THE FIREFLY

Proceedings of the 47th Annual Meeting

of the

Tennessee Entomological Society

October 9, 2020

Held Virtually in Partnership with the
National Institute for Mathematical and Biological Synthesis
University of Tennessee, Knoxville

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RICHARD E. CARON

OUTSTANDING ENTOMOLOGIST AWARD

NOMINATION FORM

The Awards Committee of the Tennessee Entomological Society invites nominations from any TES member for the Richard E. Caron Outstanding Entomologist Award. The award is awarded periodically to TES members who have distinguished themselves by making outstanding contributions to entomology in Tennessee.

Name of Nominee_____

Brief Description of His/Her Qualifications for the Award

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_____

Name of Nominator _____

Phone Number of Nominee: Area Code ( )_____

Please submit your nomination by **August 1, 2020** to:

Dr. Jerome Grant

University of Tennessee
Institute of Agriculture
432 Plant Biotechnology Building
Knoxville, TN 37996
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PROCEEDINGS OF THE 47th ANNUAL MEETING

OCTOBER 9, 2020

Held Virtually in Partnership with the
National Institute for Mathematical and Biological Synthesis
University of Tennessee, Knoxville

Only the Keynote Address and student talks were presented, due to the 2020 TES Annual Meeting being held virtually.

Keynote Address

Estimating future climatic suitability of pollinators with niche models and climate change scenarios

Monica Papeş
Associate Professor, Department of Ecology and Evolutionary Biology
University of Tennessee, Knoxville, TN

Knowledge of spatial distribution of species is central to conservation, macroecology, and biogeography. The information on species' distributions is commonly inferred from range maps and ecological niche models. Ecological niche models can also estimate future potential distributions of species, under various scenarios of climate change. I explored the use of models to estimating possible changes in climatic suitability for pollinators under future climate scenarios with two case-studies: (1) pollinators of conservation concern in the Great Plains, and (2) buzz-pollinators of tomatoes in North America. In the first case study, I showed that 14 species of conservation concern (bumble bees, butterflies, and moths) are projected to experience combinations of range expansion, range contraction, and range stability across the climate change scenarios. Overall, the species richness is projected to decrease in the southeastern part of Great Plains (KS, OK, TX) under the Global Circulation Model with the highest rate of change in temperature and precipitation. The second case study projected distributional shifts for several of the 15 buzz pollinator species for tomato crops included in the analysis. The changes in species richness was regional, concentrated in southern WI and MI, as well as OH, IN, KY and TN. The high crop production regions in these states could be at risk of decreased pollination service from wild buzz pollinators under future climate conditions.

Student Presentations: Undergraduate

The common bed bug, *Cimex lectularius* (Hemiptera: Cimicidae) does not commonly use canines and felines as a host (First Place-Undergraduate Student Award)

Marlo K. Black, J. G. Chandler, R. T. Trout Fryxell and K. M. Vail
Department of Entomology and Plant Pathology, University of Tennessee, Knoxville, TN

The common bed bug (*Cimex lectularius* L.) is a known pest and an obligate blood-feeding ectoparasite. Bed bugs can feed on a variety of warm-blooded animals including humans, bats, poultry, and rabbits, but no research has investigated the use of companion animals (canines and/or felines) as a blood source in a home environment. This study tests the hypothesis that bed bugs use companion animals as a blood source by investigating how long host DNA could be detected in a bed bug and the prevalence of bed bugs feeding on companion animals. Laboratory-raised bed bugs

were fed host blood in the laboratory to determine how long DNA of human, cat, canine, and rabbit blood could be detected up to 21 days post-feeding. Additionally, 228 bugs were collected from 12 apartments with pets (6-canine, 5-feline, and 1-canine and feline), phenotyped as engorged or unengorged and screened with host-specific primers to identify the blood meal. Host meals of human, rabbit, feline, and canine blood were detected up to 3 weeks after feeding laboratory strains. All bed bugs died after feeding on the canine blood, but DNA could be detected up to 21 days post feeding/death. Of the 228 field bed bugs analyzed, human DNA was amplified in 158 (69.3%) bed bugs, canine DNA amplified in seven bugs (3.1%) and feline DNA amplified in one bug (0.4%). PCR methods identified hosts in 73 (98.6%) of engorged bed bugs and 87 (56.5%) of unengorged bed bugs. Results of this study suggest that bed bugs predominately feed on humans and rarely feed on companion animals when they cohabitate. Our data indicates that bed bug populations are primarily being maintained on human hosts, and companion animals are not contributing much to bed bug populations nor frequently being a host.

Student Presentations: Graduate

Characterization of resistance to insecticidal double-stranded RNA in a Colorado potato beetle population (First Place-Graduate Student Award)

Swati Mishra[1], James Dee[1], William J. Moar[2], Jodie Beattie[2] and Juan Luis Jurat-Fuentes[1]
[1]Department of Entomology and Plant Pathology, University of Tennessee, Knoxville, TN
[2]Bayer U.S. - Crop Science

Delivery of double-stranded RNA (dsRNA) inside an insect cell activates the RNA interference pathway and result in the silencing of expression of a complementary vital gene, thus resulting in target insect mortality, inhibition of growth or developmental abnormalities. As the insecticidal dsRNA technology nears commercialization, it becomes critical to develop resistance management tools to secure its sustainability. We developed a population of Colorado potato beetle (*Leptinotarsa decemlineata* Say) (Coleoptera: Chrysomelidae) with >16,600-fold resistance to a topical application of a dsRNA targeting the V-ATPase subunit A gene. Bioassays revealed that the resistant population is cross-resistant to an alternate dsRNA but not to the Cry3Aa pesticidal protein from *Bacillus thuringiensis*, supporting the combined use of dsRNA and Cry3 toxins to delay resistance. Inheritance studies demonstrated that dsRNA resistance is transmitted as an autosomal recessive trait and is polygenic. These results present the first documented case of resistance against topically applied dsRNA in an insect model. Characterization of this resistance provides information for the design of a well-informed insect resistance management (IRM) framework to ensure durability of the novel insecticidal dsRNA technology.

Distribution of the odorous house ant, *Tapinoma sessile*, clades in East Tennessee and potential cryptic species status (Second Place-Graduate Student Award)

Gary Edwards, Jennifer Chandler, Kevin Moulton and Karen Vail
Department of Entomology and Plant Pathology, University of Tennessee, Knoxville, TN

Tapinoma sessile (Say), the odorous house ant, is a ubiquitous species in the U.S. and is a common nuisance pest. A decade ago, four clades, North, South, Mountain and West, were assigned using barcoding of the mitochondrial DNA cytochrome oxidase 1 gene (mDNA CO1) to *T. sessile* specimens from geographically distinct areas across the nation. Our hypotheses are (1) East Tennessee has two clades: North and South, (2) these clades are distributed by elevation, and (3) substantive differences exist among these cladistic populations to support *T. sessile* as a cryptic species complex. Hypotheses 1 and 2 were examined in this study. The Central Cumberland Plateau region eastward to the highest elevations of the Appalachian Mountains in East Tennessee were sampled for *T. sessile* during peak adult male presence. Three clades (North, South and Mountain) were assigned to these East Tennessee samples using barcoding of the mDNA CO1 gene and a phylogenetic analysis which included representatives of previously identified *T. sessile* haplotypes. The Mountain clade, of which this is the first report in East Tennessee, occurred at significantly higher elevations than the North and South. Further morphological and nuclear DNA sequencing will determine whether these observed mitochondrial variations warrant revising the current single-species designation. Precise species assignments will allow focused research into unique behaviors, physiology, and ecology, to potentially improve pest management strategies.

Development of a cover crop system for management of flatheaded borers in red maple production

Axel Gonzalez, Sujan Dawadi, Jason B. Oliver and Karla M. Addesso
Department of Agricultural and Environmental Sciences, Otis L. Floyd Nursery Research Center
Tennessee State University, McMinnville, TN

Cover crops can provide a wide range of benefits in agriculture production including improvement of soil physical, chemical, and biological properties. Studies show that cover crops can also reduce pest densities by providing a habitat for beneficial insects and altering host microclimates. In woody ornamental production, flatheaded borers (*Chrysobrothris* sp; FB) are serious pest that infesting tree trunks. They are especially damaging during the first two years following transplanting. After tree establishment, attacks decrease, but they may still occur at some level during subsequent production years. Previous research indicated that a winter cover crop grown at the base of susceptible trees during the first two years can minimize FB attacks on red maple (*Acer rubrum* L.) transplants. The trees in the original experiment were assigned to four treatments (cover crop, cover crop + insecticide, bare row and bare row + insecticide) and replicated four times in a randomized complete block design with 25 trees per block. All treatments were evaluated for FB damage and tree growth impact for the first two years. The efficacy of the winter cover crop was confirmed by controlling

FB damage during years 1 and 2, with results similar to systemic imidacloprid treatments, which is the recommended treatment method for controlling FB in nursery production. As a result of the direct competition for nutrients and water tree growth in cover crop study were followed for an additional two years under standard production methods. Tree rows in all treatment were maintained bare with pre- and post-emergent herbicide to avoid weed competition. During years 3 and 4, trees were further evaluated for growth and additional FB attacks were recorded. At the end of year 4, trees in the cover crop treatment showed some growth recovery, however, they remained smaller than trees growth under standard insecticide and herbicide production practices for all four years (24% smaller trunk diameter, 18% shorter). Additional management techniques will be required to mitigate the growth disparities between treed grown with cover crops and standard methods. Potential management options to explore include early-kill of cover crops and in-field irrigation of newly transplanted trees.

The more crops the merrier: Impact of dual-use cover cropping on pest and beneficial arthropods in soybean in Tennessee

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Soybean is the number one agricultural crop in Tennessee for both number of hectares planted and economic value. Soybean is used in various products and marketed globally. In recent years, Tennessee soybean growers have shown an increased interest in the use of cover crops with soybean. A cover crop is planted before the cash crop and benefits soil health. Cover crops have also shown to have the potential to minimize some weeds, diseases, insects, and other pests. Traditionally, cover crops are terminated in the spring before cash crop planting. Traditional methods of cover cropping provide many benefits but can also produce some undesired results. Dual-use cover cropping is a newer method of cover cropping in which dual-purpose cover crops are harvested as a forage crop prior to planting the cash crop. A two-year study designed to evaluate the impact of dual-use cover cropping on pest and beneficial arthropods in soybean was conducted in east and middle Tennessee by using five cover crop treatments and two management practices. Results of this study have shown that management practice (i.e., traditional or dual-use) did not have a significant ($p \geq 0.05$) effect on overall arthropod densities. However, significant ($p < 0.05$) differences were found between some of the cover crop treatments and arthropod densities. Management practice and cover crop treatment did not result in an increase in pest problems in soybean. Cover crop treatment and management practice also did not significantly ($p \geq 0.05$) impact soybean yield. This study also found several interesting relationships in cover crop-arthropod community composition. Findings from this research will enable soybean growers to better understand cover crop-arthropod interactions to enhance soybean production in Tennessee.

Natural enemy targets invasive kudzu bug: Where does the enemy originate?

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[2]CAPS, Arkansas Department of Agriculture, Little Rock, AR
[3]Center for Geospatial Analytics, North Carolina State University, Raleigh, NC

When kudzu bug, *Megacopta cribraria*, was identified in the U.S. in 2009 as an invasive species, populations began to establish, increase, and spread throughout the southeastern region at intense rates. The kudzu bug, known for its' tendencies to invade urban structures, causes unpleasant scenes for homeowners, and reduces crop yields, such as soybean. Kudzu bug caused about $1,000,000 in soybean yield loss and treatment in Tennessee in 2019. Although initial invasion was rapid throughout the southeastern U.S., spatial modeling has shown populations of kudzu bug are declining and reducing risk of crop damage. These local and regional declines in populations appear to be influenced by at least two natural enemies, a naturally-occurring entomopathogenic fungus, *Beauveria bassiana*, and an accidentally introduced egg parasitoid, *Ooencyrtus nezarae*. *O. nezarae* causes 52% mortality in kudzu bug eggs and *B. bassiana* causes about 90% and 33% mortality in second-generation immature kudzu bugs and adult kudzu bugs, respectively. Localized population declines reduced numbers of adult kudzu bugs surviving and overwintering by about 97%, which reduces the number that can move into new areas locally and regionally. Establishment and success of these natural enemies to cause mortality of kudzu bug will play an important role in driving population dynamics to maintain population declines in the southeastern U.S. The origin of the parasitoid is known, as it is an accidentally introduced exotic species. However, the origin of *B. bassiana* on kudzu bug is unclear. Understanding and identifying the process and rate of *B. bassiana* infection of kudzu bug is important to estimate success and population dynamics of future generations. The purpose of this presentation is to provide information on the temporal and seasonal distribution of *B. bassiana* in kudzu bugs feeding on kudzu, kudzu, and soil among kudzu in Tennessee, with implications for the U.S.

Integration of alternative strategies to optimize *Phytophthora cinnamomi* and ambrosia beetle management in flowering dogwoods under flooding conditions

Krishna Neupane, Vivek Ojha, Jason B. Oliver, Karla M. Addesso and Fulya Baysal-Gurel
Department of Agricultural and Environmental Sciences, Otis L. Floyd Nursery Research Center
Tennessee State University, McMinnville, TN

Flowering dogwood trees (*Cornus florida* L.) are prone to Phytophthora root rot when flooded and likely to be attacked by ambrosia beetles (Coleoptera: Curculionidae: Scolytinae). In this study, 7 different treatments (combination of 3 products: Subdue MAXX, permethrin and blocking agent X + kaolin) were evaluated on containerized dogwood trees artificially inoculated with and without *Phytophthora cinnamomi*. Subdue MAXX was drench applied preventatively 21 days before

flooding, while permethrin and blocking agent X + kaolin were sprayed over the trunks 1 day before flooding and 2 days after flooding, respectively. The trees were flooded for 21 days. Ambrosia beetle attacks were counted every other day. At the end of the trial, plant growth data were recorded, and roots were assessed for disease severity using a scale of 0-100% roots affected, as well as plated on PARPH-V8 medium to determine the percentage of *Phytophthora*-infected root samples. Non-inoculated blocking agent X + kaolin and non-treated, inoculated control treatments received higher number of ambrosia beetle attacks compared to other treatments, Subdue MAXX and Permethrin combined received significantly lower attacks than other treatments. In root assessment, inoculated trees treated with Subdue MAXX + permethrin significantly reduced root rot severity compared to the non-treated, inoculated control. Non-inoculated trees treated with Subdue MAXX alone or with permethrin or blocking agent + kaolin combinations, as well as permethrin alone or with blocking agent + kaolin significantly reduced the root rot severity compared to the non-treated, inoculated control. A second trial replication is ongoing.

Corn earworm (*Helicoverpa zea* Boddie) on hemp: The unwanted consumer

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By grower number, Tennessee is the nation's largest program for industrial hemp, *Cannabis sativa* L., with over 1,800 producers licensed to grow up to 6,500 hectares (16,000 acres) in 2020 according to the Tennessee Department of Agriculture. Though fiber and seed have a role in the industry, most growers (ca. 98%) concentrate on CBD production because of the expected higher cash value potential per hectare. This popularity among growers looking to meet the demand for CBD has attracted unwanted attention from another consumer, corn earworm (*Helicoverpa zea* Boddie), whose larvae feed on hemp's marketable flower during the growing season. After corn is harvested in August-September, adult corn earworm moths search for suitable oviposition sites and find hemp to be an excellent secondary host. In Tennessee, some growers have reported entire crop losses due to this destructive agricultural pest. Statewide hemp trials were conducted in 2019 and 2020; data suggest that variety was highly correlated to corn earworm larval damage. On a scale of 0-10 from lowest damage to highest, 29 varieties were rated in Greeneville, TN, in 2019; T-Rex ranked lowest at 0 (i.e., no damage) while T1/Trump ranked highest at 8.25 ($p \leq 0.05$). This presentation will discuss the feeding characteristics and damage of corn earworm on hemp, differences in corn earworm damage among varieties, and influence of fertilizer rates on corn earworm damage.

Crapemyrtle bark scale, *Acanthococcus* (= *Eriococcus*) *lagerstroemiae* (Kuwana), in Tennessee: Distribution, life cycle, and natural enemies

Amira Cornish[1], Jerome Grant[1], Frank Hale[2], David Paulsen[1] and Paris Lambdin[1]
[1]Department of Entomology and Plant Pathology, University of Tennessee, Knoxville, TN
[2]Department of Entomology and Plant Pathology, University of Tennessee, Nashville, TN.

Crapemyrtle bark scale (CMBS), *Acanthococcus* (= *Eriococcus*) *lagerstroemiae* (Kuwana), an invasive pest from Asia, is a threat to the ornamental nursery industry, homeowners and landscapers in the U.S. Although feeding is not fatal to many crape myrtles, its effects on aesthetics will affect the sale (valued at >$46 million annually) and use of crape myrtle in landscapes. This pest species has been found in numerous states, including Tennessee. Little is known about its state-wide distribution, life cycle, biology, natural enemies, and impact on crape myrtles. The purpose of this two-year study is to gain additional knowledge to mitigate CMBS before it becomes an economic barrier for crape myrtle production and growth. This pest was first found in Shelby County in Tennessee in late 2013; as of August 2020, CMBS had been documented in 13 counties (eight in western TN, four in middle TN, and only one in eastern TN). It has now been found in three major metropolitan areas (Knoxville, Memphis and Nashville), and extensive damage is apparent in these areas. Biweekly sampling of CMBS suggests that the life cycle of CMBS in Tennessee encompasses eggs, four nymphal instars, and adult females (sessile) and winged males, with two or three overlapping generations per year. Overwintering populations of last-stage instar females, adult females, and pre-pupal/pupal males were found in mid-February. Populations of several species of lady beetles were found to reduce CMBS densities at some locations. This presentation will describe the results of this study highlighting distribution, seasonality and life cycle.

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Karen Vail	'06 - '07	University of Tennessee

Don Sudbrink	'07 - '08	Austin Peay State University
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Mike Studer	'09 - '10	TN Dept. of Agriculture
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Mike Studer	'10 - '11	TN Dept. of Agriculture
David Cook	'11 - '12	University of Tennessee
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Amy Dismukes	12 - '13	University of Tennessee
Amy Dismukes	12 - '13	University of Tennessee
David Cook	13 - '14	University of Tennessee
Amy Dismukes	13 - '14	University of Tennessee
Karla Addesso	14 - '15	TN State University
David Cook	'14 - '15	University of Tennessee
Karla Addesso	15 - '16	TN State University
David Cook	'15 - '16	University of Tennessee
Gene Burgess	16 - '17	University of Tennessee (ret.)
Gray Haun	'16 - '18	TN Dept. of Agriculture (ret.)
Amy Dismukes	'19 - '21	University of Tennessee
Karen Vail	’20 – ‘22	University of Tennessee

Historians of the Tennessee Entomological Society (1973 - Present)

Historian	Term	Affiliation
Charles Pless	'73 - '76	Univ. of Tennessee
Herb Morgan	'76 - '79	USDA
Mendell Snodgrass	'79 - '82	USDA
Russ Patrick	'82 - '92	Univ. of Tennessee
Harry Williams	'92 - '01	Univ. of Tennessee (retired)
Frank Hale	'01 - '21	Univ. of Tennessee

Honorary Members of the Tennessee Entomological Society (1982 - Present)

Honorary Member	Year	Affiliation
Jimmy White	1982	Tenn. Dept. of Agric.
Mendell Snodgrass	1983	USDA
Carl Brown	1985	Memphis State
Myrtice Snodgrass	1985	Knoxville, TN
John A. Hammett	1987	Tenn. Dept. of Agric.
Joe C. Dunn	1990	American Cyanamid
Harry Williams	1997	Univ. of TN (retired)

Harry E. Williams Award (est. 2002)

Recipient	Year	Location
Kim Woodard	2002	Trousdale Co.
Liam Black and Kimberly Woodard	2003	Hardeman Co. and Trousdale Co.
Reed Avent	2006	Bolivar, TN
Andy Brown	2008	Coffee Co.
Phillip Adams	2009	Burns, TN
Jonathan Belcher	2010	Rutherford Co.
Kade Parker	2011	Maryville, TN
Kade Parker	2012	Maryville, TN
Steven Davis	2013	Loudin Co.
Angel Chaffin	2014	Sevier Co.
Perrein Heselschwerdt	2015	Claiborne Co.
-----	2016	(No award given)
Keaton Pennick	2017	Weakley Co.
Samantha Bussell	2018	Macon Co.
-----	2019	(No award given)
Benjamin Fisk	2020	Lincoln Co.

Howard Bruer Award (est. 1975)
Recipients of the Tennessee Entomological Society (1975 - Present)

Recipient	Year	Location
Whitney Eckler	1975	Memphis, TN
Joe Martin	1976	Bolivar, TN
Bryan Peters	1977	College Grove, TN
Tidus Pollard	1978	Huron, TN
John Bentley	1979	
Melissa Hart	1980	Watertown, TN
Gary Miller	1981	Knoxville, TN
Harold Glass	1982	Knoxville, TN
-----	1983	(No award given)
-----	1984	(No award given)
Penny Thompson	1985	Davidson County
Matthew Fumich	1986	Munford, TN
Christie Greer	1987	Greene Co.
Dottie Hodges	1988	Hamblen Co.
-----	1989	(No award given)
Tim Gentry	1990	Woodbury, TN
Jennifer Hartsell	1991	Hamblen Co.
Jessica Taylor	1992	Lincoln Co.
Jennifer Lenter	1993	Fayetteville Co.
Jeremy Smith	1994	Savannah Co.
George Carroll	1995	Anderson Co.
Stacy Milhahn	1996	Lincoln Co
Nancy Warden	1997	Marshall Co.
Denise Byrum	1998	Moore Co.
James Johnson	1999	Bolivar, TN
Wade Black	2000	Hardeman Co.
Sara List	2006	Coffee Co.
-----	2008	(No award given)
Grant Fisher	2009	Sevierville, TN
Julia Britto	2012	Oak Ridge, TN
Swati Mishra	2013	Davidson Co.
-----	2014-2020	(No award given)

Outstanding Entomologist (Tennessee Entomologist of the Year) Award (est. 1981) Recipients of the Tennessee Entomological Society (1981 - Present)

Recipient	Year	Affiliation
Myron Smith	1981	Hill Smith Pest Control
Harry Williams	1985	Univ. of Tennessee
John A. Hammett	1987	Tenn. Dept. of Agric.
Joe C. Dunn	1991	American Cyanamid

Richard E. Caron Outstanding Entomologist Award

Recipient	Year	Affiliation
Harry Williams	1995	Univ. of TN (Retired)
Harvey Barton	1996	Arkansas State Univ. (Retired)
Carroll Southards	1997	Univ. of TN (Retired)
Harold Bancroft	2001	Univ. of Memphis
Charles Pless	2002	Univ. of Tennessee (retired)
Gary Lentz	2008	Univ. of Tennessee (retired)
Reid Gerhardt	2009	Univ. of Tennessee (retired)
Gene Burgess	2011	Univ. of Tennessee (retired)

Undergraduate Student Award (est. 2015) Recipients of the Tennessee Entomological Society

Recipient	Year	Location
Erik Hearn (1st)	2015	University of Tennessee
Rachel Harmon (2nd)	2015	University of Tennessee
Amber Dunnaway (1st)	2017	Tennessee State University
Sandra Bojic (2nd)	2017	Belmont University
Andrew Dixon (1st)	2018	University of Tennessee
Brianna Alred (2nd)	2018	University of Tennessee
Caroline Barnes & Maya Rao (1st)	2019	University of Tennessee
Marlo Black	2020	University of Tennessee

Graduate Student Award (est. 1986) Recipients of the Tennessee Entomological Society (1986 - Present)

Recipient	Year	Location
Jay Avery	1986	Knoxville, TN
Laura Rogers	1987	Knoxville, TN
Jason Oliver	1988	Knoxville, TN
Steve D. Powell	1989	Knoxville, TN
Robert C. Brown	1990	Knoxville, TN
Donald L. Sudbrink, Jr.	1991	Knoxville, TN
Deborah Landau	1992	Knoxville, TN
Deanna Colby	1993	Knoxville, TN
Lee Holt	1994	Knoxville, TN
Kenneth Copley	1995	Knoxville, TN
Dina Roberts	1996	Memphis, TN
Bryan Hed	1997	Knoxville, TN
Gary Moughler	1998	Knoxville, TN
Andrew Beld	1999	Nashville, TN
Lacey McNally	2000	Baton Rouge, LA
Ken Davenport	2001	Clarksville, TN
Debra Hoyme	2002	Knoxville, TN
Amy Kovach	2003	Knoxville, TN
Andrew Haddow	2004	Knoxville, TN
Greg Wiggins (1st)	2005	University of Tennessee
Issac Deal (2nd)	2005	University of Tennessee
Auora Teonnisson (1st)	2006	University of Tennessee
Derek Bailey (2nd)	2006	University of Tennessee
Eric Janson (1st)	2007	Vanderbilt University
Carla Dilling (2nd)	2007	University of Tennessee
Jonathan Willis (1st)	2008	University of Tennessee
Greg Wiggins (2nd)	2008	University of Tennessee
Robert Brucker (1st)	2009	Vanderbilt University
Paul Rhoades (2nd)	2009	University of Tennessee
Abdul Hakeem (1st)	2010	University of Tennessee
Keith Post (2nd)	2010	University of Tennessee
Carla Coots (1st)	2011	University of Tennessee
Angelina Fisher (2nd)	2011	Austin Peay State University
Abdul Hakeem (1st)	2012	University of Tennessee
Brittney Jones (2nd)	2012	Austin Peay State University
Elizabeth Benton (1st)	2013	University of Tennessee
Katheryne Nix (2nd)	2013	University of Tennessee
Elizabeth Benton (1st)	2014	University of Tennessee

Sara Mays (2nd)	2014	University of Tennessee
Elizabeth Benton (1st)	2015	University of Tennessee
Katie Britt (2nd)	2015	University of Tennessee
David Theuret (1st)	2016	University of Tennessee
Emel Oren (2nd)	2016	University of Tennessee
Brandy Schnettler (2nd)	2016	Austin Peay State University
Katherin Solo (1st)	2017	University of Tennessee
WanWan Liang (2nd)	2017	University of Tennessee
Brent Newman (1st)	2018	Tennessee State University
Ratnasri Pothula (2nd)	2018	University of Tennessee
Victoria Deren (1st)	2019	Tennessee State University
Matthew Longmire (2nd)	2019	University of Tennessee
Swati Mishra (1st)	2020	University of Tennessee
Gary Edwards (2nd)	2020	University of Tennessee

CONSTITUTION
of the
TENNESSEE ENTOMOLOGICAL SOCIETY
(as of October 1991)

Article 1. Name

This Society is formed in the name and style of the "Tennessee Entomological Society", as an educational institution, not contemplating financial gain or profit. It is herein and after called the Society.

Article 2. Purpose

The purpose and object of the Society is to foster entomological accomplishment among its members and to promote the welfare of all of the State of Tennessee through the encouragement of: (1) the preparation, reading, and/or publication of papers, (2) association and free discussion among all members, (3) the dissemination of entomological information to the general public, and (4) cooperative efforts in statewide insect surveys.

Article 3. Membership

Section 1. Original Members: Any person designated at the organizational meeting of the Society to occupy the status of "Member" shall be considered as and be a Charter Member. Thereafter, the organizational membership shall have no authority to name or appoint members of the Society.

Section 2. Membership: Membership shall be open to all persons interested in Entomology.

Section 3. Sustaining Membership: Sustaining Membership is open to commercial or industrial organizations upon meeting approval and requirements of the Board of Directors.

Section 4. Honorary Membership: Honorary Members may be selected from time to time by a majority vote of the Board of Directors.

Section 5. Student Membership: Student Membership is open to students enrolled in any education institution and meeting the requirements of the Board of Directors.

Section 6. Procedure to Obtain Membership: Any person desiring to become a member of the Society shall do so by application and payment of dues to the Treasurer. After approval of the majority of the Board of Directors, said applicant shall become a duly constituted member.

Section 7. Members in Good Standing: A member who is current in payment of dues.

Article 4. Membership Rights

Section 1. Voting: Each member in good standing shall be entitled to one vote at any regular or special meeting or by mail. Voting by proxy shall not be allowed.

Section 2. Privileges: All members in good standing shall have equal privileges in the presentation of papers and discussions at meetings.

Article 5. Membership Certificates

Section 1. Certificates: The Board of Directors shall decide upon what evidence of membership each member in good standing shall be entitled to receive.

Section 2. Transfer: Evidence of membership in the Society will not be transferable or assignable.

Article 6. Dues

Section 1. Annual Dues: The amount of the annual dues for membership in the Society will be established by the Board of Directors from time to time. The use or uses of dues collected shall also be determined by the Board.

Section 2. Time of Payment: The Board of Directors shall set such times during each year as it deems advisable for the payment of annual dues by members. Generally, annual dues shall be paid during registration at the annual meetings. However, a member may mail dues to the Treasurer of the Society if the member cannot attend a given annual meeting. If a member fails to pay dues two (2) years in a row, such member shall be dropped from the rolls.

Section 3. Honorary Members: There shall be no dues required for Honorary Members or others specially designated by the Board of Directors.

Article 7. Meetings of the Society

Section 1. Annual Meetings: The Society shall hold annual meetings at such times and places as may be designated by the Board of Directors and specified in the notice thereof, for the election of officers and any other business as may be properly brought before the meeting.

Section 2. Registration Fee: A registration fee, in the amount to be determined by the Board of Directors, shall be paid at each annual meeting by all members and non-members who attend. The Board of Directors will determine the use of these fees.

Section 3. Special Meetings: Special meetings of the Society shall be held at any time and place as specified in the notice thereof whenever called by the President or any two (2) or more members of the Board of Directors.

Section 4. Notice: Notice of all meetings of the Society, annual or special, stating time, place, and agenda shall be mailed to each member by the President, Secretary, Treasurer, or Directors calling the meeting not less than seven (7) days prior to the meeting.

Article 8. Officers

Section 1. Officers: The officers of the Society shall consist of a President, President-elect, Secretary, Treasurer, Editor, and Historian, all of whom, except the President, shall be elected by and from the membership by a majority vote of members or by mail. The first President of the Society shall be elected by and from the membership at the organizational meeting for a term extending to the beginning of the first annual meeting. Thenceforth, the President-Elect shall automatically accede to the office of President at each annual meeting, or when the President is unable or unwilling to act for any reason. Nominees for each elective office of the Society shall be selected by a nominating committee of three (3) members appointed at the annual meeting by the President. Nominations may also be presented from the floor. The President and President-Elect shall hold office from the date of election at the annual meeting until the election of their successors at the next annual meeting, and shall not be eligible for re-election to the same office for a successive term. The Secretary, Treasurer, and Editor shall hold office from the date of election at the annual meeting until the election of a successor at the third following annual meeting and shall be eligible for re-election. The Historian shall hold office from the date of election at the annual meeting until the election of a successor at the fifth following annual meeting and shall be eligible for re-election. No member shall occupy more than one office at any one time.

Section 2. Duties and Powers of the President: The President shall be the Chief Executive Officer of the Society and shall preside at all meetings of the Society and the Board of Directors, have and exercise general and active management of the Society, execute and enforce all orders and resolutions and regulations duly adopted by the Board of Directors, execute all contracts in the name of the Society, and perform such other duties as assigned by the Board of Directors.

Section 3. Duties and Powers of the President-Elect: In the absence of the President, or in the case of failure to act, the President-Elect shall have all the powers of the President and shall perform such other duties as shall be imposed by the Board of Directors from time to time.

Section 4. Duties and Powers of the Secretary: The Secretary shall attend and keep the minutes of all meetings of the Board of Directors and the Society, shall have charge of the records and seal of the Society, and shall, in general, perform all the duties incident to the office of Secretary of the Society.

Section 5. Duties and Powers of the Treasurer: The Treasurer shall keep full and accurate accounts of the books of the Society and shall deposit all monies and the valuable properties and effects in the name of and to the credit of the Society in such depository or depositories as may be designated by the Board of Directors. The Treasurer shall disperse funds as may be ordered by the Board, getting proper receipts for such disbursements; and shall render to the Board of Directors whenever required by it, an accounting of all transactions as Treasurer. During each

annual meeting, the Treasurer shall give a report on the annual financial condition of the Society. The Treasurer shall, in general, perform all the duties incident to the office of Treasurer of the Society.

Section 6. Duties and Powers of the Editor: The Editor shall be a member of the Board of Directors and Chair of the Publication and Editorial Committee and be responsible for editing and publishing such publications as directed by the Board of Directors and passed by the majority of the voting membership at a called meeting.

Section 7. Duties and Powers of the Historian: The Historian shall maintain and be responsible for keeping a complete and accurate history of the activities of the Society from year to year.

Section 8. Vacancies in Office: Any vacancy in the office of President-Elect, Secretary, Treasurer, Editor, or Historian, however occasioned, may be filled, pending the election of a successor by the Society, by a majority vote of the remaining Directors. Should an office be filled by vote of the Board of Directors, the person so elected shall not become the officer upon the next annual meeting unless elected as such by the Society according to the procedures set forth for the election of officers of the Society in Article 8, Section 1, of this Constitution.

Article 9. Board of Directors

Section 1. Makeup and Responsibilities: The Board of Directors shall consist of the immediate past-President, the President, President-Elect, Secretary, Treasurer, Editor, and Historian of the Society and two members-at-large. The members-at-large shall be elected at the Annual Meeting of the Society and shall serve a term of one year. Any three (3) Directors shall constitute a quorum for the transaction of business. All properties, property rights, objects and purposes of the Society shall be managed, promoted, and regulated generally by the Board of Directors.

Section 2. Installation and Term of Office: The members of the Board of Directors shall be installed after their election as officers of the Society as set forth in Article 8, Section 1, of this Constitution, at the annual meeting of the Society, or at any adjourned meeting, or at any special meeting called for that purpose. All installed Directors shall serve for a term corresponding to that of the office in the Society to which each was elected by the members and thereafter until their successors are elected, accept office, and are installed.

Section 3. Annual Meetings: The Board of Directors shall meet immediately after the adjournment of the annual meeting of the members for the transaction of such business as may come before the Board. No notice of such meeting shall be required, and should a majority of the newly-elected Directors fail to be present, those present may adjourn, without further notice to a specified future time.

Section 4. Other Meetings: The Board of Directors shall not be required by this Constitution to hold regular meetings but may, by resolution or otherwise, establish such order of meetings as it

deems desirable. Special meetings of the Board shall be held at any time at such places as may be specified in the notice thereof, whenever called by the President or any two (2) or more Directors.

Section 5. Notice: Notice of all meetings of the Board of Directors, other than the annual meeting, starting time, place, and agenda for which the meeting was called, shall be given to each Director by the President or Directors calling the meeting not less than three (3) days prior to the meeting.

Section 6. Vacancies in Board of Directors: Any vacancy in the office of any Director, however occasioned, may be filled, pending the election of a successor by the Society, by a majority vote of the remaining Directors.

Article 10. Miscellaneous Provisions

Section 1. All checks and drafts shall be signed in such manner as the Board of Directors may from time to time determine.

Section 2. At all duly constituted meetings of the Society or Board of Directors of the Society, 10% of the eligible members, or 3 Directors, respectively, present shall constitute a quorum for the transaction of any business presented at such meetings.

Section 3. All notices required to be given by this Constitution relative to any regular or special meeting of the Society or the Board of Directors may be waived by the Directors or members entitled to such notice, either before or on the date of the meeting and shall be deemed equivalent thereto. Attendance at any meeting of the Society of the Board of Directors shall be deemed a waiver of notice thereof.

Section 4. General Prohibitions: Notwithstanding any provision of this Constitution and By-Laws which might be susceptible to a contrary construction. A. No part of the activities of the Society shall consist of carrying on propaganda, or otherwise attempting to influence legislation. B. This Society shall not participate in, or intervene in, (including the publishing or distribution of statements), any political campaign on behalf of a candidate for public office.

Article 11. Amendments

Section 1. This Constitution may be altered or amended or By-Laws adopted by a majority vote of the quorum present at any annual or special meeting of the Society membership, provided that notice of such proposed amendment or By-Laws shall have been given to the membership prior to the meeting.

OPERATING PROCEDURES OF THE TENNESSEE ENTOMOLOGICAL SOCIETY

The Tennessee Entomological Society (TES) is an organization formed for the purpose of fostering entomological accomplishment among its members and to promote the welfare of all of the State of Tennessee through the encouragement of: (1) the preparation, reading, and/or publication of papers, (2) association and free discussion among all members, (3) the dissemination of entomological information to the general public, and (4) cooperative efforts in statewide insect surveys. All necessary permanent records are maintained by person or persons designated by the Board of Directors and the President of the Organization.

Changes in Operating Procedures

The Constitution or By-laws may be altered or amended by a majority vote of the quorum present at any annual or special meeting of the Society membership, provided that notice of such proposed amendment or By-laws shall have been given to the membership prior to the meeting; the operating procedures of TES should be more flexible. The Constitution and Operating Procedures Committee is charged with the responsibility of studying these procedures each year to recommend possible improvements. Proposed changes in procedures are recommended to the Board of Directors for final action.

Registration and Dues

Registration and dues shall be set by majority vote of the Board of Directors. Dues for voting members will be collected by the membership committee at the time of the annual meeting.

The Board of Directors

The Board of Directors shall:

1. Consist of the immediate past-President, the President, President-Elect, Secretary, Treasurer, Editor, and Historian of the Society and two members-at-large.

2. Be responsible for management of the TES and conduct the affairs of the organization.

3. Conduct such business of the organization as is not delegated to the officers or committees and receive from the officers and committees reports and recommendations requiring specific board action or requiring recommendation for action by the membership.

4. Be responsible for changes in the manual of operating procedures after study and recommendation by the Constitution and Operating Procedures Committee.

5. Be responsible for transacting any official business.

6. Be responsible for assembling the board meetings.
7. Nominate honorary members to be voted on by membership.

President

The President shall:

1. Serve as Chairman of the Board of Directors, prepare an agenda for meetings of the Board of Directors and preside at such meetings.

2. Be responsible for determining that the decisions of the Board of Directors are correctly enforced within the framework of the organization's Constitution and By-laws.

3. Select chairman of committees at annual meeting and appoint committee members.

4. Serve as ex-officio member of all committees, maintain close liaison with the chairman of the committees, and encourage and assist them with development of program beneficial to the organization.

5. Work with the chairman of the program and local arrangements committees in planning the programs for annual meetings.

6. Preside at the general or introductory session of the annual meeting.

7. Advise all officers and board members on significant activities of the organization and solicit their suggestions.

8. Serve as the official representative for TES, when appropriate.

President-Elect

The President-Elect shall:

1. Perform the duties of the President if he cannot serve.

2. Serve as chairman of the program committee, and select the membership of that committee with the President and Board of Directors' approval.

3. Work with the Local Arrangements Chairman in the planning of all details of the annual meeting.

4. Prepare and mail announcements of the annual meeting. Assist with the printing of programs and mailing of programs.

5. Prepare and have the program of the annual meeting in print.

6. Be responsible for reminding speakers at each annual meeting to prepare papers before the meeting according to prescribed standards of the organization and to have these papers at the time of the presentation.

Secretary

The Secretary shall:

1. Have charge of the records and seal of the TES.

2. Take the minutes of all official business meetings of the association. Supply a copy of these minutes to the membership, Board of Directors and committee chairmen as necessary.

3. Consult with the President and inform all officers and board members of occurrences of any official meetings of the Board of Directors.

4. Maintain current lists of members and provide these along with the minutes of the annual business meeting to those persons with official need to know.

5. Make any mailing to the membership as needed or designated by the President or Board of Directors. Maintain a supply of the organizational supplies and letterhead paper for use by the officers.

6. Maintain a supply of operating procedures and provide copies to officers and board members and committee chairmen.

7. Serve as a member of the membership committee.

Editor

The Editor shall:

1. Chair the Publication and Editorial Committee.
2. Perform or be responsible for all editorial duties of the organization including the newsletter and any other publication of the organization.

Treasurer

The Treasurer shall:

1. Be responsible for the financial affairs of the TES. This includes depositing all money received by the TES into appropriate Association accounts, handling the TES's money for maximum income (upon consultation with the Finance Committee), and paying of all expenses and invoices received by the TES.

2. Serve as a member of the Finance Committee.

3. Provide a written financial report to the Board of Directors at least annually, and for the published business meeting minutes. Make an oral financial report as the annual business meeting and at Board of Director meetings as necessary. Provide the necessary information for the Auditing Committee's activities.

Immediate Past-President

The Immediate Past-President shall:

1. Serve as a member of the Board of Directors during the year following his term of Presidency.

Committees

All committees and members of committees are selected by the President (or President-Elect). Each committee shall attempt to complete his/her assigned duties during the term of their appointment. The chairman of each committee shall solicit the assistance of his/her members as necessary. The standing committees are as follows:

Program Committee

The Program Committee shall:

1. Plan the general program format to fit the annual meeting time established by the general membership.

2. Contact invitational speakers and make arrangements for an honorarium, if appropriate.

3. Request papers from the general membership and establish a deadline for submittal of titles.

4. Prepare a program outline for printing.

5. Arrange to have chairpersons for each session.

6. Compile abstracts from program speakers for the proceedings of the program.

Local Arrangements Committee

The Local Arrangements Committee shall:

1. Be responsible for all physical arrangements for the Annual Meeting, working cooperatively with the Officers.

2. Reserve meeting rooms for estimated attendance at the Annual Meeting.

3. Specific Responsibilities will include:

    a. Arranging for visual and audio equipment, including projectors.

    b. Liaison with Treasurer regarding registration help, convention typewriters, etc.

    c. Signs for sessions and activities; coordinate with Program Chairman.

    d. Helping arrange transportation or lodging of guest speakers if needed; coordinate with Program Chairman.

    e. Preparing a report of activities for inclusion in the minutes of the business meeting.

    f. Approving all expenses incurred in conjunction with the Annual Meeting and forwarding invoices to the Treasurer for payment.

4. In addition to the above, be responsible for special functions carried out in conjunction with the Annual Meeting. This may include such special activities as coordinating exhibits at the Annual Meeting, as well as door prizes, with representatives of other organizations joining in this meeting, if desired. If necessary, the Local Arrangements Committee will be appointed with a sufficient number of members that these functions may be designated as the responsibilities of sub-committees of the overall committee.

5. Insure that sufficient facilities are available for morning and afternoon breaks.

6. A sponsored or dutch banquet and/or mixer could also be in order. Arrangements for banquet facilities, an after-dinner speaker and door prizes may be desired.

Membership Committee

The Membership Committee shall:

1. Encourage any interested person in Entomology to join our Society.

2. Send information about the Society to heads of Biology and Zoology Departments at all colleges and universities in the state, enclosing a few applications.
3. Encourage interested people of Pest Control organizations and other agricultural businesses to join the Society.

4. The Secretary shall send at least two blank membership applications to each member asking them to give to good prospects.

5. Each committee member should make a conscientious effort to enroll as many new members during the year as possible.

6. When notices of annual meetings are sent to major newspapers, television, and radio stations, an invitation to interested people could be given at that time.

7. The Chairman should coordinate this committee's efforts with the publicity and other committees when appropriate.

8. Collect dues at the annual meeting.

Auditing Committee

The Auditing Committee shall:

1. Review and certify the accuracy of the financial records and books of the Treasurer prior to the general business session of each Annual Meeting.

2. Conduct special audits as may be directed by the President or the Board of Directors.

3. Report any mistakes or misuses found by the committee to the President for appropriate action prior to the general business session.

4. Prepare a report of the committee's findings, with recommendations, for presentation at the general business session.

Nominating Committee

The Nominating Committee shall:

1. Present a slate of nominees from the active membership of the TES which will include a nominee for President-elect, and two nominees for members-at-large on the Board of Directors every year. The Secretary, Editor and Treasurer hold office for three years, and shall be eligible for re-election. In each case, it is suggested that the Nominating Committee present more than one nominee for each position.

2. Secure the prior approval of all nominees before their names are put before the membership.

3. Submit a written report to the Board of Directors consisting of current committee actions and suggestions for improvement.

Awards Committee

The Awards Committee shall:

1. Consist of 5-6 TES members including a Chair. who are selected following the business meeting of the annual meeting.

2. Obtain name(s) of state 4-H winner (level II), the entomology winner of the Mid-South Fair (Tennessee resident), or other outstanding young entomologist(s) and select the Howard Bruer Award recipient.1/

3. Arrange to have a plaque made honoring the Howard Bruer Award recipient (contact TES treasurer) and deliver the plaque and news release information to the recipient's county agent for presentation/publicity at a later date.2/

4. Obtain commitments from 3-5 TES members to serve as judges of the Student Paper Competition at the upcoming annual meeting (It is preferable that none of the judges have students in the competition).

5. Contact the TES Treasurer about preparing a $150.00 and $75.00 check to be given to the Student Paper Competition 1st and 2nd place winners during the business meeting of the annual meeting.

6. Have Student Paper Competition Evaluation Forms (with student names and presentation titles) ready for the judges the morning before the competition and assist in determining the winner following the competition.

7. Arrange to have a plaque made honoring the outgoing TES President (contact the TES Treasurer) and present it to him/her when asked by the new President during the business meeting of the annual meeting.2/

8. Determine if it is appropriate to award the Richard E. Caron Outstanding Entomologist Award to a TES member at the upcoming annual meeting and submit for review by the Board of Directors. This award will be given periodically to individuals who have distinguished themselves by making outstanding contributions to entomology in Tennessee during their career. If a recipient is chosen, arrangements should be made to have a plaque made (contact the TES Treasurer) to be presented at the business meeting.2/

1/ Contact Award Committee Chair at least one month prior to the annual meeting.

[2/] Contact Award Committee Chair and President about having plaques made at least one month before the annual meeting.

9. Have a committee meeting immediately following the second paper session at the annual meeting.

Prediction, Evaluation Committee

The Prediction and Evaluation Committee shall:

1. List major agricultural commodities in Tennessee (Plant & Animal)
    a. Approximate percent commodity loss due to various insect pests.
    b. Approximate monetary loss due to each pest on various crops.
    c. Approximate cost of control for each pest.
2. List insects which face a serious threat and crops which may be affected.
3. Major household, structural, and nuisance insects.
    a. List major insects.
    b. Approximate amount of money spent each year in control.
    c. Approximate damage and loss from pest.

Constitution and Operating Procedures Committee

The Constitution and Operating Procedures Committee shall:

1. Annually review the Constitution and Operating Procedures and develop recommendations for improvements or needed changes and submit these to the Board of Directors for study and approval.
2. The Chairman of the Constitution Committee shall prepare adoption of amendments at any annual or special meeting.
3. The Chairman of the Constitution Committee shall coordinate with the Secretary in inserting such amendments into the notice and proceedings of the meeting.

Publication and Editorial Committee

The publication and Editorial Committee shall:

1. Determine and make recommendations to the Society of the type of publication suitable to the Society's needs and when such a publication should be initiated.

2. Set up guidelines and standards for such a publication, and investigate possible mechanisms for implementation upon decision of the organization.

3. Be responsible for soliciting and gathering of articles for publication.

4. Act as an editorial committee in screening such articles to be published.
5. The chairman will be responsible for the coordination of this committee's responsibilities with the Board, Secretary-Treasurer, and other committees as necessary.

Publicity Committee

The Publicity Committee shall:

1. Be responsible for developing and implementing an effective public relations program for the Tennessee Entomological Society.

2. Prepare general news releases on the society's activities and accomplishments and publicize the meetings. Specifically, these things should be done:

    a. Prepare and release general news release as soon as Program Committee has planned a theme or area of interest for either meeting. Also, include location of meeting and time. This should begin by mid-summer and meeting dates should be sent to magazines and trade publications such as Delta Farm Press, Southeast Farm Press, Tennessee Market Bulletin, Ag Pesticide Notes, newspapers, etc.

    b. A follow-up news release should be issued about one month before each meeting. Location of meeting, date, time, and outstanding invitational speakers could be mentioned.

    c. Prepare follow-up news release after the meeting for use by news media.

    d. Send notice to Entomological Society of America and other state societies.

3. Maintain close liaison with the Program Committee in obtaining early copies of the program of both meetings for publicity purposes.

4. Arrange for radio, television, and press coverage of society's meetings by contacting

area radio and TV stations just prior to the meetings and by calling the news rooms of local newspapers on the first day of the meetings.

5. Arrange for group photos of outgoing and in-coming officers and directors of the Association at the Annual meeting.

6. Prepare a report of the year's activities for the committee for presentation at the annual business meeting.

7. Post notices on the bulletin boards of the Entomology, Biology, and Zoology Departments in the colleges and universities across the state.

8. Direct mail to members.

Dates ('00), ('01) refer to last meeting attendance or last dues payment.

H = Honorary Member

Application for Membership in the

TENNESSEE ENTOMOLOGICAL SOCIETY

I (we), herewith, submit this application for membership in the Tennessee Entomological Society.

PLEASE CHECK HERE IF YOU ARE A NEW MEMBER_____

NAME:_____

ADDRESS:_____

_____

_____

_____ZIP_____

PHONE:_____

FAX: _____

E-MAIL: _____

AFFILIATION:_____

REGISTRATION: $30.00 _____ STUDENT DUES: $5.00 _____

REGULAR DUES: $10.00 _____ DONATION: _____

CORPORATE DUES: $50.00 _____ SUSTAINING DUES: $50.00 _____

TOTAL: $_____ Received by: _____
(Treasurer)

Please Remit to:

Steve Powell
Ellington Agricultural Center
436 Hogan Road
Nashville, TN 37220
Steve.Powell@tn.gov

All checks should be made payable to the Tennessee Entomological Society.

TES Predictions and Evaluations 2020 – Steve Powell

In 2020, two new counties (Dickson and Hickman) were added to the Emerald Ash Borer (EAB) quarantine in Tennessee. EAB purple prism trapping in 2020 produced 6 new county records for EAB (4 in the already quarantined counties) in Tennessee. These 6 counties are Cannon, Clay, Dickson, Grundy, Hickman, and Warren. There are 65 counties in Tennessee quarantined for EAB with 65 county records (There are no quarantined counties in Tennessee without a county record at this time). In late 2019, Lewis County was confirmed to have EAB. There is scattered EAB damage in the city of Murfreesboro (Rutherford County). Widespread Ash tree death and decline have been documented in Bedford County and in southern Rutherford County. In the next several years, there will be massive decline and death of untreated Ash trees in much of middle Tennessee as has already taken place in East Tennessee. With the far greater numbers of Ash trees in Middle Tennessee than East Tennessee, this will be much more noticeable and impactful.

In 2020, a total of 58 Gypsy Moths were captured in Tennessee Department of Agriculture (TDA) trapping plus 2 in Federal Lands trapping (Sevier County – Great Smoky Mountains National Park). The county break down of the 58 caught in TDA Gypsy Moth trapping is as follows: Blount (1 moth), Carter (1 moth), Greene (1 moth), Johnson (41 moths), McMinn (2 moths), Sevier (2 moths), Sullivan (8 moths), Unicoi (2 moths). No areas of Tennessee are known to be infested (multiple life stages found) with Gypsy Moth at this time. In mid-June two areas in Johnson County totaling over 8500 acres were treated with mating disruption from aircraft in response to high numbers of gypsy moth catches in traps placed in those areas in 2019.

No changes were made to the Imported Fire Ant Quarantine in 2020 in Tennessee. Currently, there are 58 counties fully quarantined and 8 counties partially quarantined for the Imported Fire Ant.

There was no TDA Walnut Twig Beetle trapping in 2020. The 2019 catches in TDA Walnut Twig Beetle trapping are as follows by county: Blount (13) and

Sequatchie (310). Grundy County was the most recent new county record for Walnut Twig Beetle in 2018.

Crape Myrtle Bark Scale has been found in 13 Tennessee counties: Davidson, Fayette, Gibson, Hardeman, Haywood, Knox, Lauderdale, Madison, Rutherford, Shelby, Tipton, Williamson, and Wilson.

Laurel Wilt was found (on Sassafras) in Tennessee for the first time in 2019. It has been confirmed in 6 Tennessee counties: Cheatham, Dickson, Hamblen, Montgomery, Robertson, and Williamson. It has also been found in several counties in Kentucky that border Tennessee. It is anticipated that Laurel Wilt will be confirmed in more counties soon.

Asian Longhorned Beetle (ALB) was found in a southern state (near Charleston, South Carolina) for the first time in 2020. USDA is working to determine the extent of the infestation and begin the process of eradication.

USDA United States Department of Agriculture

Pest Alert

Emerald Ash Borer

Emerald ash borer (*Agrilus planipennis* Fairmaire (Coleoptera: Buprestidae)) is a wood-boring beetle from Asia that was identified in July 2002 as the cause of widespread ash tree (*Fraxinus* spp.) decline and mortality in southeastern Michigan and adjacent parts of Ontario, Canada. Larval feeding between the bark and sapwood disrupts transport of nutrients and water in a tree, causing dieback of the branches and eventually death of the tree. Tens of millions of ash trees in forest, rural, and urban areas have already been killed, and many more are rapidly declining from this pest.

Emerald ash borer (EAB) infestations have since been confirmed in all or parts of 24 States and the Canadian Provinces of Ontario and Quebec. While most of the detections have occurred in eastern North America, the insect has been found as far west as Colorado. New EAB detections in other areas are likely as surveys continue (see www.emeraldashborer.info/ for periodic updates). Evidence indicates that EAB is often established in an area for several years before it is detected.

The broad distribution of this pest in the United States and Canada is primarily due to commerce and the inadvertent transport of infested ash firewood, unprocessed logs, nursery stock, and other ash commodities. Federal and State quarantines now regulate the movement of these products from the infested areas to areas not known to have EAB.

Identification

Adult beetles (Fig. 1) are slender, elongate, and 7.5 to 13.5 mm (0.3 to 0.5 in.) long. They generally have dark, metallic emerald green wing covers and bodies that are bronze, golden, or reddish green. The dorsal side of the abdomen is metallic purplish red and can be seen when the wings are spread (Fig. 2). Males are smaller than females and have fine hairs, which the females lack, on the ventral side of the thorax. The prothorax, the segment behind the head and to which the first pair of legs is attached, is slightly wider than the head and the same width as the wing covers. Adult EAB are generally larger and brighter green than the native North American *Agrilus* species.

Larvae reach a length of 26 to 32 mm (1.0 to 1.3 in.), are white to cream colored, and dorso-ventrally flattened (Fig. 3). The brown head is mostly retracted into the prothorax, and only the mouthparts are visible. The abdomen has 10 segments, and the last segment has a pair of brown, pincer-like appendages.

Figure 1. Adult emerald ash borer

Figure 2. Purplish red abdomen on adult beetle.

Figure 3. (Bottom to top) Second, third, and fourth stage larvae.

Figure 4. Gallery of an emerald ash borer larva

Biology

EAB generally has a 1-year life cycle. In the upper Midwest, adult beetles begin emerging in May or early June. Beetle activity peaks between mid June and early July, and continues into August. Adults probably live for about 3 weeks, although some have survived for more than 6 weeks in the laboratory. Beetles generally are most active during the day, particularly when it is warm and sunny, and move to protected locations in bark crevices or cling to foliage during inclement weather.

Adult beetles feed on ash foliage, usually leaving small, irregularly shaped patches along the leaf margins, causing negligible damage to the tree. At least a few days of feeding are needed before beetles mate, and an additional 1 to 2 weeks of feeding may be needed before females begin laying eggs. Females can mate multiple times. Each female probably lays 30 to 60 eggs during an average lifespan, but a long-lived female may lay more than 200 eggs. Eggs are deposited individually in bark crevices or under bark flaps on the trunk or branches, and soon darken to a reddish brown. Eggs hatch in 7 to 10 days.

Newly hatched larvae chew through the bark and into the phloem and cambial region of the tree. Larvae feed on phloem for several weeks, creating serpentine (S-shaped) galleries packed with fine sawdust-like frass. As a larva grows, its gallery becomes progressively wider (Fig. 4), often etching the outer sapwood. The length of the gallery generally ranges from 10 to 50 cm (about 4 to 20 in.). Feeding is usually completed in autumn.

Forest Service
Northeastern Area
State and Private Forestry
NA-PR-02-04
Revised May 2015

Prepupal larvae overwinter in shallow chambers, roughly 1 cm (0.4 in.) deep, excavated in the outer sapwood or in the bark on thick-barked trees. Pupation begins in late April or May. Newly eclosed adults often remain in the pupal chamber or bark for 1 to 2 weeks before emerging head-first through a D-shaped exit hole that is 3 to 4 mm (0.1 to 0.2 in.) in diameter (Fig. 5).

Figure 5. D-shaped hole where an adult beetle emerged.

Two-year development of EAB larvae is typical in newly infested ash trees that are relatively healthy. In these trees, many larvae overwinter as early instars, feed a second summer, overwinter as prepupae, and emerge the following summer. However, in trees stressed by physical injury, high EAB densities, or other problems, many or all larvae may develop in a single year. Whether a 2-year life cycle will occur in warmer southern States is not yet known.

Distribution and Hosts

EAB is native to Asia and is found in China and Korea. It is also reported in Japan, Mongolia, the Russian Far East, and Taiwan. In China, high populations of EAB occur primarily in *Fraxinus chinensis* and *F. rhynchophylla*, usually when those trees are stressed by drought or injury. Other Asian hosts (*F. mandshurica* var. *japonica*, *Ulmus davidiana* var. *japonica*, *Juglans mandshurica* var. *sieboldiana*, and *Pterocarya rhoifolia*) may be colonized by this or a related species.

In North America EAB has attacked only ash trees. Host preference of EAB or resistance among North American ash species may vary. Green ash (*F. pennsylvanica*) and black ash (*F. nigra*), for example, appear to be highly preferred, while white ash (*F. americana*) and blue ash (*F. quadrangulata*) are less preferred. At this time all species and varieties of native ash in North America appear to be at risk from this pest. Recently EAB was found on white fringetree (*Chionanthus virginicus*); however, its role as a susceptible host or as a secondary host in areas of high EAB densities is not fully understood and continues to be evaluated.

Signs and Symptoms

It is difficult to detect EAB in newly infested trees because they exhibit few, if any, external symptoms. Jagged holes excavated by woodpeckers feeding on late instar or prepupal larvae may be the first sign that a tree is infested (Fig. 6). D-shaped exit holes left by emerging adult beetles may be seen on branches or the trunk, especially on trees with smooth bark (Fig. 5). Bark may split vertically over larval feeding galleries. When the bark is removed from infested trees, the distinct, frass-filled, serpentine larval galleries that etch the outer sapwood and phloem are readily visible (Fig. 4 and Fig. 7). An elliptical area of discolored sapwood, usually a result of secondary infection by fungal pathogens, sometimes surrounds galleries.

Left to right:

Figure 6. Jagged holes left by woodpeckers feeding on larvae.

Figure 7. Ash tree killed by emerald ash borer. Note the serpentine galleries.

As EAB densities build, foliage wilts, branches die, and the tree canopy becomes increasingly thin. Many trees appear to lose about 30 to 50 percent of the canopy after only a few years of infestation. Trees may die after 3 to 4 years of heavy infestation (Fig. 7). Epicormic shoots may arise on the trunk or branches of the tree (Fig. 8), often at the margin of live and dead tissues. Dense root sprouting sometimes occurs after trees die.

Figure 8. Epicormic branching on a heavily infested ash tree.

EAB larvae have developed in branches and trunks ranging from 2.5 to 140 cm (1 to 55 in.) in diameter. Although stressed trees are initially more attractive to EAB than healthy trees are, in many areas all or nearly all ash trees greater than 3 cm (1.2 in.) in diameter have been colonized by this invasive beetle.

Prepared by:

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Photo credits:

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Steven A. Katovich, USDA Forest Service, www.forestryimages.org

Edward Czerwinski, Ontario Ministry of Natural Resources, www.forestryimages.org

Additional Resources

For the latest information on EAB in your area:

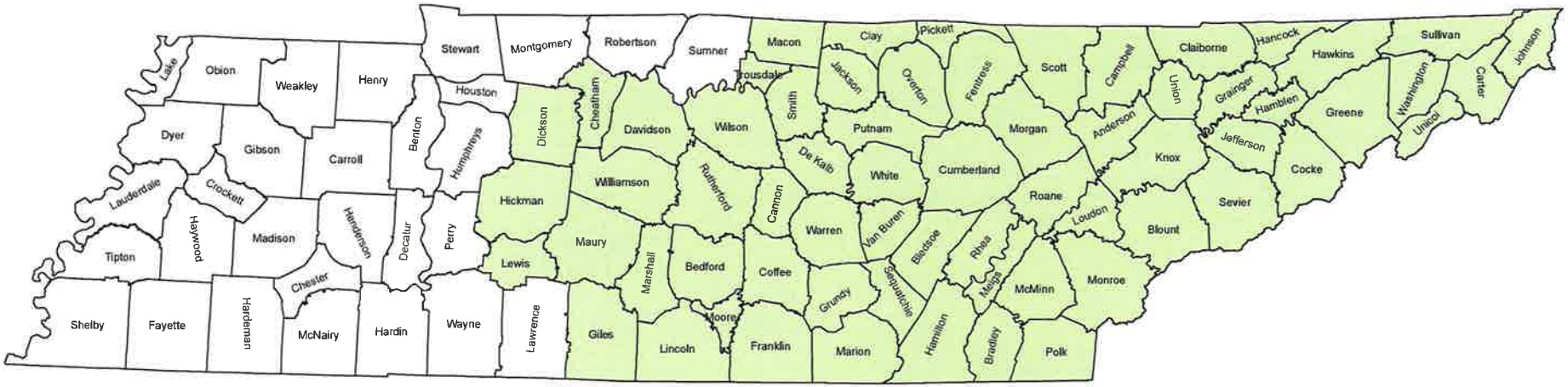
Contact your State Department of Agriculture, State Forester, or Cooperative Extension Office; and visit the following Web sites:

www.emeraldashborer.info
www.hungrypests.com

Northeastern Area
State and Private Forestry
11 Campus Boulevard, Suite 200
Newtown Square, PA 19073
www.na.fs.fed.us

5123

Tennessee Emerald Ash Borer Quarantine



Emerald Ash Borer Quarantined Areas

In Tennessee, EAB quarantines exist for 65 counties. They include **Anderson, Bedford, Bledsoe, Blount, Bradley, Campbell, Cannon, Carter, Cheatham, Claiborne, Clay, Cocke, Coffee, Cumberland, Davidson, DeKalb, Dickson, Fentress, Franklin, Giles, Grainger, Greene, Grundy, Hamblen, Hamilton, Hancock, Hawkins, Hickman, Jackson, Jefferson, Johnson, Knox, Lewis, Lincoln, Loudon, Macon, Marion, Marshall, Maury, McMinn, Meigs, Monroe, Moore, Morgan, Overton, Pickett, Polk, Putnam, Rhea, Roane, Rutherford, Scott, Sequatchie, Sevier, Smith, Sullivan, Trousdale, Unicoi, Union, Van Buren, Warren, Washington, White, Williamson and Wilson Counties**.

The following are regulated articles:

- (a) Emerald Ash Borer; firewood of all hardwood (non-coniferous) species; nursery stock, green lumber, and other material living, dead, cut, or fallen, including logs, stumps,roots, branches, mulch and composted and uncomposted chips of the genus *Fraxinus*.
- (b) Any other article, product, or means of conveyance not listed in paragraph (a) of this section may be designated as a regulated article if the Commissioner determines that it presents a risk of spreading Emerald Ash Borer and notifies the person in possession of the article, product, or means of conveyance that it is subject to these regulations.

July 24, 2020

https://www.tn.gov/agriculture/businesses/plants/plant-pests--diseases-and-quarantines/ag-businesses-eab.html

Pest Alert

United States
Department of Agriculture

Forest Service

Southern Region

Northeastern Area

NA-PR-05-01

Reprinted November 2007

Gypsy Moth

Larva (May-June) - hairy caterpillar with five pairs of blue spots and six pairs of red spots along the back

Pupa (July-August) - female left and male right

The gypsy moth has been an important pest of hardwoods in the Northeastern United States since its introduction in 1869. Established populations exist in all or parts of 19 states from Maine to Wisconsin and south to Illinois and generally in a southeasterly line from Illinois to northeastern North Carolina.

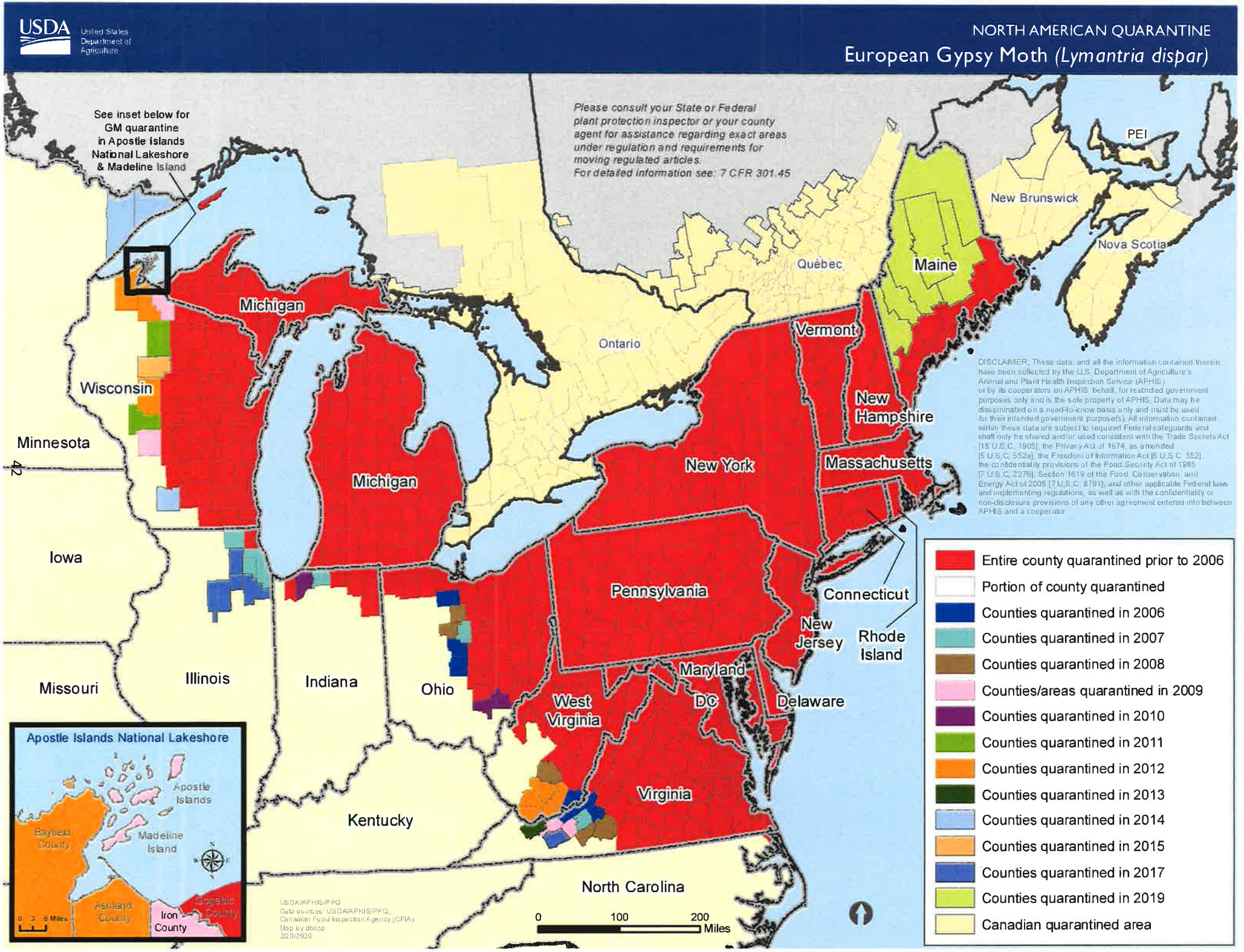
Oaks are the preferred host species for feeding caterpillars, but apple, sweetgum, basswood, gray and white birch, poplar, willow and many others serve as hosts. Gypsy moths avoid ash, yellow-poplar, sycamore, black walnut, catalpa, locust, American holly, and shrubs such as mountain laurel, rhododendron and arborvitae. Older larvae will also feed on a number of conifers such as hemlock, pines, spruces and southern white cedar.

Adults and egg mass (July-August) - male moth is brown; female is white with brown markings

Because the ecological range for this pest is extensive, there are still many states that can xpect infestations in the future. Without intervention, this pest spreads about 13 miles per year. Artificial movement dramatically hastens the spread by the insect hitchhiking on item that are moved long distances such as nursery stock, vehicles, forest products, and outdoor household articles such as deck furniture. Federal and state regulations require that items to be moved from infested areas to uninfested areas must carefully be inspected and certified to be free of gypsy moth life stages.

Adults females with egg masses (eggs-August-May)

For more information about the gypsy moth see this website:
http://www.na.fs.fed.us/pubs/detail.cfm?id=895



2018 Imported Fire Ant Quarantine

Imported Fire Ant Quarantine Area

TN Department of Agriculture | Consumer & Industry Services

March 1, 2018

https://www.tn.gov/agriculture/businesses/ag-businesses-plants/plant-pests--diseases-and-quarantines/ag-businesses-ifa.html

IMPORTED FIRE ANT AREAS IN TENNESSEE
QUARANTINED AREAS FOR YEAR 2018 - effective 3/01/2018

NOTE: Italics indicate a new county or a change from year 2017

1. **Anderson County-The** entire count y.
2. **Bedford County** - The entire co unt y.
3. **Benton County-** The entire county.
4. **Bledsoe County-** The entire county..
5. **Blount County** - The entire county.
6. **Bradley County-** The entire county.
7. **Cannon County-The** entire count y.
8. **Carroll County** - The entire count y.
9. **Chester County-** The entire county.
10. **Cocke Cou nty - The** entire county
11. **Coffee County** - The entire county.
12. **Crockett County-The** entire cou nt y.
13. **Cumberland County-** *The entire county.*
14. **Davidson County** - That portion of the county lying south of the Cumberland River.
15. **Decatur County-** The entire county.
16. **Dekalb County-The** entire county.
17. **Dickson County** - That portion of the county lying south of a line beginning at the Houston/Dickson County line on Tennessee Highway 49 and then continuing southeast alongTennessee Highway 49 until reaching Tennessee Highway 48 and then continuing south along Tennessee Highway 48 until reaching Tennessee Highway 47 and then continuing southeast along Tennessee Highway 47 until reaching United States Highway 70 and then continuing east along United States Highway 70 until reaching the Dickson/Cheatham County line.
18. **Fayette County** - The entire county.
19. **Franklin County-** The entire county.
20. **Gibson County-** That portion of the county lying southeast of a line beginning at the Dyer/Gibson County line on Tennessee Highway 104 and then continuing east on Tennessee Highway 104 until reaching United States Highway 45W and then continuing north on United States Highway 45W until reaching Tennessee Highway 54 and then continuing northeast

along Tennessee Highway 54 until reaching Tennessee Highway 105 and then continuing east along Tennessee Highway 105 until reaching the Gibson/Carroll County line.

21. **Giles County** - The entire county.
22. **Grundy County-** The entire county.
23. ***Hamblen County-*** *The entire county.*
24. **Hamilton County** - The entire county.
25. **Hardeman County-** The entire county.
26. **Hardin County-** The entire county.
27. **Haywood County-** The entire county.
28. **Henderson County-** The entire county.
29. **Hickman County-** The entire county.
30. **Houston County-The** entire county.
31. **Humphreys County-The** entire county.
32. **Jefferson County** - *The entire county.*
33. **Knox County-** The entire county.
34. **Lauderdale County** - That portion of the county lying southeast of a line beginning at the Mississippi County, Arkansas/Lauderdale County, Tennessee line at Latitude 35 Degrees 45 Minutes and then continuing east along Latitude 35 Degrees 45 Minutes until reaching Tennessee Highway 19 and then continuing east along Tennessee Highway 19 until reaching United States Highway 51 and then continuing northeast along United States Highway 51 until reaching Tennessee Highway 180 and then continuing east along Tennessee Highway 180 until reaching Tennessee Highway 209 and then continuing north along Tennessee Highway 209 until reaching Tennessee Highway 88 and then continuing east along Tennessee Highway 88 until reaching Lawrence Road and then continuing north along Lawrence Road until reaching Espy Park Road and then continuing east along Espy Park Road until reaching the Lauderdale/Crockett County line.
35. **Lawrence County** - The entire county.
36. **Lewis County** - The entire county.
37. **Lincoln County-** The entire county.
38. **Loudon County-** The entire county.
39. **Madison County** - The entire county.
40. **Marion County** - The entire county.
41. **Marshall County** - The entire county.
42. **Maury County-** The entire county.

43. **McMinn County** - The entire county.
44. **McNairy County** - The entire county.
45. **Meigs County** - The entire county.
46. **Monroe County** - The entire county.
47. **Moore County-** The entire county.
48. **Morgan County** - That portion of the county lying south of a line beginning at the Cumberland/Morgan County line on Tennessee Highway 298 and then continuing northeast along Tennessee Highway 298 until reaching Tennessee Highway 62 and then continuing southeast along Tennessee Highway 62 until reaching the Morgan/Roane County line.
49. **Perry County** - The entire county.
50. **Polk County-** The entire county.
51. **Rhea County-** The entire county.
52. **Roane County** - The entire county.
53. **Rutherford County** - The entire county.
54. **Sequatchie County** - The entire county.
55. **Sevier County-** The entire county.
56. **Shelby County-** The entire county.
57. **Stewart County-That** portion of the county lying southwest of a line beginning at the Trigg County, Kentucky/Stewart County, Tennessee border along the Cumberland River and then continuing southeast along the Cumberland River until reaching United States Highway 79 and then continuing east along United States Highway 79 until reaching the Stewart/Montgomery County line.
58. **Tipton County** - The entire county.
59. ***Trousdale County*** - *That portion of the county lying southeast of the Cumberland River.*
60. **Union County** - That portion of the county lying southeast of a line beginning at the Anderson/Union County line along Tennessee Highway 170 and then continuing northeast along Tennessee Highway 170 until reaching Tennessee Highway 33 and then continuing northeast along Tennessee Highway 33 until reaching the Union/Claiborne County line.
61. **Van Buren County** - The entire county.
62. **Warren County** - The entire county.
63. **Wayne County** - The entire county.
64. **White County** - The entire county.
65. **Williamson County-The** entire county.
66. **Wilson County-The** entire county.

Pest Alert

United States
Department of Agriculture
Forest Service
Northeastern Area
State and Private Forestry
NA–PR–02–10
Revised February 2013

Thousand Cankers Disease

Dieback and mortality of eastern black walnut (*Juglans nigra*) in several Western States have become more common and severe during the last decade. A tiny bark beetle is creating numerous galleries beneath the bark of affected branches and the main stem, resulting in fungal infection and canker formation. The large numbers of cankers associated with dead branches and the stem suggest the disease's name—*thousand cankers disease*.

The principal agents involved in this disease are a newly identified fungus (*Geosmithia morbida*) and the walnut twig beetle (*Pityophthorus juglandis*). Both the fungus and the beetle only occur on walnut species and on a closely related tree called wingnut (*Pterocarya* sp.). Infested trees can die within 3 years of initial symptoms.

Thousand cankers disease has been found in nine Western States (figure 1). Since 2010, the fungus and the beetle have also been found east of the Great Plains. This disease is expected to spread in eastern forests because of the widespread distribution of eastern black walnut, the susceptibility of this tree species to the disease, and the capacity of the fungus and beetle to invade new areas and survive under a wide range of climatic conditions in the West.

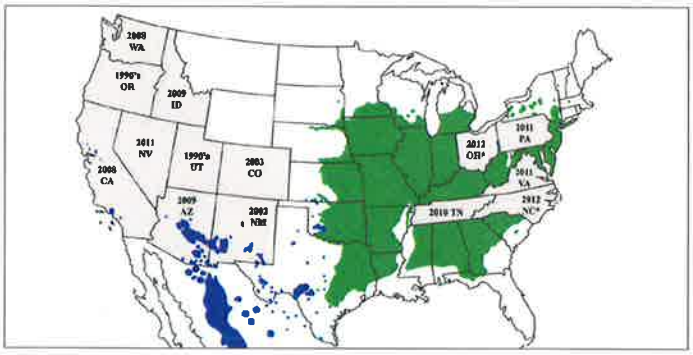


Figure 1. Thousand cankers disease occurs in nine Western and five Eastern States (shaded gray); the year in which the disease was confirmed is noted. Since 2010, TCD has been confirmed in PA, TN, and VA, whereas the beetle alone and the pathogen alone have been found in OH and NC, respectively (denoted with asterisks). The map shows the native ranges of eastern black walnut (dark green) and four western black walnut species (blue). Eastern black walnut is widely planted in the West, but this map does not depict these western locations.

Disease Symptoms

The three major symptoms of this disease are branch mortality, numerous small cankers on branches and the bole, and evidence of tiny bark beetles. The earliest symptom is yellowing foliage that progresses rapidly to brown wilted foliage, then finally branch mortality (figure 2). The fungus causes distinctive circular to oblong cankers in the phloem under the bark, which eventually kill the phloem and cambium (figure 3). The bark surface may have no symptoms, or a dark amber to black stain or cracking of the bark may occur directly above a canker. Numerous tiny bark beetle entrance and exit holes are visible on dead and dying branches (figure 4), and bark beetle galleries are often found within the cankers. In the final stages of disease, even the main stem has beetle attacks and cankers.

Figure 2. Wilting black walnut in the last stages of thousand cankers disease.

Figure 3. Small branch cankers caused by *Geosmithia morbida*.

Geosmithia morbida

Members of the genus *Geosmithia* have not been considered to be important plant pathogens, but *Geosmithia morbida* appears to be much more virulent than related species. Aside from causing cankers, the fungus is inconspicuous. Currently, either culturing on an agar

Figure 4. Exit holes made by adult walnut twig beetles.

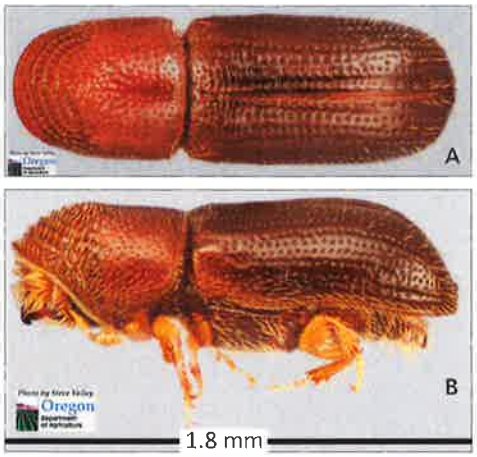


Figure 5. Walnut twig beetle: top view (A) and side view (B).

Figure 6. Walnut twig beetle galleries under the bark of a large branch.

medium or DNA analysis is required to confirm its identity. Adult bark beetles carry fungal spores that are then introduced into the phloem when they construct galleries. Small cankers develop around the galleries; these cankers may enlarge and coalesce to completely girdle the branch or stem. Trees die as a result of these canker infections that form at each of the thousands of beetle attack sites.

Walnut Twig Beetle

The walnut twig beetle is native to Arizona, California, and New Mexico. It has invaded Colorado, Idaho, Nevada, Oregon, Utah, and Washington where eastern black walnut has been widely planted. Since 2010, established populations have also been detected in Pennsylvania, Tennessee, and Virginia; North Carolina and Ohio also likely harbor populations, pending confirmation. Historically, the beetle has not caused significant branch mortality by itself. Through its association with this newly identified fungus, it appears to have greatly increased in abundance and distribution. Adult beetles are very small (1.5 to 2.0 mm long or about 1/16 in) and are reddish brown in color (figure 5). This species is a typical-looking bark beetle that is characterized by its very small size and four to six concentric ridges on the upper surface of the pronotum (the shield-like cover behind and over the head) (figure 5A). Like most bark beetles, the larvae are white, C-shaped, and found in the phloem. For this species, the egg galleries created by the adults are horizontal (across the grain) and the larval galleries tend to be vertical (along the grain) (figure 6).

Survey and Samples

Visually inspecting walnut trees for dieback is currently the best survey tool for detecting the disease in the Eastern United States. A pheromone-baited trap placed near (but never on) walnut trees is also available for detecting the beetle (http://www.ipm.ucdavis.edu/PMG/menu.thousandcankers.html). Look for declining trees with the symptoms described above. If you suspect that your walnut trees have thousand cankers disease, collect a branch 2 to 4 inches in diameter and 6 to 12 inches long that has visible symptoms. Please submit branch samples to your State's plant diagnostic clinic. Each State has a clinic that is part of the National Plant Diagnostic Network (NPDN). They can be found at the NPDN Web site (www.npdn.org). You may also contact your State Department of Agriculture, State Forester, or Cooperative Extension Office for assistance.

Prepared by:

Steven Seybold, Research Entomologist, U.S. Forest Service, Pacific Southwest Research Station

Dennis Haugen, Forest Entomologist, and Joseph O'Brien, Plant Pathologist, U.S. Forest Service, Northeastern Area State and Private Forestry

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Photographs:

Figure 1: Andrew Graves

Figure 2: Manfred Mielke, U.S. Forest Service

Figures 3, 4, 6: Whitney Cranshaw, Colorado State University, www.forestryimages.org

Figure 5: Steve Valley, Oregon Department of Agriculture

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USDA Forest Service
Northeastern Area
State and Private Forestry
11 Campus Boulevard
Newtown Square, PA 19073
www.na.fs.fed.us

Tennessee Thousand Cankers Disease Quarantine

Thousand Cankers Disease Quarantine Areas

Anderson, Blount, Jefferson, Knox, Loudon, Morgan, Rhea, Roane, Sevier and Union Counties

Citizens in these counties cannot move walnut tree products or hardwood firewood outside the quarantined counties.

TN Department of Agriculture — Consumer & Industry Services

Protect TN Forests.org

February 4, 2018

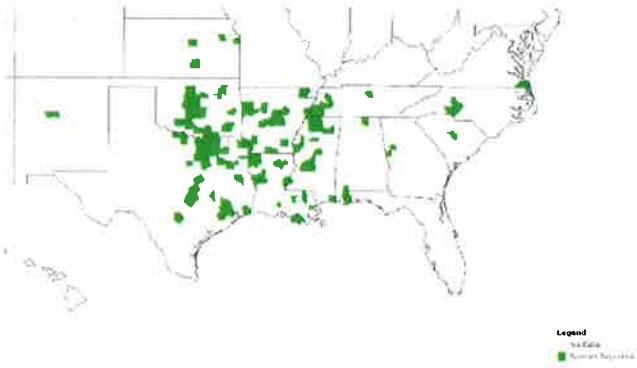
https://www.tn.gov/agriculture/businesses/ag-businesses-plants/plant-pests--diseases-and-quarantines/ag-businesses-tcd.html

Clemson Cooperative Extension
Home & Garden Information Center

Crapemyrtle Bark Scale

Factsheet | HGIC 2015 | **Updated:** Oct 03, 2019

The crapemyrtle bark scale (*Acanthococcus lagerstroemiae*) is a recently introduced pest from Asia that initially infested crapemyrtles (*Lagerstroemia* spp.) in Texas during 2004. Since then, it has spread rapidly through Oklahoma, Arkansas, Louisiana, Mississippi, and Georgia. Now it has been discovered in North Carolina and Virginia, and the distant spread of this pest has likely been through the movement of plant material. Crapemyrtle bark scale (CMBS) has been confirmed in Richland County (Columbia) in South Carolina this year. With the recent appearance of CMBS in Mecklenburg County (Charlotte) in North Carolina, this insect pest may also appear soon in Upstate South Carolina.



September 2019 Distribution map for CMBS from EDDMaps.org

The CMBS is a bark or felt scale, which is slightly different from soft scales. However, they have a waxy coating and exude honeydew, as do soft scales. Bark scales are in a different scale insect family (Eriococcidae) than soft scales (Coccidae), and they look very similar to mealybugs.

Crapemyrtle bark scale is a new insect pest to the Southeastern US. Above on a branch are the white adults and ovisacs containing their pink eggs.
Helene Dougherty, Virginia Polytechnic Institute & State University, Bugwood.org

Crapemyrtle branches can become completely covered with crapemyrtle bark scale.
Jim Robbins, University of Arkansas CES, Bugwood.org

The CMBS infestations appear as white or gray, waxy crustations on stems, large twigs, and trunks, but rarely on foliage. They especially congregate in branch crotches and at pruning sites. This scale will settle to feed under loose, exfoliating bark of the crapemyrtle, which makes control by both predators and pesticides more difficult.

These bark scales produce copious amounts of honeydew, the sugary waste the scale produces as it feeds on the plant's phloem. As a result, the leaves, branches, and trunk become covered with black sooty mold, which grows on the honeydew.

The spent crapemyrtle flower clusters may also be covered with crapemyrtle bark scale and sooty mold. Mengmeng Gu, Texas A&M AgriLife Extension Service, Bugwood.org

Insect Life Cycle

The small CMBS males are winged and will fly to find females and to mate. Once the mated females produce their ovisacs (egg-containing capsules) and lay eggs, they die. The eggs remain protected within the white colored ovisacs until the crawlers (immatures) hatch and disperse onto the branches. Each female lays about 60 to 250 eggs, which may over-winter within their ovisacs, and then hatch during mid- to late April to May. The crawlers are pink, very small, and may not be noticed without a hand lens. A second peak in crawler activity occurs in late summer. Double-sided sticky tape wrapped around small branches can be used to trap the crawlers to see when they hatch and to base the timing of additional contact insecticide applications. These mobile crawlers move out to new twigs and branches to settle down and begin feeding on the sugary phloem layer beneath the bark.

Symptoms

Crapemyrtles suffer aesthetic damage because of the CMBS infestations. These bark scales may not kill the plants, but there may likely be a reduction in plant vigor, number of flowers, and flower cluster size. Infested plants typically leaf out later than healthy plants. Branches and trunks can be covered in the white scale infestation. Another striking symptom is the extensive amount of black sooty mold that may completely cover the foliage, branches, and trunks. However, do not confuse the honeydew and resulting black sooty mold caused by an aphid infestation with that caused by the crapemyrtle bark scale. Aphids are small insect pests that feed on new tender growth on the ends of branches. With a scale heavy infestation, there may be premature bark peeling. Often there will be more female adults congregated on the lower (and shadier) sides of branches.

The crapemyrtle on the left was treated to control crapemyrtle bark scale. The tree on the right is infested and shows reduced flowering. A closer inspection of infested crapemyrtles will show copious sooty mold on leaves, branches, and trunks.
Jim Robbins, University of Arkansas CES, Bugwood.org

Management

Cultural Control: Keep crapemyrtles healthy by properly mulching, irrigating, fertilizing (based on soil test recommendations), and proper pruning. Please see HGIC 1009, *Crapemyrtle Pruning* for best pruning practices. Crapemyrtles in sunnier sites often have smaller infestations than plants growing in more shade, and plants grown in shade typically have more crawlers (immatures) than in full sun. So, always plant crapemyrtles in the full sun areas of the landscape.

Several other common landscape plants are susceptible to CMBS infestation. These include pomegranate, persimmon, edible fig, boxwood, American beautyberry, cleyera, privet, and raspberries. These plants should be closely inspected for the CMBS, especially if crapemyrtles are planted nearby.

Natural predators may take a while to build up in numbers, but both lady beetles and mealybug destroyers are very effective in controlling CMBS.

Chemical Control: The most effective chemical control is a soil drench in the spring with dinotefuran. This systemic insecticide is available in a number of brands as concentrates for use as a soil drench, and in a few brands as granular products to scatter around the plants and water into the soil. These systemic insecticides will move up into the plants and give control for at least a year. They are most effectively applied in spring as new plant growth begins. See Table 1 for examples of products containing this systemic insecticides.

Alternatively, sprays for crawlers are best applied in the late April and May, then again in late summer when immatures appear. Use a bifenthrin spray mixed with 2% horticultural oil (i.e., 5 tablespoons of horticultural oil per gallon of water in a sprayer) added for best crawler control. Follow the label directions on bifenthrin products for rate per gallon. See Table 1 for examples of products containing bifenthrin and horticultural oil.

To determine if the soil drench treatments have been effective, scrape the soft bodies of the CMBS adults on a branch. If the result is the presence of a reddish body fluid of the scales, they are still alive. No "bleeding" will occur if they have been killed.

Scraping the soft crapemyrtle bark scales can reveal if the scales are alive or dead. If alive, scraping will result in "bleeding" of their reddish body fluids. Mengmeng Gu, Texas A&M AgriLife Extension Service, Bugwood.org

Table 1. Insecticides to Control Crapemyrtle Bark Scale on Crapemyrtles.

Insecticide Active Ingredients	Examples of Common Insecticide Products Labeled for Use on Landscape Ornamentals
Systemic Insecticides	
Dinotefuran	Gordon's Zylam Liquid Systemic Insecticide Gordon's Zylam 20SG Systemic Turf Insecticide Valent Brand Safari 20SG Insecticide Valent Brand Safari 2G Insecticide (2% granules) Ortho Tree & Shrub Insect Control Ready To Use Granules (2%)
Contact Insecticides	

Bifenthrin	Ferti-lome Broad Spectrum Insecticide Concentrate Hi-Yield Bug Blaster Bifenthrin 2.4 Concentrate Monterey Turf & Ornamental Insect Spray Up-Star Gold Insecticide Concentrate Bifen I/T Concentrate Talstar P Concentrate
Horticultural Oil	Ferti-lome Horticultural Oil Spray Concentrate Bonide All Seasons Spray Oil Concentrate Southern Ag ParaFine Horticultural Oil Concentrate Espoma Earth-tone Horticultural Oil Concentrate Monterey Horticultural Oil Concentrate Summit Year Round Spray Oil Concentrate
These products are typically found for sale in small containers at feed & seed, farm supply, or landscaper supply stores. Follow all directions for mixing and safe use. Horticultural oil sprays should be applied when temperatures are above 45 °F and below 90 °F. Always spray in the late evening to slow drying time and increase effectiveness.	

Safety and Insecticide Treatment Notes: Many cultivars of crape myrtles can grow very tall, and some may reach heights of 20 or 30 feet. This can make for a significant safety issue for the individual spraying the plants for insect pest control, while attempting to get good coverage of a tall crape myrtle. Do not spray if it is windy, and wear the recommended protective gear stated on the label, especially if the plants are tall. Minor pruning of the crape myrtle will reduce some height and remove flowers present to lessen the impact of the bifenthrin insecticide spray on pollinators. This will also allow for better spray coverage. Prune, then spray with the bifenthrin and horticultural oil mix. Repeat the spray in 2 weeks and repeat 2 weeks later, which will be before the crape myrtle begins flowering again. Keep in mind that there can be a spray drift from spraying upward, and the insecticide can have an impact on pollinators of nearby flowering shrubs and herbaceous plants. Therefore, the best time to spray is in the very late evening to reduce the impact on pollinators.

For the use of soil systemic treatments (dinotefuran), the amount to apply is based upon the height of the crape myrtle (if shrub-like) or the cumulative diameters of the trunks (if tall and tree form). Therefore, a light pruning, which reduces the height, may reduce the amount of product required to treat the plant. The soil systemic insecticides may have a minor harmful effect on pollinating insects that feed on the pollen and nectar, but this should be much less of an impact than spraying a plant in bloom, which would likely kill pollinating insects. The pruning will delay bloom and lessen this harmful effect. A soil drench is far safer for the applicator and for protecting wildlife and beneficial insects (as these do not feed on the plant), much more so than spraying an insecticide all throughout the plant.

However, if one does <u>not</u> want to spray or apply a soil drench with an insecticide on the crape myrtles, there is another option. If the plant is highly infested, cut the crape myrtle off flush with the ground. Promptly burn the removed trunk and limbs, or cut up and place in garbage bags for trash pickup. Do not place on curb for regular brush pickup.

Once cut, the stumps will send up sprouts very quickly. Select three sprouts that are equally spaced around the cut stump. Prune out the rest. Mulch around the plant area to cover the stump. Fertilize the sprout growth twice during the spring (April 1st and again mid-May) with a slow-release tree & shrub fertilizer, and within 3 years, the crape myrtle will again be a beautiful flowering plant.

Author(s)

Joey Williamson, PhD, HGIC Horticulture Extension Agent, Clemson University

Pest Alert

United States
Department of Agriculture
Forest Service
Southern Region
State and Private Forestry
R8–PR–01–19
October 2019

Laurel Wilt

Laurel wilt is a disease of woody plants in the laurel family (Lauraceae). Hundreds of millions of redbay (*Persea borbonia*) trees have been killed by laurel wilt in the southeastern Atlantic Coastal Plain region of the United States (US). The disease has also killed large numbers of sassafras (*Sassafras albidum*) trees in forests and landscapes, and avocado (*Persea americana*) trees in commercial production. As of October 2019, laurel wilt was known to occur from Texas to North Carolina, south through Florida and north to Kentucky. Laurel wilt is expected to continue spreading through sassafras in the eastern US, and is a potential threat to California bay laurel (*Umbellularia californica*) in the western US and to lauraceous species elsewhere in the world.

Laurel wilt is caused by a fungus (*Raffaelea lauricola*) that is carried by an insect, the redbay ambrosia beetle (*Xyleborus glabratus*). These organisms are native to Asia, are invasive pests in North America, and can be easily transported to new areas by movement of infested wood products and firewood.

Symptoms

In early stages of laurel wilt, trees exhibit drooping, discolored leaves (**Fig. 1A**). In deciduous hosts like sassafras, leaves soon fall from the tree leaving branches bare (**Fig. 1B**). In contrast, evergreen hosts like redbay will retain reddish or brownish leaves for many months. Diseased trees typically exhibit a dark discoloration in the outer sapwood that runs with the direction of the grain (**Fig. 1C**). In sassafras, some trees may produce sparse, stunted leaves in the spring following the initial year of infection (**Fig. 2**).

Redbay ambrosia beetles (**Fig. 3**) are extremely small (~2 mm long), spend most of their life cycle inside the tree, and are not easily seen in the field. Entrance holes (<1 mm diameter) may be seen on smooth bark or on the wood surface when bark is removed. Many ambrosia beetle species produce fine, light-colored sawdust that may be seen at the bark surface, but neither sawdust nor beetle holes are signs specific to laurel wilt.

Disease Process

Spores of the laurel wilt fungus are carried in the mouthparts of the redbay ambrosia beetle. Host trees typically become infected when a female beetle lands on a stem or branch and bores into the wood. The fungal spores enter the water-conducting cells and spread through trees, causing a reaction that restricts water flow. Trees can die within a few weeks or months after infection. The redbay ambrosia beetle will attack

Fig. 1. Laurel wilt symptoms in sassafras. A) Drooping leaves in the early stages of the disease. B) Diseased trees that have recently dropped their leaves. C) Bark removed to show dark discoloration on the surface of the sapwood.

healthy trees, and entry by just one beetle may be sufficient to kill a tree. In sassafras, the fungus appears to be able to spread readily from tree to tree through root connections; however, this mode of transmission is probably not a major factor for disease spread in redbay.

After a tree has been killed by laurel wilt, redbay ambrosia beetles and other species of ambrosia beetles will produce offspring within tunnels in the wood. Some of these other ambrosia beetle species can pick up the laurel wilt fungus when tunneling in the dead trees, but their ability to spread the disease to healthy trees in natural forests has not been documented.

Hosts

All plant species in the family Lauraceae native to North America are susceptible to the laurel wilt fungus. Field occurrence of laurel wilt has been documented in redbay, swamp bay (*Persea palustris*), silk bay (*Persea humilis*), sassafras, northern spicebush (*Lindera benzoin*), pondberry (*Lindera melissifolia*), and pondspice (*Litsea aestivalis*). Laurel wilt has been induced through artificial inoculation of additional species including California bay laurel, pepperleaf sweetwood (*Licaria triandra*) and lancewood (*Nectandra coriacea*). Other lauraceous species that are not native to North America such as avocado, camphortree (*Cinnamomum camphora*) and bay laurel (*Laurus nobilis*) are also susceptible to wilt. Not all of these species are equally vulnerable to the disease nor equally attractive to the redbay ambrosia beetle. Plants that have "laurel" or "bay" in their common names but are not in the family Lauraceae, such as mountain laurel (*Kalmia latifolia*), sweetbay (*Magnolia virginiana*) and loblolly bay (*Gordonia lasianthus*), are not susceptible to laurel wilt.

Detection and Management

Confirmation of laurel wilt is typically achieved by laboratory isolation of the fungus *R. lauricola* from fresh wood samples, collected from host plants exhibiting the dark sapwood discoloration described above. Redbay ambrosia beetles may be detected or monitored using bark beetle flight traps or sticky traps baited with lures that release alpha-copaene (an attractive compound) or fresh host wood. If you suspect laurel wilt in an area where it has not been previously reported, please contact your state Department of Agriculture, state forestry agency, or cooperative extension office for assistance.

Management tactics for reducing the spread and impact of laurel wilt are limited, but may include the following:

- Do not transport dead and felled trees, firewood or other untreated woody material from laurel family species to areas where the disease does not occur. If laurel wilt is known to occur in a county, laurel family species should not be transported across county lines. See https://www.fs.usda.gov/main/r8/forest-grasslandhealth for a map of laurel wilt distribution by county.

Fig. 2. A sassafras tree with laurel wilt that has produced sparse, stunted leaves in the spring following the initial year of infection.

Fig. 3. A female redbay ambrosia beetle on a fingertip.

- Nursery stock in the laurel family showing signs of wilt, sapwood discoloration or ambrosia beetle attack should not be sold or transported.
- Chipping wood from infested trees may not destroy all redbay ambrosia beetles due to their extremely small size, but can greatly reduce the number of beetles that survive.
- Root-flare infusion with the fungicide propiconazole to protect high-value redbay and avocado trees for approximately one year has been demonstrated, and fungicide application is being explored for sassafras. Research on other control tactics is in progress.

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Photographs: A.E. Mayfield III, USDA Forest Service (all Figures)

Published by:
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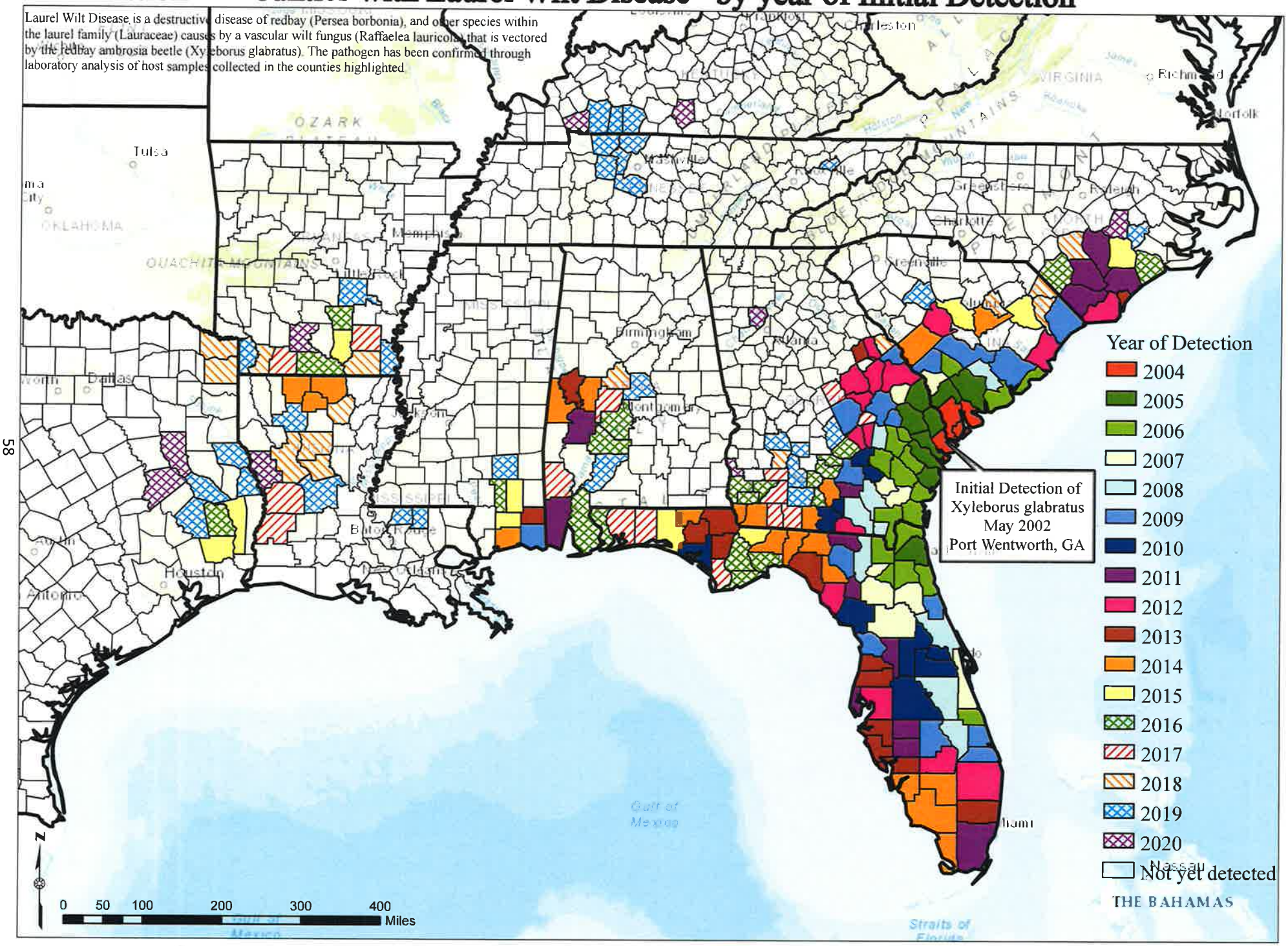
Southern Region, State and Private Forestry
1720 Peachtree Road NW, Atlanta, GA 30309
https://www.fs.usda.gov/r8

Distribution of Counties with Laurel Wilt Disease* by year of Initial Detection

September 16, 2020

Laurel Wilt Disease is a destructive disease of redbay (Persea borbonia), and other species within the laurel family (Lauraceae) causes by a vascular wilt fungus (Raffaelea lauricola) that is vectored by the redbay ambrosia beetle (Xyleborus glabratus). The pathogen has been confirmed through laboratory analysis of host samples collected in the counties highlighted.



USDA United States Department of Agriculture

Pest Alert

Asian Longhorned Beetle *(Anoplophora glabripennis)*: A New Introduction

The Asian longhorned beetle (ALB) has been discovered attacking trees in the United States. Tunneling by beetle larvae girdles tree stems and branches. Repeated attacks lead to dieback of the tree crown and, eventually, death of the tree. ALB probably travelled to the United States inside solid wood packing material from China. The beetle has been intercepted at ports and found in warehouses throughout the United States.

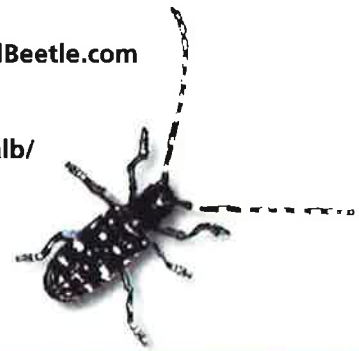
This beetle is a serious pest in China, where it kills hardwood trees in roadside plantings, shelterbelts, and plantations. In the United States the beetle prefers maple species (*Acer* spp.), including ***boxelder***, ***Norway***, ***red***, ***silver***, and ***sugar maples***. Other preferred hosts are ***birches***, ***Ohio buckeye***, ***elms***, ***horsechestnut***, and ***willows***. Occasional to rare hosts include ashes, ***European mountain ash***, ***London planetree***, ***mimosa***, and ***poplars***. A complete list of host trees in the United States continues to be refined (**http://na.fs.fed.us/pubs/detail.cfm?id=5268**).

Currently, the only effective means to eliminate ALB is to remove infested trees and destroy them by chipping or burning. To prevent further spread of the insect, quarantines are established to avoid transporting infested trees and branches from the area. Early detection of infestations and rapid treatment response are crucial to successful eradication of the beetle.

The ALB has one generation per year. Adult beetles are usually present from July to October, but can be found later in the fall if temperatures are warm. Adults usually stay on the trees from which they emerged or they may disperse short distances to a new host to feed and reproduce. Each female usually lays 35-90 eggs during her lifetime. Some are capable of laying more than that. The eggs hatch in 10-15 days. The larvae feed under the bark in the living tissue of the tree for a period of time and then bore deep into the wood where they pupate. The adults emerge from pupation sites by boring a tunnel in the wood and creating a round exit hole in the tree.

For more information about Asian longhorned beetle in the United States, visit these U.S. Department of Agriculture Web sites:

- **www.AsianLonghornedBeetle.com**
- **www.aphis.usda.gov**
- **www.na.fs.fed.us/fhp/alb/**



If you suspect an Asian longhorned beetle infestation, please collect an adult beetle in a jar, place the jar in the freezer, and immediately notify any of these officials or offices in your State:

State Department of Agriculture:

- State Plant Regulatory Official
- State Entomologist

U.S. Department of Agriculture:

- Animal and Plant Health Inspection Service, Plant Protection and Quarantine
- Forest Service

State Forester or Department of Natural Resources

County Cooperative Extension Office

Call 866–702–9938 toll free.

Forest Service | Northeastern Area State and Private Forestry | Animal Plant Health and Inspection Service | NA–PR–01–99 | Revised April 2015

Asian Longhorned Beetle: *What to look for?*

1. **Adult beetles.** Individuals are ¾ to 1¼ inches long, with jet black body and mottled white spots on the back. The long antennae are 1½ to 2½ times the body length with distinctive black and white bands on each segment. The feet have a bluish tinge.

2. **Oval to round pits in the bark.** These egg-laying sites or niches are chewed out by the female beetle, and a single egg is deposited in each niche.

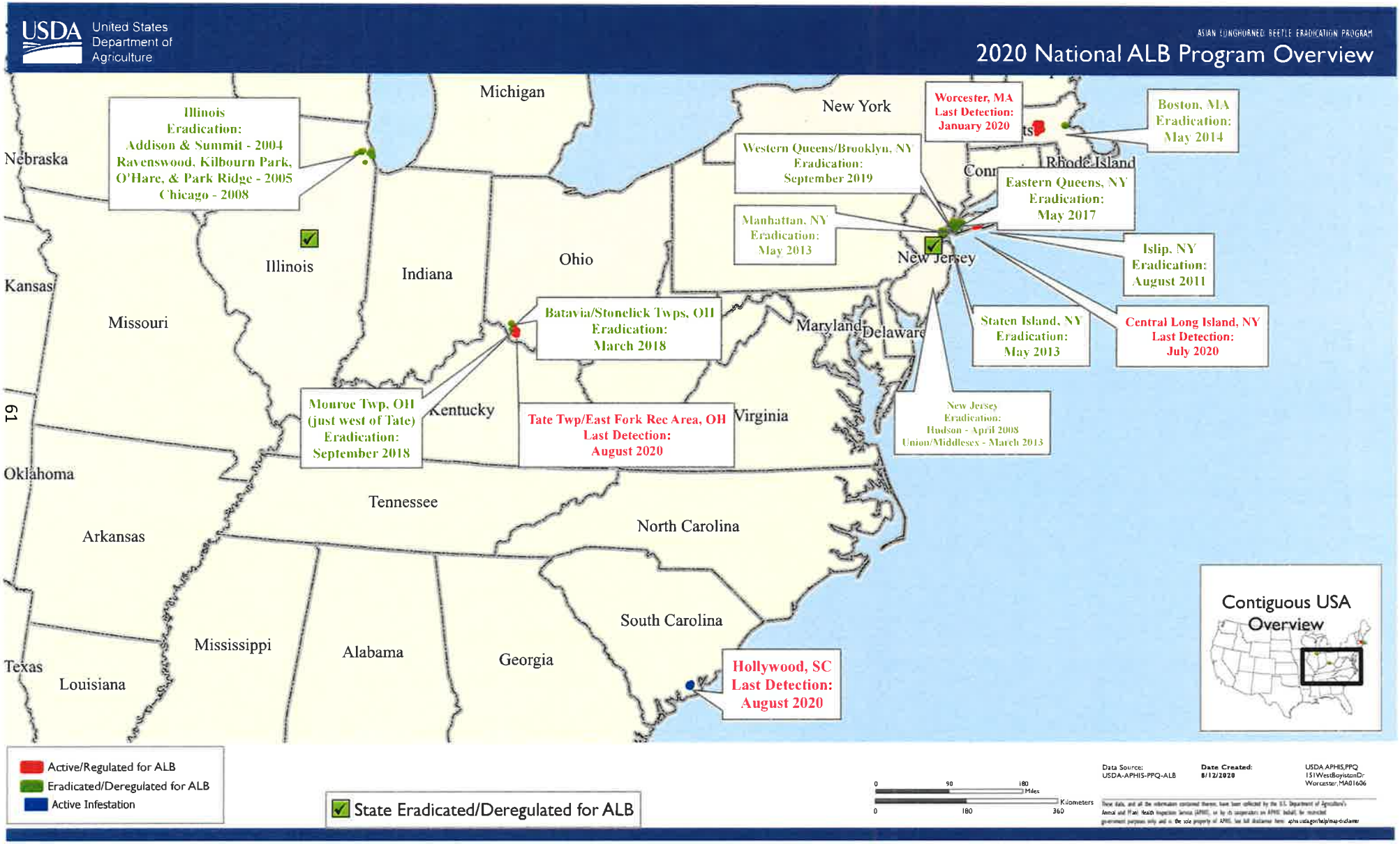
3. **Oozing sap.** In the summer, sap may flow from egg niches, especially on maple trees, as the larvae feed inside the tree.

4. **Accumulation of coarse sawdust** around the base of infested trees, where branches meet the main stem, and where branches meet other branches. This sawdust is created by the beetle larvae as they bore into the main tree stem and branches.

5. **Round holes**, 3/8 inch in diameter or larger, on the trunk and on branches. These exit holes are made by adult beetles as they emerge from the tree.

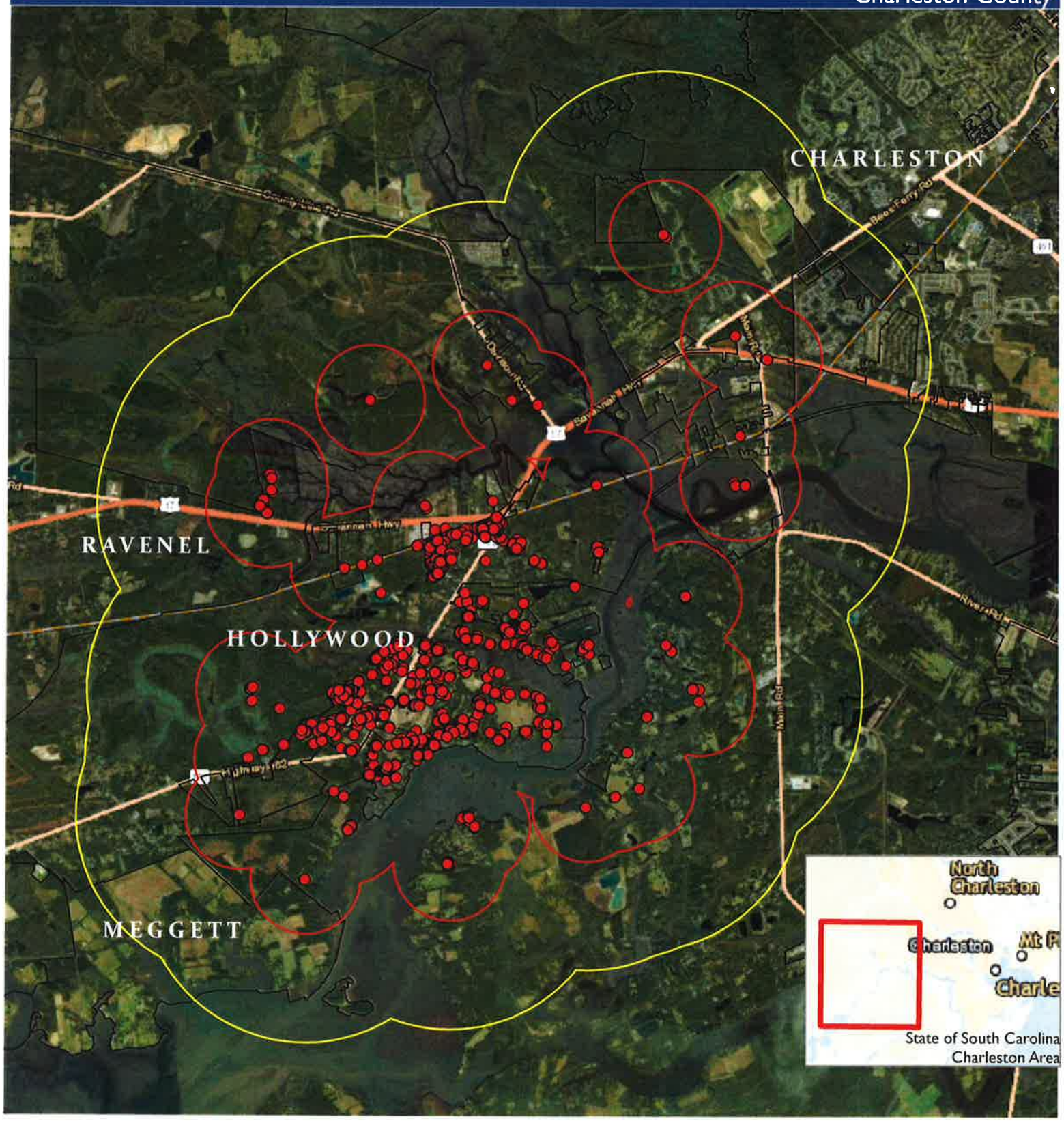
Northeastern Area
State and Private Forestry
11 Campus Boulevard, Suite 200
Newtown Square, PA 19073
www.na.fs.fed.us

5124


USDA United States Department of Agriculture
ASIAN LONGHORNED BEETLE ERADICATION PROGRAM
2020 National ALB Program Overview
Illinois
Eradication:
Addison & Summit - 2004
Ravenswood, Kilbourn Park,
O'Hare, & Park Ridge - 2005
Chicago - 2008
Worcester, MA
Last Detection:
January 2020
Boston, MA
Eradication:
May 2014
Western Queens/Brooklyn, NY
Eradication:
September 2019
Eastern Queens, NY
Eradication:
May 2017
Manhattan, NY
Eradication:
May 2013
Islip, NY
Eradication:
August 2011
Batavia/Stonelick Twps, OH
Eradication:
March 2018
Staten Island, NY
Eradication:
May 2013
Central Long Island, NY
Last Detection:
July 2020
Monroe Twp, OH
(just west of Tate)
Eradication:
September 2018
Tate Twp/East Fork Rec Area, OH
Last Detection:
August 2020
New Jersey
Eradication:
Hudson - April 2008
Union/Middlesex - March 2013
Hollywood, SC
Last Detection:
August 2020
Michigan
New York
Nebraska
Illinois
Indiana
Ohio
New Jersey
Kansas
Missouri
Maryland
Delaware
Kentucky
Virginia
Oklahoma
Tennessee
North Carolina
Arkansas
South Carolina
Mississippi
Alabama
Georgia
Texas
Louisiana
Rhode Island
Contiguous USA Overview
Active/Regulated for ALB
Eradicated/Deregulated for ALB
Active Infestation
State Eradicated/Deregulated for ALB
Miles
Kilometers
Data Source:
USDA-APHIS-PPQ-ALB
Date Created:
8/12/2020
USDA APHIS,PPQ
151WestBoylstonDr
Worcester, MA01606

USDA United States Department of Agriculture

ASIAN LONGHORNED BEETLE COOPERATIVE ERADICATION PROGRAM
Hollywood, SC
Charleston County



- Infested Tree
- Level 1 (1/2 Mile)
- 1 1/2 Mile

0 1 2 Miles
0 1 2 Kilometers

Data Source: list data sources

Date Created: 9/24/2020

USDA APHIS
151 West Boylston Dr
Worcester, MA 01606

PLANT INDUSTRY
Regulatory Services

Document Path: I:\Room_Data_SC\CharlestonCountyCommunityUpdate.aprx Coordinate System: NAD 1983 StatePlane South Carolina FIPS 3900 Feet

Pest Alert

United States
Department of
Agriculture

Forest Service

Northeastern Area
State and Private Forestry

NA–PR–09–05

August 2005

Hemlock Woolly Adelgid

Native to Asia, the hemlock woolly adelgid (*Adelges tsugae*) is a small, aphidlike insect that threatens the health and sustainability of eastern hemlock (*Tsuga canadensis*) and Carolina hemlock (*Tsuga caroliniana*) in the Eastern United States. Hemlock woolly adelgid was first reported in the Eastern United States in 1951 near Richmond, Virginia. By 2005, it was established in portions of 16 States from Maine to Georgia, where infestations covered about half of the range of hemlock. Areas of extensive tree mortality and decline are found throughout the infested region, but the impact has been most severe in some areas of Virginia, New Jersey, Pennsylvania, and Connecticut.

Hemlock decline and mortality typically occur within 4 to 10 years of infestation in the insect's northern range, but can occur in as little as 3 to 6 years in its southern range. Other hemlock stressors, including drought, poor site conditions, and insect and disease pests such as elongate hemlock scale (*Fiorinia externa*), hemlock looper (*Lambdina fiscellaria fiscellaria*), spruce spider mite (*Oligonychus ununguis*), hemlock borer (*Melanophila fulvogutta*), root rot disease (*Armillaria mellea*), and needlerust (*Melampsora parlowii*), accelerate the rate and extent of hemlock mortality.

Hosts

The hemlock woolly adelgid develops and reproduces on all species of hemlock, but only eastern and Carolina hemlock are vulnerable when attacked. The range of eastern hemlock stretches from Nova Scotia to northern Alabama and west to northeastern Minnesota and eastern Kentucky. Carolina hemlock occurs on dry mountain slopes in the southern Appalachians of western Virginia, North and South Carolina, Georgia, and Tennessee. Eastern hemlock is also commonly planted as a tree, shrub, or hedge in ornamental landscapes. At least 274 cultivars of eastern hemlock are known to exist.

Description

The hemlock woolly adelgid is tiny, less than 1/16-inch (1.5-mm) long, and varies from dark reddish-brown to purplish-black in color. As it matures, it produces a covering of wool-like wax filaments to protect itself and its eggs from natural enemies and prevent them from drying out. This "wool" (ovisac) is most conspicuous when the adelgid is mature and laying eggs. Ovisacs can be readily observed from late fall to early summer on the underside of the outermost branch tips of hemlock trees (figure 1).

FIGURE 1.—Hemlock woolly adelgid ovisacs.

Life History

The hemlock woolly adelgid is parthenogenetic (all individuals are female with asexual reproduction) and has six stages of development: the egg, four nymphal instars, and the adult. The adelgid completes two generations a year on hemlock. The winter generation, the sistens, develops from early summer to midspring of the following year (June–March). The spring generation, the progrediens, develops from spring to early summer (March–June). The generations overlap in mid to late spring.

The hemlock woolly adelgid is unusual in that it enters a period of dormancy during the hot summer months. The nymphs during this time period have a tiny halo of woolly wax surrounding their bodies (figure 2). The adelgids begin to feed once cooler temperatures prevail, usually in October, and continue throughout the winter months.

The ovisacs of the winter generation contain up to 300 eggs, while the spring generation ovisacs contain between 20 and 75 eggs. When hatched, the first instar nymphs, called crawlers, search for suitable feeding sites on the twigs at the base of hemlock needles. Once settled, the nymphs begin feeding on the young twig tissue and remain at that location throughout the remainder of their development. Unlike closely related insects that feed on nutrients in sap, the hemlock woolly adelgid feeds on stored starches. These starch reserves are critical to the tree's growth and long-term survival.

FIGURE 2.—Hemlock woolly adelgid nymphs in dormancy.

FIGURE 3.—Chemical treatment using the soil injection method.

FIGURE 4.—Predators introduced for control in the Eastern United States, left to right (origin): *Sasajiscymnus tsugae* (Japan), *Scymnus sinuanodulus* (China), and *Laricobius nigrinus* (Western North America).

Dispersal and movement of hemlock woolly adelgid occur primarily during the first instar crawler stage as a result of wind and by birds, deer, and other forest-dwelling mammals that come in contact with the sticky ovisacs and crawlers. Isolated infestations and long-distance movement of hemlock woolly adelgid, though, most often occur as the result of people transporting infested nursery stock.

Control

Cultural, regulatory, chemical, and biological controls can reduce the hemlock woolly adelgid's rate of spread and protect individual trees. Actions such as moving bird feeders away from hemlocks and removing isolated infested trees from a woodlot can help prevent further infestations. State quarantines help prevent the movement of infested materials into noninfested areas.

Chemical control options, such as foliar sprays using horticultural oils and insecticidal soaps, are effective when trees can be saturated to ensure that the insecticide comes in contact with the adelgid. Several systemic insecticides have also proven effective on large trees when applied to the soil around the base of the tree or injected directly into the stem (figure 3). Chemical control is limited to individual tree treatments in readily accessible, nonenvironmentally sensitive areas; it is not feasible in forests, particularly when large numbers of trees are infested. Chemical treatments offer a short-term solution, and applications may need to be repeated in subsequent years.

The best option for managing hemlock woolly adelgid in forests is biological control. Although there are natural enemies native to Eastern North America that feed on hemlock woolly adelgid, they are not effective at reducing populations enough to prevent tree mortality. Therefore, biological control opportunities using natural enemies (predators and pathogens) from the adelgid's native environment are currently being investigated. Several predators known to feed exclusively on adelgids have been imported from China, Japan, and Western North America and are slowly becoming established throughout the infested region (figure 4). It will likely take a complex of natural enemies to maintain hemlock woolly adelgid populations below damaging levels. Efforts to locate, evaluate, and establish other natural enemies continue.

Pesticide Precautionary Statement

Pesticides used improperly can be injurious to humans, animals, and plants. Follow the directions and heed all precautions on the labels.

Note: Some States have restrictions on the use of certain pesticides. Check your State and local regulations. Also, because registrations of pesticides are under constant review by the Federal Environmental Protection Agency, consult your county agricultural agent or State extension specialist to be sure the intended use is still registered.

For additional information or copies of this publication, visit http://www.na.fs.fed.us/fhp/hwa.

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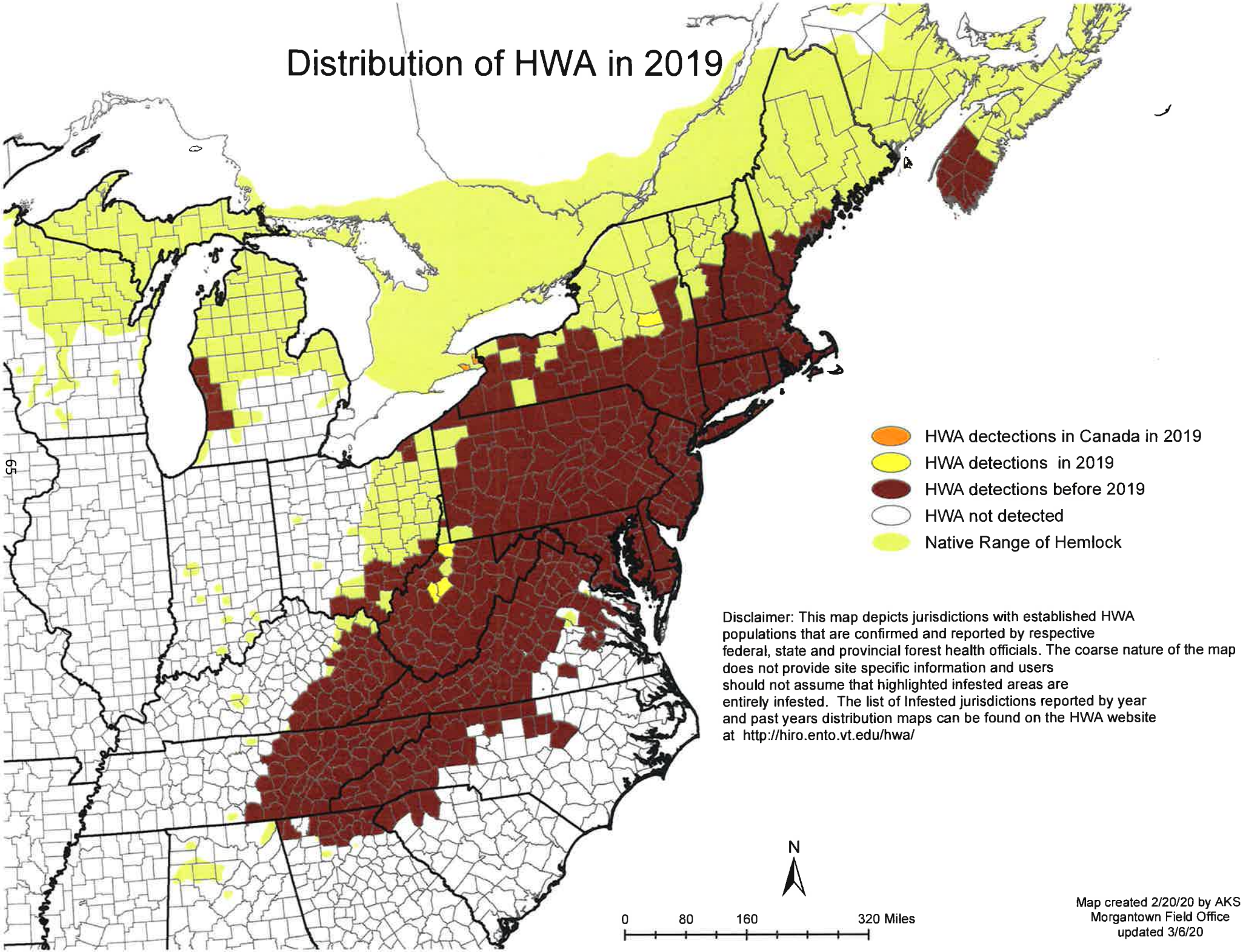
Distribution of HWA in 2019



Disclaimer: This map depicts jurisdictions with established HWA populations that are confirmed and reported by respective federal, state and provincial forest health officials. The coarse nature of the map does not provide site specific information and users should not assume that highlighted infested areas are entirely infested. The list of Infested jurisdictions reported by year and past years distribution maps can be found on the HWA website at http://hiro.ento.vt.edu/hwa/

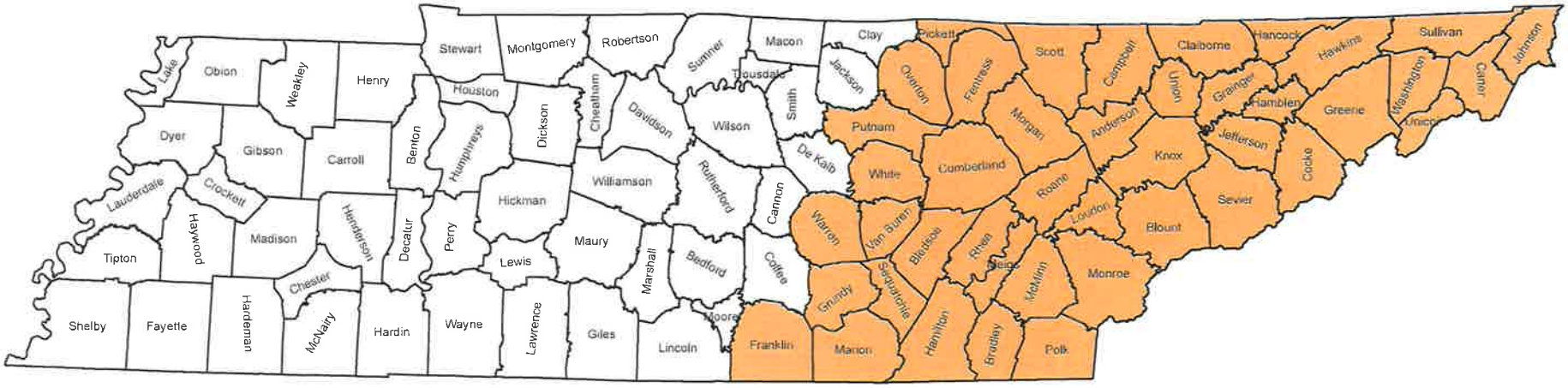
Map created 2/20/20 by AKS
Morgantown Field Office
updated 3/6/20

TN Department of Agriculture | Forestry

Forest Health & Sustainability

Tennessee Counties Infested with Hemlock Woolly Adelgid

Protect TN Forests.org



Hemlock Woolly Adelgid infested counties

In Tennessee, 43 counties are known to be infested with HWA. They include **Anderson, Bledsoe, Blount, Bradley, Campbell, Carter, Claiborne, Cocke, Cumberland, Fentress, Franklin, Grainger, Greene, Grundy, Hamblen, Hamilton, Hancock, Hawkins, Jefferson, Johnson, Knox, Loudon, Marion, McMinn, Meigs, Monroe, Morgan, Overton, Pickett, Polk, Putnam, Rhea, Roane, Scott, Sequatchie, Sevier, Sullivan, Unicoi, Union, Van Buren, Warren Washington and White**.

Six states with HWA quarantines are Maine, Michigan, New Hampshire, Ohio, Vermont, Wisconsin and Canada. Entry requirements for hemlocks from infested or adjacent areas vary from state to state. A State Phytosanitary Certificate is required. The state summaries can be found at http://na.fs.fed.us/fhp/hwa/quarantines/quarantines.shtm or at the National Plant Board (NPB) laws and summaries site http://nationalplantboard.org/laws/.

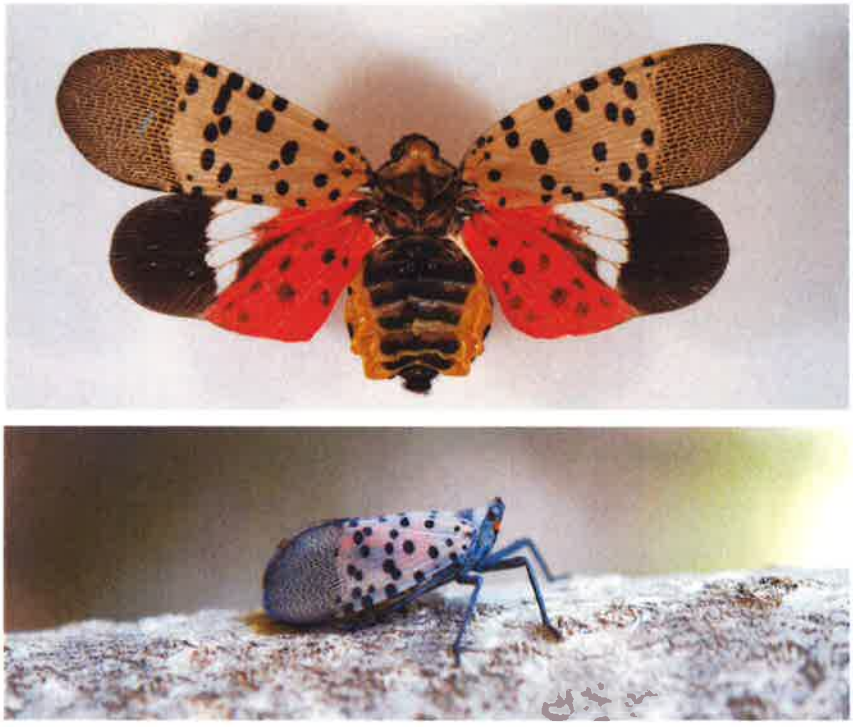
USDA
United States Department of Agriculture

Pest Alert

Animal and Plant Health Inspection Service
Plant Protection and Quarantine

Spotted Lanternfly *(Lycorma delicatula)*

The spotted lanternfly is an invasive pest, primarily known to feed on tree of heaven *(Ailanthus altissima)* but has many other host plants, including grape, hop, apple, stone fruit, maple, poplar, walnut, and willow. The insect changes hosts as it goes through its developmental stages. Nymphs feed on a wide range of plant species, while adults prefer to feed and lay eggs on tree of heaven *(A. altissima)*. Spotted lanternflies are invasive and can spread rapidly when introduced to new areas. While the insect can walk, jump, or fly short distances, its long-distance spread is facilitated by people who move infested material or items containing egg masses. If allowed to spread in the United States, this pest could damage the country's grape, orchard, and logging industries.



Adult spotted lanternfly

Distribution

The spotted lanternfly is present in China, Japan, South Korea, Taiwan, and Vietnam. In 2014, the insect was first detected in the United States in Pennsylvania. Since then, spotted lanternfly infestations have been detected in Delaware, Maryland, New Jersey, and Virginia.

Damage

Both nymphs and adults of spotted lanternfly cause damage when they feed, sucking sap from stems and branches. This can reduce photosynthesis, weaken the plant, and eventually contribute to the plant's death. In addition, feeding can cause the plant to ooze or weep, resulting in a fermented odor, and the insects themselves excrete large amounts of fluid (honeydew). These fluids promote mold growth and attract other insects.

Description

Adult spotted lanternflies are about 1 inch long and one-half inch wide, and they have large and visually striking wings. Their forewings are light brown with black spots at the front and a speckled band at the rear. Their hind wings are scarlet with black spots at the front and white and black bars at the rear. Their abdomen is yellow with black bars. Nymphs in their early stages of development appear black with white spots and turn to a red phase before becoming adults. Egg masses are yellowish-brown in color, and most are covered with a gray, waxy coating prior to hatching.

Life Cycle

The spotted lanternfly lays its eggs on smooth host plant surfaces and on non-host material, such as bricks, stones, and dead plants. Eggs hatch in the spring and early summer, and nymphs begin feeding on a wide range of host plants by sucking sap from young stems and branches. Adults appear in late July and tend to focus their feeding on tree of heaven *(A. altissima)* and grapevine *(Vitis vinifera)*. As the adults feed, they excrete sticky, sugar-rich fluid (honeydew). The fluid can build up on plants and on the ground underneath infested plants, causing sooty mold to form.

Where To Look

Spotted lanternfly adults and nymphs frequently gather in large numbers on host plants. They are easiest to spot at dusk or at night as they migrate up and down the trunk of the plant. During the day, they tend to cluster near the base of the plant if there is adequate cover or in the canopy, making them more difficult to see. Egg masses can be found on smooth surfaces on the trunks of host plants and on other smooth surfaces, including brick, stone, and dead plants.

Spotted lanternfly nymphs are black with white spots in early stages of development and turn red before becoming adults.

Report Your Findings

If you find an insect that you suspect is the spotted lanternfly, please contact your local Extension office or State Plant Regulatory Official to have the specimen identified properly.

To locate an Extension specialist near you, go to the U.S. Department of Agriculture (USDA) website at **nifa.usda.gov/Extension.** A directory of State Plant Regulatory Officials is available on the National Plant Board website at **www.nationalplantboard.org/membership.**

Covered and uncovered egg masses

Cluster of adults on the trunk of a tree at night

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