

Managing Longleaf Pine Straw

NC STATE

EXTENSION

Woodland Owner Notes

Longleaf pine trees deposit an annual blanket of needles, often called pine straw, on the forest floor. Many forest owners do not realize that it is possible to sell this straw. But in fact, wise management of this resource can substantially increase an owner's income from forestland. Retail sales of North Carolina longleaf pine straw in 2016 were estimated to exceed \$34.8 million annually. This volume could easily be doubled or tripled if owners were more aware of this opportunity and if the market were expanded by promoting sales in states to our north.

Growing Longleaf Pine

Early North Carolina settlers encountered a virgin longleaf pine forest that covered nearly all the well-drained soils of North Carolina's coastal plain. Conversion of the land to other uses and species, unfavorable cutting practices, and failure to provide proper conditions for regeneration have greatly reduced the acreage of this valuable southern pine.

Longleaf pine (*Pinus palustris*) grows well in a variety of soils, but most stands in North Carolina today are growing in soils that are sandy, have a low amount of organic matter in the surface layer, and are moderately to strongly acid. The soil drainage ranges from good to excessive. Approximately 425,000 acres with the longleaf forest type of soil are found in 20 eastern and south-central counties (Table 1). The sale of pine straw can prompt better management of forested acres. Recent conservation incentive programs have elevated landowner interest in restoring and reforesting with longleaf.

Traditionally, the planting of longleaf pine has been problematic because of low seedling survival rates. A high percentage of plantings have resulted in failure. Most of these failures have been averted

recently with the advent of containerized seedlings and early season planting. Better quality nursery stock, proper care and handling of seedlings, and adequate site preparation have raised seedling survival across the Southeast.

Seedling size affects survival success. Freshly lifted, refrigerated seedlings with a collar diameter of at least an inch are the best performers. Plant spacing varies by landowner preference, but typically 400 to 600 trees are planted per acre. Container-grown longleaf seedlings have become the preferred planting stock and consistently result in successful plantings with high survival rates. Refer to Woodland Owner Note 16, ***Steps to Successful Pine Planting***, for more information on survival rates for pines.

Longleaf seedlings are intolerant of competition. Their initial growth can be slow and height growth delayed until seedlings are well-established. Once sapling size is reached, longleaf growth rate compares favorably with other southern pines and may exceed other varieties on sites prone to drought.

Longleaf pine is more resilient to fire and most pine insects and diseases than other pines. Rarely is it grown exclusively for pulpwood. The greatest economic returns are realized when the trees are grown on longer rotations and used for large products such as poles, piling, sawtimber, and veneer logs. Rotation periods of 60 years will produce high-quality products on average sites. Longer rotation lengths provide for valuable utility poles and endangered species habitat, including red-cockaded woodpecker habitat. Straw production is highly compatible with an extended rotation period and can provide an economic justification for maintaining mature timber.

Table 1. North Carolina longleaf pine acreage by county from *Forest Inventory and Analysis* estimates.¹

County	Acres
Bladen	47,114
Brunswick	51,615
Carteret	14,438
Columbus	5,699
Craven	3,035
Cumberland	14,085
Duplin	3,628
Harnett	20,808
Hoke	67,629
Moore	46,510
New Hanover	13,230
North Hampton	5,701
Onslow	7,125
Pender	37,859
Pitt	5,868
Richmond	52,974
Robeson	2,213
Sampson	7,791
Scotland	13,355
Wayne	4,626
Total	425,314

¹ Brown, M. (January 2019). Evaluator query. *Forest Inventory and Analysis*. Version 1.8.0.00. Based on forest statistics for North Carolina by county using query code for "longleaf-slash pine forest type." Asheville, NC: Southern Research Station, U.S. Forest Service.

Longleaf pine needles are flexible and fibrous, with lengths ranging from 8 to 18 inches. Pine needles are used by the nursery and landscape industry for decorative cover and mulch. Longleaf pine straw is also used for erosion control, weed barrier, flower or foundation bedding, and natural area mulch. Traditional garden centers are the main suppliers to homeowners, but increasingly home-improvement centers are popular supply sources.

Fostering Longleaf Pine Straw Production

Pine straw consumers desire bales free of cones, hardwood leaves, and limbs. Most producers manage to keep debris and understory trees to a minimum while encouraging native grasses. Turkey oak, a species that prefers deep, sandy soils and is often associated with longleaf pine, can be a serious problem. Herbicide treatment followed by a prescribed burn a year later will do much to eliminate this species. It may be feasible to cut the oak and treat the stump. Other competing vegetation can also be treated with herbicides. Current herbicide recommendations can be obtained from your county Extension agent. Some landowners opt for a long-term contract with a pine straw producer to harvest the straw, whereby the producer cleans understory competition as part of the contract agreement.

Maximum needle production of longleaf pine straw can be attained in dense stands (from 90 to 100 square feet of basal area per acre). Overcrowding should be avoided, and a 25 to 30 percent crown-to-stem ratio (or greater) should be maintained. The balance between pine straw production and its benefits is discussed in detail in the section on planning below and specifically in the "Pine Straw Rake Plan" paragraph.

Fertilization and Longleaf Pine. Fertilization shows promise on many sites to replace nutrients lost by raking and for sites where owners want to increase production of needles and wood as well. Pine foliage typically remains for two growing seasons (approximately one-and-a-half years). Fertilized needles will be produced during the first growing season after fertilization, but needles will not fall until the second year following fertilizer application. Longleaf pine straw dry weight was increased on research plots by as much as 50 percent (compared to unfertilized neighbors) by the second growing season following application. Increases of 25 to 40 percent are common. Research on loblolly pines suggests that longleaf fertilizer responses would gradually decline over the next four-year to five-year period.

Fertilization of longleaf pine has also produced a significant response in trees' diameter growth in stands as old as 55 years. On research plots at the

Sandhills Game Land managed by the NC Wildlife Resources Commission, trees have responded to fertilization with a 19 percent increase in diameter growth (compared with unfertilized trees) during the first growing season, and a 49 percent increase (over unfertilized trees) during the second growing season. One cautionary note: competition also responds to fertilization, so replacing nutrients lost from straw removal may be more beneficial than experimental rates that maximized wood production. Refer to Woodland Owner Note 30, **Nutrition Management for Longleaf Pine Straw**, for a comprehensive discussion of fertilization and to determine fertilization needs on your property.

Planning for Longleaf Pine Straw Production

Raking and Baling. Longleaf pine needles are usually gathered into piles with a pitchfork or mechanical rake for baling. Some pine straw areas are raked and piled entirely with pitchforks where the understory vegetation prevents the use of tractor-mounted rakes.

Baling pine straw is labor-intensive. Few producers are currently using mechanical balers; most use a manual box-baler (Figures 2 and 3). Many years have passed since producers employed the mechanical balers where one person loads the straw into the baler with a pitchfork, another ties the wire that binds the bale, and another stacks the bales. A three-person crew can produce from 250 to 300



Figure 1. After a prescribed burn, needle fall is visible with minor needle browning in the distance from the recent prescribed fire. Photo courtesy of Mary Lou Addor.

bales per day. The tractor-powered baler is driven from pile to pile.

Higher production can be achieved if partial windrows can be formed and the straw then fed into the pickup reel, where the bale is mechanically tied with twine. The most efficient production is attained where the straw is raked into long, clean windrows, picked up mechanically, baled, and pushed out to the side. Production by this method can reach 1,000 bales per day. Producers are currently exploring two research avenues: mechanically cleaning the pine straw and finding a manufacturer of balers with a chamber size appropriate for pine straw that could lead to more efficient mechanized rolled and “square” balers.

Pine Straw Bale Size. No standard bale size has been established for longleaf pine straw. Bale lengths generally range from 24 to 30 inches, and the dry weight per bale may vary from 8 to 25 pounds. Average bale size differs by producer and sales area, but consumer-sized bales that are light and easy to stow in a car or truck are becoming popular. Some wholesale producers are experimenting with small round bales that are popular with landscape professionals.

Annual Yields of Longleaf Stands. Several variables control pine straw yields, including raking efficiency, the vigor and age of the trees, their basal area (a density measure), the collection season, the time interval between rakings, and the bale size. A



Figure 2. Pine straw box baler. Photo courtesy of Jerry Holder.

15-year-old stand being raked for the first time may yield 200 bales or more per acre. Vigorous, young to middle-aged stands typically yield more straw than older, low-vigor stands. A low annual yield is 50 bales per acre, a good average is 70 bales, and 100 bales is above average.

A stand with several years' accumulation of needles will not necessarily provide a greater yield than one with a two-year to three-year needle fall because producers opt for the freshly fallen or reddish-orange pine straw. On the forest floor, the needles beneath the second-year layer start to disintegrate and become too brittle to bale. To collect the red and yellow needles most desired by customers, raking should be scheduled annually or at least every second year. A two-year interval is also more efficient than raking annually, but the quality is slightly lower. See Table 2 at the end of this publication for practices that ensure resilient pine straw production.

Needles fall throughout the year, but the heaviest shedding occurs in September and October under normal weather conditions. December, January, and February are good months for raking, provided that the bales can be carried directly to the dealer or stored under shelter.

Land Management Plan. Landowners managing for pine straw production will want to consider a written forestland management plan to help guide their longleaf pine straw efforts. Depending on a landowner's management objectives, a place to start is to schedule for the deliberate maintenance and enhancement of native longleaf pine forests, which improves the quality and quantity of pine-straw-producing areas. One tool to aid the quality and quantity of pine straw production is a scheduled prescribed fire or burning plan.

Burn Management Plan. Longleaf pine is well adapted to fire, even at a young age. A controlled burn, particularly during the growing stage, will control loblolly pine and hardwood competition in the same area. Loblolly pines and small hardwoods are

more susceptible to heat damage at an early age. A plan for ongoing prescribed burns will help maintain a healthy longleaf pine ecosystem while providing these benefits:

- Fosters a bare seedbed for germination of pine seedlings and herbaceous plants
- Controls understory growth (such as hardwood and brush species), which yields "cleaner straw"
- Increases sunlight to the ground, which stimulates groundcover and increases vegetative growth, flowering, and fruiting
- Increases the quality and availability of food for various wildlife species
- Encourages the growth of native wiregrass, yields in insect populations, and wildlife food-producing plants
- Maintains a diversity of groundcover species and prevents dominance by a few species
- Reduces hazardous fuel accumulation
- Controls brown-spot needle blight on grass-stage seedlings, a disease of consequence to longleaf
- Helps to prevent invasion or spread of non-native plant species

Timber Management Plan. Management of a longleaf pine stand on a long-term rotation will extend the potential for straw harvest and maintain good wildlife habitat. A long-term longleaf management program can include a group selection harvest to promote unevenly aged trees while allowing remaining trees to naturally seed the parcel area and support future longleaf pine straw production. A forestry consultant can perform a property review and help a landowner determine a suitable timber management plan to maximize pine straw production.



Figure 3. Current pine straw baling best practices use a ground cloth to ensure that ants and other insects are not unwittingly transported to retail locations. Photo courtesy of Jerry Holder.

Pine Straw Rake Plan. For pine straw to remain available for the future, it will be important to maintain open conditions under longleaf pine stands. The open conditions allow a tractor to mechanically accumulate pine straw efficiently while allowing access for a scheduled burning program. The key to harvesting longleaf pine straw is to rotate a raking schedule with understory burns across parcels. Rotating the raking of identified parcel area avoids overharvesting. Annual pine straw raking is possible but should be avoided over an entire parcel. Repeated removal of pine straw can generate ecological consequences, such as removal of soil nutrients and moisture that the groundcover provides in dry and infertile soils. Moreover, fires will not burn hot enough to keep scrub oaks and other hardwoods from prevailing if overharvest of pine straw occurs. If timber growth seems to be affected by raking, a landowner may want to consider resorting to fertilization to offset any noticeable negative effects. Frequent and planned understory burns are essential to maintaining an open understory that improves overall wildlife habitat, produces pine straw income, and creates an aesthetically pleasing savanna type woodland. Income from pine straw production can help offset land management costs, including property taxes.

Safe Harbor Agreement Program. Landowners who are concerned about the ongoing growth of the longleaf pine and this ecosystem's support of the endangered red-cockaded woodpecker can consider enrolling their property in the Safe Harbor

Agreement program to establish a baseline red-cockaded woodpecker population. This agreement will allow the landowner to manage his or her property while enhancing wildlife habitat for federally listed species under the Endangered Species Act. Details on the Safe Harbor Agreement program are available from the U.S. Fish and Wildlife Service. Visit www.fws.gov/ncsandhills/safe_harbor.html or call (910) 695-3323.

Selling Pine Straw. Private landowners often sell their longleaf pine straw to producers, who rake, bale, and market the finished product. The producer typically pays by the bale or on a per acre lease rate. Some landowners rake and bale their own straw and sell it directly to a retailer or user. Landowners who sell on a retail basis also have storage capacity (sheds or trailers).

Federal and state agencies offer their straw for sale on a sealed bid, boundary basis. That is, they accept bids (in dollars per acre) on the right to harvest pine straw within a given area over a specified period, generally six months or annually. Private landowners can benefit by adopting the bidding approach when they sell their longleaf pine straw. The bidding approach offers some advantages: payment is made before harvesting, competitive bidding brings the highest price, and the owner need not be concerned with keeping track of every bale harvested. A sample pine straw sale contract is provided on pages 7 through 10. Note: This is not legal advice; all contracts should be individually reviewed.

As with pulpwood and timber sales, it pays to market pine straw in a businesslike manner using a written contract that specifies both parties' conditions of sale. For a list of pine straw producers in your area, contact your county Cooperative Extension agent, county forest ranger, or a consulting forester.

Always keep in mind that thinning and resting the stand between raking episodes can promote tree health and vigor against pest attacks. Table 2 summarizes easy tips to ensure longleaf stand health while allowing for raking and other production activities.

Table 2. Tips for resilient longleaf pine straw production.

Give the trees room to grow.	More room to grow means more resources (water, light, and nutrients) to support the growth of roots and needles. Trees that are too crowded cannot get enough resources, and ultimately their health and vigor decrease (and susceptibility to pests increases). The best thinning regime to maintain a healthy growth rate is thinning to 90 square feet per acre of basal area when the stand basal area exceeds 140 square feet.
Rake once a year.	Ideally, rake in the fall during peak needle drop (October through November). Raking before the trees shed all their needles allows for some needles to fall later and remain on the forest floor.
Rake only red straw.	Leave a layer of gray straw to hold in moisture. The newly fallen red needles make the most desirable product for buyers.
Allow time to rest, rake, and burn.	Begin a raking cycle that has a rest period. Raking every third year is the soundest cycle. Conduct a prescribed burn between raking. Burning helps control competition, “cleans” the stand, and provides a burst of nutrients to the trees.
Rotate your raking.	Consider dividing your pine straw stand into three raking units so that you can rake one unit, burn one unit, and let a unit rest in a given year.
Fertilize.	Apply fertilizer ever six to eight years to replace lost nutrients. Don’t overdo the nitrogen. Longleaf doesn’t need much nitrogen. Include micronutrients such as boron, calcium, and magnesium.
Use caution during droughts.	Pine trees are most susceptible to attack from <i>Ips</i> species (engraver beetles) during drought conditions. Consider holding off on thinning, fertilization, or prescribed burning that may cause unintended stress to the stand during droughts.

Source: NC Forest Service. 2019. Managing pine stands to reduce tree stress. Longleaf Leaflet (LL-#14). Raleigh: NC Department of Agriculture & Consumer Services.www.ncforestservice.gov/publications/LongleafLeaflets/LL14.pdf

Example Pine Straw Raking Agreement

State of **NORTH CAROLINA**
County of **[COUNTY]**

This agreement made and entered into this ____ day of [Month], 20XX, by and between [Names of Owners] herein called the "Owner" and [Name of Buyer], LLC herein called "Buyer".

WITNESSETH:

PARTIES AND PROPERTY

- A. Owner(s): [Names of Owners] are owners of the [Name of Property], on which is located the Pine Straw Area, described below in the attached map.
- B. Agent: [Name of Agent], as an agent of [Name of Owner], assists with management of the timber resources on the [Name of Property]. Any notice required to be given to Owners shall be given to Agent:

Name of Agent
Organization Represented by Agent
Address
City, State, Zip
Phone Info

- C. Buyer: The Buyer is [Name of Buyer], whose registered agent is [Name of Registered Agent]. Any notice required to be given to Buyer shall be given to:

Name of Buyer
Name of Registered Agent
Address
City, State, Zip
Phone Info

- D. Description of Pine Straw Area: The tract is located in [Name of County]...*provide specific description of location including property map and pine straw raking management units and total raking areas.*
- E. Description of Forest Stand: The forest in which the Pine Straw Area is located is a predominately...*describe forest stand and any attributes including parcel names.*

TERM AND PAYMENTS

- F. Term of Agreement: The parties acknowledge that the Buyer has had an exclusive right to rake straw for the three-year period of [Month, Day, Year] – [Month, Day, Year]. This agreement grants Buyer an exclusive right or refusal to rake straw for an additional three-year period from [Month, Day, Year] – [Month, Day, Year]. This agreement may be extended beyond the current term by written agreement of the parties.
- G. Payment: The Buyer will provide Owners a monthly statement showing number of bales removed from the property and will pay owners \$X.XX for each bale removed. Payments shall be sent to Owner's agent as listed above. Price per bale will be negotiated on an annual basis.

CONDITIONS OF SALE

- H. Owners warrant their title to the pine straw being sold.
- I. Owners guarantee Buyer the right of ingress and egress to the property. The property can be accessed from only one entrance to the property; it is off of Name of Road. See attached map for entrance location.
- J. Buyer agrees to control access into the property to prevent trespass. Buyer agrees to maintain gates at the entrance to the property and keep such gate locked at all times.
- K. Buyer agrees to protect all roads and trails and take necessary precautions to prevent abuse or damage to roads by vehicles, especially during wet weather. All roads will be maintained in their present or better condition during the entire agreement term.
- L. Buyer agrees to conduct pine straw operations in the designated pine straw sale areas only and follow a raking rotation plan, which will be outlined and discussed with Owner's Agent each year prior to raking. The plan breaks the raking area into three separate raking management units. Only management units designated by Owner's Agent may be raked each year. The scheduled time of this raking plan may need to be adjusted depending on weather conditions, timber and land management activities, and the ability of contractors to complete prescribed burns.
- M. The purpose of this rotational raking is to create undisturbed areas for wildlife, to accommodate prescribed burning, and to facilitate the raking of pine straw removal on a sustainable basis. This rotation plan is also in compliance with the Safe Harbor and U.S. Fish & Wildlife Services partnership agreements. Each management unit will in most cases go through a repeated cycle of raking, rest, understory burn, and then rest. Buyer agrees to meet with Owner's Agent each year to review and discuss the raking plan for the year.
- N. A year will be the fiscal year and will run from [Month, Day] through [Month, Day] of each year. On [Month, Day] the Buyer must move to the next raking unit on rotation.

- O. Buyer agrees not to cut longleaf pine trees and/or longleaf pine seedlings and saplings during the raking operation. The Buyer will take necessary precautions and make reasonable efforts to avoid damaging or skinning up longleaf pine trees or longleaf pine seedlings/saplings. Buyer may fell loblolly pine seedlings and hardwood saplings within the rake unit areas.
- P. Buyer agrees to do spot herbicide treatments during term of Agreement to control hardwood re-growth and maintain an open forest floor at his own expense.
- Q. Buyer acknowledges and agrees that neither the Buyer nor his employees or representatives will at any time interfere with any silviculture, timber, habitat improvement, hunting, understory burning or mineral operations on said lands.
- R. Buyer agrees to report promptly to Owner and/or their Agent any unauthorized activity by others (i.e. stealing pine straw) or damage from natural occurrences such as outbreaks of southern pine beetles, timber trespass, or storm damage.
- S. Buyer shall be responsible for the suppression of and damages resulting from all fires caused by Buyer, its agent, employees, and assigns.
- T. Buyer agrees to indemnify and save harmless the Owners and their Agent against all claims of loss, damage, or expense of any kind which may arise in connection with Buyer's operations on the above described tract, including, but not limited to, Workman's Compensation claims.
- U. Buyer shall annually secure and maintain adequate liability insurance coverage for Buyer and for Owners prior to execution of this Agreement. The Certificate of Insurance will show as additional insureds and as certificate holders the OWNERS: [Names of Owners], and AGENT COMPANY [Name of Buyer]. If adequate liability insurance, auto liability insurance, and workman comp insurances expires or terminates, or Certification of Insurance is never received and OWNER AND AGENT are not listed as additional insured, this Agreement is immediately terminated.
- V. Buyer is to abide by all local, state, and federal laws, including, but not limited to the protection of endangered and threatened species.
- W. Owners and/or their Agent reserve the right to inspect the raking operation and to halt or suspend said operations in the event that the terms of this agreement are not being observed. In the event of a breach of this Agreement, Owners reserve the right to terminate the Agreement and to seek other legal remedies as available. The Buyer and Owners have the right to cancel this agreement for any reason within a 30-day written notice prior to the end of the fiscal year.
- X. In the event that raking operations cannot be carried out without risk of injury to trees or soil due to unusual weather conditions, Owners reserve the right to suspend raking operations or cancel the Agreement. In the event that Owner elects to suspend operations, Owner agrees to extend the term of this agreement by the period of time during which operations were suspended.

Y. Buyer agrees not to assign, sublease or transfer any rights hereunder without the express prior written consent of the Owners.

In signing this agreement, each of the undersigned hereby acknowledges they have read the Pine Straw Raking Agreement, understands it, and signs it voluntarily

Executed in duplicate this [DAY] of [MONTH], [YEAR]

SIGNATURE _____
OWNER
Contact Info

SIGNATURE _____
Witness

SIGNATURE _____
OWNER
Contact Info

SIGNATURE _____
Witness

SIGNATURE _____
AGENT OF OWNER
Contact Info

SIGNATURE _____
Witness

SIGNATURE _____
BUYER
Contact Info

SIGNATURE _____
Witness

Attached Property Map

Resources

- McConnell, E. 2016. Economic contributions of North Carolina's pine straw industry. Raleigh: NC State Extension. content.ces.ncsu.edu/economic-contributions-of-north-carolinas-pine-straw-industry
- NC Forest Service. 2011. Harvesting pine straw in longleaf pine plantations. Longleaf Leaflet (LL-#10). Raleigh: NC Department of Agriculture & Consumer Services. www.ncforestservice.gov/publications/LongleafLeaflets/LL10.pdf
- NC Forest Service. 2011. A low-cost pine straw box baler. Longleaf Leaflet (LL-#11). Raleigh: NC Department of Agriculture & Consumer Services. www.ncforestservice.gov/publications/LongleafLeaflets/LL11.pdf

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