THE UNIVERSITY OF GEORGIA
COLLEGE OF AGRICULTURAL & ENVIRONMENTAL SCIENCES

Tobacco Research Report

2008

2008 TOBACCO RESEARCH REPORT

(Summary Report of 2008 Data)

Edited by
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Internet: www.tswv.org

Acknowledgements

The tobacco research team would like to express their appreciation to the following for their contribution to this research:

Altria Client Services-Philip Morris USA
FMC. Corp
Syngenta
Du Pont
Dow Agrisciences
Bayer CropScience
Valent
McClean Ag
Philip Morris International
Georgia Commodity Commission for Tobacco
Tobacco Education and Research Council

The editor would like to express his sincere appreciation to Amanda Swennes, managing editor of publications, University of Georgia College of Agricultural and Environmental Sciences, for her efforts in completing this report in electronic and printed formats.

TABLE OF CONTENTS

Foreword....5
Flue-Cured Tobacco Variety Evaluation in Georgia....6

Black Shank
2008 Regional Small Plot - Black Shank Evaluation....14
2008 Selected Variety Test - Black Shank Evaluation....16
2008 Syngenta Efficacy of Mandipropamid for Control of Black Shank on Tobacco....18
2008 Tobacco Rotation Study for Control of Black Shank - Black Shank Farm....20
2008 Tobacco Rotation Study for Control of Black Shank - Black Shank Nursery....24
Black Shank Race Identification Method....30

Epidemiology
Sampling the Tobacco Farmscape for Thrips Vectors of *Tomato spotted wilt virus*....34
Survey of Weeds as Hosts of *Tomato spotted wilt virus* (TSWV) in the Farmscape of Southern Georgia....38

Insect Management
Insect Pest Control with Selected Foliar Applications of Insecticides....42
Tobacco Splitworm, Budworm and Hornworm Control with Selected Insecticides....46

Sucker Control
Regional Chemical Sucker Control Test....48

***Tomato spotted wilt virus* (TSWV) Management by Chemicals Means**
2008 Actigard and Admire Pro Application Timing Study for Control of *Tomato spotted wilt virus* (TSWV) in Tobacco....54
Effect of Plant Age and Treatment with Acibenzolar-S-Methyl on *Tomato spotted wilt virus* (TSWV) in Flue-Cured Tobacco 2007-2008....60
Effects of Selected Tray Drench Insecticide Treatments on Suppressing Thrips Vectors and *Tomato spotted wilt virus* (TSWV) in Tobacco....64
Effects of Tray Drench and Transplant Water Insecticide Treatments on Thrips Suppression and *Tomato spotted wilt virus* Symptom Expression in Flue-Cured Tobacco....66
Evaluation of Alternative Compounds for Control of *Tomato spotted wilt virus* (TSWV)....68

***Tomato spotted wilt virus* (TSWV) Management with Cultural Practices**
Evaluation of Tobacco Lines for Resistance to TSWV in Georgia....72
Plasticulture for Production and Disease Management of Tobacco....74
Soil Fertility Levels Associated with Levels of *Tomato spotted wilt virus* (TSWV) in Tobacco....78
Spray vs. Drench Application Trial for Control of *Tomato spotted wilt virus* on Tobacco....82

Foreword

Flue-cured tobacco in the state of Georgia continues to be of economic importance. Although the number of growers in Georgia declined over the past few years, the average tobacco grower has increased the area under production, with several growers managing 300-plus acres. Production was about 16,000 acres in 2008, with the estimated value of tobacco for Georgia between $50 and $60 million.

Tomato spotted wilt virus (TSWV) continues to be the grower's greatest concern, with an incidence of 10 percent to 40 percent during the last few years. In 2008, losses to TSWV will expected to be near 10 percent, one of the lowest levels in years, resulting in a good year for Georgia.

The following research reports represent efforts of several research scientists to reduce production inputs in tobacco and thereby improve the profitability of tobacco production in Georgia.

John Sherwood
Department Head
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The University of Georgia has a long history of tobacco research in Tifton, Ga. From disease research to production and management practices, the contributions to advances in tobacco production have been many.

This report contains research results addressing disease and insect management and evaluating new cultivars for tobacco production in Georgia. By conducting cooperative programs with sister institutions in the southeastern United States and with financial support from the Tobacco Commission and from industry, considerable resources have been applied to tobacco research programs.

The tobacco industry has changed dramatically in recent years and continues to evolve. The faculty at the University of Georgia Tifton campus are committed to providing research and education programs to help growers adapt to changes in the industry. We hope you find that this report contains useful information to help meet these challenges and to remain profitable in the future.

Joe W. West
Assistant Dean
College of Agricultural and Environmental Sciences
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Flue-Cured Tobacco Variety Evaluation in Georgia

S.S. LaHue, C.E. Troxell 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 of these characteristics 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 unacceptable.

As a result, Regional Variety Tests are conducted to obtain data on yield, disease resistance and quality as judged by physical appearance and chemical analysis. These tests consist of a small plot test followed by a farm test where desirable varieties from the small plot test are grown in larger plots and fully evaluated. Once this information is analyzed, the desirable varieties and breeding lines from 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 data from the Regional Farm Test so that when varieties are selected from this test, the University of Georgia Cooperative Extension will have an additional data set to use in making recommendations to growers.

Materials and Methods

The 2008 Official Variety Test and Regional Small Plot Test consisted of 28 and 31 entries, respectively while the Farm Test had 11 entries. These tests were conducted at the University of Georgia Bowen Farm on an Ocilla loamy coarse sand. All transplants were treated with Actigard (1 oz./100,000 cells) and imidacloprid (0.8 oz. Admire Pro/1,000 plants) for *Tomato spotted wilt virus* (TSWV) and followed with two field sprays (7 May, 28 May) of Actigard applied at 0.5 oz./A at the first sign of TSWV symptoms in non-treated border rows and again in three weeks. The Regional Farm Test was mechanically transplanted on 27 March. The Official Variety Test followed on April 3 with 22 plants per field plot, and was replicated three times. Fertilization consisted of 550 lbs./A of 6-6-18 at first cultivation, 550 lbs./A 6-6-18 at second cultivation and an additional 175 lbs./A of 15.5-0-0 at layby, for a total of 93 lbs./A 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 per plant, plant height in inches, days to flower and percent TSWV. In addition, leaf chemistry determinations consisted of total alkaloids, total soluble sugars and the ratio of sugar to total alkaloids.

Results and Discussion

The 2008 Official Variety Test and Regional Farm Test produced excellent yields and good quality even through dry conditions early in the season. Unfortunately, labor time constraints for harvest depressed cured leaf quality slightly. However, the test benefited from the application of Telone II, applied at the recommended rate, in October 2007 with good soil conditions that kept nematode pressure to a minimum. In addition, the two field sprays of Actigard combined with the standard tray drench treatment and comparably light disease pressure resulted in a test average of 5 percent TSWV symptomatic plants as compared to 20 percent in the non-treated check of an adjacent test. Nine irrigations totaling 8 inches supplemented the 15.2 inches of rainfall that fell over the 22-week test period. Furthermore, irrigations required early in the growing season caused slight variability to the first and third replications of the test due to winds inhibiting uniform coverage.

In the Official Variety Test, yield ranged from 2,664 lbs./A for NC 2326 to 4,179 lbs./A for NC 71. Value of released varieties ranged from $2,496/A for NC

2326 to $6,247/A for PVH 1118. NC 2326 at $93/cwt was the lowest priced, while CC 13 at $158 had the best price per cwt for the released varieties. Grade index ranged from 50 for NC 2326 to 78 for CC 13. Plant heights averaged from the upper 30s to low 40s, while leaf numbers per plant were just above 20. All flowering dates averaged a week later than NC 2326, which was at 66 days. Leaf chemistry was acceptable, with sugars averaging in the middle to upper teens and alkaloids generally below 3.2. The Official Variety Test data are displayed in Table 1. Two- and three-year averages for selected varieties are found in Table 2. The Regional Farm Test (Table 3) followed the same trend as the Official Variety Test, with NC 2326 having the lowest yield. NC EX 09 yielded the highest at 4,089 lbs./A and had the highest value at $6,358/A. NC EX 08 graded the best, bringing in $166/cwt and having a grade index of 81. Leaf chemistry was not quite as good as the Official Variety Test, with sugars in the low to mid teens and alkaloids generally above 3.

Acknowledgments

The authors would like to thank the Georgia Agricultural Commodity Commission for Tobacco for financial support. Also, thanks to Barry Luke, Kevin Baldree, Heather Hilton, Lauren Cox, Kelly Dill, Ween Carter, Whitney Phillips and James Carr for technical assistance.

Table 1. Yield, Value, Price Index, Grade Index and Agronomic Characteristics of Released Varieties Evaluated in the 2008 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	Number Leaves/ Plant	Plant Height (in.)	Days to Flower	Total Alkaloids (%)	Reducing Sugars (%)	Ratio RS/TA
NC 2326	2664	2496	93	50	18	38.5	66	4.55	12.0	2.6
NC 95	3321	4159	124	66	18	37.8	70	3.75	13.3	3.5
K 326	3834	5923	155	74	23	42.6	80	2.61	16.6	3.9
K 346	3537	5462	153	74	26	34.6	77	2.62	13.1	5.0
NC 71	4179	6231	149	72	22	37.1	71	2.80	15.3	5.5
NC 72	3651	5374	147	72	24	39.5	72	3.34	13.2	3.9
NC 297	3880	5985	154	74	22	41.1	72	2.61	15.7	6.0
NC 55	3386	5086	151	75	22	38.7	76	2.63	14.8	5.6
NC 291	3838	5275	137	71	21	38.0	75	3.35	12.7	3.8
NC 196	3882	5688	147	74	22	41.7	75	2.03	16.1	7.9
NC 102	3282	4692	143	73	22	37.5	75	2.89	14.9	5.1
NC 299	3306	5094	154	73	21	39.1	76	2.69	17.4	6.5
CC 35	3846	5185	132	68	20	41.3	NF	2.48	16.0	6.5
CC 13	3889	6187	158	76	22	39.8	73	2.65	15.5	5.8
CC 700	6430	5183	149	75	21	38.3	73	2.59	14.9	5.8
CC 27	3595	4996	140	71	22	40.3	71	2.59	14.8	5.7
CC 37	3445	4476	130	64	21	40.5	78	3.10	13.2	4.2
CC 65	3872	5101	132	68	20	42.3	NF	2.98	12.5	4.2
Speight 210	3417	5123	150	74	21	40.9	75	2.68	15.3	5.7
Speight 225	3539	5409	153	74	20	40.8	70	2.65	14.4	5.4
Speight 220	3539	5378	152	74	21	40.9	78	2.47	14.7	6.0

Table 1. Yield, Value, Price Index, Grade Index and Agronomic Characteristics of Released Varieties Evaluated in the 2008 Official Flue-Cured Variety Test at the University of Georgia, Tifton, Ga.

Speight 227	3940	6011	153	74	22	40.1	73	2.50	16.3	6.5
Speight 234	3457	4850	140	72	20	37.3	78	2.50	12.6	5.1
Speight 168	3617	5189	144	70	21	39.2	74	2.67	15.1	5.7
Speight 236	3483	5379	154	75	22	41.6	80	2.80	15.3	5.5
PVH 1118	4077	6247	154	76	22	41.6	72	3.03	14.2	4.7
GF 52	4086	5820	143	71	21	40.9	75	3.02	14.8	4.9
NC 92	3756	5777	154	74	21	40.4	77	3.01	16.8	5.6
CH 1[3]	3569	5800	163	78	22	39.5	76	2.39	16.9	7.1
CH 3[3]	3938	6280	160	77	22	39.5	76	2.65	16.7	6.3
LSD@0.05	723.1	1297.8	17.6	6.42						

[1]Price Index based on two-year average (2007-2008) prices for U.S. government grades.
[2]Numerical values ranging from 1 to 99 for flue-cured tobacco based on equivalent government grades – the higher the number, the higher the grade.
[3] Non-released variety evaluated for adaptability to local climate.

Table 2. Comparison of Certain Characteristics for Released Varieties Evaluated in the 2008 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	Number Leaves/ Plant	Plant Height (in.)	Days to Flower	Total Alkaloids (%)	Reducing Sugars (%)	Ratio RS/TA
Three-Year Average, 2006-2008										
NC 2326	2229	2117	95.3	57.8	17	35	66	3.9	13.3	3.4
NC 95	3373	3632	108.3	66.0	20	39	72	3.6	14.4	3.9
K 326	3523	4553	128.0	73.4	20	36	78	2.9	15.8	4.9
K 346	2865	3686	124.3	60.7	22	35	71	3.1	12.0	4.0
NC 71	3361	4423	127.7	72.0	20	35	77	3.0	14.1	4.7
NC 72	3394	3888	114.0	68.3	20	36	76	3.3	14.2	4.3
NC 297	3592	4782	132.9	73.0	21	37	76	2.8	17.0	6.3
NC 55	2979	3958	131.1	74.2	21	35	78	3.1	15.2	5.0
NC 291	3219	3714	113.8	68.5	20	35	78	3.2	15.0	4.7
NC 196	3109	4010	127.7	72.7	20	36	78	2.6	16.6	6.5
NC 102	2597	3245	121.2	70.5	20	34	79	3.3	14.1	4.3
NC 299	3132	4136	131.9	73.0	21	36	77	2.9	17.1	6.1
CC 13	3431	4564	131.4	74.3	20	34	77	3.1	14.8	5.0
CC 700	3125	4189	132.4	73.9	20	35	76	2.9	14.7	5.1
CC 27	3484	4283	123.2	71.8	21	37	76	3.0	14.7	5.0
Speight 210	3240	4146	127.5	72.9	19	35	77	3.1	15.7	5.2
Speight 220	3995	3720	121.3	70.1	20	37	79	3.1	14.0	4.6
Speight 225	2936	3589	118.5	67.5	19	35	76	3.0	13.7	4.7
Speight 227	3317	4126	122.1	70.5	21	36	77	2.7	15.9	5.9
Speight 234	3254	3891	117.1	69.7	19	35	79	3.2	12.6	4.0

Table 2. Comparison of Certain Characteristics for Released Varieties Evaluated in the 2008 Official Flue-Cured Tobacco Variety Test at the University of Georgia, Tifton, Ga.

Speight 236	3238	4414	134.8	73.8	20	37	80	3.0	13.9	4.7
Speight 168	3199	4144	128	71.3	20	36	78	2.8	16.0	5.8
CC 37	3445	4193	122.0	66.5	21	38	76	3.0	13.4	4.4
PVH 1118	3640	5035	136.5	74.5	21	39	70	3.3	13.5	4.2
CH 1	3310	4581	137.0	73.0	21	37	73	2.6	16.9	6.6
CH 3	3605	5108	140.0	73.5	22	38	73	2.5	17.5	7.0

[1]Price Index based on two-year average (2007-2008) prices for U.S. government grades.
[2]Numerical values ranging from 1 to 99 for flue-cured tobacco based on equivalent grades – the higher the number, the higher the grade.

Table 3. Yield, Value, Price Index, Grade Index and Agronomic Characteristics of Varieties Evaluated in the 2008 Regional Farm Test at the University of Georgia, Tifton, Ga.

Variety	Yield (lb./A)	Value ($/A)	Price[1] Index $/CWT	Grade[2] Index	Number Leaves/ Plant	Plant Height (in.)	Days to Flower	Total Alkaloids (%)	Reducing Sugars (%)	Ratio RS/TA
NC 2326	2926	2814	96	52	18	38.5	66	4.55	12.0	2.6
NC 95	3780	4735	125	65	18	37.8	70	3.75	13.3	3.6
XP 596	3498	4847	139	70	19	36.7	71	3.96	9.7	2.5
RJR 75	3950	5205	131	65	20	41.7	NF	4.49	11.0	2.4
GF 318	3759	5463	146	72	19	38.7	69	3.77	13.7	3.6
RJR 15	3365	3916	116	58	20	42.1	NF	4.07	11.1	2.7
NC EX 08	3838	6358	166	81	19	40.4	76	3.78	12.4	3.3
CC 67	3685	5350	145	70	20	40.0	71	3.77	10.4	2.8
NC EX 09	4089	5617	137	67	20	41.0	72	3.94	14.3	3.6
CC 33	3937	5872	149	73	20	38.1	78	3.38	12.9	3.8
NC EX 07	3991	6238	156	76	19	38.6	74	3.38	13.2	3.9
K 326	3794	6003	159	76	20	37.8	80	2.61	16.6	6.4
LSD@0.05	476.3	900.9	15.0	6.6						

[1]Price Index based on two-year average (2007-2008) prices for U.S. government grades.
[2]Numerical values ranging from 1 to 99 for flue-cured tobacco based on equivalent grades – the higher the number, the higher the grade.

2008 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 (FL301) 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 that were replicated three times. Each plot was 32 feet long with an average of 23 plants per test plot. On 23 January, 34 tobacco varieties were seeded in a greenhouse in 242 cell flats.

2008 varieties for field evaluation were:

AOV 708	EXP 806	NC EX 14	ULT 112
CC507	K 326	C EX 15	ULT 142
CU 61	K 346	NC EX 16	XP 156
CU 75	LK 1	OX 2047	XP 254
CU 90	NC 71	RJR 25	XP 275
CU 94	NC 95	RJR 62	XP 324
CU 109	NC 2326	RJR 225	1071
EXP 305	NC EX 10	RJR 251	
EXP 803	NC EX 13	RJR 651	

The field was prepared on 22 March by disc harrowing the area. Fertilizer (4-8-12 at 500 lbs./A) was broadcast in plot areas and tilled in on 20 March. On 26 March, applications of Prowl 3.3 at 2.0 pts./A, Lorsban 4E at 3 qt./A and Nemacur 3 at 2 gal./A were incorporated into the plot area. Plots were sub-soiled and bedded on 26 March.

Tobacco transplants were treated in the greenhouse on 27 March with Admire Pro at 1 fl.oz./1,000 plants and Actigard 50 WG 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 01 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 22 April and 20 May; 500 lbs./A of 4-8-12 on 7 May, and 20 May. Layby was done on 20 May.

Additional pesticide applications on tobacco were applied as follows: 25 April, sprayed Actigard 50 WG at 0.5 oz./A in a 12-inch band, one nozzle over row in 10.35 GPA H_2O. Orthene 97 was applied for insect control on 25 April; 2 and 21 May; 6, 12, 16 and 20 June; and 15 and 29 July. Tobacco was topped and suckered on 20 June. Royal MH 4 percent solution at 50 gal./A was applied on 23 June. Total rainfall recorded at the Black Shank Farm during this period (March through August 2008) was 25.72 inches.

Summary

Results from this test were erratic. Evaluations followed a rotation study, which may have had dramatic effects on populations of *P. parasitica* var. *nicotianae*, and thus affected the results of the trial.

Acknowledgements

The authors would like to thank the Georgia Agricultural Commodity Commission for Tobacco for financial support. Thanks are also extended to Clint Powell, Cody Singletary, Haley Gibbs, Remigio Padilla-Hernandez, Mac Denny and Trevor Cook for their technical support.

Table 1. Regional Small Plot 2008, Percent Black Shank Disease and Percent *Tomato spotted wilt virus* (TSWV) Incidence

Tobacco Variety	Percent Disease from Black Shank (*Phytophthora parasitica* var. *nicotianae*)				% TSWV
	Rep I	Rep II	Rep III	Mean	
1. NC 2326	94.7	50.0	74	72.9 a-d	6.2 abc
2. NC 95	22.7	18.2	54.5	31.8 c-f	0.0 c
3. K 326	9.5	28.8	4.5	14.2 ef	0.0 c
4.CU109	45.5	100	100	81.8 abc	0.0 c
5. RJR 225	9.1	0	0	3.0f	0.0 c
6. CU 94	100	4.8	11.1	38.6 b-f	3.4 abc
7. RJR 251	13.0	4.3	13.6	10.3 f	10.3 a
8.OX 2047	0	65.2	87	50.7 a-f	0.0 c
9. CC 507	22.7	8.7	45.5	25.6 f	4.5 abc
10. NC EX 16	81.0	47.6	4.8	44.4 a-f	1.6 bc
11. NC EX 15	22.7	0	52.4	25.0 f	1.5 bc
12. NC EX 14	100	0	8.7	36.2 b-f	4.3 abc
13. ULT 142	0	77.2	0	25.8 f	4.8 abc
14. AOV 708	90.5	100	83.3	91.3 a	3.0 abc
15. XP 275	95.7	9.5	14.3	40.0 b-f	0.0 c
16. NCEX 10	36.4	13.6	0	16.7 f	4.5 abc
17. CU 61	68.2	91.7	87.5	82.5 ab	4.4 abc
18. RJR 25	4.5	0	8.7	4.4 f	8.8 ab
19. XP 156	4.8	95.5	4.5	35.0 b-f	1.6 bc
20. NC EX 13	95.5	45.5	0	47.0 a-f	0.0 c
21. CU 75	83.3	41.0	0	41.4 a-f	1.8 bc
22. XP 254	4.5	0	18.2	7.6 f	3.3 abc
23. EXP 806	41.0	0	8.7	16.5 f	2.9 abc
24. XP 254	100	95.8	22.7	72.9 a-d	3.0abc
25. EXP 803	0	0	14.3	4.8 f	1.6 bc
26. RJR 651	4.5	0	9.1	4.6 f	4.5 abc
27. CU 90	47.8	18.2	5.0	23.7 def	1.7 bc
28. XP 324	4.8	0	77.3	27.3 def	3.0 abc
29. EXP 305	52.4	91.7	0	48.0 a-f	1.5 bc
30. RJR 62	14.3	0	4.8	6.4 f	6.3 abc
31. ULT 112	80.0	22.7	4.5	35.8 b-f	9.1 ab
32. LK1	95.5	13.6	74.0	61.0 a-e	6.0 abc
33. 1071	27.8	55.0	10.5	31.1 def	5.3 abc
34. NC71	5.0	13.0	4.5	7.5 f	5.9 abc
35. K346	18.2	5.3	4.8	9.4 f	4.9 abc

[A] TSWV-infected plants were removed from total50.0 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. Plants flagged that were dead or missing were considered killed by TSWV.

2008 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 history of Black Shank of tobacco (since 1962). The plot design was a randomized complete block consisting of single row plots and 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 seeded into 242 cell flats. 2008 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 incorporated into the soil on 20 March. On 2 April, applications of Devrinol 50DF at 3.1 lbs./A, Lorsban 4E at 3 qt./A and Nemacur 3 at 2 gal./A were tilled into the plot area. Plots were sub-soiled and bedded on 3 April. Tobacco transplants were treated in the greenhouse on 27 March 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 tap water and treatment materials were washed-in with additional water after spraying.

Tobacco was transplanted on 7 April on 48-inch-wide rows with an 18-inch plant spacing. Cultivation and side-dress fertilizer was as follows: 90 lbs./A of 15.5-0-0 calcium nitrate on 23 April and 28 May; 500 lbs./A of 4-8-12 on 9 and 28 May. Layby was done on 28 May.

Additional pesticide applications on tobacco were applied uniformly over the entire test as follows: 2 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. Orthene 97 at 0.75 lb./A was applied for insect control on 2 and 21 May and 12, 17 and 19 June. Tobacco was topped and suckered on 26 June. Off Shoot T 4 percent solution at 60 gal./A was applied on 30 June. On 2 July, Flupro at 2 qt./A was tank mixed with Fair 30 at 1.5 gal./A in 50 GPA H_2O.

Stand counts were conducted every two weeks from 29 April to 4 August, noting percent disease from TSWV and Black Shank. Total rainfall recorded at the Black Shank Nursery during this period (April through August 2008) was approximately 25.3 inches. Rainfall was determined by accessing the database of the Georgia Environmental Monitoring Network from the weather station located at the Tifton-CPES location.

Summary

Mean Black Shank incidence ranged from 17 percent to 64 percent disease (Table 1). Tobacco variety NC71 had the lowest level of disease, and NC 1071 had the highest level. These findings are confusing since the monogenic resistance for Black Shank in NC71 may also contain high levels of polygenic resistance.

Acknowledgments

The authors would like to thank the Georgia Agricultural Commodity Commission for Tobacco for financial support. Thanks are also extended to Haley Gibbs, Clint Powell, Cody Singletary, Remigio Padilla-Hernandez, Mac Denny and Trevor Cook for their technical support.

Table 1. Percent Black Shank Infection (*Phytophthora parasitica* var. *nicotianae*) and Percent TSWV.[A] Black Shank Nursery, Tifton, Ga., 2008

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	21.7	60.9	52.4	39.1	43.5	20.8	36.4	39.3 abc	3.2 a
2. K326	0	75.0	43.5	95.7	100	43.5	27.3	55.0 ab	3.1 a
3. NC71	0	0	18.2	33.3	56.5	0	13.0	17.3 c	1.2 ab
4. Speight G28	0	91.0	70.0	78.3	20.8	60.9	78.3	57.0 a	2.5 ab
5. McNair 944	8.7	0	74.0	95.2	100	27.3	56.5	51.7 ab	1.2 ab
6. Coker 371Gold	17.4	12.5	13.6	23.8	56.5	37.5	17.4	25.5 bc	1.2 ab
7. G-70	9.5	41.0	17.4	87.5	100	57.1	77.3	54.6 ab	0.0 b
8. NC 72	0	10.5	13.6	82.6	91.3	4.3	25	40.0 abc	2.8 ab
9. 1071	17.4	95	68.2	95.8	68.2	76.2	65.2	63.7 a	0.6 ab

[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 was 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.

2008 Syngenta Efficacy of Mandipropamid for Control of Black Shank on Tobacco Black Shank Nursery, Tifton, Ga.

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

Introduction

Tobacco Black Shank continues to be a serious disease of tobacco in Georgia. This test evaluates two formulations of mefenoxam in a disease nursery with both Race 0 and Race 1 of *Phytophthora parasitica* var. *nicotianae* (Ppn).

Methods and Materials

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

On 24 January, tobacco variety K-326 was seeded in the greenhouse in 242 cell flats. The field was prepared on 18 February by disc harrowing the area. Fertilizer (4-8-12 at 500 lbs./A) was broadcast in plot areas and tilled in on 20 March. On 2 April, applications of Prowl 3.3 at 2.0 pts./A, Lorsban 4E at 3 qt./A and Nemacur 3 at 2 gal./A were tilled into the plot area. Plots were sub-soiled and bedded on 3 April.

Tobacco variety K-326 transplants (seeded on 24 January) were treated in the greenhouse on 31 March 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 18-inch plant spacing. Cultivation and side-dress fertilizer was as follows: 90 lbs./A of 15.5-0-0 calcium nitrate on 23 April; 500 lbs./A of 4-8-12 on 9 and 28 May.

Field applications of Revus and Ridomil Gold were applied in treatment-specified plots at transplant on 8 April, at first cultivation on 8 May and at layby on 28 May. Treatments were applied over the top in 16.9 gal. H_2O/A in a 12-inch band with one nozzle over the row. Treatments were applied using a CO_2 with two TX-12 tips/row with 50 mesh ball check screens per row at 20 PSI for 9.7 gallons of water/A. Tips were arranged to form a 12-inch band to either side of the rows, angled and aimed at the base of plants. Plots were then cultivated to incorporate treatment chemicals.

Additional pesticide applications were applied on tobacco as follows: 2 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 26 June and suckered again on 14 July. Off Shoot T, 4 percent solution was at a rate of 60 gal./A was applied 30 June. Farir 30 at 1.5 gal./A and Flupro at 2 qt./A was applied on 2 July.

Stand counts were conducted every two weeks beginning 29 April through 9 July, noting percent disease from TSWV and Black Shank. Tobacco plots were also scouted for signs of phytotoxicity on 28 May. Vigor ratings were done on a 1 to 10 scale, with 10 equaling vigorous healthy plants and 1 equaling poor vigor plants. Ratings were done on 6 June. Height measurements were done in centimeters from the soil level to the tip of the longest leaf on 29 May.

Three separate harvests were conducted, taking 1/3 of plant leaves per harvest. Harvests were done on 10 and 23 July and 6 August. Total rainfall recorded at the Black Shank Nursery during this period (March through August 2008) was 25.72 inches.

Summary

TSWV levels were very low in this trial, with disease ranging from 2 to 4%. Black Shank incidence was high, with disease ranging from a high of 77% to a low of 42% mean disease. Treatments 2 and 3 were significantly lower in disease and higher in yield than the non-treated control. Ridomil Gold-treated plots were not significantly different from the non-treated control.

Acknowledgments

The authors would like to thank the Georgia Agricultural Commodity Commission for Tobacco for financial support. Thanks are also extended to Clint Powell, Cody Singletary, Remigio Padilla-Hernandez, Haley Gibbs, Mac Denny and Trevor Cook for their technical support.

Table 1. Syngenta Ridomil Evaluation on Tobacco, Black Shank Nursery 2008

Treatment[1]	Product Rate	Application Schedule	Vigor[2]	Height measurements[3]	% Death by Black Shank[4]	% Symptomatic TSWV[5]	Dry Weight Yield[6]
1. Untreated Control	----------	----------	7.6 a	36.3 a	77.2 a	2.0 a	588.9 c
2. Revus	11 oz./A	At transplant (1) at 1st cultivation (1) at layby	8.0 a	37.7 a	59.6 b	2.6 a	918.4 b
3. Revus	44 oz./A	At transplant (1) at 1st cultivation (1) at layby	7.8 a	37.3 a	41.7 c	3.9 a	1310.6 a
4. Ridomil Gold 480 SL	1 pt./A	At transplant (1) at 1st cultivation (1) at layby	7.9 a	38.1 a	64.5 ab	2.7 a	793.4 bc

[1] Data are means of seven replications. Means in the same column followed by the same letter are not different (P = 0.05) according to Fisher's LSD test. No letters signifies non-significant difference.
[2] Vigor was done on 16 June on a 1 to 10 scale, with 10 = live and healthy plants and 1 = dead plants.
[3] Height measurements were done in centimeters from the soil level to the tip of the longest leaf on 29 May.
[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 was 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 100.
[5] Percent TSWV-symptomatic plants was calculated by using stand counts that were made from 29 April to 4 August, with TSWV being flagged every week.
[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.

2008 Tobacco Rotation Study for Control of Black Shank
Black Shank Farm, Tifton, Ga.

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

Introduction

Tobacco Black Shank continues to be a serious and persistent soil-borne disease of tobacco. With the continued use of cultivars that have the Ph gene, which imparts resistance to Race 0 of Phytophthora parasitica var. nicotianae, there has been a steady shift to isolation of Race 1 of the pathogen. There are no commercial cultivars and no known sources of resistance to the Race 1 pathogen of Black Shank. This situation has left growers without their most useful and least expensive tool for management of Black Shank on tobacco.

This study was established to evaluate the use of rotation crops, including a mustard cover crop, and mefenoxam, alone and in combinations, for management of Phytophthora parasitica var. nicotianae.

Methods and Materials

The study was located at the Black Shank Farm, CPES, Tifton, Ga., in a field with a continuous history of Black Shank disease on tobacco. The plot design was a randomized split plot design. Each plot consisted of eight rows, 4 feet wide and 32 feet long, with an average of 23 tobacco plants per row.

A fall rotational cover crop was planted on 2 October 2007 with individual plots being planted with either rye or Florida Broadleaf mustard as test treatments. Cover crop treatments were mowed and incorporated into the soil on 18 March 2008. On 24 January, tobacco variety K-326 was seeded in the greenhouse into 242 cell flats.

A fertilizer application of 4-8-12 at 500 lbs./A was broadcast and incorporated into the soil on 20 March. Prowl at 2 pts./A, Lorsban 4E at 3 qt./A and Mocap 6E at 2 gal./A was incorporated into plots on 31 March for initial control of weeds, insects and nematodes. Plots were subsoiled and bedded on 2 April.

Tobacco variety K-326 transplants were treated in the greenhouse on 31 March with Admire Pro at 1 fl. oz./1,000 plants and Actigard 50WG at 4 g/7,000 plants. Plants were pre-wet with materials being rinsed into trays with additional 0.25 inches of water. Tobacco was transplanted into test plots on 10 April on an 18-inch plant spacing. Cultivation and side dress fertilizer were as follows: 500 lbs./A of 4-8-12 was applied on 7 May and 90 lbs./A of 15.5-0-0 calcium nitrate was applied on 22 April.

Additional pesticide applications on tobacco were applied as follows: 22 April applied Actigard 50WG at 0.5 oz./A in a 12-inch band, one nozzle over row in 10.35 gal./A. Orthene 97 was applied at 0.75 lb./A for insect control on 2 and 21 May; 6, 12, 16 and 20 June; 1, 15 and 29 July and 1 August. The "at-plant" treatment of Ridomil Gold at 1 pt./A in 16.3 gal./H_20 was applied on 10 April. "Mid-season" treatments were applied to plots at first cultivation on 12 May. Layby treatments were applied on 26 May.

Tobacco was topped and suckered on 26 June. An application of Off Shoot T 4 percent solution at 60 gal./A was applied after topping. On 1 June, Fair 30 at 2 gal./A and Flupro at 2 qt./A were applied.

Stand counts were conducted every two weeks from 13 May through 22 July. Plants showing symptomatic signs of Tomato spotted wilt virus (TSWV) and Black Shank were flagged and recorded. A vigor rating was conducted on 16 June on a 1 to 10 scale, with 10 equaling vigorous healthy plants and 1 equaling poor vigor plants. Height measurements were conducted on 29 May. Plants were measured individually from the soil level to the tip of the longest leaf and recorded in centimeters.

Summary

Vigor ratings and height measurements during the year suggested that all plots were growing normally and little differences occurred between treatments. Percent Black Shank ranged from a high of 93 percent to a

low of 31 percent. Although no significant differences occurred between rye and mustard rotational plots, all of the mustard plots were lower in disease numerically than those rotated with rye. Yield of tobacco followed the same trend, with mustard-rotated plots generally having higher numerical yield than the rye-rotated plots.

Acknowledgments

The authors would like to thank Philip Morris Tobacco Company and the Georgia Agricultural Commodity Commission for Tobacco for support of this study. Thanks are also extended to Haley Gibbs, Clint Powell, Cody Singletary, Remigio Padilla-Hernandez, Kenny Whitley, Seth Dale and Mac Denny for their technical support.

Table 1. Tobacco Rotation Study, Black Shank Farm, 2008

Treatment[1]	At Plant	4 wks Post Plant	Layby	Vigor[2]	Height[3]	Dry Weight Yield[4]	% TSWV[5]	% Black Shank[6]
1. Rye-Tobacco	**None**	**None**	**None**	7.5 c-f	51.4 a	96.0 f	5.7 bc	93.4 a
2. Mustard-Tobacco	**None**	**None**	**None**	7.0 f	42.7 ab	434.3 ef	2.9 c	87.6 ab
3. Rye-Tobacco	·	-----	-----	8.0 a-d	45.0 ab	952.0 cde	5.7 bc	76.6 abc
4. Mustard-Tobacco	·	-----	-----	7.4 def	45.9 ab	748.8 def	11.4 ab	67.9 bcd
5. Rye-Tobacco	-----	·	·	8.0 a-d	50.5 ab	1556.8 abc	10.5 ab	41.7 efg
6. Mustard-Tobacco	-----	·	·	8.1 a-d	47.4 ab	1814.5 a	9.5 bc	35.8 fg
7. Rye-Tobacco	-----	-----	·	7.7 b-f	45.8 ab	1550.5 abc	8.6 bc	51.5 d-g
8. Mustard-Tobacco	-----	-----	·	7.1 ef	43.3 ab	1481.1 abc	5.7 bc	39.8 fg
9. Rye-Tobacco	·	·	-----	7.9 bcd	46.6 ab	1069.8 bcd	2.9 c	56.6 c-f
10. Mustard-Tobacco	·	·	-----	8.1 a-d	42.7 ab	1593.0 abc	5.7 bc	49.5 d-g
11. Rye-Tobacco	-----	·	-----	8.2 abc	44.6 ab	1657.8 abc	7.6 bc	45.4 efg
12. Mustard-Tobacco	-----	·	-----	7.9 bcd	46.8 ab	1708.13ab	11.4 ab	31.2 g
13. Rye-Tobacco	·	-----	·	8.7 a	48.5 ab	1270.0 a-d	10.5 ab	61.8 cde
14. Mustard-Tobacco	·	-----	·	7.8 b-e	41.4 b	1755.3 a	6.7 bc	42.0 efg
15. Rye-Tobacco	·	·	·	8.3 ab	45.7 ab	1080.2bcd	17.1 a	54.6 def
16. Mustard-Tobacco	·	·	·	8.2 abc	43.1 ab	1620.0 ab	11.4 ab	50.5 d-g

[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] Vigor was done on a 1 to 10 scale, with 10 = live and healthy plants and 1 = dead plants. Rating was conducted on 16 June.
[3] Height measurements were done in centimeters from the soil to the tip of the longest leaf on 29 May.
[4] 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 7,260 divided by base stand count. Tobacco was planted in 48-inch rows, with 18 inches between plants, which equals 7,260 plants/A.
[5] Percent TSWV was calculated by using stand counts that were made from April through July with TSWV being flagged every two weeks.
[6] 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.

2008 Tobacco Rotation Study for Control of Black Shank
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 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 2008

Tobacco variety K-326 was seeded in the greenhouse in 242-cell trays. Fall cover crops of Rye and Florida Broadleaf mustard were mowed and incorporated into test plots on 18 March. An application of 4-8-12 fertilizer at 500 lbs./A was broadcast and incorporated into soil on 20 March. Prowl H_2O at 2 pts./A + Lorsban 4E at 3 qts./A + Mocap 6E at 2 gal./A was applied and incorporated into test plots for initial control of weeds, insects and nematodes on 2 April. Test plots were subsoiled and bedded on 3 April.

Greenhouse transplants were treated with Admire Pro at 1 fl. oz./1,000 and Actigard 50WG at 4 g/7,000 plants. Plants were pre-wet with materials being rinsed into trays with an additional 0.25 inches of water. Tobacco was transplanted into test plots on 7 April on an 18-inch spacing.

Cultivation and side dress fertilizer was as follows: 500 lbs./A of 4-8-12 was applied on 9 May and 90 lbs./A of 15.5-0-0 calcium nitrate was applied on 23 April.

Additional pesticide applications on tobacco were applied as follows: 2 May applied Actigard 50 WG at 0.5 oz./A; Orthene 97 at 0.75 lb./A was applied for insect control on 2 and 21 May and on 12, 17 and 19 June.

The "at-plant" treatments of Ridomil Gold at 1 pt./A were applied on 8 April. "Mid-season" treatments were applied at first cultivation on 8 May. Layby treatments were applied on 28 May.

Tobacco was topped and suckered on 26 June. An application of Off Shoot T 4 percent solution at 60 gal./A was applied after topping on 30 June. On 2 July, Fair 30 at 1.5 gal./A and Flupro at 2 qt./A were applied. Stand counts were conducted every two weeks from 29 April through 4 August. Plants showing symptomatic signs of *Tomato spotted wilt virus* (TSWV) and Black Shank were flagged and recorded. A vigor rating was conducted on 16 of June on a 1 to 10 scale, with 10 equaling vigorous healthy plants and 1 equaling poor vigor plants. Height measurements were conducted on 29 May. Plants were measured individually from the soil level to the tip of the longest leaf and recorded in centimeters.

Fall 2007

Test plots were tilled and prepared for planting on 3 October. Florida Broadleaf Mustard and rye were direct seeded on 4 October into specific test plots.

Spring 2007

On 31 January, tobacco variety K-326 was seeded in the 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 at 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 seeds 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 was inserted approximately 8 inches into the soil and buried. The packets were retrieved from the soil on 20 March, seven days after interment. Colonized seeds and toothpicks were transferred to petri dishes containing *Phytophthora*- and *Rhizoctonia*-specific media, respectively. After 48 hours of incubation at 26° 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 2 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 g/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 applied to subplots "B" in a 12-inch band with one nozzle over row.

Cultivation and side dress fertilizer was as follows: 90 lbs./A of 15.5-0-0 calcium nitrate on 17 April; 500 lbs./A of 4-8-12 on 3 and 23 May; and on 24 April, at layby, 90 lbs./A of 15.5-0-0 calcium nitrate.

Additional pesticide applications on tobacco were applied as follows: 2 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; Orthene 97 at 0.773 lb./A on 14 June and 5 July; Acephate 75 at 1 lb./A on 2 and 16 May and 6 June; 8 and 24 May, sprayed Ridomil Gold 1 pt./A in 20 GPA H_20 with two nozzles at a 12-inch band aimed at the base of the plant. Plots were then cultivated to incorporate treatment.

Tobacco was topped and suckered on 18 and 25 June and 5 July. Royalto M 4 percent solution at 50 gal./A was applied on 27 June and 2 July. MH-30 at 1.5 gal./A and Flupro 2 qt./A in 48 GPA H_2O were tank mixed and applied on 8 July.

Stand counts were conducted every two weeks. Plants showing symptoms of *Tomato spotted wilt virus* (TSWV) and Black Shank disease (*Phytophthora parasitica* var. *nicotianae*) were flagged and recorded at each stand count. Stand count dates were 1, 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 to 10 scale, with 10 equaling vigorous and healthy plants and 1 equaling poor vigor plants. Ratings were done on 22 May and 6 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 through August 2007) was 18.15 inches. Rainfall data was obtained from 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 the 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 g/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. H_2O/A applied to subplots "B" in a 12-inch band with one nozzle over row.

Cultivation and side dress fertilizer was as follows: 500 lbs./A of 4-8-12 and 90 lbs./A of 15.5-0-0 calcium nitrate on 5 May. Additional pesticide applications on tobacco were applied as follows: 19 April, 1 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 2 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. Orthene 97 at 0.773 lb./A was applied for insect control on 19 April, 1 May, 18 May, 8 June, 22 June and 10 July.

Tobacco was topped on 7 June, Royalto M 4 percent solution at 50 gal./A was applied on 8 and 16 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 to 10 scale, with 10 equaling vigorous and healthy plants and 1 equaling poor vigor plants. Ratings were done on 8 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 3 October. On 2 November, all plots were replanted with either wheat or Florida Broad Leaf mustard.

Spring 2005

On 2 February, tobacco variety K-326 was seeded in the 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 7 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 3 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 2 February) were treated on 1 April with Admire 2F at 2.4 oz./1,000 plants and Actigard 4G at 4 g/7,000 plants. Plants were pre-wet with materials being washed-in after spraying. Tobacco was transplanted on 5 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 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_20 with two nozzles, with 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 percent 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 the foliage per harvest. Harvests were done on 29 June, 14 July and 28 July. Vigor ratings were done on a 1 to 10 scale, with 10 equaling vigorous and healthy plants and 1 equaling poor vigor plants. Ratings were done on 18 May, 3 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 1 November. On 4 November, all plots were replanted with either rye or Florida Broad Leaf mustard. Brassica plots that were weak were reseeded with mustard by hand 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 2 April, 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. That same day, plots were sub-soiled and bedded. Tobacco transplants were seeded on 4 February in the greenhouse and treated on 2 April with Admire 2F at 2.4 oz./1,000 plants and Actigard 4G at 4 g/ 7,000 plants. Plants were pre-wet with materials being washed-in after spraying.

Tobacco variety K-326 was transplanted on 6 April 2004, on 48-inch rows with 18-inch plant spacing. Cultivation and side dress fertilizer was 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 on 13 July. Peanuts were dug and harvested on 7 October.

Tobacco plots were topped and suckered on 6 June. Royal MH-30 Extra at 1.5 gal./A was applied on 7 July in 50 gallons 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

Vigor and height measurements indicated that very little difference occurred among treatments. *Tomato spotted wilt virus* ranged from 7 percent to 11 percent across the trial. The level of Black Shank ranged from a high of 67 percent to a low of 23 percent in the trial. Generally, plots with at least one application of mefenoxam were lower in disease than those that received none of the chemical. No significant differences were noted between plots that received a mustard cover crop and those that received a rye cover crop.

Acknowledgments

The authors would like to thank the Georgia Agricultural Commodity Commission for Tobacco for financial support. Thanks are also extended to Haley Gibbs, Clint Powell, Cody Singletary, Mac Denny, Kenny Whitley, Seth Dale and Remigio Hernandez-Padilla for their technical support.

Table 1. Tobacco Rotation Study, Black Shank Nursery, 2008

Treatment[1]	At Plant	4 wks Post Plant	Layby	Vigor[2]	Height[3]	Dry Wt Yield[4]	% TSWV[5]	% Black Shank[6]
1. Rye-Tobacco	**None**	**None**	**None**	7.8 a	39.0 ab	632.5 c	7.1 b	66.7 a
2. Mustard-Tobacco	**None**	**None**	**None**	7.8 a	40.8 ab	829.6 bc	7.9 b	65.2 a
3. Rye-Tobacco	·	-----	-----	7.3 a	40.7 ab	1224.4 abc	10.4 ab	37.3 ab
4. Mustard-Tobacco	·	-----	-----	8.1 a	43.4 a	904.8 abc	8.8 ab	56.6 ab
5. Rye-Tobacco	-----	·	-----	7.9 a	41.2 ab	921.4 abc	10.3 ab	51.3 ab
6. Mustard-Tobacco	-----	·	-----	7.6 a	39.8 ab	1306.3 abc	9.3 ab	35.0 ab
7. Rye-Tobacco	-----	-----	·	7.3 a	35.5 ab	1158.2 abc	10.7 ab	22.7 b
8. Mustard-Tobacco	-----	-----	·	8.3 a	39.3 ab	1624.9 a	9.0 ab	41.3 ab
9. Rye-Tobacco	·	·	-----	7.4 a	35.1 ab	1282.5 abc	12.5 a	21.7 b
10. Mustard-Tobacco	·	·	-----	8.0 a	42.7 a	1097.2 abc	9.0 ab	46.3 ab
11. Rye-Tobacco	-----	·	·	7.8 a	38.7 ab	1158.7 abc	8.8 ab	41.5 ab
12. Mustard-Tobacco	-----	·	·	8.3 a	41.0 ab	1256.7 abc	9.4 ab	38.6 ab
13. Rye-Tobacco	·	-----	·	8.3 a	41.7 a	1084.2 abc	12.7 a	33.6 ab
14. Mustard-Tobacco	·	-----	·	8.0 a	41.0 ab	1442.5 ab	10.2 ab	33.7 ab
15. Rye-Tobacco	·	·	·	7.6 a	33.1 b	1170.0 abc	10.2 ab	32.4 ab
16. Mustard-Tobacco	·	·	·	7.9 a	39.0 ab	1304.9 abc	11.1 ab	30.0 ab

[1] Data are means of five replications. Means in same column followed by the same letter are not significantly different (P=0.05) according to Fisher's LSD test.
[2] Vigor was done on a 1 to 10 scale, with 10 = live and healthy plants and 1 = dead plants. Rating was conducted on 16 June.
[3] Height measurements were done in centimeters from the soil to the tip of the longest leaf on 29 May.
[4] Dry-weight was calculated by multiplying green-weight totals of tobacco by 0.20. Pounds per acre was calculated by multiplying dry weight conversion per plot by 7,260 divided by base stand count. Tobacco was planted in 48-inch rows, with 18 inches between plants, which equals 7,260 plants/A.
[5] Percent TSWV was calculated by using stand counts that were made from April through July, with TSWV being flagged every two weeks.
[6] 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 was 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.

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 of tobacco. This study examines the race structure in a disease nursery and on some commercial 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. Four test cultivars were used as race indicators for this year's trial. They were K326, NC71, 1071 and Ky14xL8. Two rows of each cultivar were planted for a total of eight rows.

Tobacco cultivars were seeded in the greenhouse 1 February. On 25 March, the test area was disced and prepared using all current University of Georgia Cooperative Extension recommendations. On 26 March, Prowl 3.3 (2 pts./A), Lorsban 4E (3 qts./A) and Mocap 6E (2 gal./A) were applied to the test area and incorporated into the soil. The area was sub-soiled and bedded that same day. Greenhouse float plants were transplanted into field plots on 48-inch rows with an 18-inch plant spacing. Varieties K326, NC71 and 1071 were transplanted on 17 April. Variety Ky14xL8 was transplanted on 19 May due to its later seeding date.

Plots were cultivated and side dressed with 4-8-12 fertilizer at 500 lbs./A on 7 May. Calcium nitrate 15.5-0-0 was side dressed at 90 lbs./A on 15 and 19 May and again on 3 June.

Insecticides were applied as follows: Orthene 97 (90.773 lbs./A) on 2 and 21 May; 6, 12, 16, 20 and 23 June; 15 and 29 July; and 12, 14 and 21 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 parafilm lab wax, and finally wrapped in vinyl tape and labeled.

Each test cultivar (K326, NC71, Ky14xL8 and 1071) were 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

All samples tested whether a cultivar with the Ph gene had resistance to Race 0, or whether one with no resistance to Race 0 tested positive for Race 1 of *Phytophthora parasitica* var. *nicotianae*. (Table 1.) Some samples were void due to contamination or unexplained responses in the field.

Acknowledgments

The authors would like to thank Philip Morris and the Georgia Agricultural Commodity Commission for Tobacco for funding. Thanks are also extended to Crystal Samataro, Channing Paulk, Clint Powell and Zach Moye for their technical assistance.

Table 1. Tobacco Samples Submitted for Race Identification UGA CPES, Tifton, Ga., 2008

Sample #	Date Submitted	County Agent / Test	Grower / Location	Sample Cultivar	Race ID
001-08-C606	6/6/08	Jimmy Laska	Lamar Vickers-Berrien County	#27	1
002-08-C606	6/6/08	Jimmy Laska	Lamar Vickers-Berrien county	#27-2	1
003-08-C606	6/6/08	Jimmy Laska	Watson	NC299	1
210-08-08194	6/6/08	J. Michael Moore	Joey Anderson		1
000-08-08237	6/13/08	J. Michael Moore	Sydney Lord Live Oak, Fla.	CC27	1
004-08-625	6/25/08	Selected Variety Test 08	Black Shank Nursery Plot#202	K326	1
005-08-625	6/25/08	Selected Variety Test 08	Black Shank Nursery Plot#204	Speight G28	1
006-08-625	6/25/08	Selected Variety Test 08	Black Shank Nursery-UGA, Tifton, Ga. Plot#207	G-70	1
007-08-C626	6/26/08	Jimmy Laska	Paulk Farm-Berrien County	K-326	1
008-08-08254	6/25/08	J. Michael Moore	Coffee County		1
001-08-708	7/8/08	Amanda Givens	Hodge- North field #1-Alachua County, Fla.		1
0002-08-708	7/8/08	Amanda Givens	Hodge- North field #2-Alachua County, Fla.		1
003-08-708	7/8/08	Amanda Givens	Hodge- South field #2-Alachua County, Fla.		1
004-08-708	7/8/08	Amanda Givens	Hodge- South field #1-Alachua County, Fla.		1
006-08-708	7/8/08	Amanda Givens	Davis- North East field-Alachua county, Fla.		1
007-08-708	7/8/08	Amanda Givens	Davis- Cross Road field-Alachua county, Fla.	NC297	1
008-08-708	7/8/08	Amanda Givens	Davis- Cross Road west-Alachua county, Fla.	NC326	1
016-08-710	7/10/08	Regional Small Plot 08	Black Shank Farm-UGA, Tifton, Ga. Plot #332	LK1	1
017-08-710	7/10/08	Regional Small Plot 08	Black Shank Farm-UGA, Tifton, Ga. Plot #231	ULT 142	1
018-08-710	7/10/08	Regional Small Plot 08	Black Shank Farm-UGA, Tifton, Ga. Plot #206	CU94	1
019-08-710	7/10/08	Regional Small Plot 08	Black Shank Farm-UGA, Tifton, Ga. Plot #322	XP254	*void

Sample #	Date Submitted	County Agent / Test	Grower / Location	Sample Cultivar	Race ID
261-08-714	7/14/08	Keith Rucker	Greg Rutland Tift Co.	CC27	determined not BS-S. rolsii
020-08-715	7/15/08	Selected Variety Test 08	Black Shank Nursery-UGA, Tifton, Ga. Plot #708	NC72	1
021-08-715	7/15/08	Selected Variety Test 08	Black Shank Nursery-UGA, Tifton, Ga. Plot #506	Coker 371 Gold	1
022-08-715	7/15/08	Selected Variety Test 08	Black Shank Nursery-UGA, Tifton, Ga. Plot #305	McNair 944	1
023-08-715	7/15/08	Selected Variety Test 08	Black Shank Nursery-UGA, Tifton, Ga. Plot #309	1071	*void
024-08-717	7/17/08	Regional Small Plot 08	Black Shank Farm-UGA, Tifton, Ga. Plot #105	RJR 225	1
025-08-717	7/17/08	Regional Small Plot 08	Black Shank Farm-UGA, Tifton, Ga. Plot #126	RJR 651	1
026-08-717	7/17/08	Regional Small Plot 08	Black Shank Farm-UGA, Tifton, Ga. Plot #108	OX 2047	1
027-08-717	7/17/08	Regional Small Plot 08	Black Shank Farm-UGA, Tifton, Ga. Plot #217	CU61	1
028-08-723	7/23/08	Selected Variety Test 08	Black Shank Nursery-UGA, Tifton, Ga. Plot #101	K346	1
029-08-723	7/23/08	Selected Variety Test 08	Black Shank Nursery-UGA, Tifton, Ga. Plot #103	NC71	1
030-08-723	7/23/08	Selected Variety Test 08	Black Shank Nursery-UGA, Tifton, Ga. Plot #607	G70	1
031-08-723	7/23/08	Selected Variety Test 08	Black Shank Nursery-UGA, Tifton, Ga. Plot #608	NC72	1
032-08-723	7/23/08	Selected Variety Test 08	Black Shank Nursery-UGA, Tifton, Ga. Plot #509	1071	1
033-08-723	7/23/08	Selected Variety Test 08	Black Shank Nursery-UGA, Tifton, Ga. Plot #406	Coker 371 Gold	*void
034-08-723	7/23/08	Selected Variety Test 08	Black Shank Nursery-UGA, Tifton, Ga. Plot #504	Speight G28	1
035-08-723	7/23/08	Selected Variety Test 08	Black Shank Nursery-UGA, Tifton, Ga. Plot #702	K326	1
036-08-729	7/29/08	Regional Small Plot 08	Black Shank Farm-UGA, Tifton, Ga. Plot #304	CU109	1
037-08-729	7/29/08	Regional Small Plot 08	Black Shank Farm-UGA, Tifton, Ga. Plot #220	NCEX 13	*void
038-08-729	7/29/08	Regional Small Plot 08	Black Shank Farm-UGA, Tifton, Ga. Plot #329	EXP 305	1
039-08-729	7/29/08	Regional Small Plot 08	Black Shank Farm-UGA, Tifton, Ga. Plot #128	XP 324	*void

*Void indicates that sample was lost or that results were indeterminate and sample had to be resubmitted for testing.

Sampling the Tobacco Farmscape for Thrips Vectors of *Tomato spotted wilt virus*

R.M. McPherson and S. Diffie

Introduction

Thrips and the economically important disease that they transmit, *Tomato spotted wilt virus* (TSWV), remain key pest problems 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 species, including *F. occidentalis*, *F. tritici*, *F. bispinosa*, *Limothrips cerealium*, *Haplothrips* spp., and *Chirothrips* spp., are also collected on tobacco and on the weed and alternate host plants in the tobacco farmscape. *F. occidentalis*, the western flower thrips, is also a reported vector of TSWV. 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 during 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 2008, 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, Georgia. 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 labeled 1-dram glass vials containing 70 percent ethyl alcohol. The thrips specimens were mounted on microscope slides for detailed study for species identification.

On January 1, 2008, 10 3-inch x 5-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 species were identified as *F. fusca*, flower thrips species, and other thrips species. 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 mid-June. This test site was planted on 28 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 5,618 adult thrips were identified from the tobacco farmscape during this study. Twenty-four different plant hosts (plus tobacco foliage and blooms) had thrips collected from them between January and mid-May 2008. *F. fusca*, the tobacco thrips, was collected on 17 of these plant species, and *F. occidentalis* was collected from nine of the plant hosts. Other thrips species were collected on all of the plant hosts except peas (Table 1). Some immature thrips also were observed on 23 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 mean trap catch numbers (thrips per trap) are recorded for each month in Table 2. Low numbers of thrips were collected during January and February. In March, the flower thrips complex began to rise. *F. fusca* began to rise in April, were collected on the traps every month of the year, and peaked at 115.1 per trap in May. From mid-April through May 2008, there was a mean of 13 to 195 *F. fusca* per trap during this six-week period. This is significant because *F. fusca* is the most abundant thrips species on tobacco foliage (98 percent of the thrips on tobacco foliage, Table 1) and this thrips species is a reported vector of TSWV. Flower thrips were also collected every month of the year and peaked at 67.8 per trap in May.

Thrips on tobacco foliage were very low at the field site during April. On 2 May, there were around one to two thrips per plant and on 20 May, there were 7.5 thrips per plant. Then, thrips rapidly declined, with fewer than one thrips per plant on 4 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 Neal Roberson, Del Taylor, Thomas Monk, Wesley Stephens, Kayla Townsend and Dale Clark for their technical support, and the Georgia Agricultural Commodity Commission for Tobacco for financial assistance.

Table 1. Numbers of Thrips Collected from Different Plant Hosts in and Around the Tobacco Farmscape at the Bowen Research Farm, Tift County, Ga., 2008.

	Total number of thrips collected from host			
Plant Species	*F. fusca*	*F. occident.*	Other spp.	Immatures
Wild radish	174	31	527	462
Red sorrel	0	0	10	0
Broomsedge	0	0	505	10
Vetch	1	0	41	41
Nutsedge	31	0	30	9
Rye	6	2	472	58
Henbit	1	0	33	0
Pine	0	0	32	6
Primrose	17	0	15	49
Dogwood blooms	0	0	58	900
Chickweed	3	0	4	1
Crimson clover	4	11	1,568	1,033
White clover	2	0	37	29
Wheat	4	0	283	68
Privet	0	2	312	11
Rose blooms	0	0	282	40
Hydrangea	0	0	76	330
Clover	0	0	205	105
Curly dock	4	0	8	3
Morning glory	12	1	78	87
Snap beans	21	1	32	56
Soybeans	10	1	22	69
Honeysuckle	0	2	147	7
Pinkeye Peas	3	0	0	0
Tobacco blooms	2	3	334	101
Tobacco foliage	155	0	3	8
Totals	450	54	5,114	3,483

Thrips collected from January through May 2008 on plant hosts and from tobacco during April through June 2008. *F. fusca* is the tobacco thrips and *F. occidentalis* is the western flower thrips. Other spp. include *F. tritici, F. bispinosa*, *Limothrips cerealium*, *Chirothrips* spp., and *Haplothrips* spp.

Table 2. Mean Thrips Captured Per Yellow Sticky Trap Each Month in the Tobacco Farmscape, Bowen Farm, Tift County, Ga., 2008.

Month	Mean thrips per sticky trap (both sides)**		
	F. fusca	Flower thrips	Other spp.
January	0.04	5.2	0.06
February	0.4	1.4	0.5
March	0.8	18.3	1.6
April	14.6	45.3	3.8
May	115.1	67.8	2.0
June	2.5	20.0	0.3
July	0.4	34.0	2.5
August	1.2	22.0	4.6
September	1.2	24.3	1.4
October	0.5	19.9	0.6
November	0.2	3.7	0.03
December	0.08	1.4	0.05

**Means from 10 sticky traps from each week throughout the year. 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.S. Csinos, R.D. Gitaitis and C. Nischwitz

Introduction

Tomato spotted wilt virus has been one of the most devastating diseases in the Georgia agricultural community for the last two decades. Georgia, north Florida and southern South Carolina continue to be the tobacco areas that are the hardest hit by the disease. However, small pockets in North Carolina and Kentucky have reported high losses. 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.

The fact that TSWV is transmitted by a small ubiquitous insect called thrips make detection and management of the disease complicated. Viruses have traditionally been difficult to manage since we do not have materials that kill viruses in a living plant. Control of the major thrips vectors (*Frankliniella fusca* and *Frankliniella occidentalis*) is not possible primarily because of the pervasive nature of the insect and its mobility from neighboring vegetation. Thus, the level of disease in tobacco is controlled primarily by the dynamics of thrips populations and level of infection of weed hosts. These weeds may serve as reservoirs for the virus as well as reproductive hosts for the known thrips vectors of the disease.

TSWV is a very distinctive disease that threatens the livelihood of all tobacco growers in north Florida, Georgia and South Carolina. In addition, evidence is mounting that the disease is moving north and could become a major problem in North Carolina. Major efforts need to be initiated to first be able to predict outbreaks, and secondly to be able to develop management programs to reduce losses from 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 63,000 plants have been sampled over the past six years of this study to garner an understanding of the general levels of the virus in the farmscape.

Materials and Methods

The sampled areas are the Bowen Farm, Black Shank Farm and Black Shank 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) using commercially available kits (Agdia, Elkhart, IN). The plants chosen are identified in the first three-year phase of the study as plants that were susceptible to the virus and ones that were commonly infected with TSWV.

Results to Date

Tomato spotted wilt virus (TSWV) impacts increased dramatically in 2005 and leveled off in 2006. Where statewide incidence of TSWV in 2003 was at relatively low levels (less than 6 percent), 2006 saw similar numbers to 2004 and 2005 with yield losses of about 18 percent and 35 percent of all plants showing TSWV. Levels of TSWV at our experimental site at the Bowen Farm, CPES-Tifton, Ga., remained higher than the surrounding areas, as expected, around 30 percent in 2008.

Currently, we are in the seventh year of the overall study of the weed host survey. This study originally started in February 2002, and as of December 2008, 63,509 samples had been collected from all locations. Samples are continually collected from six sites every month.

In summary for 2006-2008, TSWV levels in the weeds remained low (1.08 percent) during the winter, increasing dramatically to 12.21 percent during the spring and remaining relatively level throughout the summer months. Fall saw an increase (12.25 percent) before the levels dropped to negligible levels for the winter months of November and December. April (13.6 percent) and June (19.5 percent) had the highest incidences of TSWV during the year. Overall, 2008 had a slight decrease in TSWV infections in the

weeds, and this corresponds to the slight decrease in the TSWV seen in tobacco during the 2008 growing season.

These levels correspond to the levels seen throughout the study. One of the main observations seen is the dramatic increase in weed infection levels during the late spring and during the fall. This has been a consistent feature of this study even during the years when levels have spiked higher or been markedly lower. The environmental observations have indicated that there may be an association of the higher incidences of TSWV infections and moderate conditions. Adverse weather, either colder winters or warmer summers, along with increased rainfall patterns may have a depressing effect on the levels on infection seen during the corresponding season. There also seems to be an effect regarding the changeover period of weed species seen from one season to the next.

The higher infection levels observed during the fall preceding the spring growing period corresponds favorably to a higher incidence of TSWV at the Bowen farm (Figures 1 and 2). Conversely, the infection levels seen immediately preceding the tobacco growing cycle inversely corresponded to the infection levels seen in the field.

Significance of Accomplishments

These study findings seem to validate the importance of weeds as natural reservoirs for tospoviruses. These data will allow us to hone the study in the future to further understand the relationship of TSWV levels in the weeds with the TSWV levels in tobacco fields. We may be able to elicit an early indication of TSWV incidence in an upcoming growing season by understanding the relationship of winter weed infection levels with spring and summer crop TSWV incidence.

The relationship emerging between the weed infection levels and the corresponding growing seasons is a potential tool in the management of TSWV. The establishment of an early indicator of the TSWV pressure during a growing season would be extremely valuable in determining what chemical, cultural or other management practices need to be utilized to lessen the effect that TSWV may impart on a season's tobacco crop. This host study has shown that environmental, geographical and host species all play a part in the epidemiology of TSWV and they all may be used as a disease indicator model.

Relationship to Programs in Neighboring States

Studies and observations have shown that our location is the epicenter of TSWV. Due to the high disease pressure at our locations, we are able to observe in detail the interactions of TSWV and the farmscape. This information is important to the region due to the devastating losses that have been attributed to TSWV. The neighboring states can use the information garnered in south Georgia to mitigate possible TSWV losses in their crops.

Acknowledgements

The authors want to thank Philip Morris USA and Philip Morris International for their support of this valuable study.

Figure 1. Infection Levels in the Weed Hosts by Month, 2002-2008

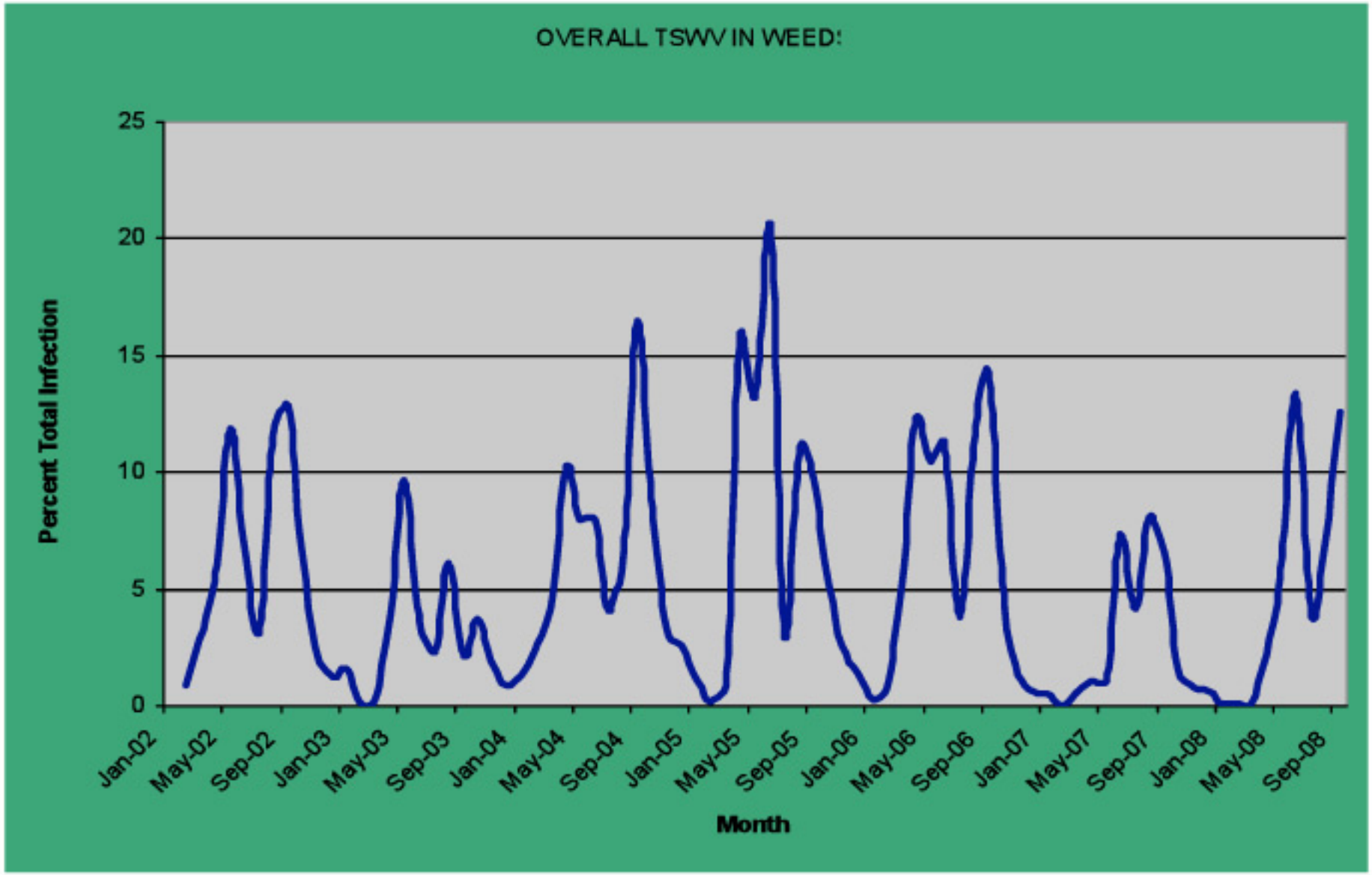
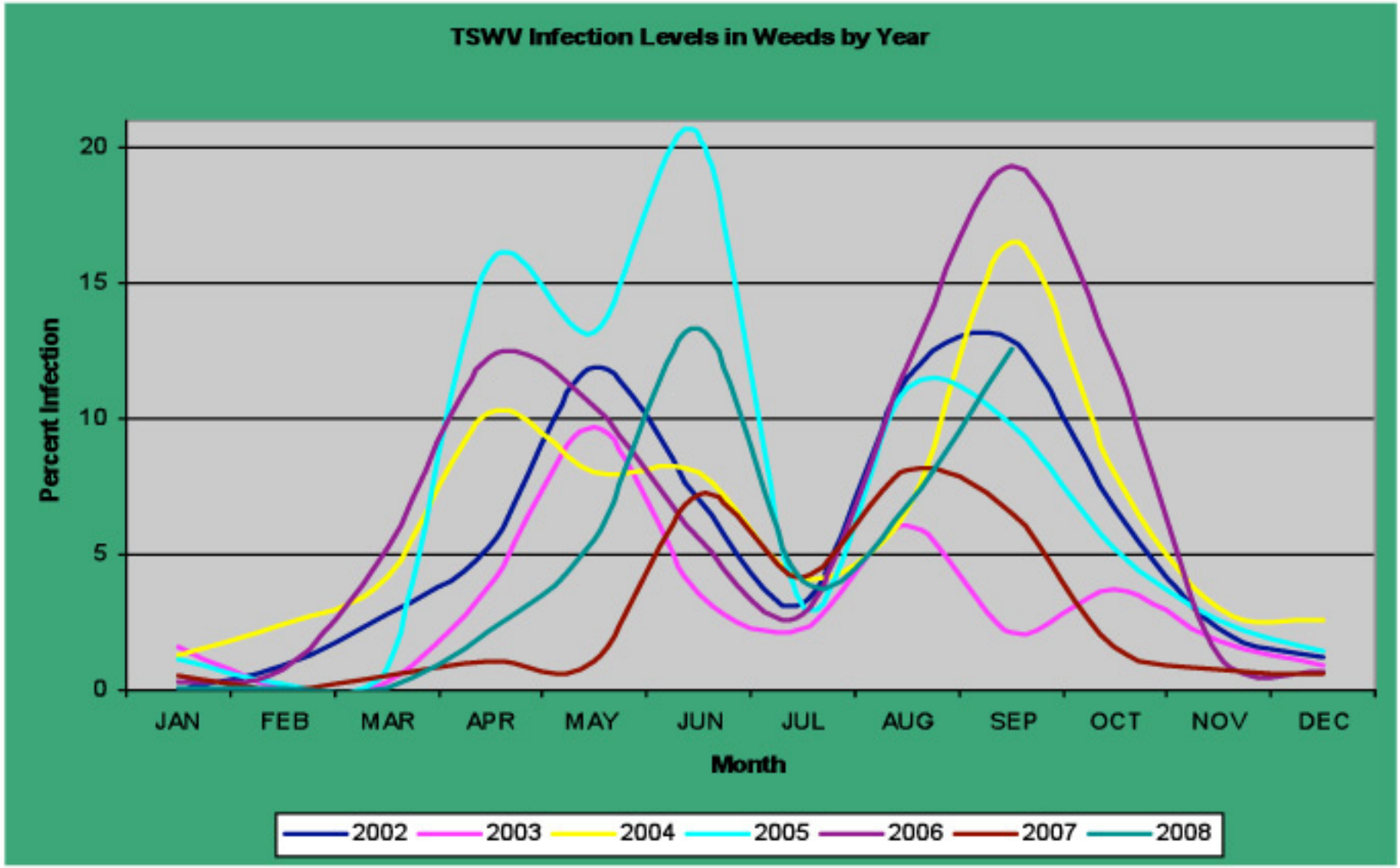


Figure 2. TSWV Infection Levels of Weed Hosts



Insect Pest Control with Selected 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 and thrips also can cause economic losses in Georgia's tobacco crop; however, the widespread use of imidacloprid has reduced the pest status of theses two insects. 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 numerous products for control of worm, thrips 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 28 March at the Georgia Coastal Plain Experiment Station Bowen Farm. Production practices were used according to the Georgia Cooperative Extension guidelines and included a preplant 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 pounds per acre, plus 100 pounds of 16-0-0 was applied at layby.

Plots three rows wide (44-inch row spacing) by 30 feet long were arranged in a RCBD with four replications. Plots were separated on each side with an untreated border row and on each end with a 4-foot-wide fallow alley. Thirteen foliar spray treatments were applied on 16 May and 23 May using a CO_2-powered backpack sprayer equipped with three TX-12 nozzles directed over a single row, delivering 24.8 gpa at 40 psi. The number of live budworms and hornworms per plot (45 plants) was recorded prior to treatment (Pre-t) plus three and six days after the first application and four, seven and 10 days after the second application. In addition to the worm counts, plants two, four, six and eight on row two of each plot were sampled for aphid and thrips infestations. Following the June sampling, all plots were rated for defoliation damage from 0 (no feeding damage) to 5 (all leaves damaged on the upper 1/3 of the plant) and for aphid infestation levels from 0 (no aphids present) to 5 (plant covered with aphids). From mid-June to mid-July, 10 plants on row two were harvested a total of three times. Green weights were obtained and then connected to cured weight (x 0.15). All the insect count, damage rating and yield data were analyzed with an Analysis of Variance (P=0.05) and means were separated using Duncan's multiple range tests.

Results and Discussion

Most of the treatments had lower budworm populations on three and six days after the first application and four, seven and 10 days after the second application (Table 1). All treatments had lower hornworm densities at six days after the first application and most were effective in reducing hornworms at 10 days after the second application (Table 2). Some treatments were effective in reducing thrips populations on three and six days following the first application and all treatments had lower thrips densities than the untreated control on four days after the second application (Table 3). Few treatment differences were noted for aphid populations (Table 4). Worm feeding damage was lower in all insecticide treatments compared to the untreated control (Table 5), while aphid infestation levels were lower in only five of the treatments (Orthene, Methonyl, Belt, Capture and Brigadier). Yields were not significantly different between the treatments (Table 5).

In conclusion, the 13 products examined in this study all demonstrated effectiveness in controlling budworms, hornworms, thrips and aphids up to 10 days after application.

Acknowledgments

The authors thank Thomas Monk, Dale Clark, Wesley Stephens, Ed Troxell and Steve LaHue for technical support, and Bayer, FMC, Syngenta, Dow AgroSciences, DuPont, Valent and the Georgia Agricultural Commodity Commission for Tobacco for financial support.

Table 1. Effects of Selected Foliar Insecticide Applications on the Abundance of Tobacco Budworms on Flue-Cured Tobacco, Tift County, Ga., 2008.

Treatment and lbs. AI/acre	Budworms per plot (45 Plants)				
	19 May	22May	27 May	30 May	2 June
HGW 86 0.066	1.5bcd	2.5bc	0.0b	0.0b	0.0b
HGW 86 0.088	1.3bcd	2.0bcd	0.8ab	0.3b	0.5b
HGW 86 0.134	1.0bcd	1.5bcd	0.5ab	0.0b	0.0b
HGW 86 0.134 + MSO 0.5% v/v	2.0abcd	1.0cd	0.0b	0.0b	0.3b
Orthene 97 PE 0.75	2.8abc	3.3ab	2.0a	1.3a	1.3b
Coragen 1.675 S 0.065	0.0d	1.0cd	0.0b	0.0b	0.0b
Untreated	4.0a	3.0ab	1.3ab	1.3a	3.3a
Methomyl 2.4LV 0.45	3.3ab	4.5a	0.8ab	0.0b	0.3b
Belt 480SC 0.09 + NIS 0.25% v/v	1.5bcd	1.0cd	0.5ab	0.0b	0.0b
Belt 480SC 0.09 + MSO 0.25% v/v	1.5bvd	1.0cd	0.0b	0.0b	0.0b
Denim 0.16EC 0.0125	0.8cd	0.3d	0.0b	0.0b	0.0b
Tracer 4SC 0.0625	2.0abcd	2.0bcd	0.0b	0.0b	0.0b
Capture LFR 1.5EC 0.08	1.3bcd	2.3bc	0.0b	0.3b	0.3b
Brigadier 2EC 0.10	2.5abc	1.8bcd	0.5ab	0.0b	0.5b

K-326 flue-cured tobacco transplanted on 28 March and topped on 9 June. Foliar applications made on 16 May and 23 May with a CO2-powered backpack sprayer delivering 24.8 gpa at 40 psi with three TX-12 nozzles per row. MSO is methylated seed oil and NIS is non-ionic surfactant. 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 Applications on the Abundance of Tobacco Hornworms on Flue-Cured Tobacco, Tift County, Ga., 2008.

Treatment and lbs. AI/acre	Hornworms per plot (45 Plants)			
	22 May	27 May	30 May	2 June
HGW 86 0.066	0.3b	0.0a	0.0a	0.0b
HGW 86 0.088	0.5b	0.0a	0.0a	0.0b
HGW 86 0.134	0.3b	0.0a	0.0a	0.0b
HGW 86 0.134 + MSO 0.5% v/v	0.3b	0.0a	0.0a	0.0b
Orthene 97 PE 0.75	0.0b	0.3a	0.0a	0.5ab
Coragen 1.675 S 0.065	0.0b	0.0a	0.3a	0.0b
Untreated	1.5a	0.3a	1.8a	2.0a
Methomyl 2.4LV 0.45	0.0b	0.0a	0.0a	0.5ab
Belt 480SC 0.09 + NIS 0.25% v/v	0.0b	0.0a	0.0a	0.0b
Belt 480SC 0.09 + MSO 0.25% v/v	0.0b	0.0a	0.0a	0.0b
Denim 0.16EC 0.0125	0.0b	0.0a	0.0a	0.0b
Tracer 4SC 0.0625	0.5b	0.0a	0.0a	0.8ab
Capture LFR 1.5EC 0.08	0.0b	0.0a	0.0a	0.0b
Brigadier 2EC 0.10	0.0b	0.0a	0.0a	0.0b

K-326 flue-cured tobacco transplanted on 28 March and topped on 9 June. Foliar applications made on 16 May and 23 May with a CO2-powered backpack sprayer delivering 24.8 gpa at 40 psi with three TX-12 nozzles per row. MSO is methylated seed oil and NIS is non-ionic surfactant. 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 Applications on the Abundance of Thrips on Flue-Cured Tobacco, Tift County, Ga., 2008.

Treatment and lbs. AI/acre	Thrips per four plants			
	15 May	19 May	22 May	27 May
HGW 86 0.066	3.0a	13.5bcd	59.0ab	0.0b
HGW 86 0.088	1.0a	11.0ad	72.3a	0.0b
HGW 86 0.134	2.3a	8.0cd	49.8ab	1.0b
HGW 86 0.134 + MSO 0.5% v/v	2.0a	13.3bcd	44.3ab	0.0b
Orthene 97 PE 0.75	1.0a	5.8cd	37.5ab	0.0b
Coragen 1.675 S 0.065	2.5a	21.0abc	75.8a	0.0b
Untreated	2.0a	36.0a	70.3a	3.8a
Methomyl 2.4LV 0.45	2.0a	10.8cd	69.3a	0.0b
Belt 480SC 0.09 + NIS 0.25% v/v	0.0a	12.3bcd	47.3ab	0.0b
Belt 480SC 0.09 + MSO 0.25% v/v	1.0a	27.8ab	74.5a	1.3b
Denim 0.16EC 0.0125	1.0a	9.8cd	56.8ab	0.0b
Tracer 4SC 0.0625	2.0a	5.0cd	39.3ab	0.0b
Capture LFR 1.5EC 0.08	1.0a	2.0d	9.5b	0.0b
Brigadier 2EC 0.10	3.0a	0.8d	15.8b	0.0b

K-326 flue-cured tobacco transplanted on 28 March and topped on 9 June. Foliar applications made on 16 May and 23 May with a CO2-powered backpack sprayer delivering 24.8 gpa at 40 psi with three TX-12 nozzles per row. MSO is methylated seed oil and NIS is non-ionic surfactant. Column means with the same letter are not significantly different (Duncan's multiple range test, P=0.05).

Table 4. Effects of Selected Foliar Insecticide Applications on the Abundance of Aphids on Flue-Cured Tobacco, Tift County, Ga., 2008.

Treatment and lbs. AI/acre	Aphids per four plants			
	22 May	27 May	30 May	2 June
HGW 86 0.066	0.0a	71.3bc	148.3ab	417.5ab
HGW 86 0.088	5.8a	27.8cd	73.3b	109.8abc
HGW 86 0.134	0.5a	25.5cd	84.5b	49.3bc
HGW 86 0.134 + MSO 0.5% v/v	0.5a	8.2cd	15.0b	50.0bc
Orthene 97 PE 0.75	0.0a	5.3d	35.3b	0.0c
Coragen 1.675 S 0.065	11.5a	38.0cd	73.3b	434.5a
Untreated	5.8a	44.3bcd	62.0b	138.8abc
Methomyl 2.4LV 0.45	0.3a	24.8cd	24.8b	50.0bc
Belt 480SC 0.09 + NIS 0.25% v/v	9.0a	103.0ab	52.0b	246.0abc
Belt 480SC 0.09 + MSO 0.25% v/v	1.0a	63.5bcd	84.0b	230.5abc
Denim 0.16EC 0.0125	0.0a	20.3cd	78.8b	114.0abc
Tracer 4SC 0.0625	27.5a	139.8a	382.0a	88.5abc
Capture LFR 1.5EC 0.08	0.0a	0.0d	3.5b	0.8c
Brigadier 2EC 0.10	1.3a	3.8d	0.0b	2.0c

K-326 flue-cured tobacco transplanted on 28 March and topped on 9 June. Foliar applications made on 16 May and 23 May with a CO2-powered backpack sprayer delivering 24.8 gpa at 40 psi with three TX-12 nozzles per row. MSO is methylated seed oil and NIS is non-ionic surfactant. Column means with the same letter are not significantly different (Duncan's multiple range test, P=0.05).

Table 5. Effects of Selected Foliar Insecticide Applications on Foliage Damage from Worm Feeding and Aphid Infestation Rating on 16 June, Plus Cured Yield of Flue-Cured Tobacco, Tift County, Ga., 2008.

Treatment and lbs. AI/acre	Damage Rating	Aphid Rating	Yield
	(0-5) *	(0-5) *	lbs. / acre
HGW 86 0.066	0.425cde	3.50a	2865a
HGW 86 0.088	0.300de	3.50a	2361a
HGW 86 0.134	0.275e	3.00ab	2481a
HGW 86 0.134 + MSO 0.5% v/v	0.225e	3.25ab	2295a
Orthene 97 PE 0.75	0.700b	0.25d	2451a
Coragen 1.675 S 0.065	0.250e	3.00ab	2768a
Untreated	1.125a	3.50a	2535a
Methomyl 2.4LV 0.45	0.450cde	1.50c	2724a
Belt 480SC 0.09 + NIS 0.25% v/v	0.575bc	2.75ab	2777a
Belt 480SC 0.09 + MSO 0.25% v/v	0.350cde	2.50b	2841a
Denim 0.16EC 0.0125	0.300de	3.00ab	2876a
Tracer 4SC 0.0625	0.525bcd	3.50a	2629a
Capture LFR 1.5EC 0.08	0.250e	0.50d	3004a
Brigadier 2EC 0.10	0.225e	0.75cd	2623a

K-326 flue-cured tobacco transplanted on 28 March and topped on 9 June. Foliar applications made on 16 May and 23 May with a CO2-powered backpack sprayer delivering 24.8 gpa at 40 psi with three TX-12 nozzles per row. MSO is methylated seed oil and NIS is non-ionic surfactant. Column means with the same letter are not significantly different (Duncan's multiple range test, P=0.05).

*Damage rating for worm defoliation ranged from 0 (no observed feeding damage) to 5 (all leaves damaged on the upper 1/3 of the plant) and aphid infestation rating ranged from 0 (no aphids observed) to 5 (plant covered with aphids, honeydew and sooty mold).

Tobacco Splitworm, Budworm and Hornworm Control with Selected Insecticides

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. Tobacco budworms and tobacco hornworms are also economic pests of tobacco in Georgia. This experiment was conducted to evaluate the effectiveness of nine foliar treatments and two transplant water treatments (Brigade and Coragen) for controlling these three worm pests.

Materials and Methods

Flue-cured tobacco, NC-71, was transplanted on 25 April at the Georgia Coastal Plain Experiment Station Bowen Farm. Production practices were used according to the Georgia Cooperative Extension guidelines. Fertilizer (6-6-18) was applied in a split application at a total of 1,000 pounds per acre.

Plots two rows wide (44-inch row spacing) by 33 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 (Coragen 5 oz./a, Brigade 4 oz./a). In addition, foliar spray treatments were each applied on 3 June and 12 June. Foliar spray equipment consisted of a CO_2-powered backpack sprayer equipped with three TX-12 nozzles directed over a single row, delivering 24.8 gpa at 40 psi. Live budworm and hornworm larvae were counted from all plants in each plot seven days after the first application and seven and 11 days after the second application. In addition, on 30 June, 10 plants were observed on row one for worm defoliation and assigned a rating of 0 (no leaf damage) to 5 (all leaves defoliated), plus the number of splitworm tunnels was recorded from all plants in each plot. All the worm count damage rating data were analyzed with an Analysis of Variance (P=0.05) and means were separated using the Waller-Duncan k-ratio t-test.

Results and Discussion

Tobacco budworms and tobacco hornworms were effectively controlled by the foliar insecticide treatments seven and 11 days after the second application, and the resulting plant damage ratings also were lower in the insecticide treated plots (Table 1). Splitworm tunnels per plot were lower in the Coragen (both TPW and foliar), Brigade (foliar only), Rimon, Warrior and Steward treatments (Table 1).

In conclusion, several insecticides appear to suppress splitworm damage on flue-cured tobacco. Coragen (DuPont) is currently not labeled for use on tobacco, but has been submitted to USEPA for registration. All of these products, along with other insecticides, need to continue to be examined for splitworm, budworm and hornworm control, so that the most effective pest management program for tobacco insects can be developed and implemented.

Acknowledgments

The authors thank Ed Troxel, Neal Roberson, Del Taylor, Wesley Stephens and Steve LaHue for technical support and FMC, Dow AgroSciences, DuPont, Valent, Syngenta and the Georgia Agricultural Commodity Commission for Tobacco for financial support of this project.

Table 1. Effects of Selected Foliar and Transplant Water (TPW) Insecticide Treatments on the Abundance of Tobacco Hornworms (THW), Tobacco Budworms (TBW), Plant Damage Rating and Tobacco Splitworm Tunnels Per Plot on Flue-Cured Tobacco, Tift County, Ga., 2008.

Treatment and formulation per acre	Worms per plot (42 plants)					Damage	Split
	7 DAT	7 DAT (2nd)		11 DAT (2nd)		Rating*	worm
	(1st) TBW	THW	TBW	THW	TBW	(0-5)	tunnels
Tracer 4SC 2.5oz	0.0b	0.3ab	0.8f	0.0b	0.0e	0.2e	23.0abc
Orthene 97PE 0.775lb.	0.3b	0.0b	5.0def	0.3b	2.3cde	1.0d	32.8a
Lannate 2.4LV 24oz	0.5ab	0.0b	8.5b-e	0.0b	3.8bcd	1.0d	27.0ab
Coragen 1.675 5oz **TPW**	1.0ab	0.0b	5.5def	2.0b	3.5bcd	1.2bcd	3.8d
Coragen 1.675 5 oz	0.0b	0.0b	0.5f	0.0b	0.0e	0.3e	1.3d
Brigade 2E 4oz **TPW**	2.3a	1.0ab	17.5a	2.3b	10.3a	2.3a	26.0ab
Brigade 2E 4oz	1.3ab	0.0b	6.8cde	0.0b	2.5cde	1.1cd	0.0d
Assail 30 WP 3oz	1.0ab	0.5ab	9.5bcd	0.3b	6.0b	1.5bc	29.3ab
Rimon 0.83 EC 12oz	0.8ab	1.0ab	7.5cde	0.8b	6.3b	1.3bcd	11.3cd
Warrior 1EC 3.9oz	1.0ab	0.0b	10.8bc	0.0b	5.3bc	1.6b	2.5d
Steward 1.25 EC 10oz	0.3b	0.0b	3.8ef	0.0b	1.3de	0.5e	18.0bc
Untreated	1.3ab	2.0a	13.5ab	6.3a	13.3a	2.3a	26.3ab

NC-71 flue-cured tobacco transplanted on 25 April at a rate of 7,000 transplants per acre. Transplant water (TPW) treatments were applied at transplanting in 100 gpa of water. Foliar sprays were applied on 3 June (1st appl.) and 12 June (2nd appl.) with a CO2-powered backpack sprayer delivering 24.8 gpa at 40psi with three TX-12 nozzles per row. THW represents tobacco hornworm larvae and TBW represents tobacco budworm larvae. Column means followed by the same letter are not significantly different (Waller-Duncan k-ratio t-test, P=0.05).

*Mean damage rating from 10 plants on row one of each plot. Individual plant damage ranged from 0 (no leaf damage) to 5 (all leaves completely defoliated).

Regional Chemical Sucker Control Test

S.S. LaHue, C.E. Troxell and J.M. Moore

Introduction

Chemical growth regulators are extensively used by tobacco growers in Georgia to control sucker growth. These materials are an essential component of the production process 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 crop, residues above 100 ppm must be reduced.

The tobacco season has lengthened because recent cultivars benefit from irrigation and higher nitrogen use. Moreover, the incidence of *Tomato spotted wilt virus* (TSWV) has increased in recent years, causing additional sucker pressure and difficulty in control due to variability in stands and especially 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 and formulations of existing materials used in combination (sequential) with fatty alcohols (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 the recommended rate of 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 550 lbs./acre of 6-6-18 at first cultivation and 550 lbs./acre of 6-6-18 at second cultivation followed with 175 lbs./acre of 15.5-0-0 at layby. Plots consisted of two rows of 30 plants each. Ten uniform plants were sampled from each plot for sucker data. The test involved four replications randomized with 15 sucker control treatments as follows:

1. TNS - Topped Not Suckered.

2. Off-Shoot-T/Off-Shoot-T /(RMH-30 + Flupro) - Two treatments of the contact Off-Shoot-T (Chemtura) at 4 percent solution then 5 percent solution three to five days apart followed in five to seven days by a tank mix of RMH-30 (Chemtura Chemical) potassium malic hydrazide at the labeled rate of 2.25 lb. ai/A and Flupro (Chemtura Chemical) at 0.6 lb. ai/A.

3. Off-Shoot-T/Off-Shoot-T /Check MH - Two treatments of the contact Off-Shoot-T at 4 percent then 5 percent three to five days apart followed in five to seven days by Check MH (Coastal AgroBusiness) at the labeled rate of 2.25 lb. ai/A.

4. Off-Shoot-T/Off-Shoot-T /(Check MH & Matrixx) - Two treatments of Off-Shoot-T at 4 percent then 5 percent three to five days apart followed in five to seven days with Check MH and the adjuvant Matrixx (Coastal AgroBusiness) at the rate of 2.25 lb. ai/A and 8 oz./A respectively.

5. Off-Shoot-T/Off-Shoot-T /(Check MH & Syntact) - Two treatments of Off-Shoot-T at 4 percent then 5 percent three to five days apart followed in five to seven days with Check MH and the adjuvant Syntact (Coastal AgroBusiness) at the rate of 2.25 lb. ai/A and 8 oz./A respectively.

6. Off-Shoot-T/Off-Shoot-T /(RMH-30 + APE Free) - Two treatments of the contact Off-Shoot-T at 4 percent then 5 percent three to five days apart followed in five to seven days by a tank mix of RMH-30 at 2.25 lb. ai/A and APE Free at 0.6 lb. ai/A.

7. Off-Shoot-T/Off-Shoot-T /Flupro/ RMH-30 - Two treatments of Off-Shoot-T at 4 percent then 5 percent three to five days apart followed in five to seven days with Flupro at 0.6 lb. ai/A followed in five to seven days with RMH-30 at 1.5 lb. ai/A.

8. Off-Shoot-T/Off-Shoot-T /APE Free/ RMH-30 - Two treatments of Off-Shoot-T at 4 percent then 5 percent three to five days apart followed in five to seven days with APE Free at 0.6 lb. ai/A followed in five to seven days with RMH-30 at 1.5 lb. ai/A.

9. Off-Shoot-T/Off-Shoot-T /Flupro/ RMH-30 - Two treatments of Off-Shoot-T at 4 percent then 5 percent three to five days apart followed in five to seven days with Flupro at 0.6 lb. ai/A followed in five to seven days with RMH-30 at 2.25 lb. ai/A.

10. Off-Shoot-T/Off-Shoot-T /(RMH Xtra & Prime+)- Two treatments of the contact Off-Shoot-T at 4 percent then 5 percent three to five days apart followed in five to seven days by a tank mix of RMH Xtra (Chemtura Chemical) potassium malic hydrazide at the labeled rate of 2.25 lb. ai/A and Prime+ at 0.6 lb. ai/A.

11. Off-Shoot-T/Off-Shoot-T /(RMH Xtra & Butralin)- Two treatments of the contact Off-Shoot-T at 4 percent then 5 percent three to five days apart followed in five to seven days by a tank mix of RMH Xtra at 2.25 lb. ai/A and Butralin (Chemtura) at 2.25 lb. ai/A.

12. Off-Shoot-T/Off-Shoot-T /(Off-Shoot-T & RMH Xtra & Flupro)- Two treatments of the contact Off-Shoot-T at 4 percent then 5 percent three to five days apart followed in five to seven days by a tank mix of Off-Shoot-T at 5 percent with RMH Xtra at 2.25 lb. ai/A and Flupro at 0.6 lb. ai/A.

13. Off-Shoot-T/Off-Shoot-T/Off-Shoot-T/(Off-Shoot-T & RMH Xtra & Prime+)- Three treatments of Off-Shoot-T at 3 percent then 4 percent and 5 percent three to five days apart followed in five to seven days with by a tank mix of Off-Shoot-T at 5 percent with RMH Xtra at 2.25 lb. ai/A and Prime+ at 0.6 lb. ai/A.

14. Off-Shoot-T/Off-Shoot-T/Off-Shoot-T/(Off-Shoot-T & RMH Xtra & Butralin)- Three treatments of Off-Shoot-T at 3 percent then 4 percent and 5 percent three to five days apart followed in five to seven days with by a tank mix of Off-Shoot-T at 5 percent with RMH Xtra at 2.25 lb. ai/A and Butralin at 2.25 lb. ai/A.

15. Off-Shoot-T/Off-Shoot-T/Off-Shoot-T/(Off-Shoot-T & RMH Xtra & Flupro)- Three treatments of Off-Shoot-T at 3 percent then 4 percent and 5 percent three to five days apart followed in five to seven days with by a tank mix of Off-Shoot-T at 5 percent with RMH Xtra at 2.25 lb. ai/A and Flupro at 0.6 lb. ai/A.

Results and Discussion

The first contact was applied on 21 June, the second on 26 June and the third set of treatments applied on 3 July. The fourth treatment for entries seven through nine and 13 through 15 was applied on 10 July. The final harvest was on 14 August, with the test concluding after the suckers were pulled, counted and weighed off 10 plants from each plot on 15 August.

Recently, a genetically transformed K326 with resistance to TSWV has been used for this test due to historically high TSWV incidence at the Bowen Farm location. However, this year NC 71 treated in the greenhouse with labeled rates of Actigard and Admire and two additional field sprays of Actigard at labeled rates was used for TSWV suppression. With the preventative treatments, control of TSWV was reduced from 20 percent in adjacent check plots to 6 percent.

All chemical treatments (Table 1) were significantly higher than the topped-not-suckered check for yield and value. Yield was good but not significantly different for all chemical treatments and ranged from 3,735 lbs./A for treatment six to 3,390 lbs./A for treatment 10. The TNS control was significantly lower, yielding only 2,763 lbs./A. Grade indices were good for all treatments and showed no significant difference, with treatments eight and 15 showing the best value and quality. Sucker number per plant was

good with a value of less than one for all chemical treatments. In addition, percent control was good for all chemical treatments and ranged from 99.7 percent for treatment 12 to 90.4 percent for treatment four. Finally, treatments 12 through 15 seemed to give the best control and might be significantly better when TSWV levels are higher.

Acknowledgments

The authors would like to thank the Georgia Agricultural Commodity Commission for Tobacco for financial support. Also, thanks to Barry Luke, Kevin Baldree, Heather Hilton, Lauren Cox, Kelly Dill, Ween Carter, Whitney Phillips and James Carr for technical assistance.

Table 1. 2008 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.	Topped-Not-Suckered	0.0	415.7	2.1	198.0	0	2763	162	4475	80
2.	OST/OST/(RMH-30 & Flupro) 4%/5%/(2.25lb ai/A+0.6 lb ai/A)	97.4	10.9	0.3	43.4	0	3659	157	5762	78
3.	OST/OST/ Check MH 4%/5%/2.25lb ai/A	96.6	14.2	0.5	31.6	0	3416	162	5543	79
4.	OST/OST/(Check MH & Matrixx) 4%/5% /(2.25lbai/A & 0.8 oz/A)	90.4	40.0	0.8	49.9	0	3643	159	5823	78
5	OST/OST/(Check MH & Syntact) 4% / 5% /(2.25lb ai/A & 0.8 oz/A)	92.7	30.5	0.7	45.2	0	3410	159	5438	78
6	OST/OST/(RMH-30 & APE Free) - 4% / 5% /(2.25lb ai/A+0.6 lb ai/A)	98.2	7.6	0.3	25.2	0	3735	159	5943	78
7	OST/OST/ Flupro / RMH 30 4%/ 5%/ 0.6lb ai/A / 1.5lb ai/A	97.0	12.6	0.4	35.9	0	3488	159	5547	78
8	OST/OST/ APE Free / RMH 30 4%/ 5%/ 0.6lb ai/A / 1.5lb ai/A	97.5	10.6	0.3	42.2	0	3571	169	6032	82
9	OST/OST/ Flupro / RMH 30 4%/ 5%/ 0.6lb ai/A / 2.25lb ai/A	93.1	28.6	0.4	71.5	0	3709	159	5889	78

	Treatments	% Control	Sucker Growth: Green Wt./ Plant(g)	Sucker Growth: No./ Plant	Sucker Growth: Green Wt./ Sucker(g)	Plant Injury[1]	Cured Leaf: Yield (lbs./A)	Cured Leaf: Price Index[2] ($/cwt)	Cured Leaf: Value ($/A)	Cured Leaf: Grade Index[3]
10	OST/OST/(RMH Xtra & Prime+) - 4% / 5% / (2.25lb ai/A+0.6 lb ai/A)	99.2	3.2	0.3	12.8	0	3390	154	5218	76
11	OST/OST/(RMH Xtra & Butralin) - 4% / 5% / (2.25lb ai/A+2.25 lb ai/A)	98.6	5.9	0.2	39.0	0	3639	147	5404	73
12	OST/OST/ (OST & RMH Xtra & F lupro) - 4%/5%/ (5% +2.25lb ai/A+0.6 lb ai/A)	99.7	1.3	0.1	25	0	3520	157	5516	77
13	OST/OST/OST/(OST & RMH Xtra & Prime+) - 3%/4%/5%/ (5% +2.25lb ai/A+0.6 lb ai/A)	99.3	2.8	0.1	37.3	0	3723	160	5960	78
14	OST/OST/OST/(OST & RMH Xtra & Butralin) - 3%/4%/5%/ (5% +2.25lb ai/A+2.25 lb ai/A)	99.0	4.0	0.2	19.8	0	3471	155	5370	75
15	OST/OST/OST/(OST & RMH Xtra & Flupro) - 3%/4%/5%/ (5% +2.25lb ai/A+0.6 lb ai/A)	99.0	4.3	0.1	34.4	0	3694	167	6182	82
	LSD-0.05						369.4	11.7	758.3	5.2

[1] Injury rating on a scale of 0 to 10, with 0 = no damage and 10 = plant killed.
[2] Price Index based on two-year average (2007-2008) prices for U.S. government grades.
[3] Grade Index is a 1 to 99 rating based on government grade. High ratings are best.
* 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.

2008 Actigard and Admire Pro Application Timing Study for Control of *Tomato spotted wilt virus* (TSWV) in Tobacco

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Introduction

This study was initiated to determine the effect of Actigard applications in the field for TSWV management. In addition, 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 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 5-foot alleys between repetitions.

On 28 January 2008, variety NC-71 was seeded into 242 cell flats. On 19 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 22-inch plant spacing. An average of 20 plants per test plot was planted.

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 3.3EC 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 12-inch band at the rate of 40 PSI for 10.0 gal. H_2O per acre. All treatments were mixed in 3 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 first symptom of TSWV and again two weeks and four weeks after initial application for some treatments. First symptom of TSWV was observed from stand counts on 28 April. 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 is listed in the following table (Table 1).

Table 1. Treatment List, Field Application Schedule and Dates of Field Application

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)	02 April
4. Actigard & Admire Pro Greenhouse	+ 14 DPT	09 April
5. Actigard & Admire Pro Greenhouse	+ 21 DPT	16 April
6. Actigard & Admire Pro Greenhouse	+ 28 DPT	23 April
7. Actigard & Admire Pro Greenhouse	+ 35 DPT	29 April
8. Actigard & Admire Pro Greenhouse	+ 42 DPT	05 May
9. Actigard & Admire Pro Greenhouse	+ 49 DPT	12 May
10. Actigard & Admire Pro Greenhouse	+ 1st symptom	05 May
11. Actigard & Admire Pro Greenhouse	+ 1stsymptom + 2 weeks + 2 weeks	05 May 20 May 02 June
12. Actigard & Admire Pro Greenhouse	+ 1st symptom of TSWV inject Actigard	06 May
13. Actigard & Admire Pro Greenhouse	+ 1st symptom of TSWV inject Admire	06 May
14. Actigard & Admire Pro Greenhouse	+ 14 DPT + 2 weeks	09 April 23 April
15. Actigard & Admire Pro Greenhouse	+ 1st symptom + 2 weeks	05 May 20 May
16. Actigard & Admire Pro Greenhouse	+ 28 DPT + 2 weeks	23 April 05 May
17. Actigard & Admire Pro Greenhouse	+ 1st symptom of TSWV inject Actigard and Admire at 2X rate	06 May
18. Actigard & Admire Pro Greenhouse	+ 1st symptom of TSWV inject Actigard and Admire	06 May
19. Actigard & Admire Pro Greenhouse	+ 21 DPT + 2 weeks	16 April 29 April
20. K326-T	No field treatment	N/A

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

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. First symptom of TSWV was noted 31 days post transplant (DPT).

Three harvests were conducted on 2 June and 17 and 30 July. Harvests were done by collecting 1/3 of the plant 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 11 April to 26 June. The final count was made on 26 June to determine the number of plants killed by TSWV and the number of non-harvestable plants.

One height measurement was conducted on 28 May. Plants were measured in centimeters from the base of the plant to the tip of the longest leaf. Two vigor ratings were conducted on a 1 to 10 scale, with 10 equaling vigorous healthy plants and 1 equaling poor vigor plants. Vigor ratings were conducted on 1 and 22 May.

Following the final harvest, root samples were collected 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 was at a moderate level in this study, with the non-treated plots having 20 percent symptomatic plants. All treatments were significantly reduced in height and vigor compared to the non-treated and K326-T treatments. Almost all of the treatments reduced TSWV incidence compared to the non-treated plots. The lowest disease occurred in plots treated during the 35- to 42-day post plant period or where two field applications of Actigard occurred in plots treated at or near first symptom of TSWV. Percent ELISA positive levels were two to three times higher than the percent symptomatic plants.

Acknowledgments

The authors would like to thank the Georgia Agricultural Commodity Commission for Tobacco, Philip Morris Tobacco Company, Syngenta Crop Protection and Bayer Crop Science for support of this study. Thanks are also extended to Clint Powell, Cody Singletary, Remigio Padilla-Hernandez, Haley Gibbs, Mac Denny and Trevor Cook.

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., 2008

Treatment[1] (Greenhouse)	Field Treatment[2]	Plant Height[3]	Vigor Ratings[4]	Dry Weight Yield[5]
1. Non-treated Control	No field treatment	62.43 ab	12.0 a	2183.4 e
2. Actigard & Admire Pro	No field treatment	55.5 c	9.4 b	2235.4 cde
3. Actigard & Admire Pro	+ 7 days post transplant (DPT)	53.3 cd	9.3 b	2280.5 b-e
4. Actigard & Admire Pro	+ 14 DPT	52.1 cd	9.2 b	2353.5 a-d
5. Actigard & Admire Pro	+ 21 DPT	53.2 cd	9.0 b	2247.6 cde
6. Actigard & Admire Pro	+ 28 DPT	52.6 cd	9.9 b	2388.7 a-e
7. Actigard & Admire Pro	+ 35 DPT	55.6 c	9.8 b	2360.4 a-e
8. Actigard & Admire Pro	+ 42 DPT	55.3 c	9.6 b	2605.4 ab
9. Actigard & Admire Pro	+ 49 DPT	54.8 cd	10.2 b	2295.4 a-e
10. Actigard & Admire Pro	+ at 1st symptom	51.7 cd	8.9 b	2331.6 a-e
11. Actigard & Admire Pro	+ at 1st symptom TSWV + 2 weeks + 2 weeks	48.2 d	9.0 b	2465.8 a-e
12. Actigard & Admire Pro	+ at 1st symptom inject Actigard in root zone	56.2 bc	9.9 b	2636.7 a
13. Actigard & Admire Pro	+ at 1st symptom inject Admire Pro in root zone	54.1 cd	9.0 b	2362.3 a-e
14. Actigard & Admire Pro	+ 14 DPT + 2 weeks	54.1 cd	9.3 b	2239.5 cde
15. Actigard & Admire Pro	+ 1st symptom TSWV + 2 weeks	54.5 cd	9.9 b	2636.6 a
16. Actigard & Admire Pro	+ 28DPT + 2 weeks	52.6 cd	9.1 b	2526.7 a-d
17. Actigard & Admire Pro	+ at 1st symptom inject Actigard & Admire Pro (x2) in root zone	55.7 bc	9.8 b	2217.4 de
18. Actigard & Admire Pro	+ at 1st symptom inject Actigard & Admire in root zone	58.2 bc	10.1 b	2473.9 a-e
19. Actigard & Admire Pro	+ 21 DPT + 2 weeks	54.1 cd	9.1 b	2570.6 abc
20. K326T	No field treatment	66.8 a	12.4 a	2492.1 a-e

[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 applied weekly beginning at seven days post transplant and continuing every seven days thereafter up to 49 days post plant. Other treatments were applied when first symptom of TSWV was identified through scouting control plots, with some receiving an additional application two weeks and four weeks afterwards according to the treatment list. 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 oz./1,000 plants-Admire Pro.

[3] Height measurements were done in inches from the soil level to the tip of the longest leaf. A height measurement was conducted on 28 May.

[4] Vigor ratings were done on a 1 to 10 scale, with 10 = live and healthy plants and 1 = dead plants, on 1 and 22 May.

[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, Percent of Non-Harvestable TSWV-Infected Tobacco Plants and Percent TSWV-Positive Plants as Identified Through ELISA Testing of Root Samples, Bowen Farm, Tifton, Ga., 2007

Treatment[1] (Greenhouse)	Field Treatment[2]	% TSWV[3]	Non-harvestable TSWV plants[5]	% ELISA (+) Plants[6]
1. Non-treated Control	No field treatment	20.2 a	3.3 a	30.0abc
2. Actigard & Admire Pro	No field treatment	9.5 b-e	2.0 b-e	21.7 b-f
3. Actigard & Admire Pro	+ 7 days post transplant (DPT)	11.8 bc	2.5 abc	30.0 abc
4. Actigard & Admire Pro	+ 14 DPT	7.9 b-e	1.8 b-f	20.0 b-g
5. Actigard & Admire Pro	+ 21 DPT	7.5 b-f	2.0 b-e	8.3 fgh
6. Actigard & Admire Pro	+ 28 DPT	7.7 b-f	2.2 a-e	23.3 b-f
7. Actigard & Admire Pro	+ 35 DPT	5.7 b-f	1.3 c-g	8.3 fgh
8. Actigard & Admire Pro	+ 42 DPT	12.9 ab	2.7 ab	28.3 a-d
9. Actigard & Admire Pro	+ 49 DPT	8.2 b-e	2.0 b-e	35.0 ab
10. Actigard & Admire Pro	+ at 1st symptom	6.7 b-f	1.0 efg	13.3 d-h
11. Actigard & Admire Pro	+ at 1st symptom TSWV + 2 weeks + 2 weeks	5.8 b-f	1.3 c-g	18.3 c-g
12. Actigard & Admire Pro	+ at 1st symptom inject Actigard in root zone	4.8 c-f	1.3 c-g	28.3 a-d
13. Actigard & Admire Pro	+ at 1st symptom inject Admire Pro in root zone	13.2 ab	2.7 ab	16.7 c-h
14. Actigard & Admire Pro	+ 14 DPT + 2 weeks	12.4 bc	1.7 b-f	35.0 ab
15. Actigard & Admire Pro	+ 1st symptom TSWV + 2 weeks	3.2 def	1.2 d-g	11.7 e-h
16. Actigard & Admire Pro	+ 28DPT + 2 weeks	10.4 bcd	1.8 b-f	25.0 b-e
17. Actigard & Admire Pro	+ at 1st symptom inject Actigard & Admire Pro (x2) in root zone	10.0 b-e	2.0 b-e	26.7 a-e
18. Actigard & Admire Pro	+ at 1st symptom inject Actigard & Admire in root zone	9.7 b-e	2.3 a-d	41.7 a
19. Actigard & Admire Pro	+ 21 DPT + 2 weeks	2.4 ef	0.7 fg	5.0 gh
20. K326T	No field treatment	0.0g	0.0 g	1.7 h

[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 applied weekly beginning at seven days post transplant and continuing every seven days thereafter up to 49 days post plant. Other treatments were applied when first symptom of TSWV was identified through scouting control plots, with some receiving an additional application.
[3] Percent TSWV was calculated by using stand counts that were made from 11 April through 26 June, with TSWV being recorded and flagged every seven days.
[4] Cumulative number of TSWV-infected plants that were flagged 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.

Effect of Plant Age and Treatment with Acibenzolar-s-Methyl on *Tomato spotted wilt virus* (TSWV) in Flue-Cured Tobacco, 2007-2008

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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 subsequently 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 control (for yield comparisons) were planted on 5 April, 2007, and 3 April, 2008. 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. Twelve-week-old transplants, no chemical treatment
4. Six-week-old transplants + greenhouse treatment
5. Nine-week-old transplants + greenhouse treatment
6. Twelve-week-old transplants + greenhouse treatment
7. Six-week-old transplants + greenhouse treatment + field treatment
8. Nine-week-old transplants + greenhouse treatment + field treatment
9. Twelve-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 in 2007 and one week after transplanting in 2008. TSWV-symptomatic plants were flagged every week. The last stand count was done on 12 June, 2007, and 12 June, 2008, after the plants had been topped.

The plants were harvested three times and after the last harvest 10 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 the 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

In 2007, transplants (regardless of age) treated with Actigard + Admire had significantly fewer symptomatic plants and a significantly higher yield than the non-treated transplants due to a high incidence of TSWV. Treatment with Actigard + Admire did not affect the percentage of systemic infections but significantly lowered the percentage of dead plants (Table 1). 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 cm shorter, their yield increased more than 600 lbs./acre compared to non-treated transplants.

In 2008, non-treated transplants, regardless of age, had a significantly higher percentage of symptomatic plants than plants treated with Actigard + Admire in the greenhouse only and plants that had an additional field application of Actigard. There was no significant difference between the two Actigard treatments. Stand loss was significantly reduced with both Actigard treatments compared to the non-treated control but there was no difference between the two Actigard treatments. Treatment with Actigard + Admire did not affect the percentage of systemic infections (Table 2).

Yield was not affected by transplant age. Transplants treated with Actigard + Admire in the greenhouse and treated with an additional Actigard field application had significantly higher yields than the non-treated control. Due to the very low incidence of TSWV in 2008, there was no significant difference in yield between non-treated transplants and plants treated with Actigard + Admire in the greenhouse only, and between plants treated with Actigard + Admire in the greenhouse only and transplants with an additional field spray (Table 2). Actigard and Admire treated transplants were on average 5 cm shorter than non-treated plants.

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 provided an additional $900 per acre income (estimated price per lb. was $1.50) in 2007. Due to low incidence of TSWV, treatment effects were not as pronounced this year as they were last year. The nine-week-old transplants treated with Actigard + Admire in the greenhouse plus the additional field spray had an increased yield of more than 330 lbs. per acre. This increased yield provided increased income of more than $500 per acre (based on an estimated price per lb of $1.50). Treatment in the greenhouse only improved yield by more than 180 lbs. per acre (additional income more than $270), making Actigard + Admire applications an economically viable strategy to manage TSWV even when TSWV pressure is low. Yields in the other age groups increased between 60 lbs. (increased income of $95) per acre in the oldest and 174 lbs. (increased income of $260) per acre in the youngest transplants between non-treated and transplants treated with Actigard + Admire in the greenhouse accompanied by an additional field spray. The greenhouse treatment alone improved yields between 96 lbs. (increased income of $140) and 118 lbs. (increased income of $175) per acre in the oldest and youngest transplants, respectively.

Acknowledgments

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

Table1. Evaluation of Actigard and Admire Treatments and Transplant Age on Percent TSWV-Symptomatic Plants, Percent Systemic Infection, Percent Stand Loss and 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 non-susceptible K-326 was 2,710 lbs./acre.

Table 2. Evaluation of Actigard and Admire Treatments and Transplant Age on Percent TSWV-Symptomatic Plants, Percent Systemic Infection, Percent Stand Loss and Plant Height and Yield, Bowen Farm, Tift Co., Ga., 2008.

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	17	16	0.4	59	2,954
	9	27	14	2	60	2,764
	12	22	20	1.2	62	2,822
	Mean[e]	**22a**	**17a**	**1.2a**	**60a**	**2,847a**
ASM + IMD in GH	6	11	18	0.2	53	3,072
	9	14	8	0	55	2,950
	12	14	22	0.4	58	2,919
	Mean[e]	**13b**	**16a**	**0.2b**	**55b**	**2,980ab**
ASM + IMD in GH and ASM in field	6	9	10	0.2	55	3,128
	9	9	26	0.2	56	3,101
	12	15	16	1	56	2,886
	Mean[e]	**11b**	**17a**	**0.5b**	**56b**	**3,038b**

[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 28 May, 2008.
[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 non-susceptible K-326 was 3,055 lbs./acre.

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

R.M. McPherson, J.M. Moore, S.S. LaHue, E. Troxell and W. Stephens

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 imidacloprid and thiamethoxam insecticides, with and without the plant activator Actigard, for suppressing early-season thrips populations and examine how these control options impact TSWV infection of flue-cured tobacco throughout the season in Georgia.

Materials and Methods

Flue-cured tobacco, variety NC-71, was transplanted on 21 April 2008 at the Bowen Research Farm in Tift County, Ga. Production practices were used according to Georgia Cooperative Extension guidelines for weed control, disease control, nematode suppression and fertilization.

Four 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. Three days prior to transplanting, the transplants were treated with a tray drench (TD) application of one of the nine insecticide 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 three rows (44-inch spacing) at 34 feet long were arranged in a randomized complete block design with four replications.

The number of live thrips on plants two, four, six and eight 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, 10 plants on row two in each plot were harvested a total of three times. Each harvest sample was weighed and the green weight was converted to cured weight. 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 20 May (Table 2). They peaked on this date at between 2.9 and 10.0 thrips per four plants. By 28 May, these populations were much lower in all treatments, ranging from 1.2 to 3.5 thrips per plant. By early June, thrips populations were near zero in all plots. Tobacco thrips (*F. fusca*) comprised more than 98 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 11.9 percent in the untreated plots (Table 1), but only a few of the tray drench insecticide 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. No treatment differences were noted for yield (Table 1).

In conclusion, most of the TD insecticide applications examined in this test suppressed the incidence of TSWV in flue-cured tobacco. The addition of Actigard lowered the incidence of TSWV for all nine insecticide treatments compared to the insecticide alone. However, this test site had an overall low incidence of TSWV in 2008, so treatment differences were difficult to separate with statistical analyses. 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.

Table 1. Effects of Selected Tray Drench Insecticide Applications, With and Without Tray Drench Actigard Treatments, on the Abundance of Thrips, Cumulative Percent of *Tomato Spotted Wilt*-Symptomatic Plants and Cured Yield of Flue-Cured Tobacco, Tift County, Ga., 2008.

Treatment and oz. / 1,000 cells	Thrips per 4 plants			%	Yield
	13 May	20 May	28 May	TSWV	lbs./acre
Untreated	0.0b	24.5ab	6.5ab	11.9a	2667.1a
Untreated + Actigard 50 WG	3.0a	31.8ab	7.0ab	11.8a	2954.5a
Admire Pro 4.6 SC 0.8oz	0.3b	20.0ab	5.8ab	7.0ab	2750.0a
Admire Pro + Actigard 50 WG	0.3b	25.8ab	6.0ab	3.7b	2988.3a
Alias 2F 1.8oz	0.3b	24.8ab	5.0ab	10.7ab	2670.5a
Alias 2F + Actigard 50 WG	0.8b	26.5ab	5.5ab	4.3ab	2404.7a
Couraze 2F 1.8oz	0.5b	20.5ab	7.3ab	7.1ab	2223.5a
Couraze + Actigard 50 WG	0.8b	20.5ab	7.0ab	6.8ab	2584.7a
Imida E-AG 2F 1.8oz	0.0b	11.5b	4.8b	9.8ab	2392.1a
Imida 2F + Actigard 50 WG	0.5b	15.0ab	7.8ab	6.8ab	2813.9a
Macho 2F 1.8oz	0.0b	32.0ab	6.0ab	9.9ab	2483.5a
Macho 2F + Actigard 50 WG	0.0b	22.5ab	5.8ab	8.3ab	2797.1a
Nuprid 2F 1.8oz	0.5b	23.5ab	5.8ab	9.3ab	2795.6a
Nuprid + Actigard 50 WG	0.0b	14.0ab	4.8b	5.6ab	2798.3a
Torrent 2F 1.8oz	0.3b	19.8ab	8.0ab	10.5ab	2456.7a
Torrent 2F + Actigard 50 WG	0.3b	30.3ab	14.0a	6.6ab	2477.9a
T-Moxx 2SC 1.3oz	0.5b	35.8ab	7.5ab	10.7ab	2521.4a
T-Moxx 2SC + Actigard 50 WG	1.0b	40.8a	10.3ab	10.5ab	2663.4a

NC-71 flue-cured tobacco on 21 April. Actigard 50 WG applied at a rate of 0.5 oz./50,000 tray cells on 17 April and insecticides applied on 18 April. All tray drench treatments were applied at spray concentrations of 10 gallons/100,000 cells. Column means followed by the same letter are not significantly different (Duncan's multiple range test, P=0.05).

Acknowledgments

The authors thank Thomas Monk and Dale Clark for technical support and the Georgia Agricultural Commodity Commission for Tobacco for financial assistance.

Effects of Tray Drench and Transplant Water Insecticide Treatments on Thrips Suppression and *Tomato spotted wilt virus* Symptom Expression in Flue-Cured Tobacco

R.M. McPherson and W. Stephens

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 with tray drench and transplant water treatments and examines their impact on the seasonal incidence of TSWV-symptomatic plants in flue-cured tobacco.

Materials and Methods

Flue-cured tobacco, variety K-326, was transplanted on 4 April at the Coastal Plain Experiment Station Bowen Farm in Tifton, Ga. Production practices were used according to Georgia Cooperative Extension guidelines for weed control, disease control, nematode suppression and fertilization.

Four days before transplanting, some of the greenhouse-produced transplants were treated with tray drench (TD) treatments of selected insecticides, while other transplants were left untreated. At transplanting, 36 field plots, two rows wide (44-inch row spacing) by 30 feet long were established in a randomized block design with four replications and planted with one of the five tray drench treatments or one of the three transplant water treatments, or left untreated (nine total treatments with four reps each). The tray drench treatments were applied in 200 ml. of water per 242-cell tray while the transplant water treatments were applied at transplanting in 4 oz. of water per plant (around 188 gpa). There was an untreated border row on each side of each plot plus a 3-foot alley on each end of each plot. The number of live thrips on plants two, four, six, and eight on row two of each plot was 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. All insect count and TSWV data were subjected to Analysis of Variance (P=0.05).

Results and Discussion

Suppressing thrips with tray drench and transplant water insecticide treatments had little impact on the seasonal incidence of TSWV (Table 1). Thrips population densities were lower on 19 May (five weeks after transplanting) in some of the treated plots compared to the untreated plots (Table 2). It is interesting to note that thrips population densities were very low in all plots throughout April. However, thrips densities rapidly increased on 6 May (four weeks after transplanting), peaked at more than 19 per plant in the untreated plots on 19 May, and then rapidly declined by late May.

In conclusion, suppressing thrips with tray drench and transplant water insecticide treatments did not suppress the incidence of TSWV and thrips populations as expected. This lack of response to insecticidal control was most probably due to low pest populations in all plots until mid-May (six weeks after transplanting) plus the overall low incidence of TSWV (only 28.5 percent in the untreated plots in mid-June). Additional research with higher populations of thrips and higher TSWV is desirable.

Acknowledgments

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

Table 1. Effects of Selected Tray Drench (TD) and Transplant Water (TPW) Treatments on the Incidence of *Tomato Spotted Wilt*- Symptomatic Plants in Flue-Cured Tobacco, Tift County, Ga., 2008.

Treatment and application rate	Mean % TSWV-symptomatic plants						
	6 May	12 May	19 May	28 May	2 June	9 June	17 June
Untreated	3.4a	5.0abc	10.0a	17.4a	21.9a	26.6a	28.5a
V-10170 2.13 SL 1.0 oz./1,000 cells **TD**	0.6a	1.1c	5.2a	16.7a	18.6a	22.3a	27.5a
V-10170 2.13 SL 2.0 oz./1,000 cells **TD**	3.6a	9.0a	13.3a	19.1a	22.3a	24.7a	28.0a
Admire Pro 4.6 SL 1.0 oz./1,000 cells **TD**	5.5a	7.6ab	10.1a	18.6a	20.2a	21.0a	22.5a
V-10170 2.13 SL 12.0 oz./acre **TPW**	1.5a	3.8abc	9.4a	19.5a	21.1a	21.9a	24.2a
Admire Pro 4.6 SL 6.0 oz./acre **TPW**	1.8a	3.5bc	9.5a	21.7a	23.4a	24.2a	26.1a
Platinum 2 SC 1.8 oz./1,000 cells **TD**	5.4a	9.1a	12.8a	19.6a	24.9a	24.9a	28.0a
Regent 4 SC 0.72 oz./1,000 cells **TD**	0.0a	2.1c	6.5a	12.6a	15.4a	17.8a	19.3a
Admire Pro 4.6 SL 12.0 oz./acre **TPW**	2.7a	3.8abc	9.3a	15.3a	17.0a	17.8a	21.6a
F value	1.91	3.15	1.30	0.52	0.50	0.53	0.63
df	8,24	8,24	8,24	8,24	8,24	8,24	8,24
Pr > f	0.106	0.014	0.288	0.827	0.844	0.823	0.747

K-326 flue-cured tobacco transplanted on 4 April 2008 at a rate of 6,000 transplants per acre (including skip rows and unplanted alleys), TD treatments were applied on 31 March in 200 ml. of water per 242-cell tray. TPW treatments were applied at transplanting in 4 oz. of water per plant (188 gpa). Plots were two rows by 30 ft. with an untreated border row on each side and a 3-ft. alley on each end arranged in an RCBD with four replications. Column means with the same letter are not significantly different (Duncan's multiple range test, P > 0.05).

Table 2. Incidence of Foliage Thrips (Almost Exclusively Tobacco Thrips) on Flue-Cured Tobacco Treated With Selective Tray Drench (TD) and Transplant Water (TPW) Insecticide Applications, Tift County, Ga., 2008.

Treatment and application rate	Mean thrips per 4 plants						
	29 Apr	6 May	13 May	15 May	19 May	22 May	28 May
Untreated	0.5a	13.8a	3.5a	25.8a	78.3a	21.8a	5.3a
V-10170 2.13 SL 1.0 oz./1,000 cells **TD**	0.0a	8.8a	2.0a	30.8a	54.0ab	15.8a	2.3a
V-10170 2.13 SL 2.0 oz./1,000 cells **TD**	0.3a	15.3a	2.5a	29.0a	56.3ab	13.5a	4.5a
Admire Pro 4.6 SL 1.0 oz./1,000 cells **TD**	0.0a	4.3a	0.5a	19.5a	54.8ab	15.5a	3.3a
V-10170 2.13 SL 12.0 oz./acre **TPW**	1.5a	12.3a	3.3a	34.0a	58.0ab	26.3a	2.5a
Admire Pro 4.6 SL 6.0 oz./acre **TPW**	0.0a	12.3a	0.8a	16.3a	59.5ab	12.5a	2.0a
Platinum 2 SC 1.8 oz./1,000 cells **TD**	1.5a	11.3a	1.5a	38.3a	60.0ab	13.8a	4.8a
Regent 4 SC 0.72 oz./1,000 cells **TD**	0.0a	4.5a	1.5a	14.5a	52.3ab	14.3a	1.8a
Admire Pro 4.6 SL 12.0 oz./acre **TPW**	0.0a	3.3a	1.0a	32.3a	36.5b	17.8a	5.3a

K-326 flue-cured tobacco transplanted on 4 April 2008 at a rate of 6,000 transplants per acre (including skip rows and unplanted alleys), TD treatments were applied on 31 March in 200 ml. of water per 242-cell tray. TPW treatments were applied at transplanting in 4 oz. of water per plant (188gpa). Plots were two rows by 30 ft. with an untreated border row on each side and a 3-ft. alley on each end arranged in an RCBD with four replications. Column means with the same letter are not significantly different (Duncan's multiple range test, P > 0.05).

Evaluation of Alternative Compounds for Control of *Tomato spotted wilt virus* (TSWV) Bowen Farm UGA-CPES Tifton, Ga., 2008

A.S. Csinos, L.L. Hickman, L. Mullis, S.W. Mullis, E. Troxel 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 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 28 January, tobacco variety NC-71 was seeded into 242 cell flats. On 19 March, greenhouse pre-transplant treatments of Admire Pro and Actigard were applied. Treatments of both Admire Pro and Actigard 50 WDG were tank mixed and applied with a CO_2 sprayer. Materials were then washed in with 0.25 inches of additional water. Nutriphite pre-transplant greenhouse treatments were applied on 20 March at a rate of 1 pt./100 gal. water (150 ml. per flat) with 3.75 ml. of material mixed in 3 liters of water and sprayed until runoff. Tobacco seedlings were transplanted on 26 March 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 4- to 6-inch band, with a 50-mesh ball check screen at the rate of 41 PSI with a delivery of 10.26 gal. of water per acre. Treatments three, four, six and seven were scheduled for field applications at two, four and six weeks post plant. An eight week treatment was scheduled for treatments three and four. Two week treatments were applied on 9 April. Four week treatments were applied on 23 April. Six week treatments were applied on 5 May. Eight week treatments were applied on 20 May. Treatments were mixed in 3 liters of water unless otherwise noted. Field sprays were triggered when the first symptom of TSWV infection was identified through scouting practices.

University of Georgia Cooperative Extension recommendations for the control of weeds, suckers and insects were followed for crop maintenance. Orthene 97 at 0.5 lbs./A was used for insect control, Prowl 3.3 EC at 2 pts./A was used for weed control and Royal MH-30 Xtra at 1.5 gal./A was used for sucker control.

Three harvests were done, collecting a third of the plant at one time with the exception of treatments one and four, which were harvested separately from other treatments with each plant in the row being numbered and individually hand harvested and weighed. Harvests for all treatments were done on 1, 16 and 30 July.

Stand counts were conducted every seven days and plants were flagged noting percent disease from TSWV symptoms from 11 April through 26 June. A final count was made on 26 June to determine the number of plants killed by TSWV and the number of non-harvestable plants.
Height measurements were conducted on 29 May. Measurements were recorded in centimeters, measuring from the base of the plant to the tip of the longest leaf. Two vigor ratings were done on 1 and 22 May. Vigor ratings were done on a 1 to 10 scale, with 10 equaling vigorous and healthy plants and 1 equaling poor vigor plants.

Following the final harvest, root samples were collected from 10 plants per plot and an ELISA test was performed to determine the percent of plants positive for TSWV. 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 was considered a positive result.

Total rainfall recorded at the Bowen farm during this period (March through August) was 23.97 inches. Rainfall data was determined by accessing the database of the Georgia Environmental Monitoring Network for the weather station located at the Bowen Farm, Tifton, Ga.

Summary

Disease pressure was relatively low in 2008 and TSWV incidence ranged from zero to 19.8 percent. Yields were not statistically different from each other at the P=0.05 level. However, the K326-T and Actigard + Admire Pro + field applications were the highest in yield numerically.

Acknowledgments

The authors would like to thank the Georgia Agricultural Commodity Commission for Tobacco and Philip Morris Tobacco Company for support of this study. Thanks are also extended to Clint Powell, Haley Gibbs, Derek Heath, Cody Singletary, Remigio Padilla-Hernandez, Mac Denny and Trevor Cook for their technical support.

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 - Bowen Farm, Tifton, Ga., 2008

Treatment [1]	Greenhouse Treatment[2]	Field Application [3]	# TSWV symptomatic plants [4]	% TSWV[6]	% ELISA (+) Plants (roots)[7]
1. Non-treated control	No greenhouse treatment	No field treatment	3.0 a	15.9 abc	18.0 a
2. Actigard + Admire Pro 4.6 SC	0.8 oz./1,000 plants	No field treatment	2.4 a	12.8 abc	14.0 a
3. Actigard + Admire Pro 4.6 SC Mancozeb 1lb/A	0.8 oz./1,000 plants No greenhouse treatment	2, 4, 6 & 8 weeks post transplant	3.0 a	16.5 ab	12.0 a
4. Mancozeb	No greenhouse treatment	2, 4, 6 & 8 weeks post transplant	3.8 a	19.8 ab	16.0 a
5. Admire Pro 4.6 SC Nutri-Phite Magnum	0.8 oz./1,000 plants 1 pint/100 gal	No field treatment No field treatment	2.8 a	15.6 abc	18.0 a
6. Admire Pro 4.6 SC Nutri-Phite Magnum	0.8 oz./1,000 plants 1 pint/100 gal	Nutri-Phite 1qt./A **Broadcast** @ 2, 4 and 6 weeks post transplant	3.2 a	17.1 a	18.0 a
7. Admire Pro 4.6 SC Nutri-Phite Magnum	0.8 oz./1,000 plants 1 pint/100 gal	Nutri-Phite 1qt./A **Banded** @ 2, 4 and 6 weeks post transplant	2.0 ab	10.9 abc	12.0 a
8. Actigard +Admire Pro 4.6 SC	0.8 oz./1,000 plants	Actigard @ 1st symptom in control plots	1.6 ab	8.6 bc	16.0 a
9. K-326T	No greenhouse treatment	No field treatment	0.0 b	0.0 c	2.0 a

[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 gal./7,000 plants-Actigard and 1 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] Cumulative number of TSWV-infected plants that were flagged during weekly stand counts. Stand counts were conducted from 11 April through June 26, 2008.
[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 11 April through 26 June with TSWV being recorded and flagged every seven days. Cumulative number of TSWV infected plants that were flagged during weekly stand counts.
7 Final harvest testing was completed on 21 August. 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., 2008

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 field treatment	7.4 a-d	55.9 abc	2584.4 a
2. Actigard + Admire Pro 4.6 SC	0.8 oz./1,000 plants	No field treatment	6.9 bcd	54.8 abc	2677.7 a
3. Actigard + Admire Pro 4.6 SC Mancozeb 1 lb./A	0.8 oz./1,000 plants No greenhouse treatment	2, 4, 6 & 8 weeks post transplant	6.4 d	52.5 c	2698.2 a
4. Mancozeb	No greenhouse treatment	2, 4, 6 & 8 weeks post transplant	7.6 abc	53.9 bc	2632.7 a
5. Admire Pro 4.6 SC Nutri-Phite Magnum	0.8 oz./1,000 plants 1 pint/100 gal	No field treatment No field treatment	7.7 abc	57.1 abc	2601.4 a
6. Admire Pro 4.6 SC Nutri-Phite Magnum	0.8 oz./1,000 plants 1 pint/100 gal	Nutri-Phite 1 qt./A **Broadcast** @ 2, 4 and 6 weeks post transplant	7.9 ab	58.4 ab	2822.3 a
7. Admire Pro 4.6 SC Nutri-Phite Magnum	0.8 oz./1,000 plants 1 pint/100 gal	Nutri-Phite 1 qt./A **Banded** @ 2, 4 and 6 weeks post transplant	7.2 a-d	52.2 c	2546.1 a
8. Actigard +Admire Pro 4.6 SC	0.8 oz./1,000 plants	Actigard @ 1st symptom in control plots	6.7 cd	54.1 bc	2842.8 a
9. K-326T	No greenhouse treatment	No field treatment	8.1 a	60.2 a	2861.2 a

[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 gal./7,000 plants-Actigard and 1 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] Height measurements were done in inches from the soil level to the tip of the longest leaf. Height measurements were done on 29 May.
[5] Vigor ratings were done on a 1 to 10 scale with 10=live and healthy plants and 1= dead plants on 1and 22 May.
[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

Evaluation of Tobacco Lines for Resistance to TSWV in Georgia Bowen Farm, Tifton, Ga.

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

Introduction

Tomato spotted wilt virus continues to be of great concern to Georgia tobacco producers. This study evaluates tobacco cultivars that have been selected for insect resistance and have demonstrated resistance to TSWV in the greenhouse. Entries that indicated low levels of TSWV were harvested for comparison with standards.

Methods and Materials

The study was located at the Bowen Farm CPES, Tifton, Ga., in a field with a history of crops such as corn, soybeans, peanuts, tobacco and assorted vegetables. The area was prepared using all current University of Georgia Extension recommendations.

The plot design was a randomized split block design replicated five times. Each plot consisted of one row of transplants that had been treated in the greenhouse as well as in the field with Actigard. One row was planted with transplants and received no greenhouse or field treatments. Each plot was 37 feet long with 6-foot alleys between repetitions.

On 28 January, tobacco varieties were seeded into 242-cell trays. Tobacco varieties that were evaluated are listed in Table 1. The test was transplanted on 31 March on 44-inch row spacing with 20 inches in row space. An average of 12 plants per row was planted. 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.

Tobacco plots were scouted weekly to determine TSWV disease incidence and percentage of infection in non-treated as compared to treated plots. Stand counts were conducted beginning 17 April with a final stand count being done on 26 June. Fourteen varieties were selected for yield collection. These varieties are indicated in variety list in Table 1. Three harvests were conducted on 16 and 30 July and 21 August. Harvests were done by collecting 1/3 of the plant leaves at one time and weighing each plot separately in pounds.

Following the final harvest, root samples were collected from 10 plants per plot and an ELISA test was performed to determine TSWV incidence. 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 gram 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

TSWV disease incidence in this test ranged from 18.7 percent to a low of zero percent. In almost all cases, the disease level was reduced dramatically in test plots that received an application of Actigard and Admire Pro in the greenhouse.

In some cases, as with CU61, CU110, H9 and H94, disease levels were reduced to zero or near zero. Yields followed the same trend. Increases were noted for most cultivars that were treated with Actigard and Admire over the non-treated plots. Although 2008 was a light year for TSWV, these results demonstrate a potential to manage TSWV with resistant cultivars.

Acknowledgments

The authors would like to thank the Georgia Agricultural Commodity Commission for Tobacco for their support of this work. Thanks are also extended to Clint Powell, Cody Singletary, Haley Gibbs, Remigio Padilla-Hernandez, Mac Denny and Trevor Cook for their assistance.

Table 1. Johnson Variety Trial % TSWV, ELISA TSWV Results and Dry Weight Yield

Variety[1]	% TSWV Symptomatic[2]		% ELISA TSWV[3]	Dry Weight Yield[4] (lbs./A)	
	A Non-treated	B Treated	A Non-treated	A Non-treated	B Treated
1. CU 109	10.0 abc	7.7 bcd	---	---	---
2. CU94	12.6 abc	4.5 cd	10.0 ab	2154.8 b	2608.6 a
3. CU61	12.0 abc	4.3 cd	12.0 ab	2283.510 ab	2526.7 a
4. CU75	8.7 bc	4.7 cd	13.3 ab	2141.1 b	2377.6 a
5. CU90	7.6 bc	5.2 cd	18.0 ab	2237.8 ab	2349.6 a
6. CU100	7.8 bc	7.1 bcd	4.0 b	2381.4 ab	2431.5 a
7. CU108	13.3 abc	7.8 bcd	---	---	---
8. CU95	9.5 abc	6.6 bcd	7.8 ab	2178.4 b	2440.4 a
9. CU110	8.7 bc	2.7 d	6.0 ab	2111.5 b	2187.6 a
10. CU92	9.2 abc	6.3 bcd	---	---	---
11. H9	17.3 ab	7.4 bcd	10.0 ab	2204.5 b	2252.3 a
12. H11	10.0 abc	4.8 cd	---	---	---
13. H22	6.0 c	3.1 cd	20.0 a	2383.0 ab	2126.3 a
14. H50	10.0 abc	13.2 ab	---	---	---
15. H59	16.4 ab	7.7 bcd	---	---	---
16. H103	18.9 a	10.4 bc	---	---	---
17. H106	5.4 c	4.3 cd	4.0 b	2071.8 b	2501.1 a
18. H117	12.9 ab	6.2 bcd	---	---	---
19. NC 71	16.1 ab	18.7 a	12.0 ab	2428.6 ab	2610.0 a
20. K326-T	4.5 c	1.5 d	4.0 b	2682.7 a	2593.5 a

[1] Data are means of five replications. Means in same column followed by the same letter are not significantly different (P=0.05) according to Fisher's LSD test. 21 Treatments consisted of selected varieties of tobacco. Each plot was two rows, 1-row treated with Actigard and Admire and one-row non-treated.

[2] Percent TSWV was calculated by using stand counts that were made from 17 April through 26 June with TSWV being recorded and flagged every seven days.

[3] 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 6491 divided by the base stand count. Tobacco was planted in 44-inch rows, with 22-inches between plants, which equals 6,491 plants/A. Fourteen varieties were selected out of the treatment list to collect yield on. These are highlighted in Table 1.

[4] 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.

Plasticulture for Production and Disease Management of Tobacco

A.S. Csinos, L.L. Hickman, L. Mullis, U. Hargett and S.S. Lahue

Introduction

Crop production systems utilizing plasticulture have become a standard in the vegetable industry. Plasticulture provides the advantage of being able to deliver water, fertilizer and chemicals directly to the root zone of plants using perforated drip tape while reducing water loss, fertilizer leaching and weed problems. This trial was conducted to evaluate and determine the efficacy of disease control and possibility of increased yield when producing tobacco in a plasticulture system as compared to bare ground.

Methods and Materials

The study was located at Bowen Farm, CPES, Tifton, Ga., in a field with a history of various row crops, vegetable crops and tobacco. The area was prepared using all current University of Georgia Extension recommendations.

The plot design was a randomized complete block design consisting of two row plots replicated four times. There were a total of five treatments with each treatment having two bare ground plots and two plastic mulch-covered plots. Each plot was 32 feet long with 10-foot alleys between plots. Field plot areas were turned on 20 March and fertilized with an application of 10-10-10 on 24 March. Fertilizer was roto-tilled into soil after application. On 26 March, beds were shaped and covered with 1 mil. black polyethylene mulch with drip tape in the center of the bed approximately 1 inch deep. Drip tape was brand AquaTraxx™ with a 12-inch emitter spacing and a flow rate of .45 gal./min. with a 12-PSI regulator.

On 28 January, tobacco variety NC-71 was seeded into 242-cell flats. Transplants were treated on 27 March in the greenhouse with Actigard 50WG at 2 g ai/7,000 plants and Admire Pro at 1 oz./1,000 plants. Products were tank mixed, sprayed over flats using a CO_2 sprayer and then washed in with 0.25 inches of water.

Plants were transplanted on 28 March into plastic mulch using a mechanical hand transplanter on an 18-inch spacing with approximately 21 plants per row. Crop maintenance was achieved by using University of Georgia Cooperative Extension recommendations for the control of weeds, suckers and insects. All plots, both plastic mulch-covered plots and bare ground plots, received fertilizer and insecticides through drip tape. Field treatments of Actigard and Admire were delivered through the drip tape on plastic mulch plots. Bare ground plots received these field treatments sprayed over the top.

Tobacco plots were scouted weekly to determine TSWV disease incidence and percentage of infection in non-treated plots. Stand counts were conducted beginning 11 April with a final stand count being done on 18 June. Two vigor ratings were conducted on 24 April and 28 May. Vigor ratings were done on a scale of 1 to 10, with 10 equaling vigorous healthy plants and 1 equaling poor vigor plants. Two height measurements were conducted on 13 and 28 May. Plants were measured in centimeters from the base of the plant to the tip of the longest leaf.

Three harvests were conducted on 2, 17 and 31 July. Yields were done by collecting 1/3 of the plant leaves at one time and weighing each plot in pounds. Following the final harvest, root samples were collected 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.

Summary

Percent incidence of TSWV ranged from 2.25 percent to 8.93 percent; however, a few trends in the test concerning incidence were evident. Yields ranged from 1,939 to 2,908 pounds per acre. In all cases, with the exception of one treatment, the plasticulture-produced tobacco was higher in yield than the corresponding bare ground-grown tobacco. Vigor and plant height were higher for all of the plastic grown tobacco compared to bare ground plots.

Acknowledgments

The authors would like to thank the Georgia Agricultural Commodity Commission for Tobacco and Philip Morris Tobacco Company for financial support of this study. Thanks are also extended to Clint Powell, Cody Singletary, Haley Gibbs, Remigio Padilla-Hernandez, Mac Denny and Trevor Cook for their technical assistance.

Table 1. Effects of Plastic Mulch-Covered Plots and Bare Ground Plots on Plant Vigor and Height of Tobacco, Bowen Farm, Tifton, Ga., 2008

Treatment[1]		Vigor[2]			Height[3]		
		24 April	01 May	Average	13 May	28 May	Average
1. Non-treated control	Plastic Mulch	8.8 a	8.4 a	8.6 a	33.2 a	64.0 a	45.3a
	Bare Ground	6.9 d	8.9 c	6.4 c	24.2 b	47.7 de	37.1 bc
2. Actigard + Admire Greenhouse	Plastic Mulch	8.0 abc	7.6 ab	7.8 b	29.6 a	56.5 bc	42.2 ab
	Bare Ground	6.9 d	5.6 c	6.3 c	19.0 bc	45.0 de	32.8 c
3. Actigard + Admire GH + Actigard -field	Plastic Mulch	7.9 bc	7.4 b	7.6 b	34.4 a	60.3 ab	45.7 a
	Bare Ground	6.5 d	5.6 c	6.1 c	20.5 bc	47.5 de	35.7 c
4. Actigard + Admire Pro GH + Admire -field	Plastic Mulch	8.6 ab	7.9 ab	8.3 ab	33.5 a	60.4 ab	45.3 a
	Bare Ground	7.3 cd	5.6 c	6.4 c	21.3 bc	50.0 cd	37.0 bc
5. Actigard + Admire Pro GH + Actigard and Admire- field	Plastic Mulch	7.8 c	7.6 ab	7.7 b	30.5 a	61.3 ab	44.7 a
	Bare Ground	6.5 d	5.3 c	5.9 c	18.9 c	41.5 e	32.1 c

[1] Data are means of four replications. Means in same column followed by the same letter are not significantly different (P=0.05) according to Fisher's LSD test.
[2] Vigor ratings were done on a 1 to 10 scale, with 10=live and healthy plants and 1= dead plants on 24 April and 1 May.
[3] Height measurements were done in inches from the soil level to the tip of the longest leaf. Height measurements were conducted on 13 and 28 May.

Table 2. Effects of Plastic Mulch-Covered Plots and Bare Ground Plots on Yield and Incidence of TSWV of Tobacco, Bowen Farm, Tifton, Ga., 2008

Treatment[1]		Yield[2]	% TSWV[3]
1. Non-treated control	Plastic Mulch	2757.0 a	4.2 ab
	Bare Ground	2050.7 c	4.8 ab
2. Actigard + Admire Greenhouse	Plastic Mulch	2548.0 ab	3.7 ab
	Bare Ground	1939.4 c	5.4 ab
3. Actigard + Admire GH + Actigard field spray	Plastic Mulch	2772.2 a	6.5 ab
	Bare Ground	2168.0 bc	6.6 ab
4. Actigard + Admire Pro GH + Admire field spray	Plastic Mulch	2908.2 a	3.6 ab
	Bare Ground	2185.0 bc	7.2 ab
5. Actigard + Admire Pro GH + Actigard and Admire field spray	Plastic Mulch	2520.2 ab	8.9 a
	Bare Ground	2253.1 bc	2.3 b

[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] 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.
[3] Percent TSWV was calculated by using stand counts that were made from 11 April through 18 June, with TSWV being recorded and flagged every seven days.

Soil Fertility Levels Associated with Levels of *Tomato spotted wilt virus* (TSWV) in Tobacco

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

Introduction

Disease incidence and severity are the result of an interaction known as the "Disease Triangle." The three arms of the disease triangle are a susceptible host, a virulent pathogen and a favorable environment. In order for disease to develop, all three components of the disease triangle have to be present. The level of disease severity is dependent upon the degree of virulence of the pathogen, the susceptibility of the host and how favorable the environment is. The soil environment, including nutrient levels, can interact with the disease triangle by affecting host susceptibility or by affecting growth of the pathogen. A favorable balance of soil nutrients can lower disease incidence or severity, whereas an unfavorable balance can increase disease levels. As such, we investigated an association of soil fertility levels with *Tomato spotted wilt virus* (TSWV) severity/incidence in tobacco.

Materials and Methods

Data were collected from field plots at the University of Georgia Bowen Farm in Tift County, Ga., in 2007 and 2008. Soil samples were taken at an approximate 6-inch depth from non-treated, control plots across a tobacco field containing several different and unrelated trials. Soil samples were sent to A & L Analytical Laboratories, Inc., Memphis, TN 38133 for analysis. Levels (lbs./A) of phosphorus, potassium, calcium, magnesium, sulfur, boron, copper, iron, manganese, zinc and sodium were determined for each soil sample. In both years, samples were collected from 25 subsites per plot in four replicated plots in the center of the field. Subsamples were combined into a composite sample for each replicate. In addition, individual soil samples were sampled from across the field and immediately below individual plants. Number of samples in 2007 and 2008 were n = 84 and n = 170, respectively. At the end of each growing season, levels of TSWV were recorded as mean level of disease in plots used for the composite soil samples, and individual disease ratings were recorded for plants from where individual soil samples were taken. Data were analyzed by linear regression comparing nutrient levels (lbs./A) and combinations of all nutrient ratios with TSWV levels.

Results

A matrix of the slopes (r values) of each regression equation is presented in Figures 1 and 2. In 2007, the r values of the ratios of phosphorus/magnesium, magnesium/copper, copper/boron, iron/copper, zinc/boron and magnesium/zinc were significant at the 95 percent level for both methods of analysis, namely composite samples and individual samples. In 2008, the r values of the ratios phosphorus/magnesium, phosphorus/copper and iron/copper were significant at the 95 percent level for both methods of analysis, namely composite samples and individual samples. The only two ratios that produced significant r values (P = 0.05) for both composite and individual methods of soil analysis and regressed against TSWV levels in both 2007 and 2008 were phosphorus/magnesium and iron/copper. Regression figures for both phosphorus/magnesium and iron/copper for both years are presented in Figures 3 and 4.

Discussion

There was a tremendous amount of variability between composite samples and individual samples in both years. However, in 2007 there were six ratios, namely P/Mg, Mg/Cu, Cu/B, Fe/Cu, Zn/B and Mg/Zn that were significant at the 95 percent level in both methods of analysis. Interestingly, it is known that five of the elements comprising the six ratios all affect the uptake of the sixth element, which is zinc. In 2008, there were only three ratios that were significantly correlated with TSWV levels. These were P/Mg, P/Cu and Fe/Cu. Of interest, four of the elements were included in the six elements that were significant in 2007, namely P, Mg, Fe and Cu. In addition to regulating the uptake of zinc, these elements affect many other metabolic reactions and P is an integral part of the structure of both plant membranes as well as nucleic acids such as DNA and RNA, including the RNA of the virus. Although the P/Mg ratio was significant in all four trials in the two different years, the composite samples

in 2008 had a negative slope, indicating a reverse relationship from the other three trials.

Of particular interest is the interaction of Fe with Cu. This interaction produced a negative slope in all four trials in the two years. This indicates that the proportion of iron increases relative to copper or that, as copper decreases in relation to iron levels, less *Tomato spotted wilt* can be expected. The competition of these two elements participates in the regulation and function of super oxide dismutase enzymes. These enzymes help detoxify damaging super oxygen radicals by forming hydrogen peroxide and are involved in disease expression and resistance pathways. Additional research is needed to determine if the relationships of these elements with TSWV is not an artifact, and if not, then if regulation of zinc uptake, regulation of super oxide dismutase genes or other function is involved with TSWV severity.

Composite samples (n=25)

	P	K	Ca	Mg	S	B	Cu	Fe	Mn	Zn	Na
P		r=0.46	r=0.30	r=0.39*	r=0.21	r=0.38	r=0.05	r=0.33	r=0.21	r=0.002	r=0.25
K			r=0.35	r=0.26	r=0.20	r=0.20	r=0.54	r=0.18	r=0.23	r=0.56	r=0.42
Ca				r=0.14	r=0.04	r=0.29	r=0.44	r=0.16	r=0.02	r=0.33	r=0.07
Mg					r=0.10	r=0.27	r=0.55*	r=0.02	r=0.08	r=0.45*	r=0.29
S						r=0.27	r=0.29	r=0.09	r=0.06	r=0.07	r=0.07
B							r=0.40*	r=0.27	r=0.24	r=0.45*	r=0.32
Cu								r=0.52*	r=0.15	r=0.10	r=0.37
Fe									r=0.07	r=0.45	r=0.25
Mn										r=0.33	r=0.05
Zn											r=0.33
Na											

Individual Samples (n=84)

	P	K	Ca	Mg	S	B	Cu	Fe	Mn	Zn	Na
P		r=0.09	r=0.29	r=0.49*	r=0.21	r=0.34	r=0.09	r=0.25	r=0.13	r=0.04	r=0.43
K			r=0.07	r=0.22	r=0.29	r=0.10	r=0.10	r=0.02	r=0.10	r=0.16	r=0.09
Ca				r=0.18	r=0.13	r=0.10	r=0.18	r=0.08	r=0.19	r=0.16	r=0.12
Mg					r=0.12	r=0.04	r=0.31*	r=0.26	r=0.35	r=0.32*	r=0.10
S						r=0.11	r=0.27	r=0.13	r=0.24	r=0.28	r=0.14
B							r=0.26*	r=0.13	r=0.18	r=0.26*	r=0.02
Cu								r=0.26*	r=0.009	r=0.07	r=0.36
Fe									r=0.08	r=0.09	r=0.30
Mn										r=0.05	r=0.27
Zn											r=0.24
Na											

Fig. 1. Matrix of r Values (* sig *P*=0.05 or better in both composite (top matrix) and individual (bottom matrix) of regression of soil samples against levels of Tomato spotted wilt of tobacco in 2007).

Composite samples (n=25)

	P	K	Ca	Mg	S	B	Cu	Fe	Mn	Zn	Na
P		r=0.13	r=0.49	r=0.19*	r=0.02	r=0.48	r=0.63*	r=0.44	r=0.61	r=0.31	r=0.41
K			r=0.23	r=0.22	r=0.28	r=0.33	r=0.18	r=0.01	r=0.25	r=0.11	r=0.18
Ca				r=0.17	r=0.30	r=0.14	r=0.24	r=0.38	r=0.47	r=0.24	r=0.13
Mg					r=0.28	r=0.28	r=0.23	r=0.23	r=0.36	r=0.13	r=0.04
S						r=0.34	r=0.16	r=0.11	r=0.20	r=0.15	r=0.19
B							r=0.06	r=0.39	r=0.06	r=0.07	r=0.28
Cu								r=0.53*	r=0.30	r=0.07	r=0.30
Fe									r=0.53	r=0.13	r=0.23
Mn										r=0.40	r=0.45
Zn											r=0.12
Na											

Individual Samples (n=170)

	P	K	Ca	Mg	S	B	Cu	Fe	Mn	Zn	Na
P		r=0.19	r=0.11	r=0.16*	r=0.18	r=0.09	r=0.16	r=0.04	r=0.06	r=0.01	r=0.11
K			r=0.21	r=0.21	r=0.06	r=0.22	r=0.14	r=0.19	r=0.15	r=0.15	r=0.18
Ca				r=0.19	r=0.19	r=0.14	r=0.18	r=0.03	r=0.002	r=0.06	r=0.15
Mg					r=0.18	r=0.01	r=0.08	r=0.19	r=0.06	r=0.06	r=0.12
S						r=0.19	r=0.07	r=0.21	r=0.06	r=0.11	r=0.13
B							r=0.20	r=0.13	r=0.11	r=0.20	r=0.09
Cu								r=0.21*	r=0.18	r=0.07	r=0.12
Fe									r=0.05	r=0.07	r=0.14
Mn										r=0.03	r=0.08
Zn											r=0.08
Na											

Fig. 1. Matrix of r Values (* sig *P*=0.05 or better in both composite (top matrix) and individual (bottom matrix) of regression of soil samples against levels of Tomato spotted wilt of tobacco in 2008).

Spray vs. Drench Application Trial for Control of *Tomato spotted wilt virus* on Tobacco Bowen Farm, Tifton, Ga., 2008

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

Introduction

Tomato spotted wilt virus on tobacco is a serious problem in Georgia. Applications of Admire Pro and Actigard are recommended in the float house. Some positive influence over the control of TSWV has been shown in past studies by applying Actigard to plants in the field after transplant. Field applications of Actigard and application techniques are under development to determine its best use.

Methods and Materials

The study was located at the Bowen Farm, CPES, Tifton, Ga., in a field with a crop rotation history of cotton, peanuts, soybeans, assorted vegetables and tobacco. The area was prepared using all current University of Georgia Extension recommendations. The plot design was a randomized complete block design (RCBD) consisting of single row plots replicated five times. Each plot was 37 feet long with 10-foot alleys between repetitions.

On 28 January, 2008, variety NC-71 was seeded into 242-cell flats. On 27 March, the pre-plant treatments of Actigard 50WG and Admire Pro were tank mixed and sprayed on in 200 ml. of water per flat then washed in with 0.25 inches of water. Actigard 50WG was applied at 2 g ai/7,000 plants. Admire Pro greenhouse treatments were applied at 1 oz./1,000 plants. The plants were transplanted 2 April in plots on 44-inch rows with a 22-inch plant spacing. An average of 20 plants per test plot was planted.

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 3.3EC at 2 pts./A for weed control and Royal NH-30 Extra at 1.5 gal./A for sucker control.

Field Treatments

Spray 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 12-inch band at the rate of 40PSI for 10.0 gal. of water per acre. Drench treatments were applied by hand by pouring 50 ml. of a stock solution into a hole next to the base of each plant in the plot. Field application rates of Actigard 50WG were 1 oz./A and the Admire Pro rate was applied at 6 oz./A. First-symptom treatments were applied on 6 May.

Tobacco plots were scouted weekly to determine TSWV disease incidence and percentage of infection in non-treated plots. Percent infection levels were noted and triggered specific treatments. The first symptom of TSWV was noted 31 days post transplant. Stand counts were taken beginning 17 April, with the final stand count being conducted on 26 June. Plants displaying symptoms of TSWV were flagged in the field.

Two vigor ratings were conducted on 1 and 22 May. Plants were rated a 1 to 10 scale, with 10 equaling vigorous, healthy plants and 1 equaling poor vigor plants. One height measurement was conducted on 28 May. Plants were measured in centimeters from the base of the plant to the tip of the longest leaf. Three harvests were conducted on 1, 16 and 30 July. Harvests were done by collecting 1/3 of the plant leaves at each harvest and weighing and recording each plot in pounds.

Following the final harvest, root samples were collected 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 gram 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

TSWV levels were relatively low in 2008, with disease incidence reaching a high of 20 percent in the non-treated control. The Actigard and Admire Pro treatment, with and without a field spray of Actigard, had significantly lower incidence than the non-treated control. No significant differences in yield were detected.

Acknowledgments

The authors would like to thank the Georgia Agricultural Commodity Commission for Tobacco and Philip Morris for support of this study. Thanks are also extended to Clint Powell, Cody Singletary, Haley Gibbs, Remigio Padilla-Hernandez, Mac Denny and Trevor cook for their technical support.

Table 1. 2008 Spray vs. Drench Application Effects on Vigor, Plant Height and Yield

Treatment[1]	Application Schedule[2]	Vigor[3]	Height[4]	Dry Weight Yield[5]
1. Actigard + Admire Pro	Greenhouse + Actigard drench at 1st symptom	7.2 c	50.8 abc	2438.4 a
2. Actigard + Admire Pro	Greenhouse + Admire Pro drench at 1st symptom	7.1 c	51.2 abc	2556.1 a
3. Actigard + Admire Pro	Greenhouse + Actigard and Admire Pro drench at 1st symptom	7.0 c	49.6 bc	2677.2 a
4. Actigard + Admire Pro	Greenhouse- No field treatment	7.5 c	51.9 ab	2678.7 a
5. Actigard + Admire Pro	Greenhouse + Actigard sprayed at 1st symptom	7.6 bc	50.7 abc	2560.2
6. Actigard + Admire Pro	Greenhouse + Admire Pro sprayed at 1st symptom	7.2 c	47.6 c	2342.2 a
7. Actigard + Admire Pro	Greenhouse + Actigard and Admire sprayed at 1st symptom	7.3 c	49.1 bc	2558.9 a
8. Non-treated Control	No treatments	8.5 a	50.1 abc	2548.4 a
9. K326-T	No treatments	8.4 ab	54.0 a	2617.8 a

[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 applied when the first symptom of TSWV was identified through scouting control plots. All Actigard and Admire Pro treatments were applied as pre-plant treatments in the greenhouse at a rate of 2 gal/7,000 plants-Actigard and 1 oz./1,000 plants-Admire Pro.
[3] Height measurements were done in inches from the soil level to the tip of the longest leaf. A height measurement was conducted on 28 May.
[4] Vigor ratings were done on a 1 to 10 scale, with 10=live and healthy plants and 1= dead plants on 1 and 22 May.
[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 2. 2008 Spray vs. Drench Application Effects on Number of TSWV-Symptomatic Plants, Percent TSWV and Percent Elisa Testing for TSWV

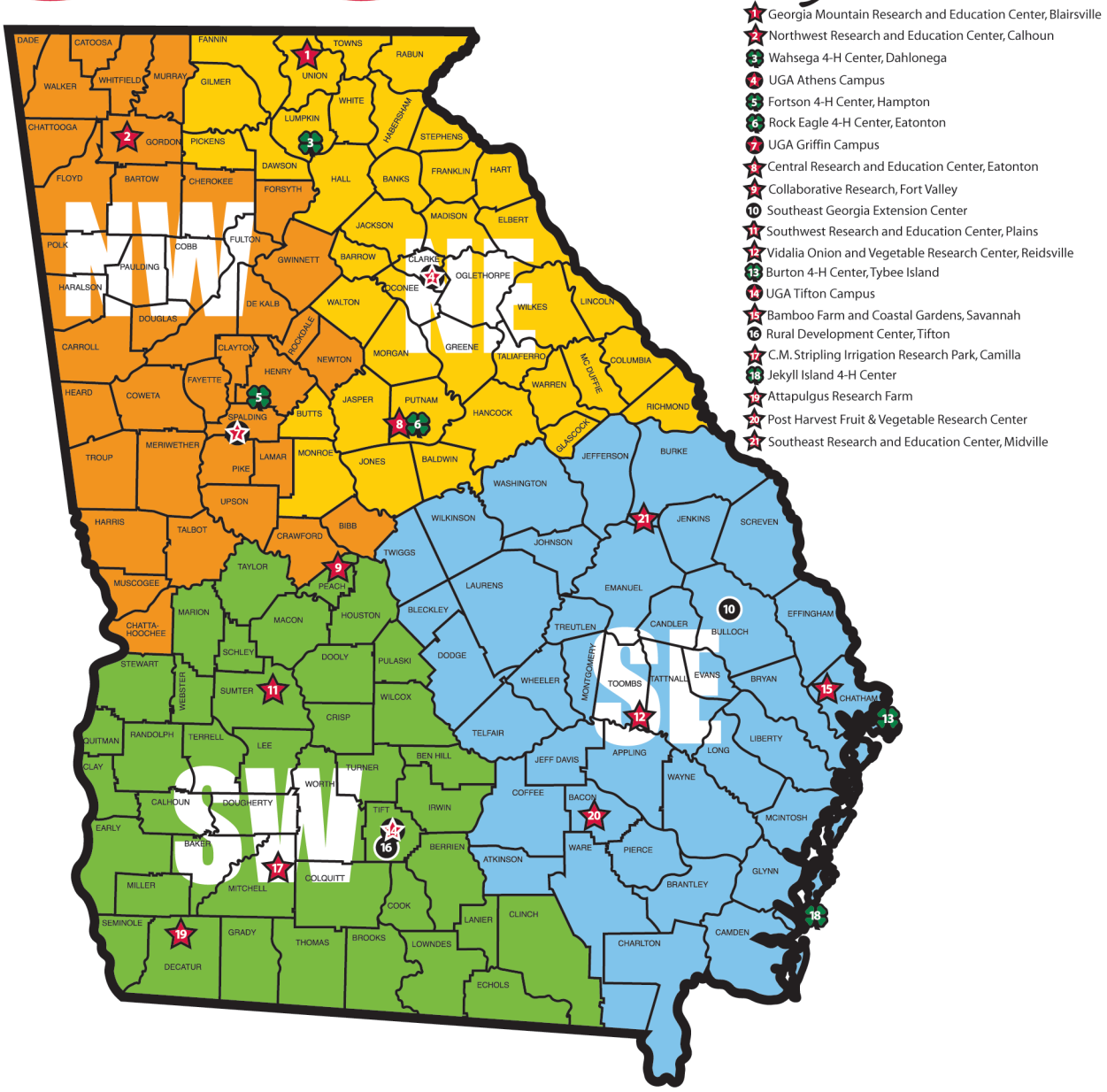
Treatment[1]	Application Schedule[2]	Number of TSWV-Symptomatic plants[3]	% TSWV[4]	% ELISA[5]
1. Actigard + Admire Pro	Greenhouse + Actigard drench at 1st symptom	1.0 ab	11.1 ab	10.0 ab
2. Actigard + Admire Pro	Greenhouse + Admire Pro drench at 1st symptom	1.0 ab	12.2 ab	28.0 a
3. Actigard + Admire Pro	Greenhouse + Actigard and Admire Pro drench at 1st symptom	0.6 ab	10.5 ab	12.0 ab
4. Actigard + Admire Pro	Greenhouse- No field treatment	0.0 b	2.4 b	12.0 ab
5. Actigard + Admire Pro	Greenhouse + Actigard sprayed at 1st symptom	0.0 b	5.5 b	14.0 ab
6. Actigard + Admire Pro	Greenhouse + Admire Pro sprayed at 1st symptom	0.6 ab	11.7 ab	12.0 ab
7. Actigard + Admire Pro	Greenhouse + Actigard and Admire sprayed at 1st symptom	1.0 ab	12.8 ab	14.0 ab
8. Non-treated Control	No treatments	1.4 a	19.7 a	16.0 ab
9. K326-T	No treatments	0.2 b	1.3 b	4.0 b

[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 applied when first symptom of TSWV was identified through scouting control plots. All Actigard and Admire Pro treatments were applied as pre-plant treatments in the greenhouse at a rate of 2gal/7,000 plants-Actigard and 1 oz./1,000 plants-Admire Pro.
[3] Cumulative number of TSWV-infected plants that were flagged during weekly stand counts.
[4] 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.
[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.

Conversion Table

U.S. Abbr.	Unit	Approximate Metric Equivalent
	Length	
mi	mile	1.609 kilometers
yd	yard	0.9144 meters
ft or ‘	foot	30.48 centimeters
in or “	inch	2.54 centimeters
	Area	
sq mi or mi^2	square mile	2.59 square kilometers
acre	acre	0.405 hectares or 4047 square meters
sq ft or ft^2	square foot	0.093 square meters
	Volume / Capacity	
gal	gallon	3.785 liters
qt	quart	0.946 liter
pt	pint	0.473 liter
fl oz	fluid ounce	29.473 milliliters or 28.416 cubic centimeters
bu	bushel	35.238 liters
cu ft or ft^3	cubit feet	0.028 cubic meter
	Mass / Weight	
ton	ton	0.907 metric ton
lb	pound	0.453 kilogram
oz	ounce	28.349 grams
Metric Abbr.	**Unit**	**Approximate U.S. Equivalent**
	Length	
km	kilometer	0.62 mile
m	meter	39.37 inches or 1.09 yards
cm	centimeter	0.39 inch
mm	millimeter	0.04 inch
	Area	
ha	hectare	2.47 acres
	Volume / Capacity	
liter	liter	61.02 cubic inches or 1.057 quarts
ml	milliliter	0.06 cubic inch or 0.034 fluid ounce
cc	cubic centimeter	0.061 cubic inch or 0.035 fluid ounce
	Mass / Weight	
MT	metric ton	1.1 tons
kg	kilogram	2.205 pounds
g	gram	0.035 ounce
mg	milligram	3.5×10^{-5} ounce

CAES across Georgia



Special Bulletin 63-2 **February 2009**