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Luther Waters, Director Auburn University
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DISEASE RESISTANCE AND ADAPTABILITY OF CRABAPPLE IN COASTAL ALABAMA

CONTENTS

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DISEASE RESISTANCE AND ADAPTABILITY OF CRABAPPLE IN COASTAL ALABAMA

A. K. HAGAN, K. M. TILT, J. D. WILLIAMS, AND J. R. AKRIDGE

INTRODUCTION

Spectacular spring floral displays, brilliant fall foliage, colorful and persistent fruit, and adaptability to a wide range of climatic and soil conditions have made crabapple (*Malus* spp.) a fixture in residential and commercial landscapes across the Northeast and Midwest *(6).* This tree, however, is rarely found in landscapes in Alabama and neighboring states, particularly in hotter, wetter regions of the Deep South *(6,9).*

Diseases may be largely responsible for the limited adaptability of crabapple in Alabama and surrounding Southern states. In this region, fireblight (*Erwinia amylovora* [Burrill] Winslow *et al.*) and cedar-apple rust (*Gymnosporangium juniperi-virginiana* Schwein) are recognized as common and often destructive diseases on crabapple, apple, hawthorn, and other members of the apple subfamily (*Pomodidae*) *(4,5,8).* Other potentially damaging diseases on crabapple in residential and commercial plantings include apple scab (*Venturia inaequalis* [Cooke] Wint.), powdery mildew (*Podosphaeria leucotricha* [Ell. & Ev.] E. S. Salmon), and frogeye leaf spot (*Botryosphaeria obtusa* [Schwein.] Shoemaker) *(4,5,7,8).* In contrast, apple scab is considered the most damaging disease on crabapple in the Midwest and Northeast followed distantly in importance by fireblight, cedar apple rust, and frogeye leaf spot *(5,6,8).*

Use of disease resistant crabapple cultivars, which is the preferred method of managing diseases in residential and commercial landscapes, greatly simplifies tree maintenance by nearly eliminating costly and time-consuming pesticide treatment programs. Resistance of crabapple to common diseases such as fireblight, apple scab, and cedar-apple rust has been assessed in field trials at several sites in the midsouth and cultivars resistant to one or more of the above diseases have been identified *(1,2,3,7,11,12).* Due to differences in regional weather patterns, cultivar

Hagan is a Professor in the Department of Entomology and Plant Pathology, Tilt is a Professor and Williams is an Associate Professor in the Department of Horticulture, and Akridge is Superintendent at the Brewton Experiment Field.

adaptation, and pathogen distribution and virulence, disease ratings from those sites may not be applicable to Alabama. As part of the National Crabapple Evaluation Program, a field planting was established to assess adaptability and disease resistance of 60 crabapple cultivars in a Benndale (A) fine sandy loam at the Brewton Experiment Field (Plant Hardiness Zone 8a), which is located approximately 50 miles north of Pensacola, Florida.

MATERIALS AND METHODS

Prior to planting, soil fertility and pH were adjusted according to the results of a soil fertility assay done by the Auburn University Soil Testing Laboratory. In May 1992, bare-root trees were planted on 18-foot centers in rows spaced 10 feet apart. Prior to planting, the healed-in, bare-root crabapples had begun to leaf out. The experimental design was a randomized complete block with five, three-tree replications. Each spring, approximately 3 pounds of 5-10-15 fertilizer was evenly distributed around the base of each tree. And directed applications of 1 pound of Gallery DF and 2 quarts of SurflanT/O per treated acre were made down the row center to control annual weeds. Hand weeding and directed applications of recommended rates of Roundup were used to control escape weeds. Alleys between the rows were mowed periodically.

Within one year of planting, fireblight and apple scab were well established on trees in this planting. Visual ratings of fireblight were made on May 28, 1993; May 24, 1994; and May 29, 1996 on a scale of 0 to 4 where 0 = no disease, 1 = one or a few blighted branch tips, 2 = numerous dead branch tips, 3 = several major branches damaged, and 4 = major portion of tree damaged or the tree died. Apple scab severity, which was assessed on the same dates as fireblight, was rated on a 0 to 5 scale where 0 = no disease, 1 = very few leaves with scab symptoms and no defoliation, 2 = many leaves with scab symptoms and no defoliation, 3 = most leaves with scab symptoms and moderate defoliation, 4 = most leaves with scab symptoms and heavy defoliation, and 5 = complete defoliation of tree. Tree survival was recorded on each date that disease ratings were taken.

In April 1997, landscape value was visually assessed on the basis of overall aesthetic appeal, flower proliferation, and disease severity on a scale of 1 to 5 where 1 = unacceptable for landscape use and 5 = highly desirable. Significance of treatment effects were tested by analysis of variance and means were compared with Fisher's protected least significance difference (LSD) test with a level of significance at $P = 0.05$ unless otherwise stated.

RESULTS

Overall, fireblight was the predominate disease observed on the 60 crabapple cultivars screened. Significant fireblight-related spur blight and shoot dieback was seen on selected crabapple cultivars in each of the years that disease ratings were taken.

Over the test period, *M. baccata* cv. Jackii remained free of fireblight (Table 1). Very minor and unobtrusive blossom or spur blight was seen only one of three years on the shoots of the cultivars Coral Burst, Pink Princess, Robinson dwarf, and Dolgo. Minimal blighting was noted in two of three years on Spring Snow dwarf, Adams dwarf, Radiant, Pink Spires, Adams, and Liset. In the other test year, these same cultivars were fireblight-free. Several cultivars such as Donald Wyman, Centurion, *M.* x *zumi* cv. Calocarpa, Indian Summer, and Liset dwarf were free of fireblight symptoms in at least one year but were lightly damaged by this disease in at least one of the other two years. Although fireblight-induced blossom and spur blight were seen in all three years on Jewelberry, Velvet Pillar (bush), Profusion, Bob White, and White Angel, the damage was generally light and had no impact on tree aesthetics.

In at least one year, most of the remaining cultivars of crabapple suffered significant and often unsightly blossom (Figure 1) and/or spur blight (Figure 2) as well as a shoot dieback (Figure 3). Crabapple cultivars that consistently had the worst fireblight damage over the three-year rating period included Mary Potter, Silver Moon, Brandywine, and Klehm's Improved Bechtel (Table 1). As indicated by disease ratings on Klehm's Improved Bechtel of 3.5 and 3.7 in 1994 and 1996, respectively, extensive scaffold limb dieback as well as a severe spur and blossom

TABLE 1. REACTION OF CRABAPPLE CULTIVARS TO FIREBLIGHT AND APPLE SCAB IN SOUTH ALABAMA

Cultivar	Fireblight[1]			Apple Scab[2]		
	1993	1994	1996	1993	1994	1996
Mary Potter	2.5[3]	2.2	2.0	0	0	0
Red Jade Dwarf	2.5	0.8	1.3	0	0	0
Purple Prince	2.3	0.7	0.6	0	0	0
Sentinel	2.3	1.7	1.5	0	0	0
Sinai Fire	2.3	1.6	0.3	0	0	0
Snowdrift Dwarf	2.2	1.8	1.5	0	0	0
Indian Magic	2.1	0.7	0.7	1	0	0
Professor Sprenger	2.0	0.8	0.5	0	0	0
Silver Moon	2.0	2.4	2.0	0	0	0
Snowdrift	2.0	1.9	0.6	0	0	0
Doubloons	1.9	1.4	0.8	0	0	0
Golden Raindrops	1.8	2.0	ND[4]	0	0	ND
Red Jade	1.8	0.3	0.8	0	0	0
Ormiston Roy	1.7	0.9	0.6	0	0	0
Klehm's Improved Bechtel	1.7	3.3	3.5	0	0	0
Sugar Tyme	1.6	0.8	0.4	0	0	0
M. floribunda	1.6	1.0	1.0	0	0	0
Selkirk	1.5	0.5	0.5	0	0	0
Candied Apple	1.5	0.1	0.1	0	0	0
Winter Gold	1.5	2.0	1.2	0	0	0
Brandywine	1.5	2.7	2.7	0	0	0

continued

TABLE 1, CONTINUED. REACTION OF CRABAPPLE CULTIVARS TO FIREBLIGHT AND APPLE SCAB IN SOUTH ALABAMA

Cultivar	Fireblight[1]			Apple Scab[2]		
	1993	1994	1996	1993	1994	1996
Hopa	1.5	2.0	1.0	0	0.1	0.5
Royalty Dwarf	1.5	0.1	0.5	0	0	0
Tea	1.4	0.3	0.1	0	0	0.4
Red Barron	1.4	1.1	0.5	0	0	0
Red Jewel	1.3	1.1	0.3	0	0	0
Baskatong	1.3	0.1	0.0	0	0	0
Andirondack	1.3	1.1	1.2	0	0	0
Red Splendor Dwarf	1.3	0.2	0.0	0	0	0
Strawberry Parfait	1.2	0.0	0.2	0.3	0	0
Beverly	1.2	0.1	0.3	0	0	0
Donald Wyman	1.2	0.0	0.0	0	0	0
M. floribunda Dwarf	1.2	0.4	1.0	0	0	0
Eleyi	1.1	0.7	0.0	1.2	2.1	1.7
Centurion	1.0	0.1	0.0	0	0	0
Prairifire	1.0	0.1	0.0	0	0	0
Louisa	1.0	0.1	1.0	0	0	0
Velvet Pillar (tree)	0.9	0.1	0.0	0	0	0
White Angel	0.8	0.5	0.1	0	0	0
M. zumi cv. Calocarpa	0.8	0.3	0.0	0	0	0
M. sargentii	0.8	1.9	1.0	0	0	0
M. sargentii Dwarf	0.7	1.6	0.2	0	0	0
Indian Summer	0.7	0.0	0.5	0	0	0
David	0.7	0.5	0.3	0	0	0
Bob White	0.7	0.1	0.1	0	0	0
Profusion	0.6	0.1	0.2	0.1	0.1	0
Liset Dwarf	0.6	0.0	0.3	0	0	0
Liset	0.4	0.1	0.0	0	0	0
Dolgo	0.3	0.0	0.0	0.2	0	0
Pink Spires	0.2	0.1	0.0	0	0.2	0
Adams	0.2	0.0	0.1	0	0	0
Velvet Pillar (shrub)	0.2	0.3	0.1	0	0	0
Radiant	0.2	0.0	0.4	0.7	0.9	0
Adams Dwarf	0.2	0.0	0.2	0	0	0
Robinson Dwarf	0.1	0.0	0.0	0	0	0.1
Jewelberry	0.1	0.2	0.3	0	0	0
Spring Snow Dwarf	0.1	0.1	0.0	0	0	0
Pink Princess	0.0	0.1	0.0	0	0	0
M. baccata cv. Jackii	0.0	0.0	0.0	0	0	0
Coral Burst	0.0	0.1	0.0	0	0	0

[1]Fireblight severity was assessed on a scale of 0 to 4 where 0 = no disease to 4 = major portion of tree damaged.
[2]Apple scab was rated on a scale of 0 to 5 where 0 = no disease to 5 = complete defoliation.
[3]Mean separation within columns for each variable was according to Fisher's protected least significance (LSD) test (P=0.05).
[4] ND = no data available due to death of all trees.

blight were recorded (Figure 4). Other cultivars, which were moderately to severely damaged (disease rating of 2.0 or above) by fireblight in at least one season, were Red Jade dwarf, Purple Prince, Sentinel, Sinai Fire, Snowdrift dwarf, Indian Magic, Professor Sprenger, Hopa, Winter Gold, and Snowdrift. Moderate disease development was noted in at least one growing season on all of the remaining crabapple cultivars.

The severity of apple scab in this crabapple planting was much lower than that recorded for fireblight. Significant disease development was seen in all three years only on the cultivar Eleyi (Figure 5) (Table 1). Radiant, which was heavily damaged by scab in a previous study *(2)*, suffered light scabbing in 1993 and 1994 but not in 1996. Noticeable scabbing of the leaves was seen in 1993 on Indian Magic. Very light scab outbreaks were noted in only one of three years on Royalty dwarf, Red Barron, Strawberry Parfait, Liset dwarf, Dolgo, Pink Spires, and Robinson dwarf.

Surprisingly, cedar apple rust, a common and often damaging disease in Alabama on apple and crabapple, was not a significant threat to tree aesthetics and health. Despite nearby stands of the red cedar, which is an alternate host for the causal fungus, the diagnostic leaf spots and premature defoliation associated with severe cedar apple rust outbreaks never appeared. In 1994, aecia associated with another cedar rust disease, probably cedar-quince rust, were noted on the fruit of 10 crabapple cultivars (Figure 6). The causal fungus *(G. clavipes)* colonized fruit of the cultivars *M. floribunda* and *M. floribunda* dwarf most often. Damage on all affected trees was light.

In 1994 and 1996, light to moderate outbreaks of the frogeye leaf spot were noted on a few crabapples. In both years, moderate to heavy spotting of the leaves was observed on Spring Snow dwarf (Figure 7), Louisa (Figure 8), David, and Ormiston Roy. Cultivars that suffered light frogeye leaf spot damage in 1994 included Professor Sprenger, Baskatong, and Snowdrift dwarf while typical leaf spotting was seen in 1996 on Bob White, Coral Burst, and Indian Summer. In a recent Tennessee study *(11)*, Spring Snow dwarf, Louisa, and Baskatong were also moderately to highly susceptible to frogeye leaf spot as were Red Splendor, Snowdrift dwarf, Donald Wyman, Jewelberry, Pink Spires, Red Barron, and White Angel. Red Barron also suffered significant leaf spotting in a Kentucky trial *(7)*.

The combination of delayed planting and no irrigation certainly contributed to the loss of many trees between May 1992 and May 1993. The cultivars *M. baccata* cv. Jackii, Donald Wyman, Golden Raindrops, Red Splendor dwarf, Sinai Fire, Red Barron, and Red Jewel had the poorest first-year survival rate (Table 2). Within the first year, 47 to 73% of the saplings of the above cultivars died. With the exception of Radiant with 100% survival, one or more trees of the remaining 52 cultivars were lost within the first year of establishment.

The level of tree survival from 1993 to 1996 declined for most cultivars. Among the cultivars suffering the sharpest decline in tree survival were Adirondack, Baskatong, Brandywine, Coral Burst, Indian Magic, Jewelberry, Liset, *M. sargentii*, Pink Princess, Pink Spires, Red Jade, Red Jade dwarf, Selkirk, Snowdrift, Straw-

Figure 1. Blossom blight.

Figure 2. Spur blight.

Figure 3. Shoot dieback.

Figure 4. Scaffold limb dieback and severe spur and blossom blight.

Figure 5. Apple scab on the cultivar Eleyi.

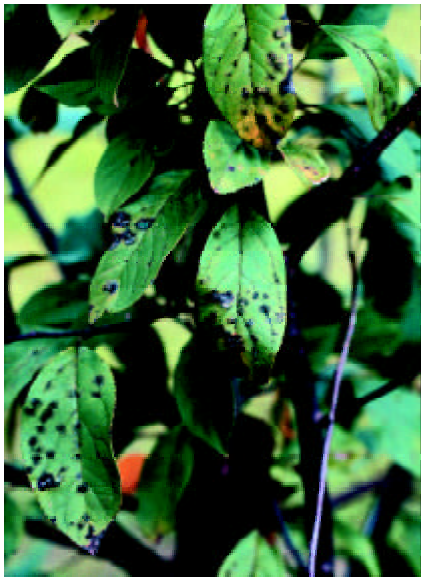

Figure 6. Aecia associated with cedar-quince rust.

Figure 7. Frogeye leaf spot on the cultivar Spring Snow dwarf.

Figure 8. (Above) Frogeye leaf spot on the cultivar Louisa.

Figure 9. (Right) Oxyporus root and collar rot is characterized by an overall decline in tree vigor, yellowing, stunting of the leaves, slowed shoot elongation, and finally by tree death.

TABLE 2. SURVIVAL OF CRABAPPLE CULTIVARS AT THE BREWTON EXPERIMENT FIELD IN 1993 AND 1996

Cultivar	% Survivors 1993	1996	Cultivar	% Survivors 1993	1996
Adams dwarf	83	83	Pink Spires	67	13
Adams	60	47	Prairifire	80	60
Adirondack	87	27	Professor Sprenger	60	53
M. baccata cv. Jackii	27	13	Profusion	87	60
Baskatong	80	13	Purple Prince	73	40
Beverly	87	80	Radiant	100	100
Bob White	67	60	Red Baron	53	27
Brandywine	80	33	Red Jade	80	33
Candied Apple	73	60	Red Jade dwarf	67	33
Centurion	93	80	Red Jewel	53	40
Coral Burst	80	40	Red Splendor dwarf	33	25
David	60	33	Robinson dwarf	73	67
Dolgo	87	53	Royalty dwarf	87	67
Donald Wyman	27	20	*M. sargentii*	73	20
Doublooms	67	33	*M. sargentii* dwarf	80	60
Eleyi	93	93	Selkirk	80	47
M. floribunda	67	53	Sentinel	60	60
M. floribunda dwarf	80	60	Silver Moon	60	20
Golden Raindrops	33	0	Sinai Fire	47	40
Hopa	80	73	Snowdrift	73	27
Indian Magic	67	33	Snowdrift dwarf	80	53
Indian Summer	87	73	Spring Snow dwarf	67	67
Jewelberry	73	40	Strawberry Parfait	80	27
Klehm's Improved Bechtel	73	47	Sugar Tyme	73	47
Liset dwarf	67	42	Tea	60	47
Liset	80	27	Velvet Pillar (shrub)	87	87
Lousia	67	27	Velvet Pillar (tree)	93	67
Mary Potter	67	33	White Angel	87	80
Ormiston Roy	80	60	Winter Gold	80	73
Pink Princess	93	40	M. zumi cv. Calocarpa	73	40

berry Parfait, Sugar Tyme, and *M.* x *zumi* cv. Calocarpa (Table 2). However, several other cultivars lost only one or two trees during this same time period. For the cultivars Adams dwarf, Eleyi, Radiant, Sentinel, Spring Snow dwarf, and Velvet Pillar (shrub), no trees died between May 1993 and May 1996. Again, 100% of the Radiant crabapples planted in 1992 survived through May 1996.

During this study, no specific information concerning the death of individual trees was collected. However, none of the foliar diseases observed, including fireblight, are the likely cause of tree death. Undoubtedly, stress attributed to the planting delay in 1992, periodic droughts, and sudden hard freezes may have contributed to tree loss. On a portion of the test site, a root and collar rot caused by the fungus *Oxyporus populinus* was also responsible for the decline and death of a

number of trees. Oxyporus root and collar rot is characterized by an overall decline in tree vigor, yellowing, stunting of the leaves, slowed shoot elongation, and finally by tree death (Figure 9) *(8)*.

At advanced stages of tree decline, the white mycelial mat of the causal fungus may frequently be seen growing on the surface of the lateral and taproot and around the root collar at or just below the soil surface. During this study, the roots were often so badly rotted that the diseased tree could easily be pulled out of the ground. In many instances, the off-white to yellow fruiting bodies (basidiocarps) of *O. populinus* were found on the trunk at the base of the dead trees just above the soil line (Figure 10). Although the soil at this site was classified as a well-drained sandy loam, wet areas were present within the test site, particularly behind several low terraces. Tree loss due to Oxyporus root rot appeared to have been concentrated in these wetter, poorly drained areas and was less common in the drier, higher portions of this site.

After eliminating cultivars susceptible to fireblight and cultivars with a poor survival rate, crabapples with the best landscape ratings included Eleyi, Radiant, Adams, Jewelberry, *M. floribunda* dwarf, and Velvet Pillar (tree form) (Table 3).

TABLE 3. LANDSCAPE VALUE OF CRABAPPLE CULTIVARS AT THE BREWTON EXPERIMENT FIELD, 1996

Cultivar	Rating[1]	Cultivar	Rating	Cultivar	Rating
Adams dwarf	2.4	Indian Magic	2.8	Red Splendor dwarf	4.0
Adams	3.4	Indian Summer	3.0	Robinson dwarf	3.0
Adirondack	2.7	Jewelberry	3.5	Royalty dwarf	2.3
M. baccata cv. Jackii	4.0	Klehm's Improved Bechtel	2.2	M. sargentii	2.7
Baskatong	2.3	Liset dwarf	2.5	M. sargentii dwarf	2.9
Beverly	2.6	Liset	3.0	Selkirk	2.7
Bob White	3.0	Lousia	3.0	Sentinel	2.3
Brandywine	3.0	Mary Potter	2.6	Silver Moon	2.5
Candied Apple	2.5	Ormiston Roy	2.1	Sinai Fire	2.2
Centurion	2.5	Pink Princess	2.5	Snowdrift	3.7
Coral Burst	3.0	Pink Spires	2.9	Snowdrift dwarf	2.9
David	2.6	Prairifire	2.5	Spring Snow dwarf	2.1
Dolgo	2.4	Professor Sprenger	2.7	Strawberry Parfait	2.2
Donald Wyman	2.0	Profusion	3.8	Sugar Tyme	2.5
Doubloons	1.4	Purple Prince	3.1	Tea	3.1
Eleyi	3.5	Radiant	3.5	Velvet Pillar (shrub)	2.4
M. floribunda	2.1	Red Baron	1.0	Velvet Pillar (tree)	3.2
M. floribunda dwarf	3.4	Red Jade	3.0	White Angel	2.7
Golden Raindrops	1.0	Red Jade dwarf	3.0	Winter Gold	2.7
Hopa	2.9	Red Jewel	2.6	*M. zumi* cv. Calocarpa	1.2

[1]Landscape value ratings range from 1 to 5 where 1 = not suitable for landscape use and 5 = highly desirable for landscape use.

Red Splendor dwarf and *M. baccata* cv. Jackii also had very high landscape values (4.0) but a majority of the trees of both these cultivars died shortly after establishment. Tea, Profusion, Red Jade, Snowdrift, Pink Spires, Red Jade, Red Jade dwarf, Purple Prince, Coral Burst, Indian Summer, Robinson dwarf, Liset, Louisa, and Brandywine crabapples had good landscape quality ratings (3.0 or above). However, sizable numbers of trees of many of the above cultivars succumbed between 1993 and 1996 to Oxyporus root rot or perhaps to some other stress-induced disorder. Clearly, the crabapples with clearly the lowest quality ratings were *M.* x *zumi Calocarpa*, Red Barron, Doubloons, and Golden Raindrops.

SUMMARY

The poor performance of many cultivars and the prevalence of Oxyporus root rot clearly show that the majority of crabapples tested are not well adapted to the Coastal Plain region of Alabama. Eleyi, Radiant, Adams dwarf, Velvet Pillar, and Tea, all of which had good landscape ratings, high rates of survival after planting, and generally good fireblight and frogeye leaf spot resistance, would be acceptable choices for Alabama landscapes, particularly those in the southern half of the state. Red Splendor dwarf and *M. baccata* cv. Jackii, which were both resistant to the above diseases and had high landscape ratings, should also make good landscape trees. Windham *et al. (11)* also reported that the cultivars Adams dwarf and *M. baccata* cv. Jackii, as well as Bob White and Profusion, were highly resistant to fireblight and frogeye leaf spot. In both this and the Tennessee study *(7)*, the sensitivity of the Tea crabapple to fireblight was also noted. Of the seven highest rated crabapples in the Alabama study, only Adams and *M. baccata* cv. Jackii were recommended for use in Plant Hardiness Zones 6 and 7 *(3)*. In South Carolina, Adams, Bob White, Professor Sprenger, and Red Jewel crabapples demonstrated good resistance to all foliar diseases and were recommended for urban and roadside use while Red Barron was suggested for urban use only *(1)*.

Of the recommended cultivars, Radiant and Eleyi crabapple were slightly and moderately susceptible, respectively, to apple scab. With the exception of Eleyi, the level of apple scab damage on Radiant and the few other scab-damaged cultivars was much lower than that typically associated with outbreaks of this disease on crabapples in other regions of the United States *(2,7,11)*. However, apple scab-susceptible crabapples like Eleyi are likely to suffer greater damage in the Appalachian Mountains and nearby foothills in North Alabama because weather patterns there are likely to be more favorable for disease than those at the Brewton Experiment Field *(7)*. Several horticulturists have suggested that scab-sensitive Radiant and Eleyi crabapples should be removed from nursery production schedules *(5,6)*. In this study, however, these cultivars had among the highest landscape ratings recorded *(10)*.

The absence of cedar apple rust in this crabapple planting was a surprise. The trees were inspected late enough during the growing season that the characteristic spotting of the leaves would have been seen. This often-damaging disease is quite

widespread on apple and crabapple, as well as on native and cultivated hawthorn in Alabama, particularly where native stands of red cedar are found. Previous work in North Carolina has shown that Ormiston Roy, David, and Radiant are susceptible to this disease *(2)*. In a recent Tennessee study *(11)*, the only crabapples damaged by cedar apple rust were Brandywine and Klehm's Improved Bechtel. Landscapers and homeowners must remember to choose crabapples that are not only resistant to fireblight and apple scab but also to cedar apple rust.

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