



Bulletin No. 642
January 2001
Alabama Agricultural Experiment
Station
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Auburn University

Disease Resistance
and Adaptability of
Flowering,
Kousa,
and
Hybrid Dogwood
in Alabama



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First Printing 2.5M, January 2001

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DISEASE RESISTANCE AND ADAPTABILITY OF FLOWERING, KOUSA, AND HYBRID DOGWOOD IN ALABAMA

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INTRODUCTION

Flowering dogwood (*Cornus florida*) ranks among the most popular and widely cultivated small flowering trees found in residential and commercial landscapes across Alabama. In Alabama forests, flowering dogwood is a common, native understory tree. Showy bracts, excellent fall color, red clusters of fruit, and adaptation to a wide variety of Alabama soils make the flowering dogwood a favorite of consumers. Despite the availability of numerous cultivars of container and field-grown flowering dogwood cultivars, native juvenile trees are commonly transplanted from the forest to the landscape.

The kousa dogwood (*Cornus kousa*), which is native to China, Japan, and Korea, is reportedly adapted as far south as USDA Zone 8 but has not been widely planted in Alabama landscapes. Although its bracts are not as showy as those of flowering dogwood, the kousa dogwood shares its dark green foliage, brilliant fall color, vivid fall fruit, and attractive form (3). Mature kousa dogwood, which reaches a height of 20 to 30 feet, makes an outstanding specimen tree (3). Recently, the Stellar Series of hybrid (*C. kousa* x *florida*) dogwood has been released into the nursery trade. Most notably, several of these selections have excellent resistance to the destructive disease dogwood anthracnose (9).

The giant dogwood (*C. controversa*), a native of Japan and China, is reportedly hardy in USDA Zone 5 through 8 (3). The Pacific dogwood (*C. nuttallii*) is widely distributed along the West Coast of the United States and Canada but is not considered very winter-hardy (3). The adaptability of these dogwood taxa and the *C. nuttallii* x *florida* hybrid 'Eddie's White Wonder' to the Southeast is unknown.

Spot anthracnose, which is caused by the fungus *Elsinoe corni* and is traditionally considered the most common disease on flowering dogwood, is found most

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commonly on trees growing in full sun (4,5,10). Although this disease typically has little impact on tree health, the bracts and leaves of cultivars and native selections of flowering dogwood susceptible to spot anthracnose may be badly defaced and distorted (4,10) (Figures 1-3). Windham and Freeland (10) have noted that early blooming flowering dogwood cultivars such as 'Cloud 9' and 'Barton White' are more sensitive to spot anthracnose than later-blooming cultivars, but those observations were not confirmed by others (1,2). Little, if any, information is available concerning the susceptibility of most cultivars of flowering, kousa, and hybrid dogwood in the nursery trade to spot anthracnose.

Prior to 1994, powdery mildew, caused by the fungus *Microsphaera pulchra*, was rarely seen on native or cultivated flowering dogwood. In a three-year survey of flowering dogwood on forested sites across North Alabama, signs and symptoms of this disease were not seen on any of the trees inspected at numerous sites in 18 counties (6). In 1994, however, powdery mildew suddenly appeared in forest, landscape, and nursery plantings of flowering dogwood statewide (5,6). Simultaneously, this disease appeared on flowering dogwood in Florida (7). In 1993, powdery mildew was reported in Georgia on selected cultivars and native flowering dogwood (1). That same year, Ranney et al. (9) also reported a severe outbreak of powdery mildew, incited by *M. pulchra*, on several selections of kousa and hybrid dogwood. Typically, powdery mildew diseases are thought to have little impact on the health and vigor of tree hosts. However, severe outbreaks of powdery mildew on dogwood can significantly slow shoot elongation and, in some cases, kill flowering dogwood seedlings (6,11).

Selections of flowering, kousa, Stellar Series hybrid (*C. kousa* x *florida*), and several other dogwood taxa were screened for their susceptibility to spot anthracnose and powdery mildew and for their overall adaptability to USDA Zone 7b.

MATERIALS AND METHODS

A field planting of 38 selections of flowering, kousa, Stellar Series hybrid (*C. kousa* x *florida*), Pacific x flowering hybrid (*C. nuttallii* x *florida*), and giant dogwood was established on the AAES Experiment Station on the campus of Auburn University, Alabama (USDA Zone 7b). Before planting, soil fertility and pH were adjusted according to soil test recommendations of the Auburn University Soil Testing Laboratory. In March 1993, bare-root liners, 2 to 3 feet tall, were planted in full sun in a Marvyn loamy sand on 8-foot centers in rows spaced 12 feet apart. The test site was sloped slightly to the southeast. The experimental design was a randomized complete block with six, two-tree replications.

A trickle irrigation system with two emitters per tree was installed at the time of tree establishment, and the trees were watered as needed. Twice each spring, approximately 0.2 pounds of 13-13-13 analysis fertilizer was uniformly distributed around the base of each tree. A tank-mix of Princep 4L and Surflan A.S. pre-emergent herbicides was applied at label rates in March 1996 and March 1997. Hand weeding and directed applications of recommended rates of Roundup herbicide were used to control any remaining weeds. Alleys between the rows were periodically mowed. In 1995, all trees were mulched with 2 to 3 inches of aged pine bark.

Within two years of planting, the causal fungi of powdery mildew and spot anthracnose had become naturally established on selected cultivars or taxa of dogwood. Powdery mildew incidence on the leaves was rated on May 23, 1995; May 30, 1996; and May 16, 1997. Powdery mildew was rated on a scale of 0 to 4 where 0 = no disease, 1 = 1 to 25% of the leaves colonized by the powdery mildew fungus *M. pulchra*, 2 = 25 to 50% colonization, 3 = 51 to 75% colonization, and 4 = 75 to 100% colonization. This disease rating scale was also used to evaluate the incidence of spot anthracnose on the bracts and leaves. The leaves were examined for symptoms of spot anthracnose on April 14, 1995; April 14, 1996; and March 31, 1997. Incidence of spot anthracnose on the flower bracts was recorded on April 29, 1996 and April 15, 1997. Tree survival was recorded on each date that disease ratings were taken. Survival data for the flowering dogwood selections was divided into categories based on bract color and leaf variegation.

RESULTS

As a group, flowering dogwoods, as well as the Pacific x flowering hybrid dogwood 'Eddie's White Wonder', are much more susceptible to powdery mildew and spot anthracnose than the remaining three taxa of dogwood (data not shown). The powdery mildew ratings for flowering dogwood, which declined between 1995 and 1996, sharply increased in 1997. Spot anthracnose-related damage to the bracts and leaves on flowering dogwood progressively worsened between 1995 and 1997. On the other hand, the overall powdery mildew and spot anthracnose ratings for kousa, Stellar Series hybrid (*C. kousa* x *florida*), and giant dogwoods were consistently very low.

Powdery Mildew

The incidence of powdery mildew varies considerably among the cultivars of flowering dogwood and often from year to year on individual cultivars (Table 1). During the three-year evaluation period, 'Cherokee Brave' remained almost free of powdery mildew. Only a few, scattered, white to buff-colored colonies of the powdery mildew fungus were seen on a handful of leaves of this flowering dogwood, and no leaf distortion was seen (Figure 4). In two of three years, the level of powdery mildew on leaves of 'Cherokee Daybreak', 'Cherokee Chief', and 'Springtime' was also relatively low and was similar to that noted on 'Cherokee Brave'. In contrast, high disease ratings were recorded in all three years on 'Stokes Pink', 'Rubra Pink', 'Pink Beauty', 'Red Beauty', 'First Lady', 'Purple Glory', 'Dwarf White', and 'Pink Flame' (Figures 5 - 6). On these flowering dogwoods, the stunting, curling, or distortion of the foliage typically associated with powdery mildew was quite noticeable, especially on the younger leaves near the shoot tips (5). Considerable colonization of the upper leaf surfaces by the powdery mildew fungus and characteristic damage of the colonized leaves were seen in at least one of three years on nearly all of the remaining flowering dogwoods cultivars and on the hybrid dogwood 'Eddie's White Wonder' (Tables 1 and 2).

TABLE 1. SUSCEPTIBILITY OF CULTIVARS OF THE FLOWERING DOGWOOD (*CORNUS FLORIDA*) TO POWDERY MILDEW AND SPOT ANTHRACNOSE¹ IN AUBURN, ALABAMA

Cultivar	—Powdery Mildew—			—Spot Anthracnose—				
	1995	1996	1997	—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	2.0
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 ²	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

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

²NB = no blooms or bracts.

TABLE 2. SUSCEPTIBILITY OF SEVERAL DOGWOOD TAXA TO POWDERY MILDEW AND SPOT ANTHRACNOSE¹ IN A SIMULATED LANDSCAPE PLANTING IN AUBURN, ALABAMA

Cultivar	—Powdery Mildew—			—Spot Anthracnose—				
	1995	1996	1997	—Bracts—		—Leaves—		
	1995	1996	1997	1996	1997	1995	1996	1997
<i>Cornus nuttalli x florida</i> hybrid dogwood²								
Eddie's White Wonder	1.3	0.5	1.9	2.0	NB ³	0.3	1.4	1.3
Kousa dogwood (<i>C. kousa</i>)								
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
<i>Cornus kousa x florida</i> hybrid dogwood⁴								
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 (<i>C. controversa</i>)								
Controversa	0.0	0.0	NR ⁵	NB	NB	0.0	0.7	NR

¹Severity 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 to 50%, 3 = 51 to 75%, 4 = 76 to 100% of leaves damaged or diseased.

²Pacific x flowering dogwood hybrid.

³NB = no blooms.

⁴Kousa x flowering dogwood hybrid (Stellar Series).

⁵NR = not rated, trees dead.

On the foliage of nearly all cultivars of kousa, Stellar Series hybrid (*C. kousa x florida*), and the single selection of giant dogwood, little or no powdery mildew development was seen, as indicated by ratings of 0.0 to 0.4 (Table 2). The highest powdery mildew ratings were recorded in 1997 on the Stellar Series hybrids 'Aurora' and 'Galaxy'. Nevertheless, when compared with many of the flowering dogwood cultivars, the level of colonization by the powdery mildew fungus on the leaves of these two hybrids was minor, and the damage was unobtrusive.



Figure 1, above. Tiny, slightly sunken purple leaf spots are typical symptoms of spot anthracnose on the newly expanded leaves of flowering dogwood.



Figure 2, below. Heavy spotting results in distortion or twisting of the leaves on the spot anthracnose-susceptible flowering dogwood 'Pink Flame'.

Figure 3, above. Spotting of the bracts of flowering dogwoods may be so severe that they are badly twisted and discolored. Heavily spotted bracts are often shed early.



Figure 4, below. The white cottony growth of the powdery mildew fungus first appears on the leaves of flowering dogwoods in April and May. Curling and twisting of the leaves are symptoms commonly associated with severe outbreaks of this disease.





Figures 5 and 6, above. Heavy powdery mildew damage on 'Stokes Pink' and 'First Lady'.

Figure 7, right. Heavy spot anthracnose damage is common on the bracts of 'Barton White' flowering dogwood.



Figure 8, below. Some flowering dogwood cultivars such as 'Welch's Bay Beauty' suffered little, if any, noticeable spot anthracnose damage to their bracts.

Figure 9, below, right. Excessive soil moisture is the cause of the death of this flowering dogwood.



Spot Anthracnose

Of the 26 cultivars of flowering dogwood screened, 'Rainbow' consistently suffered the heaviest spot anthracnose-related damage to its leaves (Table 1). Typically, the leaves of this cultivar were heavily spotted, twisted, and distorted (5). In 1996 and 1997, damage levels similar to those noted on the leaves were also seen on the bracts of 'Rainbow'. In 1995, the level of spotting on the leaves of all the remaining flowering dogwoods was negligible. Because relatively few flowering dogwood cultivars bloomed in 1995, spot anthracnose damage ratings for the bracts were not taken. In 1996 and 1997, severe spotting of the leaves and/or bracts, which was indicated by disease ratings of 2.0 or higher, was seen on 'Cherokee Princess', 'Cloud 9', 'Ozark Spring', 'Springtime', 'Dwarf White', and 'Barton White' (Figure 7). Other flowering dogwoods, which suffered considerable spotting of their leaves or bracts in those same years, included 'Wonderberry', 'World's Fair', 'First Lady', 'Pink Flame', 'Rubra Pink', and the Pacific x flowering hybrid dogwood 'Eddie's White Wonder'. In 1996 and 1997, 'Stokes Pink', 'Purple Glory', and 'Cherokee Daybreak' suffered little spotting of the leaves but severe spotting and distortion of the bracts was noted. Flowering dogwood cultivars that consistently had the lowest level of spot anthracnose damage to the bracts and leaves included 'Cherokee Chief', 'Cherokee Brave', 'Weaver's White', 'Cherokee Sunset', and 'Welch's Bay Beauty' (Figure 8).

With the exception of the cultivars 'Ruth Ellen' in 1996 and 'Constellation' in 1997, leaves and bracts of the kousa and Stellar Series hybrid (*C. kousa* x *florida*) dogwoods remained nearly free of spot anthracnose (Table 2). Light spotting of the leaves was seen on the giant dogwood in 1996 but not in 1995 (Table 2).

Tree Survival

Although kousa, Stellar Series hybrid (*C. kousa* x *florida*), and giant dogwood have superior resistance to powdery mildew and spot anthracnose, as a group they have a much lower survival rate than do all of the flowering dogwoods (Tables 3 and 4). From 1994 through 1996, the survival rate for the flowering and kousa, as well as for both taxa of hybrid dogwoods, was quite similar. By the summer of 1997, only 42% of the kousa and 32% of the Stellar Series hybrid (*C. kousa* x *florida*) dogwoods were alive, compared with a survival rate of approximately 73% of all of the flowering dogwoods and 67% of 'Eddie's White Wonder' hybrid dogwood.

The first-year survival rate for the majority of flowering dogwoods screened differed considerably (Table 3). Although 'Cherokee Daybreak', 'Stokes Pink', 'Pink Flame', and 'Dwarf White' ('Pygmy') had the poorest first-year survival rates, nearly all of the trees of each of these cultivars were still alive in 1997. On the other hand, all of the 'Welch's Bay Beauty', 'Fragrant Cloud', 'Worlds Fair', 'Ozark Spring', 'Barton White', 'Cherokee Princess', 'Rainbow', 'First Lady', and 'Cherokee Brave' dogwoods that were planted in 1993 survived to the spring 1994. Within the first growing season, at least one tree was lost for each of the remaining flowering dogwoods cultivars.

During the four-year disease evaluation, only one or two trees of the many

TABLE 3. SURVIVAL OF SELECTIONS OF SEVERAL DOGWOOD TAXA IN A SIMULATED LANDSCAPE PLANTING IN AUBURN, ALABAMA, 1994 TO 1997

Cultivar	Survivors (%)			
	1994	1995	1996	1997
<i>Cornus nuttallii</i> x <i>florida</i> hybrid dogwood¹				
Eddie's White Wonder	75	75	75	67
Kousa dogwood (<i>C. kousa</i>)				
Milky Way	100	92	92	58
Milky Way Select	92	75	50	25
National	92	92	83	58
Satomi	75	67	67	25
<i>Cornus kousa</i> x <i>florida</i> hybrid dogwood²				
Ruth Ellen	100	100	100	42
Galaxy	100	100	92	25
Aurora	100	100	75	25
Stellar Pink	100	92	33	17
Constellation	92	92	92	33
Stardust	92	92	75	50
Giant dogwood (<i>C. controversa</i>)				
Controversa	60	60	42	0

¹Pacific x flowering hybrid dogwood.

²Kousa x flowering hybrid dogwood (Stellar Series).

flowering dogwood cultivars screened died (Table 3). 'Autumn Gold', 'Pink Flame', 'Weavers White', 'Double White', and 'World's Fair' suffered the sharpest declines in tree survival. Also, 'Autumn Gold' failed to successfully flower in 1995, 1996, or 1997. In contrast, 100% of the 'Welch's Bay Beauty', 'First Lady', and 'Fragrant Cloud' flowering dogwoods survived through the summer 1997.

Initially, the survival rates for kousa and Stellar Series hybrid (*C. kousa* x *florida*) dogwood were similar to those noted for the flowering dogwoods (Tables 3 and 4). One year after establishment, 100% of the kousa dogwood 'Milky Way' and Stellar Series hybrid dogwoods 'Ruth Ellen', 'Galaxy', 'Stellar Pink', and 'Aurora' had survived. With the exception of the kousa dogwood 'Satomi', only one tree of the remaining selections of kousa and hybrid dogwood was lost within the first year of establishment.

Between 1995 and 1996, the levels of tree survival for the kousa and hybrid dogwood selections, particularly 'Milky Way Select' and 'Stellar Pink', began to decline sharply (Table 4). By 1997, the survival rates for the majority of kousa and

TABLE 4. SURVIVAL OF CULTIVARS OF THE FLOWERING DOGWOOD (*CORNUS FLORIDA*) IN A SIMULATED LANDSCAPE PLANTING IN AUBURN, ALABAMA, 1994 TO 1997

Cultivar	Survivors (%)			
	1994	1995	1996	1997
White Bracts				
Welch's Bay Beauty	100	100	100	100
Fragrant Cloud	100	100	100	100
Barton White	100	100	100	83
Double White	100	100	100	75
World's Fair	100	100	92	75
Ozark Spring	100	92	92	92
Cherokee Princess	100	92	92	83
Springtime	92	92	75	75
Wonderberry	83	83	83	75
Weaver's White	83	67	50	50
Cloud 9	75	75	75	75
Dwarf White (Pygmy)	8	8	8	8
White Bracts/Variegated Leaves				
First Lady	100	100	100	100
Rainbow	100	100	92	92
Autumn Gold	67	67	67	67
Cherokee Daybreak	58	58	50	50
Pink Bracts				
Rubra Pink	92	92	83	83
Welch's Junior Miss	92	92	83	83
Pink Beauty	83	83	83	83
Pink Flame	60	40	40	30
Stokes Pink	58	50	50	42
Red Bracts				
Cherokee Brave	100	92	92	92
Cherokee Chief	92	92	92	83
Purple Glory	92	83	83	83
Red Beauty	83	83	83	83
Red Bracts/Variegated Leaves				
Cherokee Sunset	80	80	80	80

Stellar Series hybrid dogwood selections had fallen below 33%. Among these dogwood taxa, the highest rates of survival were recorded for the kousa dogwoods 'Milky Way' and 'National' (58%) and for the hybrid dogwood 'Stardust' (50%). Between the 1996 and 1997 growing seasons, all of the giant dogwoods had succumbed to winter injury. Although the overall survival rate of the Pacific x florida hybrid dogwood 'Eddie's White Wonder' was considerably better than the survival rates of kousa, Stellar Series hybrids, or giant dogwood, all of the flower buds were destroyed each year by cold winter weather.

Although no specific data were collected concerning the loss of individual dogwoods, powdery mildew and spot anthracnose were not responsible for tree loss. Several rows of trees, which were located just above a pond, died following an extended period of heavy rain (Figure 9). The deaths of kousa and Stellar Series hybrid (*C. kousa* x *florida*) dogwoods were attributed to the southeastern aspect of the site and to the unusually hard freezes during the winter of 1996 and 1997. Splitting of the bark and large superficial cankers appeared on the south or southwestern sides of the trunk just above the root collar. On kousa and Stellar Series hybrid dogwoods, typical symptoms of cold damage included sparse foliage as well as yellowed, folded, and sometimes dwarfed leaves. Later, the leaves on one or more scaffold limbs died and were prematurely shed. In some instances, the affected trees leafed out, then suddenly wilted and died.

DISCUSSION

Selections of kousa, Stellar Series hybrid (*C. kousa* x *florida*), and giant dogwood are, with few exceptions, highly resistant or immune to spot anthracnose and powdery mildew. Results of this study are similar to those previously observed in Georgia (1) and Kentucky (2). The severe outbreak of powdery mildew reported by Ranney et al. (9) on the Stellar Series hybrid cultivars 'Stardust', 'Constellation', and 'Ruth Ellen' was not seen here on the same cultivars. Differences in weather patterns or the presence of an unidentified species of powdery mildew fungi may account for the discrepancies in disease ratings noted between these two studies.

Despite their overall excellent disease resistance, the survival rates of kousa, Stellar Series hybrid (*C. kousa* x *florida*), and giant dogwood selections over the four-year test period were poor, especially when compared with those of most of the flowering dogwood cultivars. Apparently, warm fall or winter weather may have delayed or interfered with tree dormancy, thereby making these dogwood taxa much more sensitive to winter injury. Recently, similar winter injury symptoms on Stellar Series hybrid dogwoods have been seen in southern Tennessee (D. Fare, D. Shadow, and M. Windham, personal communication). Most likely, secondary fungal pathogens such as *Lasiodiplodia theobromae* (syn. *Botryodiplodia theobromae*), which specifically attack winter-injured or stressed trees, are ultimately responsible for the decline and eventual death of many kousa and Stellar Series hybrid dogwoods (8). In addition, the flower buds on the Pacific x flowering dogwood hybrid 'Eddie's White Wonder' prove sensitive to low temperature injury. Due to the high incidence of winter injury observed here and in Tennessee, establishment of selections of kousa,

hybrid, and giant dogwood in Alabama landscapes, particularly in full sun, is not recommended. To minimize the risk of dieback and tree death, these dogwood taxa should be planted only in shaded and protected sites where the tree trunk is not exposed to early morning sun or cold, northerly winter winds.

As seen in previous studies (1,2,9), cultivars of flowering dogwood differ greatly in their susceptibility to spot anthracnose and powdery mildew. However, the ratings noted here for both of these diseases did not necessarily agree with those previously reported (1,2,10). With the notable exception of 'Barton White' and 'Cloud 9', the bracts of eight other flowering dogwood selections suffered less damage from spot anthracnose in a Tennessee study (10) than in this study. In recent Georgia (1) and Kentucky (2) studies, spotting of the bracts on the majority of flowering dogwood cultivars screened was also considerably lower than the levels seen here. Unlike this study, no significant differences in the susceptibility of commercially available flowering dogwoods to powdery mildew were reported in either in Georgia (1) or Kentucky (2). Overall, spot anthracnose and powdery mildew pressure appears to have been substantially higher in this case than in studies conducted in Georgia (1), Kentucky (2), and Tennessee (10).

Four of the 26 cultivars of flowering dogwood, which were partially to highly resistant to powdery mildew and spot anthracnose, would make excellent additions to 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. Given the high winter injury risk of the test site, the survival rate for all of the above cultivars, except for 'Weaver's White', was excellent. Several flowering dogwoods, particularly the variegated cultivars 'Cherokee Sunset' and 'Cherokee Daybreak', which suffered noticeable damage from powdery mildew or spot anthracnose in only one growing season, may not be 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', and 'Purple Glory', which proved highly susceptible to powdery mildew and/or spot anthracnose, would likely require costly fungicide treatments to maintain their beauty and vigor in the landscape.

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