Effects of Planting Date (Month) on Longleaf Pine Survival in Virginia

Research Report 134 **July 2017**

Jerre Creighton[1] and Scott Bachman[2]
[1]Department of Forestry Research Program Manager and [2]Senior Area Forester

Abstract

A study was installed in 2014-15 and repeated in 2015-16 at Lone Star Lakes City Park in Suffolk, Va., to evaluate the effects of planting date on containerized longleaf pine seedling survival. Ten-seedling plots were planted at mid-month from September through May, and survival and grass stage emergence were recorded for all seedlings periodically through January of 2017. Survival, seedling health and emergence from the grass stage are all better following the earlier (September – December) than the later (January – May) planting dates. January-February (when cold temperatures are limiting) and April - May (when either seedling age / storage or summer temperatures may be limiting) seem to be potentially high-risk planting windows. The average survival for seedlings planted "early" exceeds that for those planted "late" by 15 percent in the 2014 study and 10 percent in the 2015 study. If we subtract seedlings with low vigor or chlorotic foliage, "early" planting results in a higher proportion of healthy seedlings by 17 percent and 16 percent in the 2014 and 2015 series, respectively. In addition, by the end of the second growing season, there are three times as many seedlings out of the grass stage with "early" as opposed to "late" planting. Based on superior survival rates, improved seedling vigor and grass stage emergence, and because of potential concerns over nursery lifting or storage constraints, the conclusion from this study is that early planting (September – December) should be recommended for containerized longleaf pine in Virginia.

Methods

Longleaf pine planting efforts in Virginia have expanded greatly in the last decade. The increased activity has led to uncertainty regarding optimum planting timing at this northern limit of the species' natural range. Concerns over winter temperature extremes and fall / spring rainfall patterns have generated debate as to the recommended season for planting containerized seedlings. Therefore, in both the 2014-2015 ("2014") and 2015-2016 ("2015") planting seasons, we installed a study to compare the survival of containerized seedlings planted at mid-month from September through May.

1. The study is located at Lone Star Lakes City Park near Suffolk, Va., (36° 50' 48.08" N x 76° 33' 53.88" W). The site is a flat, abandoned old-field that had scattered sweetgum and sycamore seedlings encroaching. The soil is a Tetotum fine sandy loam, a highly weathered red or reddish-yellow acid soil with a clay-rich subsoil) and a loblolly pine site index of 88. The

site was prepared using a tiller / mulcher attachment pulled by a farm tractor to remove the sod layer and provide a clean planting space and early competition control (Figure 1).

Figure 1. Tilled planting site prior to study establishment.

Six replications of 10-tree rows (spaced 10 feet apart) were pin flagged prior to planting (Figure 2). Planting dates were randomly assigned to the rows in each block. Because only early survival was of interest in this trial, spacing effects on growth were not a concern. All plots were planted on a six-foot within-row spacing with the 2014 seedlings on the west side of the pin flag and 2015 seedlings on the east (approximately two feet apart). The ground was frozen solid on the target date for February of 2015, so no seedlings were planted then.

The seedlings for the study were containerized stock raised at the Garland Gray Forestry Center using seed collected from native Virginia longleaf parent trees. Since the seeds for all planting dates were sown at the same time, seedling age at time of planting was not consistent. For example, the seedlings planted in May of 2015 were nine months older than those planted in September of 2014. But this would also be the case in an operational scenario.

Individual seedling condition was assessed periodically on all of the plots. At the most recent evaluation, vigor (as evidenced by foliage volume and chlorosis) and emergence from the grass stage (defined as the height of the terminal bud exceeding four inches) were also recorded. Response data were the plot average for percentages of seedlings a) surviving, b) surviving and healthy in appearance (i.e. full, green foliage) and c) emerged from the grass stage. Statistical analyses were performed on plot means for survival and grass stage emergence (percentages were arcsine transformed) using a two-way analysis of variance. Statistical significance was defined as a probability of greater F statistic of 0.05 or less – meaning there is less than a five percent chance the differences occur by random chance.

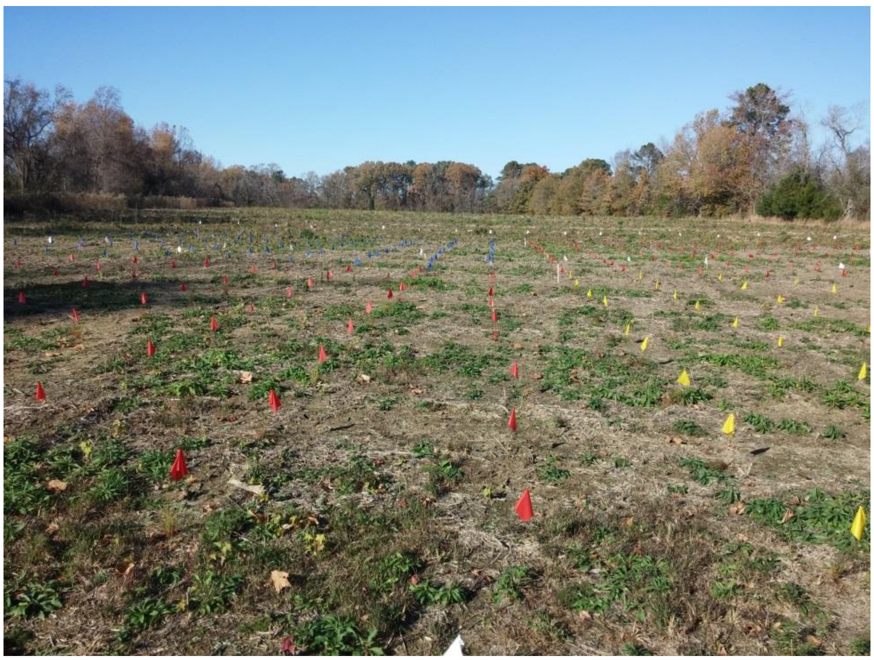

Figure 2. Pin flags marking individual planting locations (different colors designate different replications).

Results

On Jan. 25, 2017 (age two for the 2014 plots and age one for 2015), there were statistically significant effects of planting month on survival, vigor and grass stage emergence of the longleaf seedlings. All criteria were better following the earlier (September – December) than the later (January – May) planting dates. In particular, in both series of the study the September planting date was at the top of the rankings for all the response variables. January-February (when cold temperatures can be limiting) and April-May (when either seedling age / storage or summer temperatures may be limiting) seem to be potentially higher-risk planting windows. The average survival for seedlings planted "early" exceeds that for those planted "late" by 15 percent in the 2014 study (Table 1, Figure 3) and 10 percent in the 2015 study (Table 2, Figure 4). If we subtract seedlings with low vigor or chlorotic foliage, "early" planting results in a higher proportion of healthy seedlings by 17 percent and 16 percent in the 2014 (Figure 5) and 2015 (Figure 6) series, respectively.

In addition, in the 2014 plots, there are three times as many seedlings out of the grass stage with “early” as opposed to “late” planting (Figure 7). More than a quarter of the seedlings planted in September of 2014 have initiated height growth in two growing seasons, and 95 percent of them are alive and well.

Table 1. Seedling condition summary after two growing seasons for the 2014-2015 series of the longleaf planting date study.

2014-2015 Planting: (Second-Year Data)	Survival (%)	Alive and Healthy (%)	Grass Stage Emergence (%)
September 18, 2014	95.0%	95.0%	26.7%
October 16, 2014	86.2%	76.7%	10.0%
November 20, 2014	81.4%	78.3%	23.3%
December 16, 2014	85.0%	78.3%	13.3%
January 15, 2015	73.3%	66.7%	13.3%
February 16, 2015	-	-	-
March 18, 2015	76.7%	71.7%	1.7%
April 16, 2015	73.3%	68.3%	6.7%
May 20, 2015	63.3%	55.0%	3.3%
"Early" (Sep-Dec)	87%	82%	18%
"Late" (Jan-May)	72%	65%	6%

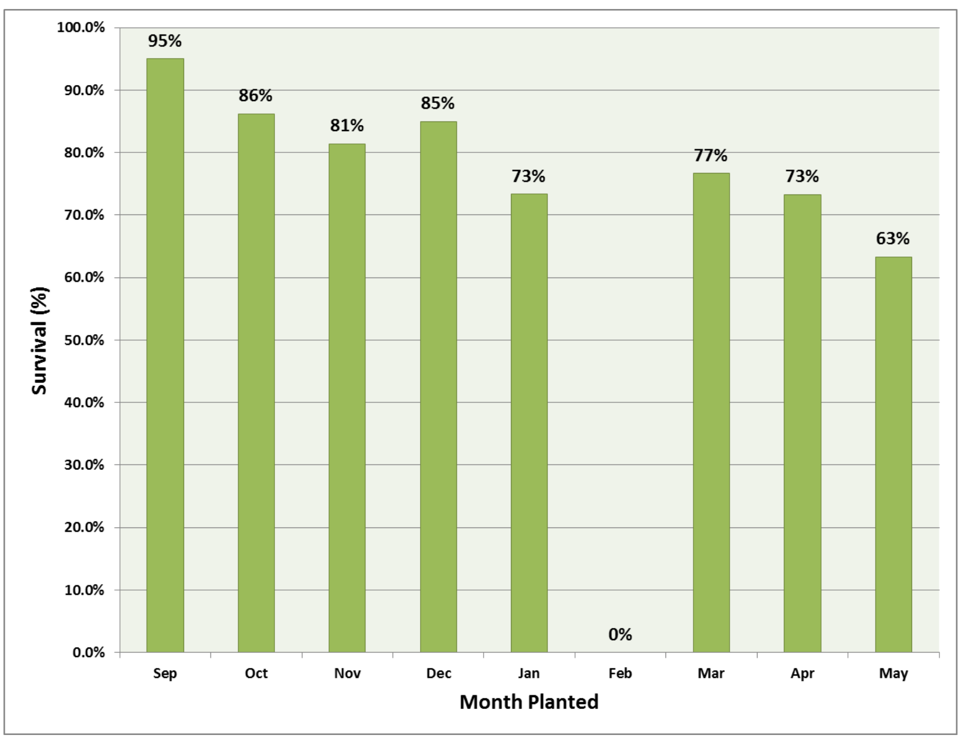

Figure 3. Seedling survival after two growing seasons on the 2014-2015 series of the longleaf planting date study.

Table 2. Seedling condition summary after one growing season for the 2015-2016 series of the longleaf planting date study.

2015-2016 Planting: (Second-Year Data)	Survival (%)	Alive and Healthy (%)
September 17, 2015	96.7%	96.7%
October 20, 2015	78.0%	76.3%
November 18, 2015	96.6%	94.9%
December 16, 2015	96.7%	96.7%
January 21, 2016	53.3%	50.0%
February 16, 2016	83.1%	83.1%
March 16, 2016	93.3%	86.7%
April 18, 2016	91.7%	88.3%
May 16, 2016	89.8%	74.6%
"Early" (Sep-Dec)	92%	91%
"Late" (Jan-May)	82%	75%

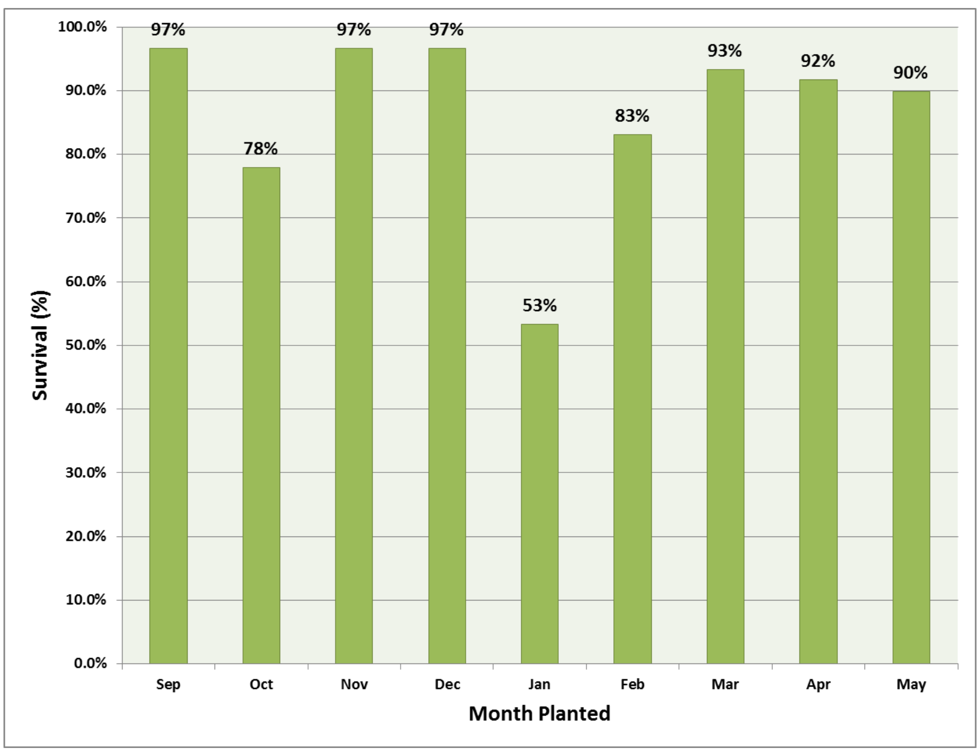

Figure 4. Seedling survival after one growing season on the 2015-2016 series of the longleaf planting date study.

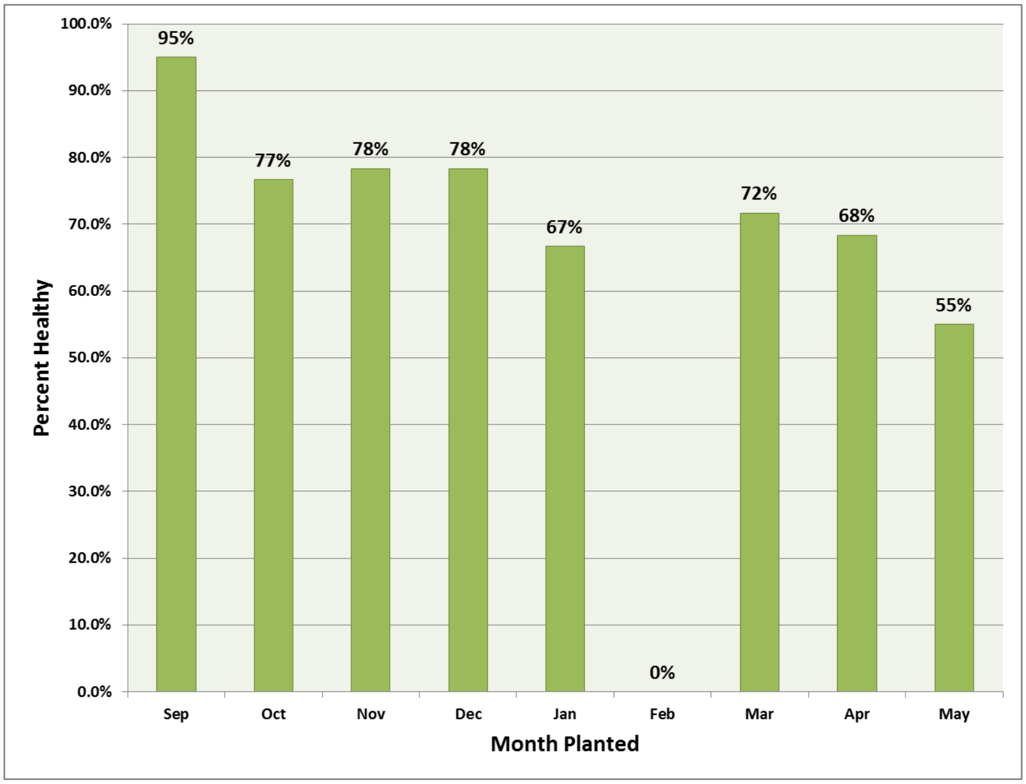

Figure 5. Percentage of seedlings both alive and appearing healthy after two growing seasons on the 2014-2015 series of the longleaf planting date study.

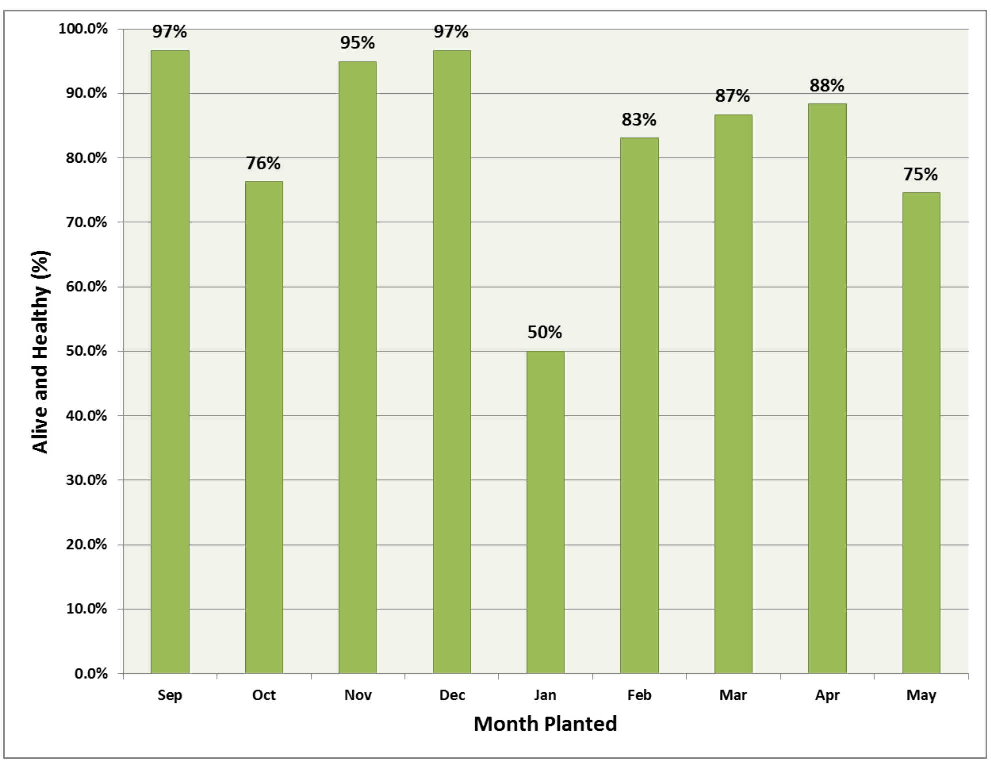

Figure 6. Percentage of seedlings both alive and appearing healthy after one growing season on the 2015-2016 series of the longleaf planting date study.

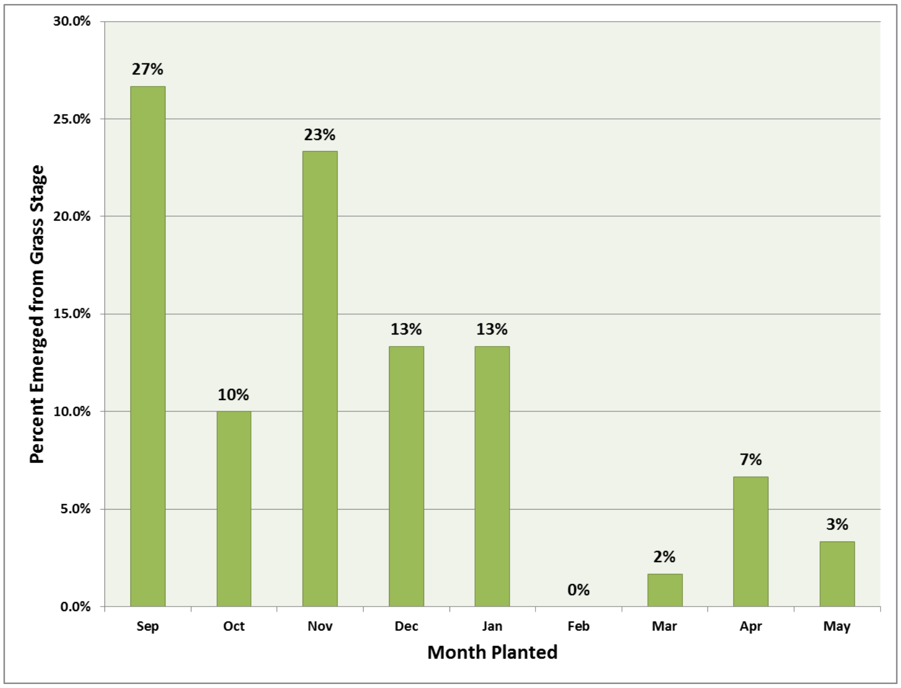

Figure 7. Percentage of seedlings emerged from the grass stage after two growing seasons on the 2014-2015 series of the longleaf planting date study.

Discussion

Seedling age (i.e. storage time), temperature extremes and precipitation patterns could (and likely did) factor into the results observed on these plots.

As mentioned earlier, all seed for the study were sown at the same time (early May of 2014). By the time the later planting dates were established, the seedlings would have spent as much as one year in containers and had experienced a range of moisture and temperature regimes. Intuitively, one would expect nothing but disadvantage from extending period of storage either on outdoor tables or inside under cover (depending on ambient weather conditions).

Weather data for the nearest NOAA weather station – at Lake Kilby in Suffolk (36^{o} 43' 26.80 " N x 76^{o} 36' 25.18" W) - were obtained and summarized for the study establishment period. It is quite challenging to draw correlations between these data and the observed seedling responses. It appears that the coldest temperatures of the winter were often related to low survival, but there are also months that experienced cold weather (for a shorter duration, perhaps) and still exhibited better survival. There were no extended rain-free periods during these two years.

Most likely, variations in survival among months were affected by a combination of these factors (and perhaps others). It is beyond the scope of these data and this study to thoroughly sort out their exact impacts. The important outcome here is that, based on this study, early planting (September – December) should be recommended for containerized longleaf pine in Virginia. This eliminates any risks associated with extended seedling storage and post-planting weather conditions while still providing a quality outcome in terms of survival and seedling vigor.