UGA extension

Tobacco Research Report

2015

2015 Tobacco Research Report

(Summary Report of 2015 Data)

Edited by Anna K. Watson

Tobacco Research Team

Alex Csinos[4]	Plant Pathologist Research	229-386-3373	csinos@uga.edu
Albert K. Culbreath[4]	Plant Pathologist Research	229-386-3156	spotwilt@uga.edu
Stan Diffie[2]	Coordinator Plant	229-386-3818	diffie@uga.edu
Bhabesh Dutta[4]	Plant Pathologist Research	229-386-3370	bhabesh@uga.edu
Ron Gitaitis[4]	Plant Pathologist Research	229-386-3157	dronion@uga.edu
Eric Goodwin[4]	Farm Supervisor	229-392-3729	ericgood@uga.edu
Unessee Hargett[3]	Coordinator Research	229-386-3370	uharg@uga.edu
Holly Hickey Anderson[4]	Research Assistant	229-325-4120	hhickey@uga.edu
Stevan S. LaHue[3]	Specialist Extension	229-388-6492	slahue@uga.edu
J. Michael Moore[1]	Agronomist	229-386-3006	jmmore@uga.edu
Sarah Rooks[4]	Research Assistant	229-391-5273	srooks@abac.edu
Rajagopalbabu Srinivasan[2]	Entomologist (Vector Biology)	229-386-3199	babusri@uga.edu
Anna K. Watson-Selph[4]	Virology Lab Manager	229-386-7230	akwat88@uga.edu

[1] Crop and Soil Sciences
[2] Entomology
[3] Field Research Services
[4] Plant Pathology

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Acknowledgments

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

Altria Client Services-Phillip Morris USA
FMC. Corp
Syngenta
Du Pont
Dow Agrisciences
Bayer CropScience
Valent BioSciences
Valent USA
MANA
Philip Morris International
Georgia Agricultural Commodity Commission for Tobacco

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FOREWORD

Agriculture is filled with risk and challenge, and for tobacco this has been a year filled with challenges. Heavy rains and disease, lower yield, reduced quality—most tobacco growers have faced these trials in their operations. Farmers deal with adversity every year, but 2015 seemed to present more than its fair share.

At the University of Georgia, it is our job to provide the latest research and educational information to help growers minimize risk, improve yield and quality, and provide greater opportunity for economic sustainability. I grew up in Tennessee where we grew burley tobacco, and as assistant dean of the UGA Tifton Campus, I still have the opportunity to be associated with tobacco production in a research capacity. The UGA College of Agricultural and Environmental Sciences continues to conduct tobacco research and educational programs to provide tobacco growers with the tools to enhance production and quality in order to strengthen the competitiveness of the tobacco industry.

Research by University of Georgia scientists investigating soil fertility, growth control, new varieties, control of spotted wilt virus, and other projects is summarized here for your use. We hope that you find this new information useful in meeting challenges and finding new opportunities. We also welcome you to our research farms to see this work in the field.

Joe W. West
Assistant Dean
University of Georgia Tifton Campus
College of Agricultural and Environmental Sciences

INTRODUCTION

Growing up in south Georgia, the landscape was rich with a variety of crops. The view of cotton, peanuts, soybean, vegetables, and tobacco ready for harvest signaled the changing of the seasons as surely as the changing colors of leaves on the trees.

As new crops appear in the farming rotation, tobacco remains a tried and true crop for many Georgia growers. The University of Georgia College of Agricultural and Environmental Sciences continues to conduct research with this Southern crop, and provides the tobacco industry with research and educational programs to enhance production and maintain competitiveness of the industry.

Research by our scientists and UGA Extension agents investigate soil fertility, growth control, new varieties, control of spotted wilt virus, and other vital topics. Those projects are summarized here for your use. We hope that you find this new information useful in meeting challenges and finding opportunities. We also welcome you to our research farms to see this work in the field and underway.

Laura Perry Johnson, Ph.D
Associate Dean for Extension
The University of Georgia
College of Agricultural and Environmental Sciences

REGIONAL CHEMICAL SUCKER CONTROL TEST

S. S. LaHue 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. 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, MH residues above 100 ppm must be reduced.

The tobacco season has lengthened because currently used cultivars benefit from irrigation and higher nitrogen rates. Moreover, the incidence of Tomato Spotted Wilt Virus (TSWV) in Georgia causes additional sucker pressure and difficulty in control due to variability in stands and flowering. The use of dinitroanalines (DNA) in combination with maleic hydrazide have shown success in controlling suckers over the lengthened season, while a third or even fourth contact has dealt with the variable stand due to TSWV. These problems can be managed while reducing MH residues.

The purpose of this study is to report the effectiveness of some new combinations of existing materials 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 in a tank mix with one of the dinitroanalines. 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, including harvesting and curing procedures, were uniformly applied and followed current University of Georgia recommendations. Fertilization consisted of 10 lb/acre of 9-45-15 in the transplant water, 500 lb/acre of 6-6-18 at first cultivation, 500 lb/acre of 6-6-18 at second cultivation, and an additional 120 lb/acre of 15.5-0-0 at lay-by. An additional 150 lb/acre of 15.5-0-0 was applied on June 5 because of 4.4 inches of rain the test received from May 31 to June 3. Therefore, the test received a total of 103 lb/acre of nitrogen. Irrigation was applied as needed throughout the growing season. Plots consisted of two rows of 30 plants each. Ten uniform plants were sampled from each plot for sucker data. Residue samples were pulled from cured yield samples and consisted of 25 leaves from each plot from the last three harvests. The test involved four replications randomized with seven sucker control treatments as follows:

1. TNS – Topped not suckered.

2. Fair 85 / Fair 85 / (Fair 30 & Prime+) – One application of the fatty alcohol contact Fair 85 (Fair Products, Inc.) at 4% solution followed in five days with an application of 5% solution. Five days later a tank mix of Fair 30 (2.25 lb ai/gal) (Fair Products, Inc.) potassium maleic hydrazide at the labeled rate of 1.0 gal/acre and Prime+ dinitroanaline (Syngenta Corporation) at 0.5 gal/acre was applied before the first harvest. All applications for all treatments utilized a standard three nozzle configuration (TG3-TG5-TG3) applying 52 gal/acre at 20 psi.

3. Fair 85 / Fair 85 / Fair 85 / (Fair 30 & Prime+) – Three applications of contact five days apart followed in five to seven days with a tank mix of Fair 30 (1.0 gal/acre) and Prime+ (0.5 gal/acre) applied after the first harvest.

4. Fair 85 / Fair 85 / Prime+ / Fair 30 – Two applications of contact, as in Treatment 2, were applied. The third application of Prime+ (0.5gal/acre) was applied three to five days later. The final application of Fair 30 (1.0 gal/acre) was applied before the first harvest.

5. Fair 85 / Fair 85 / Prime+ / Fair 30 – Identical applications and rates as in Treatment 4, but with Fair 30 applied after the first harvest.

6. Fair 85 / Fair 85 / (Fair 30 & Prime+) / Prime+ – Two applications of contact as in previous treatments followed in five days with a tank mix of Fair 30 (1.0 gal/acre) and Prime+ (0.5 gal/acre). The final application consisted of Prime+ (0.25 gal/acre) applied five to seven days later.

7. Fair 85 / Fair 85 / (Fair 30 & Prime+) / Butralin – Two applications of contact as in previous treatments followed in five days with a tank mix of Fair 30 (1.0 gal/acre) and Prime+ (0.5 gal/acre). The final application consisted of Butralin (Chemtura) (0.25 gal/acre) applied five to seven days later.

Results and Discussion

Due to historically high TSWV incidence at the Bowen Farm location, c.v. K 326 was treated in the greenhouse with the labeled rate of imidicloprid (0.8 oz Admire Pro per 1,000 plants) for TSWV suppression and transplanted on March 31. Favorable conditions for TSWV following transplanting required two field sprays (April 21, May 5) of Actigard (0.5 oz/acre). TSWV counts indicated an infection rate below 3% in the test. Generally, the crop was free of disease with an excellent plant stand.

The first contact was applied on June 11 with partly cloudy conditions. A rain event of 0.11 inches occurred three hours after the application. However, a visual inspection of the plants on the following day showed acceptable burn at the leaf axils. The second contact was applied on June 15 in favorable conditions. The third application was applied on the morning of June 22 with partly sunny skies. A rain event of 0.20 inches occurred approximately eight hours after the application. The final application for all treatments except Treatment 2 was applied on June 27 with sunny skies. All treatments were applied with a standard three nozzle arrangement on a high clearance sprayer at constant speed and pressure delivering slightly over 50 gal/acre. The test was harvested on June 23, July 7, and July 21, with the final harvest on August 4. The test was concluded after the suckers were pulled, counted, and weighed off 10 plants from each plot on August 7.

Normal rain and timely irrigation helped the crop mature quickly. However, sucker pressure was good and sufficient for comparing the treatments.

For 2015, yield and quality data varied little between treatments with the exception of Treatment 1 (TNS). Test yields were average with the TNS having the lowest yield at 1,847 lb/acre. Treatment 6 yielded the highest at 2,714lb/acre and had the highest value bringing in $4,312/acre. All chemical treatments increased yields 600-800 lb/acre over the TNS. The standard Treatment 2 brought in $3,932/acre as compared to the lowest of $3,131/acre for Treatment 1. The price and grade indices were consistent and slightly above average for all treatments.

Sucker control was excellent, with a low sucker number per plant and a mean value of 2.0 or less for all chemical treatments. Green weight per plant was higher for Treatment 7 than all other chemical treatments. Green weight per sucker was lower for treatments where MH was applied after the first harvest. Percent control was excellent (>94%) for all chemical treatments.

Acknowledgments

The authors would like to thank the Georgia Agricultural Commodity Commission for Tobacco for its financial support. Also, thanks to Hunter Brannon, Benjamin Deen, Will Gay, Brooke Hester, Richard Meadows, Alek Smith, and Catherine Summers for their experienced technical assistance.

Table 1. 2015 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[1]	**% Control**	**Green Weight /Plant (g)**	**No./ Plant**	**Green Weight /Sucker (g)**	**Plant Injury[2]**	**Yield (lb/A)**	**Value ($/A)**	**Price Index[3] ($/cwt)**	**Grade Index[4]**
1. Topped-Not-Suckered	0.0	356.9	4.8	74.7	0	1847	3131	170	86
2. Fair 85 / Fair 85 / (Fair 30 & Prime+) before first harvest	96.1	13.9	0.9	16.3	0	2579	3932	153	78
3. Fair 85 / Fair 85 / Fair 85 / (Fair 30 & Prime+) after first harvest	98.7	4.7	0.7	6.4	0	2410	3562	148	76
4. Fair 85 / Fair 85 / Prime+ / Fair 30 before first harvest	96.3	13.1	1.9	7.1	0	2438	4161	170	85
5. Fair 85 / Fair 85 / Prime+ / Fair 30 after first harvest	97.6	8.4	1.6	5.4	0	2483	3884	156	80
6. Fair 85 / Fair 85 / (Fair 30 & Prime+) / Prime+	97.1	10.4	0.8	12.5	0	2714	4312	160	81
7. Fair 85 / Fair 85 / (Fair 30 & Prime+) / Butralin	94.5	19.7	1.1	18.8	0	2557	3961	154	77
LSD: 0.05						363.9	765.7	18.3	7.9

[1] All treatments received initial contact application with Fair 85 at 4% (2.0 GPA); subsequent applications were at 5% (2.5 GPA).

[2] Injury rating on a scale of 0-10, with 0 = no damage and 10 = plant killed.

[3] Price Index based on two year average (2011-2012) prices for U.S. government grades.

[4] Grade Index is a 1-99 rating based on government grade. High ratings are best.

FLUE CURED TOBACCO VARIETY EVALUATION IN GEORGIA

S. S. LaHue and J. M. Moore

Introduction

Tobacco varieties play an essential 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 include yield, disease resistance, desirable plant qualities, curing, ease of handling, and market acceptability. For a variety to be recommended, it must be superlative in one or more factors and contain a balance of the remainder of the factors. For instance, for a variety to have an excellent yield but poor disease resistance or to yield well but have poor cured leaf quality, the variety would be unacceptable. In addition, every growing season presents these varieties with new challenges, which require documentation so growers can make informed decisions.

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 and subsequently a farm test where desirable varieties from the small plot test are grown in larger plots and receive additional evaluation. Once this information is analyzed, the desirable varieties and breeding lines from these tests advance to the official State Variety Test for further evaluation under growing and marketing conditions in Georgia.

In addition to the official variety test results, we have included data from the regional farm test, so when varieties are released from this test, Cooperative Extension agents will have an additional data set to use in making recommendations to growers.

Materials and Methods

The 2015 official State Variety Test and regional small plot test consisted of 38 and 21 entries, respectively, while the regional farm test had 16 entries. These tests were conducted at the University of Georgia Bowen Farm on Ocilla loamy coarse sand. All transplants were treated in the greenhouse with imidacloprid (0.8 oz Admire Pro per 1,000 plants) and followed with two field sprays (April 21, May 5) of Actigard applied at 0.5 oz/acre for Tomato Spotted Wilt Virus (TSWV). The regional farm test was mechanically transplanted on April 1, followed by the official State Variety Test on April 2. The regional small plot test was mechanically transplanted on April 3. All tests were transplanted with 22-24 plants per field plot and replicated three times. Fertilization consisted of 10 lb/acre of 9-45-15 in the transplant water (212 gal/A), 500 lb/acre of 6-6-18 at first cultivation, 500 lb/acre 6-6-18 at second cultivation, and an additional 120 lb/acre of 15.5-0-0 at lay-by for a total of 79 lb/acre of nitrogen.

Cultural practices, harvesting, and curing procedures were uniformly applied and followed the current University of Georgia recommendations. Data collected included plant stand, yield in lb/acre, value/acre 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 2015 official State Variety Test and regional farm test produced average yields and good quality. All tests benefitted from the application of Telone II, applied at the recommended rate, in October 2014 with good soil conditions, which kept nematode pressure to a minimum. In addition, field sprays of Actigard combined with the standard tray drench treatment of Admire resulted in a test average of around 3% TSWV symptomatic plants. The 2015 growing season was near the statistical average in rainfall and temperature. However, a warm, dry May was followed with roughly 4 inches of rain at the beginning of June. This rain event leached some of the available nitrogen from the test, causing leaves in the lower stalk positions to be thin and mature quicker. However, the crop provided good cured leaf quality on the first three harvests. The final harvest could have been delayed slightly for optimum maturity.

In the official State Variety Test, yield ranged from 1,818 lb/acre for NC 2326 to 2854 lb/acre for NC 938. Value of released varieties ranged from $2,593/acre for NC 2326 to $4,839/acre for XHN 64. Both price and grade index data were based on 2012 data due to lack of new data for 2015 at the time of publication. Price and grade data were average for all varieties due to an early final harvest. As a result, prices ranged from $124/cwt for NC 95, while GL 368 had the best price per cwt for the released varieties at $184. PVH 2310 came in a close second with a price of $183/cwt. Grade indices were good and ranged from 64 for NC 95 to 89 for PVH 2310. GL 368 was close with a grade index of 88. As a whole, later maturing varieties did not grade as well as the earlier maturing ones. Plant heights were high and averaged around 50 inches, while leaf numbers per plant averaged above 21for the test. Flowering dates ranged from 68 days for NC 2326 to 77 days for some of the other varieties. Leaf chemistry was generally good with alkaloids less than 3% and sugars averaging above 16%. The ratio of sugars to alkaloids ranged from 4.8 for PVH 2270 to 12.2 for CC 37. Generally, a value of 10 is desirable for this ratio. The official State Variety Test data are displayed in Table 1. Two and three year averages for selected varieties are found in Tables 2A and 2B.

The 2015 regional farm test yielded and graded similar to the other variety tests. In the farm test (Table 3), NC 2326 had the lowest yield at 1,760 lb/acre. XHN 60 yielded the highest at 2,667 lb/acre, but its price of $148/cwt was insufficient to give it the highest value. Value differed slightly with NC 2326 at $2,738/acre and K 326 at $4,090 dollars/A. The higher quality of K 326 overshadowed its slightly lower yield. However, CC EX 5 graded the best at $164/cwt and a grade index of 82. The lowest, NC EX 70 had a grade index of 73 with a price of $147/cwt. CU 201 had the lowest price at $147/cwt. Generally, leaf chemistry was similar to the official State Variety Test, with sugars in the upper teens and alkaloids less than 3%.

Acknowledgments

The authors would like to thank the Georgia Agricultural Commodity Commission for Tobacco for its financial support. Also, thanks to Hunter Brannon, Benjamin Deen, Will Gay, Brooke Hester, Richard Meadows, Alek Smith, and Catherine Summers for their experienced technical assistance.

Table 1. Yield, Value, Price Index, Grade Index, and Agronomic Characteristics of Released Varieties Evaluated in the 2015 Official State Flue-Cured Variety Test at the University of Georgia, Tifton, GA.

Variety	Yield (lb/A)	Value ($/A)	Price Index[1] ($/cwt)	Grade Index[2]	Leaves /Plant (No.)	Plant Height (in)	Days to Flower	Total Alkaloids (%)	Reducing Sugars (%)	Ratio RS/TA
NC2326	1818	2593	142	73	20	46.3	68	2.07	17.5	8.5
NC 95	2275	2824	124	64	23	52.5	73	2.00	18.7	9.4
K 326	2494	3610	145	74	23	47.9	72	1.71	17.2	10.1
K 346	2352	4202	179	86	20	42.9	64	1.98	19.4	9.8
K 730	2146	3393	157	79	23	45.9	68	2.35	15.6	6.6
NC 71	2526	3327	132	66	24	46.7	76	1.88	18.1	9.6
NC 72	2560	4278	167	83	24	51.5	74	1.66	16.2	9.8
NC 196	2611	4232	164	82	23	50.9	74	2.01	18.1	9.0
NC 297	2650	4244	161	81	22	48.6	70	2.20	19.3	8.8
NC 471	2349	3867	164	81	24	52.9	73	1.71	17.5	10.2
NC 606	2323	4052	174	86	23	53.5	73	1.85	19.8	10.7
NC 925	2510	3476	138	69	24	50.9	73	1.90	17.6	9.3
NC 938	2854	4422	155	78	23	53.4	77	1.80	16.8	9.3
NC 960	2352	4100	175	86	23	49.3	74	2.18	16.0	7.3
CC 13	2624	4406	168	84	23	48.5	69	1.86	17.6	9.5
CC 27	2695	4713	175	87	21	47.9	66	1.94	17.7	9.1
CC 33	2402	3974	166	82	24	50.5	75	1.64	18.3	11.2
CC 35	2164	3405	158	80	22	55.8	77	1.91	16.9	8.9
CC 37	2431	3859	158	78	23	51.1	75	1.51	18.4	12.2
CC 143	2518	4551	169	85	25	52.2	73	1.72	17.7	10.3
CC 700	2325	4072	175	86	22	47.0	67	1.92	16.4	8.5
CC 1063	2687	4631	172	84	23	51.6	75	1.94	17.5	9.0
PVH 1452	2539	4547	179	87	23	48.7	68	1.85	17.2	9.3
PVH 1600	2621	4535	173	86	22	50.0	71	1.93	18.0	9.3
PVH 2110	2301	3886	169	84	25	52.5	71	1.98	18.6	9.4
PVH 2254	2637	3792	146	74	24	54.8	73	1.55	18.9	12.2
PVH 2275	2534	4420	174	86	22	49.9	68	2.84	13.8	4.8
PVH 2310	2233	4090	183	89	22	52.1	75	2.20	11.1	5.0
PVH 16	2592	4484	172	85	27	52.7	75	1.91	18.7	9.8
SP 168	2798	4068	145	74	23	47.9	75	1.75	17.6	10.1
SP 225	2515	4002	161	81	22	51.3	72	1.87	18.0	9.6
GL 338	2243	4016	178	87	20	45.8	64	1.78	17.4	9.8
GL 368	2589	4753	184	88	22	50.2	68	2.26	16.7	7.4
GL 395	2241	3714	167	83	23	50.3	67	1.96	17.1	8.7
GL 398	2518	3661	148	74	24	51.6	77	2.19	17.4	7.9
GL 939	2288	3711	162	81	20	41.6	64	2.17	17.6	8.1
XHN 64	2793	4839	173	85	24	50.5	77	1.71	18.5	10.8

[1] Price Index based on two year average (2011-2012) prices for U.S. government grades.

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

Table 2A. Three Year Average (2013, 2014, and 2015) Comparison of Certain Characteristics for Released Varieties Evaluated in the 2015 Official State Flue-Cured Tobacco Variety Test at the University of Georgia, Tifton, GA.

Variety	Yield (lb/A)	Value ($/A)	Price Index[1] ($/cwt)	Grade Index[2]	Leaves /Plant (No.)	Plant Height (in.)	Days to Flower	Total Alkaloids (%)	Reducing Sugars (%)	Ratio RS/TA
NC2326	2111	3420	160	82	19	43.1	68	2.26	17.1	7.75
NC 95	2461	3738	151	77	21	47.7	76	1.99	17.9	9.02
K 326	2695	4315	160	81	21	43.2	75	1.96	17.5	9.09
K 346	2829	4404	157	76	20	42.2	68	2.01	18.1	9.03
NC 71	2739	4276	155	78	22	42.5	77	1.93	18.5	9.76
NC 72	2893	4366	152	75	22	46.7	77	1.86	17.5	9.43
NC 196	2932	4345	151	75	22	48.0	76	1.86	18.0	9.78
NC 297	2820	4246	150	75	21	44.4	72	2.13	18.2	8.75
NC 925	2808	3924	140	70	21	42.7	74	1.99	17.1	8.71
NC 938	3069	4400	146	73	21	44.7	76	1.79	16.8	9.47
CC 13	2955	4610	158	78	22	45.6	70	1.87	17.7	9.83
CC 27	3029	4755	159	78	20	44.5	72	2.00	17.5	9.02
CC 33	2642	4006	153	75	21	44.5	78	1.70	17.6	10.75
CC 35	2668	3968	150	74	21	49.2	78	1.92	16.7	8.99
CC 37	2842	4373	153	75	21	44.6	75	1.76	17.4	10.07
CC 700	2950	4613	158	78	20	43.3	70	1.95	16.2	8.46
CC 1063	2943	4883	167	81	21	45.7	73	2.07	17.0	8.34
PVH 1452	2923	4831	167	81	21	45.2	72	1.91	16.5	8.66
PVH 2110	2976	4760	161	80	23	48.4	75	1.91	18.4	9.92
PVH 2254	3020	4779	157	77	22	48.2	75	1.66	18.7	11.27
PVH 2275	2925	4863	167	82	21	45.3	72	2.39	15.6	6.91
SP 168	3089	4376	142	71	20	42.1	75	1.98	17.9	9.15
GF 318	3145	4774	154	77	21	44.8	71	1.98	18.7	9.53
GL 338	2846	4595	163	80	20	43.8	67	2.02	16.7	8.72
GL 395	2848	4345	156	78	21	45.7	71	2.13	16.4	7.94

[1] Price Index based on two year average (2011-2012) prices for U.S. government grades.

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

Table 2B. Two Year Average (2014-2015) Comparison of Certain Characteristics for Released Varieties Evaluated in the 2015 Official State Flue-Cured Tobacco Variety Test at the University of Georgia, Tifton, GA.

Variety	Yield (lb/A)	Value ($/A)	Price Index[1] ($/cwt)	Grade Index[2]	Leaves /Plant (No.)	Plant Height (in)	Days to Flower	Total Alkaloids (%)	Reducing Sugars (%)	Ratio RS/TA
NC2326	1991	3134	156	80	20	43.7	71	2.43	17.1	7.22
NC 95	2362	3422	144	74	23	49.0	79	2.02	18.2	9.03
K 326	2587	4042	156	79	22	43.8	79	2.03	17.3	8.71
K 346	2721	4020	151	74	19	40.9	70	2.07	18.3	8.88
NC 71	2627	3940	149	75	22	43.0	82	2.09	18.5	8.93
NC 72	2859	3938	141	70	23	47.5	79	1.91	17.4	9.16
NC 196	3001	4194	143	72	23	49.1	78	1.99	18.1	9.10
NC 297	2768	3924	141	71	21	43.9	75	2.31	18.0	7.84
NC 925	2809	3613	129	65	22	44.1	78	2.09	17.5	8.44
NC 938	3180	4344	138	70	22	46.8	82	1.91	17.0	8.93
CC 13	3001	4479	151	76	23	45.6	73	2.08	17.4	8.48
CC 27	3034	4564	154	77	21	44.4	72	2.22	18.1	8.30
CC 33	2539	3663	147	73	21	44.3	83	1.87	17.3	9.45
CC 35	2603	3690	143	71	22	50.0	77	2.11	16.8	8.05
CC 37	2677	3962	147	72	22	45.4	78	1.82	18.5	10.45
CC 143	3024	4804	157	79	24	48.1	77	1.70	18.2	10.70
CC 700	2806	4206	154	76	20	43.3	73	2.10	16.0	7.71
CC 1063	3076	5071	166	81	22	47.4	76	2.16	16.8	7.89
PVH 1452	2828	4519	162	79	22	46.2	74	1.97	17.2	8.78
PVH 2110	2911	4555	159	79	23	47.7	77	2.09	18.1	8.72
PVH 2254	2994	4481	149	75	22	49.3	78	1.71	19.4	11.40
PVH 2275	2976	4754	161	80	22	46.7	73	2.73	15.1	5.55
PVH 2310	2700	4744	177	86	22	49.3	78	2.14	13.5	6.35
SP 168	3078	3960	129	66	21	43.6	76	2.04	17.7	8.85
SP 225	2806	4205	151	76	22	47.4	75	2.10	17.2	8.33
GF 318	3086	4259	142	71	22	43.9	74	2.14	18.8	8.82
GL 338	2715	4177	157	77	20	43.7	67	2.20	16.3	7.79
GL 395	2820	4189	152	76	21	46.0	73	2.31	16.5	7.35
GF 398	2982	3956	134	68	22	46.4	77	2.02	18.5	9.24

[1] Price Index based on two year average (2011-2012) prices for U.S. government grades.

[2] Numerical values ranging from 1-99 for flue-cured tobacco based on equivalent government 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 2015 Regional Farm Test at the University of Georgia, Tifton, GA.

Variety	Yield (lb/A)	Value ($/A)	Price Index[1] ($/cwt)	Grade Index[2]	Leaves /Plant (No.)	Plant Height (in)	Days to Flower	Total Alkaloids (%)	Reducing Sugars (%)	Ratio RS/TA
NC 2326	1760	2738	156	78	19	43.5	62	2.71	17.4	6.42
NC 95	2333	3436	148	75	22	53.5	67	2.69	17.7	6.59
K 326	2621	4090	156	78	23	48.5	71	2.01	18.6	9.26
GL EX 328	2496	3753	150	76	23	45.8	73	1.95	19.4	9.99
NC EX 72	2564	3910	152	77	24	48.2	75	1.89	17.1	9.08
CC EX 5	2361	3877	164	82	23	51.1	68	2.00	15.8	7.91
CU 201	2562	3704	145	74	26	55.5	81	1.78	18.4	10.31
NC EX 70	2622	3825	147	73	25	51.5	74	1.91	16.3	8.53
CU 183	2364	3845	163	81	23	52.3	74	2.19	18.2	8.34
XHN 52	2471	3965	161	81	23	50.5	70	2.00	17.4	8.69
CU 181	2445	3842	157	79	25	54.9	75	2.04	18.2	8.92
GL EX 976	2596	4073	157	79	24	49.3	74	1.69	17.9	10.59
CC EX 4	2390	3775	158	81	23	49.5	72	1.84	18.3	9.98
NC EX 71	2564	4002	155	78	24	49.8	75	1.87	18.4	9.84
CU 156	2537	3833	152	76	23	51.6	72	2.26	17.6	7.76
XHN 60	2667	3910	148	75	23	52.8	75	2.20	17.4	7.90
LSD -0.05	267.2	627	16.0	7.2						

[1] Price Index based on two year average (2011-2012) prices for U.S. government grades.
[2] Numerical values ranging from 1-99 for flue-cured tobacco based on equivalent government grades—the higher the number, the higher the grade.

FLUE CURED TOBACCO VARIETY FERTILIZER EVALUATION

S. S. LaHue, A. S. Csinos, and W. H. Gay

Introduction

Recent research at the University of Georgia has demonstrated a significant tolerance of c.v. CC 35 to the *Meloidogyne* (Root Knot) species of nematode. Unfortunately, this variety has not performed as well as the standard variety c.v. K 326 in university variety trials. Generally, CC 35 tends to mature later than the standard varieties grown in Georgia. Many growers require an earlier maturing variety to fit into a multi-crop production system. However, the nematode tolerance of CC 35 is desirable for reducing production costs and increasing profits. Likewise, c.v. Speight 225 has performed very well in University of Georgia blackshank (*Phytophthora nicotianae*) trials. It also has not compared to K326 in recent variety trials. Once again, using a resistant variety can significantly increase profits for the grower. Therefore, a test was devised to see if adjusting the nitrogen applied could maintain yield and leaf quality as compared to a standard variety of K326.

Materials and Methods

The field experiment was conducted at the University of Georgia Tifton Campus Bowen Farm on Ocilla loamy coarse sand. All cultural practices, harvesting, and curing procedures were uniformly applied and followed current University of Georgia recommendations. Plots consisted of two rows of 30 plants each replicated four times. The test benefitted from the application of Telone II, applied at the recommended rate, in October 2014 with good soil conditions, which kept nematode pressure to a minimum. Nematode or blackshank pressure was not desired as a variable in this test. All transplants were treated in the greenhouse with imidacloprid (0.8 oz Admire Pro per 1,000 plants) and transplanted on March 31. In addition, two field sprays (April 21, May 5) of Actigard were applied at 0.5 oz/acre for Tomato Spotted Wilt Virus (TSWV). TSWV counts indicated an infection rate below 3 percent in the test. Generally, the crop was free of disease with a good plant stand. The test involved three varieties, randomized with three fertilizer rates for a total of nine treatments as follows:

1. K 326 with fertilization consisting of 10 lb/acre of 9-45-15 in the transplant water, 500 lb/acre of 6-6-18 at first cultivation, 500 lb/acre of 6-6-18 at second cultivation, and an additional 240 lb/acre of 15.5-0-0 at lay-by for a total of 98 lb/acre of nitrogen.

2. K 326 with fertilization consisting of 10 lb/acre of 9-45-15 in the transplant water, 500 lb/acre of 6-6-18 at first cultivation, 500 lb/acre of 6-6-18 at second cultivation, and an additional 120 lb/acre of 15.5-0-0 at lay-by for a total of 80 lb/acre of nitrogen.

3. K 326 with fertilization consisting of 10 lb/acre of 9-45-15 in the transplant water, 500 lb/acre of 6-6-18 at first cultivation, and 500 lb/acre of 6-6-18 at second cultivation. No fertilizer was applied at lay-by for a total of 60 lb/acre of nitrogen.

4. Speight 225 with fertilization consisting of 10 lb/acre of 9-45-15 in the transplant water, 500 lb/acre of 6-6-18 at first cultivation, 500 lb/acre of 6-6-18 at second cultivation, and an additional 240 lb/acre of 15.5-0-0 at lay-by for a total of 98 lb/acre of nitrogen.

5. Speight 225 with fertilization consisting of 10 lb/acre of 9-45-15 in the transplant water, 500 lb/acre of 6-6-18 at first cultivation, 500 lb/acre of 6-6-18 at second cultivation, and an additional 120 lb/acre of 15.5-0-0 at lay-by for a total of 80 lb/acre of nitrogen.

6. Speight 225 with fertilization consisting of 10 lb/acre of 9-45-15 in the transplant water, 500 lb/acre of 6-6-18 at first cultivation, and 500 lb/acre of 6-6-18 at second cultivation. No fertilizer was applied at lay-by for a total of 60 lb/acre of nitrogen.

7. CC 35 with fertilization consisting of 10 lb/acre of 9-45-15 in the transplant water, 500 lb/acre of 6-6-18 at first cultivation, 500 lb/acre of 6-6-18 at second cultivation, and an additional 240 lb/acre of 15.5-0-0 at lay-by for a total of 98 lb/acre of nitrogen.

8. CC 35 Speight 225 with fertilization consisting of 10 lb/acre of 9-45-15 in the transplant water, 500 lb/acre of 6-6-18 at first cultivation, 500 lb/acre of 6-6-18 at second cultivation, and an additional 120 lb/acre of 15.5-0-0 at lay-by for a total of 80 lb/acre of nitrogen.

9. CC 35 with fertilization consisting of 10 lb/acre of 9-45-15 in the transplant water, 500 lb/acre of 6-6-18 at first cultivation, and 500 lb/acre of 6-6-18 at second cultivation. No fertilizer was applied at lay-by for a total of 60 lb/acre of nitrogen.

Results and Discussion

The 2015 growing season was near the statistical average in rainfall and temperature. However, a warm, dry May was followed with roughly 4 inches of rain at the beginning of June. This rain event leached some of the available nitrogen from the test, causing leaves to be thin and mature quicker. However, the crop provided good cured leaf quality on the first three harvests for all treatments. The final harvest could have been delayed another two weeks for optimum maturity. As expected, yield followed nitrogen rates with the lower nitrogen rates limiting yields (Table 1) for all varieties. K326 yielded the best for all treatments except the 60 lb/acre rate where yield for CC 35 was slightly higher. Value differed slightly with K326 (98 lb/acre N) bringing in $3,866/acre, which was only $11/acre more than CC 35 (80 lb/acre N). Speight 225 was next with $3,787/acre. Leaf quality, as measured by price, was also better for CC 35. CC 35 (60 lb/acre N) and CC 35 (80 lb/acre N) had the two best prices at $177/cwt and $174/cwt, respectively. Moreover, Speight 225 at the 98 lb/acre N rate had a higher price ($169/cwt) than any nitrogen rate for K 326. Grade index followed the same trend as price. Reducing nitrogen rates below 80 lb/acre for CC 35 significantly reduced yield and value but increased leaf quality. The standard 80 lb/acre rate seemed to provide the best compromise of yield and quality. For Speight 225, increasing nitrogen to 98 lb/acre seemed to provide the best yield and quality combination.

Acknowledgments

The authors would like to thank the Georgia Agricultural Commodity Commission for Tobacco for its financial support. Also, thanks to Hunter Brannon, Benjamin Deen, Will Gay, Brooke Hester, Richard Meadows, Alek Smith, and Catherine Summers for their experienced technical assistance.

Table 1. 2015 Variety Fertilizer Test, Effects of Nitrogen Rates on Three Varieties in Relation to Yield, Value, Price Index, and Grade Index of Flue-Cured Tobacco.

Treatments	**Yield (lb/A)**	**Value ($/A)**	**Price Index[1] ($/cwt)**	**Grade Index[2]**
K 326 98lb/A N	2583	3866	151	77
K 326 80lb/A N	2435	3680	152	76
K 326 60lb/A N	1996	3080	155	77
Sp. 225 98lb/A N	2237	3787	169	83
Sp. 225 80lb/A N	2165	3172	147	74
Sp. 225 60lb/A N	1844	2774	150	76
CC 35 98lb/A N	2542	3702	146	74
CC 35 80lb/A N	2213	3855	174	85
CC 35 60lb/A N	2015	3569	177	85
LSD – 0.05	306.5	580.4	15.1	5.9

[1] Price Index based on two year average (2011-2012) prices for U.S. government grades.

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

INTEGRATED MANAGEMENT OF THRIPS AND TOMATO SPOTTED WILT VIRUS IN TOBACCO

R. Srinivasan, S. Diffie, and A. Csinos

Introduction

Thrips-transmitted Tomato Spotted Wilt Virus (TSWV) is still a serious production constraint for tobacco growers in Georgia and in the southeastern United States. Cultivated tobacco has no genetic resistance against thrips and/or TSWV. This has made management of thrips and/or TSWV extremely difficult. With tobacco foliage being very valuable, symptoms of TSWV on tobacco foliage are undesirable. The vector biology team, over the last four years, has focused on developing an integrated management strategy that encompasses multiple options such as plant defense inducer Actigard®, insecticides to manage thrips, and planting date alterations.

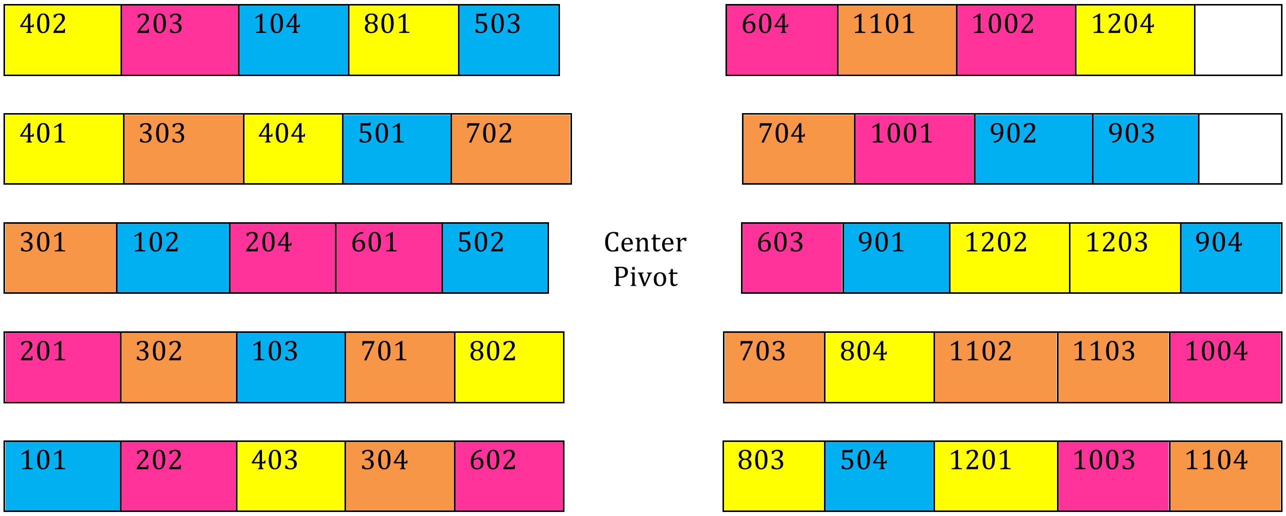
Actigard if often used regularly in conjunction with an insecticide as a float treatment in the greenhouse prior to planting. No other insecticide besides imidacloprid is predominantly used. Thrips have an extraordinary ability to develop resistance against insecticides. In fact, the western flower thrips has already developed resistance to several insecticides. Our program has concentrated on identifying alternatives to imidacloprid usage. In this study, potential alternatives such as Movento (spirotetramat) and Radiant (spinetoram) were evaluated. Besides insecticides, we also evaluated different planting dates and their impact on thrips populations as well as TSWV incidence. In addition, we have been investigating the effect of cropping system on thrips and TSWV incidence in tobacco. Presence of peanut volunteers and their impact on thrips and TSWV incidence is currently being evaluated. The trial is on going and only preliminary results will be discussed.

Materials and Methods

We used a split plot design with planting dates (March 25 [early], April 8 [mid], and April 22 [late]) representing main plots and the insecticide treatments representing sub-plots. The trial is currently in progress at Bowen Farm, University of Georgia, Tifton Campus. But some preliminary findings are provided below.

Thrips were monitored using yellow sticky cards present in each treatment plot as well as outside in non-treated areas to assess the population dynamics over time. Thrips counts were taken in two-week intervals. The sticky cards were removed and taken to the vector biology laboratory in Tifton, counted, and identified to species. The treatment thrips counts have not been estimated yet, but counts from outside the trial plots are included in this report. Plants showing TSWV symptoms were counted in three rows in each plot at three time intervals are included in this report. TSWV counts were also monitored in other areas around the trial plot that did not receive any Actigard treatment to assess the impact of Actigard application alone.

Plot Plan



402	203	104	801	503		604	1101	1002	1204	
401	303	404	501	702		704	1001	902	903	
301	102	204	601	502	Center Pivot	603	901	1202	1203	904
201	302	103	701	802		703	804	1102	1103	1004
101	202	403	304	602		803	504	1201	1003	1104

March 25 100 Actigard float
200 Actigard float + Movento float and spray
300 Actigard float + Radiant float and spray
400 Actigard float + Admire Pro float and spray

April 8 500 Actigard
600 Actigard float + Movento float and spray
700 Actigard float + Radiant float and spray
800 Actigard float + Admire Pro float and spray

April 22 900 Actigard float
1000 Actigard float + Movento float and spray
1100 Actigard float + Radiant float and spray
1200 Actigard float + Admire Pro float and spray

All seedling trays were treated with 0.07 g Actigard in 80 ml water (each). Each plot has three rows and is approximately 40 ft in length.

Results and Discussion

Thrips counts based on treatment plots were enumerated in the laboratory and identified. Though no treatment effects could be inferred from these data at this point, the data provide an idea of how the thrips population fluctuated over time in the 2015 season. The results are included in Figure 1. Results indicated that thrips populations increased from the second week of May onwards. Surprisingly, tobacco thrips populations formed only a small fraction of the total population of thrips that were trapped in sticky cards. The predominant species trapped include *Frankliniella occidentalis*, *F. bispinosa*, and *F. tritici*.

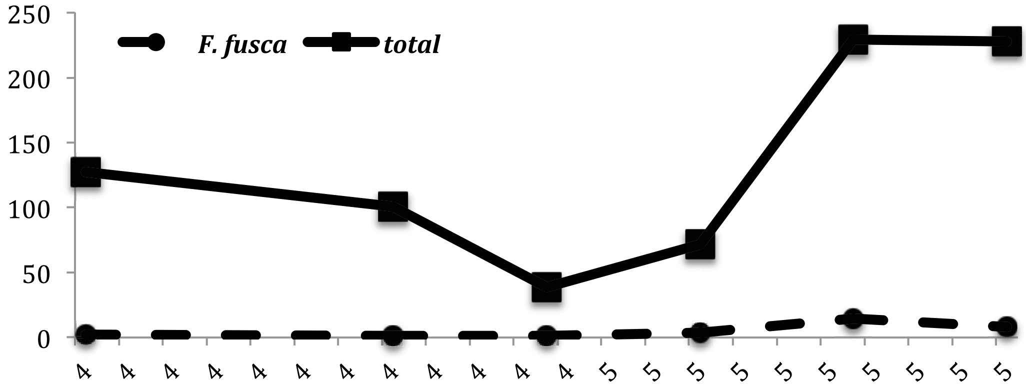


Figure 1. Average thrips counts obtained per sticky cards placed in the perimeter of the tobacco field. Six sticky cards were placed in total.

TSWV incidence in Actigard treated plants was up to 15 percent. The incidence of TSWV in non-Actigard treated plants ranged from 5 to 15 percent. The incidence of TSWV in insecticide treated plants ranged from 7 to 10 percent, with Radiant treated plots having the least amount of TSWV infection. Actigard and/or insecticide treatment did not seem to significantly influence TSWV incidence in tobacco this season. On the other hand, the planting date does seem to affect TSWV incidence. TSWV incidence in late-planted tobacco (April 22) was less than TSWV incidence in plants that were planted earlier (April 8 and 22). The results of TSWV incidence are explained in Figure 2.

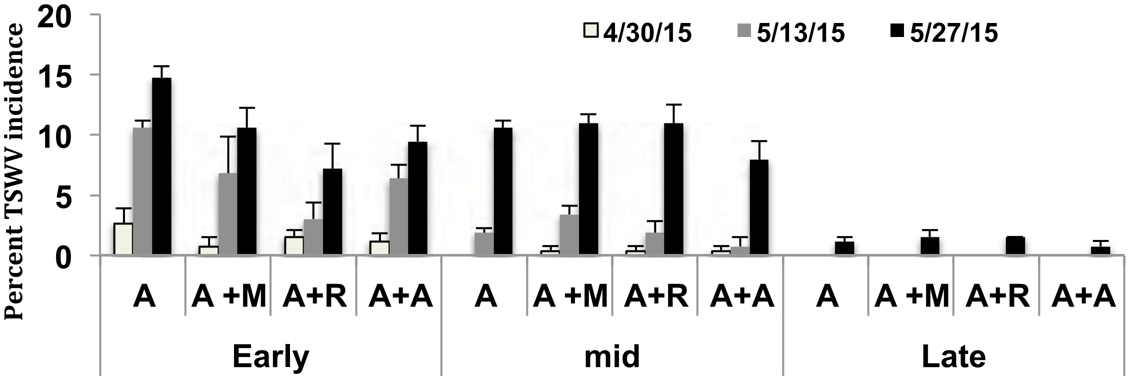


Figure 2. Percent TSWV incidence in plots planted at various dates and treated with Actigard and insecticides. Horizontal axis: A represents Actigard, M represents Movento, R represents Radiant, and A+A represents Actigard + AdmirePro. The dates above the bars represent three sampling dates. Early, mid, and late planting was conducted on March 25, April 8, and April 22, respectively.

These results suggest that planting date could have a bigger impact than applications of Actigard either alone or in combinations with insecticides. Similar results were also observed in the last field season (2014). It is not clear why the TSWV incidence was higher on early-planted plants when the pest pressure was less. More data analyses and interpretation would help comprehend this information better. Also, assessing the impact of peanuts in the cropping system and its effect on thrips and TSWV incidence will help understand this complex situation better.

FERTILITY ASSOCIATED WITH LEVELS OF TOMATO SPOTTED WILT VIRUS IN TOBACCO

Anna Selph, Albert Culbreath, Bhabesh Dutta, Sarah Rooks,
Alex Csinos, Steve LaHue, and Ron Gitaits

Introduction

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. Using this approach, data from soil samples from different locations at the Bowen Farm were plugged in to regression models that correlate Tomato Spotted Wilt Virus (TSWV) severity with concentration (ppm) of minerals. Based on results from model calculations, two sites were labeled as either high risk or low risk for TSWV and then used for planting tobacco. At the end of the season in 2014, the high-risk site had a TSWV severity rating of 33.1 percent and the low-risk site had a significantly lower TSWV severity rating of 4.4 precent. In separate evaluations, foliar-feeding studies indicated that applications of iron were associated with greater TSWV severity. In 2015, evaluation of TSWV risk at the two sites was repeated. Based on the 2014 results, treatments for the foliar-feeding studies were re-designed to gain a better understanding of how mineral levels in the tissues can affect disease resistance/severity. In addition, foliar-feeding treatments were evaluated either alone or in combination with acibenzolar-S-methyl, a systemic acquired resistance inducer.

Materials and Methods

The same high-risk and low-risk sites used in 2014 were planted in tobacco again in 2015. Tobacco transplants were planted into these fields and managed by following standard management practices recommended by the the University of Georgia. In addition, split-plot treatments were established in a randomized complete block design to evaluate supplemental foliar-feeding effects with and without acibenzolar-S-methyl (Actigard) on TSWV severity (Table 1). Non-treated control plots were used to compare TSWV severity in the high-risk and low-risk sites. Disease ratings were made on May 27, 2015, and June 17, 2015. For tissue analysis, samples were sent to the UGA Plant and Soil Analysis Laboratory in Athens, GA. Number of leaves sampled per treatment per plot was increased in 2015. Four leaves from each treatment from each of the four replicates at both sites (i.e., 32 leaves per treatment) were tested for TSWV using commercial ELISA kits (Agdia, Elkhart, IN). Only leaves that tested negative for TSWV were used for tissue analysis to avoid effects the virus may have on plant metabolism. Data were analyzed with GLM, multiple mean comparisons, t-tests, linear regression, stepwise regression, and r-square regression using SAS software version 9.4 for Windows (SAS Institute, Cary, NC). Expression levels of genes for superoxide dismutase enzymes (*Cu/ZnSOD*, *FeSOD*, and *MnSOD*) as well as the *NPR1* gene, which regulates downstream events of the systemic acquired resistance (SAR) pathway, were quantified using real-time PCR.

Table 1. Treatments at the Predicted High Risk and Low Risk Planting Sites at the Bowen Research Farm, near Tifton, GA, in 2015.

Treatment	Composition	Rate
1	Iron	0.66 oz/plot (19.4 ml/plot)
2	Copper	0.50 oz dry weight/plot
3	Manganese	5 ml/380 ml H_2O plot
4	Zinc	5 ml/380 ml H_2O plot
5	Control	
6	Iron + Actigard	0.66 oz/plot (19.4 ml/plot)
7	Copper + Actigard	0.50 oz dry weigh/plot
8	Manganese + Actigard	5 ml/380 ml H_2O + Actigard (0.0723 g/plot)
9	Zinc + Actigard	5 ml/380 ml H_2O plot + Actigard (0.0723 g/plot)
10	Actigard	(0.0723 g/plot)

Results and Discussion

In both the field sites, natural infections of TSWV were observed. When TSWV severity at the low-risk site was compared with TSWV severity at the high-risk site, the low-risk site had a mean TSWV severity of 13.9 as compared to the high-risk site, which had a significantly higher level of TSWV severity (34 percent) (Table 2).

Table 2. Levels of Tomato Spotted Wilt Virus (TSWV) Levels in Tobacco in the High-Risk and Low-Risk sites at the Bowen Research Farm in 2015.

Site	TSWV Rating[1]
High Risk	34.0 a
Low Risk	13.9 b

[1] Different letters indicate significant differences at (Pr > |t| < 0.0001).

Based on tissue analysis results, models were developed for total TSWV severity for the combined risk sites (Equation 1) using significance probability ($P = 0.0001$), adjusted R^2 (0.49), and variance inflation factor values (VIF) less than 5.0 as criteria for model selection. The standardized beta coefficients for the independent variables were 0.37, 0.33, 0.24, 0.20, and 0.11 for K, FeMn, MnMg, Al, and CuFe, respectively, indicating that K was the highest and FeMn was the second highest contributor to the model. Variance inflation values were all less than 5.0, indicating lack of a co-linearity problem.

Equation 1. TSWV Severity = 0.0008 K + 1.03 FeMn + 509.9 MnMg + 0.02 Al – 16.8 CuFe – 7.65

Since disease values were lower in the low-risk site and little variation among foliar-feeding treatments was observed, a separate model dedicated to just the high-risk site was developed (Equation 2) with probability ($P = 0.00009$), adjusted R^2 (0.39) and VIF values were all less than 2.0. The standardized beta coefficients for the independent variables for the high-risk model were 0.58, 0.24, and -0.13 for FeMn, CaP, and CuFe respectively, indicating that FeMn was the highest contributor to the model. Variance inflation values for FeMn, CaP, and CuFe were 1.02, 1.02, and 1.04, respectively, indicating the unlikelihood of co-linearity occurrence among variables.

Equation 2. TSWV Severity = 1.34 FeMn + 2.44 CaP – 15.4 CuFe + 19.3

Supplemental foliar-feeding trials indicated that zinc + Actigard and iron treatments were significantly different from Actigard alone (Table 3) in terms of observed TSW levels. Results indicated that mineral levels as well as mineral ratios could be manipulated by foliar-feeding, e.g., the copper to iron ratio (CuFe) was significantly greater in tobacco tissues in plants treated with copper or copper + Actigard (Table 4). Despite the trend of leaves treated with Actigard having a higher CuFe value than found in either leaves treated with iron or zinc + Actigard, which had the highest disease rating, the differences were not significant. Similar trends were found in results for copper, copper to aluminum, copper to zinc, and iron levels, but none were significantly different.

Table 3. Tomato Spotted Wilt (TSWV) Severity in Tobacco Plants Receiving Foliar-Feeding Treatments in the High-Risk Site.

Mean TSWV	t- Group	Treatment #	Treatment[1] Composition
51.3	a	9	Zinc + Actigard
41.3	ab	1	Iron
40.0	abc	4	Zinc
36.3	bc	3	Manganese
30.0	bc	8	Manganese + Actigard
30.0	bc	5	Control
28.8	bc	7	Copper + Actigard
27.5	bc	2	Copper
27.5	bc	6	Iron + Actigard
26.3	c	10	Actigard

[1] Different letters indicate significant differences at $P = 0.02$ and LSD =13.8

Table 4. CuFe Ratio in Virus-Free Tobacco Leaves Receiving Foliar-Feeding Treatments in the High-Risk Site.

CuFe Ratio	t- Group	Treatment #	Treatment[1] Composition
0.248	a	7	Copper + Actigard
0.239	a	2	Copper
0.089	b	10	Actigard
0.068	b	8	Manganese + Actigard
0.066	b	6	Iron + Actigard
0.052	b	4	Zinc
0.046	b	5	Control
0.041	b	1	Iron
0.040	b	9	Zinc + Actigard
0.036	b	3	Manganese

[1] Different letters indicate significant differences at $P = 0.0006$ and LSD = 0.099

However, iron to manganese levels (FeMn) were significantly different by treatment ($P = 0.03$ and LSD = 6.1), and the ranking of the treatments corresponded with TSWV rankings (Figure 1). The FeMn ratio could not be explained by manganese levels (Figure 2), as the P value was not significantly different. In addition, manganese levels in iron, zinc + Actigard, and Actigard alone were grouped near one another (< 40 ppm), indicating that manganese levels could not explain differences observed in the disease ratings.

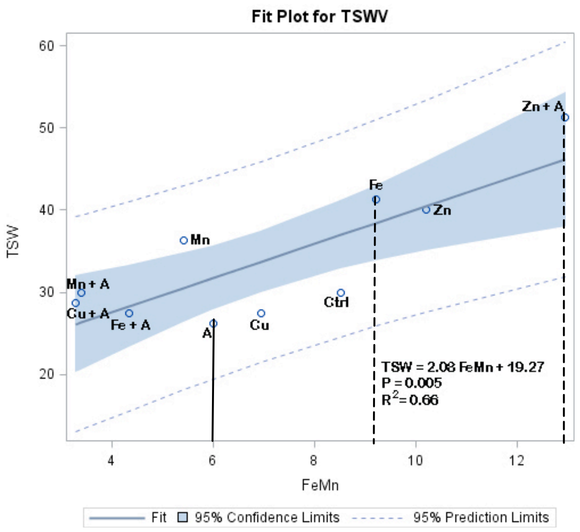


Figure 1. Correlation of iron to manganese ratio (FeMn) with TSWV severity in tobacco plants by treatment with various minerals with (+A) and without Actigard. Dotted vertical lines indicate the treatments with highest TSWV ratings and were significantly different from TSWV levels in plants treated with Actigard (solid vertical line).

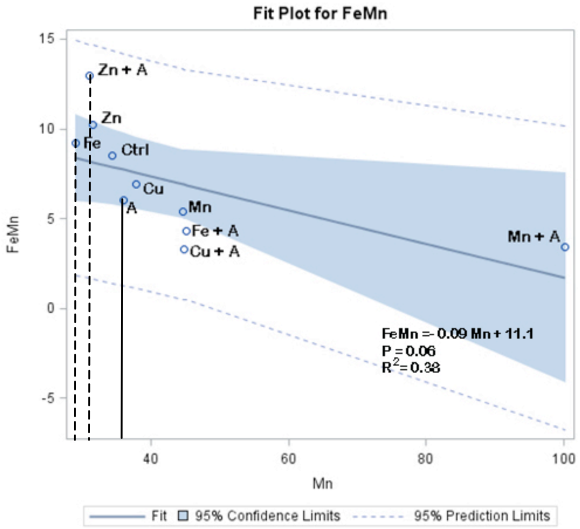


Figure 2. Correlation of iron:manganese ratio (FeMn) with manganese (Mn) levels by treatment with various minerals with (+A) and without Actigard. Dotted vertical lines indicate manganese levels in treatments with highest TSWV ratings and solid line indicates manganese levels in the treatment (Actigard) with lowest TSWV rating.

On the other hand, iron levels were significantly correlated with the FeMn by treatment (Figure 3). It was interesting that the iron levels in tobacco tissues were greater when zinc was applied either alone (262 ppm) or in combination with Actigard (217 ppm). These levels were even higher than treatments containing iron (190 ppm) or iron + actigard (173 ppm). The iron levels in iron, zinc + Actigard, and Actigard alone were spread and were arranged in a stair-step pattern with iron content in Actigard-treated plants (lowest disease rating) being 170 ppm, in iron-treated plants (second highest disease rating) being 190 ppm, and iron levels in zinc + Actigard-treated plants being 217 ppm. Viewed in context of the FeMn ratio affecting TSWV severity, increasing iron levels in tobacco tissues are associated with higher disease levels. This was verified by correlating iron levels with TSWV severity by treatment (Figure 4). The iron-TSWV model was very similar to the FeMn-TSWV model (Figure 1), but the Fe-Mn-TSWV model had a better fit and a higher R^2 value.

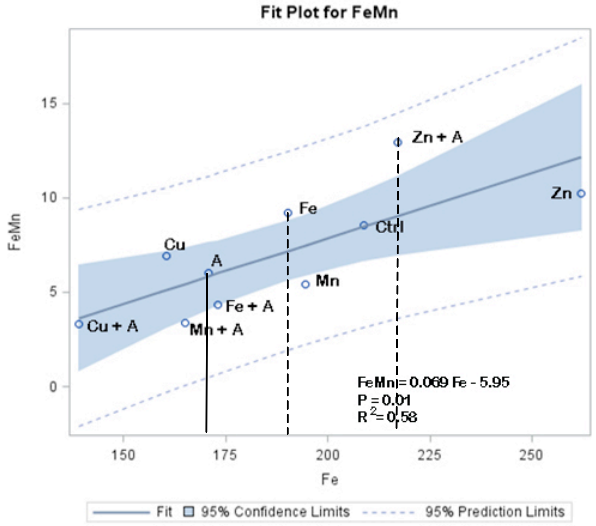


Figure 3. Correlation of iron:manganese ratio (FeMn) with iron (Fe) levels by treatment with various minerals with (+A) and without Actigard. Dotted vertical lines indicate iron levels in treatments with highest TSW ratings and solid line indicates manganese levels in the treatment (Actigard) with lowest TSW rating.

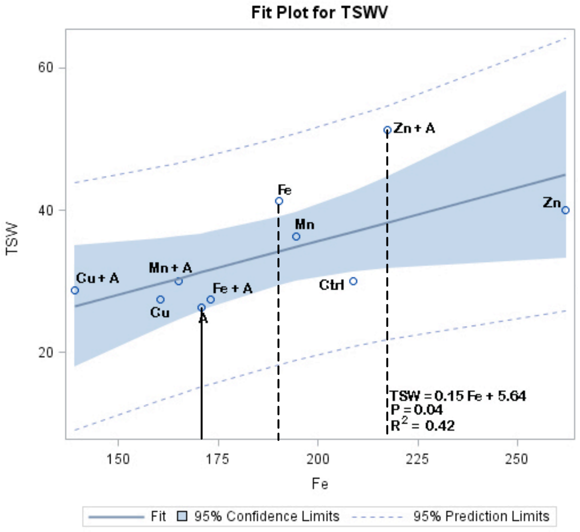


Figure 4. Correlation of iron (Fe) in tobacco tissues with TSWV severity in tobacco plants by treatment with various minerals with (+A) and without Actigard. Dotted vertical lines indicate the treatments with highest TSWV ratings and were significantly different from TSWV levels in plants treated with Actigard (solid vertical line).

It is interesting that the FeMn ratio has such a good fit with TSWV severity and can explain approximately 66 percent of the variation in the data. In 2014 we observed increased MnSOD expression in plants from the low-risk area, which had significantly less disease than the high-risk area. Normally manganese serves as the co-factor for MnSOD as Mn ions attach to the binding site making the enzyme functional. But unlike the other SODs, MnSOD can also accept

(continued on next page)

binding with Fe ions. Thus when the FeMn ratio is relatively lower, the number of Mn ions are present in greater numbers and there is less competition for binding in the active site. However, in the presence of increased iron levels, more Fe ions present can outcompete Mn ions for binding in the active site. Under those circumstances with Fe binding in the active site, the enzyme is not as efficient and is less functional. The end result downstream would be lower levels of hydrogen peroxide, which would result in lower levels of salicylic acid (SA). Lower levels of SA would result in lower expression of NPR1 and PR1 genes and, thus, lower levels of systemic acquired resistance would occur. This is one possible interpretation of the data we have collected in the high-risk and low-risk sites the past two years (2014 and 2015). To test that hypothesis we quantified the expression levels of MnSOD and NPR1 in the two treatments expressing the extreme differences in disease, namely Actigard vs. zinc + Actigard (Figure 5). It can be seen that both MnSOD and NPR 1 are down regulated in tissues treated with zinc + Actigard compared to those treated with Actigard alone.

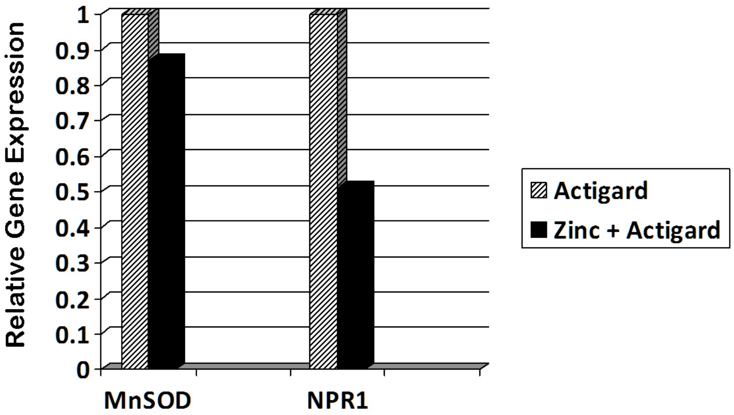


Figure 5. Relative expression of MnSOD and NPR1 genes in tobacco tissues treated with either Actigard or zinc + Actigard.

Another observation that we made was a correlation between the aluminum:sulfur (AlS) ratio and TSWV severity (Figure 6) as well as the AlS ratio and iron content in tobacco tissues (Figure 7). It is interesting that the AlS ratio has a similar relationship with iron levels in tobacco tissues as does the FeMn ratio. This would seem to validate that the increasing levels of iron by treatment is real and independent, as there was a possibility that a co-linearity problem occurred when analyzing the FeMn ratio with iron (despite the VIF values) since Fe accounted for a portion of the FeMn ratio value. However, no such association is present when we view the relationship between iron and the AlS ratio. The two regression models are almost identical, which leads credence to the fact that iron levels are affected by treatment and that treatments containing zinc have increased iron levels in the tissue. At this time we have no idea what role the AlS ratio plays in disease resistance. However, this Al ratio has consistently appeared in tobacco models as well as in disease models developed for sour skin of onion. To date, we do not have an explanation of how aluminum and sulfur interact to affect plant resistance.

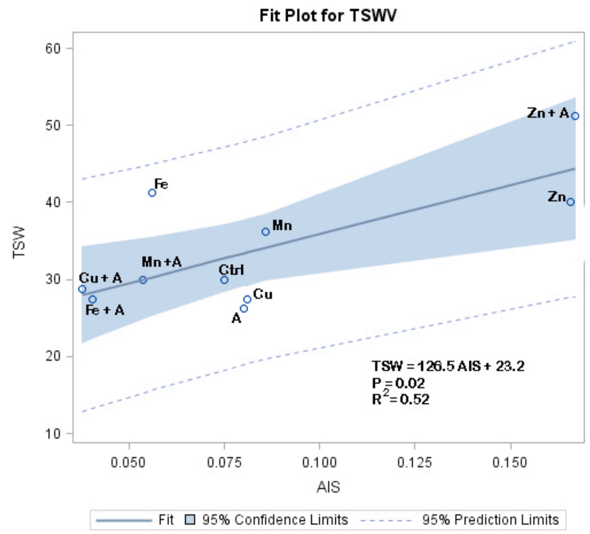


Figure 6. Correlation of the aluminum:sulfur (AlS) ratio in tobacco tissues with TSWV severity in tobacco plants by treatment with various minerals with (+A) and without Actigard.

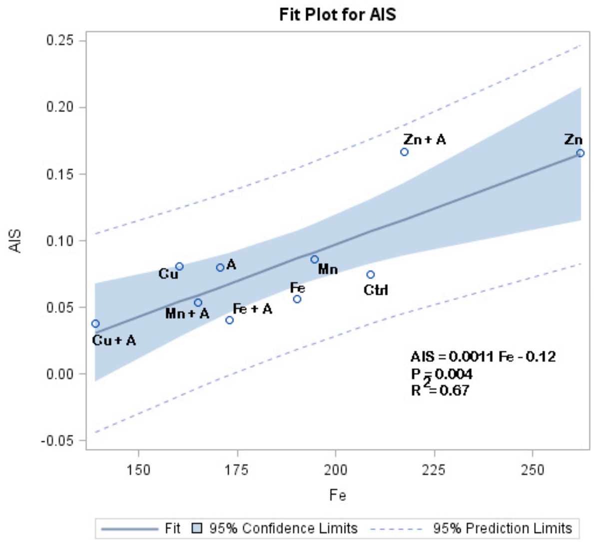


Figure 7. Correlation of the aluminum:sulfur (AlS) ratio in tobacco tissues with iron levels in tobacco tissues by treatment with various minerals with (+A) and without Actigard.

EVALUATION OF TOBACCO CULTIVARS FOR TOLERANCE AND/OR RESISTANCE TO NEMATODES WITH AND WITHOUT NIMITZ

Holly Hickey, A. S. Csinos, Steve LaHue, and Unessee Hargett

Introduction

Many crops in Georgia that are rotated with tobacco are susceptible to root knot nematode. Cotton is susceptible to *M. incognita* race 3 and 4, and peanuts are susceptible to *M. arenaria* race 1. Tobacco is susceptible to race 2 and race 4 of *M. incognita*, both races 1 and 2 of *M. arebaria*, *M. javanica*, and *M. hapla*. Vegetables are generally susceptible to all root knot species in Georgia. All species are capable of infecting tobacco. Without resistance to these pests, the use of rotation, crop destruction, and nematicides are the only means to manage the problem.

Nimitz was used as a form of chemical control in this trial. It has been proven to control nematodes on vegetables and was labeled for vegetable use in 2015. It was paired with each tobacco variety to get a side by side comparison of cultivar resistance plus chemical control.

Method and Materials

This trial was conducted at the Bowen Farm, Coastal Plain Experiment Station, Tifton, GA, in a field with a history of corn, peanuts, tobacco, and soybean production. The trial was set up in a field with a strong population of *Meloidygne arenaria* nematodes. The trial was set up in a randomized complete block design (RCBD) with six replications. Each plot was 32 feet long, 44-inch-wide beds with 10-foot alleys.

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 Black Hawk 2.5 oz/acre, Lorsban 2 qt/acre, and Belt 3 oz/acre for insect control. Also Prowl 3.3 EC at 1 qt/acre was used for weed control, Fair 85 for sucker control, and Actigard 0.5 oz/acre for TSWV control.

Total rainfall recorded at the Bowen Farm during this period (March through August 2015) was 18.06 inches, based on environmental data requested from Georgia Automated Environments monitoring Network. The trial was supplemented with irrigation as required.

Greenhouse and Field Treatments

On March 18, pre-plant application of Nimitz was applied in Treatments 8-14 at a rate of 1.25 pt/acre in a 12” band using a 22 GPA sprayer.

Tobacco transplants were treated in the greenhouse on March 24 with Admire Pro at 1 fl oz per 1,000 plants. Plants were pre-wet with material being washed in after spraying.
Tobacco varieties were transplanted on March 30 on 44-inch-wide rows with an 18-inch plant spacing. Coragen at 7 oz/acre was added into the transplant water.

Field Trial

A stand count was conducted on April 15 to establish a base count. Stand counts were conducted thereafter every one-two weeks beginning May 4 and ending June 17 to monitor loss of plants. Vigor ratings were conducted on April 15 (approximately two weeks post plant), April 21 (approximately three weeks post plant), May 4 (approximately five weeks post plant). Plant vigor was rated on a scale of 1-10, with 10 representing live and healthy plants and 1 representing dead plants.

Height measurements were conducted on May 19. Plants were measured individually from the soil level to the tip of the longest leaf and recorded in centimeters.

Three harvests were conducted: June 19, July 2, and July 16. Harvests were done by collecting one-third of plant leaves at one time and weighing each plot in pounds.

A mid-season root gall ratings was conducted on June 9 on three plants per plot using the Zeck's scale of 0-10, where 0 = no galls, 1 = very few small galls, 2 = numerous small galls, 3 = numerous small galls of which some are grown together, 4 = numerous small galls and some big galls, 5 = 25 percent of roots are severely galled, 6 = 50 percent of roots are severely galled, 7 = numerous, 75 percent of roots are severely galled, 8 = no healthy roots, but plant is still green, 9 = roots are rotting, and plant is dying, and 10 = plant and roots are dead. An at-harvest root gall rating was conducted following the final harvest on July 29, rating 10 plants per plot utilizing the same scale.

Nematode soil samples were pulled from plots on July 29. Eight to 10 cores of soil equaling about 300 ml, were collected from each plot randomly. Nematodes were extracted from a 100 cm^3 soil sub-sample using a centrifugal sugar flotation technique.

Results and Discussion

Yield of cultivars ranged from a low of 1,870 lb/acre (SP 225 + Nimitz) to a high of 3,097.8 (CC 35 + Nimitz). Tobacco cultivar CC 35, CC 35 + Nimitz, CC 13 + Nimitz, and GF 318 + Nimitz had a yield significantly higher than the standard K 326 + Nimitz.

Root gall rating on the first rating were all significantly low with minimal damage. At harvest, GF 318, GF 318 + Nimitz, and NC 196 had the highest overall rating with CC 35, CC 35 + Nimitz, and CC 13 having significantly the lowest ratings.
Nematode populations ranged from 46.7 to 601.7 with NC 196 having the highest population. All other tobacco cultivars had lower nematode numbers then CC 65 and were not different then K 326 + Nimitz

Several tobacco cultivars, notably CC 35, CC 35 + Nimitz, CC 13 + Nimitz, and GF 318 + Nimitz had high yields, and reduced populations of root knot nematode when compared to the standard K 326. As the price of nematicides increase, and their availability decreases, nematode-tolerant cultivars for management of tobacco root knot nematode will increase in popularity.

Acknowledgement
Authors thank the Georgia Agricultural Commodity Commission for Tobacco and Altria Client Services Philip Morris, USA, for financial aid to complete this trial.

Table 1. Vigor, Height, and Dry Weight Yield Results for Each Cultivar and Treatment Trialed.

Cultivar[1]	Treatment	Product Rate	Application	Vigor[2] (0-10 scale)	Height Measurement[3] (cm)	Dry Weight Yields [4] (lb/A)
1. CC 35	NT			9.22a	55.55ab	2914.2ab
2. CC 13	NT			8.83abc	55.78ab	2515.4bcd
3. SP 225	NT			8.39cd	49.28cd	1918.9ef
4. NC 196	NT			8.44cd	49.8cd	2593.7bcd
5. K 326	NT			8.44cd	50.61c	2295.7de
6. NC 297	NT			8.83abc	49.68cd	2452.4cd
7. GF 318	NT			8.89abc	53.7abc	2617.1bcd
8. CC 35	Nimitz	1.25 pt/A	12” band 3/18/2015	9.11ab	56.16a	3097.8a
9. CC 13	Nimitz	1.25 pt/A	12” band 3/18/2015	8.94abc	50.1cd	2743.6abc
10. SP 225	Nimitz	1.25 pt/A	12” band 3/18/2015	8.61bcd	49.59cd	1870.7f
11. NC 196	Nimitz	1.25 pt/A	12” band 3/18/2015	8.17d	46.12d	2326.9d
12. K 326	Nimitz	1.25 pt/A	12” band 3/18/2015	8.56cbd	51.57cb	2692.6bcd
13. NC 297	Nimitz	1.25 pt/A	12” band 3/18/2015	8.83abc	50.38cd	2594.5bcd
14. GF 318	Nimitz	1.25 pt/A	12” band 3/18/2015	8.83abc	51.85abc	2733.7abc

[1] Data are means of six replications. Means in the same column followed by the same letter are not statistically different (P = 0.05) according to Fisher’s LSD test. No letters signifies non-significant difference.
[2] Vigor was done on a 1-10 scale with 10 = live and healthy plants and 1 = dead plants on April 15, April 21, and May 4.
[3] Height measurements were done in centimeters from the soil level to the tip of the longest leaf on May 19.
[4] Dry weight yield 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 1,452 divided by the base stand count.

Table 2. Root Gall Rating and Number of *Meloidogyne* sp. Results for Each Cultivar and Treatment Trialed.

Cultivar[1]	**Treatment**	**Root Gall Ratings**[2] **(Zeck's Scale 0-10)** Mid-Season 9 June	**Root Gall Ratings**[2] **(Zeck's Scale 0-10)** At Final Harvest 29 July	**Number of *Meloidogyne* sp. Per 100cc soil**[3] At Final Harvest 29 July
1. CC 35	NT	1.33d	2.27g	70b
2. CC 13	NT	1.83cd	3.08efg	176.7b
3. SP 225	NT	4.33a	4.63bcd	441.7ab
4. NC 196	NT	3.78a	5.17abc	601.7a
5. K 326	NT	3.61ab	4.32bcde	423.3ab
6. NC 297	NT	3.78a	4.25bcde	318.3ab
7. GF 318	NT	3.61ab	6.25a	216.7ab
8. CC 35	Nimitz	1.61cd	2.22g	46.7b
9. CC 13	Nimitz	1.78cd	2.88ef	136.7b
10. SP 225	Nimitz	2.22bcd	4.28bcde	418.3ab
11. NC 196	Nimitz	1.78cd	3.97cdef	168.3b
12. K 326	Nimitz	3.39ab	4.77bcd	358.3ab
13. NC 297	Nimitz	1.78cd	3.78def	293.3ab
14. GF 318	Nimitz	2.94abc	5.4ab	432.2ab

[1] Data are means of six replications. Means in the same column followed by the same letter are not statistically different (P = 0.05) according to Fisher's LSD test. No letters signifies non-significant difference.

[2] Gall ratings were done on a scale of 0-10 with 10 = dead plants and roots and 0 = no galls and a healthy plant. An average was taken of the gall ratings on June 9 (mid-season), rating three plants per plot, and again on July 29 (at final harvest), rating 10 plants per plot.

[3] At final harvest (July 29) soil samples were collected to measure presence of root knot nematode (*Meloidogyne* sp.).

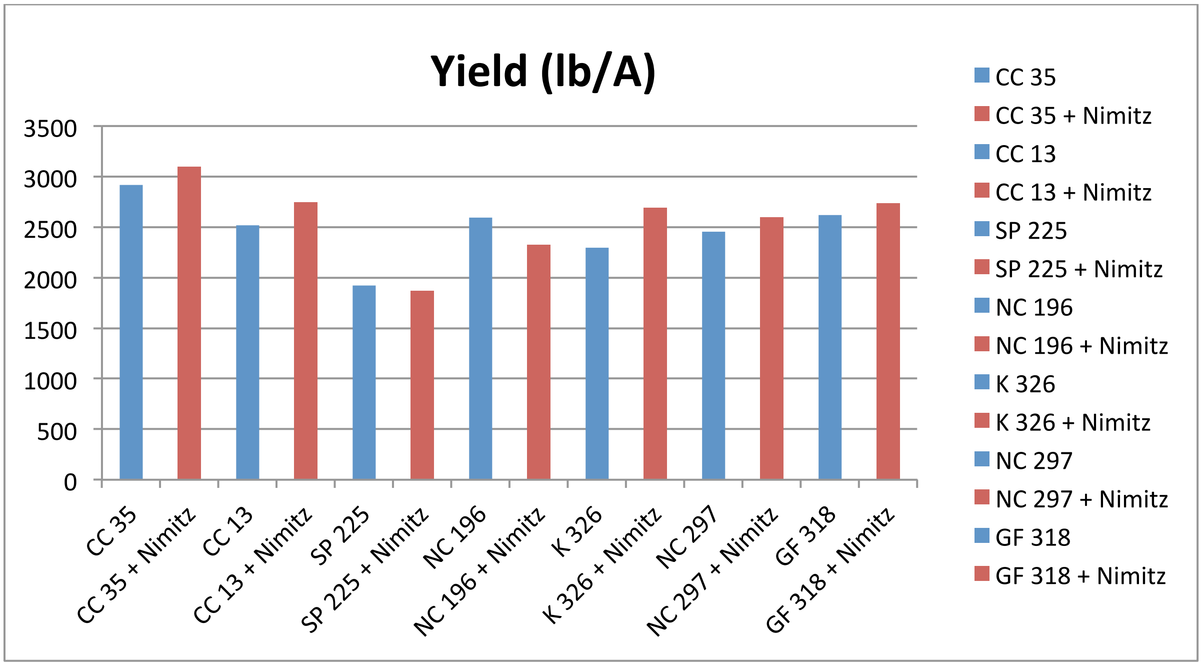


Figure 1. Yields of cultivars and treatments trialed.

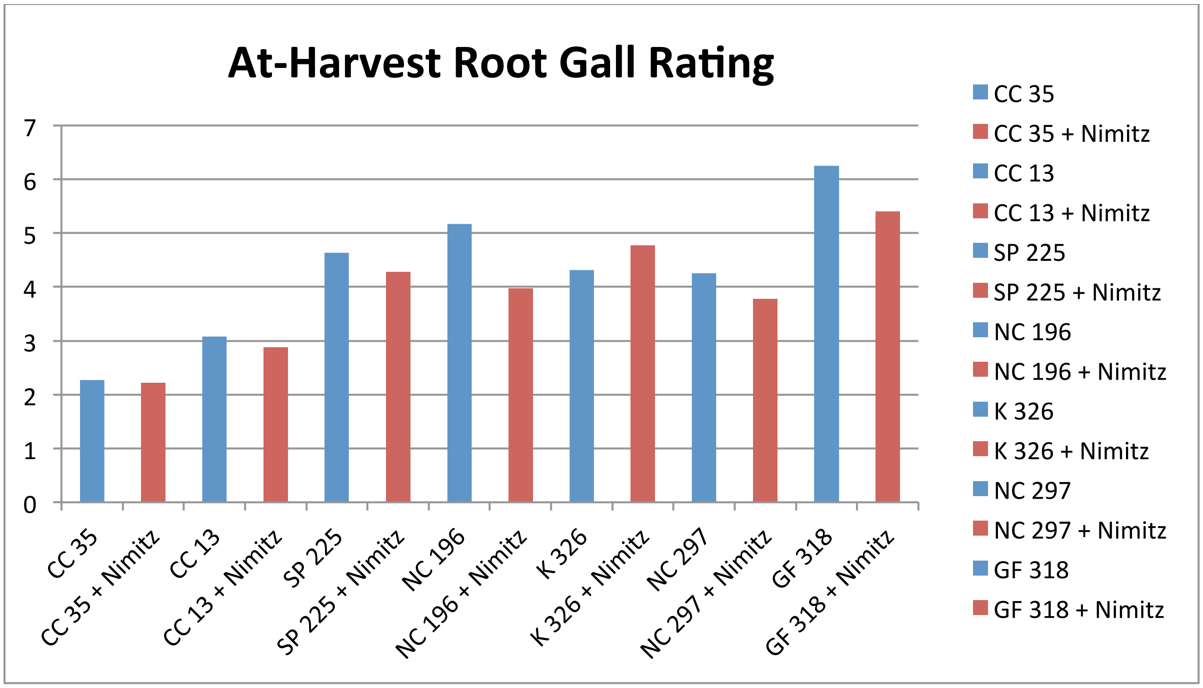


Figure 2. At-harvest root gall ratings of cultivars and treatments trialed based on Zeck's scale (0-10).

EVALUATION OF TOBACCO HOST RESISTANCE TO *PHYTOPHTHORA NICOTIANAE* RACES 0 AND 1 WITH AND WITHOUT PRESIDIO

Holly Hickey, A. S. Csnios, Steve LaHue, and Unessee Hargett

Introduction

Tobacco black shank incited by the pathogen *Phytophthora nicotianae* is a serious and persistent soil-borne disease. Often disease will reoccur in a field even after several years of rotation away from tobacco. Chemical control is variable and expensive. Other means of management of the disease would be the use of host resistance.

This trial evaluates several tobacco cultivars that have reported resistance to tobacco black shank, in a disease nursery that has both race 0 and race 1 of *Phytophthora nicotianae.* Chemical control with Presidio was also tested in this trial to see if chemical control plus host resistance decreased the risk of disease.

Method and Materials

The study was located at the University of Georgia's Black Shank Nursery in Tifton, GA, in a field with a continuous (since 1962) history of black shank of tobacco. The plot design was a randomized complete block, consisting of single row plots, and was replicated five times. Each plot was a single row, 35 feet long, with an average of 22 plants per test plot.

On January 26, tobacco varieties were seeded into 242 cell flats. Selected tobacco varieties for field evaluation were SP 225, CC 153, K 346, NC 925, NC 196, K 326, NC 297, and GL 395.

Tobacco transplants were treated in the greenhouse on March 23 with Admire Pro at 1 fl oz per 1,000 plants for insect control. Plants were pre-wet with tap water and treatment materials were washed in with additional water after spraying.

The field was prepared on March 29 by disk harrowing the area. Fertilizer 10-10-10 at 500 lb/acre was broadcast in plot area and incorporated into the soil on March 29. On March 29, applications of Prowl 1 pt/acre and Lorsban 2 qt/acre were incorporated and tilled into the plot area.

Tobacco was transplanted on April 2 on 48-inch wide rows with and 18-inch plant spacing. Coragen at a rate of 5 oz/acre was applied in transplant water using a 200 gal tank.

Additional pesticide applications on tobacco were applied uniformly over the entire test. On March 29, Lorsban 1 qt/acre + Prowl 1 qt/ acre was sprayed in a 16 inch band, three nozzles over row in 20 gal/acre H_2O.

Stand counts were conducted every two weeks beginning April 9 up until July 14, noting percent disease from TSWV and black shank.

Total rainfall recorded at the Black Shank Nursery during this period (March 29 through July 31 2015) was approximately 22.78 inches. Rainfall was determined by accessing the database of the Georgia Environmental Monitoring Network from the weather station located at the Tifton-Coastal Plain Experiment Station location.

Results and Discussion

The Black Shank Nursery has a mixture of race 0 and race 1 of *P. nicotianae*. The crop year 2015 was cool, which delayed the onset of black shank; however, as the temperature rose, the level of black shank increased, with the susceptible standard K 326 having 67 percent disease by the end of the season. Cultivars CC 143, NC 196, NC 297, and GL 395 showed the same level of susceptibility as K 326. Cultivars SP 225, K 346, and NC 925 demonstrated a significant (P = 0.05) level of resistance/tolerance to the disease. In a field with history of severe tobacco black shank, these cultivars may prove to be economically feasible to use with or without a chemical partner.

Adding chemical control of Presidio at first cultivation and lay-by reduced the occurrence of disease even in the susceptible varieties. Presidio was applied at a rate of 4 fl oz/acre. For most varieties, adding Presidio lowered the occurrence of black shank by approximately 40-50 percent.

Tomato Spotted Wilt Virus ratings were done every other week from April 9 until May 19. There were no significant differences in the percent of occurrences among the different varieties.

Lowest Percent of Black Shank to Highest Percent of Black Shank Occurrence in the Field:

1. SP 225 + Presidio – 14.47 %
2. NC 925 + Presidio – 17.45 %
3. K346 + Presidio – 20.93 %
4. CC 143 + Presidio – 30.61%
5. SP 225 – 31.29%
6. NC 297 + Presidio – 37.6%
7. GL 395 + Presidio – 40.65%
8. NC 196 + Presidio – 41.67 %
9. K 326 + Presidio – 43.44 %
10. K 346 – 44.73 %
11. NC 925 – 44.94 %
12. NC 196 – 49.9 %
13. CC 143 – 51.92 %
14. GL 395 – 65.48 %
15. K 326 – 67.41 %
16. NC 297 – 79.79 %

The relative level of black shank may change from field to field and season to season, but the relative disease severity will generally be constant among these cultivars.

Resistance to Race 0 (PHP gene) is qualitative, while Fl 301 gene is quantitative, and levels of tolerance to race 0 and race 1 defer and are cultivar dependent.

Acknowledgment

Authors thank the Georgia Agricultural Commodity Commission for Tobacco and Altria Client Services Philip Morris, USA, for financial aid to complete this trial.

Table 1. Vigor Rating, Height, Percentage Symptomatic of TSWV, Green Weight Yield, and Dry Weight Yield Results for Each Cultivar and Treatment Trialed.

Cultivar[1]	**Treatment**	**Product Rate**	**Application Schedule**	**Vigor**[2] **4/20/15**	**Vigor**[2] **4/30/15**	**Height**[3]	**% TSWV**[4]	**Green Wt Yield (lb/plot)**[5]	**Dry Wt Yield (lb/acre)**[6]
1. SP 225	NT			9.25a	9.2a	49ab	1.667bc	40.82abc	2602.7abcde
2. CC 143	NT			7.6d	9ab	45.82abc	2.86abc	28.01bcde	1836.3cdefg
3. K 346	NT			7.8cd	9ab	47.87abc	8.23a	26bcde	1700.7defg
4. NC 925	NT			7.8cd	9ab	43.12c	5.48abc	37.55abcd	2369.9abcdef
5. NC 196	NT			8cd	8.8abc	45.79abc	6.03abc	22.54cde	1454.8efg
6. K 326	NT			9ab	8.2cd	43.65bc	5.22abc	16.91de	1071.2gf
7. NC 297	NT			9ab	8.6abc	48.23abc	5.13abc	7.3e	474g
8. GL 395	NT			9ab	8.6abc	44.85abc	4.32abc	16.2de	1019.8gf
9. SP 225	Presidio	4 fl oz/A 4 fl oz/A	At 1st Culti. At Layby	8.4bc	9ab	47abc	0.95c	47.73ab	3285.4ab
10. CC 143	Presidio	4 fl oz/A 4 fl oz/A	At 1st Culti. At Layby	8.2cd	9ab	45.04abc	6.74abc	44.33abc	3144.2abc
11. K 346	Presidio	4 fl oz/A 4 fl oz/A	At 1st Culti. At Layby	7.8cd	8.8abc	47.294abc	5.34abc	54.09a	3570.7ab
12. NC 925	Presidio	4 fl oz/A 4 fl oz/A	At 1st Culti. At Layby	7.6d	9ab	43.556bc	3.89abc	54.6a	3736a
13. NC 196	Presidio	4 fl oz/A 4 fl oz/A	At 1st Culti. At Layby	8.2cd	8.8abc	44.194abc	2.81abc	45.67ab	3080.8abcd
14. K 326	Presidio	4 fl oz/A 4 fl oz/A	At 1st Culti. At Layby	9ab	7.8d	46.65abc	7.99ab	39.59abc	2563.4abcde
15. NC 297	Presidio	4 fl oz/A 4 fl oz/A	At 1st Culti. At Layby	9ab	8.4bcd	44.78abc	8.09a	35.04abcd	2270.8bcdef
16. GL 395	Presidio	4 fl oz/A 4 fl oz/A	At 1st Culti. At Layby	9ab	8.4bcd	49.708a	7.09abc	44.61ab	3094.4abc

[1] Data are means of five replications. Means in the same column followed by the same letter are not statistically different (P = 0.05) according to Fisher's LSD test. No letters signifies non-significant difference.

[2] Vigor was done on a 1-10 scale with 10 = live and healthy plants and 1 = dead plants on May 7 and 21.

[3] Height Measurements were done in centimeters from the soil level to the tip of the longest leaf on June 4.

[4] Percent of TSWV symptomatic plants was calculated by using stand counts that were made from May 14 to June 17 with TSWV being flagged every week.

[5] Green weight is total pounds per plot green.

[6] Dry weight yield 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 1,452 divided by the base stand count.

Table 2. Percent Death by Black Shank Results for Each Cultivar and Treatment Trialed Measured Five Separate Times During the Growing Season.

		% Death by Black Shank[1,2]	**% Death by Black Shank[1,2]**	**% Death by Black Shank[1,2]**	**% Death by Black Shank[1,2]**	**% Death by Black Shank[1,2]**
Cultivar	**Treatment**	**5/16/2015**	**6/1/2015**	**6/14/2015**	**6/30/2015**	**7/14/2015**
1. SP 225	NT	0b	1.742c	1.74c	21.59de	31.29cde
2. CC 143	NT	0.952b	9.244c	27.42b	44.1bcd	51.92abc
3. K 346	NT	0.87b	7.478c	19.61bc	31.52cde	44.73bcde
4. NC 925	NT	0b	5.81c	15.23bc	34.95cde	44.94bcde
5. NC 196	NT	1.962b	8.094c	28.42b	45.25bcd	49.9abcd
6. K 326	NT	3.478b	30.062b	50.23a	65.67ab	67.41ab
7. NC 297	NT	10.397a	49.921a	64.1a	77.97a	79.79a
8. GL 395	NT	0.87b	10.474c	27.84b	53.26abc	65.48ab
9. SP 225	Presidio	0b	0c	1.95c	9.86e	14.47e
10. CC 143	Presidio	1.053b	2.053c	6.26c	19.58de	30.61cde
11. K 346	Presidio	0b	0c	0c	8.1e	20.93cde
12. NC 925	Presidio	1.111b	1.111c	2.22c	9.96e	17.45de
13. NC 196	Presidio	0b	0c	5.04c	22.63de	41.67bcde
14. K 326	Presidio	0b	5.595c	11.11bc	32.64cde	43.44bcde
15. NC 297	Presidio	0.87b	2.655c	5.36c	28.42cde	37.6bcde
16. GL 395	Presidio	0b	0c	1.74c	24.37cde	40.65bcde

[1] Data are means of five replications. Means in the same column followed by the same letter are not statistically different (P = 0.05) according to Fisher's LSD test. No letters signifies non-significant difference.

[2] Percent death by black shank was calculated by subtracting the number of plants infected at each count from the original base count. The numbers of plants flagged with TSWV were subtracted from the 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.

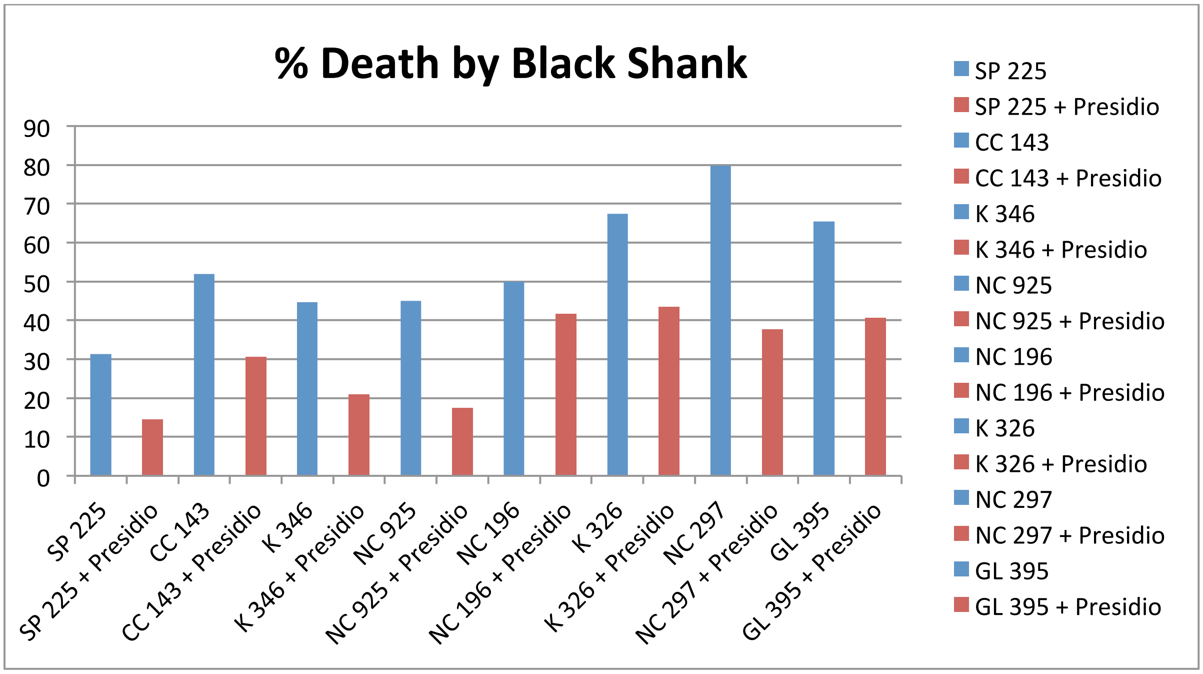


Figure 1. Percent death by black shank of cultivars and treatments trialed.

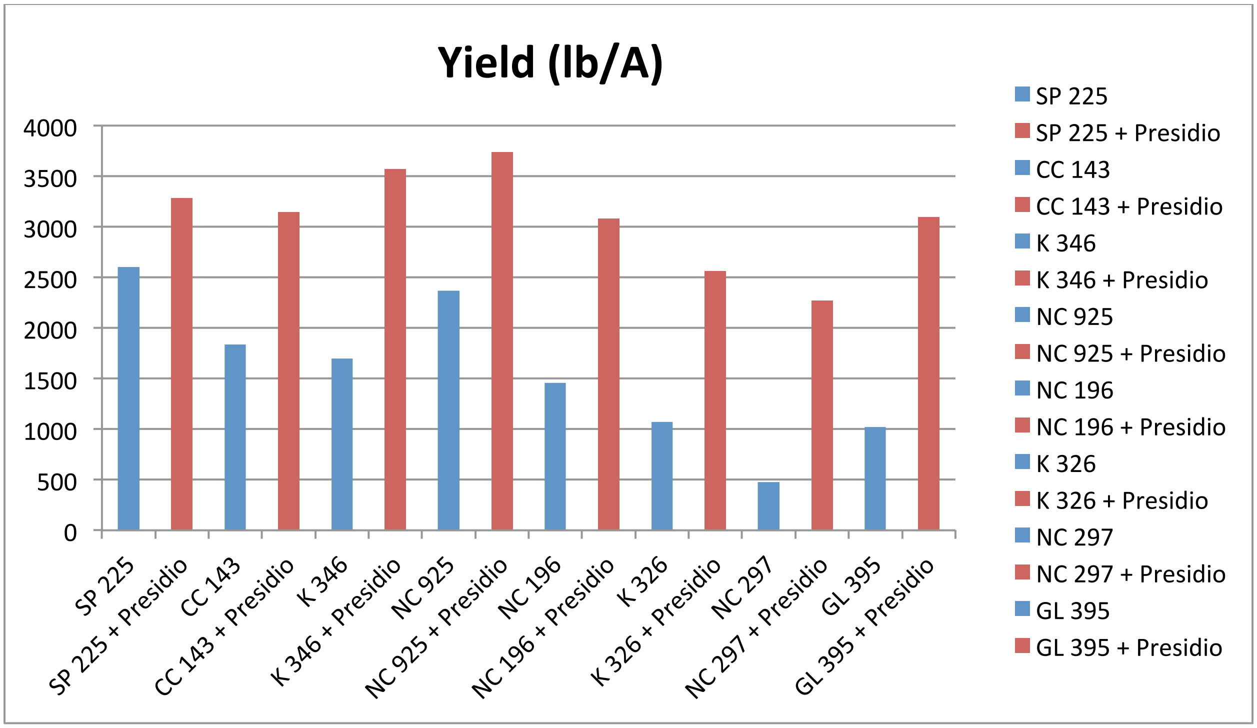


Figure 2. Yields of cultivars and treatments trialed.

EVALUATION OF NIMITZ IN THE TRANSPLANT WATER FOR NEMATODE CONTROL IN FLUE-CURED TOBACCO, 2015

A. S. Csinos, Holly Hickey-Anderson, Steve LaHue, and Unessee Hargett

Introduction

Fluensulfone (Nimitz) is being developed by Adama for nematode control in vegetables and row crops, including tobacco. The cost of Nimitz is $80-90 per pint. Competitive products such as fumigant Telone II costs about $100 per acre and is considered the standard in the industry. Any new products entering the market place must compete with Telone II in both efficiency and cost. In order for Nimitz to be competitive, the total use rate must not exceed 1.25 pt/acre.

A preliminary trial was conducted in March 2015 where transplants were drench treated with Nimitz to simulate transplant water applications at several concentrations. High concentrations of 2 and 3 pints in 200 gallons of water applied directly on the root systems were deadly to the transplants. Rates of 0.5 pint and 0.25 pint/acre of Nimitz in the transplant water did not cause phytotoxicity.

This study exploits this information and evaluates the use of Nimitz in the transplant water to evaluate any phytotoxic effects, control of peanut root knot nematode, and yield of tobacco.

Materials and Methods

The test area was on Ocilla loamy sand (89.2 percent sand, 2.4 percent clay, 8.4 percent silt) heavily infested with *Meloidogyne arenaria*. The trial was a randomized complete block design with six treatments and six replications. Each row was 35 feet long with 15 foot alleys between replications. Rows were 44 inches wide, and plants were spaced 20 inches apart in the row. The tobacco cultivar was NC 196.

The standard, Treatment 5 – Nimitz at 1.5 pint/acre, was applied in a 12-inch band seven days pre-plant incorporated on March 23. Transplant water treatments were applied in 200 gallons of water per acre at transplanting on March 30. Treatments 1 and 3 (Nimitz at 0.5 pint/acre) were applied as a lay-by treatment, as a directed spray at the base of the plants on April 28. Crop fertilization and control of unwanted pests followed University of Georgia Cooperative Extension recommendations.

Results and Conclusions

This trial was planted later than most trials at the Bowen Farm and may have suffered in yield because of that fact.

No obvious phytotoxicity was detected in any of the treatments during the first four weeks of growth (Table 1). Vigor was essentially the same for all plots, and no difference among treatments was observed during the first four weeks of growth (Table 1). Root gall indices indicated some interesting results. Treatment 1– Nimitz 0.5 pint/acre transplant water, followed by Treatments 1 and 3 (Nimitz 0.5 pint/acre lay-by treated plots) had significantly less root gall damage than the non-treated control. However, this reduction in root knot damage did not translate into an increase in yield over the non-treated control. We cannot offer an explanation for the poor yield performance, but we are encouraged by the significant root gall reduction in the transplant water treatment of Nimitz on flue-cured tobacco.

Acknowledgment

The authors would like to thank the Georgia Agricultural Commodity Commission, Adama, and Altria Client Services for their support of this tobacco research.

Table 1. Evaluation of Nimitz in Transplant Water, on Flue-Cured Tobacco for Nematode Control, 2015.

Treatment No.	**Phytotoxicity (0-10 scale)**	**Vigor – April 21 (0-10 scale)**	**Root Gall Rating (0-10 Scale)**		**Yield (Dry Weight in lb/A)**
			June 15	**Aug 6**	
1.	0.7[a]*	9.5[a]	2.4[b]	3.8[b]	1,468[a]
2.	0.7[a]	9.7[a]	2.8[ab]	4.6[ab]	1,502[a]
3.	1.3[a]	9.8[a]	2.8[ab]	5.1[ab]	1,394[a]
4.	1.3[a]	9.8[a]	3.1[ab]	4.9[ab]	1,470[a]
5.	0.3[a]	10.0[a]	3.6[ab]	6.1[a]	1,548[a]
6.	0.2[a]	9.8[a]	4.3[a]	6.1[a]	1,661[a]

*Means followed by the same letter are not significantly different from each other at $P = 0.05$.

EVALUATION OF FLUENSULFONE FOR NEMATODE CONTROL IN FLUE-CURED TOBACCO

A. S. Csinos, Holly Hickey-Anderson, Steve LaHue, Unessee Hargett

Fluensulfone (Nimitz) is a new contact nematicide being developed for nematode control in row crops and vegetables by Adama, MANA crop protection. Current nematode management programs in tobacco consist of the use of fumigant Telone II, resistant cultivars, and crop rotations. The use of a fumigant for nematode management may be compromised by weather and requires specific use restrictions for the user and surrounding inhabitants.

This study evaluates the application of fluensulfone at several rates and explores the use of reduced treated area in the field to maximize efficacy.

Materials and Methods

The cultivar NC 196 was planted on April 7, 2015, at the Bowen Farm in an area heavily infested with peanut root knot nematode (*Melodogoine arenara*). The test area was on Ocilla loamy sand, 89 percent sand, 2.4 percent clay, and 8.6 percent silt. The trial was a randomized complete block design, with each row 35 feet long and replicated six times. Treatments are listed in Table 1. Telone II was applied 21 days (March 9) before planting at 6 gal/acre. All fluensulfone treatments were applied April 1 at rates and band widths indicated in Table 1. Applications were made with a CO_2 activated backpack sprayer with three nozzle boom in 22 gal/acre. Plots were irrigated as required and all production practices followed University of Georgia Cooperative Extension recommendations.

Results and Conclusions

Nematode pressure was moderate in 2015 with the harvest RGI at 4.8 out of 10 scale. Vigor of plots was good throughout the season with several of the treated plots having a vigor rating of 10 out of 10. Treatment 4 had a vigor rating of 9.5, the lowest in the trial. Tomato Spotted Wilt Virus levels ranged from a low of 1.7 percent to a high of 7.9 percent. Root gall indices for mid-season were low ranging from a high of 2.2 out of 10, to a low of 1.3 out of 10. Root gall indices at harvest were considerably higher, ranging from a high of 4.8 out of 10 for the non-treated plot and Treatment 3 to a low of 2.4 out of 10 for Telone II treated plots.

Yield of plots was relatively high in 2015. Yields ranged from a low of 2,174 lb/acre to a high of 3,075 lb/acre. Treatment 7 (Nimitz 1.5 pt/acre in a 12 inch band) had a significantly higher yield than the non-treated control and Treatment 1 (Nimitz at 2.5 pt/acre, PPI broadcast) and was significantly different from the Telone II treated plots.

Acknowledgment

Authors thank the Georgia Agricultural Commodity Commission for Tobacco, Altria Client Services, Philip Morris, USA, and Adama for their support of this research.

Table 1. Evaluation of Nimitz Rates and Band Widths for Management of Root Knot Nematodes on Flue Cured Tobacco, 2015.

Treatment No.	Vigor (1-10 Scale)	TSWV (%)	RGI Mid (1-10 Scale)	RGI Final (1-10 Scale)	Yield (lb/A)
1.	9.8^{ab}*	4.3^{abc}	1.8^{abc}	3.5^{bcd}	$2{,}450^{bcd}$
2.	10.0^{a}	7.1^{ab}	1.6^{bc}	4.0^{abc}	$2{,}681^{abcd}$
3.	10.0^{a}	7.9^{a}	2.2^{a}	4.8^{a}	$2{,}412^{bcd}$
4.	9.5^{b}	5.9^{abc}	1.7^{abc}	3.3^{cd}	$2{,}180^{d}$
5.	9.8^{ab}	1.7^{c}	1.3^{c}	4.7^{ab}	$2{,}641^{abcd}$
6.	10.0^{a}	8.0^{a}	1.6^{abc}	4.3^{abc}	$2{,}658^{abcd}$
7.	9.8^{ab}	4.4^{abc}	1.9^{ab}	3.1^{cd}	$3{,}075^{a}$
8.	10.0^{a}	6.7^{abc}	1.5^{bc}	3.4^{bcd}	$2{,}317^{cd}$
9.	9.7^{ab}	6.1^{abc}	1.6^{abc}	3.7^{abcd}	$2{,}174^{d}$
10.	9.8^{ab}	5.0^{abc}	1.4^{bc}	3.4^{bcd}	$2{,}787^{abc}$
11.	9.8^{ab}	6.0^{abc}	1.4^{bc}	3.8^{abcd}	$2{,}620^{abcd}$
12.	10.0^{a}	7.8^{ab}	1.5^{bc}	2.4^{d}	$2{,}910^{ab}$
13.	10.0^{a}	2.5^{bc}	1.9^{ab}	4.8^{a}	$2{,}423^{bcd}$

* Means followed by the same letter are not significantly different from each other at $P = 0.05$.

OXATHIAPIPROLIN FOR MANAGEMENT OF TOBACCO BLACK SHANK

Alexander S. Csinos, Holly Hickey-Anderson, and Unessee Hargett

Introduction

Tobacco black shank is a persistent soil-borne disease and continues to be a serious problem in Georgia. Management of black shank is currently accomplished by use of cultivar resistance, crop rotation, sanitation, and fungicides.

Both Ridomil Gold and Presidio are registered for use on Tobacco black shank, but both have some undesirable issues. Oxathiapiprolin, Olondis, a new oomycete fungicide has recently been approved by EPA for use on potatoes, vegetables, and tobacco. This trial evaluates the use of oxathiapiprolin in combinations with Ridomil Gold.

Materials and Methods

K 326, a tobacco cultivar with susceptibility to both Race 0 and Race 1 of *Phytophthora nicotianae*, was planted on April 7, 2015. The trial was a RCB design, with single row (35 feet long) plots, and was replicated five times.

There were eight different treatments evaluated in the trial. Transplant water treatments were applied in the transplant water on April 7, and lay-by treatments were applied on May 19. All sprays were applied in a 16-inch band using three 8002 nozzles in 20 gallons of water per acre at 30 psi.

This trial was conducted at the Black Shank Farm in an area heavily infested with both races of *Phytophthora nicotianae*. All cultural aspects of tobacco production and other pest control methods followed University of Georgia Cooperative Extension recommendations.

Results

First incidence of disease occurred at about lay-by in mid-May (Table 1). Symptomatic plants started to appear rapidly as the temperature increased in June and plants went under stress. The non-treated plots had 42 percent disease by mid-June and nearly 80 percent by final harvest. The best treatment had only 8 percent disease by mid-June and 44 percent by final harvest.

Yields of non-treated plots were 396 pounds dry weight per acre. Treatment 3, a treatment of Ridomil Gold and Presidio, yielded 1,912 pounds dry weight per acre. Other treatment yields were between those extremes (Table 2).

Acknowledgment

Authors thank the Georgia Agricultural Commodity Commission for Tobacco, Altria Client Services, and Philip Morris, USA, for the financial aid to complete this trial.

Table 1. Incidence of Tobacco Black Shank on Tobacco Treated with Combinations of Oxathiapiprolin and Mefenoxam.

Treatment No.*	May 14 %	May 19 %	June 1 %	June 15 %	June 29 %	July 13 %
1.	1^{b}	2^{ab}	17^{a}	42^{a}	75^{a}	79^{ab}
2.	1^{b}	1^{ab}	3^{b}	20^{ab}	52^{ab}	61^{abc}
3.	2^{ab}	3^{a}	7^{b}	8^{c}	29^{b}	44^{c}
4.	0^{b}	0^{b}	7^{b}	18^{ab}	43^{b}	55^{bc}
5.	0^{b}	2^{ab}	4^{b}	5^{c}	57^{ab}	69^{abc}
6.	0^{b}	0^{b}	0^{b}	7^{c}	71^{a}	82^{a}

* Means followed by the same letter are not different from each other at *P* = 0.05.

Table 2. Yield and Total Black Shank of Tobacco Treated with Combinations of Oxathiapiprolin and Mefenoxam.

Treatment No.*	Total Black Shank (%)	Yield (lb dry wt./A)
1.	79^{ab}	396^{c}
2.	61^{abc}	1181^{abc}
3.	44^{c}	1912^{a}
4.	55^{bc}	1543^{ab}
5.	69^{abc}	985^{abc}
6.	82^{a}	856^{bc}
7.	84^{a}	626^{bc}
8.	61^{abc}	1321^{abc}

*Means followed by the same letter are not different from each other at *P* = 0.05.

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