

Effect of Switchgrass on Shortleaf Pine Growth in a West-Central Arkansas Alley Cropping System



Natural Resources Conservation Service

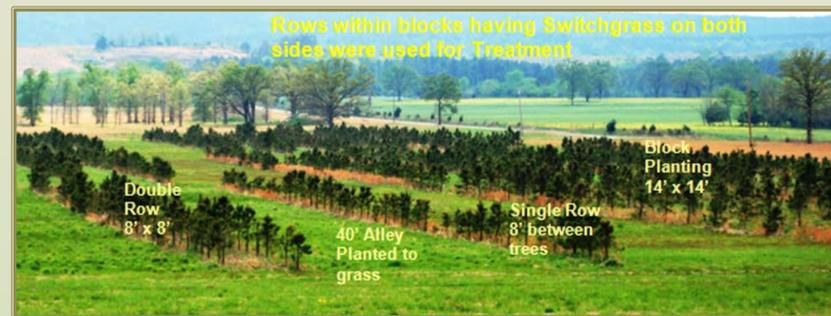
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Abstract

Growing switchgrass (*Panicum virgatum* L.) between rows of shortleaf pine (*Pinus echinata* Mill.) for biofuel may have potential as an agroforestry practice for landowners in western Arkansas. However, there is limited information on the effects on growth and production of shortleaf pine from competition of switchgrass interplanted between the rows. Objective of our study is to determine the effect of switchgrass on growth of shortleaf pine. The study is conducted at the USDA-Natural Resources Conservation Service Plant Materials Center in Booneville, Arkansas, USA on a Leadvale silt loam. Shortleaf pine was established in a block (14' x 14'), double row (8' x 8') and single row (8' x 24') tree arrangement in January 2006. Stocking rate for block, double row and single row tree arrangement was 222, 227 and 226 trees acre⁻¹, respectively. Tree arrangements were planted as a randomized complete block with three replications. Switchgrass was interplanted between tree rows in April 2006. Post frost measurements of tree height and diameter in November 2010 and 2011 were not affected by the switchgrass (P>0.05). However, diameter was significantly reduced in 2012 compared to control (no switchgrass) (P<0.05). It appears the decrease in tree diameter may have been attributed either to less leaf area caused by self pruning of lower limbs from shading of switchgrass or combination of shading and drought conditions in western Arkansas in 2012. Future studies will evaluate varying degrees of canopy loss, effects of planting arrangements, canopy development, and management schemes on switchgrass production.



Schematic view of the Double row, single row, and block planting arrangement

Methods

Tree growth measurements were made in November of 2010, 2011, and 2012. Each tree (excluding those on the edges of the plots) were tallied by their height, stem diameter at 1' above the ground, overall quality, and height to the lowest live limb (2012).

To determine the effect of switchgrass on growth of the trees, it was necessary to use only the single row arrangement and within the block plantings in order to have pine rows with switchgrass on both sides. Dry matter yield of the switchgrass was determined by harvesting two, randomly selected 3' x 10' swaths from each plot on either side of the tree rows. Sporadic stands of Indiangrass (*Sorghastrum nutans*) and big bluestem (*Andropogon gerardii*), and native forbs, primarily golden rod (*Solidago* spp.), served as a control.

An analysis of variance was performed on tree height and diameter measurements to determine if switchgrass influenced growth of shortleaf pine on this site.



Harvesting switchgrass between shortleaf pine rows



Switchgrass / shortleaf pine row arrangement

Results - Trees

The 2010 and 2011 tree measurements indicated that there was no negative effect of the switchgrass on the diameter growth of the pine trees. Conversely, measurements taken in the fall of 2012 showed diameter growth (differences in diameters from one measurement to the next) had slowed. This is understandable due to drier growing conditions in that year (Figure 1). However, the growth reduction in the treated rows (switchgrass on both sides of the pine row) was significantly greater than in the control rows.

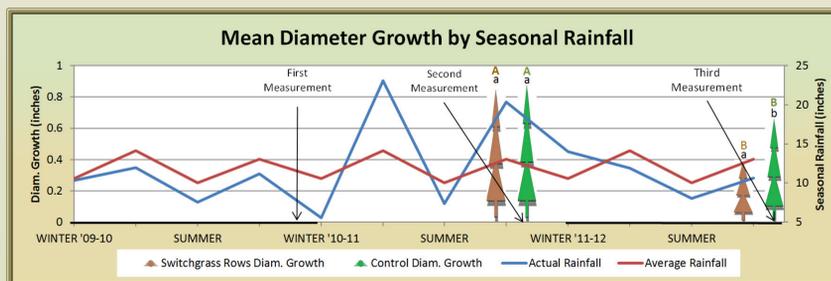


Figure 1 - Comparison of seasonal (winter 2009 – fall 2012) rainfall (inches) and shortleaf pine diameter growth (inches) showing a reduction in growth rate at the end of the 2012 growing season compared to the 2011 growing season.

- Different lower-case letters within yearly measurements indicate a difference at P<0.05 between treatments.
- Different upper-case letters for growth changes indicate a difference at P<0.05 between years for each treatment.

Trees in control rows had a 2011 to 2012 diameter growth reduction of 24% when compared with 2010 - 2011. The trees in the switchgrass rows had a 54% growth reduction.

Year	Average		Difference (Growth)	
	Switchgrass	Control	Switchgrass	Control
2010	2.5	2.5	.9	.9
2011	3.4	3.4	.4	.7
2012	3.8	4.1		

In addition, the change in height growth between the 2010 - 2011 measurements and the 2011 - 2012 measurements were significant at P<0.05. Figure 2 shows that the difference in height growth appears to be increasing.

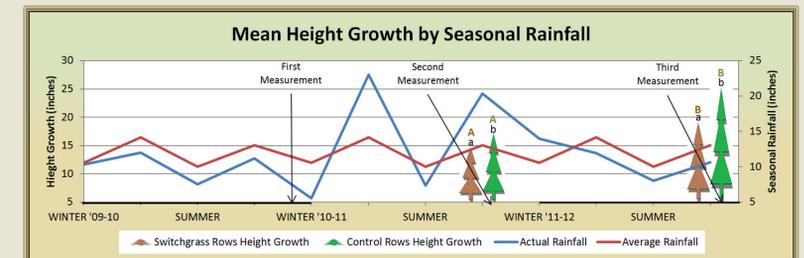


Figure 2 - Comparison of seasonal (winter 2009 – fall 2012) rainfall (inches) and shortleaf pine height growth (inches).

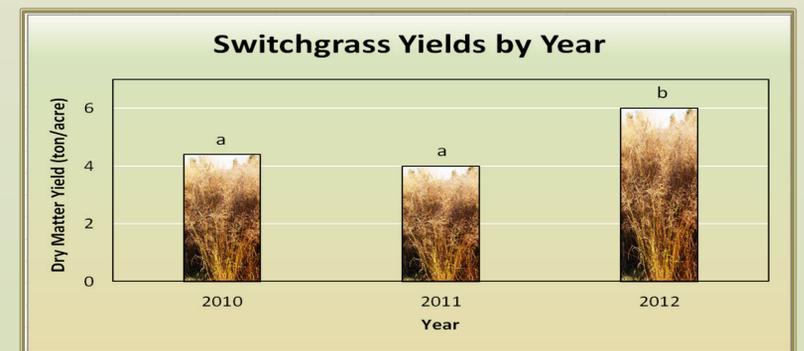
- Different lower-case letters within yearly measurements indicate a difference at P<0.05 between treatments.
- Different upper-case letters for growth changes indicate a difference at P<0.05 between years for each treatment.

Measurements were taken in 2012 to quantify what appeared to be a reduction in live canopy depth of the trees in the treatment rows. Each of the trees measured for diameter and height was also measured for height to the lowest live limb. When the average height to the lowest live limb is subtracted from the average total height, it appears switchgrass is causing early self pruning by shading the lowest limbs.



Figure 3 – Percentage of total tree height in live branches for trees grown with and without switchgrass

Results - Grass Production



Different letters above columns indicate a difference at P<0.05

Discussion

Although the drought in 2012 may have complicated the results, it appears switchgrass grown in a short leaf pine alley cropping system in west-central Arkansas may impact tree growth after 5 years. Measurements taken prior to 2012 showed no effect of switchgrass on diameter growth of shortleaf pines, despite some years prior to 2012 of below average precipitation. However, in the sixth year a notable decrease in growth occurs. It is anticipated the difference in diameter growth can be attributed to a combination of competition for moisture for tree growth and switchgrass production, and a loss of lower limbs from switchgrass shading.