Guide to Increasing Utility Pole Production in Pine Plantations

MISSISSIPPI STATE UNIVERSITY EXTENSION

Maximizing financial gain is often a motivating factor in forest management. This motivation, along with local soil conditions, has paved the way for the expansion of intensive pine plantation management in the southeastern United States. In most cases, the most profitable strategy for landowners has been to grow sawtimber as quickly as possible. Intensive treatments, including site preparation, planting improved seedlings, competition control, thinning, and fertilization, are used to accelerate the growth rate of one age class of pine. This, in turn, reduces the rotation age, allowing landowners to realize a quicker return on their investment. During periods of rapid economic expansion, this production model has performed favorably, as sawtimber prices have outweighed the costs of these intensive practices. However, during periods of economic contraction, lower sawtimber prices make intensive management less profitable and, in some cases, can result in a net financial loss.

Unfortunately, as a result of the housing crisis and subsequent drop in consumer demand, sawtimber prices have been depressed since 2007. We also have a surplus of mature pine that has accumulated and continues to depress the sawtimber market, keeping sawtimber prices from rising. Consequently, landowners are beginning to look for alternative management strategies to achieve their financial goals.

In response, we are producing a series of publications that will examine different strategies for maintaining profitability in plantations during periods of low pine sawtimber prices. The overall goal of this series is not to convince people to abandon sawtimber production as their primary means of generating timber income, but rather to provide landowners with information on lesser-known forms of timber management, so they can decide what ultimately works best for them. Often, managing for sawtimber production will remain the preferred management strategy. However, for landowners who can tolerate longer-rotation times, pole management can be a lucrative practice.

Utility Poles

Utility poles are an excellent product alternative for landowners looking to diversify their timber portfolio. Growing timber to meet utility pole market specifications has the potential to be very lucrative. Pole-quality timber typically brings at least 1.5 times the value of sawtimber, and pole prices are also less volatile, as demand for poles is less influenced by broad economic factors that can reduce housing starts. Moreover, the pole market may be particularly profitable in the southeastern U.S., as demand for poles surges following natural disasters.

The pole market, however, comes with its own set of inherent drawbacks, the most challenging of which is growing trees that meet the rigid size and form standards (**Tables 1–3**). Due to the strength requirements of utility poles, trees must possess a main bole that—

- is string-line straight (**Figures 1 and 2**) for the first 40-60 feet,
- is free of major stem defects (cankers, cat-faces, rot) (**Figure 3**),
- has minimal taper,
- is largely free of branch knots (**Figure 4**),
- has a small juvenile core, and
- meets specific height and diameter requirements (**Tables 1–3**).

Figure 1. Pole-quality timber marked for harvest.

As a result, few trees ultimately develop into poles. The proportion of poles may be even lower if seedlings are planted at lower densities, which will delay natural limb death and shed. Another drawback to growing poles is the time investment. Most pole classes have larger diameter and height requirements than sawtimber. Growing a larger tree for poles typically requires a longer rotation (10–15 years). Longer rotations increase the time a landowner must carry establishment costs and increase the risk of severe weather damage to standing timber. In many locations, this risk may not be justified, as good pole markets are regional and are not distributed evenly throughout the state. Consequently, landowners are encouraged to contact a local forester before attempting to manage for poles.

Figure 2. Example of the bole straightness required to qualify as a pole.

Figure 3. Example of a stem defect.

Figure 4. Example of a large branch defect.

Table 1. Length and diameter requirements for distribution and transmission poles.			
Stem Length (ft)	**Minimum Diameter (in)**	**Maximum Diameter (in)**	**Product Class**
40	12.0	13.0	Distribution pole
45	12.5	15.0	Distribution pole
50	14.0	16.0	Distribution pole
55	15.0	17.0	Distribution pole
60	16.0	18.0	Distribution pole
65	17.0	19.0	Transmission pole
70	18.0	20.0	Transmission pole
75	18.0	21.0	Transmission pole
80	19.0	22.0	Transmission pole
85	19.0	23.0	Transmission pole
90	20.0	23.5	Transmission pole
95	20.0	23.5	Transmission pole
100	20.0	24.0	Transmission pole
Note: Diameter is measured 6 feet from the butt end of the log. Pole specifications obtained from Kisatchie Pole and Piling L.L.C.			

Table 2. Prohibited and permitted defects for all pole product classes.	
Prohibited Defects (not permitted to any degree)	**Permitted Defects**
Decay Dead streaks Holes Hollow butts or tops Forks	Firm red heart rot Sap stain
Note: Pole specifications obtained from Kisatchie Pole and Piling L.L.C.	

Table 3. Defects permitted with limitations for all pole product classes.	
Limited Defects	Limitation Details
Sweep	Straight line from the center of the ground line to the center of the top must not pass through the edge of the pole.
Knots (distribution poles)	The diameter of any single knot must not exceed 4 inches, and the sum of all knots in a 1-foot section must not exceed 8 inches.
Knots (transmission poles)	The diameter of any single knot must not exceed 6 inches, and the sum of all knots in a 1-foot section must not exceed 10 inches.
Bark inclusion	Depressions containing bark must be no more than 1 inch deep.
Scars	None within 2 feet of ground line; elsewhere, none more than 2 feet in depth.
Compression wood	None on the outer 1 inch of diameter.
Note: Pole specifications obtained from Kisatchie Pole and Piling L.L.C.	

Unlike sawtimber, the pole development process cannot be accelerated by common intensive treatments. For example, heavy early thinnings would reduce the number of potential poles by encouraging lower-limb retainment, by increasing undesirable stem taper, and by increasing large branch knots. Instead, poles must be kept at higher densities than sawtimber throughout the rotation to maintain the required growth form. This is one of many ways management for poles can be quite different than for sawtimber. Below are some of the basic principles of managing pines for utility pole production.

Seedling Establishment

Species

Our four major southern yellow pine species—loblolly (*Pinus taeda*), shortleaf (*Pinus echinata*), longleaf (*Pinus palustris*), and slash (*Pinus elliottii*)—are capable of producing pole-quality timber. They are nationally acclaimed for their strong wood properties and for their superior ability to take up preservation treatments. But differences in these species do exist. Thanks to naturally straight vertical growth and a greater ability to self-prune branches and withstand high-winds, longleaf pine is considered the best species for pole production. However, unless you live in southern Mississippi, longleaf pine will not be a viable option. Genetic improvements in loblolly pine have made it more suitable for pole production. However, loblolly is also the least resistant to wind damage. As is always the case, selecting the species best adapted to the local climate and soil type is an extremely important first step in producing poles. For more information, see MSU Extension Publication 1776 *Planting Southern Pines: A Guide to Species Selection and Planting Techniques*. Once the species has been matched to the site, selecting superior planting stock is the next important step.

Stocking Type

Most landowners do not purposely grow poles, as they are a percentage, sometimes small, of the final crop trees. Instead, landowners recognize the quality of the trees and their ability to produce the most valuable product in the pine market. One way to increase the percentage of poles is to plant seedlings that have been selected for superior growth form. Traits needed to produce poles include stem straightness, small diameter branches that are nearly horizontal to the stem, and resistance to diseases that cause stem deformities such as fusiform rust. These traits are highly heritable in pine and can be selected for through genetic improvement.

Landowners need to understand that seedlings can be thought of as a genetic package of specific traits. Seedlings available for purchase vary in their own probability of expressing desired traits or characteristics. Open-pollinated (OP) seedlings from a variety of generations of improvement, such as the first to fourth generations, offer substantial increases in genetic expression, resulting in greater realized genetic gains in traits preferred in poles. However, open pollination means that we know the mother trees but have only slight control over which trees serve as pollen producers for these OP seedlings. Thus, OP seedlings tend to exhibit considerable genetic variability, resulting in less uniformity among traits. Mass control-pollinated (MCP) seedlings are produced by selecting both father and mother trees for desired traits. The controlled cross of selected father and mother trees can result in MCP seedlings with further improved genetic gains in traits desired for poles. Variability is lower in MCP seedlings, which can be thought of as brothers and sisters in a family. The ultimate seedlings for poles could possibly be those known as varietals ("clones"). These seedlings are the result of control-pollination as in MCP, but the best seed is duplicated, or cloned, through laboratory techniques and then tested to determine performance. Tests have demonstrated pole quality traits remained consistent from tree to tree within a specific varietal.

However, as expected, seedling cost increases with the level of genetic improvement increases (i.e., from open-pollinated to varietals). Typically, OP loblolly pine seedlings will range from $40 to $80 per thousand, MCP seedlings from $125 to $175 per thousand, and varietals from $325 to $430 per thousand. Other species have fewer seedling choices and usually cost more than loblolly pine. While genetics is extremely important when selecting seedlings for pole development, it is not the only variable influencing pole development. Investing in MCP and varietal seedlings only makes financial sense when placed on high-index sites where their genetic quality can be fully expressed. In addition to site-associated factors, a number of silvicultural treatments can influence pole production.

Spacing

Deciding how many seedlings to plant depends on several factors, including species, the intended end product, budget constraints, and the allowable time investment. This last point is important for landowners looking to grow utility poles, as poles may require an additional time commitment of 10–15 years over sawtimber. Ideally, pines should meet pole specifications in high numbers and do so relatively quickly. In addition, pole management may incur higher planting costs, depending on your initial planting density. While an optimal spacing pattern has yet to be formally determined, below are some general trends to keep in mind when considering planting for pole production.

High-density plantings (700-plus seedlings per acre) produce a better environment to develop pole characteristics (**Table 1**). Higher-density plantings also provide an opportunity to select for superior pole traits at the time of first thinning. Thus, planting OP seedlings at high densities could make sense. Nevertheless, there are also a number of negative aspects to higher density. These include higher planting costs, slower growth rates, and higher mortality rates. In some situations, landowners may have to choose between accepting stagnated young tree growth or an uncompensated loss of seedlings, or paying for a costly pre-commercial thinning to remove trees before they have reached pulpwood size. Consequently, high-density plantings are currently not recommended.

Planting at low density (400 or fewer seedlings per acre) increases the availability of light, moisture, and nutrients for each seedling. Growth and survival should be high, and trees can easily reach merchantable size by the time thinning is needed. However, pines growing in a higher-light environment tend to develop physical attributes that are inconsistent with pole standards, including greater stem taper, higher branch number and size, and larger juvenile core. Due to the strong genetic control in varietal seedlings, they may be able to withstand the excessive light environment at low densities and maintain their desirable characteristics. But, generally, planting at a lower density is not recommended for pole management.

Planting at an intermediate density (435–680 seedlings per acre) may provide the best environmental conditions to guide pine trees toward pole quality. Seedlings will initially receive enough light to facilitate high survival and moderate growth rates, but, by age 5–7, light levels will drop and shedding of lower limbs will begin. The result is a combination of desirable attributes for pole production: tall, healthy trees with low stem taper, self-pruning branches, straight growth form, few and small-diameter knots, and smaller juvenile cores. These attributes are influenced by the seedling stocking type that was used.

Thinning

The most critical step in pole production is the selective thinning operation. If done incorrectly, much of the previous effort that has gone into growing poles can be wasted. As such, it is recommended that you consult with a forester to identify which trees to retain. A forester will also be able to determine whether your stand has enough pole-quality trees to warrant further pole management. At the time of the first thinning, the stand should average between 20 and 40 potential poles per acre to warrant a continuation of pole management. If the stand does not meet this threshold, it may be a good idea to manage for sawtimber, as you likely will not have enough poles in your final stand to draw interest from a pole buyer.

First Thinning

The goal of the first thinning is to increase the vigor of the best-formed trees. It is very important to delay thinning until the average tree height exceeds 50 feet and the limbs are self-pruned to a height of 24–32 feet. Thinning before this point will result in tree stems with too much taper and too many knots to qualify as poles. Depending on how dense the stand is planted, a logger may have to remove rows of trees to gain access to the rest of your stand. If this is the case, it is always better to have a fifth-row thinning conducted rather than a third-row thinning. This will provide a larger population of trees from which to select for optimal growth form. When selecting residual trees, it is important to value form over diameter size. Residual trees should be string-line-straight, have minimal stem taper, be self-pruned to the minimum height, have small living branches (fewer than 2 inches in diameter), and be free of major stem defects (cankers, wounds, cat-faces). Trees with form deficiencies that cannot be amended (excessive sweep, forks, taper, or major defect) should be removed in the thinning unless they are absolutely needed to train an adjacent pole-quality tree. Trees violating the branch restrictions should be considered for retention if they meet all other requirements. Issues with branching can be resolved by leaving a higher residual density around the tree in question. Post-harvest pruning may also provide a solution to this issue (see below). In terms of a residual basal area target, landowners should thin lightly to an average of 80–90 square feet per acre.

Figure 5. Poles being transported.

This density level should increase the light availability enough to invigorate future growth and tree health, but not enough for trees to develop undesirable form characteristics, such as large branches.

Subsequent Thinning

Depending on the type of pole class you are growing for, at least one additional thinning will be needed to keep your stand growing and healthy. At this point, it is a good idea to reassess the future pole stocking level. There should be at least 10–25 poles per acre to justify future pole management (thinning lightly to 90 square feet per acre). If this stocking level does not exist, it may be a good idea to thin more aggressively for sawtimber, or, depending on the size of the trees and market conditions, you may want to conduct a final harvest. Alternatively, if your pole stocking is low and demand for poles is high, you could thin your stand at varying levels of intensity. Under this strategy, the area around pole-quality trees is thinned lightly (90 square feet per acre), while the rest of the stand is thinned more intensively to accelerate future diameter growth. This flexible approach to thinning, however, should not be attempted without first consulting a forester.

Unlike some first thinnings, all subsequent thinnings should be marked with paint to specify which trees are cut (or retained). Tree selection criteria should once again prioritize tree form over diameter size. From a financial standpoint, subsequent thinnings should be more profitable for the landowner, as most trees should qualify as sawtimber quality due to the selective process of the first thin.

Another important consideration is the demand for different pole classes in your area. In general, larger pole size classes bring higher returns. However, scarcity in a particular size class can cause exceptions to this pattern. Outgrowing a more profitable size class is obviously an unwise financial decision. This, again, is another reason to consult with a forester before you thin.

Pruning

Due to their negative effect on wood strength, knots are a major disqualifying feature for poles. One strategy to avoid growing knotty wood is pruning. By removing the living and dead branches, pruning allows the tree to produce clear wood with consistent strength properties. Pruning also helps to reduce taper on the lower sections of the stem. Unfortunately, little is known about pruning methods to optimize pole production. Moreover, given the logistical difficulties of pruning above 20 feet, it is unclear whether pruning is even beneficial for pole production. As such, pruning is not currently an advisable practice for pole production.

Timber Insurance

As a pine plantation matures, a considerable amount of wealth is at risk from a number of potential perils (wind, fire, ice, theft, and so forth). Standing timber insurance is one option that you may want to consider, particularly if the final harvest revenue has a dedicated purpose (retirement, college fund). For more information on standing timber insurance, see MSU Extension Publication 2911 *Risk Management Options for Family Forests: Timber Insurance*.

Conclusion

Times are certainly challenging for forest landowners. While sawtimber prices have recovered from their post-recession low, current prices are still disappointing. Worse yet, price stagnation is expected for the foreseeable future as the supply of pine sawtimber still outpaces demand. Consequently, new strategies are needed to maintain profitable forest management.

Utility poles offer an enticing alternative product for forest landowners. Poles sell for at least 1.5 times the value of sawtimber and are far more stable in price. Growing poles, however, is not as easy as growing sawtimber, as poles must meet a rigid set of growth requirements. Landowners interested in managing for poles must also be patient. Growing poles requires a greater investment of time and financial resources. In addition, landowners must accept a greater chance of timber loss to extreme weather.

Clearly, pole production is not for every forest landowner. However, if you are willing to accept the increased risk associated with growing trees for longer periods of time, then poles may provide a very valuable asset to your timber portfolio. As always, this decision comes down to your objectives as a landowner.

References

Self, A.B., and Ezell, A.W. 2015. Planting southern pines: A guide to species selection and planting techniques. Mississippi State University Extension Service. Publication number 1776.

Henderson, J.E., and Garnett, L.W. 2015. Risk management options for family forests: Timber insurance. Mississippi State University Extension Service. Publication number 2911.

The information given here is for educational purposes only. References to commercial products, trade names, or suppliers are made with the understanding that no endorsement is implied and that no discrimination against other products or suppliers is intended.

Publication 2973 (POD-06-19)

By **John L. Willis**, PhD, Assistant Professor, Forestry; **James E. Henderson**, PhD, Professor and Head, Coastal Research and Extension Center; **Randall J. Rousseau**, PhD, Extension/Research Professor, Forestry; and **Stephen G. Dicke**, PhD, Extension Professor, Central Mississippi Research and Extension Center, Forestry.

MISSISSIPPI STATE UNIVERSITY™

EXTENSION

Copyright 2019 by Mississippi State University. All rights reserved. This publication may be copied and distributed without alteration for nonprofit educational purposes provided that credit is given to the Mississippi State University Extension Service.

Produced by Agricultural Communications.

Mississippi State University is an equal opportunity institution. Discrimination in university employment, programs, or activities based on race, color, ethnicity, sex, pregnancy, religion, national origin, disability, age, sexual orientation, genetic information, status as a U.S. veteran, or any other status protected by applicable law is prohibited. Questions about equal opportunity programs or compliance should be directed to the Office of Compliance and Integrity, 56 Morgan Avenue, P.O. 6044, Mississippi State, MS 39762, (662) 325-5839.

Extension Service of Mississippi State University, cooperating with U.S. Department of Agriculture. Published in furtherance of Acts of Congress, May 8 and June 30, 1914. GARY B. JACKSON, Director