

# THE DECEMBER DIP OF LOBLOLLY PINE<sup>1</sup>

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ABSTRACT- Several planting date studies with loblolly pine (*Pinus taeda*) have shown a decline in survival during the month of December. The term "December dip" was coined to describe this phenomenon. The "dip" in survival occurs just before the prime planting season (January and February) and just after the fall planting season (October and November). The exact reason for a decline in survival is unknown but it appears to result from a decline in root growth potential. Some half-sib genotypes of loblolly pine may be more sensitive to the December dip than other genotypes.

## INTRODUCTION

Throughout the world, the "optimal" time for outplanting loblolly is determined by adequate soil moisture. For example, in the summer rainfall area of South Africa, bare-root and container-grown loblolly pines are transplanted during the summer months when rainfall is highest. In contrast, the rainy season for much of the southern United States is during the winter months. Rainfall usually exceeds the potential evapotranspiration in December, January and February (fig. 1). It is during this period when most loblolly pine seedlings are outplanted in the South.

In the southern U.S., seedling morphology changes during the fall and winter and these changes can affect outplanting survival. Typically height growth ceases in the nursery by October but diameter growth and root weights continue to increase (fig. 2). Therefore, depending on the environment, seedlings lifted in February will have larger root-collar diameters and higher root/weight ratios (root dry weight/seedling dry weight) than seedlings lifted in October (Mexal and South 1991). As a result, one might expect a gradual increase in outplanting survival over the planting season. For example, during the 1950's, survival in North Mississippi (Ursic 1963) increased from 68 percent (December) to 73 percent (January) to 76 percent (February). Based on increases in root mass and diameter (fig. 2), one would expect this increasing trend in survival. Occasionally, researchers have observed an unexpected decline in survival when planting in December. This phenomenon has been given the name "December dip" (Stumpff and South 1991). This "dip" in survival cannot be easily explained since seedlings lifted in November have received less chilling and are slightly smaller in diameter than seedlings lifted in December. It is believed the effect is caused by changes in seedling physiology. This paper reviews some planting date studies that have shown a December dip. It also updates a planting date/survival curve by South and Mexal (1984).

## WAKELEY

Philip Wakeley may have been the first to document a December dip in a 1937 study (Wakeley 1954). Seedling survival in Louisiana was greater than 90 percent when planting in October (27th) or November but survival

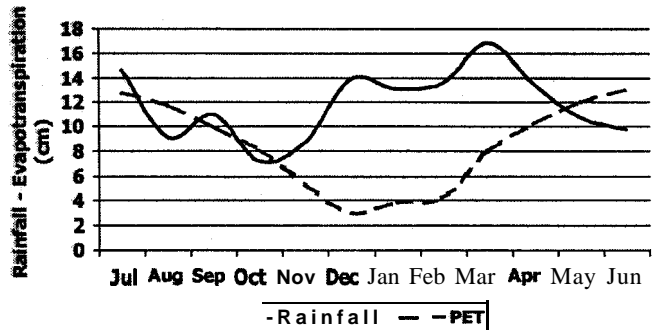


Figure 1—Average monthly rainfall and average potential evapotranspiration at Auburn, Alabama.

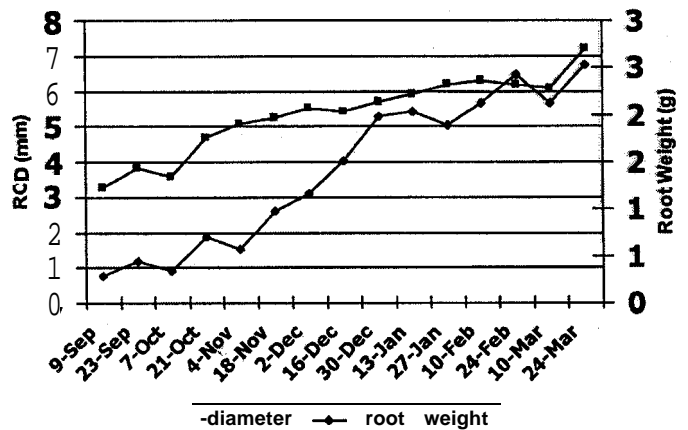


Figure 2—Changes in root-collar diameter and dry weight of roots of loblolly pine seedlings in the nursery (unpublished data provided by James Boyer).

<sup>1</sup>South, D.B. 1999. The December dip of loblolly pine. In: Landis, T.D.; Barnett, J.P., tech. coords. National proceedings: forest and conservation nursery associations—1998. Gen. Tech. Rep. SRS-25. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station: 14-17.

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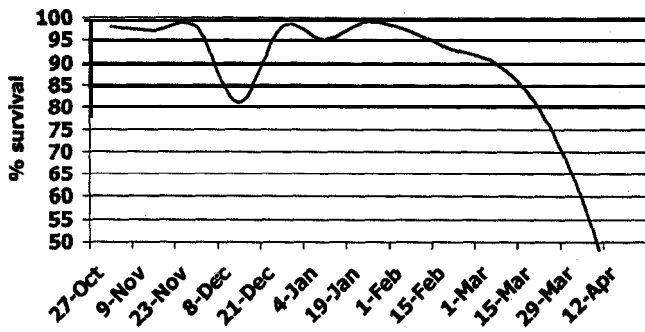


Figure 3—Survival of loblolly pine seedlings planted in Louisiana in 1937-38 (adapted from Wakeley 1954).

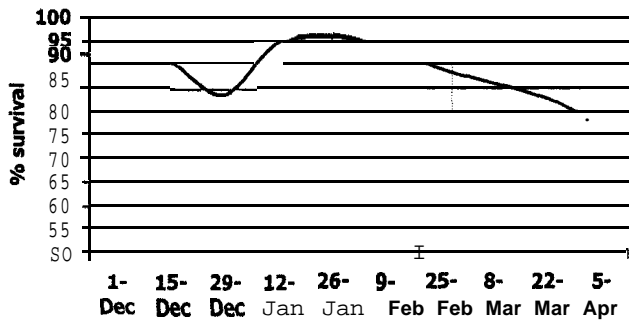


Figure 4—Average survival of loblolly pine seedlings planted in Mississippi over a three-year period from 1959-82 (adapted from Switzer 1969).

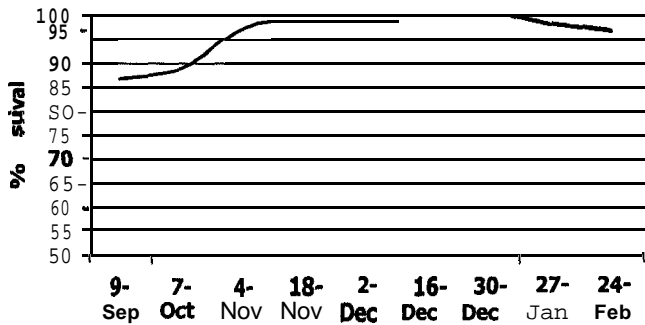


Figure 5—Survival of loblolly pine seedlings planted in Alabama in 1986-87.

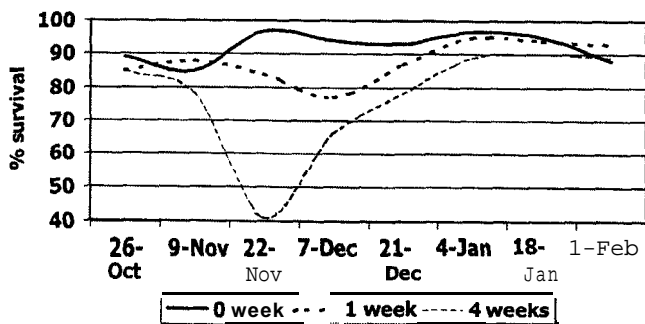


Figure 6—Survival of loblolly pine seedlings planted in Alabama in 1988-89 (adapted from Stumpff and South 1991).

declined to 81 percent around the 7-9th of December (fig. 3). This dip in survival was not deemed important and, in general, Wakeley stated that in most of the lower south, the optimum planting season extends from about December '1 to March 1 (Wakeley 1954).

### SWITZER

Georgia Switzer (1969) was likely the first researcher to detect a consistent decline in survival in December. Over three planting seasons (1959, 1960, 1961), seedlings were lifted from the nursery at two-week intervals from December 1st till April 5th. When averaged over the three years, a decline of about 6 percent in survival was noted for December 29th (fig. 4). Switzer did not know the reason for the dip but speculated the decline might be due to onset of cool temperatures (below 8° C). Based on a consistent pattern of survival, he suggested planting be delayed until late January.

### AUBURN STUDIES

The Auburn University Forest Nursery Management Cooperative installed several date of planting studies during the 1980's. James Boyer lifted seedlings by hand periodically from September 9th (1986) till February 24th (1987) from a nursery at Union Springs, Alabama. When half-sib seedlings were planted the same day of lifting, survival was typically high (fig. 5). However, seedlings lifted prior to November 18th did not store well. Seedlings lifted on November 18th and stored for 12 weeks had 91 percent survival. In this and other studies, no December dip was observed. However, in a subsequent study, a December dip was observed for seedlings stored for one or four weeks (Stumpff and South 1991). Seedlings from an orchard-mix were grown at a nursery in Opelika, Alabama. Seedlings were hand-lifted every two weeks from October 27, 1988 till February 1, 1989. Seedlings were planted the next day, or were planted after storage (one or four weeks). Survival of seedlings planted soon after lifting was high and there were no signs of a December dip. However, seedlings stored for a week or more exhibited a dramatic decline in survival (fig. 6). A physiological reason for the December dip is unknown but it may be related to a decline in root growth potential. This appears to be the case for the 1988 study since the RGP of stored seedlings declined about the same time as the reduction in survival (fig. 7). Slight declines in RGP from November to December have also been reported for loblolly pine in Virginia (DeWald and Feret 1987), Alabama (Nursery Coop Newsletter • Fall 1987) and in both Florida and Alabama (Page and Oehler 1991).

### FAMILY BY DECEMBER DIP INTERACTION

In the 1960s and 1970s, many tree improvement programs collected seed in bulk-lots from their seed orchards. As a result, differences in outplanting survival among genotypes were masked. It seems plausible that poor survival from several half-sib families was lowering the overall survival. This might explain why no December dip was observed from the half-sib source used by James Boyer but one was observed when using a mixed-lot (Stumpff and South 1991). It is known that an interaction exists between planting date and survival for half-sib lots of slash pine (Beineke and Perry 1965). Some half-sib progenies do well when lifted in

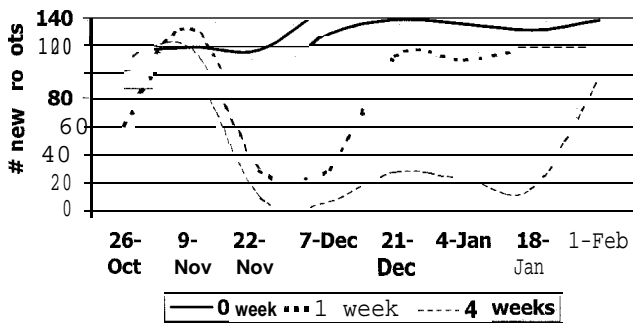


Figure 7—Root growth potential of loblolly pine seedlings in Alabama in 1986-89.

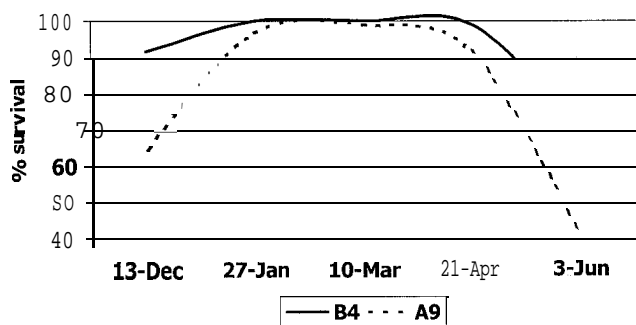


Figure 8—Survival of two half-sib slash pine families planted in North Carolina in 1963-64 (adapted from Beineke and Perry 1965).

mid-December while others do not (fig. 8). Since more organizations are now reaping the advantages of planting certain half-sib families, the chance of observing a December dip (for sensitive genotypes) could be greater now than in the past. For example, average December survival was 78 percent for 30 progenies in the slash pine study but two (AI3 and CI 1) exhibited 62 percent and 61 percent survival, respectively. The same two families performed well (100 percent survival) when planted in January.

### AN UPDATED PLANTING WINDOW MODEL

Historically, most southern foresters consider the optimum planting season to be from December 1st to March 1st (Wakeley 1954, Shultz 1997) or from mid-December to mid-March (South and Mexal 1984). During this period, loblolly pine seedlings are often stored for a week or more prior to planting. Some mixed-lots and some half-sib progenies will likely perform well when lifted throughout the month of December. However, some genotypes may exhibit a 6 percent to 40 percent drop in survival when planted or placed in cool storage in December. Since 1937, data from "hot" planting trials (where time between lifting and planting is two days or less) have shown that loblolly pine can be successfully planted in moist soil in October and November. Although seedlings lifted during this time are sometimes more succulent and are not as storable as seedlings lifted in January, proper handling can be provided at an

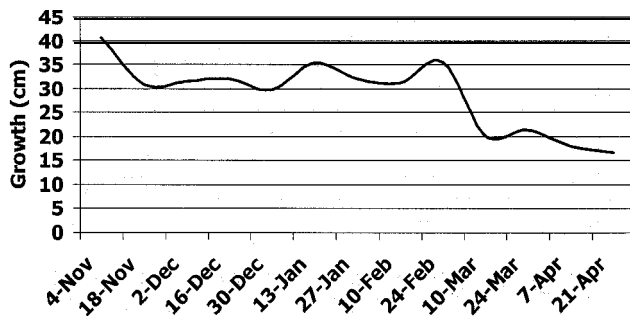


Figure 9—Early growth of loblolly pine seedlings planted in Texas in 1959-60 (unpublished data supplied by Bilan 1961).

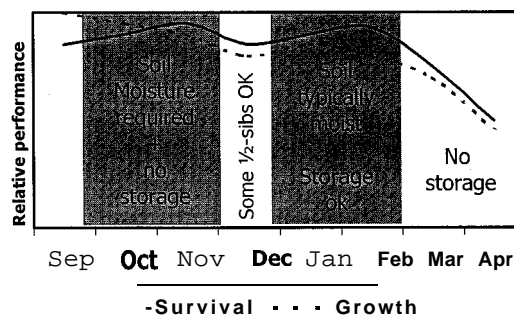


Figure 10—Relative performance of bare-root loblolly pine seedlings when "hot" planted during the fall planting season (October and November) and in the traditional planting season (January and February) in the southern United States. Some genotypes may perform well when planted soon after lifting during the month of December.

operational level. Several companies have successfully machine planted thousands of hectares of wet sites in October (mostly in Georgia and Florida). One advantage of planting into moist soil in October or November is that trees can become well established before winter freezes occur. In the lower South, roots will grow throughout the winter months and therefore the early-planted seedlings will grow more in height than March-planted seedlings (fig. 9). If the trend towards a 15-year rotation for loblolly pine continues, the economic incentives to plant in October and November will increase. For this reason, two planting windows have been designated for bare-root seedlings (fig. 10). The October-November window is for large-diameter seedlings that are "hot" planted into moist soil. To increase the probability of survival, seedlings should be machine-planted (where possible) and the root-collar should be planted about 8 cm (or more) below the groundline. Seedlings lifted during this period should be kept cool during transit to the planting site. If refrigeration is not available, seedlings should be loosely packed into boxes or in open-ended bails to avoid a buildup of heat. When transplanting seedlings in the fall, it is advised to use "morphologically improved" seedlings grown at low seedbed densities (South 1993). This will result in large-diameter seedlings that are more tolerant to rough handling.

By mid-November, succulent bare-root seedlings that have been grown at a **seedbed** density of 270/m<sup>2</sup> might have a small RCD of only 3 mm. The chance of survival of such small seedlings would not be high when planted in October or November. However, assuming soil moisture is adequate, these months would be an ideal time to plant **container-grown** stock with RCD of 3 mm or greater. December is a month of transition between the fall-planting window and the traditional winter-planting window (fig. 10). During this transition, loblolly pine seedlings are experiencing the longest nights of the year and the terminal buds are reaching their deepest endodormancy (Boyer and South 1989). Lavander (1985) suggested that a seedling's resistance to stress is low when the terminal buds (when present) are in deep endodormancy. Lifting seedlings at this time may be a problem for some genotypes. Seedlings from some half-sib families may exhibit a decline in RGP and might not store well. To increase the chance of survival, these genotypes should be kept in the **seedbed** and lifted in January. If they are lifted in December, they should be planted within a day or two of lifting in order to minimize stress. The main challenge now is to identify the half-sib families that are particularly susceptible to the December dip.

#### ACKNOWLEDGEMENT

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