Table 1. Effect of soil fumigation with thymol and the combination of thymol and the foliar application of actigard on tomato plants in bacterial wilt field experiment on disease incidence of the tomato plants and marketable fruit yield in 2006 (fall, Quincy, FL)

Cultivar [v]	Treatment [w]		Plants wilted (mean ± SE) [x]		Marketable yield (kg/ha) (mean ± SE) [x]		
Phoenix	UTC		13.2 ± 0.3		ID[y]		
	Thymol		4.2 ± 0.6		28,100.9 ± 1,995.0		
	Thymol + Actigard		2.7 ± 0.7		39,569.4 ± 3,821.6		
BH669	UTC		7.2 ± 0.7		15,519.3 ± 2,409.1		
	Thymol		1.3 ± 0.4		64,915.4 ± 3,162.7		
	Thymol + Actigard		0.5 ± 0.3		76,452.0 ± 2,605.0		
FL7514	UTC		9.3 ± 0.8		6,294.6 ± 2,714.0		
	Thymol		1.8 ± 0.3		53,225.7 ± 3,224. 2		
	Thymol + Actigard		0.7 ± 0.3		65,699.6 ± 3,305.5		
	Contrast [z]	df	F	P>F	df	F	P>F
Phoenix	Thymol vs. UTC	1	177.8	0.0001	1	49.1	0.0001
	Thymol + Actigard vs. UTC	1	204.6	0.0001	1	26.7	0.0004
	Thymol vs Thymol + Actigard	1	2.79	0.1256	1	1.8	0.213
BH669	Thymol vs. UTC	1	46.1	0.0001	1	38.6	0.0001
	Thymol + Actigard vs. UTC	1	65.6	0.0001	1	73.7	0.0001
	Thymol vs Thymol + Actigard	1	2.1	0.1556	1	2.0	0.1895
FL7514	Thymol vs. UTC	1	69.8	0.0001	1	31	0.0002
	Thymol + Actigard vs. UTC	1	91.4	0.0001	1	48.2	0.0001
	Thymol vs Thymol + Actigard	1	6.6	0.0277	1	1.8	0.2066

[v] Phoenix is susceptible to bacterial wilt and BHN669 and FL7514 are resistant to the disease.

[w] Thymol was applied once before transplanting. Actigard was applied by foliar spray 6 times: 1st a week before the seedlings were transplanted in the greenhouse, 2nd a day after transplanting, 3rd and 4th treatments were applied once a week, and 5th and 6th treatments were applied biweekly.

[x] Means and SE (standard error of the mean) were resulted from 6 replications. Treatments for each cultivar were tested for significance. Same letter in each column indicates no significant difference according to Duncan's multiple range test at $P = 0.05$.

[y] Insignificant Data

[z] Contrast determined by using a GLM (general linear model) and compared treatments for each cultivar.

Table 2. Effect of soil fumigation with thymol, foliar application of actigard, and the combination thymol and actigard on tomato plants in bacterial wilt field experiment on disease incidence of the tomato plants and marketable fruit yield in 2008 (fall, Quincy, FL)

Cultivar [w]	Treatment [x]		Plants wilted (mean ± SE) [y]			Marketable yield (kg/ha) (mean ± SE) [y]	
Phoenix	UTC		7.0 ± 1.0			3,061.0 ± 1,986.0	
	Thymol		6.7 ± 2.0			5,316.9 ± 3,040.1	
	Actigard		4.3 ± 1.3			6,553.8 ± 2,181.2	
	Thymol + Actigard		4.8 ± 1.4			9,440.4 ± 2,000.8	
FL7514	UTC		9.3 ± 1.2			1,494.3 ± 761.6	
	Thymol		7.3 ± 2.0			2,804.5 ± 1,932.1	
	Actigard		7.0 ± 1.4			5,018.7 ± 778.8	
	Thymol + Actigard		3.8 ± 0.8			5,727.8 ± 1,552.3	
	Contrast [z]	df	F	P>F	df	F	P>F
Phoenix	Thymol vs. UTC	1	0.3	0.6519	1	1.4	0.3251
	Actigard vs. UTC	1	2.1	0.2241	1	5.5	0.0785
	Thymol + Actigard vs. UTC	1	1.3	0.3018	1	7.1	0.0376
	Thymol vs. Thymol + Actigard	1	0.6	0.4923	1	1.2	0.3242
	Actigard vs. Thymol + Actigard	1	0.1	0.8498	1	0.1	0.7678
	Thymol vs. Actigard	1	0.1	0.7406	1	0.1	0.8338
FL7514	Thymol vs. UTC	1	0.6	0.4609	1	1.0	0.3671
	Actigard vs. UTC	1	1.6	0.2571	1	10.47	0.0178
	Thymol + Actigard vs. UTC	1	15.5	0.0077	1	6.0	0.0499
	Thymol vs. Thymol + Actigard	1	2.8	0.1556	1	0.6	0.4910
	Actigard vs. Thymol + Actigard	1	4.4	0.0805	1	0.2	0.6972
	Thymol vs. Actigard	1	0.1	0.9001	1	0.35	0.5783

[w] Phoenix is susceptible to bacterial wilt and FL7514 is resistant to the disease.
[x] Thymol was applied once before transplanting. Actigard was applied by foliar spray 6 times: 1st a week before the seedlings were transplanted in the greenhouse, 2nd a day after transplanting, 3rd and 4th treatments were applied once a week, and 5th and 6th treatments were applied biweekly.
[y] Means and SE (standard error of the mean) were resulted from 6 replications. Treatments for each cultivar were tested for significance. Same letter in each column indicates no significant difference according to Duncan's multiple range test at $P = 0.05$.
[z] Contrast determined by using a GLM (general linear model) and compared treatments for each cultivar.

Table 3. Disease assessment for Trial A.

	Treatment	Rate	Variety	Greenhouse Actigard	Disease Ratings							
					Sep.19.08		Oct 02 2008		Oct 16 2008		Oct 27 08	
1	UTC	-	Bella Rosa		12.9	**a**	29.9	**a**	25.1	**a**	42.1	**a**
2	Kocide + Mancozeb	1.75lbs/A	Bella Rosa		12.5	**ab**	22.5	**cde**	21.5	**abc**	33.7	**bc**
3	Actigard (1 X)	1.5 lbs/A	Bella Rosa		11.2	**abc**	26.4	**abc**	23.1	**abc**	31.3	**cd**
4	Actigard (½ X)	54 mg/L	Bella Rosa	½ x (27 mg/L	10.9	**abc**	28.7	**ab**	23.3	**abc**	39.8	**ab**
5	Actigard (1/10 X)	27 mg/L	Bella Rosa	½ x (27 mg/L)	11.5	**abc**	26.0	**abcd**	24.1	**ab**	39.2	**ab**
6	PGPR +Actigard (1/2x)	5.4 mg/L	Bella Rosa	1/10 x (5.4 mg/L)	11.5	**abc**	23.9	**bcde**	23.7	**ab**	41.2	**ab**
7	UTC	-	8314		13.3	**a**	25.5	**abcde**	21.6	**abc**	27.9	**cd**
8	Kocide + Mancozeb	1.75lbs/A	8314		10.4	**abc**	17.8	**f**	15.4	**d**	28.1	**cd**
9	Actigard (1 X)	1.5 lbs/A	8314		10.7	**abc**	26.3	**abcd**	21.9	**abc**	24.9	**d**
10	Actigard (½ X)	54 mg/L	8314	½ x (27 mg/L	7.3	**c**	21.3	**cdef**	20.4	**bc**	29.6	**cd**
11	Actigard (1/10 X)	27 mg/L	8314	½ x (27 mg/L)	7.2	**c**	20.3	**ef**	18.8	**cd**	29.9	**cd**
12	PGPR +Actigard (1/2x)	5.4 mg/L	8314	1/10 x (5.4 mg/L)	8.2	**bc**	20.6	**def**	19.1	**cd**	27.1	**cd**
				Coeficient of variation (%)	*42.4*		*29.0*		*24.5*		*23.2*	

Table 4. Disease assessment for Trial B.

	Treatment/Rate	Schedule	PGPR	A1		A2		A3		A4	
				Sep.19.08		Oct 02 2008		Oct 16 2008		Oct 27 08	
1	UTC	-	-	11.7	**b**	18.3	**ab**	15.7	**bc**	24.2	**cd**
2	Kocide3000(1.75lb/A) + Manzate 75DF (1.5lb/A)	weekly	-	10.3	**b**	17.8	**abc**	19.0	**ab**	37.8	**a**
3	Kocide3000(1.75lb/A) + Manzate 75DF (1.5lb/A)	weekly	PGPR	10.2	**b**	14.8	**cd**	16.4	**bc**	31.4	**abc**
4	Kocide3000(1.75lb/A) + Manzate 75DF (1.5lb/A)	biweekly	PGPR	14.0	**a**	16.7	**bcd**	16.9	**abc**	29.1	**bc**
5	Actigard (1/2 X = 27 mg/L)	biweekly	PGPR	10.4	**b**	17.0	**bcd**	19.9	**ab**	26.5	**bcd**
6	Kocide(1.75lb/A) + Manzate (1.5lb/A)+ Actig (1/2 X)	biweekly	PGPR	11.4	**b**	20.4	**a**	20.8	**a**	31.9	**ab**
7	Phage	twice a week	-	11.3	**b**	14.1	**d**	13.6	**c**	19.2	**d**
8	Phage	weekly	PGPR	14.6	**a**	18.3	**ab**	16.6	**abc**	20.2	**d**
9	Phage + Actigard (1/2 X = 27 mg/L)	weekly/biweekly	PGPR	9.8	**b**	16.4	**bcd**	15.8	**bc**	26.0	**bcd**
			Coeficient of variation (%)	*23.1*		*22.1*		*26.9*		*26.8*	

* Data analyzed using arcsine transformation.

Table 5. Harvest data for Trial A.

	Treatment	Rate	Variety	Greenhouse Actigard	Average fruit weight (Kg)									
					M		L		XL		M+L+XL		per pl	
1	UTC	-	Bella Rosa		0.126	**a**	0.174	**a**	0.228	**a**	0.15	**a**	2.7	**a**
2	Kocide + Mancozeb	1.75lbs/A	Bella Rosa		0.129	**a**	0.172	**a**	0.232	**a**	0.15	**a**	2.8	**a**
3	Actigard (1 X)	1.5 lbs/A	Bella Rosa		0.122	**a**	0.185	**a**	0.219	**a**	0.15	**a**	3.7	**a**
4	Actigard (½ X)	54 mg/L	Bella Rosa	½ x (27 mg/L	0.123	**a**	0.174	**a**	0.226	**a**	0.15	**a**	2.8	**a**
5	Actigard (1/10 X)	27 mg/L	Bella Rosa	½ x (27 mg/L)	0.137	**a**	0.174	**a**	0.221	**a**	0.15	**a**	2.7	**a**
6	PGPR +Actigard (1/2x)	5.4 mg/L	Bella Rosa	1/10 x (5.4 mg/L)	0.126	**a**	0.173	**a**	0.232	**a**	0.15	**a**	2.4	**a**
7	UTC	-	8314		0.133	**a**	0.177	**a**	0.222	**a**	0.15	**a**	3.0	**a**
8	Kocide + Mancozeb	1.75lbs/A	8314		0.127	**a**	0.175	**a**	0.214	**a**	0.14	**a**	2.7	**a**
9	Actigard (1 X)	1.5 lbs/A	8314		0.132	**a**	0.175	**a**	0.226	**a**	0.14	**a**	2.5	**a**
10	Actigard (½ X)	54 mg/L	8314	½ x (27 mg/L	0.143	**a**	0.169	**a**	0.238	**a**	0.15	**a**	3.5	**a**
11	Actigard (1/10 X)	27 mg/L	8314	½ x (27 mg/L)	0.151	**a**	0.179	**a**	0.23	**a**	0.16	**a**	3.2	**a**
12	PGPR +Actigard (1/2x)	5.4 mg/L	8314	1/10 x (5.4 mg/L)	0.133	**a**	0.182	**a**	0.209	**a**	0.15	**a**	3.0	**a**
				Coeficient of variation (%)	*14.3*		*5.3*		*8.3*		*9.4*		*28.2*	

Table 6. Harvest data for Trial B.

	Treatment/Rate	Schedule	PGPR	Average fruit weight (Kg)									
				M		L		XL		M+L+XL		per pl	
1	UTC	-	-	0.133	**a**	0.17915	**a**	0.2429	**a**	0.1617	**a**	2.9	**a**
2	Kocide3000(1.75lb/A) + Manzate 75DF (1.5lb/A)	weekly	-	0.129	**a**	0.18092	**a**	0.25331	**a**	0.1601	**a**	2.0	**b**
3	Kocide3000(1.75lb/A) + Manzate 75DF (1.5lb/A)	weekly	PGPR	0.131	**a**	0.18928	**a**	0.25581	**a**	0.1682	**a**	2.6	**ab**
4	Kocide3000(1.75lb/A) + Manzate 75DF (1.5lb/A)	biweekly	PGPR	0.125	**a**	0.17537	**a**	0.26578	**a**	0.161	**a**	3.0	**a**
5	Actigard (1/2 X = 27 mg/L)	biweekly	PGPR	0.129	**a**	0.17629	**a**	0.23741	**a**	0.1587	**a**	2.9	**a**
6	Kocide(1.75lb/A) + Manzate (1.5lb/A)+ Actig (1/2 X)	biweekly	PGPR	0.135	**a**	0.17595	**a**	0.2363	**a**	0.1602	**a**	2.7	**ab**
7	Phage	twice a week	-	0.130	**a**	0.18307	**a**	0.25038	**a**	0.1712	**a**	3.0	**a**
8	Phage	weekly	PGPR	0.126	**a**	0.17915	**a**	0.24507	**a**	0.1606	**a**	2.7	**ab**
9	Phage + Actigard (1/2 X = 27 mg/L)	weekly/biweekly	PGPR	0.134	**a**	0.1758	**a**	0.23781	**a**	0.1593	**a**	2.8	**ab**
			Coeficient of variation (%)	*6.7*		*6.1*		*9.0*		*6.5*		*16.3*	

Table 6. Harvest data for Trial B.

	Treatment/Rate	Schedule	PGPR	Average fruit weight (Kg)										Box/acre								fruit number/				
				M		L		XL		M+L+XL		per pl		M		L		XL		M+L+XL		M		L		
1	UTC	-	-	0.133	**a**	0.179	**a**	0.243	**a**	0.16	**a**	2.9	**a**	519.8	**a**	341.7	**ab**	248.8	**ab**	1110.3	**a**	10.5	**a**	5.0	**ab**	2
2	Kocide3000(1.75lb/A) + Manzate 75DF (1.5lb/A)	weekly	-	0.129	**a**	0.181	**a**	0.253	**a**	0.16	**a**	2.0	**b**	357.9	**a**	253.4	**b**	153.9	**b**	765.2	**b**	7.3	**a**	3.7	**b**	1
3	Kocide3000(1.75lb/A) + Manzate 75DF (1.5lb/A)	weekly	PGPR	0.131	**a**	0.189	**a**	0.256	**a**	0.17	**a**	2.6	**ab**	428.3	**a**	311.5	**ab**	258.5	**ab**	998.3	**ab**	8.5	**a**	4.3	**ab**	2
4	Kocide3000(1.75lb/A) + Manzate 75DF (1.5lb/A)	biweekly	PGPR	0.125	**a**	0.175	**a**	0.266	**a**	0.16	**a**	3.0	**a**	485.7	**a**	377.5	**ab**	285.3	**ab**	1148.5	**a**	10.2	**a**	5.6	**ab**	2
5	Actigard (1/2 X = 27 mg/L)	biweekly	PGPR	0.129	**a**	0.176	**a**	0.237	**a**	0.16	**a**	2.9	**a**	486.4	**a**	442.1	**a**	200.4	**ab**	1128.9	**a**	10.0	**a**	6.6	**a**	2
6	Kocide(1.75lb/A) + Manzate (1.5lb/A)+ Actig (1/2 X)	biweekly	PGPR	0.135	**a**	0.176	**a**	0.236	**a**	0.16	**a**	2.7	**ab**	476.3	**a**	339.0	**ab**	212.7	**ab**	1028.0	**ab**	9.2	**a**	5.0	**ab**	2
7	Phage	twice a week	-	0.130	**a**	0.183	**a**	0.25	**a**	0.17	**a**	3.0	**a**	407.3	**a**	421.8	**a**	318.7	**a**	1147.8	**a**	8.1	**a**	6.0	**ab**	3
8	Phage	weekly	PGPR	0.126	**a**	0.179	**a**	0.245	**a**	0.16	**a**	2.7	**ab**	434.1	**a**	371.0	**ab**	229.4	**ab**	1034.6	**ab**	9.0	**a**	5.4	**ab**	2
9	Phage + Actigard (1/2 X = 27 mg/L)	weekly/biweekly	PGPR	0.134	**a**	0.176	**a**	0.238	**a**	0.16	**a**	2.8	**ab**	491.5	**a**	417.5	**a**	168.4	**b**	1077.4	**ab**	9.6	**a**	6.3	**ab**	1
			Coeficient of variation (%)	*6.7*		*6.1*		*9.0*		*6.5*		*16.3*		*22.6*		*22.7*		*33.1*		*16.4*		*24.9*		*25.5*		*3*

Table 7. Effect of phosphorous acid salt (PAS) treatments on bacterial spot disease development (area under disease progress curve, AUDPC) in Quincy and Citra Florida field trials in 2005, 2006 and 2007.

Treatments[x] / Trials[y]	***1***	***2***	***3***	***4***	***5***	***6***	***7***
UTC	1488 a[z]	549 a	375 a	726 a	308 ab	568 a	785 a
Copper-mancozeb plus ASM	499 b	379 ab	-	-	-	-	-
Copper-mancozeb – full rate	-	449 ab	73 c	415 de	284 ab	416 bcd	699 cd
Copper-mancozeb – half rate	-	-	-	510 c	-	396 bcd	768 ab
PAS	736 b	-	196 b	603 b	345 a	497 abc	756 bcd
PAS alternated with copper-mancozeb	491 b	-	-	-	-	-	-
PAS plus copper-mancozeb @ full rate	-	265 b	-	476 cd	-	358 cd	689 d
PAS plus copper-mancozeb @ half rate	-	-	-	454 cd	-	508 ab	767 ab
PAS plus + ASM	-	-	190 b	-	220 b	-	699cd

[x]: UTC: Untreated control. Copper-mancozeb full rate: Kocide 2000 (2.2 kg/ha) + Manzate 75DF (2.2 kg/ha) for 2005 and 2006, and Kocide 3000 (1.96 kg/ha) + Manzate75DF (1.68 kg/ha) for 2007, applied weekly. Copper-mancozeb half rate: Kocide 3000 (0.98 kg/ha) + Manzate 75DF (0.84 kg/ha), applied weekly. ASM: Actigard (9.4 g/ha), applied biweekly. PAS: K-PHITE (2.3 – 4.6 L/ha): 2.3 L/ha in the first half of the growing season, 4.6 L afterwards.

[y]: Trials: 1=2005 Fall Quincy; 2=2006 Fall Quincy; 3=2007 Spring Quincy field 1; 4=2007 Spring Quincy field 2; 5=2007 Spring Citra field 1; 6=2007 Spring Citra field 2; 7=2007 Fall Citra.

[z]:

Means with the same letter in each column are not significantly different (P = 0.05) by Duncan's multiple range test (F was significant at P < 0.0001) (SAS)