NPB 199 FL

Final Report

197 FL-40 503 2007

"INFLUENCE OF KILL DATE AND TILLAGE ON PEANUT AFTER BAHIAGRASS"

IFAS-North Florida Research and Education Center
University of Florida, Quincy, FL 32351

ABSTRACT

Experiments were conducted in 2007 at two locations (Marianna and Quincy) of the North Florida Research and Education Center, FL to investigate effects of bahiagrass (*Paspalum notatum*) kill time and tillage practices on peanut yield and market grade. The experiments included two bahiagrass kill times (fall kill and spring kill) and six tillage methods [(1) strip till, (2) disk+turned, (3) disk+chisel, (4) paratill+strip till at planting, (5) disk+strip till, and (6) strip till+40 lbs N acre^{-1}] within each kill time. Peanut (cv. AP 3) was seeded on early to mid May 2007 with a row space of 3 feet and six seeds per foot row. During the growing season, insects and diseases were controlled and irrigation was scheduled based on peanut production practices in the region. Pod yield and market pod grade characteristics were determined. Kill time of bahiagrass did not ($P > 0.05$), but tillage methods did affected ($P < 0.05$) peanut yield. There was no interactive effect of the bahiagrass kill time and tillage type on peanut yield. In the strip till, peanut yield did not respond the N application. Averaged across the locations and tillage methods/bahiagrass kill times, peanut yields of the fall kill and spring kill were 4503 and 4529 lbs acre^{-1}, respectively; and the yields of the six tillage methods (1, 2, 3, 4, 5, and 6) were 4504, 4716, 4484, 4518, 4462, and 409 lbs acre^{-1}, respectively. These results indicate that (i) in the sod-based rotation systems in the southeast USA, farmers may have a wide window of time period to kill bahiagrass and to prepare seedbed for following peanut crop; (ii) N nutrient may not be a factor of limiting peanut yield or make a difference in crop residue decomposition in the strip till system of peanut following bahiagrass in the region; (iii) there is potential to make the sod-based crop rotation system more profitable by reducing energy input and tillage requirements; and (iv) high yields of peanuts may be expected when planting peanuts after bahiagrass.

INTRODUCTION

Studies have shown that sod-based rotation of peanut (*Arachis hypogea* L.) and cotton (*Gossypium hirsutum* L.) in the Southeast US can significantly reduce disease pressure (Dickson and Hewlett, 1989; Johnson et al., 1999; Marois and Wright, 2003a; Wright et al., 2004a), improve crop growth and development, and increase crop yield and profitability (Norden et al., 1980; Brenneman et al., 1995; Katsvairo et al., 2006; 2007) compared with conventional cropping systems. The value of bahiagrass (*Paspalum notatum*) in rotation with peanuts is clear in many field experiments (Brenneman et al., 1995; Marois and Wright, 2003b; Wright et al., 2004a; Wright et al., 2004b). However, most growers have not see the system as being out of crop production for a year or more and the cost of breaking up the land to get it back to peanut production. With rising fuel prices as well as input cost, it has become more important to find ways of reducing costs and increasing profitability while increasing peanut yields. Studies suggest that there are considerable differences among tillage methods in input cost, soil impact or crop yields (Jordan et al., 2002). In order to make the sod-based crop rotation system more profitable by reducing energy input and tillage requirements, we conducted this research at three states of Florida, Alabama, and Georgia in 2006 and 2007. The specific objectives of this study were to investigate effects of bahiagrass kill time and tillage practices on peanut yield, market grade and net return and to test if fungicide application has different effects on peanut yield. In this report, we summarize the results of peanut yield responses to bahiagrass kill time and tillage method in 2007 at two locations.

MATERIALS AND METHODS

The experiment was conducted in 2007 at two locations (Marianna and Quincy) of the North Florida Research and Education Center, University of Florida. Peanut cultivar AP-3 was used at both locations.

Marianna location

The experiment included two levels of bahiagrass kill time (fall kill and spring kill) and six tillage treatments within each kill time. The dates of bahiagrass fall kill and spring kill were 25 October 2006 and 20 March 2007, respectively. On both killed dates, bahiagrass was killed by mechanical spraying 3 qts. of Rundup Weather Max per acre. The six tillage treatments were: (1) Strip till, (2) Disk+turned, (3) Dick+chisel, (4) Paratill+strip till at planting, (5) Disk+strip till, and (6) Strip till+40 lbs N acre^{-1}. A rate of 40 lbs N fertilizer of Ammonium N per ace was forecasted on April 15 for the strip till+40 lbs N treated plots.

Peanut was seeded with a 2-row planter on 3 May 2007 with a row space of 3 feet and six seeds per foot row. During the growing season, insects and diseases were controlled and irrigation was scheduled based on peanut production practices in the region. When crop reached maturity stage on 17 September 2007, the two middle rows in each plot were mechanically dogged and reversed and harvested on 20 September. Pod samples were placed a forced-air dryer at 118°F for 72 hours to ensure for a constant weight. Peanut yield and market pod grading characteristics, including percentages of sound mature kernels (SMK), sound split kernels (SSK), other kernels (OK), Hulls, and TSWV were determined.

Quincy location

Similar to the Marianna experiment, the experiment at Quincy was also composed with two levels of bahiagrass kill time (fall kill and spring kill) and six tillage treatments. The fall kill date was 25 October 2006 with 3 qts. of Rundup Weather Max per acre and the spring kill was two times of applying Glyphomax Plus on 20 March and 10 April 2006 with the rate of 3 qts. acre^{-1} each time. The six tillage treatments were the same as that in Marianna and they were: (1) Strip till, (2) Disk+turned, (3) Dick+chisel, (4) Paratill+strip till at planting, (5) Disk+strip till, and (6) Strip till+40 lbs N acre^{-1}. Seeds of peanut were planted on 4 May 2007. Measurements of Soil mechanical resistance were taken in all plots using a CP20 Cone Penetrometer on 18 May, 5 June, 18 July, and 1 August. Except for the kill time and tillage treatments, other field management practices, such as irrigation and herbicide and insecticide application, were scheduled for all plots based on peanut production practice recommendations in the region during the growing season. At maturity (2 Oct. 2007), the two middle rows in each plot were mechanically harvested. Pod samples were dried to determine yield and market pod grading parameters using the similar methods described above.

Experimental design and data analysis

The experiments were a split plot design with four replications. The bahiagrass kill times were main plots and tillage method treatments were sub-plots. The sub-plot size was 30 (Marianna) or 50 (Quincy) feet long and 18 feet wide. Analysis of variance (ANOVA) was carried out using SAS procedures of GLM to determine the main and interactive effects of bahiagrass kill time and tillage type. The least significant difference (LSD) tests were used to distinguish the treatment difference at $P = 0.05$ level.

RESULTS AND DISCUSSION

Precipitation and irrigation

Year 2007 was extremely dry at the experimental locations as well as in the southeast USA. Cumulative precipitations at Marianna (333 mm) and Quincy (390 mm) from April to September were only 44 and 51% of the long-term average (761 mm), respectively (Table 1). Water saving irrigation was used during the growing season at both locations to eliminate plant water deficit stress. The rainfall and irrigation data may help explain the peanut yield variation between the two locations.

Table 1. Monthly precipitation (Prec), irrigation (Irr), and sum of precipitation and irrigation at Marianna and Quincy, Florida in the 2007 growing seasons.

Month	Marianna			Quincy			Long-term	
	Prec	Irr	Sum	Prec	Irr	Sum	Prec	pET
	(mm)							
April	27	25	52	24	17	41	92	122
May	57	51	108	25	37	62	122	150
June	57	38	95	78	26	104	143	145
July	71	44	115	116	13	129	171	142
Aug.	88	51	139	82	36	118	138	134
Sept.	34	32	66	65	0	65	95	114
Total	333	241	674	390	129	519	761	807

Soil mechanical resistance

Studies have confirmed that soil compaction directly affects crop root growth and limits use of deep soil water and nutrients, resulting in a reduced crop growth and low yields (Atwell, 1990; Alakukku and Elonen, 1995). Measurements of soil mechanical resistance in Quincy indicated that tillage methods greatly affected soil mechanical resistance between 0 and 25 cm depth. Averaged across measurement dates and the bahiagrass killed times, the treatments of strip till, disk+striptill and striptill+40N had much greater resistance in the top soil layer (0-25 cm) compared to other tillage methods (Figure 1A). There was no difference in soil resistance between the fall kill and spring kill of bahiagrass (Figure 1B). However, this soil penetration advantage from some tillage methods (such as turned and chiseled or paratill) did not result in yield benefit of the following peanut in the present study.

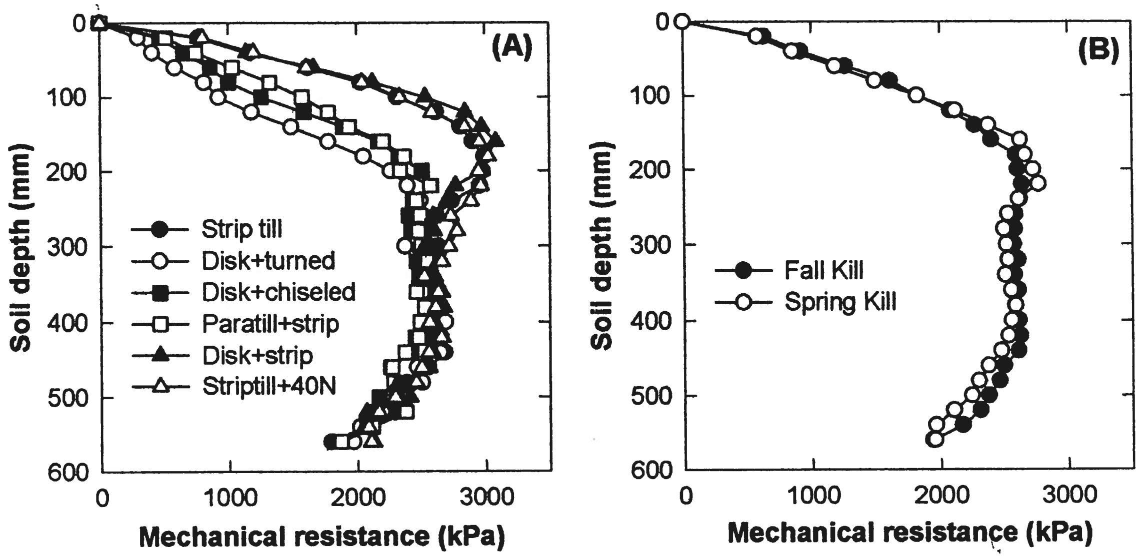

Figure 1. Soil mechanical resistance for (A) the six tillage types and (B) fall kill vs. spring kill bahiagrass. Data are means of four times of measurements on May 18, June 5, July 18, and Aug. 1, 2007 in Quincy, Florida.

Peanut yield responses to bahiagrass kill time and tillage

Peanut yields in Marianna and Quincy were 4182 and 4849 lbs acre^{-1}, respectively, averaged across the bahiagrass kill time and tillage treatments. Overall, the peanut yield in the present study is 67 to 94% higher than State average yield (about 2500 lbs acre^{-1}) of peanut in the Southeast. The good yields are attributable to being after 2 years of bahiagrass (Brenneman et al., 1995; Marois and Wright, 2003b; Wright et al., 2004a; Wright et al., 2004b). Statistical analysis indicated that there was significant difference ($P < 0.05$) in peanut yield between the two experimental locations. Therefore, yield data were analyzed independently for each location (Table 1). At both locations, the kill time of bahiagrass did not affect peanut yield ($P > 0.05$), but tillage methods affected yield significantly ($P < 0.05$). There was no significant interaction effect on peanut yield between the bahiagrass kill time and tillage method (Table 2).

Table 2. Analysis of variance (ANOVA) for peanut yield responses to the kill time of bahiagrass and tillage at Marianna and Quincy, Florida in 2006.

Source	DF	*P* value	
		Marianna	Quincy
Replication	3	0.0098	0.0053
Kill time	1	0.4063	0.0768
Rep × Kill time	3	0.2955	0.9360
Tillage	5	0.0252	0.0205
Rep × tillage	15	0.8705	0.8705
Kill time × tillage	5	0.4042	0.4042

Peanut yields from bahiagrass kill date and tillage treatments at two locations are given in Table 3. Averaged across the tillage treatments, peanut yields of the fall kill and spring kill of bahiagrass were 4103 and 4261 lbs acre^{-1}, respectively in Marianna and 4902 and 4797 lbs acre^{-1}, respectively in Quincy. Peanut yield did not differ between the fall kill and the spring kill of bahiagrass at the both locations. Our 2006 study also indicate that there are no differences in peanut yield between the fall kill and the spring kill of bahiagrass. Thus, farms have a great time window or flexibility from fall to spring to kill bahiagrass for the following row crops without any yield reduction. In Marianna, tillage did not affect peanut yield in both fall and spring kill. Yield did not differ between the fall kill and spring kill treatments when averaging yield across tillage treatments and among the six tillage methods of the fall kill bahiagrass at Quincy. The disk treatment had significantly less yield than other tillage treatments within the spring kill of bahiagrass at Quincy (Table 3).

Strip till was one of the most simple tillage method among the six tillage treatments, but its peanut yield was equivalent to that of other tillage treatments. This indicates that in sod-based peanut-cotton rotation systems in the southeast, the conservation tillage of strip till can reduce input and increase profitability. Theoretically, row crops may face N limitation when they follow bahiagrass because decomposition of bahiagrass roots and residues requires a period of time. We speculated that fall kill of bahiagrass might be better in peanut yield than the spring kill, but our results did not support our hypotheses. Results of this study also revealed that N nutrient was not a factor of limiting peanut yield in the sod based rotation system with strip till in either the fall kill or the spring kill of bahiagrass (Table 3).

Table 3. Effects of bahiagrass kill time and tillage on peanut yield at Marianna and Quincy, Florida in 2007.

Tillage	Marianna			Quincy†		
	Fall kill	Spring kill	Mean	Fall kill	Spring kill	Mean
	(lbs. acre^{-1})					
Strip till	3816 a	4087 a	3951 a	4959 a	5153 a	5056 a
Disk+turned	4389 a	4408 a	4398 a	4997 a	5073 a	5035 a
Disk+chiseled	4099 a	4508 a	4304 a	4815 a	4513 ab	4664 ab
Paratill+strip till	4140 a	4332 a	4236 a	4773 a	4826 ab	4800 ab
Disk	4417 a	4216 a	4316 a	4852 a	4365 b	4609 b
Strip till+40 lb N	3756 a	4014 a	3885 a	5017 a	4850 ab	4933 ab
LSD $_{0.05}$	810	759	533	524	669	410

† Means within a column followed by the same letter are not significantly different at the level of $P = 0.05$.

Peanut market grade characteristics

Peanut sub-samples were prepared for all treatments to determine market grading variables of percent sound mature kernels (SMK), percent sound split kernels (SSK), percent other kernels

(OK), percent hulls, or percent kernels with tobacco spot wilt virus (TSWV) infection. The 2007 data are not available yet because samples are still in processing.

In 2006, peanut market grading results of the same study indicated that bahiagrass kill time and tillage method did not affect any grading parameters of percent sound mature kernels (SMK), percent sound split kernels (SSK), percent other kernels (OK), percent hulls, or percent kernels with tobacco spot wilt virus (TSWV) infection (data not shown). There were no statistical differences between the two locations in SMS, SSK, OK, and percent hulls (Table 4). However, peanut kernels at Quincy had significantly higher TSWV compared to peanuts at Marianna in all tillage methods (Table 4). Averaged across kill times of bahiagrass and tillage types, the TSWV was 0.53% at Marianna and 0.81% at Quincy.

Table 4. Percentages (%) of sound mature kernels (SMK), sound split kernels (SSK), other kernels (OK), hulls, and TSWV of peanuts at Marianna and Quincy, Florida in 2006.

System	Marianna					Quincy				
	SMK	SSK	OK	Hull	TSWV	SMK	SSK	OK	Hull	TSWV
Strip till	60.0	6.82	4.25	28.6	0.48	59.7	7.39	4.18	28.0	0.83
Disk+turned	60.0	6.71	4.18	28.5	0.61	59.0	7.69	4.54	28.1	0.86
Disk+chiseled	60.4	6.22	4.84	28.3	0.51	59.3	7.06	4.46	28.4	0.85
Paratill+strip till	59.8	5.70	4.80	29.0	0.34	61.0	6.08	4.66	28.0	0.73
Disk	59.3	7.19	4.68	28.3	0.63	59.4	6.89	4.52	28.5	0.86
Strip till+40 lb N	59.9	6.03	5.14	28.9	0.64	60.0	6.16	5.10	28.0	0.71
Mean	59.9	6.44	4.65	28.6	0.53	59.7	6.88	4.57	28.2	0.81

† Data are means of the fall kill and spring kill of bahiagrass.

CONCLUSIONS

Results of this study at the two locations (Marianna and Quincy) of the North Florida Research and Education Center in 2007 indicated that:

1. Peanut yield and grading variables did not differ between the bahiagrass fall kill and spring kill treatments. Therefore, farmers may have a wide window to kill bahiagrass and to prepare seedbed for following peanut crop in the sod-based rotation systems in the southeast. Bahiagrass may be killed at anytime from the fall until 4-5 weeks prior to planting.

2. Peanut yield response to tillage treatments depends upon the experimental location. At Marianna, yield did not differ among the six tillage treatments in either fall kill or spring kill of bahiagrass. At Quincy, the disk treatment had significant lower yield than the strip till and the disk+turned treatments in the spring kill of bahiagrass.

3. Application of N fertilizer did not improve peanut yield, when peanut followed bahiagrass in strip till system at both locations in this study. Therefore, N nutrient may

not be a factor of limiting peanut yield or make a difference in cover crop decomposition in the strip till system of peanut following bahiagrass in Florida.

4. High yields of peanuts can be expected when planting peanuts after bahiagrass in conservation tillage.

REFERENCES

Alakukku, L., and Elonen, P. 1995. Long-term effects of a single compaction by heavy field traffic on yield and nitrogen uptake of annual crops. Soil Tillage Res, 36: 141-152.

Atwell, B.J. 1990. The effect of soil compact on wheat during early tillering. I: Growth, development and root structure. New Phytol., 115: 29-35.

Brenneman, T.B., Sumner, D.R., Baird, R.E., Burton, G.W., and Minton, N.A. 1995. Suppression of foliar and soilborne peanut diseases in bahiagrass rotations. Phytopathology 85:948–952.

Dickson, D.W., and Hewlett, T.F. 1989. Effects of bahiagrass, and nematicides on Meloidogyne arenaria on peanut. Suppl. J. Nematol. 21, 4S:671–676.

Johnson, A.W., Milton, N.A., Brenneman, T.B., Burton, G.W., Culbreath, A.K., Gascho, G.J., and Baker, S.H. 1999. Bahiagrass, corn, cotton rotations, and pesticides for managing nematodes diseases, and insects in peanuts. J. Nematol. 31:191–200.

Jordan, D.L., Bailey, J.E., Barnes, J.S., Bogle, C.R., Bullen, S.G., Brown, A.B., Edmisten, K.L., Dnphy, E.J., and Johnson, P.D. 2002. Yield and economic return of ten peanut-based cropping systems. Agron. J., 94: 1289-1294.

Katsvairo, T.W., Wright, D.L., Marois, J.J., Hartzog, D.L., Rich, J.R., and Wiatrak, P.J. 2006. Sod–livestock integration into the peanut–cotton rotation: A systems farming approach. Agron. J. 98: 1156-1171.

Katsvairo, T.W., Wright, D.L., Marois, J.J., Hartzog, D.L., Balkcom, K.B., Wiatrak, P.P., and Rich, J.R. 2007. Cotton roots, earthworms, and infiltration characteristics in sod–peanut–cotton cropping systems. Agron. J. 99:390-398.

Marois, J.J., and Wright, D.L. 2003a. Effect of tillage system, phorate, and cltivar on tomato spotted wilt of peanut. Agron. J. 95: 386-389.

Marois, J.J., and Wright, D.L. 2003b. A working business model for cattle/peanuts/cotton. Proc. Sod Based Cropping Syst. Conf., North Florida Research and Education Center-Quincy, University of Florida, Feb. 20-21, 2003, pp. 180-186.

Norden, A.J., Perry, V.G., Martin, F.G., and NeSmith, J. 1980. Effect of age of bahiagrass sod on succeeding peanut crops. Peanut Sci. 4:71–74.

Wright, D.L., Katsvairo, T.W., Marois, J.J., and Wiatrak, P.J. 2004a. Introducing bahiagrass in peanut/cotton cropping systems-effects on soil physical characteristics. In Annual Meeting Abstracts of ASA, CSSA, and SSSA. Madison, WI.

Wright, D., Marois, J., Katsvairo, T., Wiatrak, P., and Rich, J. 2004b. Value of perennial grasses in conservation cropping systems. Proc. 26th Southern Conserv. Tillage Conf. Sustain. Agric., Raleigh, NC, 8-9 June 2004. p. 135-142.