2014 North Carolina State University Tobacco Tour

Department of Crop Science

Tobacco Research & Extension Program

July 14th and 15th, 2014

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- Loveland Products
- NCSU Tobacco Foundation
- Philip Morris International
- RJ Reynolds Tobacco Company
- Syngenta
- Tobacco Research Commission
- Universal Leaf

List of Presentations

The Impact of Flue-Cured Tobacco on Palmer Amaranth Populations
Presented by: Matthew Vann

Burley Official Variety Trial
Presented by: Matthew Vann

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Presented by: Dr. Loren Fisher

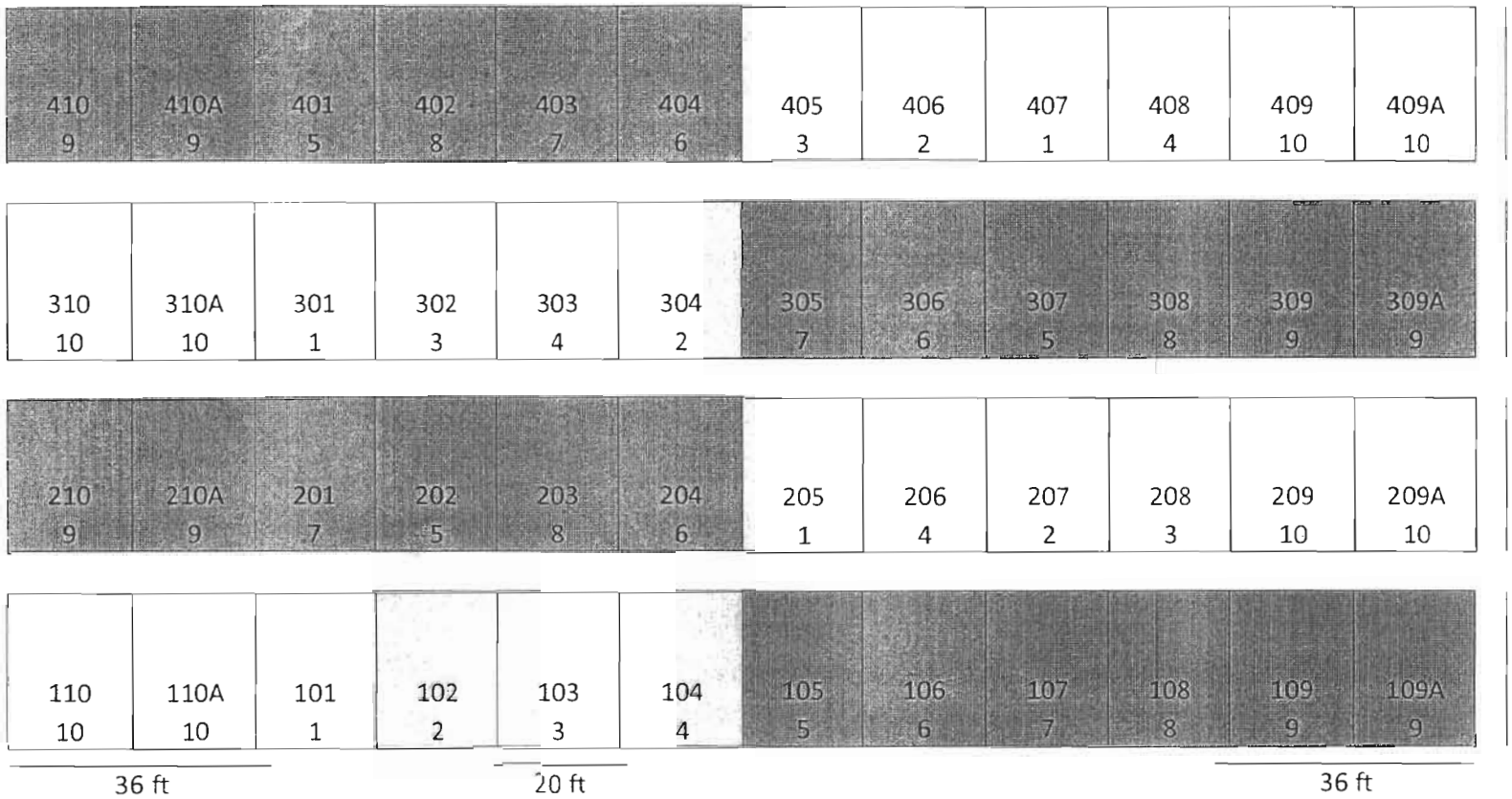
Pesticide Residue Evaluation for Flue-Cured Tobacco
Presented by Matthew Vann

Evaluation of Non-tobacco Labeled Herbicides for Late Season Application
Presented by: Tyler Whaley

Evaluation of Conveyors for Reduction of MH Residues and Improved Sucker Control
Presented by: Dr. Loren Fisher

Evaluation of Three Transgenic Varieties Compared to Three Conventional Varieties for Low Alkaloid Production
Presented by: Joseph Cheek

The Impact of Flue-cured Tobacco on Palmer Amaranth Populations (Year Three of Cropping Rotation)



Treatments:

1) Shallow w/Spartan-Hand Weed
2) Shallow w/Spartan-No Hand Weed
3) Shallow w/Command-Hand Weed
4) Shallow w/Command- No Hand Weed
Trt. 9 & 10=Alternative Crop in Year One

5) Deep w/Spartan-Hand Weed
6) Deep w/Spartan-No Hand Weed
7) Deep w/Command-Hand Weed
8) Deep w/Command-No Hand Weed
A=Hand Weeding in Alternative Crop

Shallow
Deep

Referenced herbicide treatments are from Year One-Tobacco
Cotton planted in all plots in Years Two and Three
All Cotton treated POST with Glufosinate and Glyphosate

The Impact of Flue-Cured Tobacco on Palmer Amaranth Populations

In 2012, a cropping rotation was initiated to quantify the impact flue-cured tobacco has on Palmer amaranth populations. The two main effects analyzed were deep tillage (using a bottom plow to a depth of 8 inches) verses shallow tillage (using a disc to a depth of 4 inches). Within each tillage treatment various herbicides treatments (sulfentrazone and clomazone vs. clomazone) were then applied, and within each herbicide treatment plots were both hand weeded and non-hand weeded. Weed species were identified and quantified throughout the season, prior to cultivation and/or POST herbicide application. Final crop yield and quality was also assessed.

Palmer amaranth density and tobacco yield during 2012

- In ratings one and two, deep tillage and sulfentrazone decreased Palmer amaranth populations (100% reduction in Palmer amaranth).
    - When deep tillage was utilized but sulfentrazone was not, Palmer amaranth populations were reduced by as much as 75%.
    - When deep tillage was not utilized, the addition of sulfentrazone to the herbicide program provided as much as a 98% reduction in Palmer amaranth.
- At rating three, herbicide program had an effect on Palmer amaranth populations, with the combination of sulfentrazone and clomazone providing better control than just clomazone (>90% reduction in Palmer amaranth).
- Yield was increased by both tillage and herbicide program, with deep tillage producing higher yields than no deep tillage (increase of 1300 lbs/a) and sulfentrazone and clomazone performing better than just clomazone (increase of 300 lbs/a).
- For tobacco production, preliminary results favor the use of deep tillage and the combination of sulfentrazone and clomazone to reduce Palmer amaranth populations and improve crop yield.

Palmer amaranth density in soybean and tobacco during 2012 and density in cotton during 2013

- Herbicide selection for tobacco production influenced Palmer amaranth populations more so than the tillage system used in tobacco.
- The tobacco herbicide program utilizing sulfentrazone and clomazone decreased Palmer amaranth populations in cotton more than when clomazone was applied as the only herbicide (>50% at rating one and >60% at rating two).
- Additionally, herbicide programs applied to soybeans the previous season did not reduce Palmer amaranth density in cotton.

2014 Black Shank OVT Variety List

OVT/C	1	GF 318	OVT/A	52	NC 2326
	2	SP 220		53	NC 95
	3	PVH 2275		54	K 326
	4	PVH 2110		55	CU 142
	5	CC 33		56	CU 187
	6	SP 225		57	RJR 731
	7	SP 168		58	CU 202
	8	NC 939		59	CU 175
	9	NC 299		60	RJR 732
	10	CC 35		61	CU 156
	11	PVH 1118			
	12	PVH 2254	RSP	62	NC 2326
	13	NC 471		63	NC 95
	14	CU 159		64	K 326
	15	CU 144		65	XHN 52
	16	GL 395		66	CU 181
	17	CU 186		67	CU 158
	18	K 326		68	NCEX65
	19	CC 67		69	CU 178
	20	CU 124		70	GLEX 976
	21	NC 938		71	XHN 60
	22	CC 37		72	NCEX63
	23	CC 143		73	AOV 413
	24	CC 27		74	CC Exp. 4
	25	SP 227		75	GLEX 965
	26	NC 925		76	CU 211
	27	GL 338		77	XHN 64
	28	CC 700		78	NCEX62
	29	GL 368		79	CC Exp. 6
	30	CC 13		80	CC Exp. 5
	31	NC 72		81	NCEX64
	32	NC 196		82	ULT 164
	33	PVH 1452		83	ULT 115
	34	CU 171		84	XHN 65
	35	NC 606		85	NCEX66
	36	CC 1063		86	CU 183
	37	NC 92		87	NCEX67
	38	NC 297		88	CC Exp. 1
	39	RJR 901		**89**	**NC1071**
	40	SP 236			
	41	CU 110	RFT	90	NC 2326
	42	NC 960		91	NC 95
	43	PVH 2310		92	K 326
	44	PVH 2281		93	CU 45
	45	NC 2326		94	NCEX68
	46	GL 362		95	GLEX 309
	47	PVH 1600		96	PXH 12
	48	NC 95		97	NCEX36
	49	GL 398		98	CU 185
	50	K 346		99	GLEX 394
	51	**NC1071**		100	CU 208
				101	CU 204
				102	NCEX69
				103	NCEX40
				104	PXH 16

2014 Black Shank OVT – UCPRS

287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312
40	19	66	6	68	73	62	31	23	77	87	50	20	79	52	37	100	63	28	67	14	83	58	18	7	80
261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286
90	43	10	26	89	9	1	98	87	104	9	24	47	91	83	13	17	102	100	16	74	55	51	34	57	94
235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260
48	85	49	36	11	39	96	33	78	30	31	13	59	44	3	45	4	69	12	37	71	81	15	56	25	1
209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234
29	72	91	67	46	41	48	21	22	76	22	54	75	70	35	2	60	5	59	96	101	59	53	86	32	64

183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208
69	104	17	2	59	20	54	32	83	47	72	30	13	19	80	66	103	78	37	87	84	95	49	35	9	39
157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182
36	27	81	68	71	3	60	62	56	38	89	97	57	53	65	26	16	42	75	82	86	43	85	73	55	91
131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156
8	5	98	11	25	34	33	1	28	63	48	44	23	101	18	52	31	14	79	45	7	77	24	15	21	102
105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130
40	64	22	96	41	90	50	92	94	58	6	74	46	51	88	29	99	4	70	93	61	67	100	12	10	76

79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104
71	39	99	41	17	43	6	15	58	69	34	65	4	42	51	24	102	79	82	57	40	23	19	55	20	91
53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78
54	83	53	61	90	75	56	7	104	67	28	60	48	10	62	33	66	68	29	92	74	70	84	85	18	73
27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52
25	12	35	88	77	30	64	50	8	95	27	14	94	52	98	47	81	101	5	37	103	59	31	13	87	89
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
11	21	45	16	78	26	100	36	93	76	97	22	33	3	96	63	72	44	80	2	32	86	1	49	46	9

RESULTS -- BLACK SHANK OVT

Rating Data Type		Stand Ct		Percent Disease	Percent Disease
Rating Date		6/3/2014		6/27/2014	7/12/2014
Entry No.	Entry Name	1		2	3
1	GF 318	25	abc	2.8 fg	6.5 hi
2	SP 220	21	abc	0.0 g	1.6 i
3	PVH 2275	23	abc	25.8 cd	62.9 b-e
4	PVH 2110	21	abc	0.0 g	12.3 hi
5	CC 33	24	abc	1.5 fg	4.5 i
6	SP 225	23	abc	0.0 g	0.0 i
7	SP 168	21	abc	0.0 g	6.7 hi
8	NC 939	23	abc	0.0 g	3.0 i
9	NC 299	21	abc	3.3 fg	17.7 f-i
10	CC 35	24	abc	1.5 fg	18.6 f-i
11	PVH 1118	23	abc	2.6 fg	4.0 i
12	PVH 2254	25	abc	4.2 fg	28.1 c-i
13	NC 471	25	abc	0.0 g	9.7 hi
14	CU 159	25	abc	1.4 fg	14.3 hi
15	CU 144	27	a	0.0 g	1.2 i
16	GL 395	22	abc	1.5 fg	5.9 i
17	CU 186	25	abc	2.7 fg	14.7 ghi
18	K 326	24	abc	2.0 fg	28.2 c-i
19	CC 67	20	abc	0.0 g	2.9 i
20	CU 124	21	abc	0.0 g	11.9 hi
21	NC 938	25	abc	1.2 g	0.0 i
22	CC 37	17	c	6.4 fg	14.8 ghi
23	CC 143	20	abc	0.0 g	5.1 i
24	CC 27	24	abc	13.4 efg	31.5 c-i
25	SP 227	21	abc	5.0 fg	6.7 hi
26	NC 925	23	abc	0.0 g	3.1 i
27	GL 338	24	abc	18.2 def	66.2 bcd
28	CC 700	25	abc	3.6 fg	9.7 hi
29	GL 368	21	abc	0.0 g	1.3 i
30	CC 13	26	abc	2.6 fg	21.9 e-i
31	NC 72	21	abc	4.8 fg	26.7 d-i
32	NC 196	21	abc	0.0 g	5.1 i
33	PVH 1452	25	abc	0.0 g	2.7 i
34	CU 171	24	abc	1.3 fg	1.3 i
35	NC 606	23	abc	0.0 g	10.7 hi
36	CC 1063	26	abc	0.0 g	0.0 i
37	NC 92	27	a	23.2 cde	47.9 c-h
38	NC 297	23	abc	10.3 fg	32.2 c-i
39	RJR 901	26	abc	0.0 g	3.8 i

40	SP 236	23	abc	4.3 fg	0.0 i
41	CU 110	22	abc	0.0 g	5.4 i
42	NC 960	22	abc	1.4 fg	1.4 i
43	PVH 2310	19	abc	3.4 fg	22.1 e-i
44	PVH 2281	21	abc	3.0 fg	24.5 d-i
45	NC 2326	26	ab	1.2 g	40.6 c-i
46	GL 362	20	abc	1.6 fg	9.4 hi
47	PVH 1600	22	abc	3.2 fg	12.4 hi
48	NC 95	24	abc	1.3 fg	17.7 f-i
49	GL 398	26	abc	3.8 fg	16.8 f-i
50	K 346	26	ab	0.0 g	5.2 i
51	**1071**	**19**	**abc**	**87.7 b**	**68.6 bc**
52	NC 2326	24	abc	4.3 fg	25.2 d-i
53	NC 95	25	abc	1.3 fg	26.9 d-i
54	K 326	21	abc	4.8 fg	28.8 c-i
55	CU 142	19	abc	0.0 g	1.6 i
56	CU 187	21	abc	0.0 g	2.7 i
57	RJR 731	19	abc	7.0 fg	5.4 i
58	CU 202	24	abc	0.0 g	9.8 hi
59	CU 175	24	abc	0.0 g	0.0 i
60	RJR 732	25	abc	0.0 g	10.7 hi
61	CU 156	21	abc	0.0 g	0.0 i
62	NC 2326	26	ab	2.6 fg	38.1 c-i
63	NC 95	26	ab	5.1 fg	24.4 d-i
64	K 326	23	abc	0.0 g	24.4 d-i
65	XHN 52	25	abc	33.3 c	90.7 ab
66	CU 181	24	abc	1.3 fg	14.7 ghi
67	CU 158	19	abc	1.7 fg	0.0 i
68	NCEX65	17	c	0.0 g	1.8 i
69	CU 178	23	abc	3.0 fg	20.9 f-i
70	GLEX 976	20	abc	1.8 fg	13.0 hi
71	XHN 60	25	abc	3.7 fg	57.3 c-f
72	NCEX63	25	abc	0.0 g	1.6 i
73	AOV 413	23	abc	8.6 fg	41.4 c-i
74	CC Exp. 4	21	abc	0.0 g	0.0 i
75	GLEX 965	26	abc	1.3 fg	6.5 hi
76	CU 211	21	abc	0.0 g	2.8 i
77	XHN 64	24	abc	11.8 efg	56.3 c-g
78	NCEX62	26	ab	1.2 g	2.6 i
79	CC Exp. 6	26	ab	2.8 fg	13.0 hi
80	CC Exp. 5	24	abc	0.0 g	1.3 i
81	NCEX64	23	abc	1.5 fg	0.0 i
82	ULT 164	19	abc	3.3 fg	18.3 f-i
83	ULT 115	23	abc	6.7 fg	37.4 c-i
84	XHN 65	25	abc	8.0 fg	37.5 c-i
85	NCEX66	26	abc	0.0 g	1.3 i
86	CU 183	22	abc	0.0 g	4.0 i

87	NCEX67	22	abc	0.0 g	1.4 i
88	CC Exp. 1	22	abc	0.0 g	35.2 c-i
89	**1071**	**18**	**bc**	**97.9 a**	**100.0 a**
90	NC 2326	23	abc	0.0 g	23.1 e-i
91	NC 95	21	abc	1.4 fg	21.6 e-i
92	K 326	21	abc	5.2 fg	19.5 f-i
93	CU 45	22	abc	6.5 fg	12.9 hi
94	NCEX68	24	abc	2.7 fg	19.4 f-i
95	GLEX 309	22	abc	0.0 g	8.0 hi
96	PXH 12	23	abc	0.0 g	13.2 hi
97	NCEX36	26	abc	0.0 g	5.0 i
98	CU 185	24	abc	2.9 fg	19.8 f-i
99	GLEX 394	22	abc	1.6 fg	5.8 i
100	CU 208	24	abc	0.0 g	14.1 hi
101	CU 204	25	abc	0.0 g	1.2 i
102	NCEX69	23	abc	0.0 g	13.2 hi
103	NCEX40	22	abc	0.0 g	6.3 hi
104	PXH 16	22	abc	1.6 fg	3.0 i

Replicate F	8.717	5.77	29.44
Replicate Prob(F)	0.0002	0.0036	0.0001
Treatment F	1.754	16.791	5.499
Treatment Prob(F)	0.0004	0.0001	0.0001

significantly differ (P=.05, Student-Newman-Keuls)

2014 North Carolina Tobacco Tour

New Fungicides for Control of Black Shank

Fluopicolide (Presidio)

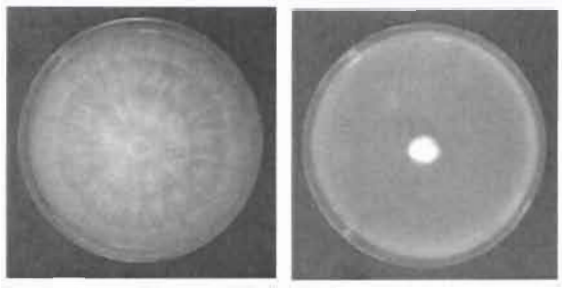
- New mode of action different from mefenoxam
- Control against oomycetes (Including *Phytophthora* species)
- Currently registered for use in vegetable crops and grapes for downy mildew, late blight, and Phytophthora root, crown, and fruit rots
- Registration on tobacco for black shank control expected for 2015

Oxathiapiprolin (A20941)

- New mode of action different from mefenoxam
- Control against oomycetes (Including *Phytophthora* species)
- Currently not registered in any crops
- In laboratory studies, oxathiapiprolin has shown ability to suppress mycelial growth, sporangia production, zoospore germination, and zoospore motility of the black shank pathogen (pictured below)

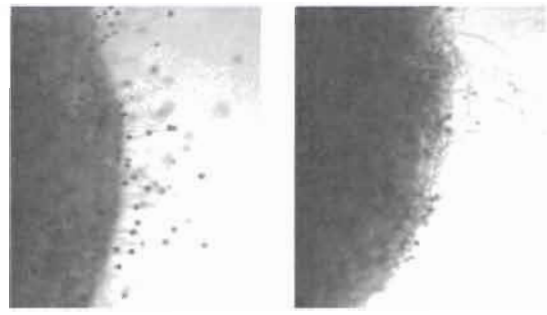
Mycelial Growth

Untreated 0.01 ppm



Sporangia Production

Untreated 0.005 ppm



* Pictures above represent effect of **oxathiapiprolin**

2014 Fungicide Trial -- UCPRS

41	42	43	44	Fill	Fill	Fill	Fill
10	5	2	7				
33	34	35	36	37	38	39	40
3	1	9	8	11	4	3	6
25	26	27	28	29	30	31	32
4	7	2	1	10	9	8	11
17	18	19	20	21	22	23	24
9	11	3	10	6	1	5	6
9	10	11	12	13	14	15	16
9	4	11	8	4	5	2	7
1	2	3	4	5	6	7	8
2	10	3	1	5	8	6	7

2014 Black Shank Chemical Trial, UCPRS

Means Table

Rating Data Type						Percent	Percent
Rating Date						6/27/2014	7/12/2014
Trt No.	Treatment Name	Rate	Rate Unit	Grow Stg	Appl Description	3	5
1	Untreated Check					0 a	5.8 a
2	Ridomil Gold	8	fl oz/a	Attran		2 a	6 a
	Ridomil Gold	16	fl oz/a	1st cult			
	Ridomil Gold	16	fl oz/a	Layby			
3	Presidio	4	fl oz/a	attran		0 a	0 a
	Presidio	4	fl oz/a	1st cult			
	Presidio	4	fl oz/a	Layby			
4	A20941	9.6	fl oz/a	attran		0 a	0 a
	A20941	9.6	fl oz/a	1st cult			
5	A20941	9.6	fl oz/a	attran		0 a	0 a
	A20941	19.2	fl oz/a	Layby			
6	A20941	9.6	fl oz/a	attran		0 a	2.8 a
	Ridomil Gold	16	fl oz/a	1st cult			
	A20941	9.6	fl oz/a	Layby			
7	A20941	9.6	fl oz/a	Attran	Tank Mix 1	1.5 a	1.5 a
	Ridomil Gold	8	fl oz/a	Attran	Tank Mix 1		
	A20941	9.6	fl oz/a	Layby	Tank Mix 2		
	Ridomil Gold	8	fl oz/a	Layby	Tank Mix 2		
8	A20941	9.6	fl oz/a	Attran	Tank Mix 1	0 a	0 a
	Ridomil Gold	8	fl oz/a	Attran	Tank Mix 1		
	A20941	19.2	fl oz/a	Layby			
9	Ridomil Gold	8	fl oz/a	Attran		0 a	0 a
	A20941	19.2	fl oz/a	1st cult			
10	Revus	8	fl oz/a	Attran		0 a	0 a
	A20941	9.6	fl oz/a	1st cult	Tank Mix		
	Ridomil Gold	8	fl oz/a	1st cult	Tank Mix		
11	Revus	8	fl oz/a	Attran		0 a	0 a
	Ridomil	8	fl oz/a	1st cult			
	A20941	9.6	fl oz/a	Layby			
LSD (P=.05)						1.675054	4.252719
Standard Deviation						1.160081	2.945276
CV						367.35	199.31
Grand Mean						0.32	1.48
Bartlett's X2						0.167	1.793
P(Bartlett's X2)						0.683	0.616
Replicate F						0.416	3.266
Replicate Prob(F)						0.7426	0.0349
Treatment F						1.509	2.643
Treatment Prob(F)						0.1845	0.0193

Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)

2013 Burley OVT Results-Upper Coastal Plain Research Station

Variety	Flower Count 7-10-13	Flower Count 7-16-13	Flower Count 7-23-13	Yield	Quality
	#/44 plants	#/44 plants	#/44 plants	Lbs./acre	
NC 5 LC	11 ab	32 ab	40 a	2383 a	71 a
NC 6 LC	6 ab	24 ab	34 a	2373 a	74 a
NC 7 LC	0 b	10 b	36 a	2135 a	72 a
KT 200 LC	14 ab	29 ab	38 a	2198 a	73 a
KT 204 LC	7 ab	19 ab	41 a	2079 a	74 a
KT 206 LC	5 ab	19 ab	40 a	2169 a	75 a
KT 209 LC	7 ab	22 ab	36 a	2254 a	74 a
KT 210 LC	6 ab	26 ab	36 a	2245 a	75 a
KT 212 LC	21 ab	34 ab	37 a	2210 a	76 a
TN 90 LC	20 ab	33 ab	39 a	2134 a	75 a
TN 97 LC	13 ab	31 ab	36 a	2216 a	73 a
R 610 LC	25 ab	34 ab	31 a	2482 a	74 a
R 630 LC	33 a	38 a	36 a	2311 a	76 a
HB 4488P LC	0 b	11 b	40 a	2238 a	72 a

*Treatment means followed by the same letter are not significantly different.

Burley tobacco yield and quality was exceptionally high at the Upper Coastal Plain Research Station in 2013. The 2013 Burley OVT was fertilized at a rate of 250 pounds of nitrogen per acre from 32% UAN (½ rate after transplanting and ½ rate at layby). It should be noted that the growing season was marked as being unusually cool and wet (30+ inches of rainfall), which to a large extent likely contributed to the overall performance of the crop. It should also be noted that only one additional burley variety was added to the 2014 OVT (HB3307P), all other varieties were present in 2013.

2014 NORTH CAROLINA FLUE-CURED TOBACCO OFFICIAL VARIETY TEST										
Commercial Varieties										
Trt. No	Variety or Line	Generation or Year of Release	Pedigree	BS	GW	FW	RK	Bn. Sp.	Virus	Sponsor
1	GF 318	2008	Hybrid	R	R		R			Raynor
2	Speight 220	2002	(K-346 X SP 117)(SP 116 X K 346)	R	R		R			CC
3	PVH 2275	2010	Hybrid		R		R1		PVY/TEV	Rickard
4	PVH 2110	2005	Hybrid		R		M.inco			Rickard
5	CC 33	2008	Hybrid	R	R		M.j/R			CC
6	Speight 225	2003	(SP 168 X K 346)(SPA-95 X (SPA-95 X SP 168)	R	R		R			CC
7	Speight 168	1996	Coker 371G X Spt. G 118	H	H		R			CC
8	NC 939	2012	Hybrid	R	R		TCN/R			NC
9	NC 299	2001	Hybrid	R	R		TCN/R			CC
10	CC 35	2007	Hybrid	R	R		M.j/R			CC
11	PVH 1118	2004	Hybrid	R	R		TCN/R			Rickard
12	PVH 2254	2011	Hybrid	R	R				TMV	Rickard
13	NC 471	2003	Hybrid	R	R				TMV	Raynor
14	CU 159	2013	Hybrid							SC
15	CU 144	2012	Hybrid							SC
16	GL 395	2010	Hybrid	R	R		R			GL
17	CU 186	2013	Hybrid							SC
18	K 326	1981	McNair 225 (McNair 30 x NC 95)	L	L		R			GL,Ric,CC
19	CC 67	2008	Hybrid	R	R		TCN/R		TMV	CC
20	CU 124	2012	Hybrid							SC
21	NC 938	2012	Hybrid	R	R		R		TMV	NC
22	CC 37	2006	Hybrid	R	R		TCN/R	M.j/R	TMV	CC
23	CC 143	2012	Hybrid	R	R		R			CC
24	CC 27	2003	Hybrid	R	R		TCN/R		TMV	CC
25	Speight 227	2003	(SP 151 X K 346)(SP 202 X K 346)	R	R		R			CC
26	NC 925	2010	N/A	R			R			GL,Ric,CC
27	GL 338	2009	Hybrid	R	R					GL
28	CC 700	2005	Hybrid	R	R		TCN/R			CC
29	GL 368	2009	Hybrid	R	R					GL
30	CC 13	2005	Hybrid	R	R		M.j/R			CC
31	NC 72	1996	Hybrid	H	L		R			Rickard
32	NC 196	2002	Hybrid	R	L		R			GL
33	PVH 1452	2006	Hybrid	R	R		TCN/R			Rickard
34	CU 171	2013	Hybrid							SC
35	NC 606	1998	NC 729 X NC 82	R	R		R			Raynor
36	CC 1063	2011	Hybrid	R	R		R			CC
37	NC 92	2007	Hybrid	R	R		TCN/R			Rickard
38	NC 297	1998	Hybrid	R	R		R		TMV	GL
39	RJR 901	2011	Hybrid	R	R		R			CC
40	Speight 236	2005	(SP 168 X SP 196)(SP 179 X SP 177)	R	R		R			CC
41	CU 110	2010	Hybrid							SC
42	NC 960	2013	Hybrid							NC
43	PVH 2310	2013	Hybrid	R		R	M.inco	M.ar	TMV/PVY	Rickard
44	PVH 2281	2013	Hybrid	R	R					Rickard
45	NC 2326	1965	(Hicks x 9102)(Hicks)(Hicks)(Hicks)	L	Su	M				NC
46	GL 362	2012	Hybrid	R	R		R		PVY	GL
47	PVH 1600	2013	Hybrid	R	R		M.inco			Rickard
48	NC 95	1961	(C-139 X Bel. 4-30) x (C-139 X Hicks)	L	H	M	R			NC
49	GL 398	2013	Hybrid	R	R		R			GL
50	K 346	1988	McNair 926 x 80241	H	H		R			GL

[1]Resistance; H - High; M - Moderate; L - Low; R - Resistance; T - Tolerant; Su - Susceptable
Diseases: BS - Black Shank; GW - Granville Wilt; FW - Fusarium Wilt; RK - Root Know; Bn. Sp. - Brown Spot;
TMV - Tobacco Mosaic Virus; PVY - Potato Vius 'y'; TSMV - Tomato Spotted Wilt Virus;
TCN - Tobacoo Cyst Nematode; TEV - Tobacco Etch Virus; M.j. - Meloidogyne javanica

2014 FLUE-CURED REGIONAL SMALL PLOT TEST										
GEORGIA, SOUTH CAROLINA, NORTH CAROLINA, AND VIRGINIA										
Trt. No	Variety or Line	Generation or Year of Release	Pedigree	BS	GW	FW	RK	Bn. Sp.	Virus	Sponsor
1	NC 2326	1965	(Hicks X 9102)(Hicks)Hicks)Hicks)	L	SU	M				NC
2	NC 95	1961	(C-139XBel.4-30)x(C-139XHicks)	L	H	M	R			NC
3	K 326	1981	McNair 225 (McNair 30 X NC95)	L	L		R			GL
4	XHN 52	F1	Hybrid	R		R	M.incog	M.aren	TMV/PVY	Rickard
5	CU 181	F1	Hybrid							SC
6	CU 158	F1	Hybrid							SC
7	NCEX65	F1	Hybrid	R	R		TCN/R			NC
8	CU 178	F1	Hybrid							SC
9	GLEX 976	F1	Hybrid							GL
10	XHN 60	F1	Hybrid	R	R	R	M.incog	M.aren	TMV	Rickard
11	NCEX63	F1	Hybrid	R	R		TCN/R			NC
12	AOV 413	F1	Hybrid							AO
13	CC Exp. 4	F1	Hybrid	R	R		R	R		CC
14	GLEX 965	F1	Hybrid							GL
15	CU 211	F1	Hybrid							SC
16	XHN 64	F1	Hybrid	R		R	M.incog	M.aren	TMV/PVY	Rickard
17	NCEX62	F1	Hybrid	R	R		R			NC
18	CC Exp. 6	F1	Hybrid	R	R		R			CC
19	CC Exp. 5	F1	Hybrid	R	R		R			CC
20	NCEX64	F1	Hybrid	R	R		TCN/R			NC
21	ULT 164	F1	Hybrid						TMV	ULT
22	ULT 115	F1	Hybrid						TMV	ULT
23	XHN 65	F1	Hybrid	R		R	M.incog	M.aren	TMV/PVY	Rickard
24	NCEX66	F1	Hybrid	R	R		TCN/R			NC
25	CU 183	F1	Hybrid							SC
26	NCEX67	F1	Hybrid	R	R		R			NC
27	CC Exp. 1	F1	Hybrid	R	R		R			CC

[1]Resistance; H - High; M - Moderate; L - Low; R - Resistance; T - Tolerant; Su - Susceptable
Diseases: BS - Black Shank; GW - Granville Wilt; FW - Fusarium Wilt; RK - Root Know; Bn. Sp. - Brown Spot;
TMV - Tobacco Mosaic Virus; PVY - Potato Vius 'y'; TSMV - Tomato Spotted Wilt Virus;
TCN - Tobacoo Cyst Nematode; TEV - Tobacco Etch Virus; M.j. - Meloidogyne javanica

2014 FLUE - CURED REGIONAL FARM TEST										
GEORGIA, SOUTH CAROLINA, NORTH CAROLINA, AND VIRGINIA										
Trt. No	Variety or Line	Generation or Year of Release	Pedigree	BS	GW	FW	RK	Bn. Sp.	Virus	Sponsor
1	NC 2326	1965	(Hicks X 9102)(Hicks)(Hicks)Hicks)	L	Su	M				NC
2	NC 95	1961	(C-139 X Bel. 4-30)X(C-139 X Hicks)	L	H	M	R			NC
3	K 326	1981	McNair 225(McNair 30 X NC 95)	L	L		R			GL
4	CU 45	F1	Hybrid							SC
5	NCEX68	F1	Hybrid							NC
6	GLEX 309	F1	Hybrid							GL
7	PXH 12	F1	Hybrid							Rickard
8	NCEX36	F1	Hybrid							NC
9	CU 185	F1	Hybrid							SC
10	GLEX 394	F1	Hybrid							GL
11	CU 208	F1	Hybrid							SC
12	CU 204	F1	Hybrid							SC
13	NCEX69	F1	Hybrid							NC
14	NCEX40	F1	Hybrid							NC
15	PXH 16	F1	Hybrid							Rickard

[1]Resistance; H - High; M - Moderate; L - Low; R - Resistance; T - Tolerant; Su - Susceptable
Diseases: BS - Black Shank; GW - Granville Wilt; FW - Fusarium Wilt; RK - Root Know; Bn. Sp. - Brown Spot;
TMV - Tobacco Mosaic Virus; PVY - Potato Virus 'y'; TSMV - Tomato Spotted Wilt Virus;
TCN - Tobacoo Cyst Nematode; TEV - Tobacco Etch Virus; M.j. - Meloidogyne javanica

2014 Advanced Breeding Lines Pedigree

2014 NORTH CAROLINA FLUE-CURED ADVANCED BREEDING LINES

Trt. No	Variety or Line	Generation or Year of Release	Pedigree	BS	GW	FW	RK	Bn. Sp.	Virus	Sponsor
1	NC 2326	1965	(Hicks X 9102)(Hicks)(Hicks)Hicks)	L	Su	M				NC
2	NC 95	1961	(C-139 X Bel. 4-30)X(C-139 X Hicks)	L	H	M				NC
3	K 326	1981	McNair 225(McNair 30 X NC 95)	L	L		R			GL
4	CU 142	F1	Hybrid							SC
5	CU 187	F1	Hybrid							SC
6	RJR 731	F1	Hybrid							RJR
7	CU 202	F1	Hybrid							SC
8	CU 175	F1	Hybrid							SC
9	RJR 732	F1	Hybrid							RJR
10	CU 156	F1	Hybrid							SC

[1]Resistance; H - High; M - Moderate; L - Low; R - Resistance; T - Tolerant; Su - Susceptable
Diseases: BS - Black Shank; GW - Granville Wilt; FW - Fusarium Wilt; RK - Root Know; Bn. Sp. - Brown Spot; TMV - Tobacco Mosaic Virus; PVY - Potato Virus 'y'; TSMV - Tomato Spotted Wilt Virus; TCN - Tobacoo Cyst Nematode; TEV - Tobacco Etch Virus; M.j. - Meloidogyne javanica

2014 Flue-Cured Tobacco Pesticide Residue Evaluation

401 1	402 2	403 3	404 4	405 5	406 6	407 7	408 8
301 1	302 2	303 3	304 4	305 5	306 6	307 7	308 8
201 1	202 2	203 3	204 4	205 5	206 6	207 7	208 8
101 1	102 2	103 3	104 4	105 5	106 6	107 7	108 8

5 ft

40 ft

16 ft

Treatments:

1. Spinosad (Blackhawk)- 6 foliar applications @ 3.2 fl oz/app
2. Cyantraniliprole (Verimark)- 1 tray drench application @ 13.5 fl oz/app
3. Fenamidone (Reason)- 3 foliar applications @ 8.2 fl oz/app
4. Chlorantraniliprole (Coragen)- 1 TPW application @ 7.0 fl oz, 2 foliar applications @ 4.2 fl oz/app
5. Difenoconazole (Inspire)- 2 foliar applications @ 10.27 fl oz/app
6. Inodoxacarb (Steward)- 2 foliar applications @ 2.054 fl oz/app
7. Tebuconazole (Folicur 3.6F)- 2 foliar applications @ 2.97 fl oz/app
8. Untreated Check

2014 Flue-Cured Tobacco Pesticide Residue Evaluation

Two insecticides were entered into the NCSU Pesticide Residue Field Testing Program: spinosad (Blackhawk) and cyantraniliprole (Verimark). Spinosad is currently labeled for use in US tobacco production, but cyantraniliprole is not (a label is expected by the end of 2014, the use pattern is not yet known but it is considered a candidate for tray drench application only). Spinosad was applied six times at a rate of 3.2 oz/acre with a ten day spray interval and three day PHI. Cyantraniliprole was applied once in a tray drench application prior to transplanting at a rate of 13.5 fl oz/acre.

Results from 2013 indicate that both products have very low residues when used in accordance with their respective labels. Not surprisingly, the single application of cyantraniliprole prior to transplanting did not result in residues that were quantifiable. Furthermore, the residue results for spinosyn-A and spinosyn-D, the active ingredients in spinsosad, were extremely low as well. Spinosyn-A and –D residues were higher in the lower stalk position but were often below the quantifiable limit (0.025 ppm) in middle and upper stalk positions. The results for spinosad and cyantraniliprole in 2013 are extremely favorable but are considered preliminary at this point. It should be noted that rainfall for 2013 was above average with both research locations receiving in excess of 30 inches during the growing season. Evaluation of these two compounds will continue in 2014 and 2015. The results of the remaining compounds are currently unavailable.

Table 1. Application rates, pre-harvest interval (PHI), and established tolerances of pesticides evaluated for residues on flue-cured tobacco in North Carolina in 2013.

Pesticide	Total Applied		Applications	PHI	Established Tolerance (ppm)	
	acre^{-1}	lb a.i. acre^{-1}	# and (type)	Days	CORESTA	USDA
Cyantraniliprole	13.5 fl. oz	--	1 (Tray Drench @ 0.648 fl. oz tray^{-1})	--	N/A	N/A
Spinosad	19.2 oz	0.432	6 (Foliar @ 3.2 oz)	3	N/A	N/A

Table 2. Pesticide residues on individual stalk positions of flue-cured tobacco leaves in 2013.

Compound Evaluated	Kinston			Rocky Mount		
	Lower	Middle	Upper	Lower	Middle	Upper
	ppm					
Cyantraniliprole (0.025[a])						
Mean	<0.025[b]	<0.025[b]	<0.025[b]	<0.025[b]	<0.025[b]	<0.025[b]
Maximum	<0.025[b]	<0.025[b]	<0.025[b]	<0.025[b]	<0.025[b]	<0.025[b]
Minimum	<0.025[b]	<0.025[b]	<0.025[b]	<0.025[b]	<0.025[b]	<0.025[b]
Standard Deviation	0.000	0.000	0.000	0.000	0.000	0.000
95% CI	---[c]	---[c]	---[c]	---[c]	---[c]	---[c]
Spinosyn-A (0.025[a])						
Mean	0.320	0.094	<0.025[b]	<0.044[b]	<0.025[b]	<0.025[b]
Maximum	0.740	0.250	<0.025[b]	0.060	<0.025[b]	<0.025[b]
Minimum	0.140	<0.025[b]	<0.025[b]	<0.025[b]	<0.025[b]	<0.025[b]
Standard Deviation	0.284	0.106	0.000	0.019	0.000	0.000
95% CI	0.042-0.598	-0.010-0.198	---[c]	0.025-0.063	---[c]	---[c]
Spinosyn-D (0.025[a])						
Mean	<0.069[b]	<0.025[b]	<0.025[b]	<0.025[b]	<0.025[b]	<0.025[b]
Maximum	0.170	<0.025[b]	<0.025[b]	<0.025[b]	<0.025[b]	<0.025[b]
Minimum	<0.025	<0.025[b]	<0.025[b]	<0.025[b]	<0.025[b]	<0.025[b]
Standard Deviation	0.068	0.000	0.000	0.000	0.000	0.000
95% CI	0.002-0.136	---[c]	---[c]	---[c]	---[c]	---[c]

[a] Detection limit in ppm.

[b] Residue number was below the established laboratory detection limit, the detection limit was used to compute the mean.

[c] Blank cells indicate a lack of standard deviation; therefore, a confidence interval could not be established.

Evaluation of Non-tobacco Labeled Herbicides for Late Season Application

401 8	402 2	403 9	404 17	405 6	406 5	407 13	408 10	409 14	410 4	411 18	412 12	413 3	414 1	415 15	416 11	417 16	418 7
301 17	302 11	303 16	304 14	305 15	306 13	307 2	308 10	309 9	310 8	311 3	312 4	313 12	314 18	315 5	316 7	317 6	318 1
201 6	202 9	203 15	204 7	205 3	206 14	207 13	208 8	209 12	210 16	211 5	212 18	213 2	214 17	215 11	216 1	217 10	218 4
101 1	102 2	103 3	104 4	105 5	106 6	107 7	108 8	109 9	110 10	111 11	112 12	113 13	114 14	115 15	116 16	117 17	118 18

Plot Size: 1 Row, 4' wide and 40' long with a common border row between treatments

Variety: NC 196 (GH Plants).

Fertilization: Standard Research Station Cultural Practices

Treatments:	
1.) Dual Magnum 7.62 EC @ 1.33 pt/a (Before Topping)	10.) Liberty 2.34EC + NIS @ 29 fl oz/a (After First Harvest)
2.) Dual Magnum 7.62 EC @ 1.33 pt/a (After First Harvest)	11.) Callisto 50 WG + NIS @ 0.188 lb/a (Before Topping)
3.) Spartan 4F @ 8.0 fl oz/a (Before Topping)	12.) Callisto 50 WG + NIS @ 0.188 lb/a (After First Harvest)
4.) Spratan 4F @ 8.0 fl oz/a (After First Harvest)	13.) Linex 4L + NIS @ 32 fl oz/a (Before Topping)
5.) Envoke 75 WG + NIS @ 0.1 oz/a (Before Topping)	14.) Lines 4L + NIS @ 32 fl oz/a (After First Harvest)
6.) Envoke 75 WG + NIS @ 0.1 oz/a (After First Harvest)	15.) Aim 2EC + NIS @ 3.0 fl oz/a (Before Topping)
7.) Reflex 2EC+ NIS @ 1 pt/a (Before Topping)	16.) Aim 2EC + NIS @ 3.0 fl oz/a (After First Harvest)
8.) Reflex 2EC +NIS @ 1 pt/a (After First Harvest)	17.) Poast 1.5 EC + COC @ 2.0 pt/a (After First Harvest)
9.) Liberty 2.34EC + NIS @ 29 fl oz/a (Before Topping)	18.) Spartan 4F @ 5.0 fl oz/a + Command 3ME @ 2 pt/a (PRE-TRANS)

Evaluation of Non-tobacco Labeled Herbicides for Late Season Application

Weed seed contamination in flue cured tobacco has become a major concern amongst export markets, specifically China. Recently, Palmer Amaranth seed along with other invasive weed seed species have been identified, triggering a zero tolerance for weed seed in tobacco. Extension Specialists have reason to believe that the majority of the weed seed entering the tobacco supply comes from the mechanized harvest of tobacco at various stalk positions. Currently, farmers have various management options, such as cultivation and hand weeding, to help reduce weed pressure and lower seed bank populations for future years. Additionally, the spectrum of chemical weed control options in tobacco is narrow, therefore; evaluation of non-tobacco labeled herbicides for late season application is greatly needed to give farmers alternative strategies in weed management.

Nine different herbicides will be evaluated at two different application times, one at topping and one after first harvest. Application will be made with a back-pack sprayer using a twenty inch boom spacing with two Teejet VisiFlo flat spray tip nozzles at a spray volume of 20 gallons/acre. Spray applications will cover the row middle as well as a portion of the tobacco bed. Product rates will be based upon extension specialist recommendations.

After completion of spray application and product activation, data will be collected to determine weed control efficacy, potential crop injury, and stunting. After extensive testing, we hope that product labels for flue-cured tobacco will be granted. Based on the research conducted, our hope is that we find effective post-emergence weed control products that tobacco growers can incorporate into their current weed management programs to reduce weed seed contamination in flue-cured tobacco.

Evaluation of Conveyors for Reduction of MH Residues and Improved Sucker Control

410 4	409 6	408 5	407 1	406 9	405 2	404 3	403 8	402 7	401 10

301 5	302 7	303 1	304 2	305 4	306 3	307 8	308 9	309 6	310 10

210 7	209 3	208 4	207 6	206 8	205 9	204 1	203 2	202 5	201 10

101 1	102 2	103 3	104 4	105 5	106 6	107 7	108 8	109 9	110 10

Treatments:	
1.) Royaltac-M @ 2.0 GPA Royaltac-M @ 2.5 GPA Flupro @ 0.5 GPA Royal MH-30 @ 1.0 GPA (Standard Nozzle Arrangement)	2.) Royaltac-M @ 2.0 GPA Royaltac-M @ 2.5 GPA Royal MH-30 @1.0 GPA Flupro @ 0.3 GPA + Butralin @ 0.3 GPA (Standard Nozzle Arrangement)
3.) Royaltac-M @ 2.0 GPA Royaltac-M @ 2.5 GPA Royal MH-30 @ 1.0 GPA Butralin @ 0.75 GPA (Standard Nozzle Arrangement)	4.) Royaltac-M @ 2.0 GPA Royaltac-M @ 2.5 GPA Royal MH-30 @ 1.0 GPA Flupro @ 0.5 GPA (Standard Nozzle Arrangement)
5.) Royaltac-M @ 2.0 GPA Royaltac-M @ 2.5 GPA Flupro @ 0.3 GPA + Butralin @ 0.3 GPA Flupro @ 0.5 GPA + Butralin @ 0.6 GPA (Conveyors)	6.) Royaltac-M @ 2.0 GPA Royaltac-M @ 2.5 GPA Flupro @ 0.1875 GPA + Butralin @ 0.1875 GPA Flupro @ 0.1875 GPA + Butralin @ 0.1875 GPA (Conveyors)
7.) Royaltac-M @ 2.0 GPA Royaltac-M @ 2.5 GPA Flupro @ 0.5 GPA Butralin @ 0.5 GPA (Conveyors)	8.) Royaltac-M @ 2.0 GPA Royaltac-M @ 2.5 GPA Flupro @ 0.5 GPA Butralin @ 0.75 GPA (Conveyors)
9.) Royaltac-M @ 2.0 GPA Royaltac-M @ 2.5 GPA Royaltac-M @ 2.5 GPA Royaltac-M @ 2.5 GPA Royaltac-M @ 2.5 GPA (Conveyors)	10.) Topped, Not Suckered

Evaluation of Conveyors for Reduction of MH Residues and Improved Sucker Control

Following their introduction to the US tobacco industry, conveyors (hooded tobacco sucker control sprayers) have offered producers another option for crop management. Conveyors fit over the standard three-nozzle sucker control arrangement and condense the spray pattern from 20 inches to roughly 14 inches, depending on design. The concept behind this apparatus is that sucker control chemical application is then concentrated down stalk, instead of being applied in the traditional broadcast fashion. This study is designed to quantify the impact of a concentrated spray pattern as well as to determine how MH residues might be impacted. Following the final crop harvest, overall sucker control and crop yield will be assessed. Cured leaf samples will be collected to determine final MH residue.

Evaluation of 3 Transgenic Varieties Compared to 3 Check Varieties K 326, NC 95 and LAFC53
For Low Alkaloid Production
Upper Coastal Plain Research Station
Rocky Mount, NC

418	417	416	415	414	413	412	411	410	409	408	407	406	405	404	403	402	401
13	7	1	16	4	10	8	14	2	17	5	11	12	6	18	3	9	15
2 GR		70 LBS N/A				2 GR		59 LBS N/A				2 GR		49 LBS N/A			2 GR

Rep IV

5' Alley

301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318
11	2	17	8	14	5	18	9	12	3	15	6	10	1	13	16	4	7
2 GR		59 LBS N/A				2 GR		49 LBS N/A				2 GR		70 LBS N/A			2 GR

Rep III

5' Alley

218	217	216	215	214	213	212	211	210	209	208	207	206	205	204	203	202	201
15	3	18	6	12	9	16	1	13	4	10	7	14	2	17	8	5	11
2 GR		49 LBS N/A				2 GR		70 LBS N/A				2 GR		59 LBS N/A			2 GR

Rep II

5' Alley

101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118
1	4	7	10	13	16	2	5	8	11	14	17	3	6	9	12	15	18
2 GR		70 LBS N/A				2 GR		59 LBS N/A				2 GR		49 LBS N/A			2 GR

Rep I

Design: Factorial

Plot Size: 2-rows, 8' wide and 40' long

Varieties: K 326 Nb1-RNAi DH22A; K 326 Nb1-RNAi DH 32; K 326 Nb1-RNAi DH 16A; K 326; NC 95; LAFC53. Transplanted 4-23-2014

Fertilization: 49, 59 and 70 lbs N/A for each variety. Research station to apply a blanket application of 10 gallons per acre of 32% (UAN) = 30 lbs of Nitrogen per acre. Project leader will apply the other nitrogen variables.

GR = 2 Guard rows

Evaluation of Three Transgenic Varieties Compared to Three Conventional Varieties for Low Alkaloid Production with Three Nitrogen Variables

4 replications per location at 3 locations: Oxford Tobacco Research Station in Oxford, NC, Upper Coastal Plain Research Station near Rocky Mount, NC, and Lower Coastal Plain Research Station in Kinston, NC.

Nicotine is one of the most studied and scrutinized plant secondary metabolites. Its concentration in tobacco products now falls under the jurisdiction of the Food and Drug Administration and it has been speculated that increased regulation might be expected. It is presumed that the FDA might begin restricting the amount of nicotine it allows in tobacco products to even lower levels, and there has been some interest in low nicotine products as smoking cessation strategies (Hatsukami et al., 2010a; Donny et al., 2014). Nicotine levels are also of importance due to the implicated role of nicotine as a precursor to one of the tobacco specific nitrosamines (TSNAs), which are a potent group of recognized carcinogens in tobacco products.

This project is designed to evaluate three different transgenic tobacco lines developed by Dr. Ramsey Lewis which have been altered to decrease alkaloid (nicotine) production. All three transgenic varieties were derived from K 326, with each have a different location at which the transgenic event took place. These three transgenic varieties along with three conventional varieties (K 326, NC 95, LAFC53) were randomized over three different nitrogen rates, for a total of 18 treatments. The nitrogen rates are the recommended rate (70lbs N/acre), -15% of the recommended rate (59lbs N/acre), and -30% of the recommended rate (49lbs N/acre). Nitrogen was applied at a base rate of 30lbs N/acre at transplanting, the difference was applied with a backpack using 28% UAN for the various treatments.

Tissue samples will be taken at topping and after curing to evaluate total alkaloid and reducing sugar content. Final crop yield will also be assessed. It is expected to see that the low alkaloid lines will outperform the conventional varieties under the lower nitrogen regimens, due to a decreased demand for nitrogen for alkaloid production.

Since there is virtually no market demand for transgenic tobacco, Dr. Lewis has pursued a mutation breeding approach to identify EMS-induced mutations which should result in the same low alkaloid, non-transgenic tobacco. These lines will be evaluated next year as well.

2014 NC State Tobacco IPM Projects

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Locations

Trial	Location	Project Leaders
Efficacy of soil applied insecticides	Lower Coastal Plain Research Station *Lenoir County*	Aurora Toennisson
	Upper Coastal Plain Research Station *Edgecombe County*	Aurora Toennisson
Management of lepidopteran pests with foliar insecticides	Lower Coastal Plain Research Station *Lenoir County*	Aurora Toennisson
	Upper Coastal Plain Research Station *Edgecombe County*	Aurora Toennisson
Management of key tobacco pests using thresholds	Lower Coastal Plain Research Station *Lenoir County*	Aurora Toennisson
	Upper Coastal Plain Research Station *Edgecombe County*	Aurora Toennisson
Identifying barriers to IPM adoption in flue cured tobacco	*Johnston County*	Bryant Spivey, Aurora Toennisson & Hannah Burrack
	Stokes County	Tim Hambrick, Aurora Toennisson & Hannah Burrack
	Wilson County	Norman Harrell, Aurora Toennisson & Hannah Burrack

Support

DuPont Crop Protection
Bayer Crop Sciences
FMC Corporation, Inc.
Dow AgroSciences
North Carolina Tobacco Foundation, Inc.
North Carolina Tobacco Growers Association
Philip Morris International

2014 NC State Tobacco IPM Project Updates

Efficacy of soil applied insecticides

Locations
Upper Coastal Plain Research Station
Rocky Mount, NC
Lower Coastal Plain Research Station
Kinston, NC

Research Associate
Aurora Toennisson

Principle Investigator
Hannah Burrack

Purpose
To compare the efficacy of soil applied insecticides against key tobacco pests, including green peach aphid (GPA), tobacco flea beetle (TFB), tobacco budworm (TBW), and tobacco/tomato hornworms (HW).

Treatment, rate, application method, and expected target pests
1. Untreated control
2. Admire Pro (imidacloprid), 0.6 fl oz/1000 plants, Greenhouse tray drench (GPA, TFB)
3. Verimark (cyantraniliprole), 13.5 fl oz/acre, Greenhouse tray drench (GPA, TFB)
4. Admire Pro (imidacloprid) + Verimark (cyantraniliprole), 0.6 fl oz/1000 plants + 13.5 fl oz/acre, Greenhouse tray drench (GPA, TFB)
5. Admire Pro (imidacloprid) + Verimark (cyantraniliprole) + Coragen (chlorantraniliprole), 0.6 fl oz/1000 plants + 13.5 fl oz/acre + 7.0 fl oz/acre, Greenhouse tray drench + Greenhouse tray drench + Transplant water (GPA, TFB, TBW, HW)
6. Admire Pro (imidacloprid) + Coragen (chlorantraniliprole), 0.6 fl oz/1000 plants + 7.0 fl oz/acre, Greenhouse tray drench + Transplant water (GPA, TFB, TBW, HW)

Plot map

401 **5**	402 **4**	403 **3**	404 **1**	405 **2**	406 **6**
301 **2**	302 **3**	303 **1**	304 **5**	305 **4**	306 **6**
201 **3**	202 **2**	203 **5**	204 **4**	205 **1**	206 **6**
101 **4**	102 **2**	103 **1**	104 **6**	105 **3**	106 **5**

Methods

This experiment was replicated at the Upper Coastal Plain Research Station, Rocky Mount and at the Lower Coastal Plain Research Station, Kinston. Plots at the at the Upper Coastal Plain Research Station were planted on 5 May 2014 at which time transplant water treatments were applied, and greenhouse tray drench treatments were applied on 28 April 2014. No insecticides have been applied to plants either pre or post transplant. Fertility, sucker control, and fungicide treatments have been applied as needed, following standard NC State University recommendations.

Data collection

At 3 and 4 weeks after transplant (WAT), the width of the largest leaf and at 5 and 6 WAT the height from base to the bud on 10 plants each in rows 2 and 3 was measured, in inches, to quantify any potential phytotoxic or plant growth regulator effects of materials. Flowering dates for plants in rows 2 and 3 will also be assessed to measure plant effects of insecticide treatments.

Beginning 3 WAT, pest populations were assessed weekly as follows:

1. Tobacco flea beetles (TFB) were counted on 10 plants each in rows 2 and 3. TFB holes were counted on the largest true leaf on the same 10 plants.
2. The number of tobacco budworm (TBW) infested plants in rows 2 and 3 were counted, and the percentage of TBW infested plants was calculated.
3. The number of plants with 50 or more wingless green peach aphids (GPA) on their upper leaves were in rows 2 and 3 were counted, and the percentage of GPA infested plants was calculated.
4. If present, the number of tobacco/tomato hornworm (HW) larvae were counted on 10 plants each in rows 2 and 3.

Results to date

Neither plant height or leaf width was significantly impacted by insecticide treatments. Plants at the Lower Coastal Plain Research Station have flowered, but there was no significant difference in flowering timing between treatments.

Aphid and hornworm numbers have been low to date and were insufficient to compare treatments.

Tobacco budworm populations did not develop until 6 WAT, and there were no significant effect of treatment on tobacco budworm infestation rate.

All treatments reduced tobacco flea beetle damage relative to the untreated control (Figure 1).

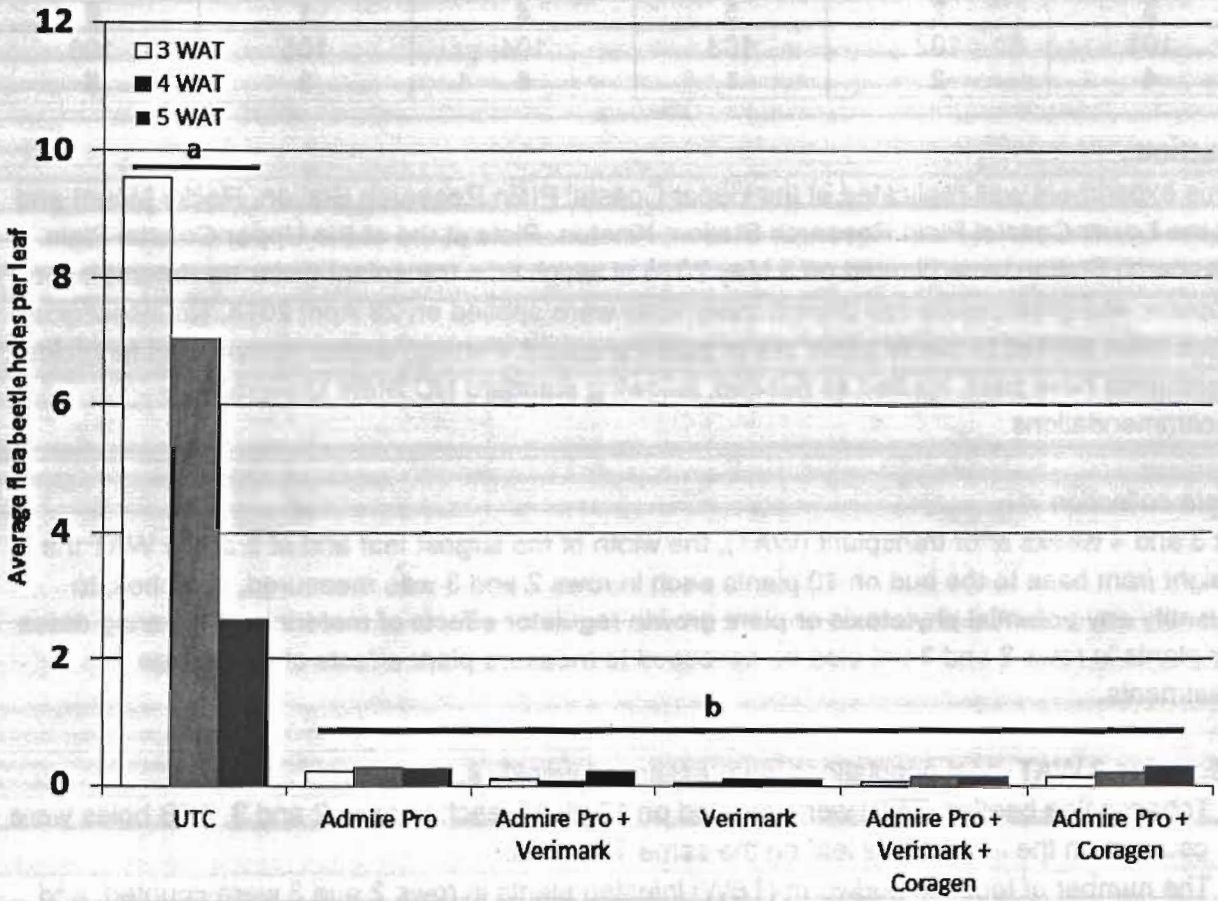

Figure 1. Average tobacco flea beetle holes on the largest leaf. Values indicated by the same letter are not significantly different from one another (α=0.05) via Fisher's Protected LSD.

Management of lepidopteran pests with foliar insecticides

Locations
Upper Coastal Plain Research Station
Rocky Mount, NC
Lower Coastal Plain Research Station
Kinston, NC

Research Associate
Aurora Toennisson

Principle Investigator
Hannah Burrack

Purpose
To compare the efficacy of foliar insecticides against against tobacco budworm and tobacco/tomato hornworm.

Treatment, rate, application method
1. Untreated control
2. Blackhawk (spinosad), 1.5 oz/acre, Field foliar application
3. Blackhawk (spinosad), 2.0 oz/acre, Field foliar application
4. Besiege (lamda-cyhalothrin & chlorantranilirpole), 9.0 fl oz/acre, Field foliar application
5. Belt (flubendiamide), 2.0 fl oz/acre, Field foliar application
6. Coragen (chlorantraniliprole), 5.0 fl oz/acre, Field foliar application
7. Coragen (chlorantraniliprole), 5.0 fl oz/acre, Transplant water
8. Coragen (chlorantraniliprole), 7.0 fl oz/acre, Transplant water

Plot map

401 **1**	402 **5**	403 **6**	404 **8**	405 **7**	406 **4**	407 **3**	408 **2**
301 **5**	302 **8**	303 **4**	304 **2**	305 **7**	306 **1**	307 **3**	308 **6**
201 **1**	202 **6**	203 **2**	204 **4**	205 **7**	206 **8**	207 **5**	208 **3**
101 **7**	102 **6**	103 **4**	104 **2**	105 **3**	106 **8**	107 **5**	108 **1**

Methods
This experiment was conducted at the Upper Coastal Plain Research Station, Rocky Mount, NC and at the Lower Coastal Plain Research Station, Kinston, NC. Plots at the at the Upper Coastal Plain Research Station were planted on 5 May 2014. Plants were treated with Admire Pro (0.6 fl oz/1000 plants) in the greenhouse on 28 April 2014 to control tobacco flea beetles and aphids during the first half of the growing season. Each treatment was replicated four times in 0.018 acre plots arranged in a randomized complete block design. Fertility, sucker control, and

fungicide treatments have been applied as needed, following standard NC State University recommendations.

Beginning 3 weeks after transplant (WAT), data were collected as follows:
1. The number of plants each in rows 2 & 3 were determined, and
2. The number of tobacco budworm larvae were counted in rows 2 & 3.
3. If present, the number of tobacco/tomato hornworm (HW) larvae were counted on 10 plants each in rows 2 and 3.

When tobacco budworm exceeded recommended treatment thresholds across all plots (1 July 2014), foliar insecticide treatments were applied in a volume equivalent to 15 gal/acre at 55 psi pressure using a CO_2 pressurized backpack sprayer. The number of tobacco budworm larvae were counted in each plot 2 and 8 days after foliar treatments were applied (DAT).

Results to date

Foliar applications of all materials, with the exception of Besiege, significantly decreased tobacco budworm densities 2 DAT. Tobacco budworm densities were significantly lower in all foliar treated plots by 8 DAT (Figure 2).

Tobacco budworm densities did not exceed treatment thresholds in any treatment until 7 WAT, and all treatments exceeded threshold by 8 WAT. At transplant soil applications of Coragen did not delay budworm infestations relative to the untreated control (Figure 3).

Hornworm numbers have been low to date and were insufficient to compare treatments.

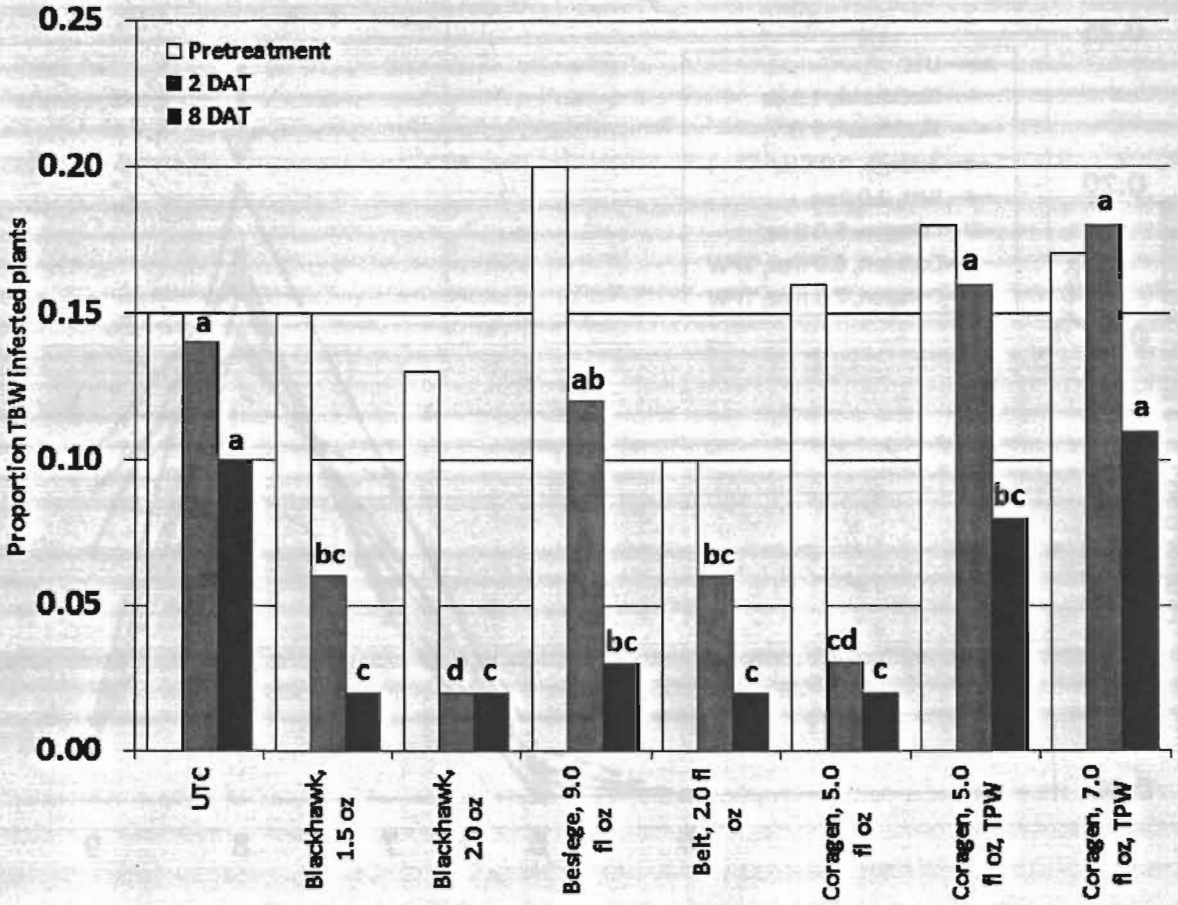

Figure 2. Proportion of tobacco budworm infested plants, Upper Coastal Plain Research Station. There was no significant difference between treatments pretreatment. Values for either 2 DAT and 8 DAT indicated by the same letter are not significantly different (α=0.05) via Fisher's Protected LSD.

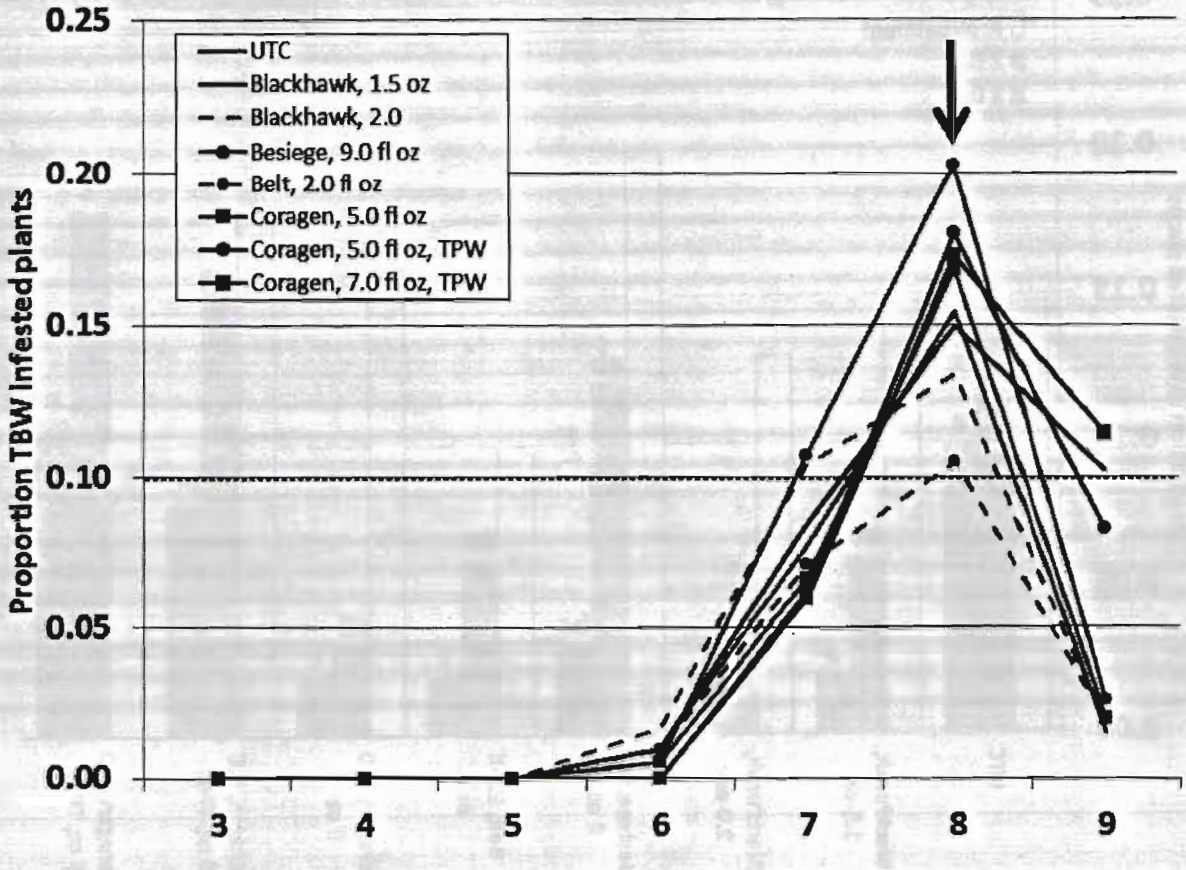

Figure 3. Proportion of tobacco budworm infested plants over time, Lower Coastal Plain Research Station. Foliar treatments indicated in gray, and treatments not receiving foliar applications indicated in black. Dashed line indicates economic threshold, and arrow indicates when foliar treatments were applied.

Using thresholds to manage key tobacco pests

Locations
Upper Coastal Plain Research Station
Rocky Mount, NC
Lower Coastal Plain Research Station
Kinston, NC

Research Associate
Aurora Toennisson

Principle Investigators
Hannah Burrack

Purpose
To compare inputs necessary and risks associated with using currently available economic thresholds to manage key foliar feeding tobacco pests.

Treatments, Rate/acre	Active ingredient(s)	Application frequency
1. Untreated control		
2. Admire Pro	Imidacloprid	Greenhouse (GTD)
3. Coragen + Admire Pro	Chlorantraniliprole + Imidacloprid	At threshold, GTD
4. Coragen + Admire Pro	Chlorantraniliprole + Imidacloprid	Scheduled, GTD
5. Belt + Admire Pro	Flubendamide + Imidacloprid	At threshold, GTD
6. Belt + Admire Pro	Flubendamide + Imidacloprid	Scheduled, GTD

Plot Map

401 **6**	402 **2**	403 **5**	404 **1**	405 **4**	406 **3**
301 **4**	302 **6**	303 **5**	304 **3**	305 **1**	306 **2**
201 **1**	202 **6**	203 **5**	204 **3**	205 **4**	206 **2**
101 **6**	102 **1**	103 **2**	104 **3**	105 **4**	106 **5**

Methods
This experiment is being conduct at the Upper Coastal Plain Research Station, Rocky Mount, NC and the Lower Coastal Plain Research Station, Kinston, NC. Plots at the Upper Coastal Plain Research Station were planted on 5 May 2014, and greenhouse tray drench treatments were applied on 28 April 2014. When a plot reached threshold for either TBW or HW, that plot was treated. Rows 1 and 4 of each plot served as buffers between plots. All foliar treatments are applied in 15 gal water per acre at 55 psi pressure.

The number of treatments necessary to maintain foliar feeding insect populations below threshold during the growing season, end of season yield estimates, and pesticide residues on cured leaf samples will be assessed at the end of the season.

In addition to research station based experiments, we are assessing inputs associated with threshold use (scouting time, pesticide applications) and comparing these inputs to grower standard practices at three on farm locations. Our goal is to identify potential barriers to IPM adoption by growers.

Results to date

The only key pest to reach treatment threshold to date has been tobacco budworms at both Upper Coastal Plain and Lower Coastal Plain Research Stations. Even in untreated control plots, aphids have not exceeded treatment thresholds.

Table 1. Number of foliar insecticide treatments to date.

Treatment	Upper Coastal Plain Research Station	Lower Coastal Plain Research Station
1. Untreated control	0.0	0.0
2. Admire Pro	0.0	0.0
3. Coragen + Admire Pro, At threshold	0.5	2.0
4. Coragen + Admire Pro, Scheduled	0.0	1.0
5. Belt + Admire Pro, At threshold	0.75	2.0
6. Belt + Admire Pro, Scheduled	1.0	2.0

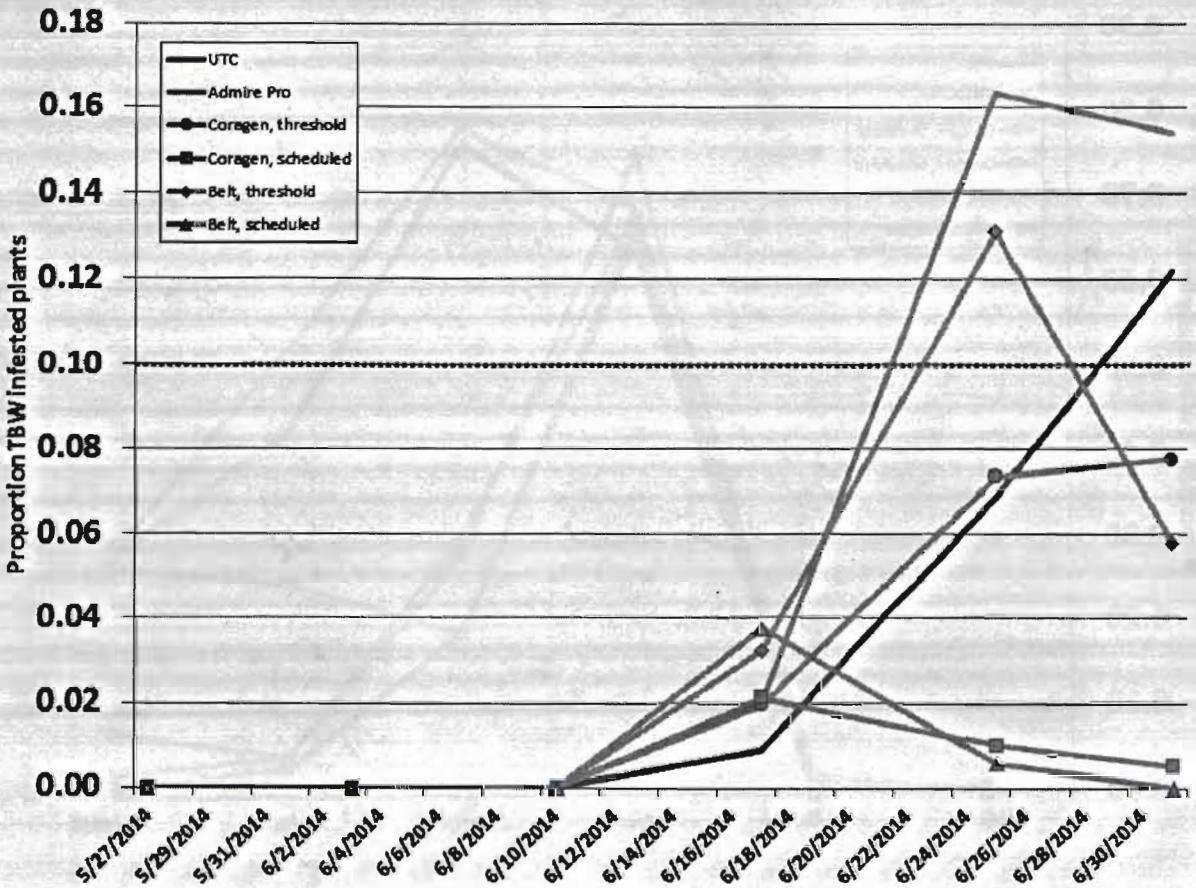

Figure 4. Tobacco budworm infestation across treatments, Upper Coastal Plain Research Station.

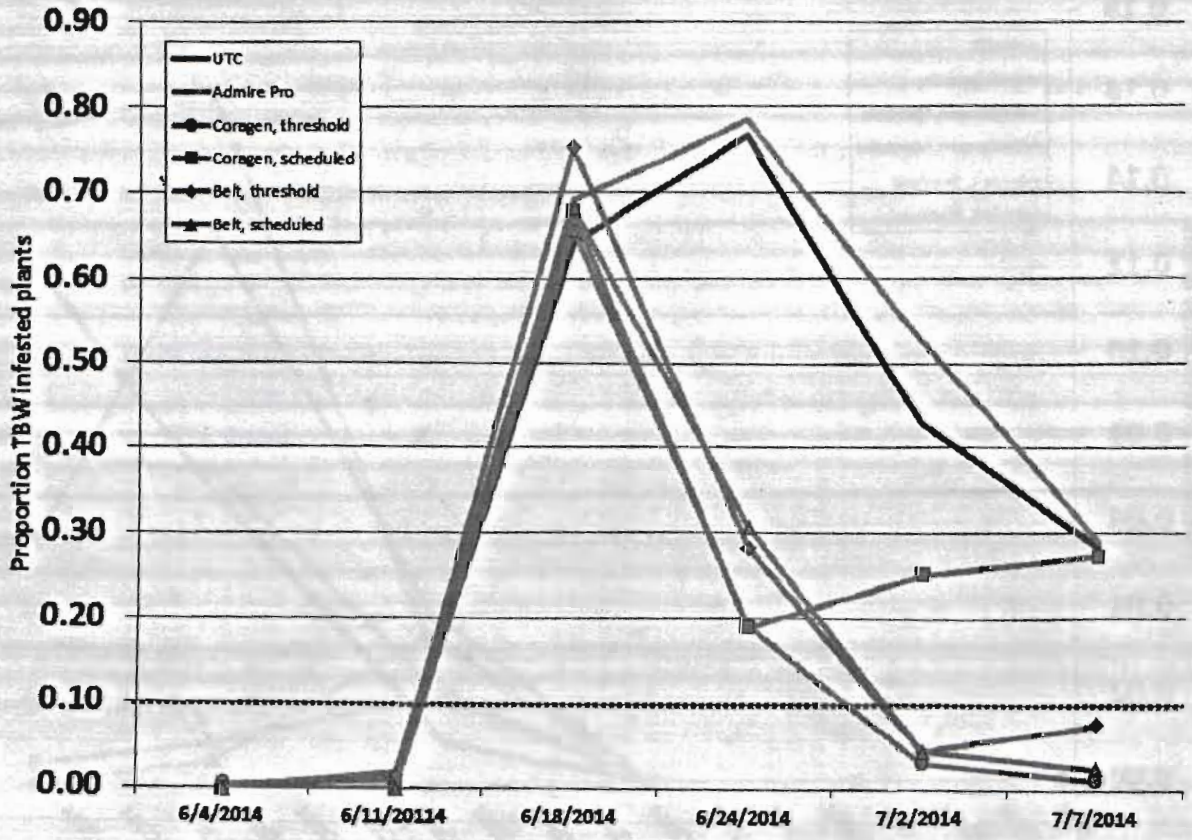

Figure 5. Tobacco budworm infestation across treatments, Lower Coastal Plain Research Station.

Prolonged flights
prolonged pressure
stick to threshold sprays
- too early
- multiple sprays