WHAT'S YOUR SURVIVAL?

S. J. Ursic, Research Forester
Southern Forest Experiment Station, U.S. Forest Service
Oxford, Miss.

What is the survival of last season's planting? This pertinent question is often foremost in the minds of foresters and others engaged in large-scale tree planting.

This paper describes sampling techniques that will provide reasonably satisfactory estimates of first-year pine survival at minimum cost and effort. It is based on 5 years experience in determining first-year survival of pine plantings within the Yazoo-Little Tallahatchie flood prevention project area. Fifty million loblolly seedlings are planted annually within the 19 north Mississippi counties in this flood prevention project.

The first step is to decide just what information is needed. In the following discussion it is assumed that a survival estimate of all planting is sufficient. It may be desirable to make comparisons between categories such as openland and conversion planting, or machine and hand planting. These breakdowns increase the sampling required, but the procedure for obtaining a valid estimate for each category is identical.

The second step is to compute the approximate number of plantations that will have to be sampled for an estimate likely to have the desired reliability. On the Yazoo-Little Tallahatchie project, 10 circular 1/100-acre plots are taken on each plantation sampled. It has been found over a period of years that the standard deviation (based on the total number of trees planted) for sets of 10 circular 1/100-acre plots rarely exceeds ± 20 percent regardless of survival. With this value and a tolerable error of ±10 percent of mean survival (meaning that unless a 1-in-3 chance has occurred the survival estimated will be ±10 percent of the true average), the minimum number of plantations that will need to be sampled depends directly upon the expected survival:

Expected survival	Minimum number of plantations required
(percent)	
30	45
50	16
70	8

The number of required plantations is estimated from the formula $n = (SD/TE)^2$, where SD is the standard deviation in percent (20 percent), and TE is the tolerable error--10 percent of the expected survival in this discussion.

An approximate survival percent is usually known to the practicing forester or can readily be determined by a cursory field check late in the summer.

The third and last step is to compile a list of all current plantations and to select those to be sampled. On the Yazoo-Little Tallahatchie project, currently planted acreage on each individual ownership is mapped and listed as a single plantation.

To eliminate the necessity of weighting plot data in the computations, plantations to be sampled should be randomly selected from the list, with probability of selection proportional to the area planted. One method is to accumulate the acreage in the list of plantations and compile an inclusive acreage column as in the example below. Numbers ranging from 0 to the total acres planted are then drawn at random. A plantation is sampled if the number drawn falls within its inclusive acreage. In the example, the number 047 tells us to sample the plantation whose inclusive acreage is 26-55.

Plantation size	Accumulative acreage	Inclusive acreage	Random numbers
(acres)			
20	20	0-20	018
5	25	21-25	
30	55	26-55	047
8	63	56-63	
116	179	64-179	087, 146
etc.	etc.	etc.	
	965 (total acreage planted)		

Sampling is with replacement; i.e., any plantation can appear more than once in the sample. In the example above, the fifth plantation was drawn twice; it would therefore be regarded as two samples in the computations, although in practice it would be sampled only once.

Field Procedure

The 10 plots to be sampled in each plantation may be located at random, but for convenience are often taken on a systematic grid. Aerial photographs are invaluable both to delineate the plantations and to decide on a grid spacing that will adequately cover them. Ideally, each 1/100-acre plot within the plantation should have an equal chance of being sampled.

Individual plots can be located by pacing with a hand compass. A staff is set at the plot center and a tape exactly 11.78 feet in length is used to measure the plot radius. A ring at the end of the tape permits it to turn freely on the staff and thus speeds the task of checking borderline seedlings.

The number of seedlings planted and the number of living seedlings are recorded for each plot. The survival on each plantation is computed as the ratio of the total number of living seedlings to the total number planted on the 10 plots. The survival for all plantings, or for any given cateogry of planting, is the average survival of the plantations sampled.

After each annual sampling it is advisable to calculate the relative standard error (in percent of mean survival) and the absolute standard deviation (in percent of total trees planted). The former will indicate if the results are within the desired ±10 percent limits of accuracy, the latter will show if the ±20 percent figure used as the standard deviation is adequate for future sample design. The standard deviation is computed as

$$\sqrt{\frac{\Sigma X^2 - (\Sigma X)^2/n}{n-1}},$$

where the X's are the survival percents on the n plantations sampled. The standard deviation divided by square root of n estimates the standard error. Because sampling is with replacement, no correction for finite population is needed for computing the standard error. A more exact estimate of the standard error could be obtained by using a correction for within-sample variability, but such refinement is rarely worth the additional effort.

Plots may be permanently staked for future examination. Although seedling losses after the first year are usually negligible, the plots may also be a convenient means of collecting data on such topics as growth, tip-moth infestation, hardwood competition, or effect of time of planting. In north Mississippi, for example, there is evidence that survival of seedlings planted in February is higher than survival of seedlings planted **earlier** or later.