From Forest Nursery Notes Winter 2013

149. © Silvicultural treatments for converting loblolly pine to longleaf pine dominance: effects on resource availability and their relationships with planted longleaf pine seedlings. Hu, H., Wang, G. G., Walker, J. L., and Knapp, B. O. Forest Ecology and Management 282:115-123. 2012.

Forest Ecology and Management 282 (2012) 115–123

Contents lists available at SciVerse ScienceDirect

Forest Ecology and Management

journal homepage: www.elsevier.com/locate/foreco

Silvicultural treatments for converting loblolly pine to longleaf pine dominance: Effects on resource availability and their relationships with planted longleaf pine seedlings

Huifeng Hu [a], G. Geoff Wang [a,*], Joan L. Walker [b], Benjamin O. Knapp [a]

[a] School of Agricultural, Forest and Environmental Sciences, Clemson University, 261 Lehotsky Hall, Clemson, SC 29634-0317, United States
[b] USDA Forest Service, Southern Research Station, Clemson University, 233 Lehotsky Hall, Clemson, SC 29634-0317, United States

ARTICLE INFO

Article history:
Received 6 June 2012
Received in revised form 7 July 2012
Accepted 8 July 2012
Available online 27 July 2012

Keywords:
Canopy treatment
Cultural treatment
Gap light index
Soil moisture
Soil temperature
Root collar diameter

ABSTRACT

Throughout the southeastern United States, land managers are currently interested in converting loblolly pine (*Pinus taeda* L.) plantations to species rich longleaf pine (*Pinus palustris* Mill.) ecosystems. In a 3-year study on moderately well- to well-drained soils of the Lower Coastal Plain in North Carolina, we examined the effects of four canopy and three cultural treatments on plant resources and quantified relationships between plant resources and longleaf pine seedling survival and growth. Canopy treatments consisted of four levels of timber harvest applied to loblolly pine stands: Control (uncut, mean basal area of 16.2 m^2/ha), MedBA (single-tree selection to a mean residual basal area of 9.0 m^2/ha), LowBA (single-tree selection to a mean residual basal area of 6.4 m^2/ha), and Clearcut (complete canopy removal). Within each canopy treatment, we applied three cultural treatments designed to benefit the early growth of planted seedlings: no treatment (NT), herbicide (H), and herbicide plus fertilization (H + F). Gap light index (GLI) significantly differed among canopy treatments and nonlinearly increased with decreasing basal area. The H treatment resulted in higher temperatures at 10 cm in the soil. Canopy thinning increased foliar calcium (Ca) concentration. The annual root collar diameter (RCD) increment of planted longleaf pine seedlings was positively correlated with GLI, and foliar phosphorus (P) and Ca concentrations but was negatively correlated with soil moisture. Our results confirm that light is an important factor controlling the growth of longleaf pine seedlings.

1. Introduction

Forest canopy cover, a stand condition that is often subjected to silvicultural manipulation, significantly affects forest succession and ecosystem function (Kohn and Franklin, 1997; Gray et al., 2002; Wagner et al., 2011). By manipulating the degree of canopy cover, silvicultural treatments can change the partitioning of solar energy between understory and overstory, affect the vertical distribution of soil moisture, and control the regeneration environment (Kohn and Franklin, 1997; Gray et al., 2002; Ma et al., 2010). Understory light availability is directly controlled by the amount and spatial distribution of the forest canopy (e.g., Lieffers et al., 1999), and the reduction in canopy cover by thinning can greatly increase light levels in the understory (e.g., Drever and Lertzman, 2003). Consistently lower daytime air and soil temperatures, higher humidity, and lower diurnal fluctuations in both temperature and humidity have been observed beneath intact forests when compared to thinned forests or large openings (e.g., Chen et al., 1993; Carlson and Groot, 1997; Ma et al., 2010). Previous research in longleaf pine (*Pinus palustris* Mill.) forests of the southeastern United States has shown that understory light availability (Palik et al., 1997; Battaglia et al., 2003), soil nitrogen availability (Palik et al., 1997, 2003), and surface soil temperature (Palik et al., 2003) increased with decreasing canopy cover. Within loblolly pine (*Pinus taeda* L.) forests, previous studies have reported that thinning increased volumetric soil moisture content and seasonal soil temperature fluctuation (Selig et al., 2008). Given the importance of canopy cover in regulating micro-site conditions, historical and current management actions can have important implications for forest development.

Due to logging, land-use changes, and fire exclusion and suppression, the extent of the longleaf pine ecosystem has declined to approximately 2.2% (or 1 million hectares) of the acreage prior to European settlement (Wahlenburg, 1946; Frost, 2006). Currently, about 11 million hectares of pine plantations, predominately loblolly and slash pine (*Pinus elliottii* Engelm.), occupy the former longleaf pine range (Frost, 2006). In recent decades, much effort has been invested in restoring the longleaf pine ecosystem to its native range, in large part to conserve biodiversity and to

* Corresponding author. Tel.: +1 864 656 4864; fax: +1 864 656 3304.
E-mail address: gwang@clemson.edu (G. Geoff Wang).

0378-1127/$ - see front matter © 2012 Elsevier B.V. All rights reserved.
http://dx.doi.org/10.1016/j.foreco.2012.07.009