

THE BUCKEYE Arborist

○ VOLUME 50, NO. 4 ○ JULY/AUGUST ○ 2019

Ohio Chapter International Society of Arboriculture
www.ohiochapterisa.org

Meet the Member



Meet Dale Hopkins. Dale is an AEP Ohio forestry supervisor in Steubenville and one of the newest members of the Ohio Chapter Board of Directors.

Born in Rochester, NY, Dale currently resides in Wellsburg, WV. He is an ISA Certified Utility Specialist. As a utility forester, he finds he needs to balance his love of trees and the effect they have on providing safe, reliable electricity. A large part of his job is educating property owners and the right tree in the right place. Dale enjoys working with and educating customers regarding the utilities obligation to keep facilities free of encroaching vegetation. He drives professional satisfaction from meeting with a property owner who is objecting to necessary line clearance work on their property and using his skills to change their mindset.

As a child, Dale's dream job was to be a conservation officer in NY where he grew up. When he realized that was not going to become a reality, a college friend sent him information about a utility forester job with ACRT. He began his career with ACRT in South Bend, IN before moving into their corporate office. A few years later, he was hired by AEP.

In his spare time, Dale enjoys traveling. He has been in the 48 contiguous states, 45 of those on his motorcycle. His goal is to see all 50 states before he reaches age 50. You can connect with Dale on Facebook.

Take time to get to know Dale and remember that like every board member, he is your conduit to the chapter and the ISA. Let him know if you want to get more involved, would like to see different programs or have a thought or idea you would like to share. The chapter board is here to serve you!

President's Branch

By Tyler Stevenson



In the middle of the night on May 27, western Ohio experienced a record tornado outbreak that resulted in one confirmed death and countless destroyed homes and properties. While evaluating tree damage at a Harrison Township park and neighborhoods in Dayton and Beavercreek, I couldn't help but imagine my own neighborhood stripped of its canopy and character and the long and difficult road ahead for the families who

lost so much that walking away from what's left of their home is the most sensible option available. Many of our members are involved in the response and recovery efforts and our collective thoughts are with them and all those that experienced the life altering effects from this tragic weather event. By the time this Buckeye Arborist reaches your mailbox, the response phase will have concluded, but the recovery phase will last for months. There are several ways for our membership to help:

The Easiest: Skip lunch on Monday and give \$10 to American Red Cross Disaster Relief. Text REDCROSS to 90999, which helps people affected by disasters such as hurricanes, floods, earthquakes, wildfires and tornadoes.

The More Focused: Donate directly to the Dayton Food Bank: thefoodbankdayton.org/learn/disasterrelief

The Most Impact: Donate your time and arboriculture skills to some of the hardest hit and most economically challenged areas in Montgomery County. The Montgomery County Land Bank is developing a list of arborists who wish to

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THE BUCKEYE ARBORIST

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Articles

Submit articles in Word format to the Editor at info@OhioChapterISA.org for consideration. All articles are subject to technical review. Accepted articles may be edited for brevity, clarity and adherence to Chapter requirements and standards. Submissions must contain original work.

An ISA Certified Arborist in good standing may receive CEUs for work published in *The Buckeye Arborist*.

Advertising

Acceptance and publication of advertisements, editorial copy or product announcements do not necessarily imply Ohio Chapter ISA's endorsement of said products or techniques, nor does it reflect the opinion of the Chapter regarding any such product or technique. *The Buckeye Arborist* reserves the right to refuse any advertisement that is deemed unsuitable for publication.

For advertising reservations and material deadlines, rates and data – as well as other Ohio Chapter ISA sponsorship and messaging opportunities – please contact the Ohio Chapter at info@OhioChapterISA.org.

Ohio Chapter ISA

The **Mission** of the Ohio Chapter International Society of Arboriculture is to advance responsible tree care practices through research, technology and education, while promoting the benefits of trees.

The Ohio Chapter **Values** investing in the future of professional arboriculture through education, research, safety and communication, while maintaining integrity and credibility.

President's Branch Cont. from page 1

donate tree work to families affected by the tornados. Any interested arborist or company who would like to get involved in this effort can notify Anita Schmalz at (937) 531-6921 or aschmalz@mclandbank.com. You will need to provide your current certificates of insurance and workers' compensation and sign a waiver to protect both parties. The Land Bank will then provide a list of homeowners who have damaged or dangerous trees so you may schedule restoration pruning or removal work with the homeowner at your convenience. The Land Bank and our Chapter will promote the goodwill and charity you are giving to the storm ravaged communities through social media, newspaper, and television coverage.

The Chapter would like to express our sincere appreciation to the Montgomery County Land Bank for generously coordinating these recovery efforts. This project is beyond their mission of eliminating neighborhood blight but because they understand the importance of including trees in their revitalization efforts through their Twigs to Trees reforestation program, they are willing to step outside their comfort zone and help these devastated neighborhoods recover their tree canopy. Please consider going above and beyond your mission and joining the Montgomery County Land Bank in restoring the tree canopy and reducing residual risk in our Ohio neighborhoods.

August is Tree Check Month

The best protection for trees? You.

By Rhonda Santos, Public Information Officer
USDA APHIS Asian Longhorned Beetle Eradication Program

Whether it's a walk in the woods or in the park, spending time outside at the lake or around a campfire – summer brings us many joys. All too often we can take for granted the beauty of our surroundings while enjoying the great outdoors, but all of us can do a little something to protect our natural resources.

The United States Department of Agriculture (USDA) designates August as Tree Check Month to keep our trees strong and healthy now and into the future. It's a chance to remind us about the impact we all can have in saving our nation's trees from the devastating Asian longhorned beetle (ALB).

The beetle has led to the loss of more than 180,000 trees in the U.S., but anyone can help prevent it from killing more trees. Since the adult beetles are active in the summer months, ALB can be easier to spot and the damage it creates can be easier to see.

Take a 10-minute walk around your yard or neighborhood and inspect your trees:

1. LOOK UP – Stand back and look at the top of the tree. Do you see any dead or dying branches?
2. LOOK IT OVER – Now get in close and focus on the tree trunk and branches. See the beetle? See any round exit holes or scars in the bark?
3. LOOK DOWN – Do you see any sawdust-like wood shavings at the tree's base or on the branches?

Early detection is important. It may mean more trees are saved. If you think you've found an Asian longhorned beetle or signs of infestation, always record the area where the beetle or damage was found. If possible, capture the insect you think is the beetle, place it in a jar and freeze it — this will preserve the insect for easy identification.

Spend some time in August giving back to the trees that play such an important part in our lives. It's a great excuse to get outside and teach others how they can help save something that is at the heart of the outdoors.

To report any signs or sightings of the ALB, visit www.AsianLonghornedBeetle.com or call the hotline at (866) 702-9938.



Image Courtesy of USDA

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Join us in Knoxville, Tennessee, 11-14 August 2019, for the **ISA International Conference and Trade Show** — the premier arboricultural professional development event of the year.

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Knoxville boasts a vibrant and very walkable downtown with a variety of fun things to experience, including the East Tennessee History Center, Mast General Store, Pretentious Glass, plus shopping and more than 80 dining options in and around Market Square.

Just minutes from downtown you'll find Knoxville's Urban Wilderness. This thousand-acre stretch features more than 50 miles of walking, hiking and biking trails, connecting parks, trails, civil war sites and recreational amenities.



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Certification Corner

By Carrie Paulus, Education and Public Outreach Committee

After coming through the wettest May on record in Ohio, the deluge of rain continued in June! Rains prevail as arborists face severe weather challenges scheduling, performing and completing work safely. It is also a time when the Chapter's Education & Public Outreach Committee is engaged in strategic planning for future industry education programming such as the ISA certification preparation courses.

The arborist certification prep course assists arborists in preparing for the ISA Certified Arborist and specialist examinations. Certification is an opportunity to advance industry knowledge, enhance your professional profile and market expertise. It has brought invaluable awareness to the public in recognizing what an 'Arborist' actually is, services the arborist provides, and how to access an ISA Certified Arborist for hire. Certification is also an avenue to establish unity among professionals throughout the industry and is a channel for networking, communication, partnerships and collaboration.

Upcoming Certification Prep Courses

ISA Certified Arborist Prep Course – September 9-12 at ODNR in Columbus from 8:30 am – 4:00 pm each day.

ISA Exams – September 13, 9:30 am – 1:30 pm at ODNR. ISA DEADLINE to register for the exam is August 27. (Registration is separate and must be done through ISA, NOT the Ohio Chapter.)

ISA Certified Arborist Prep Review – February 25-26 as part of the Ohio Tree Care Conference in Dayton.

The education committee is exploring options to hold 'specialist' prep courses every other year. Municipal is being planned for this fall and utility is slated for spring 2020. Aerial specialist training is being considered in conjunction with the Ohio Tree Climbing Championship in the spring of next year.

For more information and to register for the programs ONLY, go to www.OhioChapterISA.org or email info@OhioChapterISA.org. Application

We are honored to recognize the following individuals who recently received new credentials. Congratulations to all!

ISA BOARD CERTIFIED MASTER ARBORIST

Brian Goodall, Stoutsville

James Jenkins, Kent

ISA UTILITY SPECIALIST

Katherine Bloss, Akron

ISA CERTIFIED ARBORIST

Jay Bevard, Newark

Jacob Nau, Hilliard

Edward Cox, Chillicothe

Jamie Newland, Chillicothe

Chuck Dawson, Lancaster

Marjorie Elizabeth Ott,

Marcus Hefflinger, Waterville

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Nicholas Ryan Koeth, Painsville

Andrew Rehner, Napoleon

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Shawn McClain, Mansfield

Elza Taylor, Otway

Brian Thomas Morin,

Mike Wilson, Columbus

Washington CH

ASCA TREE & PLANT APPRAISAL QUALIFICATION (TPAQ)

Timothy Ascher, Columbus

Bob Meoak, Mason

William King, Columbus

Ronald Rothhaas, Cincinnati

Kevin Lester, West Chester

Mark Webber, Dayton

to take the ISA Certified Arborist or specialist exams is SEPARATE from the course registrations. Contact the ISA office at (678) 367-0981 or isa@isa-arbor.com. Applications can be obtained at www.isa-arbor.com/certification/becomeCertified. You must be approved in writing by ISA after submitting your application to be eligible to sit for an exam.

If you are interested in co-hosting a certification course at your place of business or other location, please contact the Chapter.

Preserve Ohio's Greatest Green Resource – Trees!

By purchasing a *Trees4Ohio* specialized interest license plate for your vehicle, you help underwrite educational programs and services that directly benefit the trees of Ohio.

The plate provides one of the best **member benefits**; it directs readers to Trees4Ohio.org. This site is designed for consumer's looking for everything from proper pruning and mulching to how to find and hire an Ohio tree care professional. **Chapter members must login to OhioChapterISA.org and update their profile. You must check "available for hire" and each of the services you provide.** Your email address associated with your membership record is your user name. If you forgot your password or have not logged in before, use the "forgot my password" and an email will be sent to you with instructions. If you have questions or problems logging in, please contact the Chapter office.

The new specialized interest plate is available under Organizational Plates at <https://www.bmv.ohio.gov/vr-sp-organization.aspx>.

Show your support by purchasing new plates and don't forget to **update your profile** so that consumers can find you!



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Ohio Training Announced



August 21 & 22, 2019
Columbus, OH

If you are looking to become proficient in conducting appraisals using multiple approaches, register now to attend TPAQ training. Established by the American Society of Consulting Arborists (ASCA), this training utilizes both instructor-led discussions and case scenarios to illustrate concepts allowing participants to become familiar with the relevant methods and techniques used to approach plant appraisals and the ability to make reasoned judgement about the value of trees and landscape plants.

Learning Objectives

Upon completion of this course, you will:

- Describe the economic principles that underlay plant appraisal.
- Describe the types of field data needed to inform plant appraisal methods and techniques.
- Define the cost compounding methods within the income approach and understand its relationship to the i-Tree suite of urban forestry management and assessment tools.
- Define the research about the contribution of trees and landscape to real estate market value, and its application to plant appraisal.
- Discuss the methods and techniques within the cost approach, particularly the direct, reproduction, and cost forwarding methods.

- Define reasoned judgments about the value of trees and landscape plants.

Eligibility

Attendees must have a minimum of three years of experience in arboriculture, horticulture, forestry, landscape contracting, or landscape architecture/design.

Required Text

Participants must read the 10th edition of *the Guide for Plant Appraisal* prior to this course. Guides are available at www.asca-consultants.org/store.

Deadline to register is August 7. Visit www.OhioChapterISA.org for complete details.

Advertisement for Nelson Tree Service celebrating 100 years. The background features a collage of images including a truck, a worker in a hard hat, and a tree. Text includes: "SINCE 1919 NELSON", "PROTECTING THE REPUTATION OF THE UTILITIES WE SERVE FOR 100 YEARS", "IT'S PART OF OUR JOB", "10 YEARS", "Nelson TREE SERVICE, LLC", "1919 2019", "Vegetation Management Specialists", "See the videos" with a QR code, "800-522-4311", "www.nelsontree.com", and "©2018 Nelson Tree Service, LLC. All rights reserved."



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The Perfect Day

On June 14, the Ohio Chapter raised \$3,000 for Team Ohio at the 21st annual golf outing. Twenty-eight enthusiasts hit the links at Hawk's Nest, managed by the Ohio State University Agricultural Technical Institute (ATI) in Wooster. Although the temperature that day was perfect, it was windy, resulting in some miscalculations.

Long time tradition of the annual outing includes a past president's hole sponsor. Contributors included Eric Davis, Larry Holkenborg, Fred Hower, Ward Peterson, Andrew Todd and Gerald Western. Davey Tree Expert Co. and Team Ohio also sponsored prize holes.

1st place this year was awarded to a Davey team consisting of Mark & Shirley Vaughn, Dave Goering and Karen Wise, with a score of 64. Each player received a \$100 Amazon gift card and \$30 Arborwear gift card.

2nd place with a score of 66 was a tie between team ACRT (Kevin Gamble, Kevin Jones, Todd Jones and Troy Ross) and Asplundh (Keith Confere, Jeffrey Anderson, Zachary Miller and Jarrod Rock). Based on a play-off of the 4 most difficult holes, ACRT was deemed the winner. Each player received \$50 Amazon gift cards.

Last place team by default was ArborMetrics with Bill Davis, Ron Didyk, Rich Gusky and Tyler Woody. They each received a \$20 Bass Pro Shops gift card so that they could find a new sport! Unfortunately, the team that probably had the most fun but left before awards was another Davey team who scored 88. That team included Mike Binkley,

Dan Herms, Manny Ong, Mike Veney.

Because this event is a fund raiser for Team Ohio and the TREE Fund, anyone who left before dinner and awards did not receive prizes. Hopefully next year, Zach Miller with Asplundh will stay for dinner – he would have received \$230 in gift certificates for the longest drive and closest to the pin. Marc Owens with Davey would have won \$200 for the longest putt. As a runner up, Ron Didyk was awarded longest drive and received \$100 Amazon and \$30 Arborwear gift cards.

\$235 was collected in the 50/50 raffle ticket sales. As a thank you and "tip" to the beer cart ladies from ACRT, Renee and Susan, several people who left early gave their tickets to them. Low and behold, they had the winning ticket! As the good Samaritans that they are, they donated their winnings back to Team Ohio. Team Ohio rider, Dave Staats, donated a large jar of his honey. The winner of that drawing was Kevin Gamble.

We are grateful to the players, sponsors and supporters of the 21st annual outing. Visit TreeFund.org to donate to Team Ohio – you can select team kitty or an individual rider.



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Branching Out

The Ohio Chapter continues to branch out with education and awareness programs.

- Specialty license plates are now available, directing readers to our consumer site, Trees4Ohio.org. We want to make it easier for consumers to search their area for professional care provided by Ohio Chapter members. If you are available for hire, update your profile in the Chapter database. Search options include air excavation services, appraisals, brush removal, consulting, diagnostics, fertilization, land clearing, landscaping services, mulching, plant health care, pruning, removal, tree moving, tree risk assessment, and so much more. Visit www.OhioChapterISA.org and Login (located in the upper righthand corner) then select Services Offered to be included in the search.
- We are now working with Associations Advance Ohio to spread our message. In April, the Chapter began a digital campaign by placing its first Facebook ad. The ad reached nearly 30,000 viewers across Ohio. Statistics reflected that the ad reached 25.4% women, 74.6% men in age ranges 25 and above. The majority of the ads were viewed on mobile devices. In May, the ad reached 42,543 viewers!
- In April we also began airing radio commercials across the state through Ohio News Network affiliates. The commercials were produced by marketing committee chair John Palmer. 75 stations aired the message a total of 375 times from April 15 – April 30. Each month, a new commercial is added to the mix. Let us know if you have heard one of the commercials. See inset to view list of radio stations.
- Did you know that the Chapter has a tabletop display that members are encouraged to use at local events? The display includes consumer brochures produced by ISA along with career and membership information. All you need to do is email info@ohiochapterisa.org with the details on the event (what, where, when) and we will arrange to get the materials to you.

We are working hard to send consumers to you and educate listeners and readers about the importance of hiring an Ohio Chapter member. Make sure you are included in the arborist search; if you do not update your profile as explained above, consumers will hire any truck and a chainsaw. Do not miss this opportunity to add great value to your Chapter membership.



Local Roots, Global Reach

Ohio Tree Care Conference

February 25 - 27, 2020
Dayton, OH



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| Athens | WATH AM 970/FM 97.1* | Logan | WKNA FM 98.3 |
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| Columbus | WBNS FM 97.1 | Oberlin | WOBL AM 1320/FM 107.7* |
| Coshocton | WTNS FM 99.3 | Portsmouth | WNXT AM 1260 |
| Dayton | WING AM 1410 | Portsmouth | WNXT FM 99.3 |
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Urban Forestry

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On June 21st, the Ohio Urban Forestry Program's 40th Anniversary Forum was held at the Ohio Expo Center in Columbus. ODNR Director Mary Mertz welcomed nearly 300 industry professionals, tree commissioners, elected officials, and urban forestry supporters. ODNR urban forestry coordinator and Ohio Chapter ISA president, Tyler Stevenson, kicked off the day-long event with a historical review of the state's urban forestry assistance program including special recognition of the many partners and supporters over its 40-year history.

Dr. Jason Grabosky, urban forestry professor in the department of ecology, evolution and natural resources at Rutgers University presented a look at Urban Forestry 2059. Alan Siewert, ODNR northeast regional urban forester and a past president of the Ohio Chapter, helped each of us in the room think about *Setting Our Priorities*.

Following an excellent lunch and networking with vendors and sponsors, the group spent the afternoon in ODNR's Natural Resources Park for urban forestry tours consisting of:

- Tree Diagnostics with the Tree Amigos (Joe Boggs, Jim Chatfield and Eric Draper)
- A panel discussion, Ohio's Tree Commissions – What Makes us Tick (Representatives of Ada, Canton, Chagrin Falls, Chillicothe, Lebanon and Urbana)
- Silva Cells – Tree Growth & Storm Water Management (with DeepRoot's Pat Greeley and Tyler Stevenson)
- Look inside a Tree – Tree Decay Detection Technology (Bartlett Tree Experts)



- Breaking Point of Trees – Tree Biomechanics Research (Dr. Greg Dahle, WVU)
- Root Collar Excavation with Air Tools (Mark Hoenigman, Busy Bee Services)
- Soil Restoration with the Ohio Recipe (Alan Siewert)

There were also on-going demonstrations of tree climbing with Ahlum & Arbor and emerging tree technologies with Davey Resource Group.

Many individuals and organizations were acknowledged for their support of urban forestry. On behalf of leaders' past, present and future, Ohio Chapter executive director Dixie Russell, was honored to accept the Cambium Award in recognition and appreciation of the Chapter's deep-rooted partnership and continued advancement of responsible tree care practices in Ohio.



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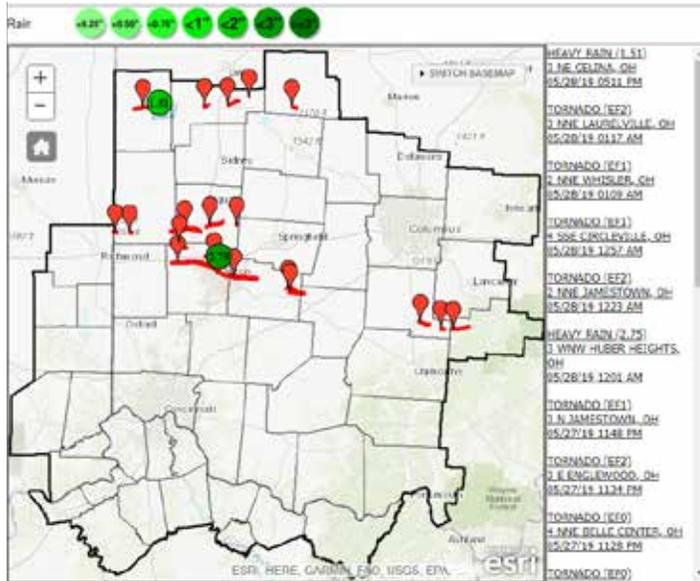
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Memorial Day Tornado's Tree Damage: "Lessons Learned"

Mark A Webber, BCMA, CPH, LTE, MArborA, OCMNT, TPAQ, TRAQ

During the night of May 27-28, 2019, after a relatively quiet 3-day Memorial Day weekend, no less than twenty-one tornadoes affected trees, homes, businesses, and the lives of many Ohio residents. This weather event brought winds as high as 166 to 200 mph and some areas received over 2.75" of rain in a 2-hour period. The paths of the most dangerous tornadoes targeted dense population centers in and around the Dayton metro area. See Picture below



Picture source NOAA (National Oceanic and Atmospheric Administration)

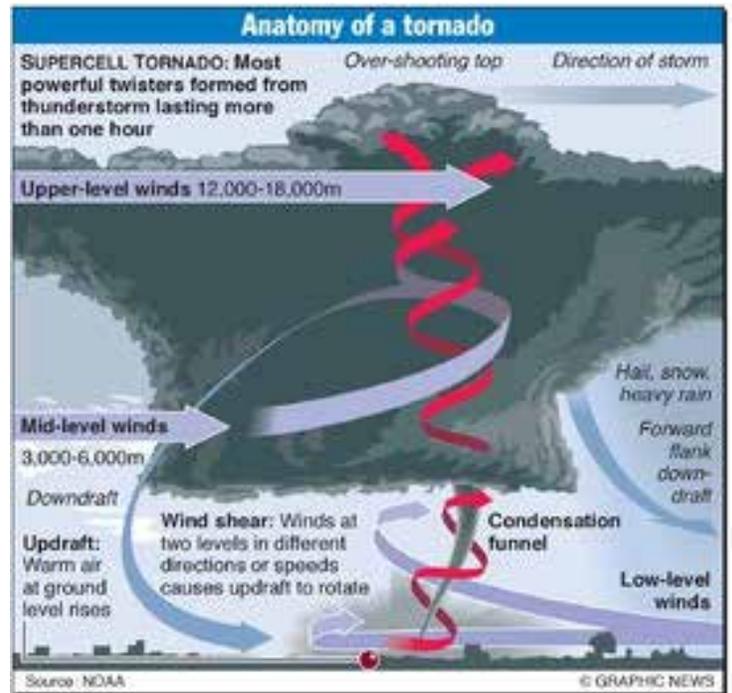
Purpose & Methodology

The purpose of this article is to provide tree professionals an understanding of how tornadoes cause trees to fail, and how the "Best Management Practices" of arboriculture can increase the likelihood of tree survival. Site inspections were completed in all the affected areas. Data and photographic evidence were collected as well as eye witnesses being interviewed as part of this investigation.

Additionally, I have personally practiced in these geographical areas since 1986. After the Memorial Day tornadoes, I inspected each of the twenty-one areas. I also relied on NOAA's findings as it relates to the damage path, wind speeds, and non-tree damage assessments. The tree damage assessments were made when I conducted inspections of trees affected by these events. These facts were then compared to scientific research on tree damage related to tornadoes.

Background

A tornado is a narrow, violently rotating column of air that extends from the base of a thunderstorm to the ground (NOAA). Because wind is invisible, it is hard to see a tornado unless it forms a condensation funnel made up of water droplets, dust, and debris. Tornadoes are the most violent of all atmospheric storms. Tornadoes come from mainly two types of thunderstorms: supercell and non-supercell. Various types of tornadoes include the multiple vortex tornado, landspout, and waterspout.



Source NOAA

The damage from this tornado outbreak caused major property damage that included broken windows, houses pushed off foundations, building walls collapsed, roofs torn off, and sheds thrown 2-3 miles from their original locations. The storm damage was so extensive that President Donald Trump issued a Presidential Disaster Declaration for federal assistance for individuals and businesses. The varying degree of tree damage was observed depending on the intensity of each of the twenty-one tornadoes. Trees located in the paths of the tornadoes of highest strength experienced failures at epic proportions. The epic failures are best described like someone took a lawnmower and cut the trees at one uniform height. Many of the previously structurally sufficient trees were overwhelmed by the high intensity wind forces found in the stronger tornadoes. Trees that were not in the direct path of these tornadoes experienced less damage.

Prior to 2008, Ohio typically experienced only 2-3 tornadoes per year (Coder, 2008); since then the Buckeye state has a yearly average of 19 per year (NOAA). Remarkably, only one person was killed as the result of this event. The pre-tornado alerts that were received via cell phones, radio, television, tornado sirens, and the National Oceanic and Atmospheric Administration (NOAA) alerts were contributed to saving many lives.

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How do Meteorologists Measure the Intensity of Tornadoes?

A tornado's intensity is measured by what is called the EF Scale. The EF scale stands for the Enhanced Fujita Scale, and it classifies tornadoes into the following categories of progressing strength and wind speeds. These are:

- EF-0...Weak...65 to 85 mph
- EF-1...Weak...86 to 110 mph
- EF-2...Strong...111 to 135 mph
- EF-3...Strong...136 to 165 mph
- EF-4...Violent...166 to 200 mph
- EF-5...Violent...>200 mph

Memorial Day Tornado Pattern/Wind Speed and Tree Damage Assessments

For the purposes of this article, I concentrated on the five individual tornadoes in and near the Dayton metro area that had the most significant tree damage. In most sites, uprooting was substantially more common than trunk breakage, although their relative frequencies varied with tree diameter, and among species and sites in complex ways. Many of the damaged trees in the other less affected areas were associated to trees with preexisting defects. The five areas that will be explored in this article were quick moving storm events, and each was designated by a unique name to show the distinct differences in damage. The information provided below was collected from the NOAA data for each event and field observations made by the author (See Table A).

Table A.

| Name & Wind Speed | Width | Area Impacted | Damage Notes | EF Scale |
|--|------------|---------------|---|-------------|
| Brookville through Trotwood to Dayton and Riverside Wind Speed 170-175 MPH | 0.60 mile | 20 miles | Event occurred from 10:41-11:13pm. The damage included well-built apartment buildings with complete roof and exterior wall removal. Also, significant tree devastation, including numerous trees debarked and nubbed down to the trunk were found along the Stillwater River east of Riverside Drive. Areas of ravines and slopes experienced more intense damage than relatively flat areas. | EF-4 |
| Riverside in Montgomery County extending to Xenia Township in Greene County, Ohio Wind Speed 136-165mph | 0.70 miles | 10 miles | Event occurred from 11:12-11:32pm. Entire roofs lifted, as well as the collapse of several exterior walls with interior walls left standing. Additional homes along Gardenview and Wendover Drives experienced high-end EF-2 damage, with windows shattered, garage doors collapsed, and entire roof structures were removed. Trees uprooted, trees were leafless, upper canopy removed. | EF-2 – EF-3 |
| Central Mercer County, Ohio, including Celina Wind Speed 150 mph | 250 yards | 11 miles | The event occurred from 10:02-10:17 pm. Homes, outbuildings, trees, utility poles were damaged, and a free-standing cellular communication tower was knocked down. At least two homes suffered partial roof loss and one home lost its entire roof. A 50-100-yard swath of trees was snapped and uprooted in a forested area leading up to the western edge of Celina. Evidence of multiple vortices within the tornado was also evident in the debris pattern here. Widespread tree damage and many trees destroyed. | EF-3 |
| Milton in Darke/Miami Counties Wind Speed 140 mph | 0.75 miles | 10.8 miles | Event occurred from 10:25-10:44pm. Widespread tree damage and many trees destroyed. Moderate structural damage to roofs. A few homes suffered the collapse of some exterior walls, and while this was more common with garage walls, it also occurred on a few well-built walls away from garages. At one home, a lawn tractor was thrown out into the adjacent field to the northeast. This event had variable wind speeds. | EF-3 |
| Northeast Montgomery County, Ohio Wind Speed 135 mph | 0.25 miles | 7.6 miles | Event occurred from 11:34-11:45pm. Tree damage was significant in this area including uprooted conifers, debarking, tree trunk failures and among survivor trees only branch stubs remained. Several homes in this area had complete or near complete roof removal, with some collapse of an exterior wall. | EF-2 |

Survivor Trees

Trees that were previously structurally sufficient that were located in the areas of the EF-0 tornados had little to no damage. However, many of the failures and loss of trees in the EF-0 tornado zones and on the outer edges of the higher categories sustained severe losses due to previous defects like codominant branch unions, decay from previous poor pruning cuts, poor root configurations, roots injured by mechanical injury (mower blight), root systems with limited volume and trees with irregular canopy architecture. Tree species in the white oak group, red oak (*Quercus rubra*), bald cypress (*Taxodium distichum*) and other trees with an excurrent form survived. Trees with limited defects with strong central leaders with a low proportion of overextended tree branches sustained less life threatening injuries even in tornados with ratings of EF-2 or EF-3.

The Sounds of the Memorial Day Tornados and the Real-Life Experiences

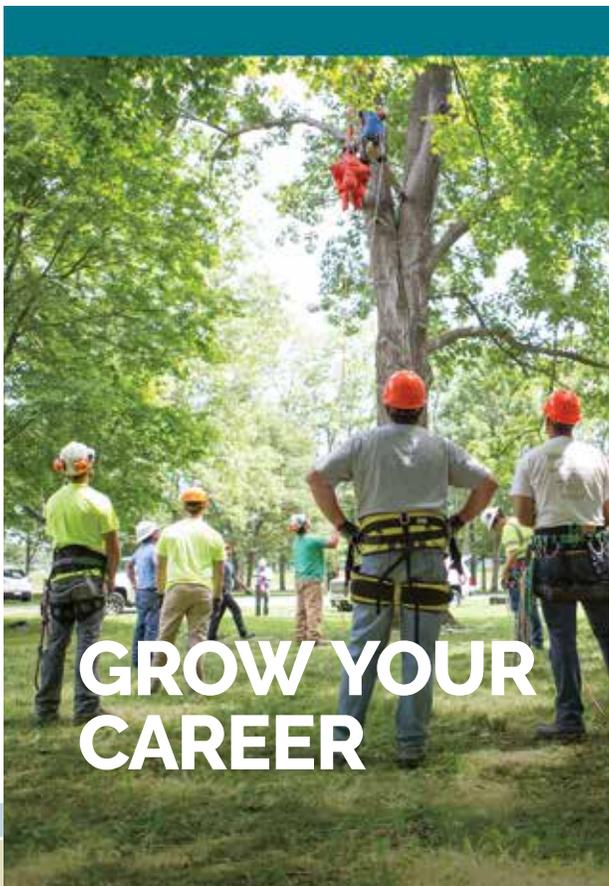
As part of this investigation, I conducted interviews with people who took cover and rode out the storm. The aftermath in the areas impacted by the tornados was reminiscent of a war zone. In the areas of the EF-2 and EF-3 tornados, many occupants reported that they never heard the sound of a train, but instead that they felt intense painful pressure to their eardrums. They also reported that windows imploded, their homes shook, and the sounds of flying debris striking their homes. During my inspections, I found house insulation that was embedded into trees. Some trees experienced such excessive bending in their branches and trunks that the cambium buckled. In many instances, 2x4's were driven through walls, and in one case, the tornado pulled



Photograph source (MkWebber, 2019). American sycamore (Platanus occidentalis) that was trained with a central leader and well cared for before 135 mile per hour winds from the Northeast Montgomery County, Ohio tornado. The trees to the left of the picture are black locust (Robinia pseudoacacia) trees that were riddled with trunk decay prior to the tornado. The main damage path of this tornado was approximately 45 feet away from the previously discussed trees.

a 1000lb wood stove from a building, and it was thrown inside a bedroom of a house that was 4-blocks away.

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Discussion Trees and tornados

Tornados can be a component of many types of storms, and they are intense, high velocity, rotating storm events that have historically plagued trees (Coder, 2008). Tree species within the same genus respond differently to the same types of tornadic events (Shirakura, 2006). The top momentary wind speeds of tornados can be tremendous, and it has been well documented in research that tornados produce variable damage to trees (Zenoble & Peterson, 2017; Frelich & Ostuno, 2012). Research also shows that variation in damage-path width could result from at least three processes beyond simply variation in the radius of the vortex itself (Karstens et al., 2013). The first being as Karstens et al. (2013) documented damaged areas that, based on the direction of treefall, this resulted from either rear-flank downdrafts or the second being a channeling of high-velocity inflows along narrow valleys and ravines. The effect the valleys and ravines had on wind flow led Karstens et al. to suggest that observed variation in damage path width may be influenced by local topography. A third possibility is that some of these damage paths result from multivortex tornadoes. The Memorial Day tornado outbreak showed all three traits since the treefall direction was variable. The Memorial Day tornados also revealed the effects of vortex number (single or multiple) on variation in damage-path width. Trees showed species variations in damage response when subjected to strong tornadic winds (Godfrey & Peterson, 2017). Additionally, my observations found that a species-dependent difference in resistance in trees exposed to excessive wind speeds has been observed and recorded in other events such as in hurricanes and may be due to particular leaf shape or trunk properties (Xi et al., 2008; Webber, 2018).

The Brookville through Trotwood to Dayton and Riverside (BTDR) tornado, for example, had estimated wind speeds of 170-175 MPH. This tornado produced significant tree damage. NOAA data states that this was an EF-4 with an average width 0.60 miles wide and had a storm path of 20 miles. Research by Godfrey & Peterson (2017) shows that tornados like the BTDR will have a greater mean width and leave more regular damage paths, while wider paths tended to have fewer undamaged portions and were more continuous. Since EF-4 and EF-5 tornadoes tend to be wider Brooks (2004) states that these events have a potential inference as more-intense vortices may fluctuate in diameter less than weaker tornados.

Coder's (2008) research found that the direction of the heaviest winds changes with the passage of the storm and in many cases, this causes wood fibers to be stretched and pulled in directions that forces wood fibers to exceed the load capacity of the tree. Trees near the direct path of the tornado must withstand the bending loads applied by winds as well as the twisting (torque) loads. Also, tornados are often accompanied by heavy rains, damaging hail, and intense lightning activity, all which impact trees. The Memorial Day tornados had wind containing rain, soil, or debris that likely created a heavier force (had more mass) than atmospheric gas components (Coder, 2008). For the same wind velocity, the more material in the windstream, the more impact this wind will have on a tree. There is a weight class difference in storm winds which all impact trees differently. In addition to twisting and bending loads applied by "heavier" winds, tissue scouring can greatly damage trees.

Force (Pressure) Not Wind Speed Is What Breaks Trees

Storm wind loads on trees are not well represented by wind velocity values (Coder, 2008; Godfrey & Peterson, 2017). Wind impacts on trees are directly related to the force or pressure wind applies to tree parts (Niklas, 2002; Osssenbruggen et al., 1986). Research by Winn et al. (1999) found that wind pressures oscillate and fluctuate as a tornado approaches and vary in intensity depending on the location of the funnel cloud. The pressure of the wind applied to a tree can be estimated by multiplying the square of wind speed times one-half the density of the air moved (Coder, 2008). The pressure of wind on trees is usually calculated at some standard temperature (like 68°F) at sea level. A simplified formula for quick estimates of wind pressure is given below:

$$\text{wind pressure in pounds per square foot} = (0.013) \times (\text{wind speed in mph} \times (0.45))^2$$

Table B demonstrates the comparison between wind velocity in miles per hour and wind pressure in pounds per square foot created using the simplified formula above. A most compelling fact is that as wind speed doubles, the wind pressure against a tree per square foot of frontal area would not simply double, but quadruple (Coder, 2008).

For example, from Table B, if wind velocity is 30 miles per hour, the wind pressure applied to a tree is 2.4 pounds per square foot. If storm wind velocity then accelerates and levels off at 60 miles per hour or 2 times the original strength, the wind pressure is now at 9.5 pounds per square foot. Table B shows a small increase in wind velocity can have great impacts on wind pressure applied to a tree. Research has shown that structural tree safety factors are completely consumed at approximately 94-96 mph or (~24 lbs/ft²) (Coder, 2008; Clanet et al., 2016).

Table B.
Estimated wind pressures in pounds per square foot (lbs/ft²) calculated under standard conditions for various wind velocities in miles per hour (mph).

| wind velocity (mph) | pounds per square feet (lbs/ft ²) | wind velocity (mph) | pounds per square feet (lbs/ft ²) |
|---------------------|---|---------------------|---|
| 5 | 0.1 | 80 | 17 |
| 10 | 0.3 | 85 | 19 |
| 15 | 0.6 | 90 | 21 |
| 20 | 1.1 | 95 | 24 |
| 25 | 1.7 | 100 | 26 |
| 30 | 2.4 | 110 | 32 |
| 35 | 3.2 | 120 | 38 |
| 40 | 4.2 | 130 | 45 |
| 45 | 5.3 | 140 | 52 |
| 50 | 6.6 | 150 | 59 |
| 55 | 8.0 | 175 | 81 |
| 60 | 9.5 | 200 | 105 |
| 65 | 11 | 225 | 133 |
| 70 | 13 | 250 | 165 |
| 75 | 15 | 275 | 199 |

$$\text{wind pressure in pounds per square foot} = (0.013) \times (\text{wind speed in mph} \times (0.45))^2$$

Source Coder, 2008

The tree damage and conditions that I observed and described compared to the NOAA data from the Memorial Day tornados adheres to the findings in previous research conducted by Coder (2008) and Clanet et al. (2016). Table C shows the previous research conducted by Coder and it compares the data to the Enhanced Fujita Tornado Scale providing the category or “EF” number of a tornado, wind velocity range of a 3-second gust, mid-point wind pressure value, tornado description term, and estimated tree impacts.

Table C.

| category | wind speed range (mph) | mid-point wind pressure (lbs/ft ²)* | tornado damage descriptor | tree impacts |
|----------|------------------------|---|---------------------------|--|
| EF0 | 65- 85 | 15 | light damage | small limbs break, large branches break |
| EF1 | 86-110 | 25 | moderate | trees uproot, trees snap |
| EF2 | 111-135 | 40 | considerable | trees debarked, only branch stubs remain |
| EF3 | 136-165 | 60 | severe | trees destroyed |
| EF4 | 166-200 | 88 | devastating | |
| EF5 | >200 mph | >105 | incredible | |

Source Coder, 2008

The same conditions seen in Table C were confirmed in my inspection of trees affected by the Memorial Day tornados compared to the weather data from NOAA.

Structural Thresholds of Trees

In addition to wind speed and pressure values, Table D shows the two critical mechanical thresholds in trees, T1 and T2 (Coder, 2008). Coder’s (2008) research showed the first limiting threshold in trees is called (T1). T1 is reached when wind speeds approach and exceed 56 miles per hour (~8 pounds of wind pressure per square foot). T1 is where the drag reconfiguration in a tree has been reached and cannot significantly be reduced any further without tissue loss (i.e., the front impact of the wind on a tree has been minimized). Up to this threshold level, leaves are blown back against the wind, then rolled, creating less drag or resistance. With increasing wind velocity, peripheral twigs and branches are reconfigured in the crown as they fall back and are bent against the wind. Finally, all crown reconfiguration through reduction of wind resistance occurs. Any more reduction in wind resistance will mean the breaking of twigs and branches. With increasing wind pressure, more crown tissues are pushed back by the wind, until complete elastic flexure (tissue will return to original position when calm) is reached. After this point, inelastic flexure (permanent tissue creep from mechanical overload) and tissue breakage processes are initiated.

The second constraining threshold in trees (T2 in Table D) is reached when a tree is confronted with speeds around 94-96 miles per hour (~24 pounds of wind pressure per square foot) (Coder, 2008; Clanet et al., 2016). At T2 is when the mechanical safety factors of tree structure have reached their maximum for most trees in common situations. At this threshold, major damage is being initiated, and resistance success by trees against increasing wind pressure is only through the position

of the tree, buffering of wind loading by surrounding conditions, or having been challenged by these wind forces over many seasons.

Table D.

| wind speed (mph) | wind pressure (lbs/ft ²) | tree damage descriptor |
|------------------|--------------------------------------|---|
| 20 mph | 1.1 lbs/ft ² | root / soil interface fractures initiated |
| 40 | 4.2 | major stem & crown sway – branch failures |
| | | |
| 60 | 9.5 | stem breakage – uprooting |
| 90 | 21 | major tree failures |
| | | |
| 125 | 41 | catastrophic tree losses |
| >160 | 67 | massive tree destruction |

Source Coder, 2008

** T1 = end of crown drag reconfigurations = ~56mph (~8 lbs/ft²) **

** T2 = tree safety factors consumed = ~96mph (~24 lbs/ft²) **

Lessons Learned

Tree failures are likely to occur in the direct path of Tornados EF-1 or higher

Trees in the direct path of a tornado of EF-1 or greater are likely to fail. The wind pressure created by these types of tornados is too great for most structurally sufficient trees to withstand.

Tree damage and loss will be variable

Tree damage and loss will be variable due to size and rotation as well as the duration of the exposure. Certain tree species will likely be more vulnerable to failure than others.

Proper Tree Care Matters

My observations found a common trait among the survivor trees. If the subject was in good health and structural condition prior to the weather events, and it was not in the direct path of an EF-1 or higher tornado it was a likely candidate to survive if it was a species native to an area that experiences similar weather and wind events.

Excurrent versus Decurrent

Trees with an excurrent growth habit (strong central leader) will likely sustain fewer injuries than those species with decurrent (broad and wide shaped) canopies (Dunster, 2013). However, decurrent species with a history of surviving high winds and contain 60-90-degree branch angles are excellent candidates to be survivor trees, if they are not positioned in the path of an EF-1 or greater tornado. The lack of failures seen in the white oak group, red oak (*Quercus rubra*), bald cypress (*Taxodium distichum*) and trees trained with central leaders

demonstrated that excurrent habits in trees are essential to surviving winds.

Tree Architectural Design

Trees with unbalanced canopies or with long branches like maples or trees with growth patterns that result in weak structure or imbalances are said to have poor architecture. Trees with architectural problems can be traced, in some cases, to a lack of pruning or plant selection. Trees combining poor architecture with other defects have very high failure potential.

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- Tornados can be a component of many types of storms.
Tornados are:
 - Intense
 - High velocity
 - Rotating storm events
 - Short duration in exposure to trees
 - All the above
- As wind speed doubles, the wind pressure against a tree per square foot of frontal area will _____.
 - Double
 - Triple
 - Increase slightly
 - Quadruple
- At what wind pressure value has the drag reconfiguration in a tree been reached and cannot significantly be reduced any further without tissue loss?
 - 56 miles per hour
 - 8 pounds of wind pressure per square foot
 - 24 pounds of wind pressure per square foot
 - EF-2 tornado
- Trees are debarked at what approximate wind pressure/wind speed value?
 - 40 lb./ft²
 - 111 – 135 miles per hour
 - 86 – 110 miles per hour
 - A & B
- Wind containing rain, soil, or debris will likely create a heavier force on trees than atmospheric gas components?
 - True
 - False
- To reduce tree losses during tornados or high wind events it is a "Best Practice" to do which of the following:
 - Train trees to exhibit a more excurrent growth habit
 - Utilize native species of trees
 - Minimize wounds that result in decay
 - Develop the crown of a tree with an unbalanced canopy
 - All of the above
 - A, B & C are correct
- The Brookville through Trotwood to Dayton and Riverside tornado reached an estimated wind speed of 170-175 MPH. What would be an estimated wind pressure of this tornado?
 - 81 lbs/inch²
 - 81 lbs/ft²
 - 18 lbs/inch²
 - 18 lbs/ft²
- Many people who witnessed the EF-2 and EF-3 tornados reported that they:
 - Didn't hear or feel anything
 - Only heard the sound of a train
 - Never heard the sound of a train, but instead reported that they felt intense painful pressure to their eardrums
 - Experienced very little rainfall during the events
- The critical wind pressure that triggers catastrophic tree loss is:
 - 8.5 lbs per square foot
 - 9.5 lbs per square inch
 - 24 lbs per square inch
 - 24 lbs per square foot (Correct)
- T/F Certain tree species are more prone to tornado damage than others?
 - True
 - False

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