



North Carolina Forest Service

Shortleaf Leaflet

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SL-04

Shortleaf Pine Natural Regeneration

Planting seedlings to reforest woodlands is a common practice in the Southeast. While less common, natural regeneration offers a viable low cost alternative using the trees annual seed crop. Shortleaf pines forests are able establish seedlings naturally due to its prolific seed production. It readily regenerates in openings created by natural or man-made disturbances such as fire, insect and disease, wind storms, or logging. Many of today's shortleaf forest established from the seedfall of border trees when agricultural fields were abandoned. Shortleaf pines irregular cone crops, limited seed dispersal distance, slow early growth, and dry site conditions impact establishment success. Adequate seedbed preparation and competition control must be done, sometimes years in advance, to improve success. For shortleaf pine the seed tree and shelterwood harvest regeneration methods are most often recommended.

Seeding Characteristics

Seed production increases as trees get older, grow bigger in diameter, and are given room for its crown to expand. Generally, older stands produce more seedfall. Shortleaf pine trees begin to produce good cone crops at age 20. Trees must be 10 -12 inches in diameter to produce high quality seed. Although some trees produce seed every year, good to excellent cone crops occur every 3-6 years in the southern and western range area; and every 3-10 years in the northern and eastern areas⁹. In the eastern Piedmont regions an increase in cone production is observed as we go south from Virginia to Georgia⁴. In the Ouachita Mountains seed crops of good, poor, and bumper were recorded after a reproduction harvest¹³. On average good seed crops occur 2 to 4 years out of 10, but are less frequent on limits of the natural range¹⁶. Overall, poor, irregular seed crops are common place for shortleaf pine.



Fig. 1. Shortleaf seedling regenerated naturally in a small opening in the Ouachita Mountains of Arkansas



Figure 2. The small cone of a shortleaf pine often persists on the tree after seed are released.

Seed-fall begins in late October or early November. Most of the small, lightweight seed only falls 75 to 150 feet from the tree. However, with the influence of topography and wind, a few seeds may travel distances of 200 to 300 feet. Each cone contains 25-38 seeds⁹. On average 130 cones per tree are produced annually. Thinned stands typically produce twice as many cones as unthinned stands¹⁵. Likewise, the number of seeds per cone also increases when the crown is released¹⁴. Thinning the stand 2-3 years before the harvest cut allows enough time for the seed trees crown to expand.

The number of seedlings that survive and grow after seedfall is very low. In fact it takes between 25 and 100 sound seeds to establish one seedling^{3, 14}. A good cone crop releases 80,000 seeds per acre, while an average one produces 30,000 to 50,000 seeds per acre¹. Since we need 750 to 1200 seedlings per acre to establish, it is important to prepare the forest floor for optimum seed catch prior to seedfall.

All southern yellow pines have four basic requirements to meet to achieve adequate natural regeneration. These are:

- An adequate seed source is available
- The seedbed is prepared
- Competition is controlled
- Soil moisture is available

Seedbed Preparation

Shortleaf seed must contact mineral soil to germinate. Seedbed preparation that removes dense litter layers is critical for to obtain acceptable natural regeneration⁵. Often the scarified forest floor after logging expose enough soil to provide an adequate seedbed^{2, 7}. Ideally, the regeneration harvest would coincide with a good seed crop to take advantage of the exposed soil. Realistically, timber contract provisions and the few months available between a forecasted bumper crop and the actual seedfall make that unlikely. Conducting a prescribed burn before and or soon after the regeneration harvest also increases seedling establishment success. With shortleaf pine you cannot cut and run and expect to be successful.

Competition Control

Shortleaf pine seedlings are shade intolerant and grow slowly their first two years⁹. If not controlled, hardwood competition will overtop the new seedlings and reduce seedling stocking. Competition control is most effective when applied several years prior and then again after the reproduction cut (but before seedfall). How much control is needed depends on site quality, soil type, available soil moisture, predicted seed crop, and the harvest method chosen. High quality, moist soils require more intensive competition control than the lower quality dry sites.

Mechanical, herbicides, and prescribed burning are several means available to control vegetative competition. Prescribed fire is an effective and inexpensive method of site preparation and competition control. A prescribed fire reduces the forest litter layer and controls some of the small woody stems^{1, 10}. Prescribed fire applied every 2-4 years has been shown to promote natural regeneration in shortleaf forests¹⁸. Hardwoods larger than 2 inches are more effectively controlled by herbicides or mechanical methods or a combination. Drum chopping is sometimes used to crush small trees and brush with a follow up burn or herbicide application to control sprouting.

A prescribe burn program started when the pines are young and conducted every 3-5 years is an inexpensive and effective way to keep the hardwoods small and under control. It is very likely that the recruitment of seedlings from the use of frequent fire, combined with shortleaf's ability to re-sprout, will, over time, result in an accumulation of seedlings and seedling sprouts underneath the existing stand just waiting for overstory removal to grow⁵. If applied successfully, enough seedlings-in-place would grow to allow for fewer seed trees, or alleviate the concern of understocking.

Soil moisture

Survival of newly germinated seed is greatly increased with adequate rainfall throughout the spring. A study in NC found that frequency of rainfall in the spring accounted for 51 percent of the variation in first year seedling survival¹². In other words, half the instances of low survival is because of infrequent rain during and after spring germination. Heavier textured soils hold soil moisture better than lighter soils, and thus require less seed.

Regeneration Methods

Shortleaf pines erratic cone crops, small cones with fewer seeds, and lower seed dispersal distance require us to leave many seed bearing trees. Both the seed-tree and shelterwood systems are suitable. For shortleaf pine more trees per acre are recommended than the more prolific seeders like loblolly pine. For both methods regeneration success is increased if one or more prescribed burns are conducted prior to harvest. The burn reduces woody competition and the litter layer. Additional seedbed preparation occurs when the logging operations disturbs the forest floor. The harvest must be timed to coincide with a good cone crop.

DBH	Seed tree	Shelterwood
10	20	54 -90 (30-50 BA)
12	14	38-63 (30-50 BA)
14	12	28-47 (30- 50 BA)
16	12	21-36 (30-50 BA)

Table 1. Number of trees per acre to leave for shortleaf natural regeneration by harvest method.

Seedtree

The seed-tree harvest method is a preferred reproduction system for dependable cone producers. A seed tree cut removes all but a few trees. For shortleaf pine, 12-20 evenly spaced trees are left per acre. Exactly how many trees to leave is influenced by tree size, seed bed condition, and locale. Only high quality individuals that are of good form, and vigorous, are selected to remain as the seed source.

Shelterwood

Shelterwood is similar to a seed tree harvest except that more seed trees are left per acre to insure an abundant seed source. It is preferred for adverse sites and when dependable cone production is questioned. For shortleaf it is recommended to leave 30 to 50 square feet of basal area per acre in quality seed bearing trees⁶. Usually the two-cut system is adequate for shortleaf.



Figure 3. A seedtree is a reproductive cut that leaves a few evenly distributed mother trees of good form and vigor to provide seed.



Figure 4. A shelterwood is a reproductive cut similar to a seedtree but leaves more mother trees per acre.

Schedule of activities for a seed-tree or shelterwood natural regeneration harvest

Activity	Why	When
Prescribed Burn**	Competition Control	6 years before to regeneration cut
Prescribed Burn**	Competition Control	3 years before regeneration cut
Preparatory Cut **	Release Crown	2-3 years before regeneration cut
Site Preparation Burn	Prepare Seedbed	Spring in year of regeneration cut
Select and Mark Seed trees	Leave vigorous high quality seed	After site preparation
Herbicide Application **	Competition Control	Spring before regeneration cut
Reproduction Cut	Harvest all pines and hardwoods except seed trees	Late summer or fall
Evaluate Stocking	750 – 1000 seedlings/acre: evenly spaced	Three years after regeneration cut
Harvest seed trees	Recover value and give seedlings room to grow	As soon as adequate stocking is established
Release Pine or Do precommercial thinning **	Control woody competition OR Control stocking for improved stand growth	3 to 5 years after regeneration cut

**If needed

Adapted from Baker 1991

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