SUSCEPTIBILITY OF CULTIVARS AND HYBRIDS OF KOUSA DOGWOOD TO DOGWOOD ANTHRACNOSE AND POWDERY MILDEW

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ABSTRACT - - Twenty taxa of dogwood including cultivars of kousa dogwood (C. kousa) and hybrids between flowering and kousa dogwoods were evaluated for susceptibility to dogwood anthracnose *(Discula destructiva)* and powdery mildew *(Microsphaera pulchra).* Trees were grown under the canopy of a native stand of flowering dogwoods that were infected with both diseases. Experimental trees were also inoculated artificially with spores of *D. destructiva.* None of the taxa were found to be immune to dogwood anthracnose, yet there was a considerable range in resistance to the disease. *C. kousa* 'Steeple', a clone of *C. kousa* 'Milky Way', *C. x* Stardust, *C.* x Stellar Pink", and *C.* x Galaxy"" were found to be resistant to dogwood anthracnose as indicated by ≤ 1% of total leaf area affected, 100% survival through the following spring, and no detection of the disease in woody tissue. The *C. kousa* cultivars 'Wolf Eyes', 'Moonbeam', and 'Autumn Rose' and seedlings of *C. florida* were found to be highly susceptible with 100% of the total leaf area affected and 100% mortality by the following spring. The other taxa were found to be intermediate in susceptibility to *D. destructiva.* Only 5 of the taxa: *C. kousa* 'Elizabeth Lustgarten' and 'Steeple' and the hybrids *C.* x Stardust™, *C.* x Constellation™, and *C.* x Ruth Ellen' showed infection by *M. pulchra.*

Under favorable disease conditions, *D. destructiva* can be an aggressive pathogen of flowering and mountain (*C. nuttallii)* dogwoods. Since early accounts of the disease in the late 1970s (Daughtrey and Hibben, 1983), dogwood anthracnose has spread throughout much of the Northeastern and Northwestern United States and has caused extensive mortality in some areas (Hibben and McArdle, 1992).

Evaluation of different species of dogwoods has shown considerable variation in susceptibility to *D. destructiva* (Windham and Trigiano, 1993). Kousa dogwood has generally been found to be more resistant to dogwood anthracnose than is flowering dogwood (Holmes and Hibben, 1989; Santamour, et al., 1989); however, variations in resistance among taxa of kousa dogwood have been noted. For example, Windham and Trigiano (1993) reported that one

selection of kousa dogwood *(C. kousa* var. *chinensis)* was relatively susceptible to *D. destructiva* while another unnamed selection of kousa was found to be resistant. Identification of taxa of kousa dogwood and related hybrids with greater resistance to dogwood anthracnose would provide valuable information for selecting disease resistant dogwoods for planting in areas where the disease is prevalent.

Powdery mildews can also be a common diseases on dogwoods. Although powdery mildews generally occur late in the growing season and seldom cause mortality, powdery mildew fungi are obligate parasites that can cause stunted, distorted growth and can be undesirable aesthetically. Identification and selection of taxa with natural resistance to powdery mildews would aid in minimizing this problem in the landscape.

Kousa dogwood is a popular, large-bracted dogwood valued as an important landscape plant (Jaynes et al., 1993). There are currently over 80 cultivars of kousa dogwood that have been selected primarily for ornamental characteristics (Jaynes et al. 1993; Santamour and McArdle, 1985; Wakefield, 1990). Selections of hybrids between *C. florida* and *C. kousa* have also been made (Orton, 1993). Little information, however, is available on variations in disease resistance among these plants.

The objective of this project was to evaluate 20 different taxa of dogwood including cultivars of *C. kousa* and hybrids between *C. florida* and *C. kousa* for resistance to dogwood anthracnose and powdery mildew.

MATERIALS AND METHODS

Plants were propagated in 1992. Kousa dogwoods and hybrids between flowering and kousa dogwood were grafted onto seedling rootstocks of kousa dogwood. Flowering dogwoods were grown from seed. Cultivars of kousa dogwood included: 'Autumn Rose', 'Big Apple', 'China Girl', 'Elizabeth Lustgarten', 'Gay Head', 'Greensleeves', 'Julian', 'Milky Way', 'Milky Way Select', 'Moonbeam' (P.P. No. 3482), 'Steeple', 'Temple Jewel', and 'Wolfeyes' (syn. 'Princeton Variegated'). See Jaynes, et al. (1993), Orton (1993) and Santamour and McArdle (1985) for cultivar descriptions. The cultivar designation 'Milky Way' does not necessarily represent an individual clone (Orton, 1991). 'Milky Way' is a cultivar name given to a group of seedlings grown from open pollinated sources. Since that time, 'Milky Way' has become a common plant in the nursery industry and is propagated by sexual and asexual means resulting in an ambiguous cultivar designation describing variable genotypes. The 'Milky Way' cultivars included in this experiment were clonal and were propagated from a single 'Milky Way' tree. Similarly, 'Milky Way Select', is a clonal selection made from seedlings of 'Milky Way' (Jaynes, et al., 1993). Hybrids between flowering and kousa dogwoods included: Aurora (C. x 'Rutban', P.P. No. 7205), Constellation (*C.* x 'Rutcan', P.P. No. 7210), Galaxy"' (C. x 'Rutdan', P.P. No. 7204), Ruth **Ellen™** (C. x 'Rutlan', P.P. No. 7732), **Stardust™** (*C.* x 'Ruftan', P.P. No. 7206), and Stellar **Pink™** (*C.* x 'Rutgan', P.P. No. 7207). See Orton (1993) for descriptions. In addition,

seedlings of flowering dogwood were included for comparison.

On May 11, 1993 the plants were moved to the US Forest Service, Bent Creek Experimental Forest, Asheville, NC and placed in a mixed hardwood forest beneath the canopy of a grove of native flowering dogwoods that were infected with *D. destructiva* and *M. pulchra.* The containerized plants were arranged in a completely randomized design, with 3 - 4 replicate trees. Photosynthetically active radiation was approximately 10 - 15% of full sunlight as measure with a quantum sensor (LI-COR, inc., Lincoln, Neb.).

In addition to naturally occurring inoculum, the plants were artificially inoculated with a suspension of dogwood anthracnose spores (conidia) in water applied with a hand held sprayer on May 27, 1993 and June 24, 1993 with 10,000 and 20,000 $spores \cdot ml^{-1}$, respectively. Spores were obtained from infected flowering dogwoods growing at the Bent Creek Experimental Forest.

Plants were periodically rated for disease severity throughout the growing season. Ratings included visual estimates of ***1)*** the percentage of leaves showing symptoms per plant (P) and 2) average percent of leaf area affected on diseased leaves (L). The product of these two factors (PXL) which provides an estimate of the percent of total leaf area affected per plant.

Infection by *D. destructiva* was confirmed on symptomatic tissue based on morphology of acervuli and conidia (Redlin, 1991). Leaf samples were examined during the growing season in 1993 while twigs samples were examined in Spring 1994. If acervuli were not present on symptomatic tissue, samples were placed on wet towels in plastic boxes in an incubator at 20C to induce sporulation.

Identification of the powdery mildew was confirmed based on the morphology of the cleistothecia, conidia, and host specificity (Braun, 1987; Farr et al., 1989). Symptomatic leaves were collected and examined periodically during October and November 1993.

Plants were overwintered in a structure covered with polypropylene fabric. On January 31, 1994 the plants were moved into a heated greenhouse at day / night temperatures of 24C (75F) / 18C (65F) to force growth and to evaluate survival and shoot infection for dogwood anthracnose.

RESULTS AND DISCUSSION

Dogwood anthracnose. By the end of October, all plants eventually developed symptoms of dogwood anthracnose (Table 1.). The kousa dogwood cultivars 'Wolf Eyes', 'Moonbeam', and 'Autumn Rose' and the flowering dogwood seedlings were found to be highly susceptible with 100% of the total leaf area affected per plant. These susceptible plants were typically infected early and suffered from rapid spread of the disease. Plant survival in Fall 1993 for 'Wolf Eyes', 'Moonbeam', 'Autumn Rose', and *C. florida* was 0, 0, 33, and 0%, respectively. Dogwood anthracnose was confirmed on leaves of all of these taxa. Following overwintering, there were no surviving plants of these four taxa and dogwood anthracnose was confirmed in-stems of all taxa except flowering dogwood which was severely decomposed. The cultivars 'Steeple', Stardust™, Stellar Pink", 'Milky Way', and Galaxy" were found to be resistant to

dogwood anthracnose as indicated by ≤ 1% of total leaf area affected, 100% survival through the following spring, and no detection of the disease in stem tissue. The remaining cultivars including 'Milky Way Select', 'Gay Head', Constellation™, 'Julian', 'Temple Jewel', 'Elizabeth Lustgarten', 'Big Apple', Aurora™, 'China Girl', Ruth Ellen', and 'Greensleeves' were found to be intermediate in resistance.

In addition to *D. destructiva,* fungi in the genera *Colletotrichum, Phomopsis,* and *Alternaria* were routinely found on dead twigs, but were believed to be either saprophytic or facultative parasites.

Powdery mildew. Powdery mildew was first observed in early September on some cultivars and appeared to result from natural inocula from native flowering dogwood with powdery mildew in the experimental area. By late October, 5 taxa including 'Elizabeth Lustgarten', 'Steeple', Stardust™, Constellation", and Ruth Ellen™ were infected (Table 2). Three of the hybrid cultivars (Stardust™, Constellation', and Ruth Ellen") were most heavily infected with over 70% of the total leaf area affected per plant. No data was collected for 'Autumn Rose', 'Moonbeam', 'Wolf Eyes', or flowering dogwood because they were severely defoliated or dead by that time. The disease organism was identified as *Microsphaera pulchra.*

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Table 1: Disease severity ratings, survival, and patoghen confirmation for cultivars of C *kousa (Ck.), C kousa x C.frorida (C x)* hybrids, and C. florida (C.f.) subjected to *Discula destructiva.* Disease severity ratings include percent of leaves infected per plant (P), average percent of area affected on infected leaves (L), and percent of total leaf area affected per plant (PxL).

	Disease Severity, Oct. 20, 1993			Survival (%)		Disease Confirmation	
Taxa	P	L	PXL	Fall 1993	Spring 1994	Leaves	Stem
C. k. 'Steeple'	**10**	5	**0**	100	100	+	-
C. x Stardust™	7	7	1	100	100	+	-
C. x Stellar Pink™	12	5	1	100	100	+	-
C. *k.* 'Milky Way'	8	7	1	100	100	-	-
C. *k.* 'Milky Way Select'	15	5	1	100	66	-	+
C. x Galaxy™	20	5	1	100	100	+	-
C. *k.* 'Gay Head'	30	8	2	100	33	+	+
C. x Constellation™	38	7	3	100	33	+	+
C. *k.* 'Julian'	35	10	3	100	50	-	+
C. *k.* 'Temple Jewel'	35	15	6	100	66	-	+
C. *k.* 'Elizabeth Lustgarten'	95	15	14	100	100	+	-
C. *k.* 'Big Apple'	96	25	24	100	75	-	-
C. x Aurora™	52	38	35	100	66	+	-
C. *k.* 'China Girl'	53	40	35	66	66	-	+
C. x Ruth Ellen™	62	40	37	66	33	+	+
C. *k.* 'Greensleves'	100	55	55	66	33	+	+
C. *k.* 'Autumn Rose'	100	100	100	33	0	+	+
C. *k.* 'Moonbeam'	100	100	100	0	0	+	+
C. *florida*	100	100	100	0	0	+	-
C. k. 'Wolf Eyes'	100	100	100	0	0	+	+
$LSD_{0.05}$	37	40	42	45	71	**N/A**	**N/A**

'PxL was calculated as the mean of the products of P and L fo r eaarily equal PxL.

Table 2: Disease severity ratings including: percent of leaves infected per plant (P), average percent of leaf area affected on infected leaves (L), and percent of total leaf area affected per plant (PxL) for powdery mildew evaluated on 20 taxa of dogwoods during a 1993.

	Diseaes Severity, Oct. 25, 1993		
Taxa	P	L	PxL
C. x Stellar Pink™	0	0	0
C. k. 'Milky Way Select'	0	0	0
C. *k.* Milky Way'	0	0	0
c. x. Galaxy™	0	0	0
C. k. 'Gay Head'	0	0	0
C. k. 'Julian'	0	0	0
C. k. 'Temple Jewel'	0	0	0
C. k. 'Big Apple'	0	0	0
C. x Aurora™	0	0	0
C. k. 'China Girl	0	0	0
C. k. 'Greensleves'	0	0	0
C. k. 'Elisabeth Lustgarten'	7	10	1
C. *k.* 'Steeple'	40	20	12
C. x Stardust™	95	75	71
C. x Constellation™	100	90	90
C. x Ruth Ellen™	100	98	98
$LSD_{0.05}$	18	9	8

PxL was calculated as the mean of the products of P and L for each replicate. For that reason, the product of the mean P and mean L will not necessarily equal PxL.