Soil nutrient and moisture dynamics following two years of loblolly pine-switchgrass co-culture

Kurt J. Krapfl[1], Jeff A. Hatten[2], and Scott D. Roberts[1]

[1] College of Forest Resources, Mississippi State University, Starkville, MS

2 College of Forestry, Oregon State University, Corvallis, OR

Introduction

Co-culture systems incorporating both forest and grassland characteristics could positively impact soil quality and diversify income earning potential compared to monoculture. However, the intensive nature of such a system may stimulate interspecific competition for soil resources, and have long-term impacts upon timber and bioenergy feedstock production. To evaluate interspecific mechanisms within such a system, we established and monitored two loblolly pine-switchgrass co-cultures in northeastern Mississippi across varying competitive intensities.

Objectives

- Examine soil moisture and nitrogen (N) availabilities across gradients of interspecific competition
- Compare production yields in relation to interspecific competition

Methods

Alamo switchgrass was established at two sites in 2010 and loblolly pine seedlings were planted in spring 2011. A randomized complete block design with five treatments (Figure 2) and 8 replicates was employed. Soil moisture was assessed bi-monthly during the growing season at 0-7.5 and 7.5-20 cm depths. Soil N availability was assessed at 0-15 and 15-30 cm depths in spring and fall of 2011 and 2012.

Figure 1. Co-production systems of loblolly pine and switchgrass could diversify income earning potential. However, the impacts of such a system upon soil resources has received little attention.

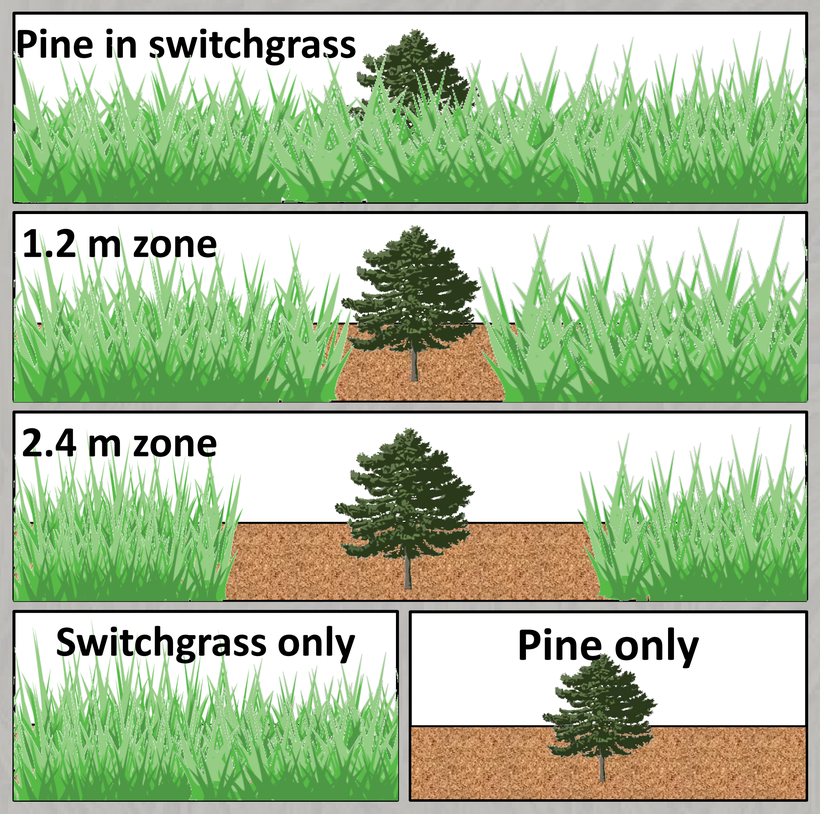

Figure 2. Treatments in this study included: pine planted directly into switchgrass, pine in a 1.2 m competition free zone, pine in a 2.4 m competition free zone, switchgrass only, and pine only.

Results

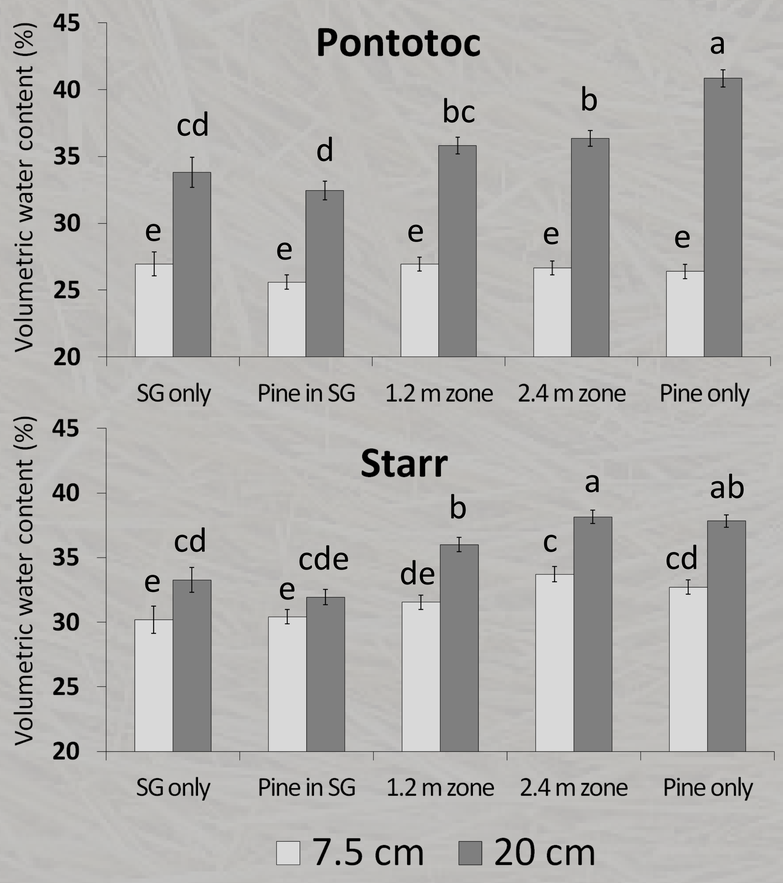

Figure 3. Volumetric water content by treatment at Pontotoc and Starr Forest. Differing letters indicate significant differences among treatments.

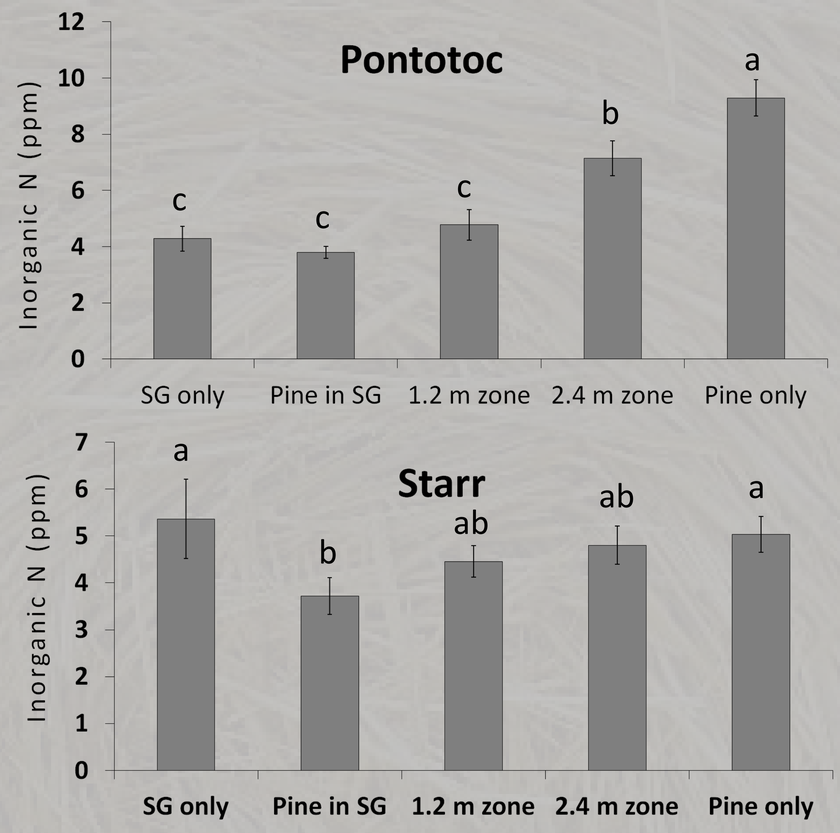

Figure 4. Inorganic N by site. Differing letters indicate significant differences among treatments.

Table 1. Production yields in 2012. Within columns, letters indicate significant differences among treatments.

	Tree height (cm)		Switchgrass yield (Mg ha^{-1})	
	Pontotoc	Starr	Pontotoc	Starr
SG only	-	-	11 ± 0.4 a	2.4 ± 0.2 a
Pine in SG	91 ± 5 c	147 ± 3 c	10 ± 0.5 a	1.6 ± 0.1 b
1.2 m zone	137 ± 5 b	189 ± 3 ab	10 ± 0.3 ab	2.3 ± 0.3 a
2.4 m zone	211 ± 5 a	190 ± 3 a	8 ± 0.4 b	2.1 ± 0.1 ab
Pine only	204 ± 4 a	179 ± 3 b	-	-

Conclusions

- Maintaining zones around trees increased soil moisture, N availabilities and tree growth.
- Resource responses to competitive treatments were similar across sites, but more pronounced at Pontotoc, due to greater competition exuded by high switchgrass yields.

Acknowledgements

SunGrant Initiative

Mississippi State University

College of Forest Resources, Forest and Wildlife Research Center