Impact of Strip-till planting using Various Cover Crops on Insect Pests and Diseases of Peanuts

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ABSTRACT

A research project is ongoing at the Wiregrass Research and Extension Center in Headland, AL to evaluate the impact of cover crops in a minimum till planting and its effects on insect pests and diseases of peanuts. The tests were conducted in a standard field with a cotton/ peanut rotation and consisted of eight winter cover crop treatments arranged in a randomized complete block design with four replications. The eight treatments were wheat, rye, oats, fallow, ryegrass, wheat/ryegrass, rye/ryegrass, and oats/ryegrass. The first half of each plot (A portion) was treated with Lorsban and the second half of each plot was untreated. Stand counts were made on the third row of each plot, and Tomato Spotted Wilt Virus (TSWV) ratings were made in the two middle rows of each plot. White mold disease ratings were made from the four middle rows (two Lorsban and two untreated rows). Three-cornered Alfalfa Hopper (TCAH) damage was determined from terminal samples taken from these same four rows. Yields were taken from the middle four rows of each plot (A and B). Further testing will be ongoing to study the long term effects of the rotation and its effects on insects, disease, and yield.

KEYWORDS

Conservation tillage, minimum tillage insecticides

INTRODUCTION

Peanuts (*Arachis hypogaea*) are a major crop in the southeastern United States and are very important to the state of Alabama. In 2001, 199,000 acres of peanuts were planted in Alabama yielding an average of 2,750 lbs per acre. Because of their importance to Alabama, some of the biggest challenges facing peanut growers are how to adequately control insects and diseases and how to increase yield. Strip-till planting is a method that is slowly becoming acceptable as an alternative way to plant peanuts. Strip-till planting involves planting peanuts in soil that was planted during the winter with cover crops and planting in the crop debris left on the surface from the cover crops. Strip-till planting is a conservation management system that includes these elements: 1) maintaining crop residue 2) managing better nutrients, 3) getting a good stand and 4) decreasing disease pressure and insects. The benefits of using a strip-till planting method vary from year to year, but in most instances, decreases in disease incidence and insect damage have been observed resulting in increases in yield.

Strip or no-till planting differs from conventional tillage in that conventional tillage refers to the sequence of operations that are most commonly used to prepare a seed-bed and produce a crop (Dickey *et al.,* 1992). Reduced tillage generally refers to any system that is less intensive and less aggressive than conventional tillage and can refer to a number of different systems (Dickey *et al.,* 1992).

One of the results of using a no-till or reduced-till program is the effect that it has on insect populations. Tillage practices have an impact on all types of soil organisms and may affect them either directly or indirectly. It has been observed that insects that spend part of their life cycle in the soil may develop more slowly in a reduced till planting, because the residue from the cover crops can moderate soil temperature (Steffey *et al.,* 1992). Among the various insects that may be affected are corn ear worn, lesser corn-stalk borer, and three cornered alfalfa hopper (TCAH). In addition, tobasso thrips (*Frankliniella fusca*) populations may also be reduced resulting in less tomato spotted wilt virus (TSMV) damage. Tillage practices may also change weed densities that may have an impact on both beneficial insects and insect pests. In addition to tillage practices, crop rotation can have an effect on insect populations.

Another positive impact that occurs from the use of a conservation tillage program is the reduction in diseases that have been observed. Because conservation tillage

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generally reduces soil temperature and conserves soil moisture, they may or may not have any effect on potential severity of the disease. Crop diseases that are favored by cool wet soils may be more of a concern than those that are favored by higher soil temperatures (Scott *et al.,* 1992). Diseases affected by strip-till planting include leaf spot diseases caused by *Cercospora arahidicola* and *Cercosporidium personatum,* white mold (WM) caused by *Sclerotium rolfsii*, and Tomato spotted Wilt Virus (TSWV). Researchers in Georgia have shown that in fields using strip-till planting, there was a 25 percent decrease in leaf spot diseases compared to fields using conventional tillage. There was also less TSWV damage in these same fields (Yancey, 2002).

One of the biggest challenges facing farmers using strip-till planting is getting a good stand. The recommended seeding rate is the same as for conventional tillage of 6 seed per foot of row. When comparing yields using the various planting methods, results seem to vary. In Florida, some conventional fields outperformed strip-till, but at other locations strip-till planted peanuts outperformed conventional tillage (Yancey, 2002). In a previous study conducted in Alabama in 1983 (Hartzog and Adams, 1984), similar results were obtained. In some locations, strip tillage had some effect on yield, while at other locations the conventional tillage fields gave better results.

Because of the variability observed using a strip-till or minimum-till planting, a long-term research project is ongoing to study the effects of crop rotation in a strip-till planted peanut field. The purpose of this study is to look at the long-term results from strip-till peanuts and to determine the effects that this type of planting method has on control of diseases and insects and its subsequent effect on yield, and to establish a consistent pattern in fields where strip-till planting is occurring over many years

MATERIALS AND METHODS

This research project was begun in 2000 at the Wiregrass Research and Extension Center in Headland, AL. Peanuts were planted in a field that was previously planted with cotton and a peanut/cotton rotation was followed. The soil type was a Dothan sandy loam that was conducive to growing peanuts in southeast Alabama. Peanut cultivar ‘Georgia Green’ was used in all plantings, and both in 2000 and 2001 peanuts were planted during the last week of April. Plots were arranged in a randomized complete block design with four replications.

Plots consisted of eight rows 60 feet in length, and eight treatments were involved in the test consisting of various winter cover crops. These included wheat, rye, oats, fallow, ryegrass, wheat/ryegrass, rye/ryegrass, and oats/ryegrass. Peanuts were planted into the plots after these cover crops were killed with herbicide. The plots were divided into subplots with the first four rows of each plot treated with Lorsban and the second four rows of each plot remaining untreated. Plots were maintained throughout the growing season, and all eight rows were treated for diseases following the recommendations of the Alabama Cooperative Extension System.

Approximately two weeks after emergence, stand counts were made from the third row of each plot. Prior to inversion, TSWV counts were made in the two middle rows of each plot. White mold hit counts were made from the four middle rows of each plot-two Lorsban treated rows and two untreated rows. Terminal samples were also taken from these rows to determine TCAH damages which was defined as the number of girdled stems per 25 terminals.

Table 1. Insect and disease data taken from minimum-till peanut test, 2001.

	Disease Ratings		Insect Damage
Forage System	TSWV[†]	White Mold[‡]	TCAH[¶]
Wheat	6.5 a[§]	1.5 a	19.8 a
Rye	2.6 a	3.5 a	20.3 a
Oats	3.9 a	2.5 a	14.3 a
Fallow (no forage)	4.3 a	4.8 a	16.3 a
Ryegrass	2.5 a	2.5 a	15.5 a
Wheat/Ryegras	5.8 a	6.3 a	24.8 a
Rye/Ryegrass	3.3 a	3.8 a	23.5 a
Oats/Ryegrass	2.8 a	6.0 a	15.5 a
$LSD_{0.05}$	5.1	5.3	11.6

[†] TSMV counts were made from the middle two rows of each plot on 8/30/01

[‡] White Mold counts were made on 9/7/01 as the number of disease loci per 120 ft of row (1 locus = 1 ft of consecutive symptoms and signs of the disease).

[¶] 25 terminal samples were taken on 9/6/01 to determine TCAH girdling damage.

[§] Numbers within columns followed by the same letter do not differ significantly according to Fisher’s protected least significant difference at $P = 0.05$.

Plots were inverted, left to dry for two to three days and then combined. Yield results were taken from the middle four rows of each plot and separated into Lorsban and untreated sub plots. All data was analyzed utilizing analysis of variance (SAS, Cary, NC).

RESULTS

Disease and insect ratings that were taken in 2001 (Table 1) from the different plots showed very little differences. None of the plots showed any significant differences in the disease and insect ratings. For TSWV, the number ranged from a low of 2.5 in the ryegrass plots to a high of 6.5 in the wheat plots. White mold results also showed that none of the plots were significantly different from each other even though the wheat plots had fewer hits than the other plots. For TCAH damage none of the plots gave significantly better results, but the numbers from the oats plots were lower than any of the other plots and the numbers from the wheat/ryegrass plots showed the greatest damage. When insect totals were compared for soil insects and foliage feeders during the summer, lowest numbers were observed for soil insects in the rye/ryegrass plots that were significantly different from the ryegrass only plots. For foliage feeders, the lowest numbers were observed in the oats plots and these were significantly different from both the wheat and rye/ryegrass plots (Table 3).

In 1999, yield data was taken from the plots to determine what effects that winter cover crops had on the final results. Yield data taken showed that none of the plots were significantly different from each other and there was very little variation within the plots (Table 2). Even though there was no significance among the plots, the yields taken from the ryegrass plots consistently gave the highest yield totals, and the yields from the oats plots were consistently lower. Yields from the no forage plots decreased each year.

In 2000, a severe drought occurred at the station and throughout the southeast with rainfall totals much below historical means. As a result, yield totals were much lower than the previous year due to the plots being located in a area where no irrigation was available. Even though yield totals were lower than the previous year, significant differences did occur among the plots. Yield totals ranged from a high in the wheat cover of 2093 lbs acre^{-1} to a low in the oats/ryegrass plots of 1095 lbs acre^{-1}.

Yield from the no forage plots were reduced from the previous year and were significantly better than the oats/ ryegrass and significantly less than the wheat plots.

In 2001 rainfall totals returned to more historical averages for the area and this was reflected in the yield results, which were much above totals from both 1999 and 2000. As in the previous year, yield taken from the oats/ ryegrass plots were the lowest observed and the yield from the rye plots gave the highest totals. Overall results from the no forage plots continued to show a decrease in relation to the other plots, but only the rye plots gave significantly higher yields.

In two out of three years, yield results from the rye plots were the highest overall and in 2000 only the wheat plots

Table 2. Peanut yield from minimum-till plots for the 1999 – 2001 crop years**.** Yield were calculated from harvest area of 6 x 60 ft

Forage System	1999	2000	2001
Wheat	3824 a	2093 a	5203 abc
Rye	3842 a	1797 ab	5687a
Oats	2868 a	1249 de	5512 ab
Fallow (no forage)	3884 a	1682 bc	4943 bcd
Ryegrass	3866 a	1615 bc	4737 cd
Wheat/Ryegras	3588 a	1561 bc	5191 abc
Rye/Ryegrass	3860 a	1482 cd	5445 ab
Oats/Ryegrass	3600 a	1095 e	4537 d
$LSD_{0.05}$	1064	305	623

Table 3. Soil insect and foliage feeder counts from minimum-tillage plots during summer 2001.

Forage system	Soil Insects	Foliage Feeders
Wheat	2.25 ab	12.00 a
Rye	1.75 ab	9.75 a
Oats	1.50 ab	3.50 b
Fallow (no forage)	2.50 ab	7.75 ab
Ryegrass	4.25 a	7.00 ab
Wheat/Ryegras	2.00 ab	7.75 ab
Rye/Ryegrass	1.25 b	9.50 a
Oats/Ryegrass	2.00 ab	7.00 ab
$LSD_{0.05}$	3.0	5.3

gave higher results, but they were not significant. In 2001, the yield total for the rye/ryegrass plots was higher than the other plots and was significantly better than the ryegrass plots and the oats/ryegrass plots. After three years of data, results indicate that the no forage plots have declined each year.

DISCUSSION

Minimum tillage practices are gaining popularity in the peanut growing regions of the United States. Research will continue to be done to determine the effectiveness of these practices and whether or not the impact on insect pests and diseases and yield will make it economically feasible for growers. Yields have also varied from year to year and from field to field with no conclusive trend in either direction. In some years conventional tillage has given better results in controlling pests and diseases and in other years minimum tillage fields gave better results.

Because of the inconclusive nature of the previous studies, more work needs to be done to determine the long-term impact that tillage systems have on peanuts. This includes the effects on insects and diseases, but more importantly the impact on yield, which to the grower is the bottom line in any type of system. Studies will be ongoing at the Wiregrass Research and Extension Center to determine the impact of tillage and rotation on long-term peanut production.

LITERATURE CITED

Dickey, E.C., J.C. Siemens, P.J. Jasa, V.L. Hofman, and D.P. Shelton. 1992. pp 6-7. *IN* Conservation Tillage Systems and Management: crop residue with no-toll, ridge-till, and strip-till. 1st ed. MidWest Plan Service, Agricultural and Biosystems Engineering Dept., Iowa State University, 1992.

Hartzog, D. and F. Adams. 1984. Minimum-till Peanuts. Highlights of Agricultural Research. Alabama Agricultural Experiment Station. V. 31 (2) p.13.

Scott, D.H., D.J. Jardine, M.P. McMullen, and E.W. Palm. 1992 . pp 75-82. *IN* Conservation Tillage Systems and Management: crop residue with no-toll, ridge-till, and strip-till. 1st ed. MidWest Plan Service, Agricultural and Biosystems Engineering Dept., Iowa State University, 1992.

Steffey, K., M. Gray, and R. Weinzierl. 1992. pp 67-74.*IN* Conservation Tillage Systems and Management: crop residue with no-toll, ridge-till, and strip-till. 1st ed. MidWest Plan Service, Agricultural and Biosystems Engineering Dept., Iowa State University, 1992.

Yancey, C. H. 2002. Strip-Till. The Peanut Farmer. Feb 2002. pp 6-8.