EFFECTS OF PLANTING DATE AND TOBACCO GERMPLASM SOURCE ON THE OCCURRENCE OF SPOTTED WILT VIRUS AND ON THE ABUNDANCE OF THRIPS AND TOBACCO APHIDS

TOBACCO SCIENCE

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Field experiments were conducted in Georgia during 1992 and 1993 to evaluate the impact of planting date and tobacco germplasm source on the abundance of thrips, primarily the tobacco thrips *Frankliniella fusca* (Hinds), and the tobacco aphid *Myzus nicotianae* Blackman, and on the incidence of tomato spotted wilt virus caused by thrips vectors. Twelve entries of flue-cured and burley tobacco, *Nicotiana tabacum* L., were planted in mid-April and early May, and they were monitored every 1-2 weeks for the presence of thrips and aphids and for the incidence of spotted wilt. Planting date had inconsistent effects on aphid population densities. More aphids were present in the late-planted tobacco in 1992 and in the early-planted tobacco in 1993. Cool weather in 1992 delayed the aphid population buildups until late in the season. Significant tobacco entry differences were observed. I-514, TI 1396, Polalta, NC 2326, and Kentucky 14 had the highest aphid population densities. Thrips populations were higher in the early-planted tobacco both seasons. K-326, TI 1396, and NC 2326 had higher thrips populations than the other entries. However, thrips population densities were not correlated with incidence of spotted wilt. Some entries with high incidences of spotted wilt (i.e., TI 1406, Tennessee 86, and Kentucky 14) had relatively low thrips populations. Conversely, the lines with suspected spotted wilt resistance (i.e., TI 1223, TI 1396, K-326, and Polalta) had lower incidence of spotted wilt, although thrips populations were relatively high. Planting date did not influence the incidence of spotted wilt among the 12 tobacco entries. Each tobacco entry had a spotted wilt incidence that was similar for both planting dates. There appears to be tobacco germplasm (I-35, TI 1223, TI 1396, TI 1586, and Polalta) that is resistant to tomato spotted wilt virus in the presence of known insect vectors.

Additional key words: *Nicotiana tabacum*, Tomato spotted wilt virus, *Frankliniella fusca*, *Myzus nicotianae*, virus vectors, cultural control, host plant resistance.

INTRODUCTION

Spotted wilt, caused by the tomato spotted wilt virus, is present throughout the tobacco-producing areas of the United States, and it accounts for annual stand and yield losses of 5-8% of flue-cured tobacco, *Nicotiana tabacum* L., in some states (1). This virus is transmitted by several thrips species, including *Frankliniella fusca* (Hinds) (8) and *F. occidentalis* (Pergande) (9). Although 43 species of thrips have been collected from tobacco foliage and blooms in Georgia, over 95% of those identified were from five species (6). *F. fusca* was commonly collected from tobacco foliage throughout the season, and *F. occidentalis* was commonly collected on tobacco blooms. *F. bispinosa* (Morgan), *F. tritici* (Fitch), and *Limothrips cerealium* (Haliday) also were collected routinely (6). Thus, potential spotted wilt vectors are common throughout the growing season in Georgia tobacco (5).

In some instances, intense thrips control practices, such as insecticide applications at transplanting plus weekly foliar insecticide sprays, were reported to reduce thrips population densities and the resultant incidence of spotted wilt (6). However, intensive insecticide applications are costly, and they are not environmentally sound. The date of transplantation affects seasonal population densities of tobacco aphids, *Myzus nicotianae* Blackman (11), tobacco flea beetles, *Epitrix hirtipennis* (Melsheimer) (12), and tobacco budworms, *Heliothis virescens* (F.) (7). However, data are lacking on the impact of using this cultural practice to control the seasonal abundance of thrips on tobacco. Host plant resistance has also been documented as a potential insect pest management technique for

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control of insect pests and diseases (4,13). However, information on the impact of this practice on thrips populations and incidence of spotted wilt also is limited. Therefore, this study was conducted to examine the effects of transplanting date and germplasm source on the abundance of thrips and the incidence of spotted wilt in Georgia tobacco fields. The impact of these two factors on the abundance of the tobacco aphid, another important pest of flue-cured tobacco, also was examined.

MATERIALS AND METHODS

Ten flue-cured and burley tobacco cultivars, breeding lines, and tobacco introductions (TIs) were transplanted in 1992 on 10 April (early planting date) and 29 April (late planting date) at the University of Georgia Coastal Plain Experiment Station, Tifton, Ga. These entries were selected on the basis of preliminary evaluations of spotted wilt incidence in yearly screening tests of tobacco entries. Both suspected resistant and susceptible entries were selected.

Plots were 4 rows wide (1.1-m row spacing) by 6.1-m long (48 plants per plot), and they were arranged in a split plot design with three replications. Planting date was the main plot and tobacco entry was the split plot. In the overall yearly analysis, sampling date (six dates at two-week intervals) was the split-split plot.

All plots were maintained according to recommended production practices of the Georgia Cooperative Extension Service (3), including a pre-plant incorporated tank mix of pebulate (Tillam®) and napropamide (Devrinol®) for weed control, metalaxyl (Ridomil®) for blue mold control, fenamiphos (Nemacur®) for nematode suppression, and chlorpyrifos (Lorsban®) for soil insect control. Fertilizer (6-6-18, N-P-K) was applied at a rate of 1,122 kg/ha in a split application. No foliar insecticides were applied in the test plots.

This field experiment was repeated in 1993 with the same 10 tobacco entries plus two additional entries. They were transplanted on 12 April (early planting date) and 3 May (late planting date) at the Coastal Plain Experiment Station. Plot size, experimental design, and production practices were identical to those in the 1992 test.

All plots were sampled for thrips and tobacco aphid populations every 1-2 weeks beginning in early May and continuing until early July. Live thrips and aphids on plants 2, 4, and 6 on an inside row of each plot were recorded on each sampling date. Thrips were also randomly collected on some dates, returned to the laboratory, mounted on microscope slides, and identified to determine species composition. Type specimens were placed in the insect museum at the Georgia Experiment Station in Griffin, Ga. All plants in each plot were visually examined weekly for symptoms of spotted wilt. Symptomatic plants were flagged and dated, and the percentage of symptomatic plants was determined for each entry. Representative plants expressing symptoms of spotted wilt were confirmed with ELISA (1), using commercially available polyclonal antiserum to the common or "L strain" of tomato spotted wilt (Agdia, Inc., Elkhart, Ind.).

Thrips and aphid count data were transformed to square root (N + 1), and the percent spotted wilt incidence was transformed using the arcsine square root transformation. All data were then analyzed by the GLM procedure of SAS (10). Thrips and aphid data were analyzed separately for each week and overall by combining all weeks, while the spotted wilt data were analyzed for overall effects (total cumulative % incidence for the season). The weekly model contained effects due to planting date (PD), replicate (REP), variety (VAR), PD x VAR, and PD x VAR x REP. The overall yearly analysis included PD, REP, PD x REP, VAR, PD x VAR, PD x VAR x REP (Error-b), week (WK), PD x WK, VAR x WK, PD x VAR x WK, and Error-c. An LSD (P=0.05) was computed to compare varietal means whenever significant varietal effects were detected.

An additional test was conducted in 1993 in a tobacco producer's field near Hazelhurst in Jeff Davis Co., Ga. Treatments consisted of the same 12 varieties used at the Coastal Plain Experiment Station site, and they were transplanted on 29 April. Individual plots were one row by 9.1 meters and were arranged in a randomized complete block design with five replications. All plants were examined for symptoms of spotted wilt every two weeks, beginning in mid-May and continuing until early July (five dates). The final incidence of spotted wilt for each variety was subjected to analysis of variance, and Fisher's protected LSDs were calculated for mean separations.

RESULTS

1992

The seasonal mean population densities of thrips were significantly different among the 10

Table 1. The effects of planting date and tobacco entry (germplasm) on the mean population density of thrips and tobacco aphids and the incidence of tomato spotted wilt virus (TSWV) in Georgia tobacco, 1992.

Planting date	Tobacco entry	Mean insects/plant thrips	Mean insects/plant aphids	Percent TSWV
1 (10 April)	TI 1406	2.1	2.6	14.9
	I-514	1.9	32.8	5.3
	Tennessee 86	1.7	27.5	10.6
	I-35	1.6	0.7	7.0
	TI 1223	1.8	9.3	0.6
	TI 1396	3.8	3.2	2.0
	K-326	8.0	14.1	2.8
	Kentucky Black	2.8	98.1	3.2
	NC 2326	2.6	7.1	1.3
	Kentucky 14	2.4	25.9	11.0
2 (29 April)	TI 1406	0.6	3.3	15.6
	I-514	1.4	169.6	9.1
	Tennessee 86	1.7	40.6	14.6
	I-35	0.7	0.9	6.5
	TI 1223	1.2	10.6	1.9
	TI 1396	1.7	61.2	4.1
	K-326	3.6	117.4	1.9
	Kentucky Black	1.1	11.3	4.7
	NC 2326	2.3	53.0	4.3
	Kentucky 14	1.7	204.2	10.1
LSD (P=0.05)		**1.6**	**NS**	4.8

Statistical Analyses

Planting date effects:	Thrips,	F = 95.60 with 1, 2 df, P = 0.01.
	Aphids,	F = 40.41 with 1, 2 df, P = 0.02.
	TSWV,	F = 2.85 with 1, 2 df, P > 0.05.
Germplasm effects:	Thrips,	F = 4.97 with 9, 18 df, P = 0.01.
	Aphids,	F = 1.76 with 9, 18 df, P > 0.05.
	TSWV,	F = 5.35 with 9, 18 df, P = 0.01.
Sampling date effects:	*Thrips,*	F = 7.72 with 5, 90 df, P = 0.01.
	Aphids,	F = 19.46 with 5, 90 df, P = 0.01.

Table 2. The effects of planting date and tobacco entry (germplasm) on the abundance of thrips on Georgia tobacco, 1992.

Planting date	Tobacco entry	Thrips per three plants 30 April	12 May	18 May	1 June	10June	23 June
1	TI 1406	0.0	6.0	23.0	7.0	0.3	1.7
	I-514	0.0	5.3	19.7	6.3	0.3	1.7
	Tenn. 86	0.3	12.0	9.7	6.7	0.3	1.3
	I-35	0.0	7.0	16.0	3.0	0.0	1.7
	TI 1223	0.3	3.0	16.0	8.7	0.7	3.0
	TI 1396	0.3	7.3	48.0	10.0	0.7	1.3
	K-326	0.3	10.3	113.7	12.0	6.3	1.7
	Ky. Black	0.0	3.0	36.0	8.0	1.0	2.7
	NC 2326	0.3	11.0	25.7	8.3	0.7	1.3
	Ky. 14	0.0	5.3	30.7	4.7	0.7	1.3
2	TI 1406	—	1.7	5.3	0.3	0.3	2.0
	I-514	—	0.7	5.3	7.7	2.0	5.0
	Tenn. 86	—	2.0	4.7	7.0	3.3	8.0
	I-35	—	1.3	4.3	3.3	0.7	1.3
	TI 1223	—	2.7	8.0	6.0	1.0	0.3
	TI 1396	—	0.7	14.3	3.7	2.7	4.7
	K-326	—	6.7	18.0	13.3	12.3	3.7
	Ky. Black	—	1.0	4.3	6.7	2.3	2.0
	NC 2326	—	0.7	14.3	14.0	0.7	4.7
	Ky. 14	—	2.3	5.7	14.3	0.7	2.3
LSD (P=0.05)		**NS**	**NS**	**27.5**	**6.6**	**5.9**	**NS**
Statistical Analyses							
Planting date (PD) effects		—	**	*	NS	NS	NS
Germplasm effects		NS	NS	**	*	*	NS
PD x germplasm effects		—	NS	**	NS	NS	NS

[a] NS indicates no significant difference (P>0.05) on that sampling date, * and ** indicate significant differences at P=0.05 and P=0.01, respectively.

tobacco entries evaluated in 1992 (**Table 1**). K-326 had higher thrips populations than the other entries. Planting date also influenced thrips population densities, with significantly more thrips present in the early-planted tobacco than in the late-planted tobacco. Aphid populations were also affected by planting date, with more aphids in the late-planted tobacco than in the early-planted tobacco, but tobacco entry differences were not significant for aphid populations (**Table 1**). There also were significant sampling date effects for both thrips and aphid populations in 1992.

The overall incidence of spotted wilt was significantly different among the 10 entries, with TI 1406, Tennessee 86, and Kentucky 14 having higher percentages of symptomatic plants than the other entries. Planting date did not influence the incidence of spotted wilt in 1992 (**Table 1**). There was no correlation between seasonal mean thrips populations and percent spotted wilt infection in 1992. The three entries with the highest incidence of spotted wilt had low thrips populations, while K-326 had the highest thrips counts but a low incidence of spotted wilt.

Thrips populations steadily increased during May and peaked in mid-May or early June, 1992 (**Table 2**). There were significantly more thrips on the early-planted tobacco on 12 and 18 May. No other planting date effects were observed. Differences in thrips infestations were detected among entries during the mid-May to mid-June sampling period, when overall thrips populations were higher. Thrips were more numerous on TI 1396 and K-326 than on other entries.

Table 3. The effects of planting date and tobacco entry (germplasm) on the abundance of tobacco aphids on Georgia tobacco, 1992.

Planting date	Tobacco entry	Aphids per three plants: 30 April	12 May	18 May	1 June	10 June	23 June
1	TI 1406	0.0	8.3	0.0	10.3	18.3	10.3
	I-514	0.0	1.0	5.0	27.3	67.0	490.0
	Tenn. 86	0.0	0.7	1.7	12.3	10.0	471.0
	I-35	0.0	0.3	1.0	0.3	1.0	9.7
	TI 1223	0.0	2.3	0.0	0.3	54.0	110.3
	TI 1396	1.0	0.7	1.0	0.3	0.7	54.0
	K-326	0.7	0.7	2.0	10.7	6.7	233.0
	Ky. Black	0.3	0.0	0.0	2.7	115.3	1646.7
	NC 2326	0.7	1.3	1.0	2.7	53.7	68.7
	Ky. 14	0.0	8.3	37.0	4.0	29.0	542.3
2	TI 1406	---	0.3	0.0	4.3	11.3	33.0
	I-514	---	0.0	3.0	73.0	110.7	3205.0
	Tenn. 86	---	0.7	0.3	1.0	69.7	536.7
	I-35	---	0.0	0.0	0.0	1.0	12.3
	TI 1223	---	1.7	0.0	0.0	0.3	157.7
	TI 1396	---	0.7	0.0	5.7	41.7	870.0
	K-326	---	0.3	1.3	15.0	313.3	1431.7
	Ky. Black	---	1.3	0.0	0.3	59.0	108.3
	NC 2326	---	0.0	0.0	0.0	10.3	784.0
	Ky. 14	---	0.3	0.7	3.3	177.0	2881.7
LSD (P=0.05)		---	**NS**	**NS**	**8.8**	**NS**	**677.6**

Statistical Analyses

	30 April	12 May	18 May	1 June	10 June	23 June
Planting date (PD) effects	---	NS	NS	NS	NS	*
Germplasm effects	NS	NS	NS	**	NS	*
PD x germplasm effects	---	NS	NS	NS	NS	NS

[a] NS indicates no significant difference (P>0.05) on that sampling date, * and ** indicate significant differences at P=0.05 and P=0.01, respectively.

Aphid populations steadily increased in all plots from late April until late June (**Table 3**). At that time, plants were topped (removal of the apical meristem and floral structures) and a fatty-alcohol sucker control agent was applied. The only significant planting date differences in aphid population levels occurred on 23 June, at the aphid population peak. At that time, there were more aphids in the late-planted tobacco. There were significant tobacco entry differences in aphid densities on 1 and 23 June, with higher aphid densities on I-514, TI 1396, K-326, Kentucky Black, and Kentucky 14.

1993

Thrips populations were lower in 1993 than in 1992 (**Table 4**). There were no planting date effects in 1993, but tobacco entry influenced thrips populations. Aphid population densities also were lower in 1993 (**Table 4**). Planting date significantly affected aphid populations, with higher population densities in the early-planted tobacco. This was opposite to the results of 1992. The tobacco entry also influenced aphid population levels. As in 1992, the 1993 abundance of thrips and aphids also was influenced by sampling date.

The spotted wilt results in 1993 were similar to the 1992 data, with no planting date effect but with differences among tobacco entries (**Table 4**). The entries TI 1406 and Tennessee 86 had the highest incidence of spotted wilt both

Table 4. The effects of planting date and tobacco entry (germplasm) on the mean population density of thrips and aphids, and the incidence of tomato spotted wilt virus (TSWV 1, Tift Co.; TSWV 2, Jeff Davis Co.) in Georgia tobacco, 1993.

Planting date	Tobacco entry	Mean insects/plant: thrips	aphids	% TSWV: 1	2
1 (12 April)	TI 1406	0.3	2.2	7.4	---
	I-514	1.1	21.6	2.8	---
	Tenn. 86	0.8	3.5	4.6	---
	I-35	0.4	1.7	0.8	---
	TI 1223	1.1	1.9	0.7	---
	TI 1396	1.8	40.7	2.7	---
	TI 1586	0.3	2.3	0.7	---
	Ky. Black	1.1	42.9	2.7	---
	Polalta	1.1	33.1	0.0	---
	NC 2326	2.9	27.8	4.4	---
	Ky. 14	0.9	33.5	4.1	---
	K-326	2.5	5.1	1.3	---
2 (3 May)	TI 1406	0.3	5.5	9.8	36.2
	I-514	0.8	20.6	1.9	14.3
	Tenn. 86	0.6	1.2	5.7	21.1
	I-35	0.2	5.0	2.0	9.0
	TI 1223	0.3	1.4	0.7	1.1
	TI 1396	0.2	15.4	0.0	2.2
	TI 1586	0.2	1.8	1.1	1.7
	Ky. Black	0.7	1.8	3.4	19.3
	Polalta	1.3	7.9	0.7	5.8
	NC 2326	0.9	15.7	3.2	31.8
	Ky. 14	0.6	13.4	3.1	17.8
	K-326	1.1	1.9	3.7	18.7
LSD (P=0.05)		**0.3**	**8.2**	**2.4**	**14.3**

Statistical Analyses

Planting date effects: Thrips, F = 4.34 with 1, 2 df, P > 0.05.
Aphids, F = 11.05 with 1, 2 df, P = 0.03.
TSWV 1, F = 4.12 with 1, 2 df, P = 0.05.

Germplasm effects: Thrips, F = 2.06 with 11, 44 df, P = 0.04.
Aphids, F = 2.61 with 11, 44 df, P = 0.01.
TSWV 1, F = 2.01 with 11, 44 df, P = 0.05.
TSWV 2, F = 5.32 with 11, 44 df, P = 0.01.

Sampling date effects: Thrips, F = 4.56 with 5, 132 df, P = 0.01.
Aphids, F = 16.34 with 5, 132 df, P = 0.01.

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Table 5. The effects of planting date and tobacco entry (germplasm) on the seasonal abundance of thrips on Georgia tobacco, 1993.

Planting date	Tobacco entry	Thrips per three plants					
		6 May	19 May	2 June	16 June	22 June	7 July
1	TI 1406	0.0	0.9	3.0	0.0	0.0	---
	I-514	0.9	9.9	1.8	0.0	3.0	---
	Tenn. 86	3.0	4.8	3.0	0.0	0.9	---
	I-35	1.8	0.9	3.0	0.0	0.0	---
	TI 1223	1.8	9.9	1.8	0.0	3.0	---
	TI 1396	0.0	16.8	9.9	1.8	0.0	---
	TI 1586	0.0	1.8	0.0	0.0	1.8	---
	Ky. Black	1.8	9.9	0.9	0.0	3.0	---
	Polalta	0.9	6.0	3.9	0.9	4.8	---
	NC 2326	6.0	15.9	6.9	9.0	6.0	---
	Ky. 14	1.8	4.8	6.0	0.0	0.0	---
	K-326	3.0	12.0	16.8	6.0	0.0	---
2	TI 1406	3.0	0.9	0.9	0.0	0.0	0.0
	I-514	0.0	1.8	6.0	3.0	0.9	3.9
	Tenn. 86	3.0	0.9	0.9	4.8	0.0	1.8
	I-35	0.0	0.0	3.9	0.0	0.0	0.0
	TI 1223	0.0	0.9	3.0	0.0	0.9	0.0
	TI 1396	1.8	0.0	0.0	1.8	0.0	0.0
	TI 1586	0.0	0.0	3.9	0.0	0.0	0.0
	Ky. Black	0.9	0.9	0.9	6.9	0.0	3.0
	Polalta	3.0	0.9	9.9	3.9	4.8	0.0
	NC 2326	0.9	0.9	3.9	4.8	4.8	0.9
	Ky. 14	0.9	3.0	6.0	0.0	0.0	0.0
	K-326	6.0	1.8	3.0	4.8	1.8	0.0
LSD (P=0.05)		**1.5**	**NS**	**NS**	**NS**	**1.8**	**NS**

Statistical Analyses

Planting date (PD) effects	NS	**	NS	NS	NS	---
Germplasm effects	**	NS	NS	NS	*	NS
PD x germplasm effects	NS	NS	NS	NS	NS	---

[a] *NS indicates no significant differences (P>0.05) on that sampling date,* and ** indicate significant differences at P=0.05 and P=0.01, respectively.*

Table 6. The effects of planting date and tobacco entry (germplasm) on the seasonal abundance of aphids on Georgia tobacco, 1993.

Planting date	Tobacco entry	Aphids per three plants					
		6 May	19 May	2 June	16 June	22 June	7 July
1	TI 1406	0.0	0.0	1.3	30.0	2.0	---
	I-514	0.3	72.6	34.3	8.0	208.6	---
	Tenn. 86	0.6	25.6	3.0	0.3	23.6	---
	I-35	0.6	12.0	6.0	0.0	6.3	---
	TI 1223	0.0	6.0	13.3	0.0	9.0	---
	TI 1396	0.0	21.3	47.0	365.0	177.8	---
	TI 1586	0.0	20.0	11.3	3.0	0.8	---
	Ky. Black	9.6	595.3	12.3	2.0	23.6	---
	Polalta	0.3	45.0	6.3	130.6	274.9	---
	NC 2326	1.3	27.6	120.3	120.0	65.6	---
	Ky. 14	0.0	8.6	9.0	245.0	239.3	---
	K-326	0.0	69.6	2.0	0.0	5.3	---
2	TI 1406	0.3	0.0	10.3	0.0	30.6	58.3
	I-514	0.0	0.0	0.6	0.0	25.3	345.3
	Tenn. 86	0.0	0.6	2.3	6.6	5.3	7.0
	I-35	0.0	0.0	0.0	0.3	4.0	85.3
	TI 1223	0.0	1.3	0.0	0.3	1.6	21.6
	TI 1396	0.0	3.0	33.6	87.6	42.3	110.3
	TI 1586	0.0	0.0	3.3	0.0	5.6	23.3
	Ky. Black	0.0	0.0	1.6	15.6	7.3	7.0
	Polalta	0.3	0.3	8.3	26.6	47.6	59.6
	NC 2326	0.0	0.3	0.0	15.5	11.1	255.3
	Ky. 14	0.3	0.0	30.3	10.0	10.5	189.3
	K-326	0.0	0.0	2.3	16.6	9.0	5.6
LSD (P=0.05)		**NS**	**NS**	**NS**	**47.0**	**201.6**	**206.4**

Statistical Analyses

Planting date (PD) effects	*	**	*	**	**	---
Germplasm effects	NS	NS	NS	**	**	*
PD x germplasm effects	*	NS	NS	**	NS	---

[a] *NS indicates no significant differences (P>0.05) on that sampling date,* and ** indicate significant differences at P=0.05 and P=0.01, respectively.*

seasons, while TI 1223 was low both years. The final incidence of spotted wilt at the Jeff Davis County site was much higher than at the Coastal Plain Experiment Station. TI 1406, NC 2326, and Tennessee 86 had the highest levels of spotted wilt. TI 1223, TI 1586, and TI 1396 had the lowest incidences of spotted wilt (**Table 4**).

The only significant planting date effect on thrips population densities in 1993 occurred on 19 May, when thrips populations on the early-planted tobacco peaked while populations were still low in the late-planted tobacco (**Table 5**). Germplasm differences in thrips populations were detected on 6 May and 22 June, with higher thrips populations on TI 1396, NC 2326, and K-326.

In 1993, there were significantly more tobacco aphids on the early-planted tobacco than on the late-planted tobacco for the five sampling dates when comparisons were made (**Table 6**). Germplasm differences also were detected on the last three sampling dates when aphid populations were highest. I-514, TI 1396, Polalta, NC 2326, and Kentucky 14 had higher aphid population densities than the other entries.

DISCUSSION

The population densities of thrips, primarily *F. fusca*, varied greatly among the 12 tobacco entries evaluated in this study. K-326, TI 1396,

Tobacco Science, 1995, 39-5, p. 23-29, ISSN. 0082-4523.pdf

and NC 2326 usually had higher thrips populations than the other entries. Thrips population densities steadily increased during April and early May, and peaked in mid-May to early June. Thrips populations were not correlated with spotted wilt incidence. Some entries with high incidences of spotted wilt (i.e., TI 1406, Tennessee 86, and Kentucky 14) had relatively low thrips populations. This indicates that the susceptible lines probably became infected with spotted wilt when low population densities of thrips were present. Conversely, the more resistant lines (i.e., TI 1223, TI 1396, and Polalta) had low incidences of spotted wilt although thrips populations on them were relatively high. This demonstrates the innate ability of certain tobacco germplasm to resist virus infections in the presence of known insect vectors. These results corroborate previous reports on peanuts, in which differences in incidence of spotted wilt among cultivars occurred when thrips populations on them were similar (2).

Peak thrips populations were higher in the early-planted tobacco during both seasons. Modification of planting date might be utilized in an integrated pest management program to alter the seasonal abundance of thrips. Delaying the planting by a couple of weeks could reduce the overall population of thrips. Unfortunately, this delayed planting did not reduce the incidence of spotted wilt among the 12 tobacco entries examined in this study. Each tobacco entry had a virus infection rate that was similar for both the mid-April and early May plantings.

Season-long aphid populations were higher in the late-planted tobacco in 1992 and higher in the early-planted tobacco in 1993. This demonstrates the complex interactions that can occur between environmental conditions, production practices, and insect behavior. Aphid populations continued to rise on the more susceptible lines until topping time. This was similar to what was reported by McPherson (5) on NC 2326 flue-cured tobacco. Although tobacco aphids are not known to contribute to transmission of spotted wilt, high aphid populations may affect host plant selection or influence transmissibility of spotted wilt by thrips. However, an interaction between aphids and transmission of spotted wilt was probably not a factor in this study, because high aphid populations were not usually present until after the thrips population densities on tobacco foliage were declining and after most of the symptomatic plants had been observed.

The use of tobacco cultivars resistant to spotted wilt could be an effective, economical, and environmentally sound production practice that would improve integrated pest management programs in tobacco in the United States. Continued research is needed to better understand the resistance mechanisms involved and to improve the agronomic desirability of the resistant germplasm that is available.

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