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## **SUSCEPTIBILITY OF BOXWOOD SPECIES, CULTIVARS, HYBRIDS AND ACCESSIONS TO BOXWOOD BLIGHT**

### **Version 1.0<sup>\*\*</sup>**

<sup>\*\*</sup>These are subject to revision based on the availability of new information (revised March 2019).

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Best management practices for boxwood blight have focused on exclusion, sanitation and fungicide application tactics. Long term management approaches will require the identification or development of resistant or partially resistant boxwood. The *Buxus* genus is diverse, with 91 species and large numbers of hybrids and cultivars. A number of studies using different methods and isolates of the pathogen have shown differences in susceptibility to boxwood blight, sometimes with contradictory results (Henricot et al., 2008; Ganci et al., 2013; Guo et al., 2015; LaMondia, 2015; Gehesquière, et al., 2016). We list here relative susceptibility of hybrids and cultivars from studies conducted at the CAES.

Of the commonly grown boxwood species evaluated as groups of cultivars or accessions, the most blight susceptible is *B. sempervirens* followed by *B. microphylla* × *sempervirens* hybrids, *B. microphylla* and *B. sinica* as the least susceptible. We have shown, however, that while we can make general conclusions, there is a lot of variation within species and that has to be recognized. Research is ongoing to evaluate susceptibility of cultivars under standard conditions. The relative rankings of susceptibility in each study are valid, as is the case for other listed collections of cultivars. It may not be possible to directly compare results from different studies until conditions are standardized, a project currently under way nationwide. The use of less susceptible, tolerant and ultimately resistant cultivars may become part of integrated management practices for nurseries, home gardens and landscapes.

Tables 1-4 are from LaMondia and Shishkoff, 2017.

Other researchers have published results; the studies are listed in the References.

**Table 1. Susceptibility of whole plant *Buxus* species and hybrids from the U.S. National Arboretum collection to boxwood blight caused by *Calonectria pseudonaviculata*.**

<i>Buxus</i> species	Number of accessions evaluated	Lesions per plant <sup>z</sup>	Normalized lesions by plant size <sup>y</sup>
<i>B. harlandii</i> (= <i>B. bodinieri</i> )	2	19.5 AB <sup>x</sup>	18.3 AB
<i>Buxus</i> hybrid ( <i>microphylla koreana</i> x <i>sempervirens</i> )	6	48.6 C	24.2 BC
<i>B. microphylla</i>	7	31.1 BC	16.7 AB
<i>B. sempervirens</i>	20	69.6 D	22.9 BC
<i>B. sinica</i>	3	11.1 A	11.1 A
<i>B. wallichiana</i> (51896*H)	1	160.1 E	37.3 C
<i>P</i> =		0.00001	0.0001

<sup>z</sup> Number of leaf and stem lesions counted per plant.

<sup>y</sup> Normalized data; lesions divided by size rating.

<sup>x</sup> Data were analyzed by the nonparametric Kruskal-Wallis one-way ANOVA on ranks and means were separated by the Kruskal-Wallis multiple comparison Z-value test. Means within columns followed by the same letter are not significantly different ( $P = 0.05$ ).

**Table 2. Susceptibility of potted boxwood accessions from the U.S. National Arboretum to *Calonectria pseudonaviculata*.**

Accession No. <sup>z</sup>	Buxus species and cultivar	Size rating <sup>y</sup>	Lesions per plant <sup>x</sup>	Normalized <sup>w</sup>
60705*H	<i>B. sinica</i> var. <i>aemulans</i>	1.4	2.4 A <sup>v</sup>	2.3 A
36365*J	<i>B. sempervirens</i>	1.2	4.6 AB	2.6 AB
18834*H	<i>B. harlandii</i>	1.4	7.4 ABC	7.0 ABC
9548*H	<i>B. sempervirens</i> 'Scupi'	1.3	14.4 ABCD	14.4 ABCDEFG
4899*CH	<i>B. microphylla</i> 'Compacta'	1	14.5 ABCD	18.0 ABCDEFGHI
57953*H	<i>B. sempervirens</i> 'Arborescens'	1	16.3 ABCDE	16.3 ABCDEFGHI
51898*H	<i>B. sinica</i> var. <i>insularis</i> 'Pincushion'	1	17.0 ABCDEF	17.0 ABCDEFGHI
72213*H	<i>B. microphylla</i> var. <i>japonica</i> 'Jim Stauffer'	2.5	17.4 ABCDEF	10.0 ABC
57950*H	<i>Buxus</i> sp.	3.3	21.9 ABCDEF	7.1 ABC
51900*H	<i>B. sinica</i> var. <i>insularis</i> 'Winter Beauty'	1	22.8 ABCDEF	22.8 CDEFGHIJK
51906*H	<i>B.</i> 'Green Mound'	2	23.1 ABCDEF	12.4 ABCDE
7025*H	<i>B. microphylla</i> var. <i>japonica</i> 'National'	2.9	24.1 ABCDEF	9.4 ABC
33810*H	<i>B. microphylla</i> 'John Baldwin'	2.9	26.0 ABCDEFG	9.4 ABC
51904*K	<i>B.</i> 'Green Gem'	1.3	27.3 ABCDEFGH	25.5 CDEFGHIJK
52423*H	<i>B. harlandii</i> (= <i>Buxus bodinieri</i> )	1.4	28.1 ABCDEFGH	26.3 DEFGHIJK
51905*J	<i>B.</i> 'Green Mountain'	1.1	30.4 ABCDEFGH	29.8 GHIJK
17078*H	<i>B. sempervirens</i> 'Decussata'	2.8	34.1 BCDEFGH	14.2 ABCDEF
54326*H	<i>B. microphylla</i> var. <i>japonica</i> 'Winter Gem'	3.3	34.3 BCDEFGH	11.4 ABCD
6395*H	<i>B. sempervirens</i> 'Vardar Valley'	2	38.1 CDEFGH	23.8 CDEFGHIJK
4233*H	<i>B. sempervirens</i> 'Handsworthiensis'	3.5	41.8 CDEFGH	11.4 ABCD
29694*H	<i>B. sempervirens</i> 'Marginata'	2.4	47.6 CDEFGH	21.3 CDEFGHIJ
78079*H	<i>B. microphylla</i> var. <i>japonica</i> 'Gregem'	2	50.4 CDEFGH	24.6 CDEFGHIJK
51907*H	<i>B.</i> 'Green Velvet'	2.1	55.6 DEFGH	28.5 FGHIJK
34196*H	<i>B. sempervirens</i> 'Denmark'	3.3	57.9 EFGH	18.5 BCDEFGHIJ
68631*H	<i>B. sempervirens</i> 'Dee Runk'	3.9	58.4 EFGH	15.6 ABCDEFGH
29224*H	<i>B. microphylla</i> 'Grace Hendrick Phillips'	1	61.0 FGH	61.0 M
68273*H	<i>B.</i> 'Glencoe'	2	61.6 FGH	30.3 GHIJK
54327*H	<i>B. sempervirens</i> 'Newport Blue'	2.9	62.0 GH	21.9 CDEFGHIJ
35487*H	<i>B. sempervirens</i> 'Edgar Anderson'	4.1	64.8 GH	15.8 ABCDEFGH

35494*H	<i>B. sempervirens</i> 'Rotundifolia'	2.8	75.0	H	33.7	IJKL
33789*J	<i>B. sempervirens</i> 'Graham Blandy'	3.6	75.5	H	20.8	CDEFGHIJ
71429*H	<i>B.</i> 'Green Ice'	4.3	83.0	H	19.6	BCDEFGHIJ
34198*J	<i>B. sempervirens</i> 'Myrtifolia'	3.8	85.1	H	22.2	CDEFGHIJ
29701*H	<i>B. sempervirens</i> 'Northern New York'	3.6	89.5	H	26.0	DEFGHIJK
29703*H	<i>B. sempervirens</i> 'Suffruticosa'	2	91.4	H	45.5	LM
59820*H	<i>B. sempervirens</i> 'Pendula'	3.6	93.0	H	26.1	DEFGHIJK
69558*H	<i>B. sempervirens</i> 'Ohio'	4	107.0	H	27.1	EFGHIJK
51910*H	<i>B. sempervirens</i> 'Northland'	4	110.6	H	27.7	FGHIJK
31793*H	<i>B. sempervirens</i> 'Arborescens'	4.1	159.5	H	39.6	KL
51896*H	<i>Buxus wallichiana</i>	4.3	160.1	H	37.3	IJKL
	<i>P</i> =	0.00001	0.00001		0.00001	

<sup>z</sup> Accession number from the U.S. National Arboretum collection.

<sup>y</sup> Size rating based on a scale of 1 to 4

<sup>x</sup> Number of leaf and stem lesions counted per plant.

<sup>w</sup> Normalized data; lesions divided by size rating.

<sup>v</sup> Data were analyzed by the nonparametric Kruskal-Wallis one-way ANOVA on ranks and means were separated by the Kruskal-Wallis multiple comparison Z-value test. Means within columns followed by the same letter are not significantly different ( $P = 0.05$ ).

**Table 3. Susceptibility of detached leaves of *Buxus* species and hybrids from the U.S. National Arboretum collection to boxwood blight caused by *Calonectria pseudonaviculata*.**

<i>Buxus</i> species	Number of accessions evaluated	Percent leaves with lesions <sup>z</sup>	Percent leaf symptomatic <sup>y</sup>	Percent leaves with sporulation <sup>x</sup>
<i>B. harlandii</i> (= <i>B. bodinieri</i> )	2	43.7 A <sup>w</sup>	80.0 AB	22.2 A
<i>Buxus</i> hybrid ( <i>microphylla koreana</i> x <i>sempervirens</i> )	6	68.4 B	74.0 A	40.7 B
<i>B. microphylla</i>	7	67.5 B	71.6 A	35.8 AB
<i>B. sempervirens</i>	20	73.9 B	84.4 B	44.6 B
<i>B. sinica</i>	3	62.4 B	78.6 AB	48.2 B
<i>B. wallichiana</i> (51896*H)	1	91.8 C	76.0 AB	76.0 C
<i>P</i> =		0.00002	0.006	0.0002

<sup>z</sup> Percent of leaves with lesions resulting from inoculation with approximately 300 conidia in a single drop on the abaxial surface

<sup>y</sup> Percent of abaxial leaf surface symptomatic.

<sup>x</sup> Percent of leaves with conidia of *C. pseudonaviculata* present.

<sup>w</sup> Data were analyzed by the nonparametric Kruskal-Wallis one-way ANOVA on ranks and means were separated by the Kruskal-Wallis multiple comparison Z-value test. Means within columns followed by the same letter are not significantly different (*P* = 0.05).

**Table 4. Susceptibility of boxwood accessions from the U.S. National Arboretum to *Calonectria pseudonaviculata* as determined by a detached leaf assay.**

Accession No. <sup>z</sup>	Buxus species and cultivar	Disease on adaxial leaf surface <sup>y</sup>	Disease on abaxial leaf surface	Percent abaxial leaf symptomatic	Percent abaxial leaves with sporulation
60705*H	<i>B. sinica</i> var. <i>aemulans</i>	82 F <sup>x</sup>	83 CDEF	44.6 ABC	38.9 BCDEFG
36365*J	<i>B. sempervirens</i>	0 A	75 BCDEF	58.8 ABCDE	18.8 ABCD
18834*H	<i>B. harlandii</i>	33 D	72 BCDE	26.3 A	20.0 ABCD
9548*H	<i>B. sempervirens</i> 'Scupi'	0 A	84 DEF	74.3 CDEF	20.0 ABCD
4899*CH	<i>B. microphylla</i> 'Compacta'	13 ABC	60 ABC	56.8 ABCDE	28.0 ABCDE
57953*H	<i>B. sempervirens</i> 'Arborescens'	33 D	84 DEF	87.8 EFG	64.0 GHI
51898*H	<i>B. sinica</i> var. <i>insularis</i> 'Pincushion'	13 ABC	76 BCDEF	70.5 CDEF	56.0 FGH
72213*H	<i>B. microphylla</i> var. <i>japonica</i> 'Jim Stauffer'	0 A	76 BCDEF	78.0 DEFG	8.0 A
57950*H	<i>Buxus</i> sp.	0 A	72 BCDE	54.3 ABCD	44.0 DEFG
51900*H	<i>B. sinica</i> var. <i>insularis</i> 'Winter Beauty'	29 D	77 BCDEF	70.5 CDEF	46.2 DEFGH
51906*H	<i>B.</i> 'Green Mound'	0 A	72 BCDE	74.5 CDEF	48.0 DEFGH
7025*H	<i>B. microphylla</i> var. <i>japonica</i> 'National'	0 A	77 BCDEF	80.5 EFG	42.3 CDEFG
33810*H	<i>B. microphylla</i> 'John Baldwin'	13 ABC	96 F	88.5 FG	68.0 GHI
51904*K	<i>B.</i> 'Green Gem'	33 D	80 CDEF	73.8 CDEF	48.0 DEFGH
52423*H	<i>B. harlandii</i> (= <i>Buxus bodinieri</i> )	0 A	90 DEF	68.6 CDE	25.0 ABCDE
51905*J	<i>B.</i> 'Green Mountain'	33 D	72 BCDE	63.7 CDE	40.0 CDEFG
17078*H	<i>B. sempervirens</i> 'Decussata'	7 AB	92 EF	77.0 DEFG	32.0 BCDEF
54326*H	<i>B. microphylla</i> var. <i>japonica</i> 'Winter Gem'	0 A	68 ABCD	50.0 ABCD	16.0 ABC
6395*H	<i>B. sempervirens</i> 'Vardar Valley'	27 CD	68 ABCD	55.3 ABCD	12.0 AB
4233*H	<i>B. sempervirens</i> 'Handsworthiensis'	13 ABC	80 CDEF	70.5 CDEF	52.0 EFGH
29694*H	<i>B. sempervirens</i> 'Marginata'	20 BCD	96 F	73.0 CDEF	32.0 BCDEF
78079*H	<i>B. microphylla</i> var. <i>japonica</i> 'Gregem'	50 E	92 EF	80.0 EFG	61.5 FGHI
51907*H	<i>B.</i> 'Green Velvet'	0 A	72 BCDE	62.8 CDE	32.0 BCDEF
34196*H	<i>B. sempervirens</i> 'Denmark'	0 A	96 F	82.3 EFG	36.0 BCDEF
68631*H	<i>B. sempervirens</i> 'Dee Runk'	20 BCD	80 CDEF	41.5 AB	52.0 EFGH
29224*H	<i>B. microphylla</i> 'Grace Hendrick Phillips'	0 A	46 A	44.3 ABC	34.6 BCDEF
68273*H	<i>B.</i> 'Glencoe'	7 AB	56 AB	44.0 ABC	20.0 ABCD

54327*H	<i>B. sempervirens</i> 'Newport Blue'	27 CD	80 CDEF	78.8 DEFG	32.0 BCDEF
35487*H	<i>B. sempervirens</i> 'Edgar Anderson'	0 A	92 EF	84.5 EFG	68.0 GHI
35494*H	<i>B. sempervirens</i> 'Rotundifolia'	13 ABC	88 DEF	73.5 CDEF	36.0 BCDEF
33789*J	<i>B. sempervirens</i> 'Graham Blandy'	7 AB	84 DEF	71.3 CDEF	48.0 CDEFGH
71429*H	<i>B.</i> 'Green Ice'	7 AB	92 EF	92.6 FG	56.0 FGH
34198*J	<i>B. sempervirens</i> 'Myrtifolia'	13 ABC	96 F	87.8 EFG	88.0 I
29701*H	<i>B. sempervirens</i> 'Northern New York'	21 BCD	88 DEF	79.8 EFG	52.0 EFGH
29703*H	<i>B. sempervirens</i> 'Suffruticosa'	13 ABC	72 BCDE	55.3 ABCD	44.0 DEFG
59820*H	<i>B. sempervirens</i> 'Pendula'	20 BCD	92 EF	74.5 CDEF	40.0 CDEFG
69558*H	<i>B. sempervirens</i> 'Ohio'	13 ABC	72 BCDE	85.0 EFG	52.0 EFGH
51910*H	<i>B. sempervirens</i> 'Northland'	13 ABC	80 CDEF	87.0 EFG	64.0 GHI
31793*H	<i>B. sempervirens</i> 'Arborescens'	33 D	84 DEF	87.8 EFG	64.0 GHI
51896*H	<i>Buxus wallichiana</i>	7 AB	76 BCDEF	91.8 FG	76.0 HI
	<i>P</i> =	0.0001	0.0002	0.0001	0.0001

<sup>z</sup> Accession number from the U.S. National Arboretum collection.

<sup>y</sup> Percent leaves with lesions resulting from inoculation with approximately 300 conidia in a single drop on the adaxial or abaxial surface.

<sup>x</sup> Data were analyzed by the nonparametric Kruskal-Wallis one-way ANOVA on ranks and means were separated by the Kruskal-Wallis multiple comparison Z-value test. Means within columns followed by the same letter are not significantly different ( $P = 0.05$ ).

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