Mortality among Seed Trees in Longleaf Pine Shelterwood Stands

William D. Boyer

Mortality of longleaf pine (Pinus palustris Mill.) seed trees was recorded in 27 regeneration areas ranging from North Carolina to Louisiana. Annual mortality averaged 0.7 percent before, and 1.9 percent after a seed cut reduced stand density to about 30 square feet of basal area per acre. On a per-acre basis, however, annual losses averaged 0.4 tree both before and after cutting. Yearly mortality of 0.2 tree par acre or less was recorded for more than half of all observations.

Mortality among high-quality longleaf pine crop trees in shelterwood stands is a real concern to forest managers using this form of natural regeneration (Figure 1). Some managers speculate that mortality will

Figure 1. *Longleaf* ***pine shelterwood*** *stand* ***on the*** *Kisatchie* National ***Forest in*** Louisiana. *How* ***many of these high-quality crop*** trees ***will he lost during the*** *regeneration* ***period?***

increase sharply when stand density is reduced to leave either a shelterwood or seed-tree stand for natural regeneration. But no information is now available on mortality among seed trees in longleaf regeneration areas, so there is no basis for predicting risks and costs. In this study, regionwide tests of longleafpine natural regeneration by the shelterwood system have provided information on seed tree mortality both before and after the seed cut. The results are reported here.

THE STUDY

From 1967 to 1970, side-by-side tests of both the three-cut and two-cut shelterwood regeneration systems were established at ten separate locations'-three in Florida, two in Alabama, and one each in North Carolina, South Carolina, Georgia, Mississippi, and Louisiana. In addition to these 20 cooperator test areas, seven tests of the two-cut shelterwood system were established on the Escambia Experimental Forest in southwest Alabama in cooperation with the T. R. Miller Mill Company. The first of the experimentai forest tests was established in 1961 and the balance between 1970 and 1974. Individual regeneration test areas ranged from 15 to 100 acres.

The three-cut areas were lightly thinned at establishment to improve spacing ofresiduals and to remove intermediate and suppressed trees; thinning left no more than 80 square feet of basal area per acre. At the same time, two-cut test areas were given a seed cut to leave 30 square feet per acre ofwell-distributed dominant and codominant trees. Residual stands on all three-cut areas averaged 50 square feet of basal area and 57 trees per acre, while two-cut areas averaged 31 square feet and 36 trees per acre.

Each of the 27 regeneration areas in this study has had sample trees marked for estimates of past and future seed production through springtime flower and conelet and cone counts. Each test area had one or two trees at each of 25 sample points, for a maximum of 50 sample trees. Sample trees were observed annually until the regeneration area was clearcut. Some test areas have had only 2 years of observation, and others as many as 10 years. These observations provided my data on seed tree mortality.

The 20 cooperator test areas initially had 922 sample trees marked for observation, from which 5,752 "tree-years"[2] of observation have been accumulated. The seven experimental forest areas had 313 sample trees, which provided a total of 1,207 tree-years of observation. Mortality among marked sample trees should be representative of losses on the regeneration area as a whole. Annual mortality percent for marked seed trees in each test area was determined by dividing total mortality by tree-years of observation in that area (Table 1).

Table 1. Mortality among seed trees on longleaf pine regeneration areas.

Location	Tree-years of observation[1]	Mortality: Total number	Mortality: Annual percent
Bladen Co., NC	462	10	2.16
Chesterfield Co.. SC	337	6	1.78
Decatur Co., GA	908	5	0.55
Leon Co., FL	534	0	0
Okaloosa Co., FL	782	0	0
Santa Rosa Co., FL	730	4	0.55
Coosa Co.. AL	292	5	1.71
Perry Co.. AL	660	8	1.21
Perry Co., MS	542	14	2.58
Grant Parish, LA	505	4	0.79
Escambia Co., AL	1.207	9	0.75
All Locations	6.959	65	0.93

[1]Sum of surviving sample trees present at beginning of each year of observation.

RESULTS

Mortality among all study locations ranged from 0.0 to 2.6 percent annually and averaged slightly less than 1.0 percent. Mortality rates of 0.75 percent or less were recorded for 60 percent of all observations.

Greatest losses were recorded in Mississippi (DeSoto National Forest). Most of the mortality, 11 of 14 trees, resulted from Hurricane Camille in 1969, and 8 of the 11 dead trees were on the two-cut area. These hurricane losses accounted for 17 percent of all mortality recorded during this study. Some mortality in North Carolina tests was attributed to a hot fall seedbed burn.

At all cooperator locations, the mortality rate was higher during the first year after logging (1.4 percent) than at other times (0.9 percent). Mortality rate was also higher on areas that had the seed cut (1.9 percent) than those with only the prep cut (0.7 percent). Although density among the 20 regeneration areas ranged from 20 to 78 square feet of basal area per acre, the effect of this factor on seed tree mortality was not great enough to be statistically significant.

The higher mortality on areas cut back to a shelterwood density of 30 square feet per acre may be a reflection of fewer trees per unit area. The loss of one

'Cooperators are National Forests in Alabama, Mississippi, Florida and Louisiana; the North Carolina, South Carolina and Florida State Forest Services; the U.S. Air Force; International Paper Company; and Kaul Lumber Company.

[2]A tree-year is observation of one living tree over a period of one year. Two tree-years can be either two trees for one year or one tree for two years.

Table 2. Annual per-acre losses of longleaf pine seed trees on regeneration areas before and after the seed cut.

Location	Annual mortality	
	Before seed cut (Three-cut areas)	After seed cut (Two-cut areas)
	Trees per acre	
Bladen Co., NC	.90	1.35
Chesterfield Co., SC	.68	.35
Decatur Co., GA	0	.20
Leon Co.. FL	0	0
Okaloosa Co., FL	0	0
Santa Rosa Co., FL	.18	.28
Coosa Co.. AL	0	[1]
Perry Co., AL	0.65	0.27
Perry Co., MS	1.48	1.00
Grant Parish, LA	.50	.12
Average	0.44	0.40

'No data

tree created a higher mortality rate for stands averaging 36 trees per acre (two-cut areas) than for those averaging 57 trees per acre (three-cut areas). This is demonstrated when mortality is expressed as trees per acre (Table 2) determined by multiplying residual trees per acre and mortality percent for each area. Annual overall losses per acre are nearly equal, averaging 0.44 tree in three-cut areas and 0.40 tree in two-cut areas. This means average annual losses of one tree per 2.3 acres before and 2.5 acres after the seed cut.

On individual cooperator two- and three-cut regeneration areas, 34 percent recorded no losses, while 73 percent recorded annual losses of 0.4 tree per acre or less. More than half of the observations recorded yearly mortality of 0.2 tree per acre or less. Attrition among seed trees should be much less than the recorded average, which was strongly influenced by the relatively few occasions with high losses.

CONCLUSIONS

The mortality of seed trees in shelterwoocl stands should not exceed, on a per-acre basis, the mortality that be expected in any other longleaf stand of similar age. During a five-year regeneration period following the seed cut, losses in 75 percent Gf regeneration areas can be expected to average two trees per acre or less. Some of the dead and dying trees can probably be salvaged at the time of the removal cut.

William D. Boyer is principal silviculturist, George W. Andrews Forestry Sciences Laboratory, Auburn, ***Alabama, maintained by the Southern Forest Experiment Station, USDA Forest*** Service, ***in cooperation with Auburn University.***