A REGIONAL STUDY TO EVALUATE TILLAGE, ROW PATTERNS, IN-FURROW INSECTICIDE, AND PLANTING DATE ON THE YIELD, GRADE, AND TOMATO SPOTTED WILT VIRUS INCIDENCE OF THE GEORGIA GREEN PEANUT CULTIVAR

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ABSTRACT

These experiments were conducted to assess the impact of certain University of Georgia tomato spotted wilt (TSWV) Risk Assessment Index components including planting date, tillage, row patterns, and in-furrow insecticide on TSWV severity and peanut yield and grade utilizing the Georgia Green cultivar (Arachis hypogaea L.). Plots were in a Randomized Complete Block split-plot design with four replications. Planting dates were main plots with tillage, row pattern and in-furrow insecticide as split-split-split plots, respectively. The test was conducted at four locations during 1999. Plots were planted in 9.0 inch twin row patterns versus 36 inch single rows at the same seeding rate (6 seed/foot singles or 3 seed/foot twins). The peanuts were planted into a wheat cover crop by strip-tillage or conventional moldboard plow methods. Phorate (Thimet 20-G) was applied in-furrow at planting compared to no in-furrow insecticide.

There were location by tillage and location by planting date interactions so data were analyzed separately by location. Tomato spotted wilt virus incidence was significantly reduced $p \leq 0.05$ by twin row patterns, strip-tillage, and Thimet. Yields were significantly higher in twin rows. Net returns were not significantly different between tillage treatments; however twin rows and Thimet had higher net returns per acre.

INTRODUCTION

As tomato spotted wilt virus (TSWV) continues to be an economically important thrips-transmitted disease, recent research results continue to help producers deal with this problem. No single cultural practice, chemical or resistant cultivar to date has been able to eliminate the effects of the virus. Rather, several cultural practices i.e. cultivar, planting date, seeding rate, row pattern, tillage, and in-furrow insecticide have been identified that can reduce TSWV incidence, and the combination of these has lead to the University of Georgia TSWV Risk Index (Culbreath et al. 1999, Brown, et al. 2001). Several studies have shown that reduced tillage production systems in peanut have been inconsistent when compared to conventional peanuts (Cheshire et al. 1985, Colvin et al. 1988, Hartzog and Adams 1989, Wright and Porter 1995, Williams et al. 1997, Baldwin et al. 1999, Dowler et al. 1999). Other studies have shown there are fewer insect pests and less tomato spotted wilt virus (TSWV) when peanuts are planted by reduced tillage methods versus conventional planting (Brandenburg et al. 1998, Baldwin and Hook 1998).

It has been previously demonstrated that numerous peanut cultivars had improved yield, grade, and reduced TSWV when planted by twin row patterns compared to single rows under conventional or strip- tillage methods (Baldwin et al. 1997, 1998,1999, and McGriff et al. 1999).

Culbreath et al. (1999) have reported the variability of the incidence of TSWV in selected peanut cultivars.

The objective of this study was to assess the impact of certain of the University of Georgia, TSWV Risk Index components including, planting dates, twin and single rows, in-furrow insecticide and strip tillage on TSWV severity and peanut yield and grade. The economic impact of the various components and the utility of using the TSWV Risk Index was also analyzed.

MATERIALS AND METHODS

During 1999, tests were conducted at four locations; The NFREC at Marianna Florida , on a Orangeburg sandy clay loam soil, Auburn University Wiregrass Station, Headland Alabama, on a Norfolk fine sandy loam soil, RDC Pivot, Tifton Georgia, on a Tifton loamy fine sand, and at the Con-Til farm at Waynesboro, Georgia, on a Bonifay fine sand soil. Three planting dates were utilized at each location; early (April 7-8), mid (May 5-6) and late (June 2-3). Wheat was established at each location in the late fall the previous year to provide a cover crop for the strip tillage plots. The conventional areas were winter fallow and harrowed, deep turned, and beds tillovated prior to planting. Plots were replicated four times in a randomized complete block design. Tillage was the main plot with row patterns and in-furrow insecticide as sub-plots. The Georgia Green cultivar was planted by strip-till or conventional methods in either single 36 inch or twin 9.0 inch row patterns. The same seed source was used at all locations and planted at a seeding rate of 6 seed/ft. of row for singles and 3 seed/ft. of row for the twin row pattern. Phorate (Thimet 20-G) was applied in-furrow at 5.0 lb./acre on single rows and 2.5 lb./acre on each twin row compared to no insecticide. The cultural practices were kept as similar as possible i.e. the fungicide program for disease control was two chlorothalonil (Bravo Ultrex) sprays (1.37 lb./acre each) followed by four applications of Folicur (7.2 oz./acre each) to the entire plot area at each location. Spray schedules were appropriate for the three individual planting dates.

One quart/acre of glyphosate (Roundup) herbicide was sprayed prior to planting as a burndown to kill the wheat cover crop in the strip-tillage areas. Other herbicides were utilized and varied by location according to weed species. The same strip-tillage unit (KMC), planter (Monosem vacuum planter), and peanut inverter (KMC with 30 inch cut frogs and 30 inch blades) were used at each location. Some supplemental irrigation was provided at each location but only Tifton had adequate irrigation season long. Plot yields were corrected to 7% moisture and graded according to FSIS standards. The SAS System for Mixed Models (1996) was utilized for statistical analysis.

Yields, grades, and final TSWV incidence levels were collected and net returns to land, quota, and management were calculated using a budget-generator incorporating a multi-tier pricing model. Quota peanuts were priced at $610/ton and additionals were priced at $300/ton with adjustments for quality depending on grade. Any underproduction of quota poundage was considered to be fall transferred at $120/ton. Land and quota rent were not included in this model. Comparisons can be made for net returns for the various components of the TSWV Index.

RESULTS AND DISCUSSION

Several interactions occurred for combined data i.e. Location x Tillage and Location x Planting Date (Table 1). As a result, data were analyzed by Location, and means for yield and

TSWV incidence are found in Table 1. Location and treatment effects for total sound mature kernels (%TSMK) and other kernels (%OK) are in Table 2. Total sound mature kernels is the primary indicator of value of peanuts. The higher the percent meat to hull (grade) the higher the value. Other kernels are valued less as they are the kernels that fall through a 16/64 screen and are generally sold and crushed for oil. The higher the %OK the less valuable the peanut. A greater frequency of %OK also indicates a greater level of immature peanuts. These grade indicators are important in calculating net returns of the crop as affected by various cultural practices and treatments.

When yields are compared at all sites, two locations showed a positive and significant ($p<.05$) yield increase for conventional tillage over strip-tillage (Table 1). The Tifton location had a significant yield increase for strip-tillage ($p<.05$) and %TSMK (Table 2). At Waynesboro, final yields were identical for both tillage treatments when averaged across row pattern, insecticide, and planting dates (Table 1). The strip-tillage plots at the Marianna location received less than one half as much supplemental irrigation as did the conventional plots (4 vs. 9 inches). The irrigation system at Headland was not functional in August, a critical time for pod addition and pod fill and also would have resulted in a differential water pattern and amount across tillage treatments and planting dates. At Waynesboro, it was a dry season and the majority of rainfall occurred late in the season to explain the improvement in yield for the June planting.

All four locations showed significant yield increases ($p<.05$) for the twin row pattern and also significantly reduced TSWV incidence at three of the four locations. Other studies have shown significantly improved %TSMK (grade) when peanuts are planted in twin row patterns. This study showed similar results at three of the four locations (Table 2). Phorate insecticide significantly increased yield at three of the four locations and significantly reduced TSWV at two of the four locations (Table 1).

Table 4 demonstrates the effectiveness of various components of this study to reduce TSWV. Table 5 shows the improvement in yield due to various components of the University of Georgia TSWV Risk Index when applied in this study. The combined components across planting dates are found in Table 6. At three of the four Locations there was a significant reduction in yield with each corresponding percent increase in TSWV incidence. Utilizing GLM ($p<.01$) the resulting yield decreases were -25.2, -36.4, and -21.2 lb./acre for Headland, Marianna, and Tifton respectively. These results have been described in other studies and in general the greater the TSWV incidence the greater the negative effect on yield. The Waynesboro location had low levels of TSWV (Table 1) and no significant yield effects occurred.

ECONOMIC ANALYSIS

One component of the "Index" analyzed in this study was planting date. When comparing the planting dates, early (April 7-8) and mid (May 5-6), the net returns to land, quota and management across all locations and treatments were not statistically different from one another at $387/acre and $367/acre (Table 3). However, both planting dates were significantly different from the late planting date (June 2-3) at $194/acre.

A second component of the "Index" that was analyzed was tillage method. Tillage was added to the 1999 TSWV Risk Index after studies have consistently shown that peanuts grown in strip-tillage systems have less thrips damage and slightly less TSWV. However, for this tillage method an inverse relationship with net returns was found due to the interaction of Location x Tillage among the locations for yield. Conventional tillage produced $91/acre higher net returns than strip-tillage though this difference was not statistically significant (Table 3). Studies have shown that the tillage method chosen can make a difference in peanut yields. As pointed-out in the "Index", strip-tillage has been shown to have some strong advantages including reduced soil erosion and reduced time and labor required for planting, but in some situations yields have been variable. The goal is to have peanut yields in reduced tillage situations be equal to or greater than conventional tillage systems.

A third component of the index is row pattern with twin rows expected to provide lower incidence of TSWV. The average net returns for twin rows was $375/acre compared to $256/acre for single rows, with the difference in net returns statistically significant (Table 3).

The final component of the "Index" in this study was at-plant insecticide. The effect of phorate (Thimet 20-G) was compared to no at-plant insecticide. Phorate has demonstrated consistent, low level suppression of TSWV. The use of phorate adds cost as compared to no at-plant insecticide, but is actually less expensive than some other commonly used insecticides. Comparison of net returns across all locations and planting dates suggests that the cost incurred from phorate is justified. Net returns were $335/acre for the treated versus $296/acre for non-treated with the difference being statistically significant (Table 3).

The net returns associated with the interaction of row pattern and tillage method and the interaction of row pattern, tillage, and at-plant insecticide are found in Table 3. Twin, conventional and Thimet treatments had the highest average net return across planting dates and locations. Table 3 also presents the average net returns across locations by planting dates for the various treatments. The late planting date of June 2-3, 1999 consistently had the lowest average net returns. Surprisingly, the early planting date of April 7-8, 1999 had the highest average net returns across locations for some of the treatments. As mentioned earlier, the average net returns across all locations and treatments were not statistically different for the early and mid planting dates. The planting date effect on peanut TSWV incidence and yield has been one of the harder effects to quantify. However, utilizing the various components in a production system may allow a grower to have more flexibility in planting without adversely affecting net returns.

CONCLUSION

Planting date effect should be further characterized at different latitudes from the Florida Panhandle to Northeast Georgia and in combination with the strip-tillage and twin row components. Tests with these combinations serve as a part of the validation experiments needed to further refine the "Index" and to give producers the information needed to develop profitable production systems. Even within a three state area, subregional differences do occur and influence results. For instance, the optimal planting date may vary across the southeast depending on subregion. The study also shows that the index components, with the exception of tillage method, not only maximize yield but also net returns.

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Table 1. Effect of tillage, row pattern, and in-furrow insecticide on yield and final TSWV incidence at four locations during 1999.

	Headland		Marianna		Tifton		Waynesboro	
Treatment	Yield	TSWV	Yield	TSWV	Yield	TSWV	Yield	TSWV
Tillage								
Conventional	3170 a	14.1 a	3730 a	30.6 b	3945 b	20.4 b	2990 a	5.1 a
Strip Tillage	2630 b	12.3 a	2395 b	11.7 a	4400 a	15.2 a	2990 a	4.8 a
Row Spacing								
Single	2670 b	18.8 b	2860 b	25.0 b	3965 b	21.8 a	2830 b	6.6 b
Twin	3140 a	7.6 a	3260 a	17.3 a	4375 a	13.9 a	3150 a	3.3 a
Insecticide								
No	2890 a	13.3 a	2940 b	24.7 b	4050 b	19.9 a	2900 b	5.8 b
Yes	2915 a	13.0 a	3190 a	17.6 a	4290 a	15.8 a	3075 a	4.2 a
Planting Date								
April	3150 a	15.4 b	3890 a	18.4 a	4290 b	18.5 a	2740 b	2.7 a
May	3250 a	-	2830 b	16.2 a	4790 a	-	2900 b	8.0 b
June	2305 b	10.9 a	2470 b	28.9 b	3430 c	17.2 a	3325 a	4.1 a

Means in a column with a different letter are significant at $P \leq 0.05$.

Table 2. Effect of tillage, row pattern, and in-furrow insecticides on grades at four locations during 1999.

	Headland		Marianna		Tifton		Waynesboro	
Treatment	% TSMK	% OK	% TSMK	% OK	% TSMK	% OK	% TSMK	% OK
Tillage					**	**		
Conventional	71.7 a	5.4 a	72.5 a	6.3 a	73.9 b	4.2 a	70.1 a	7.0 a
Strip Tillage	72.1 a	5.6 a	72.0 a	6.1 a	76.1 a	4.9 b	70.4 a	6.7 a
Row Spacing	*	*	*		**	**		
Single	71.6 b	5.7 b	72.0 b	6.3 a	74.4 b	4.9 b	70.4 a	7.0 a
Twin	72.2 a	5.2 a	72.6 a	6.1 a	75.5 a	4.3 a	70.1 a	6.7 a
Insecticide					**			
No	71.8 a	5.5 a	72.3 a	6.1 a	74.6 b	4.6 a	70.2 a	6.8 a
Yes	71.9 a	5.4 a	73.7 a	6.4 a	75.4 a	4.5 a	70.4 a	6.8 a
Planting Date	**	*	**	**		**	**	**
April	72.2 b	5.8 b	73.7 a	5.6 a	75.1 a	5.8 b	67.3 b	7.4 b
May	73.4 a	4.4 a	73.2 a	5.8 a	74.8 a	4.0 a	69.5 b	7.4 b
June	70.1 b	6.2 b	70.1 b	7.2 b	75.1 a	3.9 a	74.0 a	5.3 a

Means in a column with a different letter are significant at $P \leq 0.05$.
* $P \leq 0.05$
** $P \leq 0.01$

Table 3. Average Net Returns for Various Treatments and Planting Dates Across Locations

Treatment	Across All Planting Dates and Locations	PD 1	PD 2	PD 3
	-- $ net return/acre -----------------------------------			
	386.55 a			
	366.71 a			
	193.71 b			

Table 4. Final TSWV Severity in Regional Planting Date Studies at 4 Locations in Georgia, Florida and Alabama. Average of 8 Tests. 1999.

Comparative Advantage in Reducing TSWV [1/]		
Twins < Singles	Strip < Conventional	Thimet < None
65 times out of 72	33 times out of 34	117 times out of 136

1/ Across 3 planting dates and 4 locations

Table 5. Peanut Yields in Regional Planting Date Studies at 4 Locations in Georgia, Florida and Alabama. Average of 8 Tests. 1999.

Comparative Advantage in Yield Levels [1/]		
Conventionally Tilled	Strip-Tilled	Insecticide
Twins > Singles	Twins > Singles	Thimet > None
12 times out of 12	11 times out of 12	37 times out of 48

1/ Across 3 planting dates and 4 locations

Table 6. Effect of Tillage, Row Pattern and Thimet Insecticide on Final TSWV Severity and Yield with 'Georgia Green' Peanuts. 1999.

Treatment		**Final TSWV** [1/]		**Yield** [1/]	
Row Pattern	**Insecticide**	**Conventional**	**Strip-Till**	**Conventional**	**Strip-Till**
Single	None	19.3	10.6	3125	2877
Single	Thimet	14.7	8.0	3336	2987
Twins	None	11.3	6.3	3521	3264
Twins	Thimet	8.0	4.3	3855	3286

1/ average of 3 planting dates and 4 locations

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INTERPRETIVE SUMMARY

As tomato spotted wilt virus (TSWV) continues to be an economically important thrips-transmitted disease, recent research results continue to help producers deal with this problem. No single cultural practice, chemical or resistant cultivar to date has been able to eliminate the effects of the virus. Rather, several cultural practices i.e. cultivar, planting date, seeding rate, row pattern, tillage, and in-furrow insecticide have been identified that can reduce TSWV incidence, and the combination of these has lead to the University of Georgia TSWV Risk Index (Culbreath et al. 1999, Brown, et al. 2001).

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