DOGWOOD ANTHRACNOSE: HOW COLLABORATION WAS USED IN THE SOUTHERN UNITED STATES TO EFFECTIVELY DEAL WITH A NEW TREE DISEASE

Robert L. Anderson
Forest Pathologist
USDA Forest Service, Region 8
Forest Health Protection
Asheville, NC 28802

ABSTRACT. Dogwood anthracnose, caused by the fungus *Discula destructiva* was found in the Southern United States in 1987. Since that time millions of flowering dogwoods have been killed and disfigured by this disease. As soon as the disease was discovered a group of state and federal personnel formed a working group to develop an action plan for dealing with the disease. Collaboration was the key word from the beginning of the working group. A key to the success of the working group was a spirit of cooperation with out concern for who was going to get credit. Each time the working group met information was shared and cooperative action plans were developed to address the most pressing questions. The group established a network and mailing list where information was shared back and forth on a daily basis. The formation of a steering committee provided additional direction and organizations such as the Southern Appalachian Man in the Biosphere added additional support. As the issues on impact and rate of spread were addressed the focus of the working group shifted to research. The working group still meets to coordinate activities.

Dogwood anthracnose was first reported as a disease of flowering dogwood *Cornus florida* L. in the United States in 1978. Since that time it has caused serious losses to flowering dogwoods in the forest and in ornamental plantings over large portions of the Eastern and Southern United States. The fungus that causes the disease was fully described and identified as *Discula destructiva* sp. nov. in 1991 (Redlin 1991). This paper briefly describes the symptoms, distribution, impacts, and control procedures. Most of the paper will be devoted to a discussion of how collaboration was used in the Southern United States to effectively deal with this disease.

Dogwood Anthracnose

Symptoms

Initial symptoms of dogwood anthracnose are small tan leaf spots that develop into large tan blotches. Often a purple border occurs between dead and healthy tissues and occasionally the entire leaf is killed. In many cases, infected mature leaves are aborted prematurely; in other cases, infected leaves cling to the stems after normal leaf fall. Infections often expand from leaves into small twigs and symptoms typically start in the lower crown and progress up the tree.

The dieback of twigs and branches in the lower crown led to the original name of "lower-branch dieback" (Pirone 1980). Numerous epicormic shoots form along the entire length of the main stem and on major branches of infected plants. These shoots frequently become infected and die and the fungus proceeds from the shoots into the main stem.

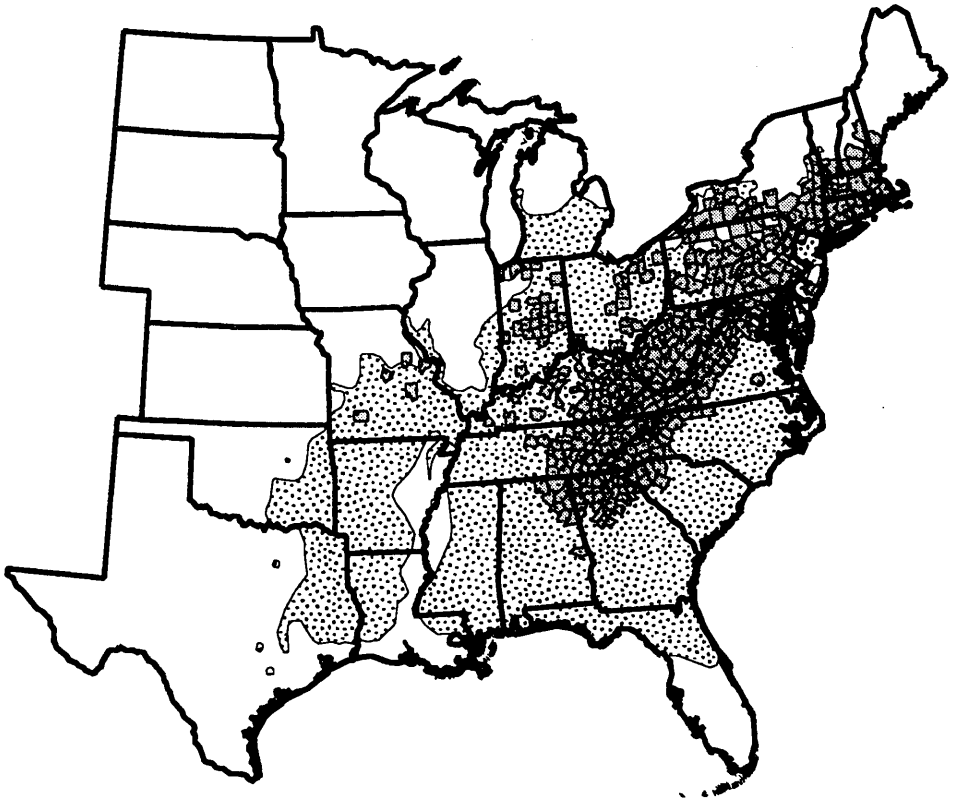
The fungus causes cankers that can kill the tree. Cankers may not be present on all the dead trees. Larger trees often die 3 to 4 years after the first symptoms are found in the leaves while young trees die the same year they are infected.

The disease kills dogwoods of all sizes, but it is most severe on young seedlings and in understory forest dogwoods. Infection of dogwoods is most likely to occur during cool, wet weather in spring and fall, but can occur at any time during the growing season. Ornamentals are often disfigured without being killed, particularly if they are growing in open, sunny sites (Anderson et al. 1994; Mielke and Daughtrey 1989).

Distribution

The following map shows the natural range of flowering dogwood and distribution of dogwood anthracnose in the eastern United States. For a county to be recorded as affected there only has to be one infected tree in a county. Therefore, the counties reported as affected can range from severely affected to a few trees. In general, the disease is more common in cooler wet environments, especially at higher elevations. The map is from the ATLAS forest health protection data base maintained by the USDA Forest Service in Asheville, NC.

Dogwood Anthracnose - 1995



Range of Dogwood

Occurrence by County

USDA –Forest Service
Forest Health Protection
Asheville Field Office

Data from 1995 Conditions Report

January 17, 1997

Impact

Dogwood anthracnose has spread rapidly and covered a significant part of the flowering dogwood range. The inpact of dogwood anthracnose has varied from slight to total mortality. In the South, above 3,000 feet in elevation most of the trees have died. Below 3,000 feet elevation the most significant damage has occurred to trees on cool wet areas. Dogwoods on dryer sites, especially in the sun, have sustained less damage. Those in full sun show little damage and are doing well. The reason for this cause/effect relationship is not clear but it may be due to environmental conditions that are condusive for disease development (Windham 1990).

Mortality estimates vary from 79 percent at the Catoctin Mountain National Park in Maryland (Schneeberger and Jackson 1989) to 56 percent at the Great Smoky Mountain National Park to 23 percent in a southwide survey conducted from 1988 to 1993 (Knighten and Anderson 1993).

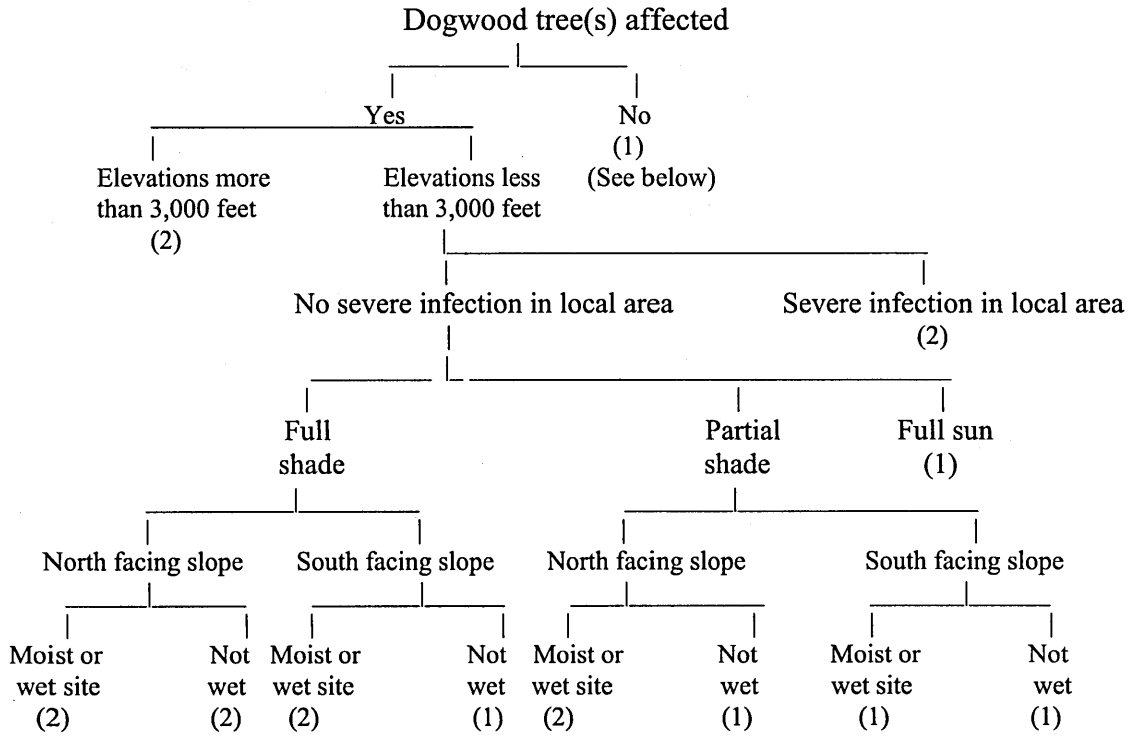
The disease impacts seem to be less severe on the hotter and dryer sites. Trees below 3,000 feet elevation in full sunlight are expected to survive and do well.

Control Procedures

Control procedures are not available at this time for dogwoods grown in the forest environment. However, a number of techniques are available to deal with the disease in generally high-value settings, such as recreation sites or urban settings.

Managers and homeowners can consider planting new flowering dogwoods if they are willing to follow the Decision Key and the Ten Essential Steps outlined in the diagram on the next page:

Dogwood Anthracnose Decision Key



(1) Apply 10 essential steps; omit fungicide and monitor

(2) Use 10 essential steps, use other tree species or consider resistant trees when they become available

Ten Essential Steps to Prevent/Control Dogwood Anthracnose

1. Know the symptoms of dogwood anthracnose and other problems that commonly affect dogwoods. Inspect trees frequently to detect the presence of the disease in its early stages.

2. Select healthy planting stock. Never plant diseased stock. Purchase trees from a reputable nursery. If symptoms are seen on the planting stock, dispose of the infected trees. Avoid transplanting trees from the forest, especially from mountainous areas.

3. Select reasonably well-drained planting sites with fertile soils. Avoid sites along streams, lakes, or ponds where moisture will remain on the foliage for many hours after sunrise. In high-hazard areas, plant flowering dogwoods only in full sun.

4. Planting holes should extend well beyond the root system of your planting stock, and should be filled with a rich mixture of soil and humus. Be sure the root collar is placed at ground level.

5. Mulch around newly planted and existing trees to a depth of 2-4 inches. Be sure the mulch does not touch the stem, and avoid using dogwood leaves or chips.

6. Prune and completely remove or destroy dead wood in the tree and leaves on the ground yearly. Avoid flush cuts, being sure to leave the branch collar. Prune all epicormic branches in late summer.

7. Water weekly during droughts. Water in the morning and avoid wetting the foliage.

8. Fertilize to provide nutrient-rich soil. Have soil tested to be certain what quantities of nutrients are needed.

9. Avoid mechanical and chemical injuries to the trees. Lawnmower and string-trimmer wounds are particularly troublesome.

10. Apply fungicides registered for prevention or control of dogwood anthracnose when it is necessary to do so. Fungicides should be applied as buds are breaking in the spring and at least twice thereafter as the leaves are expanding. Check with your local Extension Service about registration and use before applying any fungicide (Knighten and Anderson 1993).

Collaboration in Southern United States

Dogwood Anthracnose was first reported in 1978. It was causing a widespread, rapid deterioration of flowering dogwood in New York and Connecticut. In 1983, Daughtrey and Hibben reported a lower branch dieback disease with the same symptoms on flowering dogwood in New York , Connecticut, New Jersey, and Pennsylvania. They made observations on trees in Planting Fields Arboretum, Oyster Bay, Long Island, and a woodland site at the Brooklyn Botanic Garden Research Center in Ossining, NY. They reported the cause of the disease to be a species of *Discula sp.* , and

that the reason for a sudden onset of anthracnose over part of the northeastern range and its coincidental outbreak on western flowering dogwood was unknown.

In October of 1987, unusual numbers of dogwoods were reported dying on the Cohutta Ranger District on the Chattachoochee National Forest in northern Georgia. All of the symptoms matched those of dogwood anthracnose. Foresters estimated that the affected area covered about 30,00 acres of Cohutta Wilderness. *Discula sp.*, the causal organism of dogwood anthracnose, was isolated from samples from the affected area.

The Chattahoochee and Oconee National Forest Supervisor and State Forester of Georgia were notified of the occurrence. Soon thereafter, a professor from Clemson University reported an unusual problem with the dogwoods in Cashiers, NC. This area was checked and *Discula sp.* was found. In this case, the affected area was much larger than 30,000 acres. The State Forester of North Carolina was notified, and a meeting of state and federal personnel from the affected and adjacent States was held in Dillard, GA in February 1988. A key factor in the success of this group was the open sharing of information and a spirit of collaboration. All agreed to cooperate and share information openly without fear of who was going to get credit. A mailing list was created and updated where the most current information was shared on a frequent basis. This group became a dogwood anthracnose working group and agreed that the top priority in 1988 was to assess the disease distribution. The Southern Region of the USDA Forest Service distributed a southern version of the dogwood anthracnose pest alert.

By the second meeting of the working group in May of 1988, the disease had been found in Georgia, North Carolina, South Carolina, Tennessee, and Virginia. It was reported that the disease affected trees of all sizes and was more common in the mountains and cool, wet valleys. Six nurseries in North Carolina and one in South Carolina were reported to have diseased trees. Fungicide trials were started in Georgia and Tennessee by the University of Tennessee and University of Georgia and a joint pilot-test proposal was prepared by the working group for submission to the Washington Office. The North Carolina pest control forester proposed that permanent plots be established on a 15-minute grid across the affected area to assess the current and future impacts. These plots were installed by state and federal personnel in each of the respective states. In June of 1988, the fungus had been found in so many locations that the USDA Forest Service and the University of Georgia began to provide sample identification services. In September, the working group developed a news release, but it was decided not to send the release until more information was collected. After this point, the information became known to the press and public. As a result, the group news release was never issued. The National Park Service did distribute a news release from the Great Smoky Mountain National Park. Dogwood anthracnose and its impact received major media coverage.

At this time, a lot of work was being done, and the working group concept was producing results. A third meeting of the dogwood anthracnose working group was held in October 1988. By this meeting a funding proposal had been submitted to the USDA Forest Service, Washington Office for consideration (Found in 49 counties in the South). Sixty permanent plots had been established to assess impact. Birds were discussed as possible vectors, and fungicide studies in Georgia and Tennessee had not produced positive results. One important concern was the inability to inoculate trees under controlled conditions. A high priority was placed on this task by the working group. In

November of 1988 the Great Smoky Mountain National Park, in cooperation with the University of Tennessee, completed a survey of the park and found the disease was widespread.

In January of 1989, the Regional Forester for the Southern Region of the USDA Forest Service called a meeting of the federal and state cooperators to discuss dogwood anthracnose. At this meeting, a list of priorities was developed for survey, impact assessment, and research, and a dogwood anthracnose steering committee headed up by the State Forester of Georgia was developed to help with the biological, political, and funding aspects of the problem. The steering committee met two times and helped establish political support, priorities, and funding.

In March 1989, eight national forests were surveyed to assess the distribution. At the same time, a greenhouse inoculation test was completed with positive results. It was found when seedling leaves were pretreated with an acid mist, fungus spores routinely produced infections on them. Results led to a controlled acid rain study where a positive correlation was established between simulated acid rain and infection in the greenhouse. Funding was approved by the USDA Forest Service, Washington Office for a pilot test of control techniques, and several studies were started by the State Foresters, USDA Forest Service, the University of Tennessee, University of Georgia, and the National Park Service.

In the spring of 1989, the media coverage picked up considerably. The story ran in dozens of newspapers and on radio and TV. CBS National News did a Saturday segment on the disease. Realizing the need to provide the best information possible to the public, the USDA Forest Service, the University of Georgia, and the State Forester of Georgia developed and published a booklet on how to manage dogwoods. To keep public officials informed, a briefing package was developed by the USDA Forest Service. The package included a briefing paper and a list of people to be contacted. The Southeastern Forest Experiment Station assigned one person to work part-time on the disease in 1989 (found in 57 counties in the South).

In September of 1989, the working group met again to discuss progress. The impact plots showed the disease had increased from 1/2 million acres in 1988 to 2.2 million acres in 1989. The National Park Service announced that it would investigate mycological aspects of the problem. Forest Service research officials reported that they would be working on epidemiology. In 1989, the Southeastern Forest Experiment Station added a full-time scientist to work on dogwood anthracnose.

By 1990, considerable information was accumulating. The acid rain study was repeated and showed the same result. It was noted that the fungus seemed to remain active and grow down the dogwood shoots in the winter. The disease was more common at high elevations and in cool, wet coves was able to spread over large areas very quickly (127 counties now had diseased trees), and the fungus preferred cool temperatures. Pilot-test data showed that the fungicides Benlate and Daconil were providing effective control and that other fungicides showed promise. Fertilization and mulching seemed to improve tree vigor, while not increasing the disease in the field. Other greenhouse and field tests were showing that phosphorus tended to increase and lime tended to decrease disease symptoms.

Early literature reported that there was no resistance in the native flowering dogwood populations, but people were noting some trees in the field that seemed to show resistance. Resistance became a high priority in 1990.

At this time, the University of Tennessee formed a research task force composed of horticulturists, plant pathologists, entomologists, plant physiologists, foresters, and genetists. Their mission was to join forces within and outside the University to solve the dogwood anthracnose problem (Southards 1995).

In the fall of 1990, the Southern Appalachian Man and Biosphere Cooperative, consisting of the U.S. Environmental Protection Agency, USDA Forest Service, Park Service, Southeastern Forest Experiment Station, Fish and Wildlife Service, Department of Energy, Economic Development Administration, and the Tennessee Valley Authority, organized two dogwood anthracnose conferences. One was held in Knoxville, TN and the other was held in Asheville, NC. These conferences consisted of representatives from Federal, State, and private concerns, and featured speakers from a number of these agencies. The program reflected a diversity of views held by various groups throughout the South. These meetings increased the awareness of and understanding of dogwood anthracnose, and helped define specific goals, such as effective information dissemination. A follow-up meeting was held in Roanoke, VA in 1991.

USDA Forest Service, Forest Pest Management, took the lead for maintaining incidence maps. Since there are so many mimicking symptoms, it was decided that for a county to be designated "affected," disease presence had to be confirmed in the laboratory. In 1990, the plot data were added to a Geographic Information System to generate maps displaying both severity and incidence (163 counties now had diseased trees).

In January 1991, another working group meeting was held. Members reported progress in all areas. Five hundred thousand copies of an updated version of "Growing and Maintaining Healthy Dogwoods" including revised control methods were published. This was a model of cooperation where the USDA Forest Service, Carson-Newman College, Champion International Corporation, Georgia Forestry Commission, Izaak Walton League of America, Southern

Appalachian Man and the Biosphere, Southern Nurserymen's Association, Tennessee Valley Authority and the University of Georgia collaborated to produce and distribute the copies (Bailey and Brown 1991). Also in 1991, the fungus causing dogwood anthracnose was described as "*Discula Destructiva* sp. Nov." (Redlin 1991) and dogwood resistance screening was developed.

For impact assessment, some 210 permanent 10-tree dogwood plots had been established in North Carolina, South Carolina, Tennessee, Alabama, Virginia, Kentucky, and Georgia by state and federal cooperators. These plots were selected in a random stratified sample on a 15-minute grid. Data showed that the disease increased dramatically (from about ½ million acres in 1988 to 17.3 million acres in 1993), and the severity in the permanent plots had increased.

The working group continues today where state, federal, and other group collaborate on understanding the disease and developing strategies for control.

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