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COLLEGE OF AGRICULTURAL & ENVIRONMENTAL SCIENCES

Tobacco Research Report

2012

2012 Tobacco Research Report

(Summary Report of 2012 Data)

Edited by Stephen W. Mullis

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Foreword

I have always appreciated the unique attributes of tobacco. As a child growing up in southern Maryland, I topped tobacco in the fields and worked in the stripping house. During the early part of my academic career, I had the opportunity to study nutrient losses from tobacco and the impact on water quality of the Chesapeake Bay. My perspective and appreciation of the crop continued to expand during this time. Tobacco is still the only crop I have worked with where "one plant" is important and makes a difference. I consider tobacco to be the king of all Southern crops.

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
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Introduction

In 2010 (the latest farm gate figures available), tobacco ranked in the top 30 commodities in Georgia with a farm gate value of $46,364,983. While the overall the farm gate value of tobacco was just 0.39 percent of Georgia's total farm gate value (just over $12 billion in 2010), locally, tobacco can be a significant component of the farm gate value. For example, in Coffee County in 2010, tobacco contributed $7.7 million to the county's $131.4 million total farm gate value.

Progress in developing better tobacco varieties facilitates more profitable tobacco production. Advances in disease management for black shank and root knot, and improved agronomic practices, are some highlights in this report.

Continued support of scientists' work to find ways to reduce production inputs, modify production practices and improve the profitability of tobacco production in Georgia will help keep tobacco an important contributing crop to the state's yearly farm gate value.

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Flue Cured Tobacco Variety Evaluation in Georgia

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

Introduction

Tobacco varieties play a pivotal role in yield and quality improvement programs. A vital part of any breeding program is the appropriate testing and evaluation of new tobacco varieties. Important characteristics of these varieties are yield, disease resistance, desirable plant qualities, ease of handling and market acceptability. For a variety to be recommended it must be superlative in one or more of these areas 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 that 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 selected from this test, Cooperative Extension personnel will have an additional data set to use in making recommendations to growers.

Materials and Methods

The 2012 Official Variety Test and Regional Small Plot Test consisted of 24 and 26 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 with Actigard (1 oz./100,000 cells) and imidacloprid (0.8 oz. Admire Pro/1,000 plants) for Tomato spotted wilt virus (TSWV) and followed with one field spray (April 25) of Actigard applied at 0.5 oz./A at the first sign of TSWV symptoms in non-treated border rows. The Official Variety Test was mechanically transplanted on April 3. The Regional Farm and Regional Small Plot Tests followed on April 4. All tests were transplanted with 22-24 plants per field plot and replicated three times. Fertilization consisted of 6 lbs./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 2012 Official Variety Test and Regional Farm Test produced average yields and good quality through moderate growing conditions. The tests benefitted from the application of Telone II, applied at the recommended rate, in October 2011 with good soil conditions, which kept nematode pressure to a minimum. In addition, a field spray of Actigard combined with the standard tray drench treatment and light disease pressure resulted in a test average of 2.3% TSWV symptomatic plants. However, inconsistent rains required 9 irrigations that delivered approximately 8 inches of water on top of 11.6 inches of rain that fell during the test period.

In the Official Variety Test, yield ranged from 2,365 lbs./A for GF 157 to 3,017 lbs./A for K 326. Value of released varieties ranged from $2,670/A for NC 2326 to $4,942/A for CC 700. Prices were up from 2011 with NC 2326 at $113/cwt at the low end while PVH 2110, at $178, had the best price per cwt for the released varieties. Grade index ranged from 55 for

NC 2326 to 86 for PVH 2110. Plant heights averaged near 40 inches while leaf numbers per plant were close to 20. Most flowering dates averaged eight or more days later than NC 2326, which was at 67 days. Leaf chemistry was excellent with sugars averaging in the upper teens and alkaloids generally below 2.5. The Official Variety Test data are displayed in Table 1. Two- and three-year averages for selected varieties are found in Table 2.

The 2012 Regional Farm Test yielded better and graded out lower than the other tests. In the Farm Test (Table 3), NC 2326 had the lowest yield at 2,572 lbs./A. NCEX 39 yielded the highest at 3,579 lbs./A. Value ranged from $2,964/A for NC 2326 to $5,476/A for ULT 113. ULT 113 graded the best, bringing in $162/cwt and having a grade index of 79. The lowest, CU 124, had a grade index of 52 with a price of $106/cwt. PXH 1 had the best leaf chemistry with low alkaloids (2.06%) and good sugars (17.0%). Generally, leaf chemistry was similar to the Official Variety Test, with sugars in the upper teens and alkaloids generally below 2.7.

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The authors would like to thank the Georgia Agricultural Commodity Commission for Tobacco for financial support. Also, thanks to Kari Giddens, Adam Mitchell, Justin Odom, Katie Summers and Mitchell Tucker for technical assistance.

Table 1. Yield, Value, Price Index, Grade Index, and Agronomic Characteristics of Released Varieties Evaluated in the 2012 Official Flue-Cured Variety Test at the University of Georgia, Tifton, Ga.

Variety	Yield (lb/A)	Value ($/A)	Price[1] Index ($/cwt)	Grade[2] Index	Number Leaves/ Plant	Plant Height (in)	Days to Flower	Total Alkaloids (%)	Reducing Sugars (%)	Ratio RS/TA
NC 2326	2373	2670	113	55	16	35.0	67	2.89	17.9	6.19
NC 95	2946	3482	119	58	19	41.1	75	3.70	15.8	4.28
K 326	3017	4461	148	70	19	37.7	79	2.11	19.0	9.01
K 346	2375	3305	140	70	19	40.1	76	2.21	18.4	8.34
K 399	2708	3833	141	73	19	37.7	74	2.31	19.4	8.37
NC 71	2550	3956	146	76	18	38.3	78	2.14	19.0	8.87
NC 72	2871	4026	140	70	17	37.8	76	1.87	19.1	10.18
NC 92	2825	3218	114	57	19	40.5	76	2.41	19.5	8.09
NC 196	2499	3937	159	78	18	37.5	80	2.04	19.7	9.68
NC 925	2791	4035	144	72	17	39.9	75	2.43	18.5	7.62
NC 297	2752	3659	132	66	19	36.1	77	2.26	17.3	7.64
CC 27	2628	3575	136	68	19	39.3	78	1.84	17.0	9.23
CC 33	2725	4529	165	81	19	39.2	78	2.29	18.0	7.88
CC 35	2963	4593	154	76	20	40.3	81	2.15	18.4	8.52
CC 37	2652	3592	134	66	19	38.2	79	1.99	18.8	9.47
CC 65	2781	3910	140	71	19	39.9	82	2.53	17.3	6.85
CC 67	2621	4271	162	80	20	40.0	73	2.52	14.6	5.80
CC 700	2985	4942	164	81	18	39.2	77	1.95	17.7	9.10
CC 1063	2599	4177	160	79	18	37.9	76	2.40	18.1	7.55
PVH 1452	2686	4340	161	80	19	39.7	78	2.30	17.8	7.72
PVH 2110	2727	4851	178	86	21	40.2	82	1.96	16.7	8.55

Table 1. Yield, Value, Price Index, Grade Index, and Agronomic Characteristics of Released Varieties Evaluated in the 2012 Official Flue-Cured Variety Test at the University of Georgia, Tifton, GA. *(continued)*

Variety	Yield (lb/A)	Value ($/A)	Price[1] Index ($/cwt)	Grade[2] Index	Number Leaves/ Plant	Plant Height (in)	Days to Flower	Total Alkaloids (%)	Reducing Sugars (%)	Ratio RS/TA
PVH 2254	2691	4672	174	85	19	39.3	79	1.96	21.7	11.06
PVH 2275	2589	4112	158	78	19	38.7	74	2.31	16.8	7.30
Speight 168	2822	4213	150	75	19	38.8	80	2.37	17.0	7.17
GL 338	2633	4340	165	81	18	38.8	72	2.38	17.4	7.30
GL 395	2446	3856	158	79	19	38.4	73	2.03	16.2	7.97
GF 157	2365	3522	148	73	19	38.5	74	2.25	15.2	6.73
GF 318	2975	4375	146	73	20	39.9	75	2.07	18.8	9.09
RJR 901	2424	3489	146	73	19	39.4	78	2.28	17.5	7.69
LSD@0.05	382.9	1140.7	30.9	14.2						

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

Table 2. Comparison of Certain Characteristics for Released Varieties Evaluated in the 2012 Official Flue-Cured Tobacco Variety Test at the University of Georgia, Tifton, Ga.

Variety	Yield (lb/A)	Value ($/A)	Price[1] Index ($/cwt)	Grade[2] Index	Number Leaves/ Plant	Plant Height (in)	Days to Flower	Total Alkaloids (%)	Reducing Sugars (%)	Ratio RS/TA
3 Year Average (2010, 2011 and 2012)										
NC 2326	2310	2844	123	61	17	36	66	2.64	14.5	5.45
NC 95	2616	3632	140	69	19	40	77	3.02	15.3	5.17
K 326	2933	4565	154	76	19	36	78	2.45	15.8	6.67
K 346	2663	3454	132	68	18	38	75	2.42	15.7	6.59
K 399	2830	3955	140	72	19	36	76	2.34	18.3	7.82
NC 71	2817	4067	143	74	19	36	77	2.32	16.5	7.19
NC 72	3002	3996	135	69	18	38	77	2.38	15.7	6.96
NC 92	3035	3394	114	60	19	40	77	2.65	16.2	6.28
NC 196	2975	4294	147	74	19	39	80	2.33	17.5	7.71
NC 297	2835	3788	135	69	19	36	78	2.58	16.5	6.56
CC 27	2930	3822	131	67	20	38	75	2.27	14.8	6.87
CC 37	3096	3994	130	66	17	40	79	2.18	17.1	7.92
CC 65[3]	3341	4076	122	64	20	41	82	2.71	15.1	5.65
CC 67	2676	3744	139	71	19	37	75	2.25	16.4	7.46
CC 700	3015	4442	147	74	19	38	76	2.61	16.4	6.63
PVH 1452	3086	4441	146	74	19	38	76	2.52	16.2	6.47
Speight 168	3033	4280	143	72	18	37	77	2.30	16.2	7.14
GL 338	2907	4158	145	70	18	38	71	2.59	16.4	6.37
GF 318	3257	4675	144	67	20	40	76	2.47	18.1	7.61

Table 2. Comparison of Certain Characteristics for Released Varieties Evaluated in the 2012 Official Flue-Cured Tobacco Variety Test at the University of Georgia, Tifton, Ga. *(continued)*

Variety	Yield (lb/A)	Value ($/A)	Price[1] Index ($/cwt)	Grade[2] Index	Number Leaves/ Plant	Plant Height (in)	Days to Flower	Total Alkaloids (%)	Reducing Sugars (%)	Ratio RS/TA
2 Year Average (2011 and 2012)										
NC 2326	2264	2460	109	54	17	35	66	2.72	15.8	5.78
NC 95	2836	3950	141	70	19	40	74	3.18	15.0	4.78
K 326	3046	4917	161	80	19	36	77	2.21	16.2	7.44
K 346	2745	3236	121	63	18	37	77	2.41	16.5	6.95
K 399	2970	3926	132	70	19	36	74	2.36	18.7	7.91
NC 71	2948	4172	138	73	18	37	78	2.28	17.0	7.55
NC 72	3050	3794	126	66	18	37	78	2.27	16.5	7.70
NC 92	3195	3187	101	54	20	40	78	2.80	17.0	6.32
NC 196	3069	4171	140	72	19	38	80	2.40	18.1	7.81
NC 297	3037	3877	128	67	19	36	78	1.71	16.7	6.40
CC 27	2945	3734	128	66	19	38	75	2.33	15.0	6.92
CC 37	3117	3795	123	64	19	39	79	2.07	18.1	8.76
CC 65	3075	3563	117	63	20	41	82	2.57	16.4	6.37
CC 67	2780	3829	137	71	19	39	74	2.22	16.6	7.75
CC 700	3170	4676	148	75	19	38	75	2.55	16.3	6.91
PVH 1452	3080	4261	141	73	19	38	76	2.50	17.1	9.93
Speight 168	3160	4320	138	71	19	38	78	2.17	16.8	7.82
GL 338	2954	4108	142	68	18	37	72	2.54	17.1	6.76
GL 395	2874	4085	144	75	19	38	76	2.21	15.6	7.14
GF 318	3304	4592	140	63	19	38	75	2.18	18.7	8.60

Table 3. Yield, Value, Price Index, Grade Index and Agronomic Characteristics of Varieties Evaluated in the 2012 Regional Farm Test at the University of Georgia, Tifton, Ga.

Variety	Yield (lb/A)	Value ($/A)	Price[1] Index ($/cwt)	Grade[2] Index	Number Leaves/ Plant	Plant Height (in)	Days to Flower	Total Alkaloids (%)	Reducing Sugars (%)	Ratio RS/TA
NC 2326	2572	2964	118	56	17	37.7	66	3.15	15.6	4.97
NC 95	3946	3644	123	61	19	40.2	74	2.59	17.2	6.65
K 326	3298	4438	135	67	20	17.3	71	2.74	17.8	6.50
CU 124	3163	3367	106	52	22	37.2	78	2.66	16.7	6.29
ULT 143	3291	3906	119	59	20	38.5	73	2.70	16.7	6.18
PXH 1	3081	3742	123	60	20	37.9	79	2.06	17.0	8.27
GLEX 362	3322	4601	139	69	21	38.4	71	2.67	17.5	6.57
NCEX 39	3579	3982	111	55	18	37.4	72	2.56	17.6	6.91
GLEX 328	3528	4800	137	67	19	38.5	74	2.23	17.4	7.80
CC 143	3356	4595	137	68	19	40.1	71	2.32	16.2	6.95
PXH 9	3541	4689	134	66	19	38.9	70	2.40	17.5	7.31
NCEX 24	3418	4541	133	66	18	39.8	74	2.46	18.2	7.39
ULT 113	3366	5476	162	79	18	38.8	69	2.63	16.9	6.42
CU 144	3174	4371	140	67	19	39.1	70	2.52	18.2	7.25
ULT 123	3426	5024	148	73	20	40.4	70	2.31	18.5	8.03
NC EX 38	3344	4264	127	64	19	38.5	70	2.40	17.1	7.13
LSD@0.05	265.3	745.2	26.1	12.4						

[1]Price Index based on two-year average (2011-2012) prices for U.S. government grades.
[2]Numerical values range from 1-99 for flue-cured tobacco based on equivalent grades – the higher the number, the higher the grade.
[3] Average of 2008, 2011 and 2012.

Evaluation of Fungicides and Cultivars for Management of Black Shank Disease

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Abstract

Black shank, caused by the soil-born pathogen *Phytophthora nicotianae* (Breda de Hann), Tucker (12), is a serious and devastating disease of tobacco (*Nicotiana tabacum* L.). Due to the increased population of race 1, there has been a need for different methods of management. Mefenoxam (Ridomil Gold), the more active isomer of metalaxyl, has showed a significant decline in sensitivity toward the pathogen *P. nicotianae* in Georgia. Three cultivars of tobacco were tested, including NC 71, K 326 and K 346. Each variety has a different level of resistance; NC 71 has resistance to race 0 but not 1, K 326 has low levels of resistance to both races and K 346 has moderate resistance to both races. Incorporated and applied with cultivars are chemical treatments including mefenoxam, fluopicolide (Presidio) and an experimental fungicide. Research was conducted on fields with a history of black shank and a known mixture of races 0 and 1. Mortality of each variety was assessed by recording disease incidence every two weeks after disease onset. Yield, plant heights and vigor ratings were also recorded as a comparison. The experimental chemical proved significant, having lower disease incidence than the standard mefenoxam treatment. The experimental fungicide (K 346) acquired 16.67% disease incidence, compared to the best standard mefenoxam (K 346) of 42.07% disease incidence. K 346 proved to be the prominent untreated variety in the test, having the lowest disease incidence of 80.30%. Using the experimental fungicide with variety such as K 346 should provide excellent management of black shank.

Introduction

Phytophthora nicotianae, a hemibiotrophic oomycete, causes a serious root and stem disease known as black shank. The result of the disease is devastating, causing wilting and eventually death (1, 3, 4, 5). Yield losses from black shank can be severe since the pathogen can infect all parts of the plant, including roots, stems and leaves. Current research states a reduced sensitivity level to metalaxyl (5, 7). This has initiated belief that the more active isomer mefenoxam (Ridomil Gold) may have become ineffective for disease control. Twenty-six isolates of *P. nicotianae* were highly resistant to mefenoxam in a study conducted by Hu (10). With a standard treatment such as mefenoxam showing lower efficacy on *P. nicotianae*, new control methods, including chemical control and variety resistance, must be incorporated together for adequate management. Traditionally, genes from the cigar tobacco variety Florida 301 (Fla 301; 2) have been the primary defense against black shank disease (8, 10). The *Ph* gene, which is a source of resistance obtained from tobacco variety Coker 371-Gold (C 371-G), is a complete genetic resistance against race 0 of *P. nicotianae* (2, 10). The origin of the gene has not yet been identified specifically, but breeding lines possessing the *Ph* gene were hybridized with NC 1071 and L8 breeding lines. NC 1071 (flue cured) and L8 (burley) genotypes are understood to posses qualitative resistance genes from *N. plumbaginifolia* and *N. longiflora* (4,8,10). Varieties with complete resistance to race 0 have caused selective disease pressure, creating a more aggressive resistant race 1 (3).

The objective of this work was to evaluate a management plan that includes cultivars with different characteristics, the standard chemical treatment mefenoxam and other new chemicals that are proposed to have exceptional control of black shank. The research conducted should prove which chemical treatment is ideal regardless of what variety is incorporated with the management program. It will also demonstrate which variety has superior resistance to the pathogen.

Materials and Methods

The study was located at the Black Shank Farm, CPES, Tifton, Ga., in a field with a history of black shank of tobacco. Plots were arranged in a randomized complete block design and treatments were replicated five times. Each plot was 35 ft. with an average of 22 plants per test plot. On January 25, 2012 all tobacco varieties were seeded in the greenhouse in 242-cell flats. Seeding was achieved using a machine specifically designed for 242-cell flats. The field was prepared by disk harrowing the area on February 21, 2012. Fertilizer (4-8-12) was broadcast at 500 lbs./A on March 13, 2012, and Prowl 1.5 pt./A plus Lorsban 2 qts./A was rototilled incorporated on March 15, 2012 prior to planting.

Tobacco varieties were treated seven days prior to planting with imidacloprid (Admire Pro, Bayer Cropscience) 1 fl. oz./1,000 plants and acibenzolar-S-methyl (Actigard 50WG, Syngenta) 1 g./7,000 plants. Both materials were tank mixed with 80 ml. of water per number of flats. Plants were irrigated prior to application and products watered-in according to label instructions. Tobacco varieties were then transplanted on April 3, 2012 on 48-inch-wide rows with 18-inch plant spacing. Each variety was supplemented with three different chemical treatments and an untreated check for comparison. Chemical applications consisted of mefenoxam (Ridomil Gold 4SC), fluopicolide (Presidio 4SC) and an experimental fungicide. Varieties used were NC 71, K 346 and K 326 since they all have different levels of resistance to P. nicotianae. NC 71 has tolerance to race 0 because of the Ph gene, K 346 has a moderate level of horizontal resistance and K 326 has low horizontal resistance. All treatments were applied at plant, first cultivation and layby. At-plant and first cultivation applications were applied on a 6-inch band. Layby treatments were applied by post directing both sides of each row simulating an actual layby application. These applications were applied using a CO2 pressurized sprayer at 19.02 gal./A, at 35 psi. Rynaxypr (Coragen) was applied at 5 oz./A in transplant water for control of insects.

Tobacco was topped and suckered one day prior to each application of sucker control chemical. Sucker control chemicals were applied on May 30, 2012 (Royal Tac 1.5 gal./A), June 6, 2012 (Royal Tac 1.5 gal./A), June 14, 2012 (Royal Tac 1 gal./A plus 2 qts./A of Flupro) and June 22, 2012 (1 gal./A of Sucker Plucker was applied for the final application). Orthene (acephate) was applied at 1 lb./A with each sucker control application accordingly for insect control. Disease incidence was recorded on each variety by counting the number of infected plants every two weeks starting on May 7, 2012 and ending on July 25, 2012. Disease incidence was then divided by the stand count and multiplied by 100 to give an average percent of incidence for each two-week interval. The average disease incidence was evaluated over time for each variety. Since Tomato Spotted Wilt Virus (TSWV) is a prevalent problem in tobacco, incidence was determined for viral infection as well. These TSWV-infected plants were not used in disease incidence calculations. If a plant infected with TSWV became infected with black shank, it was counted as black shank. Vigor ratings were assessed using a 1-10 scale, with 10 being a healthy plant and 1 being dead or dying. Vigor ratings were taken April 23, 2012, May 7, 2012 and May 21, 2012. Height measurements were taken on April 30, 2012 to correlate with vigor ratings. Ten plants were chosen arbitrarily in each plot to be measured. The average of each plot was used for the final value recorded. Yield was recorded in three separate harvests, taking one-third of the leaves from the bottom to the top at each harvest. Harvesting occurred on June 19, 2012, July 2, 2012 and July 18, 2012. Green weight was recorded in the field and then converted into pounds per acre using the formula lbs./A= (GW(.15))X 7,260(BC) GW=green weight, .15=dry weight conversion, 7,260=number of plants per acre, and BC=base count of plants per plot. Yields for each date were compared as well as total yield for each treatment. All statistical analysis was interpreted using Fisher's least significant difference (LSD) procedure. This is a two-step testing procedure for pairwise comparisons of several treatment groups. In the first step of the procedure, a global test is performed for the null hypothesis that the expected means of all treatment groups under study are equal (13).

Discussion and Results

At the final rating, disease incidence ranged from 16.67% to 94.09% in the field. Ridomil Gold treatments proved to be insufficient at managing black shank throughout the field. This suggests that selective pressure and poorly integrated management strategies could have selected out biotypes with supplementary tolerance to the fungicide mefenoxam. The experimental fungicide, referred to as "DX" in this situation, demonstrated high efficacy against the pathogen across the field. With only 16.67% disease incidence using the variety K 346 and applications of DX, this treatment proved to be the paramount of the experiment. Presidio was also an effective chemical application, being significantly different from the variety NC 71 but not others. Yield data correlates with disease incidence with the exception of variety K 326 treated with Ridomil Gold, being significantly different with a lower disease incidence percentage. Disease incidence on treatments increased significantly between June 18 and July 5, suggesting a loss in fungicide activity or solubility characteristics that are undesirable for residual control. DX seems to be less soluble with less disease incidence between these dates. A rotation of Presidio and DX incorporated with a moderately resistant variety could be considered in the near future for integrated disease management of black shank.

Figure 1. Evaluation of Fungicides and Cultivars for Resistance to Black Shank. % Final Black Shank Incidence, Plant Height, Vigor, Total Dry Weight Yield in lbs./A. - Black Shank Farm 2012

Treatments[1]	Cultivars	% Final Black Shank Incidence	Average Plant[2] Height (cm)	Vigor (1-10)[3]	Total Yield Dry Weight lbs./Acre[4]
1. None	NC 71	94.09a	43.52bc	9.47a	886d
2. Ridomil Gold 4	NC 71	78.96ab	47.24ab	9.47a	2115abc
3. DX	NC 71	27.71de	45.06bc	9.47a	2836a
4. Presidio 4SC	NC 71	51.64cd	43.52bc	9.20ab	2293ab
5. None	K-346	80.30ab	41.84c	8.53b	1313cd
6. Ridomil Gold	K-346	42.07cde	46.92ab	8.93ab	2175ab
7. DX	K-346	16.67e	46.52abc	9.07ab	2915a
8. Presidio 4SC	K-346	31.23de	46.10abc	9.13ab	2403ab
9. None	K-326	92.03a	44.54bc	8.93ab	883d
10. Ridomil Gold	K-326	58.00bc	45.00bc	8.93ab	1769bc
11. DX	K-326	64.81bc	47.20ab	9.47a	2354ab
12. Presidio 4SC	K-326	61.06bc	50.48a	9.60a	2660a

[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 ratings were taken on a 1-10 scale, 10 being a healthy plant, 1 being dead.
[3]Average Plant Height was measured in centimeters.
[4]Yield was converted from green weight to dry weight lbs./A using the formula lbs./A = GW(0.15)*7260/ BC. GW=Green Weight, 0.15=conversion from green weight to dry weight, 7,260=plants in an acre, BC=Base Stand Count.

Figure 2. Evaluation of Tobacco Varieties for Resistance to Black Shank. % Final Black Shank Incidence by Date

Treatments[1]	Cultivars	5/7/12	5/21/12	6/4/12	6/18/12	7/5/12	7/25/12
1. None	NC 71	0.00b	0.00a	34.14a	61.13a	81.74a	94.09a
2. Ridomil Gold 4SL	NC 71	0.00b	0.91a	4.73b	32.34bc	59.17abc	78.96ab
3. DX	NC 71	0.87a	1.74a	3.77b	3.19e	17.42de	27.71de
4. Presidio 4SC	NC 71	0.00b	0.00a	3.65b	18.67cde	37.75cd	51.64cd
5. None	K-346	0.00b	1.18a	9.18b	46.39ab	65.97ab	80.30ab
6. Ridomil Gold 4SL	K-346	0.00b	0.00a	0.00b	6.90de	27.73de	42.07cde
7. DX	K-346	0.00b	0.00a	0.95b	0.95e	3.86e	16.67e
8. Presidio 4SC	K-346	0.00b	0.00a	1.91b	9.50de	19.41de	31.23de
9. None	K-326	0.00b	0.87a	45.46a	68.35a	85.89a	92.03a
10. Ridomil Gold 4SL	K-326	0.00b	0.00a	3.13b	28.67bcd	39.98bcd	58.00bc
11. DX	K-326	0.00b	0.00a	4.33b	18.32cde	43.09bcd	64.81bc
12. Presidio 4SC	K-326	0.00b	0.00a	0.00b	7.96de	35.47cd	61.06bc

[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.

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Evaluation of Tobacco Varieties for Resistance to Black Shank Disease

E.D. Beasley, A.S. Csinos, L.L. Hickman

Abstract

Black shank (*Phytophthora nicotianae*, (Breda de Hann), Tucker (10)) is a persistent soil-borne disease of tobacco in the Coastal Plain fields of Georgia. The introduction of tobacco (*Nicotiana tabacum* L.) varieties with resistance to race 0 of *Phytophthora nicotianae* has led to an increased population of race 1 in Georgia tobacco fields. Since the inevitable effect of selective pressure from varieties with vertical resistance to race 0, there has been a need for varieties capable of high tolerance levels with horizontal resistance to race 1; vertical resistance being a single gene defense and horizontal resistance consisting of different locations and resistant strategies. Research was conducted in a field with a history of tobacco grown for 50 years and a mixture of both race 0 and race 1. Experiments were conducted using a selection of varieties with variable resistance to black shank, as well as four chemical applications on the variety K-326, which has no resistance to either race. Most varieties were developed with the *Php* (*Php*=race 0 resistance) gene and Florida 301 resistance (horizontal resistance to both races). The mortality of each variety was assessed by recording disease incidence every two weeks after disease onset. Yield, plant heights and vigor ratings were also recorded as a comparison. Tobacco variety Speight 225 proved to be highly resistant to black shank with only 21% average mortality throughout the growing season. The standard chemical treatment of mefenoxam (Ridomil Gold) resulted in an 83% average mortality, with the standard variety (K-326) untreated having 97% average mortality. SP 225 proved to have resistance to black shank outperforming all other treatments and varieties.

Introduction

Phytophthora nicotianae is a serious soil-borne pathogen of tobacco (*Nicotiana tabacum*) that causes black shank disease (2, 3, 4, 5, 6). Yield losses from this pathogen can occur on all types of tobacco around the world. *P. nicotianae* can infect all parts of the plant including roots, stems and leaves, making it a pathogen that is very difficult to control. Recent research has proposed a reduced sensitivity level to metalaxyl (4), making the more active isomer mefenoxam (Ridomil Gold) also likely to become ineffective. Fungicide resistance has led researchers to develop varieties resistant to black shank. Historically, genes from the cigar tobacco variety Florida 301 (Fla 301;1) have been the primary source of resistance used in controlling losses from *P. nicotianae* (7,8). Tobacco breeders have also identified another source of resistance found in the flue-cured tobacco variety Coker 371-Gold (C 371-G), which contains the *Php* gene. This cultivar is highly resistant to race 0 but only has moderate levels of resistance to race 1 (1,7). The *Php* gene initiates high resistance to black shank disease caused by race 0 of *P. nicotianae*. The origin of the gene has not yet been identified specifically, but breeding lines possessing the *Php* gene were hybridized with NC 1071 and L8 breeding lines. NC 1071 (flue-cured) and L8 (burley) genotypes are understood to posses qualitative resistance genes from *N. plumbaginifolia* and *N. longiflora* (3,7,9). Varieties with complete resistance to race 0 have caused selective disease pressure, creating a more aggressive resistant race 1 (2).

The objective of this work was to evaluate new varieties that have been marketed as having different types of resistance to race 0 and race 1 of *P. nicotianae*. These varieties, having been tested in a black shank nursery with a history of tobacco monoculture for more than 50 years, were evaluated under high disease pressure. Varieties that performed well in this situation will be more likely to perform in grower fields with varying levels of inoculum.

Materials and Methods

The study was located at the Black Shank Nursery, CPES, Tifton, Ga., in a field with a 50-year history of black shank of tobacco. Plots were arranged in a randomized complete block design and treatments were replicated six times. Each plot was 35 feet with an average of 20 plants per test plot. On January 25, 2012 all tobacco varieties were seeded in the greenhouse in 242-cell flats. Seeding was achieved using a machine specifically designed for 242-cell flats. The field was prepared by disk harrowing the area on February 21, 2012. Fertilizer 4-8-12 was broadcast at 500 lbs./A (March 13, 2012) and Prowl 1.5 pints/A plus Lorsban 2 quarts/A (March 15, 2012) and was rototilled incorporated prior to planting.

Tobacco varieties were treated seven days prior to planting with imidacloprid (Admire Pro, Bayer Cropscience) 1 fl. oz./1,000 plants and acibenzolar-S-methyl (Actigard 50WG, Syngenta) 1g/7,000 plants. Both materials were tank mixed with 80 ml of water per number of flats. Plants were irrigated prior to application and products watered-in according to label instructions. Tobacco varieties were then transplanted on March 30, 2012 on 48-inch-wide rows with an 18-inch plant spacing. Four chemical treatments consisting of metalaxyl (Acquire, BASF), mefenoxam (Ridomil Gold, Syngenta), an experimental fungicide and fluopicolide (Presidio, Valent) were applied on the standard variety (K-326). All four chemical applications were applied pre plant incorporated, over the top at first cultivation and at layby. Fungicide PPI treatments were applied at 22 gal./A the same day prior to planting. Rynaxypyr (Coragen, DuPont) 5 oz./A was applied in transplant water at plant for control of insects. First cultivation treatments were applied on April 25, 2012 in a 6-inch band at 19.02 gal./A, 35 psi with a CO_2 pressurized sprayer. Layby treatments with the same fungicides were applied on May 9, 2012 at 19.02 gal./A, 35 psi with a CO_2 pressurized sprayer. Treatments were applied to simulate an actual layby application by post-directing spray on both sides of each row.

Cultivation took place on the following dates: April 4, April 25, May 3, and May 9, 2012. Calcium nitrate (15.5-0-0) was applied at 150 lbs./A for the first three applications and 200 lbs./A for the fourth application. Additional maintenance sprays were applied, including an application of acibenzolar-S-methyl (Actigard 50WG, Syngenta) at 0.5 oz./A and Rynaxypyr (Coragen, DuPont) at 7 oz./A on April 24, 2012. Methomyl (Lannate 4E, DuPont) was applied at 24 oz./A on May 16, 2012 for control of insects.

Tobacco was topped and suckered one day prior to each application of sucker control chemical. Sucker control chemicals were applied on May 30, 2012 (Royal Tac 1.5 gal./A), June 6, 2012 (Royal Tac 1.5 gal./A), June 14, 2012 (Royal Tac 1 gal./A plus 2 quarts/A of Flupro) and June 22, 2012 (1 gal./A of Sucker Plucker was applied for the final application). Orthene (acephate) was applied at 1 lb./A with each sucker control application, accordingly, for insect control.

Eleven varieties with partial or complete resistance to P. nicotianae races 0 or 1 were evaluated. These varieties consisted of: K-326, K-346, NC 810, SP 225, SP 227, SP 234, SP 236, NC 71, PXH 14, CC65 and CC 35. Disease incidence was recorded on each variety by counting the number of infected plants every two weeks starting on May 7, 2012 and ending on July 5, 2012. Disease incidence was then divided by the stand count and multiplied by 100 to give an average percent of incidence for each two-week interval. The average disease incidence was evaluated over time for each variety. Since Tomato Spotted Wilt Virus (TSWV) is a prevalent problem in tobacco, incidence was determined for viral infection as well. These TSWV-infected plants were not used in disease incidence calculations. If a plant infected with TSWV became infected with black shank, it was counted as black shank. Vigor ratings were assessed using a 1-10 scale, with 10 being a healthy plant and 1 being dead or dying. Vigor ratings were taken April 20, 2012, May 5, 2012 and May 18, 2012. Height measurements were taken on April 30, 2012 to correlate with vigor ratings. Ten plants were chosen arbitrarily in each plot to be measured. The average of each plot was used for the final value recorded. Yield was recorded in three separate harvests, taking one-third of the leaves from the bottom to the top each harvest. Harvesting occurred on June 15, 2012, June 27, 2012 and July 12, 2012. Green weight was recorded in the field and then converted into pounds per acre using the formula lbs./A=(GW(.15))X 7,260(BC) GW=green weight, .15=dry weight conversion, 7,260=number of plants per acre and BC=base count of plants per plot. Yields for each date were compared as well as the total yield for each treatment. All statistical analysis was interpreted using Fisher's least significant difference (LSD) procedure. This is a two-step testing procedure for pairwise comparisons of several treatment groups. In the first step of the procedure, a global test is performed for the null hypothesis that the expected means of all treatment groups under study are equal (11).

Discussion and Results

In the field, disease incidence ranged from 21.58% to 100% by the final rating. All varieties are commercially advertised as having some level of resistance to black shank disease. SP 225 ((Speight 168 x K346) X (A95 X Speight 168)) is the only variety that was proposed to have a very high resistance rating commercially. Disease incidence suggests that SP 225 is a superior variety with tolerance of black shank disease, and proves the commercial rating is correct. Yield data correlates with disease incidence throughout the season, while vigor ratings and height measurements have no prevalence in the final result. With a field history of both race 0 and 1 of *Phytophthora nicotianae* it is possible to assume that SP 225 has horizontal resistance to both races considering how well it performed in the field. In conclusion, a variety such as Speight 225 should be evaluated more closely for genetic resistance to both races of *P. nicotianae*, and could be considered a key piece in the puzzle to solving a management strategy to control race 1.

Figure 1. Evaluation of Tobacco Varieties for Resistance to Black Shank. % Final Black Shank Incidence, Plant Height, Vigor, Total Dry Weight Yield in lbs./A. - Black Shank Nursery 2012

Treatments[1]	% Final Black Shank Incidence	Average Plant Height (cm)	Vigor (1-10)	Total Yield Dry Weight lbs./Acre
Acquire 2.65SC (K-326)	74.63bcd	48.067cde	7.5de	1673abc
Ridomil Gold 4SL (K-326)	83.15ab	56.450ab	8.89abc	1361bc
DX (K-326)	72.21bcd	48.833cde	8.06bcde	1764abc
Presidio 4SC + DX (K-326)	64.18bcd	50.093bcde	7.78bcde	1921ab
Untreated (K-326)	96.96a	46.017e	7.39de	438de
K- 346	66.17bcd	52.917bcd	8.28abcd	1352bc
NC 810	70.72bcd	45.950e	7.67cde	1158cd
SP 225	21.58e	53.083bcd	8.78abc	2347a
SP227	60.45cd	45.700e	6.94e	1366bc
SP 234	81.27abc	54.233bc	9.39a	1085cd
SP 236	56.85d	47.650de	7.72bcde	1516bc
NC 71	81.68abc	50.333bcde	8.34abcd	1229bc
PXH 14	68.05bcd	54.033bcde	8.95ab	1321bc
CC 65	100a	60.933a	9.5a	90e
CC 35	100a	55.717ab	8.94ab	110e

[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]Average Plant Height was measured in centimeters.
[3]Vigor ratings were taken on a 1-10 scale, 10 being a healthy plant, 1 being dead.
[4]Yield was converted from green weight to dry weight lbs./A using the formula lbs./A = GW(0.15)*7260/ BC. GW=Green Weight, 0.15=conversion from green weight to dry weight, 7,260=plants in an acre, BC=Base Stand Count.

Figure 2. Evaluation of Tobacco Varieties for Resistance to Black Shank. % Final Black Shank Incidence by Date

Treatments[1]	5/7/12	5/21/12	6/4/12	6/18/12	7/5/12
1.Acquire 2.65SC (K-326)	0.93b	3.20c	16.80efg	47.99cd	74.63bcd
2.Ridomil Gold 4SL (K-326)	0.00b	0.00c	6.86fg	56.22cd	83.15ab
3.DX (K-326)	3.13b	8.04c	17.56ef	44.20d	72.21bcd
4.Presidio 4SC + DX (K-326)	0.00b	2.17c	16.51efg	39.62d	64.18bcd
5.Untreated (K-326)	0.00b	4.68c	61.80b	84.68ab	96.96a
6.K- 346	0.00b	1.59c	22.35de	50.92cd	66.17bcd
7.NC 810	1.04b	3.89c	21.47def	50.79cd	70.72bcd
8.SP 225	0.00b	0.83c	2.59g	13.30e	21.58e
9.SP227	0.00b	1.67c	16.90efg	43.77d	60.45cd
10.SP 234	3.49b	7.71c	37.97c	68.88bc	81.27abc
11.SP 236	0.00b	0.00c	14.52efg	39.53d	56.85d
12.NC 71	0.00b	3.07c	34.92cd	59.77cd	81.68abc
13.PXH 14	0.00b	1.55c	20.25efg	53.05cd	68.05abc
14.CC 65	10.89a	39.65a	100.00a	100.00a	100.00a
15.CC 35	8.50a	26.67b	91.93a	100.00a	100.00a

[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.

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Evaluation of Tobacco Varieties for Resistance to Root-knot Nematode

E.D. Beasley, A.S. Csinos, L.L. Hickman

Abstract

Root-knot nematodes are a serious problem in tobacco (*Nicotiana tabacum* L.) production. Nematode damage can affect yield tremendously, creating a need for pest management strategies incorporating resistance to this pathogen. Eleven varieties were evaluated in a field with a history of root-knot nematode (*Meloidogyne* spp.) for resistance or tolerance. Varieties included were: CC 13, CC 27, CC 33, CC 35, CC 67, CC 700, CC 65, PXH 10, PVH 2340, XHN 54 and NC 71. NC 71 was also treated with Telone II (a fumigant used for nematode management) for comparison. All varieties are reported to have a variable level of "resistance" to root-knot nematode commercially. The success of each variety was assessed by evaluating root galls in correlation with soil samples, vigor, plant height and yield. Tomato Spotted Wilt Virus (TSWV) occurrence was recorded and subtracted from the base count of each plot so that an accurate yield evaluation could be determined. NC 71 with an application of Telone was the most successful treatment, as expected. Varieties that yielded extremely well under heavy nematode pressure were PVH 2340, XHN 54 and CC 33. Interestingly, CC 33 and CC35 proved to be statistically the same as NC 71 (Telone II) when compared at the final gall rating, suggesting a level of resistance.

Introduction

Root-knot nematode (*Meloidogyne* spp.) is a major problem in tobacco (*Nicotiana tabacum*) around the world (Golden). Damage can be so severe that, as described by Clayton, "plants were so weak in late season from decay of galled roots that they often supported minute growth of suckers" (5). Yield losses from root-knot nematode can exceed 10% annually if not managed correctly (21). Fumigants are the primary control method of nematodes in tobacco (4, 6, 9, 13, 14). Although fumigants work well, price increases and limited availability of fumigants have encouraged a more sustainable approach to nematode management, such as resistant varieties correlated with crop rotation. Research proves that root-gall incidence has direct relations to yield data (4, 6, 13, 14). Varieties with resistance will ultimately have minute incidence of galling, although varieties with tolerance could have significant galling with adequate yield. Both "tolerant" and "resistant" varieties will have a key role in any integrated pest management program for nematode control.

The objective of this work was to evaluate new varieties that have been marketed as having different levels of resistance or tolerance to *Meloidogyne* spp. Having been tested in a field notorious for root-knot nematode damage, these varieties were evaluated under the most strenuous conditions. Varieties that performed well under high nematode pressure will prove to be applicable for growers with nematode problems across the Southeast.

Materials and Methods

The study was located at the Bowen Farm, CPES, Tifton, Ga. Plots were arranged in a randomized complete block design and treatments were replicated five times. Each plot was 35 feet x 44 inches with an average of 22 plants per test plot. On January 25, 2012, all tobacco varieties were seeded in the greenhouse in 242-cell flats. Seeding was achieved using a machine specifically designed for 242-cell flats. All applications were made according to University of Georgia standards.

The field was prepared by disk harrowing the area on February 21, 2012. Prowl 38 oz./A plus Lorsban 2 qts./A was rototilled incorporated prior to planting on March 1, 2012. Tobacco varieties were treated seven days prior to planting with imidacloprid (Admire Pro, Bayer Cropscience) 1 fl. oz./1,000 plants and acibenzolar-S-methyl (Actigard 50WG, Syngenta) 1g/7,000 plants. Both materials were tank mixed with 80 ml of water per number of flats. Plants were irrigated prior to application and products watered-in according to label instructions. Tobacco varieties were then transplanted on March 23, 2012 with 7 oz./A of Rynaxypyr (Coragen, DuPont) plus 9-45-14 at 6 lbs./A at 200 gal./A transplant water. Telone II was applied at 6 gal./A on March 9, 2012 to plots intended for treatment. Fertilizer (6-6-18) was broadcast at 700 lbs./A (April 11, 2012) and 500 lbs./A (May 4, 2012). Calcium nitrate (15.5-0-0) was broadcast at lay-by (150 lbs./A) on May 11, 2012. Additional maintenance sprays were applied, including an application of acibenzolar-S-methyl (Actigard 50WG, Syngenta) at 0.5 oz./A at 20 gal/A on April 23, 2012 for protection against TSWV.

Tobacco was topped and suckered one day prior to each application of sucker control chemical. Sucker control chemicals were applied on June 6, 2012 (Sucker Plucker (1 octanol and 1 decanol mixture 6.01 to 6.04 lbs./gal.) 4% 2 gal./A), June 22, 2012 (Sucker Plucker 5% 2.5 gal./A), June 26, 2012 (Sucker Plucker 5% 2.5 gal./A) and July 2, 2012 (0.5 gal./A of MH (maleic hydrazide) was applied for the final application). All applications were applied at 50 gal./ A.

Eleven varieties with tolerance or resistance to *Meloidogyne* spp. were evaluated. These varieties consisted of: CC 13, CC 27, CC 33, CC 35, CC 67, CC 700, CC 65, PXH 10, PVH 2340, XHN 54 and NC 71. Properties of a variety having resistance was evaluated by using a root gall rating system described by Zeck (17). This scale is described as a 0-10 scale where 0=No Galls, 1=very few small galls, 2=numerous small galls, 3=numerous small galls of which some are grown together, 4=numerous small 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, and 10=plants and roots dead. Yield was recorded in three separate harvests, taking one-third of the leaves from the bottom to the top each harvest. Harvesting occurred on June 21, July 3 and July 19, 2012. Green weight was recorded in the field and then converted into pounds per acre using the formula lbs./A=(GW(0.15))X 7,260(BC) GW=green weight, 0.15=dry weight conversion, 7,260=number of plants per acre, and BC=base count of plants per plot. Yields for each date were compared as well as total yield for each treatment. High yield correlated with severe galling shows evidence of having significant tolerance to the pathogen. Eight to 10 cores of soil, 2.5 cm were collected from each plot randomly at mid-season and final harvest. Soil sub-samples (200 cm^3) were used for extraction using a centrifugal sugar flotation technique; *Meloidogyne* spp. were then counted to prove the density of the pathogen in each row. Vigor ratings were assessed using a 1-10 scale, with 10 being a healthy plant and 1 being dead or dying. Vigor ratings were taken April 13, April 27 and May 11, 2012. Height measurements were taken on May 10, 2012 to correlate with vigor ratings. Ten plants were chosen arbitrarily in each plot to be measured. The average of each plot was used for the final value recorded. Since Tomato Spotted Wilt Virus (TSWV) is a prevalent problem in tobacco, incidence was determined for viral infection. Plants infected with TSWV were not used in the nematode evaluation procedure. All statistical analysis was interpreted using Fisher's least significant difference (LSD) test. This is a two-step testing procedure for pairwise comparisons of several treatment groups. In the first step of the procedure, a global test is performed for the null hypothesis that the expected means of all treatment groups under study are equal (10).

Discussion and Results

Final evaluation of average root gall ratings concluded in a range of 2.7 low to 8.5 high. As expected, being the only nematicide treatment, Telone II (NC 71) had the best control with a 2.7 average final gall rating and 3,604 lbs./A total yield for the season. Yield for this treatment was statistically different than all other varieties present in the trial. Yielding very well without chemical applications were varieties PVH 2340, CC 33 and XHN 54 at 3,031 lbs./A, 2,999 lbs./A and 2,997 lbs./A, respectively. Varieties CC 35 and CC 33 had final average gall ratings statistically the same as Telone II. Results of this research show different attributes that are critical in a variety for management of root-knot nematode. Having low root gall ratings as well as high yield, CC 33 should be a variety considered for use for root-knot control, but not without consideration of fellow varieties in the test. Although PVH 2340 and XHN 54 did not have lower root gall ratings, yield calculations were very high, suggesting that these varieties have some tolerance of root-knot damage.

Overall, most varieties did well against high pressure from the pathogen with no chemical treatment. Telone II is a great fumigant for nematode control and performs statistically better than every other variety, but with decline in the use of this product, top varieties in this trial, rotated in the right perspective, will fill the void and provide growers with adequate control at less expense.

Figure 1. Evaluation of Tobacco Varieties for Resistance to Root-knot Nematode. Vigor, Plant Height, Average Final Yield in lbs./A. - Bowen Farm 2012

Treatments[1]	Vigor (1-10)[2]	Plant Heights (cm)[3]	Average Final Yield lbs./A[4]
CC 13	9.40a	42.52abc	2892abc
CC 27	8.93a	37.24bc	2590bc
CC 33	9.47a	43.28abc	2999ab
CC 35	9.67a	45.04a	2844abc
CC 67	9.00a	36.40c	2157c
CC 700	9.07a	42.00abc	2528bc
CC 65	9.27a	41.12abc	2688bc
PXH 10	9.27a	42.58abc	2900abc
PVH 2340	9.67a	44.06ab	3031ab
XHN 54	9.40a	42.50abc	2997ab
NC 71	9.27a	40.30abc	2442bc
NC 71 + TELONE	9.27a	42.62abc	3604a

[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 ratings were taken on a 1-10 scale – 10 being a healthy plant, 1 being dead.
[3]Average Plant Height was measured in centimeters.
[4]Yield was converted from green weight to dry weight lbs./A using the formula lbs./A = GW(0.15)*7,260/ BC. GW=Green Weight, 0.15=conversion from green weight to dry weight, 7,260= plants in an acre, BC=Base Stand Count.

Figure 2. Evaluation of Tobacco Varieties for Resistance to Root-knot Nematode. Gall ratings (Zeck's scale (1-10), soil samples.

Treatments[1]	Average Mid-season Gall[2]	Average Mid-season Soil[3]	Average Final Gall[2]	Average Final Soil[3]
CC 13	2.40abdc	42a	5.67abc	408ab
CC 27	3.73ab	42a	8.20a	846a
CC 33	1.13cd	36a	3.40c	168ab
CC 35	0.87cd	18a	3.13c	56b
CC 67	3.22abc	42a	8.27a	150b
CC 700	3.27abc	26a	8.47a	384ab
CC 65	2.80abcd	26a	6.93ab	358ab
PXH 10	3.27abc	18a	8.20a	638ab
PVH 2340	2.13abcd	44a	4.53bc	246ab
XHN 54	1.40bcd	8a	5.73abc	200ab
NC 71	4.47a	44a	8.47a	364ab
NC 71 + TELONE	0.60d	14a	2.67c	688ab

[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]Gall Ratings (Zeck's scale 1-10) 0=No Galls, 1=very few small galls, 2=numerous small galls, 3=numerous small galls of which some are grown together, 4=numerous small 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, and 10=plants and roots dead.

[3]Eight to 10 cores of soil, 2.5 cm, were collected from each plot randomly. 200 cm^3 soil sub-samples for extraction using a centrifugal sugar flotation technique.

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Regional Chemical Sucker Control Test

S. S. LaHue, C. E. Troxell, 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) has increased in Georgia, causing 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. In addition, spray hoods (conveyors) were evaluated for the possibility of reducing residues while enhancing control. These treatments are compared with topped but not suckered and the standard treatment (for 2012) 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 lbs./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 85.7 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 14 sucker control treatments as follows:

1. TNS - Topped Not Suckered.

2. Fair 85/Fair 85/Fair 85/(Fair 30 + Prime +) - Three treatments of the contact Fair 85 (Fair Products, Inc.) at 4% solution followed in three days with two applications of a 5% solution three to five days apart. Five to seven days later, a tank mix of Fair 30 (2.25 lbai/gal) (Fair Products, Inc.) potassium maleic hydrazide at the labeled rate of 1.0 gal./A and Prime + (Syngenta Corporation) at 0.5 gal./A. Each application utilized a standard three-nozzle configuration (TG3-TG5-TG3) applying 52 gal./A at 20 psi.

3. Fair 85/Fair 85/Fair 85/Prime +/Fair 30 - Three treatments of contact as in treatment 2 followed in five days with Prime + at 0.5 gal./A followed by Fair 30 at 1.0 gal./A after the first harvest. All applications were applied as in treatment 2 except that sprayer hoods (Agri-Supply #78424) were installed for the last two applications.

4. Fair 85/Fair 85/Fair 85/Prime +/Fair 30 - The same combination and timing of applications as in treatment 3, without the sprayer hoods.

5. Fair 85/Fair 85/Fair 85/Prime +/Fair 30 - Three treatments of contact as in previous treatments followed in five days with Prime + at 0.5 gal./A followed by Fair 30 at 0.66 gal./A. All applications were applied and timed as in treatment 3, including the sprayer hoods.

6. Fair 85/Fair 85/Fair 85/Prime +/Fair 30 – The same combination and timing of applications as in treatment 5, without the sprayer hoods.

7. Fair 85/Fair 85/Fair 85/Prime +/Fair 30 - Three treatments of contact as in previous treatments followed in five days with Prime + at 0.5 gal./A followed by Fair 30 at 0.33 gal./A. All applications were applied and timed as in treatment 3, including the sprayer hoods.

8. Fair 85/Fair 85/Fair 85/Prime +/Fair 30 – The same combination and timing of applications as in treatment 7, without the sprayer hoods.

9. Fair 85/Fair 85/Fair 85/(Fair 30 + Prime +)/Prime + - Three treatments of contact as in previous treatments followed in five days with a tank mix of Fair 30 (0.33 gal./A) and Prime + (0.5 gal./A) followed by Prime + at 0.25 gal./A after the first harvest. All applications were applied as in treatment 2, except sprayer hoods were installed for the last two applications.

10. Fair 85/Fair 85/Fair 85/(Fair 30 + Prime +)/Prime + - The same combination and timing of applications as in treatment 9, without the sprayer hoods.

11. Fair 85/Fair 85/Fair 85/Prime +/Prime + - Three treatments of contact as in previous treatments followed in five days with Prime + at 0.5 gal./A followed by Prime + at 0.25 gal./A after the first harvest. All applications were applied as in treatment 2, except sprayer hoods were installed for the last two applications.

12. Fair 85/Fair 85/Fair 85/ Prime +/Prime + - The same combination and timing of applications as in treatment 11, without the sprayer hoods.

13. Fair 85/Fair 85/Fair 85/ Prime +/Butralin - Three treatments of contact as in previous treatments followed in five days with Prime + at 0.5 gal./A followed by Butralin (Chemtura) at 0.25 gal./A after the first harvest. All applications were applied as in treatment 2, except sprayer hoods were installed for the last two applications.

14. Fair 85/Fair 85/Fair 85/Prime +/Butralin - The same combination and timing of applications as in treatment 13, without the sprayer hoods.

Results and Discussion

Due to historically high TSWV incidence at the Bowen Farm location, c.v. K 326 was treated in the greenhouse with labeled rates of Actigard and Admire for TSWV suppression and transplanted on March 22, 2012. Favorable conditions followed transplanting, aiding initial growth. TSWV counts indicated an infection rate below 4% in the test. Generally, the crop was free of disease with a near perfect plant stand.

The first contact was applied on May 30, the second on June 3, and a third set of contacts applied on June 7, 2012. All contacts were applied with a standard three-nozzle arrangement. The fourth application was applied on June 13, 2012. The final application for treatments 3 through 14 was applied on June 20, 2012. The final harvest was on July 31, 2012, with the test concluding after the suckers were pulled, counted and weighed off of 10 plants from each plot on August 1, 2012.

The 2012 growing season was notable for its early spring and near normal weather conditions. However, inconsistent rains required nine irrigations that delivered approximately 8 inches of water on top of 11.6 inches of rain that fell during the 19-week test period.

For 2012, yield and quality data varied little between treatments with the exception of treatment 1 (TNS). Test yields were average with the TNS having the lowest yield at 2,142 lbs./A. Treatment 12 yielded the highest at 3,054 lbs./A and had the highest value, bringing in $5,498/A. The standard treatment 2 brought in $5,073/A compared to the lowest of $3,688/A for treatment 1. The price and grade indices were consistent and average for all treatments.

Sucker control was excellent, with sucker number per plant low with a mean value of 1 or less for all chemical treatments. Green weight per plant was higher and percent control was lower for treatments that used contact only. Finally, percent control was excellent (>98%) for all chemical treatments with MH. Treatments that incorporated contacts in combination with DNAs also provided good control. As a result, increasing the spray applications and lowering MH rates can provide adequate control and should reduce MH residues. Generally, the spray hoods did not seem to provide additional control over the standard nozzle configuration. MH residue samples should provide greater insight into the success of reducing residue levels for treatments 2-10. Unfortunately, MH residue data was not available as of this printing.

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Table 1. 2012 Regional Tobacco Growth Regulator Test, Effects of Advanced Growth Regulating Material on Sucker Growth, Cured Leaf Yields and Value of Flue-Cured Tobacco.

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]
1. Topped-Not-Suckered	0	553.1	3.2	172.8	0	2142	3688	172	84
2. CONTACTS[1]/(FAIR 30 & PRIME+ 1.0 GPA & 0.5 GPA)	100	0	0	0	1	2952	5073	172	84
3. CONTACTS /PRIME+(0.5 GPA)/FAIR 30 (1.0 GPA) With SPRAY HOODS	100	0	0	0	1	2993	5059	169	82
4. CONTACTS / PRIME+(0.5 GPA)/FAIR 30 (1.0 GPA)	100	0	0	0	1	2989	5168	172	83
5 CONTACTS /PRIME+(0.5 GPA)/FAIR 30 (0.66 GPA) With SPRAY HOODS	100	0	0	0	1	2970	5061	170	81
6 CONTACTS / PRIME+(0.5 GPA)/FAIR 30 (0.66 GPA)	100	0	0	0	1	2964	5279	178	86
7 CONTACTS / PRIME+(0.5 GPA)/FAIR 30 (0.33 GPA) With SPRAY HOODS	98.9	7.7	0.2	38.5	1	2992	5436	182	87
8 CONTACTS / PRIME+(0.5 GPA)/FAIR 30 (0.33 GPA)	98.9	7.5	0.2	42.9	1	3025	5234	173	84
9 CONTACTS/(FAIR 30 & PRIME+ 0.33 GPA & 0.5 GPA)/Prime + (0.25GPA) With SPRAY HOODS	100	0	0	0	1	2994	5089	173	82

Table 1. 2012 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]
10	CONTACTS /(FAIR 30 & PRIME+ 0.33 GPA & 0.5 GPA)/Prime + (0.25GPA)	99.8	1.7	0.1	22.0	1	3010	4501	150	74
11	CONTACTS / PRIME+ (0.5GPA)/PRIME +(0.25GPA) With SPRAY HOODS	98.3	12.2	0.3	44.2	1	2893	5038	174	84
12	CONTACTS / PRIME+ (0.5GPA)/PRIME +(0.25GPA)	98.3	12.1	0.2	80.7	1	3054	5498	180	87
13	CONTACTS / PRIME+ (0.5GPA)/BUTRALIN(0.25GPA) With SPRAY HOODS	99.1	6.4	0.1	51.2	1	2959	5172	175	85
14	CONTACTS / (PRIME+ 0.5GPA) / BUTRALIN(0.25GPA)	97.0	20.8	0.3	75.5	1	2955	4961	168	82
	LSD-0.05						159.3	647.9	21.3	8.7

[1]All treatments received three contact applications with Fair 85 at 4%, 5%, and 5% (2.0 GPA, 2.5 GPA, and 2.5 GPA).
[2]Injury rating on a scale of 0-10 with 0 = no damage and 10 = plant killed.
[3]Price Index based on two-year average (2011-2012) prices for U.S. government grades.
[4]Grade Index is a 1-99 rating based on government grade. High ratings are best.
*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 Nematicides for Control of Peanut Root-knot Nematode on Tobacco 2012 University of Georgia, CPES - Bowen Farm - Tifton, Ga.

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

Introduction

Nematicides for tobacco production are very limited. With the shortage and increase in cost of Telone II, other nematicides for tobacco must be evaluated. This trial evaluated potential nematicides in an area infested with Meloidogyne arenaria, peanut root-knot nematode.

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, with 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 2012) was 26.56 inches (environmental data requested from Georgia Automated Environmental Monitoring Network). The field trial was supplemented with additional irrigation as required.

Greenhouse and Field Treatments

On March 9, 2012, pre-plant fumigants Vapam and Telone II were applied to trial plots.

Treatment 2 - Telone II was injected into soil approximately 12 to 14 inches using a subsoil bedder with two shanks spaced 12 inches apart. Beds were immediately tilled and sealed using concrete drag.

Treatment 6 - Vapam (metham sodium) was injected into soil approximately 10 to 12 inches using a fumigation rig with four shanks spaced 12 inches apart and soil was sealed using a ring roller. All plots received 0.5 inch of irrigation after fumigant applications to provide a water seal.

Tobacco transplants were treated in the greenhouse on April 24, 2012 with Admire Pro at 1 fl. oz./1,000 plants and Actigard 50WG at 4 g/7,000 plants. Both materials were tank mixed. Plants were pre-wet, with materials being washed in after spraying.

Tobacco variety NC71 was transplanted on March 27, 2012 on 44-inch-wide rows with an 18-inch plant spacing.

On March 27, 2012, pre-plant incorporated materials of Devgen, MANA, D-EXP and Temik were applied to trial plots.

Temik (Treatment 3) was applied as a broadcast at a rate of 20 lbs./A. Treatment 4 - Devgen (6 qt./A) was applied as a pre-plant incorporated treatment using a CO_2 sprayer with one TX-12 tip/row with a 50-mesh ball check screen. Tips were angled and sprayed in a 16-inch band at the rate of 30 psi.

Treatment 5 - MANA MCW-2 was applied using a CO_2 sprayer with one TX-12 tip/row with a 50-mesh ball check screen. Tips were angled and sprayed in a 12-inch band at the rate of 30 psi for 22.0 gal H_2O per acre.

Material D-Nem-EXP - treatment 7 and treatment 8 - was applied as a pre-plant incorporated treatment using a CO_2 sprayer with one TX-12 tip/row with a 50-mesh ball check screen. Tips were angled and sprayed in a 16-inch band at the rate of 30 psi. Treatment 7 received an additional application at first cultivation on April 12, 2012.

Field Trial Data

A stand count was conducted on April 11, 2012 to establish a base count. Stand counts were conducted thereafter every two weeks beginning May 12 and ending July 6, 2012, to monitor any loss of plants.

Vigor ratings were conducted on April 10, 2012 (two weeks post-plant), April 26, 2012 (four weeks post-plant) and May 10, 2012 (six weeks post-plant). Plant vigor was rated on a scale of 1-10, with 10 representing live and healthy plants and 1 representing dead plants.

Height measurements were conducted on May 15, 2012. Plants were measured individually from the soil level to the tip of the longest leaf and recorded in centimeters.

Three harvests were conducted on June 28, July 12 and July 26, 2012. Harvests were done by collecting one-third of the plant leaves at one time and weighing each plot in pounds.

A mid-season root gall rating was conducted on June 12 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 are 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, and 10=plants and roots dead. A second root gall rating was conducted following the final harvest on August 10, 2012, rating 10 plants per plot utilizing the same scale.

Nematode soil samples were pulled from plots on March 20, 2012 (prior to planting and soil treatment) and again on August 9, 2012 (at final harvest). Eight to 10 cores of soil, 2.5 cm in diameter by 25 cm deep, were collected from each plot randomly. Nematodes were extracted from 200 cm3 soil sub-samples using a centrifugal sugar flotation technique.

Summary

Vigor ratings were high for most treatments, with the exception of the non-treated control plots, which appeared to decrease over time.

Height measurements were similar for all treatments and no differences were detected among treatments.

The mid-season root gall ratings were relatively low, ranging from 0.6 for Telone to 3.1 for Vapam treated plots. Many of the treatments were statistically similar to Telone in RGI (Table 2). Root gall indices at harvest ranged from a low of 4.9 to a high of 8.2. Several of the treatments were statistically lower than the non-treated control and not different from the Telone standard (Table 2).

Numbers of *Meloidogyne* larvae were low at pre-plant (0-22 larvae/200 cc soil) but increased to high numbers at final harvest (210-828 larvae/200 cc soil, Table 2). Yields ranged from 1,198 lbs./A to 1,351 lbs./A with no statistical differences among treatments.

2012 Nematicides for the Control of Peanut Root-knot Nematode
UGA-CPES-Bowen Farm - Tifton, Ga.

Table 1. Plant Vigor, Plant Height and Dry Weight Yield of Tobacco Variety NC71

Treatment[1]	Rate/Application Schedule	Vigor Ratings (1-10 scale)[2]				Height Measurements[3] (centimeters)	Dry Weight Yield[4] (pounds per acre)
		10 April	26 April	10 May	Average Vigor (0-10 Scale)		
1. Non-treated	N/A	9.2a	9.4a	7.6d	8.7ab	37.1a	1213.0a
2. Telone II	6 gal/A	8.8a	8.2a	9.2ab	8.7ab	34.7a	1380.9a
3. Temik	20lbs/A	8.8a	8.8a	9.0abc	8.8ab	33.0a	1267.2a
4. Devgen	6.0 qt/A	8.8a	8.2a	8.2cd	8.4b	34.8a	1108.2a
5. MANA	3.31 lbs/A	9.6a	9.2a	9.6a	9.4a	35.8a	1351.4a
6. VAPAM	37.5 gal/A	9.0a	8.6a	8.4bcd	8.6ab	36.7a	1329.7a
7. D-EXP	1.0 lba.i./A PPI + 1.0lbai/A 3wksPP	9.0a	8.8a	9.2ab	9.0ab	39.2a	1198.8a
8. D-EXP	2.0lbai/A PPI	9.4	9.4a	9.4a	9.4ab	39.8a	1272.1a

[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 April 10, April 26 and May 10, 2012.

[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 May 15, 2012.

[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 6,491 divided by the base stand count.

2012 Nematicides for the Control of Peanut Root-knot Nematode
UGA-CPES-Bowen Farm - Tifton, Ga.

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

Treatment[1]	Rate/Application Schedule	Root Gall Ratings[2] (Zecks Scale 0-10)		Number of *Melodogyne* spp. per 200 cc soil[2]	
		Mid season	At final harvest	Pre-plant	At final harvest
1. Non-treated	N/A	2.7abc	7.8ab	22.0a	804.0ab
2. Telone II	6 gal/A	0.6d	5.1c	0.0b	340.0ab
3. Temik	20lbs/A	1.4bcd	4.9c	0.0ab	210.0b
4. Devgen	6.0 qt/A	2.8ab	8.2a	8.0ab	508.0ab
5. MANA	3.31 lbs/A	2.0abc	5.9c	6.0b	260.0ab
6. VAPAM	37.5 gal/A	3.1a	7.4ab	2.0b	828.0a
7. D-EXP	1.0 lba.i./A PPI + 1.0lbai/A 1st cultivation	1.3cd	5.4c	6.0ab	304.0ab
8. D-EXP	2.0lbai/A PPI	2.4abc	6.3abc	4.0ab	398.0ab

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.
2. Gall ratings were done on a scale of 0-10 with 10=dead plants and roots and 0=no galls and a healthy plant. An average was taken of the gall ratings on June 12, 2012 (mid-season) rating three plants per plot and again on August 9, 2012 (at final harvest) rating 10 plants per plot.
3. At-planting soil samples were collected on March 20, 2012. Root Knot Nematode (*Meloidogyne* spp.). At final harvest, soil samples were collected on August 9, 2012.

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