GROWING FOR GRADE

We grow trees for many reasons, but in the end, some of them will be for sale. The value of our crop trees is largely determined by the grade of lumber they will yield. Wide, thick, and clear boards bring the highest value per board foot, and that should be a goal of forest management.

As we grow and harvest trees, we are accumulating value in the forest. Large-diameter trees with high-quality wood bring the premium price. People want it. High-quality wood is simply more useful. Labor and drying costs are less when you start with nice boards. Imagine trying to make a clear tabletop with low-grade lumber, cutting out good pieces and gluing them up. Selecting and matching grain and color, then making all the joints perfect requires effort. Compare that to gluing up four nice, wide, clear boards. That is one aspect of value. I know a shop that makes world-class picture frame mouldings, most of which are less than an inch across, and are sold in relatively short lengths. So, they could use cheap knotty lumber and cut out the good pieces, right? No, they select a small percent of top-grade lumber for color, straight grain, wider boards and the placement of minor defects. They plane and rip to their sizes and run them through a 4-sided milling machine. Color is important in their high-value end product. Curved grain around defects creates stress in the mouldings. Narrow boards leave more waste as they rip their pieces: every board has an odd piece of scrap on the edge. Minor defects at the edge, or the end of the board can be rejected before the milling cost. So, paying for top-grade lumber actually saves them labor, waste, and milling cost and results in a premium product.

Hardwood grades are based on the absence of defects and the size and location of "clear cutting" on the board, usually based on the poorest side. In hardwood logs, the quality is described as the number of clear faces. A log is considered to have four faces. Clear softwood lumber is scarce and referred to as "select." But most softwoods are graded on the quality of the knots and other defects. Small knots are better than large

Left: A high-grade maple tree ready for harvest.

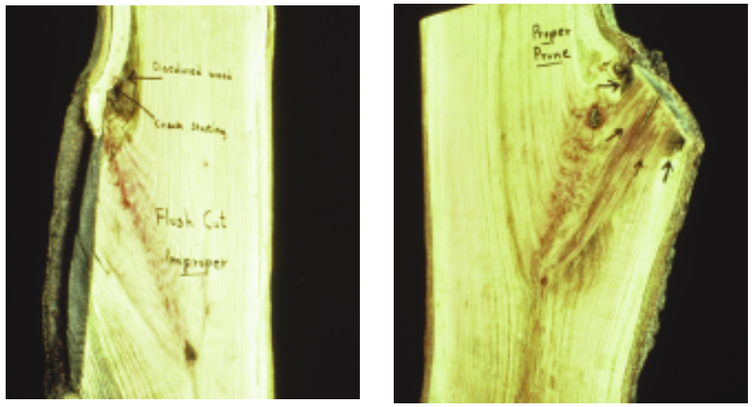
ones. Live knots are better than dead knots. These factors play into how we manage forests to grow grade lumber. We like to grow small knots in softwood, clear stems in hardwood, and then grow them to some maximum or ideal size.

As always there are conundrums. We want to grow to large size, so we need to thin early and often to maintain rapid growth. But to create clear stems and small knots, we need to maintain high stocking in young stands, or we could prune off the branches when doing early thinning. The practical solution is usually to keep the stand dense while young, and then to thin when the trees are tall enough to have sufficient stem quality.

Pruning is a great idea and hobby, and it makes a lovely woodlot, but it is hard to make financial sense with this. Some readers might be ripping these pages out already, but let me explain. For pruning to be effective, it needs to be done while trees are small, such as 4–6 inches in diameter. At 10 inches, the tree has to grow to 15 inches before it makes the first clear board. You have to account for taper, plus the years it takes to cover over the wound. Even at 20 inches DBH, less than 25% of the lumber will be clear. Perhaps this is worthwhile. But pruning at 4 inches gives almost 85% clear lumber.

If it costs $4 to select and prune a tree (labor costs and techniques will factor into your actual cost) and it does not pay back for 25 or 40 years, you have to account for the "cost of money." At 6% just to use a figure to account for inflation and interest, at 25 years you will have to gain over $17 to come ahead. At 40 years, this jumps to $41. So, pruning our 10-inch tree to 12 feet in height, and growing it for 25 years at an amazing fve rings per inch should, in theory, jump about 37 board feet from standard to clear grade, at a cost of 46 cents per board foot. In pine or high-value hardwoods with rapid growth, this might make sense. To prune at 4 inches with the same growth rate, it should take 40 years to get to a 20-inch stem. With 85% clear lumber, this gives about 125 feet of clear wood at a cost of about 33 cents per board foot. But a slower growth rate puts you out of the running. Even eight rings per inch sets your cost over time at more than a dollar per board foot.

If you do decide to prune, there are correct ways to do it. Pruning should be done just outside of the branch collar, and not flush. Cut



Improper flush pruning on the left leaves a large open wound that can infect stem tissue. The cut on the right can contain the spread of discoloration and decay..

Left: Thinning to release a selected high-grade sugar maple tree.

the lower side of live branches first, so the bark does not tear down the stem. This can make a worse defect than a regular knot. Prune to a particular log length, such as 12 or 16 feet in softwoods, and a minimum of 10 feet in hardwoods. Pruning should be done just after thinning, and not just before. Felling damage, and other unforeseen factors make this prudent. Looking at the financial return, you can see that rapid diameter growth is important to get value from your efforts and makes thinning essential. Prune only the very best crop trees that will be allowed to grow to the final rotation length, since intermediate thinning will not give the diameter increase needed to improve the grade yield. Pruning should also be documented in some way, so that decades later, the timber buyer will have some idea what he is getting.

Pre-commercial thinning is another area of controversy. Again, you have to account for the time value of money. You can see above, that pruning does not make sense unless you can thin also, and maintain the high growth rate through the rotation. With crop tree release (selecting particular trees and removing competitors on three or four sides), you do not have to treat the entire acre. In sapling stands with over 1,000 trees per acre, releasing 50 to 100 trees is about right. But this adds another cost, perhaps $5 or more per tree, doubling your total cost for growing that clear wood. In general, pre-commercial thinning is best justified when the outcome without treatment is not acceptable. For example, if you have high-value trees that are being outgrown by very low-value or non-commercial species, or a low percent of highly preferred trees in a matrix of low-quality stems. We see this with poplar or beech sprouts overtopping oak or sugar maple. It is more common to allow stands to remain dense while young to develop a clear stem (or small knots in softwood) and let the natural process determine the "winners and losers."

Once a stand gets to about an 8-inch average diameter, thinning can often pay for itself with commercial wood products, and that may be the prudent time for pruning. Thinning, and especially commercial release of crop trees, is an essential part of growing trees for grade. There are five specific benefits:

1) Selection of species with value potential that are well-suited to the soils and region.
2) Selection of specific quality potential trees with superior characteristics of stem and crown.
3) Increase in growth rate (sometimes dramatic).
4) Increase in tree health and vigor.
5) Products and value produced by the harvest.

Over the past year, we have had a whole series on silviculture, which is generally about growing trees for grade products. The April 2015 issue has a whole article on thinning. But to summarize, selecting crop trees to retain is the key to success. Early in the rotation, we tend to thin from above. This removes taller trees and short-lived species. Also, remove any remaining older trees, or larger trees with large limbs and forks. Later in the rotation, we tend to thin from below, removing suppressed and intermediate trees that crowd crop trees and might be salvaged before they perish. Mid-rotation, we tend to use "free thinning," which removes both taller and shorter trees to release the selected crop trees. Through the stand rotation, you are also looking for risk factors, damage, and decay to harvest.

Conundrums with thinning include having a low volume and value per acre, with relatively high costs. Careful logging is required to minimize damage to roots, stems, and crowns, which adds to logging cost. Trails need to be practical for harvesting equipment, and some crop trees might have to be sacrificed. Marking and setting up a job have costs to consider, so frequent light thinning is more costly. Heavy thinning can expose trees to wind damage and sprout growth that reduce grade. But growing high-grade trees to an ideal diameter seldom happens by accident, so we need to weave through this maze of options.

It is easiest to think about one tree at a time, but in the big picture we have to think of the overall stand. Growing for grade does require us to evaluate each tree for exceptional quality and optimal growth rate. But thinning and other treatments require us to think of the stand, with its costs and benefits for commercial opportunities. These thought processes apply to even-aged stands or uneven-aged stands. Most of us do not have the opportunity to steward a stand from establishment, all the way through to final harvest. We are starting somewhere in the middle, and either improving what we have for the future, or bringing the stand to final harvest and acceptable regeneration.

Young stands are usually left dense to develop clear stems, although this would be a suitable time to do pre-commercial thinning. You can see the pin cherry dropping out.

Growing trees for grade requires growing full-size trees. There are market factors for maximizing grade yield, along with biological and financial considerations. Site, species, and tree quality all play a role. In general, when a tree has the quality and vigor to be able to continue to grow into a higher-grade/price category, then it is best to leave it to grow. Of course, this is buffered by the overall stand situation, regeneration requirements, stocking, and other factors. To be specific, a healthy sugar maple or oak with no defects can be sold as a veneer log at 12 or 13 inches in diameter. But the price per board foot increases at 14, 16, 18, and perhaps 20 inches. Of course the board feet per tree increases as it grows, and the dollars jump at each interval. Logs are scaled at the small end, and we usually discuss tree measurement at "breast height," so we have to account for taper. Super premium trees might be grown to 24-inch diameter to achieve that 20-inch log price. Trees with a second or third high-quality log are gaining even more. But there is risk involved with leaving that 20-inch premium tree to grow for another 15 years. And this needs to be carefully considered when evaluating stands and individual trees.

A log with one defect is called a "3-face log." These usually top off their "price per MBF" at 14 or 15 inches, so growing these trees to 16 or 17 inches DBH maximizes their grade potential. Butt logs with one minor defect fall into an "in between" category, though. A 2-face log does not increase much beyond 14 inches, so these trees should be removed earlier in the rotation. If you find that your stand has a very low percent of 4-face logs and stocking will be reduced below acceptable levels to retain these trees, there are still two choices: retain inferior trees to "fill the space," or regenerate the stand with a two-aged system.

Sugar maple tree with 8 rings per inch; volume and value increase

year	DBH	saw height	board feet	value ($)	% increase
1943	8			0.5	
1951	10			1	100
1959	12	10	40	8	700
1967	14	16	80	30	275
1975	16	24	150	105	250
1983	18	32	240	330	214
1991	20	32	320	610	84
1999	22	35	380	925	52
2007	24	35	450	1370	48
2015	26	35	540	1680	22

Let's consider financial aspects of growing a 4-face tree in sugar maple to large diameter. The tree is healthy, with growth rate of eight rings per inch (which you maintain by careful thinning every 15 years or so). It has potential for a premium veneer butt log, a 3 face middle log and a pallet-grade upper log, plus some firewood. At 10 inches DBH, it is merely firewood and worth about $1. We will look at the board feet, stumpage value, and rate of value change as it grows (see chart above):

Prices are in today's dollars from a current price sheet, with reasonable logging costs subtracted from total log value. You can see the considerable value growth as the tree grows. The merchantable height increases early on, topping off at 22 inches DBH. The tree gains hundreds of dollars each eight-year cycle as a large tree, but the percent change is the number to watch. The biggest jump is at 12 inches, when the tree jumps from firewood to a sawlog. The next jump is to a rotary veneer category. Then it

jumps to slicer veneer at 16 inches, and my veneer grades continue to improve to 20 inches (scaling diameter). So, by the time the tree reaches 24 inches DBH, the percent increase drops dramatically. A 6% rate of return over eight years gives 59%, so by 20 inches DBH, you are dropping below 6%, even though you gain hundreds of dollars per tree in eight years. You risk $600 to leave that tree to grow. So, financial prudence dictates that this tree should be cut somewhere around 20 inches.

Bucking high-grade maple for veneer and sawlogs.

In red oak or yellow birch with lower "veneer premiums," the curve drops off more quickly. Ironically, even though the percent gain drops off on red oak at about 18 inches, we tend to grow these larger since the premium oaks are remarkably low risk for health issues and maintain a rapid growth rate. They are also a great seed source for timber regeneration and wildlife food. In species like red maple or ash, it drops off sooner, so 14–18 inches is appropriate. So the financial reward is for growing top-quality trees in high-demand species to some ideal diameter.

Softwoods are a completely different category. Spruce does not benefit from any "grade increase," with the exception of occasional clear logs for specialty use. This is merely about volume of sawtimber, unless you are sawing for specialty beams or large rafters. The commercial demand is easily met with the occasional 18–20-inch tree, either from plantation spruce or natural stands. Pine is graded and sorted by knot size as mentioned previously. In fast-growing, meticulously-managed stands, pruning might make sense to grow the "select" grades. But small knots make the "premium" grade, and this is the target in most stands.

A load of high-grade oak logs leaving the landing.

When the tree is young, the branches are live, yielding "red knots." As the lower branches die, the wood formed around these makes a "black knot," which can fall out of a finished board. So, growing trees to large size, unless they are really clear, actually increases the percent of black-knotted lumber, since the center of the tree is small, red knots. Maintaining dense stands early in the rotation for small lower branches is a good practice. Then, thinning for rapid growth is appropriate. As the crowns enlarge, upper logs will become large-knotted and low quality. Therefore, it is usually appropriate to harvest pines at about 18–24 inches to maximize grade yield. Generally, 1-inch black knots and 3-inch red knots are allowed into the premium grade if there are no other major defects. Pine is usually graded by the worst knot on the best face.

Log bucking for grade is a whole art and science. We will delve into that next month. ■

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