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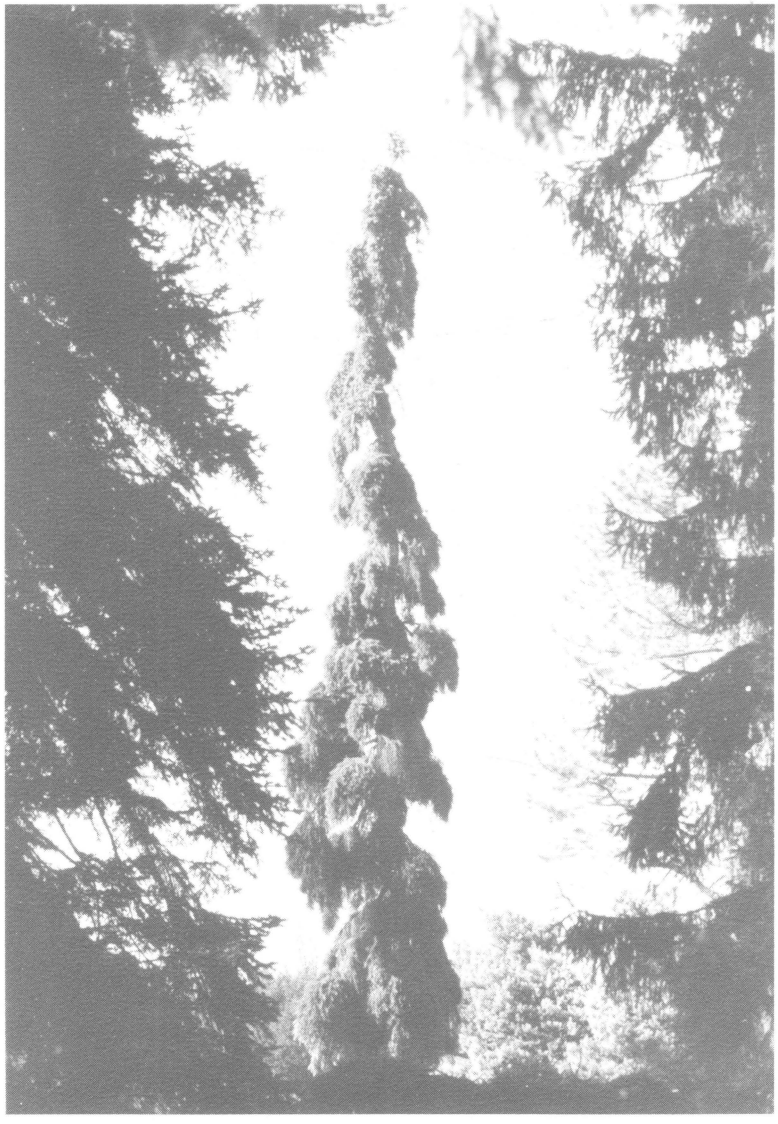

The Ohio State University
Ohio Agricultural Research and Development Center
Wooster, Ohio

Contents

On the cover: This Green Spiral Fir (*Abies alba* 'Green Spiral') is one of the unusual and rare trees in the Secrest Arboretum, the research arboretum of The Ohio State University-Ohio Agricultural Research and Development Center. The fir was planted in 1916 and continues to thrive even after the severe winter of 1993-1994.

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1-95-5M

Aesthetic Evaluation of Crabapples At the Secrest Arboretum in Wooster, Ohio: 1993-1994

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Abstract

Forty-seven crabapple selections in the National Crabapple Evaluation plot at Secrest Arboretum of The Ohio State University were evaluated for ornamental effectiveness 14 times from August 1993 through August 1994. Selections with best overall aesthetic ratings were 'Molten Lava,' 'Donald Wyman,' 'Strawberry Parfait,' 'Sugar Tyme,' 'Bob White,' 'Red Jade,' 'Red Jewel,' 'Sentinel,' and 'White Cascade.' Of the 47 selections in the plot, 40 were rated as "highly ornamental" at some point during the year.

Introduction

Crabapples (*Malus spp.*) are woody landscape trees which provide a number of ornamental features throughout the year. Unfortunately, landscapers and their customers often focus their attention on only one feature of a particular crabapple selection. One example is the focus on the term "flowering crabapple." Crabapples bloom for only one to two weeks in spring. Conversely, many crabapples exhibit good foliar and fruit displays for many months.

A second example of concentrating on only one feature is rating crabapples only for disease (1,2,6,7,8,9). Disease ratings are quite useful, but are often used by educators, landscapers, and the public as the sole criterion for comparisons of different crabapples. Again, disease susceptibility is only one aspect of the true landscape value of a particular crabapple.

This study was initiated to provide a year-long profile of selected evaluation criteria for many of the crabapples available to landscapers and homeowners.

Materials and Methods

Forty-seven crabapple selections in the National Crabapple Evaluation (NCE) plot at Secrest Arboretum were rated 14 times between August 1993 and August 1994. Crabapples were rated on 8-31-93, 10-25-93, 11-22-93, 12-16-93, 1-19-94, 2-23-94, 3-17-94, 4-15-94, 4-29-94, 5-5-94, 5-13-94, 6-1-94, 7-21-94, and 8-26-94. The NCE plots occur throughout the United States. At Secrest Arboretum, the crabapple selections are in a randomized complete block design with three replications of each crabapple. The plot was planted in 1984.

Aesthetic ratings include effects of disease and pest problems on flower, foliage, form, and fruit characteristics and were based on the following criteria:

1= Exceptionally ornamental crabapple. Based on outstanding flower, foliage, fruit, or form at time of rating.
2= Highly ornamental crabapple. Good flower, foliage, fruit, or form at time of rating.
3= Adequate as a landscape crabapple. Not highly ornamental at time of rating.
4= Substandard as an ornamental crabapple at time of rating.
5= Ornamentally unacceptable as a landscape crabapple at time of rating. Not recommended for use in the landscape.

Ratings for the crabapples in this study were averaged for the three replications on each evaluation date. These ratings were then added and divided by the number of rating periods to give an overall average rating for the year for each crabapple selection.

Results and Discussion

The multiple evaluations in this study were made because we felt that a single evaluation just for disease or aesthetic qualities is too limiting for profiling a selection's landscape effectiveness over the entire year.

Crabapples are effective ornamentals over the entire year, with spring flowering; foliage features in the spring, summer, and fall; fruits in the summer, fall, and winter; and form and texture features throughout the entire year. Profiles that reflect the entire year of ornamental ratings for crabapples are presented in Table 1.

Table 1. Descriptions, Average, Best, and Worst Aesthetic Ratings of Crabapples at Secrest Arboretum, Wooster, Ohio: August 1993-August 1994.

Crabapple	Average	Best	Worst	
'Adams'	2.8	1.3	4.0	{Pink flowers, deep red fruits.} Firm abundant teardrop-shaped fruit during fall is best ornamental feature (highest rating was November). Moderate scab and trace of frogeye leafspot. Fruit mummies persisting into bloom period and following months contribute to poor ratings from April-June. Poor overall foliage color noted in mid to late summer.
M. baccata **'Jackii'**	2.9	1.3	3.6	{White flowers, maroon-red fruits.} Glossy large green foliage is an exceptional ornamental feature. No disease observed. Handsome overall form and structure. Fruit somewhat sparse, but shiny and in attractive clusters; became soft by November. Large tree that is mediocre throughout winter months.
'Beverly'	3.7	2.0	5.0	{White flowers, bright red fruits.} Best feature is fruit in late summer and early fall. Fruits attractive to birds, but half-eaten fruits still on tree were unsightly from mid fall into the winter. No scab observed; frogeye is moderate with minor defoliation in late spring; and fireblight was present but not causing serious damage.
'Bob White'	2.5	1.0	4.5	{White flowers, yellow fruits.} Outstanding feature from November-February ("Best of Show" for all four months) is the persistent, small, firm yellow-gold fruits maturing by January into orange-gold color. No scab or fireblight noted, trace of frogeye leafspot. Worst ratings were due to poor spring (by early May) and mediocre summer appearance. Small amount of winter kill in 1994. Sparse flowering in 1994.
'Candied Apple'	3.1	2.0	4.0	{Pink flowers, cherry red fruits, weeping habit.} Best ratings are in the summer due to attractive weeping habit, red-tinged foliage, and colorful fruits. Moderate frogeye leafspot and trace of foliar scab but scab on fruit detracts from ornamental display in late summer and fall.
'Centurion'	3.3	2.3	4.7	{Rose-red flowers, glossy red fruits, open branching structure.} Best feature was unusual open, erratic branching pattern, similar to 'Strawberry Parfait.' Attractive fruits in late summer and early fall. Moderate scab, trace of frogeye. Mediocre ratings for much of the year.
'David'	3.5	2.3	4.0	{White flowers, scarlet fruits.} Late summer ratings were best due to relatively clean and glossy foliage. Trace of scab and frogeye. Fruit did not retain firmness past early fall, and rotten fruit persisted from late October through January.

Table 1. Descriptions, Average, Best, and Worst Aesthetic Ratings of Crabapples at Secrest Arboretum, Wooster, Ohio: August 1993-August 1994 *(continued)*.

Crabapple	Average	Best	Worst	
'Dolgo'	4.1	2.7	5.0	{White flowers, bright red-purple fruits.} Large, edible, almost fluorescent red-purple fruits are striking for a brief period from mid-summer to the end of August. No disease problems present, except for trace of frogeye leafspot. Starting with fruit drop (and mess) in September this cultivar was not an ornamental asset until fruit development the next summer.
'Donald Wyman'	2.3	1.0	4.0	{White flowers, bright red fruits.} Lustrous green foliage, good overall growth habit, and outstanding small glossy red fruits. Trace of scab and frogeye. Alternate flowering pattern in 1994 resulted in mediocre springtime ratings due to sparse bloom, though this selection typically has outstanding blooms.
M. floribunda	3.0	2.3	4.0	{White flowers, fruit yellow and deep red.} Best ratings were during bloom and for airy overall look provided by remaining pedicels in early spring. No scab, and a trace of frogeye leafspot. Worst ratings were in early winter. Tree was relatively ordinary for much of year. Yellow flecking of foliage in summer detracted from effectiveness.
M. halliana **'Parkmanii'**	2.9	1.3	4.0	{Double pink flowers, red fruits.} Outstanding rating was in early May when tree had light, airy delicate aspect as bloom emerged. Fruit in fall and early winter was attractive due to a commingling of golden yellow and "cider" red-brown fruits. No disease noted. Relatively attractive shape through summer and early fall but mundane appearance through winter months.
'Harvest Gold'	3.0	1.6	4.0	{White flowers, gold fruits.} An outstanding early winter feature was bright yellow clusters of fruits with bright red pedicels. Heavy scab problems in 1994. Moderate fireblight problems. Not outstanding for much of year with fruits a bland green until early fall.
'Henningii'	3.9	3.0	5.0	{White flowers, orange-red fruits.} Best ratings for fruit color in late summer and early fall. Heavy scab, trace of frogeye. Awkward upright habit. Poor ratings throughout winter.
M. adstringens **'Hopa'**	4.0	2.0	5.0	{Rose-pink flowers, bright red fruits.} Best feature was at bloom with outstanding muted rose-pink abundant flowers. Severe scab problem on both leaves and fruit. Poor ratings throughout winter due to ungainly shape and during summer months due to scab.

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Table 1. Descriptions, Average, Best, and Worst Aesthetic Ratings of Crabapples at Secrest Arboretum, Wooster, Ohio: August 1993-August 1994 *(continued)*.

Crabapple	Average	Best	Worst	
'Indian Magic'	2.9	1.3	4.0	{Deep pink flowers, red-orange fruits.} Outstanding feature was autumnal-color provided by fruits and fall foliage from early to mid fall. Scab was heavy throughout summer, causing leaf yellowing and detracting from appearance. Mummified fruits in 1994 also detracted from ornamental effectiveness.
'Indian Summer'	3.0	1.6	4.0	{Rose-red flowers, red fruits.} Best ratings were for late summer and fall display of red fruits. Heavy scab detracted in summer. Fruits began to wrinkle by late November in 1993 and were unattractive mummies during flowering in May 1994.
'Jewelberry'	3.5	3.0	4.6	{White flowers, red fruits.} Best features were attractive, lobed three-part leaves and good fruit display in fall. Heavy scab, including severe unsightliness in late season 1994. Was not outstanding at any time during the rating period. Winter injury in 1994 resulted in death of over 30% of the tree.
'Liset'	3.3	2.0	4.6	{Rose-red flowers, maroon-red fruits.} Best features were glossy, attractive foliage and maroon, somewhat sparse fruits. Moderate scab and trace of frogeye. Fruits shriveled by November; fruit mummies were unattractive throughout the winter and into bloom. Bark splitting noted in spring of 1994.
'Madonna'	4.2	2.6	5.0	{Double white flowers, gold with red blush fruits.} Very showy snow-white double flowers were best feature. Serious disease problems including scab, severe frogeye leafspot causing numerous large spots and serious defoliation, and severe fireblight. In winter of 1993-1994 persistent mummified fruits detracted and winter ratings were poor. Winter injury in 1994.
'Mary Potter'	2.7	1.6	3.3	{White flowers, red fruits, spreading habit.} Best ratings were through the summer months due to pleasing spreading growth habit. No scab noted in 1993, only a trace of scab in 1994, and overall very clean foliage. Some winter damage in 1994.
'Molten Lava'	1.9	1.3	2.6	{White flowers, red-orange fruits.} Outstanding crabapple for much of the year, and never mediocre. Fruits and yellowing fall foliage provided a fiery cascading image. After fruits rotted and shriveled in late November 1993 the remaining pedicels provided an attractive feathery winter effect that complemented the elegant branching structure. Trace of scab, but not a factor ornamentally.

Table 1. Descriptions, Average, Best, and Worst Aesthetic Ratings of Crabapples at Secrest Arboretum, Wooster, Ohio: August 1993-August 1994 *(continued)*.

Crabapple	Average	Best	Worst	
'Ormiston Roy'	2.7	1.6	4.0	{White flowers, yellow-orange fruits.} Excellent ratings were due to attractive orange fruits persisting into the winter months. Ratings plunged due to unsightly mummified 1993 fruits from mid-April all the way through August of 1994. No scab noted, but some fireblight present.
'Prairifire'	2.7	1.3	4.0	{Coral-red flowers, red-purple fruits.} Outstanding flower show and clean red-tinged foliage were strengths. Fruits were attractive but through mid summer fruits had little impact due to lack of contrast with foliage. A special feature in early fall was contrast of purplish fruits with small orange spur leaves. No disease noted. Worst ratings were through the winter months when this cultivar was not ornamental.
'Professor Sprenger'	3.4	2.3	4.6	{White flowers, orange-red fruits.} Strength was orange-red fruits. Trace of scab. Frogeye was significant in 1993, resulting in some defoliation. Frogeye moderate in 1994. Poor ratings in 1994 were due to persistent rotten fruit through winter, 1993 mummies that detracted from appearance through late August 1994, and sparse 1994 blooms with resultant fruit only at top of tree. Winter injury in 1994.
'Profusion'	3.0	2.0	4.0	{Purple-red flowers, red fruits.} Strengths were bloom period and cherry-red fruits. Heavy scab, which was somewhat disguised by purple-bronze colored foliage. Trace of frogeye. Mediocre throughout much of the year.
'Radiant'	3.7	2.0	5.0	{Deep pink flowers, bright red fruits.} Best rating was during period of deep pink bloom production. Severe scab problems, including unsightly scabby fruit. Unusual attribute of almost neon-red fruits in late summer.
'Ralph Shay'	3.3	2.3	5.0	{White flowers, large red fruits.} Best ratings were during summer and into early fall due to bright red, showy fruits. Moderate scab and trace of frogeye leafspot. Lowest ratings were in late fall, through the winter, and into spring due to rotting and mummified fruits.
'Red Barron'	3.2	1.6	4.3	{Reddish-pink flowers, dark red fruits.} High point was in mid to late fall with deep red fruits. Moderate scab and trace of frogeye. Low ratings began in winter with rotted fruit and mummified fruits continuing through late August 1994.
'Red Jade'	2.5	1.6	4.0	{White flowers, red fruits.} Great strength was attractive spreading habit, providing character through the year, especially in winter. Effective blooms and fruit. Trace of

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Table 1. Descriptions, Average, Best, and Worst Aesthetic Ratings of Crabapples at Secrest Arboretum, Wooster, Ohio: August 1993-August 1994 *(continued)*.

Crabapple	Average	Best	Worst	
				scab and frogeye. A detraction was the rotted fruits and mummies in late fall and winter. Some winter injury in 1994. Strap-like leaves and twisted petioles were characteristic of this cultivar.
'Red Jewel'	2.5	1.3	4.3	{White flowers, cherry-red fruits.} Attractive, persistent red fruits were outstanding. Has delicate, small growth habit. Best ratings through fall and winter months. No scab noted, with a trace of frogeye. Fruit mummies and winter injury in 1994 resulted in poor spring ratings.
'Red Splendor'	2.6	1.6	3.6	{Rose-pink flowers, red fruits.} Attractive, profuse round red fruits from mid summer to mid fall. Lovely pink flowers. Red tinge to foliage. Trace of scab and frogeye. Worst ratings in winter due to rotten fruits. Watersprouts detracted in mid summer.
'Robinson'	3.5	2.3	4.6	{Deep pink flowers, dark red fruits.} Best ratings were in fall for peach-colored fall foliage and abundant fruit in 1993. Heavy scab with some defoliation and moderate frogeye leafspot. Ugly fruit throughout the winter of 1993-1994 and into spring of 1994. Most ratings were mediocre.
'Royalty'	4.0	2.6	5.0	{Crimson flowers, red-purple fruits.} Best feature was during bloom. Red foliage. Moderate scab and trace of frogeye leafspot. Poor ratings through the winter, and fruit mummies a problem in spring. Little contrast between foliage and developing fruits in summer.
'Ruby Luster'	4.2	3.0	5.0	{Pinkish fruits.} Big tree with large, misshapen lackluster fruits. Moderate scab and frogeye. Cultivar deemed ornamentally ineffective at most ratings.
M. sargentii	3.6	2.0	4.3	{White flowers, red fruits.} Attractive low-spreading growth habit was excellent feature, especially as plant ages. No scab noted. Trace of frogeye leafspot. Fruits shriveled early in fall and negatively affected fall and winter ratings. Winter injury in 1994 was severe on younger specimens.
'Selkirk'	3.7	1.6	5.0	{Rose-red flowers, purple-red fruits.} Excellent flower show and accompanying fragrance in 1994. Moderate scab, trace of frogeye. Worst ratings were in late summer (scabby fruit, yellowing and drop of foliage) and from fall through early spring due to unattractive fruit.
'Sentinel'	2.5	1.3	4.0	{White with pink-tinged flowers, red fruits.} Vase-shaped upright habit. Pink buds opening to white flowers were sensational in 1994. Trace of scab. Mummified fruits detracted in spring and summer of 1994.

Table 1. Descriptions, Average, Best, and Worst Aesthetic Ratings of Crabapples at Secrest Arboretum, Wooster, Ohio: August 1993-August 1994 *(continued)*.

Crabapple	Average	Best	Worst	
'Silver Moon'	3.8	2.3	5.0	{White flowers, tiny purple-red fruits.} Excellent flower show in 1994. Narrow, upright habit. No scab noted. Trace of frogeye. Fireblight was serious problem in 1993, but only a moderate liability in 1994. Fall and winter ratings were sub-par.
'Snowdrift'	3.1	2.6	3.6	{White flowers, orange-red fruits.} Best ratings in mid-winter due to feathery effect of bare pedicels. Fruits are attractive color. Heavy scab. Fruits wrinkled by midfall and were made unattractive by partial feeding by birds. Most ratings were mediocre.
'Strawberry Parfait'	2.4	1.6	3.6	{Pink flowers, fruits start yellow with increasing red blush.} Unusual erratic upright-spreading growth habit was one of best features. Good firm fruits into the winter. Foliage was striking as it developed along the upright stems in spring. No scab noted, trace of frogeye leafspot. Unusual shape is not for every landscape.
'Sugar Tyme'	2.4	1.0	3.6	{White flowers, brilliant red fruits.} Excellent ratings in mid to late fall 1993 due to fruit display. Ratings remained good through winter due to fruit persistence and showiness. Trace of scab and frogeye leafspot. Ratings mediocre this year during bloom due to sparseness of flowers. Summer ratings also suffered in 1994 due to sparseness of fruits.
M. tschonoskii	5.0	5.0	5.0	{White flowers, yellow-green fruits.} Best feature was clean foliage. Leaves are large and have a silver-gray tinge, especially soon after emergence. No scab noted. All trees of this cultivar in the plot are dying from severe fireblight that developed over the years. Flowers not showy. Fruit was sparse, large, russeted and rough, and unattractive.
'Velvet Pillar'	3.7	3.0	5.0	{Pink flowers, orange-red fruits.} Purple foliage. Upright habit. Severe scab problems. Did not have outstanding ratings at any time of the year.
'White Angel'	3.7	3.0	5.0	{White flowers, red fruits.} No scab noted. Trace of frogeye. Did not rate highly during any rating period. Worst ratings were from mid-winter to mid-spring due to unattractive fruit mummies. Of note: Older, larger trees nearby were much more ornamental than younger specimens evaluated within the plot.
'White Cascade'	2.5	1.0	4.0	{White flowers, small yellow fruits.} Exquisite flower display with waterfall of cascading white-covered branches. Retained good ratings in early to mid summer due to attractive form. Moderate scab, trace of frogeye leafspot. Fall and winter features were ordinary.

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Table 1. Descriptions, Average, Best, and Worst Aesthetic Ratings of Crabapples at Secrest Arboretum, Wooster, Ohio: August 1993-August 1994 *(continued)*.

Crabapple	Average	Best	Worst	
'Winter Gold'	3.7	2.6	4.3	{White flowers, yellow fruits.} Best rating was during bloom due to attractive flower show. Heavy scab. Trace of frogeye leafspot. Numerous short fireblight strikes. Abundant green fruit in summer and early fall provided no contrast with foliage.
***M. zumi* 'Calocarpa'**	3.4	2.3	4.3	{White flowers, bright red fruits.} Best ratings were in fall and winter for overall shape and fine features such as feathery pedicels. Trace of scab and frogeye leafspot. Winter injury in 1994 and poor flowering contributed to mediocre ratings.

1=Exceptionally ornamental crabapple. Based on outstanding flower, foliage, fruit, or form at time of rating.
2=Highly ornamental crabapple. Good flower, foliage, fruit, or form at time of rating.
3=Adequate as a landscape crabapple. Not highly ornamental at time of rating.
4=Substandard as an ornamental crabapple at time of rating.
5=Ornamentally unacceptable as a landscape crabapple at time of rating. Not recommended for use in the landscape.

A rating of unacceptable (4 or 5) or merely adequate (3) at a given time of year does not imply that the crabapple has no landscape use. The intent of these monthly ratings is to provide a profile for the time of year that specific crabapples are effective or not effective as ornamental assets in the landscape. It is also important to keep in mind that these ratings are only for a single year and variability in flower production and winter freeze damage can dramatically affect ratings from year to year.

Certain crabapples were clearly outstanding at each of the rating periods, standing out relative to the other crabapples in the plot. These are reflected by "Best of Show" ratings presented in Table 2.

Even with the 15 evaluations there are many limitations with this study. First, it is only one year of data. Alternate bloomers in their off year suffer in bloom and fruit ratings. Factors such as winter damage in a given year inevitably affect the ratings to some extent.

Second, due to time and experimental design constraints, the evaluations were limited to the 47 crabapples replicated in the plot. Many need to be added, including a number that rate highly in other reports (4,5).

Third, the data is for only one site: Wooster, Ohio. Clearly crabapples vary in their ornamental effectiveness and disease susceptibility depending upon local environmental conditions. A number of other studies provide data on effectiveness over a wider range of geographical areas (2,4,5).

Fourth, the study is limited by the age and condition of specific plants in the plot. As noted previously, for 'White Angel' older (or younger) plants or plants pruned differently might rate higher or lower in specific situations.

Table 2. "Best of Show" for Ornamental Effectiveness for Crabapples at Secrest Arboretum in Wooster, Ohio: August 1993-August 1994.

Date	Best of Show
8-31-93	'Prairifire'
10-25-93	'Donald Wyman'
11-22-93	'Bob White'
12-16-93	'Bob White'
1-19-94	'Bob White'
2-23-94	'Bob White'
3-17-94	'Red Jewel'
	'Strawberry Parfait'
4-15-94	'Red Jade'
	'Sugar Tyme'
4-29-94	'White Cascade'
5-5-94	'White Cascade'
5-13-94	'Prairifire'
6-1-94	'Red Jade'
7-21-94	'Prairifire'
	'Molten Lava'
8-26-94	*M. baccata* 'Jackii'

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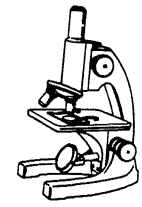
Evaluation of Crabapples for Apple Scab At the Secrest Arboretum in Wooster, Ohio: 1993-1994



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Abstract

Crabapple selections in a replicated plot at Secrest Arboretum of The Ohio State University were evaluated for apple scab once in 1993 and three times in 1994. Eleven of 47 crabapple selections evaluated exhibited no scab. Another 18 selections exhibited some level of scab, but disease severity did not negatively affect the ornamental effectiveness of the selections.

Introduction

Apple scab (pathogen: *Venturia inaequalis*) is a major disease problem of many crabapple species (*Malus spp.*). Although it generally is not a major health problem for the tree, it can severely affect ornamental effectiveness and marketability of highly susceptible crabapple selections.

Symptoms of apple scab on crabapple include olive to gray to brown to black spots on foliage, yellowing and discoloration of foliage, leaf drop, and scabby lesions on fruits. Apple scab can be effectively controlled with a fungicide spray program, and certain cultural and sanitary practices are also beneficial for control.

However, the best method for control of apple scab is through the use of genetically resistant crabapple selections. The evaluations presented here are the latest in a series of apple scab evaluations for Ohio (1,2,3,4,5). In general, apple scab incidence in 1993 and 1994 was relatively moderate compared to years when early defoliation of highly susceptible crabapple selections occurred (e.g., 1989).

The authors emphasize that apple scab in particular and diseases and pests in general are not the only consideration relative to crabapple effectiveness in the landscape. This is the rationale for the inception of more comprehensive evaluations of a number of different aesthetic criteria. These include fruit, flower, and foliage features, plant texture and shape, and diseases and pest problems. These are reported in a companion paper to this apple scab evaluation report (6).

Materials and Methods

Forty-seven crabapple selections in the National Crabapple Evaluation (NCE) plot were rated for apple scab on August 9, 1993; June 1, 1994; July 21, 1994; and August 26, 1994. The NCE plots occur throughout the United States. At Secrest Arboretum, this plot is in a completely randomized design with three replications of each crabapple selection. The plot was planted in 1984 and is not treated with fungicides or insecticides.

Apple scab evaluations were based on the following rating system:

0=No scab observed.
1=Slight scab, less than 5% of leaves affected, no negative effect on aesthetics.
2=Moderate scab, 5%-20% of leaves affected, some yellowing, little or no defoliation, moderate negative effect on aesthetics.
3=Extensive scab, 20%-50% of leaves affected, significant defoliation and/or leaf yellowing, significant negative effect on aesthetics.
4=Heavy scab, 50%-80% of leaves affected, severe defoliation and discoloration of leaves, severe negative effect on aesthetics.
5=Extreme scab, 80%-100% of foliage is affected and defoliation is complete or nearly complete.

Other diseases that occurred in the plot were also evaluated. Frogeye leafspot (pathogen: *Botryosphaeria obtusa*) is typically of minor concern relative to plant health and aesthetics, but on some selections causes significant leaf spotting, yellowing, and occasionally defoliation. Fireblight (pathogen: *Erwinia amylovora*) is a serious bacterial disease causing blossom blight, twig and branch dieback, and leaf discoloration, and in extreme cases total plant death. Fireblight is not a problem on most crabapple selections.

Further comments on these diseases and on the aesthetics of all 47 crabapple selections in the NCE plot at Secrest Arboretum are presented in the companion article in this Circular, "Aesthetic Evaluation of Crabapples at Secrest Arboretum in Wooster, Ohio: 1993-1994."

Results and Discussion

Of the 47 selections there were 11 that exhibited no scab in either 1993 or 1994. Of these 11, *M. baccata* 'Jackii,' 'Bob White,' *M. floribunda*, 'Prairifire,' 'Red Jewel,' and *M. sargentii* had both excellent aesthetic qualities in addition to no major disease problems. Both 'Silver Moon' and *M. tschonoskii* were scab-free but exhibited severe damage from bacterial fireblight. 'Beverly,' 'Dolgo,' *M. tschonoskii*, and 'White Angel' were also scab-free but did not have high aesthetic ratings (6).

Another 18 selections in the plot exhibited apple scab ratings under 2 for both years, which is the point at which moderate negative effects on overall plant aesthetics begin to play a role in ornamental effectiveness. Some of these selections with relatively low apple scab have other problems as effective landscape ornamentals. In addition, some of the final 18 selections with at least one rating of scab of 2 or greater have redeeming ornamental features for some situations, at least for a portion of the year (6).

Scab ratings in this study were only for the 47 selections in the NCE plot at Secrest Arboretum. This was done because of the replications in this plot, to avoid reporting data for just one plant and to facilitate monthly ratings of the plot (6). However, there is data for Ohio for a wider range of crabapple selections and for multiple locations (including Holden Arboretum and Dawes Arboretum) in past years (1,2,3,4,5).

Frogeye leafspot was present on most crabapple selections, but resulted in adverse effects on aesthetics (leaf spotting, yellowing, and moderate defoliation) on only two selections ('Madonna,' 'Professor Sprenger').

Bacterial fireblight was observed on seven of the 47 selections ('Beverly,' 'Harvest Gold,' 'Madonna,' 'Ormiston Roy,' 'Silver Moon,' *M. tschonoskii*, and 'Winter Gold'). Fireblight was severe (resulting in dieback of over 25% of the plant) on 'Madonna,' *M. tschonoskii*, and 'Silver Moon.'

Table 1. Apple Scab Ratings for Crabapple Selections in the National Crabapple Evaluation Plot at Secrest Arboretum in 1993 and 1994.

Crabapple	8-9-93	6-1-94	7-21-94	8-26-94
'Adams'	1.0	0.7	1.7	2.3
M. baccata 'Jackii'	0.0	0.0	0.0	0.0
'Beverly'	0.0	0.0	0.0	0.0
'Bob White'	0.0	0.0	0.0	0.0
'Candied Apple'	0.7	0.0	1.0	1.3
'Centurion'	2.0	0.0	1.7	2.3
'David'	1.0	0.0	1.0	1.0
'Dolgo'	0.0	0.0	0.0	0.0
'Donald Wyman'	1.0	0.0	1.7	1.0
M. floribunda	0.0	0.0	0.0	0.0
M. halliana 'Parkmanii'	0.5	0.0	0.3	0.0
'Harvest Gold'	2.0	0.0	3.7	3.7
'Henningii'	1.3	0.3	2.3	2.7
M. adstringens 'Hopa'	2.3	2.0	4.0	4.0
'Indian Magic'	2.7	0.3	2.0	3.3
'Indian Summer'	2.0	0.0	3.0	3.0
'Jewelberry'	2.0	0.0	2.3	4.0
'Liset'	0.7	0.0	1.3	1.3
'Madonna'	1.0	2.0	3.0	3.0
'Mary Potter'	0.0	0.0	1.0	1.0
'Molten Lava'	1.0	0.0	1.0	1.3
'Ormiston Roy'	0.3	0.0	0.0	0.0
'Prairifire'	0.0	0.0	0.0	0.0
'Professor Sprenger'	0.3	0.0	0.0	1.0
'Profusion'	2.3	0.3	3.0	4.0
'Radiant'	2.7	1.3	3.7	4.0
'Ralph Shay'	1.7	0.0	1.7	2.0
'Red Barron'	0.7	0.7	1.0	1.3
'Red Jade'	0.7	0.3	1.7	1.7
'Red Jewel'	0.0	0.0	0.0	0.0
'Red Splendor'	1.0	0.0	1.7	1.7
'Robinson'	2.3	0.0	2.7	2.7
'Royalty'	1.0	0.3	1.7	1.7
'Ruby Luster'	1.0	0.0	1.7	1.3
M. sargentii	0.0	0.0	0.0	0.0
'Selkirk'	1.0	0.7	2.3	2.0
'Sentinel'	0.3	0.0	1.0	0.7
'Silver Moon'	0.0	0.0	0.0	0.0
'Snowdrift'	2.0	0.0	2.0	3.0
'Strawberry Parfait'	0.3	0.0	0.3	0.0
'Sugar Tyme'	0.3	0.0	0.7	0.7
M. tschonoskii	0.0	0.0	0.0	0.0
'Velvet Pillar'	2.0	0.0	3.3	4.0
'White Angel'	0.0	0.0	0.0	0.0
'White Cascade'	1.3	0.0	1.7	2.3
'Winter Gold'	1.0	0.0	3.3	3.7
M. zumi 'Calocarpa'	0.7	0.0	0.7	1.0

Apple Scab Rating:

0=No scab.
1=Slight scab.
2=Moderate scab.
3=Extensive scab.
4=Heavy scab.
5=Extreme scab.

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The Ohio State University Water Quality Assessment Program

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Abstract

One hundred ninety-four water samples obtained from Ohio floriculture businesses were analyzed for pH, soluble salts, alkalinity, nitrate-N, ammonium-N, sulfate, P, K, Ca, Mg, Na, Mn, Fe, B, Zn, Mo, Cl, F, and Al. The pH and alkalinity of more than half of the samples exceeded recommended ranges. Calcium, Mg, Na, F, and nitrate-N levels exceeded recommendations in more than 10% of the samples.

Introduction

The Ohio State University Water Quality Assessment Program was conducted by John Peterson and Laura Kramer of the Department of Horticulture over a period of nine months ending in February 1984. Convinced of the critical importance of irrigation water quality to plant nutrition, these researchers solicited water samples from 960 floriculture production, wholesale, retail, and plantscape businesses throughout the United States. The goal of the study was to assess the variability in the chemical composition of water used by the floriculture industry, focusing on the properties of water that impact the production, quality, and longevity of potted and cut crops.

Materials and Methods

Peterson and Ludwig used specific ion electrodes to test pH, nitrate-N, ammonium-N, Na, chloride, and fluoride. Other elements were analyzed using an inductively coupled argon plasma spectrometer. Alkalinity was determined by acid titration. Water quality was judged using recommendations developed by John Peterson (Table 1).

Table 1. The Ohio State Water Quality Assessment—Elemental Analysis of Ohio Water Samples and Interpretation. Units are parts per million (ppm) unless otherwise noted.

Factor	Range of Responses	Mean	Recommended Range	% of Responses Exceeding Recom. Range
pH	6.2- 10.4	7.7	5-7	91%
Alkalinity (as $CaCo_3$)	18-472	157	0-100	52%
Soluble salts (mmhos/cm)	0- 1.9	0.5	0-1.5	3%
Calcium (Ca)	0-309	66	40-120	11%
Magnesium (Mg)	0-136	22	6-24	36%
Sodium (Na)	0-199	25	0-50	13%
Sodium absorption ratio (SAR)	—	—	0-4	4%
Fluoride (F)	0- 1.7	0.4	0-1	12%
Boron (B)	0- 1.5	0.1	0.2-0.8	1%
Chloride (Cl)	0-356	36	0-140	1%
Sulfate (SO_4)	0-414	55	24-240	5%
Nitrate (NO_3 as N)*	—	—	0-5	11%
Potassium (K)	—	—	0.5-10	4%
Iron (Fe)	—	—	2-5	<1%
Phosphorus (P)	—	—	.005-5	<1%

*Some data were not available for nitrate, potassium, phosphorus, iron, and sodium absorption ratio.

Results and Discussion

A total of 687 samples were received nationwide. One hundred ninety-four responses were received from Ohio businesses; of these, 43%, 37%, and 13% obtained their irrigation water from wells, municipal water supplies, and ponds, respectively. Selected results from Ohio water samples appear in Table 1.

pH and alkalinity. The pH of 91% of Ohio water samples exceeded the recommended range of 5 to 7. While water pH may directly affect the efficacy of pesticides, growth regulators, and floral preservatives, it has much less effect on medium pH and nutrient availability than the alkalinity of water. Alkalinity determines the long-term capacity of water to neutralize acidity. It is most commonly expressed as ppm calcium carbonate ($CaCO_3$) or bicarbonate (HCO_3). Use of low-alkalinity water may cause a decline in medium pH and nutrient toxicities. However, Ohio growers are more likely to encounter problems associated with excessive alkalinity; more than half of the water samples had alkalinities in excess of 100 ppm (as $CaCO_3$). Over time, use of high-alkalinity water may elevate medium pH and reduce nutrient availability, especially iron. The size of the growing container affects how rapidly the pH of the medium responds to alkalinity. While 100 ppm $CaCO_3$ in irrigation water may be detrimental to plugs, five-gallon containers may tolerate as much as 200 ppm since the effect on pH is much slower in the larger container. High alkalinity also is related to water hardness and contributes to the clogging of irrigation systems.

The appropriate choice of fertilizers and growing medium amendments may be sufficient to counteract water alkalinity, both high and low. Fertilizers are available with acid or basic reactions. Acid injection may be necessary to neutralize highly alkaline water, but injection systems must be managed carefully because of the hazards associated with concentrated acids. Phosphoric acid is the least hazardous acid, but it is less effective than sulfuric acid in terms of neutralizing power per unit volume. Acidification has limited effectiveness in preventing clogging of the irrigation tubing and the formation of unsightly white (calcium, magnesium) and orange (iron) deposits on foliage. Where the deposits are a problem in high value crops or in propagation, reverse-osmosis or deionized water may be used. Polyphosphate injection can be a cost-effective option to eliminate deposits on nursery stock.

Soluble salts (SS) Although only 3% of Ohio water samples had levels of SS>1.5 mmhos/cm, excessive salinity is a problem that can be expected to increase as the demand on water supplies increases, and growers turn to recycling to conserve water and reduce runoff. Growers who rely on ponds and wells are most likely to have soluble salt problems.

High SS in the growing medium reduce plant growth by making it harder for plants to absorb water from the medium. Soluble salt problems tend to increase under hot, dry conditions because water depletion from ground and surface waters concentrates the ions in solution. Moreover, the necessity of frequent irrigation during hot weather results in greater total salt accumulation in the plants' root zone. Species sensitivity varies considerably. Ericaceous plants are particularly sensitive to SS; levels as low as 0.75 mmhos may be harmful to certain azalea cultivars.

Salinity is a difficult problem. Where soluble fertilizers are used, fertilizers with a lower salt index should be used. Leaching periodically to flush salts from the medium may be necessary, but this practice wastes water and contributes to runoff. Growers who recycle irrigation water usually find it necessary to mix recycled solutions with water from another source that is low in SS.

The presence of even very low SS (0.5 mmhos/cm) in water used for cut flowers reduces quality and longevity. Deionized or reverse osmosis water is recommended.

Calcium (Ca), Magnesium (Mg), Sodium (Na), and Sodium Absorption Ratio (SAR). Excessive levels of Ca, Mg, and Na were evident in 11%, 36%, and 13% of the Ohio water samples, respectively. Ca and Mg are very important plant nutrients; the ratio of these ions in irrigation water affects their availability to the plant. Calcium to Mg ratios of 3:1 and 1:1 are acceptable; 2:1 is optimum. An imbalance of calcium and magnesium in water may be counteracted by adjusting the fertilizer and medium amendments. A high number of Ohio water samples had elevated Mg levels; the use of dolomitic lime could be reduced where elevated levels of Mg are present in the irrigation water.

Greater than 50 ppm Na may cause leaf burn in sensitive plants and interfere with the uptake of Ca, Mg, and other positively charged ions. The most serious problem associated with long-term use of high-Na water is the collapse of mineral soil structure; the probability of this occurring is indicated by the sodium absorption ratio (SAR), which is calculated from Ca, Mg, and Na concentrations in the irrigation water. High SARs are typically a problem of the arid western states, but there is potentially a problem with sensitive crops in the 4% of Ohio businesses that have a SAR above 4. For nursery

crops, a SAR of 10 or less is considered safe.

Boron (B). One percent of Ohio water samples had B levels that exceeded recommendations. More commonly, elevated B occurs in water from the southeastern United States and arid coastal regions. Crop sensitivity to B is species-dependent. While some plants may tolerate 2 to 4 ppm B, much lower levels may cause tip burning and chlorotic margins in tropical foliage plants and certain floral crops such as poinsettias, chrysanthemums, and lilies. Crops are most sensitive in the propagation stage. Maintaining higher calcium levels and a pH of 6-6.5 in the growing medium helps prevent B toxicity by reducing its availability. Fertilizers low in B also have been developed for sensitive plants.

Fluoride (F). Thirteen percent of Ohio water samples had excessive fluoride levels. Probably these water samples were from municipal water supplies, where 1 to 2 ppm F may be added to prevent tooth decay. Easter lily and certain foliage crops are sensitive to F. Toxicity symptoms are similar to B. As with B toxicity, maintaining higher pH and Ca levels in the growing medium counteracts F toxicity by reducing its availability.

Nitrate (NO3) and Phosphorus (P). Nitrate-N and P are critical to plant growth but are also environmental pollutants of ground and surface waters. If the irrigation water is also used for drinking water, particular attention should be given to nitrate-N. Levels above 10 ppm (as N) are considered a risk to infant and fetal health.

Conclusions

The Ohio State Water Quality Assessment indicated that excessive levels of pH, alkalinity, Ca, Mg, Na, F, and nitrate-N occurred in >10% of the water sources used by the floriculture industry. These findings have significance for the landscape and nursery industry as well since they draw on similar sources of water.

Since water properties may fluctuate with the season, testing several times a year may be required to fully understand the potential effect of water on plant growth, quality, and longevity. To collect a water sample, allow water to run at maximum flow for five minutes. Collect water in a clean, plastic pint bottle. Fill the bottle, leaving no airspace, and seal tightly. Water samples may be tested in Ohio at the Research-Extension Analytical Laboratory, The Ohio State University, Ohio Agricultural Research and Development Center, Wooster, Ohio 44691-4096, telephone 216-263-3760.

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Root Rot of *Taxus spp.* in Ohio Caused by *Phytophthora cinnamomi*

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Phytophthora cinnamomi Rands has been reported to cause a serious die-back and root rot disease of *Taxus spp.* in Indiana (4). The disease occurred on cuttings in rooting benches and rooted cuttings and older plants in Lath houses and in the field. Symptoms on infected plants included a gradual loss of normal green color (chlorosis) and die-back of the aerial portion of affected plants. The root system of affected plants showed extensive discoloration (reddish-brown to black) and a dry root rot. The disease was most severe in plantings on poorly drained sites or under conditions of high soil moisture. Growers frequently attributed losses to poor soil drainage, unfavorable weather, or poor quality stock (4).

During the summer of 1991, several accessions in the *Taxus* collection at the Secrest Arboretum, Ohio Agricultural Research and Development Center (OARDC), Wooster, Ohio, developed symptoms of foliar chlorosis, reduced growth, and eventual die-back of the aerial portions of affected plants. The purpose of this paper is to report the results of studies to determine the cause of these symptoms.

Materials and Methods

Isolation of the Pathogen. In October 1991, the following species and cultivars of *Taxus* were dug and the roots examined: *T. cuspidata* 'TV spreading,' *T. media* 'F&F compacta,' *T. media* 'Mitiska Upright,' and *T. media* 'Wilsonii.' All plants showed above-ground symptoms similar to those described earlier. Plants were dug to include major lateral roots and the crown. Root samples were taken from each plant, placed in individual plastic bags, and stored at 4°C until they were assayed for the presence of *Phytophthora spp.* No sample was stored more than 24 hours prior to conducting isolations.

Root samples were washed in running tap water then examined for lesions. A lesion was considered to be an area of discoloration (reddish brown to black) with a sharp line of demarcation between healthy (white) and diseased tissue. The epidermis was removed by scraping with a scalpel, and discolored tissue samples were taken from near the edge (line of demarcation) of the lesion. A minimum of 25 tissue pieces (5 pieces per plate) were placed on pentachloronitrobenzene-benomyl-neomycin-chloramphenicol (PBNC) medium (3), a selective medium for *Phytophthora spp.* Plates were incubated at 24°C for 5 to 7 days. The recovery of fungi was recorded from day 5 through 7. Representative isolates were made of the different fungi recovered for identification purposes.

Pathogenicity Testing

One species of *Phytophthora* was consistently recovered from lesions on affected roots. Pathogenicity tests using this fungus were conducted by inoculating two-year-old transplants of *T. media* 'Densiformis.' Bare-rooted plants were planted in a peat-sand-soil mix (1-1-2) containing infested oat kernels. Oat kernels were autoclaved, allowed to cool, then inoculated with plugs of the test fungus taken from the margin of five-day-old cultures on PBNC medium. Kernels were incubated at room temperature for eight weeks. Fifteen grams (approximately 150 kernels) of infected oat kernels were thoroughly mixed with each liter of potting mix. Plants were planted in 2 liters of potting mix in 2.5 liter ceramic pots. Plants planted in potting mix containing noninfected oat kernels served as controls. Pots were saturated with water each day, but were not maintained under flooded conditions. The test consisted of 10 inoculated and 10 noninoculated plants in individual pots. After 12 weeks, all plants were removed from pots and examined for disease symptoms. Isolations were conducted to recover the test fungus from diseased roots.

Results and Discussion

The *Phytophthora* species that was consistently isolated from lesions on affected plants was *P. cinnamomi*. Identification of the fungus was confirmed by A. F. Schmitthenner, OARDC. This is the first report of this pathogen on *Taxus* in Ohio. No other *Phytophthora spp.* or other fungi were recovered during the course of this study. After 12 weeks, all inoculated plants were dead, and *Phytophthora cinnamomi* was recovered from lesions on roots of all inoculated plants. Plants in noninfested soil

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developed no above-ground symptoms and roots appeared normal. Our results demonstrate that *P. cinnamomi* does cause a root rot of *Taxus spp.* in Ohio. Another species of *Phytophthora (P. citrophthora)* has also been reported to cause a root rot of *Taxus* in Ohio (2). Phytophthora root rot is usually associated with poorly drained areas or other situations that result in periods of high and sustained soil moisture (1). In recent years (1990 and 1992) we have experienced some of the wettest growing seasons in recorded history. Conditions such as this could result in an increased incidence of this disease in many regions of Ohio.

The extent to which this disease occurs in Ohio is not known. Several other disorders can cause above-ground symptoms similar to those observed with this disease. Crown and root feeding by the black vine weevil, *Otiorhynchos sulcatos* F., results in above-ground symptoms on *Taxus* that are almost identical to those caused by *Phytophthora* root rot; however, the two disorders are easily distinguished upon visual observation of exposed crowns and roots. Physical damage (tunnels) caused by feeding of the black vine weevil larvae was not observed on any of the plants used in this study. Further research is needed to determine the extent to which this disease is distributed in Ohio.

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Winter Injury on Woody Ornamental Plants in Ohio: The Winter of 1993-1994

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One of the charms, perhaps a curse, of the green industry is the fact that, like the weather, no two years or seasons are quite the same. A test winter comes around infrequently, and we must learn from the experience. The past winter was such a test winter and is likely to occur only once in 50 or 100 years. Reported low temperatures on January 19, 1994, ranged from −17°F to −40°F around the state. Some observations of the effects of the winter of 1993-1994 on woody ornamental plants follow.

Winter injury is a complex issue and plants often fail to respond the same way in seemingly similar winters. Some of the factors that affect the extent and severity of winter injury are noted here:

Preconditioning. Damage is generally moderated when temperatures drop slowly. This past winter, record lows occurred, but sudden drops were not a major problem. Warm temperatures in late fall and winter, followed by a quick drop in temperature, often result in more damage.

Snow Cover. Snow helps insulate the soil. In the winter of 1993-1994, most areas of Ohio had at least six inches of snow during the extreme January freeze.

Wind Chill. This is not a concern for plants as this measures the rate at which a warm body loses heat. Since plants are not warm-blooded, they respond only to the absolute temperature.

Desiccating Winter Winds. This can be a problem if the winds persist during freezing conditions. Plants can dry out, resulting in severe damage. Broadleafed plants are more subject to the problem.

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Seed source. A seed source is a breeding population of a plant from which seeds are obtained. It is often defined by the longitude and latitude of the location or the name of the location such as Yellowstone Park or McMinnville, TN. Seedlings of a known seed source will have some characteristics which may differ from other seedlings found in other locations within the species' natural range. Red maples growing native in northern Minnesota will be more cold hardy than native red maples growing in Orlando, Florida. A local seed source is one found within 200 miles of the location where the plant will be used.

The list presented here is by no means exhaustive and is often based on non-systematic observations, i.e., extensive comparative collections of related plants (e.g., all holly species and cultivars) were not evaluated. The list does, however, represent multiple observations by horticulturists from throughout Ohio. In this limitation we are not alone. As even the late L.C. Chadwick noted in a similar report he did on "Winter Injury of Some Ornamental Plants" in 1947-48: "No attempt is made to include a complete list of injured woody ornamental plants in this report."

Acer spp. (MAPLES): Most of the maples survived well, although minor bark-splitting was noted. Five species were reported as having problems.

Acer campestre (Hedge maple) as a species suffered minimal damage. 'Queen Elizabeth' is less cold hardy than the species and was damaged in earlier cold winters. Several growers stopped growing this cultivar in the late 1980s for this reason, so observations were limited in 1993-1994.

Acer griseum (Paperbark maple) showed some injury in the coldest regions of Ohio. Plants were not killed. The *griseum* × *nikoense* hybrid was not damaged.

Acer palmatum (Japanese maple) types were damaged, with injury ranging by cultivar from tip dieback to death. The cut-leafed forms were most severely injured and often killed. 'Burgundy Lace' was one of the best of the cut-leafed forms. 'Bloodgood' and 'Everred'

were injured but not killed. One grower believes that the West Coast understock is less cold hardy than the species. He has seen instances where the scion leafed out above the dead understock.

Acer japonicum (Fullmoon maple) is sometimes used as a substitute for the Japanese maple. Reports from Michigan suggested that *A. japonicum* 'Aconitifolium' is more cold hardy than the *A. palmatum* types.

Acer truncatum (Purpleblow maple) cultivar, 'Pacific Sunset,' was killed outright at −22°F in some areas of Ohio, but not in others, such as Secrest Arboretum where temperatures were even lower.

Buxus spp. (BOXWOODS): Certain boxwoods exhibited severe foliar damage and branch dieback coming out of the winter. Many thought of boxwoods as badly damaged in the winter of 1993-1994. However, the full story was considerably more complex.

Buxus sempervirens (Common boxwood) cultivars were badly damaged. For example, all of the common boxwoods at Secrest Arboretum exhibited extensive tannish foliar discoloration and branch dieback by mid-spring (with the exception of the cultivar 'Vardar Valley' for which damage was more limited). However, in many cases, if plants were properly pruned in spring, considerable recovery occurred and by mid summer many plants appeared relatively healthy and were effective ornamentally.

Buxus microphylla (Littleleaf boxwood) species and cultivars also suffered damage. In some cases, 'Wintergreen' did better than other littleleaf boxwoods, but in some areas it was also damaged considerably.

The boxwoods that suffered least damage, in some cases no apparent damage, were the *B. microphylla* var. *koreana* X *B. sempervirens* hybrid Green Series, namely 'Green Gem,' 'Green Mountain,' 'Green Mound,' and 'Green Velvet.' In the Secrest Arboretum collection, these boxwoods were undamaged.

Carpinus betulus (EUROPEAN HORNBEAM): One of the upright cultivars was killed outright in low portions of a nursery field at −40°F while in higher areas of the same field the plants were fine. This suggests that −40°F is the breakpoint for this plant and that the slightly lower temperatures in the low areas of the field were enough to kill. This temperature is quite uncommon in any area of Ohio.

Castanea mollisima (CHINESE CHESTNUT): Some nursery plants were killed to the ground at −28°F.

Cercis canadensis (REDBUD): Most nurseries in Ohio purchase only seedlings from cold hardy parents. This practice was introduced following the winters of the late 1970s and mid-1980s. Most plants were fine this year thanks to those earlier lessons. Plants from southern seed sources were often damaged or killed—another bitter reminder of the value of seed source.

Cornus spp. (DOGWOODS): In general, the shrubby dogwoods did well this past winter. The arboreal plants suffered some damage.

Cornus florida was quite variable. The native Ohio flowering dogwoods suffered no damage even in the coldest areas of the state. The seed source from Ohio marketed as Richland was not damaged. Many southern seed sources suffered damage or were killed. The value of seed source was graphically illustrated.

Red and pink flowered cultivars were seriously damaged or killed. Named whites also suffered significant damage. 'Cloud Nine' suffered some damage at −28°F. This is to be expected as most cultivars are from the southern United States and are selected for floral characteristics.

Cornus kousa is generally less cold hardy than the native tree. The seed source marketed as 'Milky Way' was variable in terms of damage reported this year. The Polly Hill selections marketed on the East Coast are not grown in Ohio because they are much less cold hardy than 'Milky Way.'

Cotoneaster spp. (COTONEASTERS): Damage was most commonly noted on *C. dammeri* and, most prominently, the 'Coral Beauty' cultivar. In many reports plants looked fine after pruning of dead shoots and foliage.

Corylus avellana (EUROPEAN FILBERT): The 'Contorta' cultivar was injured in a number of locations. Damage was seen as tip dieback and branch loss. Plants grafted on a standard were in poorer condition than the shrub form.

Crataegus (HAWTHORNS): Damage was reported, but only where the temperature dropped below −35°F. Greatest damage was reported on Washington hawthorns (*Crataegus phaenopyrum*). There seems to be a seed source potential, as some seed sources of Washington hawthorn were damaged while others showed no damage in one nursery.

Only minor twig dieback was noted on *Crataegus viridis* 'Winter King.'

X *Cupressocyparis leylandii* (LEYLAND CYPRESS): This plant has become the "upright yew of the South." An unknown clone was given to Ammon Landscape to try as more cold hardy. No damage was noted at a temperature of −28°F for this cultivar.

Deutzia spp. (DEUTZIAS): Matt Vehr at Spring Grove Cemetery in Cincinnati reports that "*D. gracilis* had significant dieback, while *D. scabra* and *D. magnifica* died completely to ground level. *D. gracilis* 'Nikko' fared pretty well."

Enkianthus campanulatus (REDVEIN ENKIANTHUS): Some nursery plants were killed at −28°F, while mature plants at Secrest Arboretum showed only moderate branch dieback and reduced flowering.

Euonymus spp. (EUONYMUS): Burning bush (*Euonymus alatus*) was killed to the snowline in some of the coldest north-central areas of Ohio. The 'Compactus' cultivar proved less cold hardy than the species. In one field, 'Compactus' was seriously damaged while no damage was seen on the species plants growing two feet away.

Many of the *Euonymus fortunei* (Wintercreeper euonymus) types, especially some of the variegated cultivars, and *Euonymus kiautchovicus* cultivars were killed to the ground or defoliated in some nurseries and landscapes. Many of these plants recovered quickly after this winter's 'rejuvenation pruning'. Often these plants are managed by pruning them to the ground every several years. This was the year to cut them back.

Fagus sylvatica (EUROPEAN BEECH): There were reports of injury to all forms of this plant, with injury ranging from tip and branch dieback to death. Seedlings seemed to survive the best. Weeping forms were the most severely injured and were sometimes killed. The purple foliaged forms had moderate damage.

Forsythia spp. (FORSYTHIA): Flower buds of most types were killed, and there was bloom only below the snowline on most forsythias. 'Meadowlark' and 'Northern Sun' are more cold-hardy and generally bloomed to the top of the plant, although some damage was reported at other sites.

Halesia spp. (SILVERBELL): Damage was variable and suggests some seed source influence. Some plants were damaged at −17°F while others were not damaged at −28°F.

Hamamelis spp. (WITCHHAZELS): Damage was not reported on *H. vernalis* or *H. virginiana*. There were reports of H. mollis being killed at −35°F, and serious damage was also reported from a number of sites for the *Hamamelis* X *intermedia* hybrids, 'Arnold's Promise' and 'Diane.'

Hedera helix (ENGLISH IVY): Snow cover was the key to reduced winter damage in Ohio. Under trees where snow cover was limited or missing, damage was more severe. This suggests why English ivy is often considered a more reliable ground cover in Michigan, with its more dependable snow cover. 'Wilson' was reported to be the most cold hardy cultivar.

Hibiscus syriacus (ROSE OF SHARON): The species was damaged variably. The National Arboretum cultivars ('Helene,' 'Minerva,' and 'Diane') suffered some dieback but were not killed, with greatest damage reported on 'Diane.'

Ilex spp. (HOLLIES): Many Japanese hollies (*Ilex crenata*) and the Blue series *Ilex* X *meserve* hybrids were often seriously injured or even killed. The 'China Boy' and 'China Girl' hybrids often did better compared to the Blue series, generally suffering just foliar damage or tip dieback.

The inkberry hollies (*Ilex glabra*) were variable and suffered moderate damage. The 'Nordic' and 'Compacta' cultivars were reported as both better and worse than each other and the species.

American hollies (*Ilex opaca*) responded differently based on cultivar. Damage ranged from none to severe.

Deciduous hollies were generally fine. Some damage was reported on *Ilex decidua*. Damage was reported as less severe in moist locations.

Kalmia latifolia (MOUNTAIN LAUREL): Some injury was reported but the plants were not seriously damaged.

Kerria japonica (JAPANESE KERRIA): Greatest damage was reported on double-flowering 'Pleniflora,' with dieback to the snow line.

Koelreuteria paniculata (GOLDEN RAINTREE): Experience this winter tells us what is needed for this urban tolerant tree. Many plants suffered damage and some were killed outright. Some plants showed no injury. Identification of a cold hardy seed source or identifying a method of asexually propagating a cold hardy individual should allow us to use this plant in Ohio. In the short term, plants

which remain in Ohio nurseries and which are in good condition are good bets for Ohio's urban scene. Plan on finding and using small numbers of plants. This is the year to tag the hardy plants.

Ligustrum spp. (PRIVETS). *L. obtusifolium* (border privet) and *L.* X *vicaryi* (golden Vicary privet) were generally killed to the snowline. Plants recovered rapidly. It seems that Vicary privet is best treated as a perennial and pruned at the soil line each year as this enhances the foliar color. If you buy that argument, then no damage was done. The cultivar 'Hillside' has never shown winter injury at Secrest Arboretum since planting in 1986.

Lindera benzoin (SPICEBUSH): Even native populations were killed to the soil line. A close look at native populations suggests that this is normal. The plants break readily from the ground and at some locations were around three feet tall by July.

Liquidambar styraciflua (AMERICAN SWEETGUM): Sweetgum has had trouble in several of the colder winters since 1972. Many Ohio nurserymen have found that cold hardy sources are a must since southern Ohio is the northern limit of this plant's natural range. Where cold hardy seedlings were used, damage was generally limited to individual plants and not the entire fields which were lost in the early 1980s.

Reports were best for two cultivars, 'Moraine' and 'Golddust.' Reports for 'Palo Alto,' 'Burgundy,' and 'Festival' suggest that these cultivars are less cold hardy than the species. Remember that sweetgum must be budded onto cold hardy seedlings.

Lonicera fragrantissima (WINTER HONEYSUCKLE): Plants were often killed to the snowline. This plant looks better if it is pruned to the soil line every three to five years. Maybe the winter did us a favor.

Magnolia spp. (MAGNOLIAS): The 'Little Girl' hybrids generally survived but 'Ann' and 'Jane' showed damage with 'Ann' in some cases being killed to the ground. The lily magnolia (*M. liliflora*) is generally less cold hardy than other deciduous magnolias and is one of the parents of 'Ann' and 'Jane.'

'Galaxy' is another hybrid of considerable interest. It suffered bark splitting this year and in previous years with less severe freezes.

Sweetbay magnolia (*M. virginiana*) damage showed the effect of seed source. Southern seed sources grown for their evergreen nature were killed to the soil line. Other seed sources selected as more cold hardy showed no damage.

Malus spp. (CRABAPPLES): Most cultivars seemed hardy through this severe winter. At temperatures below −35°F, 'White Angel' and 'Strawberry Parfait' suffered moderate to severe tip dieback. Red foliaged crabs generally seemed more tender to one nurseryman. At the crabapple plots at Secrest Arboretum, 'Madonna,' 'Jewelberry,' and *M. sargentii* all exhibited considerable winter damage. Problems on *M. sargentii* were also reported from numerous sites throughout Ohio.

Myrica pensylvanica (NORTHERN BAYBERRY): In the coldest areas in the state this plant was killed to the snowline. Some nurserymen reported no problem. Seed source can help here as this plant is reported as a hardy native in Nova Scotia.

Parrotia persica (PERSIAN PARROTIA): This is an interesting plant but not cold hardy. Plants can be expected to be damaged once every decade even in the warmer areas of Ohio.

Pieris japonica (JAPANESE PIERIS): Like the closely related azaleas, these plants were seriously damaged. Some plants were killed to the ground. No cultivar effects were reported.

Platanus X *acerifolia* (LONDON PLANETREE): 'Bloodgood' was consistently damaged. It is difficult to determine if the species is better as it is not being grown where the identity of both it and the cultivar is known. Considerable dieback occurred on the species *Platanus occidentalis.*

Prunus spp. (CHERRIES): *Prunus sargentii* generally survived without damage, though from one location there were reports that plants were slow to leaf out this spring. Bark-splitting and reduced foliar density were reported for *P. serrulata* 'Kwanzan.'

The *P. subhirtella* group was variable. The weeping forms were generally devastated, especially in low areas. Some reported that var. *autumnalis* was undamaged. Other cherries, including 'Okame,' 'Snow Fountain,' and 'White Fountain' hybrids were reported as damaged in some sites and unaffected in others.

There were numerous reports that Yoshino cherry (*Prunus yedoensis*) was undamaged. The *P. subhirtella*

X *P. yedoensis* hybrid, 'Hally Jolivette' also was reported to be free of winter damage.

Pyracantha coccinea (SCARLET FIRETHORN): Foliar injury was common. Tip dieback was also frequently seen in the landscape.

Pyrus calleryana (CALLERY PEARS): In the areas where temperatures were reported below −35°F, all cultivars of Callery pears showed twig damage and bark splitting. Most of the state reported that the plants were slow to leaf out but looked fine by mid-summer. 'Aristocrat' and 'Bradford' were thought by some to be slightly more cold hardy than 'Cleveland Select.' High fertility was credited with protecting one field while another field of the same cultivar which was not fertilized was damaged.

Quercus spp. (OAKS): Several native species were reported with damage, but this was reported to be due to poorly adapted seed sources. Death of nursery plants and significant financial losses were reported in some cases. Species having seed source problems included *Q. imbricaria, Q. palustris, Q. rubra,* and *Q. shumardii.* Native populations suffered no problems during the winter.

Quercus acutissima (Sawtooth oak) was variable with damage ranging from death to no apparent injury. Without the ability to propagate clones, this plant will remain undependable in Ohio landscapes.

Some English oaks, including the upright English oak, 'Skymaster,' were killed in some cases.

Rhododendron spp. (RHODODENDRONS AND AZALEAS): Damage to evergreen azaleas once again showed why these plants do best on the shores of Lake Erie and the extreme eastern part of the state. Damage ranged from loss of flower buds to plant death. 'Herbert' and 'Poukhanese' were reported as the most cold hardy selections. Flower bud survival on some rhododendrons, including 'PJM,' was often restricted to below the snowline.

Rosa spp. (ROSES): There was certainly a great deal of damage, but many were pleasantly surprised that loss of plants was not as bad as during some winters where sudden temperature drops and improper hardening off in late fall occurred. The considerable snow cover when temperatures were lowest also helped roses.

Sophora japonica (JAPANESE PAGODATREE): Some trees were heavily damaged and others escaped without damage. The opportunity exists to develop more cold hardy seed sources for Ohio's landscapes. The cultivar, 'Regent,' was reported to be less hardy than the species again this year.

Styrax spp. (SNOWBELLS): A surprise here is that *S. obassia* (fragrant snowbell) suffered less damage than *S. japonicus* (Japanese snowbell). The Japanese snowbell was killed at −28°F. Have we been looking at the wrong plant?

Ulmus parvifolia (LACEBARK ELM): This is a very urban tolerant tree which requires the use of the proper seed source to be successful. Desirable, cold hardy seed sources have been identified at Delaware, Ohio. Some seed sources are essentially herbaceous perennials in this state. As you would expect, some nurseries reported no damage while others reported serious damage. 'Dynasty' is a cultivar which has proved to be more cold hardy than the species.

Viburnum spp. (VIBURNUMS): Various field and landscape grown species reacted very differently this winter. The following species were not reported as having significant winter damage: *V. carlocephalum, V. cassinoides* (Witherod viburnum), *V. dentatum* (Arrowwood viburnum), *V. lantana* (Wayfaringtree viburnum), *V. lentago* (Nannyberry viburnum), *V. opulus* (European cranberrybush viburnum), *V. prunifolium* (Blackhaw viburnum), *V. sargentii,* and *V. trilobum* (American cranberrybush viburnum).

V. X *burkwoodii* was damaged at several nurseries or locations. Tip dieback was the norm, but some plants were killed to the snow line. Other locations reported no damage. It appears that the temperatures that we experienced are close to the limits of this plant's tolerance.

V. carlesii (Koreanspice viburnum) was damaged in the central part of the state. The variety 'Compactum' was injured more frequently than the species. Most areas of the state reported the loss of floral buds.

V. X *chenaultii* was increasing in popularity prior to this winter, but this plant was seriously damaged this year. Plants were killed to the soil line. *V. dilatatum* (Linden viburnum), was damaged in some areas but not others.

Damage reports on *V.* X *juddii* were variable. Damage ranged from none to branch dieback. Floral buds were lost in some locations.

V. plicatum var. *tomentosum* (Doublefile viburnum) was consistently damaged, with 'Mariesii' and

'Newport' most severely affected in some locations. *V.* X *rhytidophylloides* (Lantanaphyllum viburnum) and *V. rhytidophyllum* (Leatherleaf viburnum) were consistently damaged, with kill to the snow line.

V. setigerum (Tea viburnum) was damaged in the landscape. It is normally grown in containers for this reason in Ohio. If this plant is used so that it can be pruned to the ground every several years, the lack of cold hardiness may not be a concern.

Weigela florida. (WEIGELA): All cultivars were damaged. The variegated cultivars seemed to be damaged the most severely.

Zelkova serrata (JAPANESE ZELKOVA): This plant suffered consistent damage in many areas of Ohio. All cultivars in the Deciduous Tree Evaluation Plot at Wooster suffered damage at −25°F. 'Halka,' 'Village Green,' and 'Green Vase' were all damaged. Some individual plants on the Ohio State University Columbus campus and at Wooster suffered no damage and may offer some potential for selection.

Ornamental Plant Problems in Ohio: 1994

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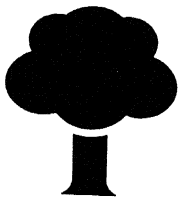

A compilation of noteworthy pest, disease, and physiological problems of ornamental plants in Ohio during the 1994 season is presented here. These observations are drawn from information in Ohio State University's Buckeye Yard and Garden Line (BYGL) reports, Plant and Pest Diagnostic Clinic (PPDC) samples, David J. Shetlar's P.E.S.T. Newsletter, reports of the Ohio Department of Agriculture (ODA), and other observations.

1. **Weather Background.** The big weather news in 1994 was the severe freeze in January. Reports from throughout Ohio ranged from −25°F to −30°F temperatures, and some nurserymen reported cold pockets down to −40°F. Matt Vehr of Spring Grove Cemetery and Arboretum in Cincinnati reports that even in southern Ohio, temperatures were below zero for almost a week in mid-January.

   Other weather features in much of Ohio included normal to fairly wet conditions through spring, an unusually dry August-October, and cool temperatures in August.

2. **Winter Injury.** Damage to woody plants was widespread, but moderated by significant insulating snow cover throughout January. Many plants killed back to the crown recovered throughout the season, especially if properly pruned. Many observers caution that the full extent of winter injury from 1994 will not be expressed until next year. A more complete record of winter injury in 1994 is reported in an accompanying article, titled Winter Injury on Woody Ornamental Plants in Ohio: The Winter of 1993-1994.

3. **Juniper Problems.** Vole injury to low-growing junipers such as 'Blue Pacific' was severe in the winter of 1993-1994, causing extensive branch dieback and foliar browning. Although damage was much more extensive than would be expected from fungal diseases such as *Phomopsis* blight (pathogen: *Phomopsis juniperovora*) and *Kabatina* blight (pathogen: *Kabatina juniperi*), misdiagnosis was common. Pulling back inner branches and looking for stripped bark from vole feeding is the key diagnostic clue.

   A dieback of sectors of certain upright junipers was noted in Ohio landscapes and nurseries. Nurserymen and horticulturists in Ohio and Minnesota both report that this has occurred for years, but a specific cause has not been identified. The plant seems to die back from a specific point, with a clear-cut delineation between healthy tissue and dead stem tissue. There is a canker-like area present but no pathogens have been isolated to date.

   The plethora of usual juniper problems were also identified, including *Phomopsis* blight, *Kabatina* blight, tip dwarfmite (*Trisetacus sp.*) damage causing stunting and twisting of new growth, juniper midges (*Contarinia juniperana*) and juniper tip midge (*Oligotrophus betheli*), plant bugs, and, of course, spruce spider mites (*Oligonychus ununguis*).

4. **Winter and Insect Survival.** There is often a great deal of speculation in the popular press about the effects of cold winter conditions on various insect populations. The speculation is often just that, and it turns out to be a bit more complicated than expected, with the interaction of various predators and parasites and their differential survival, insulating effects of snow, and other factors.

   Dave Shetlar in his P.E.S.T. summary for the year does indicate the following:

   "I had expected that the super cold winter weather would have certainly taken out some of the scales and possibly moths and butterflies. Instead, the scales did just fine and the semi-tropical mimosa webworm webbed over honeylocusts as if none had been killed...On the other hand, some of the social wasps, yellowjackets, and bald-faced hornets were much less common."

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5. **Maple Problems.** Decline of maples, especially Norway maples, was widely noted starting in mid-summer. Often the plants died one sector at a time. On many affected plants no significant pest or disease problems, including *Verticillium* wilt, were identified. Although there are still questions for many of the cases, in some instances affected plants exhibited poor annual growth for a number of years, and long-term stress factors were suspected.

   On sugar maples, pear thrips (*Taeniothrips inconsequens*) infestations were widely reported for the second straight year, still mostly from northern Ohio, but as far south as central Ohio. Symptoms included leaf mottling, tattering, and distortion from thrips feeding.

6. **Anthracnose diseases.** Dogwood anthracnose (pathogen: *Discula destructiva*) remained a minor landscape problem for most locations, although plants in wooded areas with dense shade and poor air movement were most affected. Incidence of dogwood anthracnose in forest areas of southeast Ohio was very high.

   Sycamore anthracnose (pathogen: *Apiognomonia veneta*) was prevalent throughout much of the state on sycamore and to a lesser extent on London planetree due to cool, wet conditions during early leaf development. Many sycamores were almost completely defoliated by late spring, but most refoliated and appeared relatively normal by early July.

   Ash anthracnose (pathogen: *Apiognomonia errabunda*) was quite common by late May, causing considerable water-soaked spotting and leaf drop, but most trees recovered without significant problems.

7. **Crabapple Problems.** It was another moderate disease year for crabapples in 1994. Some of the cultivars most affected by apple scab (pathogen: *Venturia inaequalis*) included: 'Harvest Gold,' 'Hopa,' 'Indian Magic,' 'Indian Summer,' 'Jewelberry,' 'Madonna,' 'Profusion,' 'Radiant,' 'Robinson,' 'Velvet Pillar,' and 'Winter Gold.' Fireblight (pathogen: *Erwinia amylovora*) was severe on 'Madonna' and 'Silver Moon.' Frogeye leaf spot (pathogen: *Botryosphaeria obtusa*) was severe on 'Madonna' and 'Professor Sprenger.'

   A different type of problem on crabapples was reported by Mike Ellis:

   "Strange (atypical) cankers were observed on the trunks of several crabapple cultivars in a large nursery planting. Cankers were atypical in the sense that they simply did not look like cankers caused by the common wood-infecting fungi that usually occur on apple and crabapple. Cankers did not have fungal fruiting bodies associated with them, and no pathogenic organisms were recovered from cankers. The cankers did not appear to be killing trees, but were unsightly and plant value was affected.

   "Samples were sent to pathologists in Pennsylvania and North Carolina, and the consensus is that the problem is Roundup (glyphosate) injury. Apparently glyphosate can be absorbed through young trunk tissue before it develops a thick layer of suberized bark. In addition, it can enter wounds, such as those caused by removing suckers or small twigs from the trunk. The absorbed material can remain isolated resulting in a localized canker, or it can be translocated upward, resulting in an elongated canker that extends for several inches or even feet.

   "The glyphosate kills tissue in the cambium and as the tree continues to grow these areas result in splits in plant tissue that resemble fungal cankers. The damage may not show up until the year following application. We have always known that you cannot spray glyphosate onto the leaves of trees, but generally are not concerned about spraying the trunks of trees, especially older trees that have a good layer of bark. Growers should consider adjusting herbicide applications to prevent materials such as glyphosate from coming in contact with young (green) trunk tissue or wounds on trunks."

8. **Other diseases.** Once again, *Guignardia* leaf blotch of horsechestnuts and buckeyes (pathogen: *Guignardia bidwellii*) was common, resulting in considerable leaf blight, discoloration, and leaf drop.

   Rose black spot (pathogen: *Diplocarpon rosae*) was severe during cool, wet periods in mid summer. Dutch elm disease was commonly identified. *Thielaviopsis* black root rot of blue hollies (pathogen: *Thielaviopsis basicola*) was identified in both nursery and landscape situations. *Septoria* leaf spot of flowering dogwood (pathogen: *Septoria spp.*) was quite common in late summer and often misdiagnosed as dogwood anthracnose.

   For additional comments on common diseases, see item No. 16 listing Ohio Department of Agriculture nursery inspection reports.

9. **New and Unusual Diseases.** Nancy Taylor of the Ohio State University Plant and Pest Diagnostic Clinic provided two new Ohio reports: Southern blight (pathogen: *Sclerotium rolfsii*) on hosta, and root knot nematode (*Meloidogyne hapla*) on cimicifuga. Nancy also reported *Armillaria* root rot on rhododendron and a *Phytophthora* canker on *Prunus avium*.

10. **Gypsy moths.** Preliminary results of the gypsy moth (*Lymantria dispar*) program in Ohio from Allen Baumgard of ODA as of October 6, 1994, were:

"We have just completed our aerial survey and are still compiling the results but early indications show a marked decrease in defoliation in Ohio for the second straight year. I think the cold spell [in January of 1994] had a lot to do with this, as well as our [eradication] work, of course.

"We are continuing our fungus project with Dr. Hunter of California University of Pennsylvania. So far this year, some of the sites are showing near 100% kill due to the fungus or at least the fungus is in all of the dead caterpillars.

"We are just starting to tabulate the summer trapping survey results. Preliminary results indicate a decrease in number of moths caught. This can be attributed in part to the cold spell we had this winter as well as to the fact that populations in neighboring Pennsylvania areas are down, hence fewer haul-ins."

11. **Spruce spider mites.** In Dave Shetlar's P.E.S.T. summary he reports an interesting observation on feeding behavior of spruce spider mites (*Oligonychus ununguis*):

"The cool, moist spring was ideal for spruce spider mite activity and their populations built up so high that many mites were forced onto the newly expanding needles — food they seemed to avoid in 1993 until the fall (as of early October 1994). However, when we got hot and dry, the mites again went dormant. They are now back on the rise though we have noticed something not realized before. Apparently, spruces which had heavy feeding last spring, especially where the current year's needles were damaged, have few or no spider mites this fall. Is it 'damage-induced' plant protection, predators, or simply lack of suitable feeding sites. Questions. Questions."

12. **Extra generations.** Many lace bug species helped themselves to an extra generation or two. Euonymus scales (*Unaspis euonymi*) added a third generation, topping the usual two. Reports from Lake County indicate that Fletcher scales (*Parthenolecanium fletcheri*) added a late season generation.

13. **Flow and ebb.** Fall webworm (*Hyphantria cunea*) populations were high. Roseslugs (*Endelomyia aethiops*) and pear sawflies (*Caliroa cerasi*) caused significant ornamental damage on amelanchier. Hickory tussock moths (*Lophocampa caryae*) were uncommonly prevalent on oaks, hickory, birch, and other hosts, massing to cause significant skeletonization. Physicians were kept busy treating children's "stings" from the irritation caused by long white hairs of the caterpillars.

Elm leaf beetle (*Pyrrhalta luteola*) populations were way down, presumably due to winter freezes. Yellow poplar weevils (*Odontopus calceatus*) caused much less damage than in the "flying tick" panic of 1993 (See page 29).

14. **European pine shoot beetle update.** Dave Shetlar provides this update on this pest (*Tomicus piniperda*) of regulatory (not landscape) significance in Ohio:

"Indiana and Michigan are much more infested with this quarantinable pest than Ohio. Ohio has two more counties added to the list of positive finds — Delaware and Stark counties. (Nurseries and Christmas tree plantations need to be inspected and certified before sales of pines from quarantined counties to non-infested counties). Ohio's list is now: Ashland, Ashtabula, Cuyahoga, Delaware, Erie, Geauga, Huron, Knox, Lake, Lorain, Mahoning, Medina, Portage, Richland, Stark, Summit, Trumbull and Wayne.

"Controls should include sanitation at the top of the list. Make sure that any stumpage, dead trees, butt ends, and the like are destroyed by mid-May. This will keep new larvae from successfully developing."

15. **White grub update.** Masked chafers (*Cyclocephala borealis*) were prevalent in southwestern Ohio while Japanese beetle (*Popillia japonica*) grubs have staked out much of the rest of the state. European chafers (*Rhizotrogus majalis*) and Asiatic garden beetles (*Maladera castanea*) are infesting the counties bordering Lake Erie. Although pheromone traps for Oriental beetles (*Anomola orientalis*) were set out in multiple locations, this beetle was captured only in

Lake County. As Dave Shetlar says, "This is certainly not good news for the local nursery producers, but it does provide hope that this critter has not spread too far across the state."

16. **Ohio Department of Agriculture (ODA) Nursery Inspection Reports.** As of October 6, 1994, the infamous ODA Top 20 for insect and mite reports (in terms of times reported) was:

Twospotted spider mite (322)
Japanese beetle (305)
Spruce spider mite (162)
Cooley spruce gall adelgid (140)
Fletcher scale (94)
Eastern spruce gall adelgid (93)
Honeylocust spider mite (84)
Black vine weevil (78)
Aphids on chrysanthemum (77)
Fall webworm (73)
Pine needle scale (72)
Zimmerman pine moth (69)
Pine bark adelgid (61)
Bronze birch borer (60)
Leafhoppers (59)
Birch leafminer (55)
Hawthorn lace bug (53)
White pine aphid (47)
Winged euonymus scale (47)
Southern red mite (46)

For disease reports by inspectors as of October 6, 1994, the Rotten 20 were:

Powdery mildews (234)
Apple scab (162)
Leaf spots, unspecified (143)
Septoria leaf spot (60)
Crown gall (47)
Fireblight (28)
White pine root decline (26)
Cankers (25)
Verticillium wilt (24)
Rose black spot (23)
Phyllosticta leaf spot (23)
Oak leaf blister (22)
Bacterial leaf spot (21)
Cedar quince rust (19)
Juniper twig blight (18)
Anthracnose blight (16)
Botrytis blight (16)
Cedar hawthorn rust (14)
Peony leaf blotch (14)
Phytophthora root rots (12)

17. **Last and least.** From the Buckeye Yard and Garden Line (BYGL #26: 9-29-94) comes this proof of the active imaginations of Ohio bug-watchers:

"BEECH BLIGHT APHID. Samples of this insect, *Prociphilus imbricator*, have arrived in Extension offices to great fanfare and amusement. Johnson & Lyon indicate that it 'feeds primarily on the bark of twigs and small branches,' but Dave Shetlar notes it can also be found on leaves.

"The seemingly synchronized behavior of colonies of these woolly aphids when disturbed has led some Extensioneers to wax rhapsodic. From Erik Draper of Mahoning County comes this: 'Dancing dustballs shaking their rear ends to the boogie-woogie.' Dave Shetlar tries to top that with a Roy Lichtenstein-esque: 'Fluffballs in flight.' The end."

Ornamental Plant Problems in Ohio: 1993

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A compilation of noteworthy pest, disease, and physiological problems of ornamental plants in Ohio during the 1993 season is provided here. These observations are drawn from information in Ohio State University's Buckeye Yard and Garden Line (BYGL) reports, Plant and Pest Diagnostic Clinic (PPDC) samples, Dave Shetlar's P.E.S.T. Newsletter, reports of the Ohio Department of Agriculture (ODA), and other observations.

1. **Weather Background.** Prior to 1993, the years of 1988 and 1991 were stressful for ornamentals, with often record-breaking droughts throughout much of Ohio, and 1990 and 1992 included record-breaking rainfall in some areas. Rainfall in 1993 was generally normal throughout much of Ohio, but in some areas, especially northern Ohio, there was an extended droughty period for six weeks from early to mid summer. This droughty period was most persistent in some northwest Ohio areas.

2. ***Taxus* Decline.** Starting in late summer of 1991, numerous large, decades-old *Taxus* began to yellow, brown, and decline at Secrest Arboretum in Wooster. Some plants continued to decline and died. This problem was also noted on older *Taxus* in other Eastern U.S. arboreta. At Secrest, *Phytophthora cinnamomi* was isolated from roots of a large declining *Taxus* plant by Mike Ellis (OSU Plant Pathology). See article by Ellis *et. al.* in this Special Circular.

   This problem has worsened at Secrest Arboretum since 1991. It is suspected that the moisture extremes of recent years led first to root rot development in 1990 with poor root reestablishment in the drought year of 1991, with subsequent continued stresses and further decline in the following years.

3. **Maple Problems.** In spring of 1993, many maples fruited heavily, leafed out late, and had an overall unthrifty appearance. Leaf stunting and reddening occurred in some areas into late June. It was unclear whether this represented significant long-term stress or whether the sparse leaf development was a normal response to excessive fruit development.

   Problems were more clear-cut on silver maples, which, in addition to small leaves and sparse foliation, exhibited considerable branch dieback. It was assumed that this decline was due to the severe droughts of 1988 and 1991 and to *Verticillium* wilt disease.

   On sugar maples, pear thrips (*Taeniothrips inconsequens*) infestations were widely reported. These were known to occur for some time in Ohio, and ODA conducted surveys in northeast Ohio in recent years, but 1993 was the first time that damage was regularly reported by county Extension offices and others. Initially leaf mottling, tattering, and distortion from thrips injury was misdiagnosed as frost injury, until Dave Shetlar began to confirm thrips infestations on samples.

4. **Root Rot on Rhododendron.** Samples of *Phytophthora* root rot on rhododendron from nurseries and landscapes were confirmed in the PPDC, and infections were presumed to trace back to the wet, cool summer of 1992.

5. **Dying White Pines.** Starting in the fall of 1992 many white pines began to yellow, brown, and die. In some cases white pine root decline (pathogen: *Verticicladiella procera*) was diagnosed. In other cases, where poorly drained clay soils were involved, physiological root decline followed by various root rot diseases was presumed. In many cases white pines and some other evergreens developed secondary bark beetle infestations, especially by the spring of 1993.

6. **Premature Needle Coloration and Drop.** This problem was noted primarily on various spruce species, but also on Scotch and Austrian pines in the fall of 1993. Often the yellowing, browning, and drop of needles was all the way to the second year or even current season's needles. General root decline problems from the moisture extremes over the past several years was presumed to be the cause.

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7. **Clematis Dieback.** Numerous reports of dieback to the ground were received in Extension offices and garden centers. There was speculation about fungal diseases such as *Coniothyrium* wilt disease or *Ascochyta* stem rot, but none of these problems was confirmed.

8. **Gypsy moths.** According to ODA reports, male gypsy moth (*Lymantria dispar*) catches increased in Ohio in 1993, exceeding 126,000. This was attributed to an expansion in overall populations. This included development of infested areas further into the oak-hickory forests of eastern and southeastern Ohio. Total acres of defoliation, however, decreased from 1,130 acres in 1992 to 610 acres in 1993, albeit over a wider range. This reduction can be attributed to several factors including the gypsy moth virus, fungal effects, and suppression work in northeastern Ohio in 1993.

9. **Honeylocust Pests.** Landscape and street tree honeylocusts continued to develop considerable unsightliness and defoliation from a series of pests. These included yellowing, leaf distortion, and defoliation from the honeylocust plant bug complex, the foliar feeding of mimosa webworms (*Homedaula anisocentra*), and the yellowing and defoliation from honeylocust spider mites (*Platytetranychus multidigitalis).*

10. **Pine Shoot Beetle.** Surveys by USDA-APHIS in Ohio in 1993 indicate two new counties with infestations of pine shoot beetle (*Tomicus piniperda*). These are Erie and Knox. This brings to 16 the number of Ohio counties where pine Christmas tree and nursery stock must be inspected prior to moving this stock into non-infested areas. These are: Ashland, Ashtabula, Cuyahoga, Erie, Geauga, Huron, Knox, Lake, Lorain, Mahoning, Medina, Portage, Trumbull, Richland, Summit, and Wayne.

    Keep plantations and nurseries as free as possible of old pine logs and stumpage, and if some remain, treat in March as for Pales weevil control.

11. **White pine cone beetle.** This beetle, *Conophthorus coniperda*, was noted in May burrowing into candles of white pines and Austrian pines. Because of the quarantine issue relative to the European pine shoot beetle, growers were concerned. However, the white pine cone beetle is a native species and generally feeds only on cones.

    Dave Shetlar suspects that stress in recent years led to excess cone production and a build-up of beetle populations followed by the pines finally running out of steam in 1993, producing less cones which left the beetles with only candles to infest.

12. **Yellow Poplar Weevils.** This pest, *Odontopus calceatus*, was particularly severe this year as the summer generation of adults cut bean-shaped holes in leaves of magnolia, tuliptree, and sassafras. Larvae also caused blotch leaf mines, but the greatest damage was from adults, and in 1993 this damage in some cases caused as much as the top third of the foliage of magnolias to become browned and very unsightly.

    In addition many horticulturists received panic calls about "flying ticks," as people became alarmed when they approached infested plants, and the black weevils curled up and dropped to the ground enmasse.

13. **Year of the Sawflies.** Dave Shetlar coined this term due to the unusual number of noticeable sawfly infestations. On pines, sawflies ran the gamut from heavy infestations of European pine sawfly (*Neodiprion sertifier*) in spring, to the redheaded pine sawfly (*Neodiprion lecontei*), to the late season white pine sawfly (*Neodiprion pinetum*), surprising many observers with a second year of heavy feeding in August and September.

    Other sawflies included an azalea sawfly, *Amauronematus azaleae* (green leaf-colored larvae on deciduous azaleas that were often unnoticed until leaves of new growth were stripped), dogwood sawflies, mountain ash sawflies, rose and pear slugs (actually sawflies but somewhat sluglike in their slimy appearance), and columbine sawflies which quickly stripped the plant of all foliage, leaving the flowers and stems behind.

14. **Agrilus Borers.** Oak twig girdler (*Agrilus acutipennis*) damage was quite noticeable on both the white oaks and red oaks in late July and August of 1993. This *Agrilus* beetle has a two-year life cycle and was last widely noted in 1991. It causes a brown flagging of short twigs, but little permanent damage. Other common *Agrilus* borers included the honeylocust borer (*Agrilus difficilis*) and the twolined chestnut borer (*Agrilus bilineatus*) which frequently attacked recently transplanted oaks. For these borers, protective borer sprays in May of 1994 were recommended.

15. **Larch casebearers.** At Secrest Arboretum in Wooster, larch casebearers (*Coleophora laricella*) caused-damage on older larches. Damage appeared as a browning, bleaching, and twisting of new foliage starting in mid-April. Numerous tiny cigar-shaped cases constructed by the larvae were present and are often mistaken for browned needles, hence the Joe Boggs term, "walking dead needles."

16. **Armyworms.** This is a turf pest, but damage was so dramatic this year that it deserves mention here. Outbreaks were severe in northern Ohio as armyworms (*Pseudaletia unipuncta*) moved by the thousands from infested farm fields to nearby lawns in early to mid-July. The armyworms literally "mowed" down the turfgrass to the crowns. The problem is cyclical. Parasites rapidly built up populations; the turfgrass recovered where adequately watered and fertilized; and insecticides where used were effective.

17. **Grubworms.** There was a general increase in "new" white grub infestations. The Asiatic garden beetle (Maladera castanea) was found in considerable numbers in the Wooster area and continues to be a problem in the Lake County nursery area and around Toledo. The European chafer (Rhizotrogus majalis) and Oriental beetle (Anomola orientalis) continue to build up in the Lake Erie counties. The oriental beetle is especially worrisome because it so readily lays eggs in nursery containers.

18. **Dogwood Anthracnose.** This disease (pathogen: *Discula destructiva*) is still not a serious problem in many Ohio areas, but was severe in forested areas of southeastern Ohio and in some landscape plantings throughout the state. It is suspected that high early season incidence in 1993 may be associated with infections that developed during the cool, wet summer of 1992, conditions which favor disease development in areas where dogwood anthracnose is a more serious threat, such as the highlands in the southeastern United States and Pennsylvania.

19. ***Guignardia* leaf blotch of horsechestnut.** Incidence of this disease (pathogen: *Guignardia bidwellii*) was very severe on street tree and arboreta plantings at many sites. Leaf scorch and curling due to the disease often extended over a majority of the tree's leaf surface, resulting in serious loss in ornamental value of the tree. Serious scorching was first noted in mid-June throughout the state.

20. **Crabapple Diseases.** Common crabapple diseases such as apple scab (pathogen: *Venturia inaequalis*) and bacterial fireblight (pathogen: *Erwinia amylovora*) were moderate in incidence in 1993. In some areas, fireblight on apples grown for fruit was very severe. It is suspected that the difference between fireblight incidence of apples relative to crabapples is two-fold. First is the relatively lower genetic susceptibility of common crabapple cultivars to fireblight compared to apple cultivars. Second is the differential in blooming time, which relates to specific environmental conditions (moisture, temperature) at the time of potential blossom infections.

    Frogeye leafspot (pathogen: *Botryosphaeria obtusa*) was severe on a few crabapples at Secrest Arboretum, especially the cultivar 'Professor Sprenger.' Frogeye leafspot causes purple-rimmed tannish leafspots, and on heavily infested plants, considerable foliar yellowing and some defoliation.

21. **Actinopelte leafspot of pin oak.** This leafspot was often severe and caused symptoms of leaf yellowing that were often misdiagnosed for iron chlorosis problems on pin oaks. Incidence appears to be variable from year to year rather than progressively worsening.

22. **New and Unusual Diseases.** First reports of *Verticillium* wilt of New Guinea impatiens (pathogen: *Verticillium dahliae*) and tomato ringspot disease of dahlia were reported by Nancy Taylor and Steve Nameth of the Ohio State University Department of Plant Pathology. *Verticillium* wilt of geranium was detected for the first time in years in the PPDC.

23. **ODA Nursery Inspection Reports.** Of the 4,585 insect/mite reports, the infamous ODA Top 20 (in terms of times reported) was:

    Aphids (505)
    Twospotted spider mite (356)
    Japanese beetle (216)
    Black vine weevil (214)
    Honeylocust spider mite (137)
    Bagworm (113)
    Leafhoppers (113)
    Spruce spider mite (106)
    Cooley spruce gall adelgid (101)
    Eastern spruce gall adelgid (90)
    Pine needle scale (88)
    Zimmerman pine moth (77)
    Birch leafminer (63)

Fall webworm (61)
Hawthorn lace bug (61)
Pine bark adelgid (60)
Thrips (56)
Fletcher scale (56)
Yellow poplar weevil (50)

Of the 1,187 disease reports of nursery inspectors, the Rotten 20 for 1993 were:

Powdery mildews (232)
Apple scab (143)
Leaf spots, unspecified (104)
Septoria leaf spots (63)
Verticillium wilt (53)
Crown gall (52)
Bacterial leaf spots (28)
Phyllosticta leaf spots (26)
Fireblight (24)
White pine root decline (24)
Cedar quince rust (23)
Pyracantha scab (20)
Gloeosporium leaf spot (17)
Downy mildews (16)
Lophodermium needlecast (16)
Phytophthora root rots (15)
Anthracnose leaf blight (14)
Volutella leaf and stem blight (13)
Hemlock rust (13)
Leaf blotch (13)

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