FOREST PRODUCTIVITY

Publication Series

WSF&NR 12-FP-4 November 2012

Growing Hardwoods for Short Rotation Woody Crops in Georgia

November 2012

E. David Dickens – Forest Productivity Professor, Mike Kane – Silviculture Professor, and Bruce Borders – Forest Biometrics/Management Professor - UGA WSF&NR

Introduction

Wood pellet demand in Europe increased by 5-fold from 2001 through 2008 with an increase in production from 2,000,000 tons to almost 10,000,000 tons during this period. Demand for wood pellets is expected to increase to 18 to 20 million tons by 2013. The large increase in demand for wood pellets has led to renewed interest in fast growing, short rotation woody biomass crops. Ethanol production has increased by 5½-fold from 1.63 billion gallons in 2000 to 9 billion gallons in 2008. Ethanol production impacts on wood consumption are currently negligible and may be so for five to ten or more years until processing commercially at scale becomes cost-effective. The wood use in co-generation and generation of electricity is growing in the US and has the potential to be a very large user of woody biomass. The focus of this paper is to illustrate growth and yield estimates for hardwood species that can be grown in Georgia.

These published growth rates are generally from intensive management with, in most cases, relatively large costs per acre to produce these results. Growth rates achieved on any given parcel of land will vary somewhat from the growth rates found in this paper due to the following factors: soils, site preparation intensity, planting timing, level of seedling genetic improvement or clone used, seedling spacing and survival, insect and/or disease control, timing and number of herbicide treatments and fertilizer treatments, timing and intensity of thinning harvests (rare in short rotation scenarios), presence and frequency of irrigation, rotation age and other factors. Hardwood growth rates will vary depending also on seedlings or cutting use versus coppice regeneration after the first rotation.

Fast growing hardwood tree species for Georgia

For Georgia, fast growing short rotation woody crops include: • sweetgum (*Liquidambar styraciflua),* • Eastern cottonwood (*Populus detloides*), and • American sycamore (*Plantanus occidentalis*). Other fast growing hardwoods include • hybrid poplar (*Populus spp.),* • willow (*Salix spp*.), and • ash (*Faxinus spp*.). Recent work using two Eucalyptus species; *Eucalyptus grandis, amplifolia, and benthamii* look promising but will have some northern range limitations (currently south Georgia and will depend on *Eucalyptus* species planted). Sweetgum and cottonwood are proven performers in Georgia. Cottonwood is very site sensitive, growing best on fertile alluvial soils while sweetgum will grow well wherever loblolly will do well. Currently, hybrid poplar and sycamore have some disease issues when grown in Georgia.

Site preparation prior to planting short rotation woody crops is typically very intensive and can include chemical (herbicides) and/or mechanical (disking, bedding, subsoiling) treatments, fertilization (typically N, NP, or NPK) and in some cases liming. To maximize short rotation woody crop growth and yields at some desired rotation age, competing vegetation (woody and herbaceous) needs to be controlled. This requires the use of herbicides and/or mechanical control. In most cases fertilization is also required (with the exception on old-field sites with high residual fertility). In some cases irrigation may also be warranted.

Summary

Biomass production ranking, based on the aforementioned tables and cited studies, using the upper end values for each species, is as follows (from highest to lowest): the three eucalyptus species (8 to 35 tons/ac/yr), cottonwood (7.2 tons/ac/yr), sycamore (6.6 tons/ac/yr), and sweetgum (4.2 tons/ac/yr).

Table 1. Mean Annual Increment (MAI) growth estimates for selected hardwood species with high levels on management

Age (years)	Hardwood species	MAI (green tons/acre/year)	Location (State)
4	sweetgum	2.3	South Carolina
5		2.4	Georgia
5		1.7	North Carolina
6		2.3	Georgia
10		4.2	North Carolina
5	Am. sycamore	2.3	South Carolina
5		4.3	North Carolina
7		2.9	South Carolina
10		6.6	North Carolina
9	E. cottonwood	2.9	Arkansas
9		6.5	Arkansas
10		3.1	Arkansas
10		7.2	Arkansas
3 1/2	*Eucalyptus grandis*	10 - 30	Florida
3 1/2	*Eucalyptus amplifolia*	5 - 35	Florida
7	*Eucalyptus benthamii*	6 - 8	South Carolina

Culmination of mean annual increment (MAI) or the point in time (age) where maximum tons per acre production is realized with these woody crops will vary by species, soils, seedling survival, and management intensity. Knowing the age range where the maximum MAI is reached for each species and stand will greatly aid in planning and harvesting decisions. Results from the cited literature in this paper do not indicate a maximum for any of the species. Hardwood stands planted from seedlings or cuttings culmination of mean annual increment age may be considered to be 12- to 20-years for sweetgum, age 8- to 12-years for sycamore and cottonwood, and 3 1/2- to 10-years for Eucalyptus *grandis, amplifolia, and benthamii.*

Cottonwood and sycamore tend to respond to both the addition of water and nutrients. Sweetgum tends to respond, more so to fertilization or fertilization+irrigation than irrigation alone. Sweetgum tended to be slower growing early on than other fast growing hardwoods, but grew at a faster rate than sycamore after age 5-years. Tested progenies of *Eucalyptus grandis* and *amplifolia* responded by 3- and almost 7-fold to fertilization when planted at the higher density. Each site will have its set of growth limiting factors and these factors will have to be addressed to optimize growth.

Warnell School of Forestry and Natural Resources
Athens, Georgia 30602-2152
Telephone 706.542.2686 Fax 706.542.8356