Tillage and Timing of Bahiagrass Termination in a Sod Rotation for Peanut

R. Scott Tubbs* and John P. Beasley, Jr.
Department of Crop and Soil Sciences, P.O. Box 748, Univ. of Georgia, Tifton, GA 31793. USA
*Corresponding author (tubbs@uga.edu).

ABSTRACT

Intensive management of row crop agriculture has led to weathered soils and extensive inputs to prevent decline in productivity. Well managed rotations can have a positive impact on numerous aspects of production agriculture, and sod-based rotations for peanut have numerous advantages over standard rotations. This study was conducted to evaluate effect of tillage and timing of termination of bahiagrass in a sod rotation for peanut. Peanuts were planted into conventionally turned soil or strip-tilled into killed bahiagrass sod in 2006 and 2007. Termination of bahiagrass took place in either the fall or spring prior to the planting of peanut. Yields were not affected by when the bahiagrass was terminated, but peanuts in fall-killed bahiagrass had higher grade and stand (70.2 %TSMK; 4.5 seed/ft) than spring-killed bahiagrass (68.4 %TSMK; 3.9 seed/ft) in 2007. Conventional tillage resulted in higher yields (2006 = 6081 lb/ac; 2007 = 3623 lb/ac) and better stands (2006 = 5.2 seed/ft; 2007 = 4.6 seed/ft) than strip-till (2006 = 4950 lb/ac and 3.2 seed/ft; 2007 = 2807 lb/ac and 3.8 seed/ft) in both years. However, strip-tilled peanuts had higher grade (73.6 %TSMK) than conventional tillage (72.1 %TSMK) in 2006. Based on these results, there is slight favor in killing bahiagrass in the fall rather than in the spring, and conventional tillage has resulted in higher yields and stand. Further research is needed to improve stand and yield in strip-till management to garner its documented benefits.
Abbreviations: ai, active ingredient; TSMK, total sound mature kernels.

INTRODUCTION

There is growing interest in the sustainability of agricultural cropping systems. This is very true in the southeastern U.S. for peanut, where the majority of the U.S. crop is grown. Intensive management can be highly profitable in the short-term, but that can come at the expense of the environment and long-term profitability (Franzluebbers, 2007; Russelle et al., 2007). Soil health can diminish by means of erosion, depletion of nutrients and organic matter, loss of soil structure and tilth, and increase of pests like diseases, insects, nematodes, and weeds (Reeves, 1997). Improper crop rotation can single-handedly negatively impact all of these ecosystem factors. Conversely, adoption of good rotational practices can lead to increased yields (Godsey et al., 2007; Jordan et al., 2002; Katsvairo et al., 2007b; Lamb et al., 2007; Wright et al., 2007), improved soil conditions (Katsvairo et al., 2007a) and reduced erosion (Gantzer et al., 1990). It can also result in lower pest incidences (Brenneman et al., 2003; Tsigbey et al., 2007), and conservation of precious resources like water from improved soil moisture retention (Weil et al., 1993; Wilhelm et al., 2004) and strong root proliferation and penetration (Elkins et al., 1977; Long and Elkins, 1983).

Studies comparing sod-based rotations for peanut to standard cotton-peanut rotations have shown greater yields (Brenneman et al., 2003; Hagan et al., 2003; Katsvairo et al., 2007b) and profitability (Katsvairo et al., 2006), plus reduced incidence of tomato spotted wilt virus (TSWV) (Balkcom et al., 2007; Tsigbey et al., 2007) and improved root and soil conditions (Katsvairo et al., 2007a). However, planting peanuts into thick residue may have the potential for problems with stand establishment or emergence. The timing of termination of the preceding bahiagrass sod could have an effect on planting and emergence of peanuts since earlier termination would allow more time for bahiagrass stolons to decompose. Therefore, the objectives of this experiment were to evaluate peanut yield, grade, and stand in fall-killed and spring-killed bahiagrass in both conventional and strip-till management.

MATERIALS AND METHODS

This experiment took place at the University of Georgia Lang Farm in Tifton, GA. One field was established in bahiagrass in May 2004 and was planted to peanut on 24 May 2006. A second field was established in bahiagrass in November 2004 and was planted to peanut on 23 May 2007. The fall termination of bahiagrass took place on 12 November 2005 and 14 November 2006, respectively and the spring termination took place on 6 April 2006 and 11 April 2007, respectively. Bahiagrass was killed with 2 qts/ac of Roundup (ai = glyphosate). Additional weed control was achieved at peanut planting with 1 qt/ac Roundup, 1 qt/ac Prowl (ai = pendimethalin), 3 oz/ac Valor (ai = flumioxazin), and 0.45 oz/ac Strongarm (ai = diclosulam). Conventional tillage consisted of deep turning + disk prior to bedding. All plots were planted to 'AP3' peanut in single row pattern on 36 inch row spacing and a plant population of 87,120 seed/ac. Each plot consisted of six rows x 50 feet long. Routine maintenance of insects and diseases took place according to UGA Extension recommendations. The middle two rows of each plot were dug at optimum maturity as determined by pod blasting and profile board (Williams and Drexler, 1981). Pod weights were adjusted to 7% moisture for uniformity. Grades were determined by the method described by Davidson et al. (1982).

Statistical Analysis

Data were analyzed using MSTAT (Freed et al., 1987) statistical software. Analysis of variance was conducted to determine levels of significance and differences among treatment means were tested using Fisher's Protected Least Significant Difference Test (LSD) at $p \leq 0.05$ (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

The timing of bahiagrass termination had no effect on pod yields (Table 1), which is similar to results reported by Zhao et al. (2007). However, unlike Zhao et al. (2007) but similar to Balkcom et al. (2007), there were significant differences between tillage effects, with strip-tilled peanuts yielding less than where conventional tillage had occurred in both years (Table 1). The final stand of peanuts likely played a major role in these yield differences, since conventionally tilled peanuts had more peanut plants at harvest than strip-till peanuts, and the strip-till plots were less than the target stand of four plants per foot of row in both years (Table 2). There was a difference in plant stand between the two termination timings in one of the two years, with a greater stand in fall-killed bahiagrass in 2007 (Table 2). Although yield differences were not detected, peanut grades followed the same treatment effect, with more total sound mature kernels (TSMK) coming from fall-killed bahiagrass in 2007 (Table 3). Despite lower yields in 2006, strip-tilled peanuts had a higher grade than conventional tillage peanuts (Table 3).

Recent reports have demonstrated reduced mechanical resistance through the soil profile when bahiagrass is terminated in fall compared to spring (Wright et al., 2006; Zhao et al., 2007). Less compacted soils may result in lower energy (and thus fuel) demand to pull implements through the soil. Earlier termination of bahiagrass would also allow more time for decomposition of root tissue, providing more root channels for the subsequent peanut crop to explore. The data from this experiment show direct improvement of stand and grade advantages in fall-killed bahiagrass compared to spring-killed, plus the aforementioned indirect benefits of fall-killing bahiagrass make it the wiser option in this system. In terms of tillage effect, conventional tillage has resulted in greater yields and stands than strip-till in the sod-based system. This is consistent with results by Balkcom et al. (2007), who also reported unfavorable economic returns in strip-tillage for the sod-based rotation for peanuts. Further studies are needed to investigate ways to make strip-till a more viable option in sod-based rotations to enhance the sustainability of this system.

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Table 1. Pod yield of peanut in a bahiagrass rotation as affected by kill timing and tillage.

	2006	2007
Kill Timing	------------- lb/ac ------------	
Fall Kill	5629 A	3276 A
Spring Kill	5402 A	3153 A
Tillage		
Conventional	6081 A	3623 A
Strip-Till	4950 B	2807 B

Means within each column followed by the same letter are not significantly different ($P \leq 0.05$) according to Fisher's Protected Least Significant Difference Test.

Table 2. Plant stand at harvest in a bahiagrass rotation as affected by kill timing and tillage.

	2006	2007
Kill Timing	------ plants/ft of row -------	
Fall Kill	4.3 A	4.5 A
Spring Kill	4.1 A	3.9 B
Tillage		
Conventional	5.2 A	4.6 A
Strip-Till	3.2 B	3.8 B

Means within each column followed by the same letter are not significantly different ($P \leq 0.05$) according to Fisher's Protected Least Significant Difference Test.

Table 3. Peanut grade in a bahiagrass rotation as affected by kill timing and tillage.

	2006	2007
Kill Timing	---------- % TSMK ----------	
Fall Kill	73.4 A	70.2 A
Spring Kill	72.4 A	68.4 B
Tillage		
Conventional	72.1 B	69.2 A
Strip-Till	73.6 A	69.4 A

Means within each column followed by the same letter are not significantly different ($P \leq 0.05$) according to Fisher's Protected Least Significant Difference Test.