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COLLEGE OF AGRICULTURAL & ENVIRONMENTAL SCIENCES

Tobacco Research Report

2007

2007 TOBACCO RESEARCH REPORT

(Summary Report of 2007 Data)

Edited by
Stephen W. Mullis

Tobacco Research Team

Alex Csinos	Plant Pathologist	229-386-3373	csinos@uga.edu
Stan Diffie	Research Coordinator	229-386-3086	diffie@uga.edu
Ron Gitaitis	Plant Pathologist	229-386-3157	dronion@uga.edu
Unessee Hargett	Research Coordinator	229-386-3370	uhargett@uga.edu
Don Hickey	Farm Supervisor	229-392-3729	dmhickey@uga.edu
Lara Lee Hickman	Research Professional	229-386-3370	hickman@uga.edu
Stevan S. LaHue	Senior Ag Specialist	229-388-6492	slahue@uga.edu
Robert McPherson	Entomologist	229-386-7141	pherson@uga.edu
J. Michael Moore	Extension Agronomist	229-386-3006	jmmoore@uga.edu
Lewis Mullis	Research Professional	229-386-5436	klmullis@uga.edu
Stephen Mullis	Research Professional	229-386-7230	swmullis@uga.edu
Neal Roberson	Research Assistant III	229-386-3086	nroberso@uga.edu
John Ruberson	Entomologist	229-386-3086	ruberson@uga.edu
Michael Stephenson	Research Coordinator	229-386-3167	cropstob@uga.edu
Del Taylor	Research Assistant III	229-386-3086	delano@uga.edu
C. Ed Troxell	Farm Supervisor	229-386-3958	etroxell@uga.edu

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Foreword

Tobacco production in Georgia has changed dramatically during the past five years. Contracting of tobacco directly with growers by tobacco companies has replaced the tobacco auction system. Many growers have accepted the "buy-out" and have either stopped growing tobacco or now are contracting directly with tobacco companies.

The number of growers is fewer, but individual growers are managing larger tobacco crops in an effort to maximize efficiency of operation.

This report contains research that evaluates disease and insect management programs, and new cultivars for agronomic aspects of tobacco production in Georgia. Tobacco research and extension at the University of Georgia College of Agricultural and Environmental Sciences is part of a regional effort with tobacco growing states and North Carolina State University, University of Kentucky, University of Florida and Clemson University. This cooperative effort in conjunction with financial support from the Tobacco Commission and industry provides science-based recommendations to enhance the profitability and environmental sustainability of production.

Robert N. Shulstad
Associate Dean for Research
College of Agricultural and Environmental Sciences
University of Georgia

Flue-Cured Tobacco Variety Evaluation in Georgia

M.G. Stephenson, S.S. LaHue, and J.M. Moore

Introduction

Tobacco varieties play a pivotal role in yield and quality improvement programs. Moreover, a vital part of any breeding program is the appropriate testing and evaluation of new tobacco varieties. Important characteristics of these varieties are yield, disease resistance, desirable plant qualities, ease of handling, and market acceptability. For a variety to be recommended it must be superlative in one or more and contain a balance of the remainder of the factors. For instance, for a variety to have an excellent yield and poor disease resistance or to yield well and have poor cured quality is undesirable.

As a result, the Regional Variety Test is conducted to obtain data on yield, disease resistance, quality as judged by physical appearance, and chemical analysis for quality characteristics. Once this information is analyzed, the desirable varieties and breeding lines in these tests advance to the Official Variety Test for further evaluation under growing and marketing conditions in Georgia.

As in previous years, we have included the Regional Farm Test so that when varieties are selected from this test the University of Georgia Cooperative Extension will have a second data set to use in making recommendations to growers.

Materials and Methods

The 2007 Official Variety Test and Regional Small Plot Test consisted of 28 and 32 entries, respectively, while the Farm Test had 15 entries. These tests were conducted at the University of Georgia Bowen Farm on Ocilla loamy coarse sand. All transplants were treated with the low labeled rate of Actigard and Admire for *Tomato spotted wilt virus* (TSWV) and followed with a field spray of Actigard applied at the recommended rate at the first sign of TSWV symptoms in non-treated border rows. The test was mechanically transplanted on 4 April with 22 plants per field plot and replicated three times. Fertilization consisted of 500 lbs./acre of 6-6-18 at first cultivation, 500 lbs./acre 6-6-18 at second cultivation, and an additional 150 lbs./acre of 14-0-14 at lay-by for a total of 81 lbs./acre of nitrogen. Cultural practices, harvesting, and curing procedures were uniformly applied and followed the current University of Georgia recommendations. Data collected included plant stand, yield in lbs./A, value/A in dollars, dollars per hundred weight, grade index, number of leaves/plant, plant height in inches, and days to flower. In addition, leaf chemical determinations consisted of total alkaloids, total soluble sugars, and the ratio of sugar to total alkaloids.

Results and Discussion

The 2007 Official Variety and Farm Test produced excellent yields and good quality even through dry conditions from March to June. Unfortunately, labor time constraints for harvest hurt cured quality. However, the test benefited from the application of Telone II, at the recommended rate, in October 2006 with good soil conditions, which kept nematode pressure to a minimum. In addition, a field spray of Actigard was applied at the recommended rate at the first visible symptoms of TSWV on non-treated border rows. A second field spray of Actigard at the same rate was applied one week later. As a result, the non-treated check had 39 percent TSWV, compared to less than six percent TSWV in the areas that received the standard greenhouse treatments of Actigard/Admire plus the field sprays of Actigard. Ten irrigations supplied more than seven inches of water per acre from 4 March through 10 June. Even with uniform irrigation and unusually persistent east winds, the test had some variability west to east due to the east side being slightly drier.

In the Official Variety test, yield ranged from 2,332 lbs./A for NC 2326 to 3,514 lbs./A for CC 27. Value ranged from $2,277/A for NC 2326 to $4,237/A for K 326. Speight 225 at $92/CWT had the lowest price, while Speight 236 at $126 had the best price per CWT. Grade index ranged from 58 for Speight 225 to 74 for K 326. Plant heights averaged above the middle 30s, while leaf numbers were close to 20. All flowering dates averaged a week or so beyond NC 2326, which was at 63 days. Leaf chemistry was good, with sugars averaging in the middle to upper teens and alkaloids at or below 3.0. The Official Variety test data are displayed in Table 1. Two and three averages

for selected varieties are found in Table 2. The Farm test (Table 3) followed the same trend as the Official Variety test, with NC 2326 having the lowest yield. RX 576 yielded the highest at 3,280 lbs./A and had the highest value at $4,127/A. AOV 506 graded the best, bringing in $129/CWT and having a grade index of 75. Leaf chemistry followed the same general trend as the Official Variety test, with sugars in the mid- to high teens and alkaloids around three.

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The authors would like to thank the Georgia Agricultural Commodity Commission for Tobacco for financial support, and Wesley Stephens, Melissa Knape, Heather Hilton, Nathan Hill, Barry Luke, and Jim White for technical assistance.

Table 1. Yield, Value, Price Index, Grade Index, and Agronomic Characteristics of Released Varieties Evaluated in the 2007 Official Flue-Cured Variety Test at the University of Georgia, Tifton, Ga.

Variety	Yield lb./A	Value $/A	Price[1] Index $/CWT	Grade[2] Index	Leaves/ Plant	Plant Height Inches	Days to Flower	Total Alkaloid %	Reducing Sugar %	Ratio TS/TA
NC 2326	2332	2277	100	62	16	34.8	63	3.63	15.4	4.0
NC 95	3227	2939	93	60	19	41.1	68	3.49	15.7	4.5
K 326	3494	4237	121	74	18	35.7	68	2.50	17.4	7.1
K 346	2629	2999	113	69	20	33.1	65	3.67	12.1	3.3
NC 71	2753	3290	116	69	20	35.8	73	3.03	13.4	4.4
NC 72	2703	2776	103	64	18	34.1	70	3.25	15.4	4.7
NC 297	3185	3809	120	70	20	36.3	70	2.33	18.6	8.0
NC 55	2635	3049	114	69	20	34.4	72	3.24	16.4	5.1
NC 291	2733	2819	104	64	19	34.4	70	2.84	16.9	5.9
NC 196	2987	3614	121	71	21	36.7	72	2.94	16.6	5.7
NC 102	2497	2754	110	67	18	32.4	73	3.36	13.6	4.0
NC 299	2938	3608	123	73	20	34.8	71	2.69	17.7	6.6
GL 350	2756	3204	117	72	19	32.6	65	2.71	17.0	6.3
CC 13	2924	3617	124	73	19	33.5	71	2.88	16.7	5.8
CC 700	2997	3506	116	70	20	33.0	69	3.20	13.9	4.3
CC 27	3514	3999	114	69	21	37.9	68	2.79	16.5	5.9
CC 37	3444	3909	114	69	20	36.2	71	2.96	13.6	4.6
Speight H20	3457	4091	119	71	21	36.1	65	2.86	16.6	5.8
Speight 210	3044	3774	124	73	19	35.2	70	2.95	16.4	5.6
Speight 220	2787	3284	118	70	20	37.6	72	3.58	12.9	3.6
Speight 225	2936	2748	92	58	19	33.3	69	2.86	13.0	4.6
Speight 227	3176	3229	103	66	21	37.0	71	2.86	14.3	5.0
Speight 234	3243	3648	109	67	19	35.5	72	3.65	10.9	3.0
Speight 168	3003	3692	123	73	19	35.2	72	2.62	17.0	6.5
Speight 236	3240	4079	126	73	20	38.0	73	3.16	14.5	4.6
PVH 1118	3203	3823	119	73	19	36.3	68	3.57	12.7	3.6
PVF 1409	3103	3368	108	67	20	34.7	69	3.48	13.8	4.0
PVH 1452	3195	3731	117	71	21	37.3	70	3.39	12.9	3.8
CH 1[3]	3051	3361	111	68	20	35.1	69	2.74	16.8	6.1
CH 3[3]	3271	3936	120	70	21	36.8	69	2.39	18.2	7.6
LK 1[3]	3226	3172	98	63	21	35.9	69	3.55	13.1	3.7
LSD @ 0.05	721.2	1026.9	18	9.1						

[1]Price Index based on two-year average (2006-2007) prices for U.S. government grades.
[2]Numerical values ranging from 1-99 for flue-cured tobacco based on equivalent government grades - higher the number, higher the grade.
[3] Non-released varieties.

Table 2. Comparison of Certain Characteristics for Released Varieties Evaluated in the 2007 Official Flue-Cured Tobacco Variety Test at the University of Georgia, Tifton, Ga.

Variety	Yield lb./A	Value $/A	Price[1] Index $/CWT	Grade[2] Index	Leaves/ Plant	Plant Height Inches	Days to Flower	Total Alkaloid %	Reducing Sugar %	Ratio TS/TA
Three Year Average 2004 / 2006 / 2007										
NC 2326	2241	2323	103	55	17	33.5	65	3.8	12.1	3.3
NC 95	3179	3067	98	55	19	37.8	72	3.7	13.5	3.7
K 326	3273	4002	123	64	18	33.9	75	2.9	15.0	5.6
K 346	2425	3124	130	58	20	35.0	74	3.3	11.5	3.5
NC 71	2820	3461	119	62	19	34.0	78	3.0	13.6	4.5
Three Year Average 2004 / 2006 / 2007										
NC 72	2887	3068	109	60	18	33.1	78	3.3	11.9	4.0
NC 196	2351	2799	122	63	19	25.2	79	3.0	14.8	5.0
NC 102	2194	2571	114	60	19	32.1	79	3.2	13.0	4.0
NC 297	3161	3915	125	62	20	35.3	78	3.1	15.3	5.3
NC 55	2428	2865	118	70	19	31.2	78	3.3	13.9	4.2
NC 291	2676	2694	104	60	20	35.3	78	3.3	13.6	4.2
GL 350	2558	3020	119	63	19	33.8	75	2.9	14.0	4.9
CC 27	2853	3277	116	62	20	35.3	77	3.1	12.2	4.0
Speight H20	3067	3660	121	62	20	36.1	75	3.3	13.4	4.0
Speight 210	2960	3580	120	61	19	33.5	76	3.3	14.8	4.6
Speight 225	2417	2572	107	56	19	33.7	76	3.0	11.5	3.8
Speight 227	2712	2907	108	58	19	34.2	78	3.1	13.6	4.5
Speight 168	2541	2889	109	60	19	33.5	78	3.0	13.1	4.7
Speight 220	2798	2984	107	57	19	34.3	79	3.4	12.6	3.7
Two Year Average 2006 & 2007										
NC 2326	2012	1928	96	62	16	33.1	66	3.6	14.0	3.8
NC 95	3400	3369	101	66	21	39.4	74	3.6	14.9	4.2
K 346	2529	2799	110	54	20	34.8	68	3.3	11.5	3.6
K 326	3368	3868	115	73	19	33.3	77	3.1	15.4	5.4
NC 71	2953	3519	117	72	20	33.5	80	3.2	13.5	4.3
NC 72	3266	3146	98	67	19	33.6	79	3.2	14.8	4.6
NC 297	3449	4181	122	73	20	34.3	78	2.9	17.7	6.4
NC 299	3045	3656	121	74	21	34.3	78	2.9	17.0	5.9
NC 55	2776	3395	121	74	20	33.0	80	3.3	15.4	4.7
NC 291	2909	2934	102	67	20	34.1	79	3.2	16.1	5.2
NC 196	2723	3172	118	72	20	33.7	80	2.9	16.9	5.8
NC 102	2255	2521	110	70	19	32.0	81	3.5	13.7	3.9
GL 350	2636	2983	115	72	19	31.9	76	3.0	15.4	5.2
CC 13	3202	3753	118	73	19	31.7	80	3.3	14.5	4.6
CC 27	3428	3927	115	72	21	35.2	78	3.2	14.6	4.7
CC 700	2973	3692	124	73	20	32.6	78	3.0	14.7	4.8
CH 1[3]	3225	3379	107	70	20	32.9	77	2.8	16.6	5.9
CH 3[3]	3368	3991	119	73	21	36.3	78	2.7	17.3	6.6
Speight H20	3322	3759	113	71	20	34.6	76	3.2	15.2	4.8
Speight 210	3153	3658	116	72	19	31.8	78	3.3	15.9	4.9
Speight 236	3116	3932	125	73	19	34.5	81	3.0	13.2	4.4
Speight 225	2635	2679	101	64	19	32.1	79	3.1	13.4	4.4
Speight 234	3153	3412	106	69	19	33.2	80	3.6	12.6	3.5
Speight 227	3005	3183	107	69	20	34.5	80	2.8	12.7	5.6
Speight 168	2991	3621	120	72	19	33.9	80	2.9	16.5	5.8
Speight 220	2724	2891	106	68	20	34.4	80	3.5	13.7	4.0

[1]Price Index based on two-year average (2006-2007) prices for U.S. government grades.

[2]Numerical values ranging from 1-99 for flue-cured tobacco based on equivalent grades - higher the number, higher the grade.

[3]Non-released Variety.

Researched by Stevan S. LaHue and M. G. Stephenson; supported by grants from the Georgia Tobacco Commission.

Table 3. Yield, Value, Price Index, Grade Index, and Agronomic Characteristics of Released Varieties Evaluated in the 2007 Farm Test at the University of Georgia, Tifton, Ga.

Variety	Yield lb./A	Value $/A	Price[1] Index $/CWT	Grade[2] Index	Leaves/ Plant	Plant Height Inches	Days to Flower	Total Alkaloid %	Reducing Sugar %	Ratio TS/TA
NC 2326	2332	2277	100	62	16	34.8	63	3.63	14.5	4.0
NC 95	3227	2939	93	60	19	41.1	68	3.49	15.7	4.5
AOV 506	2914	3722	129	75	19	38.7	73	2.92	14.7	5.0
RX 576	3280	4127	126	72	18	35.1	67	3.26	15.6	4.8
NC EX 04	2627	3256	124	71	19	38.3	72	3.01	17.7	5.9
CC 65	3065	3066	100	58	17	38.1	71	3.68	13.5	3.7
GF 52	2444	2798	115	68	18	36.7	73	3.58	13.9	3.9
NC EX 02	2780	3358	121	73	18	36.6	71	3.12	17.8	5.7
RJR 15	2920	2856	97	59	18	38.3	72	3.53	13.8	3.9
ULT 138	2505	3151	126	74	18	36.7	69	2.83	16.0	5.6
Speight 241	2066	2471	117	72	18	34.7	76	2.87	15.2	5.3
ULT 109	3254	4094	126	73	20	36.7	72	3.21	13.9	4.3
NC TG 146	2917	3548	122	73	19	35.9	64	3.45	13.6	3.9
RJR 35	2852	2806	99	63	20	41.5	74	3.23	15.0	4.6
CU 37	2744	2607	95	60	19	34.9	69	3.62	13.8	3.8
LSD @0.05	636.5	762.6	16.8	7.8						

Conducted on an Ocilla loamy sand soil fertilized with 1,000 lbs./A of 6-6-18 and 150 lbs./A 14-0-14 with plants spaced 20-22 inches apart in 44-inch rows.
[1]Price Index based on two-year average (2006-2007) prices for U.S. government grades.
[2]Numerical values ranging from 1-99 for flue-cured tobacco based on equivalent grades - higher the number, higher the grade.
Researched by Stevan S. LaHue and M. G. Stephenson; supported by grants from the Georgia Tobacco Commission.

2007 Regional Small Plot - Black Shank Evaluation
Black Shank Farm, Tifton, Ga.

A.S. Csinos, L. Mullis, and L.L. Hickman

Introduction

Tobacco Black Shank continues to be a persistent and serious root and stem disease of tobacco. In this study, several tobacco cultivars with monogenic resistance to Race 0 of Black Shank and cultivars with polygenic resistance (Fl.301) were evaluated in the disease nursery, which has a mixture of Race 0 and Race 1 of the pathogen.

Methods and Materials

The study was located at the University of Georgia's Black Shank Farm, Tifton, Ga., in a field with a continuous history of Black Shank in tobacco. The plot design was a randomized complete block consisting of single row plots and it was replicated three times. Each plot was 32 feet long with an average of 23 plants per test plot.

On 1 February, 37 tobacco varieties were seeded in greenhouse in 242 cell flats.

2007 Field Evaluation Varieties:

AOV 405	CU 67	NC EX 06	RJR 63
CH 1	CU 347	NC EX 07	RJR 75
CH 3	GF 318	NC EX 08	RJR 138
CC 68	K 326	NC EX 09	RJR 338
CC 305	K 346	NC TG 148	RJR 620
CC 307	LK 1	NC TG 149	RX 627
CC 638	NC 71	NC TG 150	RX 634
CU 23	NC 95	NC TG 152	ULT 111
CU 42	NC 2326	OX 2047	1071
CU 65			

The field was prepared on 22 February by disc harrowing the area. Fertilizer 4-8-12 at 500lbs./A was broadcast in plot areas and tilled in on 15 March. On 20 March, applications of Prowl 3.3 at 2.0 pts./A, Lorsban 4E at 3 qt./A, Nemacur 3 at 2 gal./A were tilled into the plot area. Plots were sub-soiled and bedded on 20 March.

Tobacco transplants were treated in the greenhouse on 6 April with Admire Pro at 1 fl.oz./1,000 plants and Actigard 50WG at 4 grams/7,000 plants. Both materials were tank mixed. Plants were pre-wet with materials being washed in after spraying.

Tobacco was transplanted on 7 April on 48-inch-wide rows with an 18-inch plant spacing. Cultivation and side-dress fertilizer were as follows: 90 lbs./A of 15.5-0-0 calcium nitrate on 14 April and 24 May; 500 lbs./A of 4-8-12 on 27 April, 1 May, and 24 May. Layby was done on 24 May. Additional pesticide applications on tobacco were applied as follows: 24 April and 18 May, sprayed Actigard 50 WG at 0.5 oz./A in a 12 inch band, one nozzle over row in 10.35 GPA H_2O.

Tobacco was topped and suckered on 15 June. Royalto M 4% solution at 50 gal./A was applied on 19 June. On 22 June, Flupro at 2 qt./A was tank mixed with MH-30 Extra at 1.5 gal./A in 50 GPA H_2O. Total rainfall recorded at the Black Shank Farm during this period (March through August 2007) was 15.43 inches.

Summary

Black Shank levels were high in 2007, ranging from a low of 33 to 100 percent disease. This field has a mixture of Race 0 and Race 1 as suggested by the level of disease in 1071 and NC 71. Only RJR 75 demonstrated some level of resistance to Black Shank in this trial. Data is displayed in Table 1.

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Tobacco Variety[1]	Percent Disease from Black Shank[A] (*Phytophthora parasitica* var. *nicotianae*)				% TSWV[2]
	Rep I	Rep II	Rep III	Mean	
1. NC 2326	100	90	100	96.7ab	1.7def
2. NC 95	100	100	50	83.3a-f	0.0f
3. K 326	90.5	100	90	93.5a-d	3.3b-f
4. UIT 111	100	91.3	100	97.1ab	1.5ef
5. NC TG 150	82.6	100	100	94.2a-d	1.5ef
6. CC 68	36.4	86.4	55.0	59.2g	6.5a-d
7. RJR 63	72.7	87.5	100	86.7a-f	1.5def
8.NC EX 09	90.5	72.7	100	87.7a-f	4.6b-f
9. AOV 405	95.7	100	100	98.6a	0.0f
10. CU 42	50.0	71.4	90	70.5efg	3.2b-f
11.RX 634	100	87.0	100	95.7ab	0.0f
12. RJR 75	54.2	39.1	5.0	32.8h	4.3b-f
13. NC TG 149	81.0	95.5	100	92.1a-e	3.2b-f
14. RJR 338	61.9	67.0	90.9	73.2c-g	7.9ab
15. CU 67	59.1	76.2	72.7	69.3fg	0.0f
16. CC 638	50.0	81.0	85.7	72.2d-g	2.8c-f
17. GF 318	84.2	90.5	95.5	90.1a-f	1.6def
18. NC EX 06	100	95.5	86.4	93.9a-d	0.0f
19. NC EX 07	86.4	100	95.5	93.9a-d	0.0f
20. RX 627	89.5	80.0	57.9	75.8b-g	5.2b-e
21. CC 305	100	100	100	100a	0.0f
22. OX 2047	100	95.5	95.0	96.8ab	0.0f
23. NC TG 152	86.4	100	100	95.5abc	1.5def
24. RJR 138	100	72.7	85	85.9a-f	1.7def
25. NC EX 08	100	91.3	100	97.1ab	1.4ef
26. NC TG 148	95.2	40.9	100	78.7a-g	0.0f
27. CU 65	91.3	100	95.5	95.6ab	1.4ef
28. CU 23	100	80.0	90.9	90.3a-f	1.5def
29. RJR 620	90.5	100	100	96.8ab	1.6def
30. CC 307	100	100	81.8	93.9a-d	3.0b-f
31. CU 347	86.4	73.7	84.2	81.4a-g	6.8abc
32. NC71	100	85.7	100	95.2abc	0.0f
33. CH 3	81.8	90.9	90.5	87.7a-f	6.1a-e
34. CH 1	100	100	100	100a	0.0f
35. LK 1	54.5	89.5	82.6	75.5b-g	10.7a
36. NC71	57.1	100	100	85.7a-f	0.0f
37. 1071	100	100	100	100a	0.0f
38. K346	100	80	95.2	91.8a-e	0.0f

[A] TSWV infected plants were removed from total stand counts to calculate % Disease and Disease Index for Black Shank.

[1] Data are means of three replications. Means followed by the same letter are not different (P=0.05) according to Fisher's LSD test.

[2] Death by TSWV was calculated by subtracting the final number of harvest plants from the original base count. Flagged plants that were dead or missing were considered killed by TSWV.

2007 Selected Variety Test - Black Shank Evaluation
Black Shank Nursery, Tifton, Ga.

A.S. Csinos, L. Mullis, and L.L. Hickman

Introduction

Tobacco Black Shank continues to be a persistent and serious root and stem disease of tobacco. In this study, several tobacco cultivars with monogenic resistance to Race 0 of Black Shank and cultivars with polygenic resistance (Fl.301) were evaluated in the disease nursery, which has a mixture of Race 0 and Race 1 of the pathogen.

Methods and Materials

The study was located at the University of Georgia's Black Shank Nursery Area, Tifton, Ga., in a field with a continuous (since 1962) history of Black Shank in tobacco. The plot design was a randomized complete block consisting of single row plots and it was replicated seven times. Each plot was 32 feet long with an average of 23 plants per test plot.

On 23 January, tobacco varieties were started by seed in 4"x8"x3" seed pans and then transferred on 16 February into 242 cell flats. 2007 selected tobacco varieties for field evaluation were K346, K326, NC71, Speight G-28, McNair 944, Coker 371 Gold, G-70, NC 72, and 1071.

The field was prepared on 14 March by disc harrowing the area. Fertilizer 4-8-12 at 500 lbs./A was broadcast in plot areas and tilled in on 19 March. On 30 March, applications of Devrinol 50DF at 3.1 lbs./A, Lorsban 4E at 3 qt./A, Nemacur 3 at 2 gal./A was tilled into the plot area. Plots were sub-soiled and bedded on 2 April.

Tobacco transplants were treated in the greenhouse on 2 April with Admire Proat 1 fl.oz./1,000 plants and Actigard 50WG at 4 grams./7,000 plants. Both materials were tank mixed. Plants were pre-wet with tap water and treatment materials were washed in with additional water after spraying. Tobacco was transplanted on 11 April on 48-inch-wide rows with an 18-inch plant spacing. Cultivation and side-dress fertilizer were as follows: 90 lbs./A of 15.5-0-0 calcium nitrate on 17 April and 24 May; 500 lbs./A of 4-8-12 on 3 May and 23 May. Layby was done on 25 May.

Additional pesticide applications on tobacco were applied uniformly over the entire test as follows: 2 May and 16 May, sprayed Actigard 50 WG at 0.5 oz./A in a 12 inch band, one nozzle over row in 10.35 GPA H_2O.

Tobacco was topped and suckered on 18 and 25 June. Royal Tam 4% solution at 50 gal./A was applied on 27 June and 2 July. On 8 July, Flupro at 2 qt./A was tank mixed with MH-30 Extra at 1.5 gal./A in 50 GPA H_2O.

Stand counts were conducted every two weeks from 2 May through 7 August, noting percent disease from TSWV and Black Shank.

Total rainfall recorded at the Black Shank Nursery during this period (April through August 2007) was approximately 17 inches. Rainfall was calculated by accessing the database of the Georgia Environmental Monitoring Network from the weather station located at the Tifton-CPES location.

Summary

Tobacco Black Shank level was high in 2007 and most cultivars were destroyed before harvest period. The cultivar K. 346 has the lowest level of infection at 64 percent, which suggests some tolerance to the disease. Other cultivars with the monogenic ph resistance were higher in disease level with NC 71 at 77 percent and NC 72 at 80 percent. This suggests that Race 1 is prominent in the race structure of the field.

Acknowledgments

The authors would like to thank the Georgia Agricultural Commodity Commission for Tobacco for financial support. Thanks are also extended to Jesse McMillan, Channing Paulk, Clint Powell, Cody Singletary, and Remigio Padilla-Hernandez for their technical support.

Table 1. Percent Black Shank Infection (Phytophthora parasitica var. nicotianae) and percent TSWV. [A]
Black Shank Nursery, Tifton, Ga., 2007

Variety[1]	Percent Disease from Black Shank (*Phytophthora parasitica* var. *nicotianae*)[2]								% TSWV[3]
	Rep I	Rep II	Rep III	Rep IV	Rep V	Rep VI	Rep VII	Mean	
1. K346	73.7	63.2	42.1	90.5	55.0	52.4	62.0	62.7d	7.3a
2. K326	85.0	86.4	90.0	100	89.5	84.2	90.5	89.4abc	4.3ab
3. NC71	40.0	85.0	95.0	95.2	81.0	62.0	81.0	77.0c	3.5ab
4. Speight G28	89.0	85.0	100	100	100	80.0	100	93.4ab	2.1ab
5. McNair 944	65.0	85.0	100	90.0	68.4	77.3	76.5	80.3bc	4.3ab
6. Coker 371Gold	91.0	94.4	90.5	90.5	89.5	84.2	89.5	90.0abc	2.8ab
7. G-70	77.8	80.0	100	76.2	95.0	91.0	91.0	87.3abc	2.8ab
8. NC 72	85.0	85.7	85.7	100	89.5	85.7	27.8	80.0bc	6.8a
9. 1071	100	100	100	90.0	100	100	100	98.6a	0.7b

[A] TSWV infected plants were removed from total stand counts to calculate % Disease and Disease Index for Black Shank.
[1] Data are means of seven replications. Means followed by the same letter are not different (P=0.05) according to Fisher's LSD test.
[2] Percent death by Black Shank was calculated by subtracting the final number of harvest plants from the original base count. The number of plants flagged with TSWV were subtracted from that total to get the number of plants killed by Black Shank. That number was then divided by the original base count and multiplied by a hundred.
[3] Death by TSWV was calculated by subtracting the final number of harvest plants from the original base count. Plants flagged that were dead or missing were considered killed by TSWV.

Black Shank Race Identification Method
Black Shank Farm, UGA CPES, Tifton, Ga.

A.S. Csinos, L.L. Hickman, and L. Mullis

Introduction

Tobacco Black Shank continues to be a serious soil-borne disease on tobacco in Georgia. Favored by wet spring weather, the disease causes root rot, pith discing, and decomposition of infected plants during the later part of the summer when precipitation and moisture levels are low.

The management of this disease is complicated by the fact that we have a shift in Black Shank races, from Race 0 to Race 1, as new cultivars with Race 0 resistance are being planted. Race 1 will kill all commercial varieties. This study examines the race structure in a disease nursery and on some farms in southern Georgia.

Materials and Methods

The test site was located at the Black Shank Farm, CPES, Tifton, Ga., in a field with a history of tobacco, peanuts, and assorted vegetables. Each plot was 500 feet in length with two replications. Two different test cultivars were planted — K326 and 1071 — for a total of four rows.

Tobacco cultivars were seeded in the greenhouse 09 February. On 01 March 2007, the test area was disced and prepared using all current University of Georgia Cooperative Extension recommendations. On 14 March, a 4-8-12 fertilizer was broadcast at a rate of 500 lbs./A. On 20 March, Prowl 3.3 (2.1 pts./A), Lorsban 4E (3 qts./A), and Nemacur 3 (1 gal./A) was applied to the test area and tilled in. The area was subsoiled and bedded that same day. Greenhouse float plants were treated with Orthene 97 0.773 l.b/A and Actigard 50WG 4 grams of material (2 g ai/7,000 plants) on 20 April and then transplanted into field plots on 48-inch rows with an 18-inch plant spacing.

Plots were cultivated and side dressed with 4-8-12 fertilizer at 500 lbs./A on 01 and 25 May and 15 June. Calcium nitrate 15.5-0-0 was side dressed at 90 lbs./A on 25 April and 24 May.

Insecticides were applied as follows: Orthene 97 (90.773 lbs./A) on 18 and 31 May, 06 and 29 June, 03, 11, and 28 July, and 25 August.

Samples were submitted by county Extension agents on behalf of local southern growers. Samples were also collected from the Black Shank disease nursery Regional Small Plot test and from the Selected Variety Test at Black Shank Farm for detection of Race 0 and Race 1 populations. The samples were received, recorded, and a sub-sample piece of tissue was removed from the infected stalk. The tissue was then floated in tap water for 12 to 24 hours to promote the growth of sporangia for visual identification with a microscope. The sample tissue was transported to the test site where it was aseptically inserted into the young tender sucker at the tip of the test plants. The suckers were split, a tissue sample was inserted, the stalk was wrapped in Para film lab wax, and finally wrapped in vinyl tape and labeled.

Each test cultivar (K326 and 1071) was inoculated three times each for a total of six tissue samples per submission. Within three to seven days of inoculation, test plants were rated for a positive or negative reaction. Race was determined by the infection or non-infection of the test cultivars.

Summary

Differential cultivars were used to determine the race identity of isolates from samples taken from fields at CPES and from samples submitted from growers' fields. Many of the results suggest that Race 1 dominates the experimental nursery areas as well as commercial tobacco fields. Several trials were voided, primarily due to hot, dry conditions. Only one Race 0 sample was detected. There were several samples that did not type as Race 0 or Race 1, and those results need further investigation.

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Comparison of Phosphite Treatments for Management of Tobacco Black Shank Black Shank Nursery, Tifton, Ga.

A.S. Csinos, L.L. Hickman, and L. Mullis

Introduction

Tobacco Black Shank continues to be a persistent soil-borne problem in Georgia. With the introduction of cultivars having the ph gene, almost all Black Shank is Race 1. Without the use of resistant cultivars, the use of agronomic methods and effective fungicides will become the mainstay for disease management. Many materials have been evaluated for managing Black Shank disease, several of which are phosphites. This study evaluates several phosphite materials and compares them to metalaxyl in a severe Black shank nursery area.

Materials and Methods

The study was located at the Black Shank Nursery in Tifton, Ga., in a field with a continuous (since 1962) history of *Phytophthora parasitica* var. *nicotianae* infestation of tobacco. The plot design was a randomized complete (RCBD) consisting of one-row plots replicated seven times. Each plot was 32 feet long with 5-foot alleys, with an average of 23 plants per test plot.

On 31 January, tobacco variety K-326 was seeded into 242 cell flats in the greenhouse.

Field plots were disced on 14 March. A fertilizer application of 4-8-12 was broadcast on test plots on 19 March at a rate of 500 lbs./A. On 30 March, the following materials were tilled into test plots before transplanting: Devrinol 50DF at 3.1 lbs./A, Nemacure 3 at 2 gal./A, and Lorsban 4E at 3 qt./A. On the same day, greenhouse tobacco transplants were treated with Admire Pro at 1 fl. oz. per 1,000 plants and Actigard 50WG at 4 g/7,000 plants for *Tomato spotted wilt virus* control.

Test plots were subsoiled and bedded on 02 April. Greenhouse tobacco seedlings were transplanted on 10 April. An application of Ridomil Gold 5L at 1 pt./A was applied directly after planting in an over-the-top 12 inch band spray in 10 gal. H_2O/A. An application of 15.5-0-0 calcium nitrate at 90 lb./A was applied on 17 March. Treatments two through five were applied on a schedule of two, four, six, eight, and 10 weeks post-transplant. The two week post-transplant treatments were applied on 23 April; four week treatments were applied 07 May; six week treatments were applied on 21 May; eight week treatments were applied on 04 June, and the 10 week treatments were applied on 18 June. These treatments were as follows:

Treatment 2-Kphite at 1 qt./A, Treatment 3-Nutriphite at 1 qt./A, Treatment 4-Prophyte at 1 qt./A, Treatment 5-Alliette 80 WP at 1 lb./A. All treatments were broadcast applications. Ridomil Gold treatment 6 was applied at layby on 23 May.

Actigard 50WG at 0.5 oz./A was applied to plots on 02 and 16 May in a 12 inch band. On 03 and 23 May, fertilizer applications of 4-8-12 at 500 lbs./A were cultivated and side dressed on tobacco. Also on 23 May, an application of calcium nitrate 15.5-0-0 at 90 lb./A was made.

Layby was done on 23 May. Tobacco was topped and suckered on 18 and 25 June and again on 05 July. Royaltac M 4% solution at 50 gal./A was applied to tobacco on 27 June and again on 02 July. On 08 July, MH-30 at 1.5 gal./A was tank mixed with Flupro at 2 qt./A in 50 gal. water/A and applied to tobacco test plots.

Stand counts were conducted every two weeks beginning on 01 May and ending on 24 July. Stand counts recorded the number of plants killed by black shank, those killed by TSWV, and those killed by other means. A phytotoxicity rating was done on 26 June to determine whether there was any damage from chemical treatments. Two plant vigor ratings were conducted on a 1-10 scale with 1 = dead or dying plants and 10 = healthy, vigorous plants. Vigor ratings were taken on 22 May and 06 June. Three tobacco leaf harvests were done with 1/3 of the plant leaves being taken at each harvest. Harvest dates were 03, 12, and 30 July. All weights were recorded in lbs.

Table 1. Comparison of Phosphite Treatments for Management of Tobacco Black Shank (*Phytophthora parasitica* var. *nicotianae*) Black Shank Nursery, Tifton, Ga.

Treatments	Rate	Vigor[1]	Yield[2]	% Black Shank[3]	% TSWV[4]
1. Non-treated control	1 qt./A	7.8b	131.5c	96.6a	1.3a
2. Kphite	1 qt./A	8.6a	490.0bc	89.8ab	3.4a
3. Nutriphite	1 qt./A	8.5a	508.0bc	88.1ab	1.4a
4. ProPhyte	1 qt./A	8.7a	732.2b	81.6bc	3.4a
5. Alliette 80 WP	1 lb./A	8.1b	142.6c	96.8a	2.0a
6. Ridomil Gold EC	1 pt./A	8.7a	1728.6a	71.8c	4.1a

[1] Vigor was done on a 1-10 scale, with 10 = live and healthy plants and 1 = dead plants. Ratings were taken 22 May and 06 June.

[2] Dry-weight was calculated by multiplying green-weight totals of tobacco by .15. Pounds per acre was calculated by multiplying dry weight conversion per plot by 7260 divided by base stand count. Tobacco was planted in 48-inch rows, with 18 inches between plants, which equals 7260 plants/A.

[3] Percent TSWV was calculated by using stand counts that were made from April through July with TSWV being flagged every two weeks.

[4] Percent death by Black Shank was calculated by subtracting the final number of harvest plants from the original base count. The number of plants flagged with TSWV were subtracted from that total to get the number of plants killed by Black Shank. That number was then divided by the original base count and multiplied by a hundred.

Summary

2007 was a very hot, dry year and losses from tobacco Black Shank were high. In this test area, the non-treated had 97 percent disease, while the standard Ridomil Gold treatment had 72 percent disease, which would be unacceptable in a commercial growing field. The phosphite materials slightly reduced disease about 10 percent over the non-treated control. These were not significant reductions.

Tobacco Rotation Study, 2007
Black Shank Nursery, Tifton, Ga.

A.S. Csinos, L. Mullis, and L.L. Hickman

Introduction

Black Shank disease of tobacco is a persistent soil-borne disease that results in major losses of tobacco yields in Georgia. There has been a steady and rapid shift to Race 1 from Race 0 of *Phytophthora parasitica* var. *nicotianae* (Ppn) as growers continue to use cultivars with the ph gene. This gene confers resistance to Race 0 of the pathogen Ppn but not to Race 1.

These studies attempt to evaluate glucosinolate rich crops such as mustard in an attempt to reduce Ppn inoculum in the soil, with and without mefenoxam.

Methods and Materials

The study was located at the Black Shank Nursery Area, CPES, Tifton, Ga., in a field with a continuous (since 1962) 44-year history of Black Shank in tobacco. The plot design was a randomized complete block consisting of four rows split into two row subplots and replicated four times. Each plot was 32 feet long with an average of 23 plants per test plot.

Spring 2007

On 31 January, tobacco variety K-326 was seeded in greenhouse for spring planting of the Rotation Study test.

Plots with a fall crop of rye and mustard were tilled on 15 March and again on 21 March with biomass being incorporated into the soil beds. A fertilizer application of 4-8-12 500 lbs./A was broadcast on 19 March. Soil was washed off of the tiller between treatments.

To determine the effect of treatments of wheat and brassica incorporation on the survival of *Rhizoctonia solani* and *Phytophthora parasitica* var. *nicotianae*, fungal packets were buried in test plots on 15 March after biomass had been mowed and incorporated into the soil with a tiller. Packets were prepared by filling one set of nylon mesh bags with approximately 15 beet seed colonized with *Rhizoctonia solani* and another set of nylon bags with approximately 10 wooden sterilized toothpicks soaked in V8-juice and colonized with *Phytophthora parasitica* var. *nicotianae.* One packet each of *Rhizoctonia solani* and *Phytophthora parasitica* var. *nicotianae* per plot were inserted approximately eight inches into the soil and buried. The packets were retrieved from the soil seven days after interment (on 20 March). Colonized seeds and toothpicks were transferred to petri dishes containing *Phytophthora*- and *Rhizoctonia*-specific media, respectively. After 48 hours incubation at 26 degrees C, pathogen survival was determined by counting the number of seeds and toothpicks that showed positive signs of pathogen growth.

Applications of Devrinol 50DF at 3.1 lbs./A, Lorsban 4E at 3 qt./A, Nemacur 3 at 1 gal./A, and Mocap 6E at 1 gal./A were tilled into the plot area on 30 March. Plots were sub-soiled and bedded on 02 April.

Tobacco variety K-326 transplants (seeded on 31 January) were treated on 30 March with Admire 2F at 2.4 oz./1,000 plants and Actigard 4G at 4 grams/7,000 plants. Plants were pre-wet with materials being washed in after spraying. Tobacco was transplanted on 10 April on an 18-inch plant spacing with an over-the-top treatment of Ridomil Gold at 1 pt./A in 9.7 gal. H_2O/A in 9.7 gal. H_2O/A applied to subplots "B" in a 12-inch band with one nozzle over row. Cultivation and side dress fertilizer were as follows: 90 lbs./A of 15.5-0-0 calcium nitrate on 17 April; 500 lbs./A of 4-8-12 on 03 and 23 May. On 24 April, at layby, 90 lbs./A of 15.5-0-0 calcium nitrate was applied.

Additional pesticide applications on tobacco were as follows: sprayed Actigard 50 WG at 0.5 oz./A in a 12-inch band on 02 and 16 May, one nozzle over row in 10.35 GPA H_2O; Orthene 97 at 0.773 lb./A on 14 June and 05 July; Acephate 75 at 1 lb./A on 02 and 16 May and 06 June; and Ridomil Gold 1 pt./A in 20 GPA H_20 with two nozzles on 08 and 24 May, 12-inch band aimed at the base of the plant. Plots were then cultivated to incorporate treatment.

Tobacco was topped and suckered on 18, 25 and 18 June and 05 July. Royalto M 4% solution at 50 gal./A was applied on 27 June and 02 July. MH-30 at 1.5 gal./A and Flupro at 2 qt./A in 48 GPA H_2O were tank mixed and applied on 08 July.

Stand counts were conducted every two weeks. Plants showing symptoms of *Tomato spotted wilt virus* and Black Shank disease (*Phytophthora parasitica* var. *nicotianae*) were flagged and recorded at each stand count. Stand count dates were 01, 15 and 29 May, 12 and 26 June, and 11 and 24 July. Tobacco was harvested, taking 1/3 of foliage per harvest. Harvests were done on 29 June, 12 July, and 30 July. Vigor ratings were done on a 1-10 scale, with 10 equaling vigorous and healthy plants and 1 equaling poor vigor plants. Ratings were done on 22 May and 06 June. Height measurements were done in centimeters from the soil level to the tip of the longest leaf on 31 May. Total rainfall recorded at the Black Shank Nursery during this period (March to August 2007) was 18.15 inches. Rainfall data was obtained from the Georgia Automated Environmental Monitoring Network (www.GeorgiaWeather.com).

Fall 2006
Test plots were tilled and prepared for planting on 23 October. Florida Broadleaf Mustard and wheat were seeded on 24 October into specific test plots.

Spring 2006
On 31 January, tobacco variety K-326 was seeded in greenhouse for spring planting of the Rotation Study test. Plots with a fall crop of rye and mustard were tilled on 28 February and again on 15 March with biomass being incorporated into the soil beds. Soil was washed off of the tiller between treatments. A fertilizer treatment of 4-8-12 500 lbs./A was broadcast on 15 March. Applications of Prowl 3.3 at 2.1 pts./A, Lorsban 4E at 3 qt./A, Nemacur 3 at 1 gal./A and Mocap 6E at 1 gal./A was tilled into the plot area on 21 March. Plots were sub-soiled and bedded on 22 March.

Tobacco variety K-326 transplants (seeded on 31 January) were treated on 23 March with Admire Pro at 1 fl.oz./1,000 plants and Actigard 50WG at 4 grams/7,000 plants. Plants were pre-wet, with materials being washed in after spraying. Tobacco was transplanted on 29 March on an 18-inch plant spacing with an over-the-top treatment of Ridomil Gold at 1 pt./A in 10 gal. H2O/A applied to subplots "B" in a 12 inch band with one nozzle over row. Cultivation and side dress fertilizer were as follows: 500 lbs./A of 4-8-12 and 90 lbs./A of 15.5-0-0 calcium nitrate on 05 May.

Additional pesticide applications on tobacco were applied as follows: 19 April, 01 May, and 18 May, applied Actigard 50 WG at 0.5 oz./A in a 12 inch band, one nozzle over row in 10.35 GPA H_2O; on 02 May, sprayed Ridomil Gold 1 pt./A in 20 GPA H_2O with two nozzles, 12 inch band aimed at the base of the plant; plots were then cultivated to incorporate treatment. Orthene 97 at 0.773 lb./A was applied for insect control on 19 April, 01 May, 18 May, 08 June, 22 June, and 10 July.

Tobacco was topped on 07 June, Royalto M 4% solution at 50 gal./A was applied on the 08 and 16 of June. MH- 30 1.5 gal./A and Flupro 2 qt./A were tank mixed in 50 GPA H_2O and applied on 22 June. Tobacco was harvested, taking 1/3 of foliage per harvest. Harvests were done 16 June, 27 June, and 21 July. Vigor ratings were done on a 1-10 scale, with 10 equaling vigorous and healthy plants and 1 equaling poor vigor plants. Ratings were done on 08 May, 30 May, and 15 June. Height measurements were done in centimeters from the soil level to the tip of the longest leaf on 14 May. Stand counts were conducted every two weeks from 25 April through 17 July, 2006 noting percent disease from TSWV and Black Shank. Total rainfall recorded at the Black Shank Nursery during this period (March through August 2006) was 14.29 inches.

Fall 2005
All plots to be planted with mustard were tilled on 03 October. On 02 November, all plots were replanted with either wheat or Florida Broad Leaf mustard.

Spring 2005
On 02 February, tobacco variety K-326 was seeded in greenhouse for spring planting of the Rotation Study test. Plots with a fall crop of rye and mustard were tilled on 24 February and again on 07 March with

biomass being incorporated into the soil beds. Soil was washed off of the tiller between treatments. A fertilizer treatment of 4-8-12 500 lbs./A was broadcast on 03 March. Applications of Prowl 3.3 at 2.1 pts./A, Lorsban 4E at 3 qt./A, Nemacur 3 at 1 gal./A and Mocap 6E at 1 gal./A were tilled into the plot area on 30 March. Plots were then sub-soiled and bedded.

Tobacco variety K-326 transplants (seeded on 02 February) were treated on 01 April with Admire 2F a 2.4 oz./1,000 plants and Actigard 4G at 4 grams/7,000 plants. Plants were pre-wet, with materials being washed in after spraying. Tobacco was transplanted on 05 April on an 18-inch plant spacing with an over-the-top treatment of Ridomil Gold at 1 pt./A in 9.7 gal. H_2O/A in 9.7 gal. H_2O/A applied to subplots "B" in a 12 inch band with one nozzle over row.

Cultivation and side dress fertilizer were as follows: 90 lbs./A of 15.5-0-0 calcium nitrate on 14 April; 500 lbs./A of 4-8-12 on 11 May; 500 lbs./A of 4-8-12 and 90 lbs./A of 15.5-0-0 calcium nitrate on 14 April; 500 lbs./A of 4-8-12 and 90 lbs./A of 15.5-0-0 calcium nitrate on 24 May. Additional pesticide applications on tobacco were applied as follows: 12 May sprayed Actigard 50 WG at 0.5 oz./A in a 12 inch band, one nozzle over row in 10.35 GPA H_2O; 13 May sprayed Ridomil Gold 1 pt./A in 20 GPA H_2O with two nozzles and a 12 inch band aimed at the base of the plant. Plots were then cultivated to incorporate treatment.

Tobacco was topped on 16 June, topped and suckered on 20 June and topped again on 27 June. Royalto M 4% solution at 50 gal./A was applied on 17 and 22 June. Fair 30 2 gal./A and Flupro 2 qt./A in 48 GPA H_2O. Tobacco was harvested, taking 1/3 of foliage per harvest. Harvests were done on 29 June, 14 July, and 28 July. Vigor ratings were done on a 1-10 scale, with 10 equaling vigorous and healthy plants and 1 equaling poor vigor plants. Ratings were done on 18 May, 03 June, and 14 June. Height measurements were done in centimeters from the soil level to the tip of the longest leaf on 26 May. Total rainfall recorded at the Black Shank Nursery during this period (March through August 2005) was 41 inches.

Fall 2004

All plots to be planted with mustard were tilled on 01 November. On 04 November, all plots were replanted with either rye or Florida Broad Leaf mustard. Brassica plots that were weak were reseeded by hand with mustard and raked in.

Spring 2004

The land was prepared on 10 February by mowing and tilling to kill the rye winter cover crop in plots to be planted with tobacco and peanuts. On 02 April, Prowl 3.3 at 2.1 pts./A, Lorsban 4E 3 qt./A, Nemacur 3 at 1 gal./A and Mocap 6E at 1 gal./A was tilled into the plot area. That same day, plots were sub-soiled and bedded. Tobacco transplants were seeded on 04 February in the greenhouse and treated on 02 April with Admire 2F at 2.4 oz./1,000 plants and Actigard 4G at 4 grams/7,000 plants. Plants were pre-wet, with materials being washed in after spraying.

Tobacco variety K-326 was transplanted on 06 April 2004, on 48-inch rows with 18-inch plant spacing. Cultivation and side dress fertilizer were as follows: 90 lbs./A of 15.5-0-0 calcium nitrate on 22 April; 500 lbs./A of 4-8-12 on 12 May; 500 lbs./A of 4-8-12 on 14 May; and 90 lbs./A of 15.5-0-0 calcium nitrate on 17 May.

On 14 May, 2004, Sonalan at 2 pts./A and Dual Magnum at 1.5 pts./A were tilled into plots to be planted in peanuts. Plots were planted with peanut variety GA 01R at six seed/ft. of row on 24 May. Temik 15G at 4 lbs./A was applied in furrow at the time of planting. Gypsum 750 lbs./A was applied as an 18 inch band over row on 15 July. Additional pesticide applications on peanuts were applied as follows: Cadre at 1.44 oz./A on 17 June; Bravo Weatherstik at 1.5 pts./A, 13 July. Peanuts were dug and harvested 07 October. Tobacco plots were topped and suckered on 06 June. Royal MH-30 Extra at 1.5 gal./A was applied on 07 July in 50 gal. H_20/A. Tobacco stalks were mowed over on 19 July. No harvests were done on the tobacco crop in 2004. Stand counts on tobacco were conducted every two weeks from 26 April through 19 July, 2004, noting percent disease from TSWV and Black Shank.

Summary

Disease pressure from Black Shank was high in 2007. In this test, disease ranged from a low of 8.9 percent to a high of 94 percent disease (Table 1). Yields ranged from a low of 157 lbs. to a high of 1,868 lbs. per acre (Table 1). Plots that had a fall mustard cover crop tended to have lower disease levels and higher yields. TSWV was low and ranged from a low of two percent to a high of 12 percent (Table 1).

Pathogens subjected to mustard residue generally survived at a lower rate than those subjected to wheat residue. Yields tended to be better where mustard was used as a cover crop (Table 1).

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The authors would like to thank the Georgia Agricultural Commodity Commission for Tobacco for financial support. Thanks are also extended to Jesse McMillan, Channing Paulk, Clint Powell, Cody Singletary, and Remigio Hernandez-Padilla for their excellent technical support.

Table 1. Tobacco Rotation Study, Black Shank Nursery, 2007
Dry Weight Yield, % TSWV Infection, % Black Shank Infection, Disease Index, and Pathogen Survival of Fungal Packets.

	Ridomil Gold Field Applications 1pt./A							Pathogen Survival[5] (%)	
Treatment	**At Plant**	**4 weeks Post-Plant**	**At Layby**	**Dry Weight Yield[1]**	**% TSWV[2]**	**% Black Shank[3]**	**Disease Index[4]**	***Phytophthora parasitica* var. *nicotianae***	***Rhizoctonia solani***
1. Wheat-Tobacco	**None**	**None**	**None**	164.7f	3.0b	92.23ab	31.7a	92.5a	100a
2. Wheat-Tobacco	!	-----	-----	269.6ef	1.8b	93.97a	34.9a	85.0abc	95.0a
3. Mustard-Tobacco	**None**	**None**	**None**	502.2ef	6.8ab	76.4a-d	21.7b	77.5a-d	80.0bc
4. Mustard-Tobacco	!	-----	-----	359.3ef	5.0b	80.2abc	22.4b	70.0bcd	70.0cd
5. Wheat-Tobacco	!	!	-----	1392.9bcd	4.7b	47.7de	10.4cd	85.0abc	90.0ab
7. Mustard-Tobacco	!	!	-----	1994.5a	12.4a	11.7f	3.2d	65.0cd	70.0cd
9. Wheat-Tobacco	-----	!	!	1464.3abc	7.1ab	35.3ef	8.4cd	92.5a	95.0a
10. Wheat-Tobacco	-----	-----	!	838.3de	5.1b	63.4b-e	17.4bc	90.0ab	97.5a
11.Mustard-Tobacco	-----	!	!	1966.3ab	3.0b	8.9f	2.4d	75.0a-d	80.0bc
12. Mustard-Tobacco	-----	-----	!	1163.4cd	2.5b	55.5cde	14.6bc	70.0bcd	65.0d

[1]Dry-weight was calculated by multiplying green-weight totals of tobacco by .20. Pounds per acre was calculated by multiplying dry weight conversion per plot by 7260 divided by base stand count. Tobacco was planted in 48-inch rows, with 18 inches between plants, which equals 7260 plants/A.

[2] Percent TSWV was calculated by using stand counts that were made from April through July, with TSWV being flagged every two weeks.

[3] Percent death by Black Shank was calculated by subtracting the final number of harvest plants from the original base count. The number of plants flagged with TSWV were subtracted from that total to get the number of plants killed by Black Shank. That number was then divided by the original base count and multiplied by a hundred.

[4] Disease index was calculated by averaging the percent disease at each of the seven stand counts, summing the averages, and dividing the averages by 7. Stand counts were conducted every two weeks on 01, 15, and 29 May, 12 and 26 June, and on 11 and 24 July.

[5] Percent of pathogen survival was calculated by counting the number of infested seeds (Rhizoctonia solani-10 seeds/packet/plot) and toothpicks (Phytophthora parasitica var. nicotianae-0 toothpicks/packet/plot) that showed positive signs of pathogen growth on selective media petri dishes.

Location Evaluation of *Tomato spotted wilt virus* at the Bowen Farm

S.W. Mullis, C. Nischwitz, A.S. Csinos, and R.D. Gitaitis

Introduction

Tomato spotted wilt virus has been one of the most devastating diseases in the Georgia agricultural community for the last two decades. This virus is highly variable in its infection patterns, and research undertaken here and in other tobacco-growing regions has indicated that many factors play a vital role in TSWV disease epidemiology.

This study will look at possible effects that many different factors may play upon the development of the TSWV disease. Farm location, thrips counts, temperature rainfall, TSWV symptomatology, weed TSWV infection levels, stand counts, and harvest yield will be evaluated during this study.

Materials and Methods

This study was performed at two separate locations at the Bowen Farm of the CPES in Tifton, Ga. Location "A" was located at the southwest area of the farm and location "B" was located at a more open area at the northwest part of the farm. The areas were prepared following current University of Georgia Cooperative Extension recommendations. Each treatment plot consisted of 10 row plots replicated five times, and each plot was approximately 30 feet long. Each location had three different treatment regimes. The first treatment was a control with no Actigard or Admire treatments. The second treatment has a greenhouse application of Actigard/Admire at University of Georgia recommendations at five days prior to transplant. The third treatment had the same Actigard/Admire treatment as treatment two, but with an additional field spray of Actigard. This field spray was applied at first visible sign of TSWV at a rate of 0.5 oz. Actigard 50WG per acre.

At one week prior to transplant on 20 March, eight sticky cards were placed in locations around each plot, and total thrips counts were made every other day for the rest of the growing season. At the same time, temperature probes were placed at each location for monitoring throughout the season. At the onset of transplanting, a DAS-ELISA for TSWV was performed on samples from the transplants to garner a baseline infection level. Stand counts and symptomatology evaluations were noted on a weekly basis. At the same time, root samples were taken for TSWV screening.

Results

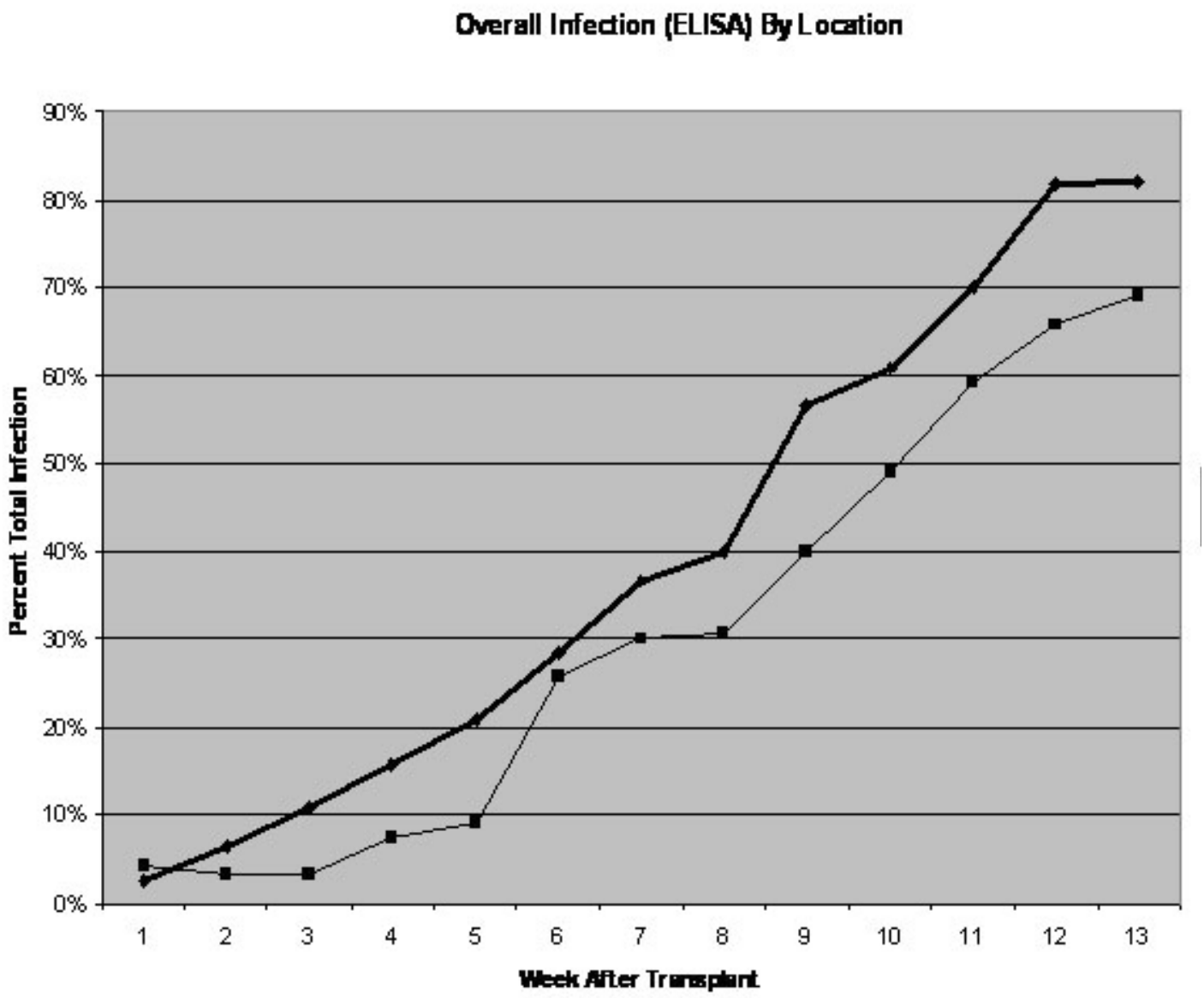
Figure 1 shows the steady increase in total infection levels throughout the season. Figure 2 shows an overlay of thrips total numbers by the increase in disease. There was no statistical correlation with either temperature or rainfall with infection levels. There was a vast difference between the non-treated control and the Actigard/Admire treatments, and a small statistical difference between the greenhouse application of Actigard/Admire and the additional field spray of Actigard as shown in Figure 3.

Acknowledgments

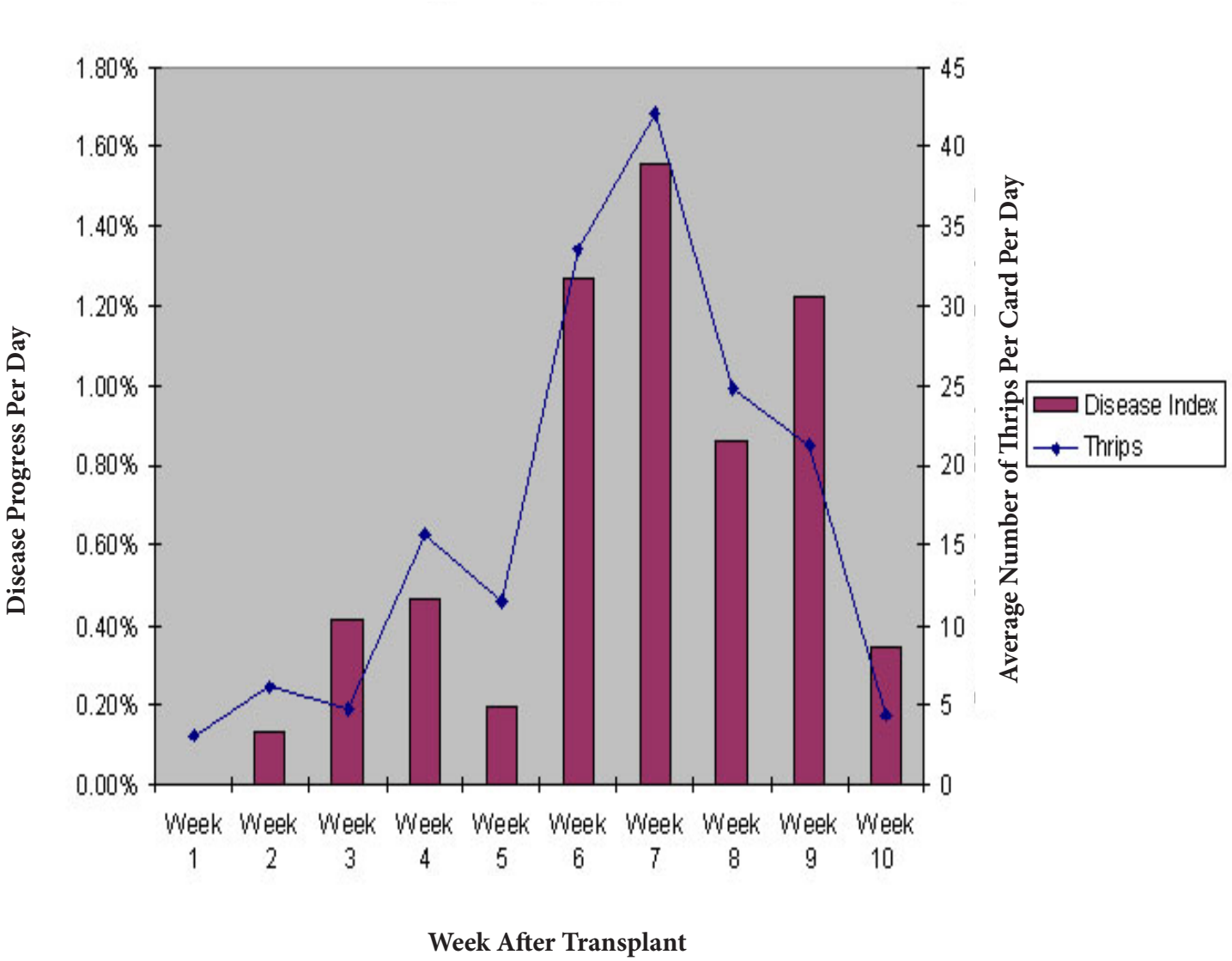
The authors want to thank Phillip Morris USA and the Georgia Agricultural Commodity Commission for Tobacco for their support of these projects.

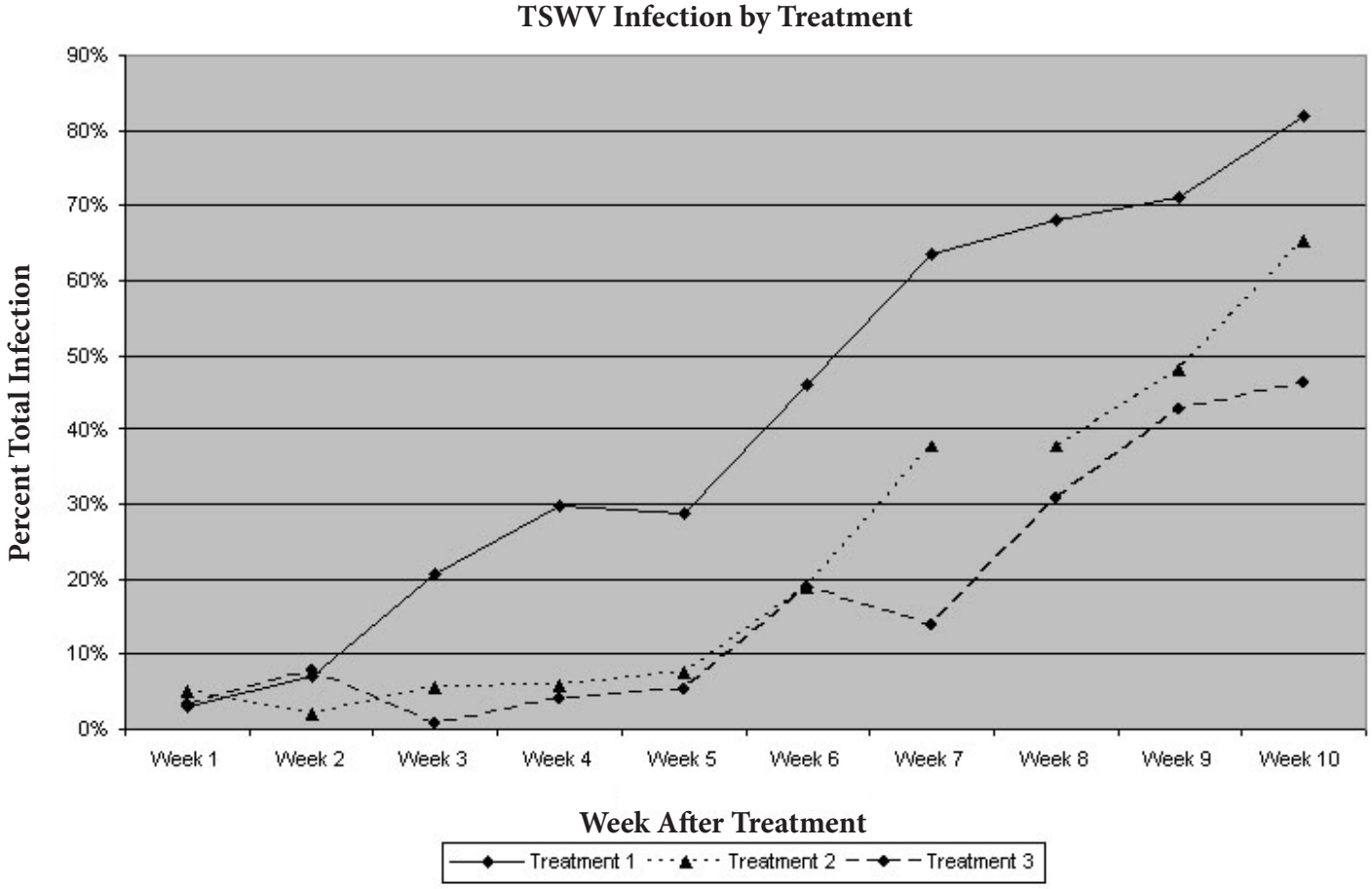
Figure 1. Overall infection levels.

Figure 1. Overall infection levels



Disease Progress by Thrips Counts of Location Study




TSWV Infection by Treatment
Percent Total Infection
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Week 1
Week 2
Week 3
Week 4
Week 5
Week 6
Week 7
Week 8
Week 9
Week 10
Week After Treatment
Treatment 1
Treatment 2
Treatment 3

Sampling the Tobacco Farmscape for Thrips Vectors of *Tomato Spotted Wilt Virus*

R.M. McPherson, S. Diffie, D. Taylor, and N. Roberson

Introduction

Thrips and the economically important disease that they transmit, *Tomato spotted wilt virus* (TSWV), remain key pests of Georgia's flue-cured tobacco crop. The tobacco thrips, *Frankliniella fusca*, is the most common foliage thrips on tobacco, and this species is a confirmed vector of TSWV. Other thrips vector species, including *F. occidentalis*, *F. bispinosa*, *Haplothrips* spp., and *Chirothrips* spp., are also collected on tobacco and on weed/alternate host plants in the tobacco farmscape. This study was conducted, through funds provided by the Georgia Agricultural Commodity Commission for Tobacco, to survey the weed host plants in the tobacco farmscape and record the thrips species present from December through mid-May. Also, sticky traps were used to monitor thrips movement in the farmscape on a weekly basis throughout the entire year, and compare these trap captures to the thrips populations developing on the tobacco crop. Results from this study will help to document where TSWV thrips vectors are over-wintering and their movement into the tobacco crop.

Materials and Methods

From January through May 2007, the commonly observed weeds and volunteer crop plants were collected every week from the flue-cured tobacco farmscape at the Coastal Plain Experiment Station Bowen Farm in Tift County, Ga. The plant material was separated by species, placed into brown paper bags, and returned to the laboratory. Up to 10 plants were placed into each bag (if that many plants were available). In the laboratory, individual plant material (by species) was either visually examined for the presence of thrips or placed into aluminum Berlese extraction funnels. All thrips collected were placed into 1-dram glass vials containing either 70 percent ethyl alcohol (to be mounted for ID only) or a phosphate-buffered saline solution (for TSWV assay). The buffer collections were frozen and assayed using the ELISA technique. The alcohol collections were mounted on microscope slides for detailed study for species identification.

On January 2, 2007, 10 three-inch by five-inch yellow sticky traps with coating on both sides were randomly placed in a tobacco field at the Bowen Farm. Five traps were placed in a North/South orientation and five traps were placed in an East/West orientation. Traps were placed in the field between 8:00 and 9:00 a.m. and retrieved one week later (every Tuesday). After field exposure, the traps were placed in clear plastic bags, labeled, and returned to the laboratory. Thrips were counted on each side of the trap, indicating the direction from which the thrips arrived at the trap (N, S, E, or W). Thrips monitoring with sticky traps continued throughout the entire calendar year.

The tobacco plants at the Bowen Farm also were sampled weekly, beginning soon after transplanting and continuing until late June. This test site was planted on 19 March, with K-326 flue-cured tobacco. Four plants were observed (both sides of all leaves) at four different locations in the field (16 total plants) on each sampling date. These thrips densities, recorded as the mean number per four plants, were compared to the thrips numbers collected on the sticky traps randomly placed at each farm site.

Results and Discussion

The numbers of thrips collected from the different weed hosts in the tobacco farmscape are recorded in Table 1. A total of 2,892 adult thrips were identified from the tobacco farmscape during this study. Sixteen different plant hosts (plus tobacco foliage and blooms) had thrips collected from them between December and mid-May. *F. fusca*, the tobacco thrips, was collected on nine of these plant species, and *F. occidentalis* was collected from 10 of the plant hosts. Other thrips species were collected on all 16 of the plant hosts. Some immature thrips also were observed on 12 of the plant species. Thus, it appears that the weed complex in the tobacco farmscape is very important in providing thrips with the refuge (shelter) and nutrients for survival and a virulent innoculant source for TSWV. One or more thrips vector species was present in the farmscape on every date that thrips were collected.

The sticky trap captures of thrips in the tobacco field document when the thrips were moving in the tobacco farmscape. The monthly mean trap catch numbers

are recorded in Table 2. Low numbers of thrips were collected during January and February. In March, both *F. fusca* and the flower thrips complex began to rise. *F. fusca* were collected on the traps every month of the year except January, and peaked at 97.6 per trap in May. From mid-April through May 2007, there was an average of 10 or more *F. fusca* per trap during this six week period. This is significant because *F. fusca* is the most abundant thrips species on tobacco foliage (81 percent of the thrips on tobacco foliage, Table 1) and this thrips species is a reported vector of TSWV. Flower thrips were collected every month of the year and peaked at 533.4 per trap in April. It is interesting to note that across all 43 weeks of sticky trap catch data summarized to date, more flower thrips were captured on the East side of the traps than on the South side of the traps (Table 2).

Thrips on tobacco foliage were very low at the field site during April. On 2 May, there were around eight thrips per plant, and on 10 May, there were three thrips per plant. Then, thrips rapidly declined, with fewer than one thrips per plant in late May through mid-June.

In conclusion, it is apparent that numerous plant hosts are available in the tobacco farmscape to maintain thrips populations and reproduction during the winter and early spring, prior to transplanting tobacco. This plant reservoir is undoubtedly an important factor in determining the potential severity of TSWV infection in the tobacco crop, as well as other susceptible cultivated crops (tomatoes, peppers, peanuts, etc.). Sticky traps can be useful in determining the movement of thrips into and throughout the tobacco farmscape and to determine when peak movements of the TSWV vectors are occurring in the field.

Acknowledgments
The authors thank Ryan Marchant and Thomas Monk for their technical support and the Georgia Agricultural Commodity Commission for Tobacco for financial assistance.

Table 1. Numbers of thrips collected from different weed hosts in the tobacco farmscape in Tift County, Ga., 2007.

	Total number of thrips collected from host			
Plant species	*F. fusca*	*F. occid*	Other spp.	Immatures
Wild Radish	21	43	187	315
Vetch	0	18	59	482
Primrose	6	1	11	3
Henbit	2	0	39	0
Red sorrel	0	0	28	1
Honeysuckle	0	0	501	24
Oats	0	0	3	0
Nutsedge	57	6	9	1
Flowering privet	0	0	1	0
Broomsedge	0	1	767	1
Tobacco foliage	116	4	23	1
Tobacco blooms	12	21	275	1
Florida pursley	1	0	33	4
Oak	0	2	15	0
Morning Glory	1	2	13	95
Wheat / Rye	6	5	601	150
Red Clover	0	0	1	0
Yellow Clover	0	0	1	0
Totals	222	103	2567	1078

*Thrips collected from January through May 2007 on weed hosts and from tobacco during early April through June 2007.
***F. fusca* is the tobacco thrips and *F. occid* is the western flower thrips,
****F. occidentalis*. Other spp. include *F. tritici, F. bispinosa, Haplothrips spp., Chirothrips spp*., and *Limothrips cerealium*.

Table 2. Mean thrips captured per yellow sticky trap each month in the tobacco farmscape, Bowen Farm, Tift County, Ga., 2007.

Month	Mean thrips per sticky trap (both sides)		
	F. fusca	Flower thrips**	Other Spp.
Jan. 07	0.0	0.4	0.2
Feb. 07	0.1	7.1	0.2
Mar. 07	6.5	204.0	1.0
Apr. 07	20.6	533.4	2.8
May 07	97.6	313.5	4.8
June 07	1.3	75.9	1.2
July 07	1.7	53.2	1.3
Aug. 07	24.5	24.4	1.6
Sept. 07	6.2	2.4	2.8
Oct. 07	5.5	17.4	1.8
East	8.9a	82.8a	0.8a
West	8.8a	61.1ab	0.8a
North	10.1a	60.0ab	1.0a
South	6.9a	46.7b	0.8a

** Flower thrips include *F. occidentalis, F. tritici*, and *F. bispinosa* combined. Other species include *Haplothrips* spp., Chirothrips spp., *Limothrips cerealium*, and others.

Survey of Weeds as Hosts of *Tomato spotted wilt virus* (TSWV) in the Farmscape of Southern Georgia

S.W. Mullis, A. Csinos, R. Gitaitis, C. Nischwitz, and N. Martinez

Introduction

Tomato spotted wilt virus has been one of the most devastating diseases in the Georgia agricultural community for the last two decades. This virus has been variable in its infection patterns and observations have indicated that wild plant hosts may play a vital role in TSWV disease epidemiology. These weeds may serve as reservoirs for the virus as well as reproductive hosts for the known thrips vectors of the disease. A study of the weeds surrounding tobacco fields was begun in 2002 with 10 locations in southern Georgia being sampled on a monthly basis to determine levels of TSWV naturally occurring in the wild plants. More than 46,000 plants have been sampled over the past five years of this study to garner an understanding of the general levels of the virus in the farmscape.

Materials and Methods

Sampled areas include the Bowen Farm, Blackshank Farm, and Blackshank nurseries of the Tifton area. Atkinson, Berrien, Burke, Coffee, and Tattnall Counties are additional areas under study at this time. A total of 990 plants are screened on a monthly basis for TSWV using Double Antibody Sandwich-Enzyme Linked Immunosorbent Assay (DAS-ELISA) and commercially available kits (Agdia, Elkhart, IN). The plants chosen were identified in the first three-year phase of the study as plants that were susceptible to the virus and commonly infected with TSWV. During the winter and spring, they included the cudweeds, chickweed, dogfennel, pepperweed, ragweed, and goldenrod. During the summer and fall, the study included pigweed, eclipta, the morningglories, beggarweed, carpetweed, and pusley. A total of 990 plants per month were collected, and a leaf and root sample from each plant was subjected to DAS-ELISA for TSWV.

Results

The first three-year phase of the study showed that weed infection levels had two distinct peaks during the year — one in the late spring and another in early fall (Figure 1). The early spring infections normally corresponded to the increase in infection in the susceptible crop in the field at the time. In all years studied, infection levels during the early winter dropped to very low levels, suggesting there may be another reservoir of the disease that has not been examined yet. Additionally, the low levels of infection seen in 2007 did not correspond to a significant decrease of disease in the field crops, which would lead to further expectations of another potential infection source.

The expected outcome of this study is to garner a better understanding of the disease dynamic and to possibly have an early indicator of infection before the infection has a chance to take hold in a commercial crop.

Acknowledgments

The authors want to thank Phillip Morris for their continuing support of this project.

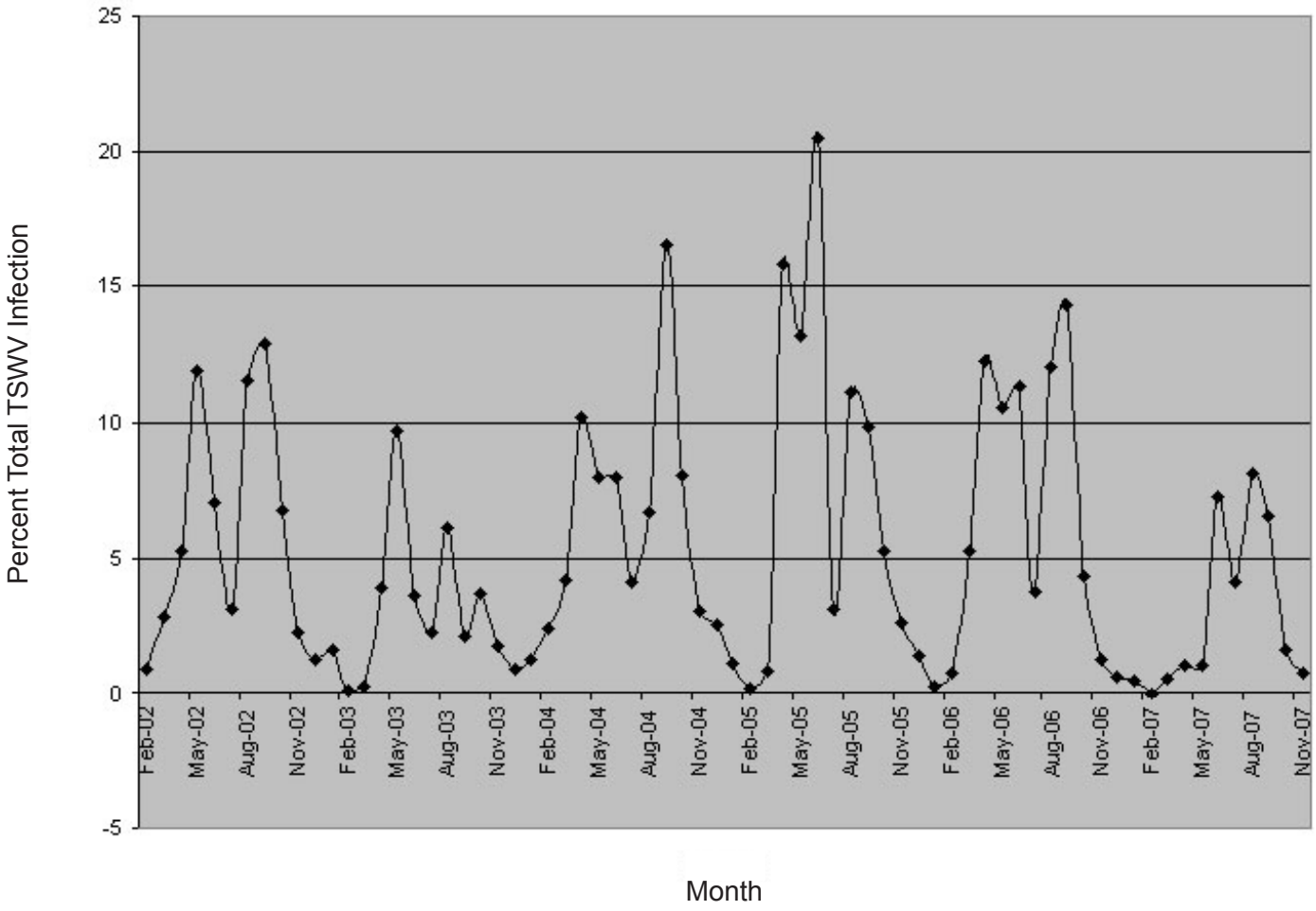


Figure 1. Overall weed infections, 2002-2007

Tobacco Hornworm and Aphid Control with Foliar Applications of Insecticides

R.M. McPherson, D. Taylor, and N. Roberson

Introduction

Tobacco budworms and hornworms continue to cause annual economic losses to Georgia's flue-cured tobacco crop due to costs of control and reduction in yields. These pests cost Georgia tobacco producers millions of dollars every year, even though they are effectively controlled with certain pesticides. Aphids also can cause economic losses in Georgia's tobacco crop; however, the widespread use of imidacloprid has reduced the pest status significantly. Insecticides continually need to be evaluated to document their effectiveness in controlling these and other insect pests. Also, new products and new application rates or use patterns of labeled insecticides need to be examined thoroughly before they can be registered for use and included in the pest control guidelines. This study was conducted to evaluate eight products for control of worm and aphid pests. Those reviewing this report are cautioned not to use any unlabeled product on their tobacco, and to review the most current issue of the Georgia Pest Management Handbook for the most up-to-date pesticide recommendations.

Materials and Methods

Flue-cured tobacco, K-326, was transplanted on 16 April at the Georgia Coastal Plain Experiment Station Bowen Farm. Production practices were used according to the University of Georgia Cooperative Extension guidelines and included a pre-plant tank mixture of Prowl and Spartan for weed control, Ridomil for disease control, Lorsban for soil insect control, and Mocap for nematode suppression. Fertilizer (6-6-18) was applied in a split application at a total of 1,000 lbs. per acre, plus 100 lbs. of 16-0-0 was applied at lay-by.

Plots two rows wide (44-inch row spacing) by 50 feet long were arranged in an RCBD with four replications. Plots were separated on each side with an untreated border row and on each end with a four-foot-wide fallow alley. Eight foliar spray treatments were applied on 27 July on tobacco that had been cut back to an 18-inch stalk in early July and allowed to regrow. Spray equipment consisted of a CO_2-powered backpack sprayer equipped with three TX-12 nozzles directed over a single row, delivering 20.1 gpa at 40 psi. The number of live hornworms per plot (50 plants) was recorded prior to treatment (Pre-t) and three, seven, and 12 days after treatment. In addition to the worm counts, two plants per plot with aphid infestations were flagged and counted. All the insect count data were analyzed with an Analysis of Variance (P=0.05), and means were separated using Duncan's multiple range tests.

Results and Discussion

All of the treatments had lower densities of small hornworm larvae than in the untreated plots on three and seven DAT; however, by 12 DAT only Warrior, Steward, and Belt had lower numbers (Table 1). Large hornworm numbers per plot were lower in all the treatments than in the untreated on three, seven, and 12 DAT (Table 2). The hornworm larvae developing in the untreated plots had caused 40 percent defoliation at 12 DAT. All of the treted plots had five to 10 percent defoliation (most occurring prior to treating) at 12 DAT, except Lannate, which had 12.5 percent. Aphid populations were not greatly affected by the insecticides being evaluated. However, on seven DAT there were lower numbers in the Lannate and Steward plots than in the untreated plots (Table 3). On 12 DAT, the Dipel treated plots had higher aphid populations than in all of the other plots, including the untreated plots (Table 3).

In conclusion, the eight products examined all demonstrated effectiveness in controlling hornworms up to 12 DAT. However, most products were not effective in reducing aphid infestation levels.

Acknowledgments

The authors thank Thomas Monk, Ryan Marchant, Mike Stephenson, and Stevan LaHue for technical support, and FMC, Syngenta, Dow AgroSciences, DuPont, and the Georgia Agricultural Commodity Commission for Tobacco for financial support.

Table 1. Effects of selected foliar insecticide treatments on the abundance of small tobacco hornworm larvae (one inch or less in length) on flue-cured tobacco, Tift County, Ga., 2007.

Treatment and lbs. AI / acre		Small hornworm larvae per 50 plants			
		Pre – T	3DAT	7DAT	12DAT
Brigade 2E	0.06	37.5a	1.3b	2.0e	24.5bc
Warrior 1EC	0.03	30.5a	1.3b	5.0de	4.3c
Denim 0.16EC	0.0125	31.3a	2.5b	33.0bc	26.8bc
Lannate 2.4 LV	0.45	26.8a	4.5b	52.8b	133.8a
Tracer 4SC	0.0625	28.0a	0.0b	17.5cde	32.3bc
Dipel ES	1pt.	29.0a	5.8b	29.0cd	34.0bc
Steward 1.25 SC	0.065	25.3a	2.0b	27.0cd	14.8c
Belt 480SC	0.09	24.3a	2.5b	9.3cde	3.8c
Untreated		27.5a	67.8a	92.3a	55.0b

K-326 flue-cured tobacco treated on 27 July on regrowth tobacco that had been cut back to an 18-inch stalk in early July. Plots were two rows wide (44-inch spacing) x 50 feet long with one untreated border row on each side and arranged in a CRBD with four reps. Column means with the same letter are not significantly different, Duncan's multiple range test, P=0.05.

Table 2. Effects of selected foliar insecticide treatments on the abundance of large tobacco hornworm larvae (one inch or more in length) on flue-cured tobacco, Tift County, Ga., 2007.

Treatment and lbs. AI / acre		Large hornworm larvae per 50 plants			
		Pre – T	3DAT	7DAT	12DAT
Brigade 2E	0.06	5.5a	0.3b	0.0b	0.8b
Warrior 1EC	0.03	6.0a	1.8b	0.8b	0.3b
Denim 0.16EC	0.0125	9.3a	0.0b	0.0b	0.0b
Lannate 2.4 LV	0.45	6.3a	1.0b	1.5b	7.3b
Tracer 4SC	0.0625	6.8a	0.3b	0.0b	0.8b
Dipel ES	1pt.	8.3a	0.0b	0.3b	0.0b
Steward 1.25 SC	0.065	4.0a	0.0b	0.0b	0.0b
Belt 480SC	0.09	7.5a	0.5b	0.0b	0.0b
Untreated		8.5a	15.5a	42.0a	97.5a

K-326 flue-cured tobacco treated on 27 July on regrowth tobacco that had been cut back to an 18-inch stalk in early July. Plots were two rows wide (44-inch spacing) x 50 feet long with one untreated border row on each side and arranged in a CRBD with four reps. Column means with the same letter are not significantly different, Duncan's multiple range test, P=0.05.

Table 3. Effects of selected foliar insecticide treatments on the abundance of aphids on flue-cured tobacco, Tift County, Ga., 2007.

Treatment and lbs. AI / acre		Aphids per plant			
		Pre – T	3DAT	7DAT	12DAT
Brigade 2E	0.06	443.8a	359.0a	619.0abc	834.8b
Warrior 1EC	0.03	356.3a	453.3a	922.8abc	863.8b
Denim 0.16EC	0.0125	787.5a	829.0a	465.0bc	212.5b
Lannate 2.4 LV	0.45	225.0a	168.8a	203.8c	356.3b
Tracer 4SC	0.0625	325.0a	313.8a	424.0bc	370.5b
Dipel ES	1pt.	487.5a	927.8a	1331.3a	2062.5a
Steward 1.25 SC	0.065	200.0a	308.8a	280.8c	368.3b
Belt 480SC	0.09	193.8a	404.8a	485.8bc	569.0b
Untreated		475.0a	756.3a	1186.8ab	666.8b

K-326 flue-cured tobacco treated on 27 July on regrowth tobacco that had been cut back to an 18-inch stalk in early July. Plots were two rows wide (44-inch spacing) x 50 feet long with one untreated border row on each side and arranged in a CRBD with four reps. Column means with the same letter are not significantly different, Duncan's multiple range test, P=0.05.

Tobacco Splitworm Control with Selected Insecticides and Impact on Spotted Wilt Expression

R.M. McPherson and J.M. Moore

Introduction

The tobacco splitworm, more commonly known as the potato tuberworm, *Phthorimaea operculella* (Zeller), has become a common pest of flue-cured tobacco in Georgia. Splitworm larvae feed on tobacco leaves in a characteristic pattern, feeding between the top and bottom membranes of the leaf surface, leaving a damaged area that looks like a window pane. This damage looks similar to a leaf disease or leaf spot. Splitworm feeding usually begins on the lower leaves and works up the stalk later in the growing season. Controlling splitworms with insecticides can be difficult because the larvae spend all their time inside the leaf as they tunnel between the two exterior leaf surfaces.

This experiment was conducted to evaluate the systemic effectiveness of two transplant water treatments (Brigade and Coragen) and the contact effectiveness of three foliar treatments applied four times at 10-day intervals (Brigade, Coragen, Tracer). Each of these insecticide treatments also was examined for the potential to suppress *Tomato spotted wilt virus* (TSWV) symptoms in tobacco. TSWV is spread (or vectored) by tiny insect pests called thrips. It is possible that the insecticide treatments applied for splitworm control could reduce thrips populations and TSWV symptomatic plants.

Materials and Methods

Flue-cured tobacco, K-326, was transplanted on 7 June at the Georgia Coastal Plain Experiment Station Bowen Farm. Production practices were used according to the University of Georgia Cooperative Extension guidelines. Fertilizer (6-6-18) was applied in a split application at a total of 1000 lbs. per acre.

Plots one row wide (44-inch row spacing) by 58 feet long were arranged in an RCBD with four replications. At transplanting, two insecticide treatments were applied in the transplant water at a rate of 253 gpa. In addition, three foliar spray treatments were each applied on four application dates: 21 June and 2, 12, and 23 July. Foliar spray equipment consisted of a CO_2-powered backpack sprayer equipped with three TX-12 nozzles directed over a single row, delivering 20.1 gpa at 40 psi. The number of splitworm tunnels per plot was recorded on 14 August, 68 days after transplanting. Every two weeks, beginning in late June and continuing until mid-August, each plant in each plot was examined for TSWV symptoms. Symptomatic plants were flagged and dated, and the percentage of TSWV was calculated. All the TSWV and splitworm data were analyzed with an Analysis of Variance (P=0.05) and means were separated using Duncan's multiple range tests.

Results and Discussion

The two transplant water treatments plus the three foliar sprays of insecticides (applied four times) all had lower numbers of splitworm tunnels than the untreated control on 14 August, 68 days after transplanting (Table 1). None of the five insecticide treatments suppressed the cumulative percentage of TSWV symptomatic plants on 14 August; however, all treatments, including the untreated control, had low incidence of TSWV, ranging from 3.9 to 9.7 percent (Table 1). This low incidence of TSWV was probably due to the late planting date, 7 June, for this experiment.

In conclusion, Brigade (FMC), Coragen (DuPont), and Tracer (Dow AgroSciences) all appear to suppress splitworm damage on flue-cured tobacco. Coragen is currently not labeled for use on tobacco. These products, along with other insecticides, need to continue to be examined, so that the most effective pest management program for tobacco splitworms can be developed and implemented.

Acknowledgments

The authors thank Ed Troxel, Neal Roberson, Del Taylor, Mike Stephenson, and Stevan LaHue for technical support, and FMC, Dow AgroSciences, DuPont, and the Georgia Agricultural Commodity Commission for Tobacco for financial support of this project.

Table 1. Effects of selected transplant water and foliar insecticide treatments on the cumulative percent of *Tomato spotted wilt* symptomatic plants and incidence of splitworm tunnels in flue-cured tobacco, Tift County, Ga., 2007.

Treatment and formulation / acre	Cumulative percent TSW symptomatic plants					Tunnels/plot
	26 Jun	12 Jul	23 Jul	2 Aug	14 Aug	14 Aug
Water Check	0.5a	1.7a	2.4ab	2.4ab	5.6a	14.5a
Brigade 2E 4oz. **TPW**	0.5a	2.8a	4.5ab	4.4ab	6.9a	2.8b
Coragen 20SC 6.75oz. **TPW**	0.8a	3.9a	6.2a	6.2a	9.7a	0.3b
Brigade 2E 4oz. **F**	0.3a	1.5a	1.5b	1.5b	4.0a	0.0b
Coragen 20SC 6.75oz. **F**	0.3a	0.8a	0.8b	0.8b	3.9a	0.0b
Tracer 4SC 2.5oz. **F**	0.3a	0.8a	0.8b	0.8b	4.8a	3.0b

K-326 flue-cured tobacco transplanted on 7 June. The transplant water (TPW) treatments were applied on 7 June in 253 gpa and the foliar treatments were applied on 21 June, 2 July, 12 July, and 23 July. Foliar sprays (F) applied with a CO2-powered backpack sprayer with 3 TX-12 nozzles per row delivering 20.1 gpa at 40 psi. Plots were one row (44-inch spacing) x 50 feet long with four replications. Column means with the same letter are not significantly different, Duncan's multiple range test, P=0.05.

Regional Chemical Sucker Control Test

M.G. Stephenson, S.S. LaHue, and J.M. Moore

Introduction

Chemical sucker control agents are extensively used by tobacco growers in Georgia because they increase yield and reduce labor costs. Moreover, the need for more effective materials and methods continues because of the necessity of reducing residues, specifically maleic hydrazide (MH). Some foreign markets require maleic hydrazide residues of 80 ppm or less. Since exports are a major outlet for the Georgia tobacco crop, residues above 100 ppm must be reduced.

In addition, the Green Revolution has lengthened the tobacco season due to cultivars that benefit from irrigation and higher nitrogen use. The incidence of *Tomato spotted wilt virus* (TSWV) has increased in recent years, causing additional sucker pressure and difficulty in control because of variability in stands and flowering. The use of dinitroanalines in combination with maleic hydrazide have shown success in controlling suckers over the lengthened season while a third or even forth contact has dealt with the variable stand due to TSWV. These problems can be managed while reducing MH residues.

The purpose of this study is to report the effectiveness of some new combinations of existing materials and unconventional application techniques of sucker control materials used in combination (sequential) with decanol (a contact) and the potassium salt of maleic hydrazide (a systemic) with and without the added benefit of dinitroanalines. These treatments are compared with topped but not suckered and the standard treatment of two contacts followed by maleic hydrazide. Each treatment is analyzed with respect to agronomic characteristics and chemical properties of the cured leaf.

Materials and Methods

The field experiment was conducted at the University of Georgia Tifton Campus Bowen Farm. All cultural practices, harvesting, and curing procedures were uniformly applied and followed current University of Georgia recommendations. Fertilization consisted of 500 lbs./acre of 6-6-18 at first cultivation and 500 lbs./acre of 6-6-18 at second cultivation, followed with 150 lbs./acre of 14-0-14 at lay-by. Plots consisted of two rows of 20 plants each. Ten uniform plants were sampled from each plot for sucker data. The test involved four replications randomized with 13 sucker control treatments as follows:

1. TNS - Topped Not Suckered.

2. Sucker Plucker/Sucker Plucker/(RMH-30 + Flupro) - Two treatments of the contact Sucker Plucker (Drexel Chemical) at 2.0 gallons per acre (gpa) then 2.5 gpa three days apart, followed in seven days by a tank mix of RMH-30 (Chemtura Chemical) potassium malic hydrazide at the labeled rate of 1.5 gpa and Flupro (Chemtura Chemical) at 0.5 gpa.

3. Sucker Plucker/Sucker Plucker/(RMH-30 + Butralin) - Two treatments of the contact Sucker Plucker at 2.0 gpa then 2.5 gpa three days apart, followed in seven days by a tank mix of RMH-30 at the labeled rate of 1.5 gpa and Butralin (Chemtura Chemical) at 0.75 gpa.

4. Sucker Plucker/Sucker Plucker/(Flupro + X-77)/ RMH-30 - Two treatments of Sucker Plucker at 2.0 gpa then 2.5 gpa three days apart, followed in seven days with Flupro and the spreader X-77 (Loveland Industries Inc.) at 0.5 gpa and 0.125 gpa, respectively. The final treatment consisted of RMH-30 applied in five days at the rate of 1.0 gpa after the first harvest.

5. Sucker Plucker/Sucker Plucker/Butralin/RMH-30 - Two treatments of Sucker Plucker at 2.0 gpa then 2.5 gpa three days apart, followed in seven days with Butralin at 0.75 gpa. Lastly, RMH-30 was applied in five days at the rate of 1.0 gpa after the first harvest.

6. Sucker Plucker/Sucker Plucker/RMH-30 - Two treatments of Sucker Plucker at 2.0 gpa then 2.5 gpa three days apart, followed in seven days with RMH-30 at the rate of 1.5 gpa.

7. Sucker Plucker/Sucker Plucker/(Flupro + X-77) - Two treatments of Sucker Plucker at 2.0 gpa then 2.5 gpa three days apart, followed in seven days with Flupro mixed with the spreader X-77 at 0.5 gpa and 0.125 gpa respectively.

8. Sucker Plucker/Sucker Plucker/Flupro - Two treatments of Sucker Plucker at 2.0 gpa then 2.5 gpa three days apart, followed in seven days with Flupro at the rate of 0.5 gpa.

9. Sucker Plucker/Sucker Plucker/RMH-30 - The same chemical combination as in treatment six, except using a nozzle configuration of TG-2; TG-6; TG-2 instead of the traditional TG-3; TG-5; TG-3 nozzles.

10. Sucker Plucker/Sucker Plucker/Flupro - The same chemical combination as in treatment eight, except using a nozzle configuration of TG-2; TG-6; TG-2 instead of the traditional TG-3; TG-5; TG-3 nozzles.

11. Sucker Plucker/Sucker Plucker/Butralin/Butralin - Two treatments of Sucker Plucker at 2.0 gpa then 2.5 gpa three days apart, followed in seven days with Butralin at 0.5 gpa. Lastly, Butralin was applied in five days at the rate of 0.5 gpa with a conventional nozzle configuration.

12. Sucker Plucker/Sucker Plucker/(Flupro + X-77)/(Flupro + X-77) - Two treatments of Sucker Plucker at 2.0 gpa then 2.5 gpa three days apart, followed in seven days with Flupro and the spreader X-77 at 0.5gpa and 0.125 gpa, respectively. The final treatment, applied in five days, consisted of Flupro and the spreader X-77 at the same rate and conventional nozzle configuration.

13. Sucker Plucker/Sucker Plucker/(Flupro + X-77)/(RMH-30 + Flupro) - Two treatments of Sucker Plucker at 2.0 gpa then 2.5 gpa three days apart, followed in seven days with Flupro and the spreader X-77 at 0.5 gpa and 0.125 gpa respectively. The fourth treatment, applied in five days, consisted of RMH-30 (0.75 gpa) mixed with Flupro (0.25 gpa) with a conventional nozzle configuration.

Results and Discussion

The first contact was applied on 22 June, the second on 25 June, the third set of treatments on 1 July, and the fourth treatment for entries 4, 5, 11, 12, and 13 on 6 July. The final harvest was on 8 August, with the test concluding after the sucker number and weights were recorded from 10 plants from each plot on 10 August. All chemical treatments (Table 1) were significantly higher than the topped-not-suckered check for yield and value. Yield and grade indices were good for all treatments. Transgenic K326 was not used this season; instead, NC 71 treated in the greenhouse with labeled rates of Actigard and Admire with two additional field sprays of Actigard at labeled rates was used. With the preventative treatments, control of TSWV was reduced from 30 percent in the check plots to six percent.

There was no significant difference between any of the chemical treatments for yield and quality. Percent control ranged from 98.5 percent for treatment 10 to 87.3 percent for treatment nine. The high yield was treatment six with 3,754 lb./A, which is the standard two contacts and MH-30 at 1.5 gpa. Changing tips in treatments nine and 10 had no real impact. Furthermore, the fourth spray in treatments 4, 5, 11, 12, and 13 was of no advantage and, considering fuel cost, a waste of money.

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Table 1. 2007 Regional Tobacco Growth Regulator Test, Effects of Advanced Growth Regulating Material on Sucker Growth, Cured Leaf Yields, and Value of Flue-Cured Tobacco.

		Sucker Growth				Cured Leaf			
	Treatments	% Control	Green Wt./ Plant (g)	No./ Plant	Green Wt./ Sucker (g)	Plant Injury[1]	Yield (lbs./A)	Price Index[2] ($/cwt)	Value ($/A)	Grade Index[3]
1.	TNSP/SP/ (Flupro &X-77)/ (Flupro&X-77) 2.0gpa/2.5gpa/0.25gpa /0.25gpa	0.0	368.3	1.6	230.1	0	2557	104.7	2643	62
2.	SP/SP/(RMH-30 & Flupro) TM 2.0gpa/2.5gpa/(1.5gpa+0.5 gpa)	93.5	24.0	1.0	24.0	0	3567	109.5	3904	68
3.	SP/SP/(RMH-30 & Butralin) TM 2.0gpa/2.5gpa/(1.5gpa+0.75 gpa)	93.0	25.9	1.1	23.5	0	3584	100.8	3626	62
4.	SP/SP/(Flupro &X-77)/RMH-30[4] 2.0gpa/2.5gpa/0.5gpa/1.0 gpa	95.8	15.6	0.6	26.0	0	3336	101.3	3351	63
5	SP/SP/Butralin/ RMH-30[4] 2.0gpa/2.5gpa/0.75gpa/1.0 gpa	97.3	10.3	0.7	14.7	0	3319	107.1	3580	66
6	SP/SP/RMH-30 2.0gpa/2.5gpa/1.5gpa	95.8	15.5	1.0	15.5	0	3754	104.5	3946	64
7	SP/SP/(Flupro &X-77) TM 2.0gpa/2.5gpa/(0.5gpa & 0.25%)	93.1	25.7	0.7	36.7	0	3423	112.5	3863	69
8	SP/SP/Flupro 2.0gpa/2.5gpa/0.5gpa	93.4	24.3	0.7	34.7	0	3240	100.5	3295	65

9	SP/SP/RMH-30[5] 2.0gpa/2.5gpa/1.5gpa	87.3	44.7	1.3	34.3	0	3206	104.3	3351	64
10	SP/SP/Flupro[5] 2.0gpa/2.5gpa/0.5gpa	98.5	5.6	0.4	14.0	0	3310	105.1	3522	64
11	SP/SP/Butralin/Butralin 2.0gpa/2.5gpa/0.5gpa/0.5gpa	96.8	12.0	0.6	20.0	0	3543	111.9	3961	67
12	SP/SP/(Flupro &X-77)/ (Flupro & X-77) 2.0gpa/2.5gpa/0.25gpa /0.25gpa	93.4	24.5	0.4	61.2	0	3351	97.6	3250	62
13	SP/SP/(Flupro &X-77)/(RMH-30 & Flupro) TM 2.0gpa/2.5gpa/0.25gpa /(0.75gpa & 0.25gpa)	93.3	24.9	0.4	62.2	0	3580	100.5	3603	62
	LSD-0.05						568.6	15.8	893.1	8.7

[1]Injury rating on a scale of 0-10 with 0 = no damage and 10 = plant killed.
[2]Price Index based on two-year average (2006-2007) prices for U.S. government grades.
[3]Grade Index is a 1-99 rating based on government grade. High ratings are best.
[4]Application after 1st harvest.
[5]Alternate nozzle configuration - TG2; TG6; TG2.
*Mention of a trade name does not constitute a guarantee or warranty of a product by the University of Georgia and does not imply its approval to the exclusion of other products.

Actigard and Admire Pro Application Timing Study for Control of *Tomato spotted wilt virus* (TSWV) in Tobacco Bowen Farm, Tifton, Ga., 2007

A.S. Csinos, M.G. Stephenson, L.L. Hickman, L. Mullis, S.W. Mullis, and S.S. Lahue

Introduction

This study was initiated to determine the effect of Actigard applications in the field for TSWV management. In addiction, different timing scenarios were evaluated to determine if the time of application was relative to the initiation of the epidemic and whether there was an influence on disease control and yield.

Materials and Methods

The study was located at the Bowen Farm, CPES, Tifton, Ga., in a field with a history of crops such as corn, peanuts, tobacco, soybeans, and assorted vegetables. The area was prepared using all current University of Georgia Cooperative Extension recommendations. The plot design was a randomized complete block design (RCBD) consisting of single row plots replicated six times. Each plot was 37 feet long with five-foot alleys between repetitions.

On 31 January 2007, variety K-326 was seeded into 242 cell flats. On 22 March, the pre-plant treatments of Admire Pro and Actigard 50WG were sprayed on in 200 ml of water per flat. Treatments that called for both Admire Pro and Actigard 50WG were tank mixed, then washed in with 0.25 inch of water. Actigard 50WG greenhouse treatments were applied at 2 g ai/7,000 plants. Admire Pro greenhouse treatments were applied at 1 oz./1,000 plants. The plants were transplanted on 26 March in plots on 44-inch rows with a 22-inch plant spacing. An average of 20 plants per test plot were planted.

Crop maintenance was achieved by using Cooperative Extension recommendations for the control of weeds, suckers, and insects. Chemicals used for maintenance of the crop were Orthene 97 at 0.5 lbs./A for insect control, Prowl 3.3EC at 2 pts./A for weed control, and Royal MH-30 Extra at 1.5 gal./A for sucker control.

Field Treatments

Field treatments were applied using a CO^2 sprayer with one TX-12 tip/row with a 50-mesh ball check screen. Tips were angled at plants and sprayed in a four- to six-inch band at the rate of 40 PSI for 10.0 gal. H_2O per acre. All treatments were mixed in three liters of water unless otherwise noted. Field treatments were applied beginning seven days post transplant and continued every seven days thereafter for 49 days post transplant. Additional treatments were applied at two weeks and four weeks after initial application for some treatments. All field applications of Actigard 50WG were made at ½ oz./A (1.1 g Actigard 50WG in 3 L/H_2O). A field treatment schedule and dates that treatments were applied are listed in the following table (Table 1).

Tobacco plots were scouted weekly to determine TSWV disease incidence, percentage of infection in non-treated control plots, and to identify any phytotoxicity problems that may be associated with the various treatment chemicals being applied. Percent infection levels were noted and triggered specific treatments. The first symptom of TSWV was noted 31 days post transplant (DPT). The two percent infection level was noted 36 days DPT, and the five percent infection level was noted 43 DPT. Three harvests were conducted on 22 June, and 03 and 20 July. Harvests were done by collecting 1/3 of the plants' leaves at one time and weighing each plot in pounds.

Stand counts were conducted every seven days; plants were flagged, noting percent disease from TSWV symptoms from 09 April through 19 June. The final count was made on 19 June to determine the amount of plants killed by TSWV and the number of non-harvestable plants. Three height measurements were conducted on 04 and 18 May and 04 June. Plants were measured in centimeters from the base of the plant to the tip of the longest leaf. Three vigor ratings were conducted on a 1-10 scale with 10 equaling vigorous and healthy plants and 1 equaling poor vigor plants. Vigor ratings were conducted on 04 and 18 May and 04 June.

Following the final harvest, root samples were collected on 25 June from 10 plants per plot and

an ELISA test was performed to determine TSWV percent positive. The screen for TSWV was accomplished by the use of double antibody sandwich-enzyme linked immunosorbent assay (DAS-ELISA) alkaline phosphatase antisera kits (Agida, Inc. Elkhart, IN). Samples of ~1.0 grams were subjected to DAS-ELISA, and any sample eliciting an absorbance reading (A405) of three times the average plus two standard deviations of a healthy negative control were considered positive results.

Summary

Tomato spotted wilt virus infection ranged from a high of 24 percent to a low of 1.8 percent in the transgenic test plots. Application of Actigard at 28 days post transplant and again two weeks later significantly reduced disease from 18.6 percent to 6.8 percent compared to plots treated with Actigard plus Admire Pro in the float bed only. Field treatments of Actigard may be more dramatic under higher disease pressure.

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Table 1. Field treatment schedule

Treatment in greenhouse float	Actigard Field application post transplant[1]	Date applied
1. Non-Treated	No field treatment	N/A
2. Actigard & Admire Pro Greenhouse	No field treatment	N/A
3. Actigard & Admire Pro Greenhouse	+ 7 days post transplant (DPT)	03 April
4. Actigard & Admire Pro Greenhouse	+ 14 DPT	09 April
5. Actigard & Admire Pro Greenhouse	+ 21 DPT	17 April
6. Actigard & Admire Pro Greenhouse	+ 28 DPT	23 April
7. Actigard & Admire Pro Greenhouse	+ 35 DPT	30 April
8. Actigard & Admire Pro Greenhouse	+ 42 DPT	07 May
9. Actigard & Admire Pro Greenhouse	+ 49 DPT	14 May
10. Actigard & Admire Pro Greenhouse	+ 1st symptom	25 April
11. Actigard & Admire Pro Greenhouse	+ 1st symptom	25 April
	+ 2 weeks	07 May
	+ 2 weeks	21 May
12. Actigard & Admire Pro Greenhouse	+ 2% TXWV	30 April
13. Actigard & Admire Pro Greenhouse	+ 5% TSWV	07 May
14. Actigard & Admire Pro Greenhouse	+ 14 DPT	09 April
	+ 2 weeks (%)TSWV	23 April
15. Actigard & Admire Pro Greenhouse	+ 1st symptom	25 April
	+ 2 weeks	07 May
16. Actigard & Admire Pro Greenhouse	+ 28 DPT	23 April
	+ 2 weeks	07 May
17. Actigard & Admire Pro Greenhouse	+ 2% TSWV	30 April
	+ 2 weeks	14 May
18. Actigard & Admire Pro Greenhouse	+ 5% TSWV	07 May
	+ 2 weeks	21 May
19. Actigard & Admire Pro Greenhouse	+ 21 DPT	17 April
	+ 2 weeks	30 April
20. Transgenic	No field treatment	N/A

[1] Tobacco was transplanted into test plots on 26 March.

Table 2. Effects of timed field treatments of Actigard and Admire on plant height, plant growth and vigor, and dry weight yields (lbs./acre)-Bowen Farm, Tifton, Ga., 2007

Treatment[1] (Greenhouse)	Field Treatment[2]	Plant Height[3]	Vigor Ratings[4]	Dry Weight Yield[5]
1. Non-treated Control	No field treatment	68.4 a	8.3 b	2192.8 ab
2. Actigard & Admire Pro	No field treatment	57.4 bc	6.7 ef	2330.2 ab
3. Actigard & Admire Pro	+ 7 days post transplant (DPT)	63.9 ab	7.1 c-f	1983.0 b
4. Actigard & Admire Pro	+ 14 DPT	63.0 abc	7.2 c-f	2001.4 b
5. Actigard & Admire Pro	+ 21 DPT	56.0 bc	7.3 b-f	2034.6 ab
6. Actigard & Admire Pro	+ 28 DPT	58.2 bc	6.7 f	2267.5 ab
7. Actigard & Admire Pro	+ 35 DPT	56.1 bc	7.2 c-f	2299.3 ab
8. Actigard & Admire Pro	+ 42 DPT	60.0 bc	6.8 def	2312.6 ab
9. Actigard & Admire Pro	+ 49 DPT	62.3 abc	7.6 b-f	2376.4 ab
10. Actigard & Admire Pro	+ 1st symptom	57.2 bc	7.1 c-f	2222.1 ab
11. Actigard & Admire Pro	+ 1st symptom TSWV + 2 weeks + 2 weeks	57.1 bc	7.7 b-e	2300.9 ab
12. Actigard & Admire Pro	+ 2% TSWV	58.4 bc	7.7 b-e	2026.1 ab
13. Actigard & Admire Pro	+ 5% TSWV	55.9 c	7.6 b-f	2059.4 ab
14. Actigard & Admire Pro	+ 14 DPT + 2 weeks	58.8 bc	6.8 def	2142.4 ab
15. Actigard & Admire Pro	+ 1st symptom TSWV + 2 weeks	63.6 abc	7.2 c-f	2246.6 ab
16. Actigard & Admire Pro	+ 28DPT + 2 weeks	59.7 bc	7.1 c-f	2357.5 ab
17. Actigard & Admire Pro	+ 2% TSWV + 2 weeks	59.5 bc	7.2 c-f	2414.4 a
18. Actigard & Admire Pro	+ 5% TSWV + 2 weeks	60.1 bc	7.8 bcd	2076.6 ab
19. Actigard & Admire Pro	+ 21 DPT + 2 weeks	58.7 bc	7.9 bc	2389.0 ab
20. Transgenic	No field treatment	68.9 a	9.4 a	2426.3 a

[1] Data are means of six replications. Means in same column followed by the same letter are not significantly different (P=0.05) according to Fisher's LSD test.

[2] Treatments consisted of field applications put out weekly starting at seven days post transplant and continuing every seven days thereafter up to 49 days post plant.

[3] Height measurements were done in inches from the soil level to the tip of the longest leaf. Height measurements were done on 04 and 18 May and 04 June, 2007.

[4] Vigor ratings were done on a 1-10 scale with 10=live and healthy plants and 1= dead plants on 04 and 18 May and 04 June, 2007.

[5] Dry weight yield was calculated by multiplying green weight totals by 0.15. Pounds per acre was calculated by multiplying dry weight conversion per plot by 6,491 divided by the base stand count. Tobacco was planted in 44-inch rows, with 22 inches between plants, which equals 6,491 plants/A.

Table 3. Incidence of TSWV infection, % of non-harvestable TSWV infected tobacco plants, and % TSWV positive plants

Treatment[1] (Greenhouse)	Field Treatment[2]	% TSWV[3]	% of Non-harvestable TSWV plants[5]	% ELISA (+)Plants[6]
1. Non-treated Control	No field treatment	24.4 a	3.5 a	32.76%
2. Actigard & Admire Pro	No field treatment	18.6 ab	2.0 bcd	42.37%
3. Actigard & Admire Pro	+ 7 days post transplant (DPT)	19.4 ab	1.2 de	37.29%
4. Actigard & Admire Pro	+ 14 DPT	18.6 ab	2.0 bcd	28.33%
5. Actigard & Admire Pro	+ 21 DPT	12.4 bcd	1.5 cde	43.33%
6. Actigard & Admire Pro	+ 28 DPT	16.7 abc	2.2 a-d	43.33%
7. Actigard & Admire Pro	+ 35 DPT	13.7 abc	2.0 bcd	45.61%
8. Actigard & Admire Pro	+ 42 DPT	19.6 ab	2.3 a-d	28.33%
9. Actigard & Admire Pro	+ 49 DPT	15.5 abc	1.5 cde	38.33%
10. Actigard & Admire Pro	+ 1st symptom	19.1 ab	3.3 ab	31.67%
11. Actigard & Admire Pro	+ 1st symptom TSWV + 2 wks + 2 wks	16.2 abc	1.7 cde	27.12%
12. Actigard & Admire Pro	+ 2% TSWV	19.1 ab	1.8 cd	30.00%
13. Actigard & Admire Pro	+ 5% TSWV	20.0 ab	2.7 abc	31.67%
14. Actigard & Admire Pro	+ 14 DPT + 2 weeks	14.6 abc	1.7 cde	28.81%
15. Actigard & Admire Pro	+ 1st symptom TSWV + 2 weeks	11.8 bcd	2.3 a-d	28.81%
16. Actigard & Admire Pro	+ 28DPT + 2 weeks	6.8 cd	1.3 cde	29.31%
17. Actigard & Admire Pro	+ 2% TSWV + 2 weeks	14.4 abc	1.8 cd	30.00%
18. Actigard & Admire Pro	+ 5% TSWV + 2 weeks	13.6 abc	2.3 a-d	31.03%
19. Actigard & Admire Pro	+ 21 DPT + 2 weeks	16.2 abc	1.3 cde	25.86%
20. Transgenic	No field treatment	1.8 d	0.3e	5.17%

[1] Data are means of six replications. Means in the same column followed by the same letter are not significantly different (P=0.05) according to Fisher's LSD test.

[2] Treatments consisted of field applications put out weekly starting at seven days post transplant and continuing every seven days thereafter up to 49 days post plant.

[3] Percent TSWV was calculated by using stand counts that were made from 09 April through 19 June with TSWV being recorded and flagged every seven days.

[4] Cumulative number of TSWV infected plants that were flags during weekly stand counts.

[5] Plants that were flagged as TSWV infected were inspected to determine whether they had harvestable leaves. Those with no harvestable leaves were counted and recorded.

[6] Final harvest testing was completed on 24 July. Ten root samples were collected per plot.

Effect of Plant Age and Treatment with Acibenzolar-S-Methyl on *Tomato spotted wilt virus* in Flue-Cured Tobacco

C. Nischwitz, A.S. Csinos, L. L. Hickman, S.W. Mullis, S.S. LaHue, and M.G. Stephenson

Introduction

Past observations have shown that transplant age and treatments with Actigard and Admire in the greenhouse and field have an impact on TSWV symptomatic plants and yield loss due to the virus.

Materials and Methods

The study was located under a center pivot at the UGA Bowen Research Farm, Tifton, Ga. The cultivar NC 71 and a non-susceptible transgenic control (for yield comparisons) were planted on 5 April, 2007. Three transplant ages — six weeks, nine weeks, and 12 weeks — and three chemical treatments — no Actigard and Admire, Actigard and Admire in greenhouse only, and Actigard and Admire in greenhouse + one field application of Actigard at the occurrence of the first symptom — were used. The greenhouse treatment was Actigard (0.07 oz. ai/7,000 plants) and Admire pro 4.6SC (1 oz./1,000 plants) three days prior to transplanting. The field application of Actigard was 0.25 oz. ai/acre. The study was a 3 x 3 factorial with five replications. Each plot consisted of two rows with an average of 19 plants per row.

The treatment combinations were:
1. six-week-old transplants, no chemical treatment,
2. nine-week-old transplants, no chemical treatment,
3. 12-week-old transplants, no chemical treatment,
4. six-week-old transplants + greenhouse treatment,
5. nine-week-old transplants + greenhouse treatment,
6. 12-week-old transplants + greenhouse treatment,
7. six-week-old transplants + greenhouse treatment + field treatment,
8. nine-week-old transplants + greenhouse treatment + field treatment,
9. 12-week-old transplants + greenhouse treatment + field treatment, 10. Non-susceptible transgenic control.

Stand counts were conducted every seven days with the initial stand count being done two weeks after transplanting. TSWV symptomatic plants were flagged every week. The last stand count was done on 12 June, 2007, after the plants had been topped.

The plants were harvested three times and after the last harvest ten root samples were randomly taken from each plot and analyzed for the presence of TSWV using ELISA to determine the percentage of infection.

Crop management was done following University of Georgia Cooperative Extension recommendations. However, no insecticides were applied that would kill thrips and interfere with the study.

The data was analyzed using Proc Mixed in SAS 9.1.

Summary

Transplants treated with Actigard + Admire, regardless of age, had significantly fewer symptomatic plants and a significantly higher yield than the non-treated transplants. Treatment with Actigard + Admire did not affect the percentage of systemic infections but significantly lowered the percentage of dead plants (Table). There was no difference between plants treated with Actigard + Admire in the greenhouse only and the plants that had an additional field application of Actigard. Even though the Actigard- and Admire-treated transplants were on average 14 to 16 centimeters shorter, their yield increased more than 600 lbs./acre compared to non-treated transplants. The cost for Actigard and Admire application in the greenhouse is about $70 per acre. An additional field application of Actigard would be another $25 per acre. The increased yield from treated transplants provides an additional $900 per acre income (estimated price per lb. is $1.50).

Acknowledgements

We would like to thank the Georgia Agriculture Commodity Commission for Tobacco for support of this study.

Table: Evaluation of Actigard and Admire treatments and transplant age on % TSWV symptomatic plants, % systemic infection, % stand loss, plant height and yield – Bowen Farm, Tift Co., Ga., 2007.

Chemical treatment[c,d]	Transplant age (weeks)	Symptomatic plants in %[f]	Systemic infection in %[g]	Stand loss in %[h]	Height in cm[i]	Yield (lbs./ acre dry wt)[j,k]
None	6	43.3	58	4	111	1,719
	9	49.5	59	3.8	110	1,738
	12	48.5	42	2	107	2,084
	Mean[e]	**47.1a**	**53a**	**3.3a**	**109a**	**1,847a**
ASM + IMD in GH	6	19.2	27	0.8	95	2,456
	9	24.0	50	0.6	100	2,281
	12	20.6	40	0.8	91	2,540
	Mean[e]	**21.3b**	**39a**	**0.7b**	**95b**	**2,426b**
ASM + IMD in GH and ASM in field	6	17.3	38	0.8	87	2,294
	9	17.3	26	0.2	94	2,607
	12	18.1	34	0.8	98	2,632
	Mean[e]	**17.6b**	**33a**	**0.6b**	**93b**	**2,511b**

[c] ASM=Actigard, IMD=Admire

[d] Data are means of five replications.

[e] Mean is the average of three transplant ages. Means followed by the same letter are not significantly different from each other according to F-test in Proc Mixed at P=0.05.

[f] Percent symptomatic plants were calculated based on stand counts made. TSWV-infected plants were flagged every week.

[g] Ten root samples per plot were collected after the final harvest and analyzed with ELISA for the presence of TSWV.

[h] Death by TSWV was calculated by subtracting the number of plants from the final stand count from the initial base count. Missing or dead plants that had been flagged were considered killed by TSWV.

[i] Height measurements were done in cm. from the soil level to the tip of the longest leaf. Height measurements were done on 4 May, 2007.

[j] Dry-weight was calculated by multiplying green-weight totals by 0.15. Pounds per acre were calculated by multiplying dry weight conversion per plot by 6,491 plants/acre divided by the base stand count.

[k] The yield for the transgenic K-326 was 2,710 lbs./acre.

Effects of Selected Tray Drench Insecticide Treatments on Suppressing Thrips Vectors and *Tomato spotted wilt virus* Symptoms in Tobacco

R.M. McPherson, J.M. Moore, M.G. Stephenson, and S.S. LaHue

Introduction

Two thrips species commonly collected on flue-cured tobacco in Georgia are reported as vectors of *Tomato spotted wilt virus* (TSWV). These thrips include *Frankliniella fusca* (tobacco thrips) and *F. occidentalis* (western flower thrips). TSWV is a serious economic problem for Georgia's tobacco producers, causing millions of dollars in losses each year. This study was designed to examine the impact of selected tray drench applications of insecticides for suppressing early-season thrips populations and how these control options impact TSWV infection of flue-cured tobacco in Georgia.

Materials and Methods

Flue-cured tobacco, variety NC-71, was transplanted on 19 April 2007 on the Bowen Research Farm in Tift County, Ga. Production practices were used according to University of Georgia Cooperative Extension guidelines for weed control, disease control, nematode suppression, and fertilization.

Eight days prior to transplanting, one-half of the greenhouse-produced plants were treated with the plant activator Actigard at a rate of 0.5 oz. per 50,000 tray cells. Six days prior to transplanting, the transplants were treated with a tray drench (TD) application of one of the 17 treatments listed on Table 1. The TD treatments were applied in 10 gallons of water per 100,000 tray cells. These insecticide treatments included insecticide alone or in combination with Actigard. At transplanting, plots containing two rows (44-inch spacing) at 30 feet long were arranged in a randomized complete block design with five replications.

The number of live thrips on plants 2, 4, 6, and 8 of the second row of each plot was counted weekly from late April through mid-June. All plants in each plot were visually examined weekly for symptoms of TSWV. Symptomatic plants were flagged and dated, and the cumulative percentage of symptomatic plants was determined. From late June to late July, all plants in each plot were harvested with a mechanical harvester a total of four times. Each harvest sample was cured, weighed and graded, and a price index was assigned to each grade. All thrips counts, TSWV ratings, and yield parameters were subjected to Analysis of Variance with P=0.05. Treatment means were separated using Duncan's multiple range test.

Results and Discussion

Thrips populations were low in all plots until 10 May (Table 2). They peaked on this date at between 1.0 and 6.6 thrips per four plants, and these densities were different between the tray drench treatments. By 16 May, these populations were much lower in all treatments, ranging from zero to 2.8 thrips per four plants, and on 22 May they ranged from 0.6 to 4.4 per four plants. By early June, thrips populations were near zero in all plots. Tobacco thrips (*F. fusca)* comprised more than 81 percent of the thrips species on tobacco foliage at this test site.

The cumulative mean percentage of TSWV symptomatic plants steadily rose in all plots from mid-May until mid-June. By early July, TSWV had reached more than 47 percent in the untreated plots (Table 3), and most of the tray drench treatments had significantly lower levels of TSWV symptomatic plants than in the untreated control. No phytotoxicity, chlorosis, or stunting symptoms were observed in any plots three weeks after transplanting. Very few treatment differences were noted for yield, price index, or crop value between the 17 TD insecticides (Table 4).

In conclusion, most of the TD applications of all treatments examined in this test were effective in suppressing the incidence of TSWV in flue-cured tobacco in a test where TSWV symptomatic plants exceeded 47 percent at 11 weeks after transplanting. Additional studies on rates and usage patterns of these materials are needed under different natural infection rates of TSWV to effectively evaluate these new thrips vector/TSWV management options.

Acknowledgments

The authors thank Neal Roberson, Del Taylor, Ryan Marchant, and Thomas Monk for technical support, and the Georgia Agricultural Commodity Commission for Tobacco for financial assistance.

Table 1. Insecticide treatment list and application rate (form./1,000 cells) for the 17 tray drench insecticides evaluated in flue-cured tobacco, Tift County, Ga., 2007.

Trt. No.	TD Insecticide Treatment	Rate
1	Untreated	
2	Admire Pro 4.6SC	0.8 oz.
3	Admire Pro 4.6SC + Actigard 50 WG	0.8
4	Alias 2F	1.8 oz.
5	Alias 2F + Actigard 50 WG	1.8
6	Couraze 2F	1.8 oz.
7	Couraze 2F + Actigard 50 WG	1.8
8	Imida E-AG 2F	1.8 oz.
9	Imida E-AG 2F + Actigard 50 WG	1.8
10	Macho 2F	1.8 oz.
11	Macho 2F + Actigard 50 WG	1.8
12	Nuprid 2F	1.8 oz.
13	Nuprid 2F + Actigard 50 WG	1.8
14	Torrent 2F	1.8 oz.
15	Torrent 2F + Actigard 50 WG	1.8
16	T-MOXX 2SC	1.3 oz.
17	T-MOXX 2SC + Actigard 50 WG	1.3

The tray drench treatments were applied in 10 gallons/100,000 cells. The Actigard was applied at a rate of 0.5 oz./50,000 cells on 11 April. The insecticide products were applied on 13 April and the NC-71 tobacco was transplanted on 19 April.

Table 2. Effects of selected insecticide tray drench treatments on the abundance of thrips on flue-cured tobacco foliage, Tift County, Ga., 2007.

	Thrips per four plants*		
Treatment	10 May	16 May	22 May
1. Untreated	6.6a	2.8a	2.4a-d
2. Admire Pro	5.2abc	0.6b	1.4bcd
3. Admire + Actigard	2.8abc	0.0b	0.6d
4. Alias 2F	6.8a	0.8b	3.4ab
5. Alias + Actigard	0.2c	0.4b	2.0a-d
6. Couraze 2F	6.0ab	0.0b	1.6bcd
7. Couraze + Actigard	2.4abc	1.2b	4.4a
8. Imida E-AG 2F	5.4abc	0.4b	3.0a-d
9. Imida + Actigard	5.0abc	0.4b	1.2bcd
10. Macho 2F	2.6abc	0.6b	2.4a-d
11. Macho + Actigard	3.0abc	0.4b	3.6ab
12. Nuprid 2F	4.6abac	0.0b	2.2a-d
13. Nuprid + Actigard	1.0bc	0.2b	3.2abc
14. Torrent 2F	1.4abc	0.0b	2.8a-d
15. Torrent + Actigard	1.6abc	0.0b	1.4bcd
16. T-Moxx 2SC	3.8abc	0.0b	3.2abc
17. T-Moxx + Actigard	6.4ab	0.0b	0.8cd

NC-71 flue-cured tobacco transplanted on 19 April. TD Actigard treatments applied on 11 April and insecticide treatments applied on 13 April at a rate of 10 gal./100,000 cells. Column means with the same letter are not significantly different (DMRT, P=0.05).

*Thrip populations were very low prior to 10 May and after 22 May (< one thrips per four plants).

Table 3. Effects of selected insecticide tray drench treatments on the cumulative % TSWV symptomatic plants in flue-cured tobacco, Tift Co., Ga., 2007.

Treatment	% TSWV symptomatic plants (WAT)			
	3 weeks	5 weeks	7 weeks	9 weeks
1. Untreated	1.2a	17.7a	42.3a	46.4a
2. Admire Pro	1.7a	11.5a	28.4bcd	32.5b-e
3. Admire + Actigard	0.6a	11.3a	26.8bcd	28.8b-e
4. Alias 2F	2.4a	9.7a	26.8bcd	28.7b-e
5. Alias + Actigard	1.2a	11.5a	22.1cd	24.9de
6. Couraze 2F	1.1a	9.3a	27.7bcd	32.1b-e
7. Couraze + Actigard	1.1a	11.5a	25.4cd	29.6b-e
8. Imida E-AG 2F	1.7a	12.2a	32.3a-d	35.1bcd
9. Imida + Actigard	1.7a	10.7a	28.3bcd	30.0b-e
10. Macho 2F	3.6a	11.4a	37.8ab	40.1ab
11. Macho + Actigard	0.6a	8.3a	23.4cd	27.8cde
12. Nuprid 2F	3.0a	12.3a	29.1bcd	33.8b-e
13. Nuprid + Actigard	0.6a	10.8a	31.1a-d	35.3bcd
14. Torrent 2F	3.4a	10.0a	28.2bcd	33.8b-e
15. Torrent + Actigard	6.5a	8.4a	21.5cd	24.9de
16. T-Moxx 2SC	1.8a	15.8a	32.5a-d	36.6a-d
17. T-Moxx + Actigard	2.2a	7.8a	20.3d	22.5e

NC-71 flue-cured tobacco transplanted on 19 April. TD Actigard treatments applied on 11 April and insecticide treatments applied on 13 April at a rate of 10 gal./100,000 cells. Column means with the same letter are not significantly different (DMRT, P=0.05).

Table 4. Cured yields, price index, and crop value of flue-cured tobacco treated with selected tray drench insecticides, Tift County, Ga., 2007.

Treatment	Yield lbs./acre	Price cwt	Crop value $$ per acre
1. Untreated	2351ab	112.50a	2645bc
2. Admire Pro	2792ab	126.20a	3524a
3. Admire + Actigard	2524ab	117.80a	2973abc
4. Alias 2F	2806ab	121.75a	3416ab
5. Alias + Actigard	2863a	123.65a	3540a
6. Couraze 2F	2783ab	119.20a	3117abc
7. Couraze + Actigard	2704ab	119.35a	3227abc
8. Imida E-AG 2F	2817ab	115.40a	3251abc
9. Imida + Actigard	2823ab	123.70a	3492ab
10. Macho 2F	2273b	111.00a	2523c
11. Macho + Actigard	2835ab	120.00a	3402ab
12. Nuprid 2F	2478ab	115.35a	2858abc
13. Nuprid + Actigard	2518ab	118.85a	2993abc
14. Torrent 2F	2769ab	122.10a	3104ab
15. Torrent + Actigard	2811ab	118.35a	3327abc
16. T-Moxx 2SC	2386ab	113.15a	2700bc
17. T-Moxx + Actigard	2880a	116.20a	3347abc

NC-71 flue-cured tobacco transplanted on 19 April. TD Actigard treatments applied on 11 April and insecticide treatments applied on 13 April at a rate of 10 gal./100,000 cells. Column means with the same letter are not significantly different (DMRT, P=0.05).

Evaluation of Alternative Compounds for Control of *Tomato spotted wilt virus* Bowen Farm, UGA-CPES, Tifton, Ga., 2007

A.S. Csinos, L.L. Hickman, L. Mullis, S.W. Mullis, M.G. Stephenson, and S.S. Lahue

Introduction

TSWV continues to be the greatest concern of Georgia tobacco growers. This trial was initiated to evaluate alternative compounds for management of Black Shank disease, and to compare them with a transgenic tobacco and Actigard - Admire standards.

Materials and Methods

The study was located at the Bowen Farm, CPES, Tifton, Ga., in a field with a history of crops such as corn, peanuts, tobacco, and assorted vegetables. The area was prepared using all current University of Georgia Cooperative Extension recommendations. The plot design was a randomized complete block consisting of single row plots replicated five times. Each plot was 37 feet long with 10-foot alleys between repetitions. On 24 January, tobacco variety NC-71 was seeded into 242 cell flats.

The Treatment #6 Nutriphite treatment was scheduled for application 30 days post-germination. Germination date for Treatment #6 seedlings was 01 February. On 02 March, Treatment #6 received a pre-transplant treatment of Nutriphite (8 oz./1,000 gal. float water), which was sprayed on using 0.946 ml. of material in four gal. of float water per flat. On 28 March, greenhouse pre-transplant treatments of Admire Pro and Actigard were applied. Treatments calling for both Admire Pro and Actigard 50 WDG were tank mixed, then washed in with 0.25 inches of water. Nutriphite pre-transplant greenhouse treatments were applied on 29 March at a rate of 1 pt./100 gal. water (150 ml. per flat) with 1 ml. of material mixed in 800 ml. water and sprayed to good coverage. Tobacco seedlings were transplanted on 03 April in plots on 44-inch rows with a 22-inch plant spacing.

Field treatments of Actigard 50WG were applied using a CO_2 sprayer with one TX-12 tip/row. Tips were angled at plants in a four- to six-inch band, with a 50-mesh ball check screen at the rate of 41 PSI for 10.26 gal. H_2O per acre. All treatments were mixed in three liters of water unless otherwise noted. Field sprays were triggered when the first symptom of TSWV infection was identified through scouting practices. Treatment #10 (10- to 11-week-old transplants) were sprayed with Paraquat 2 lb. ai/gal. H_20, 1 fl. oz./A using a CO_2 sprayer with one 80-8E tip/row. Tips were angled at plants in a four- to six-inch band, with a 50-mesh ball check screen at the rate of 32 PSI for 36.53 gal. H_2O per acre. Paraquat field sprays were applied on 09 April and 21 May.

Crop maintenance was achieved by using University of Georgia Cooperative Extension recommendations for the control of weeds, suckers, and insects. Chemicals used for maintenance of the crop were Orthene 97 at 0.5 lbs./A for insect control, Prowl 3.3 EC at 2 pts./A for weed control, and Royal MH-30 Xtra at 1.5 gal./A for sucker control. Three harvests were done, collecting a third of the plant at one time. Harvests were done on 29 June and 12 and 27 July.

Stand counts were conducted every seven days, and plants were flagged, noting percent disease from TSWV symptoms, from 17 April through 19 June. A final count was made on 19 June to determine the amount of plants killed by TSWV and the number of non-harvestable plants. Height measurements were conducted on 04 and 18 May and 04 June. Measurements were done in centimeters, measuring from the base of the plant to the tip of the longest leaf. Three vigor ratings were done on 04 and 07 May and 04 June. Vigor ratings were done on a 1-10 scale, with 10 equaling vigorous and healthy plants and 1 equaling poor vigor plants

Following the final harvest, root samples were collected 20 July from 10 plants per plot and an ELISA test was performed to determine TSWV percent positive. The screen for TSWV was accomplished by the use of double antibody sandwich-enzyme linked immunosorbent assay (DAS-ELISA) alkaline phosphatase antisera kits (Agdia, Inc., Elkhart, IN). Samples of ~1.0 grams were subjected to DAS-ELISA, and any sample eliciting an absorbance reading (A405) of three times the average plus two standard deviations of a healthy negative control were considered positive results.

Total rainfall recorded at the Bowen farm during this period (March through August) was 15.43 inches. Rainfall data was calculated by accessing the database of the Georgia Environmental Monitoring Network for the weather station located at the Bowen Farm, Tifton, Ga.

Summary

TSWV levels were moderate in this study, with infection rates ranging from a high of 34 percent to a low of nine percent. Although infection rates were moderate, the number of plants killed by TSWV was low. Thus, although plants were infected, the disease did not kill the plants and, at least in part, some yield was received from the infected plants.

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Table 1. Effects of alternative compound treatments on TSWV symptomatic plants, % non-harvestable plants, Average % TSWV, and % TSWV positive plants as identified through ELISA testing of root samples, Tifton, Ga., 2007

Treatment [1]	Greenhouse Treatment[2]	Field Application [3]	# TSWV symptomatic plants [4]	% Non-harvestable plants[5]	Average % TSWV[6]	% ELISA (+) Plants (roots)[7]
1. Non-treated control	*No greenhouse treatment*	*No greenhouse treatment*	25	3.2bcd	25.5abc	48.0
2. Admire Pro 4.6 SC	0.8 oz./1,000 plants	Actigard - ½ oz./A + Admire - 8 oz./A at 2 weeks post-plant	27	5.2a	33.7ab	47.9
3. Admire Pro 4.6 SC Nutri-Phite Magnum	0.8 oz./1,000 plants 1 pint/100 gal.*	No field treatment	32	4.2ab	37.0a	65.3
4. Admire Pro 4.6 SC Nutri-Phite Magnum	0.8 oz./1,000 plants 1 pint/100 gal.*	**Nutri-Phite** - 1 qt./A ***broadcast*** at 2, 4, 6 weeks post-transplant	19	4.0abc	17.3cd	38.0
5. Admire Pro 4.6 SC Nutri-Phite Magnum	0.8 oz./1,000 plants 1 pint/100 gal.*	**Nutri-Phite** - 1 qt./A ***banded*** at 2, 4, 6 weeks post-transplant	18	1.8de	16.1cd	32.0
6.Admire Pro 4.6 SC Nutri-Phite Magnum TriCard Rescue	0.8 oz./1,000 plants 8 oz./100 gal. to float water *No treatment*	**TriCard Rescue** -1 gal./100 gal. concentration applied at transplant, 14 days prior to lay-by, at lay-by, and (7) days before topping	20	1.8de	18.8cd	34.0
7. Admire Pro 4.6 SC TriCard Rescue	0.8 oz/1000 plants *No treatment*	**TriCard Rescue**-1gal/ 100gal concentration applied at transplant, 14 days prior to lay-by, at lay-by, and (7) days before topping	20	3.2bcd	23.5abc	42.0
8. Admire Pro 4.6 SC Actigard	0.8 oz./1,000 plants 2 gai./7,000 plants	*No field treatments*	16	3.0bcd	18.2cd	23.9
9. Admire Pro 4.6 SC Actigard	0.8 oz./1,000 plants 2 gai./7,000 plants	**Actigard** ½ oz./A at first symptom	19	2.0de	19.9cd	24.0

10.Admire Pro 4.6 SC Actigard	0.8 oz./1,000 plants 2 gai./7,000 plants	**Nutri-Phite** 1qt. broadcast at 2, 4, 6 weeks post-transplant	18	2.2d	18.7cd	18.0
11.Admire Pro 4.6 SC Actigard	0.8 oz./1,000 plants 2 gai./7,000 plants	**Kaolin** applied at 1st symptom then bi-weekly through topping	13	2.4d	14.0cd	24.5
12.Admire Pro 4.6 SC Actigard	0.8 oz./1,000 plants 2 gai./7,000 plants	Actigard and Admire post-plant drench	14	2.4d	20.6bcd	28.0
13. Transgenic	*No greenhouse treatment*	*No field treatment*	12	0.6e	8.7d	18.8
14. Vydate	Actigard and Admire	2 qts. at 2, 4, and 6 weeks banded application	18	2.6cd	17.9cd	40.4

[1] Data are means of five replications. Means in the same column followed by the same letter are not significantly different (P=0.05) according to Fisher's LSD test.

[2] All Actigard and Admire Pro treatments were applied as pre-plant treatments in the greenhouse at a rate of 2 gai./7,000 plants-Actigard and 1.0 oz./1,000 plants-Admire Pro. Tobacco variety was K326.

[3] Field treatments consisted of Actigard 50WG applications that were applied when first symptoms of TSWV were observed in field plots. First symptom field applications were applied on 25 April.

[4] Cumulative number of TSWV infected plants that were flags during weekly stand counts. Stand counts were conducted beginning 09 April through 19 June, 2007.

[5] Plants that were flagged as TSWV infected were inspected to determine whether they had leaves that showed no symptoms that could be considered harvestable. Those with no harvestable leaves were counted and recorded.

[6] Percent TSWV was calculated by using stand counts that were made from 09 April through 19 June with TSWV being recorded and flagged every seven days. Cumulative number of TSWV infected plants that were flags during weekly stand counts.

[7] Final harvest testing was completed on 24 July. Ten root samples were collected per plot. ELISA testing was performed in the lab using double antibody sandwich-enzyme linked immunosorbent assay (DAS-ELISA) alkaline phosphatase antisera kits. ELISA test results are percent positive plants.

Table 2. Effects of alternative compound treatments on plant vigor, plant heights, and yield (lbs./acre) Bowen Farm, Tifton, Ga., 2007

Treatment [1]	Greenhouse Treatment[2]	Field Application[3]	Vigor[4]	Plant Height[5]	Dry Weight Yield[6]
1. Non-treated control	*No greenhouse treatment*	*No greenhouse treatment*	8.5a	54.5a	2832.5ab
2. Admire Pro 4.6 SC	0.8 oz./1,000 plants	Actigard - ½ oz./A + Admire- 8 oz./A at 2 weeks post-plant	7.1def	51.0ab	2411.3bc
3. Admire Pro 4.6 SC Nutri-Phite Magnum	0.8 oz./1,000 plants 1 pint/100 gal.*	*No field treatment*	8.2abc	49.4abc	2559.6bc
4. Admire Pro 4.6 SC Nutri-Phite Magnum	0.8 oz./1,000 plants 1 pint/100 gal.*	**Nutri-Phite** - 1 qt./A ***broadcast*** at 2, 4, 6 weeks post-transplant	7.7a-d	43.8bcd	2541.7bc
5. Admire Pro 4.6 SC Nutri-Phite Magnum	0.8 oz./1,000 plants 1 pint/100 gal.*	**Nutri-Phite** - 1 qt./A ***banded*** at 2, 4, 6 weeks post-transplant	7.0d-g	42.3cd	2699.4abc
6.Admire Pro 4.6 SC Nutri-Phite Magnum TriCard Rescue	0.8 oz./1,000 plants 8 oz./100 gal. to float water *No treatment*	**TriCard Rescue** - 1 gal./100 gal. concentration applied at transplant, 14 days prior to lay-by, at lay-by, and 7 days before topping	7.6b-e	42.7cd	2878.1ab
7. Admire Pro 4.6 SC TriCard Rescue	0.8 oz/1000 plants *No treatment*	**TriCard Rescue** - 1 gal./100gal. concentration applied at transplant, 14 days prior to lay-by, at lay-by, and 7 days before topping	7.8a-d	45.1bcd	2505.7bc
8. Admire Pro 4.6 SC Actigard	0.8 oz./1,000 plants 2 gai./7,000 plants	*No field treatments*	6.2fg	39.7de	2874.2ab
9. Admire Pro 4.6 SC Actigard	0.8 oz./1,000 plants 2 gai./7,000 plants	**Actigard** - ½ oz./A at first symptom	6.8d-g	41.3d	2741.8abc
10.Admire Pro 4.6 SC Actigard	0.8 oz./1,000 plants 2 gai./7,000 plants	**Nutri-Phite** - 1 qt. broadcast at 2, 4, and 6 weeks post-transplant	6.0g	33.4e	2271.2c
11.Admire Pro 4.6 SC Actigard	0.8 oz./1,000 plants 2 gai./7,000 plants	Kaolin applied at 1st symptom bi-weekly through topping	6.6efg	39.6de	2595.2bc

12. Admire Pro 4.6 SC Actigard	0.8 oz./1,000 plants 2 gai./7,000 plants	Actigard and Admire post-plant drench	6.5fg	41.4d	2807.9ab
13. Transgenic	*No greenhouse treatment*	*No field treatment*	8.7a	54.0a	3141.9a
14. Vydate	Actigard and Admire	2 qts. at 2, 4, and 6 weeks banded application	7.2c-f	40.2de	2636.7bc

[1] Data are means of five replications. Means in the same column followed by the same letter are not significantly different (P=0.05) according to Fisher's LSD test.

[2] All Actigard and Admire Pro treatments were applied as pre-plant treatments in the greenhouse at a rate of 2 gai./7,000 plants-Actigard and 1.0 oz./1,000 plants-Admire Pro. Tobacco variety was K326.

[3] Field treatments consisted of Actigard 50WG applications that were applied when first symptoms of TSWV were observed in field plots. First symptom field applications were applied on 25 April.

[4] Height measurements were done in inches from the soil level to the tip of the longest leaf. Height measurements were done on 04 and 18 May and 04 June.

[5] Vigor ratings were done on a 1-10 scale, with 10=live and healthy plants and 1= dead plants on 04 and 18 May and 04 June, 2007.

[6] Dry weight yield was calculated by multiplying green weight totals by 0.15. Pounds per acre was calculated by multiplying dry weight conversion per plot by 6,491 divided by the base stand count. Tobacco was planted in 44-inch rows, with 22 inches between plants, which equals 6,491 plants/A.

Influence of Early-Season Thrips Suppression on *Tomato spotted wilt virus* Symptomatic Expression in Flue-Cured Tobacco

R.M. McPherson

Introduction

Thrips continue to increase in importance as economic pests of flue-cured tobacco because of their ability to vector *Tomato spotted wilt virus* (TSWV). This thrips-borne disease costs Georgia tobacco producers millions of dollars in lost revenue annually. The most common thrips vector on tobacco foliage is the tobacco thrips, *Frankliniella fusca* (Hinds), but other, less-abundant species are also confirmed as vectors of TSWV. Previous research indicates that the early-season thrips infestations and virus infections are the most economically damaging to the crop. This study was conducted to further investigate the significance of early-season thrips suppression and its impact on the seasonal incidence of TSWV symptomatic plants in flue-cured tobacco. Orthene foliar sprays for thrips suppression were applied to tobacco plants for varying periods up to either four, six, or eight weeks after transplanting. Weekly incidence of TSWV was compared between the thrips suppression periods plus the unsprayed tobacco plants.

Materials and Methods

Flue-cured tobacco, variety K-326, was transplanted on 19 March at on the Coastal Plain Experiment Station Bowen Farm in Tifton, Ga. Production practices were used according to University of Georgia Cooperative Extension guidelines for weed control, disease control, nematode suppression, and fertilization.

Four days before transplanting, one-half of the greenhouse-produced transplants were treated with tray drench (TD) treatments of Admire Pro 4.6 at a rate of 1.0 fl. oz./1,000 transplants and one-half of the transplants were left untreated. At transplanting, 24 field plots, six rows wide (44-inch row spacing) by 50 feet long were established in a split-plot arrangement, with one-half of these plots (three rows) planted with Admire-treated plants and one-half (three rows) planted with untreated plants. These split plots were arranged in an RCBD with four replications and were randomly assigned one of six main plot Orthene foliar treatments: (1) No Orthene; (2) Orthene weekly for the first four weeks after transplanting; (3) Orthene weekly for six weeks; (4) Orthene weekly for eight weeks; (5) Orthene weekly for four weeks once sticky traps averaged four *F. fusca* per trap; and (6) Orthene weekly for six weeks once sticky traps averaged eight *F. fusca* per trap.

The Orthene was applied at a rate of 0.75 lbs. AI/acre each week for the specified time period for each treatment. A CO_2-powered backpack sprayer delivering 8.7 gpa at 40 psi was used to apply the Orthene with a single TX-12 nozzle directed over the center of the row. The number of live thrips on plants 12, 14, 16, and 18 on row two of each split-plot were counted weekly from early April to late May, when the plants were topped. All plants in each plot were visually examined weekly for symptoms of TSWV during this same sampling period. Symptomatic plants were flagged and dated and the cumulative percentage of symptomatic plants was determined. From mid-June to late July, all plants on row two of each plot were harvested with a mechanical harvester a total of three times. Each harvest sample was cured and weighed. In early September, each sample was graded by USDA graders. A price index (dollars per one hundred pounds) was assigned to each graded sample. All insect count, TSWV, yield, grade, and price data were subjected to Analysis of Variance (P=0.05) and treatment means were separated using the Waller-Duncan K-ratio test.

Results and Discussion

Suppressing thrips with weekly foliar Orthene sprays significantly reduced the seasonal incidence of TSWV when the foliar sprays continued for six and eight weeks after transplanting (Table 1). Tobacco thrips catches on sticky cards were very low at one week after transplanting but reached four per trap on week two. Thus, Treatment #5 was sprayed with Orthene on week two after transplanting, and continued with foliar sprays through week five. On week three, *F.*

fusca captures on sticky traps averaged more than eight per trap, so Treatment #6 was sprayed with Orthene on week three and continued with weekly Orthene sprays through week eight. The Admire TD was also effective in reducing TSWV through late May (Table 1). Thrips population densities were lower on 10 April (three weeks after transplanting) in the Orthene-treated plots compared to the no Orthene plots (Table 2). On 2 May, most of the Orthene treatments also had lower thrips populations than the no Orthene treatment. Thrips populations also were lower in the Admire TD treatment on 10 May (Table 2). It is interesting to note that thrips population densities were very low in all plots throughout April even though this test site was planted relatively early (19 March). However, thrips densities rapidly increased on 2 May (six weeks after transplanting) in the untreated and Orthene W1-4 plots, then thrips rapidly declined. Aphid populations were low at this test site throughout the entire growing season, and no treatment differences were observed. Cured yields, price index, and crop value were similar between the Orthene foliar sprays (Table 3). There also were no Admire TD effects in yield, price, or value (Table 3).

In conclusion, suppressing thrips with weekly Orthene sprays for six to eight weeks after transplanting helps reduce TSWV, but Admire TD alone was just about as affective as these six to eight weekly Orthene foliar sprays at this test site in 2007. In previous years, the Orthene foliar sprays also have been effective in reducing the seasonal incidence of TSWV. Growers are advised not to spray their newly transplanted crop weekly for six to eight weeks to suppress TSWV due to environmental concerns plus the likelihood of developing Orthene resistance with such an excessive exposure of this very dependable tobacco insecticide.

Acknowledgments

The author would like to thank Neal Roberson and Del Taylor for their technical assistance, Mike Stephenson and Stevan LaHue for maintaining and harvesting the field plots, and the Georgia Agricultural Commodity Commission for Tobacco and the Georgia Agricultural Experiment Stations for financial support.

Table 1. Cumulative percentage TSWV symptomatic tobacco plants treated with a greenhouse tray drench of Admire Pro and different weekly durations of Orthene 97PE foliar sprays, Tift County, Ga., 2007.

Treatment and duration*	% TSWV symptomatic plants (Weeks AT)			
	5 weeks	7 weeks	9 weeks	11 weeks
	Foliar Orthene Effects (0.75 lbs. AI/acre)			
No Orthene	4.7a	8.8a	11.6a	17.5a
Weeks 1-4	2.6a	5.2ab	8.6ab	13.0ab
Weeks 1-6	4.1a	6.2ab	8.3ab	12.7ab
Weeks 1-8	2.0a	4.5b	5.8b	10.7b
Weeks 2-5	3.1a	5.8ab	8.1ab	14.0ab
Weeks 3-8	3.0a	6.4ab	8.3ab	12.6ab
	Admire TD Effects (1.0 oz. per 1,000 cells)			
Admire	1.3b	4.0b	5.6b	10.7b
No Admire	5.2a	8.3a	11.3a	16.1a

K-326 flue-cured tobacco transplanted on 19 March. The tray drench (TD) Admire Pro was applied on 15 March. Column means with the same letter are not significantly different (Waller-Duncan k-ratio t-test, P=0.05).

*Duration indicates when the Orthene foliar sprays were applied (e.g., weeks 1 through 4 were applied at 1, 2, 3, and 4 weeks after transplanting). The weeks 2 through 5 treatment was initiated when tobacco thrips catches in sticky traps averaged 4 per trap (2 April), and the weeks 3 to 8 treatment was initiated when tobacco thrips catches in sticky traps averaged 8 per trap (9 April).

Table 2. Incidence of thrips on flue-cured tobacco foliage treated with a greenhouse tray drench of Admire Pro and different weekly durations of Orthene 97PE foliar sprays, Tift County, Ga., 2007.

Treatment and duration*	Thrips per four plants						
	4 Apr	10 Apr	18 Apr	25 Apr	2 May	10 May	16 May
	Foliar Orthene Effects (0.75 lbs. AI / acre)						
No Orthene	0.7a	1.5a	6.3a	3.9a	31.7a	11.0a	2.3a
Weeks 1-4	0.7a	0.0b	4.8a	2.1a	17.8ab	8.3a	2.1a
Weeks 1-6	0.5a	0.0b	7.8a	2.8a	2.9b	9.6a	1.5a
Weeks 1-8	0.6a	0.0b	3.5a	2.9a	4.4b	10.4a	2.9a
Weeks 2-5	0.5a	0.0b	3.5a	1.7a	9.3b	9.8a	0.3a
Weeks 3-8	1.0a	0.0b	5.0a	3.3a	8.5b	6.1a	0.9a
	Admire TD Effects (1.0 oz. per 1,000 cells)						
Admire	0.7a	0.3a	5.2a	2.8a	16.2a	5.5b	1.9a
No Admire	0.7a	0.3a	5.1a	2.6a	8.5a	12.9a	1.4a

K-326 flue-cured tobacco transplanted on 19 March. The tray drench (TD) Admire Pro was applied on 15 March. Column means with the same letter are not significantly different (Waller-Duncan k-ratio t-test, P=0.05).

*Duration indicates when the Orthene foliar sprays were applied (e.g., weeks 1 through 4 were applied at 1, 2, 3, and 4 weeks after transplanting. The weeks 2 through 5 treatment was initiated when tobacco thrips catches in sticky traps averaged 4 per trap (2 April), and the weeks 3 through 8 treatment was initiated when tobacco thrips catches in sticky traps averaged 8 per trap (9 April).

Table 3. Cured yield, mean price index (CWT) for average grade, and crop value of flue-cured tobacco treated with Admire Pro tray drench (TD) and different weekly durations of Orthene 97PE foliar sprays, Tift County, Ga., 2007.

Treatment and duration*	Yield Lbs./acre	Price CWT	Crop value $ per acre
	Foliar Orthene Effects (0.75 lbs. AI/acre)		
No Orthene	2165.8a	144.78a	$3136a
Weeks 1-4	2267.2a	144.78a	3282a
Weeks 1-6	2413.1a	143.69a	3516a
Weeks 1-8	2274.4a	139.31a	3168a
Weeks 2-5	2210.0a	142.78a	3155a
Weeks 3-8	2268.1a	143.44a	3253a
	Admire TD Effects (1.0 oz. per 1,000 cells)		
Admire	2271.5a	143.25a	3254a
No Admire	2261.3a	143.01a	3234a

K-326 flue-cured tobacco transplanted on 19 March. The tray drench (TD) Admire Pro was applied on 15 March. Column means with the same letter are not significantly different (Waller-Duncan k-ratio t-test, P=0.05).

*Duration indicates when the Orthene foliar sprays were applied (e.g., weeks 1 through 4 were applied at 1, 2, 3, and 4 weeks after transplanting. The weeks 2 through 5 treatment was initiated when tobacco thrips catches in sticky traps averaged 4 per trap (2 April), and the weeks 3 through 8 treatment was initiated when tobacco thrips catches in sticky traps averaged 8 per trap (9 April).

Influence of Nitrogen Fertility Level on Insect Populations, Suppression of Spotted Wilt Symptoms, and Plant Growth of Flue-Cured Tobacco

Y. Chen, J.R. Ruberson, and R.M. McPherson

Introduction

Nitrogen fertility level directly impacts the growth and development of flue-cured tobacco, which can also influence the incidence of certain insect pests and pathogens. Thrips continue to increase in importance as economic pests of flue-cured tobacco because of their ability to vector *Tomato spotted wilt virus* (TSWV). This thrips-borne disease costs Georgia tobacco producers millions of dollars in lost revenue annually. The most common thrips vector on tobacco foliage is the tobacco thrips, *Frankliniella fusca* (Hinds), but other, less abundant, species are also confirmed as vectors of TSWV. Tobacco budworms and tobacco hornworms also cause economic losses to Georgia's tobacco crop each year. Aphids can be an economic pest of flue-cured tobacco, especially when the crop is not treated with imidacloprid to suppress thrips and TSWV. This study was conducted to investigate the impact of the nitrogen fertility level on the seasonal abundance of some common insect pests and natural enemies, as well as the incidence of TSWV symptomatic plants in flue-cured tobacco. Weekly insect counts and incidence of TSWV were compared between four nitrogen fertility levels throughout the season.

Materials and Methods

Flue-cured tobacco variety K-326 was transplanted on 21 March at the Coastal Plain Experiment Station Bowen Farm in Tifton, Ga. Production practices were used according to University of Georgia Cooperative Extension guidelines for weed control, disease control, and nematode suppression. Nitrogen fertility level included rates of 30, 60, 90, or 120 lbs./acre. At transplanting, 32 field plots, five rows wide (44-inch row spacing) by 30 feet long were arranged in an RCBD with eight replications. Four fertility treatments included 30 lbs. of N/acre applied in 500 lbs. of 6-6-18 on 27 April; 60 lbs. of N/acre applied in 500 lbs. of 6-6-18 on 5 and 27 April; 90 lbs. of N/acre applied in 500 lbs. of 6-6-18 on 5 and 27 April plus 7 May; and 120 lbs. of N/acre applied in 500 lbs. of 6-6-18 on 5 and 27 April and 7 May plus 188 lbs. of 16-0-0 on 14 May.

The number of live thrips and aphids on plants two, four, six, and eight on row two of each plot were counted weekly from mid-April to late May, when the plants were topped. All plants in each plot were visually examined weekly for symptoms of TSWV during this same sampling period. Symptomatic plants were flagged and dated and the cumulative percentage of symptomatic plants was determined. From mid-June to late July, all plants on row three of each plot were harvested with a mechanical harvester a total of three times. All insect counts, TSWV, and yield data were subjected to Analysis of Variance (P=0.05) and treatment means were separated using the Waller-Duncan K-ratio test.

In addition to the above samples, each plot was walked through once each week from 13 April until 7 June and all individuals of the parasitoid *Toxoneuron* (=*Cardiochiles) nigriceps* that were observed foraging within the plots were calculated. Five plants in row four of each plot were examined weekly from 13 April until 7 June for eggs and larvae of tobacco hornworms, *Manduca sexta*, and of tobacco budworms, *Heliothis virescens*, and other insects, including beneficial species. The numbers of all individuals were recorded, along with the stages in which they were found. Data were evaluated by date among treatments using a repeated measures one-way ANOVA (with $p<0.05$ deemed significant), with significantly different means observed on specific dates being separated using the Waller-Duncan Bayesian *k* ratio.

Results and Discussion

Nitrogen fertility level had very little effect on thrips population densities (Table 1). Thrips populations were relatively low throughout the entire sampling period, except early May, when as many as 32 thrips per four plants were observed. Tobacco aphid densities were higher in the 90 and 120 lbs. N rates on 22 May and in the 120 N rate on 29 May than aphid densities in the 30 and 60 lbs. rates (Table 2). Differences in TSWV symptomatic plants were observed between the nitrogen rates at seven, nine, and 11 weeks after

transplanting (Table 3). The 90 lbs. N rate had a higher percentage of TSWV than the other three N rates on these dates. Yields were not different between the nitrogen fertility rates (Table 3). Yields were lower than expected in all the N treatments due to the high levels of TSWV (ranging from 42 to 50 percent).

Other pest populations exhibited little change in response to nitrogen levels. Tobacco flea beetle adults, *Epitrix hirtipennis*, were significantly affected by nitrogen treatment on one sample date (20 April; $F_{3,28}$=2.57, P=0.0161) (Figure 1), when fewest beetles were found in the 30 lb. nitrogen plots, although there was no clear pattern for abundance in the other treatment plots. However, on this date, all of the plots had received only 30 lbs. of nitrogen, regardless of nitrogen treatment, so there were in reality no treatment differences among the plots and the significant difference cannot be related to nitrogen level.

Among the caterpillar pests, tobacco budworm egg and larval populations were unaffected by nitrogen treatment (Figures 2a and 2b). Tobacco hornworm egg abundance was marginally different among treatments on two dates (Figure 3a) — 11 May ($F_{3,28}$=2.87, P=0.0542) and 7 June ($F_{3,28}$=2.77, P=0.0598) — but in both cases, there were no clear patterns indicating preference. On both dates, the fewest eggs were observed in the 90 lb. nitrogen treatment, but most eggs were found in the 60 lb. treatment on 11 May, whereas most eggs were found in the 120 lb. treatment on 7 June. Larval hornworm populations were unaffected by nitrogen levels (Figure 3b).

Foraging *T. nigriceps* parasitoid numbers were unaffected by nitrogen level (Figure 4), regardless of date. The abundance of the wasps peaked significantly in all plots on 31 May, which corresponds with a large amount of oviposition by tobacco budworm moths (Figure 2a), the preferred host of the parasitoid.

In conclusion, the nitrogen fertility rate did impact TSWV and aphid populations in tobacco. However, nitrogen level had little or no impact on the seasonal abundance of thrips, other arthropods, and yield (due to high TSWV in all N rates). There were some specific dates on which significant differences in numbers of certain insect species were observed, with the highest numbers occurring in the highest nitrogen treatment.

Acknowledgments
The authors would like to thank Neal Roberson, Del Taylor, and Melissa Thompson for their technical assistance, Mike Stephenson and Stevan LaHue for maintaining and harvesting the field plots, and the Georgia Agricultural Commodity Commission for Tobacco and the Georgia Agricultural Experiment Stations for financial support.

Table 1. Impact of nitrogen fertility level on the seasonal abundance of thrips on flue-cured tobacco foliage, Tift County, Ga., 2007.

N rates	Mean thrips per four plants					
lbs. / acre	10 Apr	18 Apr	25 Apr	2 May	10 May	16 May
30 lbs.	1.1a	3.1a	8.8a	11.6b	20.8a	1.5a
60 lbs.	0.1a	1.3a	15.1a	15.4ab	17.0a	0.8a
90 lbs.	0.6a	4.8a	10.0a	32.3a	28.4a	0.5a
120 lbs.	0.3a	5.4a	6.5a	32.1a	33.9a	1.8a

K-326 flue-cured tobacco transplanted on 21 March. Column means with the same letter are not significantly different (Waller-Duncan k-ratio t-test, P=0.05).

Table 2. Impact of nitrogen fertility level on the seasonal abundance of aphids on flue-cured tobacco foliage, Tift County, Ga., 2007.

N rates	Mean aphids per four plants					
lbs. / acre	25 Apr	2 May	10 May	16 May	22 May	29 May
30 lbs.	0.8a	0.5a	0.8b	20.6a	12.3b	21.9b
60 lbs.	1.4a	0.5a	18.6b	14.3a	44.3b	21.1b
90 lbs.	0.8a	1.0a	31.6b	36.4a	266.4a	56.0b
120 lbs.	2.0a	0.3a	99.3a	66.3a	226.6a	354.6a

K-326 flue-cured tobacco transplanted on 21 March. Column means with the same letter are not significantly different (Waller-Duncan k-ratio t-test, P=0.05).

Table 3. Effects of nitrogen fertility level on the cumulative percentage of TSWV symptomatic plants and cured yield in flue-cured tobacco, Tift County, Ga., 2007.

N rates	% TSWV (Weeks after transplanting)					Yield
lbs. / acre	3 wk	5 wk	7 wk	9 wk	11wk	lbs./a
30 lbs.	4.9a	12.5a	27.2b	36.2b	44.8b	1526a
60 lbs.	3.0a	12.7a	26.3b	35.0b	42.3b	1628a
90 lbs.	4.9a	15.3a	33.6a	42.3a	50.1a	1558a
120 lbs.	2.9a	13.3a	26.2b	33.8b	42.8b	1891a

K-326 flue-cured tobacco transplanted on 21 March. Column means with the same letter are not significantly different (Waller-Duncan k-ratio t-test, P=0.05).

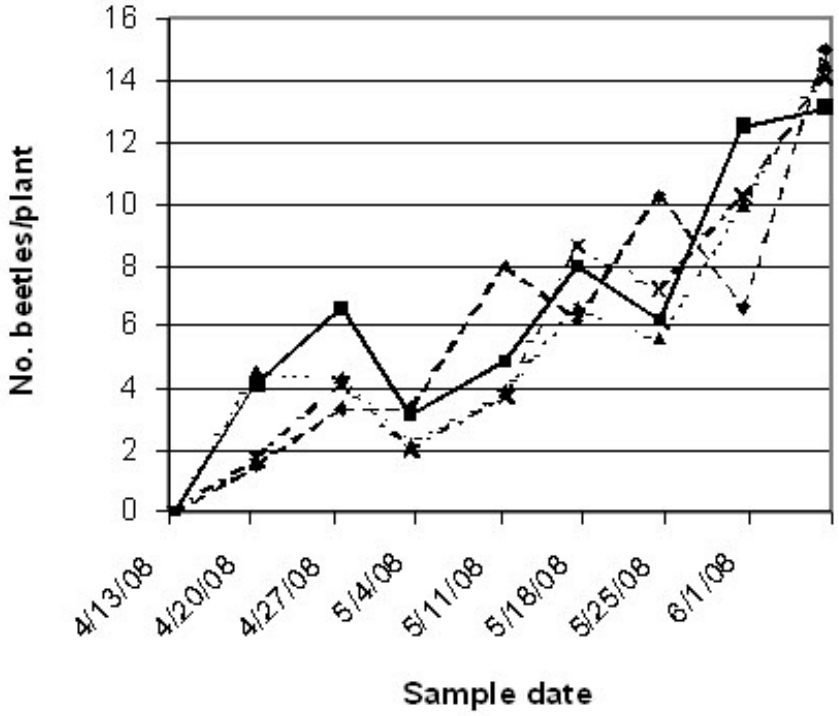

Figure 1. Abundance of adult tobacco flea beetles in each treatment during the growing season, 2007. Asterisk denotes significant differences among treatments on sample date. Dashed line with diamond marker is 30 lbs. N, solid line with square marker is 60 lbs. N, dotted line with triangle marker represents 90 lbs. N, and dashed line with X marker indicates 120 lbs. N. No significant differences were observed among treatments on any date.

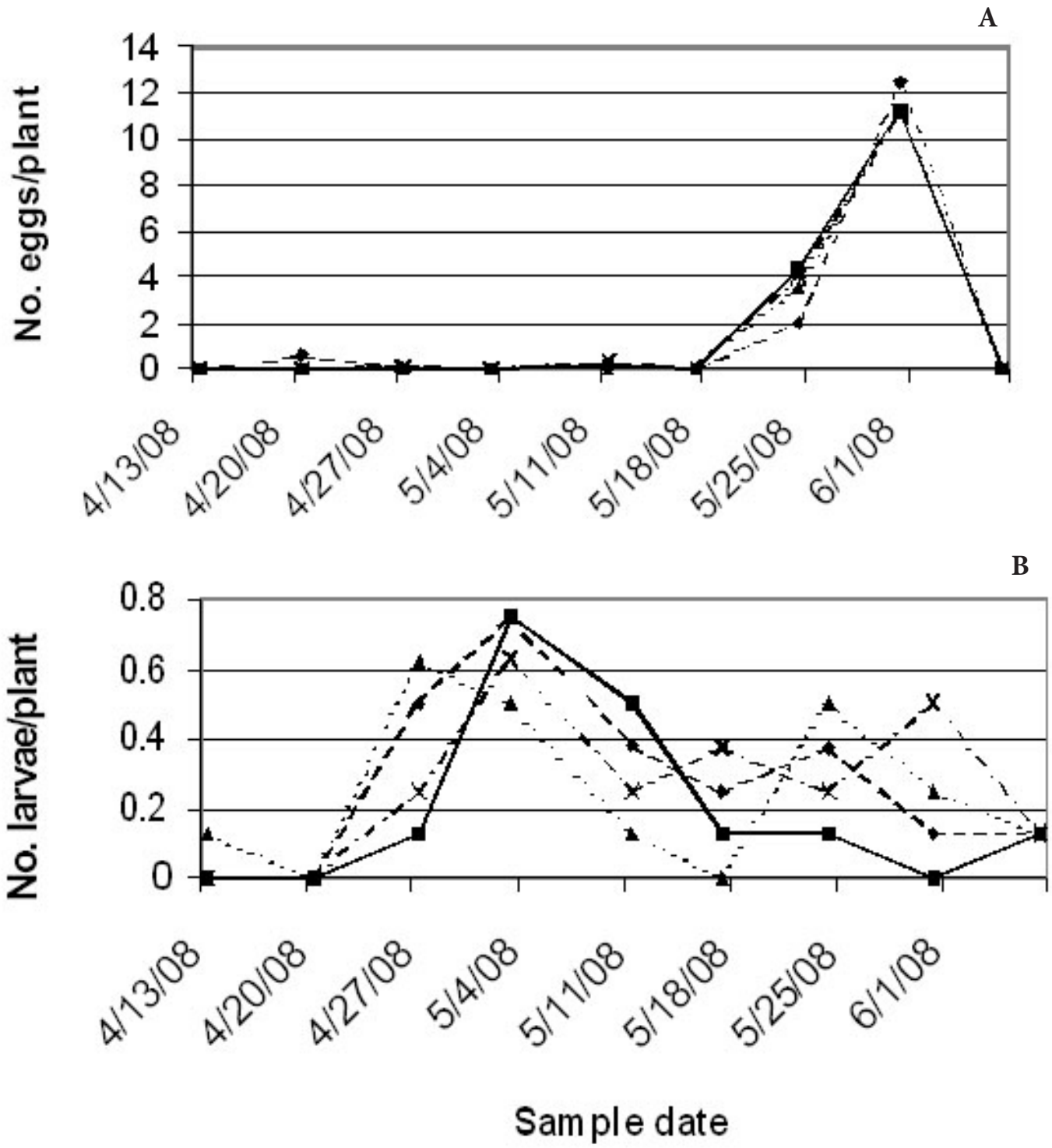

Figure 2. Abundance of tobacco budworm eggs (A) and larvae (B) in each treatment during the growing season. No significant differences were observed among treatments on any date. Dashed line with diamond marker is 30 lbs. N, solid line with square marker is 60 lbs. N, dotted line with triangle marker represents 90 lbs. N, and dashed line with X marker indicates 120 lbs. N. No significant differences were observed among treatments on any date.

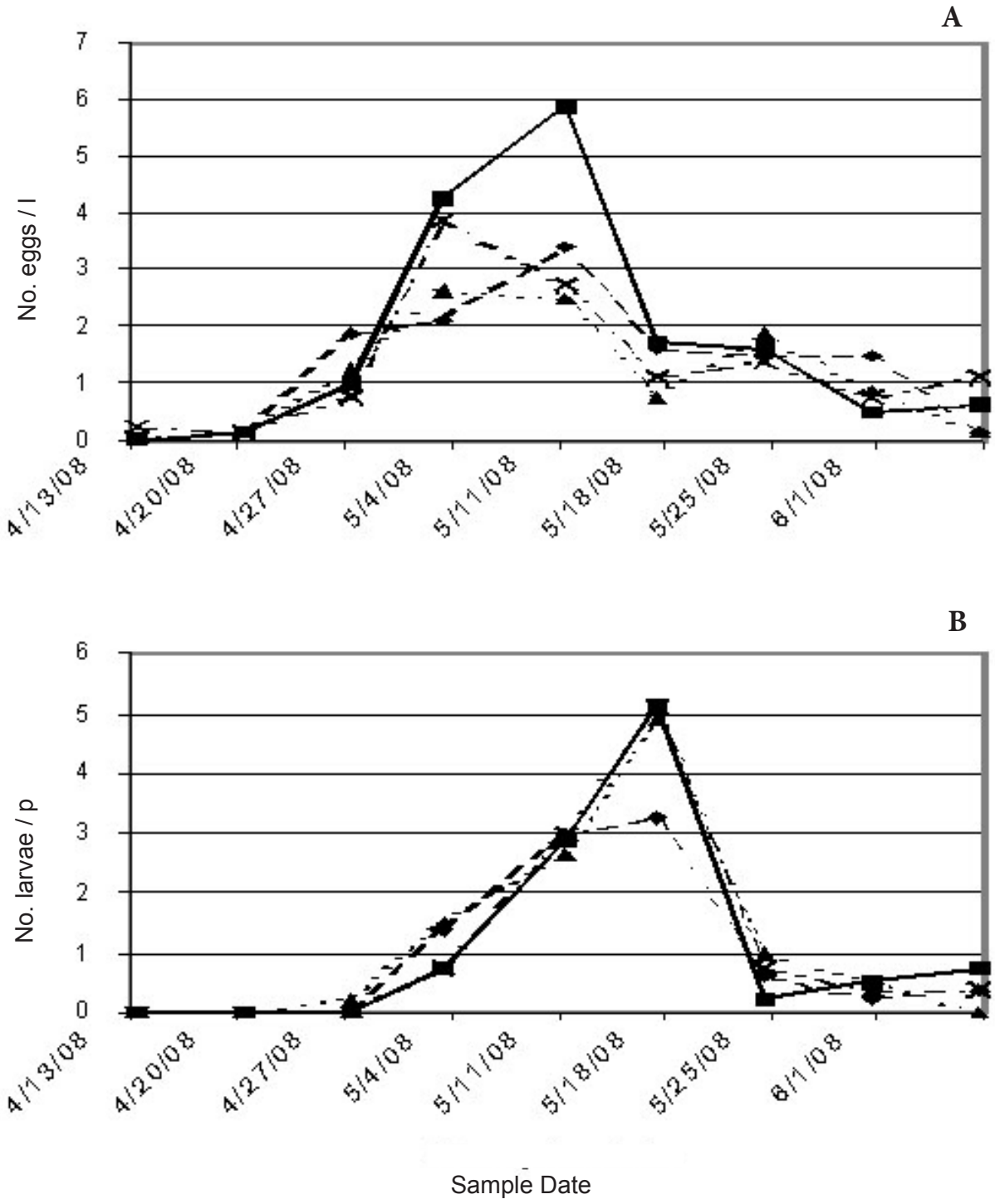

Figure 3. Abundance of tobacco hornworm eggs (A) and larvae (B) in each treatment during the growing season. Asterisks indicate marginally significant differences (0.05<P<0.10) on labeled date. Dashed line with diamond marker is 30 lbs. N, solid line with square marker is 60 lbs. N, dotted line with triangle marker represents 90 lbs. N, and dashed line with X marker indicates 120 lbs. N. No significant differences were observed among treatments on any date.

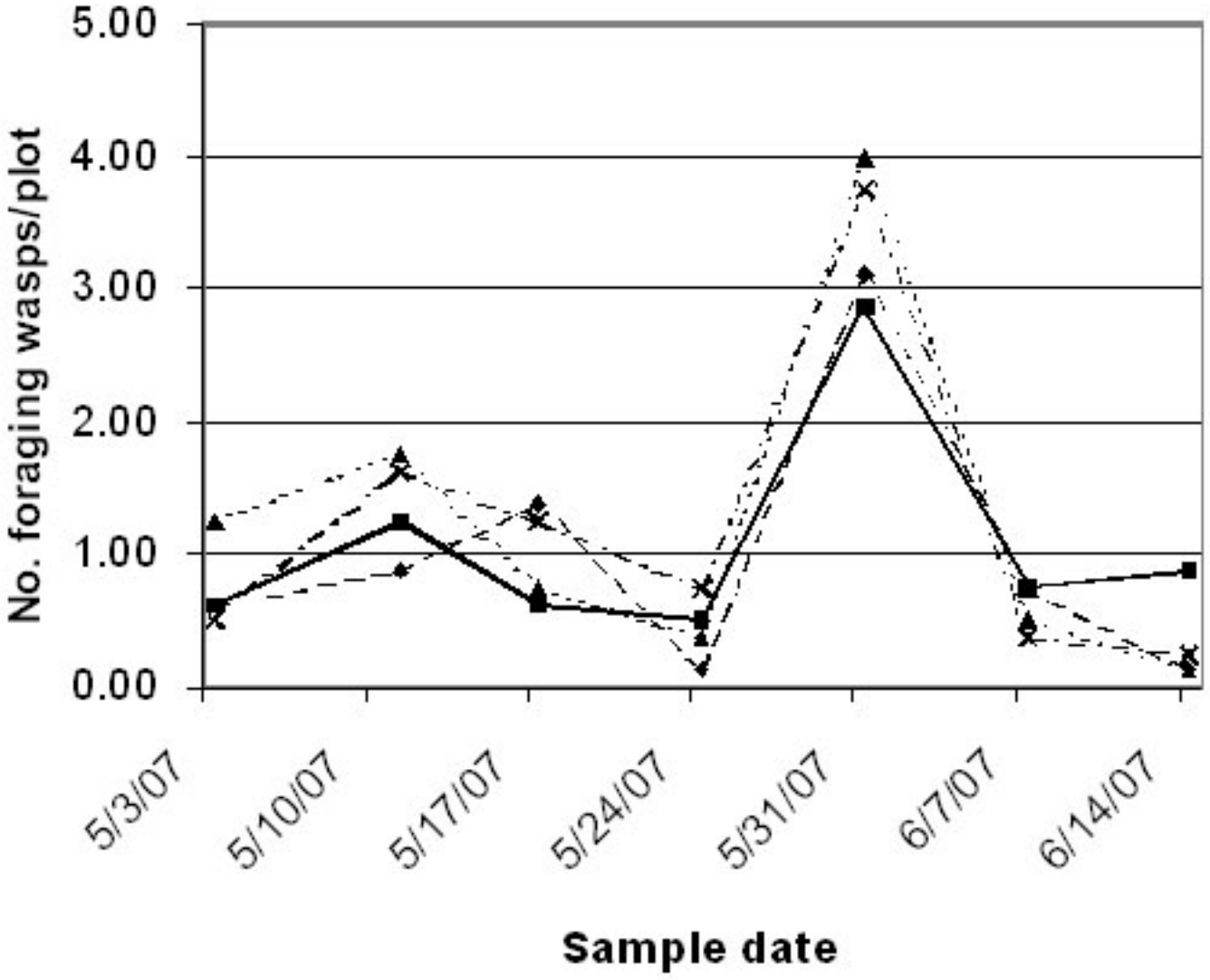

Figure 4. Number of adult Toxoneuron nigriceps wasps observed foraging in each treatment during the growing season. Dashed line with diamond marker is 30 lbs. N, solid line with square marker is 60 lbs. N, dotted line with triangle marker represents 90 lbs. N, and dashed line with X marker indicates 120 lbs. N. No significant differences were observed among treatments on any date.

Tobacco Transplant Management Study for Control of *Tomato spotted wilt virus* Bowen Farm UGA-CPES Tifton, Ga., 2007

A.S. Csinos, L.L. Hickman, L. Mullis, S.W. Mullis, M.G. Stephenson, and S.S. Lahue

Introduction

Tomato spotted wilt virus (TSWV) continues to be one of Georgia tobacco's greatest problems. The cost of management is high and current management materials may not provide adequate control of the disease. This study was designed to evaluate alternative materials for management of TSWV in flue-cured tobacco.

Materials and Methods

The study was located at the University of Georgia's Bowen Farm – CPES in Tifton, Ga., in a field with a history of crops such as peanuts, tobacco, and assorted vegetables. The area was prepared using current University of Georgia Cooperative Extension recommendations. The plot design was a randomized complete block consisting of single row plots replicated five times. Each plot was 37 feet long with 10-foot alleys between repetitions.

On 09 January, tobacco variety NC-71 was seeded into 242 cell flats for 10- to 11-week-old transplants. Tobacco variety NC-71 for seven-week old transplants was seeded into 242-cell flats on 08 February.

According to treatment list, transplants were either not clipped or received multiple clippings while growing out in the greenhouse. Clipping dates for the seven-week-old transplants were 19 and 26 March. Clipping dates for the 10- to 11-week-old transplants were 22 February and 05, 12, 19, and 26 March.

On 28 March, Treatments #4, 5, 7, and 9 received pre-plant treatments of Admire Pro and Actigard 50WDG sprayed in 200 ml. of water per flat. Treatments that called for both Admire Pro and actigard 50 WG were tank mixed and washed in with 0.25 inches of water. Tobacco seedlings were transplanted on 03 April in plots on 44-inch rows with a 22-inch plant spacing. Treatments #1 and #12 (10- to 11-week-old transplants) had all leaves removed from plants with the exception of the apical bud. Field treatments of Actigard 50 WG were applied using a CO_2 sprayer with one TX-12 tip/row. Tips were angled at plants in a four- to six-inch band, with a 50-mesh ball check screen at the rate of 41 PSI for 10.26 gal. H_2O per acre. All treatments were mixed in three liters of water unless otherwise noted.

Treatments #3, 4, 6, 8, and 11 received a field application on 25 April. Field sprays were triggered when the first symptom of TSWV infection was identified through scouting practices. Treatment #10 (10- to 11-week-old transplants) were sprayed with Paraquat 2 lb. ai/gal. H_2O, 1 fl. oz./A using a CO_2 sprayer with one 80-E tip/row. Tips were angled at plants in a four- to six-inch band, with a 50-mesh ball check screen at the rate of 32 PSI for 36.53 gal H_2O per acre. Paraquat sprays were applied on 09 April and 21 May. Crop maintenance was achieved by using University of Georgia Cooperative Extension recommendations for the control of weeds, suckers, and insects. Chemicals used for maintenance of the crop were Orthene 97 at 0.5 lbs./A for insect control, Prowl 3.3 EC at 2 pts./A for weed control, and Royal MH-30 Extra at 1.5 gal./A for sucker control. Three harvests were done, collecting a third of the plant at one time. Harvests were done on 29 June and 12 and 27 July. Stand counts were conducted every seven days, and plants were flagged, noting percent disease from TSWV symptoms, from 09 April through 19 June. A final count was made on 19 June to determine the amount of plants killed by TSWV and the number of non-harvestable plants. Height measurements were conducted on 04 and 18 May and 04 June.

Measurements were done in centimeters measuring from the base of the plant to the tip of the longest leaf. Three vigor ratings were done on 04 and 18 May and 04 June. Vigor ratings were done on a 1-10 scale with 10 equaling vigorous and healthy plants and 1 equaling poor vigor plants.

Following the final harvest, root samples were collected on 31 July from 10 plants per plot and an ELISA test was performed to determine TSWV percent positive. The screen for TSWV was accomplished by the use of double antibody sandwich-enzyme kits (Agdia, Inc. Elkhart, IN). Samples of ~1.0 grams were subjected to DAS-ELISA, and any sample eliciting an absorbance reading (A405) of three times the average plus two standard deviations of a healthy negative control were considered positive results. Total rainfall recorded at the Bowen Farm during this period (March through August) was 16.71 inches.

Summary

TSWV level in this test was moderate, ranging from a high of 37 percent in non-treated to a low of 11 percent in the transgenic. Yields ranged from a low of 1,471 to a high of 3,418 lbs./A. Plants with leaves removed and treated with Actigard and Admire had low vigor and sequentially lower yields. In 2007, older plants and plants with more foliage tended to perform better than small or young plants with less foliage.

Acknowledgments

The authors would like to thank the Georgia Agricultural Commodity Commission for Tobacco and Phillip Morris Tobacco Company for support of this study. Thanks are also extended to Jesse McMillian, Clint Powell, Channing Paulk, Cody Singletary, and Remigio Hernandez-Padilla for their technical support.

Table 1. 2007 Tobacco Transplant Management Study for Control of *Tomato spotted wilt virus*

Treatment[1]	Greenhouse[2]	Field Treatment[3]	Plant Height[4]	Vigor Ratings[5]	**Dry Weight Yield[6]**	**% Non-harvestable plants[7]**
1.10-11 week transplants (All leaves removed at trspt.)	None	None	51.8a	8.1b	2445.7b	25.5a
2. 7-week transplants (clipped)	None	None	48.1ab	7.7bc	2413.1b	19.9abc
3. 7-week transplants (non clipped)	None	None	44.3abc	6.8de	2849.1ab	16.3a-d
4. 7-week transplants (clipped)	Actigard & Admire Pro	Actigard	44.0abc	7.3cd	2845.7ab	10.3cd
5. 7-week transplants (non clipped)	Actigard & Admire Pro	Actigard	46.9ab	7.9bc	2639.3ab	26.6a
6. 10-11 week transplants (multiple clipped)	None	None	40.0bc	6.3ef	3418.8a	16.2a-d
7. 10-11 week transplants (multiple clipped)	Actigard & Admire Pro	Actigard	47.4ab	7.6bc	2984.0ab	14.2a-d
8. 10-11 week transplants (non-clipped)	None	None	46.4ab	7.9bc	2775.2ab	12.3bcd
9. 10-11 week transplants (non-clipped)	Actigard & Admire Pro	Actigard	49.3a	7.9bc	2713.2ab	15.6a-d
10. 10-11 week transplants (multiple clipped)	None	Paraquat	36.9c	6.0f	2467.1b	20.1abc
11. 10-11 week transplants (all leaves removed from plant at transplant except apical bud)	Actigard & Admire Pro	Actigard	21.5d	2.3g	1471.0c	4.7d
12. Transgenic	None	None	45.3ab	9.0	2917.7ab	7.1cd

[1] Data are means of five replications. Means in the same column followed by the same letter are not significantly different (P=0.05) according to Fisher's LSD test.
[2] All Actigard and Admire Pro treatments were applied as pre-plant treatments in the greenhouse at a rate of 2 gai./7,000 plants-Actigard and 1.0 oz./1,000 plants-Admire Pro. Tobacco variety was K326.
[3] Field treatments consisted of Actigard 50WG applications that were applied when first symptoms of TSWV were observed in field plots. Field applications were applied on 25 April.
[4] Height measurements were done in inches from the soil level to the tip of the longest leaf.
[5] Vigor ratings were done on a 1-10 scale, with 10=live and healthy plants and 1= dead plants on 04 and 18 May and 04 June.
[6] Dry weight yield was calculated by multiplying green weight totals by 0.15. Pounds per acre was calculated by multiplying dry weight conversion per plot by 6,491 divided by the base stand count. Percent TSWV was calculated by using stand counts that were made from 09 April through 19 June with TSWV being recorded and flagged every seven days. Cumulative number of TSWV infected plants that were flags during weekly stand counts.
[7] Percent non-harvestable plants was calculated by using stand counts that were made from 09 April through 19 June with TSWV being recorded and flagged every seven days. Plants that were flagged were observed and recorded as to whether they had harvestable leaves or not. Number of flagged plants was divided by the base count and multiplied by 100.

Table 2. 2007 Tobacco Transplant Management Study for Control of *Tomato spotted wilt virus*

Treatment[1]	Greenhouse[2]	Field Treatment[3]	% TSWV[4]	% ELISA (+) Plants[5] (roots)
1.10-11 week transplants (All leaves removed at transplant)	None	None	35.9ab	30.2
2. 7-week transplants (clipped)	None	None	36.9ab	18.8
3. 7-week transplants (non clipped)	None	None	26.4bcd	26.0
4. 7-week transplants (clipped)	Actigard & Admire Pro	Actigard	16.5cd	32.0
5. 7-week transplants (non clipped)	Actigard & Admire Pro	Actigard	31.5abc	51.1
6. 10-11 week transplants (multiple clipped)	None	None	25.2bcd	39.5
7. 10-11 week transplants (multiple clipped)	Actigard & Admire Pro	Actigard	25.1bcd	26.7
8. 10-11 week transplants (non-clipped)	None	None	15.4cd	40.0
9. 10-11 week transplants (non-clipped)	Actigard & Admire Pro	Actigard	23.3bcd	64.4
10. 10-11 week transplants (multiple clipped)	None	Paraquat	46.3a	47.73
11. 10-11 week transplants (all leaves removed from plant at transplanting except apical bud)	Actigard & Admire Pro	Actigard	21.9bcd	35.71
12. Transgenic	Actigard & Admire Pro	Actigard	11.3d	18.6

[1] Data are means of five replications. Means in the same column followed by the same letter are not significantly different (P=0.05) according to Fisher's LSD test.

[2] All Actigard and Admire Pro treatments were applied as pre-plant treatments in the greenhouse at a rate of 2 gai./7,000 plants-Actigard and 1.0 oz./1,000 plants-Admire Pro. Tobacco variety was K326.

[3] Field treatments consisted of Actigard 50WG applications that were applied when the first symptoms of TSWV were observed in field plots. First symptom field applications were applied on 25 April.

[4] Percent TSWV was calculated by using stand counts that were made from 09 April through 19 June with TSWV being recorded and flagged every seven days. Cumulative number of TSWV infected plants that were flags during weekly stand counts.

[5] Final harvest testing was completed on 24 July. Ten root samples were collected per plot. ELISA testing was performed in the lab using double antibody sandwich-enzyme linked immunosorbent assay (DAS-ELISA) alkaline phosphatase antisera kits. ELISA test results are percent positive plants.

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