THE UNIVERSITY OF GEORGIA
COLLEGE OF AGRICULTURAL & ENVIRONMENTAL SCIENCES

Tobacco Research Report

2013

2013 Tobacco Research Report
(Summary Report of 2013 Data)

Edited by Anna K. Watson

Tobacco Research Team

Alex Csinos[4]	Plant Pathologist Research	229-386-3373	csinos@uga.edu
Stan Diffie[2]	Coordinator Plant	229-386-3818	diffie@uga.edu
Ron Gitaitis[4]	Pathologist Research	229-386-3157	dronion@uga.edu
Unessee Hargett[3]	Coordinator Research	229-386-3370	uharg@uga.edu
Lara Lee Hickman[4]	Professional Senior Ag	229-386-3370	lhickman@uga.edu
Stevan S. LaHue[3]	Specialist Extension	229-388-6492	slahue@uga.edu
J. Michael Moore[1]	Agronomist	229-386-3006	jmmoore@uga.edu
Kodi Richardson[4]	Farm Supervisor	229-392-4719	ekricharesom45@gmail.com
Rajagopalbabu Srinivasan[2]	Entomologist (Vector Biology)	229-386-3199	babusri@uga.edu
Anna K. Watson[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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Table of Contents

Foreword

On the wall in my office is a shadowbox display of tobacco. Visitors often ask about it, and I can share my appreciation of the unique plant and its place in Southern agriculture. As a child growing up in southern Maryland, I topped tobacco in the fields and worked in the stripping house. I continued to study aspects of tobacco production throughout my academic career.

My position as dean of the University of Georgia College of Agricultural and Environmental Sciences has allowed me to learn about a different way of production and curing, but my fascination with tobacco has only increased. I am pleased that our college continues to support the tobacco industry through identifying and treating old and new diseases, developing new soil amendments to test, and creating new ways of controlling growth.

This report is a summary of the help our college provides and includes a collection of results and interpretations from studies conducted by several of our research scientists at the University of Georgia. We hope you find this information useful and invite you to visit our research farms and see this research first-hand.

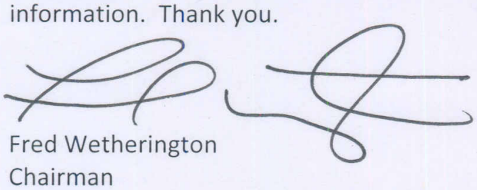
J. Scott Angle
Dean and Director
College of Agricultural and Environmental Sciences
University of Georgia

INTRODUCTION

Production agriculture is under constant change and this is certainly true for tobacco. Georgia has about 12,000 acres of tobacco and about 150-160 growers. Each year brings new production problems to add to the perennial problems associated with row crop agriculture in the South. As with most business operations flexibility and the ability to change is critical to survival. Most businesses, including agricultural based operations, will not survive if they are unable to keep up with changes in the ever changing world. Tobacco, although an old world crop, is constantly facing changes in marketing, weather, and pests.

Research and Extension services conducted at the Coastal Plain Experiment Station provide the information, technology, and stream of new products that enable growers to produce a successful crop of tobacco. Without that information being developed under Georgia conditions using tobacco cultivars suited for the Georgia climate tobacco production would be much more difficult and probably less profitable.

The Tobacco Research Report is an example of research that is conducted in the College of Agriculture at the Coastal Plain Experiment Station that benefits the tobacco growers of Georgia directly. Many of the problems like TSWV, Black Shank, nematodes, weeds, and insects are unique problems for Georgia growers and must be addressed in Georgia to be effective. We as growers applaud the efforts of the scientists and the College of Agriculture in providing us with current, science based production information. Thank you.



Fred Wetherington
Chairman
Georgia Agricultural Commodity Commission for Tobacco
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Evaluation of Efficacy and Application Methods of QGU42 for Management of Black Shank on Tobacco

P. Ji, A.S. Csinos, L.L. Hickman, U. Hargett

Abstract

Black shank caused by *Phytophthora nicotianae* is responsible for serious yield and quality reduction in tobacco production. Application of effective fungicides continues to be a significant component in developing integrated disease management programs. Studies were conducted in 2010-2013 to determine the efficacy and application methods of a new fungicide, QGU42, for management of black shank under field conditions. QGU42 was applied using different methods, and application rates ranging from 2.4-38.6 fl oz/acre were evaluated. In the experiment conducted in 2010, application of QGU42 (2.4 fl oz/acre) prior to transplanting in conjunction with applying QGU42 at 19.2 fl oz/acre in transplant water and 2.4 fl oz/acre at 1st cultivation and layby was the most effective in disease reduction. In 2011, the two most effective treatments were: 1) application of QGU42 through transplant water (4.8 fl oz/acre) and at 1st cultivation and layby (38.6 fl oz/acre); 2) application of QGU42 (4.8 fl oz/acre) prior to transplanting in conjunction with applying QGU42 at 19.2 fl oz/acre at 1st cultivation and layby. In 2012, QGU42 applied prior to transplanting (4.8 fl oz/acre) and at 1st cultivation and layby (9.6 fl oz/acre) was among the most effective treatments. In 2013, application of QGU42 through transplant water at 38.6 fl oz/acre, or QGU42 applied through transplant water at 19.2 fl oz/acre and at planting and layby, reduced disease significantly compared with the non-treated control. These treatments also increased tobacco yield significantly compared to the non-treated control. Across the experiments conducted in the four years, QGU42 was effective in reducing black shank at a rate as low as 2.4 fl oz/acre and appeared to be more effective than mefenoxam in managing this important disease.

Introduction

Black shank, caused by the soil-borne pathogen *Phytophthora nicotianae* (syn. *Phytophthora parasitica* var. *nicotianae*), is a devastating disease on tobacco in Georgia and many other tobacco-producing areas worldwide (2, 4). The pathogen infects roots, stems and leaves at all growing stages of the tobacco plant, resulting in significant yield and quality reduction (3, 5). The disease is favored by wet and humid weather conditions that are common in the southeastern U.S.

Black shank is among the most difficult diseases to control. Crop rotation is of limited value due to long-term survival of the pathogen in the soil and is not commonly adopted by growers. There are some tobacco cultivars resistant to race 0 of the pathogen; however, the gradual shift of pathogen populations from race 0 to race 1 (1, 2) makes the cultivars resistant to race 0 ineffective in disease control. Application of fungicides continues to be an effective approach in managing black shank. Products containing metalaxyl or mefenoxam have been the most widely used fungicides for control of *P. nicotianae*. However, field isolates of *P. nicotianae* were variable in sensitivity to metalaxyl and typical field rates may not be sufficient to control isolates with low levels of sensitivity (2). Identifying new active ingredients to be used as alternative or complementary approaches is highly desirable for increasing disease control efficacy and reducing selection pressure for fungicide resistance development. The objective of this study was to evaluate the efficacy and application methods of a new fungicide, QGU42, for managing black shank on tobacco.

Materials and Methods

The experiments were conducted at the University of Georgia Coastal Plain Experiment Station (Black Shank Farm) located in Tifton, Ga., in 2010-2013. The experimental field had a continuous history of black shank on tobacco in previous years. The field was prepared by disc harrowing and tilling with a stine tiller. Before transplanting tobacco, 4-8-12 N-P-K was broadcast applied at 500 lb/acre and tilled in. Plots were sub-soiled and bedded after fertilizer application.

QGU42 was applied at different rates, and different application methods were also evaluated (Tables 1-4). Prior to transplanting in the field, tobacco seedlings (cv. K326) were sprayed in the greenhouse with QGU42 at 2.4 or 4.8 fl oz/acre (2.4 or 4.8 fl oz/3500 plants) using a handheld CO_2-powered sprayer (Tables 1-3).

Tobacco seedlings were transplanted in the field on April 19, 2010, April 11, 2011, March 30, 2012, and April 10, 2013. Plants were transplanted on 48-inch-wide rows with 18-inch plant spacing. A randomized complete block design was employed with six replicates. Each plot was 32 feet long with 10-foot alleys between plots. Each plot was planted with 23 plants. To apply QGU42 through transplant water, the product was applied using a CO_2-powered sprayer delivering the chemical directly into the transplant water and plant furrow. Additional applications of QGU42 included band application seven days after transplanting and foliar sprays at 1st cultivation and layby. Layby and 1st cultivation treatments were applied with a three-boom sprayer at 20 psi, 22 gal/A and sprayed in a 12-inch directed band over-the-top. Pesticides were applied for insect and nematode control before and after transplanting and calcium nitrate (15.5-0-0) was applied to the field plots after transplanting. Tobacco was topped and suckered on June 20, 2010, June 16, 2011, June 16, 2012, and June 10, 2013, respectively.

Stand counts were conducted every two weeks after transplanting. Plants showing symptoms of black shank disease were counted and disease incidence was quantified as percentage of diseased plants. Plant height was measured from the soil level to the tip of the longest leaf. Vigor ratings were taken based on a scale of 0-10, where 10 represents healthy plants and 0 represents dead plants. Three harvests of tobacco were made when the plants were mature, and the plants were harvested taking 1/3 of the foliage per harvest. Yield was calculated by multiplying green weight by 0.15 to obtain dry weight yield. Data were analyzed using GLM procedures of the Statistical Analysis System (SAS) and treatment means were separated by Fisher's protected least significant difference (LSD) test.

Results and Discussion

In 2010, black shank disease incidence in the non-treated control plots reached 88.4%. All the treatments reduced disease significantly compared with the non-treated control (Table 1). Application of QGU42 (2.4 fl oz/acre) prior to transplanting in conjunction with applying QGU42 at 19.2 fl oz/acre in transplant water and 2.4 fl oz/acre at 1st cultivation and layby was the most effective in disease reduction, which was significantly more effective than applications of Ridomil Gold (Table 1). All the treatments increased dry weight yield and vigor of tobacco significantly compared to the non-treated control.

In 2011, black shank disease incidence in the non-treated control plots reached 53.0%. All the treatments reduced disease significantly compared with the non-treated control (Table 2). Two treatments appeared to be the most effective: 1) application of QGU42 through transplant water (4.8 fl oz/acre) and at 1st cultivation and layby (38.6 fl oz/acre; 2) application of QGU42 (4.8 fl oz/acre) prior to transplanting in conjunction with applying QGU42 at 19.2 fl oz/acre at 1st cultivation and layby. The two treatments were more effective than Ridomil Gold in disease reduction and increased tobacco yield significantly compared with the non-treated control (Table 2).

In 2012, disease incidence in the non-treated control plots was very high (97.3%). All the treatments reduced disease significantly, compared to the non-treated control, except QGU42 applied at 9.6 fl oz/acre through transplant water (Table 3). Ridomil Gold applied through transplant water and at 1st cultivation and layby,

QGU42 applied prior to transplanting (4.8 fl oz/acre) and at 1st cultivation and layby (9.6 fl oz/acre), as well as combined use of QGU42 and Ridomil Gold were the three most effective treatments. These treatments also increased tobacco yield significantly compared to the non-treated control.

In 2013, application of QGU42 through transplant water at 38.6 fl oz/acre, or QGU42 applied through transplant water at 19.2 fl oz/acre and at planting and layby, reduced disease significantly compared with the non-treated control (Table 4). Ridomil Gold applied through transplant water and at 1st cultivation and layby also reduced disease significantly compared to the non-treated control. In all four experiments conducted in 2010-2013, none of the treatments involving QGU42 reduced tobacco plant height or vigor compared to the non-treated control, and no phytotoxcicity was observed, indicating the product was safe for tobacco.

Literature Cited:

1. Csinos, A.S. 2005. Relationship of isolate origin to pathogenicity of race 0 and 1 of *Phytophthora parasitica* var. *nicotianae* on tobacco cultivars. *Plant Dis.* 89:332-337.

2. Csinos, A.S., and Bertrand, P.F. 1994. Distribution of *Phytophthora parasitica* var. *nicotianae* races and their sensitivity to metalaxyl in Georgia. *Plant Dis.* 78:471-474.

3. Csinos, A.S., and Minton, N.A. 1983. Control of tobacco black shank with combinations of systemic fungicides and nematicides or fumigants. *Plant Dis.* 67:204-207.

4. Lucas, G.B. 1975. *Diseases of Tobacco.* 3rd ed. Biological Consulting Associates, Raleigh, NC.

5. Shew, H.D., and Lucas, G.B. 1991. *Compendium of Tobacco Diseases.* The American Phytopathological Society, St. Paul, MN.

Table 1. Efficacy of QGU42 for control of black shank of tobacco (2010)

Treatment	Rate (fl oz/A)	Application schedule	Plant height (cm) [1,2]	Vigor rating [1,3]	Dry weight yield (lb/A) [1,4]	Disease incidence (%) [1,5]
1. QGU42(OD) Transplant Water 1st Cultivation Layby	2.4 19.2 2.4 2.4	Tray Drench Transplant Water 1st Cultivation Layby	36.0 bcd	9.2 a	1495.6 a	43.0 c
2. QGU42(OD) Transplant Water 1st Cultivation Layby	2.4 9.6 2.4 2.4	Tray Drench Transplant Water 1st Cultivation Layby	32.0 de	9.1 ab	1421.9 a	57.9 bc
3. QGU42(OD) Transplant Water 1st Cultivation Layby	2.4 4.8 2.4 2.4	Tray Drench Transplant Water 1st Cultivation Layby	35.9 bcd	9.0 abc	1233.7 a	56.8 bc
4. QGU42(OD) Transplant Water 1st Cultivation Layby	2.4 2.4 2.4 2.4	Tray Drench Transplant Water 1st Cultivation Layby	39.5 ab	8.9 abc	1044.9 a	60.6 bc
5. QGU42(OD) 1st Cultivation Layby	38.6 2.4 2.4	Band app. 7 days PP 1st Cultivation Layby	37.8 abc	8.7 bc	1127.0 a	63.0 b
6. QGU42(OD) 1st Cultivation Layby	19.2 2.4 2.4	Band app.7 days PP 1st Cultivation Layby	40.2 a	9.0 abc	1078.4 a	57.3 bc
7. QGU42(OD) 1st Cultivation Layby	9.6 2.4 2.4	Band app.7 days PP 1st Cultivation Layby	33.3 de	8.8 abc	1032.1 a	55.6 bc
8. QGU42(OD) 1st Cultivation Layby	4.8 2.4 2.4	Band app.7 days PP 1st Cultivation Layby	31.1 e	8.6 cd	1211.0 a	55.4 bc
9. Ridomil Gold 4 SL 1st Cultivation Layby	16 16 16	Band app.7 days PP 1st Cultivation Layby	36.0 bcd	8.3 d	1285.0 a	62.6 b
10. Non-treated control	---	---	34.5 cde	6.8 e	259.6 b	88.4 a

[1] Data are means of six replications. Means in a column followed by the same letters are not significantly different ($P = 0.05$) according to Fisher's LSD test.
[2] Plant heights were measured on 23 April, 12 May and 10 June.
[3] Vigor ratings were conducted on 13 May and 10 June.
[4] Yield was calculated by multiplying dry weight conversion per plot by 7260 divided by the base stand count.
[5] Final disease incidences (% diseased plants).

Table 2. Efficacy of QGU42 for control of black shank of tobacco (2011)

Treatment	Rate (fl oz/A)	Application schedule	Plant height (cm) [1,2]	Vigor rating [1,3]	Dry weight yield (lb/A)[1,4]	Disease incidence (%)[1,5]
1. QGU42(OD)	4.8 38.6 38.6	Tray Drench 1st Cultivation Layby	43.4 a	8.7 a	2952.6 ab	9.5 bc
2. QGU42(OD)	4.8 19.2 19.2	Tray Drench 1st Cultivation Layby	42.0 a	9.5 a	2923.9 abc	8.3 c
3. QGU42(OD)	4.8 9.6 9.6	Tray Drench 1st Cultivation Layby	43.0 a	9.5 a	2202.9 bcd	20.8 bc
4. QGU42(OD)	4.8 4.8 4.8	Tray Drench 1st Cultivation Layby	42.8 a	9.0 a	2530.7 bc	11.9 bc
5. QGU42(OD)	38.6 19.2 19.2	Band app. 7 days PP 1st Cultivation Layby	43.5 a	9.0 a	2723.4 abc	18.2 bc
6. QGU42(OD)	38.6 9.6 9.6	Band app.7 days PP 1st Cultivation Layby	41.1 a	9.0 a	2144.2 cd	28.2 b
7. QGU42(OD)	38.6 4.8 4.8	Band app.7 days PP 1st Cultivation Layby	42.3 a	9.0 a	2813.9 abc	15.7 bc
8. QGU42(OD)	4.8 38.6 38.6	Transplant Water 1st Cultivation Layby	44.3 a	9.0 a	3447.5 a	2.2 c
9. Ridomil Gold 4 SL	16 16 16	Band app.7 days PP 1st Cultivation Layby	41.1 a	9.0 a	2336.6 bcd	28.0 b
10.Non-treated control	---	---	41.7 a	9.0 a	1553.3 d	53.0 a

[1] Data are means of six replications. Means in a column followed by the same letters are not significantly different ($P = 0.05$) according to Fisher's LSD test.
[2] Plant heights were measured on 23 May.
[3] Vigor ratings were conducted on 03 and 31 May.
[4] Yield was calculated by multiplying dry weight conversion per plot by 7260 divided by the base stand count.
[5] Final disease incidences (% diseased plants).

Table 3. Efficacy of QGU42 for control of black shank of tobacco (2012)

Treatment	Rate (fl oz/A)	Application schedule	Plant height (cm) [1,2]	Vigor rating [1,3]	Dry weight yield (lb/A)[1,4]	Disease incidence (%) [1,5]
1. QGU42(OD)	4.8 9.6 9.6	Tray Drench 1st Cultivation Layby	59.9 ab	9.5 a	2362.7 abc	37.0 bc
2. QGU42(OD)	38.6	Transplant water	54.1 abc	9.2 abc	1776.8 cd	57.7 b
3. QGU42(OD)	19.2	Transplant water	59.1 ab	9.6 a	1698.0 d	60.8 b
4. QGU42(OD)	9.6	Transplant water	54.3 abc	8.6 bcd	1049.9 c	87.6 a
5. QGU42(OD)	19.2 9.6 9.6	Transplant water 1st Cultivation Layby	60.0 a	9.4 ab	2145.8 a-d	38.9 bc
6. QGU42(OD)	9.6 9.6 9.6	Transplant water 1st Cultivation Layby	53.5 bc	8.2 d	1960.1 bcd	52.8 b
7. GGU42(OD) Ridomil Gold 4 SL	9.6 16 16	Transplant water 1st Cultivation Layby	51.6 c	8.4 cd	2737.2 a	22.3 c
8. Ridomil Gold 4 SL	8 16 16	Transplant water 1st Cultivation Layby	55.0 abc	9.2 abc	2591.7 ab	18.9 c
9. Non-treated control	---	---	58.4 ab	8.9 a-d	504.1 c	97.3 a

[1] Data are means of six replications. Means in a column followed by the same letters are not significantly different ($P = 0.05$) according to Fisher's LSD test.
[2] Plant heights were measured on 10 May.
[3] Vigor ratings were conducted on 13 April, and 03 and 22 May.
[4] Yield was calculated by multiplying dry weight conversion per plot by 7260 divided by the base stand count.
[5] Final disease incidences (% diseased plants).

Table 4. Efficacy of QGU42 for control of black shank of tobacco (2013)

Treatment	Rate (fl oz/A)	Application schedule	Plant height (cm) [1,2]	Vigor rating [1,3]	Dry weight yield (lab/A) [1,4]	Disease incidence (%) [1,5]
1. QGU42(OD)	38.6	Transplant water	66.0 a	9.9 a	1593.5 ab	47.4 b
2. QGU42(OD) 	19.2 9.6 9.6	Transplant water At planting Layby	69.9 a	9.9 a	1559.7 ab	46.2 b
3. Ridomil Gold 4 SL 	8 16 16	Transplant water 1st Cultivation Layby	67.3 a	9.8 a	1881.4 a	50.2 b
4. Non-treated control	---	---	64.5 a	9.8 a	1170.9 b	79.5 a

[1] Data are means of six replications. Means in a column followed by the same letters are not significantly different ($P = 0.05$) according to Fisher's LSD test.
[2] Plant heights were measured on 10 May.
[3.] Vigor ratings were conducted on 13 April, and 03 and 22 May.
[4] Yield was calculated by multiplying dry weight conversion per plot by 7260 divided by the base stand count.
[5] Final disease incidences (% diseased plants).

Flue Cured Tobacco Variety Fertilizer Evaluation

S.S. LaHue, A.S. Csinos, 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 Georgia variety NC 71 in university variety trials. Generally, CC 35 tends to mature later than the standard varieties grown in the state. 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. Therefore, a test was devised to see if reducing the nitrogen applied could mature the crop earlier and maintain leaf quality as compared to the standard variety of NC 71.

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 70 plants each. The test benefitted from the application of Telone II, applied at the recommended rate, in October 2012 with good soil conditions, which kept nematode pressure to a minimum. Nematode pressure was not desired as a variable in this test. All transplants were treated in the greenhouse with imidacloprid (0.8 oz Admire Pro/1000 plants) and transplanted on April 8. In addition, two field sprays (April 13, May 6) of Actigard were applied at 0.5 oz/A for Tomato spotted wilt virus (TSWV). TSWV counts indicated an infection rate below 4% in the test. Generally, the crop was free of disease with a good plant stand. The test involved four replications randomized with two fertilizer treatments and two varieties for a total of four treatments as follows:

1. Transplanted c.v. NC 71 with fertilization consisting of 6 lb/A of 9-45-15 in the transplant water, 500 lbs/acre of 6-6-18 at first cultivation, and 600 lbs/acre of 6-6-18 at second cultivation for a total of 66 lbs/acre of nitrogen. No fertilizer was applied at lay-by.

2. Transplanted c.v. NC 71 while fertilization consisted of 6 lb/A of 9-45-15 in the transplant water, 500 lbs/acre of 6-6-18 at first cultivation, 600 lbs/acre of 6-6-18 at second cultivation, and an additional 120 lbs/acre of 15.5-0-0 at lay-by for a total of 85 lbs/acre of nitrogen.

3. Transplanted c.v. CC 35 with fertilization consisting of 6 lb/A of 9-45-15 in the transplant water, 500 lbs/acre of 6-6-18 at first cultivation, and 600 lbs/acre of 6-6-18 at second cultivation for a total of 66 lbs/acre of nitrogen. No fertilizer was applied at lay-by.

4. Transplanted c.v. CC 35 with fertilization consisting of 6 lb/A of 9-45-15 in the transplant water, 500 lbs/acre of 6-6-18 at first cultivation, 600 lbs/acre of 6-6-18 at second

cultivation, and an additional 120 lbs/acre of 15.5-0-0 at lay-by for a total of 85 lbs/acre of nitrogen.

Results and Discussion

The 2013 growing season was notable for its early season cool temperatures, excessive summer rain and cloudy conditions. Frequent rains delivered approximately 56 inches of water, which fell during the first eight months of 2013. The heavy rain suppressed yields and matured the crop early. The mature crop provided excellent cured leaf quality for all treatments. As expected, the lower nitrogen rates reduced yields (Table 1) for both varieties, yet CC 35 with 85 lb/A N still yielded 3326 lb/A (though not significantly better than NC 71 at the same rate). Value followed the same trend with CC35 (85 lb/A N) bringing in 452 $/A more than NC 71 (85 lb/A N). Leaf quality, as measured by price and grade index, was also better for CC 35. As a result, reducing nitrogen rates for CC 35 significantly reduced yield and value but did not significantly reduce leaf quality. Unfortunately, persistent weather conditions may have been the largest variable in the test.

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Table 1. 2013 Variety Fertilizer Test, Effects of Nitrogen Rates on Two Varieties in Relation to Yield, Value, Price Index, and Grade Index of Flue-Cured Tobacco.

Treatment	Yield	Value	Price Index[1]	Grade Index[2]
	lb/A	$/A	$/CWT	
NC 71 66lb/A N	3029	5050	167	82
NC 71 85lb/A N	3185	5525	174	85
CC 35 66lb/A N	2863	5143	179	87
CC 35 85lb/A N	3326	5977	180	86
LSD – 0.05	250.3	533.1	11.4	4.5

[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 - higher the number, higher the grade.

Flue Cured Tobacco Variety Evaluation In Georgia

S.S. LaHue, W.H. Gay, 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, curing, ease of handling and market acceptability. For a variety to be recommended it must be superlative in one or more and contain a balance of the remainder of the factors. For instance, for a variety to have an excellent yield and poor disease resistance or to yield well and have poor cured quality is 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 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 released from this test, UGA Extension agents will have an additional data set to use in making recommendations to growers.

Materials and Methods

The 2013 Official Variety Test and Regional Small Plot Test consisted of 30 and 27 entries, respectively, while the 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/1000 plants) and followed with two field sprays (April 13, May 6) of Actigard applied at 0.5 oz/A for Tomato spotted wilt virus (TSWV). The Official Variety Test was mechanically transplanted on April 10. The Regional Farm and Regional Small Plot Tests followed on April 11. All tests were transplanted with 22-24 plants per field plot and replicated three times. Fertilization consisted of 6 lb/A of 9-45-15 in the transplant water, 500 lbs/acre of 6-6-18 at first cultivation, 600 lbs/acre 6-6-18 at second cultivation, and an additional 120 lbs/acre of 15.5-0-0 at lay-by for a total of 85 lbs/acre of nitrogen.

Cultural practices, harvesting and curing procedures were uniformly applied and followed 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 2013 Official Variety Test and Regional Farm Test produced average yields and quality. All tests benefitted from the application of Telone II, applied at the recommended rate, in October 2012 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 3.1% TSWV-symptomatic plants. Unfortunately, cool early season temperatures and excessive rain throughout the growing season (>56") hampered root development and leached soil nutrients. As a result, the crop matured early and leaf chemistry was negatively affected.

In the Official Variety Test, yield ranged from 2351 lbs/A for NC 2326 to 3403 lbs/A for NC 939. Value of released varieties ranged from 3994 dollars/A for NC 2326 to 5842 dollars/A for NC 939. Both price and grade index data were based on 2012 data due to market fluctuations that would have artificially raised prices for 2013. Price and grade data were very good for all varieties due to the excessive rain providing a very mature crop. As a result, prices ranged from $152/cwt for NC 92 at the low end to $182/cwt for GF 157, which had the best price per cwt for the released varieties. Grade index ranged from 76 for NC 92 to 88 for GF 318. Plant heights averaged in the low to mid-40 inches while leaf numbers per plant were close to 20. Rain and clouds accelerated flowering dates six or more days sooner than normal, with NC 2326 at 62 days. Leaf chemistry was significantly impacted from the wet season with alkaloids consistently below 2% and the percent of sugars averaging in the upper teens. The Official Variety Test data are displayed in Table 1. Two- and three-year averages for selected varieties are found in Table 2.

The 2013 Regional Farm Test yielded and graded similarly to the other tests. In the Farm Test (Table 3), NC EX 61 had the lowest yield at 2325 lb/A. GL EX 398 yielded the highest at 3456 lbs/A. Value followed the same trend with 3939 dollars/A for NC EX 61 to 6127 dollars/A for GL EX 398. NC EX 59 graded the best, bringing in $178/cwt and having a grade index of 88. The lowest, NC 95, had a grade index of 80 with a price of $160/cwt. Generally, leaf chemistry was similar to the Official Variety Test, with sugars in the upper teens and alkaloids below 2%.

Acknowledgments

The authors would like to thank the Georgia Agricultural Commodity Commission for Tobacco for financial support. Also, thanks to Bryan Digby, Barry Luke, Adam Mitchell, Justin Odom, Eli Crosby and Ramsey Willis for technical assistance.

Table 1. Yield, Value, Price Index, Grade Index, and Agronomic Characteristics of Released Varieties Evaluated in the 2013 Official 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 (number)	Plant Ht. in	Days to Flower	Total Alkaloids %	Reducing Sugars %	Ratio RS/TA
NC2326	2352	3994	170	86	17	41.9	62	1.92	17.0	8.82
NC 95	2661	4369	164	83	18	45.0	70	1.93	17.3	8.99
K 326	2912	4862	167	84	20	42.0	66	1.82	17.9	9.83
K 346	3047	5171	169	81	20	44.9	65	1.89	17.7	9.33
NC 71	2965	4949	167	84	20	41.6	68	1.60	18.3	11.42
NC 72	2962	5223	175	86	20	45.3	73	1.77	17.6	9.98
NC 92	3213	4882	152	76	20	44.4	69	1.97	16.8	8.51
NC 196	2793	4649	166	83	21	46.0	70	1.60	17.9	11.14
NC 297	2925	4890	166	83	22	45.3	68	1.78	18.8	10.58
NC 925	2806	4545	162	81	18	39.8	66	1.77	16.4	9.26
NC 938	2848	4512	161	80	18	40.7	64	1.55	16.4	10.56
NC 939	3403	5842	172	85	20	43.5	69	1.58	17.9	11.33
CC 13	2864	4873	171	83	20	45.4	65	1.46	18.3	12.53
CC 27	3020	5139	170	82	20	44.5	73	1.56	16.3	10.48
CC 33	2848	4692	164	79	21	44.9	68	1.37	18.4	13.37
CC 35	2798	4524	162	79	20	47.7	80	1.52	16.5	10.88
CC 37	3173	5195	164	81	19	43.0	69	1.65	15.3	9.30
CC 67	2957	5232	178	88	20	44.3	65	1.68	16.6	9.86
CC 700	3239	5428	167	83	20	43.3	65	1.67	16.6	9.94
CC 1063	2677	4507	169	83	19	42.4	67	1.89	17.5	9.24
PVH 1452	3115	5456	175	86	20	43.1	67	1.80	15.1	8.41
PVH 2110	3107	5172	167	84	22	49.7	72	1.55	19.1	12.33
PVH 2254	3073	5377	173	83	20	46.1	69	1.56	17.1	11.01
PVH 2275	2822	5082	180	88	20	42.7	69	1.71	16.5	9.64
SP 168	3113	5207	167	83	18	39.2	74	1.87	18.3	9.77
GL 338	3107	5432	175	87	19	44.1	66	1.66	17.5	10.56
GL 362	3036	5309	176	86	20	41.5	66	1.89	15.8	8.34
GL 395	2904	4658	164	81	20	45.2	68	1.78	16.2	9.12
GF 157	2753	5008	182	87	20	46.5	67	1.73	16.2	9.37
GF 318	3263	5804	177	88	20	46.6	66	1.68	18.4	10.95
LSD - 0.05	592.1	1065.3	16.95	8.48						

[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 - higher the number, higher the grade.

Table 2. Comparison of Certain Characteristics for Released Varieties Evaluated in the 2013 Official 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 (number)	Plant Ht. in	Days to Flower	Total Alkaloids %	Reducing Sugars %	Ratio RS/TA
3 Year Average 2011, 2012 and 2013										
NC2326	2293	2971	129	65	17	37.0	64	2.46	16.2	6.79
NC 95	2777	4089	148	74	18	41.5	73	2.76	15.7	6.18
K 326	3001	4898	163	81	19	38.2	73	2.08	16.8	8.24
K 346	2845	3881	137	69	19	39.9	73	2.24	16.9	7.74
NC 71	2953	4431	148	77	19	38.4	75	2.06	17.5	8.84
NC 72	3020	4270	142	73	19	39.8	76	2.10	16.9	8.46
NC 92	3201	3752	118	61	20	41.7	75	2.53	16.9	7.05
NC 196	2977	4330	149	75	20	40.8	77	2.14	18.0	8.92
NC 297	2999	4214	141	72	20	38.9	74	2.40	17.4	7.80
CC 27	2970	4202	142	71	19	40.0	74	2.07	15.4	8.11
CC 37	3135	4262	137	69	19	40.3	76	1.93	17.2	8.94
CC 67	2839	4296	150	76	19	40.4	71	2.04	16.6	8.46
CC 700	3193	4926	154	78	19	40.0	71	2.26	16.4	7.92
PVH 1452	3092	4659	152	77	20	39.9	73	2.26	16.5	7.42
SP 168	3144	4615	147	75	19	38.2	76	2.07	17.3	8.47
GL 338	3005	4549	153	74	19	39.6	70	2.24	17.2	8.03
GL 395	2884	4276	150	77	20	40.5	73	2.07	15.8	7.80
GF 318	3290	4996	152	71	20	41.1	72	2.02	18.6	9.39
2 Year Average 2012-2013										
NC2326	2363	3332	141	70	17	38.4	65	2.40	17.4	7.50
NC 95	2804	3926	142	70	19	43.1	73	2.81	16.6	6.64
K 326	2965	4662	157	77	20	39.8	72	1.96	18.4	9.42
K 346	2711	4238	154	76	20	42.5	70	2.05	18.0	8.83
NC 71	2758	4453	156	80	19	40.0	73	1.87	18.6	10.15
NC 72	2917	4625	157	78	18	42.3	75	1.82	18.4	10.08
NC 92	3019	4050	133	67	19	42.0	73	2.19	18.2	8.30
NC 196	2646	4293	163	80	20	42.1	75	1.82	18.8	10.41
NC 297	2839	4275	149	74	20	41.3	72	2.02	18.0	9.11
NC 925	2799	4290	153	77	18	40.1	70	2.10	17.5	8.44
CC 27	2824	4357	153	75	19	41.9	76	1.70	16.6	9.85
CC 33	2787	4611	165	80	20	42.1	73	1.83	18.2	10.62
CC 35	2881	4559	158	77	20	44.0	81	1.84	17.4	9.70
CC 37	2913	4394	149	73	19	40.6	74	1.82	17.1	9.38
CC 67	2789	4752	170	84	20	42.1	69	2.10	15.6	7.83
CC 700	3112	5185	165	82	19	41.3	71	1.81	17.2	9.52
CC 1063	2638	4342	164	81	19	40.2	72	2.15	17.8	8.39
PVH 1452	2901	4888	168	83	20	41.4	72	2.05	16.4	8.06
PVH 2110	2917	5012	172	85	21	44.9	77	1.75	17.9	10.44

Table 2. Comparison of Certain Characteristics for Released Varieties Evaluated in the 2013 Official Flue-Cured Tobacco Variety Test at the University of Georgia, Tifton, Ga. *(continued)*.

Variety	Yield lb/A	Value $/A	Price Index[1] $/CWT	Grade Index[2]	Leaves/ Plant (number)	Plant Ht. in	Days to Flower	Total Alkaloids %	Reducing Sugars %	Ratio RS/TA
2 Year Average 2012-2013										
PVH 2254	2882	5025	173	84	20	42.7	74	1.76	19.4	11.04
PVH 2275	2706	4597	169	83	19	40.7	72	2.01	16.7	8.47
SP 168	2968	4710	159	79	18	39.0	77	2.12	17.7	8.47
GL 338	2954	4108	142	68	18	37.3	72	2.54	17.1	6.76
GL 395	2675	4257	161	80	20	41.8	71	1.91	16.2	8.55
GF 157	2559	4265	165	80	25	42.5	71	1.99	15.7	8.05
GF 318	3119	5090	162	81	20	43.2	70	1.88	18.6	10.02

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

Table 3. Yield, Value, Price Index, Grade Index and Agronomic Characteristics of Varieties Evaluated in the 2013 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 (number)	Plant Ht. in	Days to Flower	Total Alkaloids %	Reducing Sugars %	Ratio RS/TA
NC 2326	2658	4430	167.4	82	18	45.2	62	1.92	17.0	8.8
NC 95	2718	4327	159.6	80	20	47.7	70	1.93	17.3	9.0
K 326	2819	4623	163.3	81	20	42.5	71	1.82	17.9	9.8
CU 171	2735	4464	164.1	83	19	44.7	70	1.56	18.3	11.7
AOV 212	3241	5610	172.9	86	21	47.3	76	1.79	16.1	9.0
CU 186	2731	4641	169.2	84	21	45.1	76	1.59	18.4	11.6
CU 159	3039	5132	169.1	84	21	46.8	72	1.74	17.4	10.0
NC EX 61	2325	3939	170.1	85	20	41.7	74	1.85	15.1	8.2
GL EX 398	3456	6127	177.1	87	22	49.1	75	1.71	19.0	11.1
PXH 1	2879	4834	167.4	84	23	46.1	75	1.70	17.2	10.1
NC EX 60	3106	5090	163.9	83	23	47.2	73	1.77	15.3	8.6
GL EX 328	2994	5266	176.4	87	22	44.3	70	1.66	19.7	11.8
NC EX 59	2974	5305	178.4	88	19	39.3	66	1.57	18.2	11.6
PXH 7	3008	5100	169.7	84	20	45.1	75	1.89	13.9	7.4
NC EX 58	3081	5492	177.6	88	20	45.9	72	1.61	17.1	10.6
PXH 13	2821	4948	175.2	85	20	42.3	68	1.63	17.8	10.9
LSD -0.05	343.7	694.5	9.77	4.45						

[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 - higher the number, higher the grade.

Regional Chemical Sucker Control Test

S.S. LaHue, W.H. Gay, 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 year's 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 three 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, harvesting and curing procedures were uniformly applied and followed current University of Georgia recommendations. Fertilization consisted of 6 lb/A of 9-45-15 in the transplant water, 500 lbs/acre of 6-6-18 at first cultivation, 600 lbs/acre of 6-6-18 at second cultivation, and an additional 120 lbs/acre of 15.5-0-0 at lay-by for a total of 85 lbs/acre of nitrogen. 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 ground through a 2 mm screen. The test involved four replications randomized with 15 sucker control treatments as follows:

1. TNS - Topped Not Suckered.

2. RTM / RTM / RTM / (RMH 30 Xtra + Flupro) - Three treatments of the contact RoyalTac–M (RTM) (Chemtura) at 4% solution followed in five days with two

applications of a 5% solution five days apart. Five to seven days later, a tank mix of Royal MH 30 Xtra (2.25 lb ai/gal) (Chemtura) potassium maleic hydrazide at the labeled rate of 1.0 gal/A and Flupro (Chemtura) at 0.5 gal/A, the final treatment being applied prior to the first harvest. All applications for all treatments utilized a standard three-nozzle configuration (TG3-TG5-TG3) applying 52 gal/A at 20 psi.

3. RTM / RTM / RTM / Flupro / RMH 30 Xtra - Three treatments of contact as in treatment 2 followed with Flupro at 0.5 gal /A prior to the first harvest. RMH 30 Xtra at 0.66 gal/A was applied after the first harvest.

4. RTM / RTM / Flupro / (RMH 30 Xtra + Flupro) - Two treatments of contact (4% and 5%) were applied. The third treatment was Flupro (0.5 gal/A) applied five days later. Prior to first harvest, a tank mix of RMH 30 Xtra (0.66 gal/A) and Flupro (0.25 gal/A) was applied.

5. RTM / RTM / (RTM + Flupro) / (RTM+RMH 30 Xtra+ Flupro) - Two treatments of contact as in treatment 4 was followed in five days by a tank mix of RTM (5%) and Flupro (0.5 gal /A). Prior to the first harvest, a tank mix of RTM (5%), RMH 30 Xtra (0.66 gal/A) and Flupro (0.25 gal /A) was applied.

6. RTM / (RTM + Flupro) / RTM / (RTM + Flupro) – One treatment of contact (4%) was followed in five days by a tank mix of RTM (5%) and Flupro (0.5 gal /A). Five days later, a third treatment consisted of RTM (5%) only. The final treatment consisted of a tank mix of RTM (5%) and Flupro (0.25 gal/A) applied prior to first harvest.

7. RTM / RTM / (RTM+Flupro) / (RTM+Flupro) - Two treatments of contact (4% and 5%) followed in five days with a tank mix of RTM (5%) and Flupro (0.5 gal/A). The final application consisted of a tank mix of RTM (5%) and Flupro (0.25 gal/A) applied prior to the first harvest.

8. RTM / (RTM+Flupro) / RTM / (RTM+Flupro) – One treatment of contact (4%) was followed in five days with a tank mix of RTM (5%) and Flupro (0.25 gal/A). The third application was RTM (5%). The final application consisted of a tank mix of RTM (5%) and Flupro (0. 5 gal/A) applied prior to the first harvest.

9. RTM / RTM / (RTM+Flupro) / (RTM+Flupro) - Two treatments of contact (4% and 5%) was followed in five days with a tank mix of RTM (5%) and Flupro (0.25 gal/A). The final application consisted of a tank mix of RTM (5%) and Flupro (0.5 gal/A) applied prior to the first harvest.

10. RTM / RTM / RTM / Flupro / Flupro - Three treatments of contact as in treatment 2 followed with Flupro at 0.5gal/A prior to the first harvest and Flupro at 0.25 gal/A after the first harvest.

11. RTM / RTM / RTM / (RTM +Flupro) / (RTM + Flupro) - Three treatments of contact as in previous treatments followed in five days with a tank mix of RTM (5%) and

Flupro at 0.5 gal/A prior to the first harvest. The final treatment consisted of a tank mix of RTM (5%) and Flupro (0.25 gal/A) applied after first harvest.

12. RTM / RTM / RTM / Flupro / RTM - Three treatments of contact as in previous treatments followed in five days with Flupro (0.5 gal/A) then RTM (5%) after first harvest.

13. RTM / RTM / RTM / Flupro / (RTM + Flupro) - Three treatments of contact was followed in five days with Flupro at 0.5 gal/A. The final treatment consisted of a tank mix of RTM (2%) and Flupro (0.25 gal/A) applied after first harvest.

14. RTM / RTM / RTM / Flupro / (X-77 + Flupro) - Three treatments of contact was followed in five days with Flupro at 0.5 gal/A. The final treatment consisted of a tank mix of X-77 (Loveland Products Inc.) at 0.25% and Flupro (0.25 gal/A) applied after first harvest.

15. RTM / RTM / RTM / (RTM +Flupro) / (RTM + Flupro) - Three treatments of contact was followed with a tank mix of RTM (2%) and Flupro (0.25 gal/A) prior to the first harvest. The final treatment consisted of a tank mix of RTM (2%) and Flupro (0.25 gal/A) applied after first harvest.

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/1000 plants) for TSWV suppression and transplanted on March 29. In addition, two field sprays (March 30 and May 6) of Actigard (0.5 oz/A) were applied for additional TSWV suppression. Cool conditions followed transplanting, suppressing initial growth. TSWV counts indicated an infection rate below 5% in the test. Generally, the crop was free of disease with an excellent plant stand.

The first contact was applied on June 4, the second on June 9, and a third set of contacts applied on June 15. The fourth application was applied on June 21. The final application for treatments 3 and 10 through 15 was applied on June 28. The final harvest was on August 6, with the test concluding after the suckers were pulled, counted and weighed off 10 plants from each plot on August 7.

The 2013 growing season was notable for its early season cool temperatures, excessive summer rain and cloudy conditions. Consistent rains delivered approximately 56 inches of water, which fell during the first eight months of 2013. The heavy rain suppressed yields and sucker growth. Cloudy conditions hampered the efficacy of contacts. Frequent rainy conditions delayed treatment applications. An additional 10 lbs/A of nitrogen was applied to all plots on July 3. However, an additional 11.6 inches of rain fell within the next 30 days after application. Overall, the test matured too quickly and sucker pressure was low.

For 2013, yield and quality data varied little between treatments with the exception of treatment 1 (TNS). Test yields were low to average with the TNS having the lowest yield at 2105 lb/A. Treatment 4 yielded the highest at 2807 lb/A and had the highest value, bringing in $4848/A. All chemical treatments increased yields 300-700 lb/A over the TNS. The standard treatment 2 brought in $4840/A as compared to the lowest of $3852/A for treatment 1. The price and grade indices were consistent and above average for all treatments.

Sucker control was good, with sucker number per plant low with a mean value of less than 1 for all chemical treatments. Green weight per plant was generally higher for treatments without MH. Green weight per sucker was higher for treatments without MH and a treatment after the first harvest. Percent control was excellent (>96%) for all chemical treatments with MH. As a result, increasing the spray applications and lowering MH rates provided adequate control and should reduce MH residues. All chemical treatments provided adequate sucker control, though the test should be repeated in a year with higher sucker pressure for better comparison.

Acknowledgments

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Table 1. 2013 Regional Tobacco Growth Regulator Test, Effects of Advanced Growth Regulating Material on Sucker Growth, Cured Leaf Yields, and Value of Flue-Cured Tobacco.

Treatments[1]	Sucker Growth					Cured Leaf			
	% Control	Green Wt./ Plant (g)	No./ Plant	Green Wt./ Sucker (g)	Plant Injury[2]	Yield (lbs/A)	Value ($/A)	Price Index[3] ($/cwt)	Grade Index[4]
Topped-Not-Suckered	0	188.9	2.3	84.0	0	2105	3852	183	89
RTM/RTM/RTM/ RMHX(1.0 GPA) & FLUPRO (0.5 GPA)	99.7	0.9	0.0	36.0	0	2773	4840	174	85
RTM/RTM/RTM/FLUPRO(0.5 GPA)/RMHX (0.66 GPA)	96.9	9.3	0.2	46.5	0	2566	4303	166	82
RTM/RTM / (FLUPRO(0.5 GPA)/(RMHX (1.0 GPA) & FLUPRO(0.5 GPA)	100	0.0	0.0	0.0	0	2807	4848	173	85
RTM/RTM /RTM &FLUPRO(0.5 GPA)/RTM& RMHX (0.66 GPA)& FLUPRO(0.5 GPA)	98.6	4.1	0.1	32.6	0	2535	4269	167	83
RTM/RTM & FLUPRO(0.5 GPA)/RTM/RTM&FLUPRO (0.25 GPA)	97.6	7.3	0.3	29.0	0	2615	4621	177	87
RTM/RTM / RTM &FLUPRO(0.5 GPA)/ RTM &FLUPRO(0.25 GPA)	97.2	8.3	0.2	55.3	0	2418	4248	175	86
RTM/ RTM &FLUPRO(0.25 GPA) / RTM/RTM&FLUPRO(0.5 GPA)	99.2	2.3	0.1	30.0	0	2689	4702	176	87
RTM/RTM/ RTM &FLUPRO(0.25 GPA)/ RTM &FLUPRO(0.5 GPA)	97.6	7.2	0.1	72.0	0	2423	4109	169	82

Table 1. 2013 Regional Tobacco Growth Regulator Test, Effects of Advanced Growth Regulating Material on Sucker Growth, Cured Leaf Yields, and Value of Flue-Cured Tobacco (*continued*).

Treatments	Sucker Growth					Cured Leaf			
	% Control	Green Wt./ Plant (g)	No./ Plant	Green Wt./ Sucker (g)	Plant Injury[2]	Yield (lbs/A)	Value ($/A)	Price Index[3] ($/cwt)	Grade Index[4]
RTM/RTM /RTM/ FLUPRO (0.5GPA)/ FLUPRO (0.25GPA)	94.6	16.0	0.3	64	0	2756	4715	171	86
RTM/RTM /RTM/ RTM &FLUPRO(0.5 GPA)/ RTM &FLUPRO(0.25 GPA)	95.2	14.3	0.4	35.8	0	2377	3979	168	83
RTM/RTM /RTM/FLUPRO (0.5GPA)/ RTM	97.3	8.0	0.2	39.8	0	2723	4807	177	87
RTM/RTM /RTM/FLUPRO (0.5GPA)/ RTM (2%)& FLUPRO (0.25GPA)	93.1	20.5	0.3	68.2	0	2287	4024	175	86
RTM/RTM /RTM/FLUPRO (0.5GPA)/ X-77 & FLUPRO (0.25GPA)	95.1	14.5	0.2	72.5	0	2504	4249	169	82
RTM/RTM /RTM/RTM (2%)&FLUPRO (0.5GPA)/ RTM (2%)&FLUPRO (0.25GPA)	94.2	17.1	0.4	42.8	0	2658	4679	176	86
LSD-0.05						410.7	800.3	10.9	4.9

[1]All treatments received initial contact application with RoyalTac-M at 4%(2.0 GPA), subsequent applications were 5%(2.5 GPA) except where noted.

[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.

*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.

Evaluation of Fungicide and Tobacco Cultivar Combinations for Black Shank (*Phytophthora nicotianae*) on Tobacco
Black Shank Farm 2013

A.S. Csinos, L.L. Hickman, U. Hargett

Introduction

Tobacco black shank is a persistent soil-borne disease of tobacco caused by *Phytophthora nicotianae* (pn). Two races, Race 0 and Race 1, exist in Georgia and generally across the entire tobacco-growing belt of the U.S.

The introduction of the Ph gene into tobacco cultivars has provided resistance to Race 0, but not Race 1. This has caused a shift in the race make-up of Ppn to shift primarily to Race 1 of the pathogen. We have no commercial cultivars available to growers with resistance to Race 1. However, Florida 301 resistance, which is a non-specific general resistance to Pn, does exist. Thus, to manage Ppn, we must rely on the use of chemical treatments, rotations and sanitation. Even with rotations away from tobacco and sanitation to stop the spread of the pathogen, growers can sustain high losses to the disease.

Both Cross Creek Seed and Rickard Seeds list flue-cured tobacco cultivars with moderate to high levels of resistance to Race 0 and Race 1 of *Phytophthora nicotianae*. Wild type resistance to Race 1 of Ppn is not known, thus the apparent reduction in loss to Race 1 may be tolerance to the pathogen. In 2012, we evaluated Variety SP225 and found exciting results, which demonstrated a significant reduction in disease.

Within the last few years, several companies have introduced oomycetes-specific fungicides for control of *Pythium* and *Phytophthora* disease in vegetables. Many of these materials are currently available for use on vegetables, while others are still under evaluation.

Little effort has been made to evaluate these new chemicals on tobacco black shank. The tobacco crop is a long-term row crop spending five to six months in the field, while vegetables generally are only in the field two to three months. These differences in crop length will require some changes in application rates and strategies to be successful on tobacco.

Methods and Materials

The study was located at the Black Shank Farm, CPES, Tifton, Ga., in a field with a history of black shank (*Phytophthora nicotianae*) in tobacco. The plot design was a randomized complete block consisting of single-row plots and replicated five times. Each plot was 37 feet long with an average of 25 plants per test plot.

On 25 January, tobacco varieties NC71, SP225 and K326 were seeded in a greenhouse in 242 cell flats.

The field was prepared on 19 April by disc harrowing the area. Fertilizer 4-8-12 at 600 lbs/A was broadcast in plot areas and tilled in. Applications of Lorsban 1.5 qt/A + Prowl 1.5 qt/A were

applied on same date. Materials were incorporated into the soil and plots were sub-soiled and bedded.

Tobacco transplants (seeded on 25 January) were treated in the greenhouse on 19 April with Admire Pro at 1 fl oz/1000 plants. Plants were pre-wet with material being washed in after spraying.
Tobacco was transplanted on 22 April on 48-inch-wide rows with an 18-inch plant spacing. At-plant treatments were applied on 22 April in furrow at 16 gal/A. First cultivation treatments were applied on 17 May, and layby treatments applied on 03 June at 22 gal/A in a 16-inch band over the row.

Cultivation and side-dress fertilizer was as follows: 150 lbs/A of 15.5-0-0 calcium nitrate on 02 and 17 May and 03 June.

Additional pesticide applications on tobacco were applied as follows: 20 May Orthene at 1.5 lb/A + Actigard 50 WG at 0.5 oz/A; 06 and 18 June Coragen at 5 oz/a + Actigard 50 WG at 0.5 oz/A; 27 June and 08 July Orthene at 1.5 lb/A + Sucker Plucker at 1.5 gal/A. Materials were applied in a 12-inch band, one nozzle over row in 22 GPA H_2O.

Stand counts were conducted every two weeks, noting percent disease from TSWV and black shank. A base count was recorded on 06 May to determine the number of plants per plot. Tobacco plots were also scouted for signs of phytotoxcicity. Vigor ratings were done on a 1-10 scale, with 10 equaling vigorous and healthy plants and 1 equaling poor vigor plants. Ratings were conducted on 06, 22 and 31 May and 10 June.

Height measurements were conducted on 13 June. Plants were measured individually from the soil level to the tip of the longest leaf and recorded in centimeters.

Three harvests were conducted: 26 June and 09 and 19 July. Harvests were done by collecting 1/3 of the plant leaves at one time and weighing each plot in pounds.

Total rainfall recorded at the Black Shank Farm during this period (April 22 through July 19, 2013) was 20.9 inches.

Summary

Disease pressure at the Black Shank Farm was moderate, with non-treated K-326 having 68% death by the end of the season. Heavy and frequent rainfall during the early part of the season delayed the development of black shank, and although plants were infected they did not quickly collapse because of the wet soil conditions. Both NC71 and SP225 had significantly less black shank than K326 in the absence of any fungicides. SP225 was the only cultivar to show a higher yield than K326.

Vigor and growth was greatest with the use of the fungicides, while NC71 and SP225 tended to be more vigorous than K326. TSWV was low and ranged from 1-6% in the field. Black shank levels ranged from a high of 68% to a low of 2%. In general, disease levels were lower in NC71 and SP225 than K326 in all chemical treatments. SP225 with applications of QGU42 (Zorvec) had the lowest level of disease (2%) and subsequently the highest yield (1576 lb/A) in the trial.

The ranking of fungicides for management of black shank appeared to be variable and may be dependent on the cultivar. For instance, Ridomil Gold and QGU42 (Zorvec) had significantly less black shank than Presidio on cultivar NC71. However, on SP223 both Presidio and QGU42 (Zorvec) outperformed (P=.05) Ridomil Gold. On the non-resistant K326 cultivar, all three of the fungicides performed uniformly, but poorly in terms of both disease control and yield.

Black shank management will require the appropriate selection of tobacco cultivars and fungicides. Early indicators are that some fungicide/cultivar combinations may be best suited for disease management than others.

Acknowledgments
The authors would like to thank Phillip Morris International for financial support.

Evaluation of Fungicide and Tobacco cultivar Combinations for Black Shank *(Phytophthora nicotianae)* on Tobacco
University of Georgia-CPES Tifton- Black Shank Farm 2013

Table 1. Plant vigor, Percent Black Shank, Percent Tomato Spotted Wilt, and Dry Weight Yield

Cultivar	Treatment[1]	Product Rate	Application Schedule	Vigor[2]	Height Measurement[3]	% Death by Black Shank[4]	% Symptomatic TSWV[5]	Dry Weigh Yield[6]
1. NC71	Ridomil Gold	1pt/A	At plant 1st cultivation At Layby	9.0bc	93.6ab	14.3efg	1.5ab	1391.1ab
2. NC71	DPX QGU42	19.2 oz/A	At plant 1st cultivation At Layby	9.5a	92.2ab	7.0fg	1.5ab	1447.8ab
3. NC71	Presidio	4.0oz/A	At plant 1st cultivation At Layby	8.8cd	89.2ab	26.2cde	3.9ab	1203.5ab
4. NC71	--NT--	--------	--- --- ---	7.8fg	63.6cd	50.9ab	1.6ab	501.2c
5. SP 225	Ridomil Gold	1pt/A	At plant 1st cultivation At Layby	8.6cde	90.5ab	19.5def	5.5a	1327.7ab
6. SP 225	DPX QGU42	19.2 oz/A	At plant 1st cultivation At Layby	9.3ab	103.6a	1.5g	1.6ab	1576.2a
7. SP 255	Presidio	4.0oz/A	At plant 1st cultivation At Layby	9.3ab	89.9ab	6.2fg	3.2ab	1566.9a
8.Sp 225	--NT--	--------	--- --- ---	8.3ef	81.6bc	41.4bc	0.7b	994.1b

Evaluation of Fungicide and Tobacco cultivar Combinations for Black Shank *(Phytophthora nicotianae)* on Tobacco
University of Georgia-CPES Tifton- Black Shank Farm 2013

Table 1 (continued). Plant vigor, Percent Black Shank, Percent Tomato Spotted Wilt, and Dry Weight Yield

Cultivar	Treatment[1]	Product Rate	Application Schedule	Vigor[2]	Height Measurement[3]	% Death by Black Shank[4]	% Symptomatic TSWV[5]	Dry Weigh Yield[6]
9. K 326	Ridomil Gold	1pt/A	At plant 1st cultivation At Layby	8.5de	82.4bc	29.0cde	3.1ab	1020.6b
10.K 326	DPX QGU42	19.2 oz/A	At plant 1st cultivation At Layby	8.7cde	91.6ab	32.5cd	3.7ab	1180.0ab
11. K 326	Presidio	4.0oz/A	At plant 1st cultivation At Layby	8.8cd	90.0ab	32.8cd	3.1ab	1075.2b
12.K 326	--NT--	--------	--- --- ---	7.6g	61.8d	67.6a	3.4ab	278.8c

[1]Data are means of five 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 a 1-10 scale with 10= live and healthy plants and 1=dead plants on 06, 22, and 31 May and 10 June.

[3] Height measurements were done in centimeters from the soil level to the tip of the longest leaf on 13 June.

[4]Percent Death by Black Shank was calculated by subtracting the final number of harvest plants from the original base count. The number of plants flagged with TSWV were subtracted from that total to get the number of plants killed by Black Shank. That number was then divided by the original base count and multiplied by 100.

[5] Percent TSWV symptomatic plants was calculated by using stand counts that were made from 06 May to 26 June with TSWV being flagged every week.

[6] Dry weight yield was calculated by multiplying green weight totals of tobacco by .15. Pounds per acre was calculated by multiplying dry weight conversion per plot by 7260 divided by the base stand count.

2013 Evaluation of Tobacco Cultivars with Reported Resistance to Both Race 0 and Race 1 of Black Shank (*Phytophthora nicotianae*) Black Shank Nursery, Tifton, Ga.

A.S. Csinos, L.L. Hickman, U. 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*.

Methods 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 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 225, Speight 236, PXH9, PXH13 and PVH1452.

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 02 April, applications of Devrinol 50DF at 3.1 lbs/A, Lorsban 4E at 3 qt/A and Nemacur 3 at 2 gal/A was tilled into the plot area. Plots were sub-soiled and bedded on 03 April.

Tobacco transplants were treated in the greenhouse on 08 March with Admire Pro at 1 fl oz/1000 plants. Plants were pre-wet with tap water and treatment materials were washed in with additional water after spraying.

Tobacco was transplanted on 10 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 09 and 28 May. Layby was done on 28 May.

Additional pesticide applications on tobacco were applied uniformly over the entire test as follows: 07 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 07 and 29 May and 12 and 19 June.

Tobacco was topped and suckered on 20 June. Off Shoot T 4% solution at 60 gal/A was applied on 24 June. On 27 June, 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 beginning 24 April through 22 July, noting percent disease from TSWV and black shank.

Total rainfall recorded at the Black Shank Nursery during this period (April through August 2013) was approximately 34.86 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

The crop year 2013 was cool and wet, which delayed the onset of black shank; however, as the temperatures rose, the level of black shank increased, with the susceptible standard K326 having 98% disease by the end of the season. All the other cultivars demonstrated a significant (P=0.05) level of resistance/tolerance to the disease. Cultivars PXH9, PXH13, PVH1452, SP225, SP236 and K346 all showed a significant reduction in disease. However, only PXH13, SP225 and SP236 had significantly higher yield than NC71. In a field with a history of severe tobacco black shank, these cultivars may prove to be economically feasible to use with or without a chemical partner.

Acknowledgments

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Evaluation of Tobacco Cultivars with Reported Resistance to Both Race 0 and Race 1 of Black Shank (*Phytophthora nicotianae*) University of Georgia-CPES Tifton-Black Shank Nursery 2013

Table 1. Plant Vigor, Plant Height, Percent Black Shank, Percent Tomato Spotted Wilt, and Dry Weight Yield

Cultivar[1]	Vigor[2]	Height Measurement[3]	% Death by Black Shank[4]	% Symptomatic TSWV[5]	Dry Weight Yield[6]
1. PXH9	9.2 b	60.9 ab	19.4 c	5.2 ab	1391.9 ab
2. PXH13	9.0 c	57.9 b	16.6 c	8.2 ab	1636.3 a
3. PVH1452	9.3 b	58.0 b	18.2 c	3.1 b	1462.3 ab
4. SP225	9.5 ab	53.4 b	5.0 c	3.8 ab	1776.1 a
5. SP236	9.6 a	60.4 ab	5.6 c	4.9 ab	1843.0 a
6. K326	7.6 e	53.4 b	97.6 a	10.6 a	877.3 b
7. K346	8.2 d	67.3 a	18.6 c	2.4 b	1523.1 ab
8. NC71	8.0 d	62.3 ab	63.0 b	7.0 ab	907.2 b

[1]Data are means of six 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 a 1-10 scale with 10= live and healthy plants and 1=dead plants on 24 April, 09 & 22 May and 04 June.

[3] Height measurements were done in centimeters from the soil level to the tip of the longest leaf on 24 May.

[4]Percent Death by Black Shank was calculated by subtracting the final number of harvest plants from the original base count. The numbers 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 100.

[5] Percent TSWV symptomatic plants was calculated by using stand counts that were made from 24 April to 30 June with TSWV being flagged every week.

[6] Dry weight yields were calculated by multiplying green weight totals of tobacco by .15. Pounds per acre were calculated by multiplying dry weight conversion per plot by 7260 divided by the base stand count.

Evaluation of Tobacco Cultivars with Reported Resistance to Both Race 0 and Race 1 of Black Shank (*Phytophthora nicotianae*) University of Georgia-CPES Tifton-Black Shank Nursery 2013

Table 2. Pedigree for tobacco cultivars evaluated for tobacco black shank disease.

Cultivar[1]	Pedigree	Sponsor
1. PXH9	F1. hybrid	F.W. Rickard Seeds
2. PXH13	F1. hybrid	F.W. Rickard Seeds
3. PVH1452	(2006) F1. hybrid	ProfiGen
4. SP225	(2003) (Sp168 x K346) (SPA95 x SP168)	Speight Seed Farms, Inc.
5. SP236	(2005) (SP168 x SP190) (SP197 x SP178)	Speight Seed Farms, Inc.
6. K326	(1981) McNair2257 (McNair 30 x NC95)	Gold Leaf Seed company
7. K346	(1988) McNair 926 x 80241	Gold Leaf Seed Company
8. NC71	(1995) F1 hybrid	F.W. Rickard Seeds

Evaluation of Tobacco Cultivars for Tolerance and/or Resistance to Nematodes
2013 University of Georgia, CPES-Bowen Farm-Tifton, Ga.

A.S. Csinos, L.L. Hickman, S.S. LaHue

Introduction

Many crops in Georgia that are rotated with tobacco are susceptible to root knot nematode. Cotton is susceptible to *M. incognita*, and peanuts are susceptible to *M. arenaria* and *M. javanica*. Tobacco and vegetables in general are susceptible to all root knot species with a few exceptions. Several species of root knot nematodes are found in Georgia. All species are capable of infecting tobacco. Most commercial tobacco cultivars have resistance to Race 1 and Race 3 of *M. incognita* (Southern RKN), but have no resistance to Race 2 and Race 4 of *M. javanica* (Javanese RKN) or *M. arenaria* (Peanut RKN). Without resistance to these pests, the use of rotation, crop destruction and nematicides are the only means to manage the problem.

Several tobacco cultivars were evaluated for tolerance to *M. arenaria* (Peanut RKN) in 2011 and 2012 with very favorable results. NC71, the standard, was out-performed by several tobacco cultivars (see 2011 and 2012 reports) by up to 600 pounds per acre.

The use of Telone II is recommended for management of root knot nematode in Georgia. However, Telone II has become expensive ($17 per gallon+) and at times is difficult to obtain. In addition, special precautions are required for the use of fumigants. Several new contact nematicides are being evaluated by chemical companies, and a few of them show promise on tobacco.

Methods and Materials

This trial was conducted at the Bowen Farm-CPES, 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 *Meloidogyne arenaria* nematodes. The trial was set up in a randomized complete block design (RCBD) with six replications. Each plot was 32 feet long, in 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 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.

Total rainfall recorded at the Bowen Farm during this period (March through August 2013) was 29.94 inches, based on environmental data requested from Georgia Automated Environmental monitoring Network. The field trial was supplemented with additional irrigation as required.

Greenhouse and Field Treatments

On 12 March, pre-plant fumigant Telone II was applied to Treatment 8 trial plots. Telone II was injected into soil approximately 12-14 inches using a subsoil bedder with two shanks spaced 12 inches apart. Beds were immediately tilled and sealed using concrete drag.

Tobacco transplants were treated in the greenhouse on 01 April with Admire Pro at 1 fl oz/1000 plants. Plants were pre-wet with material being washed in after spraying.

Tobacco varieties XHN52, XHN55, PVH2340, CC33, CC35, CC65, and NC71 were transplanted on 03 March on 44-inch-wide rows with an 18-inch plant spacing.

Field Trial Data

A stand count was conducted on 11 April to establish a base count. Stand counts were conducted thereafter every two weeks beginning 12 May and ending 06 July to monitor any loss of plants.

Vigor ratings were conducted on 11 April (approximately two weeks post plant), 01 May (four weeks post plant), 16 May (six weeks post plant) and 29 May (eight 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 24 May. Plants were measured individually from the soil level to the tip of the longest leaf and recorded in centimeters.

Three harvests were conducted: on 25 June, and 11 and 25 July. Harvests were done by collecting 1/3 of the plant leaves at one time and weighing each plot in pounds.

A mid-season root gall rating was conducted on 11 June on three plants per plot using the Zeck's scale of 0-10, whereby 0 = no galls, 1 = very few small galls, 2 = numerous small galls, 3 = numerous small galls of which some have grown together, 4 = numerous small and some large galls, 5 = 25% of roots severely galled, 6 = 50% of roots severely galled, 7 = 75% of roots severely galled, 8 = no healthy roots, but plant is still green, 9 = roots rotting and plants dying, 10 = plants and roots dead. A second root gall rating was conducted following the final harvest on 01 August, rating 10 plants per plot utilizing the same scale.

Nematode soil samples were pulled from plots on 07 March (prior to planting and soil treatment), on 19 June (mid-season) and again on 05 August (at final harvest). Eight to 10 cores of soil, 2.5 cm diameter x 25 cm deep, were collected from each plot randomly. Nematodes were extracted from a 100-cm^3 soil sub-sample using a centrifugal sugar flotation technique.

Summary

Early vigor ratings were high across the trial, with all plots receiving a score of 10. Most cultivars retained the high vigor rating throughout the season with a few exceptions noted in Table 1. Height measurements were generally similar for all cultivars. However, CC35 and CC65 both had significantly taller tobacco than NC71 treated with Telone.

Yield of cultivars ranged from a low of 1568 lb/A (NC71) to a high of 2092 lb/A for CC35. Tobacco cultivars CC33, CC35 and CC65 all had yields that were significantly better than the standard NC71, but were not significantly different from NC71 treated with Telone II.

Root gall ratings by mid-season were high on NC71 at 6.8 RGI while all other treatments were significantly less (Table 2), including the NC71 treated with Telone. By final harvest RGIs were generally high across all the treatments, ranging from 3.9 for CC35 and a high of 4.8 for NC71.

Nematode populations were moderate to low, ranging from 10 at plant, but building to 105 to 823 by harvest. All tobacco cultivars had lower nematode numbers than NC71 and were not different from NC71 treated with Telone II (Table 2).

Several tobacco cultivars, notably CC35 and CC65, had higher yields, reduced RGI and reduced populations of root knot nematode when compared to NC71. There were no significant differences (P=0.05) among those cultivars and NC71 treated with Telone II. As the price of nematicides increase, their availability declines and regulations on application increase, nematode-tolerant cultivars for management of tobacco root knot nematode will increase in popularity.

Acknowledgments

The authors would like to thank the Georgia Agricultural Commodity Commission for Tobacco for financial support.

2013 Evaluation of Tobacco Cultivars for Tolerance and/or Resistance to Nematodes
UGA-CPES-Bowen Farm-Tifton, Ga.

Table 1. Plant Vigor, Plant Height and Dry Weight Yield

Treatment[1]	Rate/Application Schedule	Vigor Ratings (1-10 scale)[2]					Height Measurements[3] (centimeters)	Dry Weight Yield[4] (pounds per acre)
		11 April	01 May	16 May	29 May	Average Vigor (0-10 Scale)		
1. XHN52	----	10.0a	8.6ab	8.3c	8.0d	8.7c	50.8ab	1778.1bc
2. XHN55	----	10.0a	8.6ab	8.5bc	8.1cd	8.8c	50.0ab	1812.6abc
3. PVH2340	----	10.0a	9.0ab	8.5bc	8.1cd	8.9c	52.0ab	1765.0bc
4. CC33	----	10.0a	9.3a	9.0ab	8.6abc	9.2ab	54.3ab	2020.6ab
5. CC35	----	10.0a	9.1ab	9.1a	9.1a	9.3a	59.0a	2091.7a
6. CC65	----	10.0a	9.3a	9.0ab	9.0ab	9.3a	56.4a	2070.8ab
7. NC71	----	10.0a	8.5b	8.5bc	8.1cd	8.7c	46.6b	1568.2c
8. NC71	Telone II- 2-3 weeks pre-plant @ 6gal/A	10.0a	8.8ab	8.6abc	8.5bcd	9.0abc	52.1ab	1989.8ab

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

[2] Vigor was done on a scale of 1-10 with 10= live and healthy plants and 1 = dead plants and an average was taken of vigor. Ratings were conducted on 11 April, and 01, 16, and 29 May.

[3] Height measurements were conducted by measuring each plant from the base of the plant to the tip of the longest leaf. Measurements were taken in centimeters on 24 May.

[4] Dry weight yield was calculated by multiplying green weight totals of tobacco by 0.15. Pounds per acre was calculated by multiplying dry weight conversion per plot by 6491 divided by the base stand count.

2013 Evaluation of Tobacco Cultivars for Tolerance and/or Resistance to Nematodes
UGA-CPES-Bowen Farm-Tifton, Ga.

Table 2. Nematode Root Gall Ratings and Number of Plant Parasitic Nematodes

Treatment[1]	Rate/Application Schedule	Root Gall Ratings[2] (Zecks Scale 0-10)		Number of *Melodogyne sp.* per 100cc soil[2]		
		Mid-season	At final harvest	Pre-plant	Mid-season	At final harvest
1. XHN52	----	2.7bc	6.8a	5.0a	55.a	285.0bc
2. XHN55	----	3.0b	7.2a	5.0a	40.0ab	441.7b
3. PVH2340	----	2.2bc	5.6ab	3.3a	25.0bc	388.3bc
4. CC33	----	2.0bc	5.4ab	1.6a	11.6c	165.0bc
5. CC35	----	1.3c	3.9b	1.6a	10.0c	105.0c
6. CC65	----	2.4bc	6.4a	8.3a	23.3bc	245.0bc
7. NC71	----	6.8a	7.8a	3.3a	40.0ab	823.3a
8. NC71	Telone II- 2-3 weeks pre-plant @ 6gal/A	1.7bc	6.1	10.0a	20.0bc	283.3bc

1. Data are means of six replications. Means in the same column followed by the same letter are not different (P=0.05) according to Fishers LSD.
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 11 June (mid-season), rating three plants per plot and again on 01 August (at final harvest) rating 10 plants per plot.
3. Pre-planting soil samples were collected on 07 March Root Knot Nematode (*Meloidogyne sp.*). Mid-season soil samples were collected on 19 June, and At final harvest soil samples were collected on 05 August.

2013 Evaluation of Tobacco Cultivars for Tolerance and/or Resistance to Nematodes
UGA-CPES-Bowen Farm-Tifton, Ga.

Table 3. Comparison of CC 35 (in 2012) to Top Four Varieties Grown in Georgia.

VARIETY	YEAR	YIELD	VALUE	PRICE	GI	LEAVES	HEIGHT	DAYS	ALK	SUG	RATIO
CC 35	2012	2963	4593	154	76	20	40	81	2.15	18.35	8.52
	2013	2798	4524	162	79	20	48	80	1.52	16.54	10.88
2 YEAR		2881	4559	158	77	20	44	81	1.84	17.45	9.70
NC 196	2012	2499	3937	159	78	18	38	80	2.04	19.71	9.68
	2013	2793	4649	166	83	21	46	70	1.60	17.86	11.14
2 YEAR		2646	4293	163	80	20	42	75	1.82	18.79	10.41
NC 71	2012	2550	3956	146	76	18	38	78	2.14	18.98	8.87
	2013	2965	4949	167	84	20	42	68	1.60	18.30	11.42
2 YEAR		2758	4453	156	80	19	40	73	1.87	18.64	10.15
K 326	2012	3017	4461	148	70	19	38	79	2.11	18.99	9.01
	2013	2912	4862	167	84	20	42	66	1.82	17.90	9.83
2 YEAR		2965	4662	157	77	20	40	72	1.96	18.45	9.42
NC 297	2012	2752	3659	132	66	19	36	77	2.26	17.30	7.64
	2013	2925	4890	166	83	22	45	68	1.78	18.80	10.58
2 YEAR		2839	4275	149	74	20	41	72	2.02	18.05	9.11

Percent of Crop Grown in Georgia
1. NC 71 – 29%
2. NC 196 – 20%
3. K 326 – 15%
4. NC 297 – 12%

Evaluation of New Management Options for Thrips and *Tomato Spotted Wilt Virus* in Tobacco

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

Tomato spotted wilt virus continues to affect tobacco production in Georgia. TSWV incidence in 2013 was, in general, higher than in previous years. Tobacco thrips and western flower thrips can efficiently transmit TSWV to tobacco in the southeastern United States. Tobacco thrips (*Frankliniella fusca*) is often found early in the season, whereas the western flower thrips is associated with late-season infections. Unlike other crops, cultivated tobacco has no genetic resistance against thrips and/or TSWV. Hence, growers typically rely on one insecticide (imidacloprid) and a resistance-boosting chemical (Actigard®) for thrips and spotted wilt management. Thrips, particularly the western flower thrips, has already developed resistance to several insecticides. Thus, it is critical to identify alternatives to imidacloprid usage and provide flexibility to growers. In 2012, we evaluated four newer insecticides that could serve as potential replacements to imidacloprid. This year we picked the two best performing insecticides and also attempted to combine the insecticides with various planting dates. The goal is to develop an integrated management package that is sustainable.

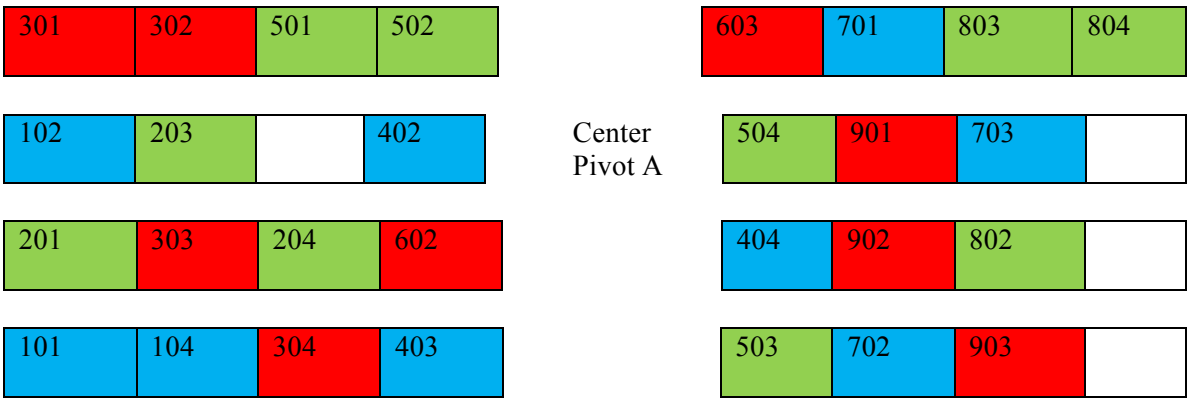
The two insecticides that were used in 2013 as alternatives to imidacloprid against thrips and TSWV were spinetoram (Radiant), dinotefuran (Venom), and cyanotraniliprole (Cyazypyr). Drench insecticides were applied at 6 to 8 oz/A and the foliar applications were ~ 10 to 12 oz/A. These insecticides have already been identified to possess efficacy against thrips, but not in tobacco. In fact, neither of the new insecticides have been registered for use in tobacco yet. The trial was conducted at the Bowen Farm, University of Georgia Tifton campus. Two insecticides and three planting dates were included in a factorial design with four replications for each planting date x insecticide combination (Fig 1).

The transplants were planted on 28 March, 8 April and 15 April. All treatments were applied as float treatments and as foliar treatments. Each replicate included a three-row plot, 40 feet in length, and had 264 plants in each plot. All other production practices were followed as per the standards established by the farm.

Thrips counts were taken at two-week intervals beginning the day after planting. The thrips samples were brought to the vector biology laboratory at Tifton and were identified by species. The results are presented separately for tobacco thrips as well as for other thrips. Other thrips included western flower thrips, *Frankliniella tritici*, and *Frankliniella bispinosa*. Visual TSWV ratings were conducted at four time intervals throughout the course of the experiment. Thrips count data, TSWV incidence, height measurements and harvest data were all subjected to generalized linear mixed models using PROC GLIMMIX in SAS. The planting dates and treatments were considered as fixed effects and replications were considered as random effects. Thrips counts were analyzed using a random statement to include the repeated measures option.

We also monitored thrips populations and TSWV incidence in unsprayed areas of the tobacco field to get an idea of the insect and virus pressure affecting the crop, as well as assess their temporal patterns.

Field design and treatment details



March 25

100 Actigard float
200 Actigard float + Cyazypyr float and spray
300 Actigard float + Radiant float and spray

April 8

400 Actigard
500 Actigard float + Cyazypyr float and spray
600 Actigard float + Radiant float and spray

April 15

700 Actigard float
800 Actigard float + Cyazypyr float and spray
900 Actigard float + Radiant float and spray

Results

Thrips counts: Average thrips counts for *F. fusca*, others, and total are illustrated in graphs 1 to 3. The graphs clearly indicated that there were no differences among treatments for tobacco thrips (df=2, F=0.79; *P* =0.4542), others (df=2, F=0.21; *P* =0.8105), and total thrips counts (df=2, F=0.35; *P* =0.7085). This pattern was noticed throughout the planting dates. Despite not-so-significant effects among treatments, significant effects were noticed with planting dates for tobacco thrips (df=2, F=0.79; *P* <0.0001), others (df=2, F=13.28; *P* <0.0001), and total thrips counts (df=2, F=15.86; *P* <0.0001). The thrips were all collected through sticky cards and not from the plants directly. This might be one of the reasons for less conspicuous treatment effects.

However, it is also hard to find thrips colonizing on tobacco plants. TSWV incidence, though indirect, might be a better predictor of treatment effects.

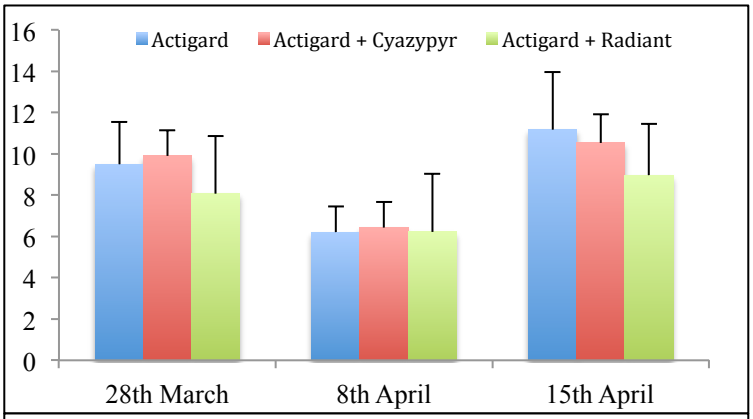


Fig. 1. Tobacco thrips counts on sticky cards placed in plots with various planting dates and insecticide treatments.

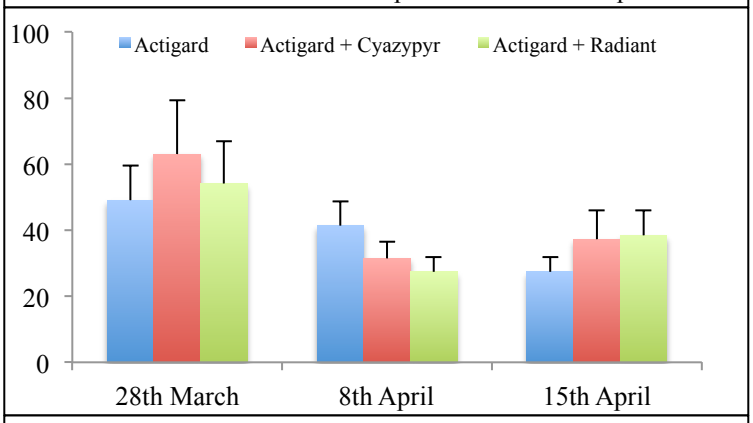


Fig. 2. Other thrips counts on sticky cards placed in plots with various planting dates and insecticide treatments.

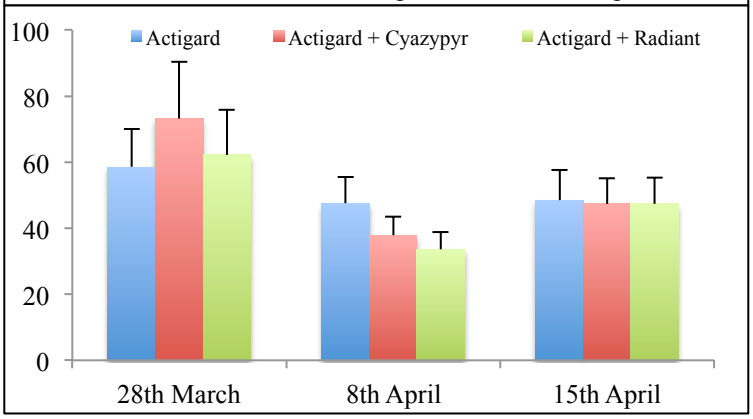


Fig. 3. Total thrips counts on sticky cards placed in plots with various planting dates and insecticide treatments.

TSWV incidence

TSWV incidence was visually recorded on four dates at two-week intervals beginning mid May. TSWV incidence in 2013 was comparatively higher than in the recent years. The incidences increased with time, which is expected. Akin to the thrips counts, treatment differences in general were not prominent. On the contrary, TSWV incidence was heavily influenced by planting dates. On the first date of sampling (May 15) no differences were observed even among various planting dates as the incidence was very

low (df=2; F=0.08; F= 0.9203) (Fig. 4). However, on the second (df=2; F=4.11; F= 0.0293) (Fig. 5) and third (df=2; F=4.15; F= 0.0284) (Fig. 6) sampling dates, differences in TSWV incidences were observed. On the last sampling date, the differences in TSWV incidences were very obvious (df=2; F=33.60; F< 0.0001) (Fig. 7).

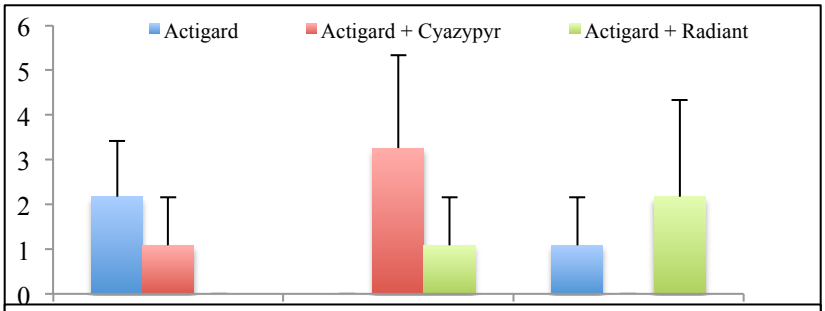


Fig. 4. Percent TSWV incidence in plots with various planting dates and insecticide treatments on May 15.

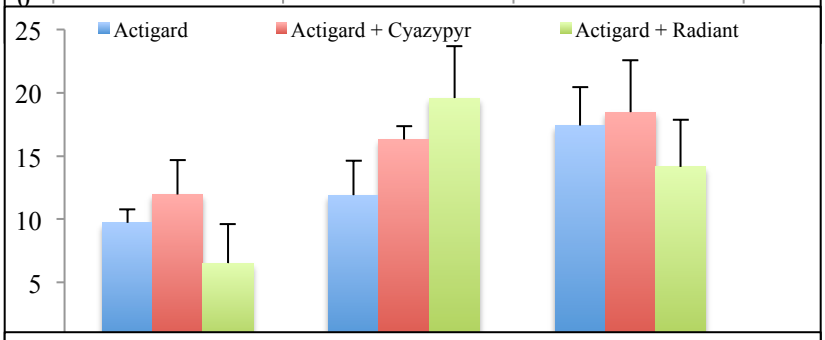


Fig. 5. Percent TSWV incidence in plots with various planting dates and insecticide treatments on May 28.

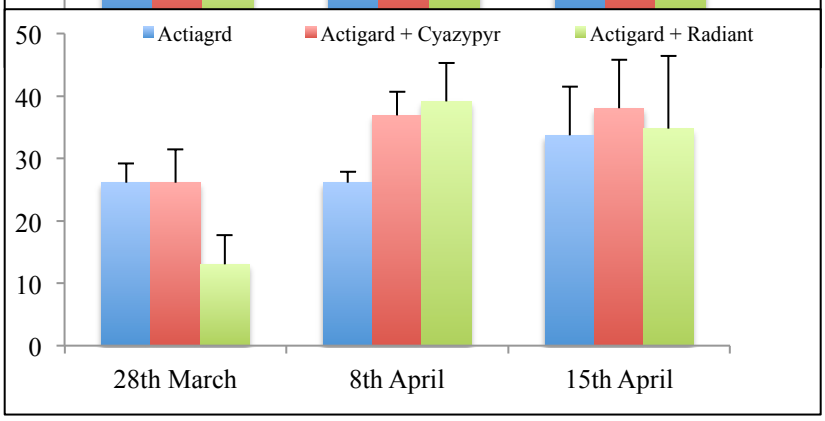


Fig. 6. Percent TSWV incidence in plots with various planting dates and insecticide treatments in mid-June.

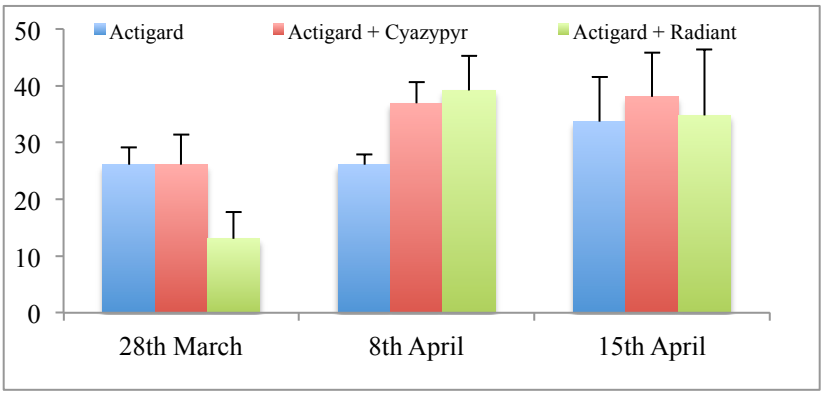


Fig. 7. Percent TSWV incidence in plots with various planting dates and insecticide treatments in late June.

TSWV incidence in general was lower in early-planted tobacco than in mid- and late-planted tobacco.

Plant Height

Plant heights were recorded at two time intervals (15 and 28 May). No differences among treatments were observed at the first (df=2; F=1.70; F= 0.2043) and second (df=2; F=1.12; F= 0.3417) time intervals. Planting dates, as expected, influenced the height differences at the first (df=2; F=183.61; F< 0.0001) (Fig. 8) and second (df=2; F=1007.33; F< 0.0001) (Fig. 9) sampling dates.

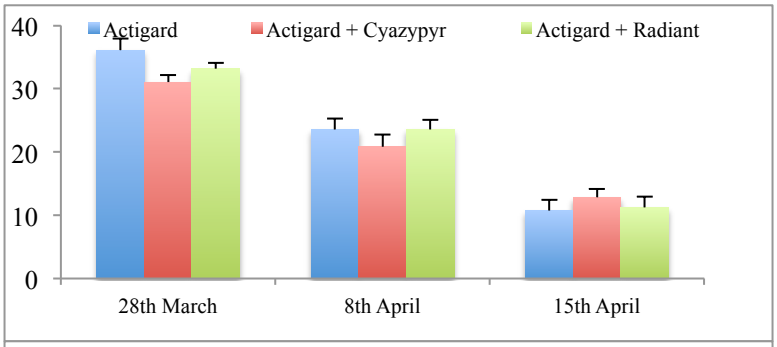


Fig. 8. Heights of plants in cm in plots with various planting dates and insecticide treatments on May 15.

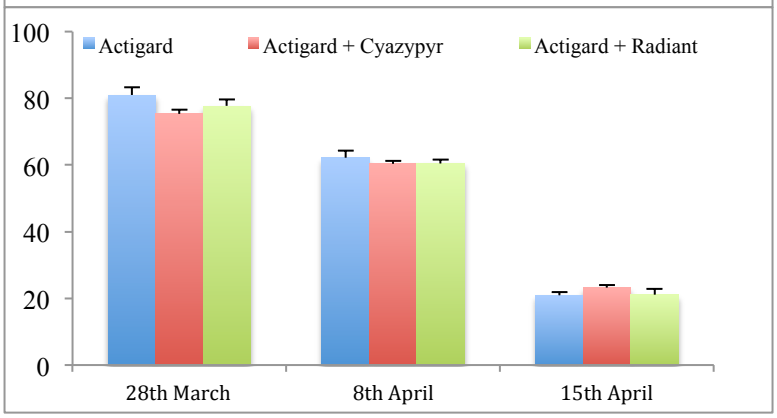


Fig. 9. Heights of plants in cm in plots with various planting dates and insecticide treatments on May 28.

Yields

As observed in previous cases, no differences in yield were influenced by treatments (df=2; F=0.31; F=7345). On the contrary, the yields were influenced by planting date (df=2; F=40.85; F< 0.0001) (Fig. 10). Yields from March-planted tobacco, regardless of the treatments, were higher than yields of tobacco planted later. The difference could merely be influenced by increased thrips and TSWV incidence later in the season.

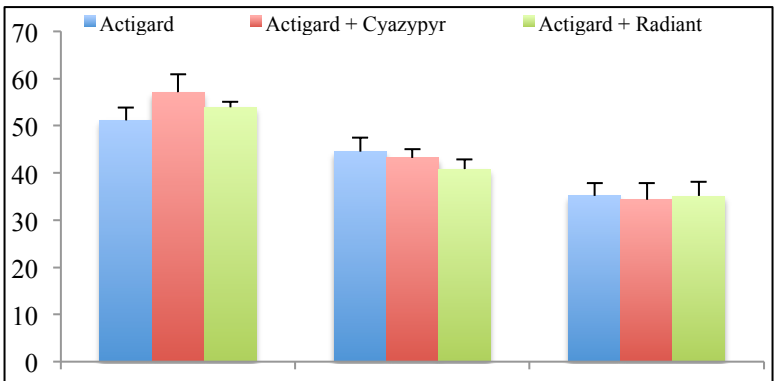


Fig. 10. Yields in lbs in plots with various planting dates and insecticide treatments on May 28.

Sticky Card Sampling for Thrips

We also monitored thrips temporally from early April through mid-June. Both tobacco thrips and all other thrips (including TSWV vectors) were recorded. The counts were observed by placing six yellow sticky cards around a production field. The counts are illustrated with graphs (Fig. 11 and 12) below.

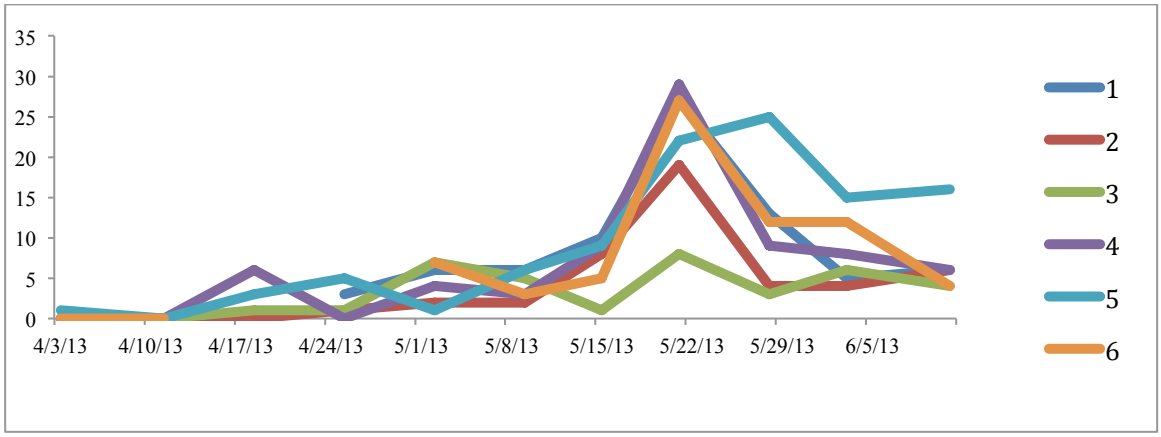


Fig. 11. Tobacco thrips populations recorded by placing six sticky cards around a production field in 2013.

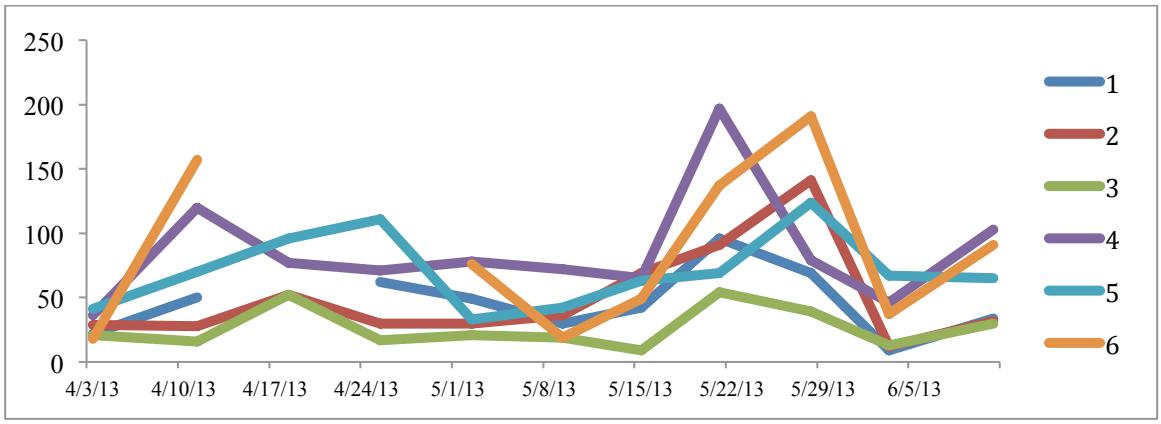


Fig. 12. Total thrips populations recorded by placing six sticky cards around a production field in 2013.

The other thrips included vectors such as *F. occidnetalis* and *F. bispinosa*. Non-vectors such as *F. tritici* were also recorded. The data clearly shows that the peak thrips incidence in 2013 was from mid- to late May. This is later than what is normally observed. We also observed TSWV incidence at several places in the field and the incidence of infection was lower than what was observed in some of the treated plots, ranging from 6 to 8%. This also indicates that the incidence of TSWV was greater in plots that were planted late than in plots that were planted earlier.

Conclusions

1. TSWV incidence, in general, was higher in 2013 than in recent years.
2. Insecticide treatments did not significantly reduce thrips populations and TSWV incidence when compared with plots that had Actigard-treated plants.
3. Planting date seemed to influence thrips populations and TSWV incidence. For instance, early-planted plots had fewer thrips than late-planted plots.
4. Early-planted plots also had reduced TSWV incidence when compared with late-planted crops.
5. Sticky card sampling data indicated that peak thrips populations were observed during mid- to late May. The early-planted plants could have become matured and consequently were more tolerant to TSWV at the time of peak thrips incidence, when compared with plants that were transplanted later.
6. Increased TSWV incidence in some of our plots could be due to the volunteer peanut plants grown nearby. Peanut is a regular rotation crop used with tobacco production. It is still not clear if peanut could influence TSWV incidence in tobacco. More research needs to be conducted to address the issue, and is proposed to be conducted in 2014.

Acknowledgement

We gratefully acknowledge the financial assistance of the Georgia Tobacco Commission, and we appreciate their continued support.

Soil Fertility Related To TSWV (*Tomato spotted wilt virus*) in Tobacco

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

Data originally collected in 2007 and 2008 were re-analyzed and assessed using a different approach. Models predicting levels of TSWV were developed using stepwise regression with TSWV incidence in tobacco as the dependent variable and micronutrient levels and ratios of micronutrients measured in soil samples as the independent variables.

Results and Discussion

Data from both years were analyzed and compared. For year 1, the model was % TSWV = -3227 Cu:Fe - 0.53 Mg:Cu - 0.78 Fe:Zn - 0.13 Fe + 188.6 ($P = 0.01$; $R^2 = 0.35$) (**Fig. 1**). For year 2, the model was % TSWV = 12682 Cu:Fe - 1.86 Fe:Mn 0.99 Fe:Zn + 66.97 ($P = 0.02$; $R^2 = 0.33$) (**Fig. 2**). When the two models were compared, a common thread was found; namely, they both contained ratios made up of the heavy metals iron, copper and zinc. Magnesium occurred only in the year 1 model and manganese occurred in only the year 2 model. Of particular interest was the fact that four of the five elements, namely Cu, Fe, Mn and Zn, serve as cofactors for superoxide dismutase enzymes (SODs). There are essentially three types of SODs in most eukaryotic cells, including plant tissues. These are the Cu-Zn SOD, the Fe SOD and the Mn SOD. The Cu-Zn SOD is generally found in plastids in the cytoplasm and in the nucleus. The Fe SOD is mostly found in the chloroplast and the Mn SOD is primarily in the mitochondria of the cell. These enzymes are part of the first line of defense against reactive oxygen species (ROS). They detoxify ROS compounds with the reaction resulting in the production of hydrogen peroxide. It is known that as many plant pathogens infect host plant cells one of the earliest events is the release of an ROS burst. If TSWV causes an ROS burst, the ROS would have to be detoxified or it would cause cell damage. SOD enzymes would be one of the first lines of defense against an ROS burst. As hydrogen peroxide is produced to reduce the ROS, it would have to be further detoxified. Eventually, a build-up of hydrogen peroxide would lead to the production of salicylic acid (SA). As salicylic acid accumulates, it can be translocated and it is believed to help signal plant resistance proteins further downstream to activate systemic acquired resistance (SAR). This is the same site where the plant activator Actigard™ works, as it is an analog of SA. It is known in the literature that the Cu:Fe ratio regulates levels of Cu-Zn SOD and Fe SOD and that the ratio of Fe:Mn affects activity of the Mn SOD as Fe competes for the active binding site, making the MnSOD less efficient. The Cu:Fe ratio was significantly correlated with TSWV incidence (**Fig. 3 & 4**) for both years. It is also known that iron and manganese compete for the binding site in the Mn SOD, as iron has an affinity for the same site as manganese. However, when iron binds to the active site, the enzyme is less efficient. Thus, the overall concentrations of these four cations and the ratios of one to another could be related to SOD activity in the tobacco plant. Availability in the soil could affect uptake by the tobacco plant as well as how they interact in tobacco cells. It appears as if the levels of these cations are variable and not homogenous within a single field. A highly significant gradient ($P = 0.0001$; $R^2 = 0.77$) of a low to high Cu:Fe ratio ranging from north to south (**Fig. 5**) could partially explain a similar-appearing gradient ($P = 0.01$; $R^2 = 0.25$) of low to high TSWV incidence occurring from north to south (**Fig**. **6**). When copper and iron levels were analyzed separately and not in a ratio, copper levels increased from north to south (**Fig. 7**) and iron levels decreased from north to south

(**Fig. 8**). Thus, the Cu:Fe ratio observed in soil from this field could be explained both by increasing levels of copper and decreasing levels of iron from north to south. Using the tobacco-TSWV models as a prototype, similar regression models were developed for bacterial leaf spot of pepper and sour skin of onion. The pepper model was significant in both years, and the onion model was significant in one out of two years because onions bolted in the second year. However, the onion model was confirmed using mechanically-inoculated bulbs in the laboratory. In these other models, both the Cu:Fe and Fe:Mn ratios play a significant role. However, unlike the tobacco field, the Cu:Fe ratios in the pepper and onion fields were strictly related to the levels of copper in the soil and not iron.

Developing multiple regression models that explain disease based on soil analysis has the potential to impact agricultural science in several different ways. First it may stimulate new research areas regarding systemic acquired resistance (SAR). To date much of the research emphasis on SAR has been trying to identify the messenger that sends a signal to activate plant defense metabolism. Some believe that messenger has already been identified and is salicylic acid (SA). There are currently SAR activators being sold commercially that are analogs of SA. This research, however, may show that the SAR pathway can also be affected at a different point, namely prior to the formation of SA. If superoxide dismutase enzyme activity can be affected by the concentration and ratios of key cations, they in turn may affect SA levels, which will affect SAR. Once these mechanisms are fully understood, it could lead to management of plant diseases with prescribed fertilization with micronutrients, most likely applied in chelate form to be absorbed through the foliage. Soil analyses could be used to identify fields that are at high risk for these diseases to occur. Growers then could make management decisions based on a number of factors (**Fig. 9**) affecting micronutrient levels in particular fields or even sites within fields, which in turn will eventually affect molecular events within plant cells and regulate disease resistance.

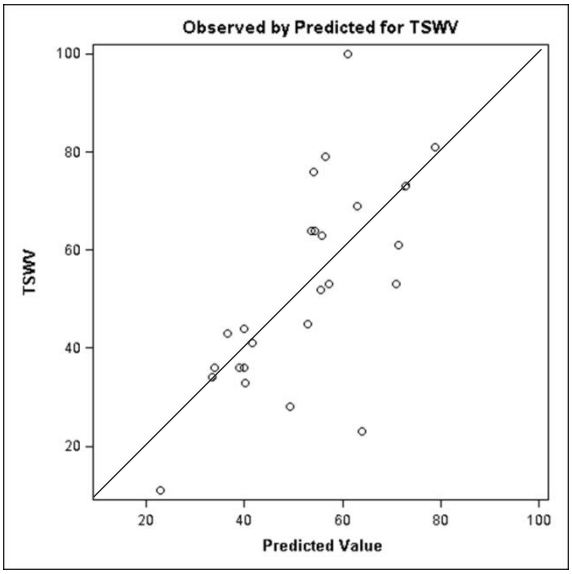


Fig. 1. Predictive model for year 1 with % TSWV of tobacco as the dependent variable and the heavy metal cations Cu, Fe, Mg, and Zn as the independent variables in the formula % TSWV = - 3227 Cu:Fe - 0.53 Mg:Cu - 0.78 Fe:Zn - 0.13 Fe + 188.6; (P = 0.01; R^2 = 0.35).

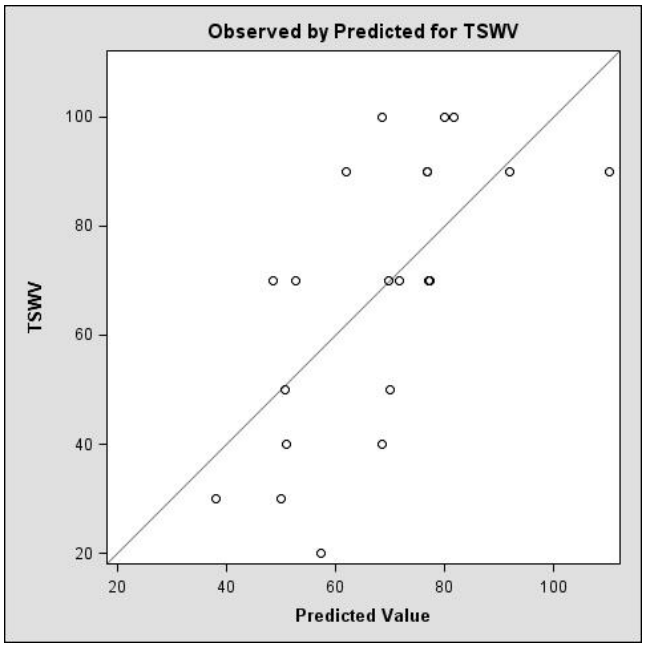


Fig. 2. Predictive model for year 2 with % TSWV of tobacco as the dependent variable and the heavy metal cations Cu, Fe, Mn, and Zn as the independent variables in the formula % TSWV = 12682 Cu:Fe - 1.86 Fe:Mn 0.99 Fe:Zn + 66.97 ($P = 0.02$; $R^2 = 0.33$).

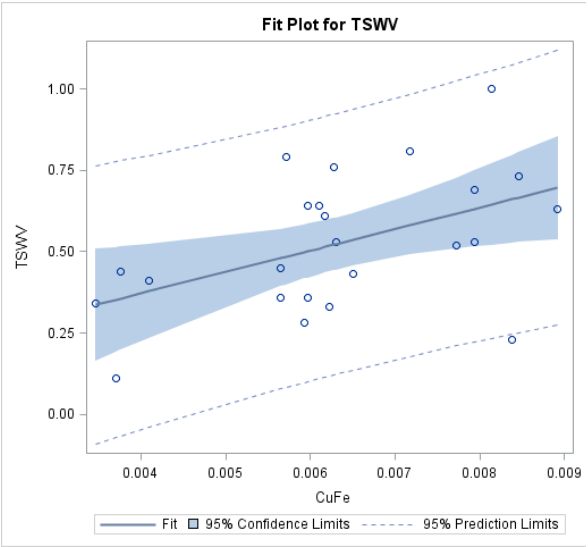


Fig. 3. Predictive model for year 1 with % TSWV of tobacco as the dependent variable and the copper:iron ratio (Cu:Fe) as the independent variable. ($P = 0.02$; $R^2 = 0.23$).

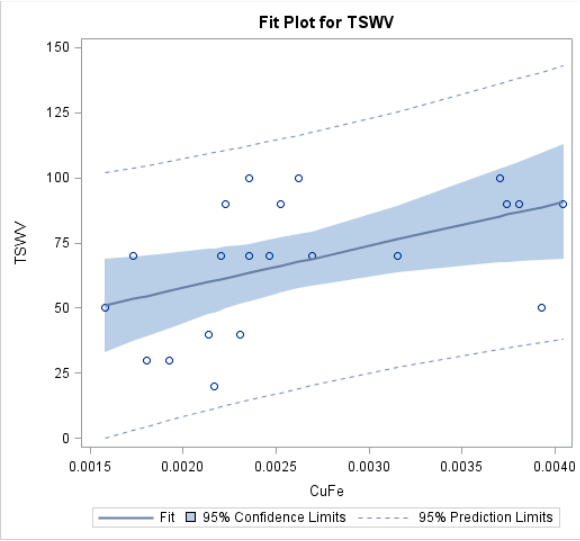


Fig. 4. Predictive model for year 2 with % TSWV of tobacco as the dependent variable and the copper:iron ratio (Cu:Fe) as the independent variable. ($P = 0.02$; $R^2 = 0.24$).

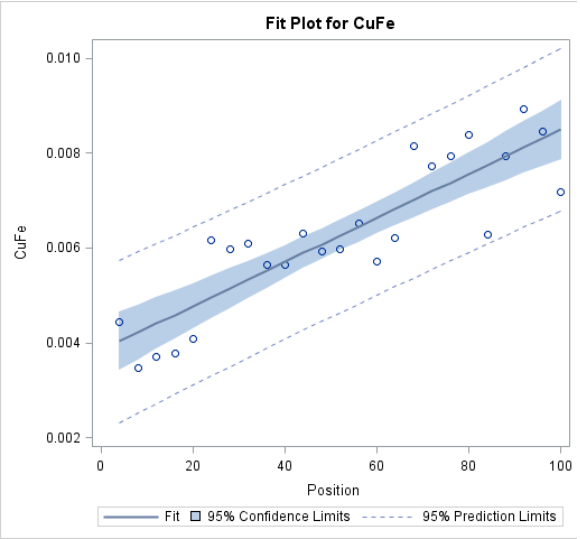


Fig. 5. Gradient of copper:iron ratio (dependent variable) in soil occurring north to south (position = independent variable) in a tobacco field for year 1. ($P = 0.0001$; $R^2 = 0.77$).

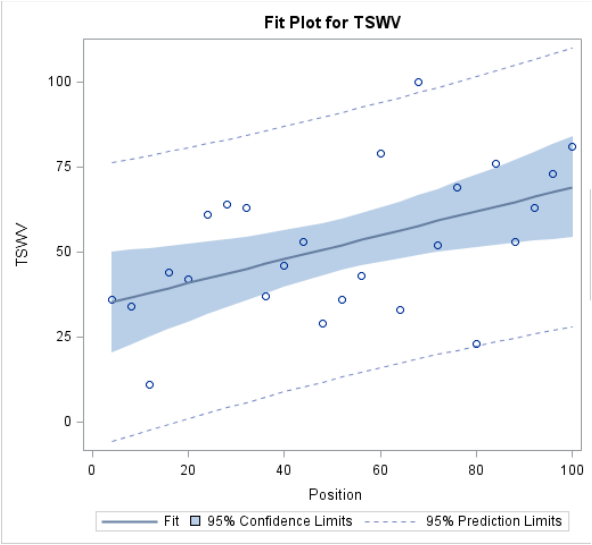


Fig. 6. Infection gradient of TSWV infected tobacco plants (dependent variable) occurring north to south (position = independent variable) in a tobacco field for year 1. ($P = 0.01$; $R^2 = 0.25$).

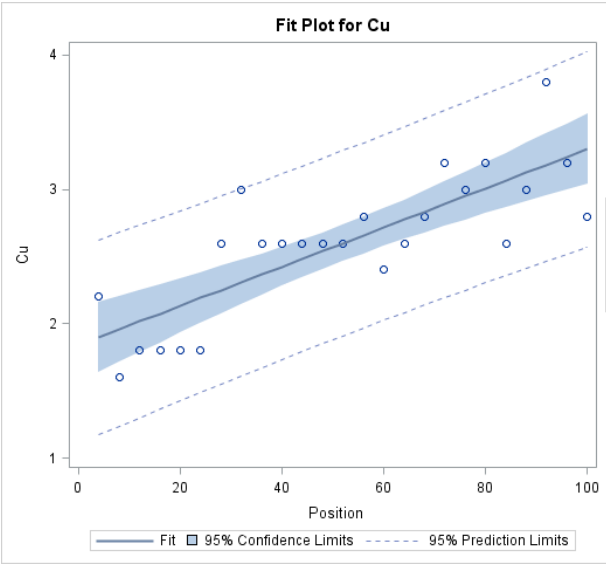


Fig. 7. Gradient of the soil copper levels (dependent variable) occurring north to south (position = independent variable) in a tobacco field for year 1. ($P = 0.0001$; $R^2 = 0.64$).

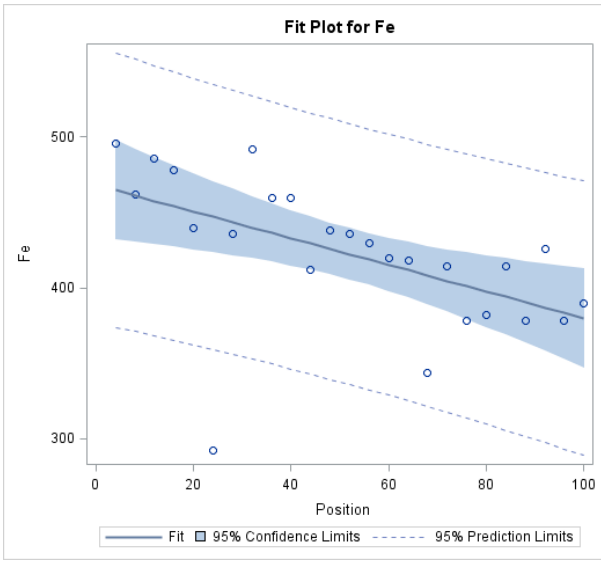


Fig. 8. Gradient of the soil iron levels (dependent variable) occurring north to south (position = independent variable) in a tobacco field for year 1. ($P = 0.005$; $R^2 = 0.30$).

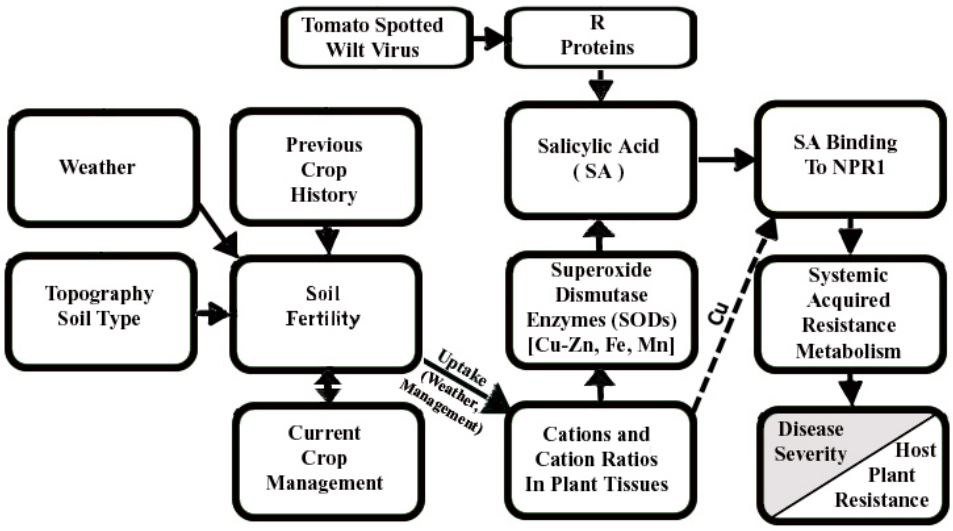


Fig. 9. Flow diagram relating field factors and management decisions used for crop production and how the results could affect systemic acquired resistance metabolism and the plant's response to infection with *Tomato spotted wilt virus*.

Special Bulletin 63-7 **January 2014**