Growth Rates of Common Tree Species in Westminster, Colorado

By Keith Wood

Introduction

This study updates a previous project and publication from 2000 in which tree-growth rates were analyzed on public property in Westminster, Colo. Eight years of diameter growth data were collected in 2000 and updated in early 2008 to obtain 16 years of growth data on the same trees. Growth rates for trees typically are classified based on individual observation or experience. This study, based on trees originally inventoried in late 1992 and early 1993, attempts to measure tree diameter growth rates to more accurately reflect what can be expected of trees growing in this area.

Growth rate numbers are intended to provide average figures of diameter growth in 18 tree types that were studied and averaged over a 16-year study period. The numbers reported are averages, so a typical tree of the types studied will grow at the expected rates over 16 years.

Figure 1: *A tree workshop taught by the Colorado State Forest Service.* *Photo: CSFS*

Methods

Prior to the 2009 growing season, many of the same trees measured for this study in 1992 and 2000 were located and re-measured on Westminster public properties, including maintained parks, city facilities, streetscapes, medians and other miscellaneous properties. Sample sizes typically decreased for each of the tree types studied due to tree removal that occurred for various reasons, especially construction-related activities. Numbers for each tree that was revisited were updated from the original values collected in 1992. In most cases, diameter numbers were collected at diameter at breast height (dbh = 4.5 feet above ground).

Trees with diameters ranging from 3 inches to 12 inches in 1992-1993 were again used in this analysis. Many of these same trees were measured in 2009 to determine growth rates over the 16 growing seasons. Diameters were measured with either a diameter tape or Biltmore stick and measured as whole numbers on the inch. Diameters less than ½-inch were rounded to the lower whole number, whereas diameter measurements more than ½-inch were rounded to the next highest whole number.

In late 1992 and early 1993, shade and evergreen trees in the 3-inch to 12-inch diameter class, and ornamental trees in the 3-inch to 7-inch diameter class, which are in the "growth" stage of their development, were measured. Most trees in the study were planted at 2-inch to 2.5-inch caliper diameters prior to 1992

January 2010
www.csfs.colostate.edu

Colorado State Forest Service

and were fully established by 1992. Severely stressed trees, or trees rated in poor or very poor condition classes, were not used in the study. Trees used in the study were predominantly classified in the fair to good condition categories, thus estimating how much a typical tree type can be expected to grow, once established, over a 16-year period in a mostly irrigated, clay soil type in the Westminster area.

Figure 2: *Catalpa trees (Catalpa speciosa) have the third highest growth rate in the study area.* *Photo: CSFS*

Sample sizes (N) varied based on tree type; low sample sizes (N = less than 10 trees) were removed from the study, unless trees were spread over several growing sites in the area (e.g. catalpa and white fir).

Results

Eleven shade tree types were evaluated at the end of the 16-year growing period (Table 1). Cottonwood, a tree with a reputation for fast growth, exhibited the highest average diameter expansion over the period. Silver maples exhibited the next highest growth rate in the shade tree category. It should be noted that many 'Autumn Blaze' maples, a silver and red maple hybrid, were planted on many landscapes in Westminster around the end of the last century. Observations indicate that they establish quickly and initial growth rate is fast, as it is in silver maples; however, many have developed a "delayed" chlorosis. As a result, growth appears to be slowing and the trees need nutrient supplements to maintain their vigor. Only nine catalpas were monitored over the 16 years, but they showed the third highest growth rate among the shade tree types. Of the remaining shade trees, varieties of white oak, mainly bur, swamp white and English, showed the next fastest growth rate. Typically, oaks are regarded as slow-growing trees, but this study has consistently found that white oak varieties can grow at a moderate rate in this area.

Next on the list of shade tree types are the lindens (mostly 'Greenspire' littleleaf and 'Redmond' American linden), varieties of green and white ash (mostly 'Marshall Seedless', 'Patmore', 'Summit' and 'Autumn Purple') and red oaks. Red oaks in the Westminster area don't seem to perform as well as the white oak group, which most likely is due to their reduced ability to thrive in higher pH soils. Honeylocust and Norway maple varieties continue to grow more slowly in this study, but nevertheless have become very desirable shade trees over time. The hackberry and red maple varieties round out the shade trees covered in this study. Hackberry is notoriously slow to establish after transplanting and battles the insect-caused nipple gall most of its life, but it is a nice shade tree if given time. Red maple, often a favorite among homeowners and landscape designers, performs poorly in the Westminster area, often becoming chlorotic and suffering much die-back due to soil and hardiness problems.

Blue spruce leads the way in growth rate for the evergreen species (Table 2). The growth rate of the blue spruce often surprises those who plant it, so this tree should be given plenty of room to mature over time. Austrian and ponderosa pine also grow fast for conifers once established. The Austrian seems to tolerate transplantation and withstands heavy soil types and urban conditions slightly better than the native ponderosa. It should be noted that an abundance of mountain pine beetle (MPB) attacks have moved into urban areas, due in large part to the vast numbers of beetles that are impacting native lodgepole pine forests in the area. MPB seems to favor Scotch pine in urban settings, although ponderosa pine

Figure 3: *The hawthorn tree (Crataegus spp's) ranked the slowest growing in the study.* *Photo: CSFS*

also are frequently attacked. Thus far, the Austrian pine has shown good resistance to MPB attacks. Rounding out the conifers studied, white fir and piñon grew significantly slower over the 16-year period.

Leading the growth rate charge in the ornamental group is the invasive Russian-olive. Many communities, including Westminster, have started Russian-olive control programs and its subsequent listing on the noxious weed list in Colorado has prevented it from being available for planting. The crabapple varieties studied show the next highest growth rate among the ornamental trees on the list, and hawthorn varieties round out the trees analyzed in this study.

Discussion

Based on the results of this 16-year study, a growth rate gradient of tree types is proposed in Tables 4 and 5 and Figure 5. This is open to debate and further analysis, but results from this ongoing study reveal these tree types fit along the described gradient in the Westminster, Colo., area.

The study conducted here applies only to a limited area of the Front Range of Colorado, which typically is characterized by a semi-arid climate, poor soil and a poor overall environment for growing trees. Most trees in this study, and those that are planted in the Westminster area, are not native to the high plains ecosystem. It can be challenging to establish and grow healthy trees in this area; however, with proper species selection, handling, planting and care, many trees can grow to their full potential. Equating growth rates with vigor also can be misleading, as some of the slower-growing tree types on this list can be the most adaptable to the area. Hawthorn, hackberry and honeylocust are good examples.

Homeowners and landscape designers should look locally for information on trees that do well in this difficult environment. Relying on nursery catalogs and information on tree performances from other areas of the country can be misleading and result in monocultures of non-adaptable species. Some tree species have been given a slow growth reputation they may not deserve, and often are passed over at planting time. Adding these species to our plant palette, and mixing them with many of the hardy, slow-growing species will increase the success of our projects and promote species diversity in this area.

(Top) Figure 4: *Green ash (Fraxinus pennsylvanica).* *Photo: CSFS* **(Left) Figure 5:** *Honeylocust (Gleditsia triacanthos) is a slower-growing tree, but can be adaptable.* *Photo: Tom DeGomez, University of Arizona , bugwood.org*

Growth Rate Analysis 1992-2008

Shade Trees

Species	Growth Rate *(average dbh inches per year)*	Growth Rate *(average dbh inches per 16-year period)*	Sample Size *(N = number of trees)*
Cottonwood	0.64	10.2	271
Silver maple	0.49	7.8	42
Catalpa	0.44	7.0	9
White oak	0.43	6.9	31
Linden	0.43	6.8	104
Ash	0.42	6.7	270
Red oak	0.40	6.3	54
Honeylocust	0.37	5.9	216
Norway maple	0.33	5.3	80
Hackberry	0.32	5.2	34
Red maple	0.30	4.8	14

Table 1: *Growth rate of shade trees and number of trees sampled.*

Evergreen Trees

Species	Growth Rate *(average dbh inches per year)*	Growth Rate *(average dbh inches per 16-year period)*	Sample Size *(N = number of trees)*
Blue spruce	0.47	7.6	133
Austrian/ ponderosa pine	0.43	6.9	503
White fir	0.37	5.9	11
Piñon	0.23	3.7	19

Table 2: *Growth rate of evergreen trees and number of trees sampled.*

Ornamental Trees

Species	Growth Rate *(average dbh inches per year)*	Growth Rate *(average dbh inches per 16-year period)*	Sample Size *(N = number of trees)*
Russian-olive	0.40	6.4	43
Crabapple	0.39	6.2	100
Hawthorn	0.17	2.7	41

Table 3: *Growth rate of ornamental trees and number of trees sampled.*

Overall Ratings

Species	Growth Rate *(average dbh inches per year)*	Growth Rate *(average dbh inches per 16-year period)*	Sample Size *(N = number of trees)*
Cottonwood	0.64	10.2	271
Silver maple	0.49	7.8	42
Blue spruce	0.47	7.6	133
Catalpa	0.44	7.0	9
White oak	0.43	6.9	31
Austrian/ ponderosa pine	0.43	6.9	503
Linden	0.43	6.8	104
Ash	0.42	6.7	270
Russian-olive	0.40	6.4	43
Red oak	0.40	6.3	54
Crabapple	0.39	6.2	100
Honeylocust	0.37	5.9	216
White fir	0.37	5.9	11
Norway maple	0.33	5.3	80
Hackberry	0.32	5.2	34
Red maple	0.30	4.8	14
Piñon	0.23	3.7	19
Hawthorn	0.17	2.7	41

Table 4: *Growth rate of all species and number of trees sampled.*

Figure 6: *Blue spruce (Picea pungens).* *Photo: CSFS*

Figure 7: *Red maple (Acer rubrum).* *Photo: John Ruter, University of Georgia, bugwood.org*

Growth Rate Over 16 Years by Tree Species

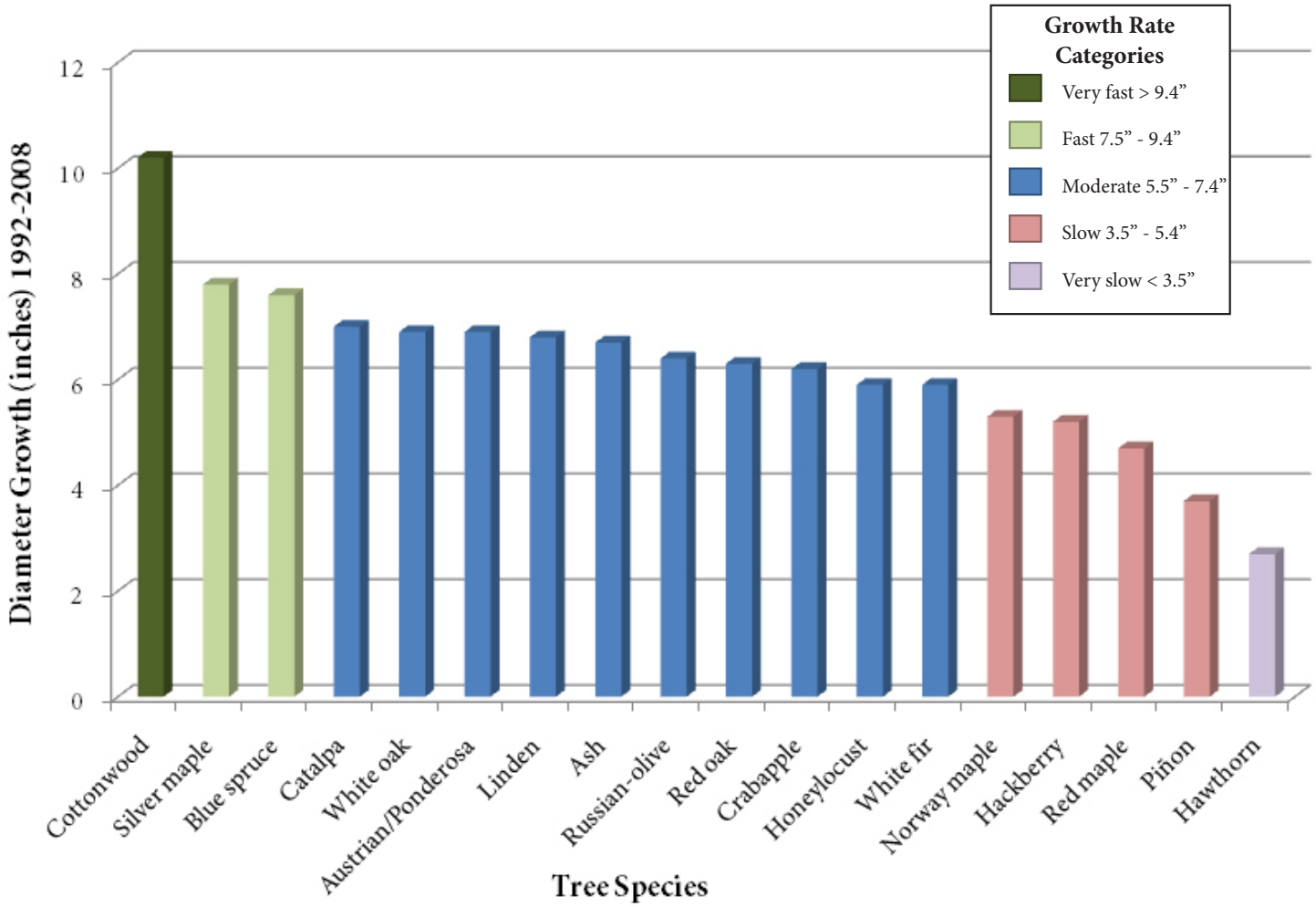

Figure 8: *Growth rates (inches in diameter) of tree species over 16 years.*

Growth Rate Categories

Very Fast > 9.4"	Fast 7.5" - 9.4"	Moderate 5.5" - 7.4"	Slow 3.5" - 5.4"	Very slow < 3.5"
Cottonwood	Silver maple	Catalpa	Norway maple	Hawthorn
	Blue spruce	White oak	Hackberry	
		Austrian/ ponderosa pine	Red maple	
		Linden	Piñon	
		Ash		
		Russian-olive		
		Red oak		
		Crabapple		
		Honeylocust		
		White fir		

Table 5: *Growth rate categories (diameter in inches per 16 years).*