THE EFFECT OF MOISTURE AND SUNLIGHT ON THE SEVERITY OF DOGWOOD ANTHRACNOSE IN STREET TREES

by A. B. Gould and J. L. Peterson

Abstract. The effect of supplemental irrigation and sunlight on the severity of dogwood anthracnose was evaluated on *Cornus florida* street trees in New Jersey during 1989 and 1990. Fewer leaf spot and twig blight symptoms were observed on trees that received supplemental irrigation in the summer during periods of drought. In addition, those trees placed in full or partial sun were less diseased than trees grown in the shade.

In the United States, dogwood anthracnose, caused by the fungus *Discula destructiva* (8, 14), occurs primarily on flowering dogwood (*Cornus florida*) (8) and Pacific dogwood (*C. nuttallii*) (15). Kousa dogwood (*C. kousa*) is moderately resistant to this disease (9, 16). Dogwood anthracnose was observed in the late 1970s in the northeastern United States (13). In New Jersey, the disease became progressively worse during the drought years of the late 1970s and early and mid-1980s.

Dogwood anthracnose first appears on developing leaves and flower bracts as tan-colored spots with purple margins. Leaf lesions may take the form of large areas of blighted tissue both within and along leaf margins. Completely blighted leaves may persist on the tree over the winter months (8). During the dormant season, the fungus may continue to grow from the leaves into the shoots. Brown, elliptical cankers, which form at the base of dead epicormic branches, may eventually girdle the tree (8). Dogwood anthracnose frequently affects the lower branches first, hence the former name of this disease, "lower branch dieback" (3).

In the northeast, dogwood anthracnose is most severe when newly developing leaves (17) become infected during cool, wet weather. The disease is frequently observed on understory trees and on lower branches during high humidity and prolonged periods of leaf wetness (5). Conditions such as drought, winter injury, environmental stress, or borer damage may predispose dogwoods to infection or contribute to the severity of the disease (5, 10, 18). Trees that are vigorous are more resistant to the disease (1). In New Jersey during the 1980s, shallow-rooted trees, including dogwood, appeared to suffer most from the effect of the extended drought and were generally less vigorous than deeply rooted trees. Although extended periods of wet, humid weather favor infection by the anthracnose fungus, dogwood trees that received adequate soil moisture for growth appeared less diseased and healthier than trees that did not receive adequate moisture.

This study was designed to assess the effect of rainfall and supplemental irrigation on the susceptibility of street trees to dogwood anthracnose. In addition, the impact of tree placement with respect to sunlight on disease severity was also evaluated.

Materials and Methods

In 1989 and 1990, white flowering dogwoods located in the suburban community of East Brunswick, New Jersey were evaluated for visual symptoms of dogwood anthracnose. Trees were approximately sixteen years old and were planted approximately 25 ft apart at or near the curb on both sides of the street. The meandering streets ran nearly three quarters of the way around a block. There were no sidewalks. The trees were situated in a sandy - sandy loam soil. Since the subsoil in this area was also very sandy, the soil had a poor water holding capacity that was not conducive to the growth of shallow-rooted plants such as dogwood without sufficient rainfall or supplemental irrigation.

In September of 1989, 23 trees were rated for leaf spot severity and twig dieback due to dogwood anthracnose on a 1 to 4 scale, where 1 = *healthy*; 2 = *slight disease*; 3 = *moderate disease*; and 4 = severe disease. For each tree, the amount of sunlight received (full sun, partial sun, or full shade), type of ground cover (mulched bed or lawn), and irrigation status (irrigated by property owners to avoid moisture stress or non-irrigated) were recorded. The amount of water applied by each homeowner was variable and could not be exactly ascertained. The water was not applied to the tree foliage.

In September of 1990, a similar disease evaluation was expanded to 76 trees in the same area. In this evaluation, however, the type of ground cover was not recorded. Trees exposed to full or partial sun were classified as "sunny" and trees in full shade were classified as "shaded." Data for both years were analyzed by analysis of variance (7). Maximum daily temperatures and rainfall for the growing seasons of 1988, 1989, and 1990, obtained from a weather station approximately three miles from the study site, are presented in Figure 1.

Results and Discussion

In both 1989 and 1990, leaf spot severity and twig blight due to dogwood anthracnose was most severe on non-irrigated trees (Table 1). In addition, the disease was more pronounced on trees in shaded locations than on trees in sunny sites (Table 1). Whether a dogwood was situated in a mulched bed or in a lawn did not appear to influence disease severity (Table 1).

Dogwood anthracnose was particularly severe in 1989, and this may be partially explained by the preceding environmental conditions. During the 1988 growing season, the weather was extremely hot (there were 30 days where the daily maximum air temperature exceeded 90°F) (Figure 1). In addition, there were two extended periods of drought during June and July (14 and 24 days, respectively). Dogwoods, because of their shallow root systems, are intolerant of severe drought stress (4). Periods of drought greater than 22 days can significantly reduce vigor (19), especially when accompanied by excessive heat. In this study, the

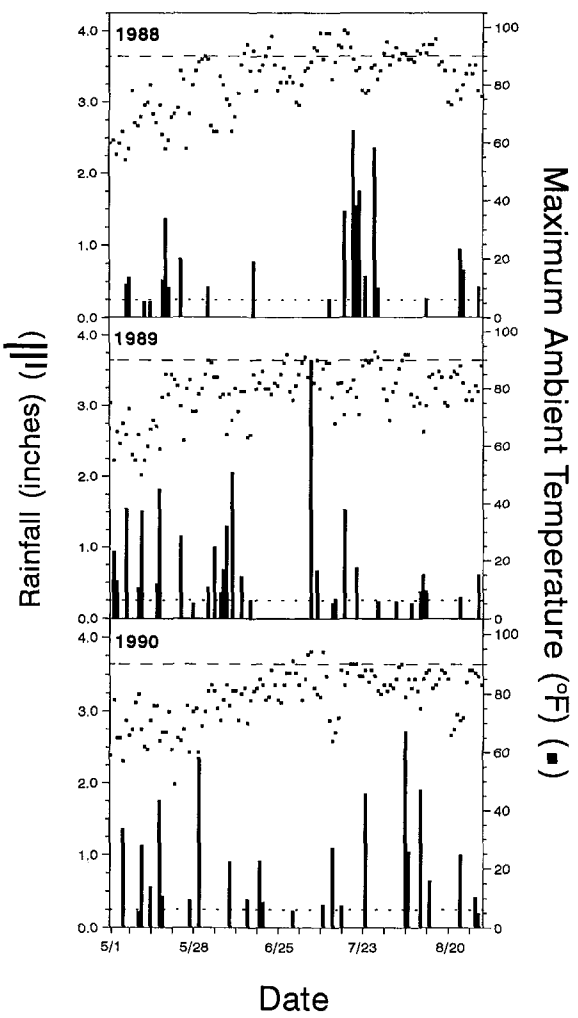

Figure 1. Daily rainfall and maximum daily air temperatures during the growing seasons of 1988, 1989, and 1990, recorded at a weather station three miles from the study site in East Brunswick, NJ.

street trees that were in poor condition due to moisture and heat stress in 1988 and prior years may have had reduced ability to resist infection. In contrast, irrigated trees that were protected from moisture stress showed fewer visual symptoms of anthracnose in 1989 and 1990 (Table 1).

The extensive leaf spotting observed in 1989 may also have been partially attributable to heavy rainfall during the spring of that year. Frequent rainfall, accompanied by cool temperatures (Figure 1), created an environment especially favorable for both spore germination and leaf infection.

Table 1. Effect of ground cover, irrigation status, and sunlight on the severity of dogwood anthracnose - 1989 and 1990.

	Disease rating	
	Leaf spot	Twig blight
1989[z]		
Ground cover		
mulch	1.75 a[x]	1.75 a
lawn	1.90 a	1.97 a
Irrigation status		
non-irrigated	2.93 a	3.07 a
irrigated	1.04 b	1.04 b
Sunlight		
shady	3.17 a	3.17 a
partial sun	1.80 b	1.80 b
full sun	1.70 b	1.85 b
1990[y]		
Irrigation status		
non-irrigated	1.91 a[x]	1.95 a
irrigated	1.09 b	1.12 b
Sunlight		
shady	1.63 a	1.64 a
sunny	1.16 b	1.20 b

[z] Mean rating of 23 trees, on a 1 to 4 rating scale in which 1 = healthy, 2 = slight disease, 3 = moderate disease, and 4 = severe disease.
[y] Mean rating of 75 trees as above
[x] Means in a column for each parameter followed by the same letter are not significantly different (least square means) ($P < 0.05$).

It was anticipated that the disease would be more serious on dogwoods in 1990 than in 1989 because of the continued frequent rains during the spring and summer of 1990. Even though environmental conditions in 1990 were again conducive to leaf infection, anthracnose was less severe than in 1989 and the trees appeared more vigorous. The increase in vigor and reduction in disease observed was possibly due to the adequate rainfall and lack of heat stress in 1989 and 1990.

Several studies concerning the effect of sunlight on dogwood anthracnose development have produced conflicting results (1,11,12,21). In our study, trees in partial or full sun were not as severely affected by dogwood anthracnose as heavily shaded trees. Trees that are not shaded typically have better air circulation and reduced humidity in the outer canopy, two conditions that tend to reduce disease development. Chellemi and Britton (2) reported that dogwood anthracnose was less severe in the exterior canopy of exposed trees than in the interior canopy or within the canopies of understory trees. In full sun, leaves on the northern exposure of a tree or within the canopy develop anthracnose first (12,20). Hartman et al (6) reported that dogwood anthracnose was most prevalent in heavily shaded landscape trees growing under stressful conditions.

Full sun may directly affect disease development by helping to reduce the period of free moisture on leaf surfaces, thereby creating an environment that is unfavorable for spore germination and leaf infection (4). Sunlight also heats the leaf surface, which reduces the number of leaf spots and the production of fungal fruiting bodies (acervuli) (11, 12). In our study, both the direct affects of sunlight and the reduction in humidity typical of exposed plantings may have contributed to the reduced disease severity in sunny sites.

Summary

In this study, supplemental irrigation was associated with reduced disease severity in street plantings. In addition, dogwoods placed in full or partial sun with adequate moisture were less diseased than trees grown in the shade. Dogwoods are shallow-rooted trees, and control recommendations for dogwood anthracnose often include irrigation during periods of moisture stress to increase plant vigor. Since anthracnose infection is enhanced when dogwood leaf surfaces are moistened, however, care should be taken to utilize irrigation practices that do not impact the foliage.

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Résumé. L'effet de la sévérité de l'anthracnose du cornouiller par une irrigation et un ensoleillement accrus a été évalué sur le *Cornus florida* en configuration d'arbres de rues au New Jersey au cours des années 1989 et 1990. Un nombre moindre de taches sur les feuilles et de ramilles présentant des symptômes de brûlure était observé sur les arbres ayant reçu une irrigation supplémentaire durant les périodes de sécheresse. De plus, les arbres localisés en plein soleil ou en milieu partiellement ensoleillé étaient moins attaqués que les arbres en milieu ombragé.

Zusammenfassung. Während 1989 und 1990 wurden in New Jersey die Auswirkungen von zusätzlichem Bewässern und Sonnenlicht auf die Schwere von Hartriegel-Anthracnosebefall auf *Cornus florida* untersucht. Es wurden weniger Blattflecken und Mehltausymptome auf den Zweigen an Bäumen beobachtet, die während einer Trockenperiode zusätzlich bewässert wurden. Darüberhinaus waren diejenigen Bäume, die in voller oder teilweise voller Sonne standen, weniger krank als Schattenbäume.