Crabapple (*Malus* spp. and cultivars) evaluations for resistance to apple scab (*Venturia inaequalis*) infections at Secrest Arboretum in Wooster, Ohio: 2012-2013.

Introduction

Flowering crabapple trees (*Malus* spp. and cultivars) are widely cultivated and planted for ornamental purposes in the northeastern and mid-western regions of the United States and in southern Canada. The numerous species and cultivars display a diversity of sizes, shapes, bloom times, and colors of leaves, blossoms and fruits. Nurseries and plant breeders have tapped into this diversity and have produced and named more than 700 cultivars (Dirr, 1998; Fiala, 1994). With such a large pallet of character diversity, one could easily fit a crabapple or two into numerous different landscape scenarios. Unfortunately, there are diseases such as apple scab (*Venturia inaequalis*), bacterial fire blight (*Erwinia amylovora*), and frogeye leaf spot (*Botryosphaeria obtusa*) that can and do cause damage to crabapples. Damage from these diseases can range from slight aesthetic injury to death of the tree.

Apple scab is a significant aesthetic disease of crabapples. Apple scab impacts the aesthetic value of crabapples by producing olive-green to grayish to brown leaf spots, gray to brown lesions on the fruits, and when severe enough, leaf yellowing and leaf drop. Heavily infected, apple scabsusceptible crabapples are frequently defoliated by mid-summer. A major emphasis in crabapple breeding and selection is to find and propagate resistance to apple scab. National Crabapple Evaluation Project (NCEP) plots have been established in several locations in North America, one of which is located at The Ohio State University Secrest Arboretum on the Ohio Agriculture Research and Development Center in Wooster, Ohio.

This report examines the apple scab incidence evaluation results from 2012 and 2013.

Materials and Methods

Tree Identity. Tree identity is based on the taxonomic and cultivar descriptions provided by the suppliers of the plant materials.

Cultural Care of Plot. Eighty crabapple taxa were planted in 1997-2005 at Secrest Arboretum in Wooster, Ohio, in a completely randomized design. There were five replicate trees planted for most but not all taxa, though fewer replicates exist currently due to a variety of factors, including inadequate original numbers (e.g., 'Hamlet'), death due to bacterial fireblight (e.g., 'Golden Raindrops'), and other attrition such as deer damage.

Plants were irrigated as needed during the year of transplanting and are mulched when needed with composted yard-waste. The soil type in which the trees are planted is a silt loam. Weeds are controlled with spot applications of glyphosate.

Data Collection. Plant evaluations were performed on June 13, and September 28, 2012, and June 27, and September 20, 2013. All trees in the plot were rated on a scale of 0 to 5, with 0 = no scab observed; 1 = less than 5% of leaves affected and no aesthetic impact; 2 = 5 to 20% of leaves affected, with some yellowing but little or no defoliation, moderate aesthetic impact; 3 = 20 to 50% of leaves affected, significant defoliation and/or leaf yellowing, substantial aesthetic impact; 4 = 50 to 80% of leaves affected, severe foliar discoloration and defoliation, severe aesthetic impact; and 5 = 80 to 100% of foliage affected, with 90 to 100% defoliation. Apple scab incidence ratings and observations were conducted by James Chatfield, Erik Draper, and Kenneth Cochran.

Data Analysis. Of the 80 taxa in the plot, 39 taxa with five (5) replicates of each were used in the data set for statistical analysis. CoStat Statistical Software (Version 6.400; Simons, 2008) was used to analyze the data sets. Means were separated using the Student-Newman-Keuls test at p=0.05.

Results and Discussion

Results of the 2012 and 2013 evaluations are presented in Table 1 and Table 2, respectively. Significant differences in the mean incidences of apple scab existed between the crabapple taxa each year and for each sampling date (6/13/2012 - $F(1,38) = 39.21$, $p<0.00001$; 9/28/2012 - $F(1,38) = 240.59$, $p<0.00001$; 6/27/2013 - $F(1,38) = 44.75$, $p<0.00001$; and 9/20/2013 - $F(1,38) = 276.08$, $p<0.00001$).

Apple scab pressure was higher in 2013 than in 2012 and started sooner in 2013 than in 2012 based on the higher mean incidence ratings observed on the June sampling dates. On the June sampling date in 2012, the mean incidences of apple scab infections were 1 or less for 29 of 39 taxa, greater than 1 but not greater than 3 for 10 of 39 taxa, and greater than 3 for 0 of 39 taxa. In 2013, the mean incidences of apple scab infections were 1 or less for 19 of 39 taxa, greater than 1 but not greater than 3 for 16 of 39 taxa, and greater than 3 for 4 of 39 taxa. On the September sampling date in 2012, the mean incidences of apple scab infections were 1 or less for 17 of 39 taxa, greater than 1 but not greater than 3 for 9 of 39 taxa, and greater than 3 for 13 of 39 taxa. In 2013, the mean incidences of apple scab infections were 1 or less for 14 of 39 taxa, greater than 1 but not greater than 3 for 5 of 39 taxa, and greater than 3 for 20 of 39 taxa.

Fourteen of the crabapple taxa maintained superior scores (1 or less) through the entire growing season in both years. These taxa included: 'Adirondack', 'Dolgo', 'Excalibur', 'Foxfire', 'Guinevere', 'Holiday Gold', 'Lollipop', 'Sargent', 'May's Delight', 'Prairie Maid', 'Strawberry Parfait', 'Tina', 'Camelot', and 'Red Jewel'. Seven of the crabapple taxa consistently scored poorly by the end of the season in both years. These taxa included: 'American Masterpiece', 'American Triumph', 'Pink Satin', 'Red Splendor', 'Snowdrift', 'Thunderchild', and 'Weeping Candied Apple'. For apple scab, this data coupled with data from previous years (e.g., Chatfield et al., 2005) provide horticulturalists and landscapers with options of diverse crabapple selections that will maintain their appearance throughout the growing season. It also suggests selections to avoid if loss of foliage due to apple scab infection through the season is a concern.

Apple scab resistance breakdowns are continuing to show in some of the crabapple taxa when apple scab pressure is high. Examples of these breakdowns were evident between 2012 and 2013. Examples can be seen in 'Candymint', 'Coralburst', 'Pink Princess', and 'Purple Prince'. Other examples of this resistance to apple scab breakdown were highlighted in a paper by Beckerman et al., 2009.

Table 1. Mean Incidence of the Fungal Disease Apple Scab (*Venturia inaequalis*) Symptoms Assessed on a Scale of 0-5* on Ornamental Crabapple Trees (*Malus* spp. and Cultivars) at Secrest Arboretum, Ohio Agricultural Research and Development Center, Wooster, Ohio in 2012.

Crabapple Taxon	# Reps	6/13/12	9/28/12
'Adirondack'	5	0 a	0 a
'Camelot'	5	0 a	0 a
'Candymint'	5	0 a	1 b
'Coralburst'	5	0 a	1 b
'Dolgo'	5	0 a	0 a
'Excalibur'	5	0 a	0 a
'Foxfire'	5	0 a	0 a
'Guinevere'	5	0 a	0 a
'Holiday Gold'	*5*	0 a	0 a
'Lollipop'	5	0 a	0 a
M. sargentii 'Sargent'	5	0 a	0 a
'May's Delight'	5	0 a	0 a
'Pink Princess'	5	0 a	1 b
'Prairie Maid'	5	0 a	0 a
'Purple Prince'	5	0 a	2 cd
'Red Jewel'	5	0 a	1 b
'Red Splendor'	5	0 a	5 i
'Strawberry Parfait'	5	0 a	0 a
'Tina'	5	0 a	0 a
Malus x *zumi* 'Calocarpa'	5	0.2 ab	2.4 d
'Molten Lava'	5	0.2 ab	3.6 g
'Lancelot'	5	0.4 abc	1.8 c
'Royal Raindrops'	5	0.6 abc	3.2 efg
'Mary Potter'	5	0.8 bcd	2.8 e
'Sentinel'	5	0.8 bcd	3 ef
'Adams'	5	1 cde	3 ef
'Doubloons'	5	1 cde	4.2 h
'Manbeck Weeper'	5	1 cde	3.4 fg
'Sugar Tyme'	5	1 cde	3 ef
'David'	5	1.4 de	2 cd
'Snowdrift'	5	1.4 de	5 i
'American Salute'	5	1.6 ef	2.2 cd
'American Triumph'	5	1.6 ef	5 i
'White Cascade'	5	2 fg	4.4 h
'Harvest Gold'	5	2.4 gh	3.4 fg
'Weeping Candied Apple'	5	2.4 gh	5 i
'American Masterpiece'	5	2.6 hi	5 i
'Thunderchild'	5	2.6 hi	5 i
'Pink Satin'	5	3 i	5 i

* 0 = no scab symptoms observed; 1 = less than 5% of leaves affected and no aesthetic impact; 2 = 5-20% of leaves affected, with some yellowing but little or no defoliation, moderate aesthetic impact; 3 = 21-50% of leaves affected, significant defoliation and/or leaf yellowing, substantial aesthetic impact; 4 = 51-80% of leaves affected, severe foliar discoloration and defoliation, severe aesthetic impact; 5 = 81-100% of foliage affected, with 90-100% defoliation.

** Means with the same letter in a column are not significantly different (Student-Newman-Keuls test, $p<0.05$).

Table 2. Mean Incidence of the Fungal Disease Apple Scab (*Venturia inaequalis*) Symptoms Assessed on a Scale of 0-5* on Ornamental Crabapple Trees (*Malus* spp. and Cultivars) at Secrest Arboretum, Ohio Agricultural Research and Development Center, Wooster, Ohio in 2013.

Crabapple Taxon	# Reps	6/27/2013	9/20/2013
'Adirondack'	5	0 a	0 a
'Dolgo'	5	0 a	0 a
'Excalibur'	5	0 a	0 a
'Foxfire'	5	0 a	0 a
'Guinevere'	5	0 a	0 a
'Holiday Gold'	5	0 a	0 a
'Lollipop'	5	0 a	0 a
M. sargentii 'Sargent'	5	0 a	0 a
'May's Delight'	5	0 a	1 b
'Prairie Maid'	5	0 a	0 a
'Strawberry Parfait'	5	0 a	0 a
'Tina'	5	0 a	0 a
'Camelot'	5	0.4 ab	0 a
'Candymint'	5	0.4 ab	2 c
'Red Jewel'	5	0.4 ab	1 b
'Pink Princess'	5	0.6 abc	2.2 c
'Coralburst'	5	1 bcd	2.4 c
'Lancelot'	5	1 bcd	2 c
'Molten Lava'	5	1 bcd	4 fg
Malus x *zumi* 'Calocarpa'	5	1.2 bcde	4.2 fg
'Purple Prince'	5	1.2 bcde	2 c
'Sugar Tyme'	5	1.2 bcde	3.4 de
'Sentinel'	5	1.4 cdef	4 fg
'Doubloons'	5	1.6 defg	3.8 ef
'Red Splendor'	5	1.6 defg	5 i
'David'	5	1.8 defg	4.2 fg
'Royal Raindrops'	5	1.8 defg	3.8 ef
'Mary Potter'	*5*	2 efg	4 fg
'Adams'	5	2.2 fgh	4.4 gh
'Manbeck Weeper'	5	2.2 fgh	4.8 hi
'American Salute'	5	2.4 gh	3.2 d
'White Cascade'	5	2.8 h	5 i
'American Triumph'	5	3 hi	5 i
'Harvest Gold'	5	3 hi	4.8 hi
'Snowdrift'	5	3 hi	5 i
'Thunderchild'	5	3.6 ij	5 i
'American Masterpiece'	5	3.8 j	5 i
'Pink Satin'	5	3.8 j	5 i
'Weeping Candied Apple'	5	4.2 j	5 i

* 0 = no scab symptoms observed; 1 = less than 5% of leaves affected and no aesthetic impact; 2 = 5-20% of leaves affected, with some yellowing but little or no defoliation, moderate aesthetic impact; 3 = 21-50% of leaves affected, significant defoliation and/or leaf yellowing, substantial aesthetic impact; 4 = 51-80% of leaves affected, severe foliar discoloration and defoliation, severe aesthetic impact; 5 = 81-100% of foliage affected, with 90-100% defoliation.

** Means with the same letter in a column are not significantly different (Student-Newman-Keuls test, $p<0.05$).

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