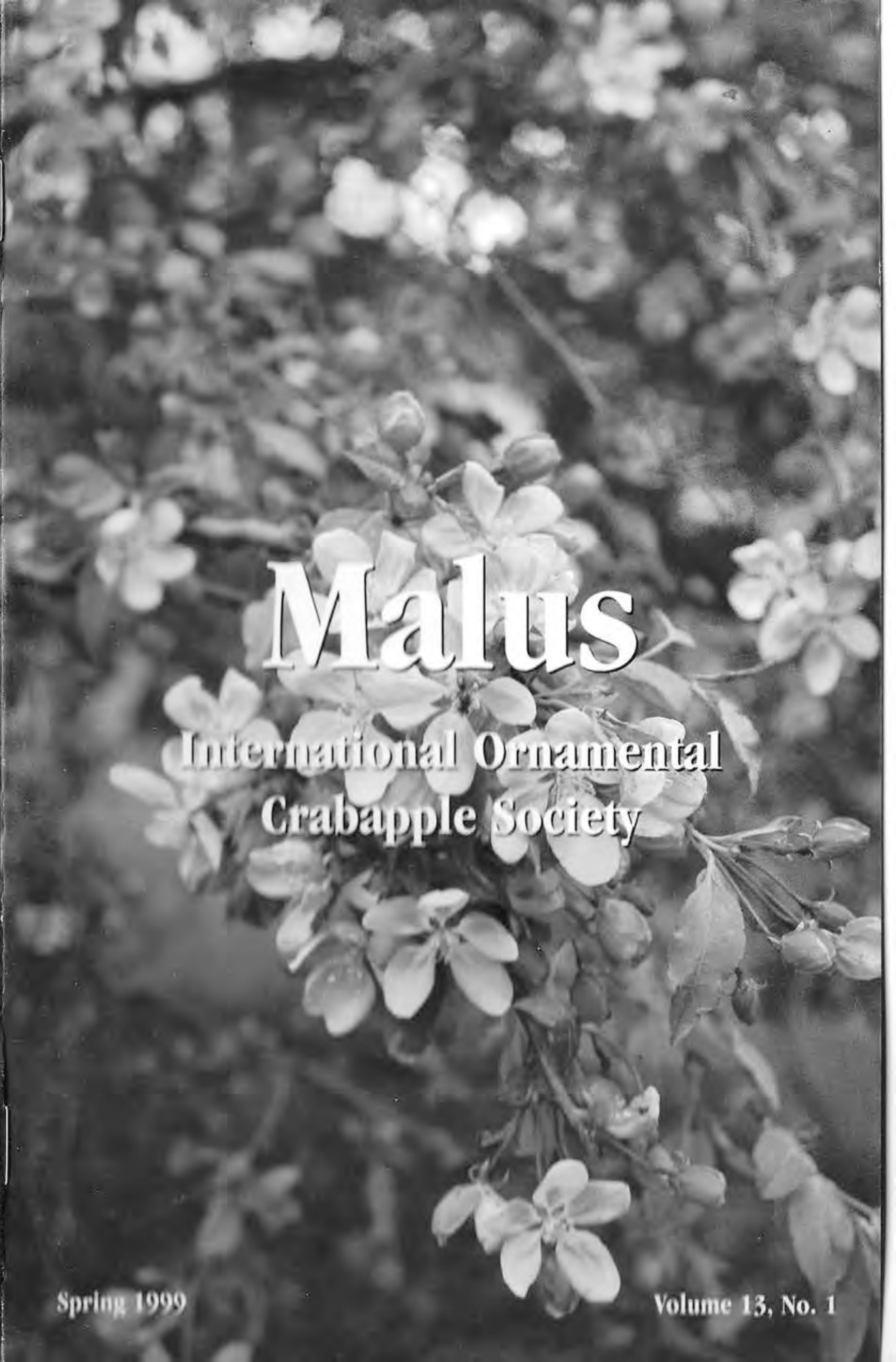


Malus

International Ornamental Crabapple Society

Spring 1999

Volume 13, No. 1

The Longenecker Gardens in the University of Wisconsin-Madison has one of the most up-to-date collection of ornamental crabapples. (Photo by B. Wolfgang Hoffmann)

The ornamental crabapple collection at the Longenecker Gardens in the University of Wisconsin-Madison in the fall. (Photo by Edward Hasselkus)

Malus

International Ornamental Crabapple Society Bulletin

Spring, 1999
Volume 13, No. 1

Malus is the official publication of the International Ornamental Crabapple Society and is published twice annually. The Society is a non-profit organization.

You are invited to join our Society. Please address all membership and other inquires to the IOCS office:

International Ornamental Crabapple Society
c/o David Allen
The Holden Arboretum
9500 Sperry Road
Kirtland, OH 44094

1998 Annual Membership Fees

• Individual	**$20.00**
• Commercial/Corp.	**$20.00**
• Organization	**$20.00**
• Student	**$10.00**
• Sponsorship	**$200.00**
• Individual Life	**$250.00**

If you are moving, please notify the IOCS office, so you may continue to receive your issues of Malus.

Manuscripts and other editorial matters pertaining to Malus should be mailed to the editor:

International Ornamental Crabapple Society
c/o David Guthery, Editor
Johnson's Nursery, Inc.
W180 N6275 Marcy Road
Menomonee Falls, WI 53051

Deadline for inclusion of articles in the Spring issue is March 1st and for articles in the Fall issue is September 1st.

Contents

Front Cover Photo: The flowers of *Malus* 'Louisa' are a clear soft pink color. (Photo by David Guthery)

Rear Cover Photos: (Top left) The unique gold beaked fruits of *Malus* Foxfire™ (Photo by Lake County Nursery). (Top right) A close-up photo of the September fruit display and clean foliage of *Malus* Sugar Tyme® (Photo by Edward Hasselkus). (Bottom right) The fruit of *Malus* 'Adirondack' taken in October at the Longenecker Gardens in the University of Wisconsin-Madison Arboretum (Photo by Edward Hasslkus). (Bottom left) The crisp white flowers of *Malus* Foxfire™ (Photo by Lake County Nursery).

President's Corner

Dear Members:

It pays well to set your sights on a vision and consistently work toward accomplishing that goal. Successful people nurture their vision by setting related goals that help to grow vision into reality.

One of the privileges of my life has been to witness Les Nichols' vision and to play a small part in helping to make it a reality. His original vision was to identify disease resistant crabapples, a project undertaken by the Pennsylvania State University plant pathologist in 1961.

From today's perspective, this seems like a sensible, realistic goal. Nevertheless, it took great courage for Les to criticize and recommend the removal of some famed crabapple cultivars that were widely accepted by the public and broadly sold in the trade.

Les kept his sights on his vision and didn't flinch at the criticism of those who were uncomfortable with change. Annual publication of his list of "dogs" and recommendation of newly identified winners that were unknown to the trade introduced the idea that crabapples could indeed be attractive year-round.

Pretty soon nurserymen began propagating the winners and publicizing the advantages of these superior cultivars. Specifiers and consumers began choosing them over the better known but less desirable, disease-ridden favorites. Les did not stop there. He convinced Fr. John Fiala to accept the disease resistance criteria in crabapple breeding along with bloom and fruit standards.

Anyone who asked Les about his work would experience his gentle sales pitch to become a partner in making his dream a reality. Hearing that sales pitch at a winter trade show led me to change my flight plans and go visit Les at Penn State. There, in the dead of winter, I bought into Les' vision and became a believer, and even bought his dinner, as I recall. I went back to Oregon and went to work to make sure that our nursery would add these improved cultivars to our crabapple line, and spread the word via color posters and flyers.

Others who head Les Nichols' pitch joined in to broaden the scope of his vision were Tom Green (Morton Arboretum), Ed Hasselkus (Univ. of Wisconsin) and Peter Bristol (The Holden Arboretum). Horticultural Leaders of the states of Ohio and Oregon, Indiana plant breeder - Bob Simpson and many others joined together to form the IOCS and create a national crabapple evaluation program.

Thus one man's vision became the vision of many and today crabapple popularity has reached a new zenith. New cultivars continue to be developed through intensified breeding programs at arboreta, university labs and in nurseries. Les died in 1986, but the IOCS continues to carry forward his dream. It is time for each of us to do a "Lester Nichols' soft sell" and encourage others to become active crabapple enthusiasts. Anyone who recruits a new IOCS member, let me know and I will publish your contribution in my subsequent columns.

Sincerely,

Norbert Kinen
Senior Vice-president
J. Frank Schmidt & Son Co.

57 Years of Ornamental Crabapple Evaluations at the University of Wisconsin-Madison Arboretum

by Edward R. Hasselkus, Professor Emeritus, Horticulture

The first ornamental crabapples were planted in what is now the Longenecker Horticultural Gardens in the spring of 1942. This collection is now considered by many to be the most up-to-date collection of ornamental crabapple cultivars in the world. I have served as curator of the Longenecker Horticultural Gardens for the past 33 years.

Aesthetic and disease evaluations have been conducted on a regular basis with emphasis on fruiting qualities. As preparation for my presentation at the 1998 Crabapple Symposium at the Holden Arboretum, I conducted a visual apple scab evaluation of our ornamental crabapple collection on August 4, 1998. Regular and above average rainfall during the 1998 growing season resulted in a high degree of apple scab infection in Madison. Ratings were assigned as follows:

Excellent Scab Resistance:	Little or no defoliation, overall clean foliage.
Fair Scab Resistance:	Partial defoliation, overall shabby appearance.
Poor Scab Resistance:	Total or severe defoliation, lack of aesthetic merit.

In the remarks column, fireblight was noted where observed. An alternate bearing pattern is also indicated along with comments on fruit size or appearance. Cultivars indicated as watersprouters should be considered as aesthetically inferior and as high maintenance landscape plants.

In summary, these are my top ten recommended ornamental crabapples:

White flowers, red fruit: Red Jewel®, Sugar Tyme®
White flowers, yellow fruit: Golden Raindrops™, 'Ormiston Roy'
Pink flowers, red fruit: 'Prairifire'
Upright form: 'Adirondack'
Weeping form: Anne E, 'Louisa', Molton Lava®
Dwarf form: *Malus sargentii* 'Tina'

Excellent Scab Resistance	**Remarks**
M. 'Adirondack'	Upright form
M. Anne E	
M. 'Autumn Glory'	
M. baccata 'Jackii'	
M. 'Baskatong'	
M. 'Beverly'	Alternate bearer
M. 'Bob White'	Watersprouter
M. brevipes	Chlorosis
M. 'Callaway'	Fruits too large
M. Camelot®	Fireblight
M. 'Canary'	
M. Canterbury®	
M. 'Cardinal'	Poor form
M. 'Cashmere'	
M 'Centennial'	Fruits too large
M. Christmas Holly®	
M. Cinderella®	Very dwarf
M. Coralburst	
M. 'Coral Cascade'	
M. 'Cranberry Lace'	Upright form
M. 'David'	Alternate bearer
*M.*x *dawsoniana*	Ugly fruit
M. 'Dolgo'	Large fruit
M. 'Ellwangeriana'	Watersprouter
M. Excalibur®	
M. Firebird™	
M. Fox Fire®	
M. 'Gibb's Golden Gage'	Fruits too large
M. 'Golden Galaxy'	
M. 'Golden Hornet'	Fruits too large
M. 'Gorgeous'	Fruits too large
M. Guinevere®	
M. 'Gwendolyn'	Fruits too large
M. Harvest Gold®	
M. x *hartwigii*	

Excellent Scab Resistance	**Remarks**
M. 'Henry Kohankie'	Fruits too large
M. Holiday Gold™	
M. hupehensis	
M. King Arthur®	
M. Lancelot®	Very dwarf
M. 'Longenecker'	
M. 'Louisa'	
M. 'Luwick'	
M. 'Makamik'	
M. 'Mary Potter'	Alternate bearer
M. 'Mollie Ann'	Fireblight
M. Molton Lava®	
M. 'Mount Arbor Special'	Watersprouter
M. 'Naragansett'	
M. 'Orange Crush'	
M. 'Ormiston Roy'	
M. 'Park Centre'	Upright form
M. Pink Princess	
M. 'Prairie Maid'	Alternate bearer
M. 'Prairifire'	
M. 'Professor Sprenger'	Watersprouter
M. prunifolia var. *xanthocarpa*	Fireblight
M. 'Purple Prince'	
M. Red Jewel®	Fireblight
M. 'Red Peacock'	Alternate bearer
M. x *robusta* var. *persicifolia*	
M. 'Rosseau'	Fruits too large
M. sargentii	
M. sargentii 'Candymint'	
M. sargentii 'Roselow'	
M. sargentii 'Tina'	
M. 'Satin Cloud'	Red autumn foliage
M. sieboldii	
M. sieboldii var. *arborescens*	
M. 'Sinai Fire'	
M. 'Spring Song'	

Excellent Scab Resistance	**Remarks**
M. 'Strawberry Parfait'	
M. Sugar Tyme®	
M. toringoides	
M. transitoria Golden Raindrops™	
M. 'White Angel' ('Inglis')	
M. x *zumi* var. *calocarpa*	Fireblight
M. x *zumi* 'Wooster'	Watersprouter, fireblight

Fair Scab Resistance	**Remarks**
M. 'Adams'	Fireblight
M. 'Amberina'	
M. American Spirit®	
M. 'Ames White'	
M. baccata 'Gracilis'	
M. baccata 'Walters'	
M. 'Birdland'	Watersprouter
M. 'Blanche Ames'	
M. Brandywine®	
M. Centurion®	
M. 'Donald Wyman'	
M. 'Doubloons'	
M. 'Edna Mullins'	
M. 'Evelyn'	Fireblight
M. floribunda	
M. 'Henningi'	
M. 'Kirk'	
M. 'Liset'	
M. 'Lullaby'	
M. 'Michael'	
M. 'Morning Sun'	
M. 'Oekonomierat Echtermeyer'	
M. 'Pink Satin'	
M. 'Pink Spires'	
M. 'Profusion'	
M. prunifolia var. *rinkii*	
M. 'Ralph Shay'	

Fair Scab Resistance	**Remarks**
M. 'Red Jade'	
M. 'Red Swan'	
M. Royal Ruby	Watersprouter
M. 'Selkirk'	
M. 'Sentinel'	
M. 'Serenade'	
M. sikkimensis 'Rockii'	
M. sieboldii 'Fuji'	
M. 'Silver Drift'	
M. Sir Galahad®	
M. 'Snow Magic'	Watersprouter
M. 'Spring Snow'	Watersprouter
M. 'Turesi'	
M. 'Van Eseltine'	
M. Weeping Candied Apple®	
M. 'White Candle'	
M. 'White Cascade'	
M. 'Winter Gold'	Fireblight
M. x *zumi*	
M. x *zumi* var. *calocarpa* "Yellow Fruit"	

Poor Scab Resistance (Discard)	**Remarks**
M. baccata 'Columnaris'	
M. baccata var. *mandshurica*	
M. baccata 'Midwest'	
M. 'Henry F. DuPont'	
M. 'Indian Magic'	
M. 'Indian Summer'	
M. 'Jewelberry'	
M. 'Katherine'	Fireblight
M. 'Leprechaun'	
M. Madonna®	
M. 'Maria'	
M. 'Pink Dawn'	
M. x *purpurea* 'Lemoinei'	
M. 'Radiant'	

Poor Scab Resistance (Discard)	**Remarks**
M. 'Red Barron'	
M. 'Red Splendor'	Watersprouter
M. 'Robinson'	
M. Royal Fountain™	
M. 'Royalty'	
M. 'Snowcap'	
M. 'Snowdrift'	
M. 'Thunderchild'	
M. Velvet Pillar™	
M. 'Zumarang'	
M. x *zumi* 'Winter Gem'	

Evaluation of Crabapples for Apple-and-Thorn Skeletonizer and Japanese Beetle Feeding Damage at Secrest Arboretum: 1996

by David J. Shetlar, James A. Chatfield, Eric Draper, and Kenneth D. Cochran

Summary

A planting of 59 selections of crabapples was rated for apple-and-thorn skeletonizer (ATS) damage and Japanese beetle (JB) adult feeding on August 9, 1996, at the Secrest Arboretum, Wooster, Ohio. Significant differences in crabapples with ATS damage were observed. Seven taxa had 10% skeletonization or less while 21 taxa had 50% leaf skeletonization, which was deemed unacceptable. JB adult feeding was less severe than ATS in 1996. Thirteen taxa sustained very little damage, while 12 taxa had more than 50% of the leaves skeletonized.

Introduction

In 1984, 45 taxa of crabapple were established with three replicates in a completely randomized plot at the Secrest Arboretum, Wooster, Ohio. In 1991, an additional 14 taxa were added to the plot, with *M. transitoria* Golden Raindrops™ losing one replicate. By 1996, one replicate each of *M.* Red Jewel® and *M.* x *zumi* var. *calocarpa* was lost. The trees in this plot were evaluated in 1994 and 1995 for growth habits and disease incidence (Chatfield et al., 1996; Draper et al., 1996). In 1996, the disease ratings were again taken, and severe skeletonizing damage was noted. This damage was caused by a caterpillar, the apple-and-thorn skeletonizer (ATS), *Choreutis pariana* (Clerck) [Lepidoptera: Choreutidae], and Japanese beetles (JB), *Popillia japonica* Neuman [Coleoptera: Scarabaeidae]. Some taxa appeared to be attacked preferentially, so an evaluation of the skeletonizing damage by ATS and JB was performed and is herein presented.

Materials and Methods

The 59 taxa of crabapples were evaluated for leaf skeletonizer damage on August 9, 1996, by a single evaluator (DJS). ATS larvae fold individual leaves together with silk webbing, Within this webbing and leaf protection, the ATS larvae skeletonize the leaves by feeding only on the upper leaf surface. Japanese beetle adults generally land on upper leaves of trees and skeletonize the leaves by eating upper, middle and lower tissues between the larger veins.

Because of the types of feeding and difficulty in reaching upper parts of the trees, two rating systems of skeletonizing were used. For ATS, a branch on the southwestern portion of the tree was selected and the first 10 leaves were rated. A rating of 0 to 10 was recorded where 0 = no webbing or skeletonized leaves observed and 10 = all 10 leaves webbed or skeletonized.

For JB, a visual rating of JB skeletonizing was given after walking around each tree, observing damage. A rating of 0 to 5 was recorded where 0 = no JB skeletonizing and 5 = almost every leaf skeletonized by JB. Rating data were analyzed using ANOVA followed with LSD mean separation at P=0;01 (MSTAT, Michigan State University).

Results

Significant differences between crabapple taxa were detected for ATS damage (df=58, F=5.82, p<0.001) and for JB skeletonizing (df=58, F=4.54, p,0.001). For ATS damage, *M.* 'Bob White', *M.* 'David', *M.* 'Indian Summer', *M.* Red Jewel®, *M.* 'Snowdrift', *M.* 'White Cascade' and *M. transitoria* Golden Raindrops™ had the least damage (10% or fewer leaves skeletonized). *M.* Weeping Candied Apple®, *M.* Centurion®, *M.* 'Dolgo', *M. floribunda*, *M.* Molton Lava®, *M.* 'Ormiston Roy', *M.* 'Professor Sprenger', *M.* 'Profusion', *M.* 'Radiant', *M.* 'Red Barron', *M.* 'Red Jade', *M.* 'Red Splendor', *M.* 'Ruby Lustre', *M.* 'Selkirk', *M.* 'Sentinel', *M.* 'Silver Moon', *M.* 'Sinai Fire', *M.* Camelot®, *M.* 'Prairie Maid', *M.* 'Louisa', *M.* 'Narragansett' and *M.* 'Pink Satin' sustained 50% or more leaves attacked by ATS. This level of activity was deemed aesthetically unacceptable.

For JB damage, *M. baccata* 'Jackii', *M.* 'Jewelberry', *M.* 'Profusion', *M.* 'Red Jade', *M.* Red Jewel®, *M.* 'Silver Moon', *M.* Sugar Tyme®, *M.* x *zumi* var. *calocarpa*, *M.* 'Sinai Fire', *M.* x *zumi* 'Winter Gem', *M.* 'Louisa', *M.* 'Canary' and *M. transitoria* Golden Raindrops™ had ratings averages of 1.0 or less. Unacceptable damage was found on *M.* 'Liset', *M.* 'Radiant', *M.* 'Red Splendor', *M.* 'Royalty', *M. sargentii*, *M.* Velvet Pillar™, *M.* Camelot® and *M. sargentii* 'Candymint' which had ratings of 3.0 or more (See Table 1 for data).

It should be noted that the severity of damage from apple-and-thorn skeletonizer at the Secrest Arboretum appears to be unusual with respect to other sites. In addition, this data is for one year only. For these reasons, the significance of this pest as a major problem on crabapples in general is questionable.

References Cited

Chatfield, J.A., E.A. Draper, K.C. Cochran, P.W. Bristol, and C. E. Tubesing. 1996. Aesthetic evaluation of crabapples at Secrest Arboretum in Wooster, Ohio: 1994-1995. The Ohio State University and Ohio Agricultural Research and Development Center, Special Circular 152. pp. 12-21.

Draper, E.A., J.A. Chatfield, K.C. Cochran, P.W. Bristol, and C.E. Tubesing, 1996. Evaluation of crabapples for apple scab at Secrest Arboretum in Wooster, Ohio: 1995. Ibid. 152. pp. 22-26.

Table 1: Summary of Apple-and Thorn Skeletonizer (ATS) Damage to 59 Taxa of Crabapples at Secrest Arboretum, Wooster, Ohio, August 9, 1996.

Table 1(Continued): Summary of Apple-and Thorn Skeletonizer (ATS) Damage to 59 Taxa of Crabapples at Secrest Arboretum, Wooster, Ohio, August 9, 1996.

Crabapple	# Replicates	Average ATS±SD[a]	(LSD separation)
M. 'Adams'	3	1.67±1.15	JKLM
M.baccata 'Jackii'	3	2.67±0.58	GHIJKLM
M. 'Beverly'	3	3.33±1.15	FGHIJKLM
M. 'Bob White'	3	0.67±0.58	M
M. Centurion®	3	5.00±2.65	DEFGHIJ
M. 'David'	3	1.00±0.00	CDEFGH
M. 'Dolgo'	3	5.00±0.00	DEFGHIJ
M. 'Donald Wyman'	3	4.67±2.31	EFGHIJK
M. floribunda	3	5.00±0.00	DEFGHIJ
M. halliana 'Parkmanii'	3	3.67±0.58	FGHIJKLM
M. Harvest Gold®	3	2.33±0.58	HIJKLM
M. 'Henningi'	3	4.33±3.51	EFGHIJKL
M. 'Hopa'	3	3.33±0.58	FGHIJKLM
M. 'Indian Magic'	3	1.33±0.58	KLM
M. 'Indian Summer'	3	1.00±0.00	LM
M. 'Jewelberry'	3	4.00±3.61	FGHIJKLM
M. 'Liset'	3	2.33±0.58	HIJKLM
M. 'Mary Potter	3	2.00±0.00	IJKLM
M. Molton Lava®	3	7.67±2.08	ABCDE
M. 'Ormiston Roy'	3	5.00±2.65	DEFGHIJ
M. 'Prairifire'	3	3.33±1.53	FGHIJKLM
M. 'Professor Sprenger'	3	5.33±3.06	DEFGHI
M. 'Profusion'	3	5.67±2.08	CDEFGH
M. 'Radiant'	3	6.00±1.00	CDEFG
M. 'Ralph Shay'	3	4.33±0.58	EFGHIJKL
M. 'Red Barron'	3	5.00±2.65	DEFGHIJ
M. 'Red Jade'	3	8.33±1.15	ABCD
M. Red Jewel®	3	1.00±0.00	LM
M. 'Red Splendor'	3	6.00±2.65	CDEFG
M. 'Robinson'	3	1.33±0.58	KLM
M. 'Royalty'	3	2.00±1.73	IJKLM
M. 'Ruby Lustre'	3	5.33±0.58	DEFGHI
M. sargentii	3	1.67±0.58	JKLM
M. 'Selkirk'	3	6.33±1.53	BCDEF
M. 'Sentinel'	3	5.67±2.52	CDEFGH
M. 'Silver Moon'	3	6.00±2.00	CDEFG
M. 'Snowdrift'	3	1.00±1.00	LM
M. 'Strawberry Parfait'	3	1.67±1.15	JKLM
M. Sugar Tyme®	3	3.00±1.00	FGHIJKLM
M. Velvet Pillar™	3	1.33±0.58	KLM
M. 'White Angel'	3	4.33±2.08	EFGHIJKL

Table 1(Continued): Summary of Apple-and Thorn Skeletonizer (ATS) Damage to 59 Taxa of Crabapples at Secrest Arboretum, Wooster, Ohio, August 9, 1996.

Crabapple	# Replicates	Average ATS±SD[a]	(LSD separation)
M. 'White Cascade'	3	1.00±0.00	LM
M. 'Winter Gold'	3	4.00±1.73	FGHIJKLM
M. x *zumi* var. *calocarpa*	2	2.50±0.71	GHIJKLM
M. Weeping Candied Apple®	3	5.00±2.65	DEFGHIJ
M. 'Sinai Fire'	3	9.67±0.58	AB
M. Lancelot®	3	1.33±0.58	KLM
M. 'Adirondack'	3	3.67±1.53	FGHIJKLM
M. Camelot®	3	6.00±2.65	CDEFG
M. 'Prairie Maid'	3	7.67±3.21	ABCDE
*M.*x *zumi* 'Winter Gem'	3	4.33±3.06	EFGHIJKL
M. 'Louisa'	3	10.00±0.0	A
M. sargentii 'Candymint'	3	3.67±2.52	FGHIJKLM
M. 'Narragansett'	3	9.00±1.00	ABC
M. 'Silver Drift'	3	4.00±1.00	FGHIJKLM
M. 'Purple Prince'	3	2.33±1.15	HIJKLM
M. 'Pink Satin'	3	8.33±0.58	ABCD
M. 'Canary'	3	3.33±0.58	FGHIJKLM
M. tr. Golden Raindrops™	2	0.50±0.71	M
LSD value (p=0.01)[d]		3.65	

Table 2: Summary of Japanese Beetle (JB) Adult Damage to 59 Taxa of Crabapples at Secrest Arboretum, Wooster, Ohio, August 9, 1996.

Crabapple	# Replicates	Average JB±SD[b]	(LSD separation)
M. 'Adams'	3	2.33±0.58	CDE
M.baccata 'Jackii'	3	0.33±0.58	F
M. 'Beverly'	3	2.33±0.58	CDE
M. 'Bob White'	3	2.33±0.58	CDE
M. Centurion®	3	2.33±1.15	CDE
M. 'David'	3	2.00±0.00	CDE
M. 'Dolgo'	3	2.00±0.00	CDE
M. 'Donald Wyman'	3	2.67±0.58	BCD
M. floribunda	3	1.67±0.58	DE

Table 2(Continued): Summary of Japanese Beetle (JB) Adult Damage to 59 Taxa of Crabapples at Secrest Arboretum, Wooster, Ohio, August 9, 1996.

Crabapple	# Replicates	Average JB±SD[b]	(LSD separation)
M. halliana 'Parkmanii'	3	2.00±0.00	CDE
M. Harvest Gold®	3	1.67±0.58	DE
M. 'Henningi'	3	2.00±0.00	CDE
M. 'Hopa'	3	2.00±1.00	CDE
M. 'Indian Magic'	3	1.67±0.58	DE
M. 'Indian Summer'	3	2.00±0.00	CDE
M. 'Jewelberry'	3	1.00±0.00	EF
M. 'Liset'	3	4.00±0.00	AB
M. 'Mary Potter	3	2.00±1.00	CDE
M. Molton Lava®	3	2.00±0.00	CDE
M. 'Ormiston Roy'	3	1.67±0.58	DE
M. 'Prairifire'	3	2.00±0.00	CDE
M. 'Professor Sprenger'	3	2.00±0.00	CDE
M. 'Profusion'	3	1.33±0.58	EF
M. 'Radiant'	3	4.33±0.58	A
M. 'Ralph Shay'	3	2.33±0.58	CDE
M. 'Red Barron'	3	2.67±0.58	BCD
M. 'Red Jade'	3	1.00±0.00	EF
M. Red Jewel®	3	1.00±0.00	EF
M. 'Red Splendor'	3	3.00±1.00	ABCD
M. 'Robinson'	3	2.33±0.58	CDE
M. 'Royalty'	3	3.33±0.58	ABC
M. 'Ruby Lustre'	3	2.67±1.53	BCD
M. sargentii	3	3.00±0.00	ABCD
M. 'Selkirk'	3	2.33±0.58	CDE
M. 'Sentinel'	3	1.67±0.58	DE
M. 'Silver Moon'	3	1.33±0.58	EF
M. 'Snowdrift'	3	1.67±0.58	DE
M. 'Strawberry Parfait'	3	1.67±0.58	DE
M. Sugar Tyme®	3	1.33±0.58	EF
M. Velvet Pillar™	3	3.67±0.58	AB
M. 'White Angel'	3	2.00±0.00	CDE
M. 'White Cascade'	3	1.67±0.58	DE
M. 'Winter Gold'	3	1.67±0.58	DE
M. x *zumi* var. *calocarpa*	2	1.00±0.00	EF

Table 2(Continued): Summary of Japanese Beetle (JB) Adult Damage to 59 Taxa of Crabapples at Secrest Arboretum, Wooster, Ohio, August 9, 1996.

Crabapple	# Replicates	Average JB±SD[b]	(LSD separation)
M. Weeping Candied Apple®	3	2.00±0.00	CDE
M. 'Sinai Fire' [c]	3	1.00±0.00	EF
M. Lancelot®	3	1.67±0.58	DE
M. 'Adirondack'	3	1.67±1.15	DE
M. Camelot®	3	3.00±1.00	ABCD
M. 'Prairie Maid'	3	2.67±1.15	BCD
*M.*x *zumi* 'Winter Gem'	3	1.00±0.00	EF
M. 'Louisa'	3	1.00±0.00	EF
M. sargentii 'Candymint'	3	3.00±1.00	ABCD
M. 'Narragansett'	3	1.67±0.58	DE
M. 'Silver Drift'	3	1.67±0.58	DE
M. 'Purple Prince'	3	2.67±1.15	BCD
M. 'Pink Satin'	3	1.67±0.58	DE
M. 'Canary'	3	1.33±0.58	EF
M. tr. Golden Raindrops™	2	1.00±0.00	EF
LSD value (p=0.01)[d]		1.34	

---

[a] Average based on number of leaves with ATS damage, out of 10.

[b] Average based on visual rating of 0 to 5 where 0 = no JB skeletonizing and 5 = every leaf skeletonized.

[c] Following 14 crabapple taxa were established in 1991.

[d] Means sharing the same LSD letters are not significantly different from each other.

Malus Fox Fire™

by Maria Zampini-Pettorini

Throughout the past few decades, Lake County Nursery has introduced many notable crabapple cultivars and it appears Fox Fire™ crabapple is earning its place at the head of the class. When we first introduced this selection back in 1989, my father originally wanted to name it Cardinal, after the unique gold "beak" that is displayed on the end of each of its brilliant red fruit. Unfortunately the trademark name Cardinal was unavailable, so instead our new crabapple introduction was given the name Fox Fire™.

Fox Fire™ crabapple has proven to be successful both in our fields as well as the landscape. We have also received many excellent reports on its disease resistance and performance. During a recent conversation, Dr. Ed Hasselkus, Professor Emeritus at the University of Wisconsin-Madison, shared his views with me on our new crabapple selection. "Maria, I feel that Fox Fire™ crabapple is one of your Dad's best selections to date. It meets the two most important criteria I look for in crabapples. Fox Fire™ has an excellent rating for scab resistance and wonderful fruit quality. The bright red fruit is highly colored and very persistent."

In selecting new ornamental crabapples, we strive to find ones with four seasons of interest and for year-round beauty, we feel Fox Fire™ ranks well above its peers. It is a prolific spring bloomer, producing masses of crisp white blossoms which contrast nicely against its smooth, charcoal-black bark. The dark green foliage remains unscathed by disease and remains attractive throughout the growing season.

In fall, Fox Fire™ crabapple offers another spectacular fruit performance. Against the clean foliage, an abundant crop of brilliant red fruit is displayed. Each fruit is adorned with a unique golden "beak" at the end. The fruit remains colorful and persists long into the winter.

Fox Fire™ is a vigorous grower, forming a well-proportioned rounded canopy at a young age. Slowing in growth rate with age, it matures into a small rounded tree that reaches a mature height of 15 feet with an equal spread.

Fox Fire™ is a selection of *Malus sieboldii* discovered by my father, who uses a process of natural field selection. It was chosen from a collection of crabapple taxa which were open pollinated in our fields. From this collection individual trees have been singled out for superior traits over an observation period of 15 to 25 years.

Originally our first field production was done by budding onto Malling 111 understock. Currently we produce Fox Fire™ crabapple by summer mist cuttings, which have proven to root readily. While our field numbers are currently limited, we have begun to increase our production recently to meet increasing demand.

Effects of Nursery Production Practices on the Growth, Insect Resistance, and Stress Tolerance of 'Sutyzam' Crabapple in the Landscape

by John E. Lloyd, Daniel A. Hermes and Mary Ann Rose

Summary

The objective of this study was to determine if fertilization and irrigation practices in the nursery affect plant performance following outplanting in the landscape. *Malus* 'Sutyzam' grown in containers under all combinations of low (irrigated at 50% container capacity) and high moisture (irrigated at 25% container capacity) and three fertilizer concentrations (50, 200 and 350 ppm N)in the nursery, were outplanted in a low-maintenance landscape in 1998. Tree growth in the landscape was highly correlated with nitrogen content of plants when they left the nursery. High fertility regimes in the nursery resulted in faster growth in the landscape, but only for trees exposed to the low-moisture treatment in the nursery (which decreased nitrogen leaching from the containers). However, trees receiving the high fertility regime were also less resistant to insects (Eastern tent caterpillar, gypsy moth and whitemarked tussock moth) and less tolerant of drought stress.

Introduction

Rapid growth of trees in the nursery is necessary to shorten production schedules and maintain profit margins. Furthermore, nutrient loading of plants in the nursery has been proposed as a strategy for increasing growth of transplants in the years following outplanting, the period when nutrient uptake may be limited by root damage and when remobilization of stored nutrients stimulates increased shoot growth (McAlister and Timmer, 1998). However, nurseries are also under increasing pressure to conserve water and limit nutrient runoff. These conflicting management objectives may be resolved through efficient use of water and nutrients if actual plant requirements can be determined. Recent studies have shown that it is possible to decrease fertilizer use in nursery production of containerized plants without sacrificing plant growth (Struve and Rose, 1998; Rose and Wang, in press).

Hamilton et al. (1981) has suggested that conservative use of fertilizer in nursery production may increase establishment and stress tolerance of plants once they reach the landscape. They argue that lower nutrient concentrations increase root growth relative to shoot growth, resulting in increased stress tolerance. Other studies have shown that reduced fertility regimes can increase insect and disease resistance by decreasing the nutritional value of the plants for microbes and insects and by increasing concentrations of plant defense compounds (Herms and Mattson, 1992).

The objective of this study was to determine how fertilization and irrigation practices in the nursery affect performance of trees following outplanting in the landscape. Parameters examined in this study include trunk growth, photosynthesis, stomatal conductance and insect resistance.

Materials and Methods

On April 15, 1997, rooted cuttings of *Malus* 'Sutyzam'(Sugar Tyme® crabapple) were transplanted to 8.6-liter containers and then exposed to all possible combinations of three fertilizer treatments (50, 200 and 350 ppm N) and two moisture levels for the duration of the growing season. The high-moisture-level treatments were irrigated when container moisture was at 25% container capacity; the low-moisture-level treatments were irrigated at 50% container capacity. The experiment was designed as a randomized complete block, with one replicate in each of the four blocks (Rose, in preparation). The moisture and fertilizer treatments were discontinued in October 1997.

The crabapple trees were removed from Columbus to the Wooster campus of the Ohio State University's Ohio Agricultural Research and Development Center (OARDC) on May 1, 1998, and were transplanted into a turf landscape on May 29, 1998. In order to evaluate the effects of the prior year's nursery treatments, trees were arranged in the same randomized complete block design used in the nursery experiment. A low-maintenance landscape environment was maintained in 1998. Trees were not fertilized and were irrigated only three times - on the day of transplanting, again one week later and finally on August 4, during a period of drought.

To determine effects of the prior year's nursery treatments on tree physiology, the authors quantified growth, photosynthesis and stomatal conductance. Effects on growth were determined by measuring trunk diameter (50 cm from the ground) on June 17 and again on October 23. Photosynthesis (µmol $m^{-2} s^{-1}$) and stomatal conductance (cm s^{-1}) were measured using a Licor 6200 portable photosynthesis system on July 30 and 31 during the drought, and again on September 1, two days after significant rainfall.

Three experiments were conducted to determine effects of fertilizer and irrigation on insect resistance. On May 7, prior to outplanting, experiments were initiated with third instar Eastern tent caterpillar (*Malacosoma americanum*) and third instar gypsy moth (*Lymantria dispar*), both of which are spring-feeding insects. To determine if effects on insect resistance were consistent throughout the field season, a third experiment was initiated on August 25 with first instar whitemarked tussock moth larvae (*Orgyia leucostigma*), a late-season defoliator. Each of the three experiments was conducted under controlled conditions in the laboratory. Larvae were fed foliage from the experimental trees and their growth determined by measuring their weight immediately before and after the experiment. Leaves and caterpillars were confined to petri dishes (15 cm in diameter, 2.5 cm high) containing a base of plaster of paris. Water added to the plaster base provided a high humidity environment, which maintained the turgor of the leaves. Petri dishes were then randomly positioned in a growth chamber maintained at 25°C with an 18:6 day:night photoperiod.

Results and Discussion

Tree Growth

The fertilization regime applied during the previous year in the nursery had a significant effect on tree growth in the landscape. However, the effect of fertilization was dependent on the irrigation regime with which it was combined (Figure 1). When trees were grown under the low-moisture regime in the nursery, growth in the landscape increased at each level of fertilization. In fact, trees that received the high-fertilization rate in combination with the low-moisture treatment in the nursery grew substantially faster in the landscape than trees receiving any other treatment effect.

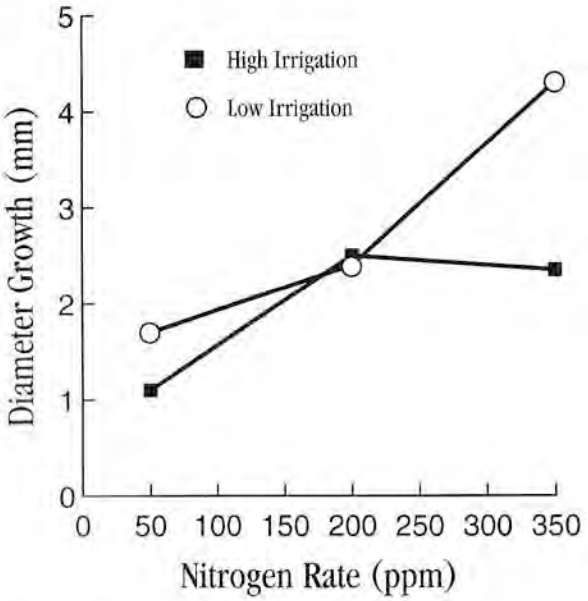


Figure 1. Effect of fertilization and irrigation regime in the nursery in 1997 on trunk diameter growth of *Malus* 'Sutyzam' in the landscape followiwng outplanting in 1998.

When trees were exposed to a high level of irrigation in the nursery, the effects of fertilization on subsequent growth in the landscape were not as dramatic. Increasing the rate of N-fertilization in the nursery from 50 to 200 ppm did increase growth following out-planting. However, increasing the rate from 200 to 350 ppm had no additional effect (Figure 1).

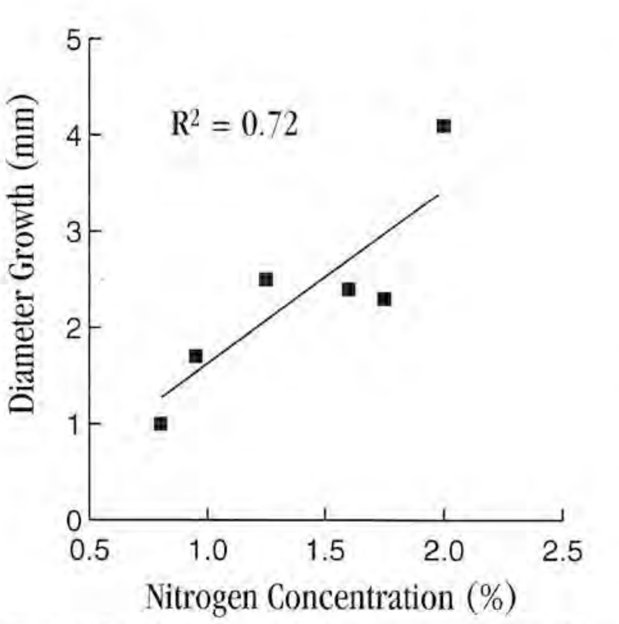


Figure 2. Relationship between whole-plant nitrogen concentration of dormant plants in the nursery in 1997 and subsequent growth in the landscape following outplanting in 1998.

The carry-over effect of nursery fertilization on subsequent growth in the landscape is somewhat surprising, since fertilization rate had no effect on tree growth in the nursery, although the irrigation regime had major effects (Rose, in preparation). However, these results can be explained if nitrogen accumulated by the tree in the nursery was stored and then used to support growth the following year. Indeed, growth in the landscape in 1998 was highly correlated with nitrogen concentration of the dormant plant following the 1997 growing season (Figure 2).

The lack of effect of the high-fertilization rate on tree growth when applied in combination with the high-moisture treatment is consistent with the role of stored nitrogen as an important determinant of plant growth the following year. Dormant trees in the low-moisture treatment had a higher concentration of nitrogen (1.95%) than did trees from the high-irrigation treatment (1.74%), because less nitrogen was leached from containers in the low-moisture treatment (Rose, in preparation).

Photosythesis and Stomatal Conductance

As plants experience moderate to severe drought stress, photosythesis becomes limited by the closure of stomata (pores in the leaf through which gas and water vapor enter and exit). Stomatal conductance is a measure of the rate at which water vapor moves from the leaf through the stomata to the atmosphere by means of transpiration. As stomata close and transpiration decreases, stomatal conductance declines. Closure of stomata conserves water by decreasing transpiration, but at the same time decreases uptake of CO_2 from the atmosphere. Not all plants are affected by drought to the same degree. Drought-tolerant plants maintain higher rates of photosynthesis and stomatal conductance during drought than do plants that are less tolerant of drought stress (Schulze, 1986; Kubiske and Abrams, 1993).

In 1998, photosythesis and stomatal conductance were measured on July 30 and 31 during drought conditions. There had been no rain the previous week and over the previous three weeks evaporation exceeded precipitation by 3.88 inches. Photosythesis and stomatal conductance were also measured on September 1, following the end of the drought (4.36 inches of precipitation fell between August 23 and 29).

The fertilizer regime used in the nursery had clear effects on drought stress tolerance following outplanting. Plants grown under the low-nitrogen treatment (50 ppm) were more tolerant of drought than plants grown under the two higher nitrogen levels. This is indicated by the higher photosynthesis and stomatal conductance rates that low-N plants were able to maintain during drought (Table 1).

There are a number of reasons why high rates of N-fertilization may decrease drought stress tolerance. Increased nitrogen availability generally stimulates shoot growth to a greater degree than root growth, thus decreasing the root:shoot ratio of the tree (Linder and Rook, 1984). In this way, fertilization can simultaneously increase tree water demands while decreasing the tree's ability to acquire water during drought. Trees receiving the low-fertilizer treatment in this experiment had a higher root:shoot ratio when they left the nursery (Rose, in preparation), which could have been responsible for their increased tolerance of drought stress.

High rates of fertilizer may also decrease drought stress through effects on the chemical compostion of leaves. A well-documented effect of high fertilization rates is to decrease foliar concentration of tannins and other secondary metabolites that provide trees with stress tolerance and insect resistance (Herms and Mattson, 1992). Tannins impregnate the outer wall of epidermal cells, making them more impervious to water, and thus contribute to water conservation under stress (Bussotti et al., 1998). Analysis of foliar tannin concentrations of these trees is under way.

Insect Resistance

Numerous studies provide strong evidence that fertilization almost always decreases resistance of trees to defoliating insects. This is because fertilization generally increases the nutritional value of the plant and decreases concentrations of the trees' defensive chemicals (Herms and Mattson, 1997). The results of this are consistent with this pattern. As the fertilizer rate used in the nursery increased, so did the the insect growth rate (Figure 3). This was true for both early-season (gypsy moth and eastern tent caterpillar) and later-season (white-marked tussock moth) species. Only eastern tent caterpillar was affected by the irrigation regime used in the nursery. Larvae grew faster on plants receiving the high-moisture treatment.

Table 1. Effect of fertilizer regime used in the nursery in 1997 on net rate of photosynthesis (µmol $m^{-2}s^{-1}$) and stomatal conductance (cm s^{-1}) of *Malus* 'Sutyzam' in the landscape following outplanting in 1998 (mean± standard error). Means within a column followed by the same letter are not significantly different.

	July 30		July 31	
Nitrogen Fertilization Rate (ppm)	Photosynthesis Rate	Stomatal Conductance	Photosynthesis Rate	Stomatal Conductance
50	4.3±0.5 a	0.05±0.01 a	4.3±0.05 a	0.06±0.01 a
200	3.4±0.5 ab	0.04±0.01 ab	2.5±0.5 b	0.03±0.01 b
350	2.4±0.5 b	0.03±0.01 b	2.1±0.6 b	0.03±0.01 b

	September 1	
Nitrogen Fertilization Rate (ppm)	Photosynthesis Rate	Stomatal Conductance
50	10.5±0.6 a	0.32±0.02 a
200	12.3±0.6 a	0.32±0.02 a
350	11.6±0.6 a	0.26±0.02 b

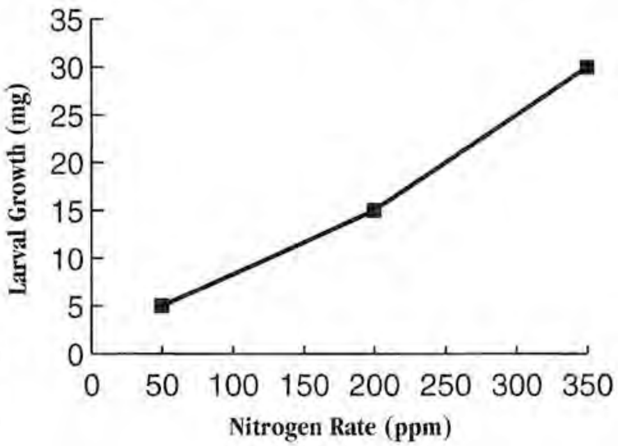
Conclusions

The fertilization regime used in the nursery during 1997 had major effects on the growth, stress tolerance and insect resistance of crabapple in a low-maintenance landscape in 1998, even though it had little effect on tree growth in the nursery. Conversely, the irrigation regime used in the nursery had little effect on trees following outplanting, although it had major effects on tree growth in the nursery.

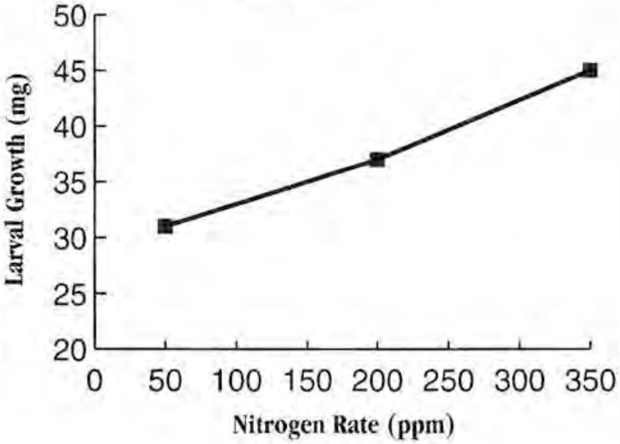
The growth rate of trees in the landscape was highly correlated with their nitrogen concentration when they left the nursery. The higher the nitrogen content of the plant, the faster it grew following outplanting. However, increased fertilizer rates in the nursery also decreased the drought stress tolerance and insect resistance of trees once they were in the landscape, possibly because they had lower root:shoot ratios and decreased concentrations of naturally occurring defensive chemicals. Trees receiving the high-fertilizer rate in the nursery had lower rates of photosynthesis during drought, although there were no differences when soil moisture was favorable. Growth rates of eastern tent caterpillar, gypsy moth and whitemarked tussock moth all increased as the rate of fertilizer increased.

Nutrient-loading in thenursery has been proposed as a strategy for increasing growth and hastening establishment of trees following transplanting (McAlister and Timmer, 1998) and thus could represent a value-added component of nursery production. This is especially true in situations where fertilization is undesirable, such as in forest regeneration where fertilization favors competing vegetation. However, this study suggests that nutrient-loading may be most beneficial when trees are growing under favorable conditions and may be detrimental under stressful conditions. With the exception of a moderate drought from mid-July to early August , growing conditions for trees were good in Wooster in 1998, and there was little insect pressure in the experimental plots. The decreased stress tolerance and insect resistance of trees heavily fertilized in the nursery may counteract positive effects of nutrient-loading during years of more severe drought and insect outbreaks sometimes experienced in low-maintenance landscapes.

Eastern Tent Caterpillar



Gypsy Moth



White-Marked Tussock Moth

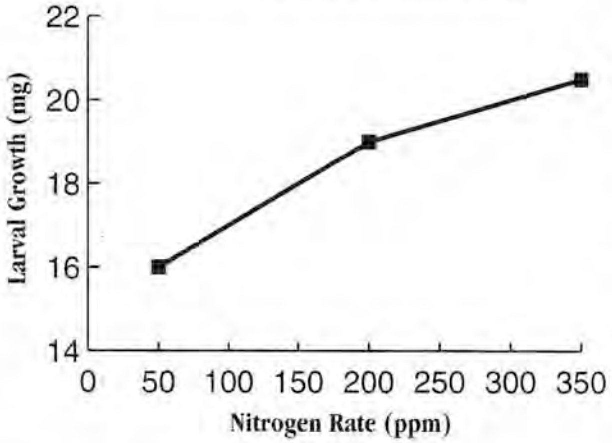


Figure 3. Effect of fertilization regime in the nuresry in 1997 on growth of eastern tent caterpillar, gypsy moth and white-marked tussock moth larvae feeding on *Malus* 'Sutyzam' in 1998.

Literature Cited

Bussotti, F., E. Gravano, P. Grossoni, and C. Tani. 1998. Occurrence of tannins in leaves of beech trees (*Fagus sylvatica*) along an ecological gradient, detected by histochemical and ultrastructural analysis. *New Phytologist* 138:469-479.

Hamilton, D.F., M.E.C. Graca, and S.D. Verkade. 1981. Critical effects of fertility on root and shoot growth of selected landscape plants. *Journal of Arboriculture* 7:281-290.

Herms, D.A. and W.J. Mattson. 1992. The dilemma of plants: to grow or defend. *Quarterly Review of Biology* 67(3):283-335.

Hermes, D.A. and W.J. Mattson. 1997. Trees, stress and pests. *In*: J. E. Lloyd, Ed. *Plant Health Care for Woody Ornamentals*. International Society of Arboriculture. Champaign, Ill. pp. 13-26.

Linder, S. and D.A. Rook. 1984. Effects of mineral nutrition on carbon dioxide exchange and partitioning of carbon in trees. *In*: G. D. Bowen and E.K.S. Nambiar, Eds. *Nutrition of Plantation Trees*. Academic Press.

McAlister, J.A. and V.R. Timmer. 1998. Nutrient enrichment of white spruce seedlings during nursery culture and initial plantation establishment. *Tree Physiology* 18:195-202.

Rose, M.A. and H. Wang. Fertilizer concentration and moisture tension affect growth and foliar N, P, and K of two woody ornamentals. *HortScience*. In Press.

Struve, D.K. and M.A. Rose. 1998. Early-season fertilization reduces fertilizer use without reducing plant growth. *Journal Environmental Horticulture* 16:47-51.

International Ornamental Crabapple Society

OFFICERS

President
Norbert Kinen
J. Frank Schmidt & Son Co.
P.O. Box 189
Boring, OR 97009
(503)663-4128

Executive Director
David Allen
The Holden Arboretum
9500 Sperry Road
Kirtland, OH 44094
(440)256-1110

Vice President
Jim Stolzenburg
Bailey Nurseries, Inc.
1325 Bailey Road
St. Paul, MN 55119-6199
(612)459-9744

Secretary
Maria Zampini-Pettorini
Lake County Nursery
P.O. Box 122
Perry, OH 44081-0122
(440)259-5571

Editor & Publisher
David Guthery
Johnson's Nursery, Inc.
W180 N6275 Marcy Rd.
Menomonee Falls, WI 53051
(414)252-4988

Past President
Maria Zampini-Pettorini
Lake County Nursery
P.O. Box 122
Perry, OH 44081-0122
(440)259-5571

International Ornamental Crabapple Society

BOARD OF DIRECTORS

John H. den Boer (Exp. 1/00)
Rt. 2, Box 197 A
Killen, AL 35645
(205)757-4787

Douglas Chapman (Exp. 1/01)
The Dow Gardens
1018 West Main St.
Midland, MI 48640-4292
(517)631-2677

William Hendricks (Exp. 1/01)
Klyn Nursery, Inc.
3322 South Bridge Road
P.O. Box 343
Perry, OH 44081
(440)259-3811

William Muetze (Exp. 1/00)
Poplar Farms Nursery
39W100 Main St.
Batavia, IL 60510
(630)879-7202

James A. Chatfield (Exp. 1/01)
Ohio State University Extension
1680 Madison Ave.
Wooster, OH 44691
(330)263-3831

Erik Draper (Exp. 1/00)
Ohio State University Extension
490 S. Broad Street
Canfield, OH 44406
(330)533-5538

Tom Simpson (Exp. 1/00)
Simpson Nursery Company
1504 Wheatland Road
P.O. Box 2065
Vincennes, IN 47591
(812)882-2441

Dr. Jeffery Iles (Exp. 1/01)
Iowa State University
106 Horticulture Bldg.
Ames, IA 50011
(515)294-1870

LIFE MEMBERS

John H. den Boer
Roger Fick
Bernard Holmes
Philip Keenan
Engelbert Koetter
Phillipe LeMaistre
Steven Mayer
Jef Van Meulder
Gary Moller
William Muetze
Catherine Oliver
Van Wade
James Webb
Ned Wells
Michael Yanny

HONORARY LIFE MEMBERS

Dr. Elton M. Smith
Dr. Thomas L. Green
Dr. Edward R. Hasselkus
John Sabuco

SPONSORING MEMBERS

Bailey Nurseries, Inc.
St. Paul, Minnesota.

Bigelow Nurseries, Inc.
Northborough, Massachusetts.

Bordine Nursery
Rochester Hills, Michigan

Fahl Colors Landscape & Design
Columbia City, Indiana.

G&G Nursery, Lesage
West Virginia.

J. Frank Schmidt & Son, Co.
Boring, Oregon.

Johnson's Nursery, Inc.
Menomonee Falls, Wisconsin.

Lieds Nursery, Inc.
Sussex, Wisconsin.

Moon Nurseries
Chesapeake City, Maryland.

Sunleaf Nursery
Madison, Ohio.

Surface Nursery, Inc.
Gresham, Oregon.

Tuckahoe Nurseries, Inc.
Tuckahoe, New Jersey.

Wick Brothers, Ltd.
Millington, Maryland.

Malus sargentii 'Tina' as a specimen in the garden. (Photo by Edward Hasselkus)

The unique foliage and excellent fruit display of *Malus transitoria* Golden Raindrops™ make it an easy recommendation for Edward Hasslekus. (Photo by David Guthery)