

Results of the 1990
Dogwood Anthracnose
Impact Assessment and Pilot Test in
the Southeastern United States

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A Preliminary Hazard Rating for
Dogwood Anthracnose
in the Southern Appalachians

by

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INTRODUCTION

Background

In the mid-1970's, a new fungal disease was reported on dogwoods (Coruns spp.) in North America. First found near Chehalis, Washington, on Cornus nutalli, the disease was found in successive years northward into the Puget Sound region and into British Columbia. This disease caused lesions on leaves and defoliations, but usually not the death of the tree. About the same time, a new disease was found to be killing flowering dogwoods (Cornus florida) in the New York City area. This disease became known as dogwood anthracnose and was placed in the genus Discula. By the early 1980's, the disease was identified in Maryland and in 1987 in the Southern Appalachians (2). To date, it has not colonized the Atlantic Coastal Plain south of the Chesapeake Bay region, despite proximity to infected areas (1).

Issues

As more and more workers became attracted to the problem, a number of fundamental questions about dogwood anthracnose arose, such as: whether it is introduced to part or all of North America? how it is dispersed? what is the disease's potential range? what is the long-term effect? are there climatic parameters that limit fungus to identifiable geographic areas or habitats?

This project is concerned with the last question. Interagency monitoring of disease extent and severity has been tracked by Forest Pest Management in Asheville (1) for the entire upland South since 1987, and for the mid-Atlantic States since 1989. This has allowed the first gross mapping of the disease extent vs. fast distribution. Several investigators are currently examining the role of individual tree placement in shaded canopies or sunny exposures. Little, if any, previous work has been conducted at the "meso" scale--from several to tens of kilometers. This study will answer two specific, investigative questions:

1. Are there significant differences in anthracnose severity across a Southern Appalachian landscape?
2. If there are differences, can these be modeled accurately

enough to allow the classification of sites into a hazard rating system?

METHODS

Several study areas were selected in the Great Smoky Mountains National Park for intensive survey of dogwood anthracnose: Fighting Creek, west of park headquarters, Oconaluftee River above Cherokee, and a section of the Little River watershed near Chiquapin Knob. The Chiquapin Knob area was chosen for the conical knob-mountain, that has similar steepness and geology on all slope aspects. All three study sites were covered in 1989 or 1990 blooming season aerial photography by the USDA-Forest Pest Management. Aerial photos were used to ascertain general host distributions within the areas. Ground crews were then sent to rate dogwood stands continuously along transects selected to coincide with dogwoods, to bisect dogwood stands, and to extend into non-dogwood habitats.

Stands were mapped in approximately 50-meter or 100-meter cruise-widths, depending on size of survey party. Proceeding along a predetermined route, the dogwood resource, viewed as that portion of the stand within visual range, was classified into one of six categories and drawn by hand on topo sheets:

1. Few or no dogwoods
2. Little or no anthracnose apparent
3. Generally "light" infection (usually lower branches and seedlings) on up to 50 percent of trees
4. Moderate infection - more than half of trees with infection, but most not severely affected
5. Severe infection - most infected and more than half severely so, with loss of canopy and some mortality
6. Dying - half or more dying or already dead.

Currently, several vegetation-related Geographic Information System (GIS) themes are available for full-park coverage. There were tested for "best fit" with what was actually seen in the field. The GIS themes below were developed or customized by Charles Parker at the Uplands Field Research Laboratory. More details on each theme can be found in Parker, et al., 1990.

<u>Theme</u>	<u>Resolution</u>	<u>How used</u>
Vegetation type	90m ²	Comparison of 13 vegetation types made dogwood and anthracnose maps
Aspect (from Digital Elev. Model)	90m ²	Compared northerly (WNW to ENE aspects) to southerly aspects
Proximity to streams	Line data from USGS quads	Searched out 1, 2, and 3 pixels from stream segments of various orders

Topographic sheltering	90m ₂	Topographic exposure checked against anthracnose and dogwood distribution
Moisture	90m ₂	Two models with 9 and 13 classifications, based on topography, were used to compare

Various combinations of these themes were tested for "best fit" after it became obvious that single themes under or over predicted either geographic extent or severity. Since each theme may have multiple attributes (e.g., streams may be either first, second, or third order and may be searched out one, two, three, or more pixels), large matrices quickly developed. The largest matrix had 42 values to which low, moderate, and high were assigned, as general risk categories of anthracnose.

As each major theme combination was produced graphically, another transect was selected for ground truthing. Specific routes were selected to test the accuracy of the new GIS attributes used.

RESULTS

As expected, many theme attributes and some entire themes, such as the vegetation type, were found to be of little value, either singly or in combination. Also some themes encompassed disease extent well but had little sensitivity to severity of anthracnose.

The best results were obtained using the following GIS prescription:

Elevation: On northerly slopes, only elevations below 3,000 feet used due to lack of dogwood stands above that elevation. On southerly slopes, elevations below 3,500 feet were used. Dogwoods occur above that elevation, but stands are much more uncommon.

Stream proximity: Southerly slopes were considered to be at moderate risk only for the pixel through which stream flowed. Southerly slopes farther from streams were classified as of low risk. Northerly slopes were generally considered to be of moderate risk, unless within one pixel of first-order streams or two pixels of second-order streams.

Aspect: As used above.

Preliminary ground truthing indicated an accuracy of 60-70 percent for the first iteration. Autumn leaf fall prevented a more extensive assessment of accuracy. The map was run at two scales, 1:24,000 for the Fighting Creek area and at 1:117,000 for the entire park (contact author for a copy of the map).

DISCUSSION

Most dogwood anthracnose workers have recognized a difference in infection rates in different habitats when conducting field surveys (4). This study indicates that there is a significant difference across the landscape (in the

park) that may be attributable to temperature and moisture changes, which are, in turn, influenced by topography and distance from streams.

A preliminary accuracy assessment of 60-70 percent is good for geographic models. Although refinements may bring accuracy up, 100 percent is probably not achievable, since the model assumes there was a uniform distribution of fungus in both time and space, and this is extremely remote. The model's accuracy is also adversely affected by host density and weather in the months preceding the field survey. Since trees are known to be dying in the study areas, and new trees are being infected, repeatability of this project in the future may prove the ultimate test of accuracy.

In the meantime, this type of modeling may be useful in assessing which natural areas in forests and parks may be most at risk, and it should be tested and refined into localized models in other portions of the Southern Appalachians. Modeling the dogwood resources in each district of a land management agency will facilitate the prioritization of stands where in situ preservation efforts are not needed or may be a losing battle. It will also prioritize those stands for ex-situ preservation, through seed or scion collection. Since urbanized areas introduce a number of horticultural variables, it is not appropriate to use this rating system in other than natural areas at this time.

Further refinements in moisture modeling and the use of indicator species that are mappable through aerial photography, especially Rhododendron maximum or Tsuga canadensis may prove valuable in accurately assessing the dogwood anthracnose threat.

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