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Susceptibility of Cultivars of Several Dogwood Taxa to Powdery Mildew and Spot Anthracnose[1]

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Abstract

Incidence of powdery mildew (*Microsphaera penicillata*) and spot anthracnose (*Elsinoe corni*) was assessed on 37 selections or cultivars of flowering dogwood (*Cornus florida*), kousa dogwood (*C. kousa*), hybrid dogwood (*C. kousa* x *florida* and *C. nuttallii* x *florida*) and giant dogwood (*C. controversa*). Across all cultivars, the flowering dogwood and *C. nuttallii* x *florida* 'Eddie's White Wonder' are more susceptible to powdery mildew and spot anthracnose than the kousa, *C. kousa* x *florida* hybrids and giant dogwood. Among the cultivars of flowering dogwood screened, 'Cherokee Brave', 'Cherokee Chief', 'Welch's Bay Beauty' and 'Weaver's White' were partially to highly resistant to both diseases. With few exceptions, the kousa dogwood and *C. kousa* x *florida* hybrids, and giant dogwood suffered very little powdery mildew or spot anthracnose-related damage.

Index words: disease, resistance, *Microsphaera penicillatta, Elsinoe corni*, hybrid dogwood.

Species used in this study: flowering dogwood (*Cornus florida L.*); kousa dogwood (*C. kousa Hance*); hybrid dogwood (*C. kousa* x *florida* and *C. nuttallii* x *florida*); giant dogwood (*C. controversa Hemsl.*).

Significance to Nursery Industry

Spot anthracnose and powdery mildew are common and often damaging diseases of flowering dogwood during production as well as in the landscape. Cultivars of flowering dogwood with resistance to both diseases have been identified. Cultivars of kousa, *C. kousa* x *florida* hybrid and giant dogwood possess excellent resistance to both diseases, although questions concerning their winter hardiness in the Deep South must be addressed. The production, marketing, and establishment of disease resistant dogwood taxa make good economic and environmental sense for nursery producers as well as retail outlets, landscape managers, and homeowners. Disease resistance allows the nursery producer to grow a quality and attractive container or field-grown dogwood with fewer costly pesticide and labor inputs. For consumers and landscape managers, a disease resistant dogwood is a welcome addition to the growing list of low maintenance landscape shrubs and trees. When selecting flowering dogwood for the landscape based on resistance to powdery mildew and spot anthracnose, the superior white cultivars were 'Welch's Bay Beauty' and 'Weaver White'; while the superior red cultivars were 'Cherokee Brave' and 'Cherokee Chief'. Kousa, kousa hybrids, and giant dogwoods cannot be recommended for use in this part of the south due to survival problems occurring with nearly all cultivars.

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Introduction

Prior to 1994, powdery mildew was rarely observed in Alabama on flowering dogwood (*Cornus florida L.*). In a 1991 to 1993 survey of flowering dogwood on forested sites in North Alabama, powdery mildew was not observed at any of the locations checked for foliar diseases (3). In 1994, powdery mildew, which is caused by the fungus *Microsphaera penicillata* (Wallr.: Fr.) Lev. (syn = *M. pulchra* C.& P. and *M. alni* (Wallr.) Wint.), appeared simultaneously in forest, landscape, and nursery plantings of flowering dogwood statewide (4). A similar increase in the occurrence of powdery mildew on flowering dogwood was reported that same year in Florida (6). In 1993, Britton (1) noted this disease in Georgia on selected cultivars of flowering and seedling kousa (*C. kousa Hance*). Over the last three years, powdery mildew has displaced spot anthracnose across Alabama as the most common disease of flowering dogwood in residential landscapes (4). Although disease-related damage to established flowering dogwood is largely cosmetic, slowed growth, reduced vigor, and in some cases death of year-old seedlings has been attributed to severe outbreaks of powdery mildew (Mark Windham, personal communication).

In Alabama, native flowering dogwoods differ considerably in their reaction to this disease. Trees with leaves heavily colonized by *M. penicillata* are often found adjacent to those showing few signs of this pathogen. Britton (1) noted that seedling 'wild type' flowering dogwoods are generally more susceptible to powdery mildew than commercial cultivars. Although the reaction of some cultivars of flowering dogwood to powdery mildew is known (1, 2), the susceptibility of the majority widely produced cultivars has yet to be determined. Most cultivars of kousa (*C. kousa*) and hybrid dogwood (*C. kousa* x *florida*) have been shown to be highly resistant to powdery mildew (7).

Spot anthracnose, which is caused by the fungus *Elsinoe corni* Jenkins and Bitanc., occurs wherever flowering dogwood is found and is most prevalent on trees grown in full sun (8). Although the impact of this disease on tree vigor is minor, bracts and leaves on cultivars and native selections of flowering dogwood susceptible to spot anthracnose may be badly defaced and distorted (5). Windham and Freeland (8) have noted that the early-flowering cultivars such as 'Cloud 9' and 'Barton White' were more susceptible to spot anthracnose than later-flowering cultivars, but that observation was not confirmed by Britton (1) and Doney *et al.* (2). As is the case with powdery mildew, the susceptibility of many cultivars of flowering dogwood to spot anthracnose has not been reported.

The objective of this study was to determine the reaction of cultivars of flowering, kousa, *C. kousa* x *florida* hybrid dogwoods as well as a single selection of *C. nuttallii* x *florida* (Pacific x flowering dogwood 'Eddie's White Wonder') and giant dogwood (*C. controversa Hemsl.*) To powdery mildew and spot anthracnose in a simulated landscape planting.

Materials and Methods

Bare-root dogwoods approximately 0.6–1.0 m (24–36 in) in height, were planted on March 3, 1993, in full sun in a Marvyn loamy sand on 2.4 m (8 ft) centers in rows spaced 3.7 m (12 ft) apart on the Alabama Agricultural Experiment Station at Auburn University, AL. The experimental design was a randomized complete block with 6 two-tree replications. A trickle irrigation system with two emitters per tree was installed at tree establishment and the trees were watered as needed. In March and May, approximately 80g (0.2 lb) of 13N–5.6P–10.8K fertilizer was uniformly distributed around the base of each tree. Directed applications of Roundup® herbicide at recommended rates were made periodically to control weeds. Escape weeds around the base of each tree were also pulled by hand. Alleys between the rows were periodically mown. In 1996, all trees were mulched with 5–7 cm (2–3 in) aged pine bark.

Within two years of planting, both *M. penicillata* and *E. corni*, became naturally established on selected cultivars or taxa of dogwood. Powdery mildew incidence on the foliage was assessed on May 23, 1995, May 30, 1996, and May 16, 1997, on a scale of 0 to 4 where 0 = no disease, 1 = 1 to 25%, 2 = 26 to 50%, 3 = 51 to 75%, and 4 = 75 to 100% of the leaves colonized by *M. penicillata*. On April 14, 1995, spot anthracnose incidence was rated on the bracts, then on the bracts and foliage, respectively on April 14 and April 29, 1996, and March 31 and April 15, 1997, on a scale of 0 to 4

Table 1. Susceptibility of dogwood taxa to spot anthracnose and powdery mildew.

		Disease ratings							
					Spot anthracnose[z]				
		Powdery mildew[z]			Bracts		Leaves		
Dogwood taxa	No. cultivars	1995	1996	1997	1996	1997	1995	1996	1997
Flowering dogwood	26	1.4	0.9	1.7	1.5	1.8	0.3	1.3	1.8
Kousa dogwood	3	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
C. kousa x *florida* hybrid	7	0.1	0.0	0.3	0.6	0.8	0.0	0.3	0.4
C. nuttallii x *florida* hybrid	1	1.7	0.5	1.9	2.0	NB	0.2	1.4	1.3
Giant dogwood	1	0.0	0.0	NR[x]	NB[y]	NR	0.0	0.7	NR
LSD (P = 0.05)		0.7	0.6	0.6	1.2	0.6	NS	0.7	0.7

[z]Severity of powdery mildew and spot anthracnose was assessed on a scale of 0 to 4 where 0 = no disease, 1 = 1 to 25%, 2 = 26–50%, 3 = 51 to 75%, 4 = 76–100% of leaves or bracts damaged or diseased.

[y]NB = no blooms.

[x]NR = not rated.

Table 2. Susceptibility of cultivars of flowering dogwood to powdery mildew and spot anthracnose.

Cultivar	Powdery mildew[z]			Spot anthracnose[z]				
				Bracts		Leaves		
	1995	1996	1997	1996	1997	1995	1996	1997
White bracts								
Dwarf White	3.0	0.0	2.0	2.0	4.0	0.0	2.0	2.0
Wonderberry	2.2	0.5	1.8	1.8	2.2	0.4	0.6	2.1
World's Fair	1.9	0.8	1.8	1.9	2.0	0.0	1.8	1.8
Welch's Bay Beauty	1.8	0.8	1.1	0.9	0.3	0.2	0.4	0.2
Ozark Spring	1.8	1.2	2.0	2.3	2.8	0.2	2.0	2.9
Fragrant Cloud	1.8	1.0	1.3	1.3	1.7	0.0	1.3	2.1
Cloud 9	1.7	1.3	1.4	2.6	2.3	0.0	2.6	2.4
Barton White	1.5	0.7	1.6	3.3	2.5	1.0	2.7	2.0
Cherokee Princess	1.5	1.1	1.8	2.3	2.3	0.0	1.3	2.1
Double White	1.5	0.5	1.2	0.5	0.8	0.5	1.3	2.2
Weaver's White	1.1	1.0	1.4	1.1	1.5	0.0	0.8	1.1
Springtime	0.8	0.3	1.0	2.3	2.4	0.0	2.3	2.6
White bracts/variegated leaves								
Autumn Gold	2.9	0.7	1.8	NB[y]	NB	0.7	1.4	1.8
First Lady	2.1	0.6	2.4	1.8	2.0	0.3	1.5	2.2
Rainbow	1.6	1.3	1.1	2.0	1.9	2.8	3.0	3.7
Cherokee Daybreak	0.9	0.0	1.5	3.0	1.7	0.5	1.1	1.4
Pink bracts								
Pink Beauty	2.6	1.5	2.8	1.6	2.4	0.0	1.1	1.8
Pink Flame	2.5	1.2	2.7	2.0	1.5	0.0	1.2	2.0
Rubra Pink	2.0	1.6	2.0	0.5	1.5	0.3	1.1	2.0
Welch's Junior Miss	1.7	0.9	2.2	1.3	1.3	0.0	0.9	1.1
Stokes Pink	1.5	1.8	2.6	1.5	2.8	0.0	0.9	0.2
Red bracts								
Red Beauty	2.0	1.4	1.8	1.0	0.8	0.3	1.4	2.0
Purple Glory	2.0	1.3	2.3	1.5	2.0	0.0	1.0	1.1
Cherokee Chief	1.4	0.6	1.6	0.7	1.0	0.0	0.6	1.3
Cherokee Brave	0.2	0.0	0.0	1.0	1.1	0.0	0.6	1.5
Red bracts/variegated leaves								
Cherokee Sunset	1.3	0.5	2.4	0.0	0.5	0.2	0.9	1.4
LSD (P = 0.05)	0.8	0.9	0.7	0.9	1.0	0.6	0.6	0.8

[z]Severity of powdery mildew and spot anthracnose was assessed on a scale of 0 to 4 where 0 = no disease, 1 = 1 to 25%, 2 = 26–50%, 3 = 51–75%, and 4 = 76 to 100% of leaves or bracts damaged or diseased.

[y]NB = no blooms.

where 0 = no disease, 1 = 1 to 25%, 2 = 26 to 50%, 3 = 51 to 75%, and 4 = 75 to 100% of the leaves or bracts damaged or diseased. Significance of treatment effects were tested by analysis of variance and means were compared with Fisher's protected least significant difference (LSD) test with a level of significance at P = 0.05 unless otherwise stated.

Results and Discussion

Overall, the flowering dogwood and hybrid (*C. nuttallii* x *florida*) 'Eddie's White Wonder' were more susceptible to both powdery mildew and spot anthracnose than the other three dogwood taxa (Table 1). Powdery mildew ratings for the flowering dogwood and 'Eddie's White Wonder', which declined between 1995 and 1996, sharply increased in 1997. Spot anthracnose- incited discoloration and distortion of the leaves and bracts progressively worsened across nearly all cultivars of flowering dogwood from 1995 to 1997. Low spot anthracnose and powdery mildew ratings for the kousa, giant, and hybrid (*C. kousa* x *florida*) dogwoods clearly demonstrates their high levels of resistance to these two diseases.

Incidence of powdery mildew varied significantly among the cultivars of flowering dogwood and often from year to year on individual cultivars (Table 2). The cultivar 'Cherokee Brave' remained almost free of powdery mildew over the three year evaluation period. In two of three years, ratings for powdery mildew on the cultivars 'Cherokee Chief', 'Cherokee Daybreak', and 'Springtime' was relatively light and unobtrusive. High mildew ratings were consistently noted on the cultivars 'Stokes Pink', 'Rubra Pink', 'Pink Beauty', 'Red Beauty', 'First Lady', 'Purple Glory', 'Dwarf White', and 'Pink Flame'. Noticeable colonization of the leaves by *M. penicillata* was recorded in at least one of three years on nearly all remaining cultivars of flowering dogwood. Light to moderate mildew development, as indicated by ratings of 0.5 in 1996 to 1.9 in 1997, was observed on hybrid 'Eddie's White Wonder' (Table 3). Little or no colonization of the foliage of nearly all of the cultivars of kousa, hybrid (*C. kousa* x *florida*), and giant dogwood by the powdery mildew fungus *M. pencillata* was observed (Table 3). The highest powdery mildew ratings were recorded in 1997 on the leaves of the hybrid (*C. kousa* x *florida*) cultivars Aurora® and Galaxy®.

Among the 26 cultivars of flowering dogwood, 'Rainbow' suffered the most extensive spot anthrancose-related spotting and distortion of the leaves over the three-year evaluation period (Table 2). In 1996 and 1997, noticeable damage on the bracts on 'Rainbow' was also noted. In 1995, damage

Table 3. Susceptibility of several dogwood taxa to powdery mildew and spot anthracnose.

Cultivar	Powdery mildew[z]			Spot anthracnose[z]				
				Bracts		Leaves		
	1995	1996	1997	1996	1997	1995	1996	1997
***C. nuttalli* x *florida* hybrid dogwood**								
Eddie's White Wonder	1.3	0.5	1.9	2.0	NB[y]	0.3	1.4	1.3
Kousa dogwood								
Milky Way	0.3	0.0	0.0	0.0	0.0	0.2	0.0	0.0
Satomi	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Milky Way Select	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0
National	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
***C. kousa* x *florida* hybrid dogwood**								
Stardust®	0.2	0.0	0.4	0.0	0.7	0.0	0.0	0.0
Ruth Ellen®	0.1	0.1	0.2	1.1	0.9	0.0	0.3	0.8
Galaxy®	0.1	0.0	0.8	0.0	0.5	0.0	0.0	0.1
Constellation®	0.0	0.1	0.0	1.0	1.8	0.2	1.1	0.8
Stellar Pink®	0.0	0.0	0.0	0.0	0.3	0.0	0.2	0.0
Aurora®	0.0	0.0	0.8	0.0	0.8	0.0	0.0	0.7
Giant dogwood								
Controversa	0.0	0.0	NR[x]	NB	NR	0.0	0.7	NR
LSD (P = 0.05)	0.8	0.9	0.7	0.9	1.0	0.6	0.6	0.8

[z]Severity of powdery mildew and spot anthracnose was assessed on a scale of 0 to 4 where 0 = no disease, 1 = 1 to 25%, 2 = 26–50%, 3 = 51–75%, and 4 = 76 to 100% of leaves damaged or diseased.

[y]NB = no blooms.

[x]NR = not rated.

to the leaves of all of the remaining cultivars of flowering dogwood was negligible. Because relatively few cultivars bloomed in 1995, damage ratings on the bracts were not taken. Over the next two years, substantial intensification of this disease on the leaves and bracts was seen on many cultivars of flowering dogwood. In 1996 and 1997, severe spotting and distortion of the leaves and/or bracts, as indicated by ratings of 2.0 or above, was noted on the cultivars 'Cherokee Princess', 'Cloud 9', 'Ozark Spring', 'Springtime', 'Dwarf White' and 'Barton White'. Over the same time period, noticeable damage to the leaves and bracts was recorded on cultivars of flowering dogwood such as 'Wonderberry', 'World's Fair', 'First Lady', 'Pink Flame', and 'Rubra Pink'. On the hybrid (*C. nuttallii* x *florida*) 'Eddie's White Wonder', light to moderate spotting of the bracts and leaves was seen in both years. In 1996 or 1997, the cultivars 'Stokes Pink', 'Purple Glory', and 'Cherokee Daybreak' suffered little spotting of the leaves but heavy spot anthracnose-related bract damage was noted. Cultivars of flowering dogwood that consistently had the least spot anthracnose damage to the bracts and leaves included 'Cherokee Chief', 'Cherokee Brave', 'Weaver's White', 'Cherokee Sunset', and 'Welch's Bay Beauty'.

With the exception of the cultivars Ruth Ellen® in 1996 and Constellation® in 1997, leaves and bracts of the kousa and hybrid (*C. kousa* x *florida*) dogwoods remained nearly free of spot anthracnose. Light spotting of the leaves was noted on the giant dogwood 'Controversa' in 1996 but not in 1995.

Although the kousa, hybrid (*C. kousa* x *florida*), and giant dogwoods have superior resistance to powdery mildew and spot anthracnose, they apparently may be much more sensitive to winter injury than the flowering dogwoods (data not shown). After the winter of 1996, significant tree death was noted in nearly all cultivars of kousa, hybrid (*C. kousa* x *florida*), and giant dogwood. By mid-May 1997, few individuals among the above dogwood taxa evaluated remained healthy. Over that same time period, similar stand losses of cultivars of flowering dogwood were not observed. Additional studies need to be conducted in order to determine the cause of the rapid decline and death of these three dogwood taxa.

While the severity of powdery mildew varied considerably from year to year, spot anthracnose damage intensified as the trees aged. Overall, flowering dogwood along with the hybrid (*C. nuttallii* x *florida*) 'Eddie's White Wonder' were more susceptible to spot anthracnose and powdery mildew in a simulated landscape planting than the kousa, hybrid (*C. kousa* x *florida*), or giant dogwood. Britton (1) and Doney *et al* (2) have also observed similar differences in the sensitivity of these 3 dogwood taxa to powdery mildew and spot anthracnose.

As has been noted in previous studies, cultivars of the kousa and hybrid (*C. kousa* x *florida*) dogwood, with few exceptions, were highly resistant or immune to spot anthracnose (1, 2) and powdery mildew (2). A severe outbreak of powdery mildew reported by Ranney *et al* (7) on the hybrid (*C. kousa* x *florida*) dogwood cultivars Stardust®, Constellation® and Ruth Ellen® was not observed on those same cultivars in this study. Differences in weather patterns, the biotype of *M. penicillata*, or presence of an unidentified species of powdery mildew fungus may account for the discrepancies in cultivar disease ratings noted between these two studies.

Previous field studies (1, 2, 8) have demonstrated that 'wild type' seedlings and cultivars of flowering dogwood differ significantly in their reaction to spot anthracnose and powdery mildew. The list of cultivars of flowering dogwood screened for resistance to both diseases in each of the above studies was, however, limited as compared with that for this

trial. Also, spot anthracnose and powdery mildew ratings for cultivars of flowering dogwood obtained here often differed from those previously reported (1, 2, 8). With the notable exception of the heavily spot anthracnose-damaged cultivars 'Barton White' and 'Cloud 9', Windham and Freeland (8) often observed less disease-related injury to the bracts of eight additional cultivars of flowering dogwood than in this study. Britton (1) and Doney *et al* (2) did not report severe spot anthrancose-related damage on 'Cloud 9', 'Barton White', or on the majority of the other flowering dogwood cultivars evaluated. While the cultivar 'Cherokee Sunset' had the highest spot anthracnose rating of the cultivars screened in Georgia (1), this cultivar proved to be among the most anthracnose-resistant of the 26 cultivars of flowering dogwood screened. Unlike this study, Britton (1) and Doney *et al* (2) did not observe any significant differences in powdery mildew colonization among the commercially cultivated cultivars of flowering dogwood. Overall, spot anthracnose and powdery mildew pressure appears to have been substantially higher in this study than in those previously conducted in Georgia (1), Kentucky (2) and Tennessee (8).

In summary, four of the 26 cultivars of flowering dogwood screened, which demonstrated partial to a high level of resistance to powdery mildew and spot anthracnose, would be excellent choices in a low maintenance landscape. Of these, 'Cherokee Brave' and 'Cherokee Chief' have red bracts while those of 'Weaver's White' and 'Welch's Bay Beauty' are white. Among the flowering dogwoods with pink bracts or variegated leaves, all were damaged by one or both diseases. Several flowering dogwoods, particularly the variegated cultivars 'Cherokee Sunset' and 'Cherokee Daybreak', sustained noticeable damage from either disease in only one growing season and may not be especially disease-prone. On the other hand, 'Rainbow', 'Dwarf White', 'Ozark Spring', 'Cloud 9', 'Barton White', 'Springtime', 'Autumn Gold', 'First Lady', 'Pink Beauty', 'Pink Flame', 'Rubra Pink', 'Stokes Pink', 'Purple Glory', which were highly susceptible to powdery mildew and/or spot anthracnose, would likely require costly fungicide treatments to maintain crop quality in the nursery and tree appearance in the landscape.

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