2009 Forest Insect and Disease Conditions in Pennsylvania

Commonwealth of Pennsylvania
Department of Conservation and Natural Resources
Bureau of Forestry
Division of Forest Pest Management
208 Airport Drive, 2nd Floor
Middletown, PA 17057-5027
Office: (717)948-3941 Fax: (717)948-3957

Topics Covered In This Issue:

Pennsylvania Weather Conditions in 2009

Temperature trends for the 2009 growth period from April through October were cooler then normal. Early spring temperatures were near normal until the April 20-24 period when temperatures spiked to 85-90 F°. This event appeared to advance host tree bud emergence and synchrony of egg mass hatch of major defoliating insect species (i.e. gypsy moth, forest tent caterpillar, and eastern tent caterpillar). From early May through September temperatures tended to remain at or below normal throughout the Commonwealth.

Precipitation remained well above normal throughout most of the growth period with early season shortfalls in the North central, Northwestern, East central and Southwestern regions until late May. By late June, precipitation levels tended to remain above normal throughout the Commonwealth. In general, soil moisture levels tended to be at or near adequate levels in most areas throughout the growth period. During the period between June and early-September high rainfall events of several inches were documented at regular intervals in the Southeastern region resulting in excessive surface runoff and stream bank erosion.

A series of frost and freeze events occurred between May 19 and May 25; these cold temperature events caused significant and widespread damage to foliage and reproductive structure development on sugar maple, beech, and oak species across the northern half of the Commonwealth. Seed sets of sugar maple were lost in many areas of the northern tier counties due to the frost; and abortion of beech nuts was also observed. Damage to acorns of oak appeared to be variable with many areas having a very good crop of acorns.

Gypsy Moth Suppression Program

The operational period for the 2009 gypsy moth suppression program was May 7 through May 29, with aerial applications conducted in 25 counties (Table 1). A total of 177,668 acres consisting of 1,017 spray blocks (Figure 1) were treated using *Bacillus thuringiensis* var. *kurstaki* (Btk) (Foray® 76B) undiluted at a dose of 38 CLUs in a single application of ½ gallon per acre. Expenses for the 2009 gypsy moth suppression program totaled $6,397,741 with an average cost of $31.79 per acre. State, county, and federal governments shared the expense of this program, with counties contributing $21 per acre for the treatment of private and county/municipal forest lands.

A total of 210 of the 1,017 sprayed blocks were sampled for post-treatment evaluation. Overall, forest defoliation due to gypsy moth was significantly reduced in 2009. The cool, wet weather during the larval development period is believed to have promoted an epizootic of the gypsy moth fungal pathogen that contributed to a reduction of larvae and a decrease in defoliation. Information on the gypsy moth suppression program in Pennsylvania can also be found on the DCNR Bureau of Forestry web page located at: http://www.dcnr.state.pa.us/forestry/gypsymoth/2008suppression.aspx

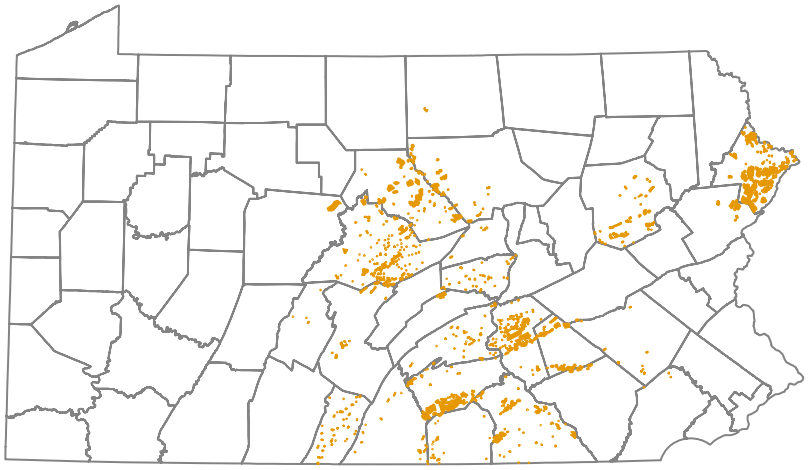

Figure 1. 2009 Gypsy Moth Suppression Program Spray Blocks

Surveys for gypsy moth egg masses were conducted during the summer and fall of 2009. Egg mass densities are so low that no requests for treatment in 2010 were submitted to the Division by counties or other cooperators. In addition, recent state budget cuts have eliminated funding for the gypsy moth suppression program. If gypsy moth population increases follow past outbreak cycles, we expect gypsy moth populations to rebound by 2012. Warm, dry springs in the months of April-May-June will favor gypsy moth populations. The Division will keep the County Gypsy Moth Coordinators informed regarding gypsy moth populations and budgetary/funding issues during 2010 and 2011.

	Private		Stewardship		State Parks		PA Game Comm		Federal		State Forest		Other		TOTALS	
COUNTY	Block	Acre	Block	Acre	Block	Acre	Block	Acre	Block	Acre	Block	Acre	Block	Acre	Block	Acre
Adams	31	887									1	591			32	1478
Berks	11	427													11	427
Blair	5	126													5	126
Centre	124	6535			7	797			4	706	17	6758	2	1102	154	15898
Chester	3	127													3	127
Clearfield											1	4523			1	4523
Clinton	46	1966			4	171	3	4159			18	12588			71	18884
Cumberland	72	6779	1	29	5	958					7	12432			85	20198
Dauphin	99	6211			2	977	3	7416			3	1496	9	580	116	16680
Franklin	15	440									6	1913			21	2353
Fulton	49	1364													49	1364
Huntingdon					8	312			11	456	6	2001			25	2769
Juniata							2	2243							2	2243
Lancaster							4	2035							4	2035
Lebanon	10	3273					5	3880					15	1700	30	8853
Luzerne	50	6633			1	206	3	257							54	7096
Lycoming	12	649			3	174					14	6875			29	7698
Monroe	2	201					1	443			2	4056			5	4700
Perry	23	1018			4	228	8	664							35	1910
Pike	107	32101					2	160	1	87	11	16491			121	48839
Schuylkill							1	178							1	178
Snyder	30	1164	1	54			1	75							32	1293
Tioga					2	209									2	209
Union					3	127					5	551			8	678
York	114	6262			3	244	4	603							121	7109
TOTALS	803	76163	2	83	42	4403	37	22113	16	1249	91	70275	26	3382	1017	177668

Table 1. 2009 Gypsy Moth Suppression Treatment Acres and Blocks by County.

Gypsy Moth Population Collapse

The gypsy moth has had severe impacts on the Commonwealth's forests since the early 1970's. It has caused outbreaks at various intervals. On average, an outbreak has occurred every five to seven years since 1968. The latest outbreak started in 2005 and ended in 2009. Figure 2 below illustrates gypsy moth defoliation and treatments from 1968 to 2009. The degree of gypsy moth defoliation varied considerably over the years and regions. At its peak in 1990, gypsy moth defoliated 4.3 million acres of forest in Pennsylvania. However, only a small proportion of infested areas are treated in any given year.

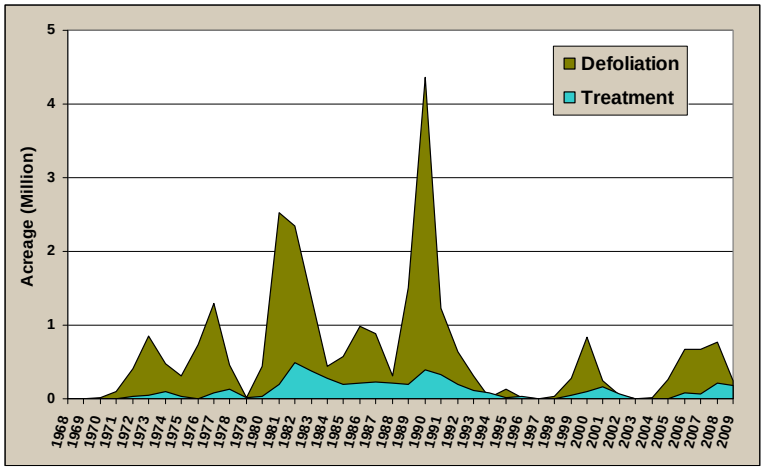

Figure 2. Gypsy Moth Defoliation and Treatment Acreage 1968-2009.

In 2009, gypsy moth populations collapsed across the Commonwealth following several years of heavy defoliation. A fungal pathogen, *Entomophaga maimaiga*, and the gypsy moth nuclear polyhedral virus (NPV) were prevalent throughout the infested areas and were responsible for the overall population decline. The recent outbreak cycle in Pennsylvania began in 2005 following two years of very low populations in 2003 and 2004. Rainy weather from April to early June in 2008 and 2009 was extremely favorable to the rapid growth and spread of the gypsy moth fungal pathogen. The gypsy moth virus spreads rapidly in the larval population after several years of outbreak-level populations.

Aerial Survey

The 2009 aerial defoliation and mortality survey was conducted between June 10 and July 28. The majority of public and private forest lands were surveyed. A separate aerial survey of tornado damage was conducted in the Moshannon State Forest on September 1, 2009. Aerial surveys were conducted to visually assess and document location, severity of damage, and affected host species caused by biotic or abiotic damage causal agents.

The Division of Forest Pest Management (FPM) coordinated the 2009 aerial survey with the Bureau of Forestry's 20 Forest Districts and with three aerial contractors (Joseph R. Costa Inc., Mills Brothers Aviation, and Val Air). The total cost for the aerial contractors in 2009 was $37,047 at a rate of $162 to $400 per flight hour. Areas of defoliation, mortality, discoloration and associated causal agents were mapped for each forest district. Post-flight ground investigations and data review were accomplished by the District Forest Insect & Disease Coordinator and Forest District staff.

The survey covered all 20 Forest Districts with a cumulative flight route of 9,162 miles. The survey covered 17,591,040 acres (9162 mile x 3 mile-buffered x 640 acre/mile^2).

Aerial Survey Results – Forest Defoliation and Mortality

Gypsy moth and forest tent caterpillar were identified as the leading insect defoliators on oak and sugar maple respectively in 2009. Together they contributed to 96% of the total defoliation reported in 2009 (Figure 3). In addition, forest tent caterpillar surpassed gypsy moth to become the top forest insect defoliator in the state (Table 2). Fall cankerworm continued to be a problem in Westmoreland and Somerset Counties, with some expansion to Cambria County. Oak mortality throughout the state is primarily associated with gypsy moth defoliation and drought stress (Figure 4).

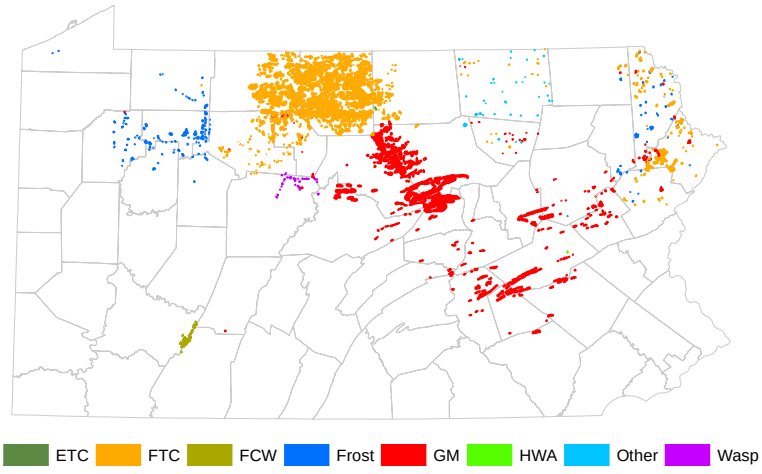

Figure 3. 2009 Defoliation by Damage Causing Agent

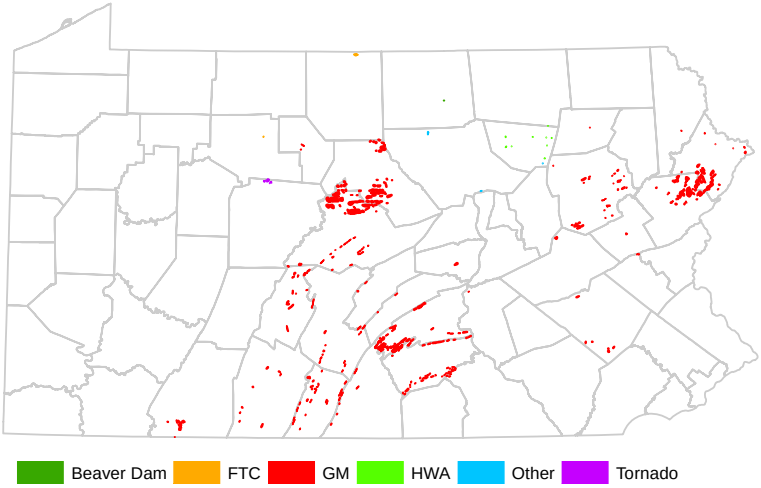

Figure 4. 2009 Mortality by Damage Causing Agent

Agent	Defoliation	Mortality
Beaver Dam		*38*
Cynipid Wasp	*1548*	
Eastern Tent Caterpillar (ETC)	*252*	
Fall Cankerworm (FCW)	*5507*	
Frost	*15785*	
Forest Tent Caterpillar (FTC)	*371267*	*547*
Gypsy Moth (GM)	*239694*	*108402*
Hemlock Woolly Adelgid (HWA)	*71*	*186*
Other	*2018*	*233*
Tornado		*171*
Total	636142	109577

Table 2. Total Acreage of Forest Defoliation and Tree Mortality by Damage Causing Agent.

Forest Defoliation and Tree Mortality by Gypsy Moth

Aerial surveys of gypsy moth defoliation and mortality were conducted in June and July. Defoliation was mapped on 239,694 acres (108,884 acres heavy >60%; and 130,810 acres moderate <60%) (Figure 5 and Table 3). The defoliation acreage for 2009 decreased dramatically from what was observed in 2008. Tree mortality due to gypsy moth totaled 108,402 acres (Figure 6 and Table 3). The major incidence of tree mortality occurred in central and northeastern Pennsylvania.

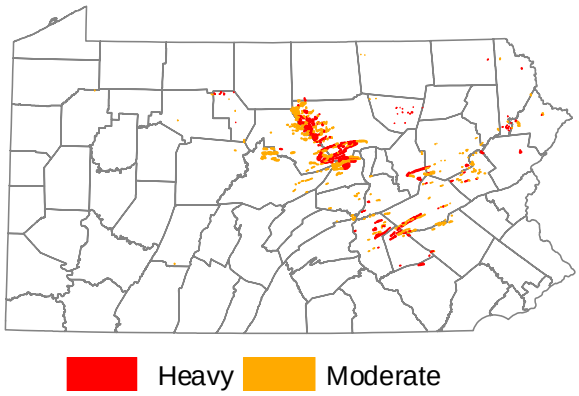

Figure 5. 2009 Forest Defoliation by Gypsy Moth

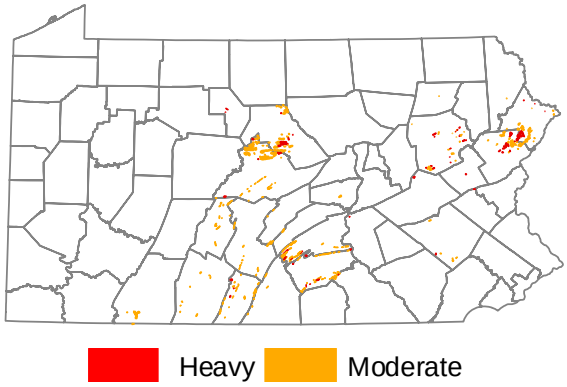

Figure 6. 2009 Forest Mortality by Gypsy Moth

COUNTY	Defoliation	Mortality	COUNTY	Defoliation	Mortality
Bedford		1198	Lehigh		96
Berks	4197	1130	Luzerne	6790	4732
Blair		2788	Lycoming	88113	328
Bradford	26		Mifflin		566
Cambria	111		Monroe	1392	14392
Cameron	950	180	Montour	24	
Carbon	5496	175	Northumberland	1363	
Centre	16442	26258	Perry	369	13702
Clearfield	228		Pike	2843	11425
Clinton	36269	16258	Schuylkill	14560	412
Columbia	9357		Snyder	1069	596
Cumberland		5587	Somerset		1556
Dauphin	10659	40	Sullivan	658	
Elk	184		Susquehanna	118	
Franklin		963	Tioga	836	
Fulton		3653	Union	24983	
Huntingdon		1787	Venango	14	
Juniata	659	125	Wayne	1673	43
Lackawanna	408		Wyoming	24	11
Lancaster	1878		York		401
Lebanon	8001		Grand Total	239694	108402

Table 3. Acreage of Forest Defoliation and Tree Mortality by Gypsy Moth in 2009.

Forest Tent Caterpillar (FTC)

In 2009, forest tent caterpillar, *Malacosoma disstria* Hubner (Lepidoptera: Lasiocampidae), surpassed the gypsy moth in the numbers of acres defoliated. FTC damage throughout Potter County was severe. A total of 371,267 acres of northern hardwood forests were defoliated, with approximately two-thirds characterized as heavy (>60% defoliation shown as red in Figure 7). FTC primarily attacks sugar maple, oak, poplar and other deciduous hardwoods. FTC populations caused extensive defoliation in northern Pennsylvania in the counties of Cameron, Elk, McKean, Potter, and Tioga (see map below). An increase in FTC populations was also observed in the southern portions of Pike and Monroe Counties. FTC populations decreased in Luzerne, Lycoming, and Sullivan Counties where outbreaks had been recorded in 2008. Wayne County has had an ongoing FTC outbreak since 2006. The pupal parasitoid, *Sarcophaga aldrichi* Parker (Diptera: Sarcophagidae), and the larval pathogen *Furia gastopachae* (Raciborski) Filotas, Hajek and Humber (Entomophthoromycotina: Entomophthorales) were abundant in most locations late in the season. However, FTC population declines are not expected in 2010, especially in newly infested areas due to available host resources and inadequate regulation by natural enemies.

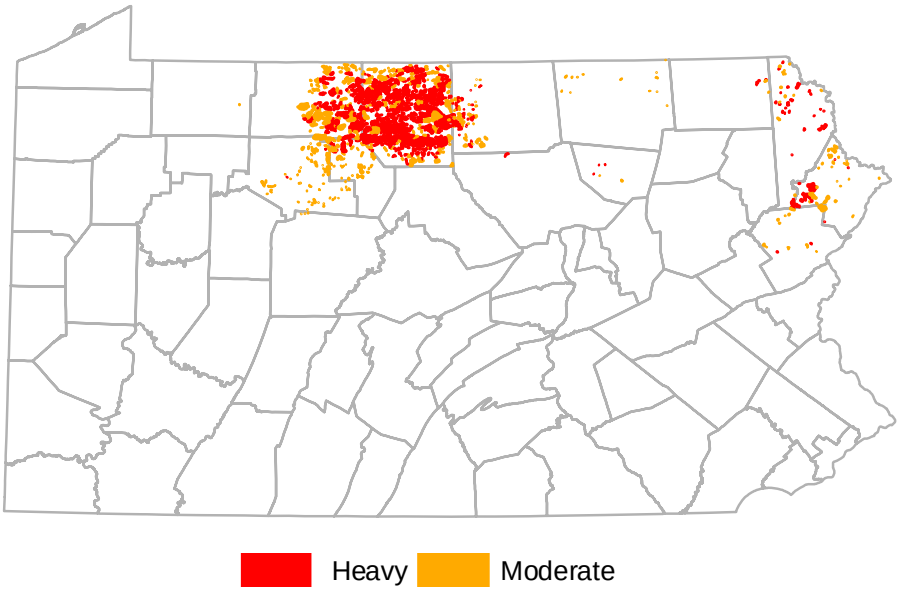

Figure 7. 2009 Forest Defoliation by Forest Tent Caterpillar

Emerald Ash Borer (EAB)

The emerald ash borer, *Agrilus planipennis* Fairmaire (Coleoptera: Buprestidae) was first detected in western Pennsylvania in Cranberry Township, Butler County, PA in June 2007. Subsequent detection surveys revealed that several townships in Butler and Allegheny Counties were also infested. As a result, both Butler and Allegheny Counties, along with neighboring Beaver and Lawrence Counties, were placed under quarantine by the Pennsylvania Department of Agriculture and the U.S. Department of Agriculture. This quarantine was expanded to Mercer County in the summer of 2008 as additional EAB infested trees were found in the Borough of Wheatland.

DCNR has been actively involved in the survey and monitoring of EAB since 2003. Those activities intensified in 2008 and 2009 after the first discovery of this pest in Pennsylvania in 2007. Seven new counties (Armstrong, Indiana, Juniata, Lawrence, Mifflin, Washington, and Westmoreland) were added to the infestation map in 2009, with 123 acres of moderate to heavy damage to ash trees reported from Allegheny, Butler, and Mifflin Counties through ground surveys.

For additional information on the emerald ash borer, visit the following web sites:
http://www.dcnr.state.pa.us/forestry/fpm_invasives_EAB.aspx
http://ento.psu.edu/extension/trees-shrubs/emerald-ash-borer
http://www.emeraldashborer.info/
http://www.dontmovefirewood.org/

Suspected emerald ash borer or other invasive species sightings can be reported to badbug@state.pa.us

EAB Seasonal Study – FPM carried out a project to study the seasonal abundance and dispersal potential of EAB in western Pennsylvania in 2009. A total of 53 sites were selected for this study, including 38 sites within a 20-mile radius around the Cranberry infestation and 15 sites within a 10-mile radius around the Wheatland infestation in Mercer County. In addition, a total of 5 (Cranberry) and 4 (Wheatland) sites were selected outside the study areas to serve as outlier sites (Figure 8). Standard purple panel traps baited with Manuka/Phoebe oil (80/20 mixture) lure was used to monitor adult emergence and seasonal abundance of emerald ash borer. One live ash tree (infested or un-infested) was selected from each site for this study, with two traps placed on each tree. Traps were monitored every other week from May 31 to September 26, with the lures replaced once during the week of July 27-31.

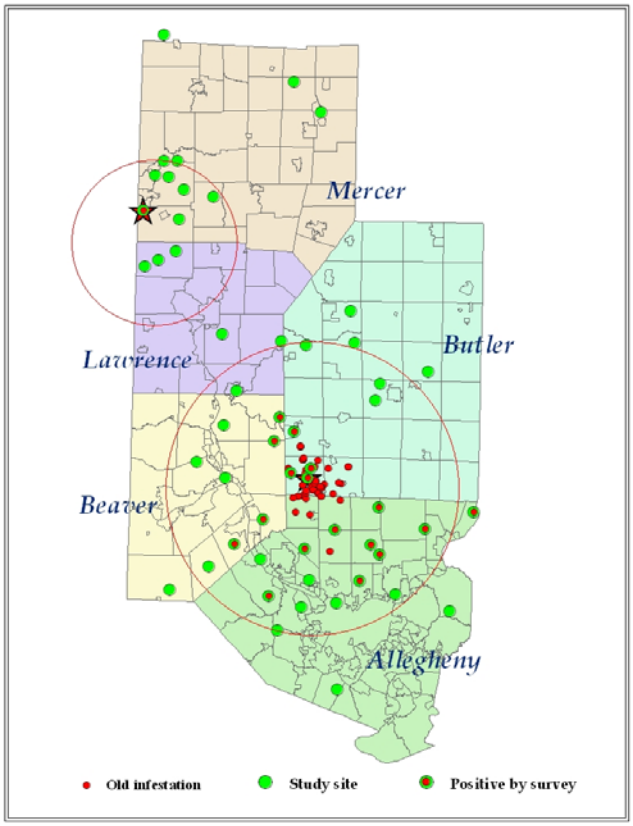

Figure 8. EAB Study Sites in Western Pennsylvania.

Results indicate that emerald ash borer adults were found at the epicenter in the Wheatland study area, with 2 beetles captured throughout the season. No adults were found at any other sites. The removal of the previous infested ash trees at the epicenter prior to this study by Pennsylvania Department of Transportation may have contributed to the low adult population recorded at this site.

For the Cranberry study area, 17 out of the 38 sites were positive with EAB based on trap catches, including one outlier site 21 miles away from the epicenter. A total of 462 adults were collected from the 17 sites, with the highest catch of 96 adults at New Sewickley, PA in Beaver County. Trapping results indicated that EAB adults were active from June 1 to September 21, with peak flight time occurring between mid- to late June. A negative correlation was found between trap distance from the epicenter and the total number of adults captured; with the majority (64%) of the adults found on traps placed between 5 to 10 miles away from the epicenter.

EAB National Survey – DCNR also participated in the national EAB detection survey for emerald ash borer in 2009. A total of 61 purple panel traps were placed in 32 counties in central and eastern Pennsylvania (Figure 9). Traps were monitored monthly from June to September. No emerald ash borer adults were collected from the traps. DCNR activities were coordinated with the Pennsylvania Department of Agriculture, USDA Forest Service, and USDA APHIS Plant Protection & Quarantine.

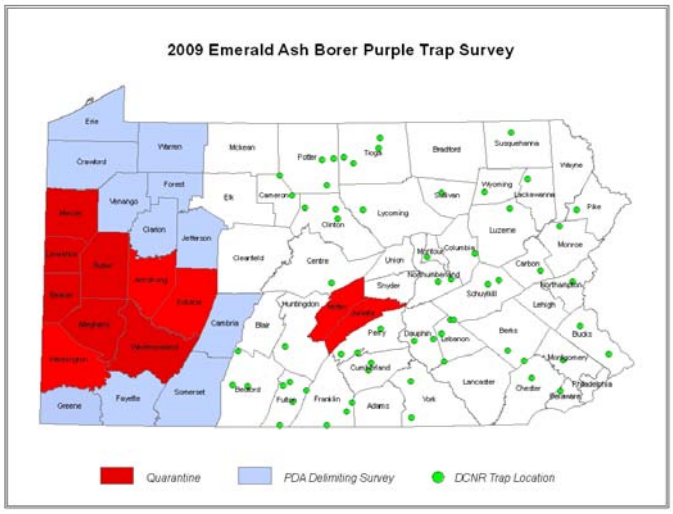

Figure 9. Emerald Ash Borer Survey - 2009.

Chemical Treatment of Seed Orchards & Pumpkin Ash – The DCNR Bureau of Forestry maintains three ash seed orchards. Two seed orchards, at Dague and Erie Bluffs, are currently producing seeds; and one seed orchard at Greenwood, PA is anticipated to begin seed production in the near future. A fourth seed orchard located in Bald Eagle State Forest is being established (Figure 10). FPM, in conjunction with Penn Nursery, conducted pre-emptive chemical treatments of ash trees in two seed orchards and collected seeds from those orchards as well as other state forest lands. More than 100 white ash trees in the Dague seed orchard were treated with emamectin benzoate (Treeage®) through trunk injection. About 50 pumpkin ash trees (a Pennsylvania listed species of concern) at Erie Bluffs State Park were treated with imidacloprid (MERIT®) through soil injection. Seeds from pumpkin, green, and white ash trees were collected and sent to the USDA Forest Service National Seed Laboratory.

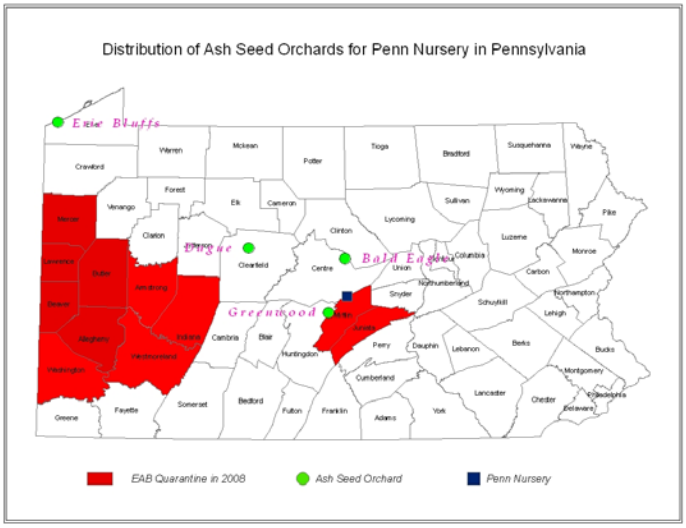

Figure 10. Ash Seed Orchard Locations.

Asian Longhorned Beetle (ALB)

The Asian longhorned beetle, *Anoplophora glabripennis* (Motsch.) (Coleoptera: Cerambycidae) is an exotic woodboring beetle from Asia. It was first discovered in North America on urban shade trees in New York in 1996. Since then, infestations have been detected in Illinois, New Jersey, Massachusetts and Ontario, Canada. ALB attacks maple, horsechestnut, elm, willow, birch, poplar, and other broadleaf trees. Larval tunneling inside the wood girdles branches and the trunk of the tree. Repeated attacks lead to crown dieback, structural weakness of stems and branches, and eventual death of the tree. Infestations in Chicago, IL have been successfully eradicated while efforts to combat this pest in other locations continue. The infestation in Worcester, MA, detected in 2008, is extremely troublesome compared to previous infestations because of the size (64 km^2) and its close proximity to the northern hardwood forests of New England. Left unchecked, ALB will severely impact urban/suburban landscapes and northern hardwood forests.

Pennsylvania's proximity to New York and Massachusetts increases the likelihood of Pennsylvania's forests and urban landscapes to attack by ALB. DCNR has been working with the Pennsylvania Department of Agriculture (PDA), USDA Forest Service, and USDA-APHIS-PPQ on the survey and detection of ALB in Pennsylvania since 2005. State-owned high-risk areas such as campsites, picnic areas, resting areas along highways are surveyed. ALB has been added to the list of targeted pests in our forest insects and diseases (FI&D) reporting system. In 2010, DCNR plans to continue ground surveys and public outreach activities in cooperation with the PDA, USDA Forest Service and USDA APHIS PPQ.

Asian Longhorned Beetle Adults

In 2009, DCNR conducted a visual survey for ALB at 35 State Parks in eastern Pennsylvania (Figure 11). Host trees at high-risk areas in the State Parks were visually inspected from the ground for signs and symptoms of ALB. Multiple sites, such as campgrounds, picnic areas, boat launch sites, sanitary stations, popular hiking trails, etc. were visited within each Park. Each site encompassed a circular area of ca ¼ acre. A total of 10 host trees were thoroughly inspected using binoculars. Tree species, diameter at breast height (DBH), and signs of beetle damage (egg-pits, leaking sap, sawdust/frass, exit holes, yellow/drooping leaves, and branch dieback) were recorded. A total of 1,088 host trees were visually inspected for signs and symptoms of ALB. No infestations were detected in 2009.

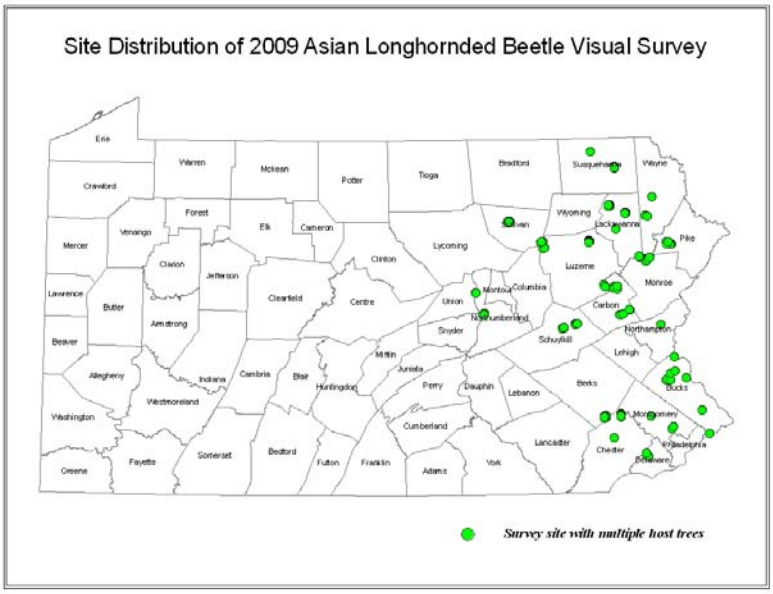

Figure 11. Asian Longhorned Beetle Survey Sites 2009.

General Hemlock Survey (GHS)

Eastern hemlock (*Tsuga canadensis*), the state tree of Pennsylvania, is one of the major forest species of the Commonwealth. The introduction of hemlock woolly adelgid (HWA) and elongated hemlock scale (EHS) has contributed to the decline of hemlock in Pennsylvania. In many sites, hemlock mortality and decline is significant within a few years following infestation.

The GHS was initiated in 2004 by DCNR to survey hemlock distribution and associated forest pests threatening this tree species. The survey has been conducted annually for the last five years. A total of 12,222 hemlock trees have been sampled (Figure 12) in the GHS and 4,847 were infested with HWA (39.7%) at various levels of severity; 2,296 were infested with EHS (18.8%); and 2,934 were infested with Fabrella needle cast (24.0%). Of those hemlocks infested with HWA, 1,328 (27.4%) were also infested with EHS.

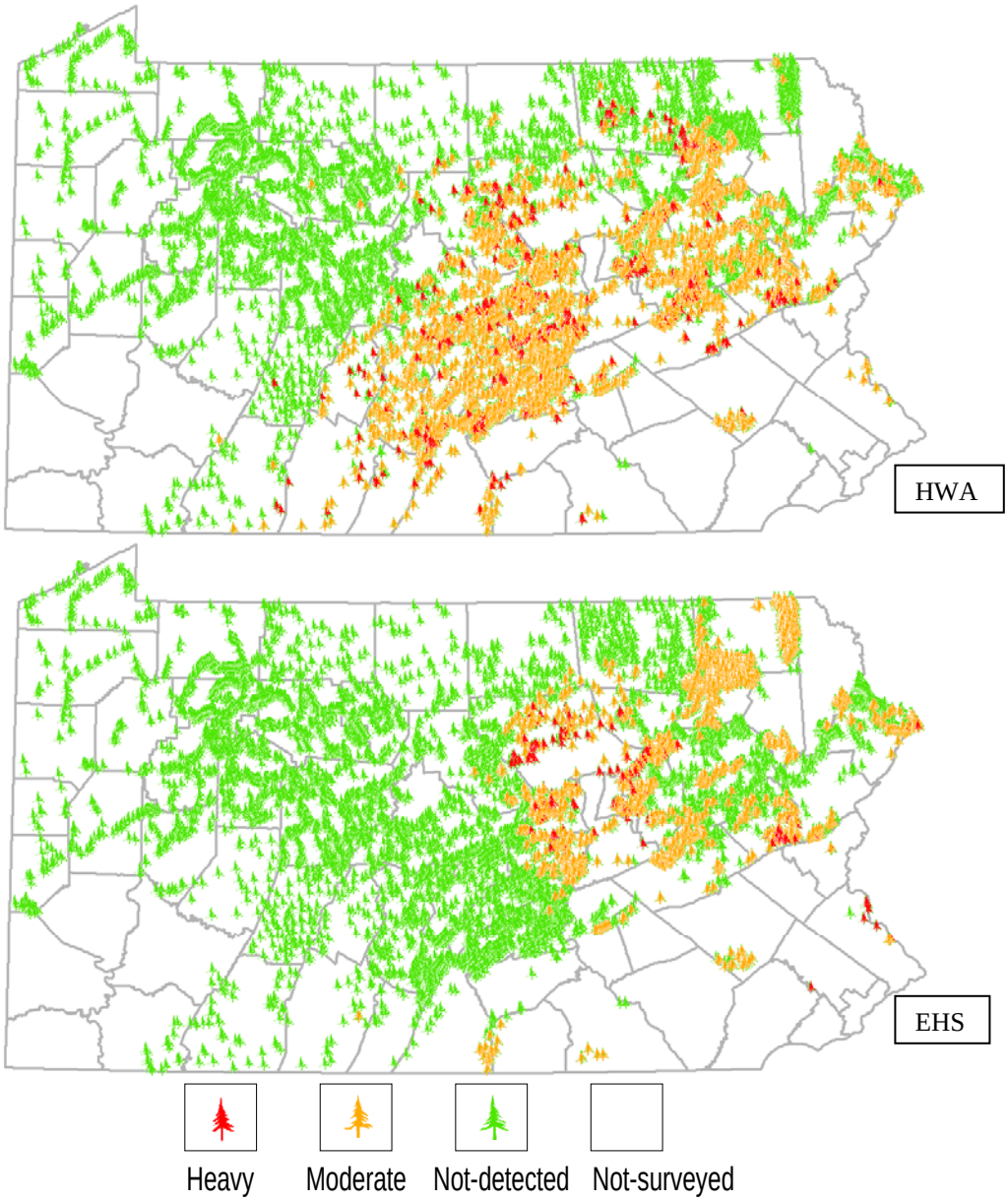

Figure 12. General Hemlock Survey Results by County & Township for HWA and EHS.

Hemlock Woolly Adelgid (HWA)

Hemlock woolly adelgid, *Adelges tsugae* Annand (Homoptera: Adelgidae), was first introduced to Virginia in 1951. It has since become the causal agent of widespread hemlock mortality throughout the eastern United States. Both eastern and Carolina hemlocks are affected. Current distribution includes 17 states from Maine to Georgia, covering 50% of the hemlock geographic range. Chemical insecticide applications are effective against HWA in small areas where limited number of high value trees can be treated. However, no effective method is currently available to control this pest in larger landscapes.

HWA was first recorded in southeastern Pennsylvania in 1967 and has been moving north and west since it first became established. Since then, it has been spreading steadily due to the lack of host resistance, the lack of natural enemies, and favorable weather conditions. A total of 51 counties in the State are infested. HWA was recorded in Fayette County in 2009 (Figure 13). In general, HWA populations decreased dramatically in most of its range within the state in 2009. The very low temperatures recorded early in the year may have contributed to high overwintering mortality. As a result, the total acreage of defoliation by HWA decreased by 96% in 2009 (71 acres defoliated) compared with that of 2008 (2,000 acres defoliated).

High value hemlocks in DCNR managed State Parks and State Forests are being identified for possible treatment with insecticides in 2010.

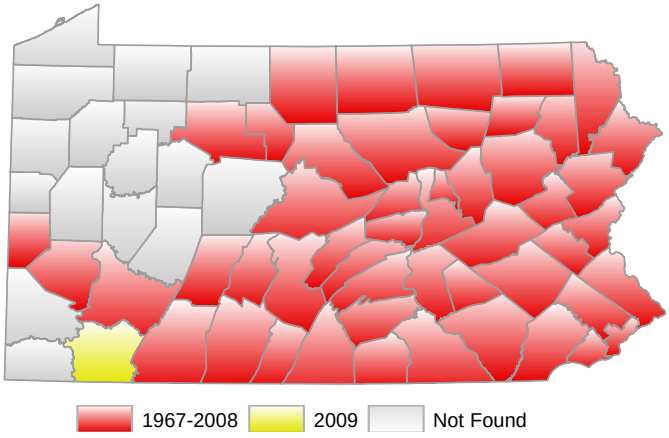

Figure 13. Distribution of Hemlock Woolly Adelgid in Pennsylvania by County.

Biological Control

DCNR continued to work on the biological control of HWA by releasing the predatory beetle *Laricobius nigrinus* Fender (Coleoptera: Derodontidae) in 2009. A total of 2,000 laboratory-reared adult beetles from Virginia Tech University were released at four sites along the leading edges of HWA in western Pennsylvania. This beetle is native to the northwestern United States and has been found effective against HWA on western and mountain hemlocks. At each release site, ten healthy eastern hemlock trees with medium to high HWA infestations were selected. A total of 50 adult beetles were released on the lower branches of each tree. In addition, research assistance was provided to the University of Massachusetts with the post-release evaluation (conducted in 2007 and 2008) of the Idaho-strain of *L. nigrinus* at several locations in Pennsylvania. Additional releases and evaluations are planned for 2010. The goal of the biological control program is to establish a suite of predators that will eventually begin to suppress HWA populations and minimize the impact on hemlock.

For additional information on HWA please see our web page located at: http://www.dcnr.state.pa.us/forestry/woollyadelgid/index.aspx

Elongated Hemlock Scale (EHS)

Elongated hemlock scale, *Fiorinia externa* Ferris (Homoptera: Diaspididae), infestations increased in 2009. One new county was added to the infestation: Perry. To date, EHS infestation has been detected in 35 out of 67 counties in Pennsylvania (Figure 14). EHS was first detected in Queens, NY in 1908. Predator releases for EHS were not conducted in 2009.

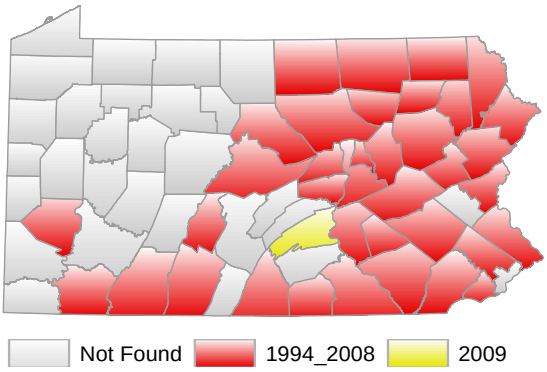

Figure 14. Distribution of Elongated Hemlock Scale in Pennsylvania.

Cynipid Wasps

Oak leaf and twig galls were caused by oak apple gall, *Amphibolips confluenta* (Harris), and gouty oak gall, *Callirhytis quercuspunctata* (Bassett), respectively. Damage was reported through aerial surveys and confirmed by ground investigations. Defoliation on oak trees by these two oak galls was found in Clearfield County, with smaller infestations recorded in Centre, Clinton, and Elk Counties. A total of 1,548 acres were affected (Figure 3).

Eastern Tent Caterpillar (ETC)

Eastern tent caterpillar, *Malacosoma americanum* (Fabricius) (Lepidoptera: Lasiocampidae), was observed statewide in 2009. Significant defoliation was observed in Cameron, Clinton, Lycoming, and Potter Counties. A total of 41,112 acres of moderate to heavy defoliation were mapped during aerial surveys and ground investigations. In Potter County, defoliation was caused by two defoliators on different host tree species. Approximately 10% of the defoliation was due to ETC on black cherry and 90% of the defoliation was due to FTC on maple (Figures 3 and 7).

Fall Cankerworm (FCW)

Outbreaks of fall cankerworm, *Alsophila pometaria* (Harris) (Lepidoptera: Geometridae), were reported from Somerset and Westmoreland Counties in 2008. Defoliation from FCW remained at outbreak levels in the two counties in 2009. FCW infestations expanded to neighboring Cambria County in 2009. Small infestations were also found in Berks and Dauphin counties in central Pennsylvania. A total of 8,597 acres of defoliation were reported in 2009 (Figure 3).

Fall Webworm

Fall webworm, *Hyphantria cunea* (Drury) (Lepidoptera: Arctiidae), was prevalent in central and southeastern Pennsylvania, with heavy infestations found in York, followed by Perry, Juniata, Lancaster, Mifflin, Chester and Delaware Counties. A total of 13,338 acres of damage was reported.

Locust Leaf Miner

Locust leaf miner, *Odontata dorsalis* (Thunb.) (Coleoptera: Chrysomelidae), was prevalent throughout the State on black locust. The heaviest infestations were found in Bedford, Blair, and Washington Counties. A total of 5,023 acres were reported damaged in 2009. Adults skeletonize and eat holes in the leaves, whereas larvae mine the leaves, causing aesthetic discoloration of black locust foliage. Although this species is considered non-destructive, its presence, in combination with other stress factors, infestations can contribute to growth loss and even mortality.

Redheaded Ash Borer and Ash Decline

The health of ash trees attracted more attention with the discovery of emerald ash borer in Pennsylvania. Ash decline in Pennsylvania may also result from drought stress, ash yellows, and a native insect species, the redheaded ash borer, *Neoclytus acuminatus* (Fabricius) (Coleoptera: Cerambycidae). Round adult exit holes in the bark and larval galleries under the bark are evidence of infestation by this ash borer. The redheaded ash borer attacks ash trees that are already under stress from other factors, but contributes to the decline of the ash tree it is infesting. The larval galleries in the sapwood are not S-shaped like EAB and the rounded exit holes do not look similar to EAB exit holes, which are D-shaped.

Frost Damage

Freezing temperatures caused widespread damage in northwestern Pennsylvania in the late spring. Damage on oaks and maples was observed in Forest, Elk, Wayne, Jefferson, Venango, Lackawanna, Luzerne, Pike, and Clarion Counties. The most severe incidents of frost damage were observed in Forest County. A total of 15,785 acres of damage were reported (Figure 3).

Phytophthora ramorum Stream Baiting Survey

Stream baiting of select streams in Delaware County was conducted for the fourth consecutive year. Four stream bait locations were monitored beginning in late April and continuing through mid-October. Results indicated that *P. ramorum* was not detected in any of the *Rhododendron* leaf-bait samples, either by PCR (polymerase chain reaction) testing or direct culturing of leaf lesions. Additional surveys of adjacent watersheds may be considered in the 2010 survey.

Beech Scale and Beech Bark Disease

A total of 6,001 acres were reported infested by beech scale, *Cryptococcus fasisuga* Lindinger (Homoptera: Eriococcidae) based on ground surveys. Moderate infestations were observed in Potter County, while sparse infestation levels were reported in Schuylkill County.

Beech scion wood from scale resistant material, for grafting onto beech rootstocks, was provided to the USDA Forest Service Northern Research Station in Delaware, OH. American beech materials from the Moshannon State Forest were collected and sent in December 2008 for hot-grafting and additional requests for scale resistant material are being considered for the 2009-2010 grafting cycle.

Sugar Maple Monitoring Project

Insect defoliation and anthracnose activity were examined on nine long-term study plots to evaluate sugar maple health. Sugar maple defoliation was observed by forest tent caterpillar, eastern tent caterpillar, and gypsy moth at four sites, two in Potter County and two in Tioga County. Defoliation was light (<30%) on two plots in Tioga County and heavy (>60%) on two plots in Potter County. Little or no active defoliation was observed on the remaining plots in Susquehanna, Bedford, and Blair Counties. Trace to light damage due to sugar maple anthracnose was observed in the lower crown of some mature trees and on seedlings. Anthracnose damage was not significant in 2009 except on seedlings.

Anthracnose *Apiognomonia spp.* (Diaporthales: Valsaceae)

Sycamore anthracnose was observed in many areas of Pennsylvania along riparian woodlands and in urban landscapes. The disease was not prevalent in the early growing season. However, symptoms appeared in July as rainfall increased. By late August leaf lesions were apparent at light to moderate intensity in many areas where sycamore is prevalent.

Ash Yellows (a phytoplasma)

Ash yellows is common to white ash, green ash, and other native species. Although the disease is widespread in Pennsylvania, it is not easily diagnosed until advanced symptoms appear on the host. The incidence of ash yellows and mortality was low and widely scattered. Detections were found in Adams, Bedford, Westmoreland, and York Counties in 2009.

Elm Yellows (a phytoplasma)

Elm yellows, a major cause of elm mortality, is frequently observed on American elm and red elm throughout Pennsylvania. Observed tree mortality due to elm yellows was low to moderate in intensity and widely scattered.

Fabrella Needle Cast

Fabrella needle cast, *Fabrella tsugae* (Farlow) (Helotiales: Hemiphacidiaceae), is widespread throughout Pennsylvania. Generally this disease is detected at low or trace levels of damage. Due to cool wet conditions throughout the 2009 growth period, needle cast symptoms were observed in counties where a history of the disease has been recorded. The disease has been reported in 46 of 67 counties since 2002 (red highlighted counties in Figure 15).

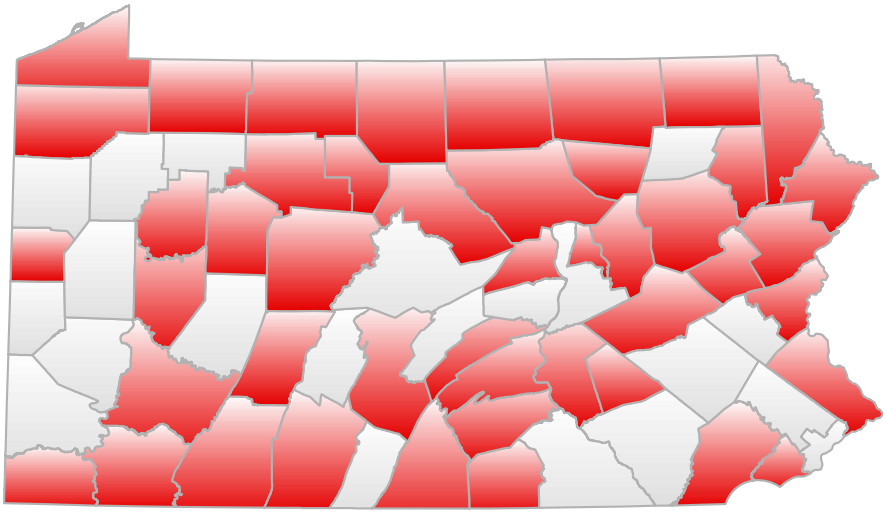

Figure 15. 2009 Distribution of Fabrella Needle Cast by County.

Oak Wilt

Oak wilt was observed periodically in 2009, but levels of activity remain sporadic. Oak wilt has been found in western, southwestern and central Pennsylvania. This disease may be more prevalent due to reduced activity of insect defoliators on oak in the immediate future. Oak wilt was first identified in the United States in 1944. The fungal pathogen that causes the disease, *Ceratocystis fagacearum*, is thought by most to be native to the eastern United States, but difficulty in isolating and identifying the fungus delayed recognition of the extent of its impact until the 1980's. Some plant pathologists think that oak wilt is an exotic disease, arriving in North America in the early 1900's, but the fungus has never been reported from any country other than the United States.

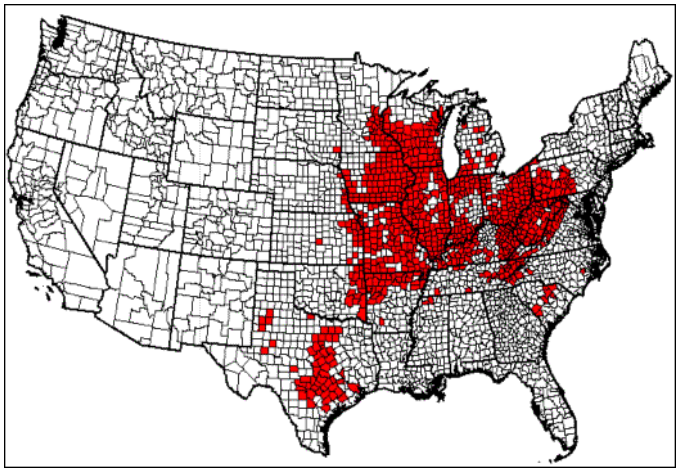

Figure 16. Oak Wilt Distribution in the United States – 1998.