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# Susceptibility of Crabapple Cultivars to Several Diseases in the Gulf Coast Region of Alabama[1]

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## Abstract

The occurrence and severity of fireblight (*Erwinia amylovora*), apple scab (*Venturia inequalis*), cedar rust diseases (*Gymnosporangium* sp.), powdery mildew (*Podosphaeria leucotricha*) and frogeye leaf spot (*Botryosphaeria obtusa*) were assessed on 60 cultivars of flowering crabapple (*Malus* sp.) in Brewton, AL (Plant Hardiness Zone 8). Of these diseases, fireblight was the most widespread and damaging over the four-year test period. Noticeable and sometimes damaging levels of frogeye leaf spot and apple scab were seen on a few select crabapple cultivars. Surprisingly, none of the cedar rust diseases commonly found in Alabama on members of the apple family caused significant damage. The signs or symptoms of powdery mildew were never seen on any of the 60 crabapples. Of the crabapple cultivars screened, 'Eleyi', 'Radiant', 'Adams' dwarf, and 'Velvet Pillar' had the highest survival rates, as well as resistance to fireblight and frogeye leaf spot. However, 'Radiant' and, particularly, 'Eleyi' are sensitive to apple scab and may suffer considerable damage in landscape plantings where the climate is cooler. 'Red Splendor' dwarf and *M. baccata* cv. 'Jackii' were also highly disease resistant but did not have good rates of survival. Oxysporus root and collar rot (*O. latemarginatus*) killed many trees and was most prevalent in poorly drained areas found behind several low terraces. On the basis of the high risk of disease and poor overall survival rate, the majority of crabapples tested cannot be considered well adapted to the Gulf Coast region of Alabama nor to adjoining states.

**Index words:** *Malus* sp., disease resistance, fireblight, *Erwinia amylovora*, cedar rust diseases, *Gymnosporangium* sp., apple scab, *Venturia inequalis*, frogeye leaf spot, *Botryosphaeria obtusa*, powdery mildew, *Podosphaeria leucotricha*, Oxysporus root and collar rot, *Oxysporus latemarginatus.*

**Species used in this study:** crabapple (*Malus* sp.); Siberian crabapple (*M. baccata* (L.) Borkhausen); Japanese flowering crabapple (*M. floribunda* Siebold); Sargent's crabapple (*M. sargentii* Rehder); Redbud crabapple (*M. zumi* Rehder).

### Significance to the Nursery Industry

Currently, crabapples are greatly underutilized in southern landscapes, particularly those across the Deep South. Their limited use may be due to diseases such as fireblight, cedar apple rust, and to a lesser extent apple scab, powdery mildew, and frogeye leaf spot, all of which can have a negative impact on tree aesthetics and health in both the landscape and the production nursery. Also, other diseases, which may be seen rarely in more temperate regions, may also pose a significant threat to the tree health and beauty. Of the diseases observed on 60 crabapple cultivars, fireblight was the most widespread and destructive. Over the four-year evaluation, however, a number of crabapples consistently suffered little if any significant blossom and spur blight. 'Coral Burst', *M. baccata* cv. 'Jackii', 'Pink Princess', 'Jewelberry', 'Robinson' dwarf, 'Adams' dwarf, 'Velvet Pillar', 'Adams', 'Dolgo', and 'Liset', which were among the cultivars with the best fireblight ratings, also demonstrated good resistance to frogeye leaf spot and apple scab. When tree survival was also included as a factor, the highest rated crabapples, all of which would be acceptable choices for southern Alabama landscapes, were 'Eleyi', 'Radiant', 'Adams' dwarf, and 'Velvet Pillar'.

### Introduction

Spectacular spring floral displays, brilliant fall foliage, colorful and persistent fruit, as well as adaptability to a wide range of climatic and soil conditions, have made crabapple (*Malus* sp.) a favorite in residential and commercial landscapes across the Northeast and Midwest (6). Crabapple is found primarily in landscapes in the cooler, drier regions of Alabama (6, 7, 10).

Diseases may be partially responsible for the limited adaptability of crabapple in Alabama and adjoining Gulf Coast states. Throughout this region, fireblight (*Erwinia amylovora* (Burrill) Winslow *et. al.*) and cedar apple rust (*Gymnosporangium juniperi-virginiana* Schwein) are recognized as the most common and destructive diseases on crabapple and other members of the apple subfamily (*Pomodidae*) (4, 5, 9). Other potentially damaging diseases of crabapple in nursery and landscape 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, 8, 9). In the Midwest and Northeast, apple scab, which is the most damaging disease on crabapple, is distantly followed in importance by fireblight, cedar apple rust, and frogeye leaf spot (5, 7, 9).

The use of adapted, disease-resistant crabapples, which is the preferred method of managing diseases in landscape plantings and in the nursery, greatly simplifies tree production and maintenance by eliminating the need for costly and time consuming fungicide treatments. Resistance of crabapples to common diseases such as fireblight, apple scab, and cedar apple rust has been assessed in field trials at several Upper- and Mid-South sites and cultivars resistant to one or more of theses diseases have been identified (1, 2, 3, 8, 12, 13). Due to differences in regional weather patterns as well as pathogen distribution and pathotype virulence, the results of those studies may not be applicable to the southern half of Alabama. As part of the National Crabapple Evaluation Program, a planting of 60 crabapple cultivars was estab-

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lished to identify the common diseases in the Gulf Coast region of Alabama and to assess their resistance to those diseases.

## Material and Methods

Prior to planting, soil fertility and pH of a Benndale (A) fine sandy loam soil 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 5.5 m (18 ft) centers in rows spaced 3.1 m (10 ft) apart on the Brewton Experiment Field in Brewton, AL (USDA Plant Hardiness Zone 8a), which is located approximately 50 miles northeast of Pensacola, FL. Prior to plot establishment, the healed-in bare-root crabapple saplings had begun to leaf out. The experimental design was a randomized complete block with 5 three-tree replications. Each spring, approximately 2.3 kg (3 lb) of 5–10–15 fertilizer was uniformly distributed around the base of each tree. Except for the summer of 1992, the trees were not irrigated. Each spring, directed applications of 0.9 kg (1 lb/A) of Gallery™ DF and 4.6 liters (2 qt/A) of Surflan™ T/O per treated hectare 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 numerous 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 tree died. Apple scab severity, which was visually assessed on the same day 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. Significance of treatment effects was 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 and Discussion

*Fireblight*. Overall, fireblight was the predominant disease observed on the 60 crabapple cultivars screened. Significant fireblight-related spur blight and shoot dieback were seen on selected cultivars in each year that disease ratings were taken. Over the test period, considerable differences in disease severity were noted from one year to the next on the fireblight-sensitive crabapples.

Over the three-year evaluation period, *M. baccata* cv. 'Jackii' was the only crabapple that remained free of fireblight (Table 1). As indicated by fireblight ratings of 0.1 to 0.3, extremely low and unobtrusive levels of blossom or spur blight were seen in one of three years on 'Coral Burst', 'Pink Princess', 'Robinson' dwarf, and 'Dolgo'. Similarly low levels of blossom and spur blight were seen in two of three years on 'Spring Snow' dwarf, 'Adams' dwarf, 'Radiant', 'Pink Spires', 'Adams', and 'Liset'. In the remaining years, the above crabapples were fireblight-free. Although fireblight occurred in all three years on 'Jewelberry' and 'Velvet Pillar' (shrub), damage ratings for these two cultivars did not differ significantly from those recorded for the fireblight-free *M. baccata* cv. 'Jackii'. In 1993, disease ratings for 'Profusion', 'Bob White', 'David', 'Centurion', *M.* x *zumi* cv. 'Calocarpa', 'Indian Summer', 'Velvet Pillar' (tree), 'Prairifire', 'White Angel', and 'Liset' dwarf were significantly higher than those of *M. baccata* cv. 'Jackii'. With fireblight ratings of 0.7 to 1.0, the injury to these selections was limited to blighting of only one or a handful of bloom clusters or spurs, which had no impact on tree aesthetics. In 1994 and 1996, when overall fireblight pressure appeared to be lower, disease ratings of the above crabapples were similar to those recorded for the blight-free *M. baccata* cv. 'Jackii'. Crabapple selections such as 'Donald Wyman', 'Beverly', 'Strawberry Parfait', 'Red Splendor' dwarf, 'Baskatong', 'Tea', 'Royalty' dwarf, 'Candied Apple', and 'Selkirk' suffered moderate damage in 1993 but not in the remaining two years.

In at least one year, most of the remaining cultivars of crabapple suffered significant and often unsightly blossom and spur blight, as well as varying levels of shoot dieback. Over the three year rating period, the crabapples that consistently had the heaviest levels of blossom and spur blight were 'Mary Potter', 'Silver Moon', 'Brandywine', and 'Klehm's Improved Bechtel' (Table 1). As indicated by disease ratings of 3.3 to 3.5, respectively, in 1994 and 1996, an extensive dieback of the scaffold limbs, as well as severe spur and blossom blight, was recorded on 'Klehm's Improved Bechtel'. Also, 'Brandywine' and 'Klehm's Improved Bechtel' were among the few cultivars on which fireblight intensified over the test period. Additional cultivars with disease ratings of 2.0 or above in at least one year were 'Red Jade' dwarf, 'Purple Prince', 'Sentinel', 'Sinai Fire', 'Snowdrift' dwarf, 'Indian Magic', 'Professor Sprenger', 'Hopa', 'Winter Gold', 'Golden Raindrops', and 'Snowdrift'. Moderate fireblight damage was noted in at least one growing season on all of the remaining crabapples.

The reaction of crabapples to fireblight in a recent Tennessee study (12) generally was similar to the results reported here. In both studies, 'Mary Potter', 'Red Jade' dwarf, 'Purple Prince', 'Snowdrift' dwarf, 'Professor Sprenger', 'Silver Moon', 'Klehm's Improved Bechtel', 'Sugar Tyme' and *M. floribunda* were among the crabapples most susceptible to fireblight. In contrast to the Tennessee study (12), 'Sentinel', 'Sinai Fire', 'Doubloons', and 'Golden Raindrops' were susceptible to fireblight in South Alabama. 'Coral Burst', *M. baccata* cv. 'Jackii', 'Spring Snow' dwarf, 'Robinson' dwarf, 'Adams' dwarf, 'Radiant', 'Adams', and 'Dolgo' were identified in both studies as being highly resistant to fireblight. On the other hand, 'Pink Princess', 'Jewelberry', 'Velvet Pillar', 'Pink Spires', and 'Liset', which were moderately susceptible to fireblight in the Tennessee study (12), demonstrated a high level of resistance to this disease in Alabama.

*Apple scab*. Over the three year rating period, the incidence and severity of apple scab were considerably below those noted for fireblight. The great majority of crabapples screened remained free of this disease. In any given year that ratings were taken, disease levels on only 5 crabapples were significantly higher than for those of the disease-free selections (Table 1). 'Eleyi' was the only cultivar that consistently

**Table 1. Reaction of crabapple cultivars to fireblight and apple scab in South Alabama.**

| Cultivar | Fireblight[z] | | | Apple Scab[z] | | |
|---|---|---|---|---|---|---|
| | 1993 | 1994 | 1996 | 1993 | 1994 | 1996 |
| Mary Potter | 2.5[x] | 2.2 | 2 | 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 | 0.8 | 0.5 | 0 | 0 | 0 |
| Silver Moon | 2 | 2.4 | 2 | 0 | 0 | 0 |
| Snowdrift | 2 | 1.9 | 0.6 | 0 | 0 | 0 |
| Doubloons | 1.9 | 1.4 | 0.8 | 0 | 0 | 0 |
| Golden Raindrops | 1.8 | 2 | ND[w] | 0 | 0 | ND[w] |
| Red Jade | 1.8 | 0.3 | 0.8 | 0 | 0 | 0 |
| Onniston 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 | 1 | 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 | 1.2 | 0 | 0 | 0 |
| Brandywine | 1.5 | 2.7 | 2.7 | 0 | 0 | 0 |
| Hopa | 1.5 | 2 | 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 |
| Andirondack | 1.3 | 1.1 | 1.2 | 0 | 0 | 0 |
| Red Splendor dwarf | 1.3 | 0.2 | 0 | 0 | 0 | 0 |
| Strawberry Parfait | 1.2 | 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 |
| *M. floribunda* dwarf | 1.2 | 0.4 | 1 | 0 | 0 | 0 |
| Eleyi | 1.1 | 0.7 | 0 | 1.2 | 2.1 | 1.7 |
| Centurion | 1 | 0.1 | 0 | 0 | 0 | 0 |
| Prairifire | 1 | 0.1 | 0 | 0 | 0 | 0 |
| Louisa | 1 | 0.1 | 1 | 0 | 0 | 0 |
| Velvet Pillar (tree) | 0.9 | 0.1 | 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 |
| *M. sargentii* | 0.8 | 1.9 | 1 | 0 | 0 | 0 |
| *M. sargentii* dwarf | 0.7 | 1.6 | 0.2 | 0 | 0 | 0 |
| Indian Summer | 0.7 | 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 | 0.3 | 0 | 0 | 0 |
| Liset | 0.4 | 0.1 | 0 | 0 | 0 | 0 |
| Dolgo | 0.3 | 0 | 0 | 0.2 | 0 | 0 |
| Pink Spires | 0.2 | 0.1 | 0 | 0 | 0.2 | 0 |
| Adams | 0.2 | 0 | 0.1 | 0 | 0 | 0 |
| Velvet Pillar (shrub) | 0.2 | 0.3 | 0.1 | 0 | 0 | 0 |
| Radiant | 0.2 | 0 | 0.4 | 0.7 | 0.9 | 0 |
| Adams dwarf | 0.2 | 0 | 0.2 | 0 | 0 | 0 |
| Robinson dwarf | 0.1 | 0.0 | 0 | 0 | 0 | 0 |
| Jewelberry | 0.1 | 0.2 | 0.3 | 0 | 0 | 0 |
| Spring Snow Dwarf | 0.1 | 0.1 | 0 | 0 | 0 | 0 |
| Pink Princess | 0 | 0 | 0 | 0 | 0 | 0 |
| *M. baccata* cv. Jackii | 0 | 0 | 0 | 0 | 0 | 0 |
| Coral Burst | 0 | 0.1 | 0 | 0 | 0 | 0 |
| LSD (P = 0.05) | 0.5 | 0.7 | 0.8 | 0.3 | 0.2 | 0.3 |

[z]Fireblight severity was assessed on a scale of 0 to 4 where 0 = no disease to 4 = major portion of tree damaged.

[y]Apple scab was rated on a scale of 0 to 5 where 0 = no disease to 5 = complete defoliation.

[x]Mean separation within columns for each variable was according to Fisher's protected least significance difference (LSD) test (P = 0.5).

[w]ND = no data available due to death of all trees.

suffered moderate to heavy scabbing of the leaves and premature defoliation. Light but significant scabbing of the leaves was seen on 'Radiant' in 1993 and 1994 as well as on 'Indian Magic' in 1993. In 1996, scab ratings for 'Hopa' and 'Tea', which were an unobtrusive 0.4 and 0.5, respectively, were significantly higher than those recorded for the disease-free crabapples. In one or two years, light and insignificant scabbing of the leaves was noted on 'Strawberry Parfait', 'Profusion', 'Dolgo', 'Pink Spires', and 'Robinson' dwarf.

Of the recommended cultivars (11), only '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 disease outbreaks on crabapple in other regions of the United States (2, 8, 12). However, apple scab-susceptible crabapples like 'Eleyi' are likely to suffer greater damage in the Appalachian Mountains and nearby foothills in North Alabama where weather patterns may favor disease onset (8). Although the removal of scab-sensitive 'Radiant' and 'Eleyi' crabapples from nursery production schedules has been suggested (5, 7), these cultivars had among the highest survival rates and landscape ratings recorded in this study (11).

*Cedar rust diseases*. Cedar apple rust, which is a common and often damaging disease on several members of the apple subfamily in Alabama, did not pose a significant threat to tree aesthetics and health. Despite nearby stands of the red cedar, which is the most common alternate host for the causal fungus, the characteristic leaf spotting and premature defoliation associated with severe cedar apple rust outbreaks never developed. In 1994, aecia associated with cedar quince rust appeared on the fruit of 10 crabapple cultivars. Most often, the fruit of *M. floribunda* and *M. floribunda* dwarf were colonized by causal fungus of cedar quince rust, *G. clavipes*. Damage on all diseased trees was light.

The absence of cedar apple rust in this crabapple planting was a surprise. Typically, symptoms of this damaging disease are commonly seen in late spring and early summer across Alabama on apple, crabapple, and other members of the apple family wherever 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 Tennessee (12), the only crabapples damaged by cedar apple rust were 'Brandywine' and 'Klehm's Improved Bechtel'. Landscapers and homeowners must remember to select crabapples that are not only resistant to fireblight and apple scab but also to cedar apple rust.

*Frogeye leaf spot*. Frogeye leaf spot proved more damaging to selected crabapples than expected. In 1994 and 1996, light to moderate outbreaks of frogeye leaf spot were noted on several crabapple selections (data not presented). In both years, the heaviest spotting of the leaves was observed on 'Spring Snow' dwarf, 'Louisa', 'David', and 'Ormiston Roy'. In 1994, 'Professor Sprenger', 'Baskatong', and 'Snowdrift' dwarf suffered noticeable leaf spot damage. Typical frogeye leaf spot symptoms were seen in 1996 on the leaves of 'Bob White', 'Coral Burst', and 'Indian Summer' crabapples. In a recent Tennessee study (12), 'Spring Snow' dwarf, 'Louisa', and 'Baskatong' also proved moderately to highly susceptible to frogeye leaf spot. Noticeable spotting of the leaves was also found on Red Splendor, Snowdrift dwarf, 'Donald Wyman', 'Jewelberry', 'Pink Spires', 'Red Barron', and 'White Angel'. In Kentucky, McNeil (8) reported that 'Red Barron', as well as 'Dolgo', 'Red Splendor', 'Robinson', 'Selkirk', and 'Adams' crabapple suffered significant spotting of the leaves.

Recent crabapple cultivar evaluations, particularly those in Kentucky (8) and Tennessee (12), have demonstrated that this disease can be responsible for significant leaf spotting, thereby having a negative impact on tree aesthetics. Crabapples such as 'Spring Snow' dwarf, 'Louisa', 'Baskatong', 'Snowdrift' dwarf, and 'Red Barron', which suffered noticeable leaf spot damage in all three trials (8, 12), should not be established in landscape plantings.

The combination of delayed planting and no irrigation 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 after establishment, most likely to the previously mentioned factors.

For most of crabapples, the percentage of surviving trees declined from 1993 to 1996. The sharpest decline in tree survival was noted for 'Adirondack', 'Baskatong', 'Brandywine', 'Coral Burst', 'Indian Magic', 'Jewelberry', 'Liset', *M. sargentii*, 'Pink Princess', 'Pink Spires', 'Red Jade', 'Red Jade' dwarf, 'Selkirk', 'Snowdrift', 'Strawberry Parfait', 'Sugar Tyme', and *M.* x *zumi* cv. 'Calocarpa' (Table 2). For a number of other cultivars, only one or two trees were lost during the same time period. For 'Adams' dwarf, 'Eleyi', 'Radiant', 'Sentinel', 'Spring Snow' dwarf, and 'Velvet Pillar' (shrub), the percentage of surviving trees did not change between 1993 and 1996. Again, 100% of the 'Radiant' crabapples planted in 1992 survived into the 1996 growing season.

Over the four-year test period, powdery mildew was not observed on the leaves or tender shoots of any of the 60 cultivars of crabapple screened. Similar results were reported for previous studies on crabapple in Kentucky (8) and North Carolina (2). In Tennessee, Windham *et al.* (12) attributed the very low level of powdery mildew to the resistance of the 55 cultivars screened. In South Carolina, Aitken (1) noted that the 'Winter Gold' crabapple was slightly susceptible to this disease. Overall, powdery mildew apparently poses little threat to the health and beauty of the majority of crabapple selections across the Southeast.

During this study, no specific information concerning the cause of death for individual trees was collected. However, none of the foliar diseases observed, including fireblight, were the likely cause of tree death. Undoubtedly, stress attributed to the planting delay in 1992 as well as periodic droughts, sudden hard freezes, and inadequate chill hours all contributed to tree loss. A root and collar rot caused by the fungus *Oxyporus latemarginatus* 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 or chlorosis of the foliage, stunting of the leaves, slowed shoot elongation, and, finally, tree death (9). At advanced stages of tree decline, the

**Table 2. Survival of crabapple cultivars at the Brewton Experiment Field in 1993 and 1996.**

| Cultivar | Survivors % | | Cultivar | Survivors % | | Cultivar | Survivors % | |
|---|---|---|---|---|---|---|---|---|
| | 1993 | 1996 | | 1993 | 1996 | | 1993 | 1996 |
| Adams dwarf | 83[z] | 83 | Indian Magic | 67 | 33 | Red Splendor dwarf | 33 | 25 |
| Adams | 60 | 47 | Indian Summer | 87 | 73 | Robinson dwarf | 73 | 67 |
| Adirondack | 87 | 27 | Jewelberry | 73 | 40 | Royalty dwarf | 87 | 67 |
| *M. baccata* cv. Jackii | 27 | 13 | Kelhm's Improved Bechtel | 73 | 47 | *M. sargentii* | 73 | 20 |
| Baskatong | 80 | 13 | Liset dwarf | 67 | 42 | *M. sargentii* dwarf | 80 | 60 |
| Beverly | 87 | 80 | Liset | 80 | 27 | Selkirk | 80 | 47 |
| Bob White | 67 | 60 | Lousia | 67 | 27 | Sentinel | 60 | 60 |
| Brandywine | 80 | 33 | Mary Potter | 67 | 33 | Silver Moon | 60 | 20 |
| Candied Apple | 73 | 60 | Ormiston Roy | 80 | 60 | Sinai Fire | 47 | 40 |
| Centurion | 93 | 80 | Pink Princess | 93 | 40 | Snowdrift | 73 | 27 |
| Coral Burst | 80 | 40 | Pink Spires | 67 | 13 | Snowdrift dwarf | 80 | 53 |
| David | 60 | 33 | Prairifire | 80 | 60 | Spring Snow dwarf | 67 | 67 |
| Dolgo | 87 | 53 | Professor Sprenger | 60 | 53 | Strawberry Parfait | 80 | 27 |
| Donald Wyman | 27 | 20 | Profusion | 87 | 60 | Sugar Tyme | 73 | 47 |
| Doublooms | 67 | 33 | Purple Prince | 73 | 40 | Tea | 60 | 47 |
| Eleyi | 93 | 93 | Radiant | 100 | 100 | Velvet Pillar (shrub) | 87 | 87 |
| *M. floribunda* | 67 | 53 | Red Baron | 53 | 27 | Velvet Pillar (tree) | 93 | 67 |
| *M. floribunda* dwarf | 80 | 60 | Red Jade | 80 | 33 | White Angel | 87 | 80 |
| Gold Raindrops | 33 | 0 | Red Jade dwarf | 67 | 33 | Winter Gold | 80 | 73 |
| Hopa | 80 | 73 | Red Jewel | 53 | 40 | *M. zumi* cv. Calocarpa | 73 | 40 |
| LSD (P = 0.05) | 38 | 35 | LSD (P = 0.05) | 38 | 35 | LSD (P = 0.05) | 38 | 35 |

[z]Mean separation within columns for each variable was according to Fischer's protected least significance difference (LSD) test (P = 0.05).

white mycelial mat of the causal fungus may often be seen growing on the surface of the lateral and taproot and around the root collar at or just below the soil surface (9). Often, the roots are so badly rotted that the diseased tree can easily be pulled out of the ground. The off-white to yellow basidiocarps of *O. latemarginatus* were often found on the trunk at the base of the dead trees just above the soil line. 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. As previously reported (9), tree loss due to Oxyporus root rot was concentrated in these wetter, poorly drained areas and appeared to be less common in the drier, higher portions of this site.

The threat of damaging fireblight outbreaks, poor survival rates, and the occurrence of Oxyporus root rot indicate that many of the 60 crabapple selections screened are not well adapted to the Gulf Coast Region of Alabama and adjoining states. 'Eleyi', 'Radiant', 'Adams' dwarf, 'Velvet Pillar', and 'Tea', all of which had high survival rates, were generally resistant to fireblight and frogeye leaf spot, and had good landscape ratings (11), and 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 resistant to both of the above diseases but had low survival rates, may, with proper care, also make good landscape trees. Windham *et al.* (12) also reported that 'Adams' dwarf and *M. baccata* cv. 'Jackii', as well as 'Bob White' and 'Profusion', were highly resistant to both fireblight and frogeye leaf spot. In both this and the Tennessee study (12), 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 Zone 6 and 7 (3). In South Carolina, 'Adams', 'Bob White', 'Professor Sprenger', and 'Red Jewel' crabapples demonstrated good overall disease resistance and were recommended for urban and roadside use, while 'Red Barron' was suggested for urban use only (1).

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