Thinning Shortleaf Pine

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This guide describes the use of tree thinning in even-aged shortleaf pine stands. A stand is considered even-aged if the difference in age between the oldest and youngest trees does not exceed 20% of the time between establishment and planned regeneration harvest.[2] So if the stand is to be grown until it reaches age 100, then it is even-aged if the ages of the trees being managed are within 20 years of one another.

Why do stands need thinning?
After establishment, young stands typically start out with hundreds or even thousands of trees per acre. As they grow older and larger, there is less room for each tree and the most vigorous trees or the trees best adapted to the environment generally begin to overtop weaker trees. As light, moisture, and nutrients become limited, tree mortality increases and stand density decreases, which is called natural thinning or stem exclusion. During this process, even the larger trees are stressed and are more likely to be damaged or killed by disturbance agents like wind, ice, drought, fire, or insects.

In plantation management, this inter-tree competition and the need for thinning can be delayed by planting the right number of trees per acre and reducing numbers of unwanted tree species. However, reducing stand density excessively where trees remain completely open-grown for too long can produce limby, crooked, and shorter trees that would be less desirable from a timber production standpoint. In the absence of periodic fires, these trees would be larger in diameter due to their larger crowns, but they would produce low quality lumber and less merchantable timber per acre.

In previously unmanaged natural stands or stands where multiple species occur, natural thinning will have already favored the most vigorous trees by 20 years of age. As the stand continues to grow, thinning can often be used to select the most desirable species and the highest quality trees by removing less desirable trees. But once the crown of a tree has been reduced in size by the competition of its more vigorous neighbors, it cannot always be restored to a dominant position by cultural treatment. Therefore, in thinnings it is best to encourage the growth of the tallest trees rather than try to resuscitate those that have fallen behind.[2] Where the landowner's objective is to favor shortleaf pine, alone or mixed with oaks or other species, the tallest ones would be favored while also trying to consider tree spacing that would allow crown development.

Shortleaf pine growth traits:
Shortleaf pine has a height growth rate that is nearly the same as white oak, black oak, southern red oak, and chestnut oak. So if shortleaf saplings are kept free-to-grow for the first 15 years, they have a good chance of becoming co-dominant in the developing stand. However, for the first 45-50 years, Virginia pine and loblolly pine can outgrow shortleaf pine, especially on more productive sites. Fortunately, shortleaf pine has the ability to add live crown readily when given more space to grow, even at an advanced age. Since many shortleaf pines can survive for 200-300 years, they can outlive their competitors and occupy the growing space left by taller dead or fallen trees. When older, fully stocked stands become under management, shortleaf pine growth can benefit greatly by removing trees whose crowns are touching or shading the shortleaf pine crowns.

Shortleaf pines can lose their ability to withstand outbreaks of Southern pine beetles when they are under stress. This can occur when the stand density is too high, which is

measured by estimating the cross-sectional area of tree stems on an acre, called basal area (BA). Shortleaf planted at close spacings such as 8'x8' may have BAs from 110 to 160 sq ft/ac when they are between 18 and 33 years old. The average diameters in such stands are usually no more than 6-9 inches. Normally, thinning in shortleaf pine stands is not recommended until crown closure occurs. Shortleaf pines typically have narrow crowns when they are young, unlike loblolly pines which have more and larger limbs, larger stem and crown diameters, and need thinning at a younger age than shortleaf pine.

When to thin and how much to cut:
Rogers (1983) established that thinning to 60% of full stocking in shortleaf pine in southeastern Missouri allowed trees maximum growth rate without wasting growing space. For trees over 7" in diameter, the corresponding leave BA would be 80-100 sq ft/ac. He reported that above 100% full stocking, trees were too dense to maintain adequate growth, and tree mortality began to increase. For trees over 7" in diameter, the corresponding leave BA would be 140-170 sq ft/ac.

Therefore, in shortleaf pine stands, first thinnings should occur when the BA approaches 140 sq ft/ac, and the BA should be reduced to 80 sq ft/ac for maximum growth. When the trees are older and larger, thinning should occur before the BA reaches 170 sq ft/ac, and for maximum diameter growth, the desired residual BA would be approximately 100 sq ft/ac.

This level of thinning corresponds to the USFS Southern Region Compartment Prescription Field Book[3], which specifies that the leave BAs of trees larger than 5" in diameter would be 80 sq ft/ac for yellow pines with 46-65 ft total heights; 90 sq ft/ac for 66-75 ft heights; and 100 sq ft/ac for 76-105 ft heights.

These thinning levels are to achieve maximum crown expansion and diameter growth of shortleaf pines. Thinning levels might differ in mixed pine-hardwood stands or when landowners desire fewer trees per acre to meet objectives other than maximum growth. Where prescribed fire is used in shortleaf pine stands, burning must be coordinated with thinning operations. Dead pine needles and small limbs left from logging must have time to decompose before burning. Therefore, burning should be postponed until at least one year after thinning.

Free thinning:
Free thinning involves leaving the best trees that meet landowner objectives with priority on attributes such as species, height, straightness, self-pruning, spacing, wildlife benefit, and aesthetics. Vigorous shortleaf pines might be favored over Virginia pines and loblolly pines. White oak, northern red oak, black oak, chestnut oak, and southern red oak trees might be favored over scarlet oaks, sweet gums, and red maples. When marking and using free thinning, focus first on designating the best trees to leave, then leave other healthy trees to achieve good spacing and achieve the BA target.

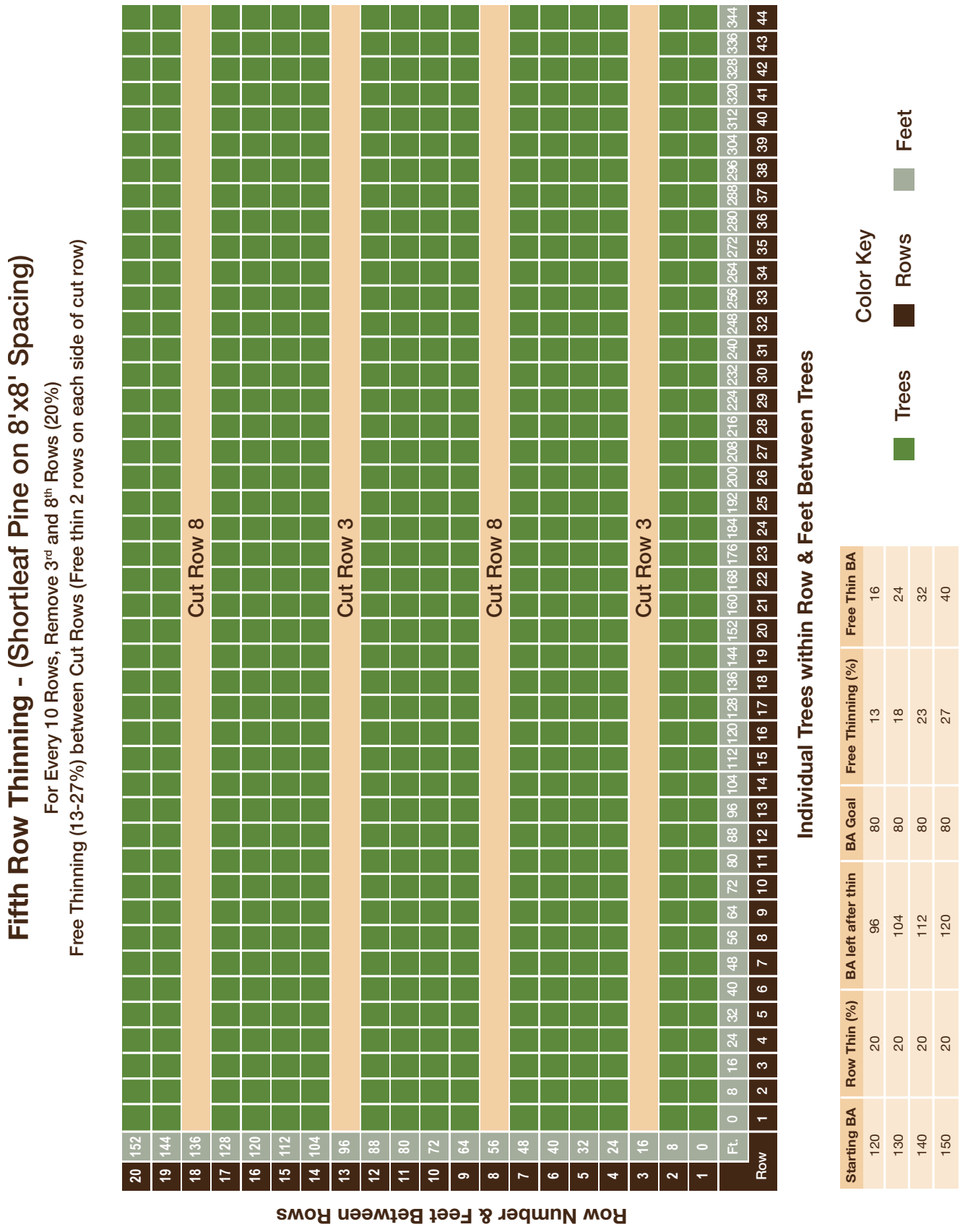
Generally, trees that are damaged, suppressed, diseased, or undesirable would be cut, although some might be left to provide shade where a better tree is not available. Otherwise, leaving large open spaces between trees might cause dense thickets of small trees and shrubs to form. If some of the trees left for good spacing in the first thinning are crooked or have other undesirable traits, they can be cut in a future thinning. As a result of free thinning, the average diameter of the stand would increase because more small trees would be cut than large trees. Viewing distance into the stand would increase as would the abundance of grasses and herbs that benefit from more light at ground level.

Row thinning:
Row thinning might be done in a pine plantation to allow the first thinning to be part of a commercial sale at an earlier age, especially if the average diameter is barely above merchantable size. The timber purchaser would be allowed to harvest some of the largest trees as well as the smallest trees in the cut rows. This option may be available where trees are planted in straight rows on gentle slopes, a truck road is nearby, and markets for small diameter pines are good. As a result of row thinning alone, the average diameter and the quality of trees in the stand would remain the same, and no more than half of the rows would be cut in one entry, depending on the level of BA reduction needed.

Combination thinning:
With combination thinning, certain rows are designated for cutting to improve access for logging equipment, and then thinning between the cut rows is done in the same logging operation to further reduce BA, to increase average diameter, and to improve the overall quality of residual trees. The rows would be designated for cutting based on how much reduction in BA or how many skidder lanes are needed for a particular stand.

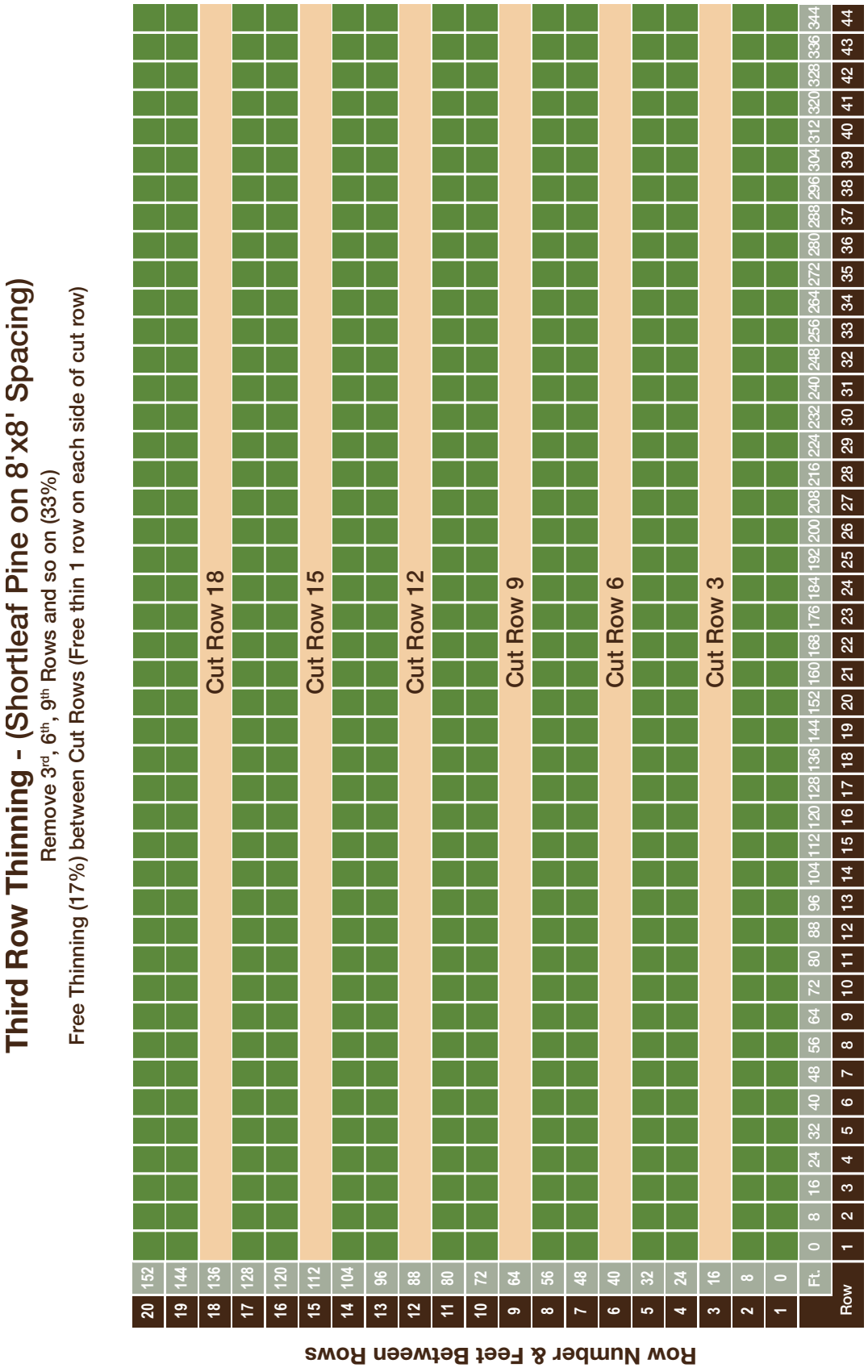
Table 1 shows 20% of BA removed in cut rows #3 and #8 of each 10 rows. This allows as much as 13-27% of BA to be removed by free thinning between cut rows. This method might be used when initial BA is 120-150 sq ft/ac.

Table 1: Row thinning guide for a starting BA of 120-150 ft2/ac in young stands



Starting BA	Row Thin (%)	BA left after thin	BA Goal	Free Thinning (%)	Free Thin BA
120	20	96	80	13	16
130	20	104	80	18	24
140	20	112	80	23	32
150	20	120	80	27	40

Table 2: Row thinning guide for BA of 160+ft²/ac in young stands.



Individual Trees within Row & Feet Between Trees

Starting BA	Row Thin (%)	BA left after thin	BA Goal	Free Thinning (%)	Free Thin BA
160	33	107	80	17	27
170	33	114	85	17	29
180	33	121	90	17	31
190	33	127	95	17	32
200	33	134	100	17	34

The cutting pattern in Table 2 might be used where initial BAs and tree densities are higher, making mechanical thinning between rows more difficult. Thirty percent of BA would be removed in cut rows #3, #6, and #9, and so on. This allows up to 17% additional BA to be removed by free thinning between the cut rows.

Potential damage from thinning too heavily:
No more than 50% of BA should be removed from a shortleaf pine stand in one thinning. The trees have developed in close proximity to each other, providing mutual support when exposed to high wind, ice, or both. If these same trees are opened up too much in one thinning, especially when diameters are below 12", they will not be structurally sound enough to prevent them from breaking. Figure 1 shows damage in a heavily thinned stand a few days after an ice storm. This is one of several heavily thinned stands in the vicinity where larger diameter trees blew down or broke because there was too much exposure to wind and no support from adjacent crowns.

On the contrary, Figure 2 shows a properly thinned shortleaf pine stand on a similar site that had almost no damage from the same ice storm, even though ice/snow loads on crowns were similar to the nearby damaged stands. During that storm, damage in young, unthinned shortleaf pine stands was minor, also.

Figure 1: A heavily-thinned shortleaf pine stand subsequently damaged during an ice storm in December 2013. Credit: John Blanton

Figure 2: A properly-thinned shortleaf pine stand that has weathered the December 2013 ice storm. Credit: John Blanton

References

[1]Rogers, R. 1983. Guides for thinning shortleaf pine. P. 217-225 in Proc of Second Bienn. South. Silv. Res. Conf. USDA For. Serv. Gen Tech. Rep. SE-24. 514 p.

[2]Smith, D.M. 1962. The practice of silviculture. 7th ed. New York, NY: Wiley and Sons. 298 p.

[3]USDA Forest Service, 1992. Southern Region, Compartment Prescription Field Book, p. 29