf water during dry conditions, visible signs depend upon leaf thickness and support tissue within leaves.

Leaf scorch—In some species, leaf scorch can occur in response to a water deficit. Older leaves, which are thick and rigid, and most conifer leaves may not wilt. Instead, they may turn brown entirely or just at tips (Figure 2) or margins (Figure 3). As conditions progress, marginal or tip browning may spread into areas between veins (Figure 4). After that, oldest leaves on weak branches turn brown and begin to fall. Species most susceptible to leaf scorch include flowering dogwood, maple, horse chestnut, ash, elm, and beech.

Leaf drop—Wilted or scorched leaves often drop. In this process an abscission layer is formed between twig and leaf, and nutrients are reabsorbed back into the plant from the leaf prior to dropping. This leaf loss improves the root-to-shoot ratio, helping to reduce transpiration. However, reduced photosynthesis can cause plant stress. Note that in some species, leaves do not abscise; they die and remain attached.

Figure 2. Conifers such as pines do not wilt; instead needle tips turn brown in response to drought.

Figure 3. Water deficiency in leaves may cause scorch of leaf margins.

Root loss—In dry soils, roots are unable to absorb sufficient water. They lose turgor, thereby losing contact with soil. Root hairs may become suberized (coated with waxy suberin), which prevents water loss. However, this process permanently reduces the ability of that root hair to take up water, even when soil moisture increases. Full water uptake and photosynthesis is not fully restored until new roots are produced.

Dieback—If drought conditions progress or worsen, both roots and woody tissues are affected. As feeder roots dry and lose functionality, water uptake is reduced, and stems are deprived of water and nutrients. Dieback is a common symptom of severe drought conditions (Figure 5). Even when soil moisture is replenished, root loss may not allow for sufficient uptake. This continued deprivation can result in continued abscission of twigs and branches. The dieback process resizes the canopy so it is proportionally similar to root capacity.

Increased susceptibility to diseases and insects—Stressed and declining plants are more susceptible to insect and disease than vigorous plants. In fact, some diseases and insects only affect damaged or stressed plants. These pests and pathogens are called secondary invaders. In some instances, infection or infestation by these secondary invaders deliver the "final blow" to drought stressed trees.

Susceptibility to winter injury—Stressed and declining plants are often more susceptible to winter injury. Cold injury takes several forms, including black heart in stems of trees and shrubs, sunscald and frost splitting of tree trunks, winter burn of conifer foliage, and dieback of overwintering broad-leaved plants. Plants can be injured or killed by low temperatures at any time of the year, but especially in autumn when plants are not yet hardened off.

Loss of next year's growth—Drought impact may be seen the following year in reduced leaf formation and reduced shoot expansion. In addition, the resulting reduced cambial growth limits food supplies for the next season's growth. Trees that have shed leaves as a drought response may form new buds in late summer or fall when rains return. If these buds do not fully harden, they may be subject to winter kill and result in a sparse crown the following season.

Other Effects of Drought Stress

Short-term drought—Even short-term drought can have negative effects on woody plants. After soil moisture is replenished, stomata can take a long time to reopen, delaying adequate exchange of gasses and production of plant

Figure 4. Extensive leaf scorch includes browning of leaf margins that spreads to tissue between veins.

carbohydrates (energy). Stressed trees may also direct energetic resources to production of seeds and cones (energetic partitioning to reproduction) rather than to growth. These factors create additional stress to plants.

Long-term drought—During periods of repeated or extreme drought conditions, plants may suffer long-term effects from tissue loss. Growth can remain stunted for many years due to loss of critical tissue.

Plant Care during Extended Drought Conditions

Healthy plants are better able to tolerate stressful events, including drought. Vigorous plants often have deeper, more extensive root systems that can use water from broader areas. Therefore, maintaining plant health is the first step in protecting woody plants from drought. During dry seasons, gardeners must take extra steps to reduce plant damage.

Supplemental irrigation—Wilting is one of the first symptoms of water stress. If plants begin to wilt, they should be watered before permanent damage occurs. Often, herbaceous plants, such as annual bedding plants, are early indicators of dry soils. Ideally, gardeners should use a moisture meter to monitor soil moisture.

Shallow rooted plants and newly planted woody plants (less than five years old) require higher soil moisture, and thereby more frequent irrigation, than established plants. New trees and shrubs should not be planted during summer, as they are extremely sensitive to fluctuations in soil moisture.

The number of irrigations and the amount of water required during dry summers depends upon the water-holding capacity of the soil, rooting depth of the plants (age and/or establishment), and environmental conditions. The following guidelines are generalizations for watering trees and shrubs. Gardeners should consider site-specific factors as well as plant species when scheduling irrigation.

Figure 5. Prolonged water deficiencies cause death of woody tissue, leading to dieback.

Examples of Stress-Induced Diseases

Botryosphaeria and Cytospora cankers on wounded deciduous and evergreen plants

Verticillium wilt on drought-stressed redbud and maple, and many other hosts

Diplodia and Stigmina needle casts on weakened pine and spruce

Armillaria root rot (Figure 7) on a wide range of woody plants, especially stress-weakened trees

Seridium canker on drought and water-stressed Leyland cypress

Insects Attracted to Stressed Trees

Borers (Figure 6), such as two-lined chestnut borer and flat-headed apple tree borer, on deciduous trees

Bark beetles on stressed deciduous and evergreens

Scale insects on water-stressed trees

Tip moths and twig girdlers on small branches and twigs

Gall-makers on stressed deciduous trees

Frequency of watering—Where plants are well-established and in well-drained soil, a thorough watering once every two weeks often is sufficient. Newly planted trees and shrubs require watering every five to 10 days.

A single deep watering is better than the same amount of water applied more frequently in smaller doses. Deep watering encourages plants to root more deeply, as opposed to surface rooting, which occurs with frequent, shallow irrigations.

Conditions conducive to water loss (day temperatures 90oF or above, night temperatures above 70oF, reduced humidity, etc.) result in increased need for irrigation. Dense, clay-type soils retain more water than medium- or coarse-textured soils, so these soils do not need watering as often.

Time of watering—Early morning or late evening water applications reduce water loss to evaporation compared with afternoon water applications. Apply water at a slow rate to

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Figure 6. Some diseases, such as Armillaria root rot (honey mushrooms), favor stress-weakened trees.

allow water to filter into (infiltrate) soil and to prevent runoff. If using overhead irrigation, water early in the day so leaf surfaces dry more quickly, thus reducing risk for infection by foliar pathogens that favor leaf wetness.

How much water to apply—Often, 1½ to 2 inches of water every two weeks is sufficient for keeping root zones moist. This varies with plant size and species, and with soil and site. Newly planted trees and water-loving trees may require 3 inches of water when temperatures climb above 90oF degrees. These include birches, alders, poplars, tulip poplars, pin oaks, and silver maples. Drought-tolerant trees require less water once established in the landscape.

Where to water—Water should be applied evenly across root zones where root hairs and feeder roots are growing. Tree roots often extend 1½ to 2 times the diameter of the dripline, so irrigation should cover entire root zones. Watering at the trunk will not provide water to the feeder roots.

Avoid overwatering—Increased efforts to prevent drought stress may lead to excessive irrigation. Overwatering is common in clay and clay loam soils, which have high water-retention properties and do not drain quickly. Additionally, low-lying areas are often at risk for overwatering if nearby soils dry out more quickly when uniform irrigation is scheduled for all zones.

Reduction of competitor plants—Remove cover crops around trees and shrubs. Kill or remove grass around them as well.

Mulch—Organic mulch (bark, wood chips, pine straw, leaves, or grass clippings) up to 2 to 3 inches deep should be extended to the edge of root zones (at least to driplines) to conserve soil moisture. Avoid placing mulch within 6 inches of tree root flares, keeping trunks dry while minimizing potential for girdling by pests. Refer to Mulch Myths (HO-106) for more information.

Limit pruning—Do not prune plants in extremely hot, dry weather.

Fertility—Low-level fertilizer applications, based on soil test report recommendations, may be helpful to trees recovering from a drought.

Plant Selection

Plants with good survival records during drought— **Table 1.** Some native plants in Kentucky have had a good record of survival during past dry periods. These plants have potential for planting in poor landscape sites (shallow soils, compacted soils, and other disturbed soils):

Table 1. Plants with good survival records during drought.

Botanical name	Common name
Carya spp.	Hickory (pignut, shagbark)
Celtis spp.	Hackberry (hackberry, dwarf hackberry)
Cercis canadensis	Eastern redbud
Chionanthus virginicus	Fringetree
Cladrastris kentukea	Yellowwood
Corylus americana	American hazelnut
Ginkgo biloba	Ginkgo
Gymnocladis dioicus	Kentucky coffeetree
Juniperus spp.	Junipers (Eastern redcedar)
Nyssa sylvatica	Black gum (black tupelo)
Pinus spp.	Pines (shortleaf, pitch, Virginia, loblolly)
Quercus spp.	Oaks (blackjack, chestnut, post, willow, shingle, southern red, overcup, Shumard, northern red, black, scarlet, bur, pin, white)
Rhus spp.	Sumacs (smooth, staghorn)
Robinia pseudoacacia	Black locust
Sassafras albidum	Sassafras
Ulmus spp.	Elms

Figure 7. *Borers are attracted to stressed plants.*

Plants with poor survival records during droughts—

Table 2. These plants have shown widespread decline and death during past dry periods in Kentucky:

Table 2. Plants with poor survival records during drought.

Botanical name	Common name
Acer palmatum	Japanese maple
Acer saccharum	Sugar maple
Cornus spp.	Dogwood
Fagus spp.	Beech
Picea abies	Norway spruce
Pinus strobus	White pine
Tsuga spp.	Hemlock

Additional Resources

Web Sites

Entomology Extension Publications (ENTFacts): http://www2.ca.uky.edu/entomology/dept/entfacts.asp

Horticulture Extension Publications for Homeowners: http://www.uky.edu/hort/home-horticulture

Plant Pathology Extension Publications: http://www2.ca.uky.edu/agcollege/plantpathology/extension/pubs.html

UK Ag Weather Center Irrigation Manager: http://weather.uky.edu/ky/agmodels.php#Irrigation_Manager

Publications

Leaf Scorch and Winter Drying of Woody Plants (PPFS-W-OR-17): http://www2.ca.uky.edu/agcollege/plantpathology/ext_files/PPFShtml/PPFS-OR-W-17.pdf

Mulch Myths (HO-106): http://www2.ca.uky.edu/agc/pubs/ho/ho106/ho106.pdf

Principles of Home Landscape Fertilization (ID-72): http://www2.ca.uky.edu/agc/pubs/id/id72/id72.pdf

Stress and Decline in Woody Plants (ID-50): http://www.ca.uky.edu/agc/pubs/id/id50/id50.htm

Transplant Shock: Disease or Cultural Problem (PPFS-OR-W-19): http://www2.ca.uky.edu/agcollege/plantpathology/ext_files/PPFShtml/PPFS-OR-W-19.pdf

Trees and Compacted Soils (HO-93): http://www2.ca.uky.edu/agc/pubs/ho/ho93/ho93.pdf

Acknowledgement

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Figures

1: Nicole Ward Gauthier; **2:** Robert L. Anderson USDA Forest Service, Bugwood.org; **3, 4, 7**: Cheryl Kaiser, UK Plant Pathology **5, 6**: William Fountain, UK Horticulture

Garden Renovation Project...

Installing a butterfly garden can play a critical role in plant pollination

Source: Faye Kuosman, UK Food Connection coordinator

Butterflies aren't the only ones that can benefit from butterfly gardens. Honeybees, which are native to Europe and introduced to the United States, are also important pollinators for home gardens. Numerous other pollinator species including native bees, butterflies and moths, beetles, birds and bats benefit our gardens. Sadly, many of the pollinators have suffered from habitat loss, chemical misuse, diseases and parasites.

Butterfly gardeners play a critical role in nurturing and conserving both native and introduced pollinators. Butterfly gardens and landscapes provide pollinators with food, water, shelter and habitat to complete their life cycles. Urban areas typically feature large areas of pavement and buildings and offer little in the way of food and shelter for pollinators. Garden plantings can help bridge that gap.

Just like with any new flower bed, you want to pick a site for your butterfly garden with good drainage, full sun and an area with good weed control. If you are starting a new butterfly garden, get a soil test, eliminate the weeds and add organic matter.

Butterflies, honeybees and other pollinators need protein from flower pollen and carbohydrates from flower nectar. Plan to provide a variety of different types of flowers and aim to have three different flower species in bloom throughout the growing season. Showy, colorful flowers and massed groups of flowers, particularly in small gardens, provide efficient feeding stations for the pollinators. Flowering trees and shrubs also provide excellent food sources. Native plants share a long history with their pollinators, including a wide variety of natives will make your garden a favorite destination for pollinators.

You want to have a variety of plants, preferably native and non-native ones that will bloom throughout the growing season. Some of these are purple cone flower, black-eyed susan, asters, golden rod, yarrow, tall blazing star, milkweed, coreopsis and many more. The Kentucky Native Plant Society has an updated listing of nurseries in Kentucky that sell native plants.

Be sure to have puddling spots for butterflies to get a drink of water. Pollinators also need shelter from the wind, scorching sun, and heavy rain. Fences can serve as windbreaks, which may make the garden more attractive to pollinators.

For information on starting a butterfly garden, contact the Campbell County Extension office.

Fall Frost and Freeze Information for The Bluegrass State

By Derrick Snyder – National Weather Service Paducah, KY

As we move through the month October, the risk of crop-killing frosts and hard freezes will quickly increase. The National Weather Service office in La Crosse, WI, compiled the following list of meteorological conditions that can lead to frost conditions:

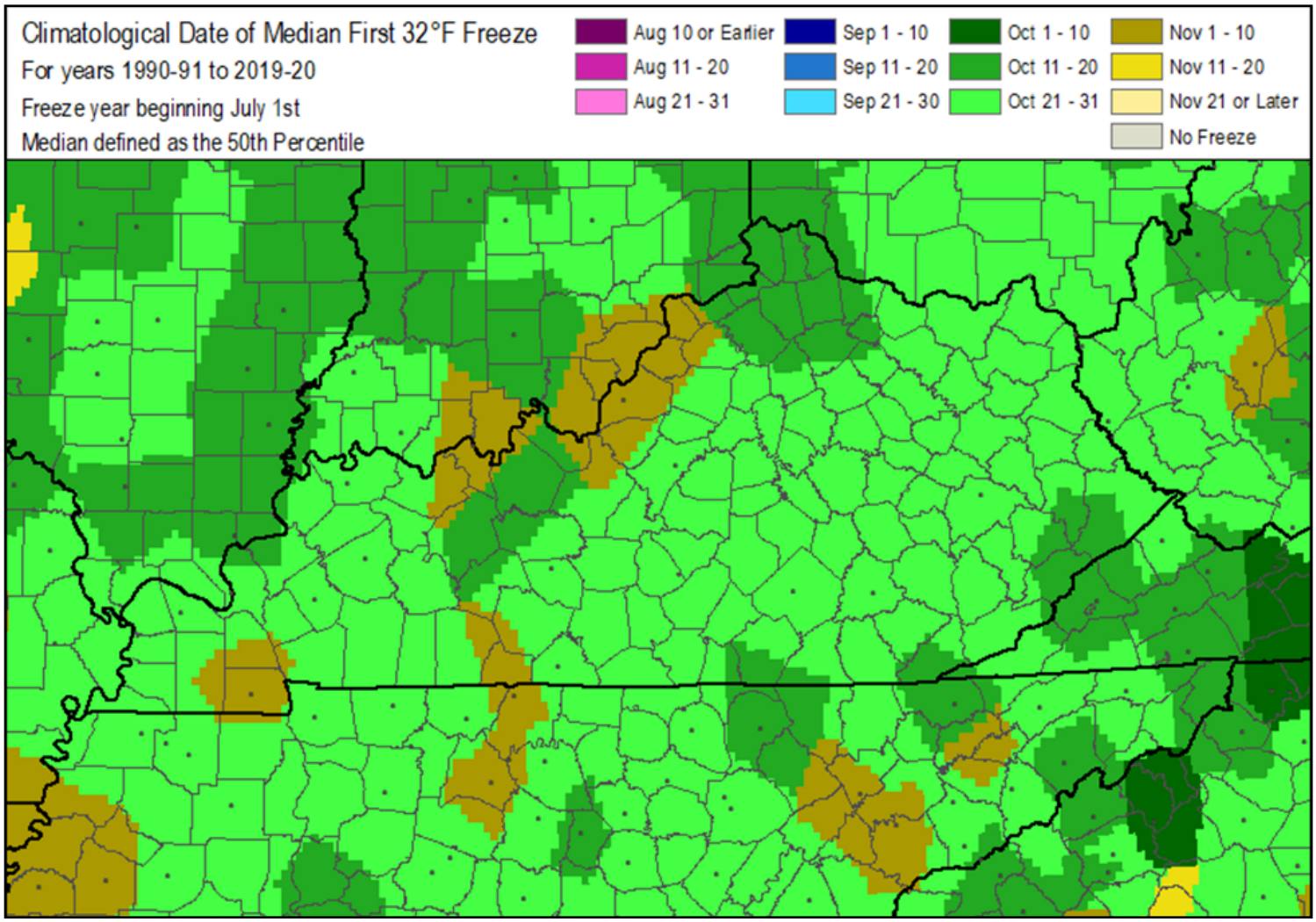
Clear skies lead to radiational cooling, allowing the greatest amount of heat to exit into the atmosphere.

Calm to light winds prevent stirring of the atmosphere, which allows a thin layer of super-cooled temperatures to develop at the surface. These super-cooled temperatures can be up to 10 degrees cooler than five to six feet above the surface, where observations are typically taken. This is why frost develops even when reported temperatures are a few degrees above freezing.

Cool temperatures, with some moisture, that promote ice crystal development. If the supercooled, freezing temperatures can cool to the dew point (the temperature at which, when cooled to at constant pressure, condensation occurs; moisture will have to come out of the atmosphere as fog, frost, etc.) frost could develop on exposed surfaces.

Local topography also has a large role in determining if and where frost develops. Cold air will settle in the valleys since cold air is heavier than warm air, therefore frost conditions are more prone in these regions. Valleys are also sheltered from stronger winds, enhancing the potential for frost.

Other local effects, such as soil moisture and temperature, and stage of vegetation "greenness", are factors that can affect the possibility of frost forming. The Midwest Regional Climate Center has put together a map of when Kentucky can typically expect to see the first 32 degree freeze of the season. The great majority of the commonwealth will see the first hard freeze during the last 10 days of October, but this can vary a week or two sooner or later depending on the set-up for that particular year.



Cooperative Extension Service

Northern Kentucky Master Gardener Program

Cost: $150.00

$50 refund if your volunteer hours are completed within one year.

Fridays–10:00 a.m.–2:00 p.m.
January 3, 2025 thru March 28, 2025

For more information call (859) 572-2600

Registration deadline: November 1, 2024

Join other gardeners for this 12-week volunteer training program. Subjects include botany, tree identification, soils, propagation, disease and insect identification and much more. Complete the program requirements and use your new knowledge by volunteering 40 hours at Extension–approved sites in order to become a *Certified Master Gardener*.

Classes will be held at:
Campbell County Extension Office
3500 Alexandria Pike
Highland Heights, KY 41076

This class has limited space.

KENTUCKY MASTER GARDENER

Cooperative Extension Service

Agriculture and Natural Resources
Family and Consumer Sciences
4-H Youth Development
Community and Economic Development

MARTIN-GATTON COLLEGE OF AGRICULTURE, FOOD AND ENVIRONMENT

Lexington, KY 40506

Disabilities accommodated with prior notification.

Campbell County Hosts the next Master Gardener Class

The Master Gardener Volunteer Program may be for you if you answer YES to either of the questions below the pictures.

The NKY Master Gardener Volunteer Program is a partnership between Boone, Campbell and Kenton counties.

This is a two-part program. The first is an extensive 12-week training program. Participants will learn about a wide variety of horticulture subjects, such as botany, soils, disease and insect identification, plant propagation and much more. They will then take that knowledge to volunteer at extension-approved locations in the community.

If you are not interested in becoming a volunteer, the extension service offers a variety of homeowner gardening programs free of charge.

Campbell County will be hosting the next session. Classes begin Friday, January 3, 2025 and end March 28. We meet every Friday from 10:00am-2:00pm. Tuition is $150. If you complete the volunteerism portion, within a year, you qualify for a $50 refund.

For more information and to get an application, contact Terri Turner at 859-572-2600.

Do you want to volunteer in your community?

Do you have a passion for gardening?

ORCHARD FIELD WALK

September 18, 2024

4 – 6 p.m. (EDT)

University of Kentucky North Farm

1925 Research Farm Road | Lexington, KY 40511

Join us for an orchard walk at the new Modern Orchard Systems and Climate Resilience Research and Extension Orchard at the University of Kentucky's North Farm in Lexington. The event will begin with an open house/self-guided tour starting at 4 p.m. (EDT), then a guided tour and group discussion starting at 5 p.m. Participants will learn about new training systems and production techniques in apples, pears, and peaches as well as special considerations for pest and disease control in young orchards from UK extension faculty in horticulture, plant pathology, and entomology. This event will be useful for new growers interested in starting orchards and for existing producers who want to learn the most up-to-date techniques. Spanish translation will be provided for both written and oral materials; please bring a cell phone with head phone/ear bud capabilities.

Registration is required and can be found here:
https://uky.az1.qualtrics.com/jfe/form/SV_0CHafwgWqeuZ5Ua

It's Back!...

Return of the Fall Armyworm?

In 2021, Kentucky was one of many states that were impacted by a historic outbreak of fall armyworms. That year marked perhaps the worst year for the pest since the 1970s and has inspired fear and dread about these hungry, hungry caterpillars rearing their head again. In the past week, reports from western and central Kentucky have indicated that some folks are seeing fall armyworms in turfgrass areas. It doesn't seem to be at the same levels we experienced in 2021 but it doesn't hurt to review how this pest works and what can be done about it.

Click Here for more information: https://kentuckypestnews.wordpress.com/2024/08/20/return-of-the-fall-armyworm/

Apple Rust Disease

Nicole Ward Gauthier Extension Plant Pathologist | Annette Meyer Heisdorffer Extension Horticulture Agent
University of Kentucky College of Agriculture, Food and Environment

Importance
Cedar-apple rust is the most common and economically important rust disease occurring on apple in Kentucky. Two other rusts, cedar-hawthorn rust and cedar-quince rust, are of lesser importance on apple, but can significantly impact ornamental plants. All three diseases occur on crabapple, hawthorn, mountain ash, pear, and serviceberry.

Rust diseases may cause serious losses within orchards. Leaf infections weaken trees and result in a reduction in fruit size and quality of the current crop, as well as reduced bloom the following year. Heavy infections occurring over several consecutive years result in stunting, increased susceptibility to winter injury, and failure to produce fruit. These stresses may result in tree death. Infected fruit may drop prematurely, while those that remain on trees until harvest have reduced market value.

Symptoms & Signs On Apple Leaves
Cedar-apple rust infections begin as small, pale yellow spots on upper leaf surfaces in mid- to late spring. Spots gradually enlarge (up to ¼ inch in diameter), become bright yellow-orange, and are frequently surrounded by a reddish border (Figure 1). Fungal fruiting bodies (pycnia; not the same as pycnidia) appear as black dots in spot centers (Figure 2). As the fungus continues to

Figure 2. *Fruiting bodies of Cedar-apple rust on apple appear as pycnia (black dots) in lesions.*

colonize infected leaves, yellow spots develop on lower leaf surfaces and tissue becomes noticeably thickened. In late spring or early summer, clusters of small orange-yellow, tubular fruiting bodies (aecia) project downward from these lower surface spots (Figure 3); aecia eventually release mass of light brown spores (aeciospores). Infected

Figure 1. *Cedar-apple rust on apple leaves are bright yellow-orange with a red border.*

leaves may turn yellow and drop, especially as trees become stressed (e.g., drought).

Cedar-hawthorn rust spots on apple, crabapple, hawthorn, pear, and serviceberry are similar in appearance to cedar-apple rust, but few tubular aecia form.

Cedar-quince rust often does not cause leaf spots on these trees.

Fruit
Cedar-apple rust fruit spots usually appear near the blossom end (calyx) of fruit (Figure 4). They are similar in color to leaf spots (yellow- orange), but are much larger (¾ inch or more in diameter). Each fruit spot is surrounded by a dark green zone on otherwise light green fruit. When present, tubular aecia are found in a circular pattern surrounding black dots (pycnia); pycnia develop on a raised, roughened cushion of

Figure 3. *Advanced signs of Cedar-apple rust on apple include tubular Fruiting bodies (aecia) projecting downward.*

tissue. Fruit flesh underneath surface lesions turns somewhat corky, but remains alive. Infected fruit frequently becomes deformed and may drop prematurely.

Cedar-quince rust causes fruit to become puckered at the blossom end (calyx) if infection occurs when fruit are an inch or less in diameter. Later, sunken, dark green spots develop. Fruit flesh underneath surface lesions dies and becomes brown and spongy, often all the way to the core. Pycnia and aecia rarely develop, making

positive diagnosis difficult. Hawthorn fruit, on the other hand, show profuse numbers of the tubular aecia on abnormally swollen fruit (Figure 5).

Cedar-hawthorn rust fruit infections are rare.

Twigs
Cedar-apple rust seldom affects apple twigs. Cedar-quince rust causes infected hawthorn and crabapple twigs to become swollen; tissue above infected sites dies as twigs are girdled.

Figure 4. *Cedar-apple rust occurs on or near blossom end (Calyx) of apple Fruit.*

On *Juniperus* species
Apple rusts affect junipers and cedars in what is considered an alternate host relationship. These alternate hosts include many Juniperus species, such as native red cedars and ornamental junipers. These hosts are not seriously damaged by cedar rust diseases.

Cedar-apple rust results in the development of brown, rounded galls (known as 'cedar apples') in leaf axils of infected cedars and junipers. Galls are pea-sized to 2 inches in diameter with surfaces that become pitted

Figure 5. Cedar-quince rust on hawthorn Fruit includes protruding tubular aecia.

with circular depressions (Figure 6). In early spring, slimy, jelly-like, yelloworange tendrils ('spore horns') up to 2 inches long protrude from these depressions following rainy periods (Figures 7 & 8). A single gall may produce from one to more than 100 spore horns, which often cause the galls to resemble orangecolored blossoms from a distance.

Cedar-hawthorn rust galls are small, irregular in shape, and do not develop a regular arrangement of circular depressions. Spore horns are short, generally few in number, and wedge- or club-shaped.

Cedar-quince rust does not form rounded galls, but instead forms perennial, spindle-shaped swellings on twigs. A gelatinous, orange-brown mass of spores (teliospores) is produced in the swellings in spring (Figure 9).

Figure 6. Cedar-apple rust galls (called 'cedar apples') develop on cedar and juniper, appearing initially as brown globular masses.

Figure 7. Telia begin to emerge from cedar-apple rust galls following rainy weather.

Cause & Desease Development

The cedar rusts are caused by different species of the fungus *Gymnosporangium*:

- Cedar-apple rust—G. *juniper-virginianae*
- Cedar-hawthorn rust—G. *globosum*
- Cedar-quince rust—G. *clavipes*

The life cycle of each fungus is very similar and quite complex—several spore types are produced, and two different hosts are required to complete a cycle that spans 2 years.

On *Juniperus* species

Rust fungi overwinter as galls or swellings produced on Juniperus species. These galls/

Figure 8. Eventually, bright yellow-orange tendrils (telial horns) develop.

Figure 9. Cedar-quince rust causes swellings of orange telia on juniper.

swellings expand under favorable environmental conditions over a period of 2 years and then produce yellow-orange gelatinous masses (teliospores) in spring following the second winter. Teliospores germinate under moist conditions to form another spore type (basidiospores).

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Table 1. Disease-resistant apple cultivars.[1]

Cultivar	Disease Resistance Ratings To[2]			
	Apple Scab	Cedar Rust	Fire Blight	Powdery Mildew
Pristine[3]	VR	S	S	R
Williams Pride	VR	S	MR	R
Redfree[3]	VR	VR	S	S
Dayton[3]	VR	R	MR	R
Liberty[3]	VR	R[4]	R	R
Nova Easygro	VR	VR	R	S
Spartan[3]	MR	R	MR	R
Jonafree[3]	VR	S	S	R
Pixie Crunch[3]	VR	—	—	—
Macfree	VR	VR[4]	MR	S
Priscilla[3]	VR	VR[4]	VR	R
WineCrisp	VR	MR	VR	MR
CrimsonCrisp	VR	MR	S	S
Enterprise[3]	VR	VR[4]	MR	R
GoldRush[3]	VR	S	MR	S
Sundance[3]	VR	VR	VR	VR

Ratings

VR = very resistant R = resistant

MR = moderately resistant

S = susceptible

— = insufficient information.

notes

All apples require cross-pollination by a different variety. Winesap and Sir Prize cannot serve as pollinizers because they have sterile pollen.

- [1] For the complete table that includes apple cultivar characteristics, harvest period, and storage comments, refer to ID-21, listed in Additional Resources.
- [2] Resistance to diseases other than scab has not been fully evaluated and may differ in some locations from that reported here.
- [3] Produces high-quality apples in Kentucky.
- [4] Although these cultivars are resistant to cedar apple rust, they are susceptible to cedar quince rust.

On Apple

In early spring, basidiospores are carried by air currents from cedar/juniper to apple trees (or other related hosts). Although trees may occasionally become infected by basidiospores produced up to several miles away, most infections result from spores produced on infected Juniperus species within a few hundred feet of trees. Basidiospores can cause infections

Leaf spots develop on upper apple leaf surfaces about 10 to 14 days after infection by basidiospores. Another spore type, pycniospores, forms in the developed lesions. Several weeks later, aecia form on the undersides of leaves; aeciospores are then blown to nearby cedars and junipers. The infection of Juniperus species by aeciospores results in the formation of cedar- apple galls or swellings, thus completing the cycle that began 2 years earlier.

Disease management

Resistant Cultivars

- Select and grow apple or juniper cultivars that are resistant or immune to rust. See Table 1 for information on apple cultivars and their response to cedar-apple rust, as well as other common apple diseases.
- Resistance may vary among localities, depending upon the specific races of the rust species present in the area.

Sanitation

- Destroy nearby unmanaged, abandoned, or wild apple, crabapple, cedar, or juniper trees.
- When practical, prune and destroy cedar apples found on ornamental junipers and cedars.

Fungicides

- Follow a recommended fungicide management program for apple. Early protection beginning at the pink-bud stage is especially important for management since most infections occur within the first 30 days after bloom.
- For specific spray recommendations, refer to the appropriate publications listed in Additional Resources; these are available online and at county Extension offices.

Additional Resources

- Disease and Insect Control Program for Homegrown Fruit in Kentucky including Organic Alternatives, ID-21 http://www.ca.uky.edu/agc/pubs/id/id21/id21.pdf
- Midwest Tree Fruit Spray Guide (for commercial growers), ID-92 http://www2.ca.uky.edu/agcollege/plantpathology/ext_files/PPFShtml/MwTreeFruitSprayGuideID92.pdf
- Simplified Backyard Apple Spray Guides, PPFS-FR-T-18 http://www2.ca.uky.edu/agcollege/ plantpathology/ext_files/PPFShtml/PPFS- FR-T-18.pdf
- Woody Plant Disease Management Guide for Nurseries and Landscapes, ID-88 http://www.ca.uky.edu/agc/pubs/id/id88/id88.pdf

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Photos—*James Chatfield, The Ohio State University (fig. 1), Brian Olson, Oklahoma State University (fig. 2), Dawn Dailey O'Brien, Cornell University (figs. 5 & 9), Elizabeth Bush, Virginia Polytechnic Institute (fig. 8), Bugwood. org; and Nicole Ward Gauthier, UK (figs. 3, 4, 6, 7)*

Revised from the fact sheet, Rust Diseases of Apple (PPA-23), originally written by W.F. Wilcox, C.A.Kaiser, J.R. Hartman, and R.E. Stuckey

Pawpaws: Kentucky's Underappreciated Fruit

Custard Apple. Dog Banana. Michigan Banana. Hoosier Banana. Kentucky Banana. These are all names given to the pawpaw (*Asimina triloba*).

The pawpaw is the largest edible fruit in the U.S. and Canada. It is a Kentucky native fruit with a tropical taste. The flavor is often compared to mangoes, bananas and even pineapples. The flesh has a creamy, custard-like texture. The main limitation in pawpaw production is a short shelf life. It is not usually found in stores. You are more likely to find fresh pawpaws at a farmers' market. Pawpaws are also used in many food products. They can be used in muffins, bread, custard. It is also used to make ice cream!

Pawpaws have played a part in American history. George Washington recorded in his diary, March 7, 1785 "planted all my cedar trees, pawpaw trees, and honeylocust trees". It was said that chilled pawpaw was one of his favorite desserts. Pawpaws were also a favorite of Thomas Jefferson. He sent several shipments of seed to friends in Europe. Explorers Lewis and Clark gave credit to the pawpaw. On September 18, 1806, William Clark wrote in his journal, "entirely out of provisions Subsisting on poppaws"

Pawpaw trees are also the exclusive host of the Zebra Swallowtail butterfly. If you see this butterfly around your trees, it is probably laying its eggs on the leaves.

Pawpaw trees are usually found in the forest understory. Tree seedlings under 18" tall are sensitive to full sun. However, once trees are over 18" tall, they produce more fruit in sunny locations. Trees can reach about 15-20 tall. The small, bell-like, dark purple flowers bloom in April and May. It is pollinated mostly by flies and beetles. Placing roadkill in the "pawpaw patch" to attract flies was a common practice. This would probably not be practical in the home landscape. Fruits ripen from August-October. The fruits have been described as large green potatoes and are usually found in clusters of 2-5 fruits. Inside the fruit, you will find yellow-orange flesh and two rows of large seeds. Do not eat the skin or seeds as the taste is quite bitter. Pawpaws are high in nutrients compared to other fruits.

Many will comment that they have a large patch of pawpaw trees but no fruit. The pawpaw tree is not self-fertile. You will often see pawpaw trees sucker to form a colony or patch. These suckers are coming from the original tree. This means you will need at least two different trees for pollination.

Kentucky State University has the only full-time *Pawpaw research* program in the world as part of the KSU Land Grant Program. Their

breeding program have introduced cultivars (cultivated varieties) of pawpaw such as KSU-Attwood and KSU-Benson and Chappel. These cultivars may better production and flavor than seed grown varieties.

Many communities celebrate the pawpaw with yearly festivals. The Second Annual Louisville Pawpaw Festival was held September 7th, 2024 at the Louisville Nature Center.

For more information on growing pawpaws in Kentucky, visit https://www.kysu.edu/academics/college-ahnr/school-of-anr/pawpaw/index.php

Pawpaw Ice Cream

- **1 qt. cold milk**
- **6 eggs**
- **½ tsp. salt**
- **1½ c. sugar**
- **1 c. pureed pawpaw pulp, or more to taste**
- **juice of 1 lemon**
- **1 qt. heavy cream**
- **2 Tbsp. vanilla**

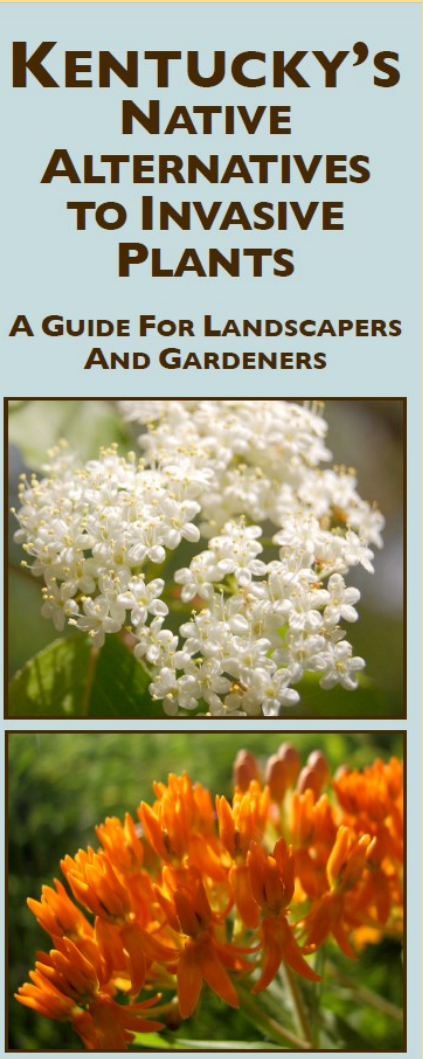
- Scald 3 c. of the milk in the top of a double boiler. Beat eggs well; add salt, sugar, and the remaining cup of milk. Stir egg mixture slowly into the hot milk and cook over a small amount of simmering hot water, stirring constantly, until mixture just coats a clean metal spoon. To prevent curdling, do not have the water boiling vigorously, and take care not to overcook. Stop cooking as soon as the custard coats the spoon and remove from heat at once. Cool pan of custard in another pan containing cold water, then chill thoroughly in refrigerator.
- Combine pawpaw puree with the lemon juice and add to the chilled custard along with the cream and vanilla. Pour mixture into a chilled 1-gallon ice cream freezer canister and fit dasher into place. Freeze and ripen according to directions accompanying ice cream freezer, or as follows:
- Fill the freezer tub around the canister with finely cracked ice and salt, using 1 part ice cream salt to 8 parts of ice, or about 1 qt. of salt for a gallon-sized ice cream freezer. Fill the freezer half full of ice before adding the first layer of salt, then alternate layers of ice and salt until the tub is filled. Freeze until the ice cream stiffens (about 20 minutes with an electric ice cream freezer). Then repack the freezer tub with ice, or remove the ice cream and place it in an ice cream mold, and let the ice cream ripen for several hours before serving.
- To repack the freezer, remove the dasher, plug up the hole in the lid of the ice cream canister, drain out the salt water through the hole in the side of the ice cream freezer, and add fresh ice and salt to fill the freezer tub. Put cracked ice, but no salt, over the top of the canister, too. Cover the whole freezer with blankets or newspapers and let it stand in a cool place for several hours.

Keep an eye out for this bug. Beautiful, but dangerous!

If you find it, please don't squish and kill it.
Please collect and place in the freezer AND call us!

[Click Here for more information: https://entomology.ca.uky.edu/ef465](https://entomology.ca.uky.edu/ef465)

Fall is a great time to identify invasive plants and plan for removal. *Here is a great resource as you plan for replanting:*



KENTUCKY EXOTIC PEST PLANT COUNCIL
KY-EPPC
Est. 2000
http://www.se-eppc.org/ky/

The Garden Clubs of Kentucky
http://www.gardenclubky.org/

[Click Here for more information: https://www.se-eppc.org/ky/KY_native_alternatives.pdf](https://www.se-eppc.org/ky/KY_native_alternatives.pdf)

Sarah Imbus

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Garden Calendar: September - October

General

- **Watering:** You may need to continue watering in the fall. Most landscape plants require 1" of rainfall every 7 days. If rainfall has not been adequate, supplement watering. A rain gauge is a handy tool to track rainfall in your yard.
- **Soil Testing:** If you plan to fertilize your plants or lawn this fall, you may want to get a soil test first. This is a free service for Campbell County residents. To learn how to take and submit a soil sample, visit www2.ca.uky.edu/agcomm/pubs/agr/agr16/agr16.pdf

Lawns

- **Seeding:** You still have time to put down grass seed. Mid-August through September is the best time of year to put down your grass seed. To learn more about establishing a lawn visit: www2.ca.uky.edu/agcomm/pubs/AGR/AGR50/AGR50.pdf
- **Lawn renovation:** visit http://www2.ca.uky.edu/agcomm/pubs/agr/agr51/agr51.pdf
- **Fertilizing:** The best time to fertilize cool-season lawns (Kentucky bluegrass, tall fescue, perennial ryegrass, fine fescue) in Kentucky is during the autumn. These grasses all grow optimally during cooler weather and can best utilize nutrients at this time of year.

Flowers

- **Planting:** Plant mums, aster, and pansies for fall color. If left in the ground, pansies will often survive the winter and put on a beautiful spring display.
- **Plant spring blooming bulbs this fall.** Select bulbs that bloom early, mid and late spring to extend your blooms. To learn more visit, www.uky.edu/hort/sites/www.uky.edu.hort/files/documents/5204springbulbs.pdf

Trees & Shrubs

- **Fertilize:** Fall is the best time to fertilize trees and shrubs. Go to www2.ca.uky.edu/agcomm/pubs/id/id72/id72.pdf for more information.
- **Planting:** Early fall is a great time to plant trees. To learn proper planting techniques, see https://forestry.ca.uky.edu/sites/forestry.ca.uky.edu/files/forfs_17-08_planting_trees_inlandscapes.pdf

Vegetables

- **Dig sweet potatoes** when the tops have died. Use a pitchfork to avoid damaging the tubers.
- **Plant garlic** from October to early November. Hardneck garlic performs best in Kentucky.
- **Many diseases and insects can overwinter in garden debris.** Remove dead or diseased plants from the garden.

Fruits

- **Fall—September** is the time to harvest PawPaws. For more information on growing our native KY fruit, KSU has more helpful growing information: https://www.kysu.edu/academics/college-acs/school-of-ace/pawpaw/index.php
- **Late summer/early fall** is the time to harvest grapes. To learn more about growing grapes and when to harvest, check out this helpful UK publication: chrome-extension: http://www2.ca.uky.edu/agcomm/pubs/id/id126/id126.pdf

- **Late summer/early fall** is the best time to harvest figs, persimmon and other tree fruits: https://www.uky.edu/ccd/sites/www.uky.edu.ccd/files/figs.pdf

  https://www.uky.edu/ccd/sites/www.uky.edu.ccd/files/persimmon.pdf

  https://www.uky.edu/hort/document-list-home-fruit