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Effect of Varying Nitrogen Rates on Growth of Southeastern Christmas Trees

Abstract

Real Christmas tree sales have increased recently with 26.2 million trees sold in 2019. As research has not always been applicable to southeastern states; the Southern Christmas Tree Association requested tree species and growing conditions research. Four tree species treated with varying nitrogen rates were grown from 2021 to 2024. Data showed final stem height and diameter at the 1.0x (50 pounds N/acre) rate were significantly more productive in Leyland Cypress and Arizona Cypress varieties. The 0.25x rate was the most productive in cedar trees. This provides a recommended fertility base rate for these species in southern states.

Introduction

A 2019 National Christmas Tree Association (NCTA) survey found that 26.2 million real Christmas trees were sold at a median price of $76.87, up from $66.43 in 2018. Thirty-two percent were sold at farms and 54% were sold at retail locations (NCTA, 2019). While Christmas tree prices have risen over the last 4 decades, tree production in Mississippi has steadily declined. This work aims to improve production practices and encourage more Christmas tree farms in southern states.

Traditionally, minimal research has been conducted on southern Christmas tree varieties (Hall, 1965). Virginia Pine, grown in Mississippi, was studied in South Carolina, where the climate can be vastly different from Mississippi (Knoth et.al., 2002). How soil pH and fertility affect Leyland Cypress growth was studied in North Carolina (Hinesley, et al., 2008). This is also a much different climate than Mississippi. In 2017, Mississippi State University Extension held a workshop on growing Christmas trees as alternative income streams (Parajuli et al., 2020).

Research conducted outside of the southeastern United States rarely applies to growing conditions or tree species utilized in this region. Grybas (2020) studied mapping forest changes across New Hampshire. Hibbert-Frey et al. (2011) studied the effect of scion origin on grafted Fraser Fir trees. Silen and Wilson (1977) studied genetically improved Douglas-Fir Christmas tree seedling implications on forest health. Sullivan (1961) studied Christmas tree prices in Minnesota.

Therefore, the Southern Christmas Tree Association (SCTA), which includes Alabama, Louisiana, and Mississippi, requested production evaluations of southern native Christmas tree species. Four tree species (Leyland Cypress ‘Ovensii’, Eastern Red-cedar ‘Burkii’, Arizona Cypress ‘Blue Ice’, & Eastern White Pine) were grown using varying nitrogen (N) fertilizer rates applied in spring and summer of 2022 to 2024. Initial and final annual growth data (stem height and caliper) were collected to determine the treatment effect on each tree species. The study was completed in November 2024.

Objectives

Determine optimal native tree species to recommend for production in Mississippi and surrounding states. Determine optimal N fertility rates for tree production.

Materials and Methods

Four Christmas tree species - Eastern Red-cedar ‘Burkii’, Leyland Cypress ‘Ovensii’, Arizona Cypress ‘Blue Ice’, and Eastern White Pine - were purchased and installed in

December 2021 (Table 1). Rows were amended with ammoniated pine bark fines (Figure 1) and tilled in preparation for planting (Figure 2). Trees were side-dressed with N (33-0-0) in April and June of 2022 - 2024 using rates of 0.25x (7.5 ml), 0.5x (15ml), 1.0x (30 ml), and 2.0x (60 ml) based on soil test recommendation of 50 pounds N per acre. No phosphorus, potassium, or lime was required. Trees were installed in groups of ten each, with four replications per block across four blocks.

Table 1. List of Christmas Tree Varieties

Common Name	**Scientific Name**	**Number of Trees**
Eastern Red-cedar ‘Burkii’	*Juniperus viriginiana* ‘Burkii’	160
Leyland Cypress ‘Ovensii’	*X Cupressocyparis leylandii* ‘Ovensii’	160
Arizona Cypress ‘Blue Ice’	*Cupressus arizonica* ‘Blue Ice’	160
Eastern White Pine	*Pinus strobus*	160

Figure 1. Rows amended for planting.

Figure 2. Trees being installed.

Initial and final growth data for stem diameter and stem height were collected to determine treatment effects on different tree species. Initial measurements of tree height and stem caliper were taken in March of 2022, and final measurements were taken on every alive tree in November 2024. Tree caliper was measured at three inches above the soil line using a VINCA Digital Caliper (DCLA-0605) instrument. Tree height was measured from the soil line to the top of each tree using a standard tape measure and ladder.

Plants were watered as needed with drip irrigation. A pre-emergent herbicide containing Napropamide (Devrinol) was used each spring and fall to prevent annual weeds. Post-emergent herbicides containing Glyphosate (Round-up), Glufosinate (Finale), and Sethoxydim (Segment) were used as needed for summer weed and grass control. All products were applied at the recommended label rates. Trees were scouted weekly for pests. Insecticides containing Spinosad and Imidacloprid and fungicides containing Chlorothalonil (Daconil) were used as needed. Trees were sheared twice in 2023 and 2024 using a Stihl™ battery-powered hand-held 24” trimmer.

Several trees were lost to freezing temperatures, poor drainage, severe drought, and herbicide drift. Most of the Eastern White Pines were lost to excessive southern heat and humidity. Final data covering the remaining three species was collected in November 2024. There were 98 Leyland Cypress, 97 Arizona Cypress, and 80 Eastern Red-cedars alive at final measurement.

Statistical analysis of the data was performed using SAS (version 9.4; SAS Institute, Cary, NC). Data was analyzed using PROC GLIMMIX analysis of variance (two-way ANOVA) followed by mean separation. The standard errors were based on the pooled error term from the ANOVA table. Tukey’s test ($p \leq 0.05$) was used to differentiate between classifications and treatment.

Results

Final Leyland Cypress data showed no significant differences with initial stem height ($p = 0.78$). Data showed the 1.0x rate to be significantly greater than all other treatments with final stem height ($p < .0001$) and the difference between initial and final stem heights ($p < .0001$). The 0.5x rate was also greater than the 0.25x and 2.0x rates, with the 2.0x rate being lowest in all cases (Table 2).

Table 2. Final Leyland Cypress ‘Ovensii’ Tree Stem Height

Treatment	Final Height cm		Difference Between Initial & Final Height cm	
L1 - .25x	82.26	C	40.41	C
L2 - .50x	96.11	B	54.22	B
L3 – 1.0x	**114.59**	**A**	**71.10**	**A**
L4 – 2.0x	67.66	D	26.62	D

Final Arizona Cypress data showed no significant differences with initial stem height ($p = 0.68$), final stem height ($p = 0.20$), or difference between initial and final stem heights ($p = 0.35$). The 1.0x rate provided the greatest final height and greatest amount of growth (Table 3).

Table 3. Final Arizona Cypress ‘Blue Ice’ Tree Stem Height

Treatment	Final Height cm		Difference Between Initial & Final Height cm	
Z1 - .25x	83.86	n.s.	44.87	n.s.
Z2 - .50x	80.84	n.s.	42.29	n.s.
Z3 – 1.0x	**96.24**	n.s.	**55.72**	n.s.
Z4 – 2.0x	80.96	n.s.	42.70	n.s.

n.s. = not significantly different

Final Eastern Red-cedar data showed no significant differences with initial stem height ($p = 0.63$) or final stem height ($p = 0.15$). Data showed the difference between initial and final stem heights at the 0.25x rate to be significantly greater than the 0.5x rate ($p < .03$) (Table 4). Most productive growth in Eastern Red-cedar resulted from using the lowest fertility rate of 0.25x.

Table 4. Final Eastern Red-cedar ‘Burkii’ Tree Stem Height

Treatment	Final Height cm		Difference Between Initial & Final Height cm	
C1 - .25x	**119.73**	n.s.	**81.54**	**A**
C2 - .50x	104.34	n.s.	61.01	B
C3 – 1.0x	110.24	n.s.	72.96	A,B
C4 – 2.0x	112.45	n.s.	74.66	A,B

n.s. = not significantly different

Final Leyland Cypress data showed a significant difference with initial stem diameter ($p < .04$) with the 0.25x rate being greater than the 2.0x rate. This was not due to any specific fertility treatment as trees had not been treated yet, were all purchased from the same producer, and were randomly selected for installation. Data showed a significant difference with final stem diameter ($p < .0003$) and with the difference between initial and final stem diameter ($p < .0004$), with the 1.0x being greater than all other rates. The 0.25 and 0.5x rates were greater than the 2.0x rate in both cases. The 2.0x rate was the least productive in all cases (Table 5).

Table 5. Final Leyland Cypress ‘Ovensii’ Tree Stem Diameter

Treatment	Final Diameter cm		Difference Between Initial & Final Diameter cm	
L1 - .25x	40.41	B	34.94	B
L2 - .50x	41.21	B	34.98	B
L3 – 1.0x	**47.88**	**A**	**42.15**	**A**
L4 – 2.0x	32.36	C	27.18	C

Final Arizona Cypress data showed no significant difference with initial stem diameter ($p = 0.44$) or between initial and final stem diameter ($p = 0.08$). Data showed a significant difference in final stem diameter with the 1.0x and 0.25x rates being greater than the 0.5x rate ($p < 0.05$). The 1.0x rate provided the greatest final diameter and most amount of growth, and the 0.5x rate provided the least amount of growth (Table 6).

Table 6. Final Arizona Cypress ‘Blue Ice’ Tree Stem Diameter

Treatment	Final Diameter cm		Difference Between Initial & Final Diameter cm	
Z1 - .25x	40.36	A	35.12	n.s.
Z2 - .50x	32.61	B	27.65	n.s.
Z3 – 1.0x	**40.68**	A	**35.18**	n.s.
Z4 – 2.0x	35.19	A,B	30.18	n.s.

n.s. = not significantly different

Final Eastern Red Cedar ‘Burkii’ data showed no significant differences with initial stem diameter ($p = 0.53$), final stem diameter ($p = 0.08$), or differences between initial and final stem diameter ($p = 0.07$). (Table 7). Most productive growth in all cases with Cedar resulted using the lowest fertility rate of 0.25x. This was different from the other tree species tested.

Table 7. Final Eastern Red Cedar 'Burkii' Tree Stem Diameter

Treatment	Final Diameter cm		Difference Between Initial & Final Diameter cm	
C1 - .25x	**37.81**	n.s.	**33.76**	n.s.
C2 - .50x	31.82	n.s.	27.60	n.s.
C3 – 1.0x	32.52	n.s.	28.72	n.s.
C4 – 2.0x	33.36	n.s.	29.33	n.s.

n.s. = not significantly different

Conclusions

Many Eastern White Pines were lost to excessive heat and humidity. Others were lost to freezing temperatures, poor drainage, severe drought, and herbicide drift. Final data was not collected or reported on the pines for these reasons.

Leyland Cypress 'Ovensii' results showed the 1.0x N fertilizer rate was significantly different in final height, final height gained, final stem diameter, and final stem diameter gained. Results showed the 2.0x rate resulted in the lowest amount of growth in all cases.

Arizona Cypress 'Blue Ice' results showed the 1.0x rate was significantly different on final stem diameter, but not on the other measurements. The 1.0x rate did provide the greatest growth. The 0.5x rate had the least productive growth in all cases, which was different than with Leyland Cypress. Future work would study if these results were repeated and why. For Leyland Cypress 'Ovensii' or Arizona Cypress 'Blue Ice' in the south, it is recommended to fertilize at a rate of 50 pounds N/acre to get optimal growth.

Eastern Red Cedar 'Burkii' results showed the 0.25x rate was significantly different in final stem height gained and was most productive in all measures. This could be attributed to Cedar being a slower growing species than other varieties tested ant requiring high rates of Nitrogen. It should be noted that the 0.5x rate had the poorest results in all cases, meaning more research on this species is required.

Data indicates that higher-than-recommended fertilizer inputs do not necessarily lead to better crop response. The height and diameter measurements indicate that the highest rate of fertilizer (2x) had the least impact on crop growth for Leyland Cypress and Arizona Cypress. This indicates that recommended soil test rates should be followed. This research is potentially beneficial for southern Christmas tree producers and those educators who provide production information. It will hopefully lead to more trees being planted and more growers entering the market.

Leyland Cypress 'Ovensii', Eastern Red-cedar 'Burkii', and Arizona Cypress 'Blue Ice' trees can all be successfully grown and should be recommended for production in Mississippi. Future work should involve more tree varieties, across more hardiness zones, and in different soil types. It could also study whether lower rates would consistently provide adequate plant growth and save producers time, energy, and money.

Figure 3. Leyland Cypress 'Ovensii' growth after 3 years.

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