



Contrasting Ohio Nursery Stock Availability with Community Planting Needs

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Abstract. There has been a continuing disparity between what urban foresters say they request for community plantings and the stock availability from nurseries. To investigate this, twenty-two of Ohio's urban foresters were surveyed in February 2008 to contrast their planting needs with nursery stock availability. Urban foresters reported planting more than 9,000 trees in 2005 and expected to plant more than 15,000 trees in their respective communities in 2010. At the same time, nearly 278,000 trees [5 cm (2 in)] were reported as being available for sale by nurseries participating in the 2008 Ohio Nursery Stock Survey. The results suggested that maples, crabapples, many hawthorns, and pears generally were present in nurseries in excess of the quantities desired by urban foresters. Conversely many legumes, oaks, elms, lilacs and lindens were lacking in availability. Several other species were somewhat balanced in terms of urban foresters' requests and nursery production. Ohio, U.S. has been dealing with the impacts of the emerald ash borer on *Fraxinus* species. Increasing taxonomic diversity can be a relatively low cost means of insuring against the possible introduction of another exotic pest that might attack another genus (such as *Acer*) and requires increased availability of some species currently lacking in availability in the nursery supply chain.

Key Words. *Acer*; Community Planting; *Crataegus*; *Fraxinus*; *Gleditsial*; *Malus*; Nursery Stock Availability; *Pyrus*; *Quercus*; *Tilia*; *Ulmus*.

A commonly reported paradox has been heard when talking with urban foresters and nursery producers in the state of Ohio, U.S. Urban foresters claim they cannot get the plants they desire for planting on community streets, in parks, or in other public spaces, and must settle for second or third choices. Nursery producers, in contrast, claim that they will produce anything customers wish if they become aware of a demand. In order to bridge the gap between trees desired by urban foresters and those available from producing nurseries in the state, surveys of urban foresters were taken in 1995, 2000, and 2008. Summary results were published in the *Buckeye* (the official publication of the Ohio Nursery and Landscape Association), so that results would be available to the Ohio nursery community (Sydnor 1996; Sydnor et al. 2000; Sydnor 2008).

Some nurseries have responded and are growing some previously requested plants but many urban foresters find they are still unable to get their first choice in plant material. Another part of the puzzle would be to compare what is being requested with what is actually available for sale in nurseries. Nurseries have had information on what was requested in the 1995, 2000, and 2008 surveys, but neither the urban foresters nor nurseries have had a feel for the supply side of the equation. This study seeks to address this problem.

The impact of emerald ash borer (EAB) has reinforced the need for increased diversity in urban forests. Communities often try to limit a single species to 10%, a genus to 20%, and families to 30% (10-20-30 rule or guideline) of the trees in their forest (Santamour 1990). Using these criteria, many Ohio communities are too heavily planted in maple and pear. For example, some Ohio community public spaces have been found to contain more than 30% maple (Sydnor and Subburayalu 2008a; Sydnor and Subburayalu 2008b). Ohio's original shade tree evaluation project, which included 97 community plantings, found 27 of the plantings (28%) were maple (Sydnor et al. 1999).

A 2007 survey of urban foresters suggested a potential economic impact of EAB in Ohio communities at USD \$2 to \$8 billion (Sydnor et al. 2007). Furthermore, about 8% of community forests in Ohio are in ash species, while maples are in excess of 30% (Sydnor and Subburayalu 2008a). Given that maple abundance is approximately four times greater than ash abundance, the statewide community impact might reach \$8 to \$30 billion if a similarly devastating exotic pest of maple were to strike. Biological diversity is a relatively inexpensive way to deal with the threat of exotic pests, especially when compared to removing and replacing trees. While these examples relate specifically to Ohio and the Midwest, other regions in the United States and even other countries have imbalances they must consider as well (McBride 2008). The southeastern U.S., for example, depends too heavily on oak species while other regions have different imbalances.

Previous surveys of nursery stock needs have concentrated on urban foresters with the results published in literature available to the nursery producer. However, if urban foresters had some notion of what might be available, they could seek additional suppliers, encourage existing suppliers to produce material that might not be available, grow some material themselves, or develop contracts for plants to be produced in the future. Columbus, Ohio, expanded its own nursery in the 1990s to produce plants for out planting as a result of the inability to gain the desired mix of plants (Low 2008). Existing nursery stock surveys are designed for an individual to identify a grower from whom a given plant might be secured; they convey information to outlets marketing to the final user but are not designed to provide information to upstream segments in the supply chain—such as liner or seedling producers—who are likely to be in other states. To this end, a survey of existing nursery stock relative to current and anticipated needs by urban foresters for community

plantings would be useful. The objective of this study was to identify differences between what was requested by urban foresters and what nurseries offer for sale and to provide a means for a community forester to begin a dialog with potential suppliers to provide less commonly grown trees for use on community streets.

MATERIALS AND METHODS

In February 2008, fifty-nine e-mail surveys were sent to all of Ohio's urban foresters on the Ohio Division of Forestry's community urban forester mailing list. The survey instrument was similar to those used in previous years (Sydnor 1996; Sydnor et al. 2000; Sydnor 2008). Responses could be returned by e-mail, FAX, or postage mail. A follow-up survey mailing was not conducted. A total of twenty-two responses were returned for a 39% response rate. Responses were received from all areas of the state and all community size classes.

Urban foresters were asked to identify, from a predetermined list on the survey form, how many trees of a species were planted in 2005 and how many plants of the same species were expected to be planted in 2010. The original list contained more than 200 species of trees that might be planted on Ohio streets. Of the plants listed on the survey form, responses were given for 183 taxa. Plants requested one or more times for either 2005 or 2010 were identified for comparison with the nursery stock survey. Plants not requested by urban foresters but grown by Ohio nursery producers were not evaluated. Respondents were asked for contact information in case follow-up questions were needed. Appendix 1 shows an abbreviated survey instrument with the first five lines presented.

In March 2008, permission was obtained to access the online version of the Ohio Nursery Stock Survey (Anonymous 2008). Table 1 gives an example of a portion of a stock survey entry. Nursery stock entries are reported by taxa, grower, plant size, production method (container or field), and quantity. Individual records were created for each nursery, 5 cm (2 in) size, production method, and taxa, with an associated quantity code. Quantity codes in the nursery stock survey represented ranges, such as 50–100 plants. The range mid-point, 75 in this example, was entered into the resulting database for further exploration. Family, genera and species codes were assigned by the investigators. All cultivars, size, production technique, and quantity counts were combined into a single species count. Information on grower was not carried into the evaluation. Counts thus represented the totals of all growers with 5 cm trees of a single genus and species (including all cultivars). There were a total of 277,856 trees listed for sale from the Ohio Nursery Stock Survey for 2008 in the 5 cm size class (as described in the next section, this was the plant size most commonly purchased by responding urban foresters).

There were 9,279 trees planted in 2005 in the respondents' 22 communities, and 15,333 requests for trees anticipated for planted during 2010. It was decided to normalize the data such that comparisons could be made between years and sources. Thus, in 2005, responding urban foresters planted 9,279 of the 277,856 trees available in Ohio nurseries (3.339% of the trees available). By multiplying the number of trees of a given species available in nurseries by 0.03339 (3.339%), one obtains the number of trees available to communities for planting. Then by subtracting the number planted in 2005 from the number available in nurseries, one gets a measure of the difference between available trees relative to planting needs. A positive number for a given family or

species suggests an excess of trees in nurseries, while negative numbers indicate a shortage of plants available for communities from nurseries. Similarly, in 2010, there were 15,333 requests anticipated by responding urban foresters. The 277,856 trees listed for sale in the 2008 Ohio Nursery Stock Survey were again used as the nursery stock base. If one divides the 15,333 forester requests by 277,856 (trees available), one finds that 5.518% of Ohio nursery output will be requested by these communities for 2010.

Table 1. An example of an Ohio Nursery Stock Survey entry for a given species. Grower codes are listed in the first column, and sizes in the remaining columns. Quantity codes for each grower are noted under the size headings with numeric codes given for container plants and alpha codes for B&B stock.

Hedge Maple (Tree Form) <i>Acer campestre</i>		1"	1.5"	2" ²	2.5"	3"	4"+
Grower	NP SL	B	A	A	A	A	A
DKR		2		1			
DTF			B	B	B	B	A
KLY			C	B	B	A	

²Column contains the data used to generate nursery availability.

RESULTS AND DISCUSSION

The survey of urban foresters showed that trees were normally purchased as 5 cm plants. Thus it was this size of plant for which quantities were recorded from the Nursery Stock Survey. Results contrasting nursery stock availability with urban foresters' planting requests for 2005 and 2010 are reported at the family and species levels. After a review of the data, a cut-off of plus or minus 70 trees was selected for brevity of presentation in the species table (Table 2). As shown in Appendix 2, several species were somewhat balanced in terms of urban foresters' requests and nursery production.

Family Level

The rose family had the greatest excess with 628 more plants available to communities than were requested in 2005 and with nearly 2,282 more available for 2010 (Table 3). Plants in the rose family are generally smaller flowering trees, such as crabapples and medium-sized Callery pears. Crabapples are often planted beneath utility lines and both crabapples and Callery pears are frequently planted in sidewalk cuts or smaller tree lawns. This will likely continue as crabapples and pears are among the only flowering trees capable of withstanding the environmental stress found in these planting sites. This also likely reflects the heavy demand for flowering trees in landscape applications.

Whereas species from the rose family are smaller trees with reduced environmental benefits, maples are generally used as canopy trees. Most of the environmental benefits of trees in urban areas accrue to larger trees (Sydnor and Subburayalu 2008a); as a result, communities are often planting larger trees where the site allows. Toward this end, maple availability in Ohio nurseries exceeded what urban foresters wanted both in 2005 and 2010, by 536 and 1,178 plants, respectively. Maples have become popular street trees for a variety of reasons, including ease of clonal propagation, ease of transplant, shade, often vivid fall color, and marketing efforts by nursery suppliers. Further analysis in many cities, however, suggest canopy-sized maples are currently present

in excess of the 10-20-30 rule (Santamour 1990). For example, maples constituted 50% of the street trees in Toledo, Ohio, and 37% of the trees representing 56% of the canopy cover in Xenia, Ohio (Sydnor and Subburayalu 2008a; Sydnor and Subburayalu 2008b). Based on the 10-20-30 guidelines, it would not be recommended to plant maples in Ohio's public spaces unless or until community stocking levels are reduced below 20% to reduce the potential risk of an introduced exotic pest such as the Asian longhorned beetle that might attack maples (Fater 2008). In another study, when demand was expressed as percent market share, the demand for maples by urban foresters was expected to decline by almost two percentage-points from 2005 to 2010 (Sydnor 2008).

The Cornaceae, Hamamelidaceae, and Pinaceae families tended to be available in excess of quantities demanded by urban foresters. Pines and spruce are rarely used as street trees in Ohio, but commonly available due to demand for landscape plantings. Likewise, many plants in the dogwood family are forest understory plants and infrequently used on community streets.

Plants in the Betulaceae, Eucommiaceae, Fagaceae, Leguminosae, Oleaceae, Platanaceae, Tiliaceae, and Ulmaceae families generally are lacking in availability. Seed sources are important for plants in the beech family, thus making propagation more difficult. For example, pin oak, a member of Fagaceae, is native and adaptable if grown from local seed sources in the higher pH of central Ohioan soils, but is prone to develop an iron deficiency if grown from seed plants adapted to an acidic soil region of the United States.

Genus and Species Level

When considering species, *Acer palmatum* (Japanese), *A. platanoides* (Norway), *A. saccharum* (sugar), *A. × Freemanii* (Freeman), and *A. rubrum* (red) maples demonstrated excess availability for both 2005 and 2010 (Table 2). Conversely, *Acer campestre* and *A. truncatum* maples were deficient in availability for 2005 and 2010, while *A. buergerianum* and *A. ginnala* maples supplies appeared to fall short of anticipated demand for 2010.

The projected lack of downy serviceberry may simply be a nomenclatural problem as Amelanchiers are often sold under more than one scientific name. Most cultivars seen in the nursery trade are *Amelanchier × grandiflora* but are sold under a variety of names.

Carpinus betulus (European hornbeam) was projected to be in limited supply for both 2005 and 2010. Interestingly, this plant has not done well in Ohio except in the colder areas (Sydnor et al. 1999). The senior author has observed this plan doing well north of Ohio. Hornbeam borer attacks plants in the warmer areas of Ohio.

Crataegus (hawthorns) establish but perform poorly in stressful urban sites, such as tree lawns, in Ohio (Sydnor et al. 1999), and now tend to be used in less stressful lawn panels or plant beds. Hawthorn hybrids were or are projected to be lacking in availability. *Crataegus viridis*, *C. punctata*, *C. Phaenopyrum*, and *C. crus-galli inermis* hawthorns are also utilized in landscape plantings with green and thornless cockspur hawthorn being available in excess of demand.

Ash (*Fraxinus* spp.) was an interesting situation with a warning as to the importance of taxonomic diversity. In February 2003, EAB was discovered in Lucas County, Ohio. In spring 2004, the landscape market for ash collapsed. Ohio communities planted few ash trees to fill in plantings or for special requests in 2005, and none were requested for 2010. The plant was not listed in the 2008 Ohio Nursery Stock Survey.

Gleditsia triacanthos inermis (thornless honeylocust) was deficient in availability for 2005 but in excess for 2010. Communities have been reducing the use of honeylocust as a street tree as it frequently damages sidewalks but performs well and rarely exceeds 10% of an Ohio community's urban forest. If properly sited, this tree could be used more frequently. Some communities substitute *Gymnocladus dioica* (Kentucky coffeetree), for honeylocust. This leguminous tree grows slowly in nursery production and has an open, irregular canopy making it unpopular with many growers thus explaining its limited availability in 2010.

Parrotia persica (Persian parrotia) and *Phellodendron amurense* (Amur corktree) are projected as deficient in availability for 2010 despite urban forester's lack of experience with this tree. Communities looking for greater diversity are seeking these plants. This may represent a possible marketing opportunity for producers.

Platanus spp. were deficient in availability in 2005 and are projected to be so in 2010 as well. Communities favor London planetree (*P. × acerifolia*) for planting despite its being marginally cold hardy because of resistance to sycamore anthracnose, a common cosmetic disease. Sycamore (*P. occidentalis*), in contrast, has been variably sensitive to the cosmetic disease but resistant to canker-stain (often fatal to London planetrees in Ohio). Interestingly, if demand were expressed as an expected change in percent market share from 2005 to 2010, sycamore would be increasing slightly while London planetree would be diminishing (Sydnor 2008).

Prunus sp. (cherries and plums) were variable with some shortages in flowering cherries as communities seek alternatives to crabapples and pears. When considered as percent market share, cherries are generally decreasing in community demand (Sydnor 2008). Plums and cherries are more commonly seen in private landscapes rather than streetscapes.

Quercus spp. (oaks) are variable but generally lacking in availability, especially for 2010. Many nursery professionals prefer to grow clones and many oaks are difficult to propagate asexually. Additionally, many oaks take additional time to grow which adds to a nursery's costs. Despite these challenges, oaks appear to be a real opportunity for nursery producers given the increasing interest from urban foresters.

Pekin (*Syringa pekinensis*) and Japanese (*S. amurensis*) tree lilacs are deficient in availability and increasing in demand as a percent market share (Sydnor 2008). They are being used as flowering trees but are small in stature and slow growing in tree lawns.

Lindens (*Tilia* sp.) are generally undersupplied with American (*T. americana*) and silver (*T. tomentosa*) being in highest demand. Again inaccurate nomenclature in this genus may factor in the results shown.

Elms (*Ulmus* sp.) are generally lacking in availability. Fast growth and urban tolerance are among the assets for elm species. Disease resistance has been identified for many serious problems, but some cosmetic concerns are present. Interestingly, lacebark elm (*U. parvifolia*) was one of the few elms decreasing in demand when expressed as change in percent market share (Sydnor 2008). Overall, availability fell short in this study for 2005 and 2010. Elm seems poised to be among the most popular species for landscape applications in another ten years.

Table 2. Total nursery availability (number of trees by species), number of trees available to responding communities, number of trees planted by responding communities, and difference between availability and plantings, 2005 and 2010. Trees with availability within +/- 70 trees are not shown in this table but are listed by scientific name in Appendix 2.

Genus and Species Names	Common Name	Nursery Availability	Available to Communities 2005	Planted 2005	Difference 2005	Available to Communities 2010	Estimated Planting 2010	Difference 2010
<i>Acer buergeranum</i>	Trident Maple	150	5	58	-53	8.3	126	-117.7 ^z
<i>Acer campestre</i>	Hedge Maple	1700	56.8	258	-201.2 ^z	93.8	335	-241.2 ^z
<i>Acer ginnala</i>	Amur Maple	700	23.4	36	-12.6	38.6	128	-89.4 ^z
<i>Acer palmatum</i>	Japanese Maple	2675	89.3	6	83.3 ^y	147.6	3	144.6 ^y
<i>Acer platanoides</i>	Norway Maple	14800	494.2	115	379.2 ^y	816.7	172	644.7 ^y
<i>Acer rubrum</i>	Red Maple	18727	625.4	450	175.4 ^y	1033.4	412	621.4 ^y
<i>Acer saccharum</i>	Sugar Maple	7075	236.3	235	1.3	390.4	301	89.4 ^z
<i>Acer truncatum</i>	Shantung Maple	3075	102.7	199	-96.3 ^z	169.7	375	-205.3 ^z
<i>Acer x Fremanii</i>	Freeman Maple	12275	409.9	153	256.9 ^y	677.4	313	364.4 ^y
<i>Aesculus x carnea</i>	Ruby Red Horsechestnut	1900	63.5	25	38.5	104.8	27	77.8 ^y
<i>Amelanchier arborea</i>	Downy Serviceberry	875	29.2	145	-115.8 ^z	48.3	143	-94.7 ^z
<i>Carpinus Betulus</i>	European Hornbeam	2575	86	137	-51	142.1	320	-177.9 ^z
<i>Cercis canadensis</i>	Eastern Redbud	7900	263.8	176	87.8 ^y	435.9	315	120.9 ^y
<i>Cladrastis lutea</i>	American Yellowwood	1025	34.2	91	-56.8	56.6	164	-107.4 ^z
<i>Cornus Kousa</i>	Japanese Dogwood	2200	73.5	17	56.5	121.4	42	79.4 ^y
<i>Corylus Columna</i>	Turkish Filbert	1025	34.2	49	-14.8	56.6	218	-161.4 ^z
<i>Crataegus crus-galli inermis</i>	Thornless Cockspur Hawthorn	3150	105.2	11	94.2 ^y	173.8	35	138.8 ^y
<i>Crataegus viridis</i>	Green Hawthorn	3175	106	34	72 ^y	175.2	39	136.2 ^y
<i>Crataegus x hybrida</i>	Hawthorn Hybrids	0	0	85	-85 ^z	0	135	-135 ^z
<i>Eucommia ulmoides</i>	Hardy Rubbertree	850	28.4	23	5.4	46.9	356	-309.1 ^z
<i>Fagus sylvatica</i>	European Beech	4525	151.1	13	138.1 ^y	249.7	45	204.7 ^y
<i>Fraxinus americana</i>	White Ash	0	0	151	-151 ^z	0	0	0
<i>Ginkgo biloba</i>	Maidenhair Tree	650	21.7	114	-92.3 ^z	35.9	306	-270.1 ^z
<i>Gleditsia triacanthos inermis</i>	Thornless Honeylocust	10125	338.1	443	-104.9 ^z	558.7	402	156.7 ^y
<i>Gymnocladus dioica</i>	Kentucky Coffeetree	950	31.7	85	-53.3	52.4	237	-184.6 ^z
<i>Maclura pomifera</i>	Thornless Osage-orange	150	5	12	-7	8.3	116	-107.7 ^z
<i>Malus Sargentii</i>	Sargent Crabapple	1575	52.6	0	52.6	86.9	0	86.9 ^y
<i>Malus x</i>	Crabapple Hybrids	34750	1160.5	685	475.5 ^y	1917.6	688	1229.6 ^y
<i>Parrotia persica</i>	Persian Parrotia	200	6.7	10	-3.3	11	120	-109 ^z
<i>Phellodendron amurense</i>	Amur Corktree	725	24.2	42	-17.8	40	115	-75 ^z
<i>Picea Abies</i>	Norway Spruce	3900	130.2	48	82.2 ^y	215.2	90	125.2 ^y
<i>Pinus Strobus</i>	Eastern White Pine	8475	283	28	255 ^y	467.7	15	452.7 ^y
<i>Platanus x acerifolia</i>	London Planetree	3800	126.9	233	-106.1 ^z	209.7	314	-104.3 ^z
<i>Prunus cerasifera</i>	Purpleleaf Plum	2700	90.2	1	89.2 ^y	149	0	149 ^y
<i>Prunus subhirtella</i>	Higan Cherry	2900	96.8	37	59.8	160	13	147 ^y
<i>Prunus x</i>	Flowering Cherry Hybrids	2000	66.8	245	-178.2 ^z	110.4	373	-262.6 ^z
<i>Pyrus Calleryana</i>	Callery Pear	19425	648.7	696	-47.3	1071.9	347	724.9 ^y
<i>Quercus acutissima</i>	Sawtooth Oak	650	21.7	171	-149.3 ^z	35.9	277	-241.1 ^z
<i>Quercus bicolor</i>	Swamp White Oak	1725	57.6	156	-98.4 ^z	95.2	258	-162.8 ^z
<i>Quercus imbricaria</i>	Shingle Oak	1175	39.2	57	-17.8	64.8	224	-159.2 ^z
<i>Quercus macrocarpa</i>	Bur Oak	1375	45.9	115	-69.1	75.9	149	-73.1 ^z
<i>Quercus palustris</i>	Pin Oak	2900	96.8	84	12.8	160	82	78 ^y
<i>Quercus rubra</i>	Red Oak	2525	84.3	170	-85.7 ^z	139.3	233	-93.7 ^z
<i>Quercus Shumardii</i>	Shumard Oak	825	27.6	53	-25.4	45.5	118	-72.5 ^z
<i>Syringa pekinensis</i>	Pekin Lilac	0	0	12	-12	0	85	-85 ^z
<i>Syringa reticulata</i>	Japanese Tree Lilac	2700	90.2	311	-220.8 ^z	149	550	-401 ^z
<i>Tilia americana</i>	American Linden	800	26.7	278	-251.3 ^z	44.1	368	-323.9 ^z
<i>Tilia tomentosa</i>	Silver Linden	1200	40.1	187	-146.9 ^z	66.2	252	-185.8 ^z
<i>Tilia Xeuclora</i>	Crimean Linden	0	0	17	-17	0	87	-87 ^z
<i>Tsuga canadensis</i>	Canadian Hemlock	1850	61.8	13	48.8	102.1	8	94.1 ^y
<i>Ulmus americana</i>	American Elm	750	25	92	-67	41.4	247	-205.6 ^z
<i>Ulmus parvifolia</i>	Lacebark Elm	4075	136.1	279	-142.9 ^z	224.9	385	-160.1 ^z
<i>Ulmus Wilsoniana</i>	Wilson's Elm	325	10.9	25	-14.1	17.9	125	-107.1 ^z
<i>Ulmus x</i>	Hybrid Elm	5175	172.8	76	96.8 ^y	285.6	435	-149.4 ^z
<i>Zelkova serrata</i>	Japanese Zelkova	2750	91.8	147	-55.2	151.8	291	-139.2 ^z
TOTAL		277856	9279	9279	0^y	15333	15333	0^y

^z Represent deficient availability (for differences of +/- 70 trees or more).

^y Represents excess availability (for differences of +/- 70 trees or more).

Table 3. Total nursery availability (number of trees by family), number of trees available to responding communities, number of trees planted by responding communities, and difference between availability and plantings, 2005 and 2010.

Family Name	Common Name	Nursery Availability	Available to Communities 2005	Planted 2005	Difference 2005	Available to Communities 2010	Estimated Planting 2010	Difference 2010
Aceraceae	Maple	63702	2127.3	1591	536.3 ^z	3515.3	2337	1178.3 ^z
Anacardiaceae	Cashew	1504	50.2	6	44.2	83.0	22	61.0
Annonaceae	Annona	225	7.5	15	-7.5	12.4	35	-22.6
Aquifoliaceae	Holly	125	4.2	7	-2.8	6.9	13	-6.1
Betulaceae	Birch	8375	279.7	353	-73.3 ^y	462.2	947	-484.8 ^y
Bignoniaceae	Bignonia	625	20.9	1	19.9	34.5	46	-11.5
Caprifoliaceae	Honeysuckle	475	15.9	16	-0.1	26.2	18	8.2
Cercidiphyllaceae	Katsura	675	22.5	64	-41.5	37.2	50	-12.8
Cornaceae	Dogwood	4325	144.4	71	73.4 ^z	238.7	164	74.7 ^z
Cupressaceae	Cypress	775	25.9	0	25.9	42.8	20	22.8
Ebenaceae	Ebony	100	3.3	20	-16.7	5.5	31	-25.5
Ericaceae	Heath	975	32.6	0	32.6	53.8	11	42.8
Eucommiaceae	Eucommia	850	28.4	23	5.4	46.9	356	-309.1 ^y
Fagaceae	Beech	20400	681.3	990	-308.7 ^y	1125.7	1895	-769.3 ^y
Ginkgoaceae	Ginkgo	650	21.7	114	-92.3 ^y	35.9	306	-270.1 ^y
Hamamelidaceae	Witchhazel	2950	98.5	94	4.5	162.8	227	-64.2
Hippocastanaceae	Horsechestnut	5500	183.7	47	136.7 ^z	303.5	147	156.5 ^z
Juglandaceae	Walnut	275	9.2	7	2.2	15.2	44	-28.8
Lauraceae	Laurel	75	2.5	12	-9.5	4.1	15	-10.9
Leguminosae	Legume	20700	691.3	888	-196.7 ^y	1142.3	1232	-89.7 ^y
Magnoliaceae	Magnolia	5725	191.2	162	29.2	315.9	350	-34.1
Malvaceae	Mallow	0	0.0	0	0.0	0.0	7	-7.0
Moraceae	Mulberry	825	27.6	12	15.6	45.5	117	-71.5 ^y
Nyssaceae	Blackgum	1025	34.2	38	-3.8	56.6	93	-36.4
Oleaceae	Olive	3550	118.6	550	-431.4 ^y	195.9	668	-472.1 ^y
Pinaceae	Pine	18875	630.3	231	399.3 ^z	1041.6	334	707.6 ^z
Platanaceae	Planetree	5000	167.0	294	-127.0 ^y	275.9	430	-154.1 ^y
Rosaceae	Rose	82850	2766.8	2138	628.8 ^z	4571.9	2290	2281.9 ^z
Rutaceae	Rue	725	24.2	42	-17.8	40.0	120	-80.0 ^y
Salicaceae	Willow	675	22.5	1	21.5	37.2	71	-33.8
Sapindaceae	Soapberry	525	17.5	22	-4.5	29.0	75	-46.0
Scrophulariaceae	Figwort	0	0.0	0	0.0	0.0	0	0.0
Simaroubaceae	Quassia	0	0.0	0	0.0	0.0	1	-1.0
Stryacaceae	Storax	575	19.2	0	19.2	31.7	21	10.7
Taxodiaceae	Yew	3825	127.7	106	21.7	211.1	254	-42.9
Theaceae	Tea	475	15.9	0	15.9	26.2	8	18.2
Tiliaceae	Linden	5550	185.3	649	-463.7 ^y	306.3	900	-593.7 ^y
Ulmaceae	Elm	14375	480.1	715	-234.9 ^y	793.3	1678	-884.7 ^y
TOTAL		277856	9279.0	9279	0.0	15333.0	15333	0.0

^z Represent excess availability (for differences in excess of +/- 70 trees).

^y Represent deficient availability (for differences in excess of +/- 70 trees).

CONCLUSION

Results from this study highlight the need for establishing stronger lines of communication between nursery stock suppliers and urban foresters. Requests for nursery stock by responding urban foresters were found to represent only 3%–5% of Ohio nursery production. Thus nurseries have many additional customers. Urban foresters must communicate with nursery suppliers and let them know what they will need and when they are satisfied with their services. The segmentation of the nursery industry into various components such as seedling production, whip production, wholesale producers, and brokers over the past decades has likely resulted in reduced prices for consumers. One of the casualties of segmenting the supply chain has been the limited communication between segments, especially those growers early in the production cycle and end users such as urban foresters.

Another difficulty arises when an urban forester requests an oak (309 shortfall for 2010), for example, but has to accept a maple substitute since oaks are not available from the success-

ful bidder. The nursery then logs the substituted maple as a sale, using sales data in determining what to plant the following year. In this way, information regarding the original request might be lost and market disequilibrium can result. Some nurseries see this as a means of managing inventory. Still others are willing to work with customers to bring plants to market not currently in inventory; for several species, the quantities being demanded and supplied were somewhat balanced (Appendix 2).

Maples, crabapples, many hawthorns, and pears are generally present in nurseries in excess of what urban foresters demand. Some of these excesses represent plants being grown for other purposes such as pines for screening or Japanese maples for decorative purposes. Conversely, many legumes, oaks, elms, lilacs, and lindens are deficient in availability; such species likely represent plants purchased by Ohio community foresters from out-of-state sources. Urban foresters can increase taxonomic diversity by informing their preferred nursery suppliers of the plants they expect to purchase, ordering those

plants, and not accepting substitutes when the low bidder says the plants are not available. This will increase the taxonomic diversity in their communities and in the nursery industry as well.

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Résumé. Il y a une disparité continue entre ce que les forestiers urbains affirment avoir besoin pour la plantation dans les villes et les stocks disponibles dans les pépinières. Pour étudier cette question, une enquête a été faite en février 2008 auprès de 22 des forestiers urbains de l'Ohio afin de comparer le contraste entre leurs besoins en plantation et la disponibilité des stocks en pépinière. Les forestiers ont indiqué avoir planté plus de 9000 arbres en 2005 et comptaient en planter plus de 15000 arbres dans leurs villes respectives en 2010. Au même moment, il a été fait mention que près de 278000 arbres de 5 cm de calibre étaient disponibles pour la vente auprès des pépinières participantes en 2008. Ces résultats suggèrent que les érables, les pommiers, plusieurs aubépines et les poiriers présents dans les pépinières étaient en excès par rapport aux quantités désirées par les forestiers urbains. À l'inverse, plusieurs légumineuses, chênes, ormes, lilas et tilleuls se trouvaient en quantités inférieures aux besoins. Plusieurs autres espèces étaient plus ou moins en quantités équivalentes entre les besoins des forestiers urbains et celles disponibles en pépinières. L'Ohio a été confronté aux impacts de l'agrile du frêne sur les espèces du genre *Fraxinus*. Une diversité taxonomique accrue pourrait être une méthode à faible coût pour s'assurer d'éviter une possible introduction d'un nouveau parasite exotique qui pourrait possiblement attaquer un autre genre (ex.: *Acer*), ce qui requiert une disponibilité accrue de certaines espèces actuellement manquantes au sein de la chaîne de production en pépinière.

Zusammenfassung. Es gibt eine kontinuierliche Differenz zwischen den Anforderungen, die von den verantwortlichen Forstplanern an die Bäume gestellt werden und der in der Baumschule erhältlichen Qualität. Um dieses näher zu untersuchen, wurden im Februar 2008 zweiundzwanzig Stadtförster in Ohio im Hinblick auf ihre Planungsanforderungen und des tatsächlichen Angebots in den Baumschulen befragt. Die Stadtförster berichteten, daß sie in 2005 mehr als 5.000 Bäume gepflanzt hätten und daß sie für 2010 mehr als 15.000 in ihren Bezirken pflanzen wollen. Zur gleichen Zeit waren in den Baumschulen, die sich an der Umfrage bezüglich ihres Angebots in 2008 beteiligt hatten, nahezu 278.000 Bäume zum Kauf erhältlich. Die Ergebnisse zeigten, daß Äpfel, Zieräpfel, viele Weißdorne und Birnen in der von den Stadtförstern gewünschten Anzahl erhältlich waren. Auf der anderen Seite waren viele Hülsenfrüchte, Eichen, Ulmen, Flieder und Linden nicht ausreichend vorhanden. Bei einigen anderen Arten gab es ein ausgeglichenes Verhältnis zwischen Angebot und Nachfrage. Ohio muss sehr mit den Schäden des Eschenbohrers kämpfen. Zunehmende taxonomische Diversität könnte eine preiswerte Alternative sein zu der möglichen Einführung von weiteren Schädlingen, die eine andere Baumart befallen (zum Beispiel Ahorn) und das erfordert ein wachsendes Angebot von einigen Arten, die derzeit in den Baumschulen nicht oder nicht ausreichend erhältlich sind.

Resumen. Ha habido una continua disparidad entre las especies que los dasónomos urbanos requieren para las plantaciones y la disponibilidad en los viveros. Para investigar esto, veintidós de los dasónomos de Ohio fueron encuestados en Febrero de 2008 para contrastar sus necesidades de plantación con la disponibilidad en los viveros. Los dasónomos urbanos reportaron una plantación de más que 9,000 árboles en 2005 y esperan plantar más de 15,000 en sus respectivas comunidades en 2010. Al mismo tiempo, aproximadamente 278,000 árboles [5 cm (2 in)] fueron reportados disponibles para la venta en los viveros participantes en la encuesta de 2008 en Ohio. Estos resultados sugieren que los maples, manzanos, muchos piracantos y perales generalmente estuvieron en exceso en los viveros, en comparación a las cantidades deseadas por los dasónomos. Contrariamente, muchas leguminosas, encinos, olmos, lilas y tilos estaban ausentes. Varias otras especies estuvieron balanceadas en términos de las necesidades y la producción de los viveros. Ohio, U. S. ha estado tratando con los impactos del barrenador esmeralda en las especies de *Fraxinus*. El incremento en la diversidad taxonómica puede ser, a un costo relativamente bajo, un medio de asegurarse contra la posible introducción de esta y otras plagas exóticas que pudieran atacar otros géneros (tales como *Acer*). Se requiere incrementar la disponibilidad de algunas especies faltantes en cuanto a disponibilidad en los viveros en la cadena de abastecimiento.

APPENDIX 1. AN ABBREVIATED SURVEY INSTRUMENT SHOWING THE FIRST FIVE ENTRIES OF THE ORIGINAL LIST THAT CONTAINED MORE THAN 200 SPECIES. THE HEADER AND THE FIRST TWO COLUMNS WERE FILLED OUT BY RESPONDENTS. THE REMAINING FOUR COLUMNS WERE USED FOR CODING AND TO IDENTIFY PLANTS IN THE SURVEY.

PLANTING SURVEY FORM

Insert the approximate number of trees planted in 2005 for each species that you planted in the first column. Insert the estimated number for each species you wish to plant in 2010 assuming no problems with availability.

Community _____ Phone No. _____ .

Expected number planted for 2010 _____ Expected Size _____ .

PLANTED IN 2005	EXPECTED FOR 2010	SCIENTIFIC NAME	COMMON NAME	FAMILY	CODES		
					FmC	GnC	SpC
		<i>Acer buergeranum</i>	Trident Maple	Aceraceae	15	18	15
		<i>Acer campestre</i>	Hedge Maple and cultivars	Aceraceae	15	18	20
		<i>Acer circinatum</i>	Vine Maple	Aceraceae	15	18	22
		<i>Acer ginnala</i>	Amur Maple and cultivars	Aceraceae	15	18	30
		<i>Acer griseum</i>	Paperbark Maple	Aceraceae	15	18	35

APPENDIX 2. LIST OF TREES EVALUATED WHERE URBAN FORESTERS' REQUESTS AND NURSERY PRODUCTION APPROACHED BALANCE (DIFFERENCES WITHIN +/- 70 TREES).

<i>Acer circinatum</i>	<i>Juniperus chinensis</i>	<i>Salix babylonica</i>
<i>Acer griseum</i>	<i>Koelreuteria paniculata</i>	<i>Salix nigra</i>
<i>Acer negundo</i>	<i>Liquidambar styraciflua</i>	<i>Sassafras albidum</i>
<i>Acer nigrum</i>	<i>Liriodendron Tulipifera</i>	<i>Sophora japonica</i>
<i>Acer pensylvanicum</i>	<i>Maackia amurensis</i>	<i>Sorbus alnifolia</i>
<i>Acer pseudoplatanus</i>	<i>Magnolia acuminata</i>	<i>Stewartia Pseudocamellia</i>
<i>Acer saccharinum</i>	<i>Magnolia grandiflora</i>	<i>Styrax japonicus</i>
<i>Acer tataricum</i>	<i>Magnolia Kobus</i>	<i>Taxodium distichum</i>
<i>Acer truncatum</i>	<i>Magnolia stellata</i>	<i>Tilia cordata</i>
<i>Aesculus glabra</i>	<i>Magnolia virginiana</i>	<i>Ulmus carpinifolia</i>
<i>Aesculus Hippocastanum</i>	<i>Magnolia × Loebneri</i>	<i>Ulmus japonica</i>
<i>Aesculus octandra</i>	<i>Magnolia × Soulangiana</i>	<i>Viburnum lentago</i>
<i>Aesculus Pavia</i>	<i>Malus baccata</i>	<i>Viburnum prunifolium</i>
<i>Ailanthus altissima</i>	<i>Malus floribunda</i>	<i>Viburnum rufidulum</i>
<i>Alnus glutinosa</i>	<i>Malus hupehensis</i>	
<i>Amelanchier × grandiflora</i>	<i>Malus ioensis</i>	
<i>Asimina triloba</i>	<i>Malus sieboldii zumi</i>	
<i>Betula alleghaniensis</i>	<i>Malus tschonoskii</i>	
<i>Betula lenta</i>	<i>Metasequoia glyptostroboides</i>	
<i>Betula nigra</i>	<i>Morus species</i>	
<i>Betula papyrifera</i>	<i>Nyssa sylvatica</i>	
<i>Betula pendula</i>	<i>Ostrya virginiana</i>	
<i>Betula populifolia</i>	<i>Oxydendrum arboreum</i>	
<i>Betula utilis</i>	<i>Pinus Bungeana</i>	
<i>Carpinus Caroliniana</i>	<i>Pinus flexilis</i>	
<i>Carya cordiformis</i>	<i>Pinus nigra</i>	
<i>Carya glabra</i>	<i>Pinus ponderosa</i>	
<i>Carya illinoensis</i>	<i>Pinus rigida</i>	
<i>Carya ovata</i>	<i>Pinus sylvestris</i>	
<i>Catalpa bignonioides</i>	<i>Pinus virginiana</i>	
<i>Catalpa speciosa</i>	<i>Platanus occidentalis</i>	
<i>Celtis laevigata</i>	<i>Populus deltoides</i>	
<i>Celtis occidentalis</i>	<i>Populus spp</i>	
<i>Celtis reticulata</i>	<i>Prunus Padus</i>	
<i>Cercidiphyllum japonicum</i>	<i>Prunus Sargentii</i>	
<i>Chionanthus retusus</i>	<i>Prunus serotina</i>	
<i>Chionanthus virginicus</i>	<i>Prunus serrulata</i>	
<i>Cornus alternifolia</i>	<i>Prunus virginiana</i>	
<i>Cornus Drummondii</i>	<i>Prunus yedoensis</i>	
<i>Cornus florida</i>	<i>Pseudotsuga Menziesii</i>	
<i>Cornus mas</i>	<i>Ptelea trifoliata</i>	
<i>Cornus officinalis</i>	<i>Pyrus betulifolia</i>	
<i>Crataegus crus-galli</i>	<i>Pyrus Fauriei</i>	
<i>Crataegus Phaenopyrum</i>	<i>Quercus alba</i>	
<i>Crataegus punctata</i>	<i>Quercus coccinea</i>	
<i>Crataegus × Lavalley</i>	<i>Quercus lyrata</i>	
<i>Diospyros virginiana</i>	<i>Quercus marilandica</i>	
<i>Fagus grandifolia</i>	<i>Quercus Muehlenbergii</i>	
<i>Fraxinus excelsior</i>	<i>Quercus nigra</i>	
<i>Fraxinus pennsylvanica</i>	<i>Quercus phellos</i>	
<i>Gleditsia triacanthos</i>	<i>Quercus prinus</i>	
<i>Halesia carolina</i>	<i>Quercus robur</i>	
<i>Halesia monticola</i>	<i>Quercus stellata</i>	
<i>Hibiscus syriacus</i>	<i>Quercus velutina</i>	
<i>Ilex opaca</i>	<i>Rhus typhina</i>	
<i>Juglans cinerea</i>	<i>Robinia Pseudoacacia</i>	
<i>Juglans nigra</i>	<i>Robinia × ambigua</i>	