



AF Note-37

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Pine straw — a profitable agroforestry enterprise

Introduction

The foundation of agroforestry is putting trees to work in conservation and production systems for farms, forests, ranches and communities. Agroforestry systems using *Working Trees* that produce pine straw can provide supplemental income to woodland owners during years when no trees are being harvested or if used in a silvopasture system during the establishment years before livestock are introduced. If pine straw production is incorporated into an active silvopasture system, careful management of the livestock is critical.

Pine straw (fresh, un-decomposed pine needles that have fallen on the forest floor) is a valuable woodland resource in the southern pine region of the United States.

Most pine straw markets are in the southern U.S. with a slow but steady expansion northward and westward. Pine straw has been a popular landscape ground cover throughout the South since the 1980s. It is one of the most widely used mulches in that area for projects of any size, from residential flowerbeds to industrial complexes and highway landscapes.



Pine straw gathered into windrows on the floor of a pine plantation.
Photo credit: Mack Evans

Benefits

Why use pine straw as a garden or landscaping mulch? Besides being produced naturally and sustainably, there are a number of garden and landscape health and beauty advantages to using pine straw mulch over other mulches:

- long lasting
- light weight
- stays in place — needles interlock
- high in nitrogen
- fine textured and uniform color
- pest free — doesn't attract termites

Getting Started

The easiest way to get started in pine straw management is with an established pine plantation or natural pine stand. An alternative is to plant pines on unused or marginal cropland or pastureland and then harvest pine straw after pine establishment. Either way, the following are some important management steps in getting started with pine straw production.

1. *Develop a management plan.* To successfully begin and manage a pine straw enterprise, it is important to have a management plan that includes short- and long-term objectives, practices that maintain site productivity, level of involvement, market potentials and assistance needed.
2. *Identify sites.* Start with sites of at least 10 acres. Existing native pine stands 8-10 years old eliminate the need and cost of starting from scratch. Longleaf, slash and loblolly are the most commonly used species for pine straw. Other pine species can be used as long as the needle characteristics are similar.
3. *Control weeds.* The pine stand must be free of undesirable vegetation in the understory because these plants may interfere with raking. Undesirable vegetation can be controlled with fire, herbicides, livestock or mechanical weeding.
4. *Establish management units.* Divide the acreage to be raked into several units and rotate the raking and harvesting regime so that only a portion of any area is harvested each year.

Natural pine stands with high quality native understory vegetation, sites that contain rare plants or sites that support threatened and endangered species should not be used for pine straw production.

General Operations *Prepare the site.* At least two years of preparation may be required before high quality clean pine straw can be mechanically harvested with minimal effort. Before raking, the area must be cleared of all twigs, leaves, trash, pine cones and tree limbs.

- Remove (prune) the lower limbs of every tree that might block the movement of equipment and laborers within the rows. Prune by hand or remove limbs by using powered cutters attached to a small tractor. Depending on tree height, pruning may not be necessary in hand-raking operations.
- Remove all trees and shrubs within the baling rows. This also is a good time to remove diseased trees within the rows as well. Control hardwoods. Hardwood leaves will reduce the quality of the straw.
- Remove all limbs and other debris from the baling rows. The debris must be picked up or raked off the site. Depositing the debris every sixth or seventh row eliminates the need to move the debris great distances and reduces labor cost.



Pruning the lower limbs of the pine trees facilitates equipment movement and can also increase the value of the tree itself.
Photo: Mack Evans



Raking pine straw by hand is a labor-intensive operation. Photo: Jim Barnes

Stand density management. There can be a tradeoff between the optimum stocking level for maximum straw production and timber production. Local markets and prices for pine straw and timber also will influence which product should be emphasized. Stocking needs should be based on the pine straw harvesting method and its associated equipment. If pine straw production is the primary goal then carrying a higher basal area per acre may be more desirable.

Raking pine straw. Raking can be done by hand or machine. When raking by hand, rake the pine straw into piles, which can be later pitch-forked into a baling machine. Raking machines, on the other hand, will rake the pine straw into windrows that can then be picked up by hand or machine. Production is higher with raking machines but a disadvantage is that machines may damage pine trees. Damaged trees will have reduced growth and are more susceptible to bark beetle attack and possible mortality. Rake needles in the middle of the peak needle fall period, typically September through November. Later needle fall will contribute a small amount of new needles to the forest floor even in years when raking occurs. Additional items to consider when harvesting pine straw include:

Avoid erosion damage by not developing pine straw production on sites with slopes greater than 8 percent.

- Exclude any insects (especially ants), excess litter, grass and hardwood leaves that might reduce the value of the bale. Be careful to avoid seeds of noxious weeds and other plants that might present a problem in landscaping yards or flower beds.
- Rake only 'red needles,' which are the un-decomposed, recently fallen needles. Leave the partially decomposed 'gray needles' undisturbed. These will provide some protection for the forest floor after harvest.



Tractor-powered balers can be used with one person pitch-forking the straw into the baler, another tying the wire or twine around the bale and a third person stacking the bales. A three-person crew can produce 250 to 300 bales per day. Photo: David Moorhead

Bale pine straw. Many landowners may have the equipment needed for a pine straw venture. Basic equipment includes a hay rake, mechanical baler, small tractor, equipment trailer, storage barn and truck. Some producers use an old-style dump rake that can go between trees more easily, can be lifted over obstructions and will windrow the straw. There also are several other machines made specifically for pine straw raking and baling that have been designed to minimize the impact to trees and understory vegetation.

A highly productive crew of five people may require 2-3 weeks to prepare, clean, bale and haul pine straw bales from a typical 30-acre pine plantation.

Baling pine straw is very labor intensive. Today, box balers are most common method of baling, with an individual capable of putting up between 100-200 bales per day. Tractor-powered balers also can be used with one person pitch-forking the straw into the baler, another tying the wire or twine around the bale, and a third person stacking the bales. A three-person crew can produce 250-300 bales per day. If the straw is raked into windrows and then mechanically picked up and baled, production can reach 1,000 bales per day.

Fertilize. Over time, as the pine straw is removed, tree growth and vigor may decline. As much as 40 pounds of nitrogen is lost for every 100 bales of straw per acre harvested. Fertilizer can be used to improve tree growth and replace the nutrients that are removed with raking. Fertilization also may increase pine needle (pine straw) production. Some studies have shown 2-5 times more needle biomass after fertilization.



Bales of pine straw loaded on a wagon ready to be taken to market. Photo: www.123rf.com

Fertilization recommendations generally suggest broadcasting 150-200 pounds of nitrogen per acre and 50 pounds of elemental phosphorus per acre every 5 years. Trees use phosphorus to increase wood growth, and nitrogen stimulates foliage growth and thereby pine straw yields. Additional potassium may also be needed on some sites. Careful fertilization will increase needle fall volumes but over-fertilization can damage or kill some pine trees, especially longleaf. It is important for harvesting operations to leave a layer of straw and organic matter. Harvesting pine straw also may have long-term effects on the soil health.

Monitor fertility levels by periodic soil testing and pine needle nutrient analysis and, if deficient, be prepared to add fertilizer at recommended rates.

Rotate harvests. The greatest concerns regarding pine straw harvesting are the possible negative effects on tree growth, soil productivity and wildlife habitat. Pine needles provide a protective cover for the soil and also are a source of recycled nutrients that pine trees need for growth. By removing the pine needles, the soil is exposed to erosion and nutrients are removed from the ecosystem. The frequency of raking should depend upon landowner goals and objectives and the productivity of the site. Fertile sites can be raked more often than non-fertile sites. To avoid long-term negative effects from pine straw harvests, it is advisable to rake an area no more than 5 times during a 20-year rotation.

Studies have shown that productive sites can be managed on a 3-year, 'rest-rake-burn' rotation. Needles accumulate the first year, raking occurs the second year and the third-year needle fall is used as fuel to carry a prescribed burn. Burns can be conducted either in late winter (December-February) or during the growing season (April-July). Other sources recommend a longer 3-4 year raking interval. This interval may be suitable for less productive or more environmentally sensitive sites. Decisions about when to rake and when to burn, should be based upon site productivity, the condition of the understory and whether prescribed fire is needed to control woody species encroachment.

Raking straw can impact the diversity and richness of plant and animal species. Harvesting pine straw from the site can dramatically alter the natural, ecological system because pine needles provide food and habitat for animals that help decompose litter and improve soil health.



Pine straw makes an attractive ground mulch that is long-lasting, light-weight, inter-locking, uniform in color and pest free. Photo: USDA National Agroforestry Center

Some wildlife species which normally reside in pine stands may be adversely affected by a lack of cover and food supply caused by intensive pine straw management. Raking every 4 years may reduce any long-term deleterious effects.

Marketing and Selling

Pine straw harvesting can be highly profitable and sustainable as long as appropriate management practices are followed. Typically, pine stands will yield 100 to 150 bales per acre per year if all conditions are right or approximately two tons per acre each year. This quantity can vary from 60 bales per acre on less productive sites to as much as 200 bales per acre on exceptional sites. Factors such as tree age, species, stand density, soil fertility, management inputs, and season affect straw yields. Other variables that contribute to pine straw yields include interval between harvests, bale size, “cleanliness” of stand, weather, and raking efficiency.



Pine straw lies on the floor of a Georgia pine forest ready to be taken to market. Photo: USDA National Agroforestry Center

Typically, pine straw is sold and moves to market in two ways:

- Harvest the straw and sell retail or wholesale with payments typically on a per bale basis.
- Lease or contract the land for baling rights to a pine straw company that will rake, bale, and market the pine straw. Payment is usually on a per acre basis.

If leasing or contracting, a written contract between the buyer and seller should always be developed that includes, at a minimum: Where, when, and how the straw will be baled, and the agreed upon selling price for the pine straw.

More information

Landowner associations can disseminate information, enhance the professionalism and increase the availability of quality pine needles. Associations typically are organized to maximize the mutual benefits of pine-needle production for the landowner and the consumer. Other excellent sources of information include:

- Pine straw landowner associations
- University extension pine straw publications
- Experienced pine straw producers
- Pine straw collection and distribution companies
- Landscaping businesses
- Workshops and landowner training courses



Landowner associations allow sharing of equipment and technical knowledge. Photo: North Carolina Pine Needle Producers Association

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