Growing Pine Needles and Timber

Photo by David Schnake, North Carolina Department of Agriculture and Consumer Services.

One of the best things about owning forest land is the opportunity to manage for multiple objectives and products. For decades, financially motivated forest landowners could sell timber to strong local pulp and sawtimber markets. Recent declines in stumpage prices for both products have reduced profit margins, prompting many forest landowners to consider alternative management strategies.

Growing needles for the emerging pine straw market is one way forest landowners may be able to generate more income. Pine straw has become a popular mulching material because of its insulating qualities and aesthetics. Pine straw (recently fallen, undecomposed pine needles) has many advantages over other mulches. For example, it does not float and wash away like bark chips; it can be easier to apply and costs less than stone; and, unlike synthetics, it adds nutrients and promotes soil tilth in landscaping beds to stimulate healthy plant development. Pine straw can also be used to limit erosion around construction sites or recently burned areas.

While selling pine needles may seem trivial to some, the value of pine straw has increased tremendously in the last decade (Boatwright & McKissick, 2000–2010). Indeed, pine straw has become a significant forest commodity in several Southeastern states. The most robust pine straw markets are in Florida and Georgia, where pine straw generates $60 million to $80 million annually (Casanova, 2007). This contribution matches the economic impact of pulp in these states (Hodges et al., 2005). Although the pine straw market in Mississippi is not as developed, interest in both raking and selling pine straw has increased over the past decade. Consequently, forest landowners may want to consider pine straw in future management plans.

This publication gives landowners information on how to generate extra income from their timberland while growing sawtimber. We will address common questions regarding species and site considerations, planting strategies, vegetation management options, nutrient management options, and best management practices for producing pine straw.

Species Considerations

Historically, longleaf (*Pinus palustris*) and slash pine (*P. elliottii*) have been the preferred species for pine straw production. Landscapers explain that the longer needles bale better, the reddish-brown color fades more slowly, and the rate of deterioration is slower than loblolly (*P. taeda*) needles (**Figure 1**). Thus, pine straw raking tends to be more profitable in southern Mississippi, where longleaf and slash pine grow naturally. Nevertheless, there is a potential market in the northern half of the state where loblolly pine dominates the landscape and may be produced and transported at lower costs than alternative mulches. Some experts have noted loblolly to be a better mulch for vegetable crops (Morris et al., 1992). Loblolly straw can also be used for limiting erosion around construction sites. Although forest landowners in northern Mississippi may not be able to grow the preferred species for straw production, Loblolly straw offers economic opportunities.

Figure 1. Comparison between needles of longleaf pine (top) and loblolly pine (bottom). Photos by John L. Willis, Mississippi State University.

Site Considerations

Every pine stand generates straw, but not every stand should be raked. First, the stand should be flat (< 8% slope). Land with above-average erosion or land that is subjected to surface compaction should not be considered because pine straw helps protect the soil. Flat ground also facilitates easier equipment access. Pine straw harvesting is best in productive, clay soils. By contrast, deep, sandy soils need all the nutrients they can get, and if pine straw is removed, productivity will decrease. This is a particularly important consideration if growing timber is a management objective, as slower growing trees create longer, less profitable sawtimber rotations. Removing straw from sandy sites can also increase pine moisture stress, which could increase the risk of attack from southern pine beetles (*Dendroctonus frontalis*), deodar weevils (*Pissodes nemorensis*), or Ips bark beetles (*Ips* spp.).

Existing understory vegetation is another important factor to consider. The site should be free of established vines in the understory. Many contractors will not bid on stands where vines are present in the understory, as the baling process becomes very inefficient and some vines, such as peppervine (*Ampelopsis arborea*), are difficult to control once they become established. Stands should also be free of invasive species before raking operations commence. Species that develop rhizomes such as cogongrass (*Imperata cylindrica*) (**Figure 2**) and Japanese climbing fern (*Lygodium japonicum*) (**Figure 3**) can be unintentionally baled with pine needles, facilitating their spread. While there are no laws currently regulating invasive species in the pine straw industry, we urge forest landowners to practice good stewardship and

forgo raking opportunities until the invasive species have been eradicated from the understory. Further information on commonly encountered invasive species and recommendations for controlling them can be found in MSU Extension Publication 2873 *Herbicide Options for Hardwood Management* (Self & Ezell, 2015).

Figure 2. Cogongrass invading a pine stand. Photo by John L. Willis, Mississippi State University.

Figure 3. Japanese climbing fern growing within a pine stand. Photo by John L. Willis, Mississippi State University.

Straw Management

For financially motivated landowners, one of the more attractive aspects of growing straw is how easy it is to incorporate into timber management plans. Pine plantations that are managed for timber production are efficient at producing pine straw. Needle production is maximized, and needles are evenly spread within the stand. In addition, even spacing between the rows helps synchronize when canopy closure (the developmental stage when the tree branches in adjacent rows completely overlap) occurs (**Figure 4**), which will help control understory vegetation growth.

Figure 4. View of a pine plantation reaching the canopy closure stage of development. Photo by John L. Willis, Mississippi State University.

Many landowners have questions regarding planting density. While planting at a higher density (700 or more trees per acre) may seem beneficial for straw production, the reality is that there is a biological limit to needle production. Higher density planting will result in stands reaching canopy closure faster than stands planted at lower densities (e.g., 450–600 TPA), but individual trees will have smaller crowns and fewer needles. Moreover, higher density plantings generally result in higher mortality and slower diameter growth, which could result in patchy straw production, longer timber rotations, and the possible need for a pre-commercial thinning. Consequently, planting at a high density is not recommended.

Another aspect of planting that landowners should pay attention to is spacing. Distance between pine tree rows has no impact on hand baling operations. However, newer mechanical balers require at least 8 feet to safely navigate through the stand. Further information on seedling spacing options can be found in **Table 1**. Failure to properly space the rows could result in fewer contractors bidding on your property.

Table 1. Row spacing options and resulting seedling densities.

Spacing (feet)	Number of seedlings	Spacing (feet)	Number of seedlings
6 x 8	907	9 x 9	537
6 x 9	806	9 x 10	484
6 x 10	726	9 x 11	436
6 x 11	660	9 x 12	403
6 x 12	605	10 x 10	435
7 x 7	888	10 x 11	396
7 x 8	777	10 x 12	363
7 x 9	691	12 x 11	330
7 x 10	622	12 x 12	302
7 x 11	565	12 x 15	242
7 x 12	518	15 x 7	414
8 x 8	680	15 x 8	363
8 x 9	605	15 x 9	322
8 x 10	544	15 x 10	290
8 x 11	495	15 x 15	193
8 x 12	453		

Source: MSU Extension Publication 1776 *Planting Southern Pines: A Guide to Species Selection and Planting Techniques.*

After planting, a stand generally requires between 9 and 15 years to reach canopy closure. It is at this point that needle production is maximized. Raking can be conducted prior to canopy closure; however, it is important not to rake before the stand reaches age 8, as the small amount of straw that can be harvested before this age is unlikely to justify the logistical challenges and negative growth impact of early raking.

Prior to any raking operation, it is critical that the understory be clean (absent of volunteer trees, shrubs, herbaceous vegetation, sticks, or cones) (**Figure 5**). Some contractors will offer this service as part of their initial bid. However, the cost of this work will be reflected in the price offered for the straw. For landowners interested in actively managing their property, the best way to achieve a clean understory is with a combination of herbicide and prescribed fire treatments. Herbicides are generally considered the most effective tool for killing unwanted vegetation.

Herbicides that are safe for pines can be applied using several methods: hack-n-squirt, backpack sprayer, four-wheeler, or small tractor. The type of application prescribed is determined based on the size and density of vegetation to be removed. **Table 2** lists common treatments and associated chemical applications. Remember to read product labels or consult a certified professional for more specific information, safety concerns, and application procedures. Once herbicides have killed the understory vegetation, a dormant-season prescribed burn can be

Figure 5. A pine understory in clean condition for raking. Photo by David Schnake, North Carolina Department of Agriculture and Consumer Services.

Table 2. Herbicide application techniques for controlling understory vegetation.

Treatment	Vegetation characteristics	Typical herbicides*	Application
Backpack spray	< 6 ft high	Combination of glyphosphate and imazapyr in water with surfactant	Spray foliage to ⅔ of crown during late summer to beginning of fall. Do not spray glyphosphate on pine foliage.
Broadcast or banded Spray		Imazapyr, glyphosphate, or sulfometuron for perennial grasses	Use ATV or small tractor with applicator tank and nozzles attached to spray foliage during late summer and early fall. For grasses, apply glyphosphate in the spring, but keep away from pine foliage.
Basal spray (direct)	> 6 ft high, stem diameters < 6 in, thin bark species	Triclopyr with surfactant	Using a squirt bottle, spray root collar (the base of the trunk where stem meets soil) any time of the year.
Hack-n-squirt (direct)	Diameter > 3 in	Imazapyr in water	Using a hatchet, create an opening just inside outer bark in a downward fashion. Use squirt bottle to place herbicide in the opening (one pull of the trigger). Can be applied throughout the year, except early spring.
Spot (direct)	Multiple stems in small area	Hexazinone or sulfometuron	Use squirt bottle or backpack to treat soil at base of stems.

*Active ingredients are listed. Consult a certified chemical sales agent for brand names and concentrations.
Source: MSU Extension Publication 2741 *Pine Straw: Growing Pine Needles.*

conducted to reduce residual woody debris. From this point forward, prescribed fire will be your primary tool for maintaining open understory conditions. Prescribed burns should be conducted between rakes on a 2- to 3-year burning interval.

Thinning

Canopy closure marks the point of maximum needle production in the stand. This is also when competition for resources begins to intensify. This is the reason that needle production begins to decline and stress within the stand begins to increase. Eventually, it will become necessary to thin the stand to reduce stress. Thinning should occur before a stand reaches 110–120 square feet of basal area per acre. (Basal area is a common forest measurement that describes stand density in terms of average stem occupancy over a given area of land.) Thinning increases resource availability to residual trees, but it also reduces the amount of needles available to rake. Furthermore, thinning increases light to the forest floor, which will stimulate understory vegetation growth. For all of these reasons, some landowners choose to exit the pine straw raking business after the first thinning. However, this does not mean your only choices are spending more money and leaving the pine straw business. Leaving a higher residual basal area (80 or more square feet) will help maintain more needles in your stand and provide a degree of understory vegetation control. This strategy could be combined with growing timber for the utility pole market, and it may be particularly lucrative for landowners growing longleaf pine.

Fertilization

The forest floor contains a large portion of the total amount of nitrogen, phosphorous, and potassium present within a stand. Trees depend on these mineral nutrients for growth and survival. One of the major concerns with pine straw raking is the loss of these essential nutrients. Indeed, repeated rakings have been shown to negatively influence nutrient availability (Chevasco et al., 2016). One way to combat this is to add nutrients back into the stand through fertilization. Fertilizers are typically added in late January or early February about 4 years before the first thinning and 4 years before the final harvest. High-quality sites are fertilized after stands have been raked intensively for 3 to 5 years. Lower-quality sites will require more frequent fertilization to retain productivity. Morris et al. (1992) recommend the application of 200 pounds of diammonium phosphate (18-46-0) per acre. Alternatively, straw growers can add 100 pounds of nitrogen (ammonium nitrate or urea), 50 pounds of phosphorous (triple super phosphate and ground rock phosphate), and 50 pounds of potassium (potassium sulfate) per acre. Remember that application rates vary. For instance, sandy soils have a low cation exchange capacity and do not hold nutrients well. Morris

et al. (1992) and Dickens et al. (2004) make further recommendations based on site and stand characteristics and application regime. Fertilizers should not be applied to stands when risk of annosus root rot (*Heterobasidion annosum*) is moderate to high or where pitch canker (*Fusarium circinatum*) is found in the stand (Dickens et al., 2004). It is highly recommended that you conduct a soil and foliar nutrient test before adding any fertilizers to the soil, as overfertilizing the site can cause significant damage and mortality if nutrient loads become too high. Thus, you are strongly encourage to consult with a registered forester, natural resource professional, or MSU Extension agent before adding fertilizers. For further information on performing a soil test, consult MSU Extension Information Sheet 1294 *Soil Testing for the Homeowner* (Crouse, 2016).

Altering the frequency and intensity of straw harvesting also can help mitigate the loss of essential plant nutrients. Harvesting on 3-year intervals will allow for a modest recovery of nutrients within the stand. Nutrient losses can also be reduced by raking early in the fall. Operations that occur in September are ideal for nutrient conservation, as needle fall in October and November would remain on the forest floor. Following this method, however, will result in a smaller straw harvest. Periodic applications of prescribed burning can also increase nutrient availability. In particular, prescribed fire increases the availability of base cations, such as potassium, and stimulates inorganic nitrogen production. Moreover, as previously mentioned, fire will help keep the understory clean. Thus, prescribed burning is an excellent management tool for landowners interested in producing straw.

Raking Frequency

There are a number of different raking regimes. At one end of the spectrum, stands could be raked every year. Depending on several factors, this approach could allow for as many as 8–10 rakes before the first thinning. However, landowners should keep in mind that raking this intensively will slow pine growth without fertilization. On the other end of the spectrum, landowners could rake on 4- or 5-year rotations. This approach would reduce straw proceeds but would also have the lowest potential impact on pine growth. The most common approach is to rake on 2- or 3-year intervals. This strategy will provide a balance of straw proceeds and negative effects on pine growth.

Best Management Practices (BMPs)

BMPs are highly recommended when using herbicides, fertilizers, or prescribed fire. While Mississippi landowners are not required to follow BMPs, these recommendations are designed to protect water quality and animal life. If every Mississippi forest landowner voluntarily follows them, mandatory BMPs, as found in other states, can be averted. Finally, it is important to voluntarily implement BMPs because anyone who pollutes or degrades waterways is in violation of state law (Statutes 49-17-29 and 97-15-41, Miss. Code, 1972). Streamside management zones (SMZs) are vegetated areas adjacent to streams and watercourses that help protect them from polluting chemicals and sedimentation. The minimum SMZ width on a perennial or intermittent stream is at least 30 feet on both sides of the waterway. For perennial streams, SMZ width increases as slope of the land adjacent to the stream increases.

The majority of environmental problems associated with prescribed fire are related to erosion stemming from plowed firelines. The Mississippi BMP guidelines state that firelines should not be constructed within an SMZ. Further, if a fireline is to be anchored to an SMZ, the line should be turned at the edge of the SMZ, so that the plowed line runs parallel. Finally, prescribed fire temperatures should be kept cool to avoid alterations in soil chemistry that reduce soil infiltration, which can increase surface runoff.

Care should also be taken when applying herbicides near streams. If an herbicide must be applied within an SMZ, the application should be by injection or direct application and only when the label instructions approve the product for SMZ application. This also ensures the most efficient herbicide use on the target vegetation. Under no circumstances should chemicals be applied to moving surface waters unless the product is expressly labeled for aquatic use. Do not rinse equipment or discharge rinse water into water bodies, and remember to remove all herbicide containers from the site.

Summary

Declines in pulp and sawtimber markets have stimulated interest in alternative markets for pine products. Compared to other southern states, Mississippi has a relatively small pine straw industry. However, interest in pine straw has been steadily increasing. For many landowners, the primary advantage of growing pine straw is how easy it is to incorporate into traditional timber management plans. While this certainly is an advantage, landowners should recognize that growing straw requires a greater investment in understory vegetation control and possibly fertilization than most forms of timber management. Moreover, landowners should be aware that loblolly pine is less desirable for straw contractors than other pine species. Therefore, the returns you receive on a loblolly plantation may be less than a neighboring property growing longleaf or slash pine. Consequently, we urge landowners to consider these factors before pursuing this exciting opportunity. We also encourage landowners to contact Mississippi State University Extension Forestry (***extension.msstate.edu/natural-resources/forestry***) for further advice on growing pine straw or finding a contractor in your area.

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