The Proceedings of the 2nd National Oak Wilt Symposium

Edited by:

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Sponsored by

International Society of Arboriculture – Texas Chapter

Cooperators

Texas Forest Service
Texas AgriLife Extension Service
The Nature Conservancy of Texas
Lady Bird Johnson Wildflower Center
USDA Forest Service, Forest Health Protection

2009

USDA FOREST SERVICE PERSPECTIVE ON OAK WILT SUPPRESSION

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ABSTRACT

For many years, insect and disease suppression has been a part of the efforts of the USDA Forest Service and its state and federal cooperators in fulfilling our mission to the nation. Various enabling laws have provided authority to cooperatively fund suppression projects. Disease suppression efforts in the U.S. began with the discovery of the introduction of several non-native and virulent tree pathogens which cause such diseases as chestnut blight and white pine blister rust. Both federal and state governments have supported suppression efforts against such diseases. Other diseases have also received attention such as oak wilt and dwarf mistletoes. Cooperative oak wilt suppression programs began in the early 1950s in Pennsylvania, West Virginia, and other eastern states; but by the 1970s they were deemed largely ineffective and unnecessary. More recently, outbreaks of oak wilt in central Texas and southeastern Minnesota have precipitated suppression projects that have had better success and continue at the present time. Funding of cooperative pest suppression projects is provided where a pest presents a significant threat to a major forest resource and the likelihood of success is reasonably high. Availability of funds, competition with other significant pest threats, and politics can often influence funding availability and decisions. Oak wilt suppression projects, like all projects, are considered within this context. While suppression projects remain a fundamental component of the overall USDA Forest Service mission (and that of state agencies, too), prevention activities and early detection/rapid response efforts are being increasingly employed in an effort to minimize the introduction, spread, and effects of insect and disease pests at an early date, before major epidemics can occur.

Key words: *Ceratocystis fagaceaum*, disease management

For many years insect and disease suppression has been a part of the efforts of the USDA Forest Service and its state and federal cooperators in fulfilling our mission to the nation. Various acts of legislation have authorized funding of suppression projects over the years. Our current authority resides primarily in the **"**Cooperative Forestry Assistance Act of 1978, As Amended Through 2002**"** (USDA Forest Service 2005). The Forest Health Protection Section (Section 8, 16 U.S.C. 2104) authorizes many activities related to forest health including suppression. Suppression funding is applied directly on federal lands of all types, but on state and private lands, project funding is cooperative, with states or other entities providing about 50 percent of the funds as a "match" to federal funds.

Matching expenditures can be direct cash outlays or indirect costs such as salary supporting an employee's time, institutional overhead charges, or labor and equipment used in lieu of contracted work, etc. However, matching cannot be made using funds from other federal grants. Most suppression funding is provided to state agencies, although occasionally non-profit, non-governmental organizations are also funded. Historically, insect suppression projects have probably dominated in size and financial scope, but disease projects have been funded as well. And most recently, non-native invasive plant suppression projects have been added to the spectrum.

EARLY DISEASE SUPPRESSION

Forest disease suppression efforts in the U.S. began with the introduction and discovery of several non-native, virulent tree pathogens which caused serious diseases and threatened major forest resources. The first of these was the chestnut blight (Beattie and Diller 1954, Hepting 1976). The fungal pathogen that causes the blight, *Cryphonectria parasitica,* (Murrill) Barr, was first discovered in the New York area in 1904, although it was probably introduced prior to that. It is now known to be of Asian origin. As the blight spread into the native chestnut population in eastern forests, the first suppression efforts came via a state program, not a federal one. The state of Pennsylvania created the Chestnut Blight Commission in 1911 and over a 4-year period allocated over $500,000 to the work. The federal government did play a role, though, and provided funds for research on the disease - $5,000 dollars in 1911 and $80,000 in 1912 and 1913.

The suppression effort in Pennsylvania was attended by much controversy over the potential for success. The skepticism turned out to be well-founded as the blight spread too fast for operational activities to keep up and by 1914, suppression efforts were abandoned. The blight spread mostly unabated and by about 1940 was found throughout the host range of American chestnut. Early interest in disease resistance to the blight was generated by the observation that Japanese and Chinese chestnuts were resistant. Experimental plantings of oriental trees and crosses with American chestnuts began a long-term effort to develop and deploy a resistant replacement to the native tree. This work continues today and test plantings of resistant trees from the American Chestnut Foundation are currently being made on some national forest sites.

White pine blister rust was the second introduced disease to threaten a major North American forest resource (Pack 1934, Hirt 1956, Maloy 1997, Kinloch 2003). This disease is caused by a fungus, *Cronartium ribicola* Fish. and is also of Asian origin. It was introduced first to Europe and then the New York area. The fungus requires an alternate host, *Ribes* spp. (currents, gooseberries), and it was on these that it was first found in 1906. It was later found on planted white pine in 1909 and on natural white pine in 1915. Coming so closely on the heels of the chestnut blight, concern was immediate and control efforts quickly considered. The earliest control efforts, about 1910, were aimed at nursery production in an effort to keep diseased seedlings from being widely outplanted. To make matters worse, the disease was also found introduced to Vancouver, Canada in 1921, adding a threat to the western 5-needle pines.

The threat from this disease was the genesis of one of our earliest forest disease legislative efforts in 1912, the “Plant Quarantine Act”. Under this act, Quarantine #1 prohibited the importation of 5-needle pines to the U.S. The Act also enabled states to regulate the movement and cultivation of certain plants—this became the basis for the *Ribes* eradication efforts which were the focus of white pine blister rust suppression efforts for many years. The theory was that eliminating *Ribes* bushes in and around white pine stands would break up the complicated life cycle of this fungus and reduce or eliminate infection. Federal funds were initially provided in the amount of $20,000 in 1916, matching a $21,974 multi-state allocation. *Ribes* eradication grew into probably the biggest, most expensive forest disease suppression effort ever.

Efforts in one or more areas of the U.S. were active for about 50 years, ending in the 1960s with an estimated total expenditure of about $150 million. During the depression years, and the years after, the Civilian Conservation Corps was used as well as groups of men from other work relief programs. An estimated 20 million acres (8 million ha) were treated for white pine blister rust amelioration, a truly stunning amount. Unfortunately, the effect of all this effort was

considered only minimally beneficial in the East and mostly unsuccessful in the West where the disease was more severe. As with the chestnut blight, difficulty in controlling blister rust engendered an interest in disease resistance, especially in the western white pines and breeding and research continues today. This disease continues to be a threat to valuable forest resources, especially in the western U.S.

OAK WILT SUPPRESSION

Other diseases such as oak wilt, the subject of this symposium, have also received attention. Oak wilt, caused by the fungus *Ceratocystis fagacearum* (Bretz) Hunt, was first recognized as a threat in the 1940s and 1950s (MacDonald 1995). Early suppression efforts began in the 1950s with programs in Pennsylvania, West Virginia, Kentucky, North Carolina, and Tennessee. Most of these received some federal funding although documentation is scant or difficult to locate. West Virginia and Pennsylvania apparently had the biggest, most active programs. For example, in 1957 West Virginia received about $30,000 as a 33.3% share of a $90,000 project. Federal funding continued for at least these two states for nearly 20 years until the suppression efforts were discontinued, being deemed either ineffective, uneconomical, or both. These programs were summarized at the 1st National Oak Wilt Symposium in 1992 (Haynes 1995, Merrill 1995). U.S. Forest Service research and monitoring of suppression methods was very active at this time and various state programs were intensively studied for effectiveness (Jones 1965, Jones 1971).

Renewed interest in oak wilt suppression surfaced in the 1980s when the disease became widely diagnosed in central Texas live oaks and research efforts began to test and demonstrate effective control tactics. A 5-year cooperative federal-state demonstration project during 1982-1987 in central Texas showed the extent of oak wilt distribution and the likelihood of a successful suppression project (Cameron and Billings 1995). A cooperative federal-state suppression project was initially funded in 1988 with $168,600 federal and matched by state and local expenditures. Since then, the project has been continuously operated by the Texas Forest Service with federal funding increasing to about $500,000 per year (Fig. 1) and is summarized elsewhere in this symposium (Billings, this proceedings). A similar project was also initiated in southeastern Minnesota in 1990 which ran for about 7 years (Fig. 2). After a period without federal funding, cooperative funding resumed in 2002, and continues to the present. These two projects have experienced success in controlling oak wilt due mostly to the uniformity of the host type being damaged. Spread in both areas is primarily by root contacts or grafts and trenching or plowing to sever these grafts does a good job of stopping infection center expansion.

Another disease problem which has received a good bit of suppression funding over quite a number of years is dwarf mistletoe (*Arceuthobium* spp). Most projects have been in the western regions and data on expenditures and locations are scattered and difficult to summarize. But, as an example, one summary of work in the Pacific Northwest documents suppression activities beginning about 1959 and peaking in the 1970s with expenditures of about $400,000 in one year (Hadfield and Russell 1978). Mistletoe control programs remain active and are still being funded.

This year, over $49 million has been allocated for forest pest suppression efforts. Pests include gypsy moth, southern pine beetle, dwarf mistletoes, emerald ash borer, hemlock woolly adelgid, oak wilt, and others. About $600,000 of this has been dedicated to cooperative oak wilt projects. Some of these are listed in Table 1. Other oak wilt projects which are receiving funds (although from a different source of federal funds) are listed in Table 2.

SUPPRESSION PERSPECTIVES

Federal funding of forest pest suppression projects is driven by a number of issues. But, to generalize, projects which successfully receive federal funds usually address a significant threat to a major economic or ecological resource and have a reasonable potential for biological and operational success. Project selection is also affected by (1) the amount of funding available in a given year, (2) the differing pest threats that loom in a given year, and (3) the ever-present wild card of politics (as then State Forester Bruce Miles said in his welcoming address to the 1st National Oak Wilt Symposium, sometimes a project gets funding when a senator or congressman "…explains it better…"; Miles 2005).

When funding levels are adequate, decision-making on federal funding requests by Forest Health Protection is relatively uncomplicated. Our specialists verify the need and potential success of proposed projects and, as long as sufficient funds are available, most projects are approved. When budgets are tight or when huge, expensive suppression needs arise, some projects must be left un-funded and others must do with less-than-requested amounts. Occasionally, federal funding exigencies, such as a disastrous wildfire season, have diverted suppression dollars away from legitimate, worthwhile pest suppression projects.

NON-SUPPRESSION EFFORTS

As a counterpoint to suppression, the U.S. Forest Service also is active in funding, operating, and supporting a number of prevention and early detection programs aimed at minimizing the introduction, spread, and detrimental effects of insect and disease pests at an early date, before major epidemics develop. Some examples of these are the (1) Southern Pine Beetle Prevention and Restoration Program, (2) the Sudden Oak Death Survey Program, and (3) the Early Detection/Rapid Response Program for exotic bark beetles.

The Southern Pine Beetle (*Dendroctonus frontalis* Zimm.) Prevention Program has been funded since 2003 as a cooperative effort with southern states. Nearly $60 million has been allocated to date and all 13 southern states as well as 12 national forests currently have active programs. Efforts are aimed at thinning pine stands early in their life cycle, including pre-commercially, to reduce the hazard to southern pine beetle. Many states are using cost-share incentives to encourage landowner participation. Hundreds of thousands of acres have been treated so far.

The sudden oak death surveys have been a response to the potential introduction of this disease-causing organism (*Phytophthora ramorum* S. Werres, A.W.A.M. de Cock and W.A. Man in't Veld) to other states from California, Oregon and Washington on infected nursery stock (Todd undated, USDA Forest Service 2004). The disease was discovered in California in 1995 killing oaks (*Quercus* spp.) and tanoaks (*Lithocarpus densiflorus*) in coastal and central counties. As the disease problem grew there, it was discovered in 2003 and 2004 that the causal agent was also infecting a large number of nursery plant species in commercial container nurseries and that these potentially-infected plants had been shipped unawares to 49 of the 50 states. Many of these plants were sold before the USDA and state agricultural agencies could get the nurseries inspected and destroy infected plants. The potential for the organism to escape into the natural environment outside of California was instantly huge. The Forest Service in conjunction with state cooperators quickly implemented a large-scale detection survey program looking at the perimeters of nurseries that received infected or potentially-infected nursery stock. Nearby forested areas with potential hosts or forest areas with suitable hosts and climate were also surveyed.

Detection survey work began with 7 states in 2003 and has increased to 38 states in 2006 (Oak et al. 2008). Funding levels have been between $300,000 and $1.3 million annually. To date, no introductions of the pathogen to new wildland areas have been discovered. Since distribution of infected nursery stock has been substantially reduced, the survey efforts are now being reduced in size, scope, and funding although this reduced effort will continue for some time. Since survey results have been negative for 4 years, an alternative detection technique is being used to sample larger areas with less effort. Stream baiting is being used in 2007 to detect the presence of the pathogen in waterways downstream of nurseries or forest areas worthy of survey.

The early detection and rapid response program for exotic bark beetles began in about 2001 with $30,000 in funding and has grown to a $750,000 program in 2007. Bark beetle trapping is currently being done in 17 states in about 120 locations. Traps are placed in proximity to ports of entry, shipping, storage or manufacturing facilities that represent pathways for the introduction of exotic beetles in wood products or shipping materials. A number of exotic beetles have been trapped and identified. One of particular interest was trapped in 2002 at Port Wentworth near Savannah, Georgia (Mayfield and Thomas 2006, Johnson et al. 2007). It was identified as an ambrosia beetle of Asian origin, *Xyleborus glabratus* Eichoff.

Unfortunately, in spite of this "early detection" the beetle has established itself in local populations of red bay (*Persea borbonia*) and sassafrass (*Sassafras albidum*) trees. This beetle, as with other ambrosia beetles, carries a fungus which colonizes the attacked trees and provides food for the beetles. The one carried here is a pathogenic fungus of the genus *Raffaelea* which acts as a vascular wilt, quickly killing infected trees. The pair of pests has rapidly expanded their range into 31 counties in Georgia, South Carolina, and Florida. The host range has also expanded with attacks and infections now known in pondberry (*Lindera melissafolium*), pondspice (*Litsea aestivalis*), and avocado (*Persea americana*) (Hanula et al. 2008).

CONCLUSIONS

In the future, suppression funding and projects will still be needed and will continue to play a significant role in the increasingly complex arena of forest health management and oak wilt projects will probably remain among those funded. However, prevention and aggressive detection programs may play an increasingly important role in a world of fast-paced, global commerce.

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Table 1. Fiscal year 2007 funds (USDA Forest Service) allocated to cooperative oak wilt suppression projects.

Cooperator	Allocation
Texas *($300,000 + $200,000 Southern Region funds)*	$500,000
Minnesota	$200,000
Michigan	$50,000
Wisconsin	$50,000
Chequamegon-Nicolet NF	$25,000

Table 2. Fiscal year 2007 funds (USDA Forest Service) allocated to other federal installations for oak wilt suppression projects.

Federal Installation	Allocation
Fort Hood, Texas	$70,000
Balcones National Wildlife Refuge, TX	$24,000
Army Corps Engineers, St. Paul District	$1,330
Fort McCoy, WI	$40,000

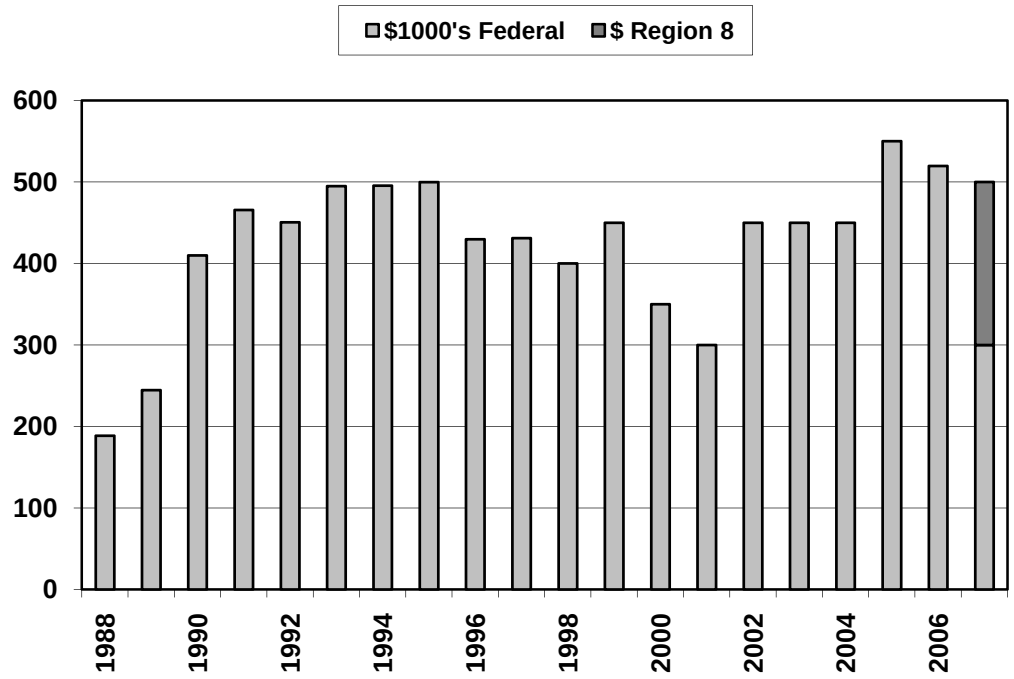

Figure 1. Federal (USDA Forest Service) dollars allocated to the Texas Cooperative Oak Wilt Suppression Project.

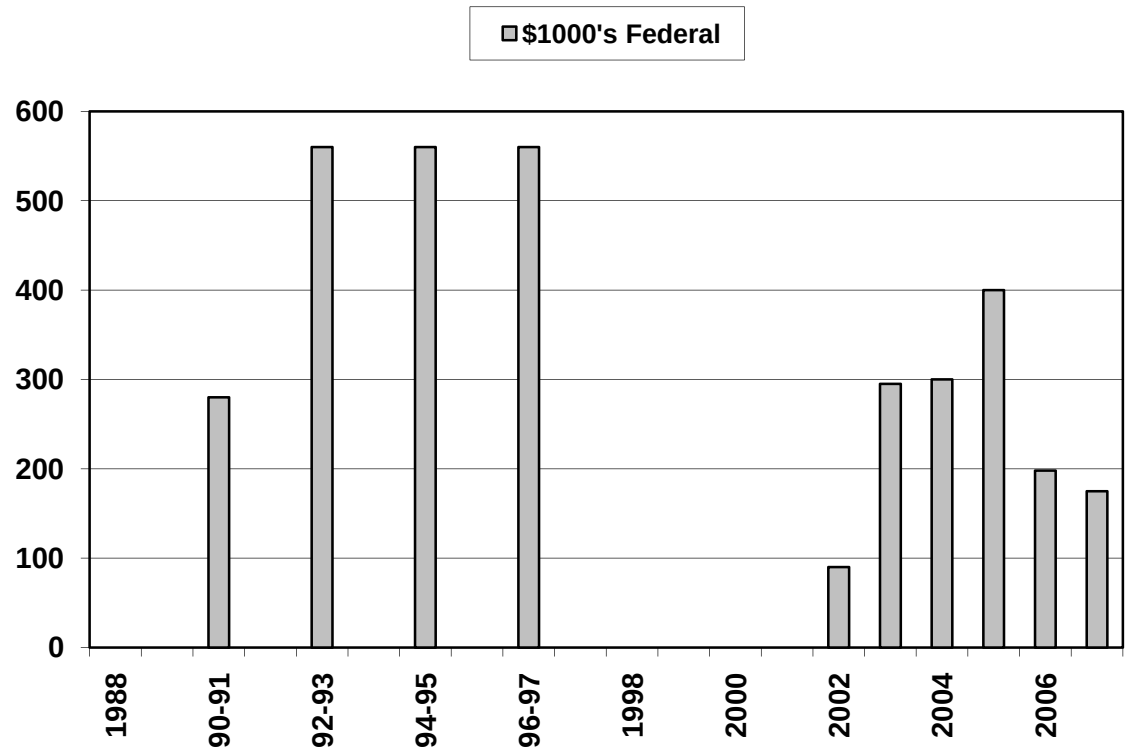

Figure 2. Federal (USDA Forest Service) dollars allocated to the Minnesota Cooperative Oak Wilt Suppression Project.