2017

A Comparison of Tree Growth in Loblolly Pine (Pinus taeda) Plantations and Silvopasture Settings in East Texas

B. P. Oswald
Y. Weng
K. W. Farrish
J. Grogan
W. Kruckeberg

See next page for additional authors
Authors
B. P. Oswald, Y. Weng, K. W. Farrish, J. Grogan, W. Kruckeberg, and T. Barton
A Comparison of Tree Growth in Loblolly Pine (Pinus taeda) Plantations and Silvopasture Settings in East Texas

Oswald BP*, Weng Y, Farrish KW, Grogan J, Kruckeberg W and Barton T

Arthur Temple College of Forestry and Agriculture, Stephen F Austin State University, 419 East College Street, Nacogdoches, TX 75962, USA

*Corresponding author: Oswald BP, Arthur Temple College of Forestry and Agriculture, Stephen F Austin State University, College Street, Nacogdoches, USA, Tel: 9364682275; E-mail: boswald@sfasu.edu

Received date: September 14, 2017; Accepted date: September 19, 2017; Published date: September 21, 2017

Abstract

A desire by landowners to diversify potential income sources has resulted in an increased interest in silvopasture. This intensive land management option allows for the production of timber, livestock and/or forage on the same land base. With traditional plantation systems featuring loblolly pine (Pinus taeda) common in the western gulf coast region of the southeastern United States, comparisons of tree growth are needed to justify the use of silvopasture. This study evaluated the height, diameter and volume growth 13 years post-establishment of loblolly pine in both silvopasture and plantation spacings on a single site in east Texas. Individual trees in silvopasture plots had greater diameter and volume than those in plantation plots; however, plantation plots yielded greater volume per hectare. The greater volume per hectare was driven by the greater number of trees planted (1282 trees ha−1) in plantation plots than those planted (598 trees ha−1) in silvopasture. In silvopasture, site resources are concentrated on producing larger-diameter, sawtimber size, and theoretically, higher-value trees.

Keywords: Silvopasture; Loblolly pine; Wood volume

Methods

Site description

The study site was an established Bahia grass (Paspalum notatum) pasture south of Carthage, Texas, approximately 80 km southwest of Shreveport, Louisiana. Soils at the site ranged from well-drained to moderately well-drained, and consist of: Eastwood soils (Chromic Vertic Hapludalfs), Lilbert soils (Arenic Plinthic Paleudults), Latex soils (Glossic Paleudalfs) and Scottsdale soils (Glossaquic Paleudalfs). The climate is classified as subtropical, permanently humid climate with a mean growing season of 240 days and mean annual precipitation of 112 cm (NRCS 2004).

Field layout

Four replicates were established 2003, each containing a 4.1 ha silvopasture block (1.8 × 9.1 m for 598 trees ha−1) and a 4.1 ha plantation block (2.1 × 3.7 m for 1282 trees ha−1). Containerized loblolly pine (Pinus taeda) seedlings were planted in single rows in both spacings. Prior to winter planting, a banded application of Imazapyr (Arsenal) at 47.8 ml ha−1 was applied in the fall of 2003, the rows ripped, and seedlings then planted. Banded Oust Extra (56.25% sulfometuron and 15% metsulfuron methyl) at 35.5 ml ha−1 (granular dry product converted to liquid equivalent) was applied in the spring of 2004 to further control herbaceous competition, followed by a summer fertilization treatment of 20-8-15 at 68 kg ha−1. A second application of Oust Extra was applied in the summer of 2006. Pruning of lower branches (“lifting”) was performed in 2013 and 2016 for both spacings.

Tree measurement

In December 2016 - January 2017, all tree heights were measured from a distance of 20.12 m using a Suunto clinometer and a 15 m
loggers tape to the nearest 0.1 m, and Diameter at Breast Height (1.36 meters; dbh) was measured to the nearest mm using a diameter tape and basal area (BA) calculated. Volume was calculated following previously published equations [9]. Data were analyzed using An Analysis of Variance on individual tree height, dbh, BA and volume with treatment (silvopasture or plantation) as a fixed effect and block, and interaction between block and treatment and error as the random factors, was performed using SAS [10]. Individual tree basal area and volume were summarized to per hectare basis using appropriate expansion factors by block, and the difference between the two treatments was tested using t-test with α=0.05. Treatment means were calculated using the Estimate function.

Table 1: Mean diameter (DBH), height, basal area, and volume for individual trees in each treatment and per hectare averages of basal area and volume for each treatment, with respective standard errors in brackets. Values within a column followed by different letters differ significantly (Pr<0.05) between them.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Individual Tree</th>
<th>Per Hectare</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DBH (cm)</td>
<td>Height (m)</td>
</tr>
<tr>
<td>Pine Plantation</td>
<td>20.57 (0.45)a</td>
<td>14.64 (0.76)a</td>
</tr>
<tr>
<td>Silvopasture</td>
<td>23.55 (0.46)b</td>
<td>13.24 (1.07)a</td>
</tr>
</tbody>
</table>

Results

For each individual tree trait, effects of block and the interaction between block and treatment explained less than 2% of the total variation. Trees in silvopasture plots displayed a significantly greater DBH, BA, and volume than those in the pine plantation plots. Heights were not significantly different between the treatments (Table 1). Although the individual trees in the silvopasture plots were larger than those in the pine plantation plots, the increased density of the pine plantation resulted in a significantly higher volume and basal area on a per hectare basis (Table 1).

Discussion

The data support the basic assumption that, on an individual basis, trees in the silvopasture treatment would have greater diameters, which results in greater BA and, with comparable heights, a greater volume than those in the pine plantation treatment. Although plantations have greater basal area and volume per hectare, the increase is due to greater numbers of trees, rather than size of individual trees. The ultimate goal of both treatments is to maximize economic return from the production of timber. For pine, this is achieved by maximizing the production of the highest-value product, in this case, sawtimber. In traditional plantation management, removal of smaller, inferior form or quality trees (thinning) is necessary to redistribute site resources to the remaining trees in order for the remaining trees to reach sawtimber size. However, in the silvopasture system, lower densities necessary to achieve sawtimber-size trees in a relatively short rotation are implemented at establishment, thus reducing the need for thinning. The lower density of the silvopasture treatment also results in additional site resources being available for livestock forage production.

Acknowledgments

Our appreciation is extended to the Natural Resource Conservation Service and McIntire-Stennis Cooperative Forestry Research Program for providing the funds to establish this study, and to Dr Fowler and Ms. Kim Castiaux Fowler for providing the bahiagrass pasture. We also thank the numerous students who assistant in the field activities over the years.

References