Forest Research Group

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Growth Rates and Growing Seasons

Trees grow faster in the Southern United States than they do in the Northeast. A good annual growth rate in central Maine is one ton per acre per year. Annual growth rates in the South can range from 3 to 12 tons per acre per year.

One of the factors affecting annual growth rates is the number of days that trees can grow each year. Annual growth is higher in the South in part because the growing season is longer (surprise!).

How long is the growing season? The growing season is considered the number of days between the last frost in the Spring and the first frost in the Fall. The National Weather Service provides records on frosts, including last and first frosts. You can really get into the details(/weeds) and find the range of dates over which the first and last frosts occur and the average dates of those frosts for thousands of locations across the US.

The number of days between the last and first frost is the number of days in the growing season. This is particularly important for food crops, as even a light frost (32˚F/0˚C) will kill tender crop plants, but it provides a good indication of the growing season for trees.

For example, the average last frost for Bangor (and Hermon), ME is May 9 and the average first frost is September 30—an average growing season of 141 days. Figure 1 shows three pictures of the view from the Forest Research Group office in May 2021. On May 5 there were no hardwood leaves showing, but buds were swollen and ready to break. Six days later, quaking aspen (*Populus tremuloides*) and bigtooth aspen (*Populus grandidentata*) leaves were out. Maples and oaks had leafed out by the 24th.

Figure 1. Spring in Central, ME ~45°North

May 3, 2021

May 11, 2021

May 24, 2021

Remember that May 9 is the only ***average*** last frost date. In 2020, May 9 looked like this (Figure 2):

Figure 2. Snow in Central, ME ~45°North May 9, 2020

At the other end of the growing season, the local forest is just about wrapping it up (Figure 3). The aspens are still green but the maple leaves are yellow and there are a lot of leaves on the ground.

Figure 3. Fall in Central, ME ~45°North September 30, 2020

So, based on this small sample (n = 1), we conclude that the frost-free-growing season is a good indicator of the tree-growing season.

We began our analysis with the assumption that latitude would be an important determinant of growing season, but also wondered if elevation/altitude would make a difference.

The East

Table 1 shows 31 locations in the eastern US for which we gathered data. They are all in areas where timber growing is an important part of the local economy and many are home to large timber-consuming facilities. They range from one of the northern most points in the East (International Falls, MN) to near the southern limit of commercial southern pine (Kissimmee, FL).

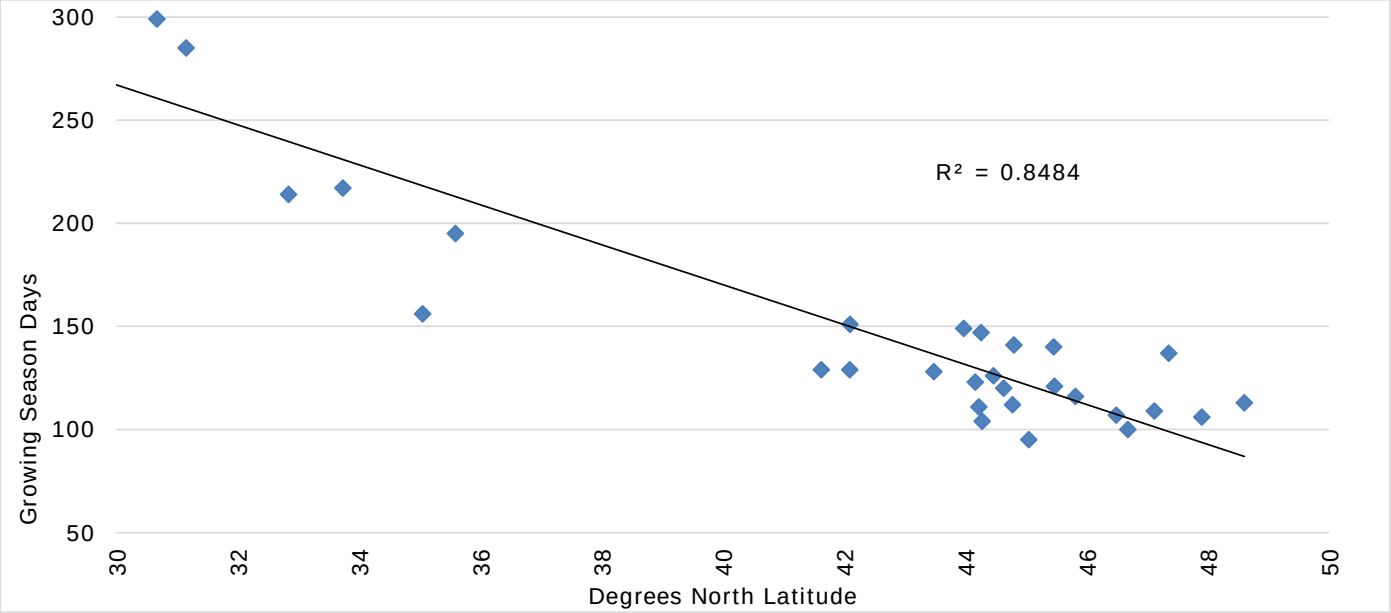
The locations are sorted by latitude and those in the north tend to have shorter growing seasons but the two series are not perfectly correlated. The northern-most location has a longer growing season than 9 other locations. The shortest growing season is found in Pittsburg, NH, which is the northern-most town in the state of New Hampshire—but there are 10 locations at higher latitudes.

Table 1. Eastern Locations Sorted by Latitude

Region	Location	Latitude	Days
Lake States	International Falls, MN	48.6	113
Lake States	Ely, MN	47.9	106
New England	Madawaska, ME	47.4	137
Lake States	Houghton, MI	47.1	109
New England	Presque Isle, ME	46.7	100
Lake States	Kenton, MI	46.5	107
New England	Houlton, ME	46.1	102
Lake States	Iron Mountain, MI	45.8	116
Lake States	Tomahawk, WI	45.5	121
New England	Greenville, ME	45.5	140
New England	Pittsburg, NH	45.1	95
New England	Bangor, ME	44.8	141
New England	Errol, NH	44.8	112
New England	Andover, ME	44.6	120
New England	Berlin, NH	44.5	126
New England	Bethlehem, NH	44.3	104
Lake States	Appleton, WI	44.3	147
Middle Atlantic	Tupper Lake, NY	44.2	111
New England	Bath, NH	44.2	123
Middle Atlantic	Watertown, NY	44.0	149
New England	Boonville, NY	43.5	128
Middle Atlantic	Binghamton, NY	42.1	151
Middle Atlantic	Jamestown, NY	42.1	129
Middle Atlantic	Titusville, PA	41.6	129
South	Asheville, NC	35.6	195
South	Highlands, NC	35.1	156
South	Washington, GA	33.7	217
South	Macon, GA	32.8	214
South	Brunswick, GA	31.2	285
South	Fernandina Beach, FL	30.7	299
South	Kissimmee, FL	28.3	326

While the correlation is not perfectly negative, it is very strong ($R = -0.92$) and produces an R^2 of 0.85. This can be interpreted as latitude accounts for 85% of the difference in growing season (Figure 4).

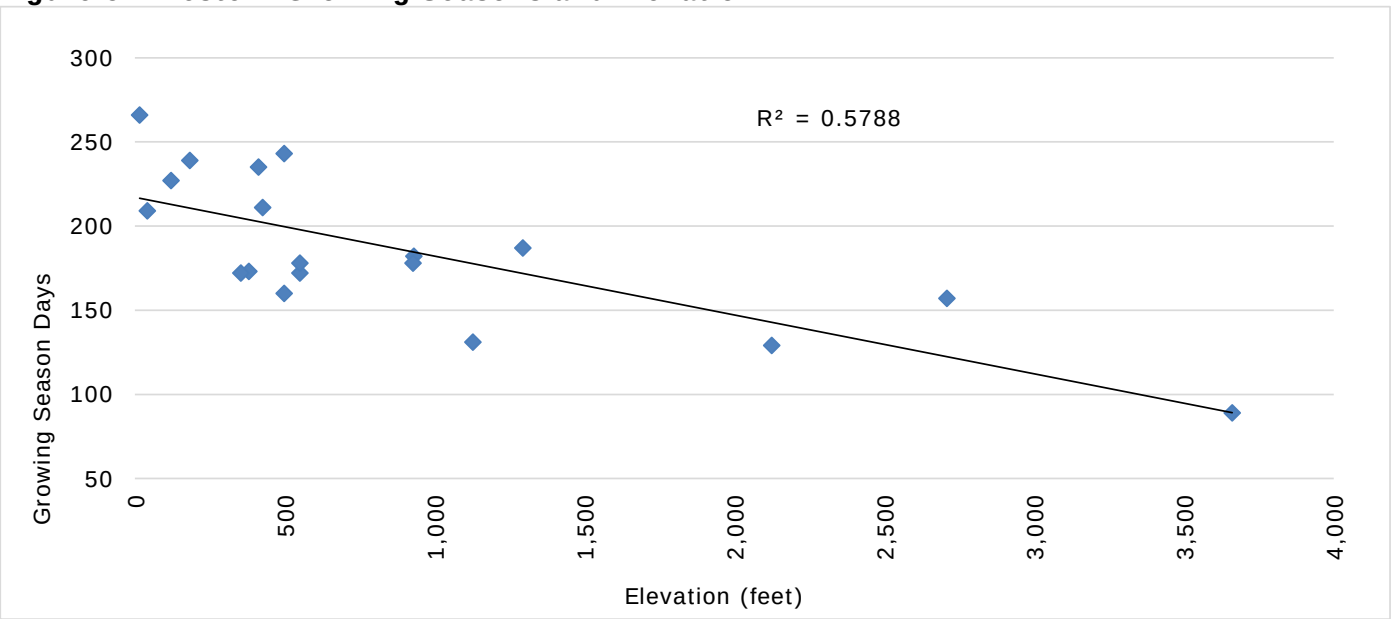
Figure 4. Eastern Growing Seasons and Latitude



The West

To an Easterner with much less experience in the West, the West looks a little different than the East. One interesting difference is that snowfall total forecasts in the Northeast reference distance inland from the coast (inland locations usually get more snow than coastal locations), while snowfall total forecasts in the Pacific Northwest reference elevation (higher elevations usually get more snow than lower elevations). Many of the timber-related towns in the West are located in the valleys and on the lower slopes of the mountains. This puts a lot of timber at higher elevations for which there are no frost data reported. That being said, we found elevation was a better predictor of growing season than latitude in the West (Figure 5).

Figure 5. Western Growing Seasons and Elevation



The shortest growing season in our limited sample was for Bend, OR (Table 2), located roughly half way between the Canadian border to the north and Sacramento, CA to the South. It is located about 1,000 feet higher than the next-highest town (Yreka, CA) and has a growing season that is just over half of Yreka's.

Table 2. Western Locations Sorted by Elevation

Location	Elevation	Days
Bend, OR	3,661	89
Yreka, CA	2,709	157
Sandpoint, ID	2,125	129
Medford, OR	1,295	187
Leavenworth, WA	1,128	131
Grants Pass, OR	931	182
Skykomish, WA	928	178
Darrington, WA	551	172
Foster Dam, OR	551	178
Hood River, OR	498	160
Redding, CA	498	243
Roseburg, OR	426	211
Maple Creek, CA	413	235
Cowlitz, WA	380	173
Eugene, OR	354	172
Chico, CA	183	239
Newport, OR	121	227
Blaine, WA	42	209
Coos Bay, OR	16	266

Regional Comparison

Table 3 compares the coefficients of correlation and determination for the East and West. Growing season is very strongly correlated with latitude in the East and with elevation in the West. The weaker correlations are not very weak, and a regression analysis that included both variables might produce a very strong predictive model.

Table 3. Statistical Results by Region

	East	West
	R	
Latitude	-0.9211	-0.4643
Elevation	-0.4405	-0.7608
	R^2	
Latitude	0.8484	0.2156
Elevation	0.1941	0.5788

Other Factors Affecting Growth Rates

While latitude and elevation have a big impact on the length of the growing season, there are other factors that will affect growth rates, but not the growing season:

- rainfall
- soil types (coastal plain vs glaciated, acidic soils
- silviculture
- slope/aspect

Summary

If you apply fertilizer to a stand in the South, you get more days for the trees to use it—often twice as many days as a tree in New England or the Lake States does.

A timber stand near Bangor, ME might have an annual growth rate of 1 ton/acre/year while a stand near Brunswick, GA would probably start at 3 tons/acre/year, at least 3 times higher annual growth. But if we consider that the stand near Bangor has an average growing season of 141 days, we can calculate that the stand is growing at just over 14 pounds/acre/day during the season (the tons/acre/day numbers are really small). The stand near Brunswick has an average growing season of 285 days (twice Bangor's) and its daily growth rate is just over 21 pounds/acre/day, which is barely 1.5 times the daily growth rate near Bangor.

(Of course, the 3 tons/acre/year we picked for Brunswick is at the low end of the growth rate range for the South and even a modest investment in silviculture can push that number higher.)

Some soils are rockier and less productive than others (Baxter State Park, ME)

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