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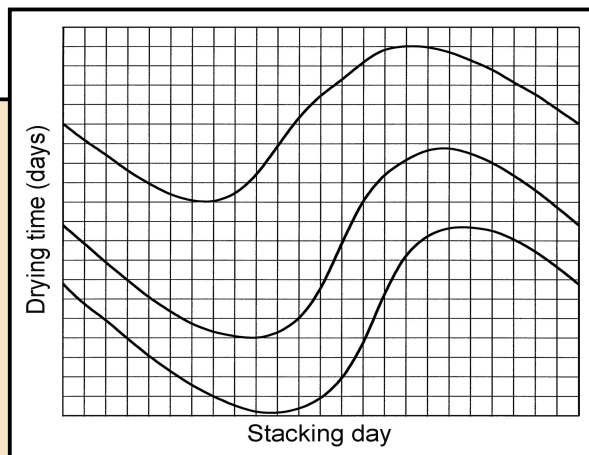
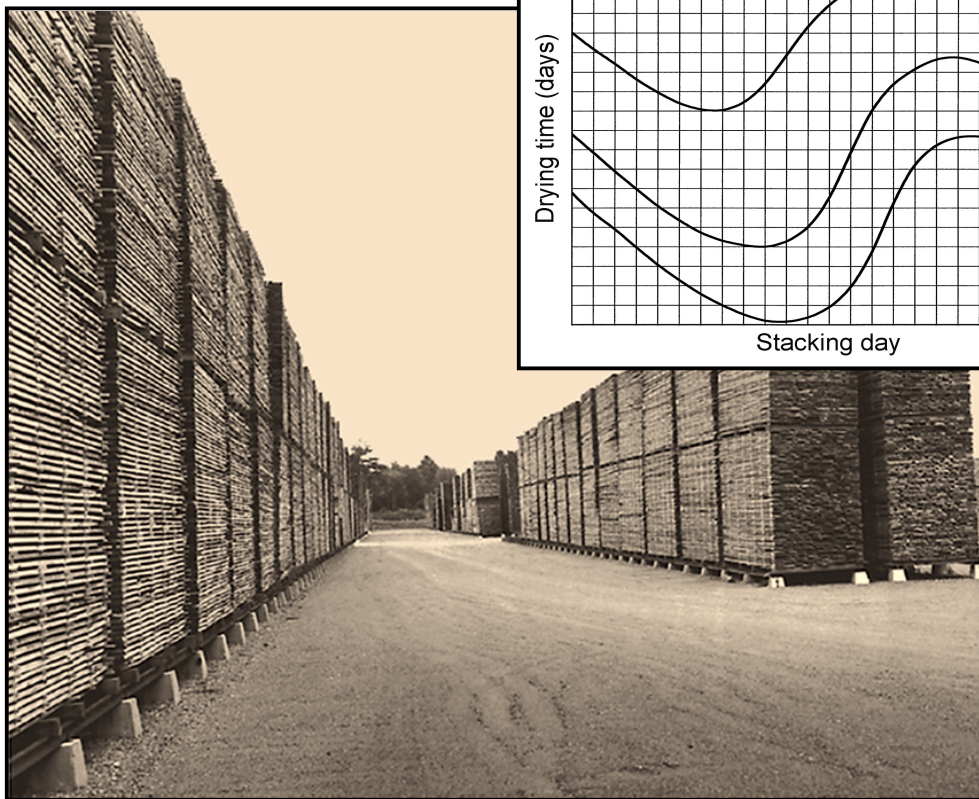
Forest
Products
Laboratory

General
Technical
Report
FPL-GTR-121



Estimates of Air Drying Times for Several Hardwoods and Softwoods

William T. Simpson
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Abstract

Published data on estimated air drying times of lumber are of limited usefulness because they are restricted to a specific location or to the time of year the lumber is stacked for drying. At best, these estimates give a wide range of possible times over a broad range of possible locations and stacking dates. This report describes a method for estimating air drying times for specific locations by optimizing a drying simulation using existing experimental air drying times for northern red oak, sugar maple, American beech, yellow-poplar, ponderosa pine, and Douglas-fir. The results are simulation parameters that make it possible to estimate the air drying times of these species regardless of when they are stacked, in any location where average temperature and relative humidity are known, and for lumber of any thickness dried to any final moisture content. Graphs of these estimated air drying times to several final moisture contents are given for several nominal thicknesses of lumber at various locations within the growing range of the six species studied.

Keywords: air drying, computer simulation, lumber

November 2000

Simpson, W.T.; Hart, C.A. 2000. Estimates of air drying times for several hardwoods and softwoods. Gen. Tech. Rep. FPL–GTR–121. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 70 p.

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Estimates of Air Drying Times for Several Hardwoods and Softwoods

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Introduction

Estimating the time required to air dry lumber is not an easy task. Drying times depend on species and thickness, as well as the geographical location of the air drying yard. In general, low density species dry faster than higher density species. Estimation becomes more complicated when the influence of weather variability is considered. Temperature and relative humidity, which have major effects on drying rate, vary from year to year. The best we can do to characterize any location is to consider weather conditions that represent the average of many years of meteorological data. In addition to the effect of summer–winter temperature differences, estimates of air drying time are affected by the time of year when the lumber is stacked. Lumber stacked in the spring may dry in a relatively short time because a large portion of the drying may be in the warm spring and summer months. In contrast, lumber stacked in late summer or early fall may take a relatively long time to dry because it will be exposed to winter temperatures, when drying may almost stop.

The purpose of this report is to present estimates of air drying times to several final moisture contents for northern red oak, sugar maple, American beech, yellow-poplar, ponderosa pine, and Douglas-fir lumber stacked at any time of the year in various locations within the growing range of the species.

Background

Rietz and Page (1971) tabulated approximate air drying times to 20% moisture content for nominal 1-in. thick hardwood and softwood species. (See Table 1 for actual dimensions.) Presumably because of the lack of data, these values are only ranges of time estimates. The authors state that the minimum air drying times listed are for lumber stacked for drying in southern locations in the spring or early summer, and the maximum times are for lumber stacked in northern locations in the fall or early winter. For example, the time range for air drying northern red oak is 70 to 200 days; the

width of this range limits its usefulness for air drying in specific locations.

Rietz (1972) improved these estimates by developing an air drying map that divides the eastern United States into five zones. The boundaries of the zones are based on the average cumulative “growing degree days” developed by the U.S. Department of Agriculture (USDA 1975). The five zones are based on estimates of the length of good air drying conditions, ranging from 12 months in the south to 4 months in the north. Rietz (1972) also presented his estimates in terms of an effective air drying calendar for the Upper Midwest. For example, he estimated five “effective air drying days” in December, January, and February, with gradually increasing numbers of effective days (up to 30 days) in June through August. McMillen and Wengert (1978) tabulated air drying times to 20% moisture content for most nominal 1- and 2-in.-thick lumber of hardwood species dried in the U.S. South, mid-South, Central, and mid-North. These estimates are given in terms of ranges that depend on the time of the year the lumber is stacked.

The Tennessee Valley Authority (1974) published an air drying guide applicable to the Tennessee Valley. Charts presented in this guide show estimated air drying times to 20% moisture content for nominal 1- and 2-in.-thick lumber stacked on the 5th, 15th, and 25th days of each month. However, because the charts purportedly represent all hardwood species, they are likely to be inaccurate for some species.

Denig and Wengert (1982) developed a method for estimating air drying times for red oak and yellow-poplar. Air drying samples were exposed to the environmental conditions of three commercial air drying yards over a 5-month period. The daily rate of moisture loss was then related to meteorological variables obtained from a regional weather station. That result was developed into regression equations for each species that estimate daily moisture content loss from initial moisture content, temperature, and relative humidity data.

Approach to Drying Time Estimation

Experimental Data Base

Six previous air drying studies provided the experimental data necessary to develop the estimation method. Four of these studies were conducted by Edward Peck of the Forest Products Laboratory, USDA Forest Service: northern red oak (Madison, Wisconsin, Peck 1959), sugar maple (Upper Michigan, Peck 1957), American beech (Philadelphia, Pennsylvania, Peck 1954), and ponderosa pine (Flagstaff, Arizona, Peck and others 1956). Denig and Wengert (1982) studied yellow-poplar in Roanoke, Virginia. Johnson and Gibbons (1927) studied Douglas-fir in the Seattle-Tacoma area of Washington, and their data were further analyzed by Peck (1962). Lumber sizes for the study species are shown in Table 1.

In the studies by Peck (1954, 1957, 1959) and Peck and others (1956), the lumber was stacked four times during the year (each season) and the air drying time to 20% lumber moisture content was noted. In the study by Johnson and Gibbons (1927), the lumber was stacked five times during the year. The yellow-poplar data were for lumber stacked at the beginning of each month and dried to final moisture contents ranging from 15% to 23%, depending on the month of stacking (Denig 1980, Denig and Wengert 1982). These data were the results of a regression equation, not the actual experimental data.

The drying times from the Johnson and Gibbons (1927) study and the studies by Peck (1954, 1957, 1959) and Peck and others (1956) apply only to the five locations studied. The major objective of our study was to expand these data to any location where weather data are available. The results of Denig and Wengert (1982) can be expanded to other locations through the regression equations of these authors.

Table 1. Species and thickness of lumber

Species	Lumber thickness		
	Nominal (in.)	Actual (in.)	Actual (mm)
Northern red oak, sugar maple, American beech, yellow-poplar	4/4	1.125	29
	5/4	1.375	35
	6/4	1.688	43
	8/4	2.188	56
Ponderosa pine, Douglas-fir	4/4	1.000	25
	5/4	1.250	40
	2	1.700	43
	8/4	2.215	54

Analytical Method

The computer drying simulation developed by Hart (1982) offers a method for expanding the air drying time estimates to other locations. The general nature of this method is to determine simulation parameters from the experimental data and apply them in the simulation using weather data for other locations. The simulation involves adjusting computer program input coefficients until the simulation calculates a drying time that closely approximates an observed experimental drying time. One of these coefficients is an apparent diffusion coefficient D , which is defined in the program as corresponding to some base temperature. Because diffusion of water through wood is highly temperature dependent, the simulation requires adjustment of D as drying temperature changes. This adjustment is in proportion to the saturated vapor pressure of water, and the adjustment can be further refined through a coefficient designated by Hart (1982) as relative activation energy (RAE). Other input variables to the simulation are board thickness and width, initial temperature of the lumber, dry- and wet-bulb temperatures, air velocity, and initial moisture content.

The dry- and wet-bulb temperatures can be entered in two ways: (1) as moisture content controlled schedules (dry- and wet-bulb temperatures are changed as lumber moisture content decreases) and (2) as time-based kiln schedules (dry- and wet-bulb temperatures are changed at predetermined times regardless of moisture content). For this study, the dry- and wet-bulb temperatures were changed every 15 days for northern red oak, sugar maple, and American beech, and, because of anticipated faster drying, every 5 days for yellow-poplar, ponderosa pine, and Douglas-fir. The weather data were generally taken as monthly averages and then linearly interpolated to 5- and 15-day increments. Shorter time increments could have been chosen and might have resulted in finer tuned estimates, but the level of computer time required would have become excessive and probably not justifiable given the only approximate accuracy of the estimates. For input to the simulation, wet-bulb temperatures were calculated from relative humidity and dry-bulb temperatures by using the method of Lily (1996).

The selection of air velocity in the simulation was somewhat of a problem. Wind speed data were available, but direct use of those values did not seem justifiable because it is unlikely that the air flow through the lumber stacks would be that high. The amount of air flow depends on yard orientation and other local disturbances that lower the air velocity to less than that in an open and free space. Therefore, the air velocity in the simulation was, perhaps somewhat arbitrarily, taken as 25% of the meteorologically reported wind speed. As it turned out, the differences in estimated air drying times using full wind speed differed by only 1 or 2 days from the times estimated using 25% of full wind speed. Denig and Wengert (1982) also found that meteorologically reported wind speed had only a minor effect on air drying time.

The final result of applying the drying simulation to the reported experimental air drying data for the six species was optimized values of *D* and RAE that can be used in the simulation to estimate air drying times for any thickness of lumber dried to any final moisture content and for any stacking date in any location where average monthly temperature and relative humidity data are available.

The simulation is described in detail in the original report by Hart (1982). However, after the publication of this report, Hart continued to refine the simulation, and the version used for the work reported here differs from that in the original publication. Although Hart did not publish his refinements, his FORTRAN computer program, both the code and the executable program, and a user's manual for the simulation are available on the world wide web at <http://www.fpl.fs.fed.us/documnts/programs/dds/dds.htm>

Air Drying Time Estimates

Table 2 shows an example of estimated air drying times for nominal 1-in.- thick northern red oak in Madison, Wisconsin. The temperature and relative humidity data are 30-year averages from the National Climate Data Center, National Oceanic and Atmospheric Administration (1997). Air drying times for all the study species for a number of locations throughout their growing ranges are shown graphically in the appendix. The continuous curves presented in the graphs allow easy interpolation between the 15-day increments of stacking dates listed in Table 2. Green moisture contents of northern red oak, sugar maple, American beech, yellow-poplar, ponderosa pine, and Douglas-fir lumber were 80%, 65%, 55%, 80%, 150%, and 37%, respectively.

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- Relative humidity:
<http://www.ncdc.noaa.gov/ol/climate/online/ccd/avgrh.html>
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Table 2—Estimated air drying times for 4/4 northern red oak to 30%, 25%, and 20% moisture content in Madison, Wisconsin

Stacking date	Dry-bulb temp ^a (°F)	Relative humidity ^a (%)	Wet-bulb temp (°F)	Air velocity ^b (ft/min)	Drying time (days) to various wood moisture contents		
					30%	25%	20%
Jan 1	17.5	74.9	15.8	229 ^b	106	123	144
Jan 15	17.2	73.8	15.5	231	96	112	133
Feb 1	19.5	73.3	17.6	229	87	102	122
Feb 15	23.6	72.7	21.5	233	77	92	111
Mar 1	29.4	72.2	26.8	192	68	82	100
Mar 15	35.6	70.8	32.2	246	60	73	91
Apr 1	42.2	68.3	38.0	249	53	65	82
Apr 15	48.2	66.9	43.2	243	47	58	75
May 1	53.8	66.6	48.2	228	42	53	69
May 15	59.0	67.0	52.9	215	38	48	65
Jun 1	63.8	68.0	57.4	205	35	45	62
Jun 15	67.4	69.3	60.9	195	33	44	63
Jul 1	69.8	70.8	63.4	184	33	44	66
Jul 15	70.4	72.4	64.3	178	34	47	72
Aug 1	69.0	74.1	63.4	177	37	52	82
Aug 15	66.2	75.3	61.1	179	42	59	111
Sep 1	62.0	75.8	57.4	186	48	73	154
Sep 15	57.1	75.1	52.7	195	60	104	178
Oct 1	51.7	73.4	47.4	206	83	133	184
Oct 15	45.6	73.4	41.8	217	107	147	183
Nov 1	38.8	75.1	35.8	230	122	151	179
Nov 15	32.0	76.4	29.6	233	124	147	172
Dec 1	25.2	77.1	23.3	227	121	140	164
Dec 15	20.3	76.6	18.6	226	114	132	154

^aTemperature and relative humidity values are for the date between the listed dates and represent the average conditions during drying. $T_{°C} = (T_{°F} - 32)/1.8$.

^b1 ft/min = 0.005 m/s.

Appendix—Graphs of Estimated Air Drying Times

The graphs in this appendix show air drying times for various sizes of northern red oak, sugar maple, American beech, yellow-poplar, ponderosa pine, and Douglas-fir lumber throughout their growing ranges (Burns and Honkala 1990). These graphs can be used to estimate air drying times, as illustrated by the following example:

Problem: If 4/4 northern red oak is stacked on September 1 in Asheville, North Carolina, how many days are required for moisture content to reach 20%?

Solution: Locate September 1 on the horizontal axis and go up to the 20% moisture content (MC) curve. Notice that the 20% MC curve intersects the September 1 vertical grid line at 90 days. Thus, the air drying time to 20% MC for 4/4 northern red oak stacked in Asheville, North Carolina, on September 1 is estimated to be 90 days.

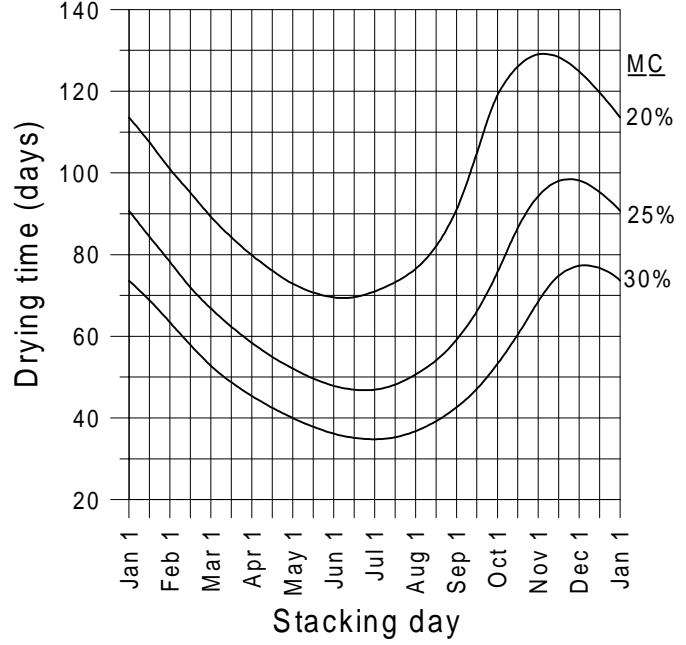
Table 3 provides an index to graphs for various species air dried in different locations.

Table 3—Index to graphs of air drying times

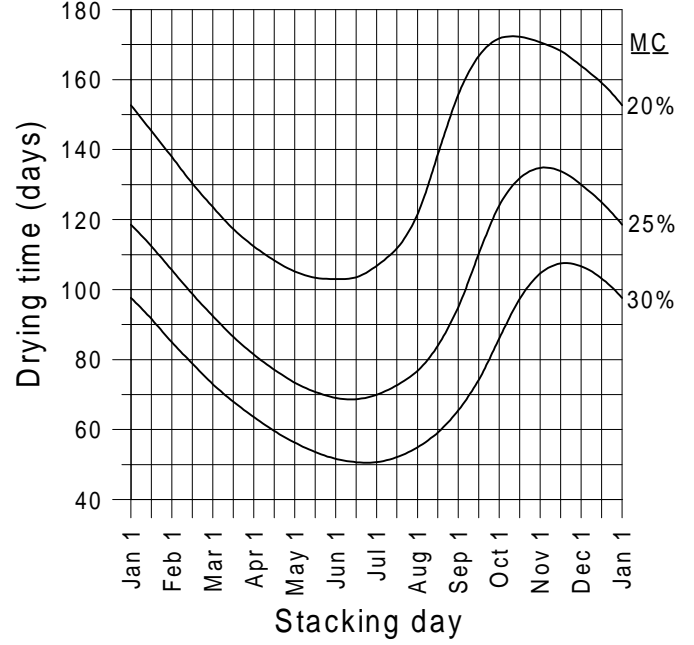
Species and location	Page	Species and location	Page
Northern red oak		American beech	
Asheville, NC	6	Asheville, NC	37
Burlington, VT	7	Burlington, VT	38
Caribou, ME	8	Charleston, WV	39
Charleston, WV	9	Columbus, OH	40
Columbia, MO	10	Montgomery, AL	41
Columbus, OH	11	Williamsport, PA	42
Concord, NH	12	Yellow-poplar	
Duluth, MN	13	Charleston, WV	43
Grand Rapids, MI	14	Columbus, OH	44
Huntsville, AL	15	Columbia, SC	45
Louisville, KY	16	Louisville, KY	46
Madison, WI	17	Montgomery, AL	47
Memphis, TN	18	Nashville, TN	48
Peoria, IL	19	Roanoke, VA	49
Portland, ME	20	Ponderosa pine	
Roanoke, VA	21	Albuquerque, NM	50
Williamsport, PA	22	Bishop, CA	51
Worcester, MA	23	Boise, ID	52
Sugar maple		Denver, CO	53
Burlington, VT	24	Flagstaff, AZ	54
Caribou, ME	25	Lewiston, ID	55
Charleston, WV	26	Medford, OR	56
Columbia, MO	27	Missoula, MT	57
Columbus, OH	28	Pendleton, OR	58
Concord, NH	29	Redding, CA	59
Duluth, MN	30	Spokane, WA	60
Grand Rapids, MI	31	Winslow, AZ	61
Nashville, TN	32	Douglas-fir	
Peoria, IL	33	Boise, ID	62
Portland, ME	34	Denver, CO	63
Syracuse, NY	35	Lewiston, ID	64
Worcester, MA	36	Medford, OR	65
		Missoula, MT	66
		Pocatello, ID	67
		Portland, OR	68
		Redding, CA	69
		Seattle-Tacoma, WA	70

Northern Red Oak

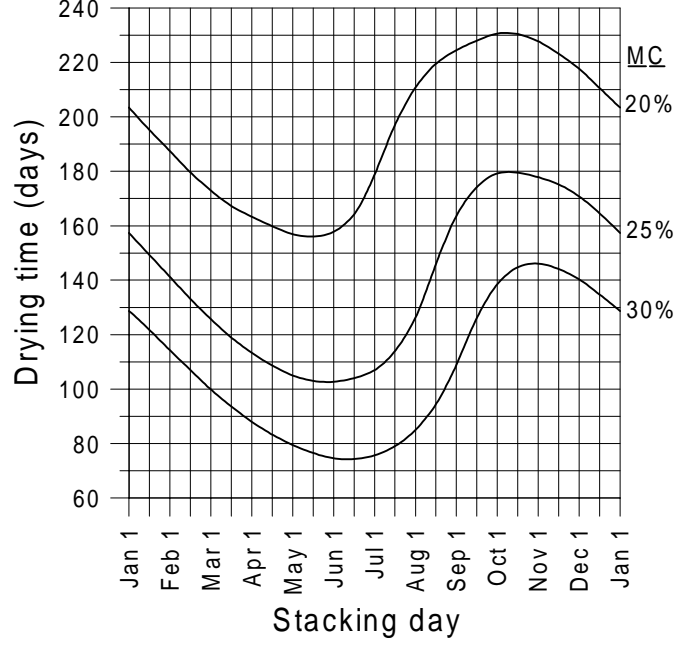
4/4 Northern red oak: Asheville, NC



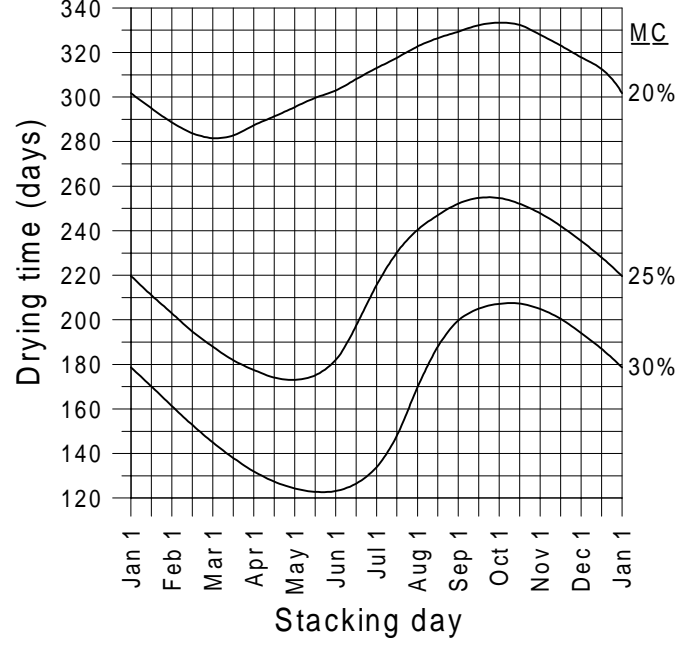
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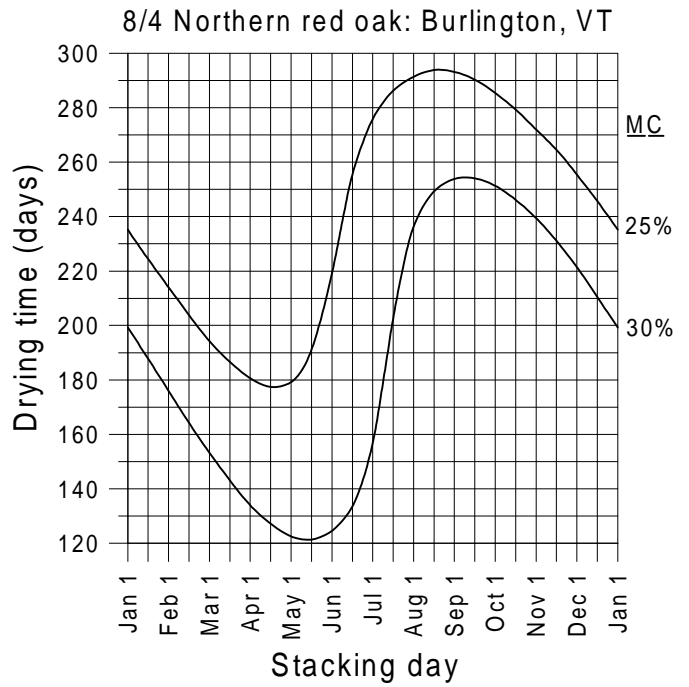
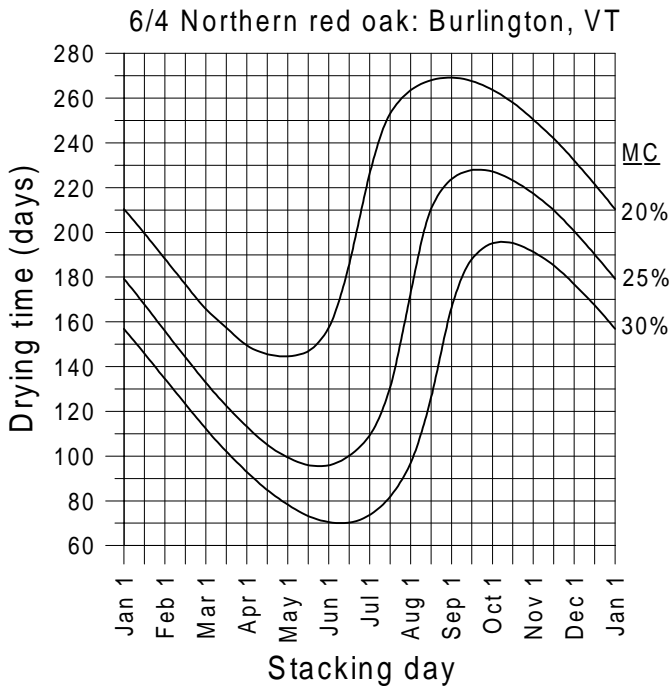
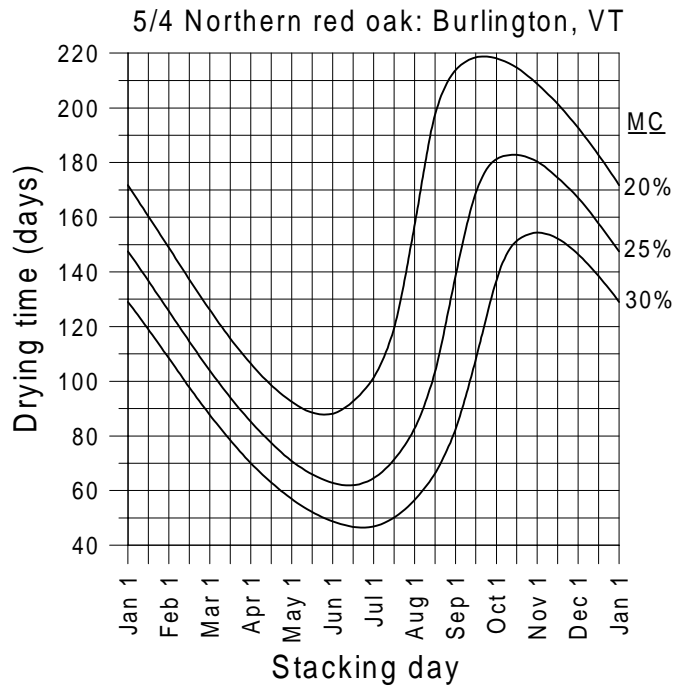
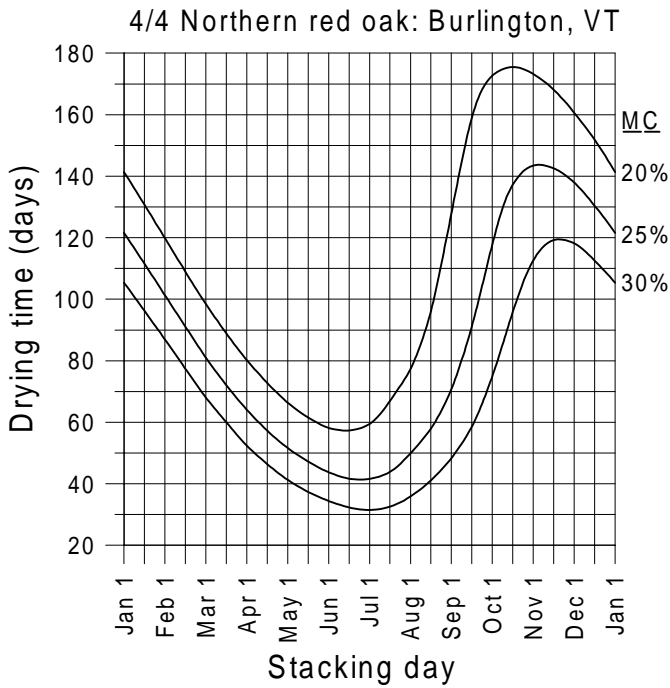


6/4 Northern red oak: Asheville, NC

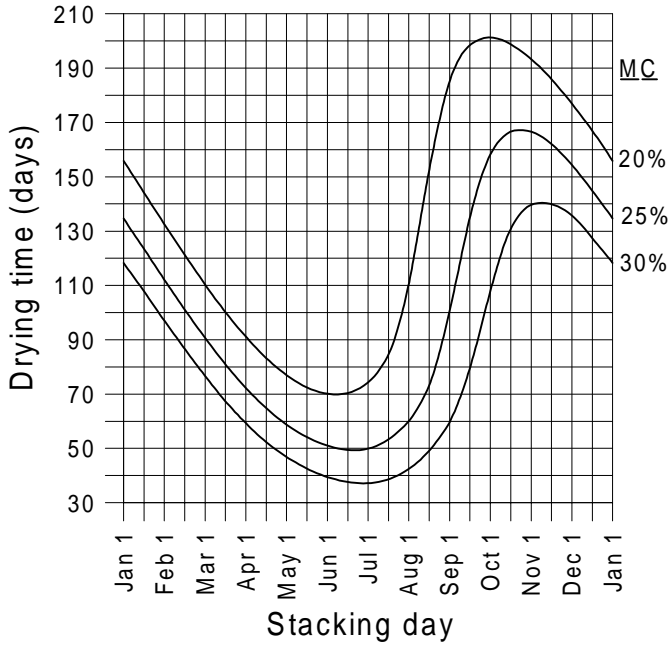


8/4 Northern red oak: Asheville, NC

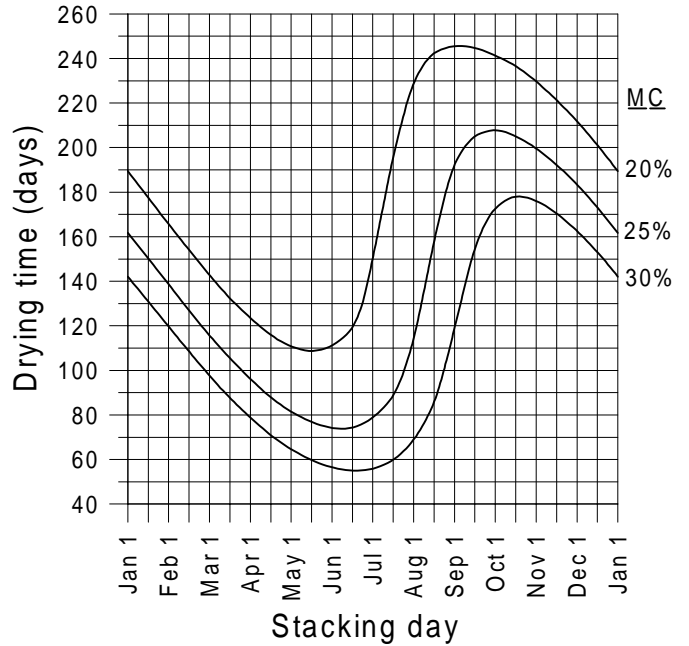




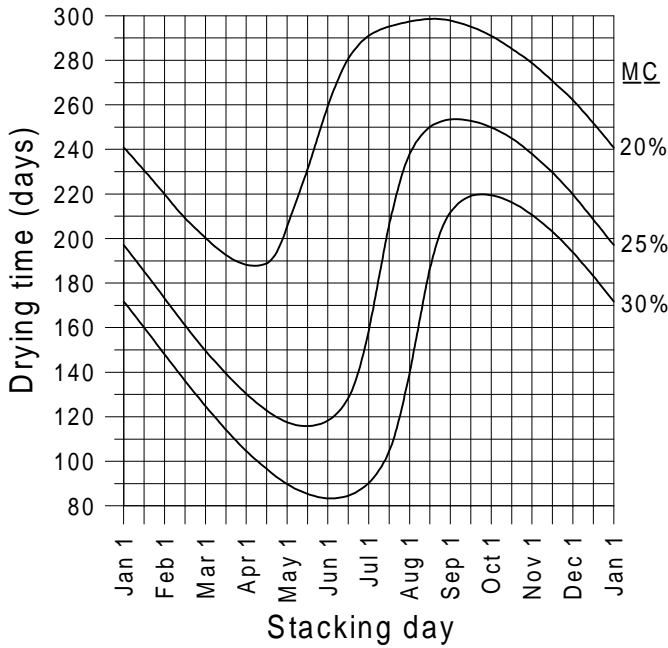
4/4 Northern red oak: Caribou, ME



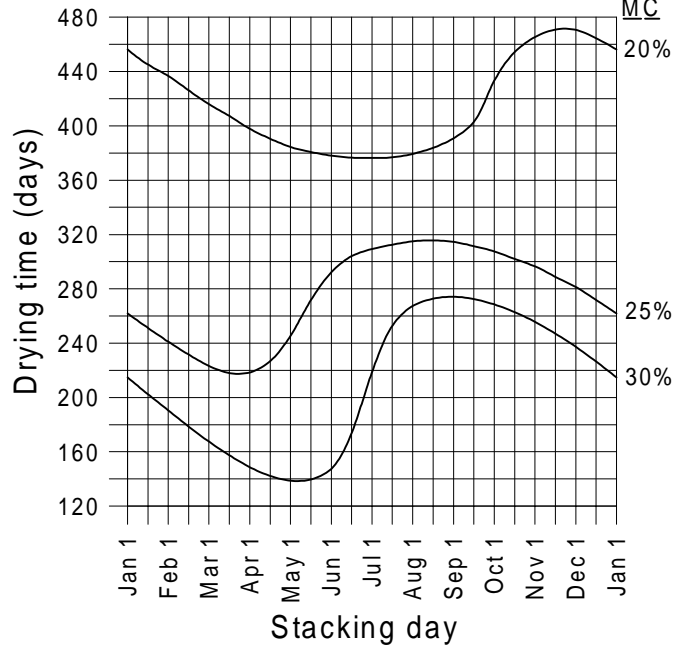
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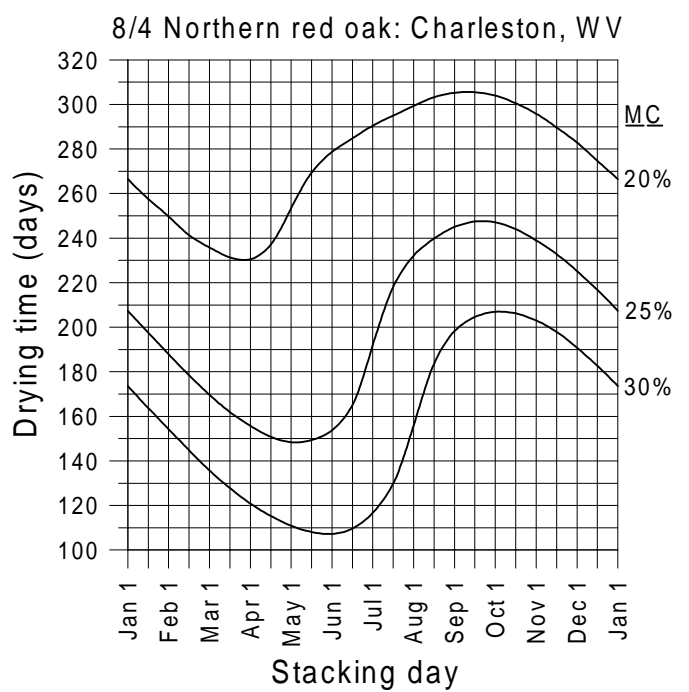
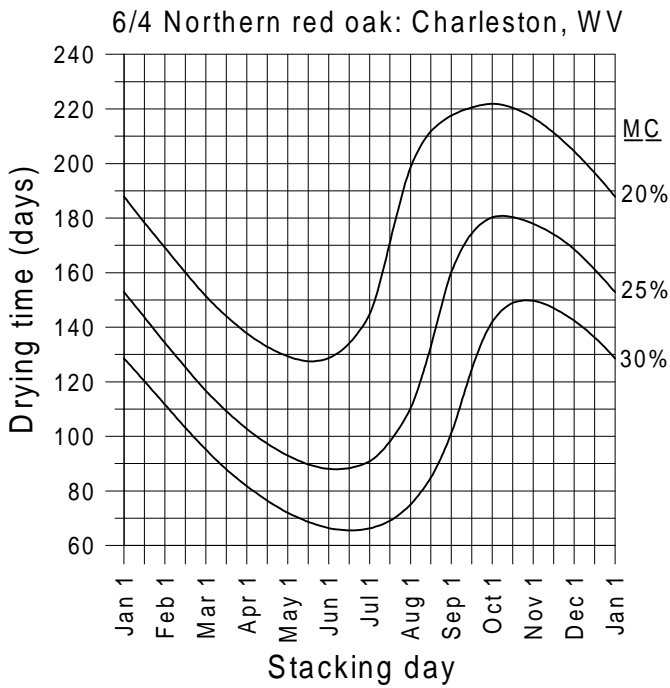
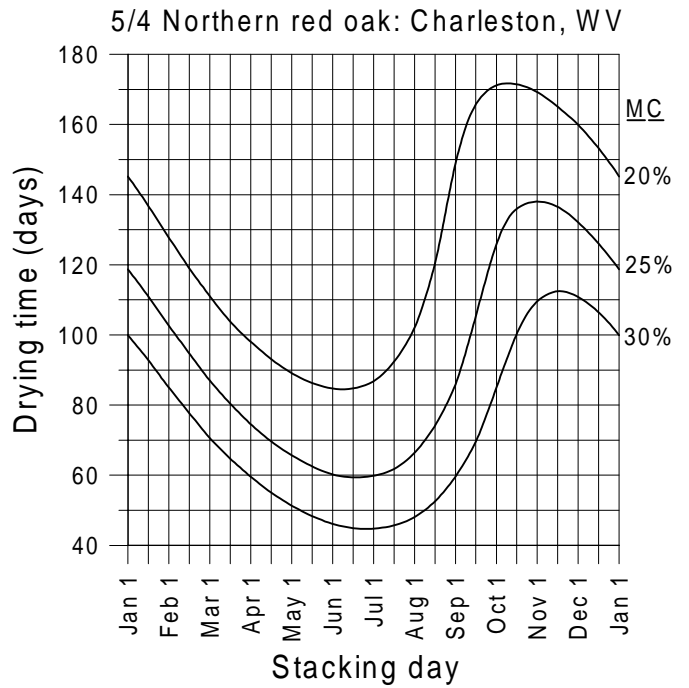
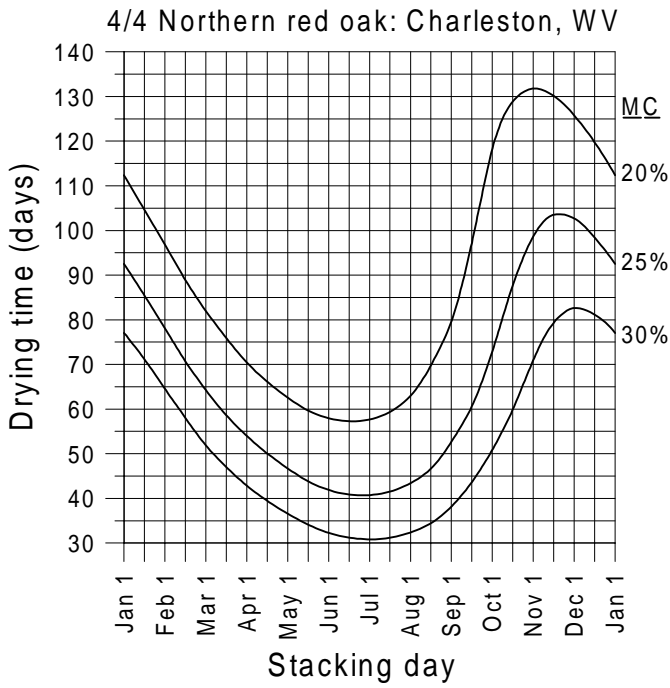


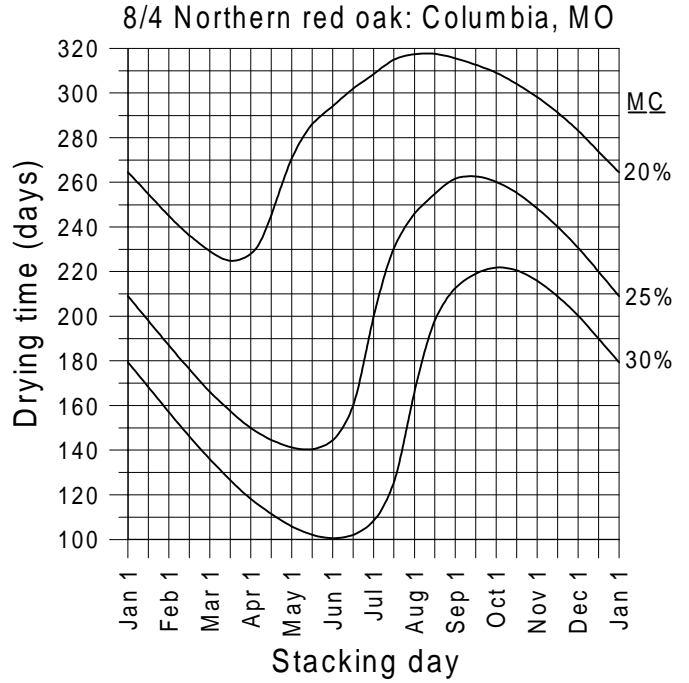
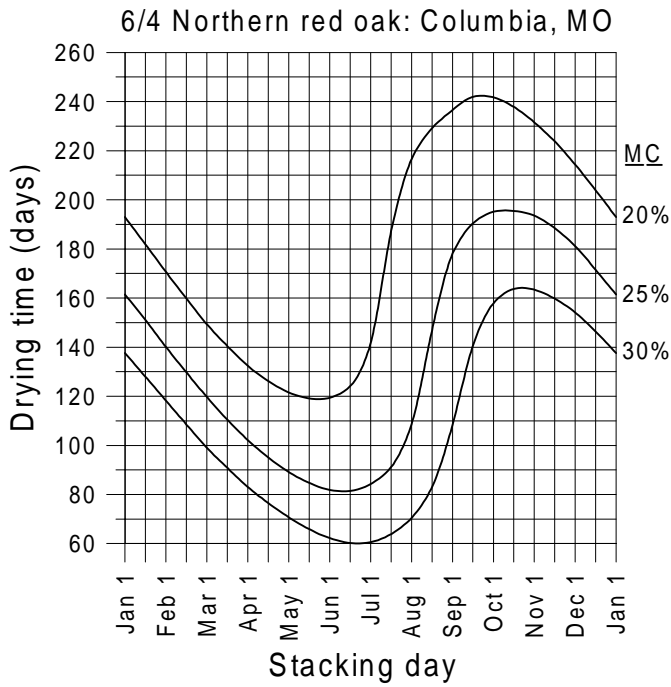
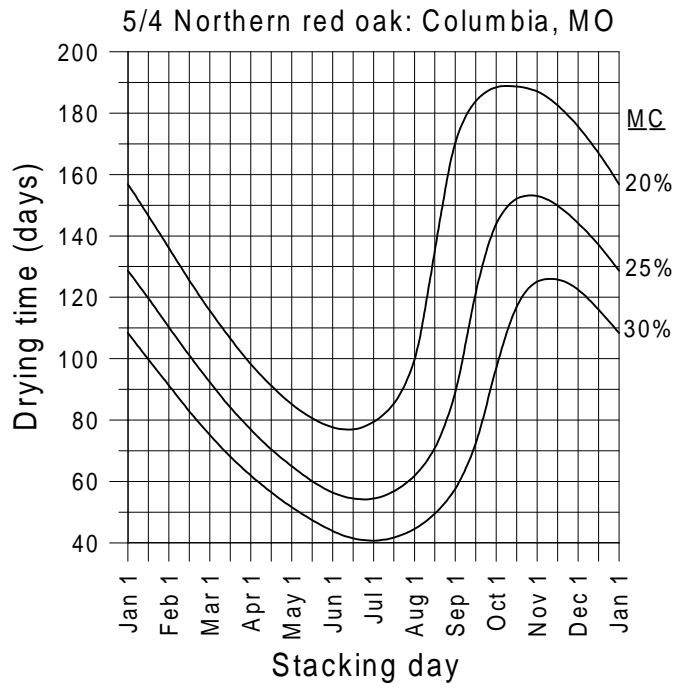
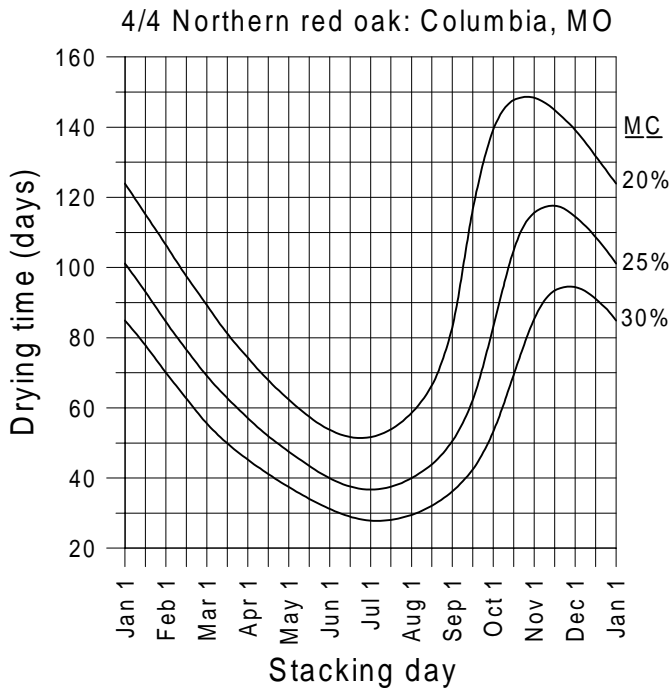
6/4 Northern red oak: Caribou, ME

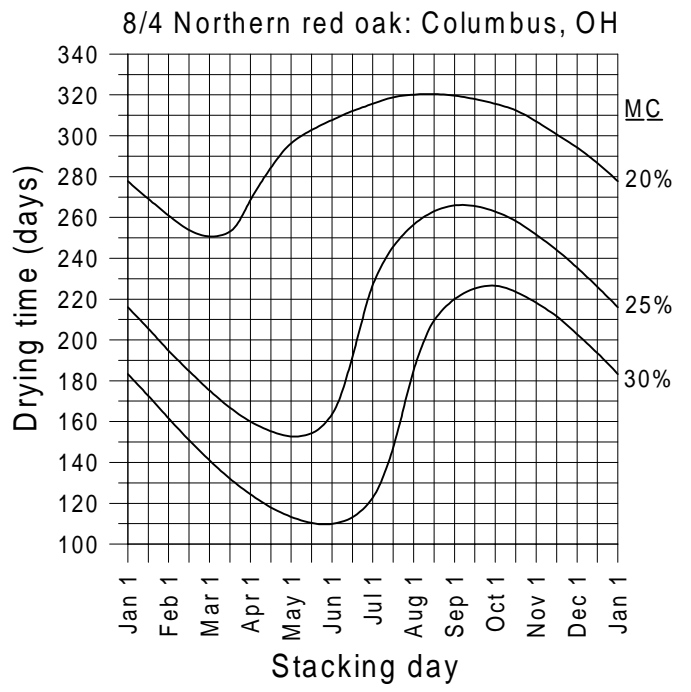
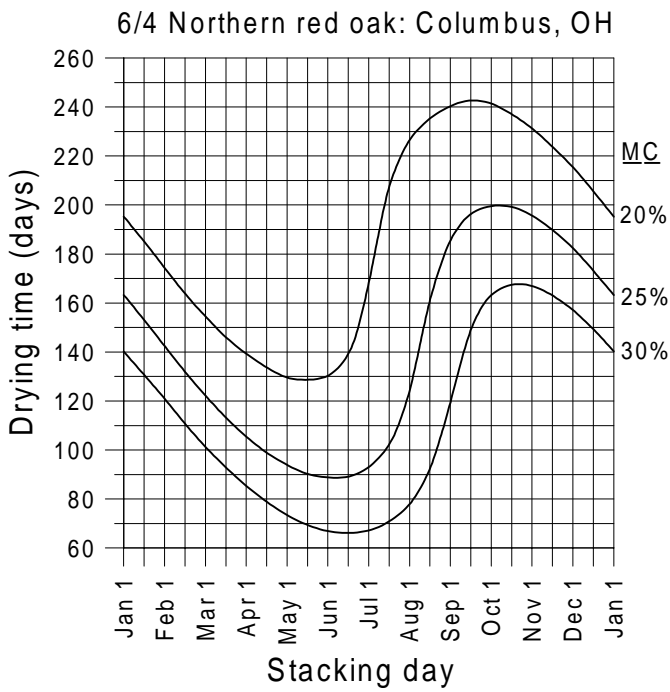
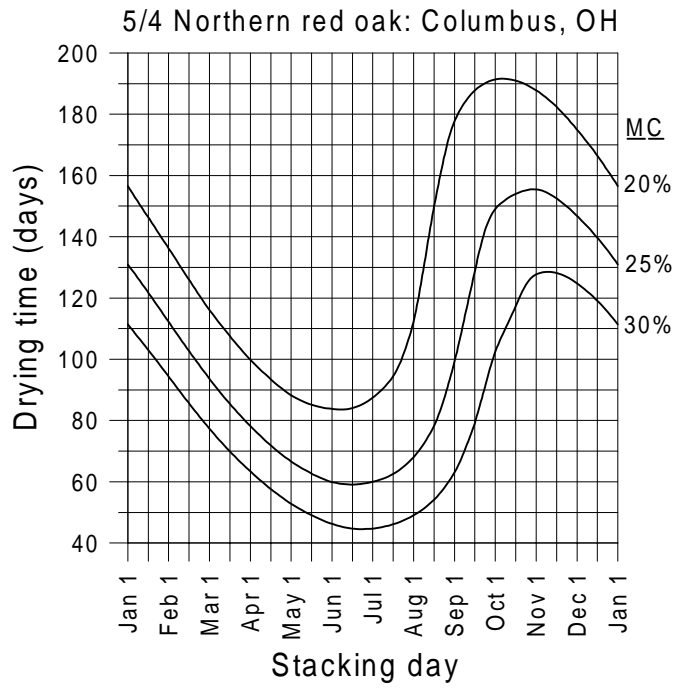
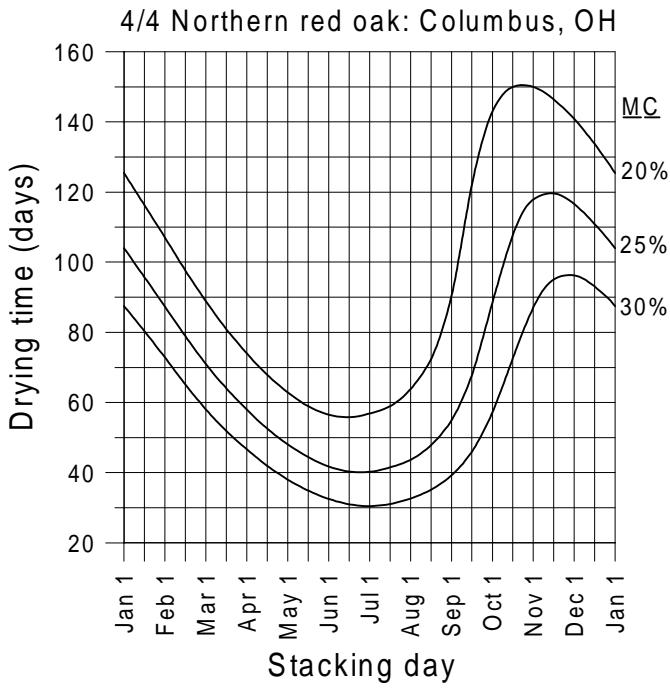


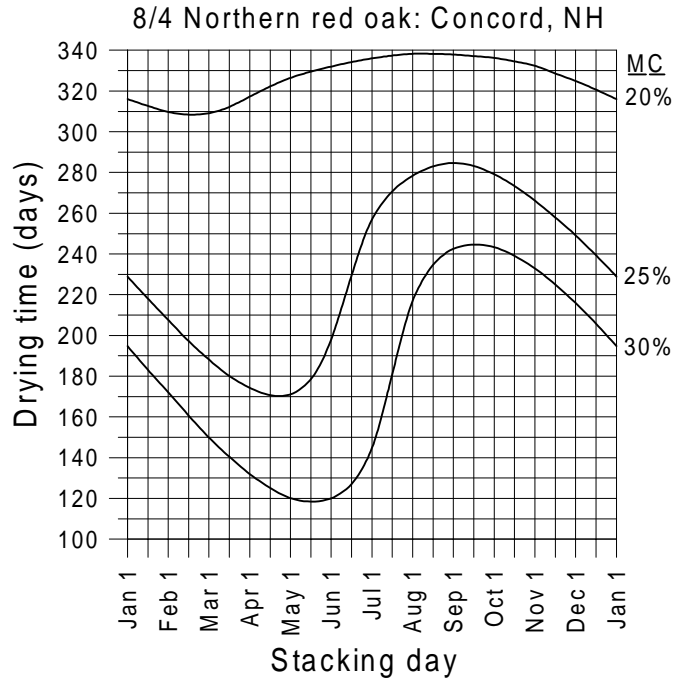
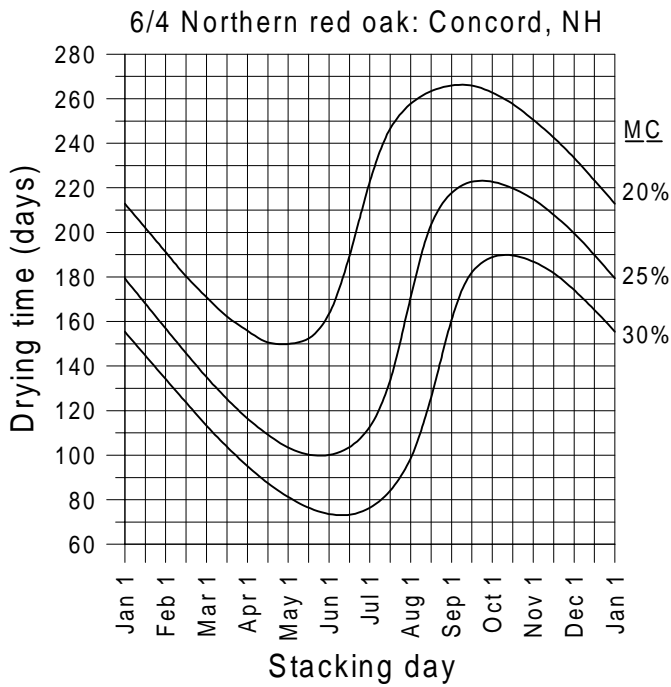
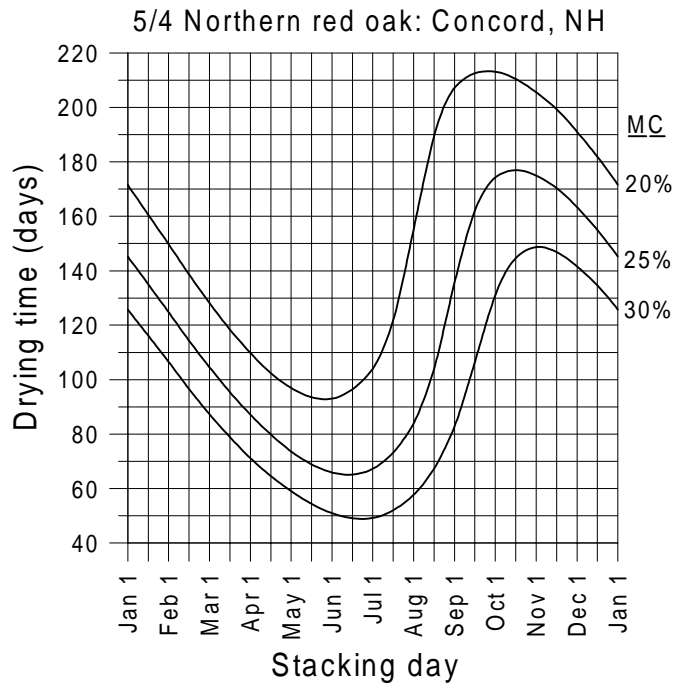
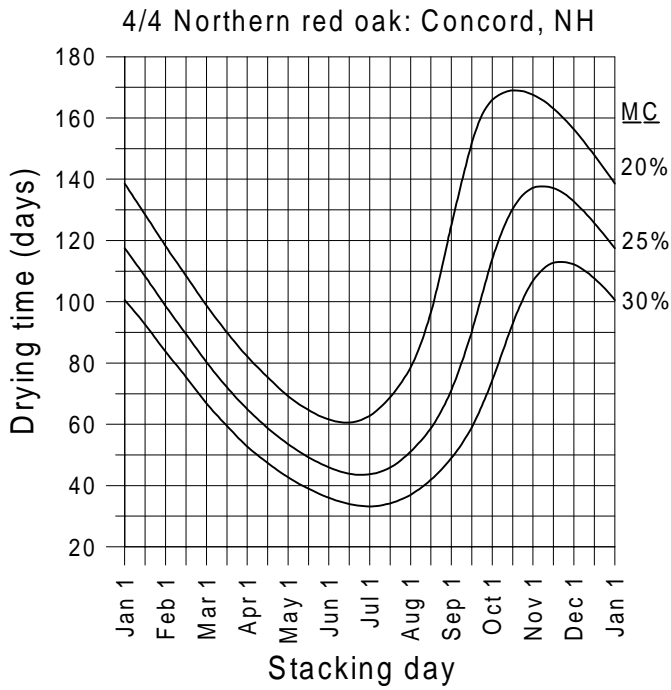
8/4 Northern red oak: Caribou, ME



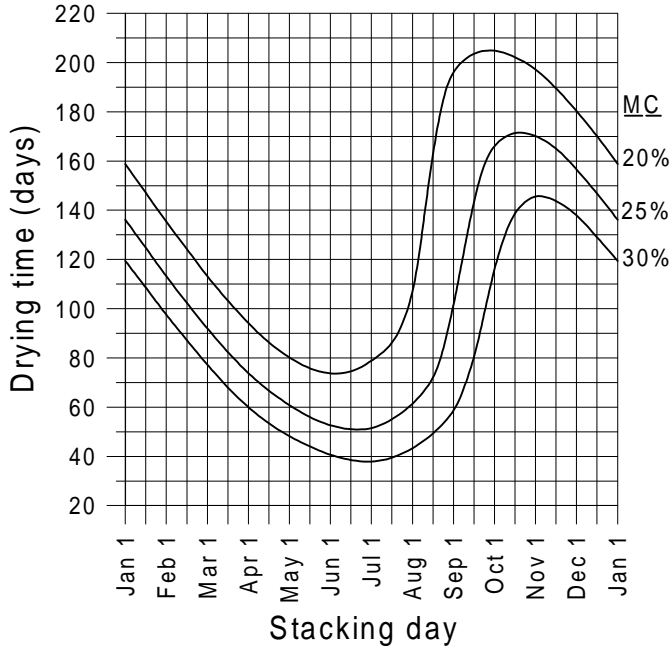




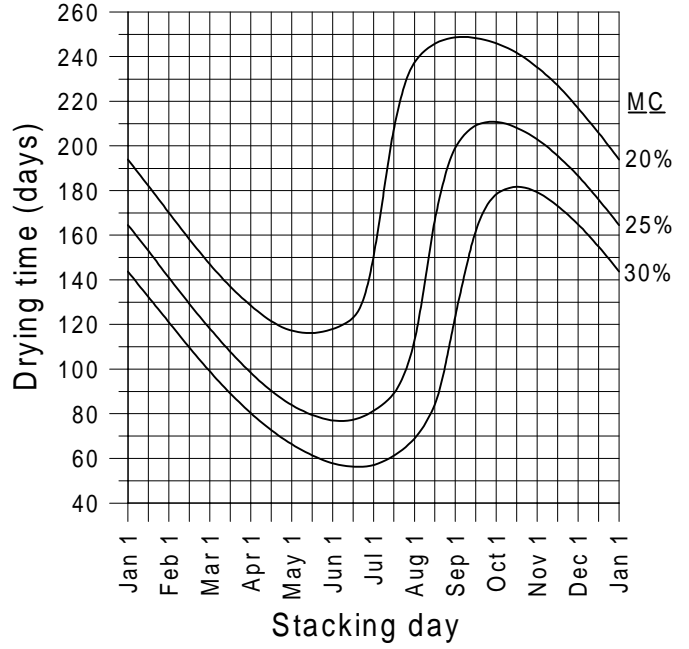




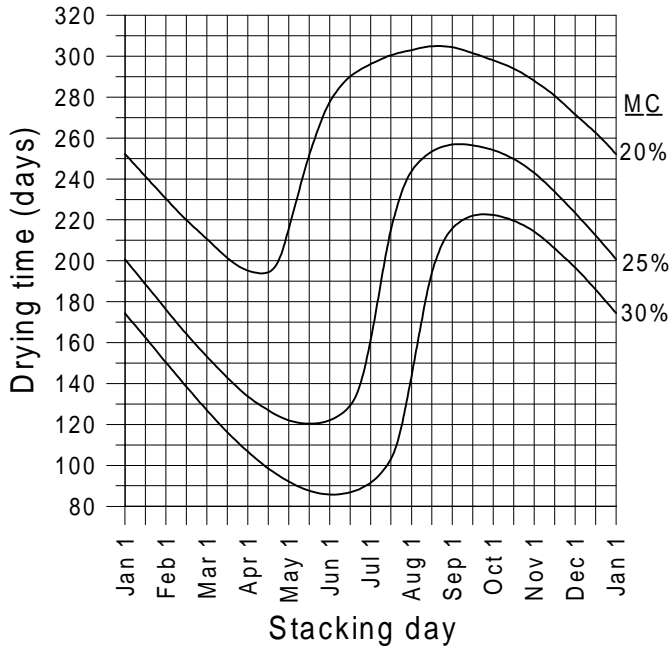
4/4 Northern red oak: Duluth, MN



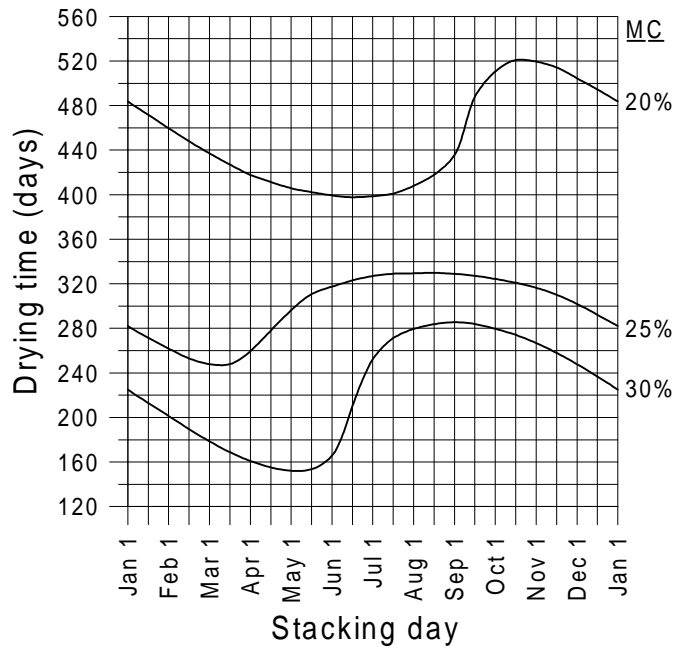
5/4 Northern red oak: Duluth, MN



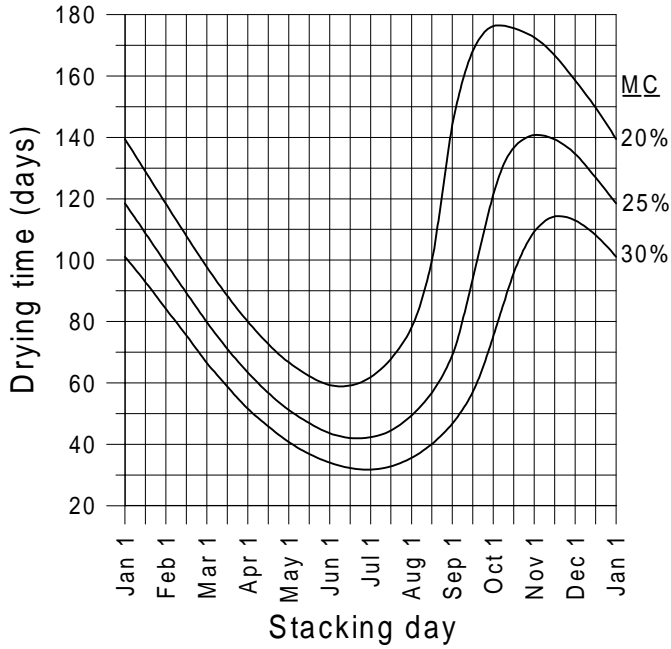
6/4 Northern red oak: Duluth, MN



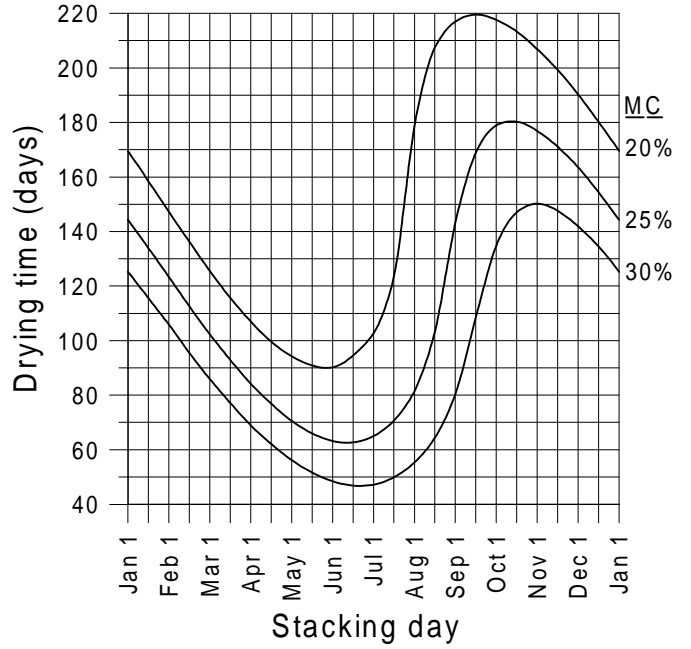
8/4 Northern red oak: Duluth, MN



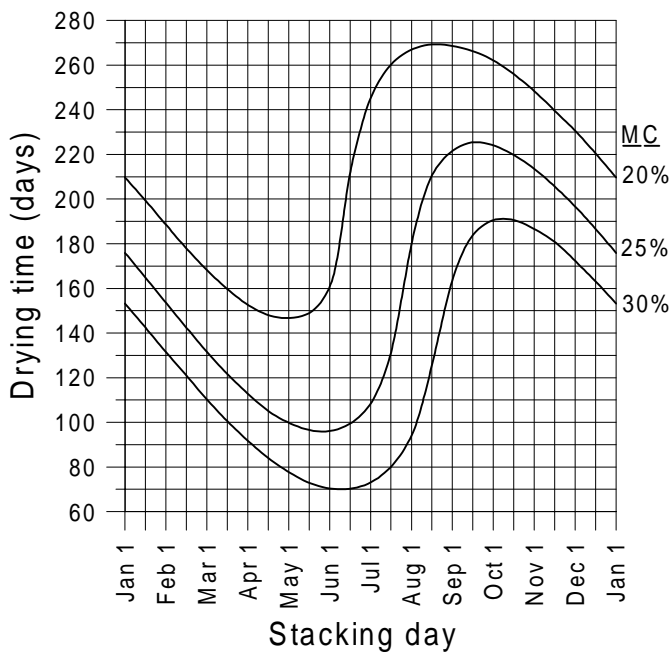
4/4 Northern red oak: Grand Rapids, MI



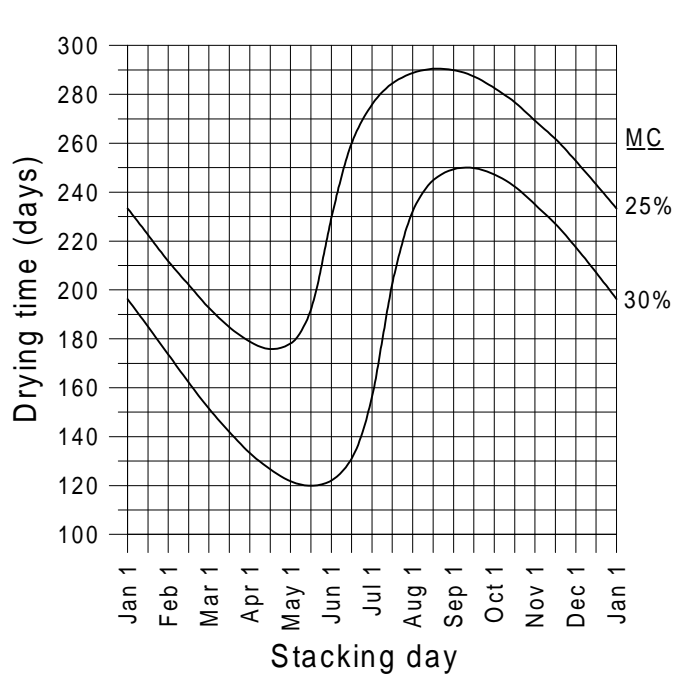
5/4 Northern red oak: Grand Rapids, MI

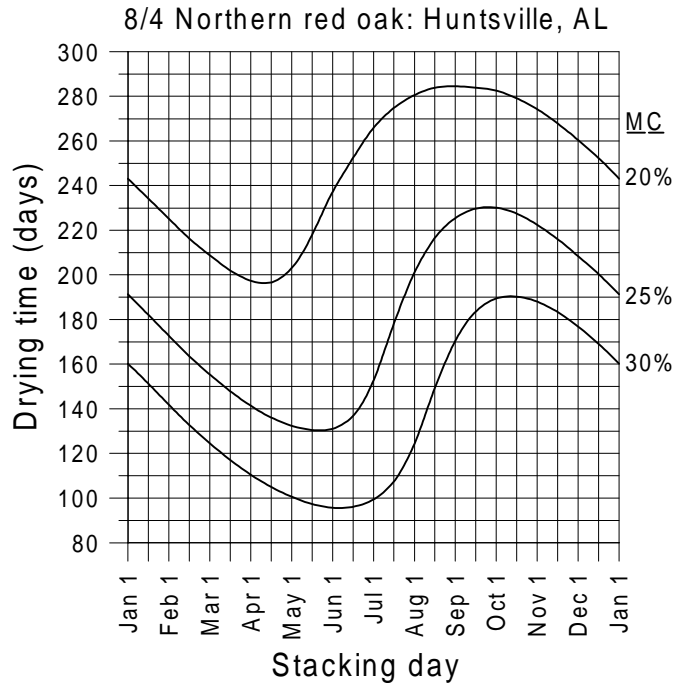
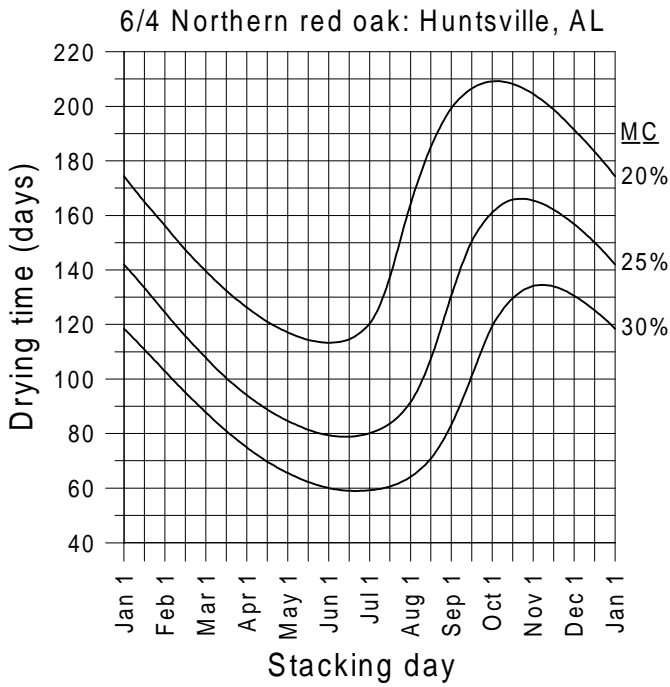
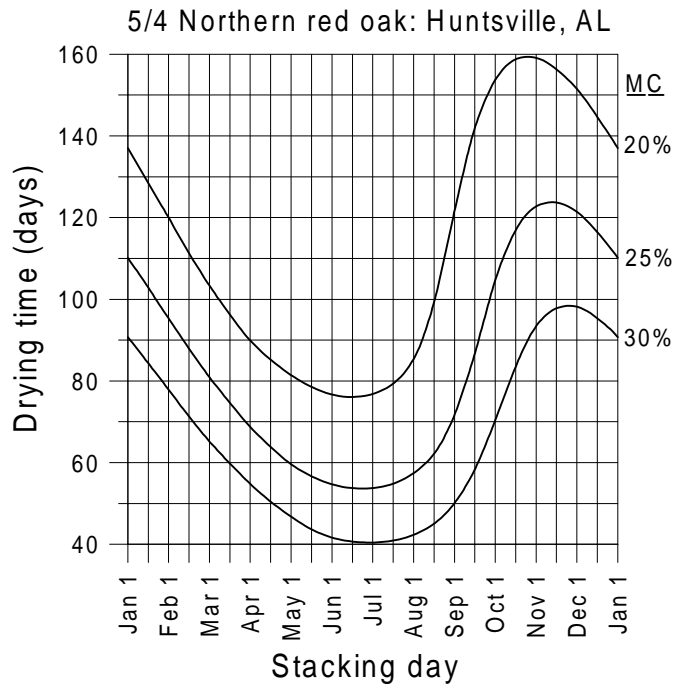
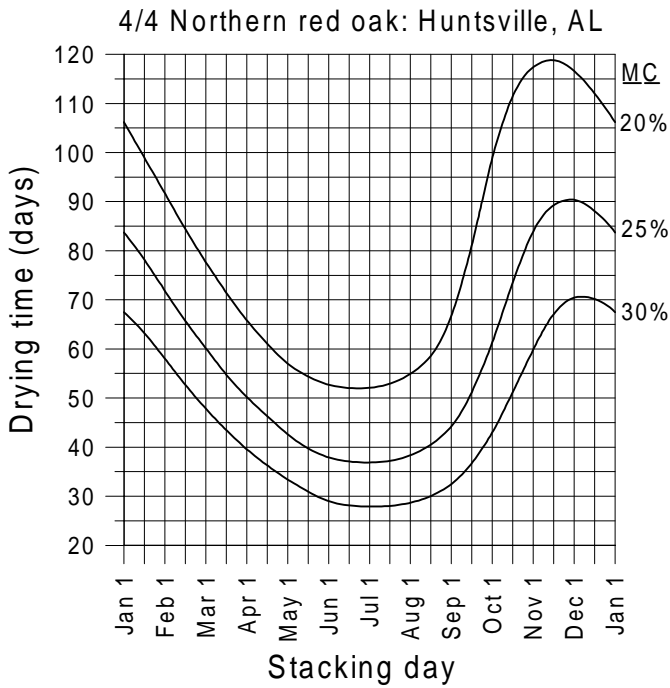


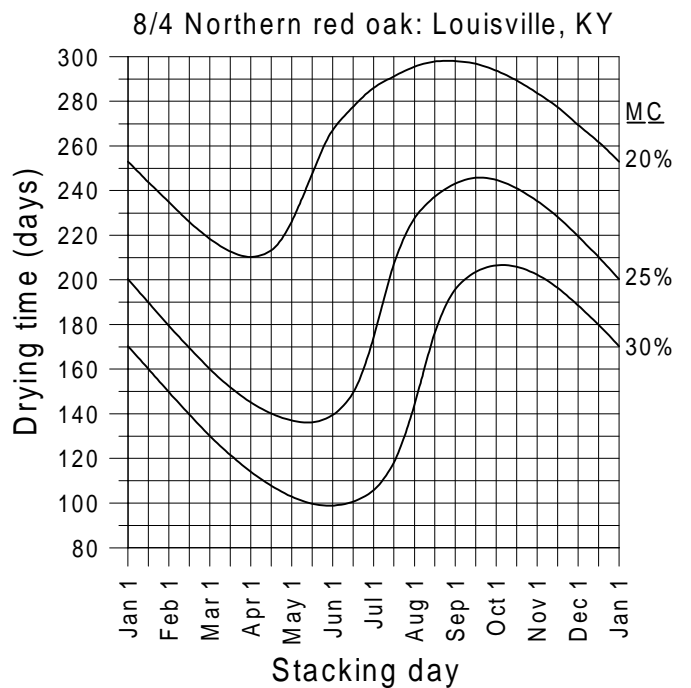
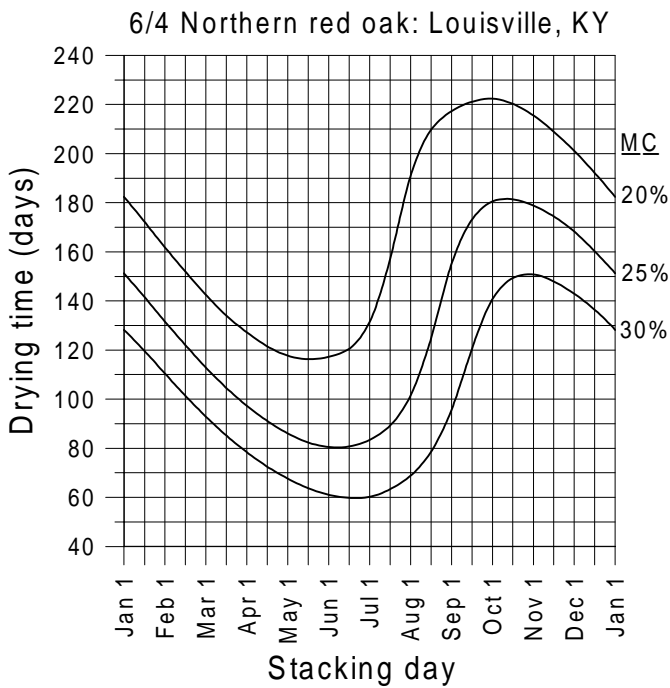
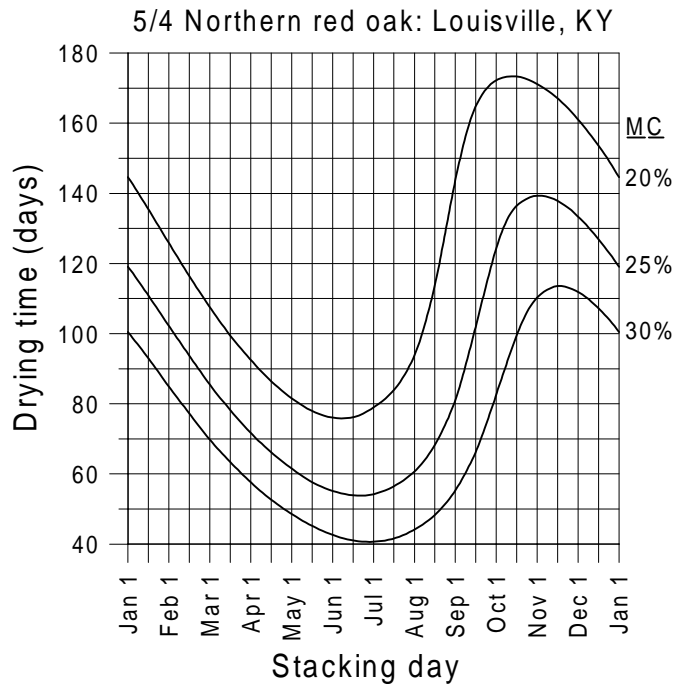
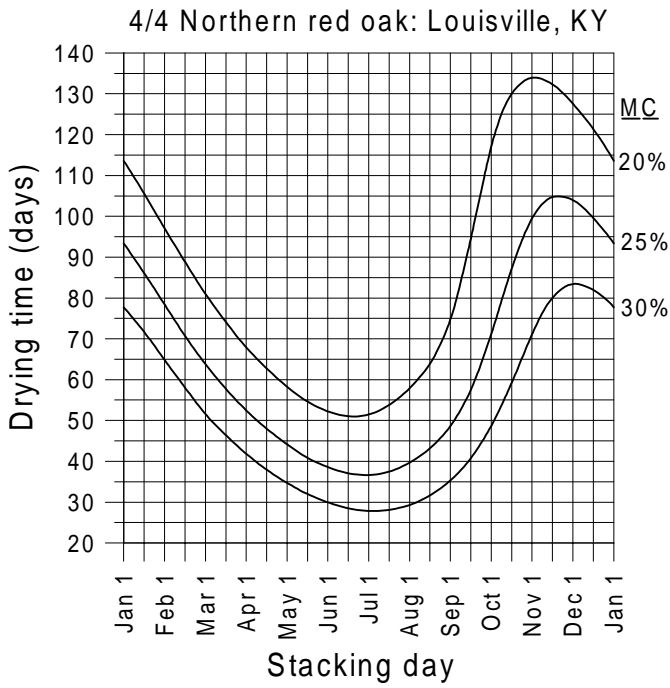
6/4 Northern red oak: Grand Rapids, MI

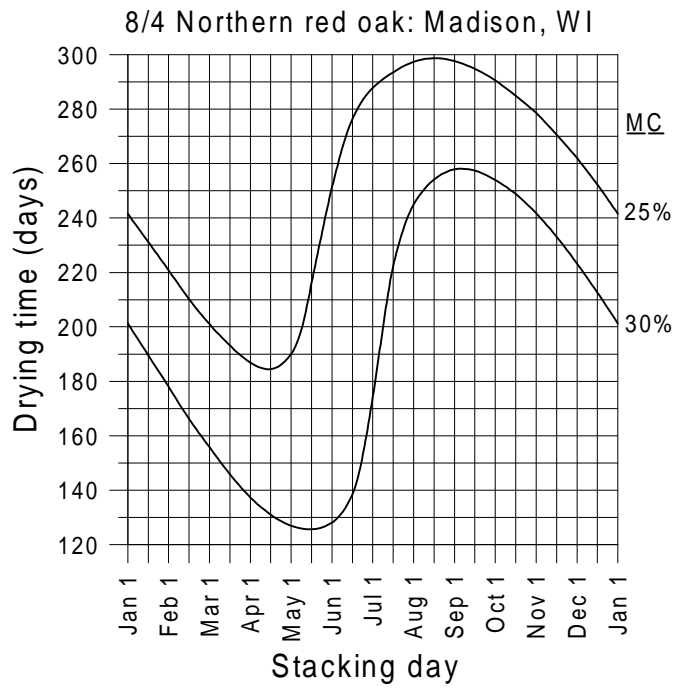
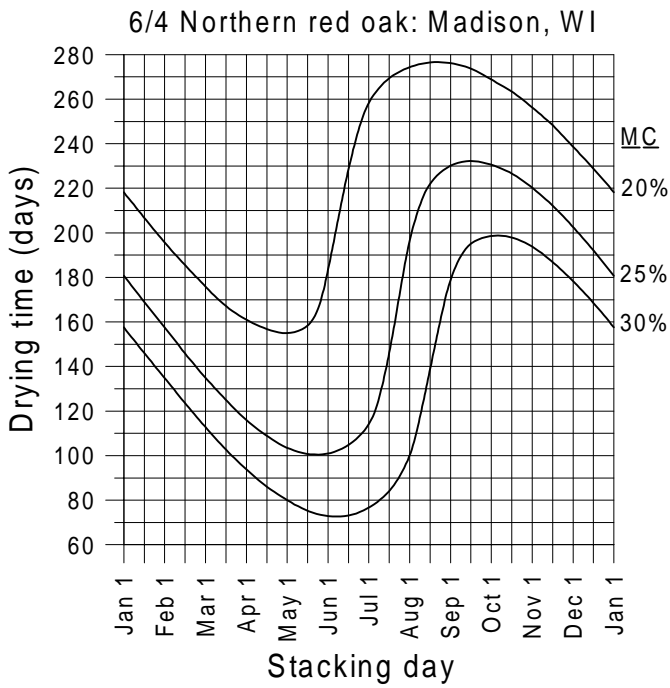
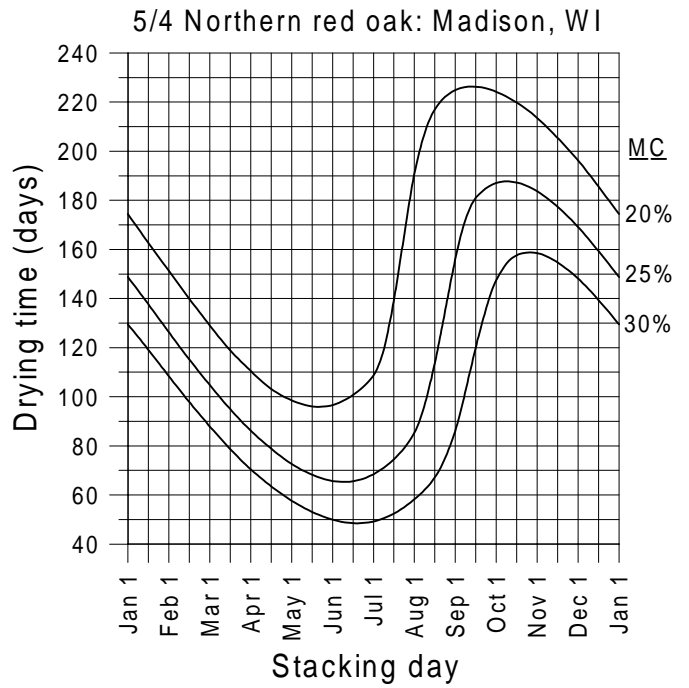
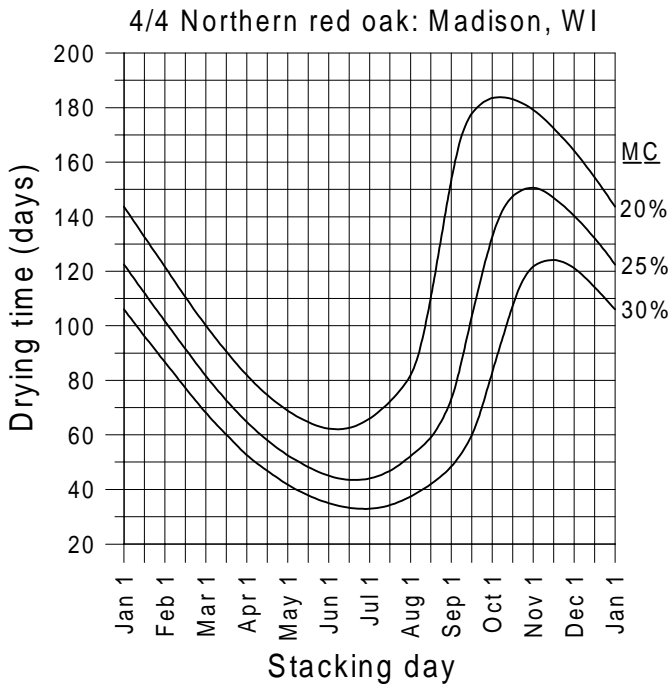


8/4 Northern red oak: Grand Rapids, MI

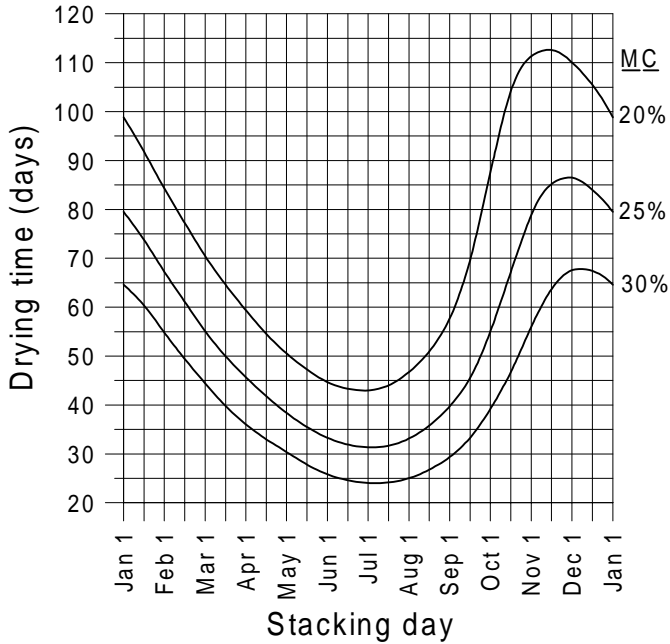




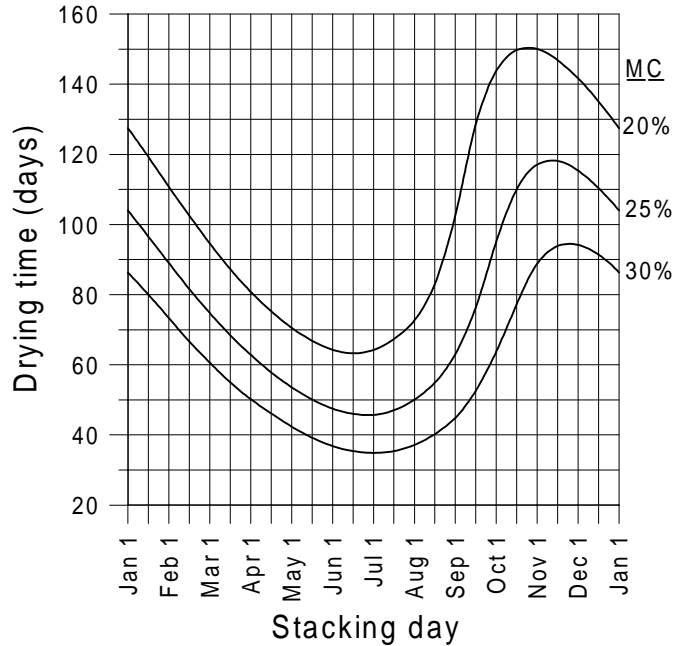




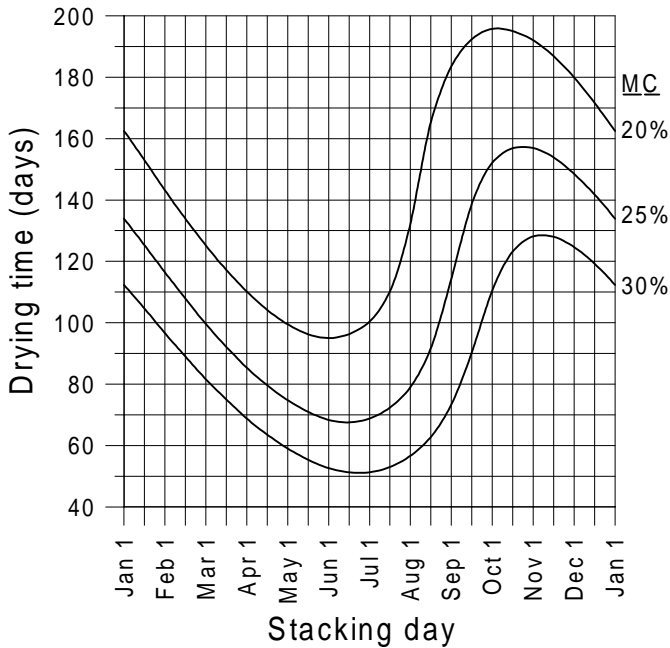
4/4 Northern red oak: Memphis, TN



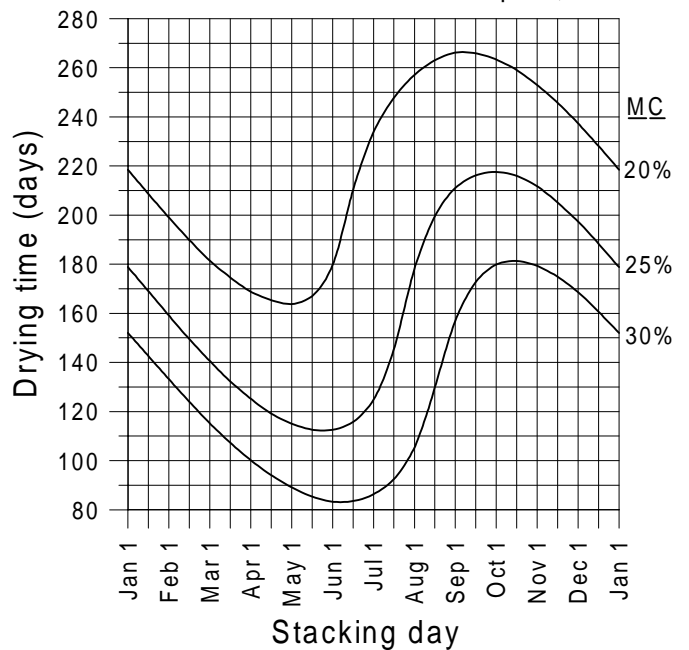
5/4 Northern red oak: Memphis, TN



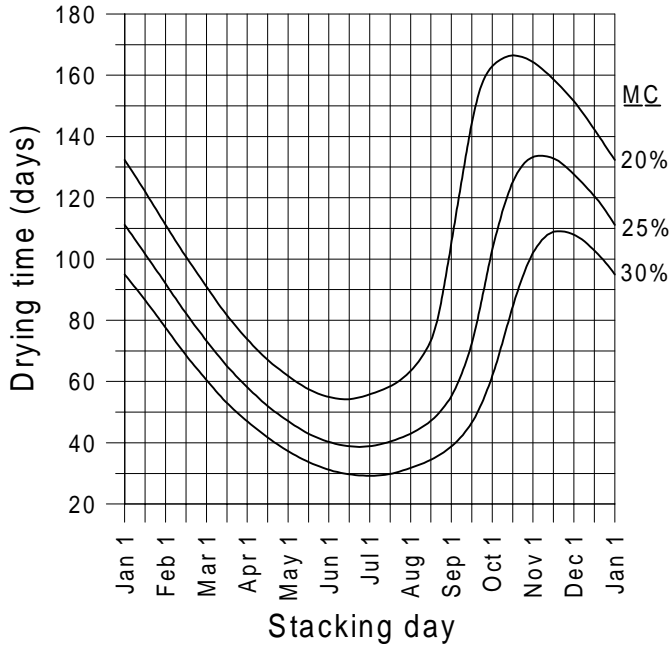
6/4 Northern red oak: Memphis, TN



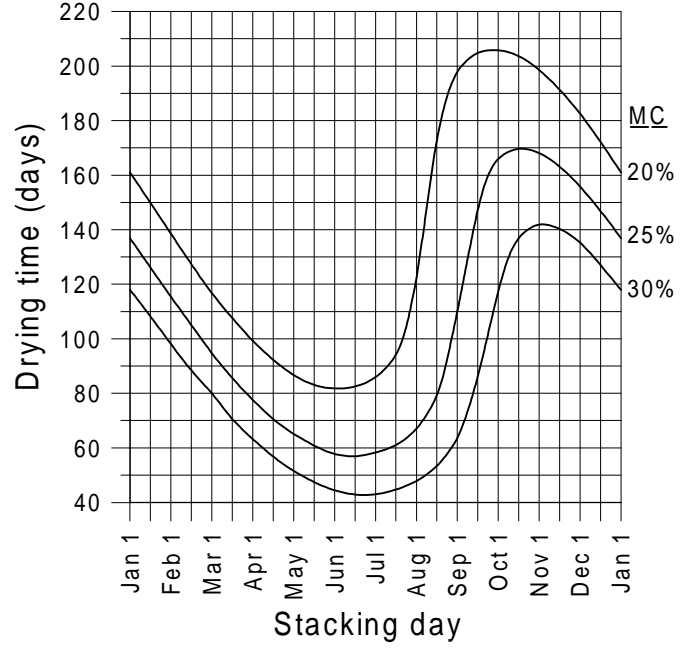
8/4 Northern red oak: Memphis, TN



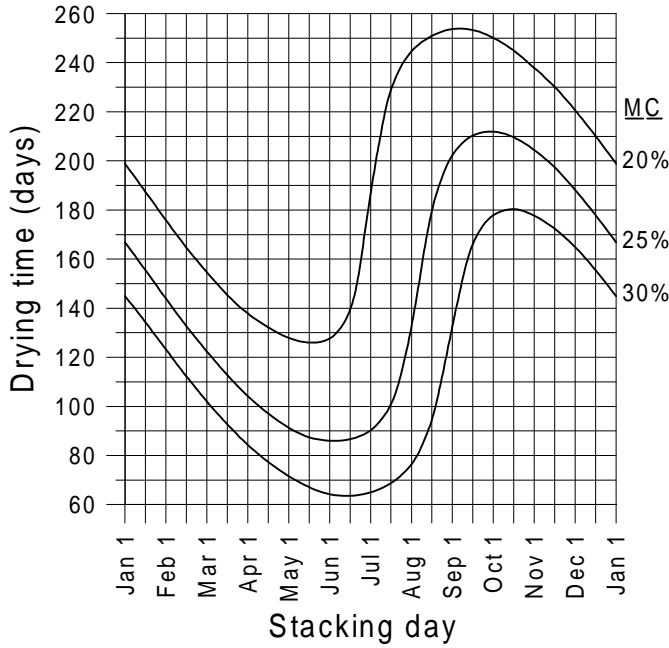
4/4 Northern red oak: Peoria, IL



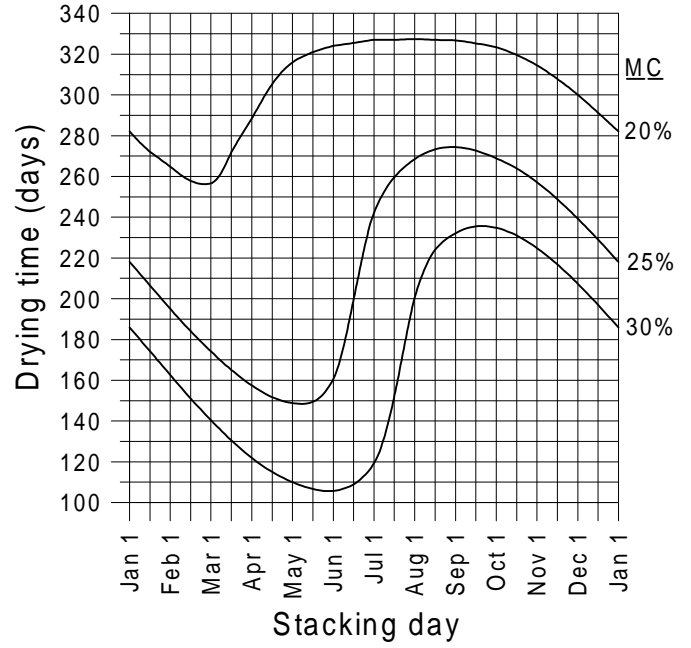
5/4 Northern red oak: Peoria, IL

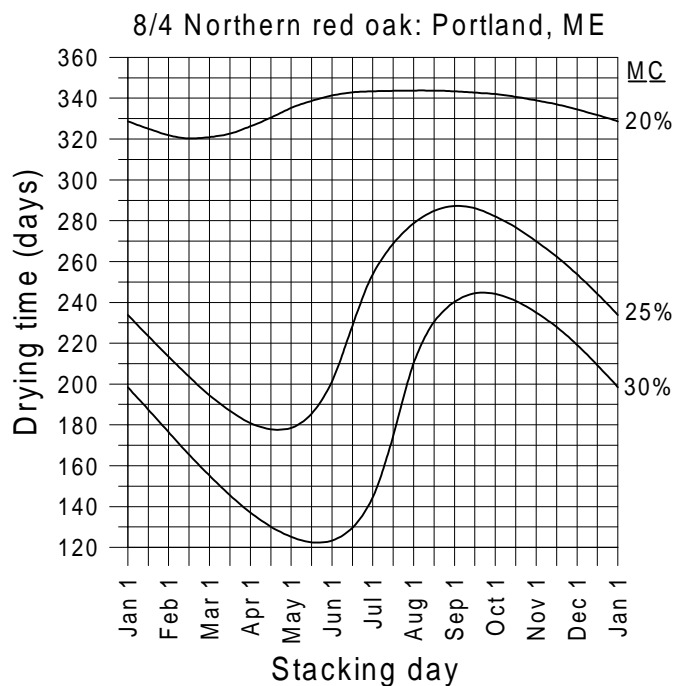
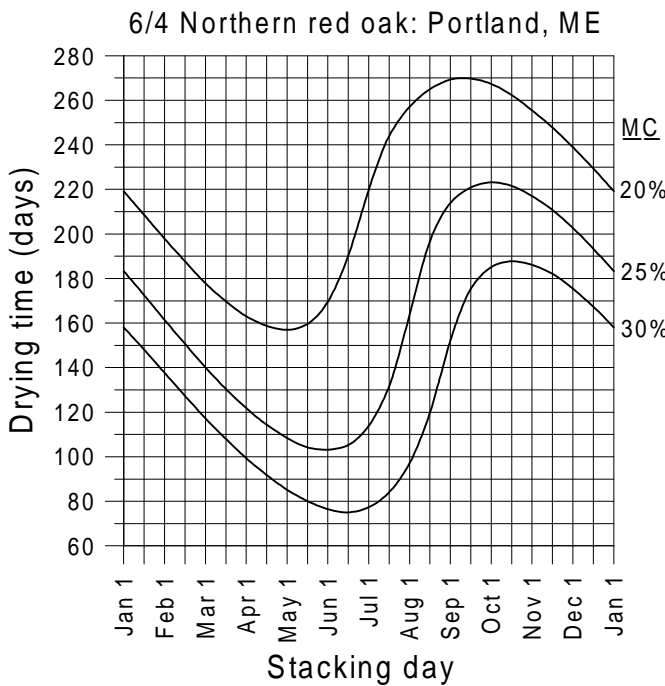
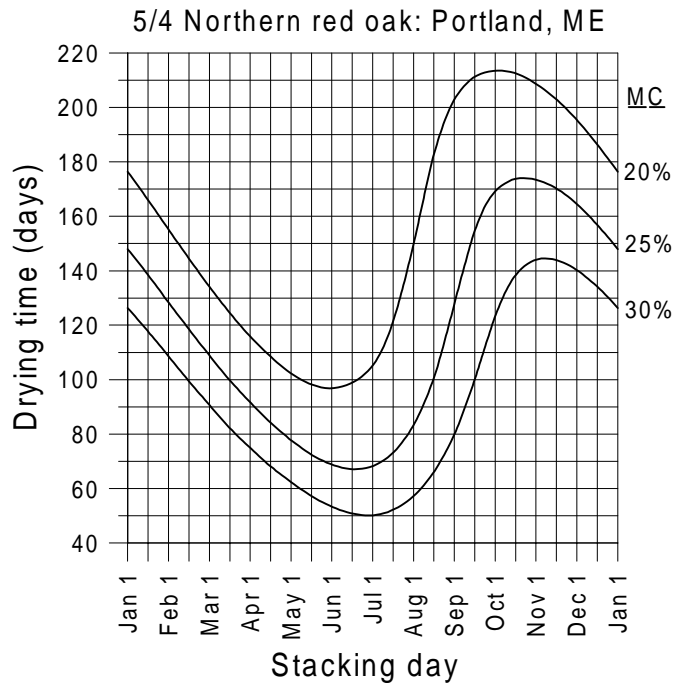
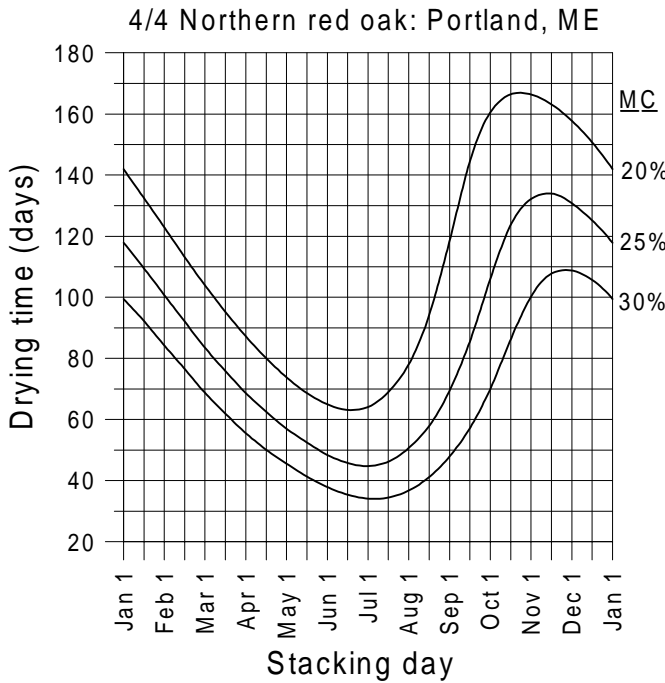


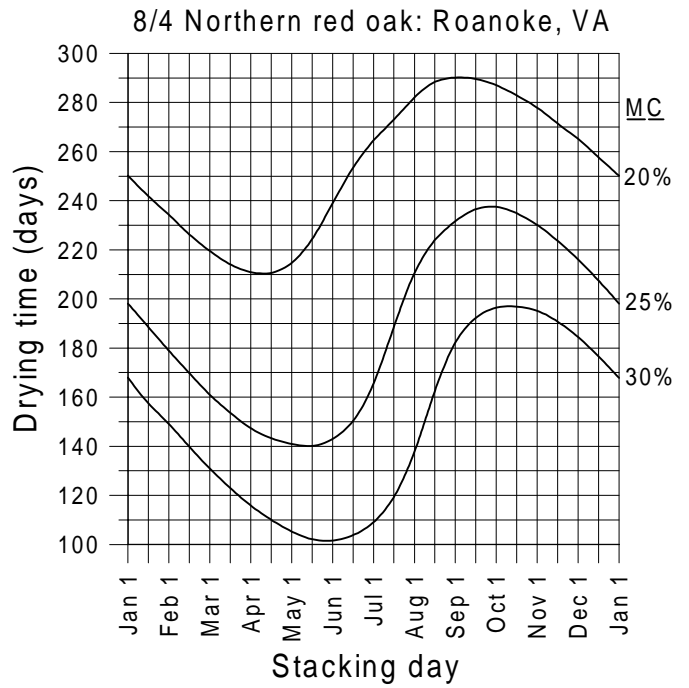
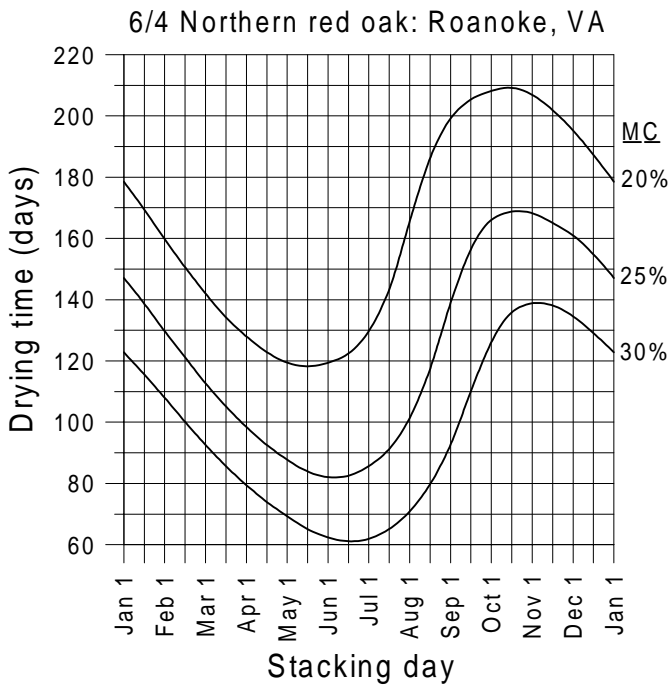
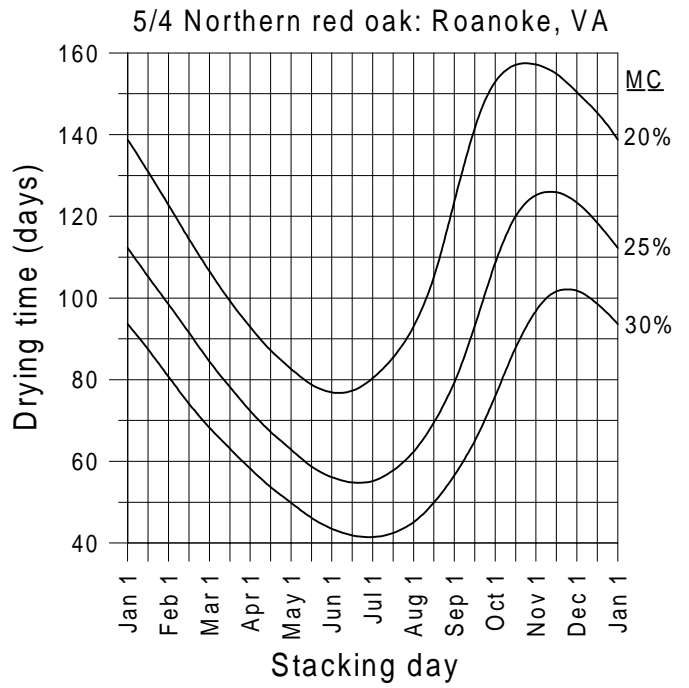
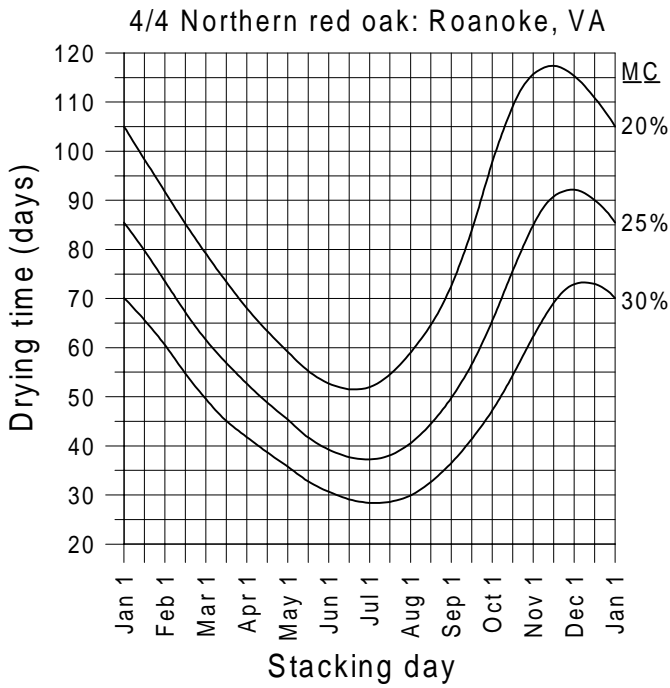
6/4 Northern red oak: Peoria, IL



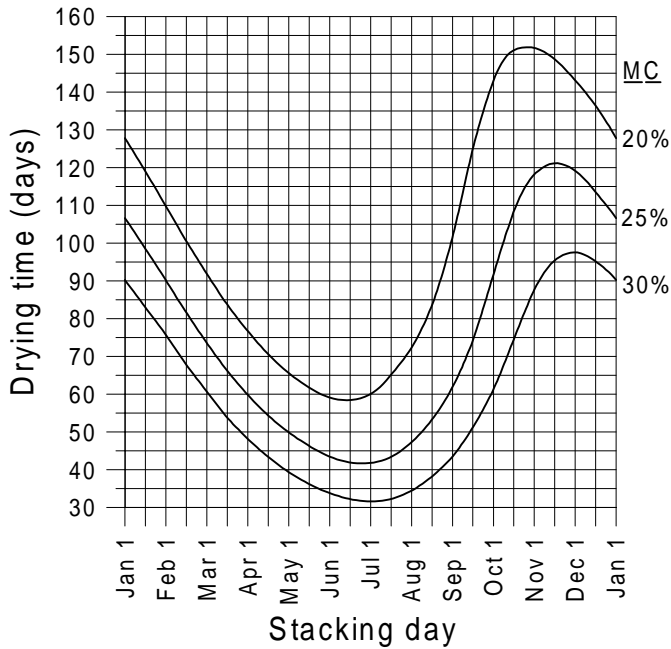
8/4 Northern red oak: Peoria, IL



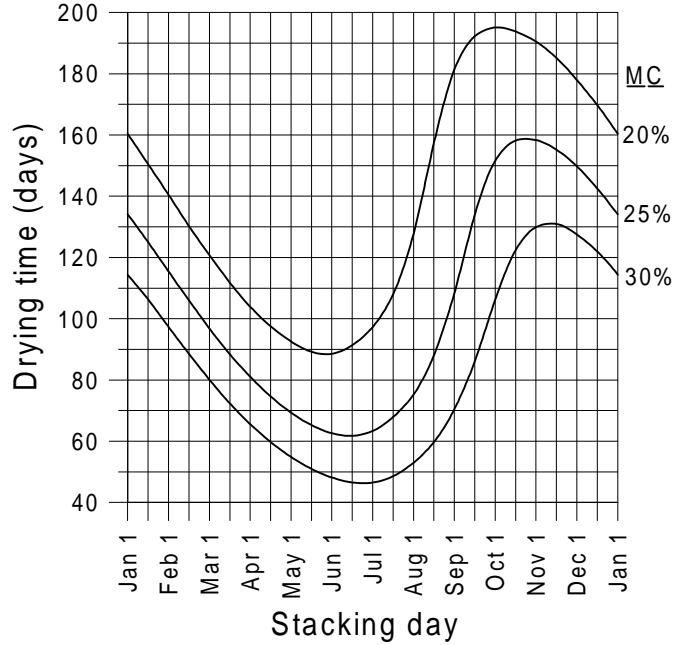




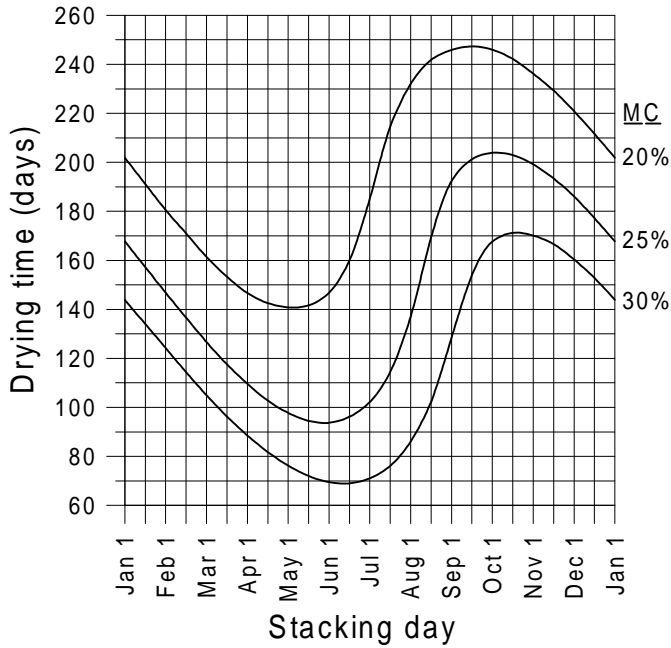
4/4 Northern red oak: Williamsport, PA



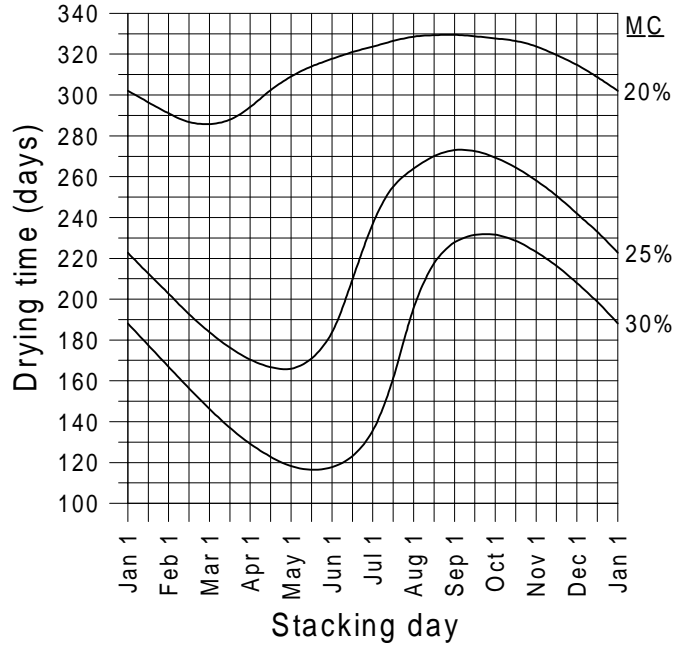
5/4 Northern red oak: Williamsport, PA



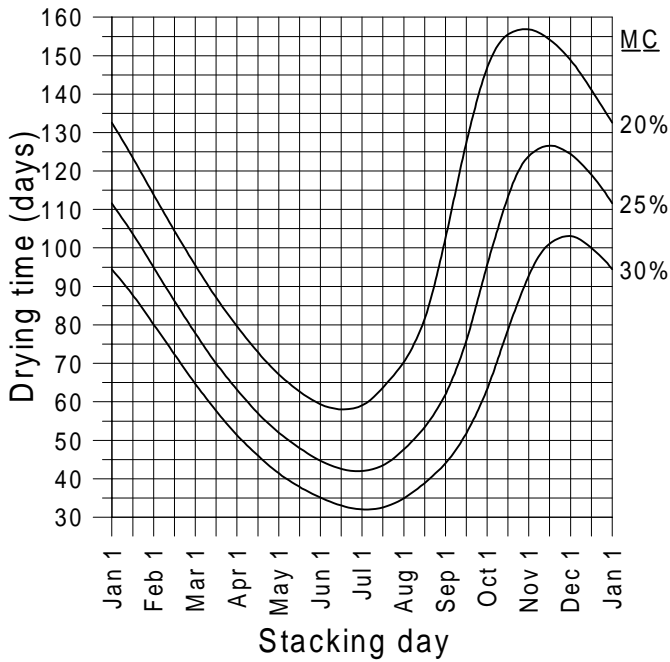
6/4 Northern red oak: Williamsport, PA



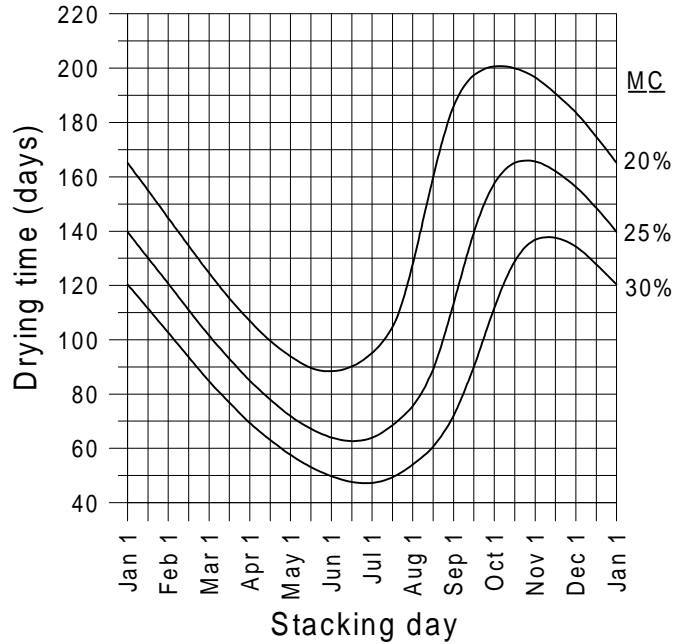
8/4 Northern red oak: Williamsport, PA



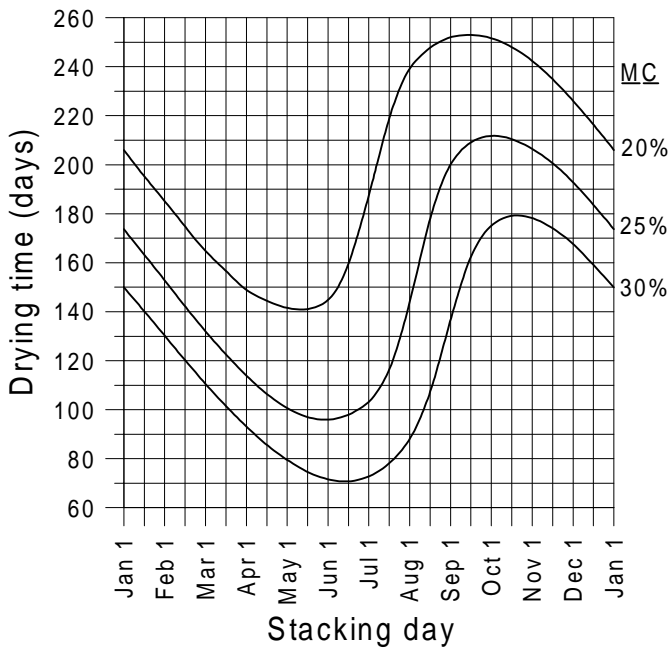
4/4 Northern red oak: Worcester, MA



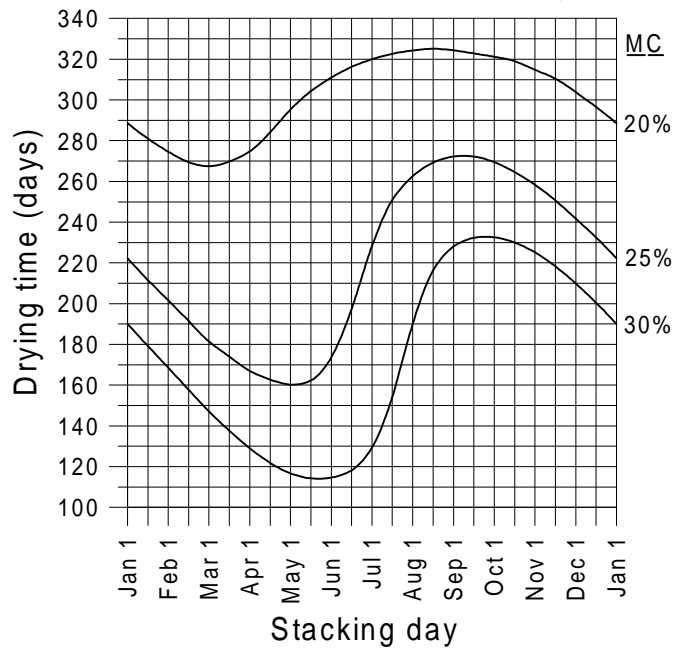
5/4 Northern red oak: Worcester, MA



6/4 Northern red oak: Worcester, MA

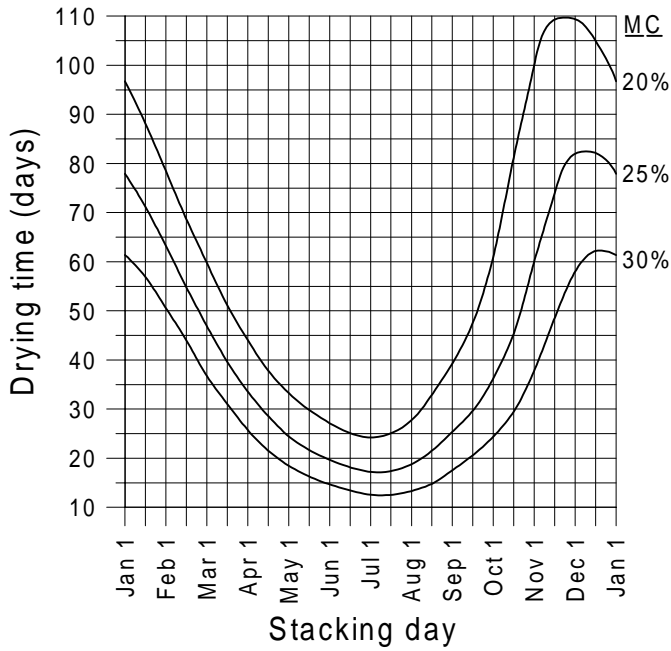


8/4 Northern red oak: Worcester, MA

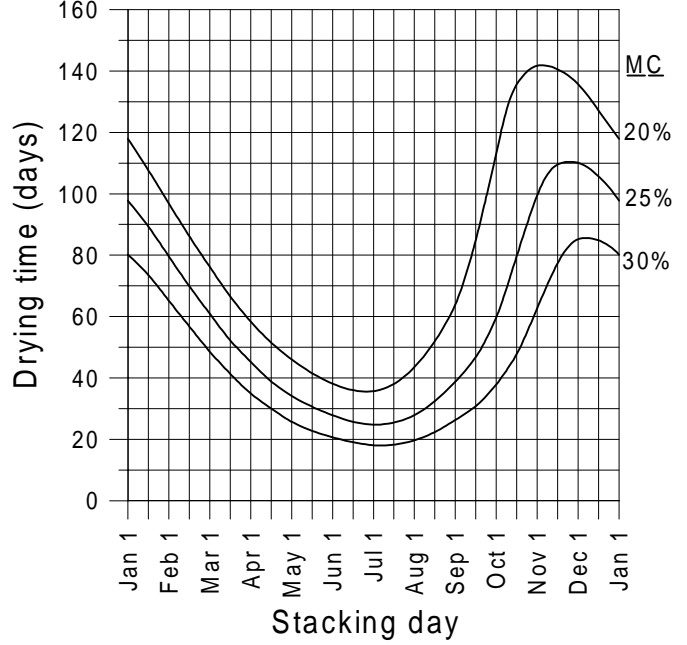


Sugar Maple

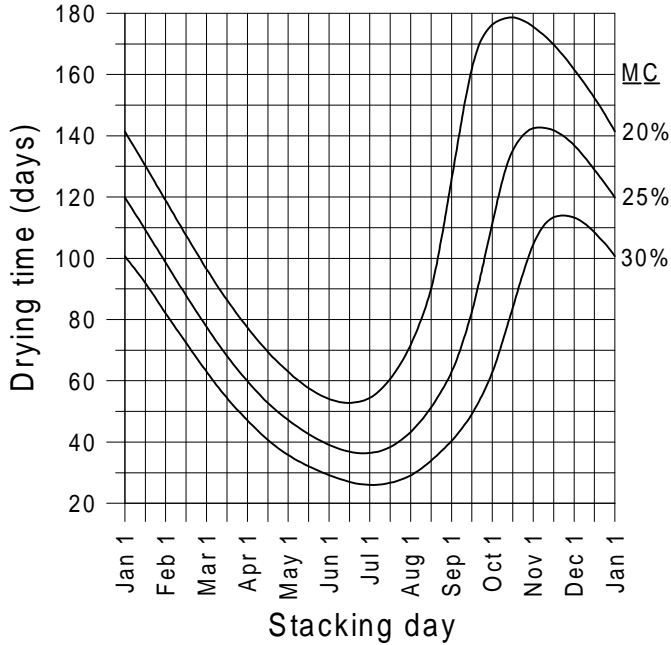
4/4 Sugar maple: Burlington, VT



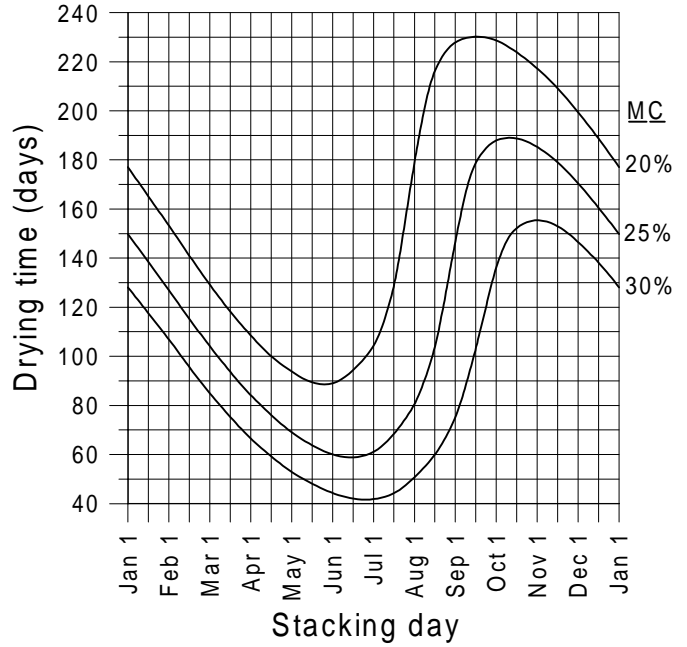
5/4 Sugar maple: Burlington, VT



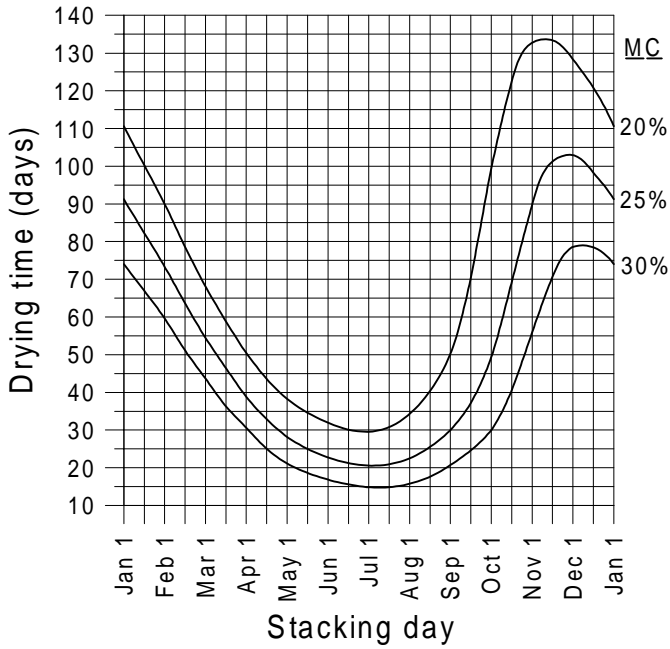
6/4 Sugar maple: Burlington, VT



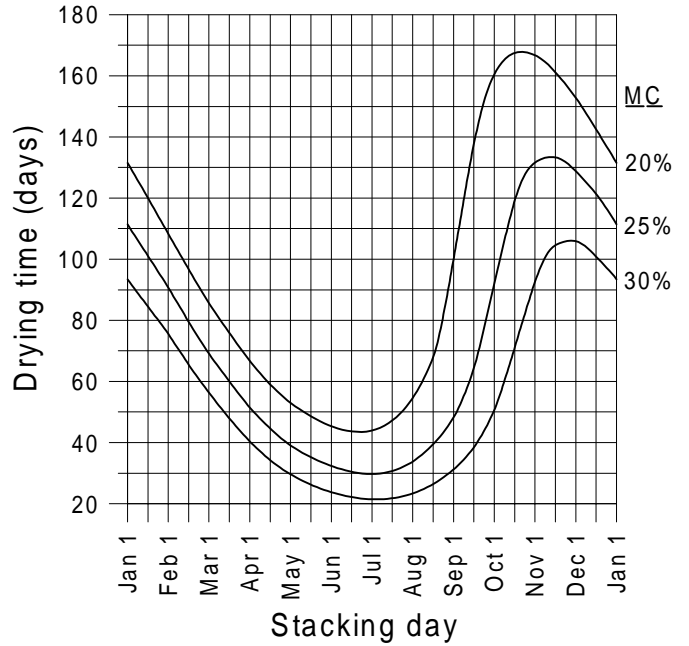
8/4 Sugar maple: Burlington, VT



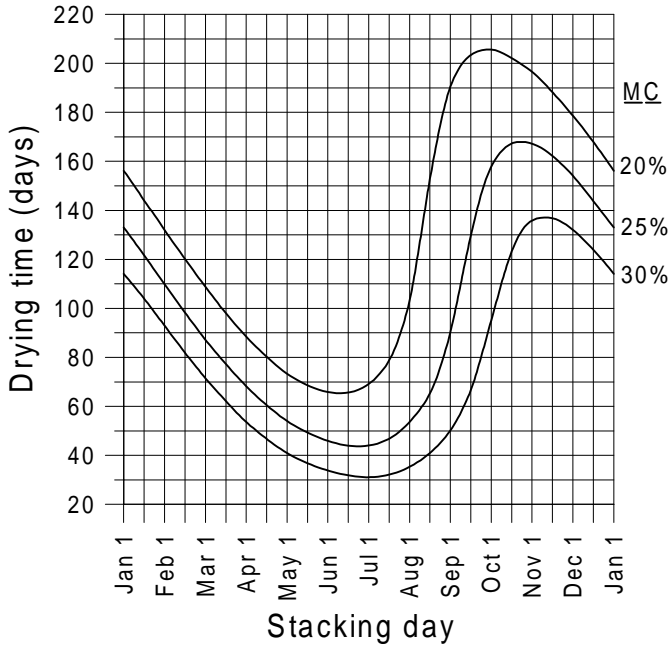
4/4 Sugar maple: Caribou, ME



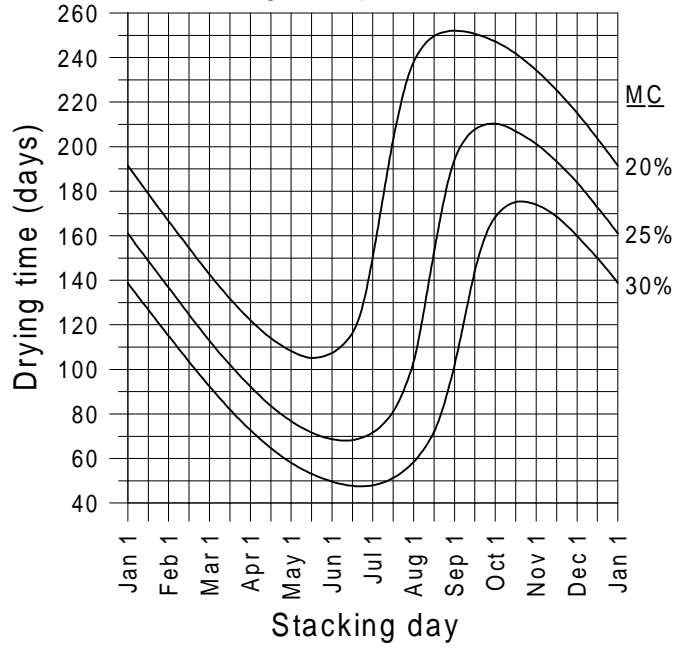
5/4 Sugar maple: Caribou, ME

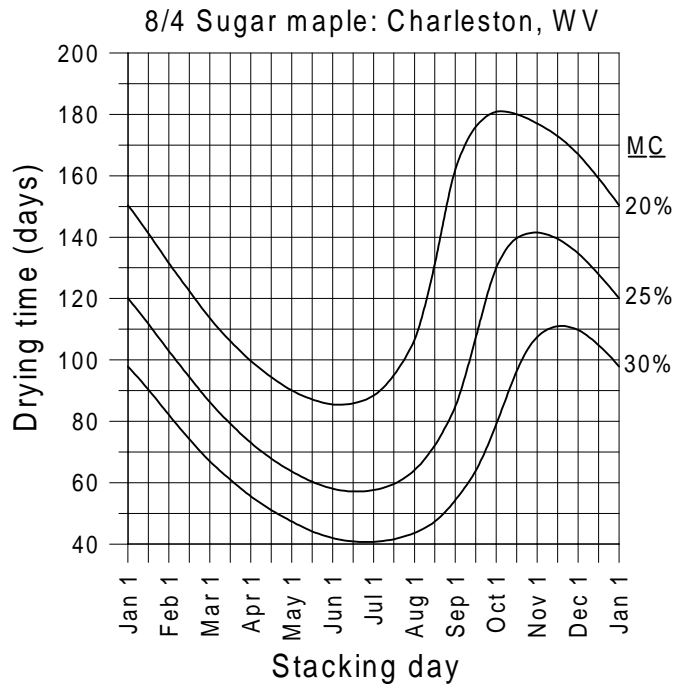
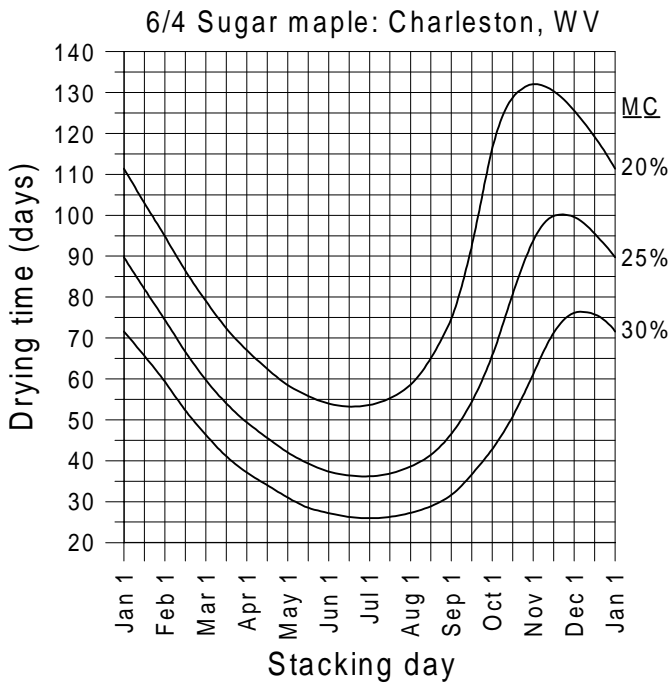
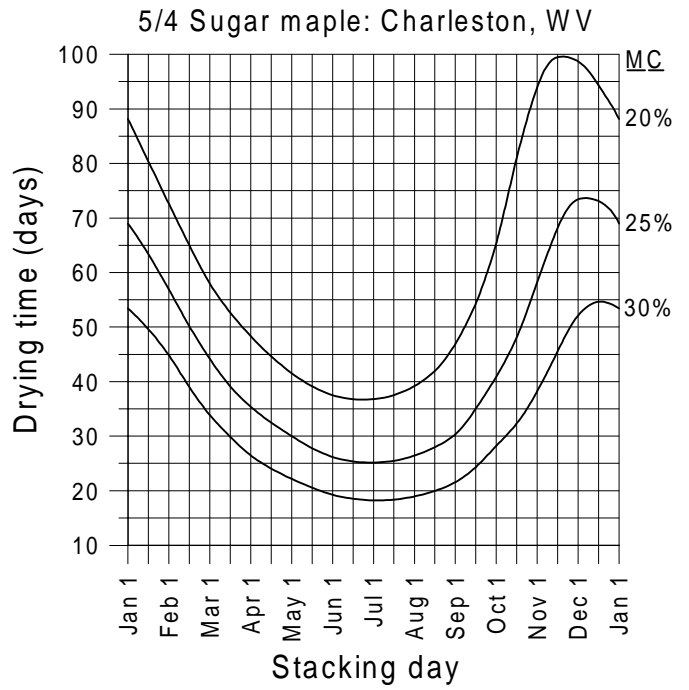
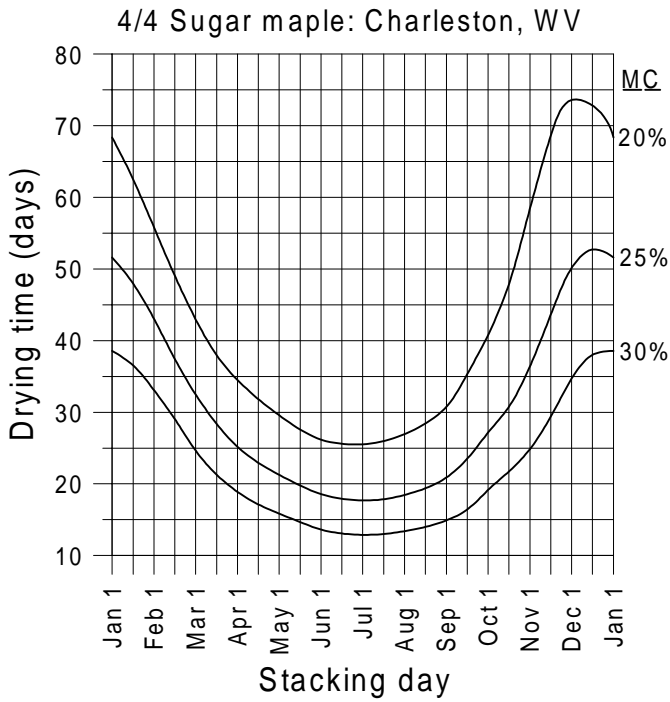


6/4 Sugar maple: Caribou, ME

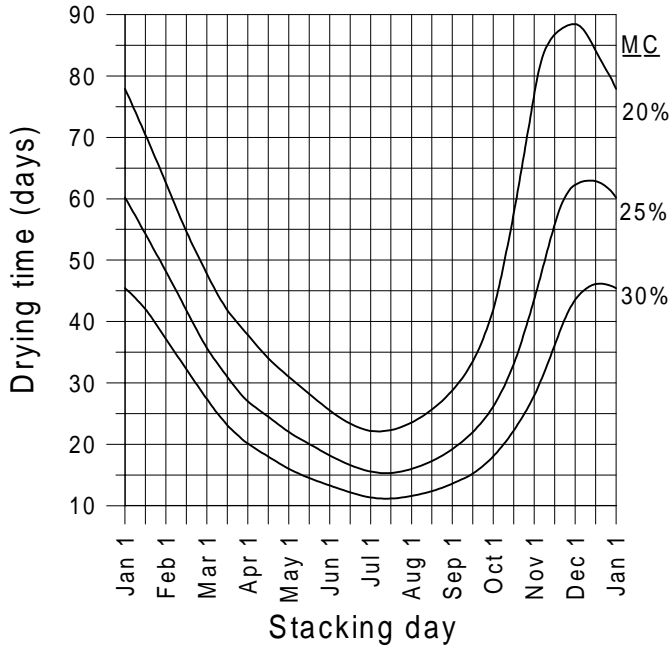


8/4 Sugar maple: Caribou, ME

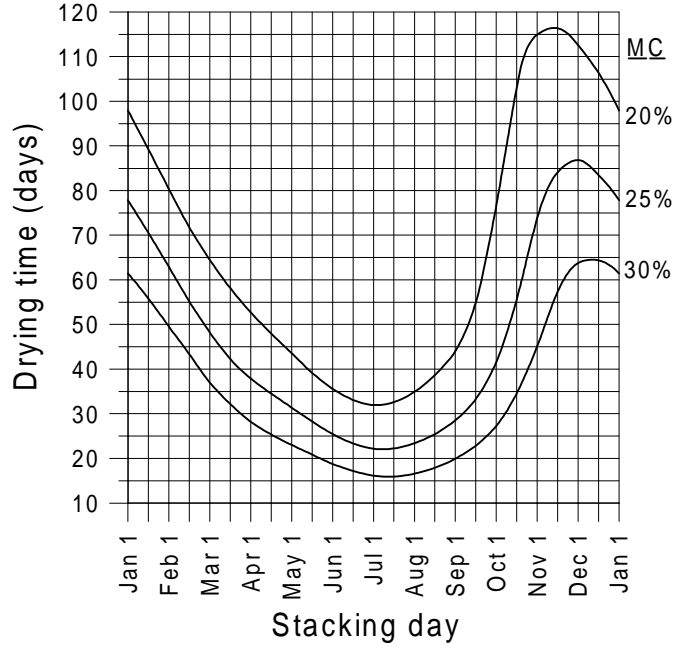




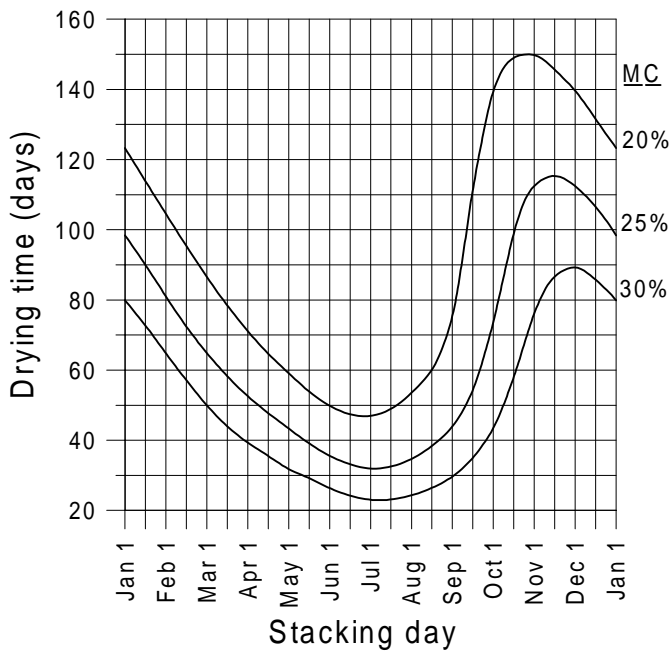
4/4 Sugar maple: Columbia, MO



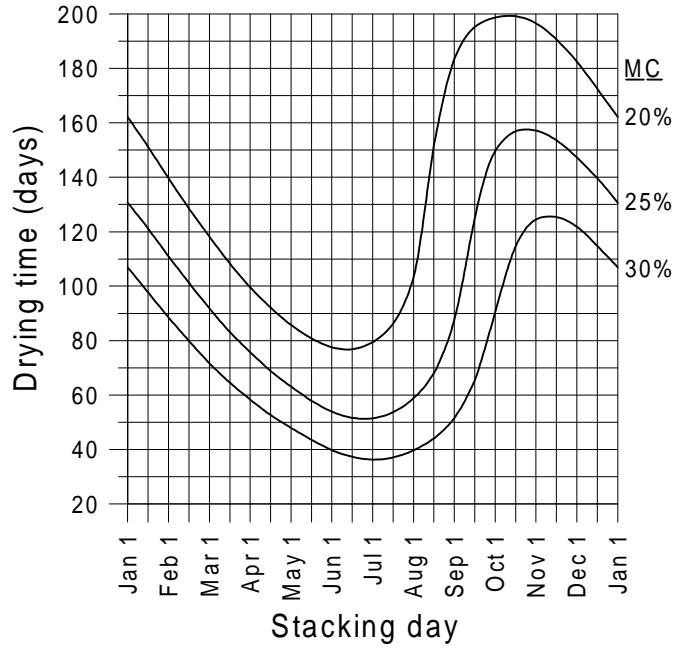
5/4 Sugar maple; Columbia, MO



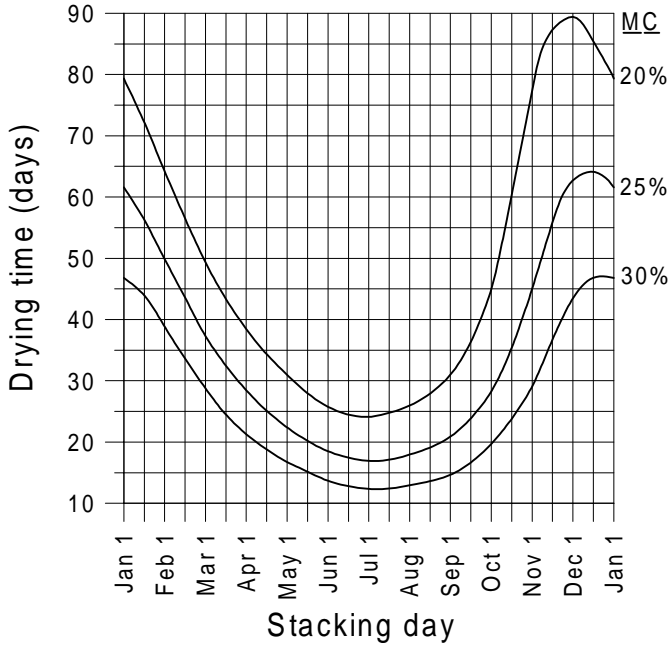
6/4 Sugar maple: Columbia, MO



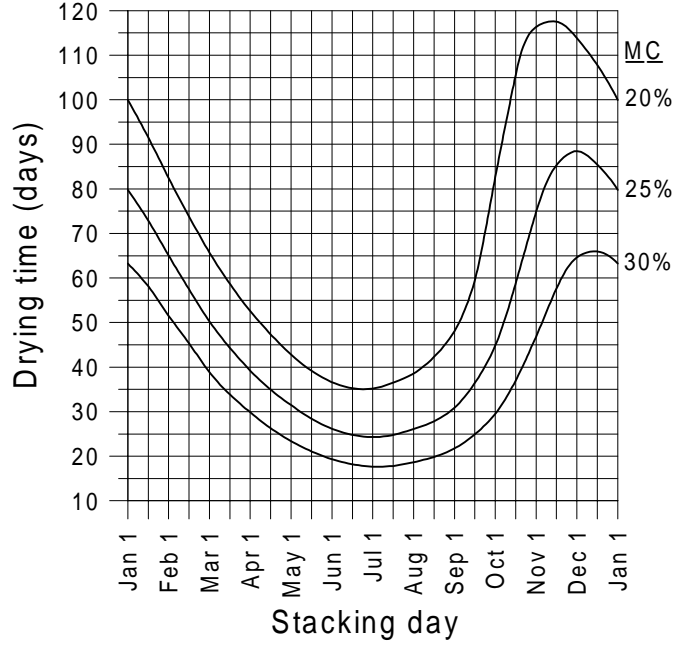
8/4 Sugar maple; Columbia, MO



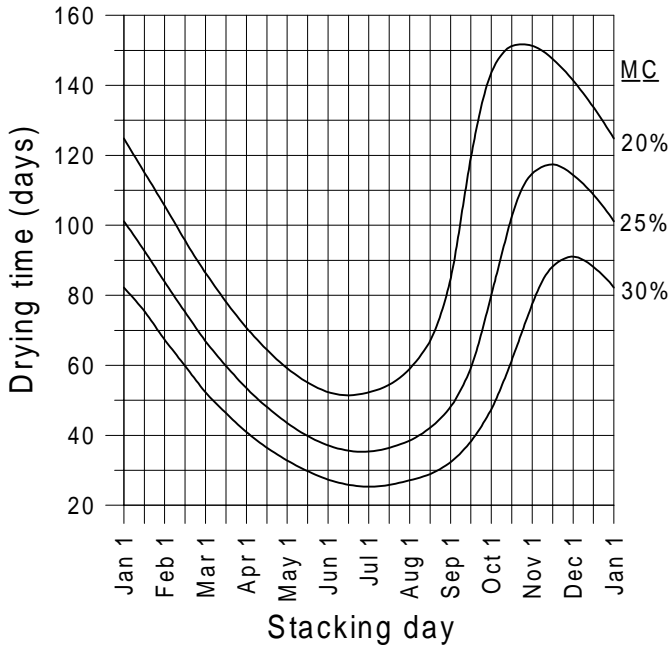
4/4 Sugar maple: Columbus, OH



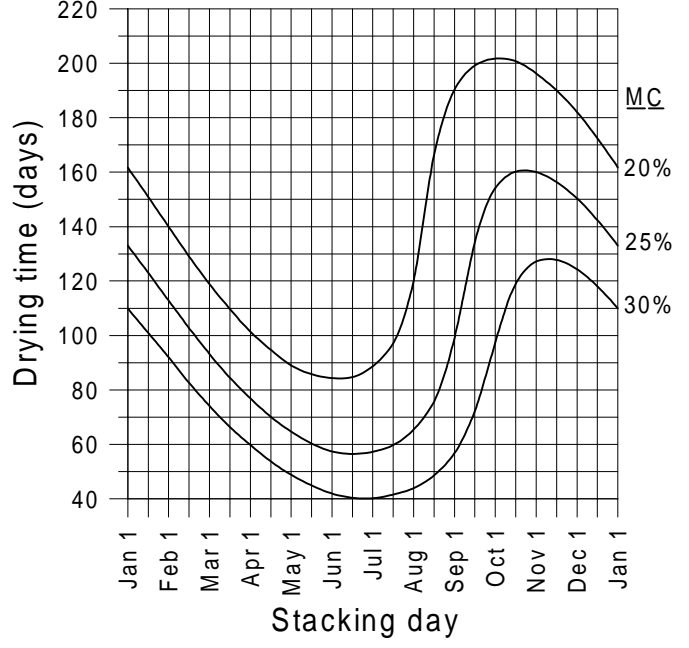
5/4 Sugar maple: Columbus, OH



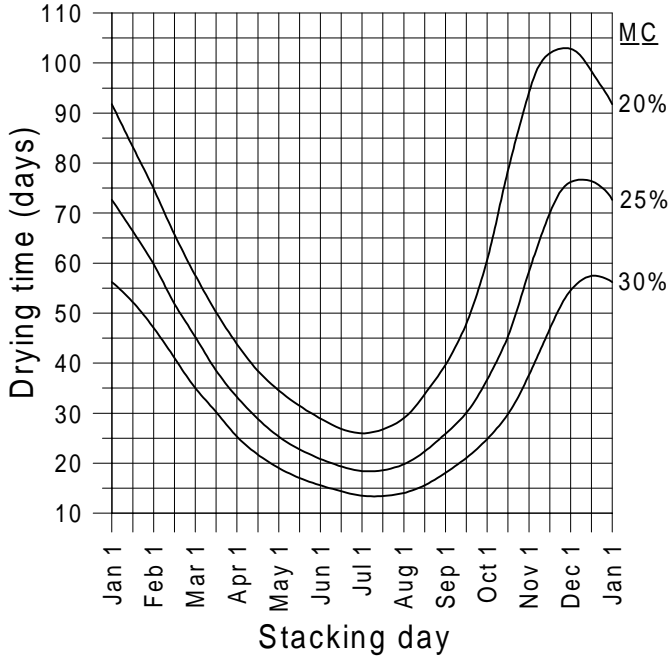
6/4 Sugar maple: Columbus, OH



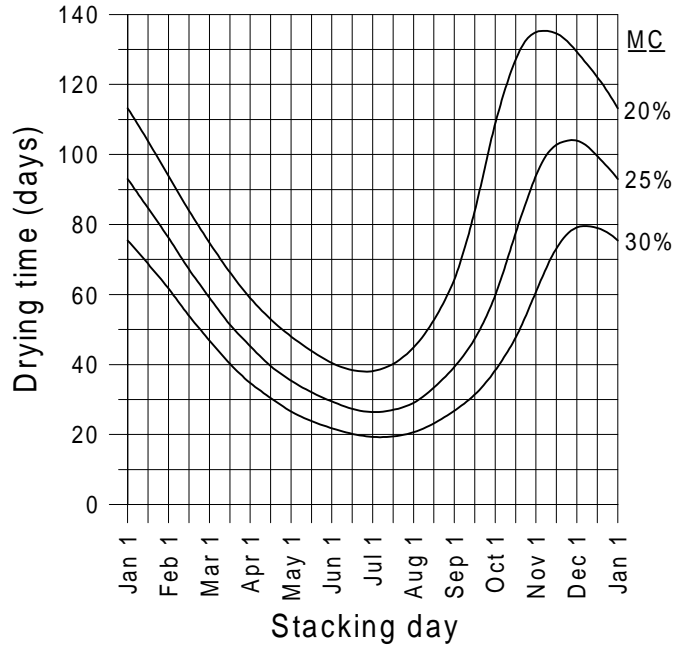
8/4 Sugar maple: Columbus, OH



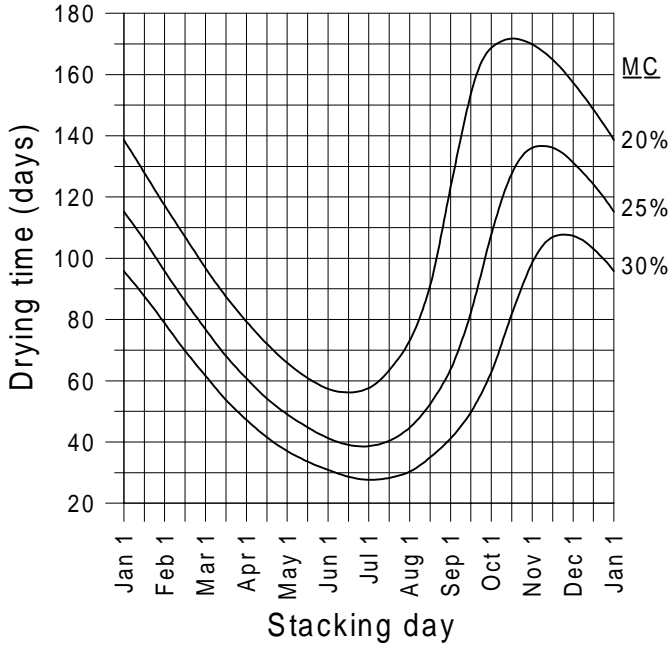
4/4 Sugar maple: Concord, NH



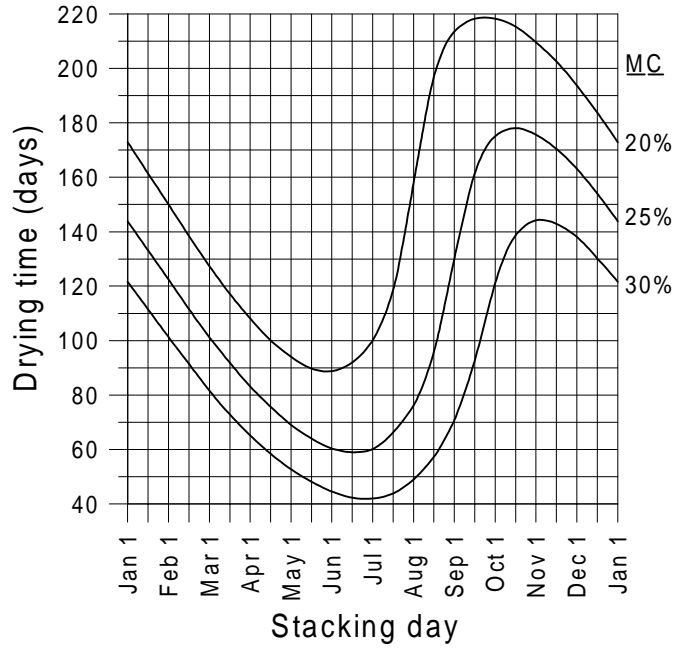
5/4 Sugar maple: Concord, NH



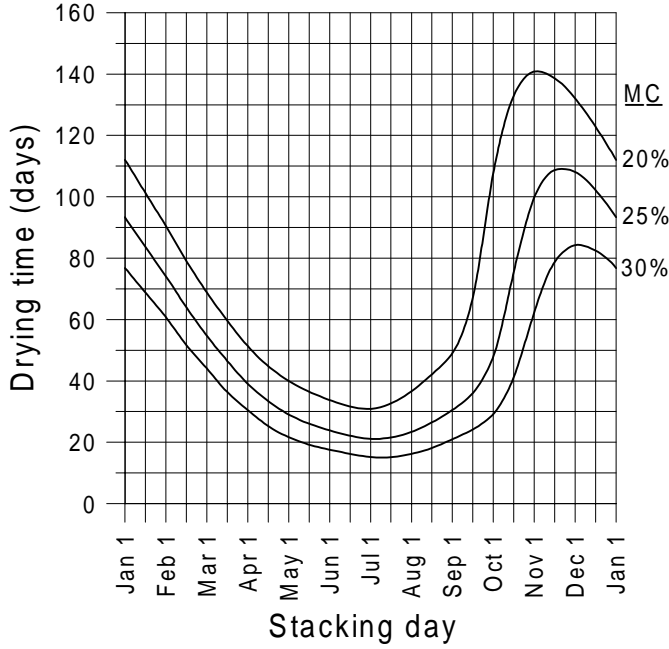
6/4 Sugar maple: Concord, NH



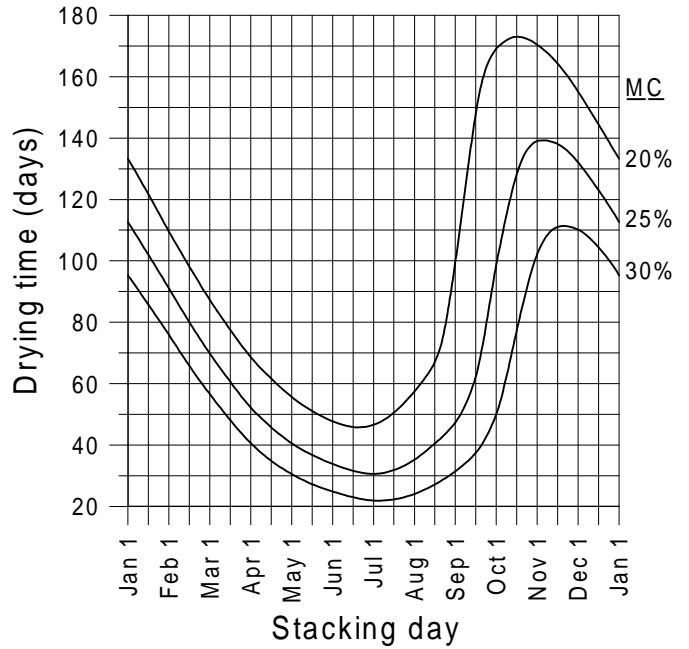
8/4 Sugar maple: Concord, NH



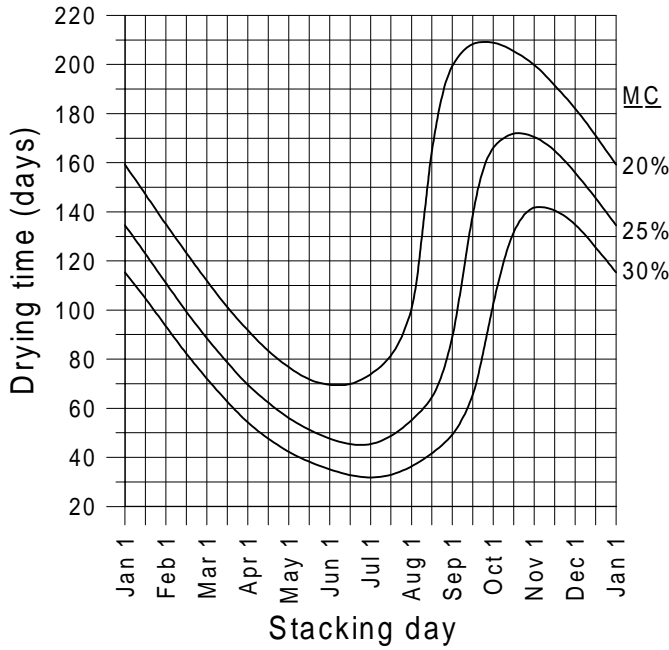
4/4 Sugar maple: Duluth, MN



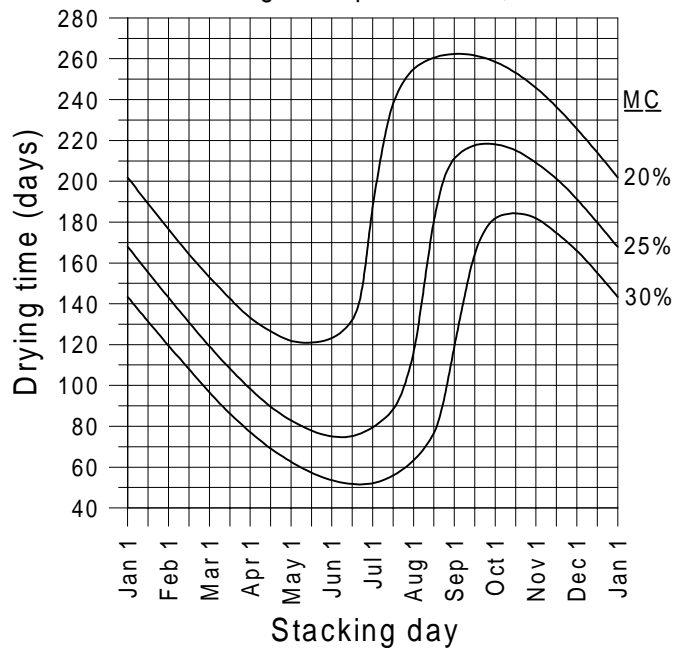
5/4 Sugar maple: Duluth, MN

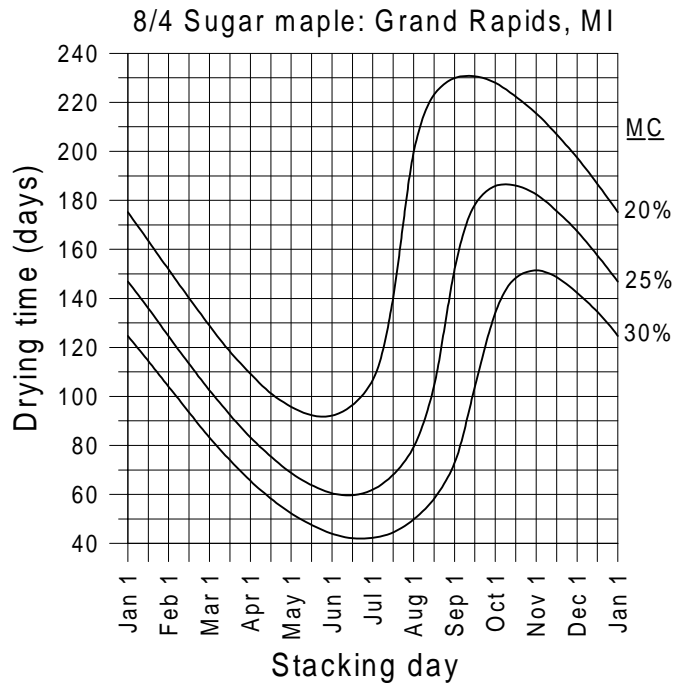
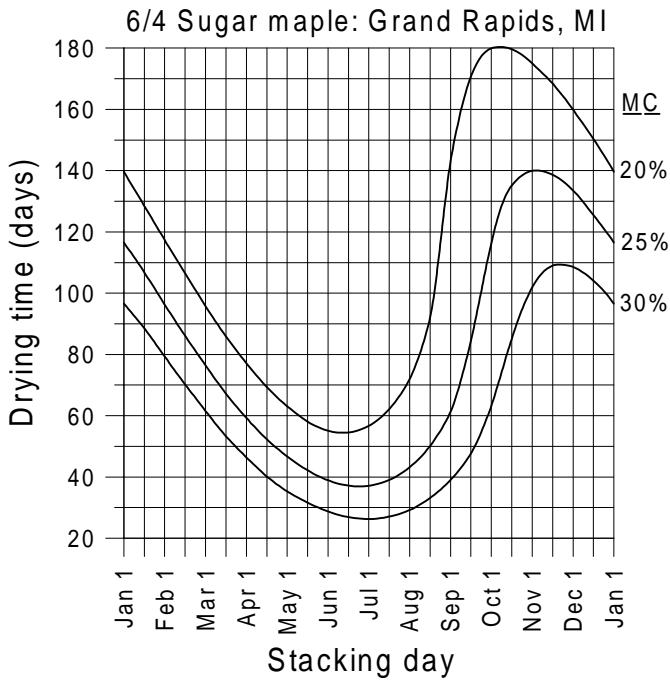
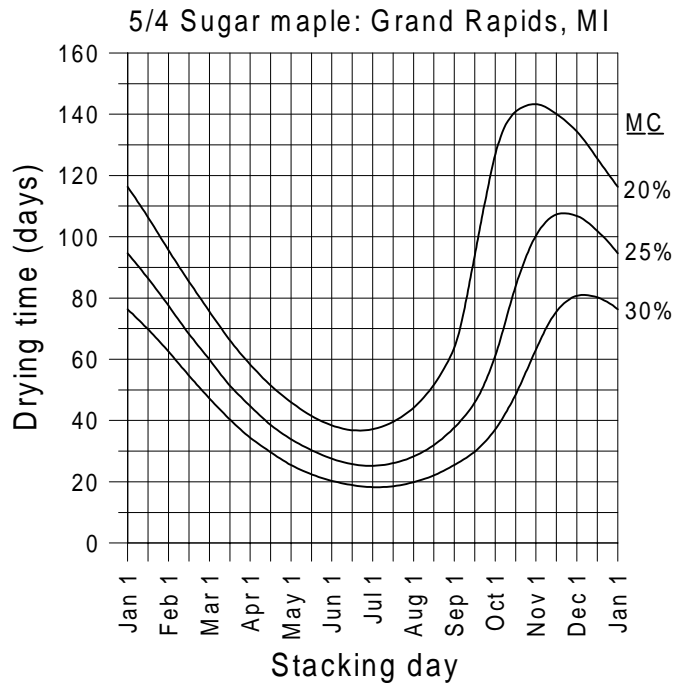
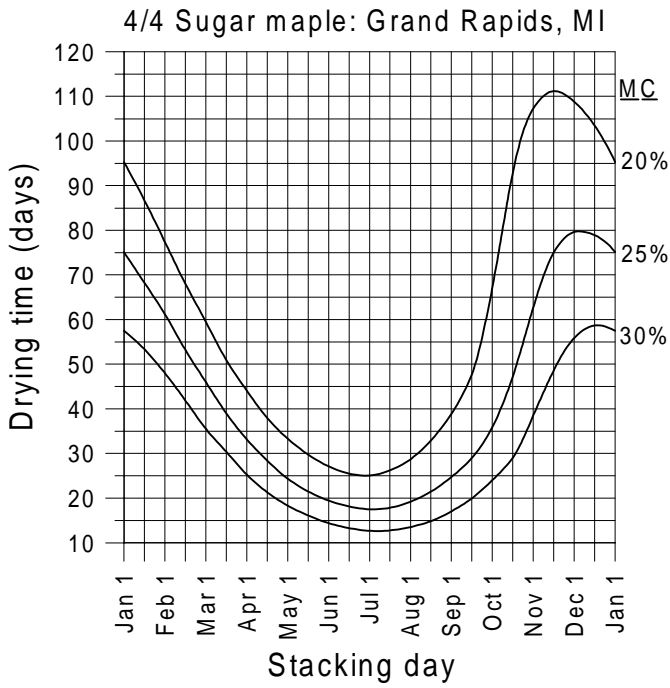


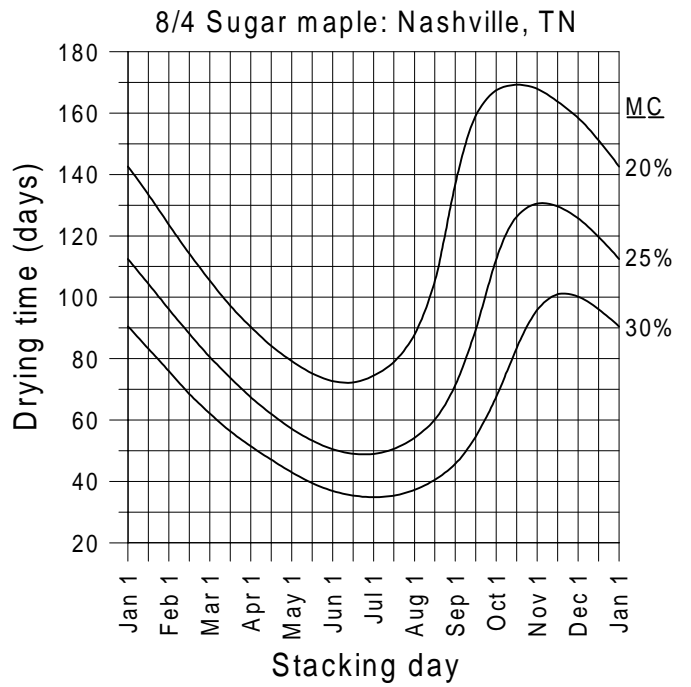
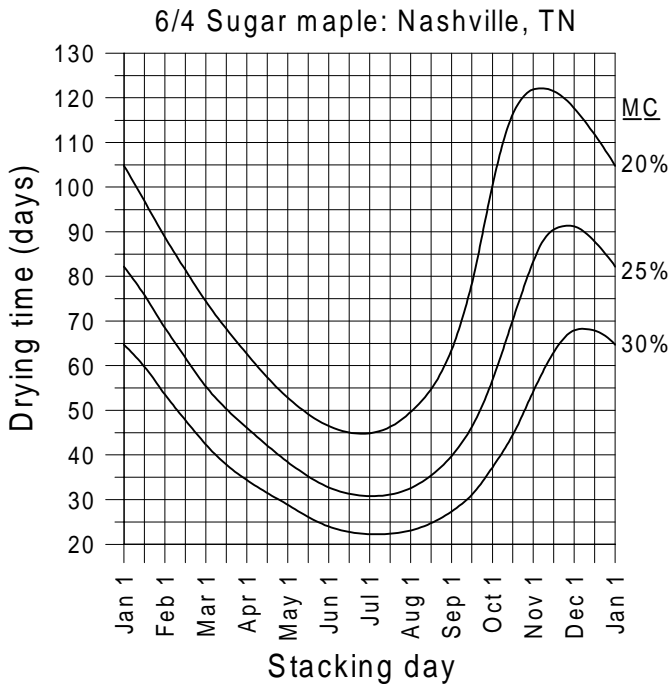
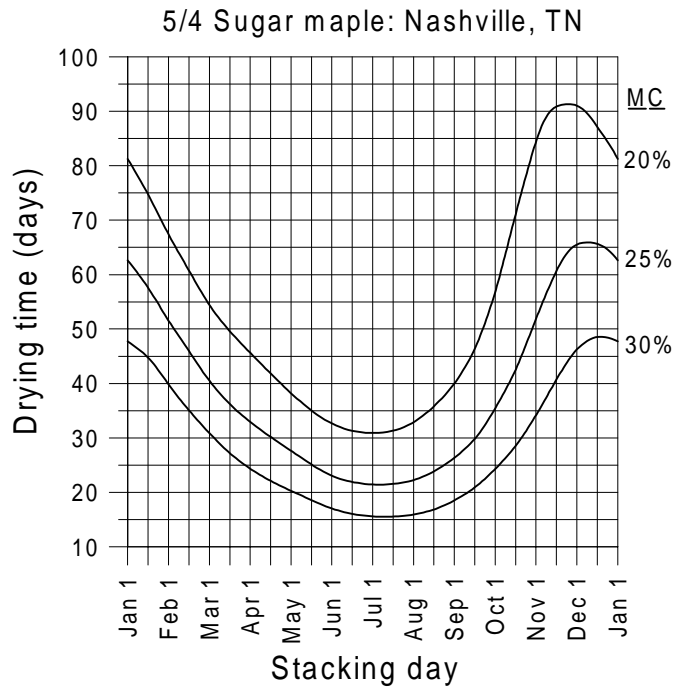
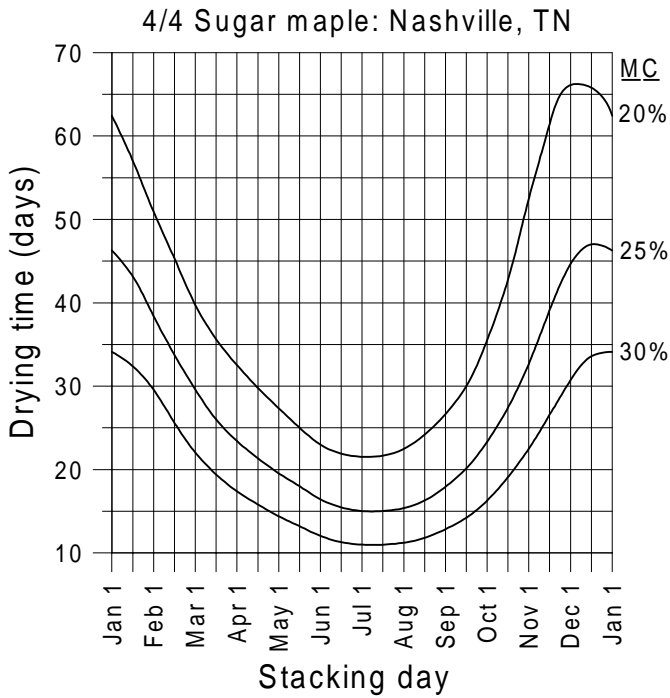
6/4 Sugar maple: Duluth, MN



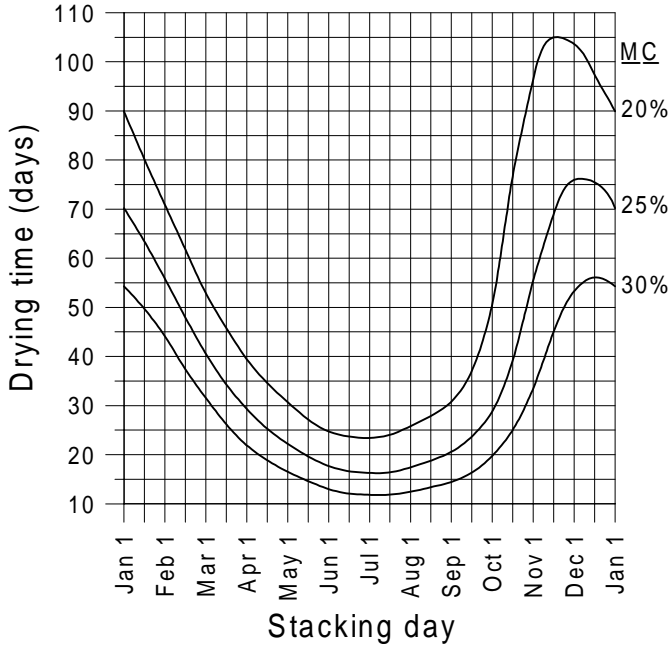
8/4 Sugar maple: Duluth, MN



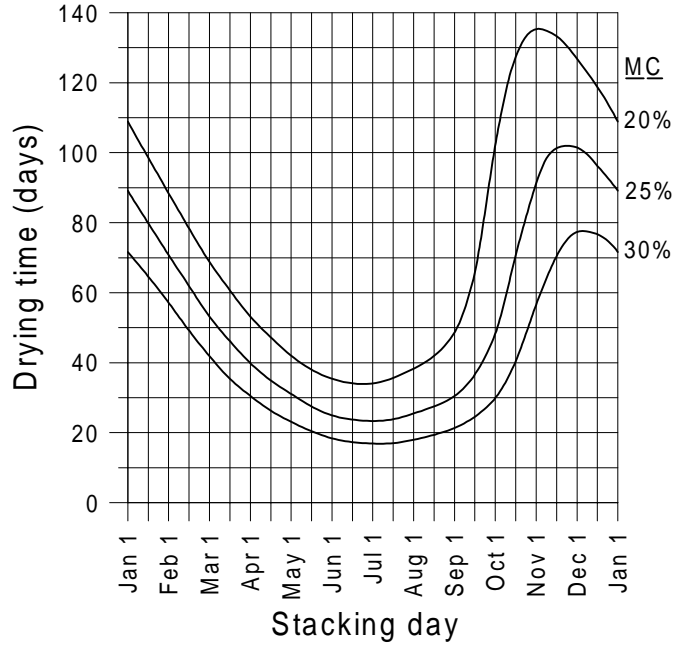




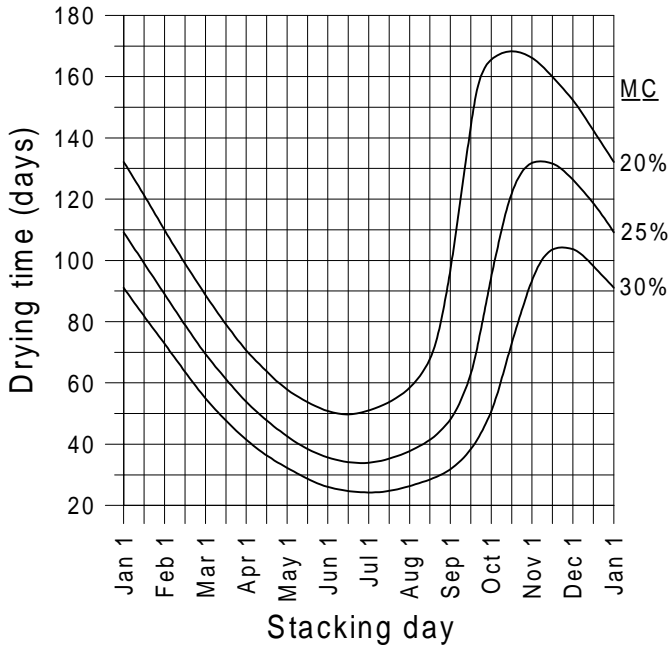
4/4 Sugar maple: Peoria, IL



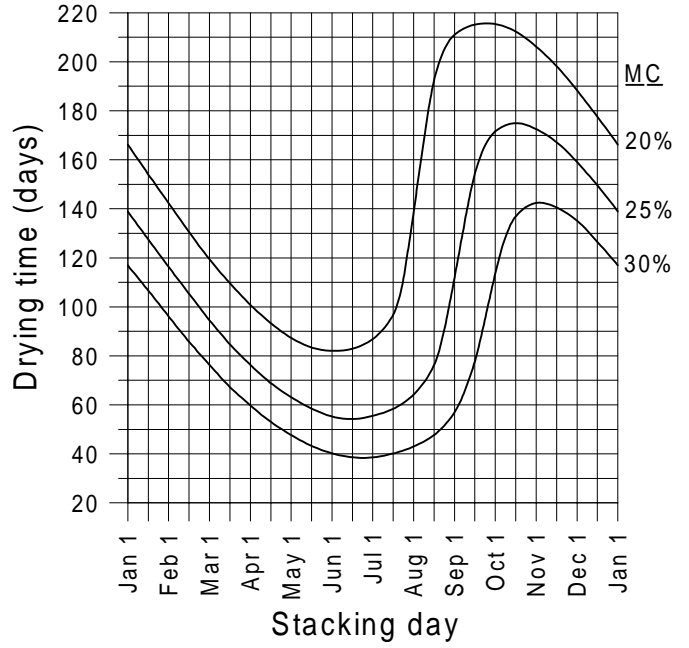
5/4 Sugar maple: Peoria, IL

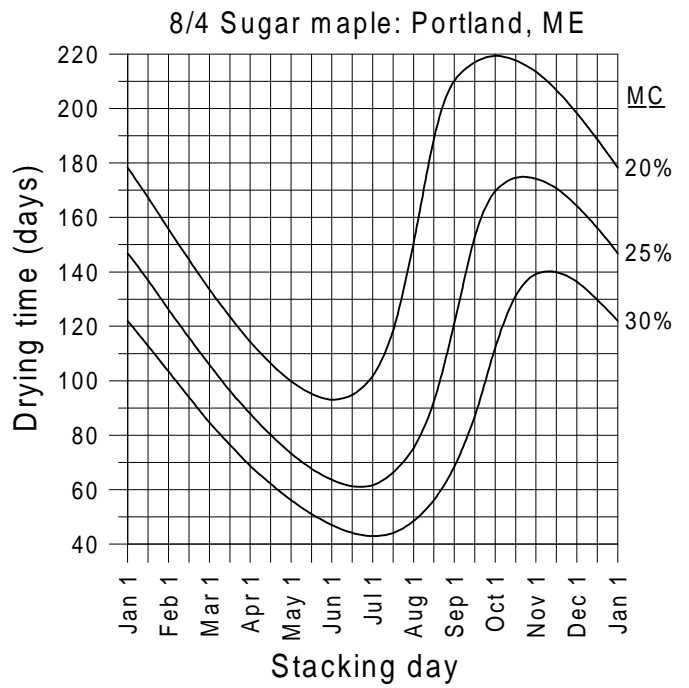
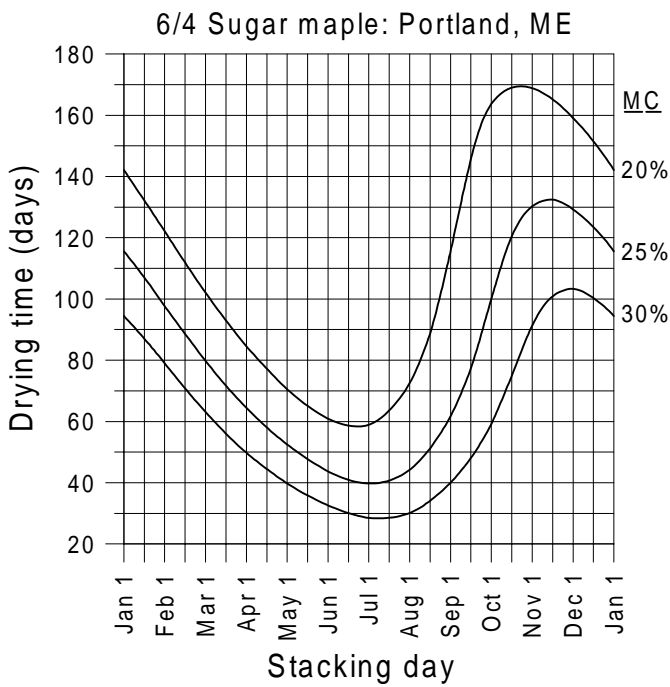
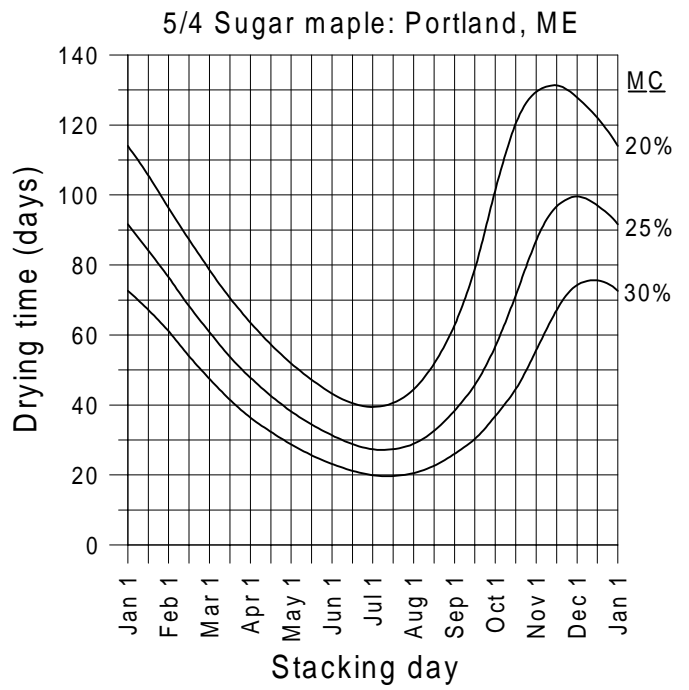
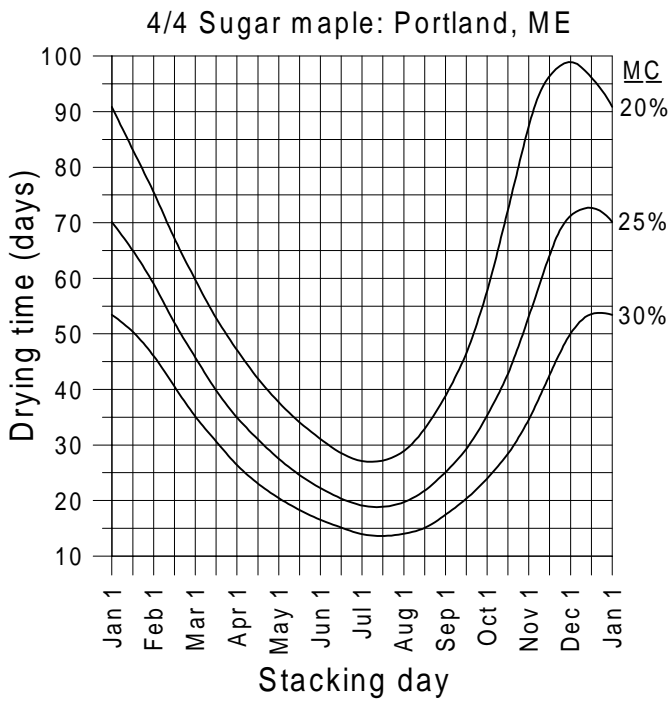


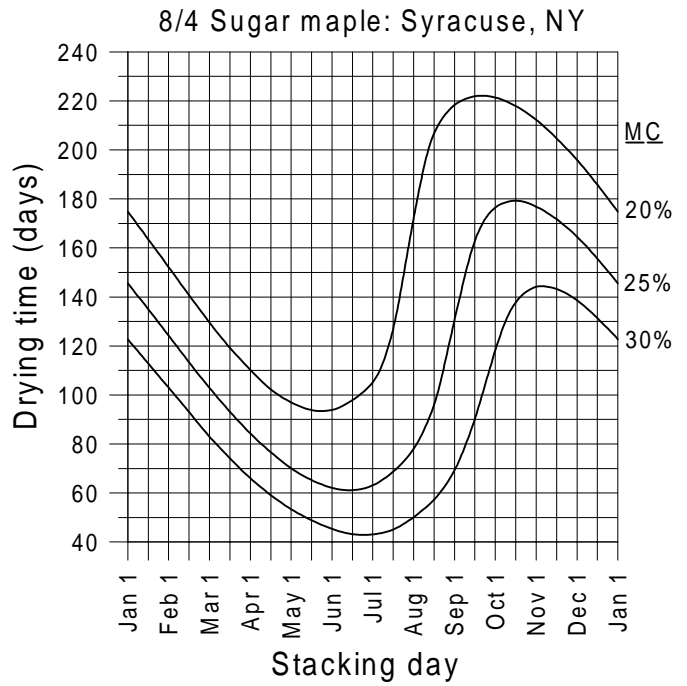
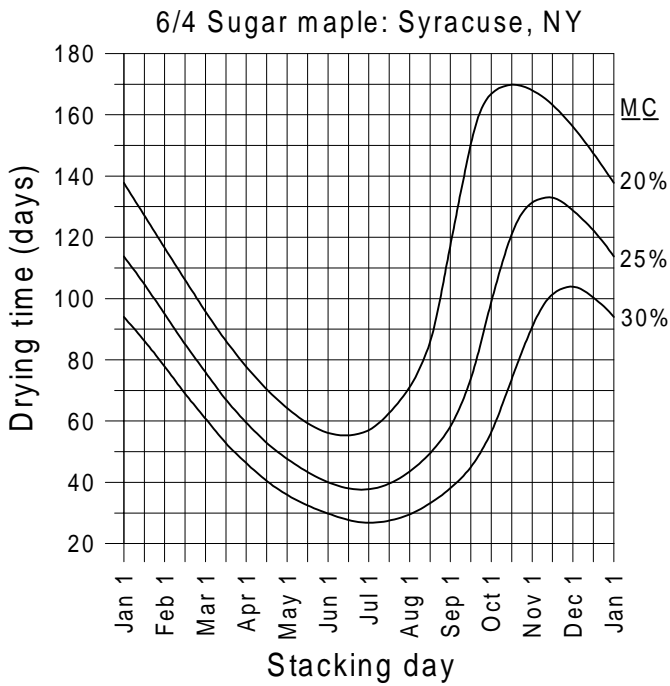
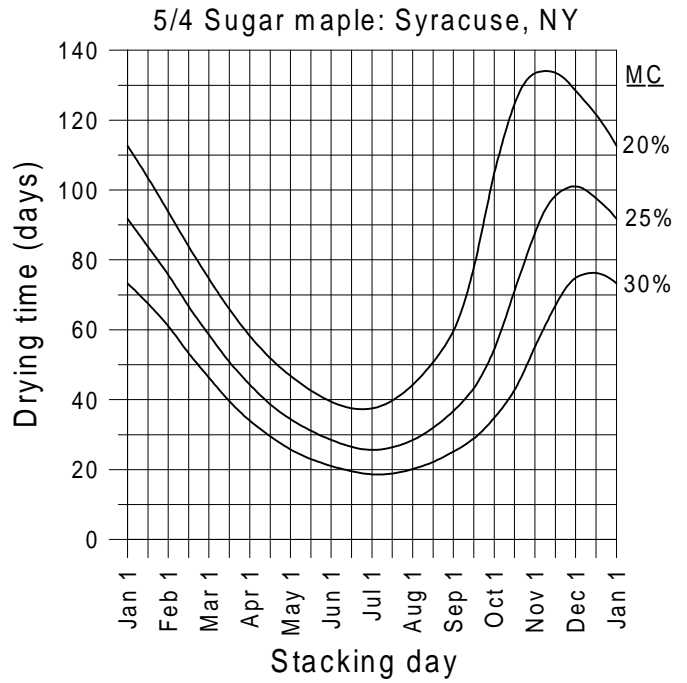
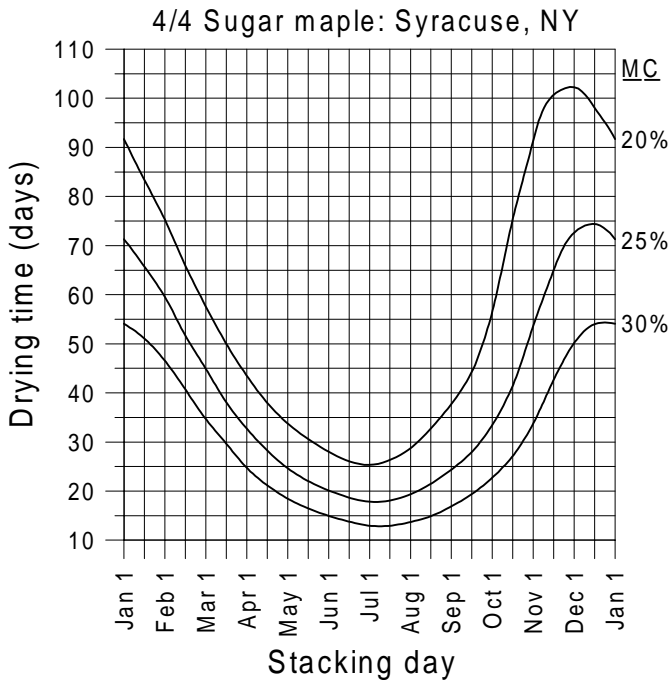
6/4 Sugar maple: Peoria, IL



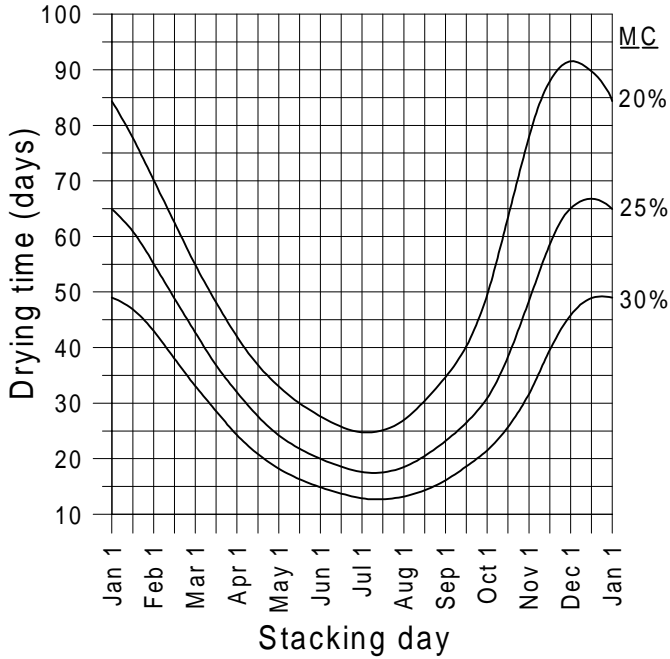
8/4 Sugar maple: Peoria, IL



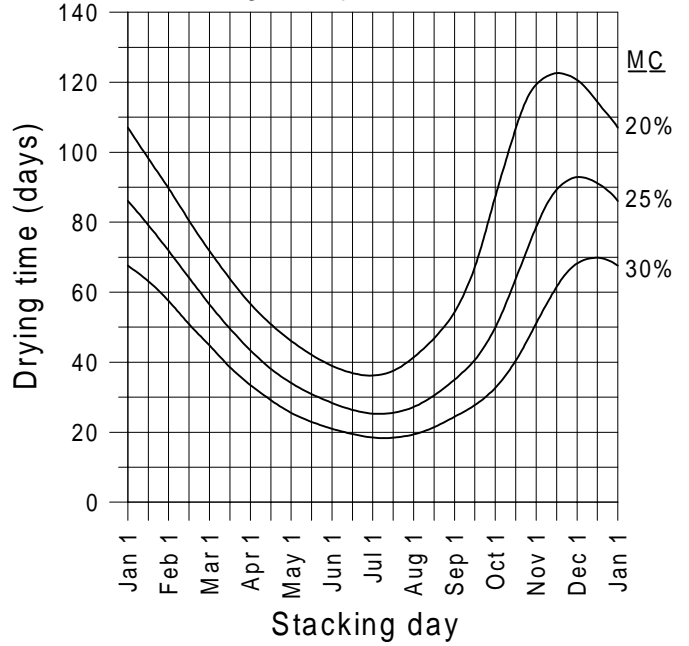




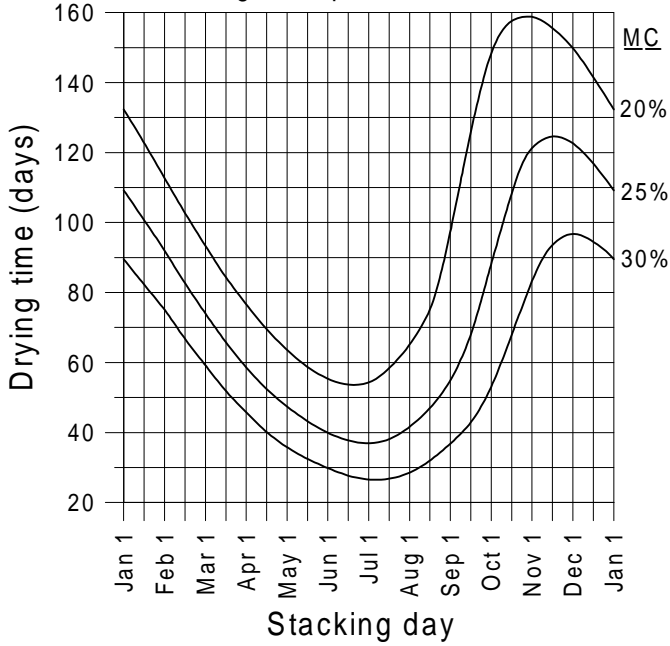
4/4 Sugar maple: Worcester, MA



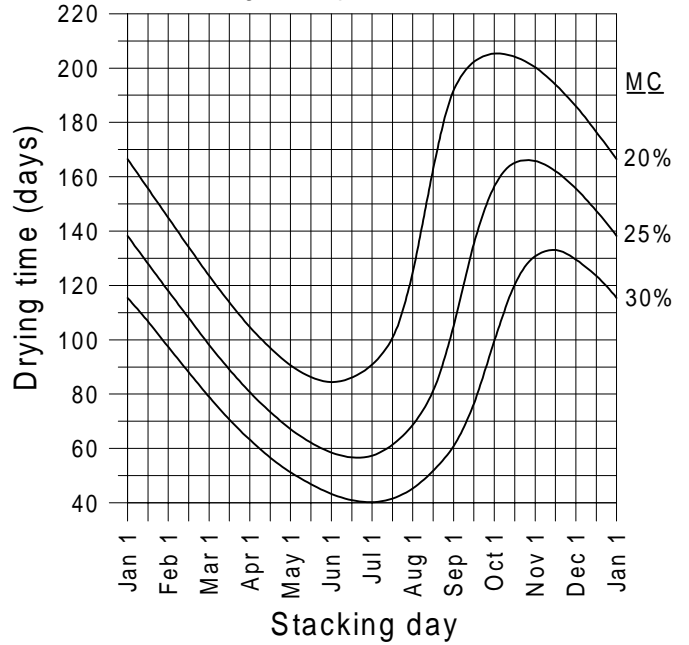
5/4 Sugar maple: Worcester, MA



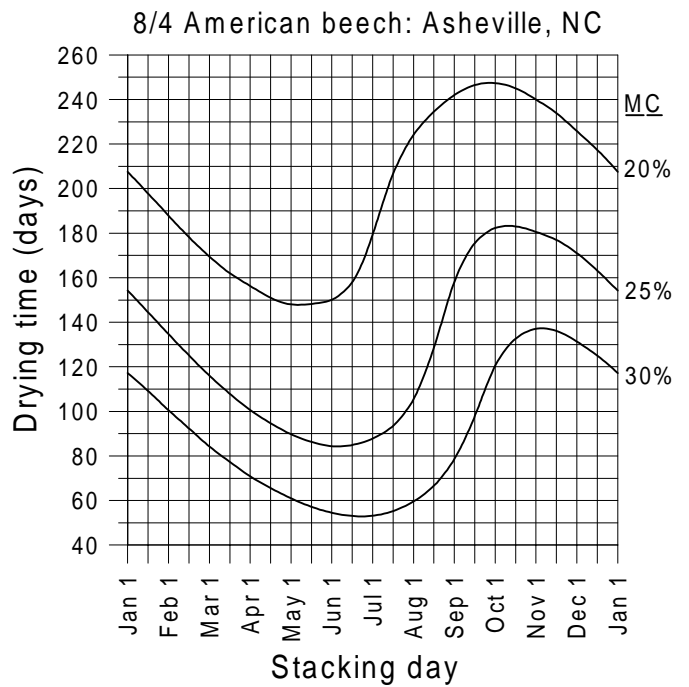
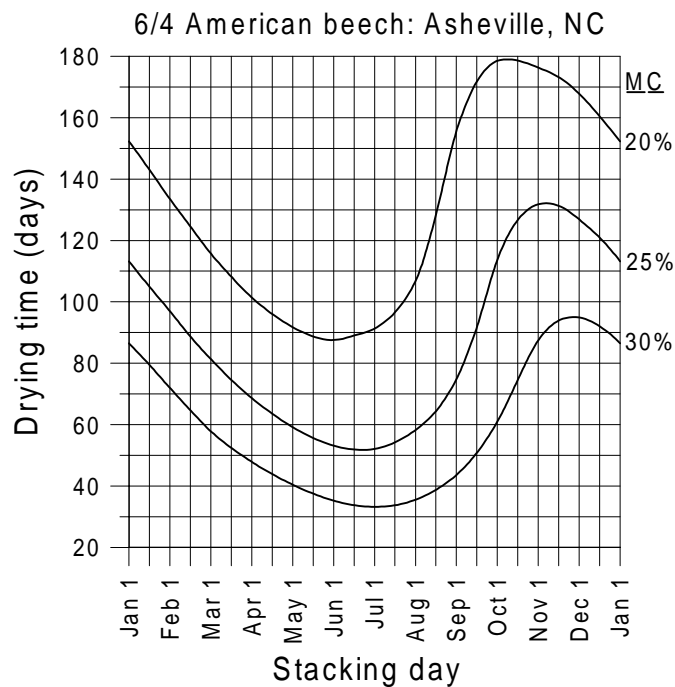
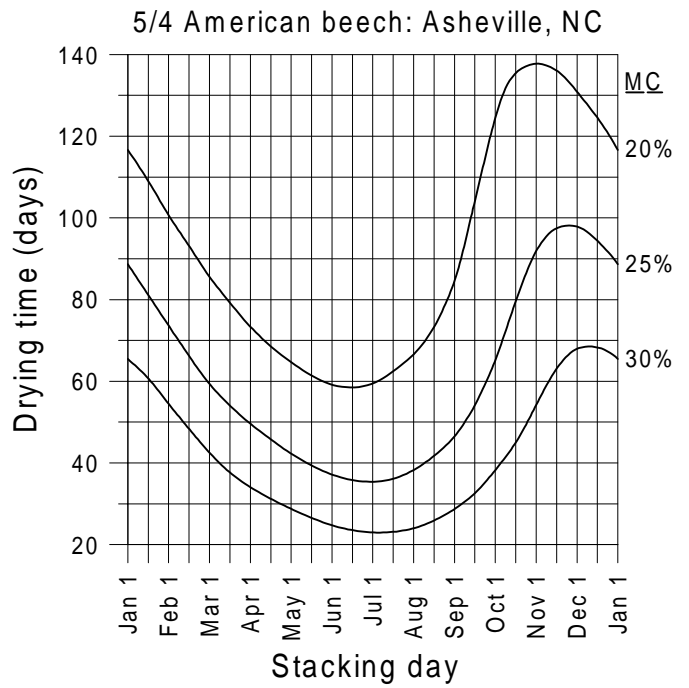
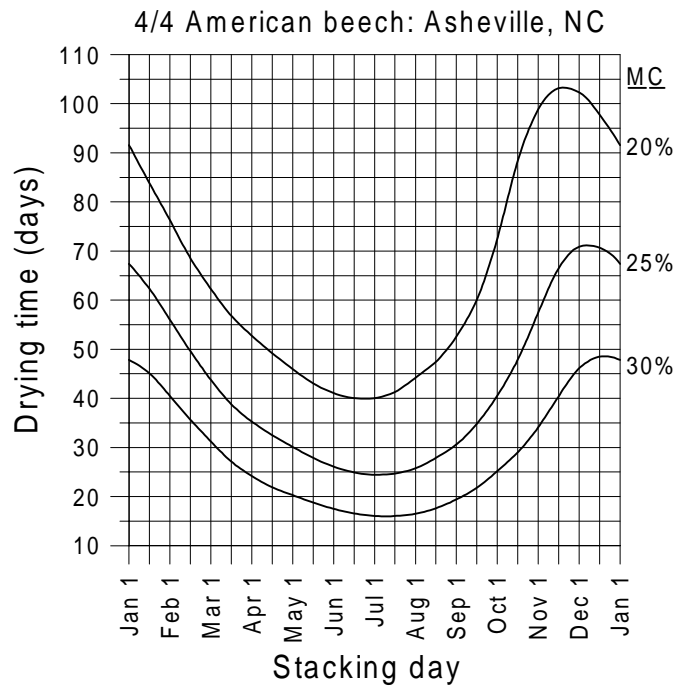
6/4 Sugar maple: Worcester, MA

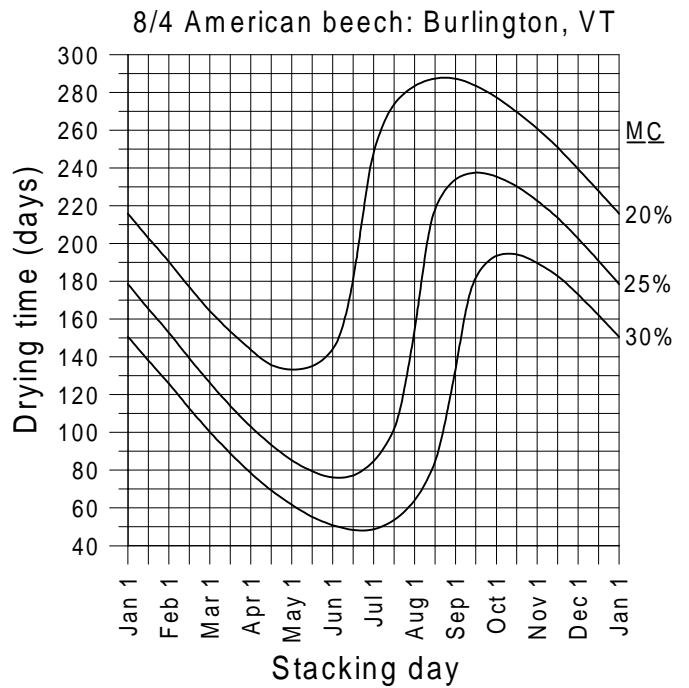
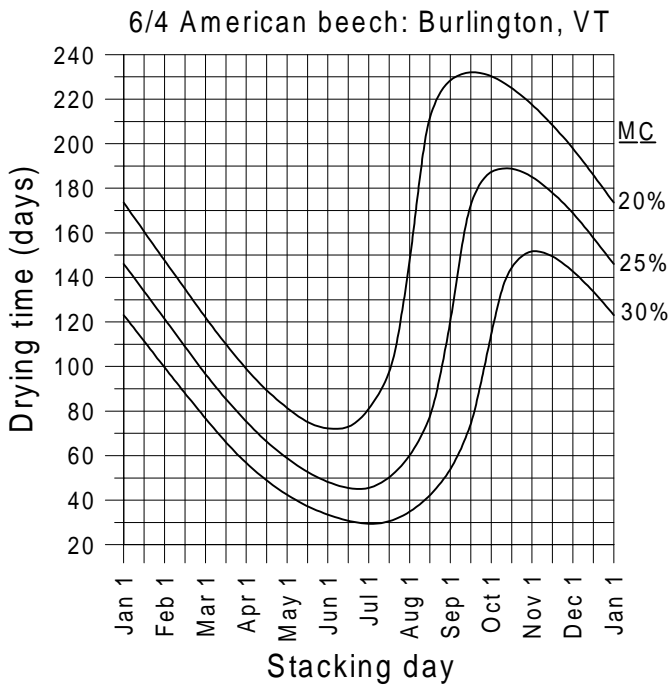
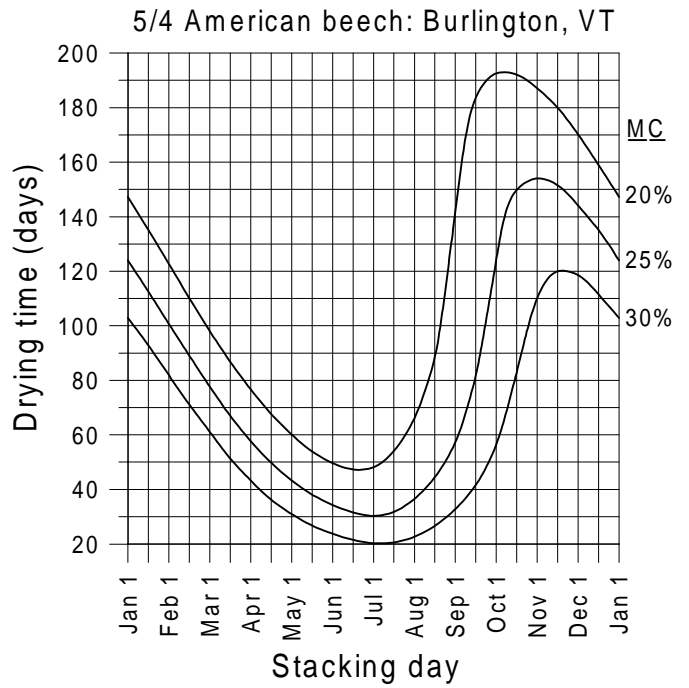
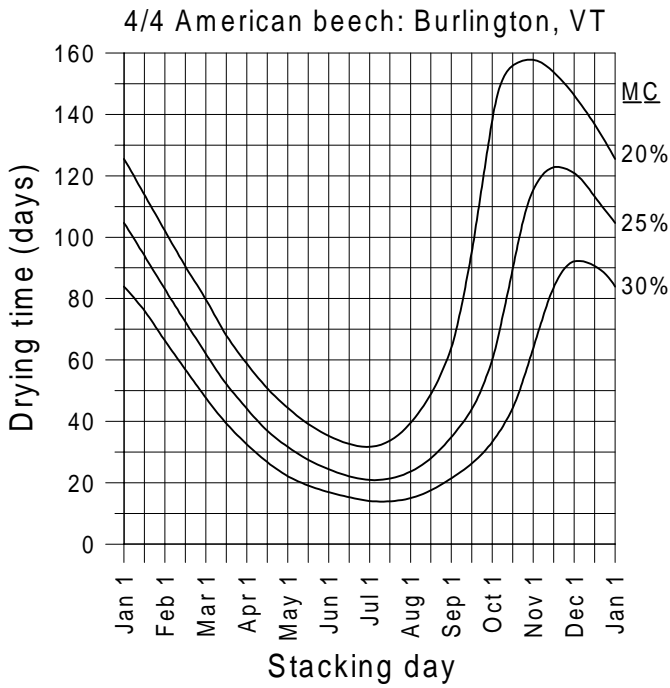


8/4 Sugar maple: Worcester, MA

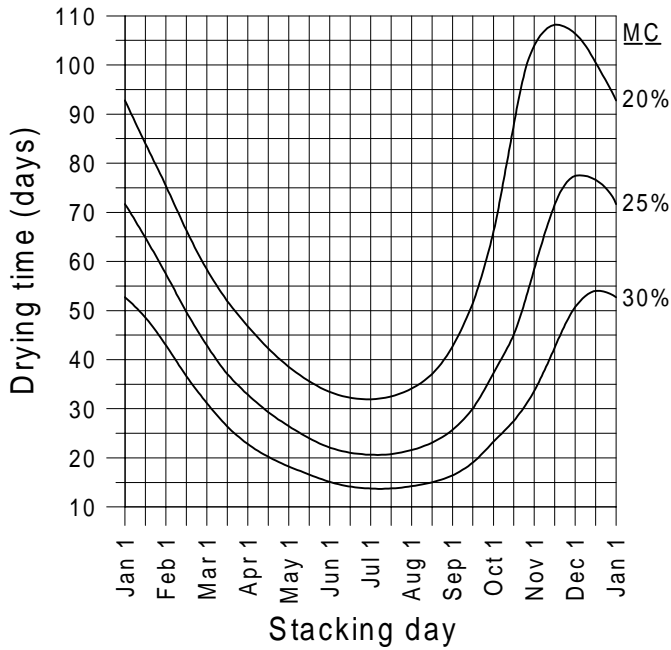


American Beech

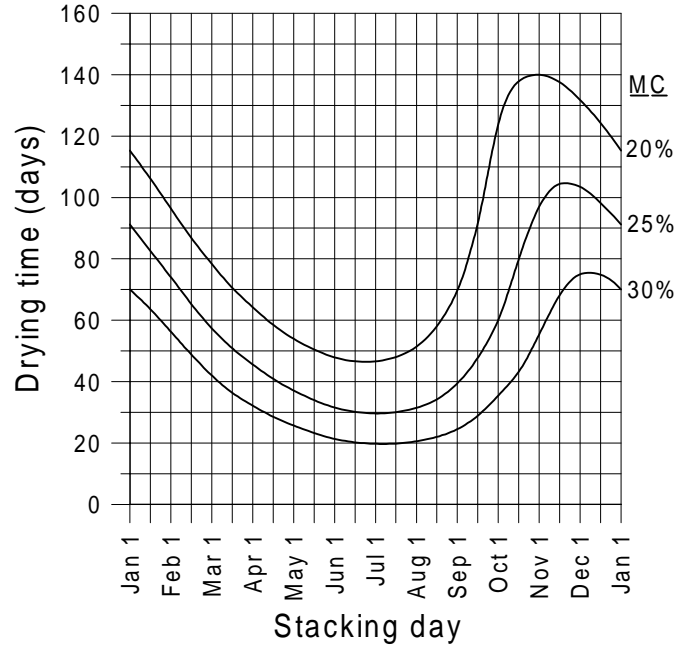




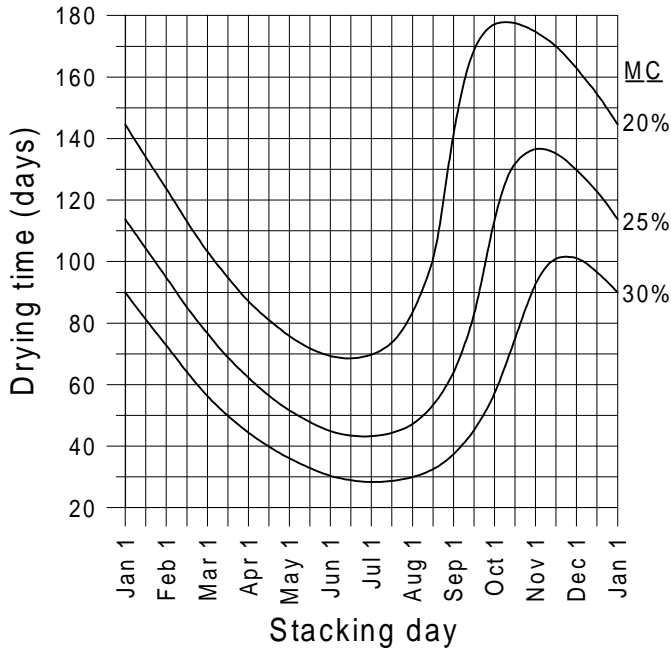
4/4 American beech: Charleston, WV



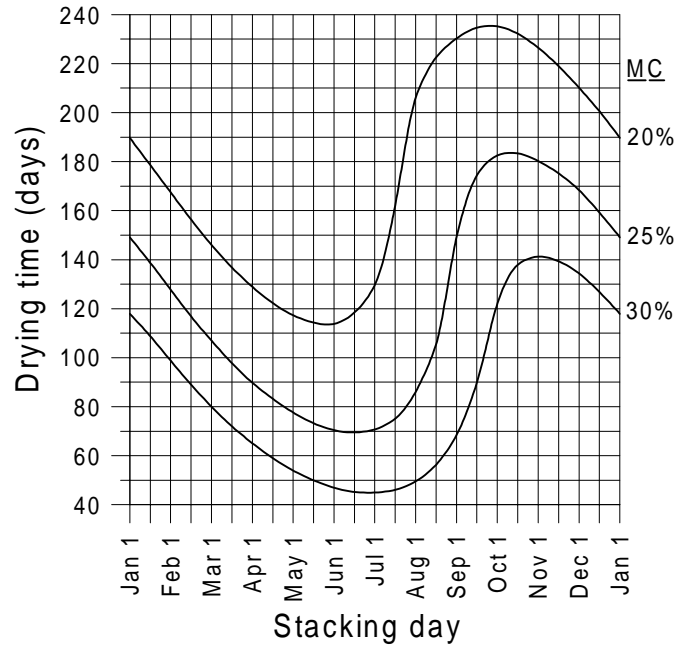
5/4 American beech: Charleston, WV

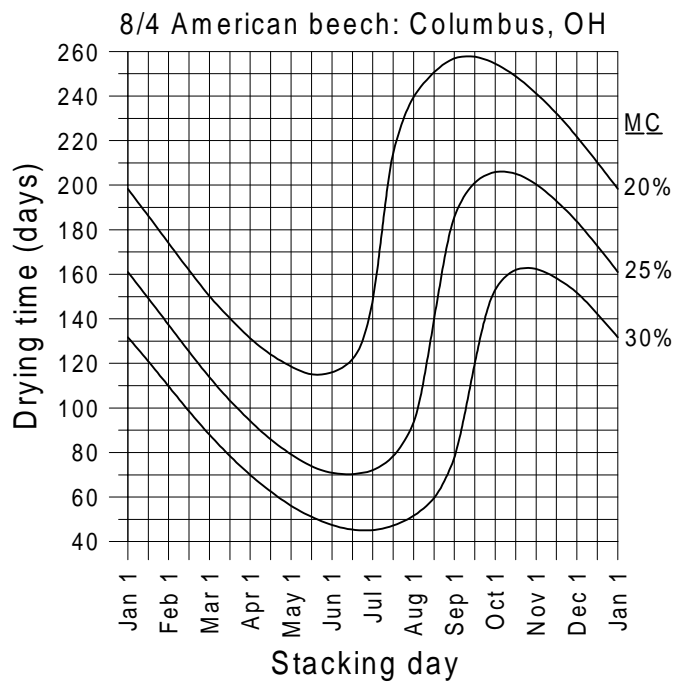
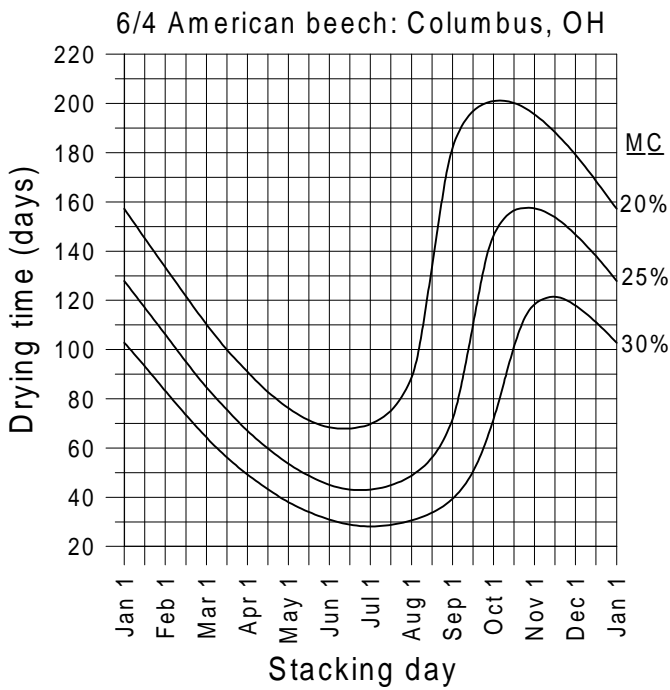
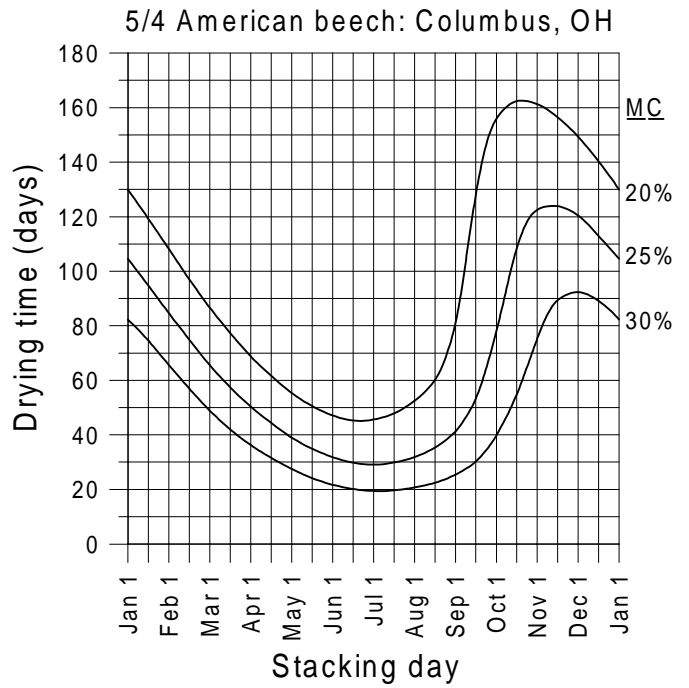
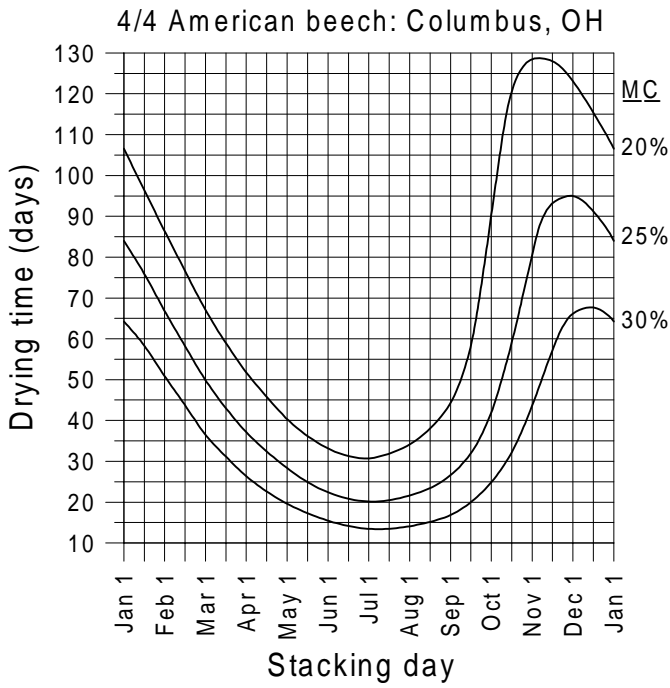


6/4 American beech: Charleston, WV

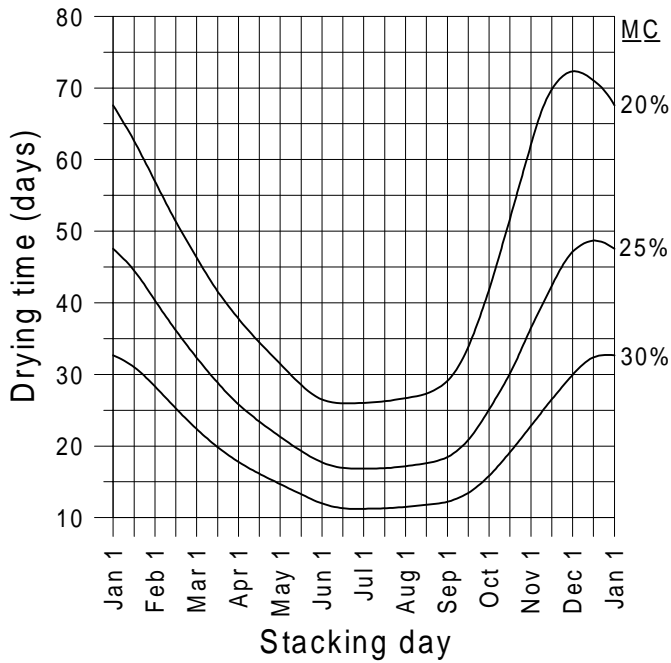


8/4 American beech: Charleston, WV

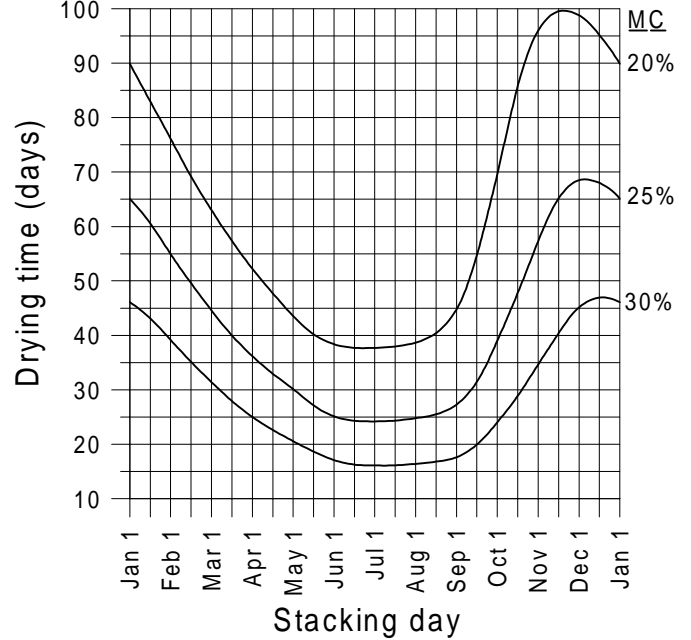




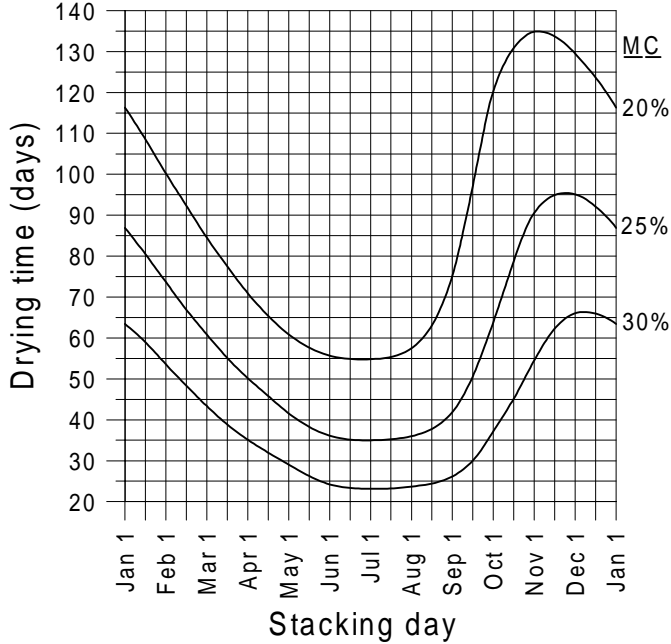
4/4 American beech: Montgomery, AL



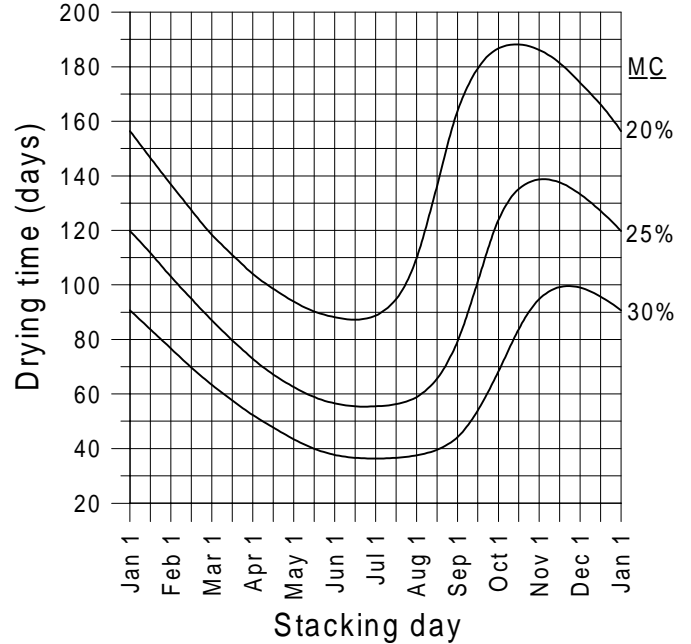
5/4 American beech: Montgomery, AL



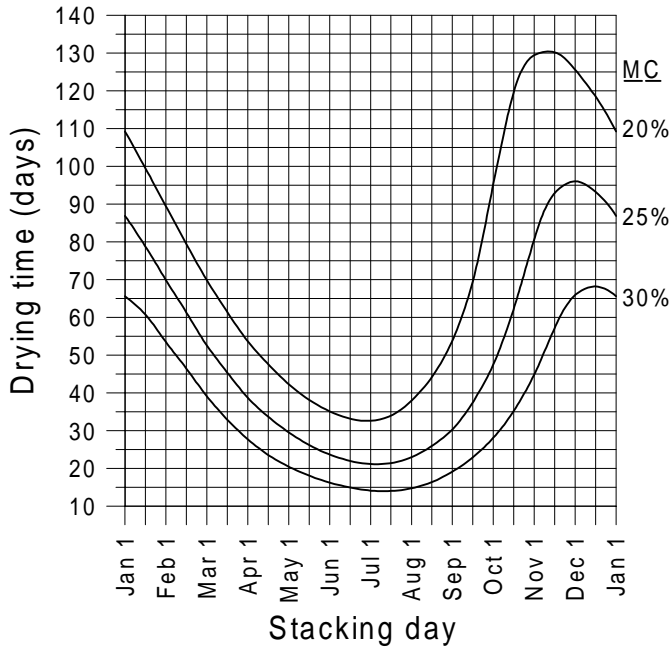
6/4 American beech: Montgomery, AL



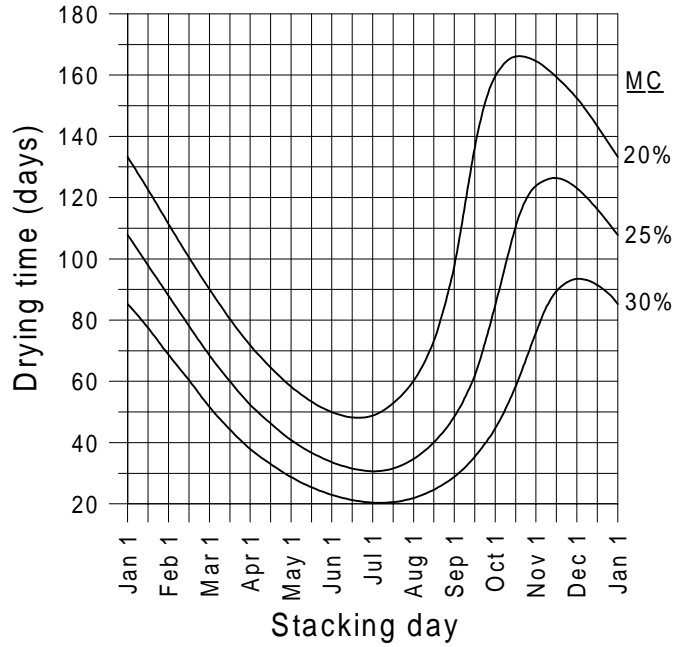
8/4 American beech: Montgomery, AL



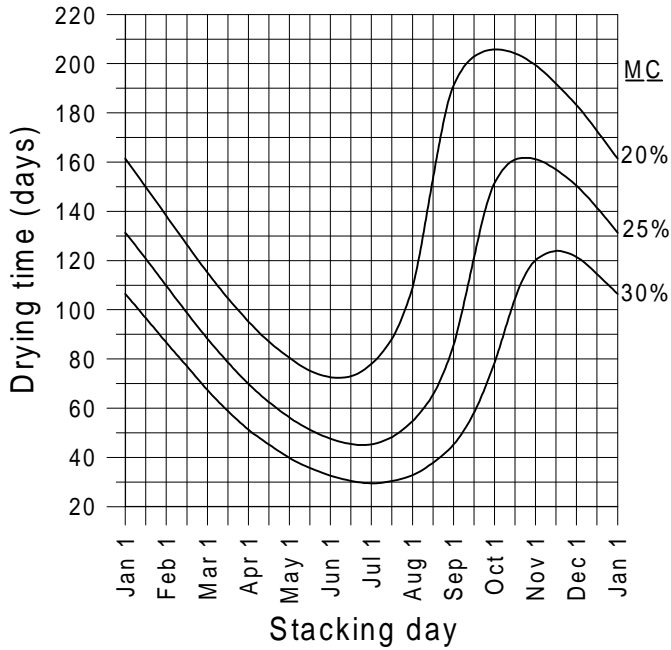
4/4 American beech: Williamsport, PA



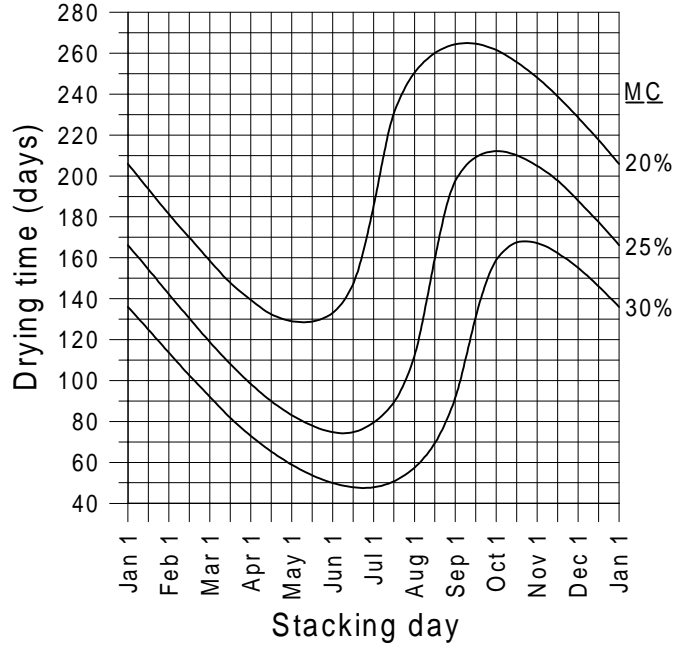
5/4 American beech: Williamsport, PA



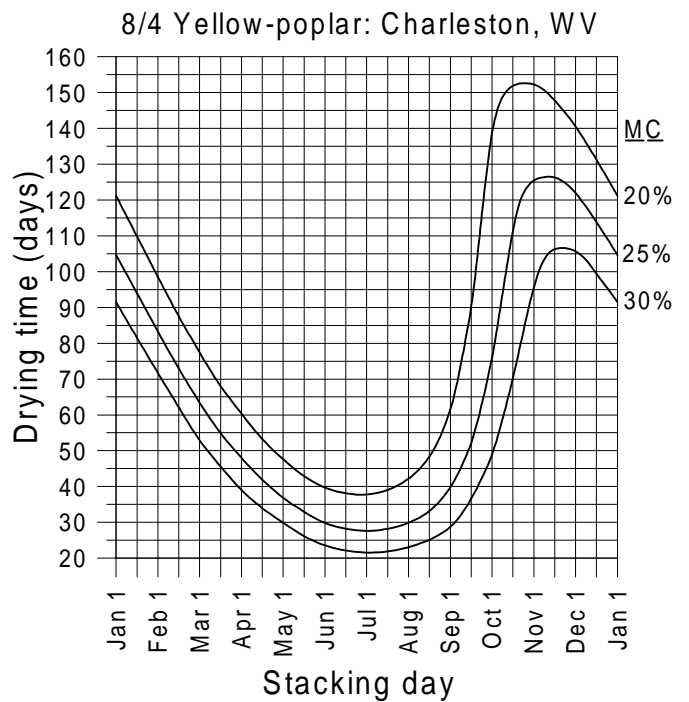
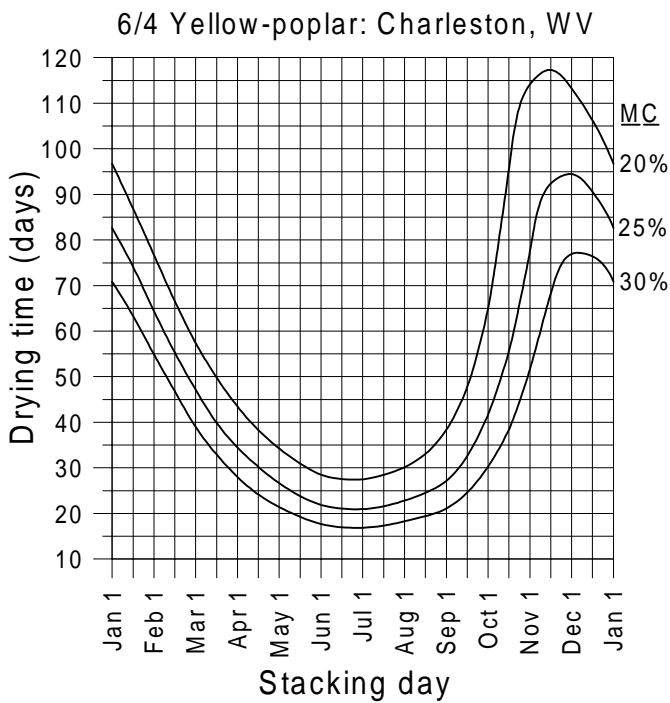
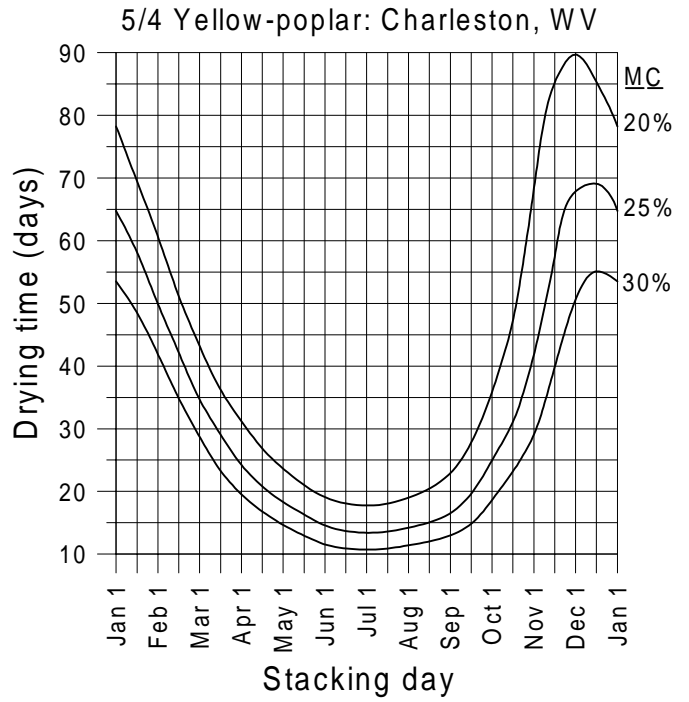
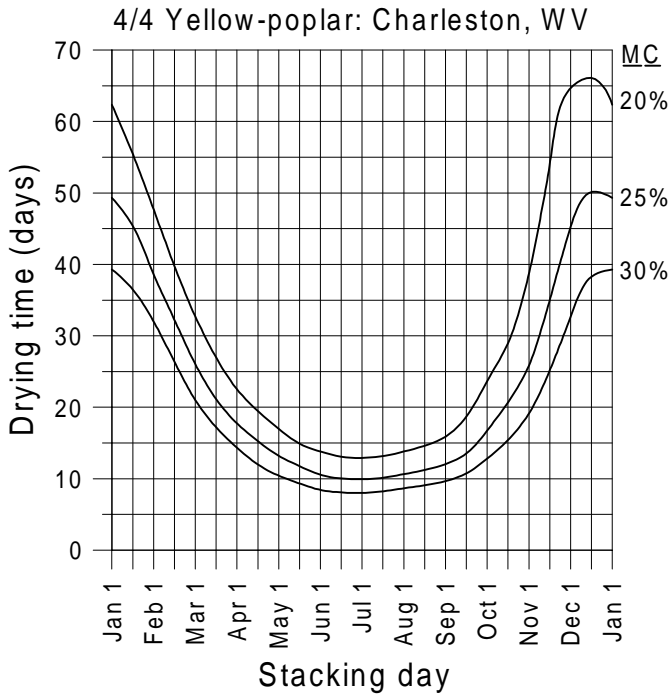
6/4 American beech: Williamsport, PA



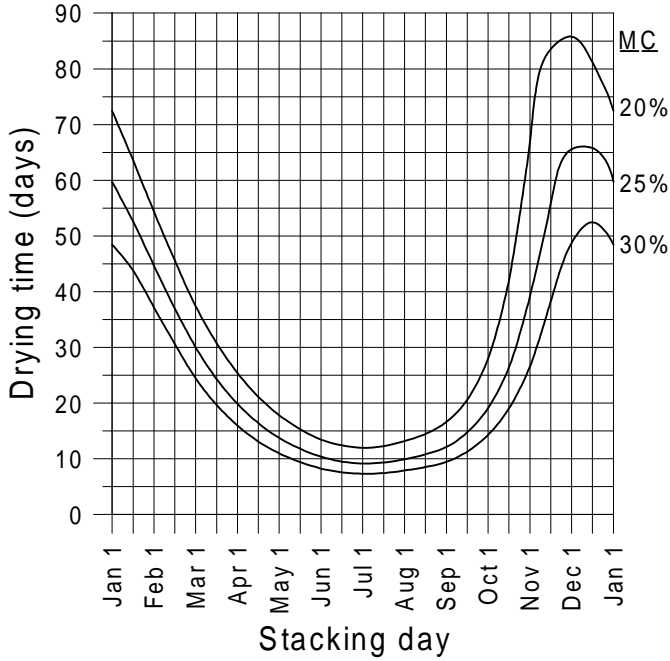
8/4 American beech: Williamsport, PA



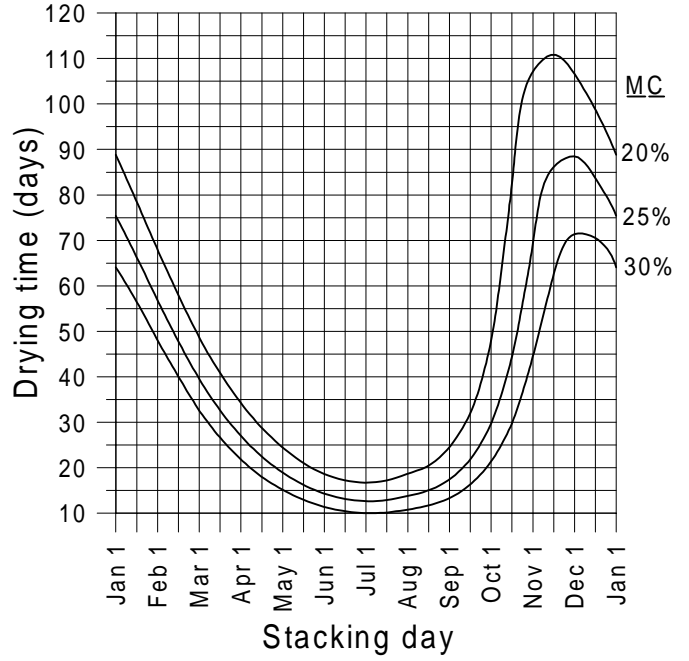
Yellow-poplar



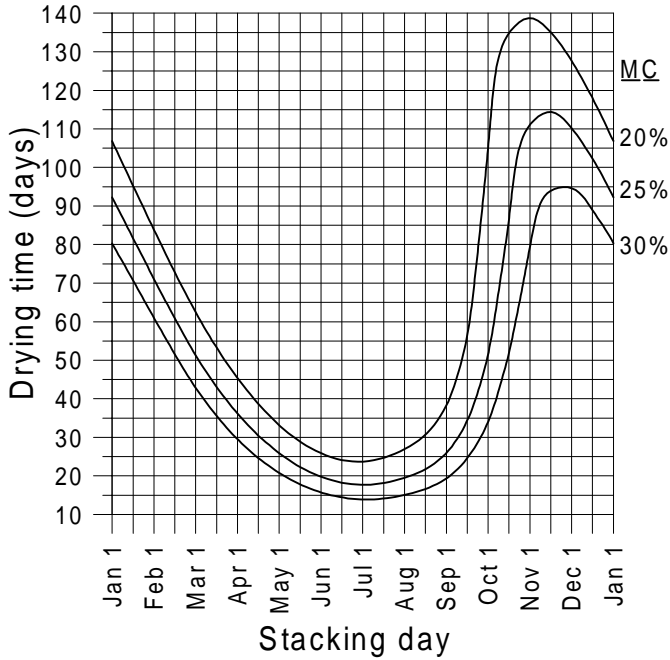
4/4 Yellow-poplar: Columbus, OH



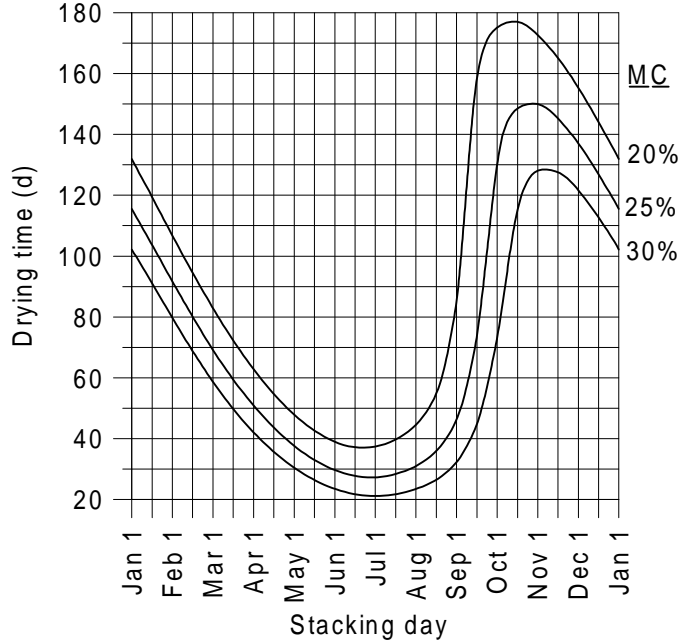
5/4 Yellow-poplar: Columbus, OH



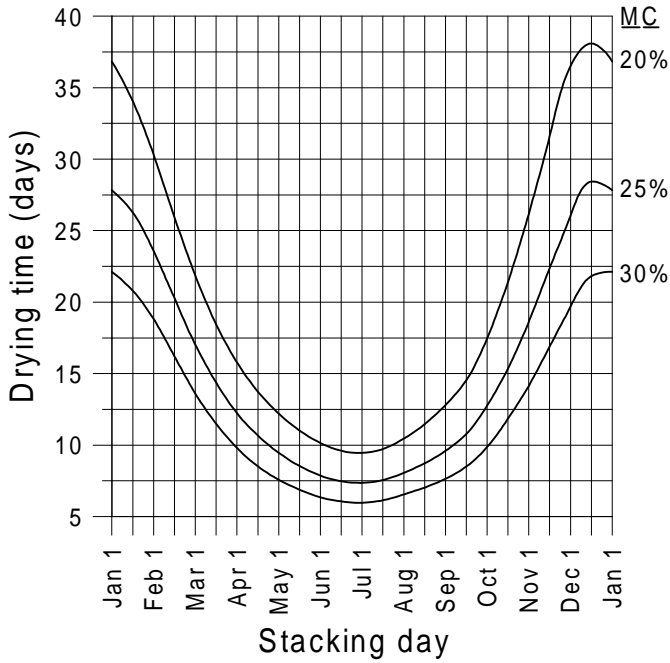
6/4 Yellow-poplar: Columbus, OH



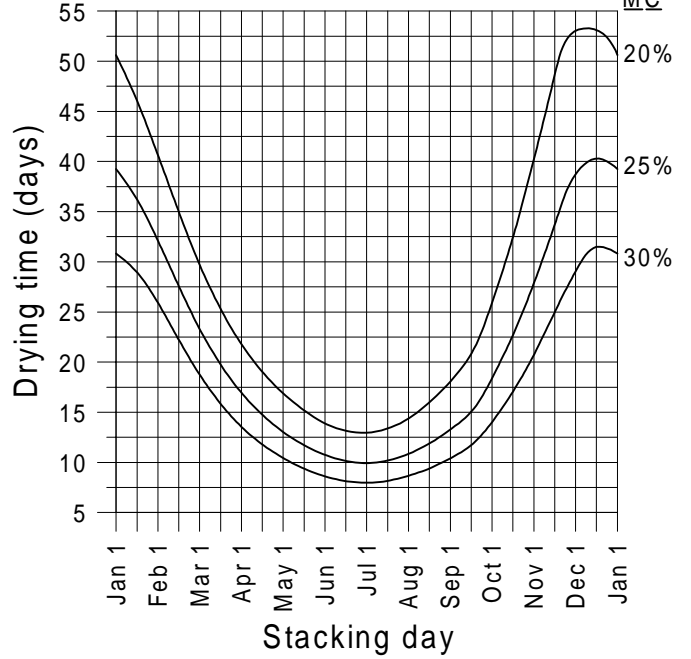
8/4 Yellow-poplar: Columbus, OH



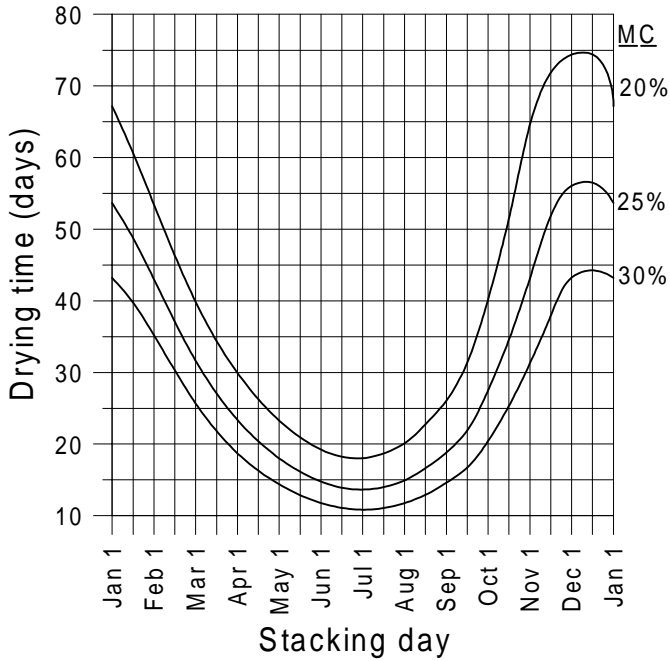
4/4 Yellow-poplar: Columbia, SC



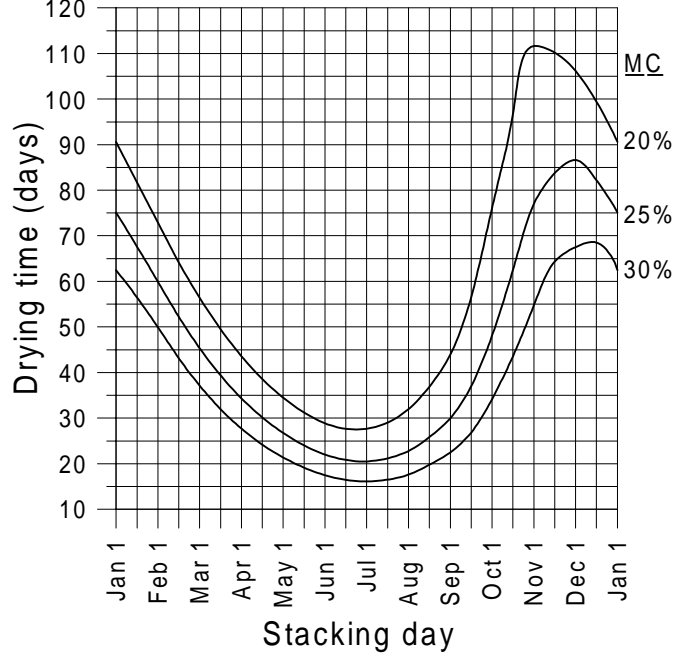
5/4 Yellow-poplar: Columbia, SC

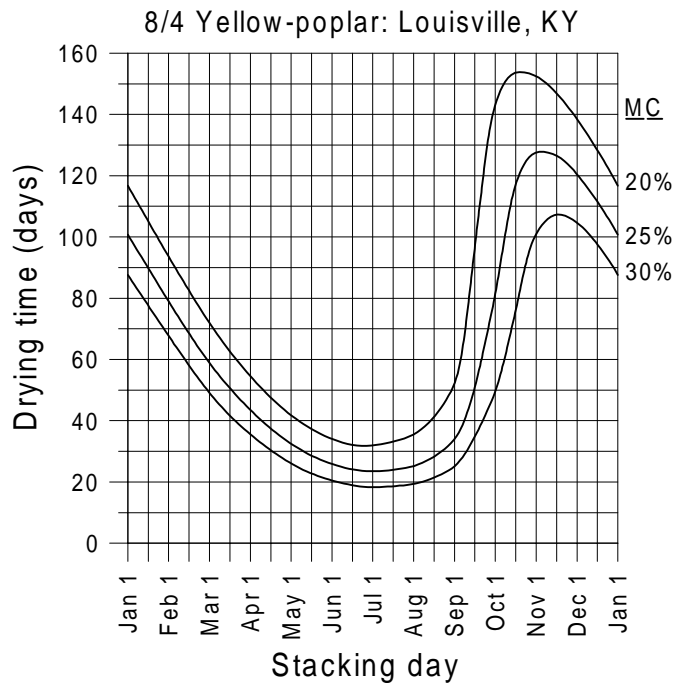
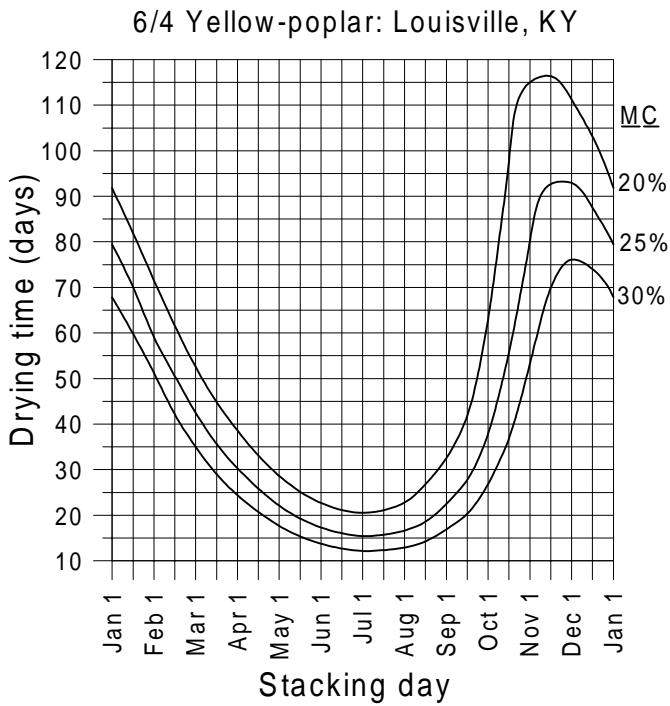
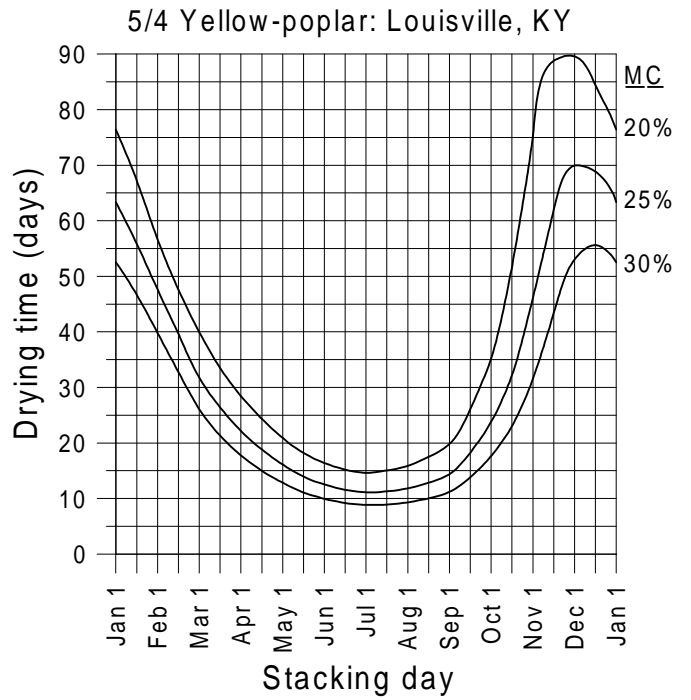
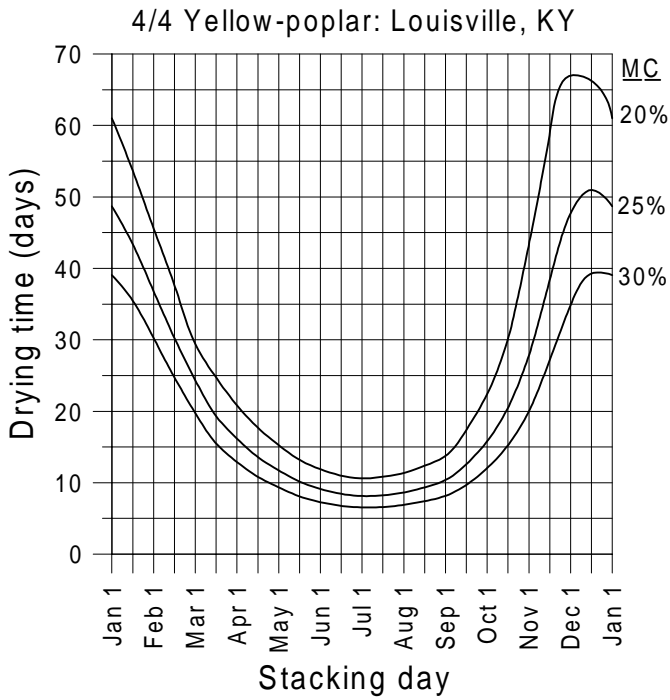


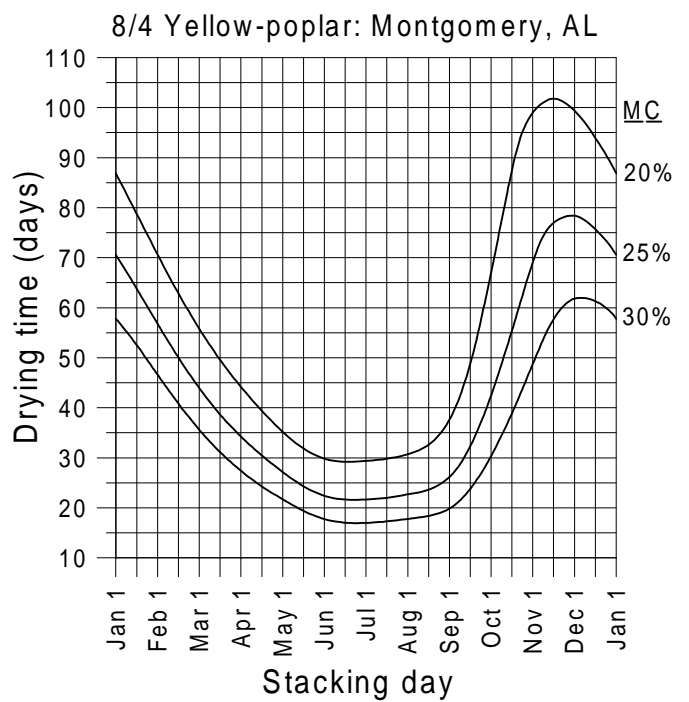
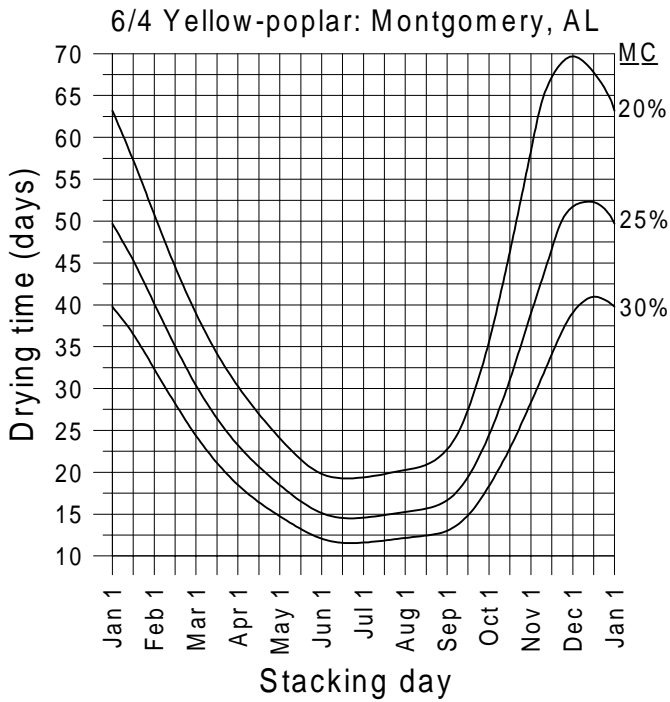
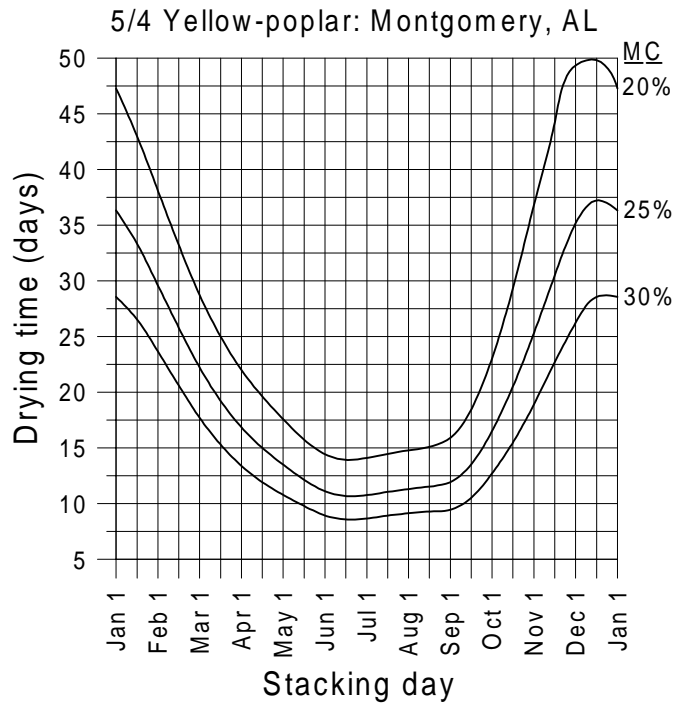
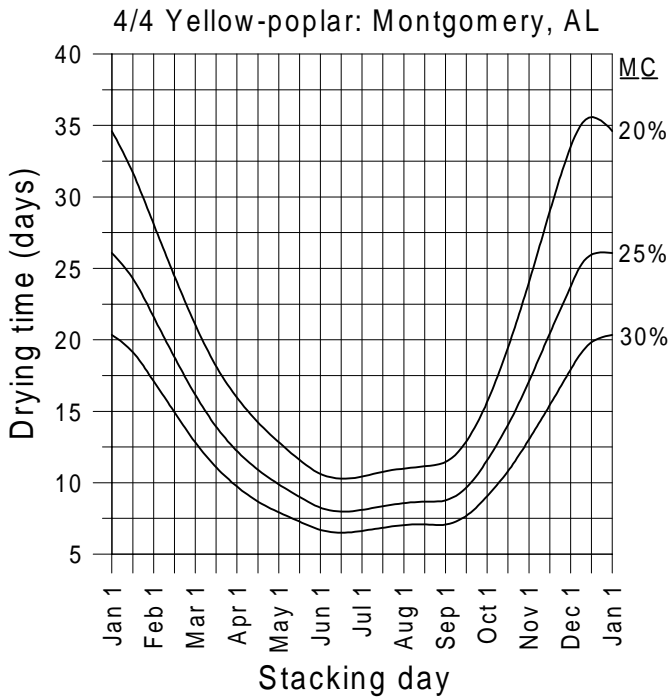
6/4 Yellow-poplar: Columbia, SC



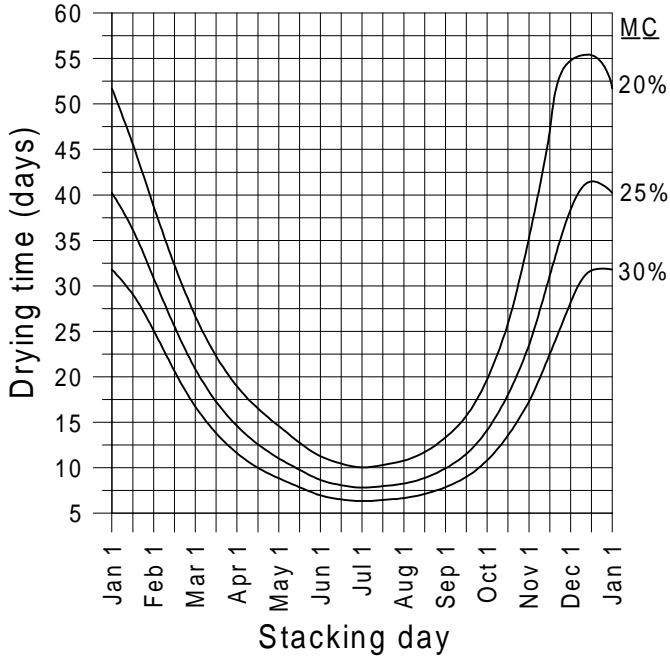
8/4 Yellow-poplar; Columbia, SC



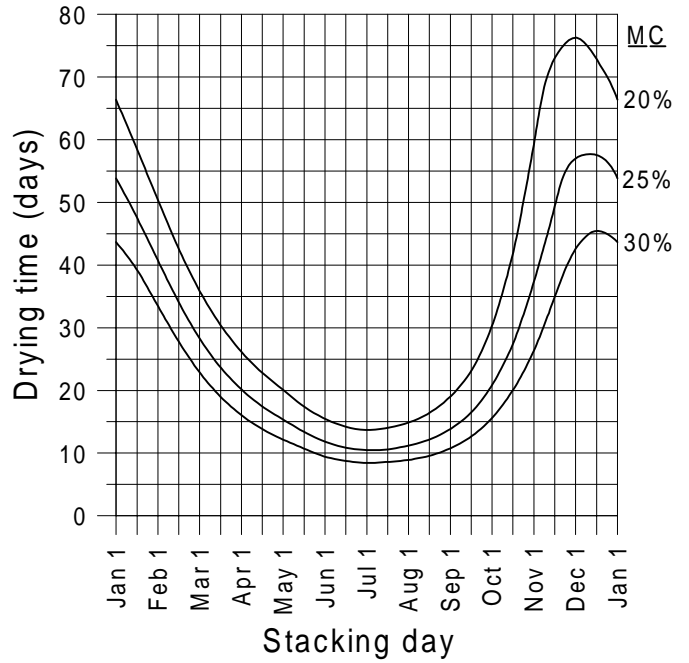




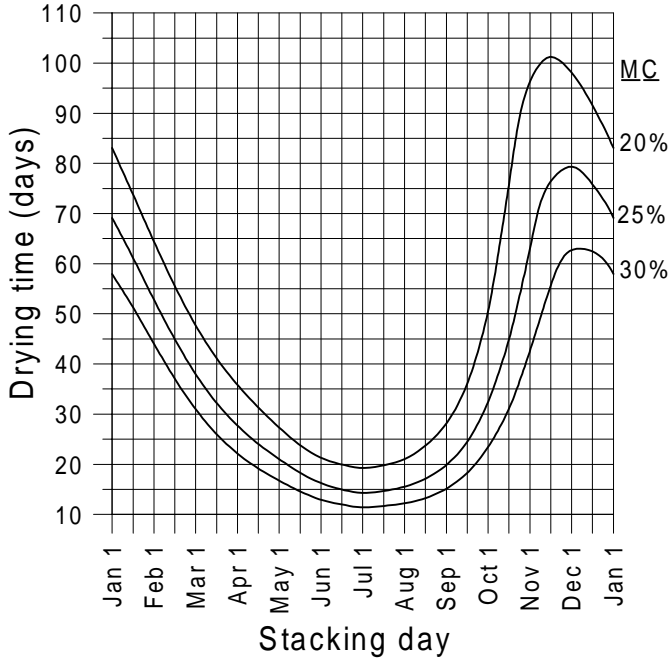
4/4 Yellow-poplar: Nashville, TN



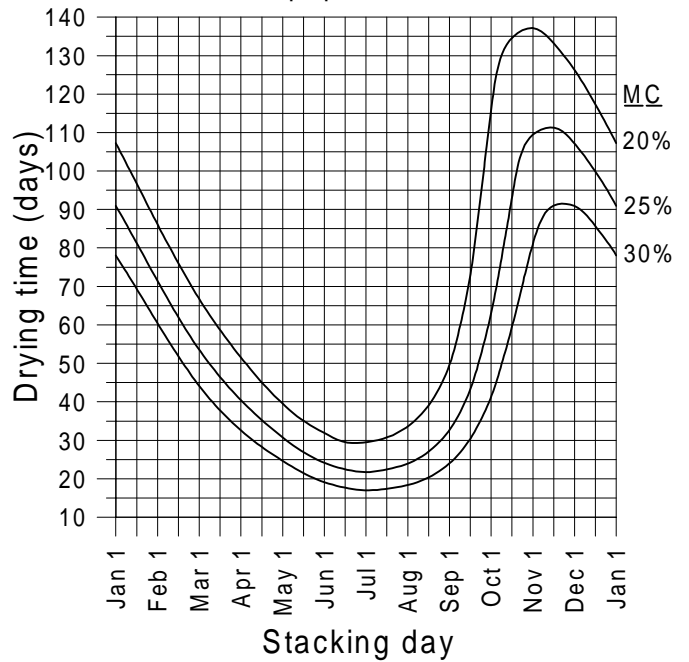
5/4 Yellow-poplar: Nashville, TN

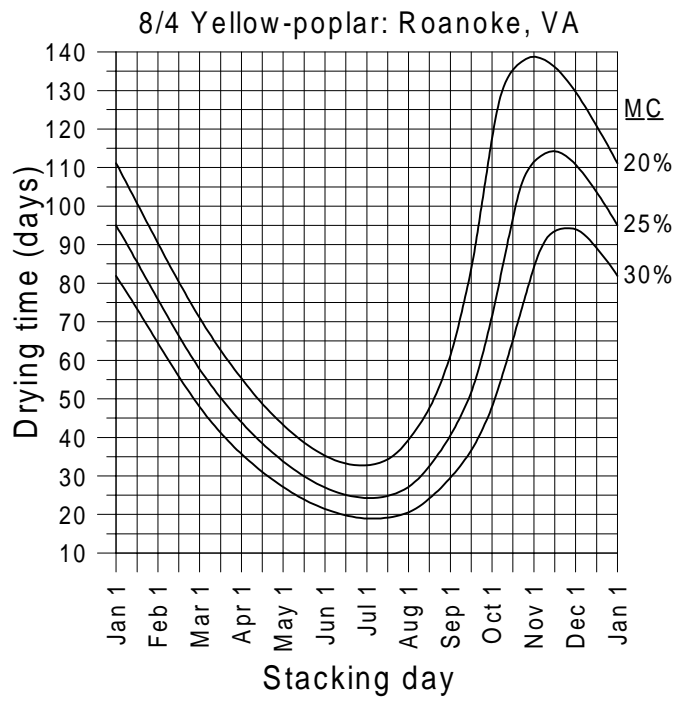
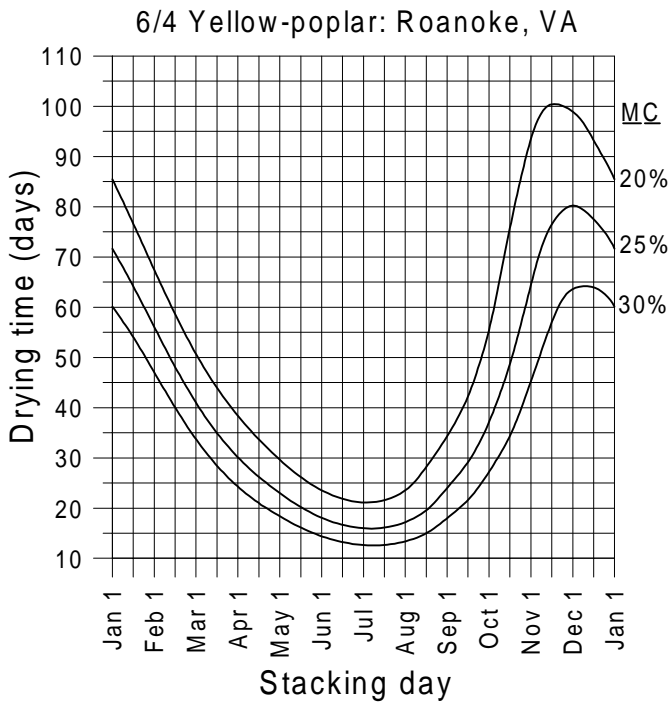
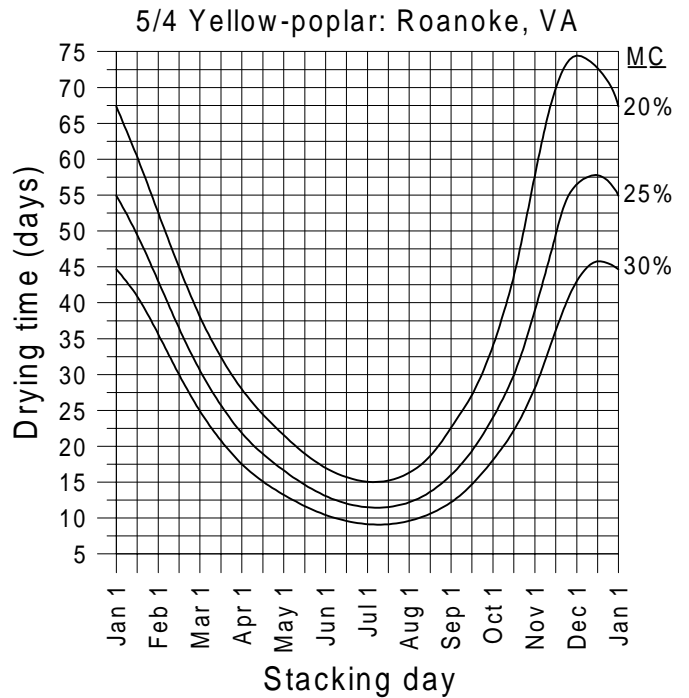
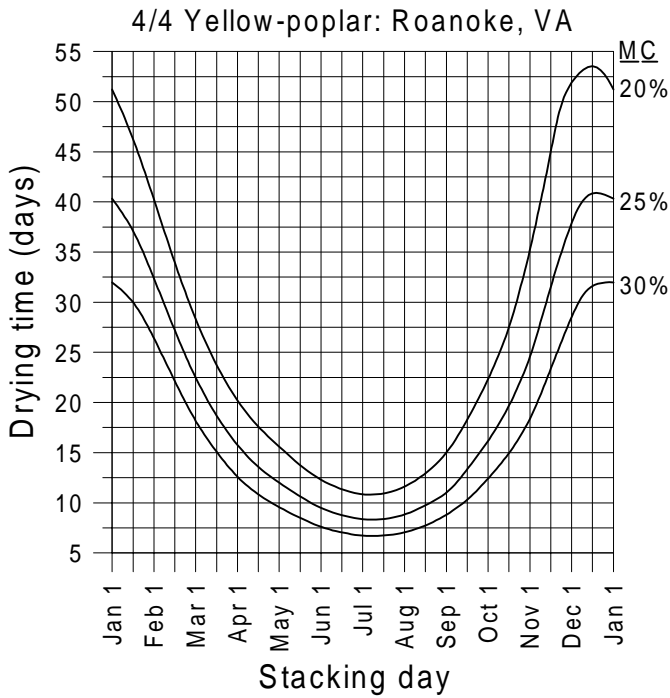


6/4 Yellow-poplar: Nashville, TN



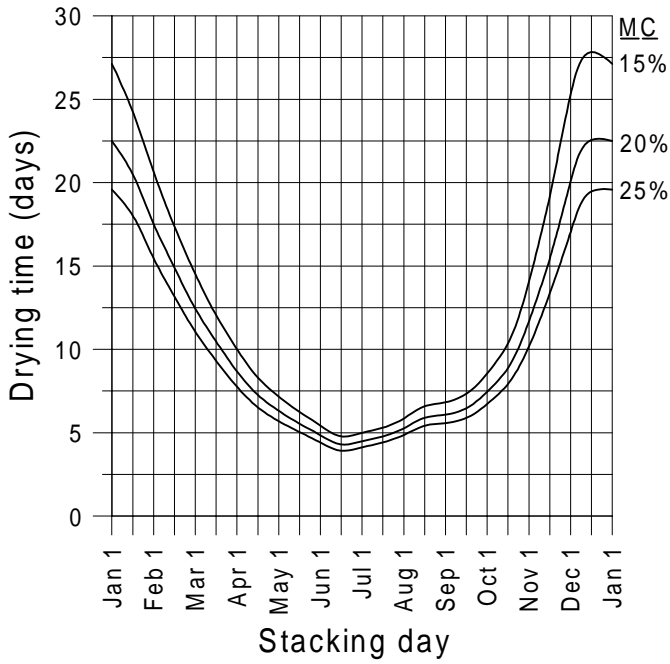
8/4 Yellow-poplar: Nashville, TN



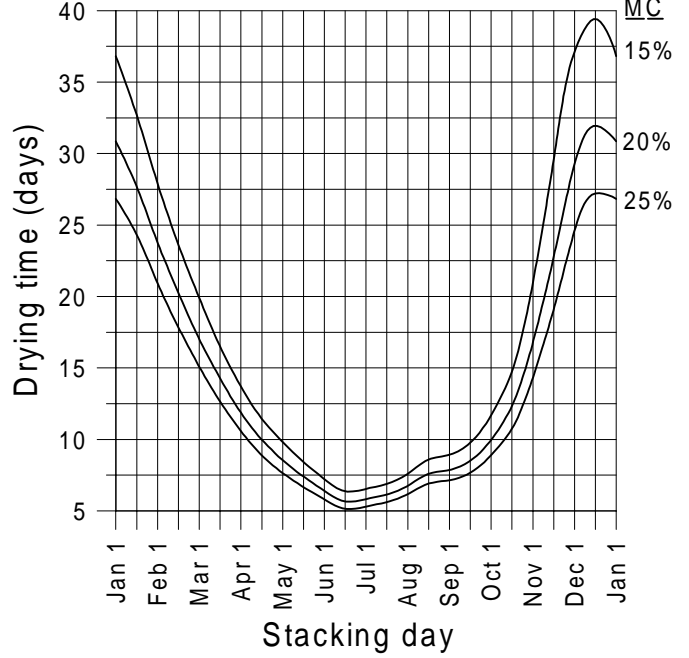


Ponderosa Pine

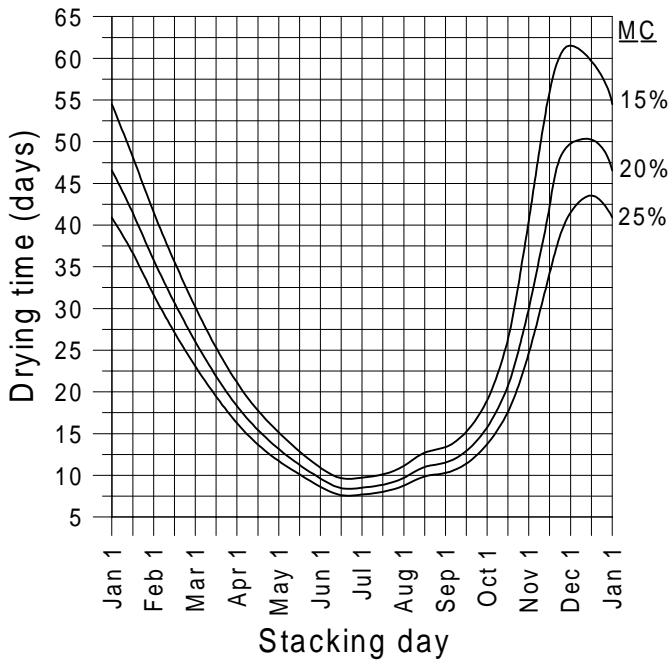
4/4 Ponderosa pine: Albuquerque, NM



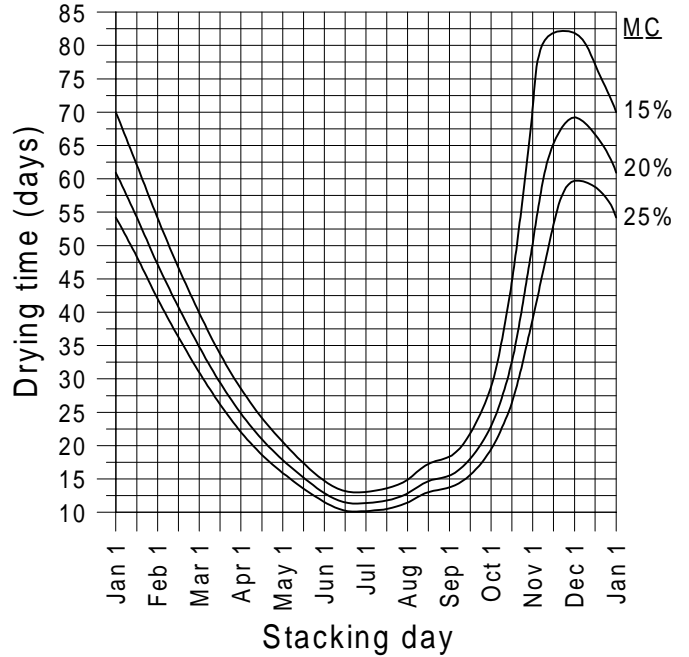
5/4 Ponderosa pine: Albuquerque, NM

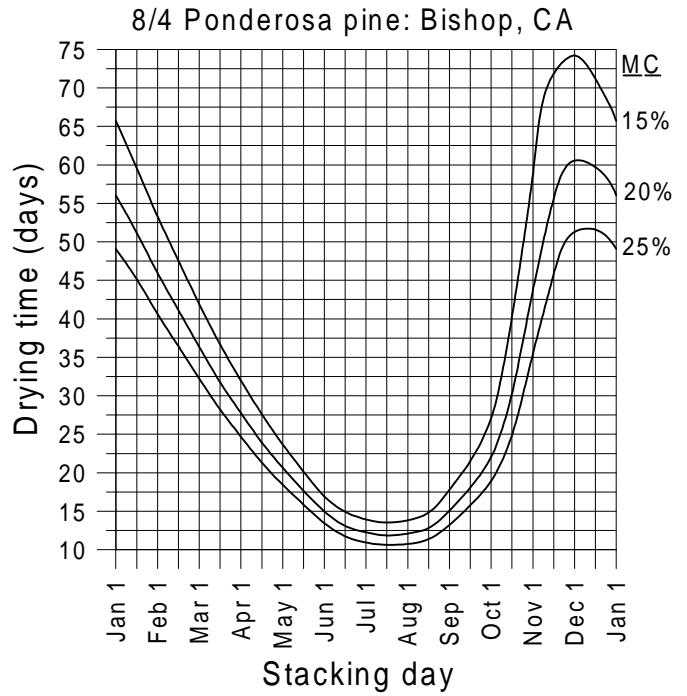
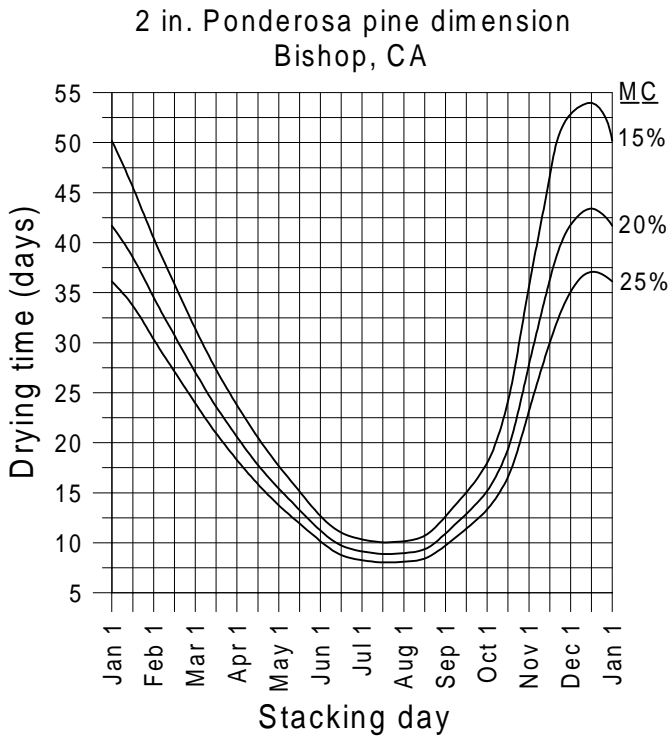
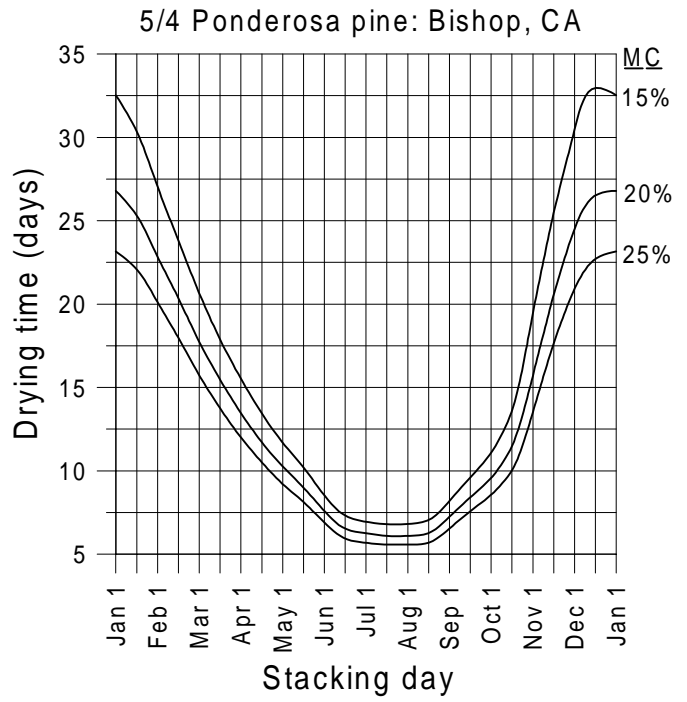
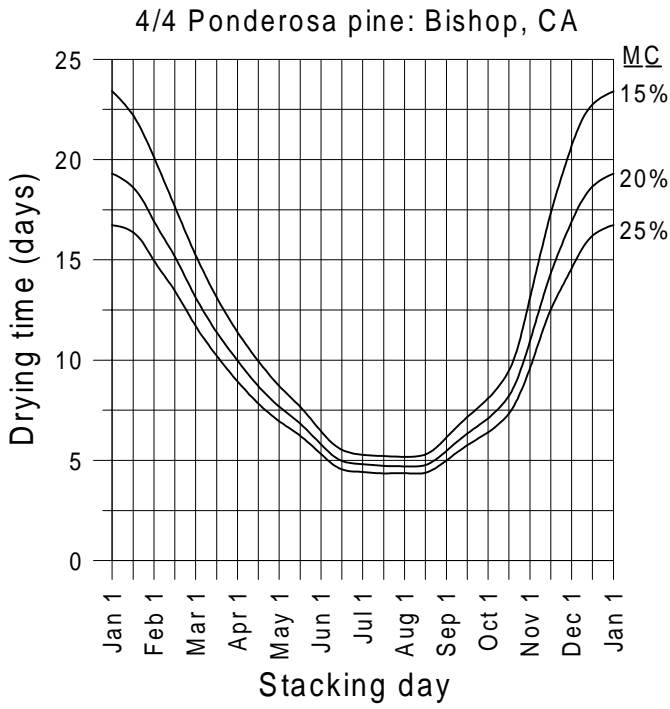


2 in. Ponderosa pine dimension
Albuquerque, NM

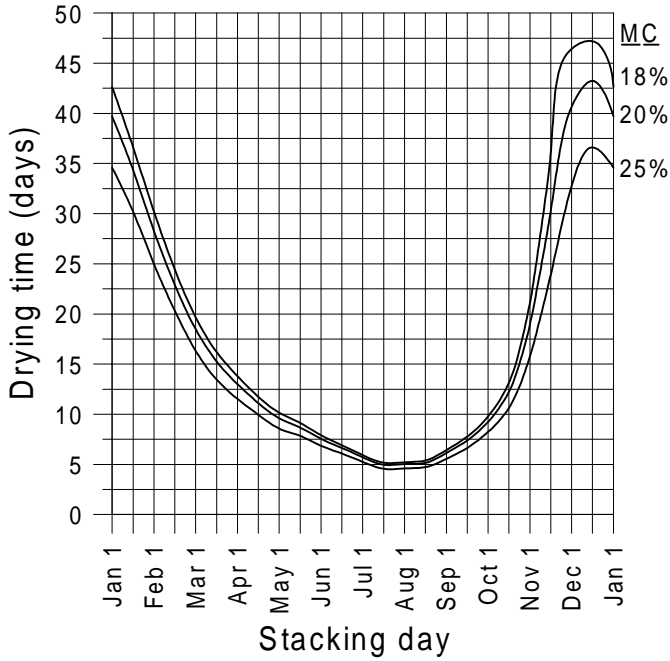


8/4 Ponderosa pine: Albuquerque, NM

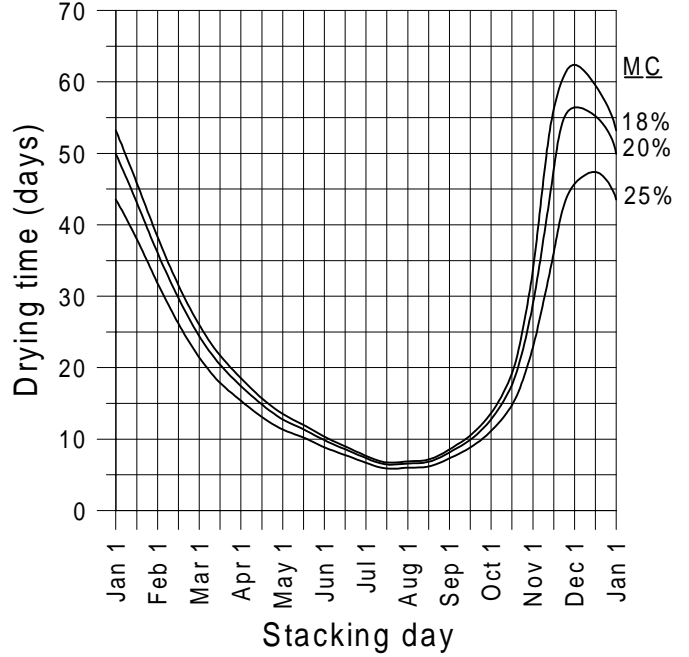




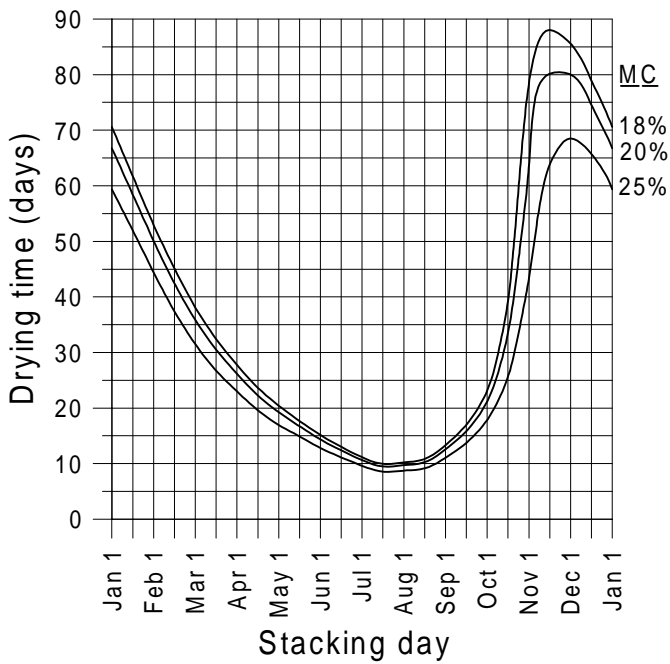
4/4 Ponderosa pine: Boise, ID



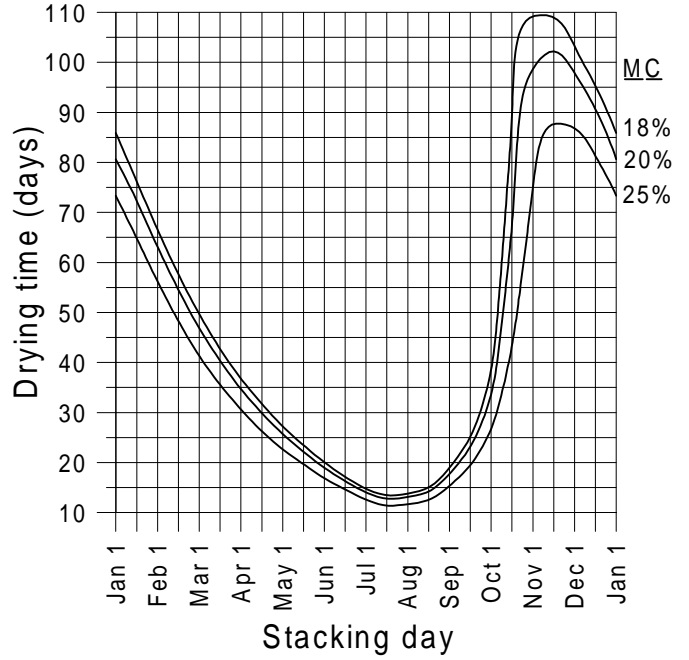
5/4 Ponderosa pine: Boise, ID

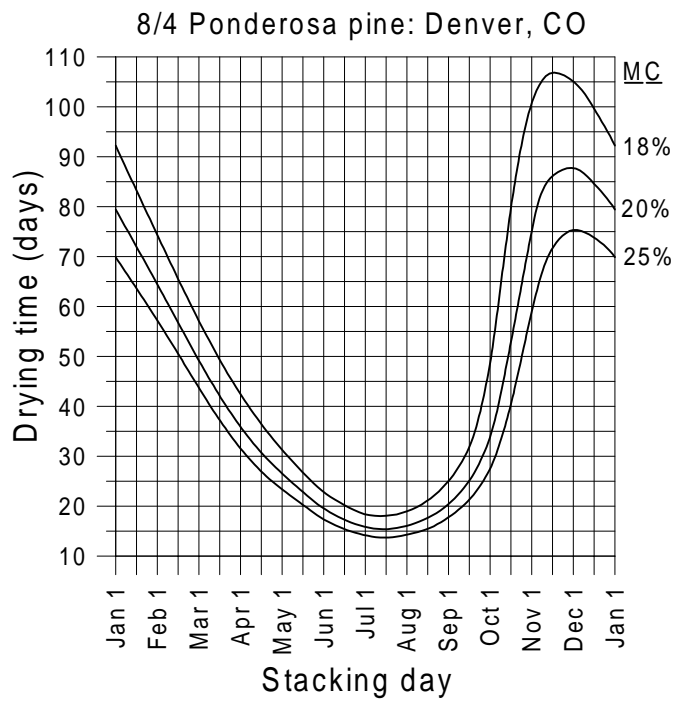
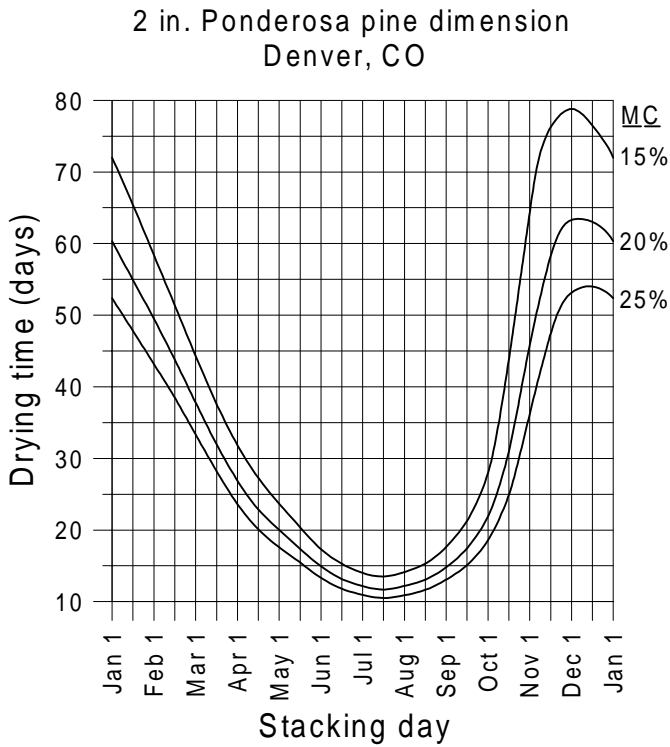
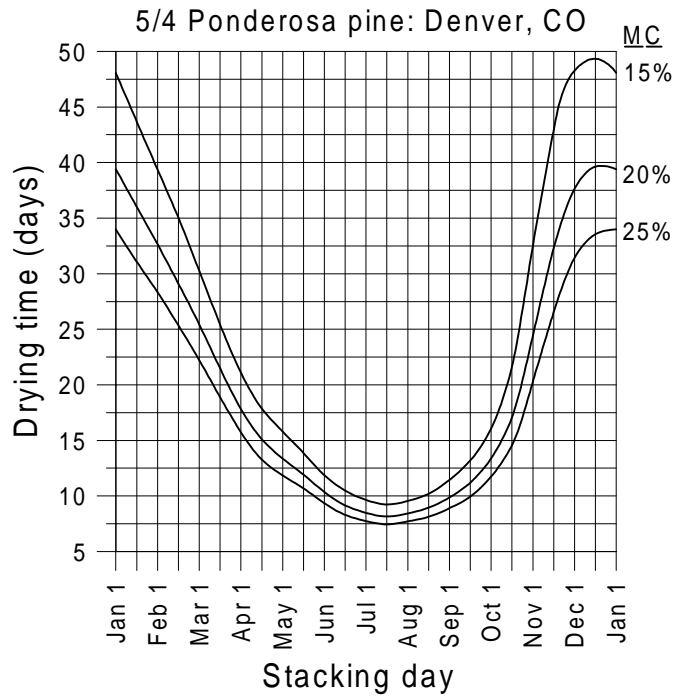
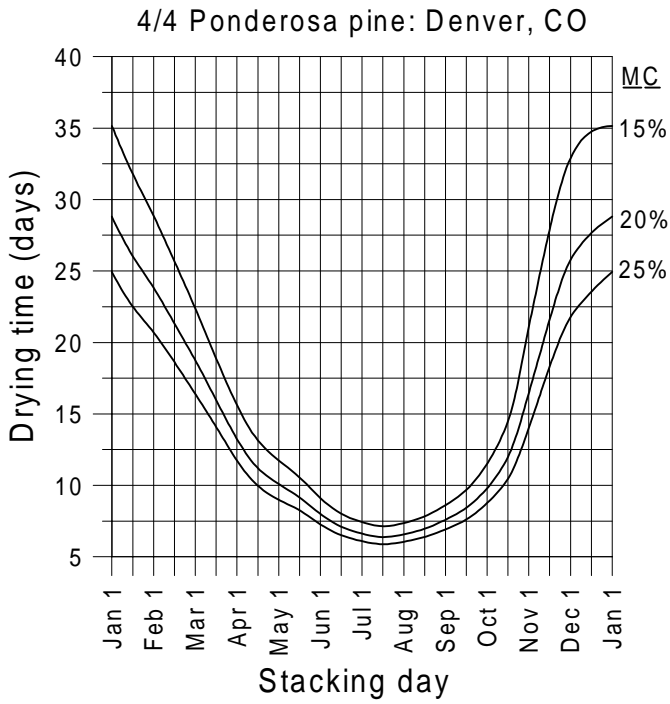


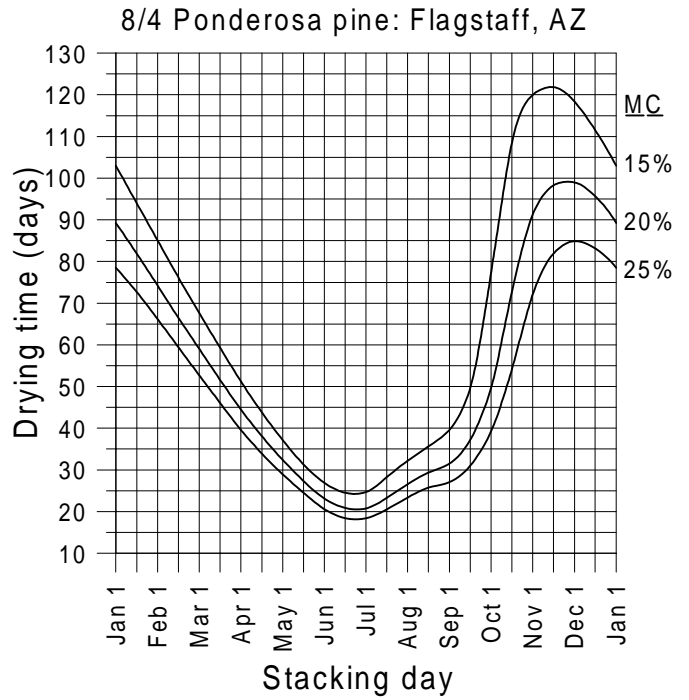
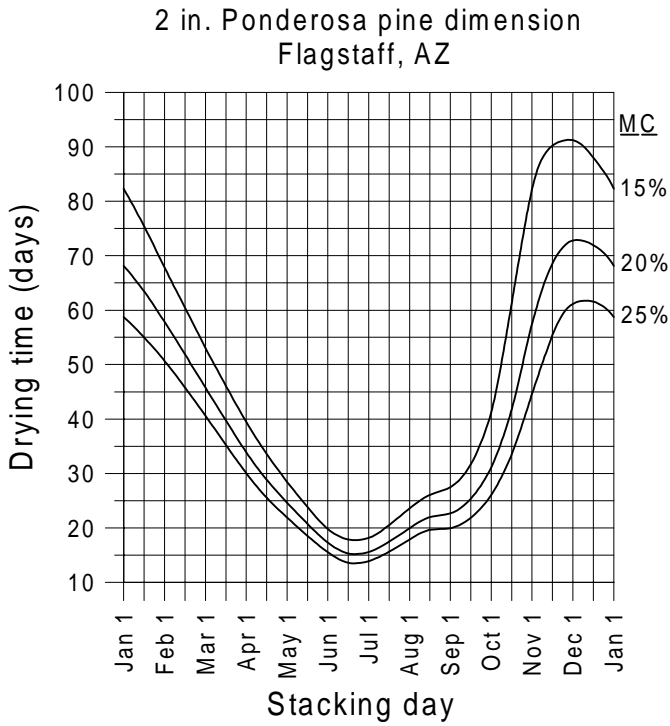
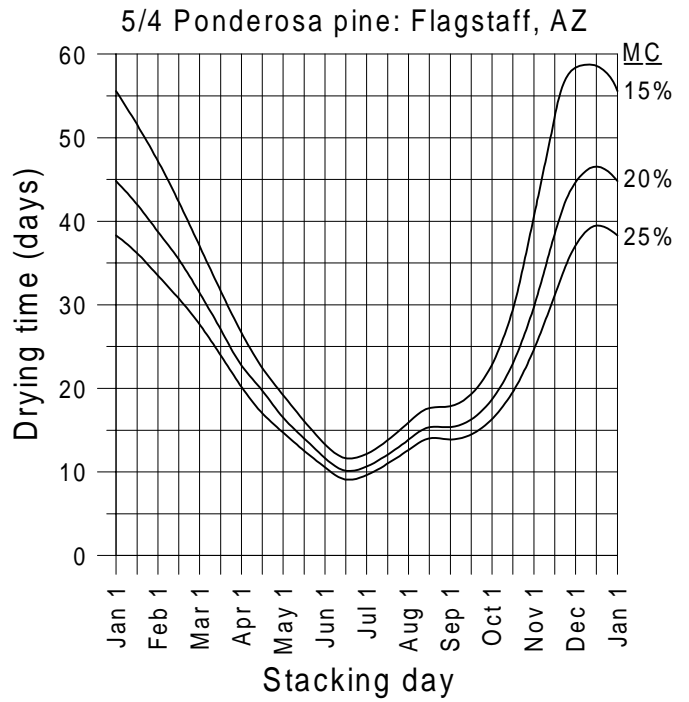
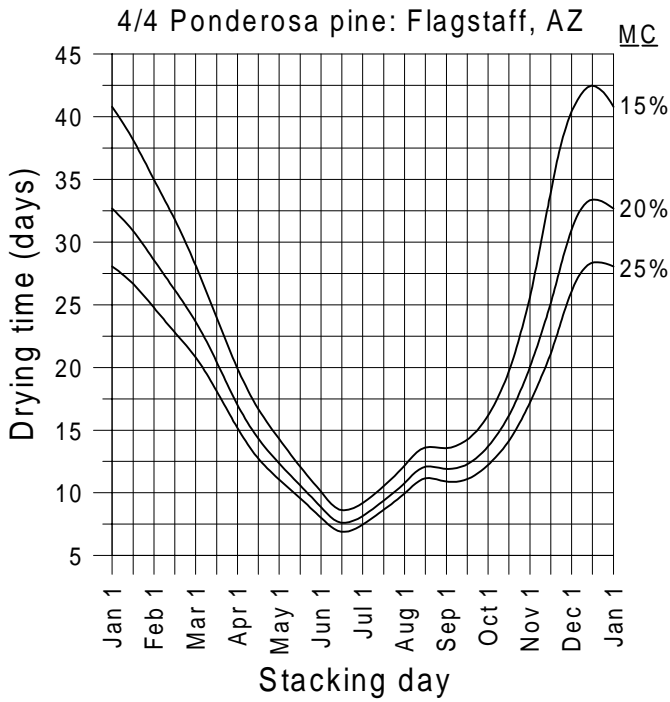
2 in. Ponderosa pine dimension
Boise, ID

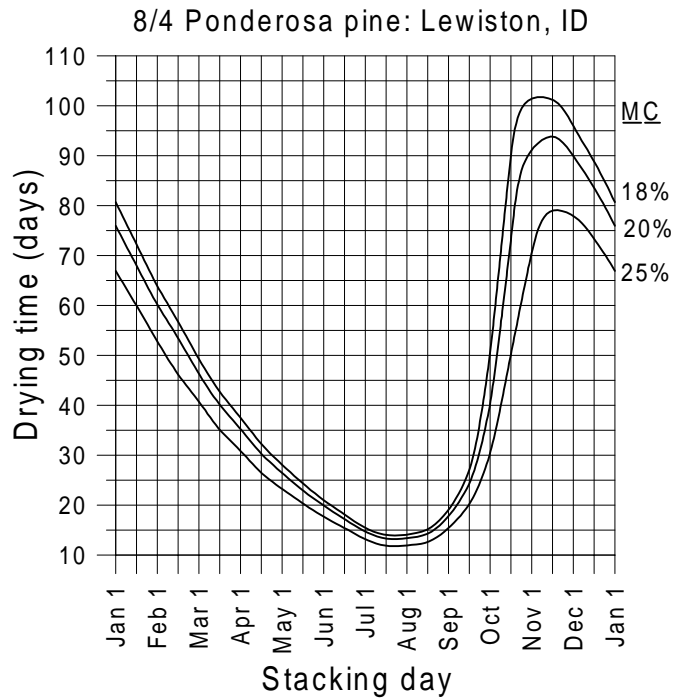
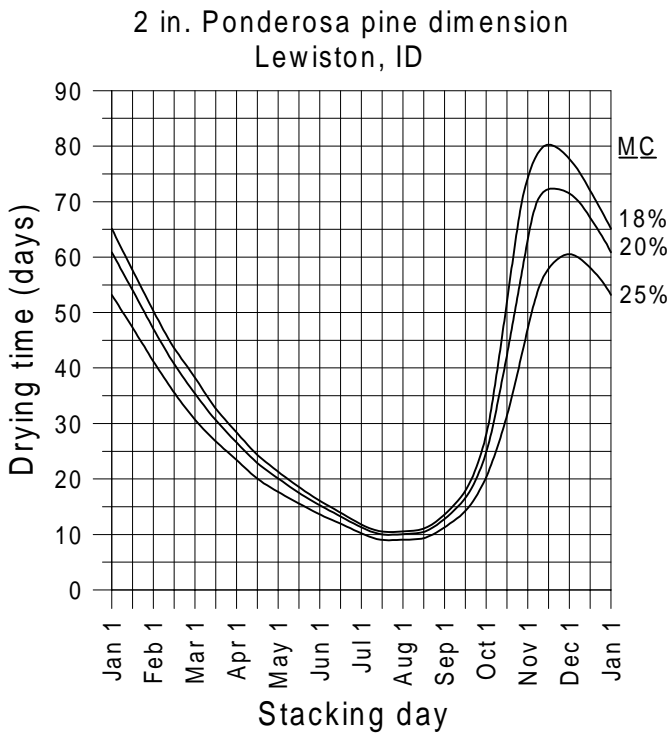
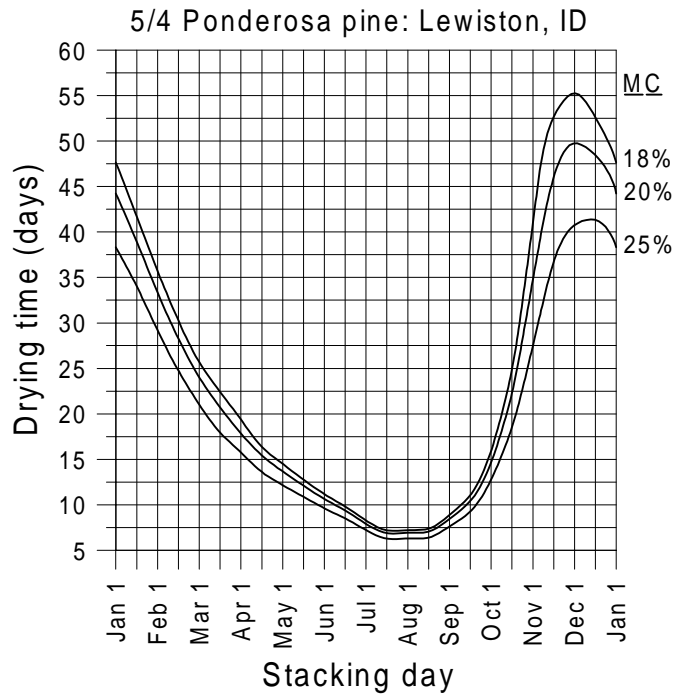
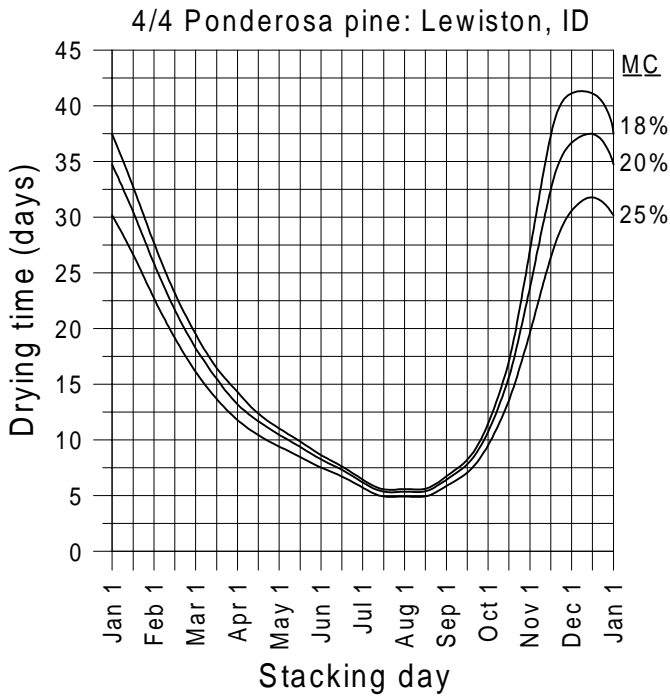


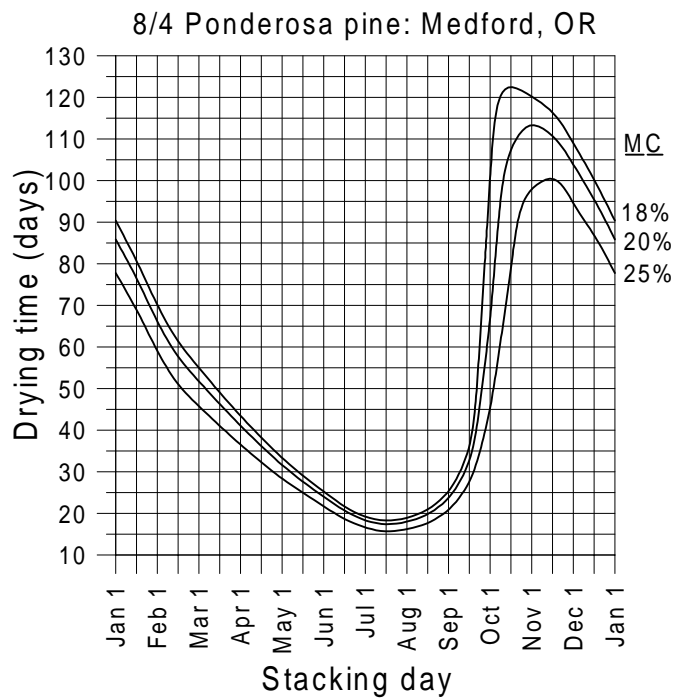
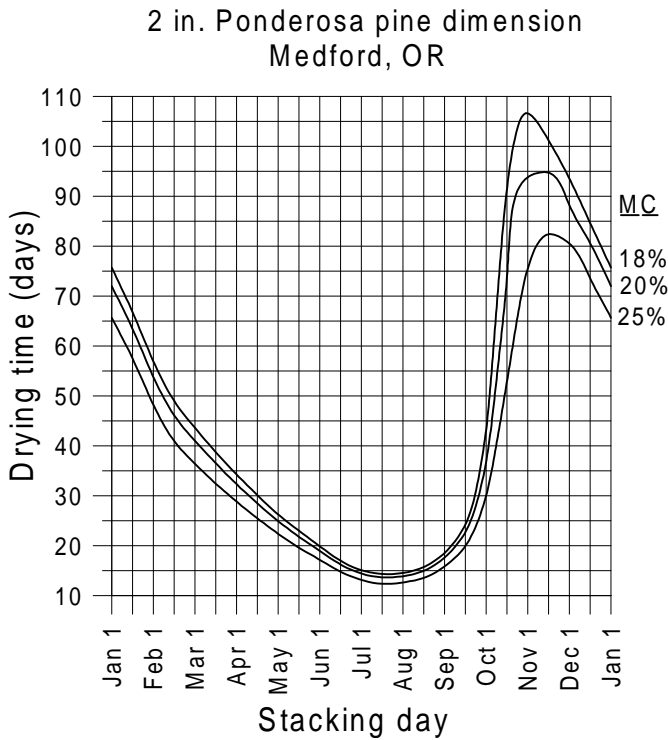
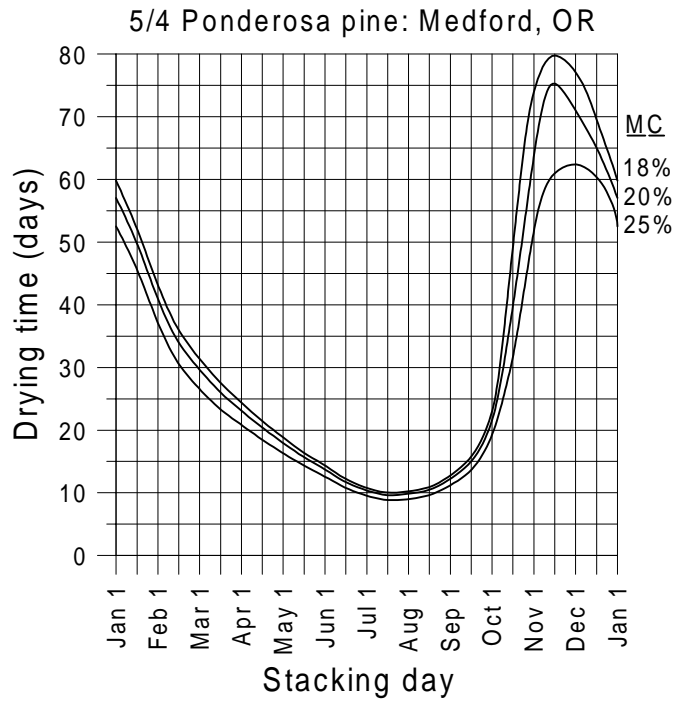
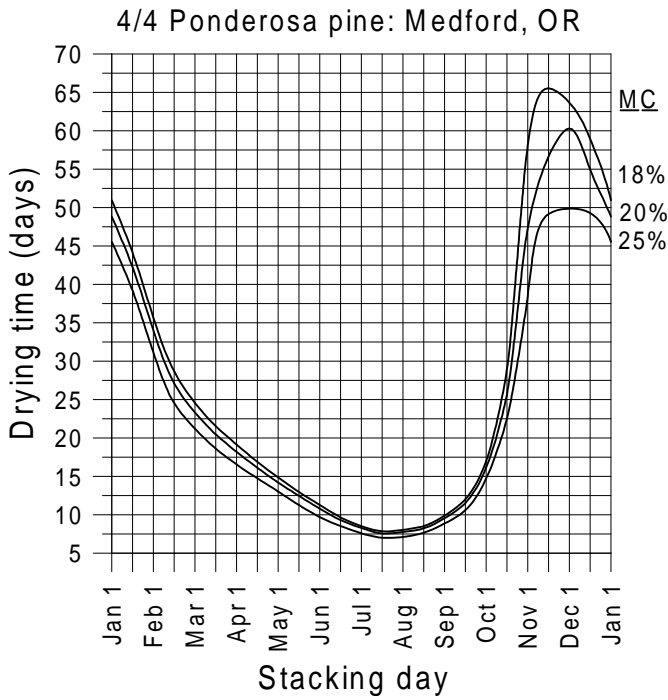
8/4 Ponderosa pine: Boise, ID

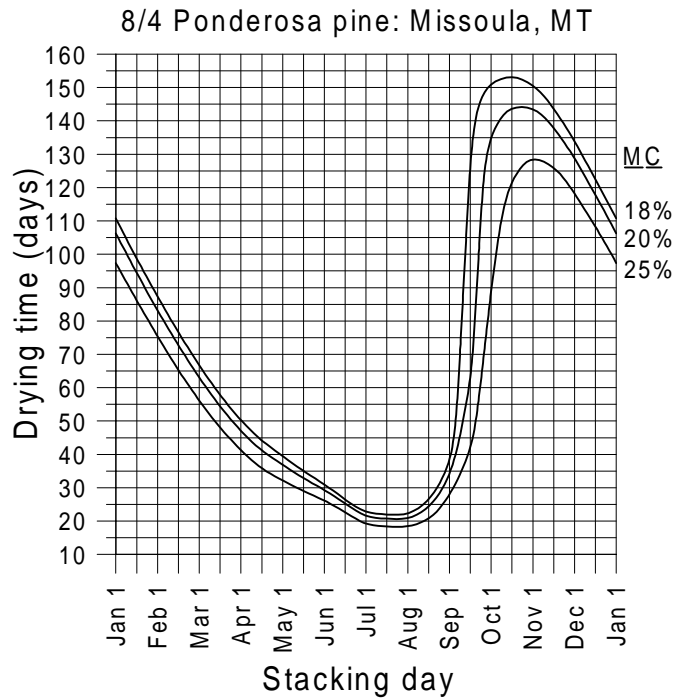
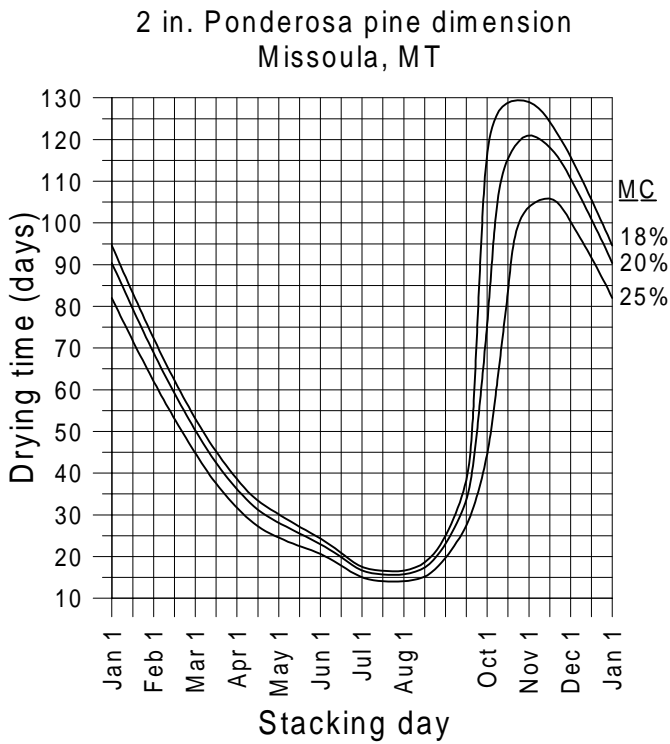
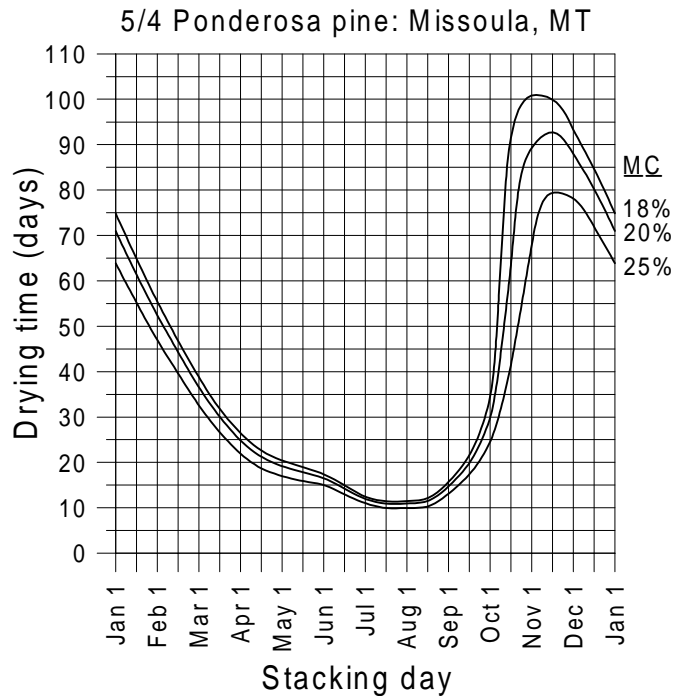
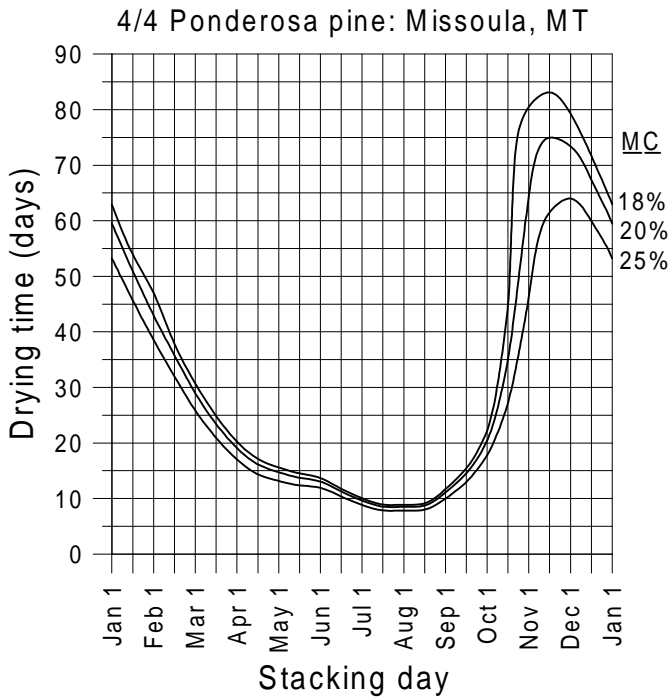


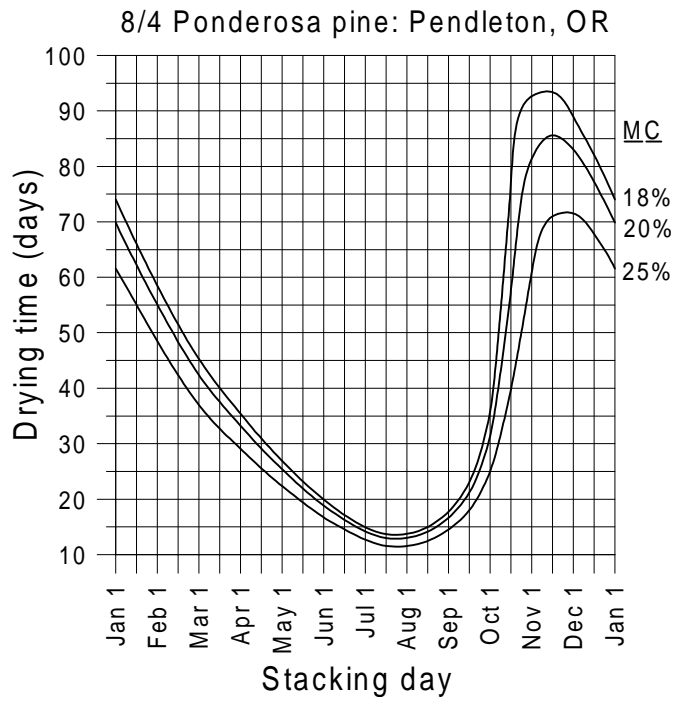
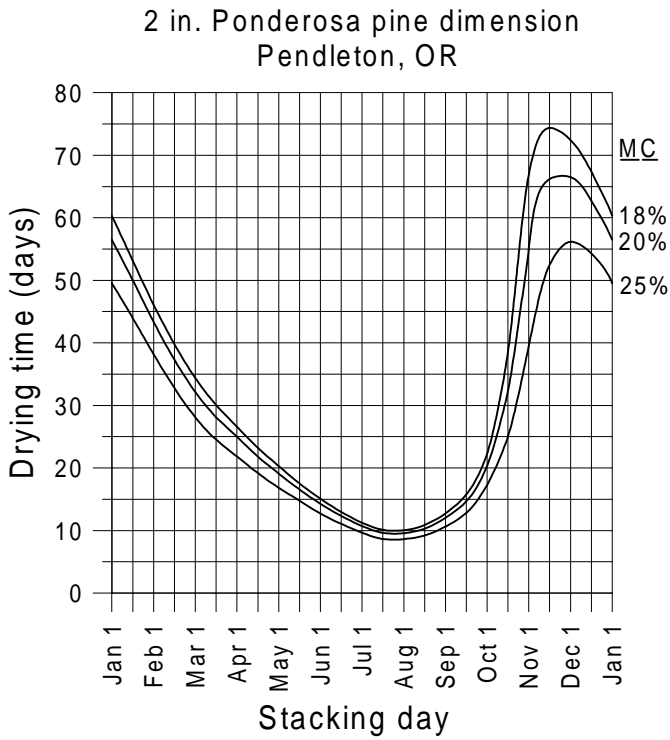
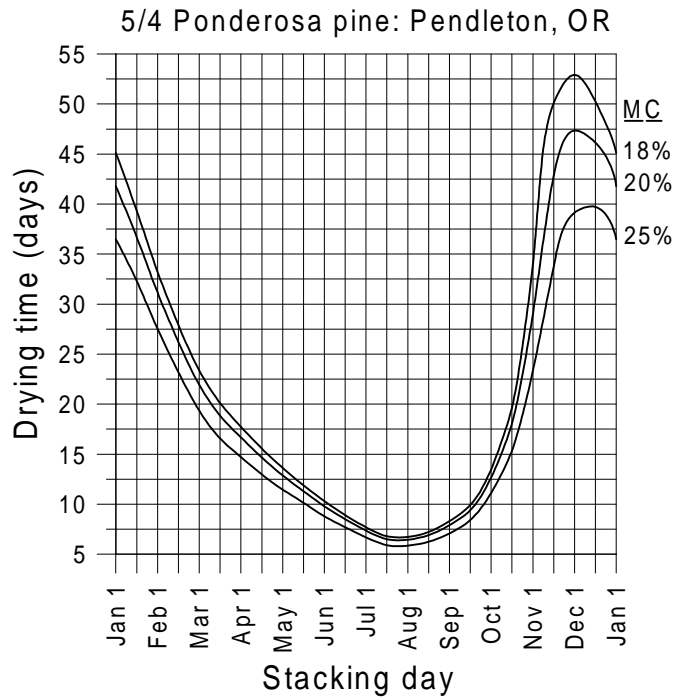
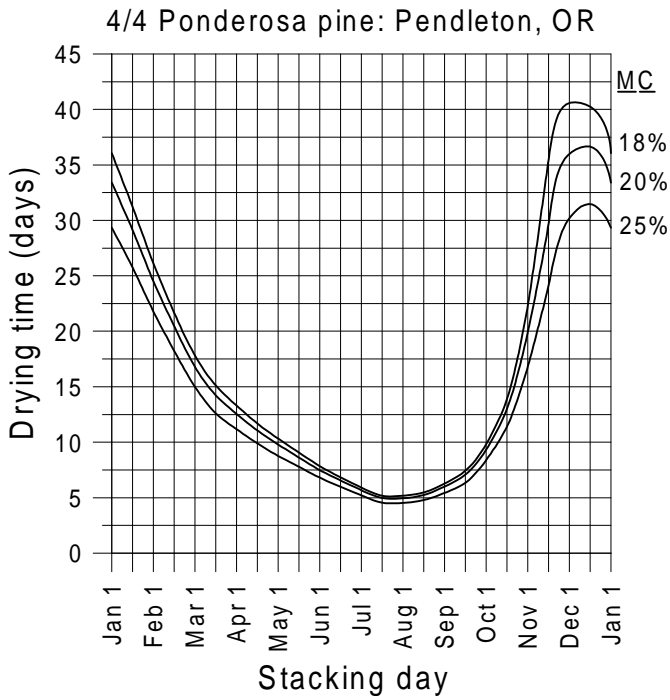


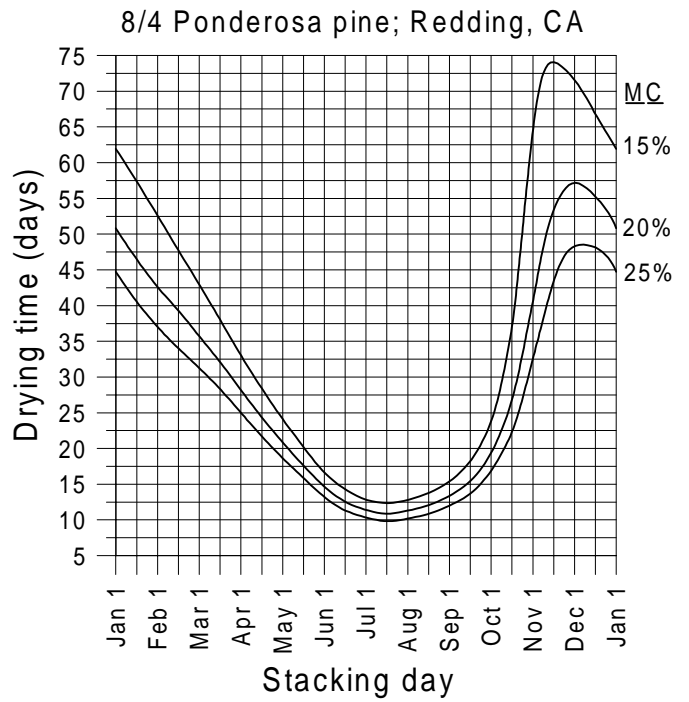
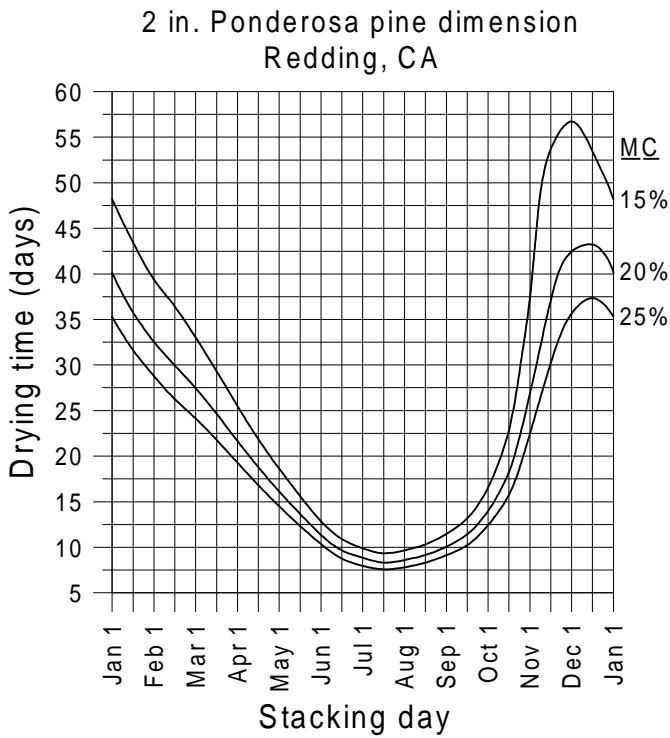
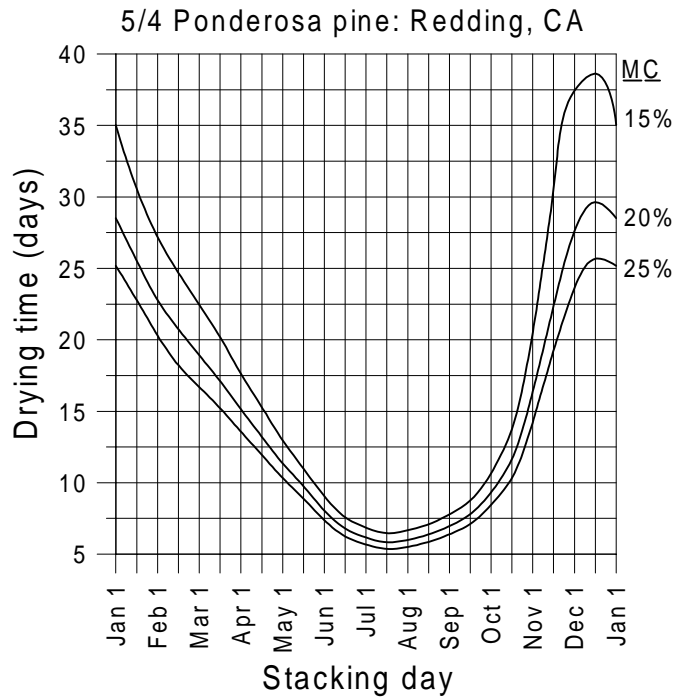
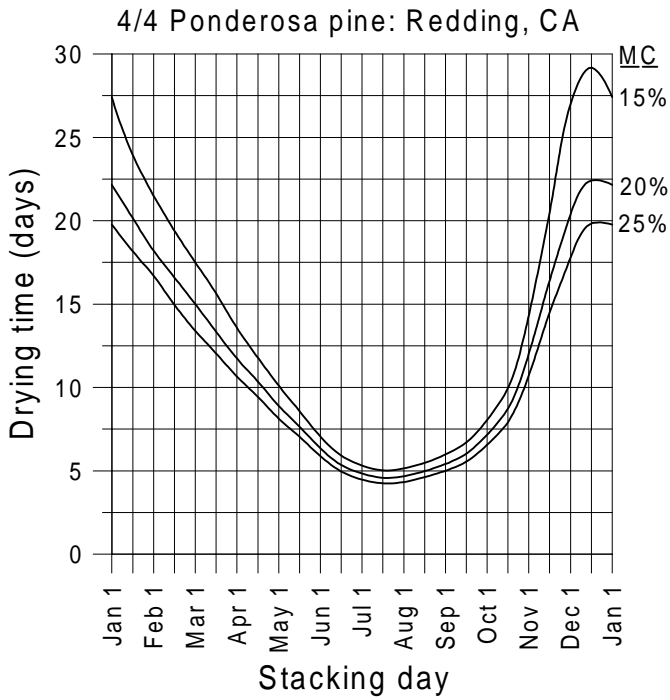


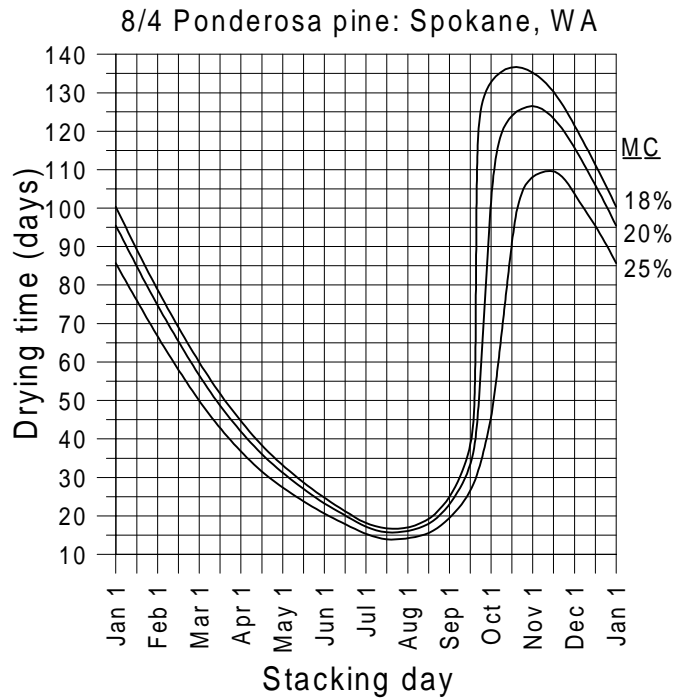
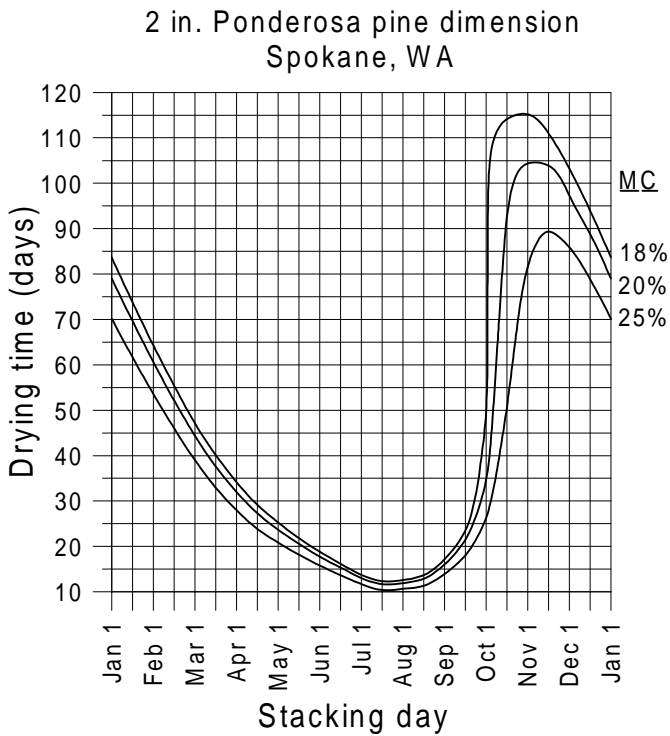
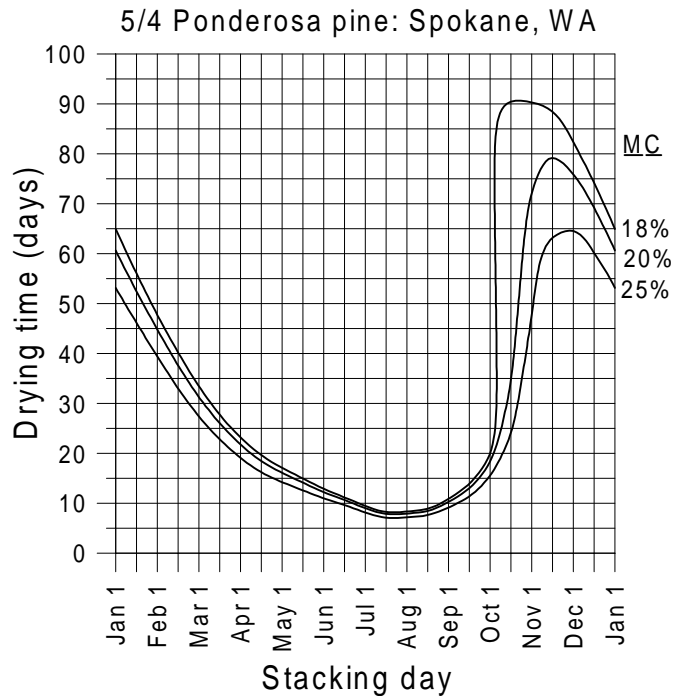
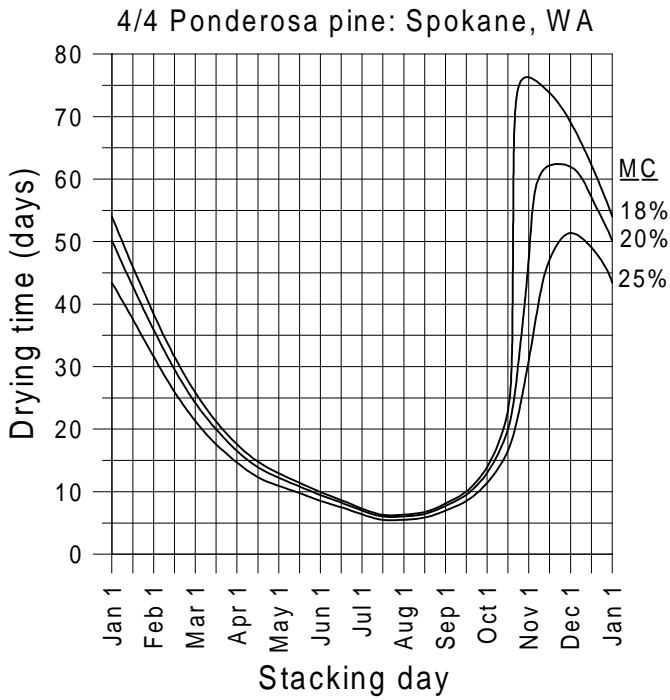


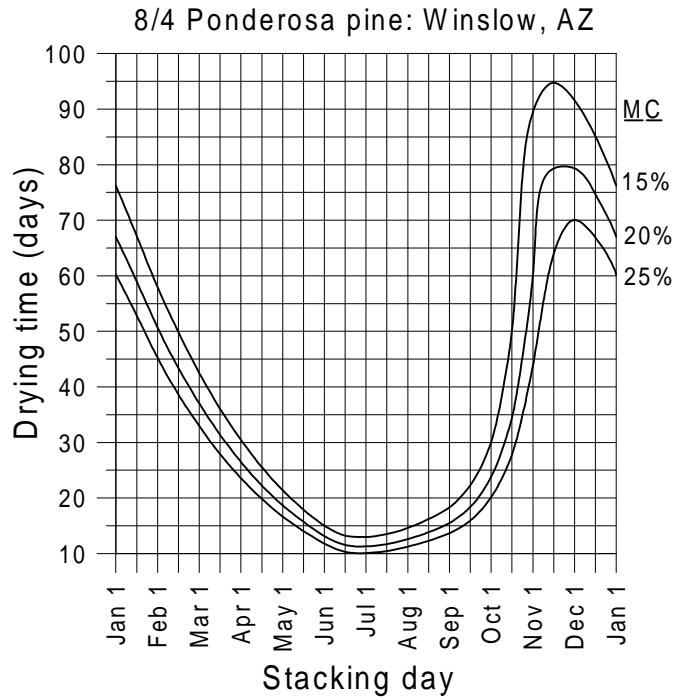
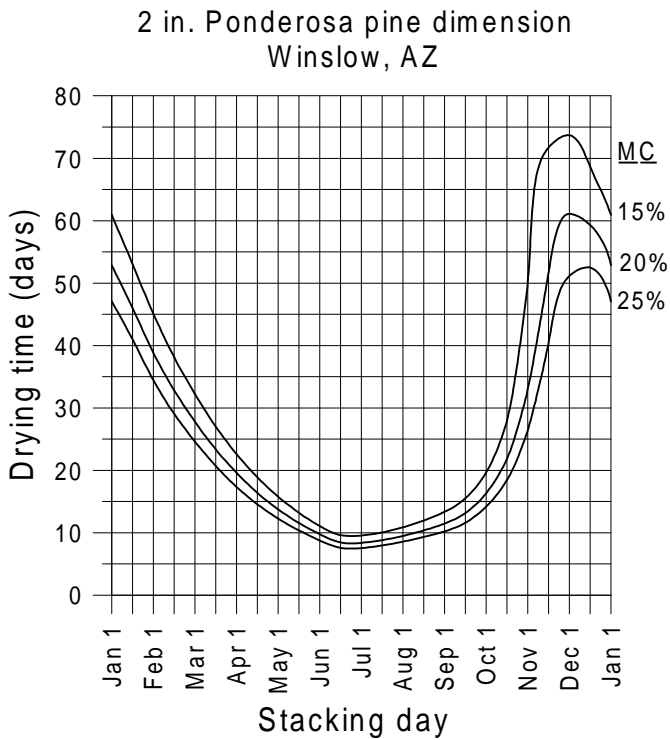
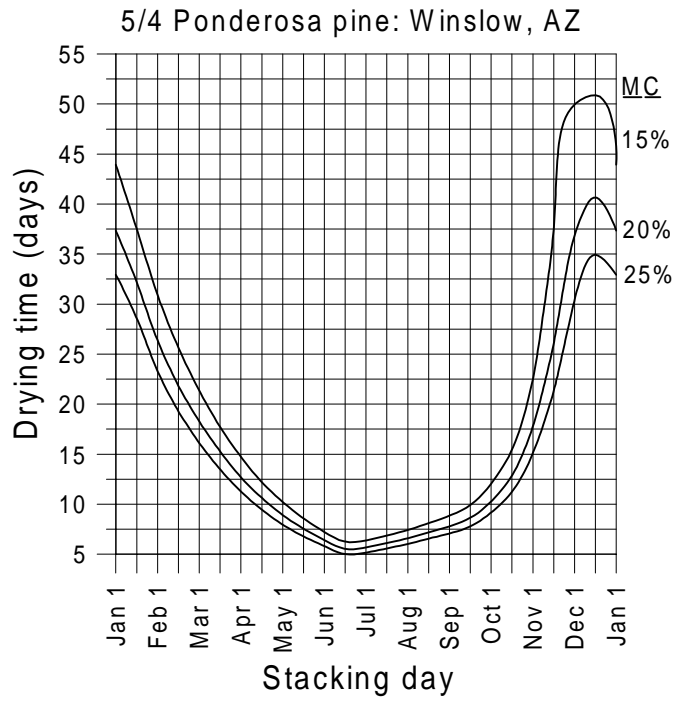
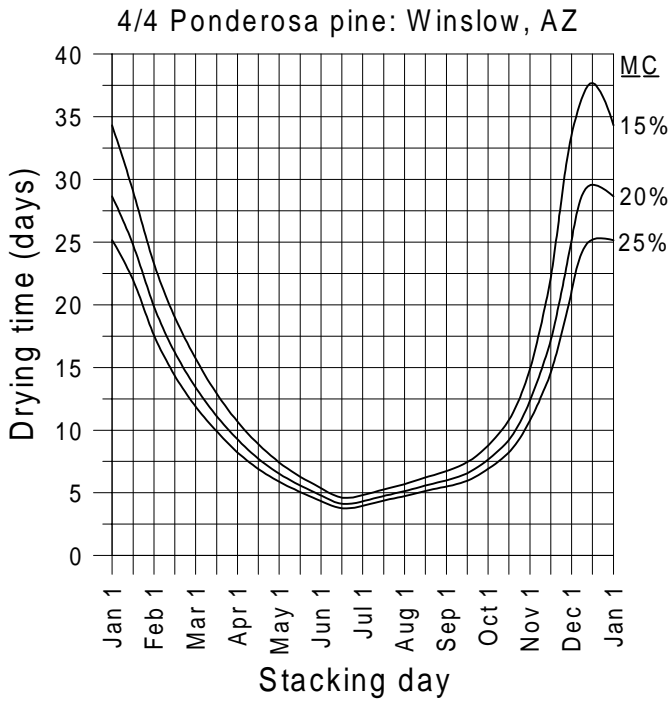






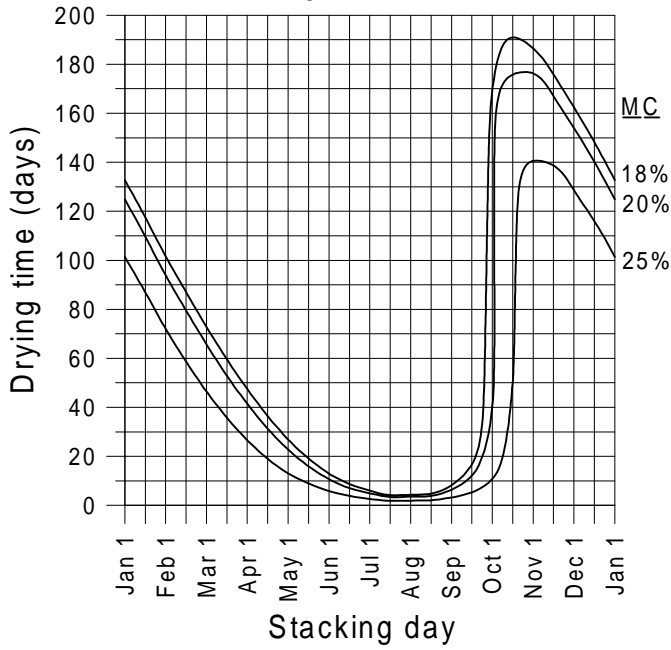




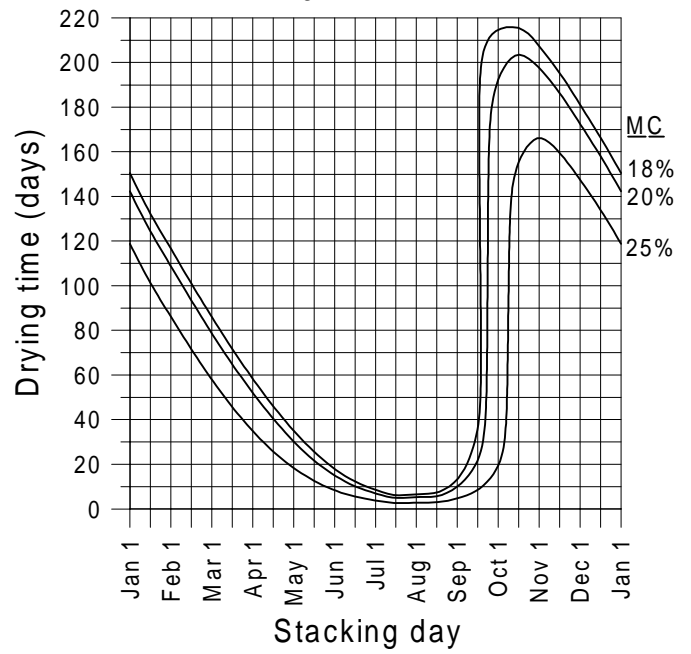


Douglas-fir

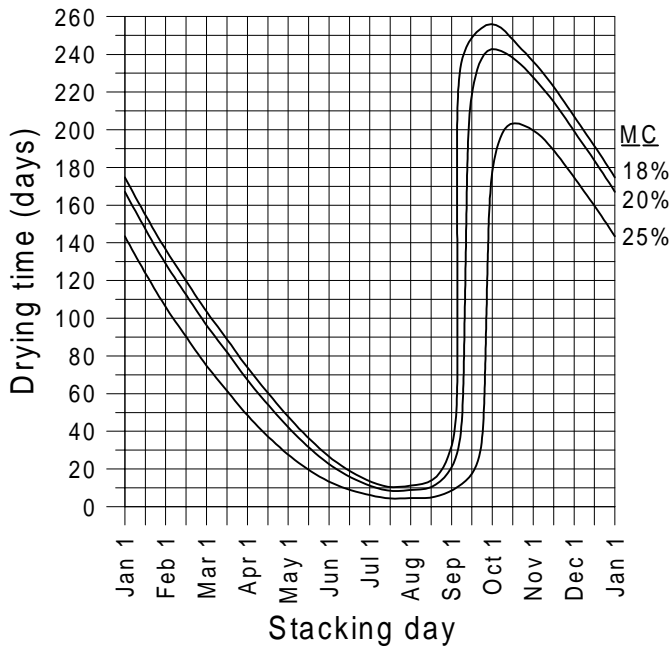
4/4 Douglas-fir: Boise, ID



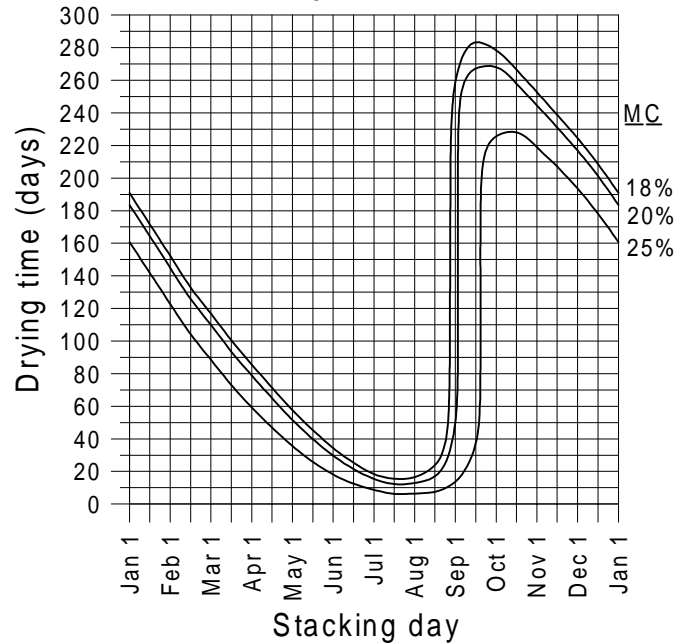
5/4 Douglas-fir: Boise, ID

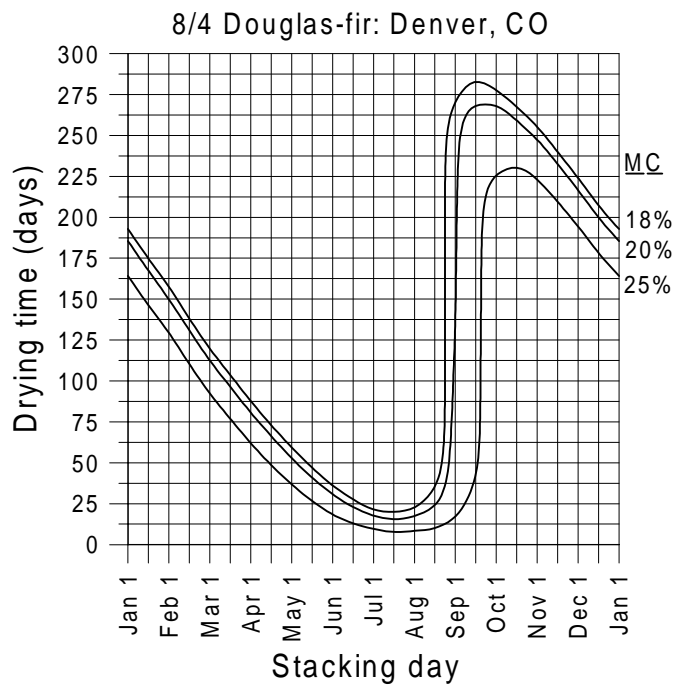
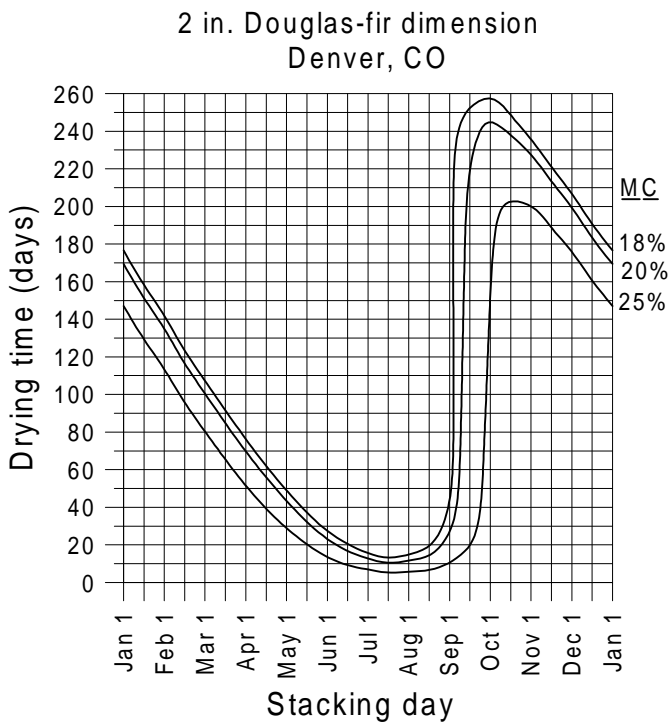
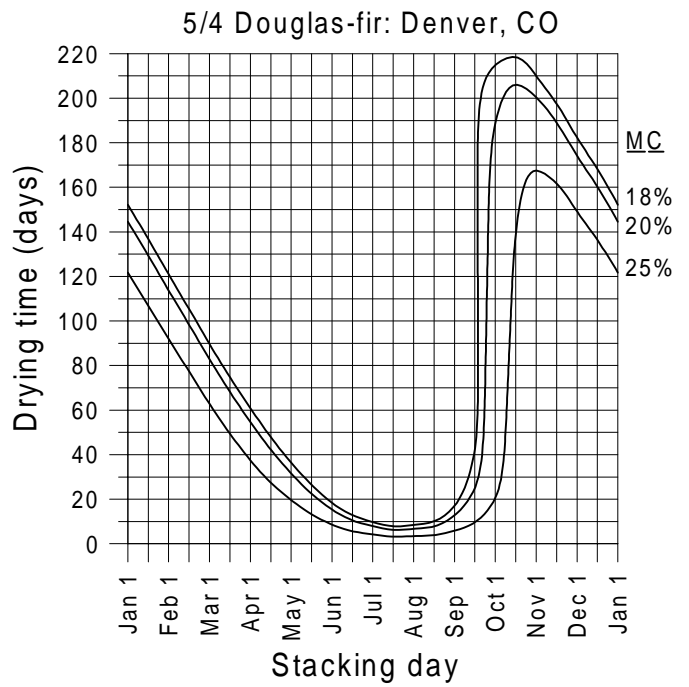
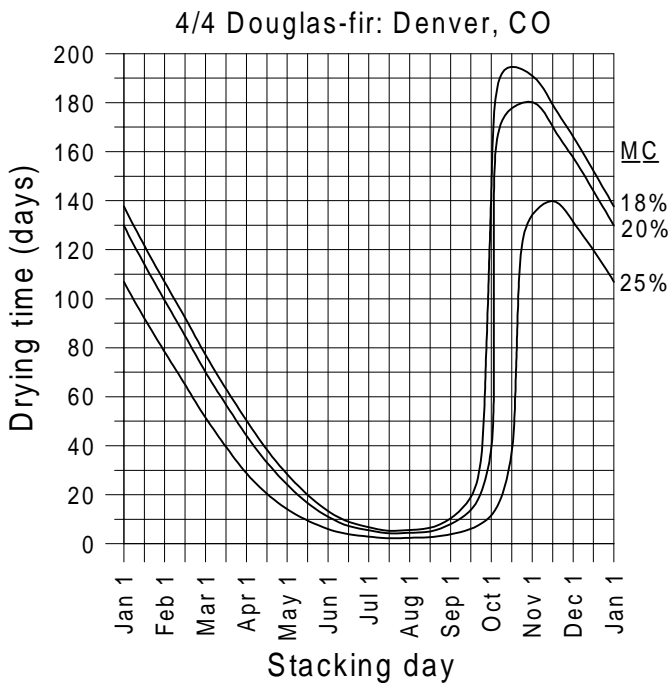


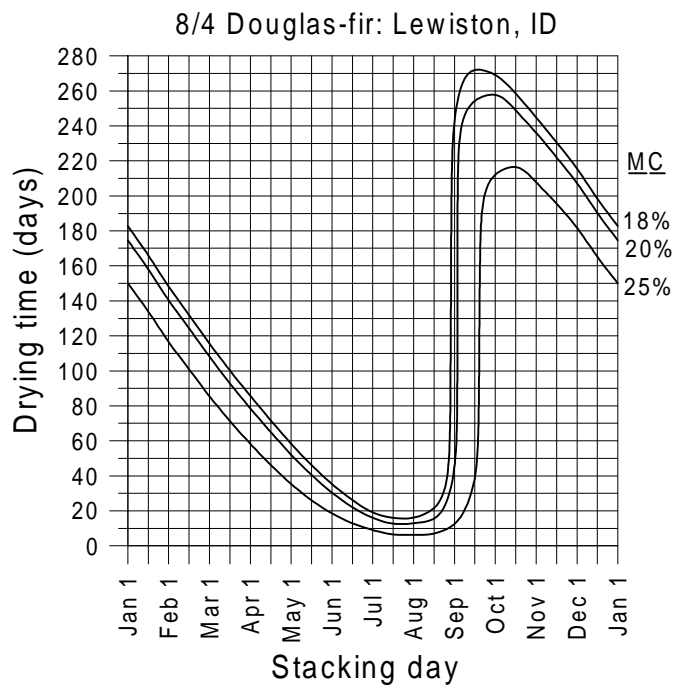
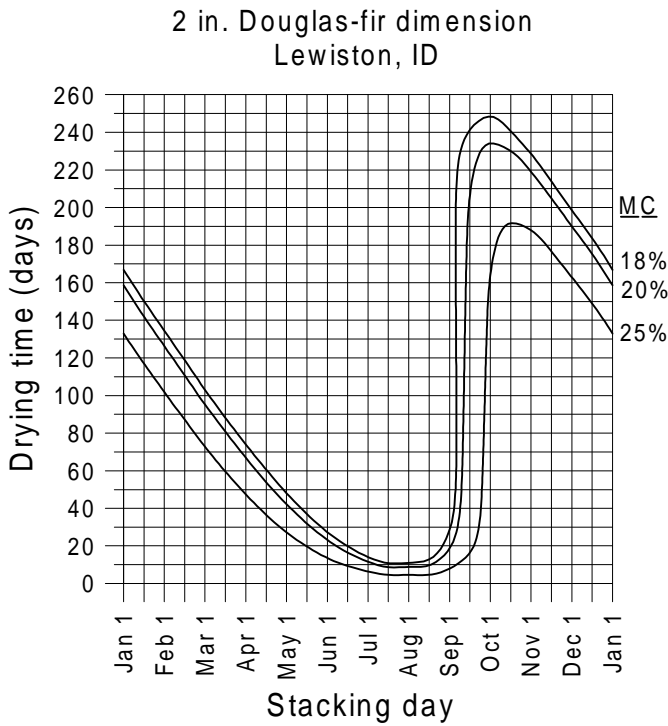
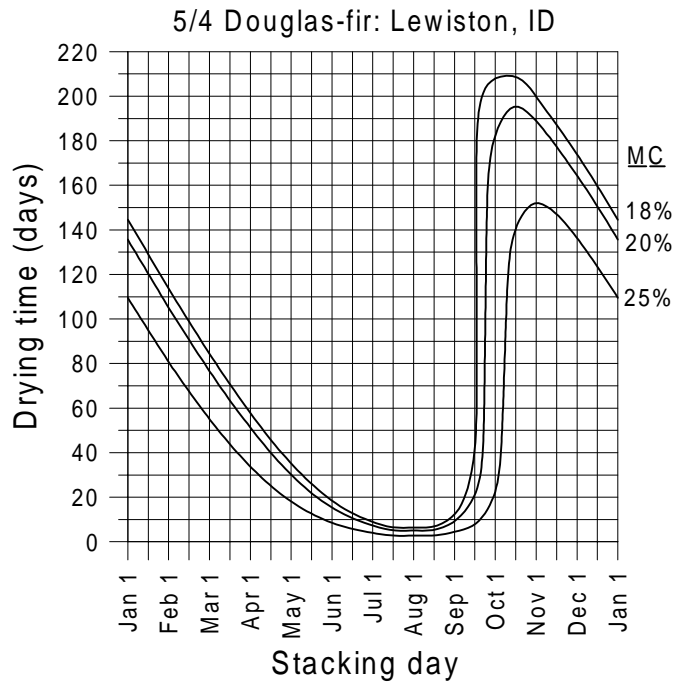
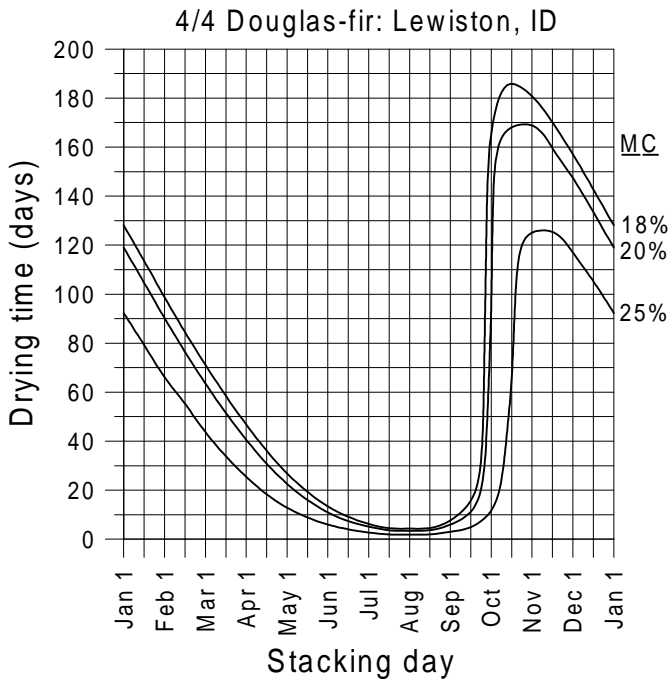
2 in. Douglas-fir dimension
Boise, ID

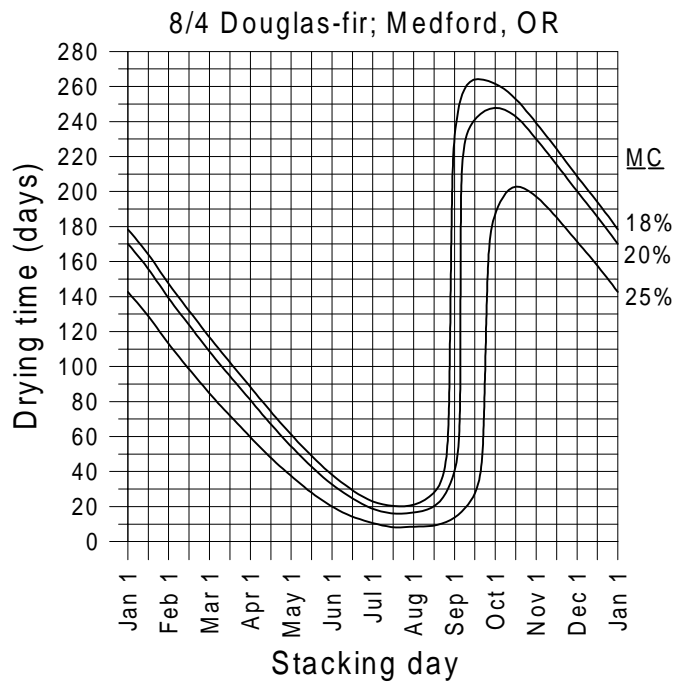
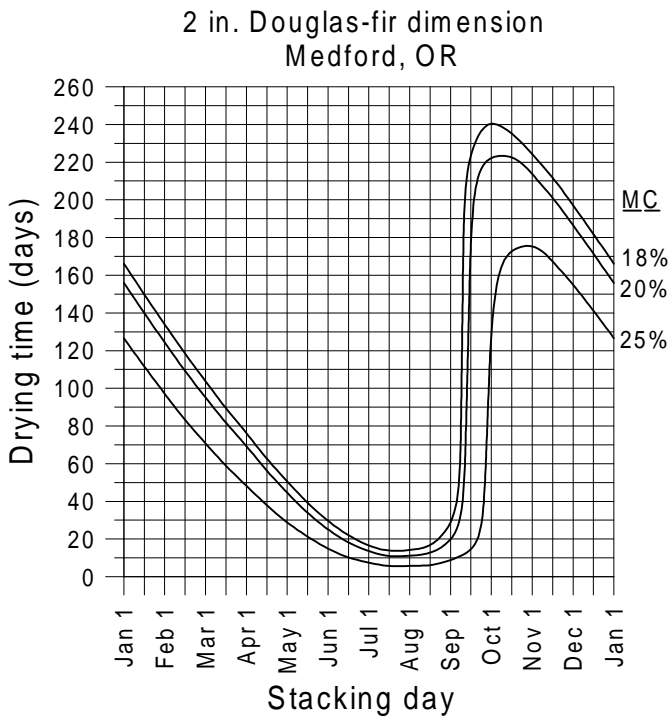
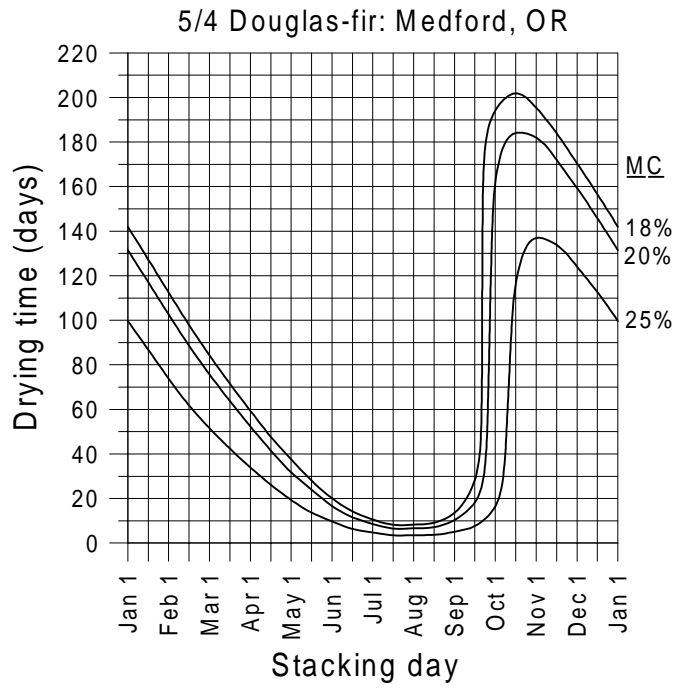
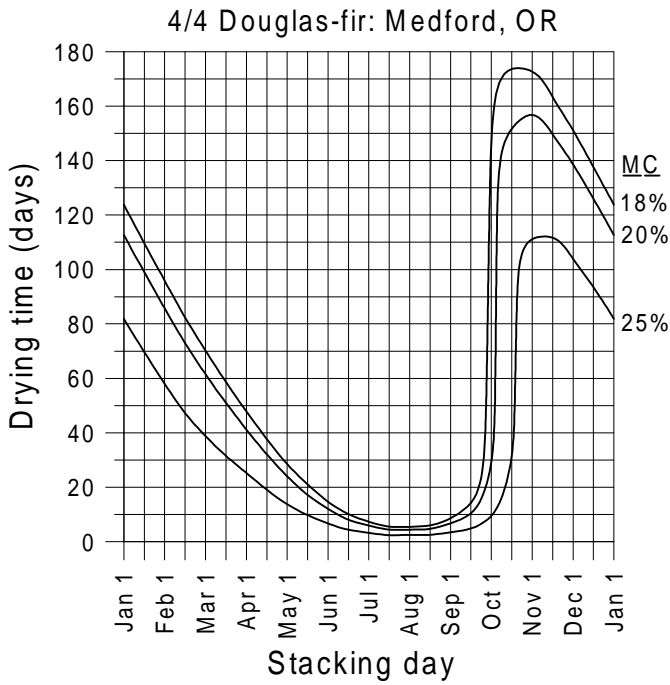


8/4 Douglas-fir: Boise, ID

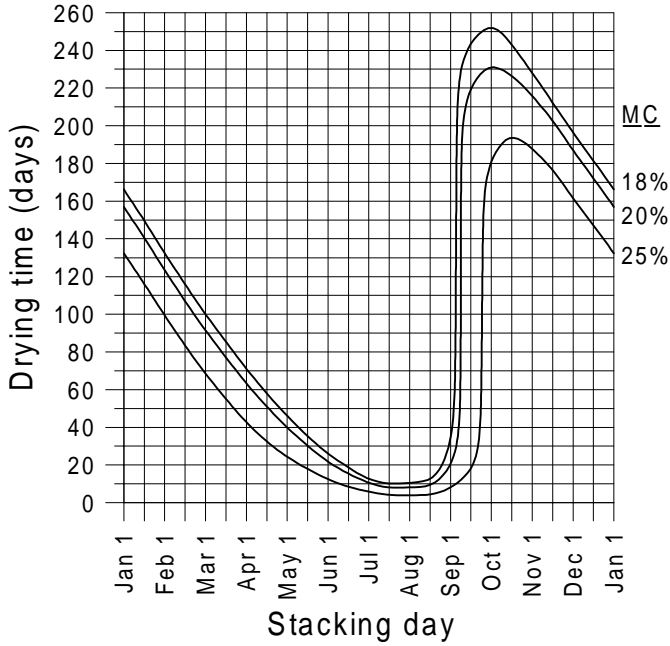




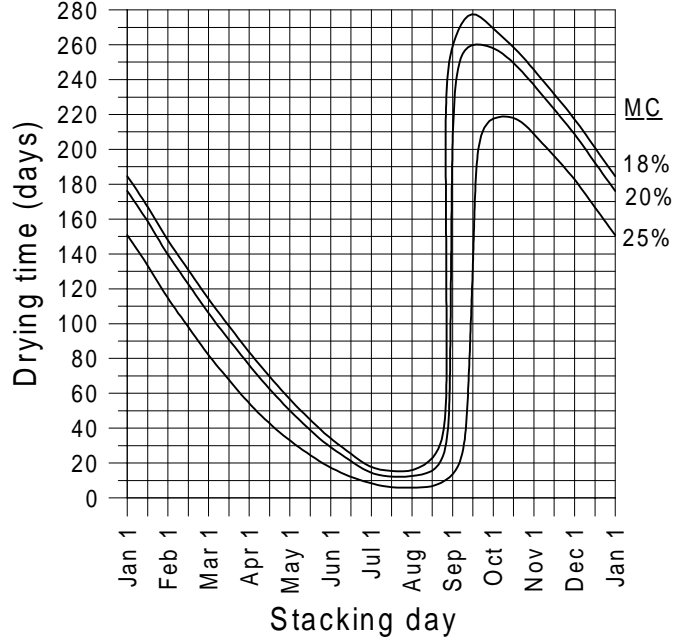




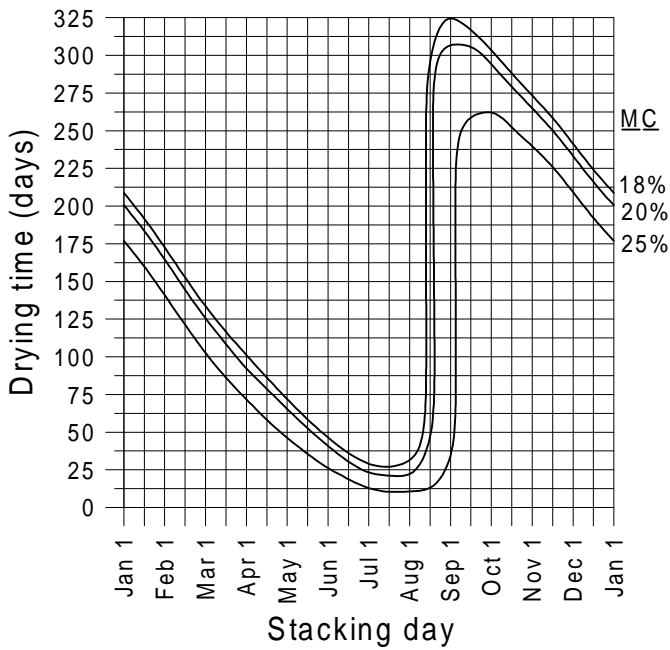
4/4 Douglas-fir: Missoula, MT



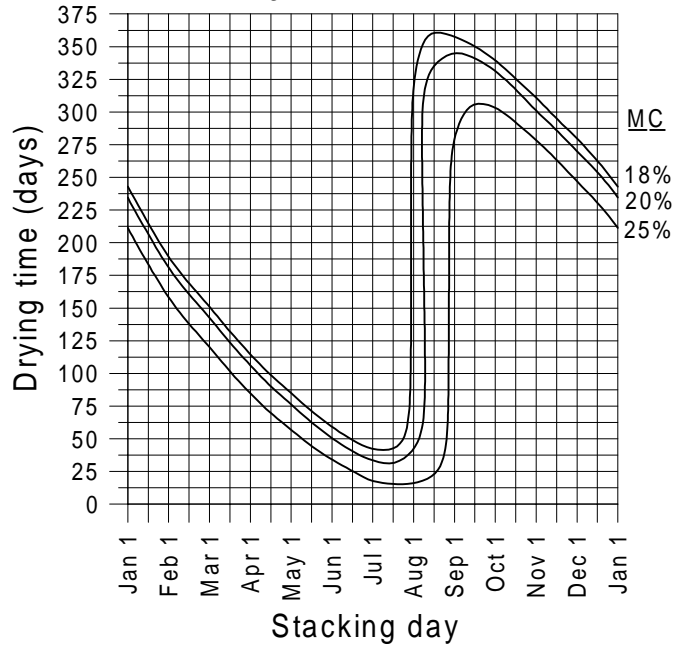
5/4 Douglas-fir: Missoula, MT



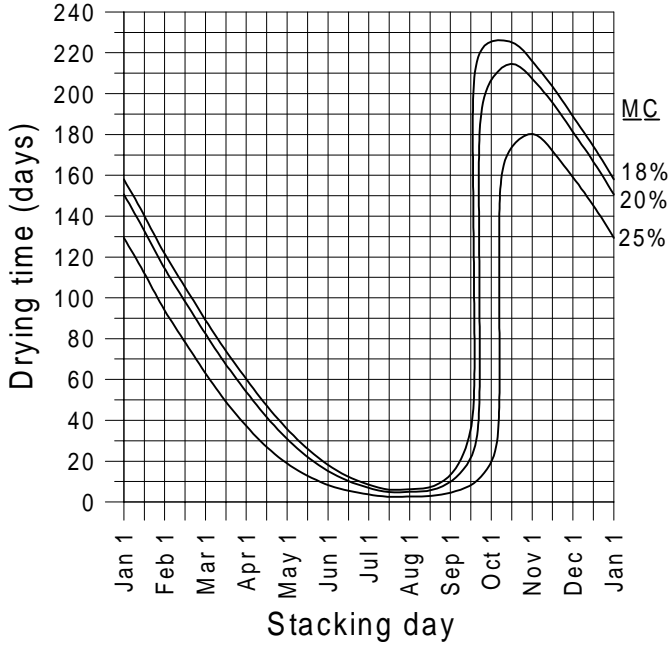
2 in. Douglas-fir dimension
Missoula, MT



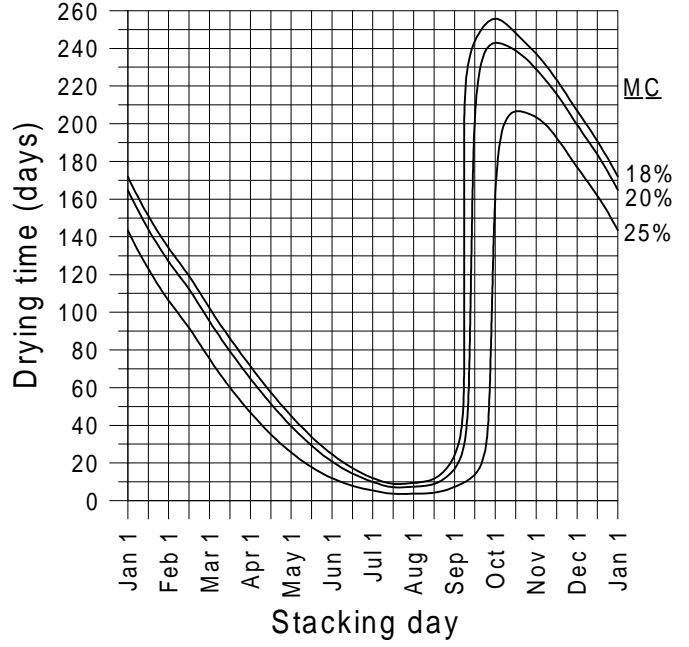
8/4 Douglas-fir: Missoula, MT



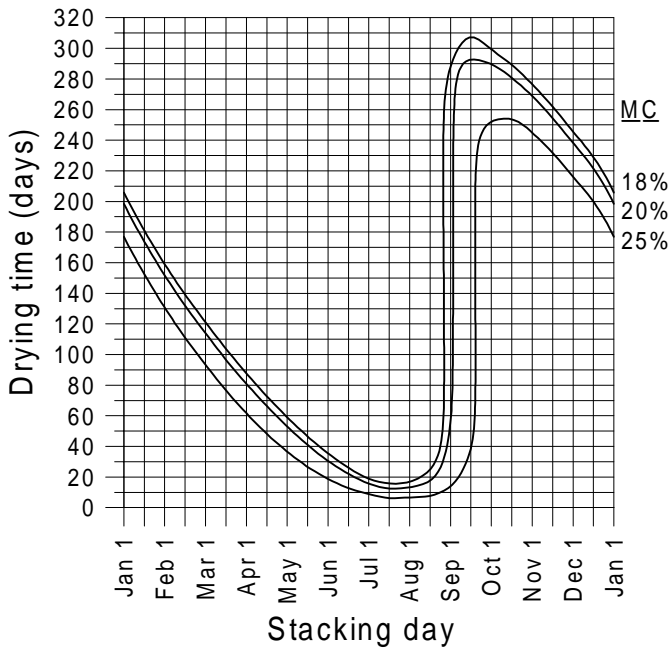
4/4 Douglas-fir: Pocatello, ID



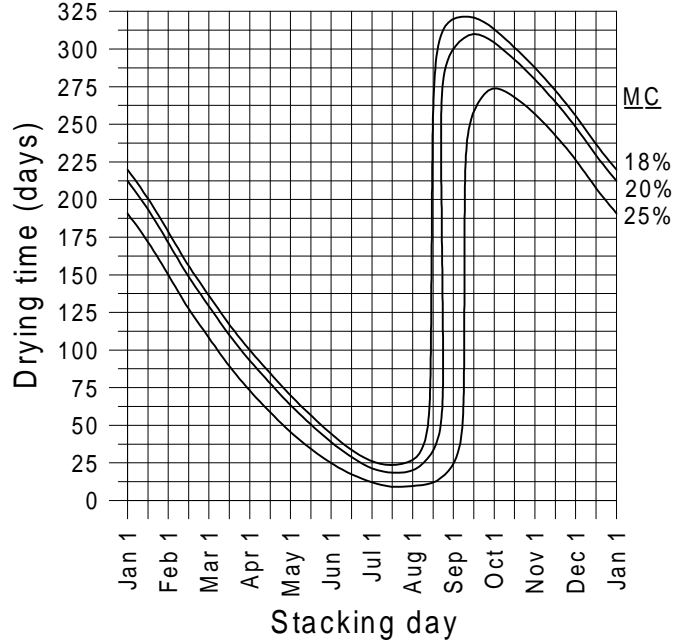
5/4 Douglas-fir: Pocatello, ID

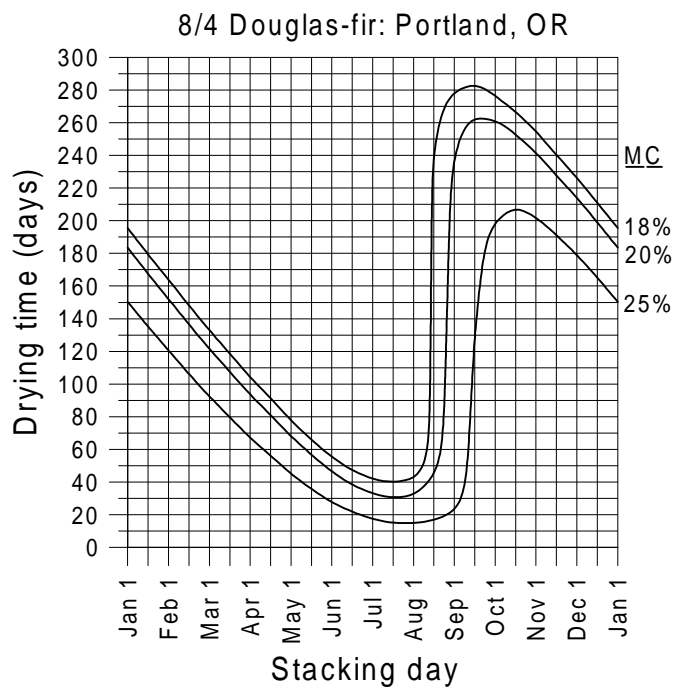
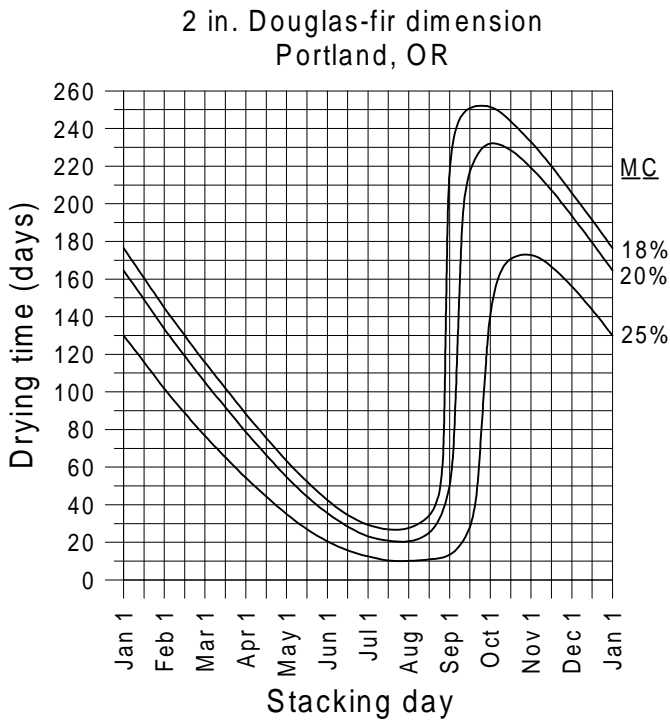
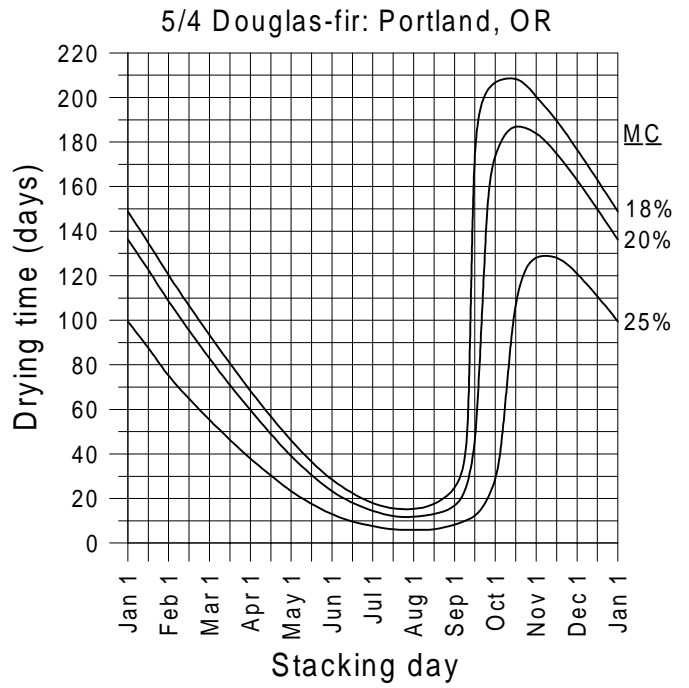
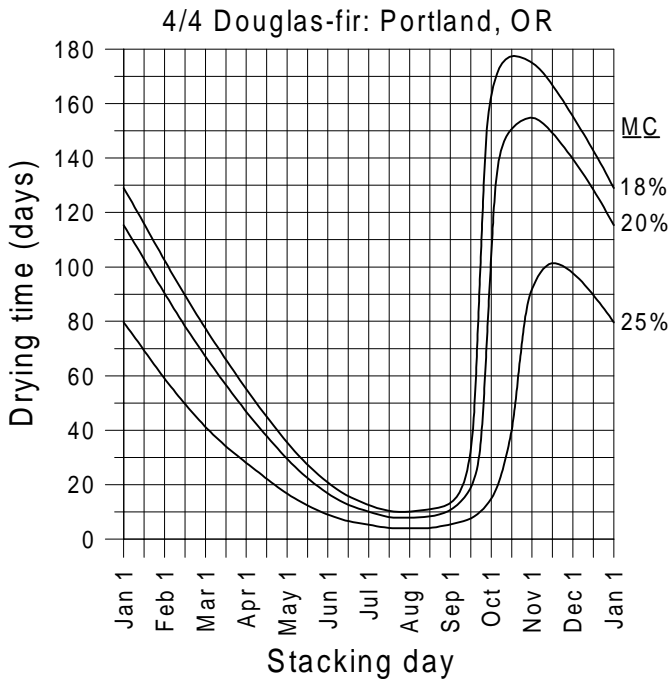


2 in. Douglas-fir dimension
Pocatello, ID

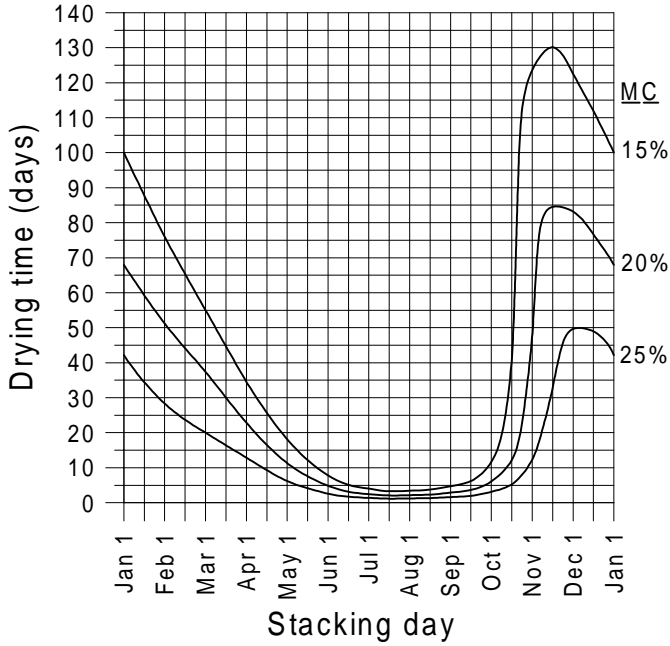


8/4 Douglas-fir: Pocatello, ID

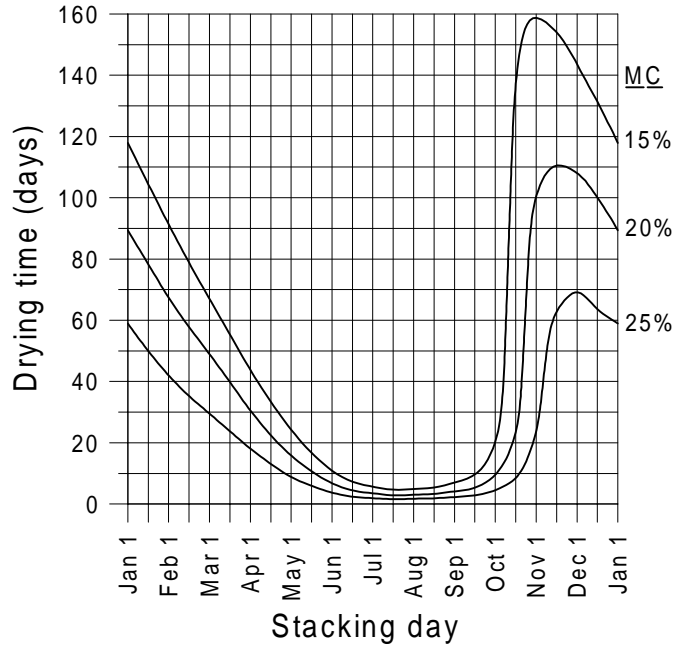




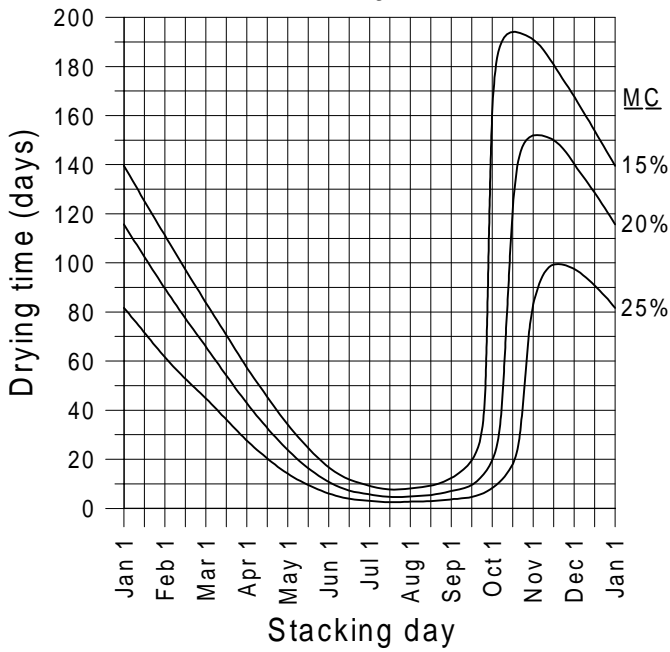
4/4 Douglas-fir: Redding, CA



5/4 Douglas-fir: Redding, CA



2 in. Douglas-fir dimension
Redding, CA



8/4 Douglas-fir: Redding, CA

