Development of disease management recommendations for Bailey and other multiple-disease resistant varieties

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Executive Summary for 2010

Virgina-type peanut cultivars generally have little resistance to leaf spots, stem rot, Sclerotinia blight, Cylindrocladium black rot (CBR), and spotted wilt. At best, cultivars have moderate resistance to only one or two diseases, while being susceptible to others. The resistance in most cultivars is too low to allow reduced disease control inputs.

Recently, NC State University released two new disease-resistant cultivars. Bailey and Sugg were bred for resistance to spotted wilt, CBR, leaf spots, and Sclerotinia blight. A surprising result of preliminary field studies was a marked reduction in stem rot in Bailey compared to susceptible Gregory, indicating that Bailey also has stem rot resistance.

Traditionally, we have recommended 5 fungicide sprays for control of leaf spots in NC. Several fungicides used for leaf spot control are also active against stem rot. For the first time, it may be possible to significantly change traditional approaches to disease management by allowing growers to use fewer inputs for leaf spot and/or stem rot control.

The objectives of this research were to 1) develop fungicide programs for use on Bailey, Sugg, or other multiple disease resistant cultivars; and 2) investigate methods to modify existing leaf spot advisories for use on multiple disease resistant cultivars. This was the second year of a two-year study.

Bailey and the susceptible cultivar Gregory were planted at Lewiston, NC and sprayed 3, 4, or 5 times per season according to a calendar schedule. The 4-spray program was initiated 2 weeks after the 5-spray program, and the 3-spray program was delayed 4 weeks. Each spray schedule had three treatment programs: 1) Tilt-Bravo for all sprays; 2) a leaf spot focused program of alternating Bravo and Headline sprays; and 3) a stem rot focused program of alternating Bravo and Provost sprays. An untreated check also was included.

Disease development was limited in 2010 by drought and high temperatures. Across all fungicide programs, Bailey had less leaf spot, defoliation, stem rot and CBR than Gregory. Bailey also produced significantly higher yield on average (3958 lb/a vs. 3553 lb/a).

On Bailey, all fungicide programs controlled leaf spot and defoliation. All programs except the 4-spray Tilt-Bravo program reduced stem rot compared to unsprayed. There were few differences in yield, but the Tilt-Bravo treatments tended to yield lower than the other programs on Bailey.

For the second objective, Bailey was planted in a cooperator farm and sprayed according to 1) advisory starting at R3; 2) calendar sprays starting at R3; 3) advisory at R3 + 2 weeks; 4) calendar sprays at R3 + 2 weeks; 5) untreated check. Little to no leaf spot developed due to severe drought. Yields were severely depressed and did not differ among treatments.

The 2010 and 2009 results confirmed that Bailey has stem rot resistance superior to that in other virginia-type cultivars. The leaf spot (Headline) and stem rot (Provost) programs performed equally well on Bailey when 4 or 5 sprays were used. A 4-spray program starting at R3 + 2 weeks gave very good leaf spot control on Bailey even with high disease pressure in 2009. Optimal timing of sprays for stem rot control needs further investigation.

Development of Disease Management Recommendations for Bailey and Other Multiple-Disease Resistant Cultivars

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For the past several years, Dr. Isleib's breeding program has emphasized the development of multiple-disease resistant lines. The new cultivars Bailey (tested as N03081T) and Sugg (tested as N03091T) are the first virginia-types to have multiple disease resistance. Planting Bailey or Sugg has the potential to significantly change traditional approaches to disease management.

We have established that Sclerotinia blight can be controlled on Bailey with 1 or 2 fewer fungicide applications than on other cultivars (including Perry). We also compared full (5 sprays initiated at R3) and reduced (3 or 4 sprays) fungicide schedules for leaf spot control on Bailey in 2007 and 2008. Results of these studies indicated that it may be possible to reduce the number of leaf spot sprays on Bailey without increasing disease or yield loss. However, leaf spot pressure was very light in both years due to drought, so additional testing is needed before firm recommendations can be made.

A surprising result of the leaf spot control studies was a marked reduction in stem rot in Bailey compared to Gregory, indicating possible stem rot resistance in Bailey. Several fungicides used for leaf spot control, including Provost, Abound, and Headline, are also active against stem rot. On susceptible cultivars, programs that include these fungicides usually increase yields over cheaper fungicides, like Tilt/Bravo, that control only leaf spots. It may be possible to control leaf spots with less expensive fungicides and/or lower application frequency on Bailey or Sugg without compromising stem rot control.

The objectives of this research were to 1) develop fungicide programs for use on multiple disease resistant cultivars; and 2) investigate methods to modify existing leaf spot advisories for use on multiple disease resistant cultivars. This was the second year of a two-year study.

For the first objective, Bailey was planted at Lewiston in 2009 and in 2010 and sprayed 3, 4, or 5 times per season according to a calendar schedule. Gregory also was planted as a susceptible standard. The five-spray program was initiated at R3. The four-spray program was initiated two weeks after the five-spray program and the three-spray program was initiated two weeks after the four-spray program. Each of the spray schedules had three treatments examining different sequences of specific fungicides. These treatments consisted of 1) a low-cost program targeted at leaf spots only (Tilt-Bravo for all sprays), and programs using combinations of fungicides focusing on 2) leaf spot or 3) stem rot control. An untreated check also was included. Leaf spot incidence, defoliation, and stem rot data were collected. Incidence of spotted wilt and/or Sclerotinia blight was determined as required and yields were compared.

In 2009, high levels of leaf spots and stem rot developed on the susceptible cultivar Gregory. Yield was greatly reduced when fungicides were not applied to Gregory and Bailey's unsprayed yield was 1398 pounds/a higher than Gregory's (Table 1). All 5-spray programs gave equal and high yields on Bailey (mean of 5,021 lb/a). On Bailey, the 4-spray and 3-spray stem rot control programs yielded equal to all 5-spray programs, but the 3-spray leaf spot and Tilt Bravo programs had lower yields.

Disease development was limited in 2010 by drought and high temperatures. Averaged across all fungicide programs, Bailey had significantly less leaf spot, defoliation, stem rot and CBR (data not shown) than Gregory. Bailey also produced higher yield (Table 2). On Bailey, all fungicide programs resulted in significant reductions in leaf spot and defoliation relative to the untreated control. There were no differences in leaf spot or defoliation between 3, 4, or 5 spray programs on Bailey. All programs except the 4-spray Tilt-Bravo program reduced stem rot on Bailey compared to the untreated control. There were few differences in yield, but the Tilt-Bravo treatments tended to yield lower than the others on Bailey.

For the second objective, Bailey was planted in three non-irrigated locations (two in 2009 and one in 2010) and sprayed according to 1) the North Carolina leaf spot advisory initiated at R3; 2) a calendar schedule initiated at R3; 3) the advisory initiated two weeks after R3; 4) a calendar schedule initiated two weeks after R3. An untreated check also was included. Leaf spot incidence, defoliation, and stem rot data were collected. Incidence of spotted wilt and/or Sclerotinia blight were determined as required and yields were compared.

In the on-farm studies in 2009, fungicide application (4 or 5 sprays) significantly reduced disease compared to unsprayed treatments. In 2010, little to no leaf spot developed due to severe drought and treatments did not differ. Yields did not differ among treatments in any of the three on-farm trials due to relatively low leaf spot and stem rot pressure (data not shown).

These trials confirmed that Bailey has stem rot resistance much superior to that in Gregory and other virginia-type cultivars. A four-spray program starting at R3 + 2 weeks (late July) will give good leaf spot control on Bailey even in years with high disease pressure. In general, the leaf spot (Headline) and stem rot (Provost) programs performed equally well on Bailey when 4 or 5 sprays were used. The level of leaf spot resistance in Bailey will make it more “forgiving” but best yields will be obtained with good a leaf spot control program starting at R3 + 2 weeks. Additional research is needed to clarify optimal timing of fungicide applications for stem rot control on both resistant and susceptible cultivars.

Table 1. Disease incidence and yield of Bailey and Gregory sprayed 3 - 5 times with different fungicide programs in 2009

Bailey	All leaf spot		Defoliation		Stem rot count		Sclerotinia	Yield	
unsprayed	90.0	a	50.0	a	39	a	2.0	4064	d
5 leaf spot	5.1	d	11.3	d	4	b	2.5	5027	ab
4 leaf spot	1.0	d	11.3	d	7	b	2.5	4840	abc
3 leaf spot	6.1	c	27.5	bc	16	b	0.5	4395	cd
5 stem rot	0.9	d	7.5	d	2	b	2.3	5237	a
4 stem rot	1.1	d	13.1	d	5	b	3.0	4915	abc
3 stem rot	7.0	c	25.6	bc	2	b	0.5	4758	abc
5 Tilt Bravo	1.0	d	10.6	d	12	b	1.3	4800	abc
4 Tilt Bravo	1.3	d	17.5	cd	10	b	0.8	4547	bcd
3 Tilt Bravo	11.9	b	28.8	b	13	b	4.3	4578	bcd
Bailey mean	**12.5**		**20.3***		**10.8****		**2.0**	**4716****	

Gregory	All leaf spot		Defoliation		Stem rot count		Sclerotinia	Yield	
unsprayed	96.9	a	80.0	a	59	ab	5.8	2666	d
5 leaf spot	1.3	g	12.5	ef	52	abc	7.0	3087	cd
4 leaf spot	7.5	ef	25.0	d	35	bc	1.8	4108	ab
3 leaf spot	14.9	c	43.1	b	47	cd	2.0	3453	bc
5 stem rot	2.3	fg	11.3	f	17	de	4.0	4435	a
4 stem rot	4.1	efg	19.4	de	7	e	10.5	4580	a
3 stem rot	14.4	cd	35.6	bc	37	bcd	2.3	3610	bc
5 Tilt Bravo	4.4	efg	22.5	d	71	a	4.0	3145	cd
4 Tilt Bravo	8.6	de	18.8	def	43	bc	1.5	3897	ab
3 Tilt Bravo	21.3	b	33.8	c	55	abc	2.0	3576	bc
Gregory mean	**17.8**		**30.2**		**42.3**		**4.1**	**3656**	

Leaf spot program = alternating Bravo/Headline; Stem rot program = alternating Bravo/Provost; Tilt Bravo program = full season Tilt Bravo

Means within columns and cultivars followed by the same letter are not significantly different based on Waller-Duncan procedure with K=100. Means cannot be compared across columns or cultivars. Asterisks indicate the difference between cultivar means is significant at $P \leq .05$ (*) or $P \leq .01$.

Table 2. Disease incidence and yield of Bailey and Gregory sprayed 3 - 5 times with different fungicide programs in 2010

Bailey	All leaf spot		Defoliation		% Stem rot		Yield	
unsprayed	89.0	a	44.4	a	15.0	a	3761	abc
5 leaf spot	5.4	b	16.3	b	5.2	bcd	4182	abc
4 leaf spot	4.9	b	18.1	b	7.3	bc	4187	abc
3 leaf spot	5.0	b	21.3	b	0.4	d	4010	abc
5 stem rot	3.6	b	13.8	b	1.0	d	4324	ab
4 stem rot	3.9	b	17.5	b	1.2	d	3774	abc
3 stem rot	4.0	b	14.4	b	3.3	cd	4468	a
5 Tilt Bravo	14.3	b	13.8	b	2.5	cd	3485	c
4 Tilt Bravo	7.3	b	18.4	b	10.2	ab	3781	abc
3 Tilt Bravo	3.8	b	19.4	b	1.7	cd	3609	bc
Bailey mean	**14.1***		**19.7****		**4.8****		**3958***	

Gregory	All leaf spot		Defoliation		% Stem rot		Yield	
unsprayed	93.5	a	73.6	a	18.7	a	3330	a
5 leaf spot	13.9	b	24.4	bc	18.7	a	3791	a
4 leaf spot	5.9	b	20.0	c	13.5	a	3509	a
3 leaf spot	17.5	b	20.0	c	9.2	a	3776	a
5 stem rot	24.1	b	21.3	c	12.9	a	3266	a
4 stem rot	27.5	b	21.3	c	12.9	a	3410	a
3 stem rot	32.5	b	37.5	b	19.2	a	3435	a
5 Tilt Bravo	15.0	b	18.8	c	9.9	a	3823	a
4 Tilt Bravo	24.4	b	29.4	bc	20.0	a	3650	a
3 Tilt Bravo	29.4	b	31.9	bc	18.0	a	3548	a
Gregory mean	**28.4**		**29.8**		**15.3**		**3553**	

Leaf spot program = alternating Bravo/Headline; Stem rot program = alternating Bravo/Provost; Tilt Bravo program = full season Tilt Bravo

Means of spray treatments (within columns) followed by the same letter are not significantly different based on Waller-Duncan procedure with K=100. Means cannot be compared across columns or cultivars. Asterisks indicate the difference between cultivar means is significant at $P \leq .05$ (*) or $P \leq .01$.

Impact Statement

Peanut fungal diseases (leaf spots, stem rot, CBR and Sclerotinia blight) cause yield losses of an average of about 4 -10% annually in North Carolina, or about $38 - 95/a. In addition, growers spend an average of about $80/a for leaf spot and stem rot control; CBR and Sclerotinia blight control can add $30 - $100/a or more to this total. Using control programs optimized for use on resistant cultivars can reduce control costs by 20% or more while also reducing the risk of yield loss.