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2014

Evaluation of Tillage, Cover Crop & Herbicide Effects on Weed Control in Peanut Production Systems.

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Final Report

Project Summary

A multi-year experiment was established in Alabama and Georgia to identify effective integrated weed management strategies in peanut production. The objective of the study was to evaluate efficacy of tillage practices, cover crops, and various herbicide management options for weed control and peanut yield. The experiment consisted of three tillage treatments: conventional tillage, reduced tillage with a cover crop, and a winter fallow, reduced tillage treatment. Herbicide treatments included: Strongarm alone, Cadre alone, Valor alone, Strongarm plus Cadre, Valor plus Cadre, Valor plus Strongarm, Valor plus Cadre plus Strongarm, and a non-treated control. Experiment locations were at the Wiregrass Research Center in Headland, AL in 2014 and 2015 and at the Ponder Research Farm, TyTy, GA in 2014 and at the Lang-Rigdon farm in Tifton, GA in 2015. This report covers the Alabama 2015 location whereas GA submitted their report independently.

A trial was implemented at Wiregrass Research and Extension Center to determine herbicide efficacy under various tillage systems and with a cover crop. The main plots of this study were 1) winter fallow, 2) conventional tillage, 3) and strip tillage with a winter cover crop of rye. The sub plots treatments were: 1) No herbicide, 2) Only Cadre (4 oz/ac), 3) only Strongarm (0.45 oz/ac), 4) only Valor (3 oz/ac), 5) Strongarm and Cadre (0.45 oz/ac and 4 oz/ac), 6) Valor and Cadre (3 oz/ac and 4 oz/ac), 7) Valor and Strongarm (3 oz/ac and 0.45 oz/ac), and 8) Valor, Strongarm, and Cadre (3 oz/ac, 0.45 oz/ac, and 4 oz/ac). Valor was applied as and early PRE, Strongarm was applied as a PRE at planting, and Cadre was applied POST.

There were significant differences in the yield with respect to tillage and to herbicide application. Winter fallow was not as good as conventional tillage (Table 1). This result is possibly due to the creation of an over wintering habit for weed seed. This led to increased initial weed pressure on winter fallow plots. The herbicide treatments resulted in a greater variation of yield than tillage system effects. A POST application of Cadre was seen to be the most beneficial to the yield. This may mean that the conventional and conservation tillage systems created sufficient early weed control, and therefore, a later application of an herbicide was necessary to continue weed control after the effects of tillage on weed control diminished over the season.

Percent weed control was widely varied with conventional tillage providing the top tier of weed control in all weeds (Table 2). This is most likely because of the increased PRE activity in these plots. Generally earlier applications of herbicide resulted in better weed control.

Table 1. Agronomic and Weed Control Effects of Different Tillage Systems and Herbicides in Peanuts –
Wiregrass 2015. Significance at P=0.1.

		% Weed Control				
Tillage	Yield (kg/Ha)	Crabgrass	Palmer Amaranth	Sicklepod	Morningglory	Nutsedge
WF[1]	3328[b]	47[b]	73[ba]	71[b]	79[ba]	95[a]
CT[2]	4113[a]	95[a]	84[a]	91[a]	87[a]	94[a]
Rye[3]	3792[ba]	49[b]	66[b]	93[a]	66[b]	93[a]
LSD (α=0.1)	486	11	12	11	12	5
Herbicide						
Non-treated[4]	3178[bc]	56[a]	66[ba]	82[a]	52[b]	93[a]
A[5]	3345[bc]	59[a]	92[a]	80[a]	64[ba]	95[a]
B[6]	2903[c]	58[a]	63[ba]	81[a]	95[a]	97[a]
C[7]	3967[bac]	73[a]	63[ba]	91[a]	52[b]	89[a]
A_B	3576[bc]	71[a]	96[a]	80[a]	96[a]	97[a]
A_C	5103[a]	58[a]	89[a]	89[a]	71[ba]	88[a]
B_C	3605[bc]	71[a]	54[b]	89[a]	94[a]	96[a]
A_B_C	4279[ba]	63[a]	74[ba]	85[a]	97[a]	97[a]
LSD (α=0.1)	782	18	20	18	20	8

[1]Plots were left fallow throughout the winter.
[2]Plots were disked and cultivated prior to planting.
[3]Rye was drilled at 90 lbs/A in the fall, then rolled flat prior to planting.
[4]No herbicide was applied.
[5]Valor (3 oz/A) was applied 3 weeks prior to planting.
[6]Strongarm (0.45 oz/A) was applied at planting.
[7]Cadre (4 fl oz/A) was applied after early weed emergence.
*LS-Means with the same letter are not significantly different.
**All statistical analysis was performed with SAS using PROC GLIMMIX.

Table 2. Weed Control of Different Tillage Systems and Herbicides in Peanuts – Wiregrass 2015

	% Weed Control														
	Winter Fallow System[1]					Conventional Tillage System[2]					Conservation System[3]				
Herbicide	CG[8]	PA[9]	SP[10]	MG[11]	NS[12]	CG	PA	SP	MG	NS	CG	PA	SP	MG	NS
Non-treated[4]	35[ba]	87[a]	63[a]	62[a]	97[a]	96[a]	50[a]	91[a]	61[a]	87[a]	38[ba]	62[a]	92[a]	32[a]	96[a]
A[5]	28[b]	88[a]	62[a]	52[a]	94[a]	98[a]	99[a]	85[a]	91[a]	94[a]	52[ba]	88[a]	93[a]	50[a]	96[a]
B[6]	43[ba]	57[a]	62[a]	94[a]	97[a]	84[ba]	77[a]	91[a]	96[a]	97[a]	45[ba]	57[a]	92[a]	93[a]	98[a]
C[7]	73[ba]	78[a]	93[a]	60[a]	84[a]	97[a]	73[a]	85[a]	60[a]	92[a]	48[ba]	37[a]	95[a]	35[a]	91[a]
A_B	74[ba]	93[a]	58[a]	92[a]	96[a]	99[a]	99[a]	94[a]	98[a]	98[a]	40[ba]	96[a]	89[a]	98[a]	98[a]
A_C	27[b]	77[a]	78[a]	85[a]	98[a]	98[a]	98[a]	96[a]	91[a]	94[a]	50[ba]	92[a]	93[a]	37[a]	71a
B_C	62[ba]	45[a]	88[a]	93[a]	98[a]	99[a]	80[a]	89[a]	98[a]	92[a]	53[ba]	37[a]	90[a]	92[a]	98[a]
A_B_C	37[ba]	62[a]	64[a]	96[a]	98[a]	88[ba]	98[a]	96[a]	98[a]	95[a]	63[ba]	63[a]	94[a]	96[a]	98[a]
LSD (α=0.1)	31	35	31	35	14	---	---	---	---	---	---	---	---	---	---

[1]Plots were left fallow throughout the winter.
[2]Plots were disked and cultivated prior to planting.
[3]Rye was drilled at 90 lbs/A in the fall, then rolled flat prior to planting.
[4]No herbicide was applied.
[5]Valor (3 oz/A) was applied 3 weeks prior to planting.
[6]Strongarm (0.45 oz/A) was applied at planting.
[7]Cadre (4 fl oz/A) was applied after early weed emergence.
[8]Crabgrass.
[9]Palmer Amaranth.
[10]Sicklepod.
[11]Morningglory.
[12]Nutsedge.
*LS-Means with the same letter are not significantly different.
**All statistical analysis was performed with SAS using PROC GLIMMIX.

Winter fallow and the conservation system provided the poorest control of crabgrass. Conventional tillage was the only tillage system that provided quality control of crabgrass. This data shows that even with high herbicide input systems, tillage is still a crucial part of weed control. It may be possible to create adequate weed control with even higher herbicide inputs, but that will also incur higher costs.

Table 3. Agronomic Effects of Different Tillage Systems and Herbicides in Peanuts – Wiregrass 2015

	Peanut Yield (kg/Ha)		
Herbicide	Winter Fallow System[1]	Conventional Tillage System[2]	Conservation System[3]
Non-treated[4]	2758[ba]	3453[ba]	3323[ba]
A[5]	2758[ba]	4213[ba]	3062[ba]
B[6]	2411[b]	3041[ba]	3258[ba]
C[7]	3584[ba]	3931[ba]	4387[ba]
A_B	2215[b]	4648[ba]	3866[ba]
A_C	4626[ba]	5647[a]	5037[ba]
B_C	4040[ba]	3953[ba]	2824[ba]
A_B_C	4235[ba]	4018[ba]	4583[ba]
LSD (α=0.1)	1354	---	---

[1]Plots were left fallow throughout the winter.
[2]Plots were disked and cultivated prior to planting.
[3]Rye was drilled at 90 lbs/A in the fall, then rolled flat prior to planting.
[4]No herbicide was applied.
[5]Valor (3 oz/A) was applied 3 weeks prior to planting.
[6]Strongarm (0.45 oz/A) was applied at planting.
[7]Cadre (4 fl oz/A) was applied after early weed emergence.
*LS-Means with the same letter are not significantly different.
**All statistical analysis was performed with SAS using PROC GLIMMIX.

This data shows that in conventional and conservation tillage the herbicide input will not have an effect on the yield. Only in the case of winter fallow is the herbicide input significant, and in that case a POST is usually more beneficial.

In conclusion, these results show that the conventional tillage system is the most likely to have the most yield and the best weed control of all the tillage systems. This may be because winter fallow and cover cropping create another barrier that the peanut must be able to work through to be able to produce a fruit. The extra energy invested in growth would minimize the peanut yield. It was also seen that an early POST herbicide application would provide the best weed yield and weed control. It is possible that the POST herbicide was more efficacious because earlier on in the season there was more cover present from the rye or winter weeds that prevented the PRE herbicides from being soil absorbed.

Evaluation of Tillage, Cover Crop, & Herbicide Effects on Weed Control, Yield and Grade in Peanut

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ABSTRACT

Peanut production plays a large role in agriculture in the Southeastern United States. Weeds are detrimental to their production because of the competition that they create; weeds will compete with crops for resources such as nutrients and sunlight, among others. Therefore, it is important to reduce weed pressure on peanut to protect yield and grade. With traditional use of herbicides for weed control, the frequency of herbicide resistant weeds has grown. Because of this, alternative integrated methods of weed control must be investigated to maintain crop yield and combat herbicide resistance development. Conservational tillage is a production method that can offer weed suppression through use of high-residue cover crops and needs further investigation due to agronomic and cover crop/herbicide interference concerns. Thus, an experiment was established evaluating tillage, cover crop, and herbicide use intensity conducted as a split-plot design with tillage type as the main plot and herbicide input as the sub plot. The main plot treatments were: 1) conventional tillage including a moldboard plow, 2) conservation tillage winter weedy fallow and spring within-row non-inversion tillage, and 3) conservation tillage using cereal rye as a cover crop and spring within-row non-inversion tillage. Sub plot treatments included: 1) Flumioxazin (3 oz/acre) early PRE, 2) Diclosulam (.45 oz/acre) Imazapic (4 fl oz/acre) early POST, 4) Flumioxazin (3 oz/acre) early PRE Imazapic (4 fl oz/acre) early POST, 5) Diclosulam (.45 oz/acre) PRE Imazapic (4 oz/acre) early POST, or 6) nontreated. The treatments were arranged in the design in a factorial arrangement so that all possible treatment combinations were applied to each replication. There were 24 unique plots and three replications, resulting in 72 total plots. Weed control ratings were taken along with yield. Yield from conventional tillage (4113 kg/ha) was shown to be significantly higher than winter fallow (3328 kg/ha), but not significantly higher than conservational tillage (3792 kg/ha). Results also show that a PRE and POST herbicide application are the most effective at improving yield (5103 kg/ha), whereas applying herbicide only at the time of planting or late POST is less effective (2903 kg/ha and 3967 kg/ha, respectively). Weed control was best under the conventional tillage system for crabgrass (*Digitaria sanguinalis*), palmer amaranth (*Amaranthus palmeri*), morningglory (*Jaquemontia tamnifolia*) (95%, 84%, and 87%, respectively). Conservation tillage provided comparable control relative to conventional tillage for *Senna obtusifolia*) and nutsedge (*Cyperus rotundus*) (93% and 93% respectively in conservation tillage and 91% and 94% in conventional tillage). In general, integrated weed management systems provided adequate weed control and yield protection in conservation systems as compared to winter fallow or conventional peanut systems.

INTRODUCTION

Weed control is a growing concern in many agronomic crops. Herbicide resistance has changed the way that weed control must be approached. An integrated management system must be investigated to determine if sufficient weed control can be accomplished through the use of conservation tillage and cover crops. Conservation tillage is capable of improving soil quality because of the fewer passes that are made over a field and less soil disturbance than conventional tillage. These properties will allow soil organic matter to increase and reduce compaction problems in fields. Cover crops can also improve soil organic matter by creating residue that is decomposable. Cover crops create an impenetrable physical and sunlight barrier that to suppress weed growth. This suppression allows crops to get a jumpstart and begin growing without weed competition. High residue cover crops such as rye are highly effective at creating this barrier to prevent weed growth. Herbicides are also effective at preventing weed growth. Due to the concerns with herbicide resistance some herbicide applications need to be increased to provide effective weed control. higher herbicide input systems will incur higher variable costs to producers. Therefore, it is crucial that levels of herbicide input are investigated to determine what levels of herbicide are needed to provide effective weed control. Herbicides and cover crops both provide weed control. Therefore, it is important to see the amount control possible when herbicides and cover crop are interacting with each other. A system where they are complementary to each other would provide the most effective, sustainable, and economic weed control.

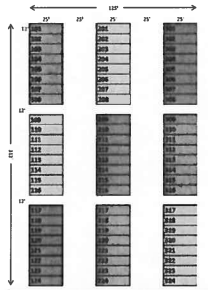
OBJECTIVES

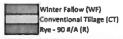
The objecives of this study are to investigate which combinations of tillage system (winter fallow, conventional, and conservation) and herbicide input will result in the highest yield and weed control for peanut plants.

MATERIAL & METHODS

The experiment was laid out in a split plot design with the main plot as tillage system. Three tillage systems were used: 1) conventional tillage including a moldboard plow, 2) conservation tillage winter weedy fallow and spring within-row non-inversion tillage, and 3) conservation tillage using cereal rye as a cover crop and spring within-row non-inversion tillage. In the conservation plots rye was planted in the late fall. The sub plot treatment is herbicide which was: 1) Flumioxazin (3 oz/acre) early PRE, 2) Diclosulam (.45 oz/acre) PRE, and 3) Imazapic (4 fl oz/acre) early POST, 4) Flumioxazin (3 oz/acre) early PRE followed by Imazapic (4 fl oz/acre) early POST, 5) Diclosulam (.45 oz/acre) PRE followed by Imazapic (4 oz/acre) early POST, Flumioxazin (3 oz/acre) early PRE followed by Diclosulam (.45 oz/acre) PRE, Flumioxazin (3 oz/acre) early PRE followed by Diclosulam (.45 oz/acre) PRE followed by Imazapic (4 fl oz/acre) early POST, or 8) nontreated. This design resulted in 24 unique plots that were replicated 3 times.

The peanut was planted in single rows in all plots. Plots were fertilized and irrigated as needed using a lateral irrigation system. After all of the herbicide applications had occurred a weed rating was conducted to determine the percent weed control in each plot. Upon reaching maturity the plots were harvested and yield data was collected for each plot. The data was then analyzed in SAS 9.4 using PROC GLIMMIX.





Far left: Plot plan for the peanut test. Left: Peanut field post harvest. Below left: Peanut field preplanting. Below middle: Conservation tillage peanut. Below right: Conventional tillage peanut.

RESULTS

Table 1. Agronomic and Weed Control Effects of Different Tillage Systems and Herbicides in Peanuts – Wiregrass 2015

		% Weed Control				
Tillage	Yield (kg/Ha)	Crabgrass	Palmer Amaranth	Sicklepod	Morningglory	Nutsedge
WF[1]	3328[b]	47[b]	73[ba]	71[b]	79[ba]	95[a]
CT[2]	4113[a]	95[a]	84[a]	91[a]	87[a]	94[a]
Rye[3]	3792[ba]	49[b]	66[b]	93[a]	66[b]	93[a]
LSD (α=0.1)	486	11	12	11	12	5
Herbicide						
Non-treated[4]	3178[bc]	56[a]	66[ba]	82[a]	52[b]	93[a]
A[5]	3345[bc]	59[a]	92[a]	80[a]	64[ba]	95[a]
B[6]	2903[c]	58[a]	63[ba]	81[a]	95[a]	97[a]
C[7]	3967[bac]	73[a]	63[ba]	91[a]	52[b]	89[a]
A_B	3576[bc]	71[a]	96[a]	80[a]	96[a]	97[a]
A_C	5103[a]	58[a]	89[a]	89[a]	71[ba]	88[a]
B_C	3605[bc]	71[a]	54[b]	89[a]	94[a]	96[a]
A_B_C	4279[ba]	63[a]	74[ba]	85[a]	97[a]	97[a]
LSD (α=0.1)	782	18	20	18	20	8

[illegible]

RESULTS

Table 2. Weed Control of Different Tillage Systems and Herbicides in Peanuts – Wiregrass 2015

	% Weed Control											
	Winter Fallow System[1]					Conventional Tillage System[2]					Conservation System[3]				
Herbicide	CG[8]	PA[9]	SP[10]	MG[11]	NS[12]	CG	PA	SP	MG	NS	CG	PA	SP	MG	NS
Non-treated[4]	35[illegible]	87[a]	63[a]	62[illegible]	97[a]	96[a]	50[b]	91[a]	61[a]	87[illegible]	38[ba]	62[a]	92[illegible]	32[a]	96[a]
A[5]	28[b]	88[a]	62[a]	52[a]	94[a]	98[a]	99[a]	85[a]	91[a]	94[a]	52[ba]	88[a]	93[a]	50[a]	96[a]
B[6]	43[ba]	57[a]	62[a]	94[a]	97[a]	84[ba]	77[a]	91[a]	96[a]	97[a]	45[ba]	57[a]	92[a]	93[a]	98[a]
C[7]	73[illegible]	78[a]	93[illegible]	60[illegible]	84[a]	97[a]	73[illegible]	85[a]	60[a]	92[illegible]	48[ba]	37[a]	95[illegible]	35[a]	91[a]
A_B	74[illegible]	93[a]	58[illegible]	92[a]	96[a]	99[a]	99[a]	94[a]	98[a]	98[illegible]	40[ba]	96[a]	89[illegible]	98[a]	98[a]
A_C	27[b]	77[a]	78[a]	85[illegible]	98[a]	98[a]	98[a]	96[a]	91[a]	94[a]	50[ba]	92[a]	93[illegible]	37[a]	71a
B_C	62[ba]	45[a]	88[a]	93[illegible]	98[a]	99[a]	80[illegible]	89[illegible]	98[a]	92[illegible]	53[ba]	37[a]	90[illegible]	92[a]	98[a]
A_B_C	37[ba]	62[a]	64[a]	96[illegible]	98[a]	88[ba]	98[illegible]	96[illegible]	98[a]	95[illegible]	63[ba]	63[a]	94[a]	96[a]	98[a]
LSD (α=0.1)	31	35	31	35	14	---	---	---	---	---	---	---	---	---	---

[illegible]

Table 3. Agronomic Effects of Different Tillage Systems and Herbicides in Peanuts – Wiregrass 2015

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A[5]	2758[ba]	4213[ba]	3062[ba]
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C[7]	3584[ba]	3931[ba]	4387[ba]
A_B	2215[b]	4648[ba]	3866[ba]
A_C	4626[ba]	5647[a]	5037[ba]
B_C	4040[ba]	3953[ba]	2824[ba]
A_B_C	4235[ba]	4018[ba]	4583[ba]
LSD (α=0.1)	1354	---	---

[illegible]

DISCUSSION

The results from table 1 show that there is a significant difference in yield between winter fallow plots and plots receiving conventional tillage. Conservation tillage is not significantly different from either. Herbicide input level also has a significant effect on yield with an early PRE and POST application resulting in the most yield. When looking at yield with respect to tillage and herbicide the results are similar with the highest yield coming from plots that had conventional tillage and an early PRE and POST application. Conservation tillage provided comparable yield to conventional tillage in most situations. Winter fallow yield was the most improved by herbicide applications. It is surprising that the highest intensity herbicide application (early PRE, PRE, and POST) did not result in a significantly higher yield in any of the tillage systems used. The amount of weed control provided by conventional tillage was significantly higher than conservation in crabgrass, palmer amaranth, and morningglory. Conservation tillage provided comparable to conservation tillage weed control in sicklepod and nutsedge. Winter fallow was comparable to conservation tillage in palmer amaranth, morningglory, and nutsedge. An early PRE and a PRE at planting resulted in the best weed control from the treatments. Crabgrass, sicklepod, and nutsedge control was statistically uniform, but palmer amaranth control was better with an early PRE. Moringglory control was better with later applications of herbicide. Crabgrass control was poorest under all of the conservation tillage and winterfallow treatments regardless of herbicides used.

ACKNOWLEDGEMENT

Thanks given to the American Peanut Producers of America for funding the project.