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IR-4 Ornamental Horticulture Program
Bacterial Disease Efficacy

Agrobacterium tumefaciens
Erwinia amylovora
Erwinia chrysanthemi
***Erwinia* sp.**
Pseudomonas cichorii
Pseudomonas marginalis
***Pseudomonas* spp.**
Pseudomonas syringae
Xanthomonas axonopodis
Xanthomonas campestris
***Xanthomonas* spp.**

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Abstract

From 2008 to 2017, 72 products were tested through the IR-4 Program as drench or foliar applications against bacterial pathogens. In addition to research collected through the IR-4 program, this summary includes a review of experiments conducted from 2005 to 2017, mainly on tree crops. Species tested included: *Agrobacterium tumefaciens, Erwinia amylovora, E. chrysanthemi, Pseudomonas cichorii, P. marginalis, P. syringae, Pseudomonas* sp., *Xanthomonas axonopodis, Xanthomonas campestris,* and *Xanthomonas* spp. In general, all products, including the standard copper containing bactericides (Camelot, CuPRO, Cuprofix, Cuprofix MZ, Junction, Kocide, MasterCop, Phyton 27, ReZist, etc.), mancozebs (Dithane, Penncozeb, Protect) and biologicals (Cease, Regalia, Rhapsody and Serenade), provided variable efficacy on these bacterial pathogens. Several new products that are included in the IR-4 Bacterial Efficacy project looked promising based on their efficacy relative to standards. These include Acibenzolar, CG100, Citrex, HM-0736, Kasumin, Regalia, Taegro, Tanos and ZeroTol. Further research is needed to obtain additional efficacy data to recommend actions to register or amend labels for these pests.

Introduction

Bacterial diseases are often very challenging to manage once established. The mainstay tools currently are copper-based products. In 2008, IR-4 initiated a high priority project to determine efficacy of several fungicides on bacterial pathogens so data can be obtained to support current and future registrations. Research for this project was conducted during 2008 to 2017. This report is based upon information generated through the IR-4 Ornamental Horticulture Program. To present a fuller picture on bacterial efficacy, additional reports from researchers published in Fungicide & Nematicide Tests (F&N Tests) and Plant Disease Management Reports (PDMR) are also included. Tables containing these reports have an asterisk (*) at the beginning of their titles.

Materials and Methods

During 2008 to 2017, 72 products were tested through the IR-4 Program as drench or foliar applications against bacterial pathogens (Table 1). In addition to research collected through the IR-4 program, this summary includes a review of experiments conducted from 2005 to 2016 mainly on tree crops. Species tested included: *Erwinia amylovora, E. chrysanthemi, Pseudomonas cichorii, Pseudomonas marginalis, Pseudomonas syringae, Pseudomonas* spp., *Xanthomonas axonopodis, Xanthomonas campestris* and *Xanthomonas* spp. Treatments were generally applied a few days before disease inoculation. A minimum of four plants (replicate treatments) were required with most researchers exceeding this minimum. Disease severity and incidence were recorded at various intervals after initial application. Phytotoxicity was recorded on a scale of 0 to 10 (0 = no phytotoxicity; 10 = complete kill) at each rating date for any treatment exhibiting damage unrelated to disease.Fifteen researchers were involved in the testing (Appendix 1).

Products were supplied by their respective manufacturers.

For IR-4 testing, the following protocols were used: 08-004, 09-002, 10-008, 11-006, 12-008, 16-003, and 17-003. Please visit http://ir4.rutgers.edu/ornamental/OrnamentalDrafts.cfm to view and download these protocols.

For all research data tables, product names have been updated where manufacturers have established trade names, and tables have been rearranged by product alphanumeric order. Where both inoculated and non-inoculated checks were included in the experiment, the inoculated check appears last in the table with the non-inoculated check immediately preceding it.

Table 1. List of Products and Rates Tested from 2008 to 2017.

Product	Active Ingredient(s)	Manufacturer	Rate(s) Tested		# Experiments
A14658C	A14658C	Syngenta	Foliar	2 pt per 100 gal	5
				4 pt per 100 gal	
A91800A	A91800A	Syngenta	Foliar	1 oz per 100 gal	2
Actigard, Acibenzolar, Insimmo	Acibenzolar	Syngenta	Foliar	0.019 oz per 100 gal	23
				0.5 oz per 100 gal, 0.5 oz per acre	
				0.75 oz per 100 gal	
				1 oz per 100 gal	
				1.25 oz per 100 gal	

Product	Active Ingredient(s)	Manufacturer	Rate(s) Tested		# Experiments
				2 oz per 100 gal	
			Drench	0.25 oz per 100 gal	8
Actinovate NI108	*Streptomyces lydicus*	Natural Industries	Foliar	12 oz per 100 gal	8
Agri-Mycin	Streptomycin	NuFarm	Foliar	8 oz per 100 gal	2
Ag Streptomycin	Streptomycin Sulfate	ADAMA	Foliar	24 oz per acre	3
Alexin	Various nutrients	Elisio, Ltd	Foliar	50 ml per 100 gal	1
Aliette WDG	Fosetyl-Al	Bayer	Foliar	6.4 oz per 100 gal	6
				12.8 oz per 100 gal	
ASAP	Silver		Foliar	5 ppm	1
				10 ppm	
				30 ppm	
BioPhos	Dipotassium phosphonate + Dipotassium phosphate	AgBio	Foliar	2 %	8
BlightBan A506	*Pseudomonas fluorescens* A506	Nufarm	Foliar	5.3 oz per 100 gal	3
BloomTime	*Pantoea agglomerans* strain E325	Nufarm	Foliar	5.3 oz per 100 gal	7
				10.5 oz per 100 gal	
				1.3 oz per 100 gal	
				5.3 oz per acre	
Blossom Protect	*Aureobasidium pullulans* strains DSM14940 and DSM 14941	Nufarm	Foliar	1.25 lb per acre	3
				1.25 lb per acre	
BmJ	*Bacillus mycoides* isolate J	Montana Microbial Products	Foliar	100 g per 100 gal	3
				4.5 oz per 100 gal	
				13.5 oz per acre	
BW165N	*Ulocladium oudemansii* strain U3	BioWorks	Foliar	3 lb per 100gal	1
Camelot	Copper salts	Sepro	Foliar	16 oz per 100 gal	7
				3 pt per 100 gal	
				1 gal per 100 gal	
				2 gal per 100 gal	
Canker Kill			Foliar	1.5 qt per 100 gal	1
Cease, Rhapsody, Serenade Optimum	*Bacillus subtilis* strain QST 713	BioWorks, Agraquest	Foliar	0.05%	13
				1 %	
				2 %	
CG100	Caprylic acid	AMVAC	Foliar	0.8 %	15
				0.3 %	
				38.4 fl oz per 100 gal	1
Champ 2F	Copper hydroxide	NuFarm	Foliar	21 fl oz per 100 gal	1
Citrex	Citrus extracts	Citrex, Inc.	Foliar	120 ml per 100 L	23
				150 ml per 100 L	
				5 fl oz per 100 gal	
Companion	*Bacillus subtilis* GB03	Growth Products	Foliar	0.5 %	2
				1 %	
				2 %	
Copper Count-N	Copper	MRD	Foliar	1 qt per 100 gal	1
Cueva	Copper octanoate	Certis	Foliar	1 pt per acre	5
				1.5 pt per acre	

Product	Active Ingredient(s)	Manufacturer	Rate(s) Tested		# Experiments
				2 qt per acre	
CuPRO, Kocide	Copper hydroxide	SePro	Foliar	0.75 lb per 100 gal	12
				2 lb per 100 gal	
		DuPont		0.75 lb per 100 gal	23
				1 lb per 100 gal	
				2 lb per 100 gal	
				3 lb per 100 gal	
				3.5 lb per 100 gal	
Cuprofix	Copper sulfate	UPI	Foliar	1.5 lb per 100 gal	2
Cuprofix MZ	Mancozeb+Copper sulfate	UPI	Foliar	8.75 lb per 100 gal	2
Dithane 75WP	Mancozeb	Dow	Foliar	16 oz per 100 gal	1
Double Nickel LC	*Bacillus amyloliquefaciens* strain D747	Certis	Foliar	8 fl oz per 100 gal	1
EarthTec	Copper	Earthsciences Labs	Foliar	1.5 fl oz per 100 gal	2
Fireline	Oxytetracycline	AgroSource	Foliar	16 oz per acre	5
				24 oz per acre	
				48 oz per acre	
Firewall 17WP	Streptomycin sulfate	UPI	Foliar	200 ppm	8
				6 oz per 100gal	
				12 oz per acre	
				24 oz per acre	
Firewall 50WP	Streptomycin sulfate	AgroSource	Foliar	10 oz per acre	2
Fire Quencher	Bacteriophage		Foliar	8 fl oz per 100 gal	3
				32 fl oz per acre	
Florel	Ethephon	Bayer	Foliar	10 qt per 100 gal	1
				20 qt per 100 gal	
GC Pro	Hydrogen dioxide	BioSafe	Foliar	50 oz per 100 gal	3
				150 oz per 100 gal	
Harbour	Streptomycin sulfate	ADAMA	Foliar	12 oz per acre	1
				24 oz per acre	
HM 0736	Laminarin	Agrimar	Foliar	14.4 fl oz per 100 gal	23
				58 fl oz per 100 gal	
Junction DF	Mancozeb+Copper hydroxide	SePro	Foliar	1.5 lb per 100 gal	2
				3 lb per 100 gal	
Kasumin	Kasugamycin	Arysta	Foliar	45 fl oz per 100 gal	39
				64 fl oz per 100 gal	
				16 fl oz per acre	
				48 fl oz per acre	
				64 fl oz per acre	
KleenGrow	Didecyl dimethyl ammonium chloride	Pace Chemicals	Foliar	6 oz per 100 gal	4
				13 fl oz per 100 gal	
				25 fl oz per 100 gal	
				50 fl oz per 100 gal	
K-Phite	Phophorus acid salts	Plant Food Systems	Foliar	2 qt per 100 gal	10
				5 qt per 100 gal	
MagnaBon CS2005	Copper sulfate pentahydrate	Magna-Bon	Foliar	1 pt per acre	1
MasterCop	Copper sulfate pentahydrate	ADAMA	Foliar	1.5 pt per acre	2

Product	Active Ingredient(s)	Manufacturer	Rate(s) Tested		# Experiments
MBI-110	*Bacillus amyloliquifaciens* strain F727	Marrone	Foliar	1 gal per 100 gal	3
Milstop	Potassium bicarbonate	BioWorks	Foliar	1.25 lb per 100 gal	1
NAI-4201	Tiadinil	Nichino America	Foliar	5 fl oz per 100 gal	4
			Drench	5 fl oz per 100 gal	7
Nu-Cop	Copper hydroxide	Albaugh	Foliar	1 lb per 100 gal	3
				2 lb per 100 gal	
				3.33 lb per 100 gal	
Omega-Grow Plus	Fish oil	Omega Protein	Foliar	2 %	1
OxiPhos	Mono and di potassium salts of phosphorus acid + hydrogen peroxide	BioSafe	Foliar	42 fl oz per 100 gal	3
				128 fl oz per 100 gal	
Penncozeb	Mancozeb	UPI	Foliar	1.5 lb per 100 gal	4
Previsto	Copper hydroxide	Gowan	Foliar	3 qt per acre	1
Prophytex EC	*Bacillus subtilis* strain B1111	LAM International	Foliar	64 fl oz per 100 gal	1
Prophytex WP				32 oz per 100 gal	
Protect	Mancozeb	Cleary	Foliar	2 lb per 100 gal	6
Phyton 27	Copper sulfate pentahydrate	Source Technology	Foliar	25 oz per 100 gal	12
				50 oz per 100 gal	
Regalia SC (MOI-106), Milsana	*Reynoutria sachalinensis* extract	Marrone	Foliar	1 %	22
				2 qt per acre	
ReZist	Chelated Copper+Mn+Zn	Stoller	Foliar	16 oz per 100 gal	1
				32 oz per 100 gal	
Serenade Optimum	*Bacillus subtilis* strain QST 713	Bayer	Foliar	1.25 lb per acre	7
				1.5 lb per acre	
Sett	Calcium+Boron	Stoller	Foliar	32 oz per 100 gal	1
SP2015, Tanos	Famoxadone + Cymoxanil	SePro	Foliar	8 oz per 100 gal	14
				12 oz per 100 gal	
		DuPont	Foliar	8 oz per 100 gal	14
				16 oz per 100 gal	
Starner	Oxolinic acid	Valent	Foliar	0.75 %	1
STBX-304	Cupric ammonium formate	Phyton	Foliar	25 fl oz per 100 gal	1
Taegro	*Bacillus subtilis* var. *amyloliquefaciens* strain FZB24	Novozymes	Foliar	3.5 oz per 100 gal	9
			Drench	3.5 oz per 100 gal	5
			Alt. Foliar/ Drench	3.5 oz per 100 gal	3
TDA01	TDA01	TDA Research	Foliar	4 g per 100 gal	2
				RTU	
TDA 02 Part A + Part B	TDA02	TDA Research	Foliar	100 g + 300 ml	1
				200 g + 600 ml	
Thyme Guard	Thyme oil	Agro International	Foliar	0.25 %	1
				0.5 %	
Triathlon BA	*Bacillus amyloliquefaciens* Strain D747	OHP	Foliar	6 qt per 100 gal	2
Tricon		BioWorks	Foliar	0.4 %	10

Product	Active Ingredient(s)	Manufacturer	Rate(s) Tested		# Experiments
	Sodium tetraborahydrate decahydrate			0.8 %	
				2 %	
Vital	Potassium phosphite	Luxembourg-Pamol	Foliar	4 pt per 100 gal	6
				8 pt per 100 gal	
Vitalonil	Potassium phosphate+Chlorothalonil	Luxembourg-Pamol	Foliar	5 pt per 100 gal	2
ZeroTol	Hydrogen dioxide+peroxyacetic acid	BioSafe	Foliar	1 gal per 100 gal	9
				2 gal per 100 gal	

Results

Comparative Efficacy on Agrobacterium tumefaciens.

In 2011, Chase examined the efficacy of several products for preventative control of *Agrobacterium tumefaciens* on goldenrod (*Solidago* sp.). All treatments were applied as a weekly foliar spray (to drip) or drench at on Aug 1, 8, 15, 22, 29, Sep 6, 12, 19 and 26. Plants were inoculated with a culture of *Agrobacterium tumefacien*s sprayed onto wounded plants on Aug17, and then the plants were placed into clear plastic bags under mist (high humidity) for 48 hours. The plastic was removed and the plants remained under intermittent mist for the duration of the experiment. Based on plant height, top grade, number of galls and gall size, no treatment significantly reduced disease incidence in this experiment (Table 2). Agri-Mycin caused significant phytotoxicity (smaller, yellow plants).

Table 2. Efficacy for *Agrobacterium tumefaciens* on Goldenrod (Solidago sp.), Chase, CA, 2011.

Treatment	Rate per 100 Gal	Height [y] (cm) 8/23	Top Grade		Number of Galls Per Plant				Gall Size 10/7
			8/23	9/16	9/7	9/16	9/23	9/30	
Acibenzolar drench	0.25 oz	40.0 a	3.6 a	3.9 bc	0.2 a	0.4 a	1.1 a	1.8 b	3.6 bc
Acibenzolar spray	1 oz	39.8 a	3.4 a	3.8 bc	0.0 a	0.7 a	1.2 a	1.8 b	2.7 bc
Agri-Mycin	8 oz	35.9 a	3.6 a	2.8 a	0.6 a	1.1 a	1.8 a	2.6 b	2.6 b
CG100	1.2 pt	42.4 a	3.7 a	3.7 bc	0.7 a	1.2 a	2.0 a	1.7 b	3.7 c
Citrex	1.5 ml/L	42.9 a	3.7 a	3.9 bc	0.2 a	0.8 a	1.2 a	2.1 b	3.1 bc
HM-0736	14.4 oz	36.0 a	3.6 a	3.9 bc	0.7 a	0.4 a	1.8 a	2.3 b	3.2 bc
Kasumin	45 fl oz	32.0 a	3.3 a	3.9 bc	0.9 a	1.3 a	1.8 a	1.9 b	3.7 c
NAI-4201 drench	5 oz	37.0 a	3.4 a	3.9 bc	0.3 a	1.3 a	1.9 a	2.1 b	3.3 bc
Regalia SC	1%	35.7 a	3.4 a	3.6 bc	0.8 a	1.2 a	1.7 a	2.8 b	3.5 bc
ZeroTol	1%	45.0 a	3.7 a	4.0 c	0.3 a	0.8 a	1.4 a	2.9 b	2.8 bc
Untreated uninoculated	-	42.0 a	3.7 a	3.9 bc	0.0 a	0.0 a	0.0 a	0.0 a	1.0 a
Untreated inoculated	-	38.9 a	3.4 a	3.6 b	1.2 a	1.2 a	1.6 a	1.8 b	3.2 bc

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[x] Means followed by the same letter do not differ significantly based on Fisher's LSD (P=0.05.

Comparative Efficacy on Erwinia species.

In general, *Erwinia spp.* incidence and severity were too low in most experiments to provide definitive conclusions on efficacy. Generally the standard copper products (Camelot, Cueva, CuPRO, Kocide, MasterCop) and mancozeb (Protect) were statistically comparable to the untreated uninoculated check, while streptomycin (Ag Streptomycin, Firewall) provided excellent control (Table 3). Acibenzolar, Blossom Protect, Citrex and KleenGrow looked promising in at least one experiment while CG100 was ineffective in two experiments and Double Nickel in one. Other products (A14658C, Citrex, HM-0736, Kasumin, NAI-4201 Tanos, Taegro), provided mixed efficacy (either +/- or – ratings), but generally were comparable to copper compounds in many experiments so they may be promising materials at different rates or application intervals. Kasumin provided good to excellent control on apple and is now a registered product. Tanos mixed with CuPRO generally did not improve performance of CuPRO. See the discussion and data of individual experiments for more details.

Table 3. General summary of efficacy for *Erwinia* spp. on various crops - Part 1.

Product	Oncidium Orchid		Phaelanopsis Orchid		Poinsettia	Pear	Apple			
	Chase 2009*	Chase 2009	Norman 2009	Norman 2010	Chase 2009	Steddom 2012	Cox 2013*	Cox 2014*	Cox 2015*	Cox 2016*
A14658C						+/-				
Acibenzolar		+/-	-	-	+/-	+	+/-			+/-
Ag Streptomycin, Firewall							++	++	++	++
Aliette						-				
Bloomtime							+			
Blossom Protect										
BMJ								+		+/-
Camelot	+/-					+/-				
CG100			-	-						
Citrex		+/-	-	-	+/-	+				
Cueva									+	++
CuPRO, Kocide, NuCop		+/-	+/-	++	+/-	-				
Double Nickel									+/-	
Fireline									++	++
Fire Quencher										
Florel						-				
HM-0736		+/-	-	-	+/-	-				
Kasumin		-	-	-	+/-	+/-	++	++	++	++
KleenGrow	++					+/-				
Kocide 3000	+/-									
MagnaBon										
MasterCop							+/-	+		
NAI-4201			+/-			+/-				
Previsto										
Protect				++						
Regalia			+/-	-		-	+/-			+/-
ReZist					+/-					
ReZist + Sett					+					
Serenade Optimum							+/-	+/-	-	+
Tanos		+/-	+/-	-	+/-					
Tanos + CuPRO		+/-	+/-	++	+/-					
Taegro		+/-	-	-	+					
Thyme Guard										+/-

* Not an IR-4-sponsored experiment.
1 Rating Scale: ++ = clearly statistically equivalent or better than untreated non-inoculated and/or clearly statistically different than untreated inoculated; + = statistically different from untreated inoculated and untreated non-inoculated; +/- statistically equivalent to both untreated inoculated and untreated non-inoculated; - = statistically equivalent to untreated inoculated. For experiments without non-inoculated check, efficacy determined on author's conclusions, % control or comparisons to standard product(s).
2 Where more than one rate or application type for a product was included in the experiment and each performed statistically different, the better rating is provided in this table.

Table 4. General summary of efficacy for *Erwinia* spp. on various crops - Part 2.

Product	Apple							
	Yoder 2013*	**Yoder 2015***	**Yoder 2015***	**Yoder 2016***	**Sundin 2015***	**Sundin 2016***	**Sundin 2017***	**Lehman 2016***
A14658C								
Acibenzolar	-							
Ag Streptomycin, Firewall	++	++	+	+			++	++
Aliette								
Bloomtime		-			-			
Blossom Protect		-		-	+		+	
BMJ								
Camelot								
CG100								
Citrex								
Cueva		+			+		+	+
CuPRO, Kocide, NuCop						+		
Double Nickel		-						
Fireline			-			+/-		
Fire Quencher		-			+			-
Florel								
HM-0736								
Kasumin			+	-		+		+
KleenGrow								
Kocide 3000								
MagnaBon								+
MasterCop								
NAI-4201								
Previsto							+	
Protect								
Regalia	+/-							+
ReZist								
ReZist + Sett								
Serenade	+/-		+/-				+	+/-
Tanos								
Tanos + CuPRO								
Taegro								
Thyme Guard								

* Not an IR-4-sponsored experiment.

1 Rating Scale: ++ = clearly statistically equivalent or better than untreated non-inoculated and/or clearly statistically different than untreated inoculated; + = statistically different from untreated inoculated and untreated non-inoculated; +/- statistically equivalent to both untreated inoculated and untreated non-inoculated; - = statistically equivalent to untreated inoculated. For experiments without non-inoculated check, efficacy determined on author's conclusions, % control or comparisons to standard product(s).
2 Where more than one rate or application type for a product was included in the experiment and each performed statistically different, the better rating is provided in this table.

In 2009, Chase examined impact of several products for preventative control of *Erwinia chrysanthemi* on Oncidium orchid. All treatments were applied as a weekly foliar spray (to drip) on 14, 21, 28 September, and 7, 14 October. Plants were inoculated with a culture of *Erwinia chrysanthemi* sprayed onto the plants on 18 Septemberand 5 October, and then the plants were placed under clear plastic sheeting (high humidity) for 48 hours. The plastic was removed and the plants remained under intermittent mist (30 sec/hour 24 hr/day) for the duration of the experiment. Based on the number of infected leaves, KleenGrow was the only treatment that significantly reduced disease incidence in this experiment (Table 5).

Table 5. * Efficacy for *Erwinia chrysanthemi* on *Oncidium* orchid, Chase, CA, 2009.

Treatment	Rate per 100 Gal	Number of infected leaves per plant 10-20-09	Number of infected leaves per plant 10-28-09
Agri-Mycin	8 oz	0.2 a	1.1 ab
Camelot	16 oz	0.2 a	1.3 ab
Camelot + KleenGrow	16 oz + 6 oz	0.2 a	1.5 ab
KleenGrow	6 oz	0.4 a	0.6 a
Kocide 3000	16 oz	1.7 b	1.9 ab
Kocide 3000 + KleenGrow	16 oz + 6 oz	0.9 ab	1.7 ab
Untreated non-inoculated	-	0.5 a	0.8 ab
Untreated inoculated	-	1.1 ab	2.4 b

* Not an IR-4 Experiment (00-000-Chase-1)

In another experiment, orchid liners were obtained from commercial producers (72 cell size) and established in orchid medium in 3.5 inch pots. Plants were inoculated with a strain of *Erwinia chrysanthemi* after two bactericide applications. During the experiment period, Phalaenopsis did not develop disease symptoms. Oncidium developed moderate levels of *Erwinia* during the experiment. For disease control at the first rating, none of the treatments were significantly different than the water sprayed controls, although the plants with fewest spotted leaves were those treated with Tanos alone, Tanos+ CuPRO and CuPRO alone (Table 6). At the end of the experiment, there were no significant differences between any treatments and the water sprayed controls. However, the lowest percentage of infection was found on those plants treated with Acibenzolar, Tanos alone and CuPRO alone. The greatest percentage of the plant infected was seen on those treated with Citrex, Kasumin and Taegro. Significant phytotoxicity as shown by overall top grade was found on Phalaenopsis plants treated with Acibenzolar, Tanos + CuPRO and CuPRO alone.

Table 6. Efficacy for *Erwinia chrysanthemi* on Orchid (*Oncidium* sp) 'Wilson's Wicked Qua' and Orchid (*Phalaenopsis* sp.), Chase, CA, 2009.

Treatment	Rate per 100 Gal	No. spots/plant *Onicidium* 9-4-09	No. spots/plant *Oncidium* 9-10-09	% soft rot *Oncidium* 9-16-09	Top grade *Phalaenopsis* 9-16-09
Acibenzolar	0.75 oz	0.6 a	0.6 a	7.2 a	3.2 a
Citrex	150 ml/ 100 L	0.5 a	1.0 a	31.7 ab	4.2 b
CuPRO	2 lb	0.0 a	0.4 a	2.2 a	3.3 a
HM-0736	14.4 fl oz	0.6 a	1.1 a	13.9 ab	3.4 a
Kasumin	45 fl oz	0.7 a	1.7 a	38.3 b	4.1 b
Tanos	12 oz	0.0 a	0.7 a	3.3 a	4.0 b
Tanos+ CuPRO	8 oz + 2 lb	0.2 a	0.7 a	14.2 ab	3.0 a
Taegro - drench	3.5 oz	0.8 a	0.3 a	30.0 ab	3.6 ab
Untreated non-inoculated	-	0.0 a	0.0 a	5.0 a	4.2 b
Untreated inoculated	-	0.8 a	0.5 a	25.0 ab	3.6 ab

09-002-Chase-02

In 2010, Palmateer examined the efficacy of several products for preventative control of *Erwinia chrysanthemi* on Oncidium orchid. All treatments were applied as weekly foliar sprays from Jul 22 to Aug 26, except NAI-4201 and Taegro which were applied biweekly from Jul 22 to Sep 16. Plants were inoculated with *E. chrysanthemi* sprayed onto wounded leaves on Aug 7-10 and Sep 19. Plants were incubated for 2 days in a humidity chamber and placed in blocks on shade house benches after incubation. Disease was rated based on the number of leaves and pseudobulbs with soft rot and the percentage of the leaf that was diseased. The ratings were then added for a total disease rating. The two scales are below. Disease levels were low for the experiment, with median ratings ranging from 0-3, and 0 for both controls, and there were no significant differences between treatments (Table 7). No phytotoxicity was found on any treatment.

Leaf Rating Scale:

0=no disease
1=1 symptomatic leaf with <10% leaf diseased (severity)
2=1 symptomatic leaf with 10-50% diseased or 2 leaves with <10% severity
3=1 symptomatic leaf >50% severity or 2 leaves <50% severity
4=2 leaves with one >50% or 3 symptomatic leaves with <10% severity
5=2 leaves both >50% severity or 3 leaves with one 10-50% severity
6=3 leaves up to 50% severity or one >50%
7=3 symptomatic leaves, 2>50% or 4 symptomatic leaves <10% severity
8=3 symptomatic leaves, all >50% or 4 symptomatic leaves, one >10% severity
9=4 symptomatic leaves, 2>10% severity
10=4 symptomatic leaves, 3>10% severity
11=4 symptomatic leaves, all >10% severity or 5 symptomatic leaves, all<10% severity
12=5 symptomatic leaves, 1>10% severity
13=5 symptomatic leaves, 2>10% severity
14=5 symptomatic leaves, 3>10% severity
15=5 symptomatic leaves, 4>10% severity

Pseudobulb Rating Scale:
Note: Diseased pseudobulbs often don't recover and the affected tissue dies.
0=no disease
1=1 diseased pseudobulb
2=2 diseased pseudobulbs
3=3 diseased pseudobulbs

Table 7. Efficacy for Soft Rot (*Erwinia chrysanthemi*) on Oncidium Orchid, Palmateer, FL, 2010.

Treatment	Rate per 100 Gal	Median Disease Rating*	Mean Rank	Estimated Relative Effect[y]
Acibenzolar	1 oz	3	35.5	0.54
Cease + Milstop	1 % + 2.5 lb	0	16.5	0.25
CG100	0.8 %	3	35.25	0.53
Citrex	150 ml/100 L	0.5	26.88	0.41
Copper Count N	1 qt	0	26	0.39
HM-0736	14.4 fl oz	0	26	0.39
Kasumin	45 fl oz	0	25.12	0.38
NAI-4201	5 fl oz	2	33.75	0.51
Regalia	1 %	2	34.62	0.53
Tanos	12 oz	1.5	30.5	0.46
Tanos + CuPRO	8 oz + 2 lb	1.5	30.5	0.46
Taegro	3.5 oz	1.5	31.38	0.48
Untreated non-inoculated	-	0	16.5	0.25
Untreated inoculated	-	0	26	0.39
		P = 0.7644		

10-008-Palmateer-1
* Nonparametric analysis was used to first rank the ordinal rating data and then to compare ranks using ANOVA (SAS v 9.1), following the analysis methods described in Shah and Madden. 2004. Phytopathology 94:33-43.
[y] Higher relative effect signifies higher disease levels

In 2009 and 2010, Norman examined the efficacy of various products for preventative control of *Erwinia* sp. on Phalenopsis orchid. In 2009, plants were inoculated 11 days after the first application. For unknown reasons the disease control had less soft rot than most of the treatments, therefore, a true evaluation treatment efficacy was not possible. Although CuPro, Tanos, and Tanos + CuPro treatments had numerically lower leaf spots than untreated Control, no treatment provided significant reduction (Table 8). In 2010, all treatments were applied as foliar sprays (to runoff) on May 14 and/or 21; disease inoculation occurred on May 25. Soft-rot lesions were measured 3 days after inoculation. The only effective products were CuPRO and Protect; other treatments did not significantly reduce lesion size (Table 9). No phytotoxicity was found on any treatment.

Table 8. Efficacy for Leaf Spot (*Erwinia* sp.) on Orchid (*Phalaenopsis* sp.), Norman, 2009.

Treatment	Rate per 100 gal	Date of Application	Number of Leaf Spots[x] 7-31-09
Acibenzolar	0.75 oz	July 16, 23	16.3 bcd
Actinovate	12 oz	July 23	14 bcd
CG100	0.8%	July 23	17.2 cd
Citrex	150 ml/L	July 16, 23	20.1 cde
CuPRO	2 lb	July 23	3.4 ab
HM-0736	14.4 floz	July 16, 23	23 de
Kasumin	45 floz	July 23	14.1 bcd
NAI-4201 - drench	5 floz	July 16	8.8 abc
Regalia	1%	July 23	12.6 abcd
Tanos	12 oz	July 23	6.5 abc
Tanos + CuPRO	8oz + 2lb	July 23	7.5 abc
Taegro	3.5 oz	July 23	31.8 e
Vitalonil	5 pt	July 16, 23	11.4 abcd
Untreated non-inoculated	-	-	0 a
Untreated inoculated	-	-	7.8 abc

09-002-Norman-1

[x] Means followed by same letter do not differ significantly based on Fisher's Protected LSD) (P=.05).

Table 9. Efficacy for Soft Rot (*Erwinia* sp.) on Orchid (*Phalaenopsis* sp.), Norman, 2010.

Treatment	Rate per 100 gal	Date of Application	Size of Soft Rot Lesions[x]
Acibenzolar	0.75 oz	May 14, 21	10.5 b-e
CG100	0.3 %	May 21	8.8 bcd
Citrex	150 ml/L	May 14, 21	15 de
CuPRO	2 lb	May 21	3.3 abc
HM-0736	14.4 floz	May 14, 21	12.9 de
Kasumin	45 floz	May 21	17.4 e
Protect	2 lb	May 21	2.6 ab
Regalia	1 %	May 21	11.4 cde
Tanos	12 oz	May 21	14 de
Tanos + CuPRO	8 oz + 2lb	May 21	4.1 abc
Taegro	3.5 oz	May 21	10.8 b-e
Untreated non-inoculated	-	-	0 a
Untreated inoculated	-	-	13 de

10-008-Norman-2

[x] Means followed by same letter do not differ significantly based on Fisher's Protected LSD) (P=0.05).

In 2010, Steddom conducted a field experiment in a commercial nursery to determine efficacy of various products for preventative control of *Erwinia amylovora* on Keifer pear (*Pyrus communis* x *Pyrus pyrifolia*). All treatments were applied weekly except NAI-4201 and Taegro which were scheduled on a 14-day interval and the Acibenzolar drench which was scheduled on a 28-day interval. Treatments began on Mar 24, and due to weather, were repeated 7, 15, 22, 29, and 39 days from initiation. On Mar 24, most trees were at green tip with a few flowers beginning to bloom and by Apr 9 most trees were through flowering. Disease incidence was virtually zero and there were no significant treatment effects in this experiment (Table 10). Similarly no significant growth differences were observed between treatments.

Significant but very minor leaf mottling was observed from Citrex and KleenGrow and should not reduce marketability.

Table 10. Efficacy for Fireblight (*Erwinia amylovora*) on Keifer Pear (*Pyrus communis* x *Pyrus pyrifolia*)'Keifer', Steddom TX, 2010.

Treatment	Rate per 100 Gal	Number of Blighted Shoots[x] 3 May	Growth Increase At Experiment End 5-9-10		Phytotoxicity Rating[y] 5-3-10	
			Height	Canopy Area	Leaf Scorch	Mottling
Acibenzolar - foliar	1 oz	0.0 a	1.72 a	0.87 a	0.2 a	0.0 c
Acibenzolar - drench	0.25 oz	0.0 a	2.25 a	1.56 a	0.4 a	0.0 c
Aliette	12.8 oz	0.0 a	1.95 a	1.01 a	0.0 a	0.0 c
CG100	0.3 %	0.8	1.94 a	1.48 a	0.6 a	0.0 c
Citrex	19.2 fl oz	0.8	1.89 a	0.90 a	0.9 a	1.9 a
CuPRO	2 lb	0.0 a	1.19 a	0.69 a	0.6 a	0.0 c
HM-0736	14.4 fl oz	0.0 a	1.57 a	2.15 a	0.1 a	0.0 c
Kasumin	45 fl oz	0.0 a	2.79 a	1.39 a	0.4 a	0.0 c
KleenGrow	25 fl oz	0.0 a	1.20 a	0.87 a	0.6 a	1.2 b
NAI-4201	5 fl oz	0.3	1.06 a	1.27 a	0.6 a	0.3 c
Regalia	1 %	0.0 a	2.26 a	1.35 a	0.1 a	0.0 c
Tanos	12 oz	0.4	1.11 a	1.52 a	0.3 a	0.0 c
Tanos + CuPRO	8 oz + 2 lb	0.0 a	1.73 a	2.07 a	0.3 a	0.0 c
Taegro	3.5 oz spray/drench alt.	0.0 a	2.75 a	1.29 a	0.7 a	0.0 c
Untreated	-	0.0 a	1.07 a	0.14 a	0.3 a	0.0 c

10-008-Steddom-1

x Means followed by the same letter do not differ significantly based on Fisher's Protected LSD (P=0.05.

y Ratings based on a 0 to 5 scale with 0=no phytotoxicity, 3=phytotoxicity plainly visible, reducing marketability, and 5=phytotoxicity severely disfiguring tree.

In 2012, Steddom studied whether 14 products could manage fireblight (*Erwinia sp.*) on ornamental pear (*Pyrus calleryana* 'Cleveland'). Due to the erratic nature and long duration of disease this year, the proportion of flowers or stems blighted were summed across data collection dates. Flower blight was not significantly different for any treatments (Table 11). Shoot blight showed high variability with significant differences at the *p=0.02* level. The following treatments had significantly less shoot blight than the untreated uninoculated control: Acibenzolar foliar, Acibenzolar drench, Camelot O foliar, NAI-4201 foliar, Citrex foliar, Kasumin foliar, Cease + Milstop foliar tank mix, KleenGrow foliar, and KleenGrow + CuPro foliar tank mix. Since CuPro by itself did not provide significant control and the KleenGrow + CuPro foliar tank mix did not provide significantly more disease reduction that KleenGrow by itself, it is likely that the control seen in the KleenGrow + CuPro foliar treatment was from the KleenGrow contribution. Disease progress did not follow the typical route of flower blight followed by movement of the bacterium down the pedicel to the stems. It is unclear if the treatments listed above will provide effective control against the flower blight stage of this disease but the control of the shoot blight phase can be an important management tool for suppression of this disease.

Table 11. Efficacy for Fireblight (Erwinia sp.) on Ornamental Pear (Pyrus calleryana) 'Keifer', Steddom TX, 2012.

Product (active ingredients) Rate	Flower Blight [a]	Shoot Blight [b]
A14658C 2 pt per 100 gal	0.06	0.33 bcde
A14658C 4 pt per 100 gal	0.67	0.19 cde
Aliette (fosetyl Al) 12.8 oz per 100 gal	0.60	0.34 bcde
Camelot O (copper salts of fatty and rosin acids) 2 gal per 100 gal	0.22	0.17 de
Cease+Milstop (*Bacillus subtilis* + potassium bicarbonate) 4 qt + 3 lb per 100 gal	0.23	0.11 de
Citrex (Citrus extraction) 150 ml per 100 L	0.00	0.15 de
CuPro (copper hydroxide) 2 lb per 100 gal	0.00	0.41 abcde
Florel (ethephon) 1 qt per 100 gal	0.36	0.85 a
Florel (ethephon) 2 qt per 100 gal	0.25	0.57 abcd
HM-0736 (laminarin) 14.4 fl oz per 100 gal	0.17	0.47 abcde
Insimmo (acibenzolar) 0.25 oz per 100 gal Foliar	0.25	0.04 e
Insimmo (acibenzolar) 1 oz per 100 gal Drench	0.00	0.08 de
Kasumin (kasugamycin) 45 fl oz per 100 gal	0.08	0.18 de
KleenGrow (didecyl dimethyl ammonium chloride) 50 fl oz per 100 gal	0.00	0.16 de
KleenGrow + CuPro (didecyl dimethyl ammonium chloride + copper hydroxide) 50 fl oz + 2 lb per 100 gal	0.00	0.14 de
NAI-4201 (5 fl oz per 100 gal	0.00	0.14 de
Regalia (extract of *Reynoutria sachalinensis*) 1 qt per 10 gal	0.50	0.69 ab
Untreated uninoculated Control	0.19	0.69 abc
Least Significant Difference	0.70	0.50

12-008-Steddom-01

[a] Proportions of blighted flower or stems summed across all examination dates of experiment

[b] Differences in blighted shoots were significant at the *p=0.02* level. Mean separation was by Fisher's Protected LSD test with a probability threshold of *p=0.05*.

In 2012, Steddom conducted another experiment on Cleveland pear (*Pyrus calleryana*). All treatments were applied foliar except Acibenzolar which was applied drench 3 times or foliar 7 times (Table 12). Flower blight was not significantly different for any treatments. The following treatments had significantly less shoot blight than the untreated uninoculated control: Acibenzolar drench or foliar, Camelot O, NAI-4201, Citrex, Kasumin, Cease + Milstop, KleenGrow, and KleenGrow + CuPro. It is unclear if these treatments will provide effective control against the flower blight stage of this disease but the control of the shoot blight phase can be an important management tool for suppression of this disease. Aliette, CG100, CuPro, Florel, HM-0736 and Regalia did not significantly reduce shoot blight incidence.

Table 12. Efficacy for Fireblight (*Erwinia amylovora*) on Cleveland Pear (*Pyrus calleryana*), Steddom TX, 2012.

Treatment	Rate per 100 Gal	Application Timing (DOY)	Crop Stage	Flower Blight[x]	Shoot Blight[x]
A14658C	2 pt	72,81,88,95,102	Green tip thru petal fall	0.06 a	0.33 b-e
A14658C	4 pt	72,81,88,95,102	Green tip thru petal fall	0.67 a	0.19 cde
Acibenzolar foliar	1 oz	51,58,72,81,88,95,102	Green tip thru petal fall	0.25 a	0.04 e
Acibenzolar drench	0.25 oz	43,72,102	Dormant and bloom	0.00 a	0.08 de
Aliette	12.8 oz	51,58,72,81,88,95,102	Green tip thru petal fall	0.60 a	0.34 b-e
Camelot O	2 gal	58,72,81,88,95,102	Bloom thru petal fall	0.22 a	0.17 de
Cease + Milstop	4qt + 3 lb	58,72,81,88,95,102	Bloom thru petal fall	0.23 a	0.11 de
Citrex	150 cc/100 L	51,58,72,81,88,95,102	Green tip thru petal fall	0.00 a	0.15 de
CuPro	2 lb	58,72,81,88,95,102	Green tip thru petal fall	0.00 a	0.41 a-e
Florel	1 qt/10 gal	72,81,88,95,102	Bloom thru petal fall	0.36 a	0.85 a
	2 qt/10 gal	72,81,88,95,102	Bloom thru petal fall	0.25 a	0.57 a-d
HM-0736	14.4 fl.oz	51,58,72,81,88,95,102	Green tip thru petal fall	0.17 a	0.47 a-e
Kasumin	45 fl.oz	58,72,81,88,95,102	Green tip thru petal fall	0.08 a	0.18 de
KleenGrow	50 fl.oz	58,72,81,88,95,102	Green tip thru petal fall	0.00 a	0.16 de
KleenGrow + CuPro	50 fl.oz + 2 lb	72,81,88,95,102	Green tip thru petal fall	0.00 a	0.14 de
NAI-4201	5 fl.oz	58,72,81,88,95,102	Bloom thru petal fall	0.00 a	0.14 de
Regalia (MOI 106)	1 qt/10 gal	58,72,81,88,95,102	Bloom thru petal fall	0.50 a	0.69 ab
Untreated	-	-	-	0.19 a	0.69 abc

[x] Proportions of blighted flower or stems summed across all examination dates of experiment. Means followed by the same letter do not differ significantly based on Fisher's Protected LSD (P=0.05).
* Capsil was added at the rate of 12 fl oz/100 gal to all treatments except KleenGrow, KleenGrow + CuPro, and Cease + Milstop.

During 2013 to 2016, Cox conducted four experiments to determine efficacy of various products applied foliar for preventative control of *Erwini amylovora* on apple (*Malus domestica*). In all experiments, trees were inoculated at full bloom. In 2013, Kasumin, Ag Streptomycin and Bloomtime provided the best control of blossom blight followed by Actigard, Fireline, MasterCop and Serenade (Table 13). While only Ag Streptomycin and Kasumin provided a considerable and significantly reduced progression of shoot blight development, Actigard and Bloomtime provided a marginal, but significant reduction in the extent of shoot blight. In 2014, the antibiotics Kasumin and Ag Streptomycin again provided the best control of blossom blight followed by MasterCop, BmJ and Serenade (Table 14). Kasumin and Ag Streptomycin also had the lowest progression of shoot blight on new shoots. In 2015, Kasumin, Ag Streptomycin, FireWall and FireLine provided the best control of blossom blight followed by Cueva, Double Nickel and Serenade (Table 15). Of the antibiotics, FireWall 50WP and Kasumin performed exceptionally strong. Interestingly, there were no significant differences between FireWall 17 and Kasumin 2L applied in protectant or in curative mode. Similarly in 2016, the antibiotics FireWall 50WP, FireWall 17WP, FireLine, and Kasumin applied at 80% bloom provided the highest levels of control (Table 16). Cueva was nearly effective as the antibiotics, and could be viable option for organic growers if timed well.

Table 13. *Efficacy for Fireblight (*Erwinia amylovora*) on Apple (*Malus x domestica*) 'Idared', Cox, NY, 2013.

Treatment	Rate per Acre	Application Timing [y]	Blossom Blight (%) [x]	Shoot Blight Canker Length (mm)
Actigard 50WG (acibenzolar)	0.5 oz	1-2, 4-5	11.2 ± 2.0 c	99.2 ± 1.9 cde
Ag Streptomycin (streptomycin) + Regulaid	24 oz + 3 pt	2, 4-5	2.6 ± 1.1 efg	29.7 ± 4.7 f
Bloomtime (*Pantoea agglomerans* strain E325)	5.28 oz	4-5	6.2 ± 2.2 de	91.5 ± 2.6 d
Fireline 17WP (oxytetracycline)	48 oz	2, 4	11.2 ± 1.2 c	-
Kasumin 2L (kasugamycin)	16 fl oz	4-5	0.6 ± 0.4 fg	25.2 ± 2.6 f
MasterCop (copper sulfate pentahydrate)	1.5 pt	2, 4-5	17.2 ± 3.1 b	125.8 ± 8.5 a
Serenade Optimum (*Bacillus subtilis* strain QST 713) + Regulaid	1.5 lb + 3 pt	2, 4-5	18.4 ± 1.1 b	-
Untreated	-	-	29.6 ± 2.1 a	121.4 ± 8.9 ab

* Not an IR-4 Experiment: PDMR Vol. 8:PF007. Not all products tested included in table.
[x] Means followed by the same letter do not differ significantly based on Tukey's HSD (P=0.05).
[y] Treatment timings were: 1 = 20% bloom (May 13); 2 = 50% bloom (May 14); 3 = 80% bloom (May 15); 4 = full bloom (May 16); 5 = during terminal shoot growth (Jun 7).

Table 14. *Efficacy for Fireblight (*Erwinia amylovora*) on Apple (*Malus x domestica*) 'Idared', Cox, NY, 2014.

Treatment	Rate per Acre	Application Timing [y]	Blossom Blight (%) [x]	Shoot Blight (% of Shoot Length)
Ag Streptomycin (streptomycin) + Regulaid	24 oz + 3 pt	3	0.3 ± 0.3 f	11.5 ± 2.2 cd
BmJ (*Bacillus mycoides* isolate J)	13.5 oz	1, 3, 4	19.0 ± 6.3 bcd	-
Kasumin 2L (kasugamycin)	16 fl oz	3, 6	0.0 ± 0.0 f	5.1 ± 2.6 d
MasterCop (copper sulfate pentahydrate)	1.5 pt	3, 6	11.2 ± 2.0 cde	24.4 ± 8.5 bc
Serenade Optimum (*Bacillus subtilis* strain QST 713) + Regulaid	1.5 lb + 3 pt	2-6	28.7 ± 8.1 b	-
Untreated	-	-	59.2 ± 4.7 a	71.9 ± 8.6 a

* Not an IR-4 Experiment: PDMR Vol. 9:PF023. Not all products tested included in table.
[x] Means followed by the same letter do not differ significantly based on Tukey's HSD (P=0.05).
[y] Treatment timings were: 1 = 20% bloom (May 13); 2 = 50% bloom (May 14); 3 = 80% bloom (May 15); 4 = full bloom (May 16); 5 = during terminal shoot growth (Jun 7); 6 = during terminal shoot growth (Jun 12).

Table 15. *Efficacy for Fireblight (*Erwinia amylovora*) on Apple (*Malus x domestica*) 'Idared', Cox, NY, 2015.

Treatment	Rate per Acre	Application Timing [y]	Blossom Blight (%) [x]
Ag Streptomycin (streptomycin) + Regulaid	24 oz + 3 pt	1-4	11.6 ± 2.2 h-k
Cueva (Cueva (copper octanoate)	2 qt	1-3	19.5 ± 4.1 d-i
	3 qt	1-3	14.8 ± 6.1 f-j
Double Nickel LC (*Bacillus amyloliquefaciens* strain D747)	1 qt	1-3	22.5 ± 1.9 c-h
FireLine 17WP (oxytetracycline) + Regulaid	48 oz + 3 pt	3	8.0 ± 2.0 ijk
FireWall 17WP (streptomycin) + Regulaid.	24 oz + 3 pt	3	11 ± 3.0 h-k
	24 oz + 3 pt	3P	3.8 ± 1.0 jk
	24 oz + 3 pt	3K	2.1 ± 0.8 k
FireWall 50WP (streptomycin) + Regulaid	10 oz + 3 pt	3	2.5 ± 1.2 k
Kasumin 2L + Regulaid	64 fl oz + 3 pt	3	3.5 ± 2.1 k
	64 fl oz + 3 pt	3P	4.5 ± 1.3 jk
	64 fl oz + 3 pt	3K	4.1 ± 1.5 jk
Serenade Optimum (*Bacillus subtilis* strain QST 713) + Regulaid	1.5 lb + 3 pt	1-4	37.3 ± 6.7 b
Untreated	-	-	89.4 ± 5.1 a

* Not an IR-4 Experiment: PDMR Vol. 10:PF014. Not all products tested included in table.

[x] Means followed by the same letter do not differ significantly based on Tukey's HSD (P=0.05).

[y] Treatment timings were: 1 = 20% bloom (May 9); 2 = 50% bloom (May 10); 3 =80% bloom (May 10); 4 = full bloom/petal fall (May 20). Treatment programs designated with timings designated by a "P" or "K" received applications exactly 24 hours "prior to" or "after" inoculation (May 11).

Table 16. *Efficacy for Fireblight (*Erwinia amylovora*) on Apple (*Malus x domestica*) 'Gala', Cox, NY, 2016.

Treatment	Rate per Acre	Application Timing [y]	Blossom Blight (%) [x]	Shoot Blight (%)
Actigard 50WG (acibenzolar)	2 oz	3-6	26.3 ± 5.2 b	5.8 ± 1.8 b-e
BmJ (*Bacillus mycoides* isolate J)	4.5 oz	1-4	24.3 ± 5.4 b	7.1 ± 2.3 bc
Cueva (Cueva (copper octanoate)	2 qt	3-6	8.3 ± 1.3 d-h	1.5 ± 0.7 cde
FireLine 17WP (oxytetracycline) + Regulaid	48 oz + 3 pt	4	1.8 ± 1.2 h	0.4 ± 0.4 de
FireWall 17WP (streptomycin) + Regulaid	24 oz + 3 pt	4	3.9 ± 1.8 e-h	0.0 □ 0.0 e
FireWall 50WP (streptomycin) + Regulaid	10 oz + 3 pt	4	3.2 ± 1.2 e-h	0.4 ± 0.3 de
Kasumin 2L (kasugamycin) + Regulaid	64 fl oz + 3 pt	4	2.0 ± 0.4 gh	0.7 ± 0.4 de
Regalia (*Reynoutria sachalinensis* extract)	64 fl oz	1,3-6	20.8 ± 9.8 bc	5.4 ± 1.8 b-e
Serenade Optimum (*Bacillus subtilis* strain QST 713) + Regulaid	20 oz + 3 pt	3-4, 6-7	9.0 ± 4.2 d-h	2.4 ± 1.4 b-e
Thyme Guard (thyme oil) + Top Film	0.25% + 6 oz	4	23.0 ± 8.1 b	8.4 ± 3.6 b
	0.5% + 6 oz	4	15.5 ± 10.3 b-e	4.2 ± 1.5 b-e
Untreated	-	-	65.0 ± 4.0 a	23.9 ± 3.5 a

* Not an IR-4 Experiment: PDMR Vol. 11:PF003. Not all products tested included in table.

[x] Means followed by the same letter do not differ significantly based on Tukey's HSD (P=0.05).

[y] Treatment timings were: 1 = "pink" (May 3); 2= 20% bloom (May 9); 3 = 40% bloom (May 10); 4 = 80% bloom (May 11); 5 = full bloom/petal fall (May 16); 6 = petal fall/early terminal shoot growth (May 20); 7 = during terminal shoot growth (Jun 2).

During 2013 to 2016, Yoder conducted four experiments to determine efficacy of various products applied foliar for preventative control of *Erwinia amylovora* on apple. In all experiments, trees were inoculated during late bloom/petal fall stage. In 2013, Firewall and Harbour provided excellent suppression of a high cluster infection; Serenade and Regalia also gave significant blossom blight suppression, but Actigard did not (Table 17). In the first 2015 experiment, the streptomycin standard Firewall performed as expected under these conditions with significant suppression of a severe cluster infection, comparable to the untreated uninoculated control (Table 18). Cueva at the higher rate and Blossom Protect were less effective, while Bloomtime, Double Nickel and Fire Quencher looked ineffective. In the second 2015 experiment, Firewall again performed as expected under these conditions with significant suppression of a severe cluster infection, followed by Kasumin and Serenade; Fireline was ineffective (Table 19). Similarly in 2016, Firewall performed as expected with significant suppression of a severe cluster infection (Table 20). However, Kasumin did not significantly reduce infection in this test.

Table 17. *Efficacy for Fireblight (*Erwinia amylovora*) on Apple (*Malus x domestica*) 'Idared', Yoder, VA, 2013.

Treatment	Rate per Acre	Application Timing [y]	Blossom Blight (%) [x]
Actigard 50WG (acibenzolar) + Regulaid	0.5 oz + 1 pt	1, 2, 3, 4, 5, 6	58.4 hi
FireWall 17W (streptomycin) + Regulaid	12 oz + 1 pt	2, 3, 4	25.2 b-d
FireWall 17W (streptomycin) + Regulaid	24 oz + 1 pt	2, 3, 4	6.0 a
Harbour 17W (streptomycin) + Regulaid	12 oz + 1 pt	2, 3, 4	20.4 bc
Harbour 17W (streptomycin) + Regulaid	24 oz + 1 pt	2, 3, 4	15.1 ab
Regalia (*Reynoutria sachalinensis* extract)	2 qt	2, 3, 4	53.1 gh
Serenade Optimum (*Bacillus subtilis* strain QST 713) + Regulaid	1.5 lb + 1 pt	2, 3, 4	50.5 f-h
Untreated	-	-	72.3 i

* Not an IR-4 Experiment: PDMR Vol. 8:PF026. Not all products tested included in table.
[x] Means followed by the same letter do not differ significantly based on Waller-Duncan K-ratio t-test (P=0.05).
[y] Treatment timing were: 1 = pink (Apr 11), 2 = early bloom (Apr 18); 3 = full bloom (Apr 23); 4 = late bloom (May 1); 5 = petal fall (May 10); 6 = 1st cover (May 18).

Table 18. *Efficacy for Fireblight (*Erwinia amylovora*)on Apple (*Malus x domestica*) 'Gala', Yoder, VA, 2015.

Treatment	Rate per 100 Gal	Application Timing [y]	% Clusters Infected [x]
Bloomtime (*Pantoea agglomerans* strain E325)	1.3 oz	1, 2, 3, 4	59.1 e-g
Blossom Protect (*Aureobasidium pullulans*)+ Buffer Protect	5 oz	1, 2, 3, 4	41.6 c-e
Cueva (copper octanoate)	1 pt	1, 2, 3, 4	54.8 d-g
	1.5 pt	1, 2, 3, 4	27.0 bc
Double Nickel LC (*Bacillus amyloliquefaciens* strain D747)	8 fl oz	1, 2, 3, 4	60.2 e-g
FireWall 17W (streptomycin)	6 oz	1, 2, 3, 4	15.5 ab
Fire Quencher (bacteriophage)	8 fl oz	1, 2, 3, 4	68.5 g
Untreated uninoculated	-	-	6.8 a
Untreated inoculated	-	-	65.4 fg

* Not an IR-4 Experiment: PDMR Vol. 10:PF026. Not all products tested included in table.
[x] Blossom clusters infection and number of shoot strikes observed May 25 and Jun 13, respectively. Means followed by the same letter do not differ significantly based on Waller-Duncan K-ratio t-test (P=0.05).
[y] Treatment timings were: 1 = early bloom (Apr 22); 2 = midbloon bloom (Apr 27); 3 = late bloom (Apr 29), 4 = petal fall (May5).

Table 19. *Efficacy for Fireblight (*Erwinia amylovora*) on Apple (*Malus x domestica*) 'Idared', Yoder, VA, 2015.

Treatment	Rate per Acre	Application Timing [y]	% Clusters Infected [x]
FireLine 17WP (oxytetracycline)	1 lb + 1 pt	1, 2, 3	75.1 fg
FireWall 17W (streptomycin) + Regulaid	1.5 lb + 1 pt	1, 2, 3	47.8 a
Kasumin 2L (kasugamycin) + Regulaid	2qt + 1 pt	1, 2, 3	71.4 ef
Kasumin 8L (kasugamycin) + Regulaid	1pt + 1pt	1, 2, 3	58.0 a-e
Serenade Optimum (*Bacillus subtilis* strain QST 713)	1.25 lb + 1 pt	1, 2, 3	62.7 b-f
Untreated	-	-	85.9 g

* Not an IR-4 Experiment: PDMR Vol. 10:PF027. Not all products tested included in table.
[x] Means followed by the same letter do not differ significantly based on Waller-Duncan K-ratio t-test (P=0.05).
[y] Treatment timings were: 1 = early bloom (Apr 20); 2 = mid bloom (Apr 29); 3 = late bloom/petal fall (May 5).

Table 20. *Efficacy for Fireblight (*Erwinia amylovora*) on Apple (*Malus x domestica*) 'Idared', Yoder, VA, 2016.

Treatment	Rate per Acre	Application Timing [y]	% Clusters Infected [x]
Blossom Protect (*Aureobasidium pullulans*)+ Buffer Protect	1.25 lb	1, 2, 3, 4	49.6 ef
F1781aa + Regulaid	2 qt + 1 pt	1, 2, 3, 4	47.5 ef
F1781ab + Regulaid	2 qt + 1 pt	1, 2, 3, 4	41.0 c-f
FireWall 17 (streptomycin)	1.5 lb	1, 2, 3, 4	23.6 a-c
FireWall 17W + Regulaid	1.5 lb + 1 pt	1, 2, 3, 4	21.4 ab
HM0303	2 qt	1, 2, 3, 4	53.0 f
Kasumin 2L (kasugamycin) + Regulaid	2 qt + 1 pt	1, 2, 3, 4	33.8 a-e
Untreated	-	-	50.4 ef

* Not an IR-4 Experiment: PDMR Vol. 11:PF023. Not all products tested included in table.
[x] Means followed by the same letter do not differ significantly based on Waller-Duncan K-ratio t-test (P=0.05).
[y] Treatment timings were: 1 = early bloom (Apr 14); 2 = mid bloom (Apr 18); 3 = late bloom (Apr 21); 4 = petal fall (Apr 27).

During 2015 to 2017, Sundin conducted three field experiments to determine efficacy of various products applied foliar for preventative control of *Erwinia amylovora* on apple. In all experiments, trees were inoculated at the 70-80% bloom stage. In the 2015 experiment, all treatments except Bloomtime provided significant control of blossom blight, while all treatments except Bloomtime and Cueva provided better shoot blight control (Table 21). Blossom Protect and Fire Quencher provided good control of both blossom and shoot blights. In the 2016 experiment, all treatments provided significant control of both blossom and shoot blights, with Nu-Cop providing the best control of shoot blight (Table 22). In the 2017 experiment, all treatments provided significant control of blossom blight, and all treatments, except Cueva, also provided significant shoot blight control (Table 23). The standard Firewall provided the best blossom and shoot blight control, with Previsto providing statistically similar efficacy.

Table 21. *Efficacy for Fireblight (*Erwinia amylovora*) on Apple (*Malus x domestica*) 'McIntosh', Sundin, MI, 2015.

Treatment	Rate per Acre	Application Timing	Blossom Blight (%) [x]	Shoot Blight (%)
Bloomtime (*Pantoea agglomerans* strain E325)	0.33 lb	20%; 50%; FB [z]; LB-PF [y]	27.5 ab	25.8 ab
Blossom Protect (*Aureobasidium pullulans*)	1.25 lb	20%; 50%; FB; LB-PF	5.8 d	9.8 bc
Cueva (copper octanoate)	2 qt	20%; 50%; FB; LB-PF	20.0 bc	13.8 abc
Fire Quencher (bacteriophage)	2 pt	20%; 50%; FB; LB-PF	12.3 cd	12.3 bc
Untreated uninoculated	-	-	0.0 e	0.0 d
Untreated inoculated	-	-	41.7 a	28 a

* Not an IR-4 Experiment: PDMR Vol. 10:PF021. Not all products tested included in table.
[x] Means followed by the same letter do not differ significantly based on Fisher's Protected LSD (P=0.05).
[z] FB represents the full bloom stage of apple blossom development
[y] LB-PF represents late bloom-petal fall stage of apple blossom development
Blossom Protect mixed with Buffer Protect adjuvant.

Table 22. *Efficacy for Fireblight (*Erwinia amylovora*) on Apple (*Malus x domestica*) 'Jonathan', Sundin, MI, 2016.

Treatment	Rate per Acre	Application Timing	Blossom Blight (%) [x]	Shoot Blight (%)
FireLine (oxytetracycline)	1.5 lb	70-80%; FB [z]	31.5 b	35.5 b
Kasumin 2L (kasugamycin)	2 qt	70-80%; FB	18.6 cde	37.6 b
Nu-Cop 30HB (copper hydroxide)	2 lb	70-80%; FB	13.0 de	4.6 d
	3.33 lb	70-80%; FB	9.3 e	4.9 d
Untreated	-	-	84.1 a	62.8 a

* Not an IR-4 Experiment: PDMR Vol. 11:PF002. Not all products tested included in table.
[x] Means followed by the same letter do not differ significantly based on Fisher's Protected LSD (P=0.05).
[z] FB represents the full bloom stage of apple blossom development
Kasumin and FireLine mixed with Regulaid adjuvant.

Table 23. *Efficacy for Fireblight (*Erwinia amylovora*) on Apple (*Malus x domestica*) 'McIntosh', Sundin, MI, 2017.

Treatment	Rate per Acre	Blossom Blight (%) [x] Jun 12	Shoot Blight (%) Aug 25
Blossom Protect (*Aureobasidium pullulans*)	1.25 lb	5.2 cd	1.3 bc
Cueva (copper octanoate)	2 qt	7.7 bc	4.7 ab
FireWall 17W (streptomycin) + Regulaid	1.5 lb + 1 pt	1.9 e	0.5 c
Previsto (copper hydroxide)	3 qt	3.2 de	1.2 bc
Serenade Optimum (*Bacillus subtilis* strain QST 713)	20 oz	6.1 bcd	2.3 bc
Untreated uninoculated		0.0 f	0.0 c
Untreated inoculated		17.1 a	6.2 a

* Not an IR-4 Experiment: PDMR Vol. 10:PF021. Not all products tested included in table.
[x] Means followed by the same letter do not differ significantly based on Fisher's Protected LSD (P=0.05).
Blossom Protect mixed with Buffer Protect adjuvant.
Treatments applied at 70-80% bloom and full bloom.

In 2016, Lehman conducted a field experiment to determine efficacy of various products applied foliar for preventative control of *Erwinia amylovora* on apple (*Malus domestica*). Trees were inoculated at 50% and 100% bloom stages. Overall, FireWall performed better for control of blossom blight (and subsequent shoot blight) than Kasumin and the biopesticides (Regalia and Serenade), copper products (Cueva and MagnaBon), and lime sulfur (Table 24). Fire Quencher was ineffective.

Table 24. *Efficacy for Fireblight (*Erwinia amylovora*)on Apple (*Malus x domestica*) 'Gala', Lehman, PA, 2016.

Treatment	Rate per Acre	Application Timing [y]	% Clusters Infected [x]	No. Shoot Strikes
Cueva (copper octanoate)	2 qt	1, 2, 3	60.4 b-f	25.8 cd
FireWall 17W (streptomycin) + Regulaid	1.5 lb + 1 pt	1, 2, 3	22.1 i	1.8 f
Fire Quencher A (bacteriophage)		1, 2, 3	71.3 ab	41.8 bc
Fire Quencher B (bacteriophage) + UV protectant		1, 2, 3	75.3 a	74.3 a
Kasumin 2L (kasugamycin) + Regulaid	2 qt + 1 pt	1, 2, 3	49.9 e-g	23 c-e
Lime Sulfur (lime sulfur)	1.5 %	1, 2, 3	66.4 a-d	59.5 ab
MagnaBon CS2005 (copper sulfate pentahydrate)	1 pt	1, 2, 3	59.6 b-f	37.8 c
Regalia (*Reynoutria sachalinensis* extract)	2 qt	1, 2, 3	57.7 c-f	28.5 c
Serenade Optimum (*Bacillus subtilis* strain QST 713)	1.25 lb	1, 2, 3	66.5 a-d	34.8 c
Untreated uninoculated	-	-	27.9 hi	27.3 cd
Untreated inoculated	-	-	72.6 ab	65.8a

* Not an IR-4 Experiment: PDMR Vol. 11:PF019. Not all products tested included in table.

[x] Blossom clusters infection and number of shoot strikes observed May 25 and Jun 13, respectively. Means followed by the same letter do not differ significantly based on Fisher's Protected LSD test (P=0.05).

[y] Treatment timings were: 1 = 50% bloom (Apr 19); 2 = 100% bloom (Apr 21); 3 = late bloom (Apr 25).

In 2009, Chase conducted an experiment to determine efficacy of several products for preventative control of *Erwinia chrysanthemi* on poinsettia *(Euphorbia pulcherrima).* All treatments were applied as foliar sprays (to drip) on Sep 22, 29, Oct 7, 13, except Taegro which was applied as drench on Sep 22. Plants were inoculated with a strain of *E. chrysanthemi* after two foliar applications. Poinsettia plants developed slight to moderate levels of *Erwinia* during the experiment. Disease severity was slight to moderate due to the cool temperatures. Least disease occurred on plants treated with Taegro and Rezist + Sett (Table 25). Other treatments were statistically the same as the inoculated control.

Table 25. Efficacy for *Erwinia chrysanthemi* on Poinsettia (*Euphorbia pulcherrima*) 'Prestige' and 'Autumn Red', Chase, CA, 2009.

Treatment	Rate per 100 Gal	Number of infected leaves per plant 10-20-09	Numberof infected leaves per plant 10-28-09
Acibenzolar	0.75 oz	1.8 b	2.2 bc
Citrex	1.5ml per liter	1.0 a	2.1 abc
CuPRO	2 lb	1.4 ab	1.4 abc
HM-0736	14.4 fl oz	1.1 a	1.5 abc
Kasugamycin	45 fl oz	1.2 ab	1.6 abc
ReZist	32 oz	1.4 ab	1.4 abc
ReZist + Sett	16 oz + 32 oz	1.2 ab	1.5 abc
ReZist + Sett	32 oz + 32 oz	1.0 a	1.2 ab
Tanos	12 oz	1.4 ab	1.4 abc
Tanos + CuPRO	8 oz + 2 lb	1.3 ab	1.6 abc
Taegro - drench	3.5 oz	1.2 ab	1.1 a
Untreated non-inoculated	-	1.1 a	1.2 ab
Untreated inoculated	-	1.6 ab	2.3 c

09-002-Chase-1

Comparative Efficacy on Pseudomonas species

All products, including the standard copper compounds, provided inconsistent performance for *Pseudomonas* spp., ranging from no to good control (Table 26). Most experimental products, including Acibenzolar, Citrex, HM-0736, Kasumin, NAI-4201, Regalia, Taegro and ZeroTol, may be promising enough based on their efficacy compared to standards. The new experimentals BW165N and TDA02 looked ineffective. Tanos mixed with CuPRO generally did not improve performance of CuPRO. See the discussion and data of individual experiments for more details.

Table 26. General summary of efficacy for *Pseudomonas* spp. on various crops.

Product	Chrysanthemum			Hibiscus		Impatiens	Oak Leaf Hydrangea		Bolivian Jasmine	Lavender	Lilac			Japanese Maple
	Norman 2010	Norman 2012	Norman 2017	Strandberg 2006	Strandberg 2007	Norman 2012	Strandberg 2006	Strandberg 2007	Chase 2010	Chase 2009	Pscheidt 2005*	Pscheidt 2011	Pscheidt 2012	Regan 2009
A14658C		-				-							+/-	
A91800A												-		
Acibenzolar	-	-				++			++	-				-
Aliette												-	++	
BlightBan			+											
Bloomtime			+											
BW165N			-											
Camelot													++	
Cease														-
CG100	-	-				-			+/-			-	+/-	
Citrex	+	++				-			+/-	-		-		-
CuPRO, Kocide, Nu-Cop	++	++	++	-	-	+	-	-			++	++		-[3]
GC Pro			-											
HM-0736	-	-		-		+	-		+/-			-		
Junction											+			
Kasumin	+	++		-		+	-		++	-		++		-
Kasumin + Kocide					+			-						
KleenGrow			-										+/-	
MBI-110			+											
NAI-4201		-				+			+/-					
OxiPhos			-											
Phyton 27					-			-	++	-	++			
Protect	+								+/-					-
Regalia	+	-				+			+/-	-		-	+/-	

STBX											+/-			
Tanos	-			-					+/-					-
Tanos + CuPRO (Tanos + Kocide)	+			-	-		-	-	++	+				- [3]
TDA02			-											
Taegro	+								+/-	-				-
Triathlon			+											
ZeroTol		+	+			-							++	

* Not an IR-4-sponsored experiment.

[1] Rating Scale: ++ = clearly statistically equivalent or better than untreated non-inoculated and/or clearly statistically different than untreated inoculated; + = statistically different from untreated inoculated and untreated non-inoculated; +/- statistically equivalent to both untreated inoculated and untreated non-inoculated; - = statistically equivalent to untreated inoculated. For experiments without non-inoculated check, efficacy determined on author's conclusions, % control or comparisons to standard product(s).

[2] Where more than one rate or application type for a product was included in the experiment and each performed statistically different, the better rating is provided in this table.

[3] No disease observed in these treatments, but high variability in untreated non-inoculated so statistically equivalent to control.

In 2010 and 2012, Norman examined the efficacy of various products for preventative control of *Pseudomonas cichorii* (strain P329) on chrysanthemum (*Chrysanthemum/Dendrathema* sp). In 2010, treatments were applied as foliar sprays (to runoff) or drenches on May 17 and/or 24 and 31; disease inoculation occurred on May 29. Treatments that significantly decreased the number of leaf spots as compared to the disease control treatment included: ZeroTol, Citrex, Kasumin and the standard CuPro (Table 27). Note that ZeroTol was applied 24 hours after plants were inoculated and unbagged. Some control was observed with the Acibenzolar treatments, HM-07361, and NAI-4201, however not significant at the $P = 0.05$ level. No phytotoxicicty was observed in any of the treatments. In 2012, all treatments were applied at various times as foliar sprays except Insimmo and NAI-4201 applied as drench from May 10 to 31; disease inoculation occurred on May 29. The number of leaves with characteristic black lesions were counted on Jun 6. Treatments that significantly decreased the number of leaf spots included: ZeroTol, Citrex, Kasumin and the standard CuPro (Table 17). Insimmo treatments, HM-07361 and NAI-4201 decreased number of lesions, however not significantly at the $P = 0.05$ level. No phytotoxicicty was observed in any of the treatments.

In 2017, Norman conducted two experiments to examine the efficacy of new products for preventative control of *Pseudomonas cichorii* (strain P329) on chrysanthemum (*Chrysanthemum/Dendrathema* sp). In the first test, treatments were applied as foliar sprays on Jul 3, 7, 13,and/or 17; disease inoculation occurred on Jul 5. In the second test, treatments were applied as foliar sprays on Oct 9; disease inoculation occurred on the same day. Treatments that significantly decreased the number of leaf spots as compared to the disease control treatment included: Blightban, Bloomtime, MBI-110, Triathlon BA, Zerotol, and CuPro (**Table 29**). Foliar damage to the chrysanthemums occurred with applications of GCPro, OxiPhos and TDA02. The pathogen was more severe on those treatments that demonstrated injury. These products may need to be reformulated or application levels lowered to reduce phytotoxicity. Residue rating was acceptable for all products except CuPro.

Table 27. Efficacy for *Pseudomonas chickorii* on Chrysanthemum (*Chrysanthemum/Dendrathema* sp), Norman, 2010.

Treatment	Rate per 100 Gal	Application Dates	No. Leaves With Lesions[x] 6-4-10
Acibenzolar	0.75 oz	May 13, 20, 27	15.9 ef
CG100	0.3 %	May 20, 27	23.1 g
Citrex	150 ml/L	May 13, 20, 27	8.3 c
CuPRO	2 lb	May 20, 27	2.8 ab
HM-0736	14.4 floz	May 13, 20, 27	13.9 de
Kasumin	45 floz	May 20, 27	3.4 b
Protect	2 lb	May 20, 27	5.2 bc
Regalia	1 %	May 20, 27	5.7 bc
Tanos	12 oz	May 20, 27	18.8 f
Tanos + CuPro	8 oz + 2lb	May 20, 27	3.7 b
Taegro	3.5 oz	May 20, 27	12.7 d
Untreated uninoculated	-	-	0.0 a
Untreated inoculated	-	-	16.7 ef

10-008-Norman-1

[x] Means followed by same letter do not differ significantly based on Fisher's Protected LSD) (P=.05).

Table 28. Efficacy for *Pseudomonas cichorii* on Chrysanthemum (*Chrysanthemum/ Dendrathema* sp) 'Shasta Improved', Norman, 2012.

Treatment	Rate per 100 Gal	Application Dates	No. of Lesions [x] 6/6/12
A14658C	4 pt	May 24, 31	15.2 cd
Insimmo drench	0.25 oz	May 10	13.9 bc
Insimmo spray	0.50 oz	May 17, 24, 31	14.9 cd
Insimmo spray	0.75 oz	May 17, 24, 31	12.7 bc
CG100	38.4 fl oz	May 24, 31	20 e
Citrex	150 ml/100 L	May 17, 24, 31	2.2 a
CuPro TNO	2 lb	May 24, 31	1.6 a
HM-0736	14.4 fl oz	May 17, 24, 31	14 bc
Kasumin	64 floz	May 24, 31	3 a
NAI-4201 drench	5 fl oz	May 17, 31	12.9 bc
Regalia	1% v:v	May 24, 31	17.7 de
ZeroTol	128 fl oz	May 31	10.4 b
Untreated uninoculated	-	-	0 a
Untreated inoculated	-	-	16.1 cd

11-006-Norman

[x] Means followed by same letter do not differ significantly based on Fisher's Protected LSD) (P=.05).

Table 29. Efficacy for *Pseudomonas cichorii* on Chrysanthemum (*Chrysanthemum/ Dendrathema* sp.) 'Sparkling Cheryl Yellow', Norman, 2017.

Treatment	Rate per 100 Gal	Application Dates	No. of Lesions [x]	Phytot. [y]
BlightBan (*Pseudomonas fluorescens* A506)	5.3 oz	July 3, 10, 17	3.9 cd	0
BloomTime(*Pantoea agglomerans* strain E325)	5.3 oz	July 3, 10, 17	2.5 bc	0
BW165N (*Ulocladium oudemansii* strain U3)	3 lb	July 3, 10, 17	5.9 d-g	0
CuPro (copper hydroxide)	2 lb	July 3, 10, 17	0.4 ab	0
GC Pro (hydrogen dioxide)	50 oz	July 3, 10, 17	10.6 h	1
	150 oz	July 3, 10, 17	21.6 i	2
KleenGrow (didecyl dimethyl ammonium chloride)	13.0 fl oz	July 3, 10, 17	6.4 efg	0
MBI-110 (*Bacillus amyloliquifaciens* strain F727)	1 gal	July 3, 10, 17	5.0 de	0
OxiPhos (mono and di potassium salts of phosphorus acid + hydrogen peroxide)	42 fl oz	July 3, 10, 17	7.0 efg	1
	128 fl oz	July 3, 10, 17	7.9 fg	2
Triathlon BA (*Bacillus amyloliquefaciens* Strain D747)	6 qt	July 3, 10, 17	5.8 def	0
ZeroTol 2.0 (hydrogen dioxide+peroxyacetic acid)	2 gal	July 3, 7, 13, 17	3.8 cd	0
Untreated uninoculated	-	-	0.0 a	0
Untreated inoculated	-	July 5	8.2 g	0
Second Test				
TDA 02 Part A + Part B	100g + 300ml	Oct 9	7.3 c	1
TDA 02 Part A + Part B	200g + 600ml	Oct 9	5.5 c	2
Untreated uninoculated	-	-	0.0 a	0
Untreated inoculated	-	Oct 9	3.1 b	0

[x] Means followed by same letter do not differ significantly based on Fisher's Protected LSD) (P=.05). Data recorded on 7/24/17 for Test 1, and on 10-16-17 for Test 2.

[y] Phytotoxicity, marginal leaf burn (0 = no damage, 1 = 1 - 10%, 2 = 11 – 20%, 3 = 21 – 30%, 4 = 31 – 40%, 5 = 41 – 50%, 6 = 51 – 60%, 7 = 61 – 70%, 8 = 71 – 80%, 9 = 81 – 90%, 10 = 91 - 100%).

In 2006 and 2007, Strandberg examined efficacy of several products for control of *Pseudomonas cichorii* on hibiscus *(Hibiscus rosa-sinensis*) and oak leaf hydrangea *(Hydrangea quercifolia*). All treatments were applied as foliar sprays at 14-day intervals during May through early November in a 2006 experiment and at 7-day intervals during June through September in the 2007 experiment. In the 2006 experiment, Actinovate + Tricon was the only treatment that consistently suppressed *P. cichorii* on both plants, but the levels of disease were not always significantly different than the controls or from other treatments (Table 30 and Table 32). In 2007, Kasumin + Kocide and Tricon alternated with Phyton significantly reduced a slight to moderate *P. cichorii* severity (AUDPC) on hibiscus; other treatments somewhat reduced disease, though not significantly (Table 31). On oak leaf hydrangea, no treatment significantly reduced a moderate to severe *P. cichorii* severity (Table 33). No phytotoxicity was found on any treatment in both experiments.

Table 30. Efficacy for *Pseudomonas cichorii* on Hibiscus (*Hibiscus rosa-sinensis*), Strandberg, FL, 2006.

Treatment	Rate per 100 Gal	AUDPC[1] Percent LAD	Last[2] Percent LAD	AUDPC[3] Percent Infected	Last[4] % leaves Infected
Actinovate + Tricon	12 oz + 0.4 %	64.8 a	1.4	24.1	50.0
BioPhos + Chelated copper	2 % + 0.2 lb ai	141.1 bc	2.5	25.9	67.5
Cease + Kocide 2000+ Vital	1 % + 3 lb + 8 pt	93.2 ab	2.6	21.1	52.5
HM-0736	58 fl oz	110.2 bc	2.0	23.4	52.5
Kasumin	64 fl oz	155.2 c	2.0	25.2	55.0
Kocide 2000	3.5 lb	112.0 bc	2.7	25.2	57.5
K-Phite	5 qt	126.7 bc	1.6	24.4	50.0
Tanos 50% WG + Kocide 2000	16 oz + 3 lb	145.7 c	2.3	27.7	70.0
Untreated	-	132.4 b	2.0	28.0	57.5

00-000-Strandberg-2

Means followed by the same letter do not differ significantly based on Student-Newman-Keuls Test (P = 0.05).

[1] Calculated mean area under the disease progress curves in arbitrary units for percent leaf area damaged (LAD).

[2] Percent LAD on last sampling day.

[3] Calculated mean area under the disease progress curves in arbitrary units for percent of leaves infected.

[4] Percent of leaves infected on last sampling day.

Table 31. Efficacy for *Pseudomonas cichorii* on Hibiscus (*Hibiscus rosa-sinensis*), Strandberg, FL, 2007.

Treatment	Rate per 100 Gal	AUDPC[1] Percent LAD	Last[2] Percent LAD	AUDPC[3] Percent Infected	Last[4] % leaves Infected
BioPhos + Chelated copper	2 % + 0.1 lb ai	31.84 ab	0.38	20.40 ab	0.12
Kasumin + Kocide 3000	64 fl oz + 2 lb	6.02 a	0.20	22.68 ab	0.07
Kocide 3000	2 lb	22.34 ab	0.35	28.54 ab	0.08
K-Phite + Tricon	2 qt + 0.4 %	29.98 a	0.75	19.37 ab	0.12
Phyton 27	25 oz	18.72 ab	0.93	35.73 ab	0.15
Tanos + Kocide 3000	8 oz + 2 lb	30.94 ab	0.67	40.55 ab	0.10
Tricon	0.8 %	14.06 ab	0.37	28.08 ab	0.10
Tricon alt. Phyton	0.8 % + 25 oz	33.02 ab	0.25	14.91 a	0.05
Untreated	-	39.62 b	1.07	40.13 b	0.20

07-022-Strandberg-1

Means followed by the same letter do not differ significantly based on Student-Newman-Keuls Test (P = 0.05.

[1] Calculated mean area under the disease progress curves in arbitrary units for percent leaf area damaged (LAD).

[2] Percent LAD on last sampling day.

[3] Calculated mean area under the disease progress curves in arbitrary units for percent of leaves infected.

[4] Percent of leaves infected on last sampling day.

Table 32. Efficacy for *Pseudomonas chickorii* and an unknown *Xanthomonas* spp. on Oak Leaf Hydrangea (*Hydrangea quercifolia*), Strandberg, FL, 2006.

Treatment	Rate per 100 Gal	AUDPC[1] Percent LAD	Last[2] Percent LAD	AUDPC[3] Percent Infected	Last[4] % leaves Infected
Actinovate + Tricon	12 oz + 0.4 %	346.6 a	2.20	66.7 a	77.5
BioPhos + Chelated copper	2 % by volume 0.2 lb ai	499.4 b	3.50	75.0 ab	85.0
Cease + Kocide 2000 + Vital	1 % + 3 lb + 8 pt	641.2 bc	5.90	79.3 ab	95.0
HM-0736	58 fl oz	657.7 bc	5.10	80.2 b	87.5
Kasumin	64 fl oz	612.1 bc	5.30	81.63 b	90.0
Kocide 2000	3.5 lb	541.9 bc	5.30	75.3 ab	87.5
K-Phite	5 qt	653.7 bc	2.90	78.6 ab	87.5
Tanos + Kocide 2000	16 oz + 3 lb	676.8 bc	5.70	79.0 ab	92.5
Untreated	-	707.4 c	4.20	80.7 b	97.5

00-000-Strandberg-3
Means followed by the same letter do not differ significantly based on Student-Newman-Keuls Test (P = 0.05.
[1] Calculated mean area under the disease progress curves in arbitrary units for percent leaf area damaged (LAD).
[2] Percent LAD on last sampling day.
[3] Calculated mean area under the disease progress curves in arbitrary units for percent of leaves infected.
[4] Percent of leaves infected on last sampling day.

Table 33. Efficacy for *Pseudomonas cichorii* and an unknown *Xanthomonas* spp. on Oak Leaf Hydrangea (*Hydrangea quercifolia*), Strandberg, FL, 2007.

Treatment	Rate per 100 Gal	AUDPC[1] Percent LAD	Last[2] Percent LAD	AUDPC[3] Percent Infected	Last[4] % leaves Infected
BioPhos + Chelated copper	2 % + 0.1 lb ai	218.05	3.38	179.04	63.3
Kasumin + Kocide 3000	64 fl oz + 2 lb	225.28	2.78	168.92	55.0
Kocide 3000	2 lb	228.06	2.83	204.69	50.0
K-Phite + Tricon	2 qts + 0.4 %	255.55	3.59	194.21	56.7
Phyton	25 oz	257.83	3.22	222.31	55.0
Tanos + Kocide 3000	8 oz + 2 lb	210.67	2.71	168.38	53.8
Tricon	0.8 %	196.76	1.72	188.79	46.7
Tricon alt. Phyton	0.8 % +25 oz	244.89	3.55	250.35	61.7
Untreated	-	231.78	3.37	239.91	58.3

07-022-Strandberg-2
Means followed by the same letter do not differ significantly based on Student-Newman-Keuls Test (P = 0.05.
[1] Calculated mean area under the disease progress curves in arbitrary units for percent leaf area damaged (LAD).
[2] Percent LAD on last sampling day.
[3] Calculated mean area under the disease progress curves in arbitrary units for percent of leaves infected.
[4] Percent of leaves infected on last sampling day.

In 2009, Chase examined impact of several products for preventative control of *Pseudomonas sp.* on lavender (*Lavandula heterophylla)*. Treatments were applied as weekly foliar spray (to drip) on Jan 26, Feb 2, 9, and 16, or drench on Jan 26 and Feb 9. Rooted cuttings developed leaf blight before inoculation and no inoculation was performed. Tanos + Kocide was the only treatment that significantly reduced number of infected leaves (Table 34). Most products failed to give any prevention of Pseudomonas leaf blight in this experiment. The fact that the plants were asymptomatic when the experiments started but

clearly were infected dramatically affected the results. Acibenzolar, Citrex and Kasumin caused significant loss of top grade (poorer quality) due to phytotoxicity compared to all other treatments. These products also caused significantly reduced plant height.

Table 34. Efficacy for Pseudomonas Leaf Spot (*Pseudomonas* sp.) on Lavender (*Lavandula heterophylla*), 'Patriot Bright Red', Chase, CA, 2009.

Treatment	Rate per 100 Gal	No. Infected Leaves 2-10-09	No Infected Leaves 2-23-09	Top Grade 2-24-09	Height (cm) 2-24-09
Acibenzolar	0.75 oz	4.7 a	3.9 b	3.7 c	13.7 b
Citrex + Latron B 1956	1.5 ml/L + 4 oz	3.8 a	3.3 b	3.2 b	10.1 a
Kasumin	45 fl oz	13.6 b	20.3 c	2.5 a	9.6 a
Phyton 27	50 oz	3.8 a	3.2 b	3.8 d	14.2 bc
Regalia SC + Nu-Film P	1% + 0.02%	2.1 a	2.4 b	4.0 d	15.2 bcd
SP-2015	12 oz	2.8 a	3.5 b	4.0 d	14.3 bc
Taegro - Drench	3.5 oz	2.0 a	1.7 b	4.0 d	16.6 d
Tanos + Kocide 3000	8 oz + 32 oz	1.9 a	1.3 a	4.0 d	15.4 cd
Untreated uninoculated	-	2.6 a	1.9 b	3.9 d	16.0 d
Untreated inoculated	-	2.4 a	2.3 b	4.0 d	15.7 cd

In 2010, Chase examined impact of several products for preventative control of *Pseudomonas* sp. on Bolivian jasmine (*Mandevilla boliviensis)*. All treatments were applied as weekly foliar sprays except Acibenzolar and NAI-4201 applied as drench, with 28- and 14-day intervals, respectively. Also, Taegro was applied as alternate spray/drench every 14 days. Initial treatments were applied on Mar 29, with additional applications occurring on Apr 5, 12, 19, 26, and May 3. Plants were inoculated on Apr 17. Kasumin was the best treatment, providing excellent control of Pseudomonas leaf spot (Table 35). Acibenzolar as a drench or spray, HM-0736, NAI-4201, Phyton 27 and Tanos + CuPRO significantly reduced number of leaf spots; CG100, Citrex, Protect, Regalia, Tanos alone and Taegro did not give significant control. There were a few treatments that resulted in a very high level of prevention of vine infection including: Kasumin, Phyton 27 and Tanos + CuPRO; Acibenzolar foliar, CG100, Citrex, Protect and Regalia also significantly reduced vine infection. Protect and Tanos + CuPRO showed significantly more residue than the water treated controls. Kasumin significantly reduced vine length.

Table 35. Efficacy for Pseudomonas Leafspot (*Pseudomonas* sp.) on Bolivian Jasmine (*Mandevilla boliviensis*)'Alice DuPont', Chase, CA, 2010.

Treatment	Rate per 100 Gal	Residue 4-15-10	Vine Length (cm) 4-22-10	Disease Severity[y] 5-7-10	Residue[z] 5-7-10	Vine Length (cm) 5-12-10	No Spots Leaves 5-12-10	No. Spots Vines 5-12-10
Acibenzolar – foliar	1 oz	1.6 ab	15.4 a	1.8 bc	2.1 a	44.9 b	13.3 ab	2.5 a
Acibenzolar – drench	0.25 oz	1.5 ab	19.6 a	2.0 bcd	2.0 a	49.2 b	12.5 ab	5.8 ab
CG100	0.3 %	2.2 c	19.0 a	2.2 bcd	2.0 a	46.7 b	22.1 bc	2.1 a
Citrex	150 ml/100 L	1.7 abc	20.2 a	2.0 bcd	2.0 a	50.7 b	20.4 bc	2.9 a
HM-0736	14.4 fl oz	2.0 bc	19.0 a	1.7 b	2.1 a	46.8 b	15.0 ab	6.2 ab
Kasumin	45 fl oz	1.6 ab	14.7 a	1.0 a	2.1 a	16.3 a	1.2 a	0.1 a
NAI-4201 – drench	5 fl oz	1.4 ab	18.2 a	2.0 bcd	2.2 a	50.0 b	13.7 ab	5.8 ab
Phyton 27	25 oz	1.7 abc	19.3 a	2.6 d	2.0 a	50.9 b	13.3 ab	0.4 a
Protect	1.5 lb	4.5 e	17.2 a	2.1 bcd	4.1 c	45.7 b	19.6 bc	1.2 a
Regalia	1 %	1.6 ab	20.3 a	1.6 b	2.0 a	45.1 b	18.7 bc	2.9 a
Tanos	12 oz	1.7 abc	20.8 a	2.0 bcd	2.1 a	45.8 b	20.8 bc	4.2 ab
Tanos + CuPRO	8 oz + 2 lb	3.5 d	18.9 a	1.0 a	3.0 b	51.6 b	9.6 ab	0.4 a
Taegro	3.5 oz spray/drench alt.	2.2 c	19.6 a	2.2 bcd	2.1 a	45.8 b	23.5 bc	4.6 ab
Untreated non-inoculated	-	1.3 a	20.4 a	1.0 a	2.0 a	54.1 b	0.0 a	0.0 a
Untreated inoculated	-	1.6 ab	25.0 a	2.4 cd	2.0 a	61.7 b	32.1 c	10.4 b

[y] Scale: 1-5 where 1 – no spots, 2 – slight, 3 – moderate, 4 – severe to 5 – plant dead.
[z] Scale: 1-5 where 1 – no spots, 2 – slight, 3 – moderate, 4 – severe to 5 – plant completely covered in residue.

In 2011, Norman examined the efficacy of various products for preventative control of *Pseudomonas syringiae* pv. *hibiscus* (strain X1720) on hibiscus (Table 36). Treatments were applied as foliar sprays (to runoff) or drench; disease inoculation occurred on Sep 19. Number of leafspots per plant were counted on Oct 4. Because of high variability within treatments, no significant differences in number of leafspots were obtained except with NAI-4201 which appeared to enhance disease development. Eight treatments had substantially less lesion development than the disease control and they included Acibenzolar (spray), CG100, Citrex, Kasumin, Regalia, Protect, CuPro, and EarthTec at the highest rate. No phytotoxicity was found on any treatment except the high rate of EarthTec (chlorosis and leaf drop) and Acibenzolar drench (lighter green plants).

Table 36. Efficacy for Pseudomonas Leafspot (*Pseudomonas syringiae* pv. *hibiscus*) on Hibiscus (*Hibiscus* sp) 'Double Red', Norman, 2011.

Treatment	Rate per 100 Gal	Application Method	Application Date(s)	No. of Leafspots[x] 10-4-11
Acibenzolar	0.75 oz	Foliar	9/8,9/15,9/22,9/29	1.0 a
Acibenzolar	0.25 oz	Drench	8/30	3.7 a
CG100	0.3 %	Foliar	9/22,9/29	0.8 a
Citrex	150 ml/100 L	Foliar	9/8,9/15,9/22,9/29	1.2 a
CuPRO TNO	2 lb	Foliar	9/22,9/29	0.3 a
EarthTec	1.5 fl oz	Foliar	9/22,9/29	3.1 a
EarthTec	8 fl oz	Foliar	9/22,9/29	0.0 a
HMO-0736	14.4 fl oz	Foliar	9/8,9/15,9/22,9/29	4.6 a
Kasumin	45 fl oz	Foliar	9/22,9/29	0.0 a
NAI-420	5 fl oz	Drench	8/30,9/6,9/20	15.7 b
Protect	2 lb	Foliar	9/22,9/29	0.0 a
Regalia	1 % v:v	Foliar	9/22,9/29	1.2 a
ZeroTol	128 fl oz	Foliar	9/22,9/29	4.0 a
Untreated non-inoculated	-	-	-	0.0 a
Untreated inoculated	-	-	-	3.6 a

[x] Means followed by same letter do not differ significantly based on Fisher's Protected LSD (P=.05).

In 2012, Norman examined the efficacy of various products for preventative control of *Pseudomonas syringae* on impatiens. Treatments were applied as foliar sprays (to runoff) or drenches; disease inoculation occurred on May 29. Number of leafspots per plant were counted on Jun 6. Acibenzolar provided the most effective control of leaf spots, followed by the standard CuPro, Kasumin, HM-07361, Regalia and NAI-4201 (Table 37). Plants were stunted and chlorotic with the Citrex treatment as well as both spray applications of Actigard. No chlorosis or stunting was observed with the drench application of Actigard. There also appeared to be an abnormally high number of leaf abscission with plants treated with A14658C.

Table 37. Efficacy for Pseudomonas Leafspot (*Pseudomonas syringae*) on Impatiens (*Impatiens* sp) 'Super Elfin XP Violet Improved', Norman, 2012.

Treatment	Rate per 100 Gal	Application Method	Application Date(s)	No. of Leafspots [x] 6-6-12
A14658C	4 pt	Foliar	5/24, 5/31	20.1 g
Acibenzolar	0.5 oz	Foliar	5/17, 5/24, 5/31	1.3 ab
Acibenzolar	0.75 oz	Foliar	5/17, 5/24, 5/31	0.8 ab
Acibenzolar	0.25 oz	Drench	5/10	0.8 ab
Cg100	38.4 fl oz	Foliar	5/24, 5/31	21.8 g
Citrex	1.5 ml/L	Foliar	5/17, 5/24, 5/31	19.7 g
CuPro TNO	2 lb	Foliar	5/24, 5/31	4.2 bc
HM-07361	14.4 fl oz	Foliar	5/17, 5/24, 5/31	7.1 cd
Kasumin	64 fl oz	Drench	5/24, 5/31	5.6 c
NAI-4201	5 fl oz	Drench	5/17, 5/31	11 e
Regalia	1% v:v	Foliar	5/24, 5/31	9.4 de
ZeroTol	128 fl oz	Foliar	5/31	12.2 ef
Untreated non-inoculated	-	-	-	0 a
Untreated inoculated	-	-	-	14.8 f

[x] Means followed by same letter do not differ significantly based on Fisher's Protected LSD (P=.05).

Pscheidt conducted field experiments in 2005, 2011 and 2012 to determine efficacy of several products applied as foliar sprays for preventative control of bacterial blight (*Pseudomonas syringae* pv *syringae*) on lilac (*Syringa vulgaris*) 'Ellen Willmott'. In 2005, treatments were applied on Feb 14, Mar 1, 15, and 30 (from bud swell to early bloom). On Apr 11, all bactericide treated bushes had significantly fewer shoots with bacterial blight than nontreated bushes (Table 18). On Apr 28, only bushes treated with Kocide or Phyton 27 had significantly fewer shoots with bacterial blight than nontreated bushes. There was no significant difference in the number of shoots with bacterial blight on bushes treated with Phyton 27 or STBX-304. In 2011, treatments were applied on Mar 3, 11, 18, 24, and 31 (from bud swell to 6 inch shoot growth). Inoculated nontreated bushes did not have significantly more disease than uninoculated bushes, indicating plenty of natural inoculum (Table 39). Kasumin and Nu-Cop provided the best control, resulting in more vigorous plants. A91800A, Aliette, Citrex, HM-0736, CG100 and Regalia did not significantly reduce disease. In 2012, treatments were applied on Mar 16 (buds swollen), Mar 23 (bud break to half inch growth), Apr 1 (2 to 3 inch growth), Apr 5 (3 inch growth), and Apr 17 (beginning of bloom). Untreated, uninoculated bushes were diseased indicating plenty of natural inoculum. Aliette, Camelot and ZeroTol provided the best control; A14658C, CG100, KleenGrow and Regalia were not significantly different from either the inoculated or the uninoculated bushes (Table 40). In both experiments, no phytotoxicity was found on any treatment.

Table 38. * Efficacy for Bacterial Blight (*Pseudomonas syringae* pv *syringae*) on Lilac (*Syringa vulgaris*) 'Ellen Willmott', Pscheidt, OR, 2005.

Treatment	Rate per 100 Gal	% Infected Shoots[x]	
		4-11-05	4-28-05
Junction DF	3.0 lb	12.8 b	14.3 ab
Kocide 2000	1.5 lb	14.0 b	4.5 b
Phyton 27	25 fl oz	7.8 b	10.5 b
STBX-304	25 fl oz	20.3 b	13.0 ab
Untreated	-	37.8 a	24.5 a

* Not an IR-4 Experiment: F&N Tests Vol 61: OT031.

[x] Means followed by the same letter do not differ significantly based on Fisher's protected LSD *(P*=0.05).

Table 39. Efficacy for Bacterial Blight (*Pseudomonas syringae* pv *syringae*) on Lilac (*Syringa vulgaris*) 'Ellen Willmott', Pscheidt, OR, 2011.

Treatment	Rate per 100 Gal	Percent Diseased Shoots[x]			Shoots/Bush With ≥ 50 % Blighted Leaves		Change in Plant Ht (cm)
		4/5/11	4/22/11	5/5/11	4/22/11	5/5/11	
A91800A WG	1 oz	21.0 a	78.3 a	94.3 a	30.0 a	72.3 a	12.0 c
Aliette	12.8 oz	12.3 a	30.0 bcd	70.8 b	6.5 cd	30.0 cd	20.0 bc
CG100	38.4 fl oz	17.0 a	49.0 abc	93.8 a	17.0 a-d	58.8 ab	13.3 c
Citrex	18.2 fl oz	19.3 a	58.3 ab	97.5 a	27.5 ab	74.5 a	9.5 c
HM-0736	14.4 fl oz	13.5 a	56.5 ab	93.8 a	24.3 abc	56.8 abc	11.0 c
Kasumin	45 fl oz	1.8 a	18.3 cd	32.0 c	2.3 d	12.0 d	37.5 a
	64 fl oz	4.5 a	8.5 d	21.3 c	1.5 d	6.0 d	33.3 ab
Nu-Cop 50 DF	1 lb	25.5 a	35.8 bcd	31.5 c	8.0 cd	12.3 d	39.5 a
Regalia	1 gal	20.3 a	74.3 a	96.5 a	31.3 a	66.5 ab	4.5 c
Untreated, non-inoculated	-	12.5 a	48.5 abc	86.5 ab	16.5 a-d	47.5 abc	7.0 c
Untreated, inoculated	-	15.5 a	46.5 abc	80.0 ab	11.8 bcd	41.3 bc	9.0 c

[x] Means followed by the same letter do not differ significantly based on Fisher's protected LSD *(P*=0.05).

Table 40. Efficacy for Bacterial Blight (*Pseudomonas syringae* pv *syringae*) on Lilac (*Syringa vulgaris*) 'Ellen Willmott', Pscheidt, OR, 2012.

Treatment	Rate per 100 Gal	Percent Diseased Shoots[x]		Shoots/Bush With ≥ 50 % Blighted Leaves		Change in Plant Ht (cm)
		4/20/12	5/4/12	4/20/12	5/4/12	
A14658C	64 fl oz	63.8 abc	40.6 a	3.0 a	6.4 a	22.4 a
Aliette	12.8 oz	27.8 c	30.2 a	0.0 a	2.8 a	30.5 a
Camelot	2 gal	29.0 c	31.4 a	1.4 a	1.6 a	34.0 a
CG100 (AMV-4024)	38.4 fl oz	54.0 abc	39.6 a	3.6 a	9.0 a	30.5 a
KleenGrow	25 fl oz	62.2 abc	48.0 a	9.8 a	12.4 a	27.4 a
Regalia	1 gal	43.0 abc	36.6 a	2.4 a	8.6 a	27.9 a
ZeroTol	128 fl oz	24.4 c	30.6 a	1.4 a	4.8 a	18.3 a
Untreated, uninoculated	-	53.0 abc	45.0 a	4.6 a	6.2 a	22.9 a
Untreated, inoculated	-	70.6 a	59.4 a	13.8 a	11.4 a	30.0 a

[x] Means followed by the same letter do not differ significantly based on Fisher's protected LSD *(P*=0.05).

In 2008-09, Regan evaluated efficacy of several products for preventative control of a natural infection of *Pseudomonas syringae* on Japanese maple (*Acer palmatum*). All treatments except Taegro were applied as six weekly foliar sprays from Oct 15 to Nov 19, 2008; Taegro was applied as spray alternated with drench application every 14 days from Oct 1 to Dec 10, 2008. Based on percent plants showing stem cankers, no treatment significantly reduced disease infection (Table 30). Overall, the disease infection level was about 28 percent of the trees, which is very similar to the level expected under typical nursery conditions in western Oregon. No phytotoxicity was found on any treatment.

Table 41. Efficacy for *Pseudomonas syringae* on Japanese Maple (*Acer palmatum*) trees, Regan, OR, 2008-09.

Treatment	Rate per 100 Gal	Percent trees with visible cankers[x] 4-9-09
Acibenzolar	1 oz	8.3 a
Cease	2% solution	16.7 ab
Citrex	150 ml/100 L	50.0 bc
Kasumin	45 fl. oz	33.3 abc
Kocide	2 lb	0.0 a
Protect	2 lb	58.3 c
Tanos	12 oz	50.0 bc
Taegro*	3.5 oz	33.3 abc
Tanos+Kocide	8 oz. + 2 lb	0.0 a
Untreated non-inoculated	-	25.0 abc

[x] Means followed by the same letter do not differ significantly based on Fisher's protected LSD *(P*=0.05).
* Spray alternated with drench application every 14 days from 10-1-08 to 12-10-08.

In 2011, Pscheidt conducted a field experiment to determine the efficacy of various products for preventative control of bacterial blight (*Pseudomonas syringae* pv. *syringae*) on Japanese maple (Table 42). Treatments were applied on Apr 1, 7, 16, 21, May 1 and 6 (from bud break to 10 inch shoot growth), and inoculated on Apr 13. Unfortunately, no disease developed and plant height change was not significant between treatments (Table 42). Trees treated with either rate of Kasumin developed a washed, light red color more typical of sun bleaching in the summer. These trees clearly stood out from the normal deep burgundy color typical of this cultivar. No phytotoxicity was found on other treatments.

Table 42. Efficacy for Bacterial Blight (*Pseudomonas syringae* pv. *syringae*) on Japanese Maple (*Acer palmatum*) 'Bloodgood', Pscheidt, OR, 2011.

Treatment	Rate per 100 Gal	Change in Plant Ht (cm)[x]
91800A WG	1 oz	9.3 a
Aliette	12.8 oz	15.3 a
CG100	38.4 fl oz	12.0 a
Citrex	18.2 fl oz	3.0 a
HM-0736	14.4 fl oz	9.8 a
Kasumin	45 fl oz	9.0 a
	64 fl oz	7.0 a
Nu-Cop 50 DF	1 lb	10.3 a
Regalia	1 gal	1.5 a
Untreated, uninoculated	-	8.3 a
Untreated, inoculated	-	7.5 a

[x] Means followed by the same letter do not differ significantly *(P*=0.05).

Comparative Efficacy on Xanthomonas species

The tables below contain a general summary of *Xanthomonas* efficacy. While there were many experiments conducted, experimental products were included in very few experiments; hence more experiments are needed to make definitive conclusions. Most experimental products, including Acibenzolar, CG100, Citrex, HM-0736, Kasumin, MBI 110, Tanos, Taegro, and TDA01 may prove promising based on their efficacy compared to standards. See the discussion and data of individual experiments for more details.

Table 43. General summary of efficacy for *Xanthomonas* spp. on various crops – Part 1.

	Geranium											
Product	**Buck 2003***	**Norman 2006a**	**Norman 2006b**	**Norman 2006c**	**Norman 2007a**	**Norman 2007b**	**Norman 2007c**	**Chase 2008**	**Reddy 2009**	**Norman 2009a**	**Norman 2009b**	**Norman 2016**
Acibenzolar								++	+		++	
Actinovate			+/-				-				-	
Alexin						+/-						
ASAP					+							
BlightBan												+/-
Bloomtime							-					+/-
BMJ							-					
Camelot		+			++							
Cankerkill						+/-						
CG100									+		-	
Cease	+						-			-		
Cease + Actinovate			-									
Cease + Citrex										-		
Cease + Kocide 2000			++									
Cease + KPhite			+									
Cease + Milstop										-		
Cease + Penncozeb			++									
Cease + Phyton 27	+		+									
Cease + Tricon										+		
Cease + Vital				-								
Citrex								+/-	+	+	++	
Companion			++				-					
CuPRO										+	++	+
CuProfix		+			++							
CuProfix MZ					++							
GC Pro												+/-
HM-0736				-					+		-	
HM-0736 + Kocide 2000				++								
HM-0736 + KPhite				-								
HM-0736 + Penncozeb				-								
HM-0736 + Phyton				++								
Junction		+			++							
Kasumin			-			-		-	+		-	
Kasumin + Kocide 2000			++									

Product	Geranium											
	Buck 2003*	**Norman 2006a**	**Norman 2006b**	**Norman 2006c**	**Norman 2007a**	**Norman 2007b**	**Norman 2007c**	**Chase 2008**	**Reddy 2009**	**Norman 2009a**	**Norman 2009b**	**Norman 2016**
Kocide 2000		+										
Kocide 3000					+							
KPhite				-								
KPhite + Kocide 2000				++								
KPhite + Penncozeb				++								
KPhite + Phyton				++								
MBI 110												+/-
Milstop										-		
NAI-4201											-	
Omega-Grow Plus						+/-						
Oxiphos												+/-
Penncozeb		+			++							
Phyton 27	+		+				+	+				
Prophytex EC												+/-
Prophytex WP												+/-
Regalia								-			++	
Tanos						-		-	+		-	
Tanos + CuPRO		++						++	+		++	
TDA01												+
Taegro								+/-	+	-	-	
Taegro + Milstop										-		
Triathlon												+/-
Tricon						-				+		
Vital				++		-					++	
Vitalonil												
ZeroTol 2.0												+/-

* Not an IR-4-sponsored experiment.

[1] Rating Scale: ++ = clearly statistically equivalent or better than untreated non-inoculated and/or clearly statistically different than untreated inoculated; + = statistically different from untreated inoculated and untreated non-inoculated; +/- statistically equivalent to both untreated inoculated and untreated non-inoculated; - = statistically equivalent to untreated inoculated. For experiments without non-inoculated check, efficacy determined on author's conclusions, % control or comparisons to standard product(s).

[2] Where more than one rate or application type for a product was included in the experiment and each performed statistically different, the better rating is provided in this table.

[3] Inconclusive data due to extremely low disease incidence

Table 44. General summary of efficacy for *Xanthomonas* spp. on various crops – Part 2.

Product	Ornamental Kale		Japanese Plum		Poinsettia	Wax Myrtle	
	Becker 2008		Strandberg 2006	Strandberg 2007	Norman 2011	Strandberg 2006	Strandberg 2007
	'Nagoya Rose'	White Crane'					
Acibenzolar	++	+/-			++		
Aliette	+	+/-					
Cease	+	+/-					
CG100					-		
Champ	+	-					
Citrex	+	-					
CuPro, Kocide	+	+	-	-	+	+	-
Dithane, Protect	+	-			++		
HM-0736			-		+	-	
Kasumin	+	+/-	-		-	-	
Kasumin + Kocide				-			-
NAI-4201					-		
Phyton 27				-			-
Regalia					-		
Tanos	+	-					
Tanos + Kocide	+	-	-	-		-	-
Taegro	+	-					
ZeroTol					-		

[1] Rating Scale: ++ = clearly statistically equivalent or better than untreated non-inoculated and/or clearly statistically different than untreated inoculated; + = statistically different from untreated inoculated and untreated non-inoculated; +/- statistically equivalent to both untreated inoculated and untreated non-inoculated; - = statistically equivalent to untreated inoculated. For experiments without non-inoculated check, efficacy determined on author's conclusions, % control or comparisons to standard product(s).

[2] Where more than one rate or application type for a product was included in the experiment and each performed statistically different, the better rating is provided in this table.

[3] Inconclusive data due to extremely low disease incidence

In 2003, Buck evaluated Phyton 27 and Cease AS for preventative control of *Xanthomonas campestris* on geranium (*Pelargonium x hortorum*)'Patriot Cranberry Red'. Treatments were applied as foliar spray (to drip) two days before and 5 days after inoculation. Both treatments significantly reduced number of lesions per leaf 15 days post-inoculation (Table 45). The combination also reduced infection but the number of lesions was not statistically different from Cease or Phyton 27 applied alone. No phytotoxicity was found on any treatment.

Table 45. * Efficacy for Bacterial Spot (*Xanthomonascampestris*) on Geranium (*Pelargonium x hortotum*) 'Patriot Cranberry Red', Buck, GA, 2003.

Treatment	Rate per 100 Gal	No. Lesions per leaf [x]
Phyton-27	25 oz	83.1 a
Cease AS	1.0 gal	79.3 a
Cease + Phyton-27	1.0 gal + 25 oz	83.5 a
Untreated inoculated	-	149.6 b

* Not an IR-4 Experiment: F&N Tests Vol 60: OT010.

[x] Means followed by the same letter do not differ significantly based on Fisher's Protected LSD(P=0.05).

In 2006, Norman conducted three experiments to determine efficacy of new products and product combinationsfor control of Xanthomonas leaf spot (*Xanthomonas* sp.) on geranium **(***Pelargonium x hortorum*) 'Patriot Bright Red' (Table 46 through Table 48). All treatments were applied twice as weekly foliar spray (to drip). Plants were inoculated with a culture of *Xanthomonas* sp. 3 days after the first fungicide application. The most effectivetreatments were products that contained copper hydroxide (Camelot, CuPro/Kocide, Cuprofix, Junction, Phyton 27), copper sulfate, and mancozeb. Biologicals including Actinovate, Companion and Cease, and some of the antibiotics including Firewall, were also effective. HM-0736, Kasumin and K-Phite were not effective. Further research is needed to determine other combinations and rotations of products that would be effective against bacterial pathogens. Due to the high temperature in Florida during these experiments (100ºF+), all copper containing products as well as Cease and Companion caused some marginal burning of leaves. This may not have occurred in cooler temperatures.

Table 46. Efficacy for Xanthomonas leaf spot (*Xanthomonas* sp.) on Geranium (*Pelargonium x hortorum*) 'Patriot Bright Red' – Test 1, Norman, FL, 2006a.

Treatment	Rate per 100 Gal	Number of Leaf Spots[x]
Camelot	3 pt	59 bcd
Cuprofix	1.5 lb	77 cd
Cuprofix MZ	8.75 lb	23 ab
Firewall	200 ppm	45 abc
Junction	1.5 lb	52 bc
Kocide 2000	0.75 lb	67 bcd
Penncozeb	1.5 lb	52 bc
Starner	0.75 %	55 bc
Tanos + Kocide 2000	8 oz + 1 lb	45 abc
Untreated non-inoculated	-	0 a
Untreated inoculated	-	154 e

[x] Means followed by same letter do not differ significantly based on Fisher's Protected LSD (P=.05).

Table 47. Efficacy for Xanthomonas leaf spot (*Xanthomonas* sp.) on Geranium (*Pelargonium x hortorum*) 'Patriot Bright Red' – Test 2, Norman, FL, 2006b.

Treatment	Rate per 100 Gal	Number of Leaf Spots[x]
Actinovate	12 oz	119 cd
Cease	8 qt	128 de
Cease + Actinovate	8 qt + 12 oz	117 bcd
Cease + Kocide	8 qt + 2 lb	41 a
Cease + KPhite	8qt + 2 qt	157 de
Cease + Penncozeb	8qt + 1.5 lb	34 a
Cease + Phyton 27	8 qt + 50 oz	53 ab
Companion	2 %	47 a
Kasumin	2 qt	189 ef
Kasumin+ Kocide 2000	2 qt + 2 lb	56 abc
Phyton 27	50 oz	42 a
Untreated non-inoculated	-	0 a
Untreated inoculated	-	230 f

[x] Means followed by same letter do not differ significantly based on Fisher's Protected LSD (P=.05).

Table 48. Efficacy for Xanthomonas leaf spot (*Xanthomonas* sp.) on Geranium (*Pelargonium x hortorum*) 'Patriot Bright Red' – Test 3, Norman, FL, 2006c.

Treatment	Rate per 100 Gal	Number of Leaf Spots[x]
HM-0736	58 oz	234 d
HM-0736 + Kocide	58 fl oz + 2 lb	29 a
HM-0736 + K-Phite	58 fl oz + 2 qt	163 c
HM-0736 + Penncozeb	58 fl oz + 1.5 lb	137 c
HM-0736 + Phyton	58 fl oz + 50 oz	44 a
K-Phite	2 qt	157 c
K-Phite + Kocide	2 qt + 2 lb	26 a
K-phite +Penncozeb	2 qt + 1.5 lb	46 a
K-Phyte + Phyton	2 qt + 50 oz	53 ab
Vital	2 qt	26 a
Vital + Cease	2 qt + 8 qt	114 c
Untreated non-inoculated	-	0 a
Untreated inoculated	-	120 c

[x] Means followed by same letter do not differ significantly based on Fisher's Protected LSD (P=.05).

In 2007, Norman conducted three additional tests on geranium (Table 49 through Table 51). Results confirmed data obtained in 2006 that showed the most effective treatments were products that contained copper hydroxide, copper sulfate, and mancozeb, including Camelot, Cuprofix, Junction, Kocide, Phyton 27 and Penncozeb. However the biologicals tested in 2007, including Actinovate, BloomTime, Companion and Cease, were not effective. Also other products like Alexin, Canker Kill, Kasumin, Milsana, Omega-Grow Plus, Tanos, Tricon, and Vital were not effective. Due to the high temperature in Florida during these experiments (100ºF+), all copper containing products, as well as Cease and Companion, caused some marginal burning of leaves. This may not have occurred in cooler temperatures.

Table 49. Efficacy for Xanthomonas leaf spot (*Xanthomonas* sp.) on Geranium (*Pelargonium* x *hortorum*) 'Patriot Bright Red' – Test 1, Norman, FL, 2007a.

Treatment	Rate per 100 Gal	Number of Leaf Spots[x]
ASAP	5 ppm	3.9 ab
ASAP	10 ppm	9.2 b
ASAP	30 ppm	4.2 ab
Camelot	3 pt	4.2 ab
Cuprofix	1.5 lb	0.8 a
Cuprofix MZ	8.75 lb	1.7 ab
Junction	1.5 lb	0.4 a
Kocide 3000	0.75 lb	4.9 ab
Penncozeb	1.5 lb	0 a
Untreated uninoculated	-	0 a
Untreated inoculated	-	19 c

[x] Means followed by same letter do not differ significantly based on Fisher's Protected LSD (P=.05).

Table 50. Efficacy for Xanthomonas leaf spot (*Xanthomonas* sp.) on Geranium (*Pelargonium x hortorum*) 'Patriot Bright Red' – Test 2, Norman, FL, 2007b.

Treatment	Rate per 100 Gal	Number of Leaf Spots[x]
Alexin	50ml	24 abc
Canker Kill	1.5 lb	26 abcd
Kasumin	1.5qt	27 bcd
K-Phite	2qt	94 f
Omega-Grow Plus	2%	21 abc
Tanos	8 oz	52 de
Tricon	0.8%	73 ef
Vital	2qt	32 bcd
Untreated uninoculated	-	0 a
Untreated inoculated	-	41 cd

[x] Means followed by same letter do not differ significantly based on Fisher's Protected LSD (P=.05).

Table 51. Efficacy on Xanthomonas leaf spot (*Xanthomonas* sp.) on Geranium (*Pelargonium x hortorum*) 'Patriot Bright Red' – Test 3, Norman, FL, 2007d.

Treatment	Rate per 100 Gal	Number of Leaf Spots[x]
Actinovate	12 oz	173 d
BloomTime	10.5 oz	140 cd
BMJ	100 g	173 d
Cease	0.5 %	91 bc
Companion	0.5%	99 c
	1%	107 cd
Milsana	1%	145 cd
Phyton 27	50 oz	23 ab
Untreated uninoculated	-	0 a
Untreated inoculated	-	130 cd

[x]Means followed by same letter do not differ significantly based on Fisher's Protected LSD (P=.05).

In 2009, Norman continued evaluation of products for preventative control of *Xanthomonas campestris* on geranium. In the first experiment, CuPRO, Cease at the low rate, Tricon, Citrex, Cease + Citrex, and Cease + Tricon significantly reduced number of Xanthomonas leaf spots (Table 52), though not as low as uninoculated Control. Milstop, Taegro and Milstop + Taegro provided no control. In the second

experiment, Acibenzolar, Citrex, CuPro, Regalia and Vitalonil were effective in controlling Xanthomonas (Table 53). Actinovate, CG100, HM-0736, Kasumin, NAI-420, SP-2015 and Taegro provided no control. Cease, Tricon and Vitalonil caused some leaf burn that was probably related to very warm temperatures in the greenhouse (100ºF+). Leaf burn in these cases may not have occurred under cooler weather conditions.

Table 52. Efficacy for Xanthomonas leaf spot (*Xanthomonas campestris*) on Geranium (*Pelargonium x hortorum*) 'Patriot Bright Red',Norman, FL, 2009.

Treatment	Rate per 100 Gal	Number of Leaf Spots[x]
Cease	1 %	165 def
	2 %	201 fg
Cease + Citrex	1 % + 1.2ml/L	158 de
Cease + Milstop	1 % + 1.25 lb	218 gh
Cease + Tricon	1 % + 2 %	64 b
Citrex	1.2 ml/L	151 d
CuPRO	0.75 lb	103 c
Milstop	1.25 lb	246 h
Taegro	3.5 oz	180 defg
Taegro + Milstop	3.5 oz + 1.25 lb	193 efg
Tricon	2%	75 bc
Untreated non-inoculated	-	0 a
Untreated inoculated	-	217 gh

[x] Means followed by same letter do not differ significantly based on Fisher's Protected LSD (P=.05).

Table 53. Efficacy for Xanthomonas leaf spot (*Xanthomonas campestris*) on Geranium (*Pelargonium x hortorum*) 'Patriot Bright Red',Norman, FL, 2009.

Treatment	Rate per 100 Gal	Number of Leaf Spots[x]
Acibenzolar	0.01875 oz	34.7 abc
Actinovate	12 oz	86.2 cde
CG100	0.8 %	97.7 de
Citrex	150 ml/L	8.1 a
CuPRO	2 lb	10.7 a
HM-0736	14.4 fl oz	125.2 e
Kasumin	45 fl oz	85.4 cde
NAI-4201	5 fl oz	69.7 bcd
Regalia SC	1 %	12.3 a
Tanos	12 oz	133.3 e
Tanos + CuPRO	8 oz + 2 lb	8.8 a
Taegro	3.5 oz	116.9 de
Vitalonil	5 pt	22.3 ab
Untreated non-inoculated	-	0 a
Untreated inoculated	-	97.4 de

[x] Means followed by same letter do not differ significantly based on Fisher's Protected LSD (P=.05).

In 2016, Norman continued evaluation of products for preventative control of *Xanthomonas hortorum* pv. *pelargonii* (formerly *X. campestris* pv. *pelargonii*) on geranium. Two experiments were done with identical setup, timing and interval of product evaluation. The first test was setup with all the products where products were applied 24 hr before disease inoculation. The second test was conducted when researcher received notice from the TDA product manufacturers that they would like a disease inoculation 4 hr after product application. Treatments were applied on Jun 14 and 21. All products tested in this study were effective in lowering the amount of leaf spots, with TDA01 and CuPro providing the best control,

though not as low as uninoculated Check (**Table 54**). Note that the ratio between the disease control at 4 hr and TDA (4 hr) was similar to that observed at 24 hr. There were a number of products that caused marginal leaf burn that was probably related to very warm temperatures during testing (+90ºF). Some spray residue was observed with CuPro and Prophytex WP treatments.

Table 54. Efficacy for Xanthomonas leaf spot (*Xanthomonas hortorum* pv. *pelargonii*) on Geranium (*Pelargonium x hortorum*) 'Calliope Crimson Flame', Norman, FL, 2016.

Treatment	Rate per 100 Gal	Number of Leaf Spots[x]
BlightBan	5.3 oz	45.3 de
BloomTime	5.3 oz	48.2 de
CuPro	2 lb	16.6 abc
GC Pro	50 oz	38.2 cde
GC Pro	150 oz	26.9 bcd
MBI-110	1 gal	32.6 b-e
OxiPhos	42 fl oz	49 e
OxiPhos	128 fl oz	35 cde
Prophytex EC	64 fl oz	48.4 de
Prophytex WP	32 oz	48.8 e
TDA01 24 hr	0.4 g	12.9 ab
Triathlon BA	6 quarts	32.3 b-e
USF 2018a	220 ml	43.6 de
USF 0914	575 g	43.2 de
Zerotol 2.0	2 gal	42.5 de
Untreated uninoculated, 24 hr	-	0 a
Untreated inoculated, 24 hr	-	88.2 f
TDA01 4 hr	0.4 g /100gal	3.8 b
Untreated non-inoculated, 4 hr	-	0 a
Untreated inoculated, 4 hr	-	23.2 c

[x] Observed on Jun 29. Means followed by same letter do not differ significantly based on Fisher's Protected LSD (P=0.05).

In 2008, Chase evaluated several new biopesticide products and mixtures with the potential for suppression and control of Xanthomonas leaf spot (*Xanthomonas* sp.) on geranium **(***Pelargonium x hortorum*) 'Patriot Bright Red' (Table 55). All treatments were applied as a foliar spray to drip on Nov 3, 10 and 17, except Taegro which was applied as drench on Nov 3 and 17, alternated with a spray on Nov 10. Based on number of spots three weeks after inoculation (12-1-08), acibenzolar and Tanos + Kocide were the only treatments that significantly reduced Xanthomonas infection. Phyton, Citrex and MOI-106 were also somewhat effective. The products performing poorly in this experiment included Kasumin, SP-2015 and Taegro. Final plant height and top grade were significantly reduced by the presence of Xanthomonas and also by direct phytotoxicity of acibenzolar. The only plants that appeared close to the uninoculated controls in top grade were those receiving the combination of Tanos and Kocide.

Table 55. Efficacy for Xanthomonas leaf spot (*Xanthomonas* sp.) on Geranium (*Pelargonium x hortorum*) 'Patriot Bright Red', Chase, CA, 2008.

Treatment	Rate per 100 Gal	Height (cm) 11-20-08	Top grade[z] 11-20-08	No. spots per plant 11-25-08	No. spots per plant 12-1-08	Height (cm) 12-1-08	Top Grade 12-1-08
Acibenzolar	0.75 oz	10.0 a	2.9 a	0.0 a	0.0 a	9.9 a	2.3 a
Citrex + Latron B	1.5 ml/L + 4 oz	10.4 a	3.2 ab	19.0 a	50.0 ab	11.3 abc	2.5 ab
Kasumin	45 oz	9.8 a	3.1 ab	42.0 a	156.5 bc	11.0 abc	2.5 ab
Phyton 27	50 oz	11.2 a	3.5 b	13.9 a	37.0 ab	12.5 bc	2.7 b
Regalia SC + Nu-Film P	1% + 0.02 %	11.1 a	3.5 ab	34.2 a	84.5 abc	11.9 abc	2.6 ab
Tanos	12 oz	9.8 a	3.1 ab	42.5 a	174.0 c	10.5 ab	2.4 ab
Taegro drench alt. spray	3.5 oz	10.7 a	3.4 ab	81.5 b	115.0 abc	11.3 abc	2.5 ab
Tanos + Kocide 3000	8 oz + 32 oz	11.0 a	3.3 ab	8.6 a	16.0 a	12.3 abc	3.2 c
Untreated non-inoculated	-	10.9 a	3.5 ab	0.0 a	0.0 a	13.1 c	3.7 d
Untreated inoculated	-	11.1 a	3.4 ab	25.1 a	154.5 bc	11.8 abc	2.7 b

[z] Top grade was recorded using the following scale: 1 - plant dead, unsaleable, 2 - poor, unsaleable, 3 - moderate, saleable, 4 - good, saleable to 5 - excellent, saleable.

In 2009, Reddy evaluated the efficacy of various products for control of *Xanthomonas campestris* pv. *pelargonii* on geranium (*Pelargonium sp.*). All treatments were applied as weekly foliar spray (to drip) starting 4 days after inoculation and every week after this. The experiment lasted 7 weeks. All products significantly reduced disease severity (Table 56). No phytotoxicity was found on any treatment.

Table 56. Efficacy for *Xanthomonas campestris* pv. *pelargonii*on geranium (Pelargonium sp.), Reddy, AL, 2009.

Treatment	Rate per 100 Gal	Disease Severity[x, y]
Acibenzolar	1.25 oz	2.8 *
CG100	0.8 %	3.6 *
Citrex	150 ml/100 L	4.5 *
HM-0736	14.4 fl oz	5.3 *
Kasumin	45 fl oz	4.9 *
Tanos	12 oz	6.1 *
Tanos + CuPRO	8 oz + 2 lb	1.8 *
Taegro	3.5 oz	5.6 *
Untreated uninoculated	-	0.4 *
Untreated inoculated		9.6 b

[x] All treatment means differed significantly from untreated inoculated control based on a LSD (P=.05).
[y] Mean number of lesions per plant 7 weeks after transplant.

In 2008, Becker evaluated several products for preventative control of *Xanthomonas campestris* pv *campestris* on two cultivars of ornamental kale (*Brassica oleracea*) 'Nagoya Rose' and 'White Crane'. Treatments were applied as weekly foliar spray (to drip) on Mar 3 to Apr 28. Plants were inoculated on 4 and Mar 17. Kocide was the only treatment that significantly reduced disease severity on 'White Crane'

while all treatments provided significant disease reduction on 'Nagoya Rose' (Table 57). Acibenzolar was the only treatment that caused slight chlorosis and necrosis on 'White Crane'. On 'Nagoya Rose', Acibenzolar, Citrex, Aliette and Dithane caused slight chlorosis.

Table 57. Efficacy for *Xanthomonas campestris* pv *campestris* on Ornamental Kale (*Brassica oleracea*), Becker, NY, 2008.

Treatment	Rate per 100 Gal	% Foliar Severity[x y]					
		'Nagoya Rose'			'White Crane'		
		3-18-09	4-28-09	5-15-09	3-18-09	4-28-09	5-15-09
Acibenzolar	0.75 oz	1.67 ab	5.25 ab	0.2 d	3 a	5.9 abc	7.05 abc
Aliette	6.4 oz	5 a	2.6 ab	1.15 bcd	2.92 a	4.3 abc	9 abc
	12.8 oz	2.5 ab	4.8 ab	1.7 bcd	5 a	4.95 abc	11.8 ab
Cease	1 %	2.71 ab	2.6 ab	3.95 b	3.75 a	5 abc	8.6 abc
	2 %	4.17 a	1.95 ab	3.4 bc	4.75 a	6.1 abc	12.9 ab
Champ	21 fl oz	1.67 ab	8.15 a	2.65 bcd	3.75 a	9.1 a	11.85 ab
Citrex	5 fl oz	4.17 a	3.3 ab	2.85 bcd	4.25 a	9.25 a	13.5 ab
Dithane	16 oz	3.96 a	4.6 ab	3 bcd	4.5 a	9.25 a	12.15 ab
Kasumin	45 fl oz	3.33 a	6.15 ab	1.55 bcd	4 a	7.05 ab	10.45 abc
Kocide 3000	2 lb	3.83 a	2.6 ab	0.85 cd	4.75 a	1.7 bc	2.15 bc
Tanos	12 oz	2.5 ab	5.8 ab	2.75 bcd	4.75 a	8.05 ab	15.7 a
Taegro	3.5 oz	2.75 ab	3.7 ab	2.75 bcd	4.75 a	7.85 ab	13.8 ab
Tanos + Kocide 3000	8 oz + 2 lb	3.75 a	3.75 ab	2.35 bcd	4.75 a	4.45 abc	17.8 a
Untreated uninoculated		0 b	0 b	0 d	0 b	0 c	0 c
Untreated inoculated		2.64 ab	3.7 ab	6.55 a	3 a	7.95 ab	19.5 a

[x] Means followed by the same letter do not differ significantly based on Student-Newman-Keuls Test (P = 0.05.
[y] Percentage of leaf area with necrotic lesions.

In 2006 and 2007, Strandberg examined efficacy of several products for control of *Xanthomonas* on Japanese plum (*Prunus incisa x campanulata*) 'Okame' and wax myrtle (*Myrica cerifera).* All treatments were applied as foliar spray at 14-day intervals during May through early November in a 2006 experiment and at 7-day intervals during June through September in the 2007 experiment. In the 2006 experiment, Actinovate + Tricon was the only treatment that consistently suppressed leaf area damaged on both plants, but the percent of leaves infected were not always significantly different than the controls or from other treatments (Table 58 through Table 61). In 2007, no treatment significantly reduced a severe Xanthomonas severity on both plants. No phytotoxicity was found on any treatment in both experiments.

Table 58. Efficacy for *Xanthomonas campestris* pv. *pruni* on Japanese Plum (*Prunus incise x campanulata*) 'Okame', Strandberg, FL, 2006.

Treatment	Rate per 100 Gal	AUDPC[1] Percent LAD	Last[2] Percent LAD	AUDPC[3] Percent Infected	Last[4] % leaves Infected
Actinovate + Tricon	12 oz + 0.4 %	934.2 a	12.3 a	69.0	82.5
BioPhos +Chelated copper	2% + 0.2 lb ai	1681.4 b	29.3 b	74.0	97.5
Cease + Kocide 2000 + Vital	1% + 3 lb + 8 pt	1417.2 ab	33.3 b	75.5	95.0
HM-0736	58 fl oz	1908.7 b	29.2 b	79.3	90.0
Kasumin	64 fl oz	2014.5 b	31.6 b	76.5	97.5
Kocide 2000	3.5 lb	1800.1 b	34.1 b	76.8	100.0
K-Phite	5 qt	2229.1 b	32.4 b	77.5	97.5
Tanos + Kocide 2000	16 oz + 3 lb	1842.6 b	27.4 b	73.8	97.5
Untreated	-	1986.4 b	32.4 b	78.8	95.0

00-000-Strandberg-3

Means followed by the same letter do not differ significantly based on Student-Newman-Keuls Test (P = 0.05.

[1] Calculated mean area under the disease progress curves in arbitrary units for percent leaf area damaged (LAD).

[2] Percent LAD on last sampling day.

[3] Calculated mean area under the disease progress curves in arbitrary units for percent of leaves infected.

[4] Percent of leaves infected on last sampling day.

Table 59. Efficacy for Xanthomonas spp. on Wax Myrtle (Myrica cerifera), Strandberg, FL, 2006.

Treatment	Rate per 100 Gal	AUDPC[1] Percent LAD	Last[2] Percent LAD	AUDPC[3] Percent Infected	Last[4] % leaves Infected
Actinovate + Tricon	12 oz + 0.4 %	506.6	0.6	57.2 a	52.5
BioPhos + Chelated copper	2 % + 0.2 lb ai	604.6	0.5	63.2 ab	52.5
Cease+ Kocide 2000 + Vital	1% + 3 lb + 8 pt	545.7	0.7	59.8 a	47.5
HM-0736	58 fl oz	605.0	0.7	67.1 ab	50.0
Kasumin	64 fl oz	595.0	1.1	65.3 ab	62.5
Kocide 2000	3.5 lb	522.4	0.9	60.5 a	57.5
K-Phite	5 qt	628.9	1.0	71.8 b	65.0
Tanos 50% WG + Kocide 2000	16 oz + 3 lb	599.2	0.9	63.8 ab	52.5
Untreated inoculated	-	731.5	1.1	73.2 b	60.0

00-000-Strandberg-4

Means followed by the same letter do not differ significantly based on Student-Newman-Keuls Test (P = 0.05.

[1] Calculated mean area under the disease progress curves in arbitrary units for percent leaf area damaged (LAD).

[2] Percent LAD on last sampling day.

[3] Calculated mean area under the disease progress curves in arbitrary units for percent of leaves infected.

[4] Percent of leaves infected on last sampling day.

Table 60. Efficacy for *Xanthomonas campestris* pv. *pruni* on Japanese Plum (*Prunus incise x campanulata*) 'Okame', Strandberg, FL, 2007.

Treatment	Rate per 100 Gal	AUDPC[1] Percent LAD	Last[2] Percent LAD	AUDPC[3] Percent Infected	Last[4] % leaves Infected
BioPhos +Chelated copper	2% + 0.1 lb ai	5105.9 b	8.50	4111.5 ab	78.33
Kasumin +Kocide 3000	64oz +2 lb	4278.7 a	7.20	3915.3 ab	70.00
Kocide 3000	2 lb	4211 4 a	14.76	3939.5 ab	80.00
K-Phite +Tricon	2 qt + 0.4 %	4182.2 a	18.12	4683.7 ab	88.33
Phyton 27	25 oz	4350.6 a	31.86	4877.8 b	88.33
Tanos +Kocide 3000	8 oz + 2 lb	3957.6 a	11.38	4353.7 ab	66.67
Tricon	0.8 %	4105.4 a	24.00	3977.1 ab	91.67
Tricon alt. Phyton 27	0.8 % +25 oz	5174.9 b	24.28	3968.3 ab	95.00
Untreated	-	4550.9 a	12.47	3644.7 a	81.67

07-022-Strandberg-3

Means followed by the same letter do not differ significantly based on Student-Newman-Keuls Test (P = 0.05.

[1] Calculated mean area under the disease progress curves in arbitrary units for percent leaf area damaged (LAD).

[2] Percent LAD on last sampling day.

[3] Calculated mean area under the disease progress curves in arbitrary units for percent of leaves infected.

[4] Percent of leaves infected on last sampling day.

Table 61. Efficacy for *Xanthomonas* spp. on Wax Myrtle (*Myrica cerifera*), Strandberg, FL, 2007.

Treatment	Rate per 100 Gal	AUDPC[1] Percent LAD	Last[2] Percent LAD	AUDPC[3] Percent Infected	Last[4] % leaves Infected
BioPhos +Chelated copper	2% + 0.1 lb ai	2963.8	2.38	3077.5	40.00
Kasumin +Kocide 3000	64oz +2 lb	2844.0	2.07	3038.9	40.00
Kocide 3000	2 lb	3112.1	1.68	3065.7	31.67
K-Phite +Tricon	2 qt + 0.4 %	2946.6	2.37	3566.3	51.67
Phyton 27	25 oz	2957.1	2.62	3298.6	45.00
Tanos +Kocide 3000	8 oz + 2 lb	2986.0	2.28	3156.7	41.67
Tricon	0.8 %	2946.6	3.05	3357.7	45.00
Tricon / Phyton 27	0.8 % / 25 oz	3133.5	5.65	3521.3	53.33
Untreated	-	3304.3	4.23	3278.6	46.67

07-022-Strandberg-4

Means followed by the same letter do not differ significantly based on Student-Newman-Keuls Test (P = 0.05.

[1] Calculated mean area under the disease progress curves in arbitrary units for percent leaf area damaged (LAD).

[2] Percent LAD on last sampling day.

[3] Calculated mean area under the disease progress curves in arbitrary units for percent of leaves infected.

[4] Percent of leaves infected on last sampling day.

In 2011, Norman examined the efficacy of various products for preventative control of Xanthomonas leaf spot (*Xanthomonas axonopodis* pv. *poinsetticola* strain X1720) on poinsettia (*Euphorbia pulcherrima*) (Table 62). Treatments were applied as foliar sprays (to runoff) or drench; disease inoculation occurred on Sep 19. Number of leaf spots per plant were counted on Oct 4. Acibenzolar drench and Protect provided the best control, followed by Acibenzolar foliar, CuPro and HMO-07361. A moderate amount of leaf burning was observed with the Acibenzolar spray treatment. This may be related to the warm temperatures or to specific cultivar used. EarthTec at the high rate burned leaves and appeared to enhance

disease. Citrex produced extensive leaf burn on the poinsettia leaves prohibiting any counting of any lesions. No phytotoxicicty was observed in any of the other treatments.

Table 62. Efficacy for Xanthomonas Leaf Spot (*Xanthomonas axonopodis* pv. *poinsettiicola*) on Poinsettia (*Euphorbia pulcherrima*) 'Eckespoint Prestige Red', Norman, FL, 2011.

Treatment	Rate per 100 Gal	Application Method	Date(s) of Application	No. of Leafspots[x] 10-4-11
Acibenzolar	0.75 oz	Foliar	9/8,9/15,9/22,9/29	83.9 b
Acibenzolar	0.25 oz	Drench	8/30	8.7 a
Cg100	1.2 pts	Foliar	9/22,9/29	187.2 de
Citrex	1.5 ml/L	Foliar	9/8,9/15,9/22,9/29	Burn
CuPro TNO	2 lb	Foliar	9/22,9/29	70.6 b
EarthTec	1.5 fl oz	Foliar	9/22,9/29	133.3 bc
EarthTec	8 fl oz	Foliar	9/22,9/29	200+ e
HMO-0736	14.4 fl oz	Foliar	9/8,9/15,9/22,9/29	99.4 b
Kasumin	45 fl oz	Foliar	9/22,9/29	172.2 cde
NAI-4201	5 fl oz	Drench	8/30,9/6,9/20	143.3 bcd
Protect	2 lb	Foliar	9/22,9/29	19.3 a
Regalia	1% v:v	Foliar	9/22,9/29	178.2 cde
ZeroTol	128 fl oz	Foliar	9/22,9/29	200+ e
Untreated uninoculated	-	-	-	0 a
Untreated inoculated	-	-	-	171.1 cde

[x] Means followed by same letter do not differ significantly based on Fisher's Protected LSD (P=.05).

In 2016, Ong examined the efficacy of various products for preventative control of Xanthomonas leaf spot (*Xanthomonas axonopodis* pv. *zinniae*) on zinnia (*Zinnia* sp.). Treatments were applied as foliar sprays starting on Day 0 following the schedule in Table , and plants inoculated on Day 3. There was NO *Xanthomonas* infection observed on any of the treatments including untreated inoculated control. Phytotoxicity observations indicated that ZeroTol 2.0, TDA01, GC Pro and Camelot O resulted in damage to the zinnia plants, and no toxicity damage was observed on BlightBan, Bloomtime, MBI-110 and OxiPhos. Because of this lack of data, this test was not included in the *Xanthomonas* efficacy summary - Part 1 in **Table 43**.

Table 63. Efficacy for Xanthomonas Leaf Spot (*Xanthomonas axonopodis* pv. *zinniae*) on Zinnia (*Zinnia* sp.) 'Lilliput Yellow', Ong, TX, 2016.

Treatment	Rate per 100 Gal	Application Dates	Phytotoxicity Rating [x]				
			Day 0	Day 7	Day 14	Day 21	Day 28
BlightBan A506	5.3 oz	Day 0, 7, 14	0.00 a	0.00 d	0.00 f	0.00 e	0.00 f
Bloomtime	5.3 oz	Day 0, 7, 14	0.00 a	0.00 d	0.00 f	0.00 e	0.00 f
Camelot O	128 fl oz	Day 0, 10, 14	0.00 a	0.50 cd	3.80 d	2.70 c	2.50 d
GC Pro	50 oz	Day 0, 7, 14	0.00 a	0.70 d	0.80 e	0.80 d	0.50 e
	150 oz	Day 0, 7, 14	0.00 a	4.40 b	4.70 c	4.00 b	3.00 c
MBI-110	1 gal	Day 0, 7, 14	0.00 a	0.00 d	0.00 f	0.00 e	0.00 f
OxiPhos	42 fl oz	Day 0, 7, 14	0.00 a	0.00 d	0.00 f	0.00 e	0.00 f
	128 fl oz	Day 0, 7, 14	0.00 a	0.00 d	0.00 f	0.00 e	0.00 f
TDA01	RTU	Day 1, 7, 14	0.00 a	6.10 a	6.30 a	5.90 a	4.40 b
ZeroTol 2.0	2 gal	Day 0, 5, 10	0.00 a	3.90 b	5.70 b	6.30 a	5.50 a
Untreated uninoculated	-	Day 0, 7, 14	0.00 a	0.00 d	0.00 f	0.00 e	0.00 f
Untreated inoculated	-	Day 0, 7, 14	0.00 a	0.00 d	0.00 f	0.00 e	0.00 f

[x] Rating of 0-10 where 0= no injury, 10= complete plant death. Means followed by same letter do not differ significantly at P=0.05, LSD.

Efficacy Summary by Product/Active Ingredient

A brief efficacy summary for select products is given below, with a reminder that there are very limited published data available to draw definitive conclusions for each product/pest species. Products were selected based on interest in these products for testing for bacterial efficacy from 2008 to 2017.

A14658C. This active ingredient provided no efficacy on *Erwinia amylovora* in a Cleveland pear experiment, *Pseudomonas cichorii* in a chrysanthemum experiment, and *Pseudomonas syringae* in an impatiens and a lilac experiment.

Acibenzolar. An experiment on goldenrod for *Agrobacterium tumefaciens* was not conclusive because all treatments, including standards, did not significantly reduce disease incidence. Acibenzolar provided no to poor efficacy on *Erwinia* on Phalaenopsis orchid and poinsettia. Experiments for *Erwinia amylovora* on Keifer pear and *E. chrysanthemi* on Oncidium orchid were inconclusive due to extremely low disease incidence. In a Cleveland pear experiment for *Erwinia amylovora*, Acibenzolar applied drench or foliar significantly reduced shoot blight incidence; mixed results were obtained from foliar treatment in 3 apple experiments. On *Pseudomonas*, excellent efficacy was observed in an impatiens experiment but no to mediocre efficacy was observed in single experiments on chrysanthemum, Bolivian jasmine, lavender and Japanese maple; inconclusive data were obtained in a hibiscus experiment. Acibenzolar provided excellent control of *Xanthomonas campestris* on 'Nagoya Rose' cultivar of ornamental kale but no control on 'White Crane' cultivar. Excellent control of *X. axonopodis* on poinsettia was obtained with Acibenzolar drench, but mediocre with spray application. In three geranium experiments, it provided fair to good control of *Xanthomonas*.

Actinovate. This biological product provided no efficacy on *Erwinia* in one Phalaenopsis orchid experiment. On *Xanthomonas*, no to poor efficacy was observed in three geranium experiments.

Ag Streptomycin/Firewall. This standard generally provided good to excellent control of *Erwinia amylovora* in 10 apple field experiments.

Aliette. A field experiment for *Erwinia amylovora* on Keifer pear was inconclusive due to extremely low disease incidence. In a Cleveland pear experiment for *Erwinia amylovora*, Aliette did not significantly reduce shoot blight incidence. It provided good control of *Pseudomonas syringiae* in a lilac experiment. This active ingredient provided mediocre to good control of *Xanthomonas campestris* on 'Nagoya Rose' cultivar of ornamental kale but no control on 'White Crane' cultivar.

BlightBan A506. This product provided good efficacy for *Pseudomonas cichorii* in a chrysanthemum experiment, and mediocre efficacy for *Xanthomonas hortorum* in a geranium experiment. A experiment for *Xanthomonas axonopodis* on zinnia was inconclusive because disease did not develop.

BloomTime. This product provided poor to good efficacy for *Erwinia amylovora* in 3 apple experiments, and poor to mediocre efficacy for *Xanthomonas* spp. in 2 geranium experiments. Good efficacy for *Pseudomonas cichorii* was obtained in a chrysanthemum experiment. A experiment for *Xanthomonas axonopodis* on zinnia was inconclusive because disease did not develop.

Blossom Protect. This product provided poor and good efficacy for *Erwinia amylovora* in 4 apple experiments.

BW165N. This product provided poor efficacy for *Pseudomonas cichorii* in a chrysanthemum experiment.

Cease/Serenade Optimum. A experiment for *Erwinia chrysanthemi* on Oncidium orchid was inconclusive due to extremely low disease incidence. In a Cleveland pear experiment for *Erwinia amylovora*, Cease + Milstop significantly reduced shoot blight incidence; in 8 apple experiments, Serenade Optimum provided poor to good efficacy. Cease provided no efficacy on *Pseudomonas syringiae* in a Japanese maple experiment. It provided no or mediocre control of *Xanthomonas* in three geranium experiments, and mediocre control on 'Nagoya Rose' cultivar of ornamental kale but no control on 'White Crane' cultivar.

CG100. A experiment on goldenrod for *Agrobacterium tumefaciens* was not conclusive because all treatments, including standards, did not significantly reduce disease incidence. This active ingredient provided no efficacy on *Erwinia* in two Phalaenopsis orchid experiments. Experiments for *Erwinia amylovora* on Keifer pear and *E. chrysanthemi* on Oncidium orchid were inconclusive due to extremely low disease incidence. In a Cleveland pear experiment for *E. amylovora*, CG100 did not significantly reduce shoot blight incidence. Virtually no efficacy was observed on *Pseudomonas* on chrysanthemum, Bolivian jasmine, impatiens and lilac; inconclusive data were obtained in a hibiscus experiment. On *Xanthomonas*, no to poor efficacy was observed in a poinsettia and two geranium experiments.

Citrex. A experiment on goldenrod for *Agrobacterium tumefaciens* was not conclusive because all treatments, including standards, did not significantly reduce disease incidence. Citrex provided no efficacy on *Erwinia* on Oncidium orchid, Phalaenopsis orchid and poinsettia. Experiments for *Erwinia amylovora* on Keifer pear and *E. chrysanthemi* on Oncidium orchid were inconclusive due to extremely low disease incidence. In a Cleveland pear experiment for *E. amylovora*, Citrex significantly reduced shoot blight incidence. On *Pseudomonas*, no efficacy was observed in single experiments on Bolivian jasmine, impatiens, lavender, lilac and Japanese maple; poor and excellent efficacy was observed on chrysanthemum, and inconclusive data were obtained in a hibiscus experiment. Citrex provided no to poor efficacy on *Xanthomonas* in an ornamental kale experiment. In 4 geranium experiments, poor to good *Xanthomonas* control was observed.

Copper Compounds. The copper products CuPRO, Kocide or ReZist provided poor to mediocre efficacy on *Erwinia* on Oncidium orchid, Phalaenopsis orchid and poinsettia. Excellent efficacy for *Pseudomonas cichorii* was obtained in a chrysanthemum experiment. Experiments for *Erwinia amylovora* on Keifer pear and *E. chrysanthemi* on Oncidium orchid were inconclusive due to extremely low disease incidence. In a Cleveland pear experiment for *E. amylovora*, Camelot O significantly reduced shoot blight incidence but CuPro did not; in 8 apple experiments, Cueva, MagnaBon, MasterCop, Nu-Cop and Previsto provided good to excellent efficacy. On *Pseudomonas*, no efficacy was observed with Kocide and Phyton on lavender, Japanese maple, hibiscus, and oak leaf hydrangea. Camelot O, Junction, Kocide, Nu-Cop and Phyton 27 did provide some control of *Pseudomonas* in lilac, while CuPRO and Phyton provided mediocre control in a Bolivian jasmine experiment. CuPRO provided good control in chrysanthemum and impatiens, but inconclusive data were obtained in a hibiscus experiment. Champ and Kocide provided mediocre and good control of *Xanthomonas* on 'Nagoya Rose' cultivar of ornamental kale, but no and good control on 'White Crane' cultivar. Camelot, CuPRO, Cuprofix, Cuprofix MZ, Junction, Kocide and Phyton 27, provided poor to good efficacy on *Xanthomonas* in geranium, Japanese plum, poinsettia and wax myrtle experiments.

Dithane/Penncozeb/Protect. This active ingredient provided good efficacy on *Erwinia* in a Phalaenopsis orchid experiment. It provided no efficacy on *Pseudomonas* on Japanese maple, mediocre efficacy on chrysanthemum, and variable efficacy on Bolivian jasmine; inconclusive data were obtained in a hibiscus experiment. It provided excellent control of *Xanthomonas axonopodis* on poinsettia, mediocre control of *X. campestris* on 'Nagoya Rose' cultivar of ornamental kale but no control on 'White Crane' cultivar. It provided excellent control of *Xanthomonas* sp. in a geranium experiment.

Double Nickel/Triathlon. Double Nickel provided poor efficacy for *Erwinia amylovora* in an apple experiment. Triathlon provided mediocre efficacy for *Xanthomonas hortorum* in a geranium experiment, and for *Pseudomonas cichorii* in a chrysanthemum experiment.

Florel. In a Cleveland pear experiment for *Erwinia amylovora*, this active ingredient did not significantly reduce shoot blight incidence.

GC Pro. This product provided mediocre efficacy for *Xanthomonas hortorum* in a geranium experiment. No efficacy for *Pseudomonas cichorii* was obtained in a chrysanthemum experiment. A experiment for *Xanthomonas axonopodis* on zinnia was inconclusive because disease did not develop.

HM-0736. A experiment on goldenrod for *Agrobacterium tumefaciens* was not conclusive because all treatments, including standards, did not significantly reduce disease incidence. This active ingredient provided provided no to poor efficacy on *Erwinia* on Oncidium orchid, Phalaenopsis orchid and poinsettia. Experiments for *Erwinia amylovora* on Keifer pear and *E. chrysanthemi* on Oncidium orchid were inconclusive due to extremely low disease incidence. In a Cleveland pear experiment for *E. amylovora*, it did not significantly reduce shoot blight incidence. On *Pseudomonas,* it provided no efficacy in two chrysanthemum experiments, and in single experiments on hibiscus, lilac and oak leaf hydrangea. Mediocre efficacy was obtained on Bolivian jasmine and impatiens, and inconclusive data obtained in a hibiscus experiment. HM-0736 provided mediocre efficacy on *Xanthomonas* in a poinsettia experiment, and no to poor efficacy in three experiments on geranium and in single experiments on Japanese plum and wax myrtle.

Kasumin. A experiment on goldenrod for *Agrobacterium tumefaciens* was not conclusive because all treatments, including standards, did not significantly reduce disease incidence. Kasumin provided no to poor efficacy on *Erwinia* on Oncidium orchid, Phalaenopsis orchid and poinsettia. Experiments for *Erwinia amylovora* on Keifer pear and *E. chrysanthemi* on Oncidium orchid were inconclusive due to extremely low disease incidence. In a Cleveland pear experiment for *E. amylovora*, Kasumin significantly reduced shoot blight incidence; in 8 apple experiments, it generally provided effective control comparable to the standard Ag Streptomycin. On *Pseudomonas,* no efficacy was observed in single experiments on lavender, Japanese maple, hibiscus, and oak leaf hydrangea; inconclusive data were obtained in a hibiscus experiment. Kasumin did provide mediocre control of *Pseudomonas* on impatiens, good control on chrysanthemum and lilac, and excellent control on Bolivian jasmine. It provided good control of *Xanthomonas* on 'Nagoya Rose' cultivar of ornamental kale but no control on 'White Crane' cultivar. It provided no to poor efficacy on *Xanthomonas* in five experiments on geranium and in single experiments on Japanese plum, poinsettia and wax myrtle. When tank-mixed with Kocide, it did not improve efficacy of Kocide alone.

KleenGrow. This active ingredient was the only treatment that significantly reduced *Erwinia chrysanthemi* infection on Oncidium orchid; it was superior to Kocide. A field experiment for *Erwinia amylovora* on Keifer pear was inconclusive due to extremely low disease incidence. In a Cleveland pear experiment for *E. amylovora*, KleenGrow significantly reduced shoot blight incidence. No efficacy for *Pseudomonas cichorii* was obtained in a chrysanthemum experiment.

MBI 110. This product provided mediocre efficacy for *Xanthomonas hortorum* in a geranium experiment, and for *Pseudomonas cichorii* in a chrysanthemum experiment.. A experiment for *Xanthomonas axonopodis* on zinnia was inconclusive because disease did not develop.

NAI-4201. An experiment on goldenrod for *Agrobacterium tumefaciens* was not conclusive because all treatments, including standards, did not significantly reduce disease incidence. This active ingredient provided no efficacy on *Erwinia* in one Phalaenopsis orchid experiment. Experiments for *Erwinia*

amylovora on Keifer pear and *E. chrysanthemi* on Oncidium orchid were inconclusive due to extremely low disease incidence. In a Cleveland pear experiment for *E. amylovora*, NAI-4201 significantly reduced shoot blight incidence. Poor efficacy was observed on *Pseudomonas* on impatiens, mediocre efficacy on Bolivian jasmine, and no efficacy in hibiscus and chrysanthemum experiments. On *Xanthomonas,* no efficacy was observed in a geranium and a poinsettia experiment.

Oxiphos. This product provided mediocre efficacy for *Xanthomonas hortorum* in a geranium experiment, and poor efficacy for *Pseudomonas cichorii* in a chrysanthemum experiment. A experiment for *Xanthomonas axonopodis* on zinnia was inconclusive because disease did not develop.

Prophytex. Prophytex EC and WP provided mediocre efficacy for *Xanthomonas hortorum* in a geranium experiment.

Regalia. An experiment on goldenrod for *Agrobacterium tumefaciens* was not conclusive because all treatments, including standards, did not significantly reduce disease incidence. This extract of *Reynoutria* provided no efficacy on *Erwinia* in two Phalaenopsis orchid experiment. Experiments for *Erwinia amylovora* on Keifer pear and *E. chrysanthemi* on Oncidium orchid were inconclusive due to extremely low disease incidence. In a Cleveland pear experiment for *E. amylovora*, Regalia did not significantly reduce shoot blight incidence; in 4 apple experiment it provided mediocre to good efficacy. On *Pseudomonas,* it provided no to mediocre efficacy on chrysanthemum, poor efficacy on Bolivian jasmine and impatiens, and no efficacy on lavender and lilac; inconclusive data were obtained in a hibiscus experiment. It provided poor to good efficacy on *Xanthomonas* in three geranium experiments, but no efficacy in a poinsettia experiment.

TDA01. This active ingredient provided good efficacy for *Xanthomonas hortorum* in a geranium experiment. An experiment for *Xanthomonas axonopodis* on zinnia was inconclusive because disease did not develop.

TDA02. This product provided poor efficacy for *Pseudomonas cichorii* in a chrysanthemum experiment.

Taegro. This biological product provided no to poor efficacy on *Erwinia* on Oncidium orchid, Phalaenopsis orchid and poinsettia. Experiments for *Erwinia amylovora* on Keifer pear and *E. chrysanthemi* on Oncidium orchid were inconclusive due to extremely low disease incidence.On *Pseudomonas,* poor efficacy was observed on chrysanthemum, and no efficacy on Bolivian jasmine, lavender and Japanese maple. It provided mediocre control of *Xanthomonas* on 'Nagoya Rose' cultivar of ornamental kale but no control on 'White Crane' cultivar. It provided no to poor efficacy on *Xanthomonas* in four experiments on geranium.

Tanos. This active ingredient provided no to poor efficacy on *Erwinia* on Oncidium orchid, Phalaenopsis orchid and poinsettia. Experiments for *Erwinia amylovora* on Keifer pear and *E. chrysanthemi* on Oncidium orchid were inconclusive due to extremely low disease incidence. On *Pseudomonas,* no efficacy was observed in single experiments on chrysanthemum, Bolivian jasmine, lavender and Japanese maple. It provided mediocre control of Xanthomonas on 'Nagoya Rose' cultivar of ornamental kale but no control on 'White Crane' cultivar. It provided no to poor efficacy on *Xanthomonas* in four experiments on geranium and in single experiments on Japanese plum and wax myrtle. When tank-mixed with Kocide, it did not improve efficacy of Kocide alone. At this time Tanos will not be introduced to the ornamental hortiuculture marketplace.

ZeroTol. A experiment with this product on goldenrod for *Agrobacterium tumefaciens* was not conclusive because all treatments, including standards, did not significantly reduce disease incidence. In a chrysanthemum experiment, ZeroTol provided poor efficacy on *Pseudomonas cichorii*. It provided good

efficacy on *Pseudomonas syringae* in a lilac experiment, but poor efficacy in an impatiens experiment; inconclusive data were obtained in a hibiscus experiment. It provided mediocre efficacy for *Xanthomonas hortorum* in a geranium experiment, and no efficacy for *Xanthomonas axonopodis* on poinsettia. An experiment for *Xanthomonas axonopodis* on zinnia was inconclusive because disease did not develop.

Please see Table 64 for individual summaries of IR-4 experiments conducted during 2008 – 2017.

Phytotoxicity

In general most products did not exhibit damage to the treated crops. Significant phytotoxicity was observed on Phalaenopsis plants treated with Acibenzolar and CuPRO. Significant but very minor leaf mottling on Keifer pear was observed from Citrex and KleenGrow and should not reduce marketability. Kasumin caused significant stunting on Bolivian jasmine. Acibenzolar, Citrex and Kasumin caused significant phytotoxicity on lavender. Acibenzolar caused significant injury on geranium. Due to the high temperature in Florida experiments (+100F), all copper containing products (Camelot, Cuprofix, Cuprofix MZ, Junction, Kocide, Phyton 27), as well as Cease, Companion, Cease, Tricon and Vitalonil caused some leaf burning of leaves on geranium; this may not occur in cooler temperatures. Acibenzolar was the only treatment that caused slight chlorosis and necrosis on ornamental kale 'White Crane'. On 'Nagoya Rose', Acibenzolar, Citrex, Aliette and Dithane caused slight chlorosis. On Japanese maple, Kasumin resulted in lighter leaf color. Acibenzolar foliar, Citrex and EarthTec caused significant leaf burn on poinsettia. Acibenzolar foliar and Citrex caused significant chlorosis and stunting on impatiens. There also appeared to be an abnormally high number of leaf abscission with impatiens treated with A14658C. Agri-Mycin caused significant phytotoxicity (smaller, yellow plants) on goldenrod. ZeroTol 2.0, TDA01, GC Pro and Camelot O resulted in damage in a zinnia experiment. In a chrysanthemum experiment, foliar damage occurred with GCPro, OxiPhos and TDA02.

Table 64. Summary of product efficacy by pathogen and crop.

Note: Table entries are sorted by product, pathogen Latin name, and then by crop Latin name. Only those IR-4 experiments received by 1/17/2018 are included in the table below.

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
29554	Actinovate Soluble (Streptomyces lydicus WYEC 108)	Erwinia (Erwinia sp.)	Orchid, Moth (Phalaenopsis sp.)	Greenhouse	Norman	FL	2009	Foliar	Very low disease pressure in inoculated Check; not possible to evaluate efficacy of all treatments.
27588	Actinovate Soluble (Streptomyces lydicus WYEC 108)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Bright Red'	Greenhouse	Norman	FL	2009	Foliar	No significant control at 12 oz per 100 gal.
27588	Actinovate Soluble (Streptomyces lydicus WYEC 108)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Red'	Greenhouse	Norman	FL	2006	Foliar	Poor efficacy at 12 oz per 100 gal.
27588	Actinovate Soluble (Streptomyces lydicus WYEC 108)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Red'	Greenhouse	Norman	FL	2007	Foliar	No efficacy at 12 oz per 100 gal.
30652	Agrimycin 17 (Streptomycin sulfate)	Agrobacterium sp. (Agrobacterium sp.)	Goldenrod (Solidago sp.)	Greenhouse	Chase	CA	2011	Foliar	Did not significantly reduce number and size of galls with 8 oz per 100 gal; significant phytotoxicity.
27957	Alexin (Fruit and vegetable extract)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Red'	Greenhouse	Norman	FL	2007	Foliar	Poor efficacy at 50 ml per 100 L.
30071	Aliette WDG (Fosetyl Al)	Erwinia (Erwinia sp.)	Callery Pear (Pyrus calleryana) 'Cleveland'	Field Container	Steddom	TX	2012	Foliar	Did not significantly reduce shoot blight with 12.8 oz per 100 gal applied 7 times (green tip to petal fall).
30071	Aliette WDG (Fosetyl Al)	Erwinia (Erwinia sp.)	Callery Pear (Pyrus calleryana) 'Kieffer'	Field Container	Steddom	TX	2010	Foliar	No effect on a very low disease pressure at 12.8 oz per 100 gal; virtually no injury.
30071	Aliette WDG (Fosetyl Al)	Erwinia (Erwinia sp.)	Callery Pear (Pyrus calleryana) 'Kieffer'	Field Container	Steddom	TX	2011	Foliar	No significant control with 12.8 oz per 100 gal applied 6 times.
30210	Aliette WDG (Fosetyl Al)	Pseudomonas syringae blight (Pseudomonas syringae)	Maple, Japanese (Acer palmatum) 'Bloodgood'	Field Container	Pscheidt	OR	2011	Foliar	No disease developed in this trial.

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
31226	Aliette WDG (Fosetyl Al)	Pseudomonas syringae blight (Pseudomonas syringae)	Lilac (Syringa sp.) S. vulgaris 'Ellen Willmott'	Field In-Ground	Pscheidt	OR	2010	Foliar	Some reduction in disease incidence and severity with 12.8 oz per 100 gal.
31226	Aliette WDG (Fosetyl Al)	Pseudomonas syringae blight (Pseudomonas syringae)	Lilac (Syringa sp.) S. vulgaris 'Ellen Willmott'	Field In-Ground	Pscheidt	OR	2012	Foliar	Significantly reduced disease incidence but not severity with 12.8 oz per 100 gal.
29485	Aliette WDG (Fosetyl Al)	Xanthomonas sp. (Xanthomonas sp.)	Ornamental Cabbage/Kale (Brassica oleracea) Kale 'Nagoya Rose'	Greenhouse	Becker	NY	2009	Foliar	Significantly reduced disease severity at 6.4 and 12.8 oz per 100 gal.
29485	Aliette WDG (Fosetyl Al)	Xanthomonas sp. (Xanthomonas sp.)	Ornamental Cabbage/Kale (Brassica oleracea) Kale 'White Crane	Greenhouse	Becker	NY	2009	Foliar	Reduced disease severity, but not significantly, at 6.4 and 12.8 oz per 100 gal.
27753	ASAP (Silver)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Red'	Greenhouse	Norman	FL	2007	Foliar	Fair to good efficacy at 5, 10 and 30 ppm.
33536	BlightBan A506 (Pseudomonas fluorescens A506)	Pseudomonas cichorii (Pseudomonas cichorii)	Chrysanthemum, Garden (Chrysanthemum/Dendranthema sp.) 'Sparkling Cheryl Yellow'	Field Container	Norman	FL	2017	Foliar	Good efficacy with 5.3 oz per 100 gal applied 3 times weekly; inferior to noninoculated check.
32968	BlightBan A506 (Pseudomonas fluorescens A506)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Calliope Crimson Flame'	Greenhouse	Norman	FL	2016	Foliar	Effective control with 5.3 oz per 100 gal applied twice at weekly intervals; inferior to CuPro.
33133	BlightBan A506 (Pseudomonas fluorescens A506)	Xanthomonas sp. (Xanthomonas sp.)	Zinnia (Zinnia sp.) 'Lilliput Yellow'	Greenhouse	Ong	TX	2016	Foliar	No disease infection developed. No injury with 5.3 oz per 100 gal applied 3 times.
33543	Bloomtime FD (Pantoea agglomerans strain E325)	Pseudomonas cichorii (Pseudomonas cichorii)	Chrysanthemum, Garden (Chrysanthemum/Dendranthema sp.) 'Sparkling Cheryl Yellow'	Field Container	Norman	FL	2017	Foliar	Good efficacy with 5.3 oz per 100 gal applied 3 times weekly; inferior to noninoculated check.
27962	Bloomtime FD (Pantoea agglomerans strain E325)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Calliope Crimson Flame'	Greenhouse	Norman	FL	2016	Foliar	Effective control with 5.3 oz per 100 gal applied twice at weekly intervals; inferior to CuPro.
27962	Bloomtime FD (Pantoea agglomerans strain E325)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Red'	Greenhouse	Norman	FL	2007	Foliar	No efficacy at 10.5 oz per 100 gal.

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
33134	Bloomtime FD (Pantoea agglomerans strain E325)	Xanthomonas sp. (Xanthomonas sp.)	Zinnia (Zinnia sp.) 'Lilliput Yellow'	Greenhouse	Ong	TX	2016	Foliar	No disease infection developed. No injury with 5.3 oz per 100 gal applied 3 times.
27960	BMJ (Bacillus mycoides isolate J)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Red'	Greenhouse	Norman	FL	2007	Foliar	No efficacy at 100 g per 100 gal.
33537	BW165N (Ulocladium oudemansii strain U3)	Pseudomonas cichorii (Pseudomonas cichorii)	Chrysanthemum, Garden (Chrysanthemum/Dendranthema sp.) 'Sparkling Cheryl Yellow'	Field Container	Norman	FL	2017	Foliar	Poor efficacy with 3 lb per 100 gal applied 3 times weekly; inferior to noninoculated check.
31444	Camelot (Copper salts of fatty and rosin acids)	Erwinia (Erwinia sp.)	Callery Pear (Pyrus calleryana) 'Cleveland'	Field Container	Steddom	TX	2012	Foliar	Significantly reduced shoot blight with 2 gal per 100 gal applied 6 times (bloom to petal fall).
31305	Camelot (Copper salts of fatty and rosin acids)	Pseudomonas syringae blight (Pseudomonas syringae)	Lilac (Syringa sp.) S. vulgaris 'Ellen Willmott'	Field In-Ground	Pscheidt	OR	2012	Foliar	Significantly reduced disease incidence but not severity with 2 gal per 100 gal.
27574	Camelot (Copper salts of fatty and rosin acids)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Red'	Greenhouse	Norman	FL	2006	Foliar	Significantly reduced leafspots at 3 pt per 100 gal; equal to Kocide.
27574	Camelot (Copper salts of fatty and rosin acids)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Red'	Greenhouse	Norman	FL	2007	Foliar	Significantly reduced leafspots at 3 pt per 100 gal; equal to Kocide.
33139	Camelot (Copper salts of fatty and rosin acids)	Xanthomonas sp. (Xanthomonas sp.)	Zinnia (Zinnia sp.) 'Lilliput Yellow'	Greenhouse	Ong	TX	2016	Foliar	No disease infection developed. Moderate injury with 128 fl oz per 100 gal applied 3 times.
27956	Canker Kill (Unknown)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Red'	Greenhouse	Norman	FL	2007	Foliar	Poor efficacy at 1.5 lb per 100 gal.
29089	Cease (Bacillus subtilis strain QST 713)	Pseudomonas syringae blight (Pseudomonas syringae)	Maple, Japanese (Acer palmatum)	Field Container	Regan	OR	2008	Foliar	No significant difference from untreated check with 2 % solution.
29486	Cease (Bacillus subtilis strain QST 713)	Xanthomonas sp. (Xanthomonas sp.)	Ornamental Cabbage/Kale (Brassica oleracea) Kale 'Nagoya Rose'	Greenhouse	Becker	NY	2009	Foliar	Reduced disease severity, but not significantly, at 1 and 2 % V/Very
29486	Cease (Bacillus subtilis strain QST 713)	Xanthomonas sp. (Xanthomonas sp.)	Ornamental Cabbage/Kale (Brassica oleracea) Kale 'White Crane	Greenhouse	Becker	NY	2009	Foliar	Significantly reduced disease severity at 1 and 2 % V/Very

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
27582	Cease (Bacillus subtilis strain QST 713)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Bright Red'	Greenhouse	Norman	FL	2009	Foliar	Significantly reduced disease incidence at 1, but not at 2 % dilution; 2 % caused leaf burn.
27582	Cease (Bacillus subtilis strain QST 713)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Red'	Greenhouse	Norman	FL	2006	Foliar	Poor efficacy at 8 qt per 100 gal.
27582	Cease (Bacillus subtilis strain QST 713)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Red'	Greenhouse	Norman	FL	2007	Foliar	Poor efficacy at 0.5 % concentration.
30654	CG100 (Caprylic acid)	Agrobacterium sp. (Agrobacterium sp.)	Goldenrod (Solidago sp.)	Greenhouse	Chase	CA	2011	Foliar	Did not significantly reduce number and size of galls with 1.2 pt per 100 gal.
29211	CG100 (Caprylic acid)	Erwinia chrysanthemi (Erwinia chrysanthemi)	Orchid, Dancing Lady (Oncidium sp.)	Greenhouse	Palmateer	FL	2010	Foliar	Low disease incidence (both inoculated and non-inoculated Checks had 0 disease rating); no significant effect at 0.8 % (v/v).
29201	CG100 (Caprylic acid)	Erwinia (Erwinia sp.)	Orchid, Moth (Phalaenopsis sp.)	Greenhouse	Norman	FL	2009	Foliar	Very low disease pressure in inoculated Check; not possible to evaluate efficacy of all treatments.
29201	CG100 (Caprylic acid)	Erwinia (Erwinia sp.)	Orchid, Moth (Phalaenopsis sp.)	Greenhouse	Norman	FL	2010	Foliar	Did not significantly reduce leaf lesion size at 0.3 % conc.
28935	CG100 (Caprylic acid)	Erwinia (Erwinia sp.)	Callery Pear (Pyrus calleryana) 'Kieffer'	Field Container	Steddom	TX	2010	Foliar	No effect on a very low disease pressure at 3 % conc.; very minor injury comparable to untreated.
28935	CG100 (Caprylic acid)	Erwinia (Erwinia sp.)	Callery Pear (Pyrus calleryana) 'Kieffer'	Field Container	Steddom	TX	2011	Foliar	No significant control with 0.3 % v:v applied 6 times.
29577	CG100 (Caprylic acid)	Pseudomonas cichorii (Pseudomonas cichorii)	Chrysanthemum, Garden (Chrysanthemum/Dendranthema sp.)	Field Container	Norman	FL	2010	Foliar	Did not reduce leaf lesion incidence at 0.3 % conc.
29577	CG100 (Caprylic acid)	Pseudomonas cichorii (Pseudomonas cichorii)	Chrysanthemum, Garden (Chrysanthemum/Dendranthema sp.) 'Shasta Improved'	Field Container	Norman	FL	2012	Foliar	Did not reduce leaf spots with 38.4 fl oz per 100 gal applied twice.
29605	CG100 (Caprylic acid)	Pseudomonas sp. (Pseudomonas sp.)	Bolivian Jasmine (Mandevilla boliviensis) 'Alice DuPont'	Greenhouse	Chase	CA	2010	Foliar	Significantly reduced vine infection but not disease severity at 0.3 % solution.

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
30206	CG100 (Caprylic acid)	Pseudomonas syringae blight (Pseudomonas syringae)	Maple, Japanese (Acer palmatum) 'Bloodgood'	Field Container	Pscheidt	OR	2011	Foliar	No disease developed in this trial.
30260	CG100 (Caprylic acid)	Pseudomonas syringae blight (Pseudomonas syringae)	Rosemallow (Hibiscus sp.) 'Double Red'	Greenhouse	Norman	FL	2011	Foliar	Less lesion development, though not statistically significant, with 1.2 pt per 100 gal applied twice.
32360	CG100 (Caprylic acid)	Pseudomonas syringae blight (Pseudomonas syringae)	Impatiens, Common Garden/Buzzy Lizzy (Impatiens walleriana) 'Super Elfin XP Violet Improved'	Greenhouse	Norman	FL	2012	Foliar	Did not reduce number of leaf spots with 38.4 fl oz per 100 gal applied twice.
29571	CG100 (Caprylic acid)	Pseudomonas syringae blight (Pseudomonas syringae)	Lilac (Syringa sp.) S. vulgaris 'Ellen Willmott'	Field In-Ground	Pscheidt	OR	2010	Foliar	No reduction of disease incidence and severity with 38.4 fl oz per 100 gal.
29571	CG100 (Caprylic acid)	Pseudomonas syringae blight (Pseudomonas syringae)	Lilac (Syringa sp.) S. vulgaris 'Ellen Willmott'	Field In-Ground	Pscheidt	OR	2012	Foliar	No significant reduction of disease incidence and severity with 38.4 fl oz per 100 gal.
30252	CG100 (Caprylic acid)	Xanthomonas sp. (Xanthomonas sp.)	Poinsettia (Euphorbia pulcherrima) 'Eckespoint Prestige Red '	Greenhouse	Norman	FL	2011	Foliar	Did not significantly reduce number of leaf spots with 1.2 pt per 100 gal applied twice.
28932	CG100 (Caprylic acid)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Maverick Red'	Greenhouse	Reddy	AL	2009	Foliar	Significantly reduced severity of X. campestris at 0.8 % V:V; inferior to non-inoculated Check.
28932	CG100 (Caprylic acid)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Bright Red'	Greenhouse	Norman	FL	2009	Foliar	No control at 0.8 % dilution.
29488	Champ Formula 2F (Copper hydroxide)	Xanthomonas sp. (Xanthomonas sp.)	Ornamental Cabbage/Kale (Brassica oleracea) Kale 'Nagoya Rose'	Greenhouse	Becker	NY	2009	Foliar	Significantly reduced disease severity at 21 fl oz per 100 gal
29488	Champ Formula 2F (Copper hydroxide)	Xanthomonas sp. (Xanthomonas sp.)	Ornamental Cabbage/Kale (Brassica oleracea) Kale 'White Crane	Greenhouse	Becker	NY	2009	Foliar	Reduced disease severity, but not significantly, at 21 fl oz per 100 gal.
30655	Citrex (Citrus extraction)	Agrobacterium sp. (Agrobacterium sp.)	Goldenrod (Solidago sp.)	Greenhouse	Chase	CA	2011	Foliar	Did not significantly reduce number and size of galls with 1.5 ml per liter.

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
28038	Citrex (Citrus extraction)	Erwinia chrysanthemi (Erwinia chrysanthemi)	Poinsettia (Euphorbia pulcherrima) 'Prestige' and 'Autumn Red'	Greenhouse	Chase	CA	2009	Foliar	Did not reduce infection at 1.5 ml per liter
29212	Citrex (Citrus extraction)	Erwinia chrysanthemi (Erwinia chrysanthemi)	Orchid, Dancing Lady (Oncidium sp.)	Greenhouse	Palmateer	FL	2010	Foliar	Low disease incidence (both inoculated and non-inoculated Checks had 0 disease rating); no significant effect at 150 ml per 100 L.
29212	Citrex (Citrus extraction)	Erwinia chrysanthemi (Erwinia chrysanthemi)	Orchid, Dancing Lady (Oncidium sp.) 'Wilson's Wicked Qua'	Greenhouse	Chase	CA	2009	Foliar	Higher infection than inoculated Check at 1.5 ml per liter
29195	Citrex (Citrus extraction)	Erwinia (Erwinia sp.)	Orchid, Moth (Phalaenopsis sp.)	Greenhouse	Norman	FL	2009	Foliar	Very low disease pressure in inoculated Check; not possible to evaluate efficacy of all treatments.
29195	Citrex (Citrus extraction)	Erwinia (Erwinia sp.)	Orchid, Moth (Phalaenopsis sp.)	Greenhouse	Norman	FL	2010	Foliar	Did not significantly reduce leaf lesion size at 150 ml per 100 L.
28799	Citrex (Citrus extraction)	Erwinia (Erwinia sp.)	Callery Pear (Pyrus calleryana) 'Cleveland'	Field Container	Steddom	TX	2012	Foliar	Significantly reduced shoot blight with 150 cc per 100 L applied 7 times (green tip to petal fall).
28799	Citrex (Citrus extraction)	Erwinia (Erwinia sp.)	Callery Pear (Pyrus calleryana) 'Kieffer'	Field Container	Steddom	TX	2010	Foliar	No effect on a very low disease pressure at 19.2 oz per 100 gal; very minor injury.
28799	Citrex (Citrus extraction)	Erwinia (Erwinia sp.)	Callery Pear (Pyrus calleryana) 'Kieffer'	Field Container	Steddom	TX	2011	Foliar	No significant control with 150 cc per 100 L + Capsil applied 6 times.
29576	Citrex (Citrus extraction)	Pseudomonas cichorii (Pseudomonas cichorii)	Chrysanthemum, Garden (Chrysanthemum/Dendranthema sp.)	Field Container	Norman	FL	2010	Foliar	Significantly reduced leaf lesion incidence at 150 ml per 100 L; inferior to CuPro.
29576	Citrex (Citrus extraction)	Pseudomonas cichorii (Pseudomonas cichorii)	Chrysanthemum, Garden (Chrysanthemum/Dendranthema sp.) 'Shasta Improved'	Field Container	Norman	FL	2012	Foliar	Significantly reduced leaf spots with 1.5 ml per L applied 3 times; comparable to untreated non-inoculated check.
28388	Citrex (Citrus extraction)	Pseudomonas sp. (Pseudomonas sp.)	Lavender (Lavandula sp.) L. heterophylla 'Patriot Bright Red'	Greenhouse	Chase	CA	2008	Foliar	No efficacy at 1.5 ml per liter + Latron; phytotoxic

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
29606	Citrex (Citrus extraction)	Pseudomonas sp. (Pseudomonas sp.)	Bolivian Jasmine (Mandevilla boliviensis) 'Alice DuPont'	Greenhouse	Chase	CA	2010	Foliar	Significantly reduced vine infection but not disease severity at 0.15 ml per L
27567	Citrex (Citrus extraction)	Pseudomonas syringae blight (Pseudomonas syringae)	Maple, Japanese (Acer palmatum)	Field Container	Regan	OR	2008	Foliar	No significant difference from untreated check with 150 cc per 100 liters.
27567	Citrex (Citrus extraction)	Pseudomonas syringae blight (Pseudomonas syringae)	Maple, Japanese (Acer palmatum) 'Bloodgood'	Field Container	Pscheidt	OR	2011	Foliar	No disease developed in this trial.
30261	Citrex (Citrus extraction)	Pseudomonas syringae blight (Pseudomonas syringae)	Rosemallow (Hibiscus sp.) 'Double Red'	Greenhouse	Norman	FL	2011	Foliar	Less lesion development, though not statistically significant, with 1.5 ml per L applied 4 times.
32365	Citrex (Citrus extraction)	Pseudomonas syringae blight (Pseudomonas syringae)	Impatiens, Common Garden/Buzzy Lizzy (Impatiens walleriana) 'Super Elfin XP Violet Improved'	Greenhouse	Norman	FL	2012	Foliar	Did not reduce number of leaf spots with 1.5 ml/L applied 3 times. Plant injury observed.
29565	Citrex (Citrus extraction)	Pseudomonas syringae blight (Pseudomonas syringae)	Lilac (Syringa sp.) S. vulgaris 'Ellen Willmott'	Field In-Ground	Pscheidt	OR	2010	Foliar	No reduction of disease incidence and severity with 18.2 fl oz per 100 gal.
28522	Citrex (Citrus extraction)	Xanthomonas sp. (Xanthomonas sp.)	Ornamental Cabbage/Kale (Brassica oleracea) Kale 'Nagoya Rose'	Greenhouse	Becker	NY	2009	Foliar	Significantly reduced disease severity at 5 fl oz per 100 gal; slight injury (leaf chlorosis).
28522	Citrex (Citrus extraction)	Xanthomonas sp. (Xanthomonas sp.)	Ornamental Cabbage/Kale (Brassica oleracea) Kale 'White Crane'	Greenhouse	Becker	NY	2009	Foliar	Reduced disease severity, but not significantly, at 5 fl oz per 100 gal
30253	Citrex (Citrus extraction)	Xanthomonas sp. (Xanthomonas sp.)	Poinsettia (Euphorbia pulcherrima) 'Eckespoint Prestige Red '	Greenhouse	Norman	FL	2011	Foliar	Severe leaf burn with 1.5 ml per L applied 4 times.
27748	Citrex (Citrus extraction)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Maverick Red'	Greenhouse	Reddy	AL	2009	Foliar	Significantly reduced severity of X. campestris at 150 ml per 100 L; inferior to non-inoculated Check.

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
27748	Citrex (Citrus extraction)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) P. x hortorum 'Patriot Bright Red'	Greenhouse	Chase	CA	2008	Foliar	67 % reduction at 1.5 ml per liter + Latron
27748	Citrex (Citrus extraction)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Bright Red'	Greenhouse	Norman	FL	2009	Foliar	First Trial: Good control at 150 ml/L; comparable to CuPro and non-inoculated Check.
27748	Citrex (Citrus extraction)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Red'	Greenhouse	Norman	FL	2007	Foliar	Good efficacy at 1.2 ml per L; equal to Firewall
27589	Companion (Bacillus subtillis GB03)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Red'	Greenhouse	Norman	FL	2006	Foliar	Good efficacy at 2 % concentration
27589	Companion (Bacillus subtillis GB03)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Red'	Greenhouse	Norman	FL	2007	Foliar	No efficacy at 0.5 and 1 % concentration
30519	Copper Count N (copper diammonia diacetate complets)	Erwinia chrysanthemi (Erwinia chrysanthemi)	Orchid, Dancing Lady (Oncidium sp.)	Greenhouse	Palmateer	FL	2010		Low disease incidence (both inoculated and non-inoculated Checks had 0 disease rating)
32367	CuPro (Copper hydroxide)	Pseudomonas syringae blight (Pseudomonas syringae)	Impatiens, Common Garden/Buzzy Lizzy (Impatiens walleriana) 'Super Elfin XP Violet Improved'	Greenhouse	Norman	FL	2012	Foliar	Significantly reduced number of leaf spots with 2 lb per 100 gal applied twice; inferior to non-inoculated check.
32998	CuPro (Copper hydroxide)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Calliope Crimson Flame'	Greenhouse	Norman	FL	2016	Foliar	Effective control with 2 lb per 100 gal applied twice at weekly intervals; comparable to non-inoculated check. Minor marginal leaf burn.
30511	CuPro 2005 (Copper hydroxide)	Erwinia chrysanthemi (Erwinia chrysanthemi)	Poinsettia (Euphorbia pulcherrima) 'Prestige' and 'Autumn Red'	Greenhouse	Chase	CA	2009	Foliar	Some but not significant reduction in disease severity at 2 lb per 100 gal.
29225	CuPro 2005 (Copper hydroxide)	Erwinia chrysanthemi (Erwinia chrysanthemi)	Orchid, Dancing Lady (Oncidium sp.) 'Wilson's Wicked Qua'	Greenhouse	Chase	CA	2009	Foliar	Reduced infection, though not statistically significant from inoculated Check, at 2 lb per 100 gal.
29555	CuPro 2005 (Copper hydroxide)	Erwinia (Erwinia sp.)	Orchid, Moth (Phalaenopsis sp.)	Greenhouse	Norman	FL	2009	Foliar	Very low disease pressure in inoculated Check; not possible to evaluate efficacy of all treatments.
29555	CuPro 2005 (Copper hydroxide)	Erwinia (Erwinia sp.)	Orchid, Moth (Phalaenopsis sp.)	Greenhouse	Norman	FL	2010	Foliar	Significantly reduced leaf lesion size at 2 lb per 100 gal; almost comparable to CuPro and non-inoculated check.

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
30072	CuPro 2005 (Copper hydroxide)	Erwinia (Erwinia sp.)	Callery Pear (Pyrus calleryana) 'Cleveland'	Field Container	Steddom	TX	2012	Foliar	Did not significantly reduce shoot blight with 2 lb per 100 gal applied 6 times (green tip to petal fall).
30072	CuPro 2005 (Copper hydroxide)	Erwinia (Erwinia sp.)	Callery Pear (Pyrus calleryana) 'Kieffer'	Field Container	Steddom	TX	2010	Foliar	No effect on a very low disease pressure at 2 lb per 100 gal; very minor injury comparable to untreated.
30072	CuPro 2005 (Copper hydroxide)	Erwinia (Erwinia sp.)	Callery Pear (Pyrus calleryana) 'Kieffer'	Field Container	Steddom	TX	2011	Foliar	No significant control with 2 lb per 100 gal applied 6 times.
30320	CuPro 2005 (Copper hydroxide)	Pseudomonas cichorii (Pseudomonas cichorii)	Chrysanthemum, Garden (Chrysanthemum/Dendranthema sp.)	Field Container	Norman	FL	2010	Foliar	Significantly reduced leaf lesion incidence at 2 lb per 100 gal; almost comparable to non-inoculated check; best product.
30320	CuPro 2005 (Copper hydroxide)	Pseudomonas cichorii (Pseudomonas cichorii)	Chrysanthemum, Garden (Chrysanthemum/Dendranthema sp.) 'Shasta Improved'	Field Container	Norman	FL	2012	Foliar	Significantly reduced leaf spots with 2 lb per 100 gal applied twice; comparable to untreated non-inoculated check.
30320	CuPro 2005 (Copper hydroxide)	Pseudomonas cichorii (Pseudomonas cichorii)	Chrysanthemum, Garden (Chrysanthemum/Dendranthema sp.) 'Sparkling Cheryl Yellow'	Field Container	Norman	FL	2017	Foliar	Excellent efficacy with 2 lb per 100 gal applied 3 times weekly; comparable to noninoculated check.
31234	CuPro 2005 (Copper hydroxide)	Pseudomonas syringae blight (Pseudomonas syringae)	Rosemallow (Hibiscus sp.) 'Double Red'	Greenhouse	Norman	FL	2011	Foliar	Less lesion development, though not statistically significant, with 2 lb per 100 gal applied twice.
31231	CuPro 2005 (Copper hydroxide)	Xanthomonas sp. (Xanthomonas sp.)	Poinsettia (Euphorbia pulcherrima) 'Eckespoint Prestige Red '	Greenhouse	Norman	FL	2011	Foliar	Significantly reduced number of leaf spots with 2 lb per 100 gal applied twice; inferior to non-inoculated check.
29546	CuPro 2005 (Copper hydroxide)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Bright Red'	Greenhouse	Norman	FL	2009	Foliar	First Trial: Good control at 2 lb per 100 gal; comparable to non-inoculated Check.
27578	Cuprofix MZ Disperse (Mancozeb + Basic copper sulfate)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Red'	Greenhouse	Norman	FL	2006	Foliar	Significantly reduced leafspots at 8.75 lb per 100 gal; considered one of the best treatments

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
27578	Cuprofix MZ Disperse (Mancozeb + Basic copper sulfate)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Red'	Greenhouse	Norman	FL	2007	Foliar	Significantly reduced leafspots at 8.75 lb per 100 gal; equal to Kocide
27577	CuproFix Ultra 40 Disperse (Basic copper sulfate)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Red'	Greenhouse	Norman	FL	2006	Foliar	Significantly reduced leafspots at 1.5 lb per 100 gal; considered one of the best treatments
27577	CuproFix Ultra 40 Disperse (Basic copper sulfate)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Red'	Greenhouse	Norman	FL	2007	Foliar	Excellent efficacy at 1.5 lb per 100 gal; considered one of the best treatments
29487	Dithane 75DF Rainshield (Mancozeb)	Xanthomonas sp. (Xanthomonas sp.)	Ornamental Cabbage/Kale (Brassica oleracea) Kale 'Nagoya Rose'	Greenhouse	Becker	NY	2009	Foliar	Significantly reduced disease severity at 1 lb per 100 gal.
29487	Dithane 75DF Rainshield (Mancozeb)	Xanthomonas sp. (Xanthomonas sp.)	Ornamental Cabbage/Kale (Brassica oleracea) Kale 'White Crane	Greenhouse	Becker	NY	2009	Foliar	Reduced disease severity, but not significantly, at 1 lb per 100 gal.
31235	EarthTec (Copper)	Pseudomonas syringae blight (Pseudomonas syringae)	Rosemallow (Hibiscus sp.) 'Double Red'	Greenhouse	Norman	FL	2011	Foliar	Less lesion development, though not statistically significant, with 1.5 and 8 fl oz per 100 gal applied twice: some phytotoxicity at the high rate.
31232	EarthTec (Copper)	Xanthomonas sp. (Xanthomonas sp.)	Poinsettia (Euphorbia pulcherrima) 'Eckespoint Prestige Red '	Greenhouse	Norman	FL	2011	Foliar	Did not significantly reduce number of leaf spots with 1.5 and 8 fl oz per 100 gal applied twice.
27576	Firewall 17WP (Streptomycin sulfate)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Red'	Greenhouse	Norman	FL	2006	Foliar	Significantly reduced leafspots at 200 ppm; equal to Kocide
27576	Firewall 17WP (Streptomycin sulfate)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Red'	Greenhouse	Norman	FL	2007	Foliar	Good efficacy at 200 ppm concentration
27959	Flameout (Oxytetracycline)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Red'	Greenhouse	Norman	FL	2007	Foliar	No efficacy at 200 ppm concentration
30450	Florel (Ethephon)	Erwinia (Erwinia sp.)	Callery Pear (Pyrus calleryana) 'Cleveland'	Field In-Ground	Steddom	TX	2012	Foliar	Did not significantly reduce shoot blight with 1 and 2 qt per 10 gal applied 5 times (bloom to petal fall).
30450	Florel (Ethephon)	Erwinia (Erwinia sp.)	Callery Pear (Pyrus calleryana) 'Kieffer'	Field In-Ground	Steddom	TX	2011	Foliar	No control with 10 qt per 100 gal applied 4 times.

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
33538	GC Pro (TerraCyte Pro, GreenClean Max) (Sodium carbonate peroxyhydrate)	Pseudomonas cichorii (Pseudomonas cichorii)	Chrysanthemum, Garden (Chrysanthemum/Dendranthema sp.) 'Sparkling Cheryl Yellow'	Field Container	Norman	FL	2017	Foliar	No efficacy with 50 and 150 oz per 100 gal applied 3 times weekly; some foliar damage observed.
32969	GC Pro (TerraCyte Pro, GreenClean Max) (Sodium carbonate peroxyhydrate)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Calliope Crimson Flame'	Greenhouse	Norman	FL	2016	Foliar	Effective control with 50 and 150 oz per 100 gal applied twice at weekly intervals; comparable to CuPro. Minor marginal leaf burn.
33135	GC Pro (TerraCyte Pro, GreenClean Max) (Sodium carbonate peroxyhydrate)	Xanthomonas sp. (Xanthomonas sp.)	Zinnia (Zinnia sp.) 'Lilliput Yellow'	Greenhouse	Ong	TX	2016	Foliar	No disease infection developed. Slight and moderate injury with 50 and 150 oz per 100 gal applied 3 times.
30656	HM-0736 (aka Physpe) (Laminarin)	Agrobacterium sp. (Agrobacterium sp.)	Goldenrod (Solidago sp.)	Greenhouse	Chase	CA	2011	Foliar	Did not significantly reduce number and size of galls with 14.4 oz per 100 gal.
29289	HM-0736 (aka Physpe) (Laminarin)	Erwinia chrysanthemi (Erwinia chrysanthemi)	Poinsettia (Euphorbia pulcherrima) 'Prestige' and 'Autumn Red'	Greenhouse	Chase	CA	2009	Foliar	Reduced infection, though not statistically significant from inoculated Check, at 14.4 oz per 100 gal.
29213	HM-0736 (aka Physpe) (Laminarin)	Erwinia chrysanthemi (Erwinia chrysanthemi)	Orchid, Dancing Lady (Oncidium sp.)	Greenhouse	Palmateer	FL	2010	Foliar	Low disease incidence (both inoculated and non-inoculated Checks had 0 disease rating); no significant effect at 14.4 fl oz per 100 gal.
29213	HM-0736 (aka Physpe) (Laminarin)	Erwinia chrysanthemi (Erwinia chrysanthemi)	Orchid, Dancing Lady (Oncidium sp.) 'Wilson's Wicked Qua'	Greenhouse	Chase	CA	2009	Foliar	Reduced infection, though not statistically significant from inoculated Check, at 14.4 oz per 100 gal.
29196	HM-0736 (aka Physpe) (Laminarin)	Erwinia (Erwinia sp.)	Orchid, Moth (Phalaenopsis sp.)	Greenhouse	Norman	FL	2009	Foliar	Very low disease pressure in inoculated Check; not possible to evaluate efficacy of all treatments.
29196	HM-0736 (aka Physpe) (Laminarin)	Erwinia (Erwinia sp.)	Orchid, Moth (Phalaenopsis sp.)	Greenhouse	Norman	FL	2010	Foliar	Did not significantly reduce leaf lesion size at 14.4 fl oz per 100 gal.
28800	HM-0736 (aka Physpe) (Laminarin)	Erwinia (Erwinia sp.)	Callery Pear (Pyrus calleryana) 'Cleveland'	Field Container	Steddom	TX	2012	Foliar	Did not significantly reduce shoot blight with 14.4 fl oz per 100 gal applied 7 times (green tip to petal fall).

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
28800	HM-0736 (aka Physpe) (Laminarin)	Erwinia (Erwinia sp.)	Callery Pear (Pyrus calleryana) 'Kieffer'	Field Container	Steddom	TX	2010	Foliar	No effect on a very low disease pressure at 14.4 fl oz per 100 gal; virtually no injury.
28800	HM-0736 (aka Physpe) (Laminarin)	Erwinia (Erwinia sp.)	Callery Pear (Pyrus calleryana) 'Kieffer'	Field Container	Steddom	TX	2011	Foliar	No significant control with 14.4 fl oz per 100 gal applied 6 times.
29895	HM-0736 (aka Physpe) (Laminarin)	Pseudomonas cichorii (Pseudomonas cichorii)	Chrysanthemum, Garden (Chrysanthemum/Dendranthema sp.) 'Shasta Improved'	Field Container	Norman	FL	2012	Foliar	Did not significantly reduce leaf spots with 14.4 fl oz per 100 gal applied 3 times.
28088	HM-0736 (aka Physpe) (Laminarin)	Pseudomonas cichorii (Pseudomonas cichorii)	Rosemallow (Hibiscus sp.) H. rosa-sinensis	Field Container	Strandberg	FL	2006	Foliar	No significant efficacy at 450 ml per 100 L
29607	HM-0736 (aka Physpe) (Laminarin)	Pseudomonas sp. (Pseudomonas sp.)	Bolivian Jasmine (Mandevilla boliviensis) 'Alice DuPont'	Greenhouse	Chase	CA	2010	Foliar	Significantly reduced disease severity but not vine infection at 14.4 fl fl oz per 100 gal.
27572	HM-0736 (aka Physpe) (Laminarin)	Pseudomonas syringae blight (Pseudomonas syringae)	Maple, Japanese (Acer palmatum) 'Bloodgood'	Field Container	Pscheidt	OR	2011	Foliar	No disease developed in this trial.
30262	HM-0736 (aka Physpe) (Laminarin)	Pseudomonas syringae blight (Pseudomonas syringae)	Rosemallow (Hibiscus sp.) 'Double Red'	Greenhouse	Norman	FL	2011	Foliar	More lesion development, though not statistically significant, with 14.4 fl oz per 100 gal applied 4 times.
32363	HM-0736 (aka Physpe) (Laminarin)	Pseudomonas syringae blight (Pseudomonas syringae)	Impatiens, Common Garden/Buzzy Lizzy (Impatiens walleriana) 'Super Elfin XP Violet Improved'	Greenhouse	Norman	FL	2012	Foliar	Significantly reduced number of leaf spots with 14.4 fl oz per 100 gal applied 3 times; much inferior to non-inoculated check.
29566	HM-0736 (aka Physpe) (Laminarin)	Pseudomonas syringae blight (Pseudomonas syringae)	Lilac (Syringa sp.) S. vulgaris 'Ellen Willmott'	Field In-Ground	Pscheidt	OR	2010	Foliar	No reduction of disease incidence and severity with 14.4 fl oz per 100 gal.
28093	HM-0736 (aka Physpe) (Laminarin)	Pseudomonas marginalis (Psuedomonas marginalis)	Hydrangea, Oakleaf (Hydrangea quercifolia)	Field Container	Strandberg	FL	2006	Foliar	No significant efficacy at 450 ml per 100 L

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
30254	HM-0736 (aka Physpe) (Laminarin)	Xanthomonas sp. (Xanthomonas sp.)	Poinsettia (Euphorbia pulcherrima) 'Eckespoint Prestige Red '	Greenhouse	Norman	FL	2011	Foliar	Significantly reduced number of leaf spots with 14.4 fl oz per 100 gal applied twice; inferior to non-inoculated check.
28083	HM-0736 (aka Physpe) (Laminarin)	Xanthomonas sp. (Xanthomonas sp.)	Wax Myrtle (Myrica cerifera)	Field Container	Strandberg	FL	2006	Foliar	No significant efficacy at 450 ml per 100 L
27591	HM-0736 (aka Physpe) (Laminarin)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Maverick Red'	Greenhouse	Reddy	AL	2009	Foliar	Significantly reduced severity of X. campestris at 14.4 oz per 100 gal; inferior to non-inoculated Check.
27591	HM-0736 (aka Physpe) (Laminarin)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Bright Red'	Greenhouse	Norman	FL	2009	Foliar	No control at 14.4 fl oz per 100 gal.
27591	HM-0736 (aka Physpe) (Laminarin)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Red'	Greenhouse	Norman	FL	2006	Foliar	No efficacy at 58 oz per 100 gal.
28078	HM-0736 (aka Physpe) (Laminarin)	Xanthomonas sp. (Xanthomonas sp.)	Plum (Prunus sp.) P. incisa x campanulata 'Okame'	Field Container	Strandberg	FL	2006	Foliar	No significant efficacy at 450 ml per 100 L
31443	Inosco (A14658C) (Potassium phosphite)	Erwinia (Erwinia sp.)	Callery Pear (Pyrus calleryana) 'Cleveland'	Field Container	Steddom	TX	2012	Foliar	Did not significantly reduce shoot blight with 2 and 4 pt per 100 gal applied 5 times (green tip to petal fall).
31487	Inosco (A14658C) (Potassium phosphite)	Pseudomonas cichorii (Pseudomonas cichorii)	Chrysanthemum, Garden (Chrysanthemum/Dendranthema sp.) 'Shasta Improved'	Field Container	Norman	FL	2012	Foliar	Did not significantly reduce leaf spots with 4 pt per 100 gal applied twice.
32359	Inosco (A14658C) (Potassium phosphite)	Pseudomonas syringae blight (Pseudomonas syringae)	Impatiens, Common Garden/Buzzy Lizzy (Impatiens walleriana) 'Super Elfin XP Violet Improved'	Greenhouse	Norman	FL	2012	Foliar	Did not reduce number of leaf spots with 4 pt per 100 gal applied twice. Plant injury observed.
31303	Inosco (A14658C) (Potassium phosphite)	Pseudomonas syringae blight (Pseudomonas syringae)	Lilac (Syringa sp.) S. vulgaris 'Ellen Willmott'	Field In-Ground	Pscheidt	OR	2012	Foliar	Some reduction of disease incidence and severity with 64 fl oz per 100 gal.
30653	Insimmo (Acibenzolar-S-methyl)	Agrobacterium sp. (Agrobacterium sp.)	Goldenrod (Solidago sp.)	Greenhouse	Chase	CA	2011	Drench	Did not significantly reduce number and size of galls with 1 oz per 100 gal applied as spray or 0.25 oz per 100 gal drenched.

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
30653	Insimmo (Acibenzolar-S-methyl)	Agrobacterium sp. (Agrobacterium sp.)	Goldenrod (Solidago sp.)	Greenhouse	Chase	CA	2011	Foliar	Did not significantly reduce number and size of galls with 1 oz per 100 gal applied as spray or 0.25 oz per 100 gal drenched.
28037	Insimmo (Acibenzolar-S-methyl)	Erwinia chrysanthemi (Erwinia chrysanthemi)	Poinsettia (Euphorbia pulcherrima) 'Prestige' and 'Autumn Red'	Greenhouse	Chase	CA	2009	Foliar	Did not reduce infection at 0.75 oz per 100 gal.
29210	Insimmo (Acibenzolar-S-methyl)	Erwinia chrysanthemi (Erwinia chrysanthemi)	Orchid, Dancing Lady (Oncidium sp.)	Greenhouse	Palmateer	FL	2010	Foliar	Low disease incidence (both inoculated and non-inoculated Checks had 0 disease rating); no significant effect at 1 fl oz per 100 gal.
29210	Insimmo (Acibenzolar-S-methyl)	Erwinia chrysanthemi (Erwinia chrysanthemi)	Orchid, Dancing Lady (Oncidium sp.) 'Wilson's Wicked Qua'	Greenhouse	Chase	CA	2009	Foliar	Reduced infection, though not statistically significant from inoculated Check, at 0.75 oz per 100 gal.
29194	Insimmo (Acibenzolar-S-methyl)	Erwinia (Erwinia sp.)	Orchid, Moth (Phalaenopsis sp.)	Greenhouse	Norman	FL	2009	Foliar	Very low disease pressure in inoculated Check; not possible to evaluate efficacy of all treatments.
29194	Insimmo (Acibenzolar-S-methyl)	Erwinia (Erwinia sp.)	Orchid, Moth (Phalaenopsis sp.)	Greenhouse	Norman	FL	2010	Foliar	Did not significantly reduce leaf lesion size at 0.75 oz per 100 gal.
28798	Insimmo (Acibenzolar-S-methyl)	Erwinia (Erwinia sp.)	Callery Pear (Pyrus calleryana) 'Cleveland'	Field Container	Steddom	TX	2012	Drench	Significantly reduced shoot blight with 0.25 oz per 100 gal applied 3 times (dormant and bloom).
28798	Insimmo (Acibenzolar-S-methyl)	Erwinia (Erwinia sp.)	Callery Pear (Pyrus calleryana) 'Cleveland'	Field Container	Steddom	TX	2012	Foliar	Significantly reduced shoot blight with 1 oz per 100 gal applied 7 times (green tip to petal fall).
28798	Insimmo (Acibenzolar-S-methyl)	Erwinia (Erwinia sp.)	Callery Pear (Pyrus calleryana) 'Kieffer'	Field Container	Steddom	TX	2010	Drench	No effect on a very low disease pressure at 0.25 oz per 100 gal; very minor injury comparable to untreated.
28798	Insimmo (Acibenzolar-S-methyl)	Erwinia (Erwinia sp.)	Callery Pear (Pyrus calleryana) 'Kieffer'	Field Container	Steddom	TX	2010	Foliar	No effect on a very low disease pressure at 1 oz per 100 gal; very minor injury comparable to untreated.

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
28798	Insimmo (Acibenzolar-S-methyl)	Erwinia (Erwinia sp.)	Callery Pear (Pyrus calleryana) 'Kieffer'	Field Container	Steddom	TX	2011	Drench	No significant control with 0.25 oz per 100 gal drench applied twice.
28798	Insimmo (Acibenzolar-S-methyl)	Erwinia (Erwinia sp.)	Callery Pear (Pyrus calleryana) 'Kieffer'	Field Container	Steddom	TX	2011	Foliar	No significant control with 1 oz per 100 gal applied fioliar 6 times.
29575	Insimmo (Acibenzolar-S-methyl)	Pseudomonas cichorii (Pseudomonas cichorii)	Chrysanthemum, Garden (Chrysanthemum/Dendranthema sp.)	Field Container	Norman	FL	2010	Foliar	Did not significantly reduce leaf lesion incidence at 0.75 oz per 100 gal.
29575	Insimmo (Acibenzolar-S-methyl)	Pseudomonas cichorii (Pseudomonas cichorii)	Chrysanthemum, Garden (Chrysanthemum/Dendranthema sp.) 'Shasta Improved	Field Container	Norman	FL	2012	Drench	Did not significantly reduce leaf spots with 0.25 oz per 100 gal applied once.
29575	Insimmo (Acibenzolar-S-methyl)	Pseudomonas cichorii (Pseudomonas cichorii)	Chrysanthemum, Garden (Chrysanthemum/Dendranthema sp.) 'Shasta Improved'	Field Container	Norman	FL	2012	Foliar	Did not significantly reduce leaf spots with 0.5 and 0.75 oz per 100 gal applied 3 times.
28387	Insimmo (Acibenzolar-S-methyl)	Pseudomonas sp. (Pseudomonas sp.)	Lavender (Lavandula sp.) L. heterophylla ‘Patriot Bright Red’	Greenhouse	Chase	CA	2008	Foliar	No efficacy at 0.75 oz per 100 gal; phytotoxic
29604	Insimmo (Acibenzolar-S-methyl)	Pseudomonas sp. (Pseudomonas sp.)	Bolivian Jasmine (Mandevilla boliviensis) 'Alice DuPont'	Greenhouse	Chase	CA	2010	Drench	No reduction in vine infection when drenched at 0.25 oz per 100 gal.
29604	Insimmo (Acibenzolar-S-methyl)	Pseudomonas sp. (Pseudomonas sp.)	Bolivian Jasmine (Mandevilla boliviensis) 'Alice DuPont'	Greenhouse	Chase	CA	2010	Foliar	Significantly reduced vine infection sprayed at 1 oz per 100 gal.
27566	Insimmo (Acibenzolar-S-methyl)	Pseudomonas syringae blight (Pseudomonas syringae)	Maple, Japanese (Acer palmatum)	Field Container	Regan	OR	2008	Foliar	No significant difference from untreated check with 1 oz per 110 gal.
27566	Insimmo (Acibenzolar-S-methyl)	Pseudomonas syringae blight (Pseudomonas syringae)	Maple, Japanese (Acer palmatum) 'Bloodgood'	Field Container	Pscheidt	OR	2011	Foliar	No disease developed in this trial.

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
30259	Insimmo (Acibenzolar-S-methyl)	Pseudomonas syringae blight (Pseudomonas syringae)	Rosemallow (Hibiscus sp.) 'Double Red'	Greenhouse	Norman	FL	2011	Foliar	Less lesion development, though not statistically significant, with 0.75 oz per 100 gal applied 4 times.
32358	Insimmo (Acibenzolar-S-methyl)	Pseudomonas syringae blight (Pseudomonas syringae)	Impatiens, Common Garden/Buzzy Lizzy (Impatiens walleriana) 'Super Elfin XP Violet Improved'	Greenhouse	Norman	FL	2012	Foliar	Excellent control with 0.5 and 0.75 oz per 100 gal applied 3 times; almost comparable to non-inoculated check; best product in trial. Plant injury observed.
29564	Insimmo (Acibenzolar-S-methyl)	Pseudomonas syringae blight (Pseudomonas syringae)	Lilac (Syringa sp.) S. vulgaris 'Ellen Willmott'	Field In-Ground	Pscheidt	OR	2010	Foliar	No reduction of disease incidence and severity with 1 oz per 100 gal.
28521	Insimmo (Acibenzolar-S-methyl)	Xanthomonas sp. (Xanthomonas sp.)	Ornamental Cabbage/Kale (Brassica oleracea) Kale 'Nagoya Rose'	Greenhouse	Becker	NY	2009	Foliar	Significantly reduced disease severity at 0.75 oz per 100 gal; slight injury (leaf chlorosis and necrosis).
28521	Insimmo (Acibenzolar-S-methyl)	Xanthomonas sp. (Xanthomonas sp.)	Ornamental Cabbage/Kale (Brassica oleracea) Kale 'White Crane	Greenhouse	Becker	NY	2009	Foliar	Reduced disease severity, but not significantly, at 0.75 oz per 100 gal; slight injury (leaf chlorosis and necrosis).
30251	Insimmo (Acibenzolar-S-methyl)	Xanthomonas sp. (Xanthomonas sp.)	Poinsettia (Euphorbia pulcherrima) 'Eckespoint Prestige Red '	Greenhouse	Norman	FL	2011	Foliar	Significantly reduced number of leaf spots with 0.75 oz per 100 gal applied 4 times; inferior to non-inoculated check.
27747	Insimmo (Acibenzolar-S-methyl)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Maverick Red'	Greenhouse	Reddy	AL	2009	Foliar	Significantly reduced severity of X. campestris at 1.25 oz per 100 gal; inferior to non-inoculated Check.
27747	Insimmo (Acibenzolar-S-methyl)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) P. x hortorum 'Patriot Bright Red'	Greenhouse	Chase	CA	2008	Foliar	100 % effective at 0.75 oz per 100 gal; severe injury.
27747	Insimmo (Acibenzolar-S-methyl)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Bright Red'	Greenhouse	Norman	FL	2009	Foliar	Good control at 0.019 oz per 100 gal; almost comparable to CuPro and non-inoculated Check.
27579	Junction (SePro) (Mancozeb + copper hydroxide)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Red'	Greenhouse	Norman	FL	2006	Foliar	Significantly reduced leafspots at 1.5 lb per 100 gal; considered one of the best treatments

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
27579	Junction (SePro) (Mancozeb + copper hydroxide)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Red'	Greenhouse	Norman	FL	2007	Foliar	Excellent efficacy at 1.5 lb per 100 gal; considered one of the best treatments
30657	Kasumin (Kasugamycin)	Agrobacterium sp. (Agrobacterium sp.)	Goldenrod (Solidago sp.)	Greenhouse	Chase	CA	2011	Foliar	Did not significantly reduce number and size of galls with 45 oz per 100 gal.
28039	Kasumin (Kasugamycin)	Erwinia chrysanthemi (Erwinia chrysanthemi)	Poinsettia (Euphorbia pulcherrima) 'Prestige' and 'Autumn Red'	Greenhouse	Chase	CA	2009	Foliar	Reduced infection, though not statistically significant from inoculated Check, at 45 oz per 100 gal
29214	Kasumin (Kasugamycin)	Erwinia chrysanthemi (Erwinia chrysanthemi)	Orchid, Dancing Lady (Oncidium sp.)	Greenhouse	Palmateer	FL	2010	Foliar	Low disease incidence (both inoculated and non-inoculated Checks had 0 disease rating); no significant effect at 45 fl oz per 100 gal.
29214	Kasumin (Kasugamycin)	Erwinia chrysanthemi (Erwinia chrysanthemi)	Orchid, Dancing Lady (Oncidium sp.) 'Wilson's Wicked Qua'	Greenhouse	Chase	CA	2009	Foliar	Higher infection than inoculated Check at 45 oz per 100 gal
28942	Kasumin (Kasugamycin)	Erwinia (Erwinia sp.)	Orchid, Moth (Phalaenopsis sp.)	Greenhouse	Norman	FL	2009	Foliar	Very low disease pressure in inoculated Check; not possible to evaluate efficacy of all treatments.
28942	Kasumin (Kasugamycin)	Erwinia (Erwinia sp.)	Orchid, Moth (Phalaenopsis sp.)	Greenhouse	Norman	FL	2010	Foliar	Did not reduce leaf lesion size at 45 fl oz per 100 gal.
28801	Kasumin (Kasugamycin)	Erwinia (Erwinia sp.)	Callery Pear (Pyrus calleryana) 'Cleveland'	Field Container	Steddom	TX	2012	Foliar	Significantly reduced shoot blight with 45 fl oz per 100 gal applied 6 times (green tip to petal fall).
28801	Kasumin (Kasugamycin)	Erwinia (Erwinia sp.)	Callery Pear (Pyrus calleryana) 'Kieffer'	Field Container	Steddom	TX	2010	Foliar	No effect on a very low disease pressure at 45 fl oz per 100 gal; very minor injury comparable to untreated.
28801	Kasumin (Kasugamycin)	Erwinia (Erwinia sp.)	Callery Pear (Pyrus calleryana) 'Kieffer'	Field Container	Steddom	TX	2011	Foliar	No significant control with 45 fl oz per 100 gal applied 6 times.
29896	Kasumin (Kasugamycin)	Pseudomonas cichorii (Pseudomonas cichorii)	Chrysanthemum, Garden (Chrysanthemum/Dendranthema sp.)	Field Container	Norman	FL	2010	Foliar	Significantly reduced leaf lesion incidence at 45 fl oz per 100 gal; comparable to CuPro.

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
29896	Kasumin (Kasugamycin)	Pseudomonas cichorii (Pseudomonas cichorii)	Chrysanthemum, Garden (Chrysanthemum/Dendranthema sp.) 'Shasta Improved'	Field Container	Norman	FL	2012	Foliar	Significantly reduced leaf spots with 64 fl oz per 100 gal applied twice; comparable to untreated non-inoculated check.
28089	Kasumin (Kasugamycin)	Pseudomonas cichorii (Pseudomonas cichorii)	Rosemallow (Hibiscus sp.) H. rosa-sinensis	Field Container	Strandberg	FL	2006	Foliar	No efficacy at 64 oz per 100 gal
28389	Kasumin (Kasugamycin)	Pseudomonas sp. (Pseudomonas sp.)	Lavender (Lavandula sp.) L. heterophylla 'Patriot Bright Red'	Greenhouse	Chase	CA	2008	Foliar	No efficacy at 45 oz per 100 gal; phytotoxic
29608	Kasumin (Kasugamycin)	Pseudomonas sp. (Pseudomonas sp.)	Bolivian Jasmine (Mandevilla boliviensis) 'Alice DuPont'	Greenhouse	Chase	CA	2010	Foliar	Excellent control at 45 fl oz per 100 gal; best treatment; significant stunting.
27568	Kasumin (Kasugamycin)	Pseudomonas syringae blight (Pseudomonas syringae)	Maple, Japanese (Acer palmatum)	Field Container	Regan	OR	2008	Foliar	No significant difference from untreated check with 45 fl oz per 100 gal.
27568	Kasumin (Kasugamycin)	Pseudomonas syringae blight (Pseudomonas syringae)	Maple, Japanese (Acer palmatum) 'Bloodgood'	Field Container	Pscheidt	OR	2011	Foliar	No disease developed in this trial. Some indication of abnormal leaf color with 45 and 64 fl oz per 100 gal.
30263	Kasumin (Kasugamycin)	Pseudomonas syringae blight (Pseudomonas syringae)	Rosemallow (Hibiscus sp.) 'Double Red'	Greenhouse	Norman	FL	2011	Foliar	Less lesion development, though not statistically significant, with 45 fl oz per 100 gal applied twice.
32366	Kasumin (Kasugamycin)	Pseudomonas syringae blight (Pseudomonas syringae)	Impatiens, Common Garden/Buzzy Lizzy (Impatiens walleriana) 'Super Elfin XP Violet Improved'	Greenhouse	Norman	FL	2012	Foliar	Significantly reduced number of leaf spots with 64 fl oz per 100 gal applied twice; much inferior to non-inoculated check.
29567	Kasumin (Kasugamycin)	Pseudomonas syringae blight (Pseudomonas syringae)	Lilac (Syringa sp.) S. vulgaris 'Ellen Willmott'	Field In-Ground	Pscheidt	OR	2010	Foliar	Significantly reduced disease incidence and severity with 45 and 64 fl oz per 100 gal; comparable to Nu-Cop.
28094	Kasumin (Kasugamycin)	Pseudomonas marginalis (Psuedomonas marginalis)	Hydrangea, Oakleaf (Hydrangea quercifolia)	Field Container	Strandberg	FL	2006	Foliar	No significant efficacy at 64 oz per 100 gal

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
28523	Kasumin (Kasugamycin)	Xanthomonas sp. (Xanthomonas sp.)	Ornamental Cabbage/Kale (Brassica oleracea) Kale 'Nagoya Rose'	Greenhouse	Becker	NY	2009	Foliar	Significantly reduced disease severity at 45 fl oz per 100 gal.
28523	Kasumin (Kasugamycin)	Xanthomonas sp. (Xanthomonas sp.)	Ornamental Cabbage/Kale (Brassica oleracea) Kale 'White Crane	Greenhouse	Becker	NY	2009	Foliar	Reduced disease severity, but not significantly, at 45 fl oz per 100 gal.
30255	Kasumin (Kasugamycin)	Xanthomonas sp. (Xanthomonas sp.)	Poinsettia (Euphorbia pulcherrima) 'Eckespoint Prestige Red '	Greenhouse	Norman	FL	2011	Foliar	Did not reduce number of leaf spots with 45 fl oz per 100 gal applied twice.
28084	Kasumin (Kasugamycin)	Xanthomonas sp. (Xanthomonas sp.)	Wax Myrtle (Myrica cerifera)	Field Container	Strandberg	FL	2006	Foliar	No significant efficacy at 64 oz per 100 gal
26721	Kasumin (Kasugamycin)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Maverick Red'	Greenhouse	Reddy	AL	2009	Foliar	Significantly reduced severity of X. campestris at 45 fl oz per 100 gal; inferior to non-inoculated Check.
26721	Kasumin (Kasugamycin)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) P. x hortorum 'Patriot Bright Red'	Greenhouse	Chase	CA	2008	Foliar	No efficacy at 45 fl oz per 100 gal
26721	Kasumin (Kasugamycin)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Bright Red'	Greenhouse	Norman	FL	2009	Foliar	No significant control at 45 fl oz per 100 gal.
26721	Kasumin (Kasugamycin)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Red'	Greenhouse	Norman	FL	2006	Foliar	Poor efficacy at 2 qt per 100 gal
26721	Kasumin (Kasugamycin)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Red'	Greenhouse	Norman	FL	2007	Foliar	Poor efficacy at 1.5 qt per 100 gal
28079	Kasumin (Kasugamycin)	Xanthomonas sp. (Xanthomonas sp.)	Plum (Prunus sp.) P. incisa x campanulata 'Okame'	Field Container	Strandberg	FL	2006	Foliar	No efficacy at 64 oz per 100 gal
30070	Kleengrow (Didecyl dimethyl ammonium chloride)	Erwinia (Erwinia sp.)	Callery Pear (Pyrus calleryana) 'Cleveland'	Field Container	Steddom	TX	2012	Foliar	Significantly reduced shoot blight with 50 fl oz per 100 gal applied 6 times (green tip to petal fall).
30070	Kleengrow (Didecyl dimethyl ammonium chloride)	Erwinia (Erwinia sp.)	Callery Pear (Pyrus calleryana) 'Kieffer'	Field Container	Steddom	TX	2010	Foliar	No effect on a very low disease pressure at 25 fl oz per 100 gal; minor injury.
30070	Kleengrow (Didecyl dimethyl ammonium chloride)	Erwinia (Erwinia sp.)	Callery Pear (Pyrus calleryana) 'Kieffer'	Field Container	Steddom	TX	2011	Foliar	No significant control with 50 fl oz per 100 gal applied 6 times.

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
33541	Kleengrow (Didecyl dimethyl ammonium chloride)	Pseudomonas cichorii (Pseudomonas cichorii)	Chrysanthemum, Garden (Chrysanthemum/Dendranthema sp.) 'Sparkling Cheryl Yellow'	Field Container	Norman	FL	2017	Foliar	Poor to no efficacy with 13 fl oz per 100 gal applied 3 times weekly.
31307	Kleengrow (Didecyl dimethyl ammonium chloride)	Pseudomonas syringae blight (Pseudomonas syringae)	Lilac (Syringa sp.) S. vulgaris 'Ellen Willmott'	Field In-Ground	Pscheidt	OR	2012	Foliar	No significant reduction of disease incidence and severity with 25 fl oz per 100 gal.
27673	Kocide 2000 (Dupont) (Copper Hydroxide)	Pseudomonas cichorii (Pseudomonas cichorii)	Rosemallow (Hibiscus sp.) H. rosa-sinensis	Field Container	Strandberg	FL	2006	Foliar	No significant efficacy at 1.75 lb per acre
27673	Kocide 2000 (Dupont) (Copper Hydroxide)	Pseudomonas cichorii (Pseudomonas cichorii)	Rosemallow (Hibiscus sp.) H. rosa-sinensis	Field Container	Strandberg	FL	2007	Foliar	Slight to moderate disease pressure; no significant efficacy at 2 lb per 100 gal
29088	Kocide 2000 (Dupont) (Copper Hydroxide)	Pseudomonas syringae blight (Pseudomonas syringae)	Maple, Japanese (Acer palmatum)	Field Container	Regan	OR	2008	Foliar	No significant difference from untreated check with 2 lb per 100 gal.
27666	Kocide 2000 (Dupont) (Copper Hydroxide)	Pseudomonas marginalis (Psuedomonas marginalis)	Hydrangea, Oakleaf (Hydrangea quercifolia)	Field Container	Strandberg	FL	2006	Foliar	No significant efficacy at 1.75 lb per acre
27666	Kocide 2000 (Dupont) (Copper Hydroxide)	Pseudomonas marginalis (Psuedomonas marginalis)	Hydrangea, Oakleaf (Hydrangea quercifolia)	Field Container	Strandberg	FL	2007	Foliar	Moderate to severe disease pressure; no significant differences among treatments
27659	Kocide 2000 (Dupont) (Copper Hydroxide)	Xanthomonas sp. (Xanthomonas sp.)	Wax Myrtle (Myrica cerifera)	Field Container	Strandberg	FL	2006	Foliar	Statistically significantly suppressed disease at 1.75 lb per acre, but not biologically significant.
27659	Kocide 2000 (Dupont) (Copper Hydroxide)	Xanthomonas sp. (Xanthomonas sp.)	Wax Myrtle (Myrica cerifera)	Field Container	Strandberg	FL	2007	Foliar	Severe disease pressure; no significant differences among treatments
27573	Kocide 2000 (Dupont) (Copper Hydroxide)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Red'	Greenhouse	Norman	FL	2006	Foliar	Significantly reduced leafspots at 0.75, 1 and 2 lb per 100 gal; considered one of the best treatments
27652	Kocide 2000 (Dupont) (Copper Hydroxide)	Xanthomonas sp. (Xanthomonas sp.)	Plum (Prunus sp.) P. incisa x campanulata 'Okame'	Field Container	Strandberg	FL	2006	Foliar	No significant efficacy at 1.75 lb per acre

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
27652	Kocide 2000 (Dupont) (Copper Hydroxide)	Xanthomonas sp. (Xanthomonas sp.)	Plum (Prunus sp.) P. incisa x campanulata 'Okame'	Field Container	Strandberg	FL	2007	Foliar	Severe disease pressure; no significant efficacy at 2 lb per 100 gal
29489	Kocide 3000 (Copper hydroxide)	Xanthomonas sp. (Xanthomonas sp.)	Ornamental Cabbage/Kale (Brassica oleracea) Kale 'Nagoya Rose'	Greenhouse	Becker	NY	2009	Foliar	Significantly reduced disease severity at 2 lb per 100 gal
29489	Kocide 3000 (Copper hydroxide)	Xanthomonas sp. (Xanthomonas sp.)	Ornamental Cabbage/Kale (Brassica oleracea) Kale 'White Crane	Greenhouse	Becker	NY	2009	Foliar	Significantly reduced disease severity at 2 lb per 100 gal
31368	Kocide 3000 (Copper hydroxide)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot'	Greenhouse	Norman	FL	2007	Foliar	Good efficacy at 0.75 lb per 100 gal
28091	K-Phite (Phophorus acid salts)	Pseudomonas cichorii (Pseudomonas cichorii)	Rosemallow (Hibiscus sp.) H. rosa-sinensis	Field Container	Strandberg	FL	2006	Foliar	No significant efficacy at 5 qt per 100 gal
28096	K-Phite (Phophorus acid salts)	Pseudomonas marginalis (Psuedomonas marginalis)	Hydrangea, Oakleaf (Hydrangea quercifolia)	Field Container	Strandberg	FL	2006	Foliar	No significant efficacy at 5 qt per 100 gal
28086	K-Phite (Phophorus acid salts)	Xanthomonas sp. (Xanthomonas sp.)	Wax Myrtle (Myrica cerifera)	Field Container	Strandberg	FL	2006	Foliar	No significant efficacy at 5 qt per 100 gal
27600	K-Phite (Phophorus acid salts)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Red'	Greenhouse	Norman	FL	2007	Foliar	No efficacy at 2 qt per 100 gal
28081	K-Phite (Phophorus acid salts)	Xanthomonas sp. (Xanthomonas sp.)	Plum (Prunus sp.) P. incisa x campanulata 'Okame'	Field Container	Strandberg	FL	2006	Foliar	No efficacy at 5 qt per 100 gal
33539	MBI 110 (MBI110)	Pseudomonas cichorii (Pseudomonas cichorii)	Chrysanthemum, Garden (Chrysanthemum/Dendranthema sp.) 'Sparkling Cheryl Yellow'	Field Container	Norman	FL	2017	Foliar	Mediocre efficacy with 1 gal per 100 gal applied 3 times weekly; inferior to noninoculated check.
32970	MBI 110 (MBI110)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Calliope Crimson Flame'	Greenhouse	Norman	FL	2016	Foliar	Effective control with 1 gal per 100 gal applied twice at weekly intervals; comparable to CuPro. Minor marginal leaf burn.
33136	MBI 110 (MBI110)	Xanthomonas sp. (Xanthomonas sp.)	Zinnia (Zinnia sp.) 'Lilliput Yellow'	Greenhouse	Ong	TX	2016	Foliar	No disease infection developed. No injury with 1 gal per 100 gal applied 3 times.

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
27961	Milsana (now Regalia) (Extract of Reynoutria sachalinensis)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Red'	Greenhouse	Norman	FL	2007	Foliar	No efficacy at 1 % concentration
30658	NAI-4201 (NAI-4201)	Agrobacterium sp. (Agrobacterium sp.)	Goldenrod (Solidago sp.)	Greenhouse	Chase	CA	2011	Drench	Did not significantly reduce number and size of galls with 5 oz per 100 gal.
29215	NAI-4201 (NAI-4201)	Erwinia chrysanthemi (Erwinia chrysanthemi)	Orchid, Dancing Lady (Oncidium sp.)	Greenhouse	Palmateer	FL	2010	Foliar	Low disease incidence (both inoculated and non-inoculated Checks had 0 disease rating); no significant effect at 5 fl oz per 100 gal.
29197	NAI-4201 (NAI-4201)	Erwinia (Erwinia sp.)	Orchid, Moth (Phalaenopsis sp.)	Greenhouse	Norman	FL	2009	Foliar	Very low disease pressure in inoculated Check; not possible to evaluate efficacy of all treatments.
30073	NAI-4201 (NAI-4201)	Erwinia (Erwinia sp.)	Callery Pear (Pyrus calleryana) 'Cleveland'	Field Container	Steddom	TX	2012	Foliar	Significantly reduced shoot blight with 5 fl oz per 100 gal applied 6 times (bloom to petal fall).
30073	NAI-4201 (NAI-4201)	Erwinia (Erwinia sp.)	Callery Pear (Pyrus calleryana) 'Kieffer'	Field Container	Steddom	TX	2010	Foliar	No effect on a very low disease pressure at 5 fl oz per 100 gal; very minor injury comparable to untreated.
30073	NAI-4201 (NAI-4201)	Erwinia (Erwinia sp.)	Callery Pear (Pyrus calleryana) 'Kieffer'	Field Container	Steddom	TX	2011	Foliar	No control with 5 fl oz per 100 gal applied 4 times.
29581	NAI-4201 (NAI-4201)	Pseudomonas cichorii (Pseudomonas cichorii)	Chrysanthemum, Garden (Chrysanthemum/Dendranthema sp.) 'Shasta Improved'	Field Container	Norman	FL	2012	Drench	Did not significantly reduce leaf spots with 5 fl oz per 100 gal applied twice.
29609	NAI-4201 (NAI-4201)	Pseudomonas sp. (Pseudomonas sp.)	Bolivian Jasmine (Mandevilla boliviensis) 'Alice DuPont'	Greenhouse	Chase	CA	2010	Foliar	Significantly reduced vine infection but not disease severity at 5 fl oz per 100 gal.
30265	NAI-4201 (NAI-4201)	Pseudomonas syringae blight (Pseudomonas syringae)	Rosemallow (Hibiscus sp.) 'Double Red'	Greenhouse	Norman	FL	2011	Drench	Slight reduction in lesion development with 5 fl oz per 100 gal applied 3 times.

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32364	NAI-4201 (NAI-4201)	Pseudomonas syringae blight (Pseudomonas syringae)	Impatiens, Common Garden/Buzzy Lizzy (Impatiens walleriana) 'Super Elfin XP Violet Improved'	Greenhouse	Norman	FL	2012	Foliar	Significantly reduced number of leaf spots with 5 fl oz per 100 gal applied twice; much inferior to non-inoculated check.
30257	NAI-4201 (NAI-4201)	Xanthomonas sp. (Xanthomonas sp.)	Poinsettia (Euphorbia pulcherrima) 'Eckespoint Prestige Red '	Greenhouse	Norman	FL	2011	Drench	Did not significantly reduce number of leaf spots with 5 fl oz per 100 gal applied 3 times.
29203	NAI-4201 (NAI-4201)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Bright Red'	Greenhouse	Norman	FL	2009	Foliar	No significant control at 5 fl oz per 100 gal
31225	Nu-Cop 50DF (Copper Hydroxicide)	Pseudomonas syringae blight (Pseudomonas syringae)	Maple, Japanese (Acer palmatum) 'Bloodgood'	Field Container	Pscheidt	OR	2011	Foliar	No disease developed in this trial.
30553	Nu-Cop 50DF (Copper Hydroxicide)	Pseudomonas syringae blight (Pseudomonas syringae)	Lilac (Syringa sp.) S. vulgaris 'Ellen Willmott'	Field In-Ground	Pscheidt	OR	2010	Foliar	Significantly reduced disease incidence and severity with 1 lb per 100 gal.
27958	Omega Grow Plus (Fish oil)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Red'	Greenhouse	Norman	FL	2007	Foliar	Poor efficacy at 2 % concentration
33540	OxiPhos (Mono and di potassium salts of phosphorus acid + hydrogen peroxide)	Pseudomonas cichorii (Pseudomonas cichorii)	Chrysanthemum, Garden (Chrysanthemum/Dendranthema sp.) 'Sparkling Cheryl Yellow'	Field Container	Norman	FL	2017	Foliar	No efficacy with 128 fl oz per 100 gal applied 3 times weekly; some foliar damage observed.
32995	OxiPhos (Mono and di potassium salts of phosphorus acid + hydrogen peroxide)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Calliope Crimson Flame'	Greenhouse	Norman	FL	2016	Foliar	Effective control with 42 and 128 fl oz per 100 gal applied twice at weekly intervals; inferior to CuPro. Minor marginal leaf burn.
33137	OxiPhos (Mono and di potassium salts of phosphorus acid + hydrogen peroxide)	Xanthomonas sp. (Xanthomonas sp.)	Zinnia (Zinnia sp.) 'Lilliput Yellow'	Greenhouse	Ong	TX	2016	Foliar	No disease infection developed. No injury with 42 and 128 fl oz per 100 gal applied 3 times.
27580	Penncozeb DF (Mancozeb)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Red'	Greenhouse	Norman	FL	2006	Foliar	Significantly reduced leafspots at 1.5 lb per 100 gal; considered one of the best treatments
27580	Penncozeb DF (Mancozeb)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Red'	Greenhouse	Norman	FL	2007	Foliar	Excellent efficacy at 1.5 lb per 100 gal; considered one of the best treatments

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28884	Phyton-27 (Copper sulfate pentahydrate)	Pseudomonas sp. (Pseudomonas sp.)	Lavender (Lavandula sp.) L. heterophylla 'Patriot Bright Red'	Greenhouse	Chase	CA	2008	Foliar	No efficacy at 50 oz per 100 gal
27590	Phyton-27 (Copper sulfate pentahydrate)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) P. x hortorum 'Patriot Bright Red'	Greenhouse	Chase	CA	2008	Foliar	76 % reduction at 50 fl oz per 100 gal
27590	Phyton-27 (Copper sulfate pentahydrate)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Red'	Greenhouse	Norman	FL	2006	Foliar	Good efficacy at 50 oz per 100 gal; equal to Kocide
27590	Phyton-27 (Copper sulfate pentahydrate)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Red'	Greenhouse	Norman	FL	2007	Foliar	Good efficacy at 50 oz per 100 gal
27667	Phyton-27 New Dimension (Copper sulphate pentahydrate)	Pseudomonas cichorii (Pseudomonas cichorii)	Rosemallow (Hibiscus sp.) H. rosa-sinensis	Field Container	Strandberg	FL	2007	Foliar	Slight to moderate disease pressure; no significant efficacy at 25 oz per 100 gal
27660	Phyton-27 New Dimension (Copper sulphate pentahydrate)	Pseudomonas marginalis (Psuedomonas marginalis)	Hydrangea, Oakleaf (Hydrangea quercifolia)	Field Container	Strandberg	FL	2007	Foliar	Moderate to severe disease pressure; no significant differences among treatments
27653	Phyton-27 New Dimension (Copper sulphate pentahydrate)	Xanthomonas sp. (Xanthomonas sp.)	Wax Myrtle (Myrica cerifera)	Field Container	Strandberg	FL	2007	Foliar	Severe disease pressure; no significant differences among treatments
27646	Phyton-27 New Dimension (Copper sulphate pentahydrate)	Xanthomonas sp. (Xanthomonas sp.)	Plum (Prunus sp.) P. incisa x campanulata 'Okame'	Field Container	Strandberg	FL	2007	Foliar	Severe disease pressure; no significant efficacy at 25 oz per 100 gal
32971	Prophytex EC (Bacillus subtilis strain B1111)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Calliope Crimson Flame'	Greenhouse	Norman	FL	2016	Foliar	Effective control with 64 fl oz per 100 gal applied twice at weekly intervals; inferior to CuPro. Minor marginal leaf burn.
32972	Prophytex WP (Bacillus subtilis strain B1111)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Calliope Crimson Flame'	Greenhouse	Norman	FL	2016	Foliar	Effective control with 32 oz per 100 gal applied twice at weekly intervals; inferior to CuPro. Minor marginal leaf burn.
30322	Protect T/O (Mancozeb)	Erwinia (Erwinia sp.)	Orchid, Moth (Phalaenopsis sp.)	Greenhouse	Norman	FL	2010	Foliar	Significantly reduced leaf lesion size at 2 lb per 100 gal; almost comparable to non-inoculated check.
30321	Protect T/O (Mancozeb)	Pseudomonas cichorii (Pseudomonas cichorii)	Chrysanthemum, Garden (Chrysanthemum/Dendranthema sp.)	Field Container	Norman	FL	2010	Foliar	Significantly reduced leaf lesion incidence at 2 lb per 100 gal; almost comparable to CuPro.

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
29090	Protect T/O (Mancozeb)	Pseudomonas syringae blight (Pseudomonas syringae)	Maple, Japanese (Acer palmatum)	Field Container	Regan	OR	2008	Foliar	No significant difference from untreated check with 2 lb per 100 gal.
31233	Protect T/O (Mancozeb)	Pseudomonas syringae blight (Pseudomonas syringae)	Rosemallow (Hibiscus sp.) 'Double Red'	Greenhouse	Norman	FL	2011	Foliar	No lesion development, though not statistically significant, with 2 lb per 100 gal applied twice.
31230	Protect T/O (Mancozeb)	Xanthomonas sp. (Xanthomonas sp.)	Poinsettia (Euphorbia pulcherrima) 'Eckespoint Prestige Red '	Greenhouse	Norman	FL	2011	Foliar	Significantly reduced number of leaf spots with 2 lb per 100 gal applied twice; comparable to non-inoculated check.
30659	Regalia O5 (MOI-10605) (Extract of Reynoutria sachalinensis)	Agrobacterium sp. (Agrobacterium sp.)	Goldenrod (Solidago sp.)	Greenhouse	Chase	CA	2011	Foliar	Did not significantly reduce number and size of galls with 1 % conc.
29574	Regalia O5 (MOI-10605) (Extract of Reynoutria sachalinensis)	Erwinia chrysanthemi (Erwinia chrysanthemi)	Orchid, Dancing Lady (Oncidium sp.)	Greenhouse	Palmateer	FL	2010	Foliar	Low disease incidence (both inoculated and non-inoculated Checks had 0 disease rating); no significant effect at 1 % (v/v).
29202	Regalia O5 (MOI-10605) (Extract of Reynoutria sachalinensis)	Erwinia (Erwinia sp.)	Orchid, Moth (Phalaenopsis sp.)	Greenhouse	Norman	FL	2009	Foliar	Very low disease pressure in inoculated Check; not possible to evaluate efficacy of all treatments.
29202	Regalia O5 (MOI-10605) (Extract of Reynoutria sachalinensis)	Erwinia (Erwinia sp.)	Orchid, Moth (Phalaenopsis sp.)	Greenhouse	Norman	FL	2010	Foliar	Did not significantly reduce leaf lesion size at 1 % conc.
30451	Regalia O5 (MOI-10605) (Extract of Reynoutria sachalinensis)	Erwinia (Erwinia sp.)	Callery Pear (Pyrus calleryana) 'Cleveland'	Field Container	Steddom	TX	2012	Foliar	Did not reduce shoot blight with 1 qt per 10 gal applied 6 times (bloom to petal fall).
30451	Regalia O5 (MOI-10605) (Extract of Reynoutria sachalinensis)	Erwinia (Erwinia sp.)	Callery Pear (Pyrus calleryana) 'Kieffer'	Field Container	Steddom	TX	2011	Foliar	No significant control with 1 % v:v applied 6 times.
29580	Regalia O5 (MOI-10605) (Extract of Reynoutria sachalinensis)	Pseudomonas cichorii (Pseudomonas cichorii)	Chrysanthemum, Garden (Chrysanthemum/Dendranthema sp.)	Field Container	Norman	FL	2010	Foliar	Significantly reduced leaf lesion incidence at 1 % conc.; almost comparable to CuPro.

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
29580	Regalia O5 (MOI-10605) (Extract of Reynoutria sachalinensis)	Pseudomonas cichorii (Pseudomonas cichorii)	Chrysanthemum, Garden (Chrysanthemum/Dendranthema sp.) 'Shasta Improved'	Field Container	Norman	FL	2012	Foliar	Did not reduce leaf spots with 1 % v/v conc. applied twice.
30208	Regalia O5 (MOI-10605) (Extract of Reynoutria sachalinensis)	Pseudomonas syringae blight (Pseudomonas syringae)	Maple, Japanese (Acer palmatum) 'Bloodgood'	Field Container	Pscheidt	OR	2011	Foliar	No disease developed in this trial.
30264	Regalia O5 (MOI-10605) (Extract of Reynoutria sachalinensis)	Pseudomonas syringae blight (Pseudomonas syringae)	Rosemallow (Hibiscus sp.) 'Double Red'	Greenhouse	Norman	FL	2011	Foliar	Less lesion development, though not statistically significant, with 1 % v:v applied twice.
32361	Regalia O5 (MOI-10605) (Extract of Reynoutria sachalinensis)	Pseudomonas syringae blight (Pseudomonas syringae)	Impatiens, Common Garden/Buzzy Lizzy (Impatiens walleriana) 'Super Elfin XP Violet Improved'	Greenhouse	Norman	FL	2012	Foliar	Significantly reduced number of leaf spots with 1 gal per 100 gal applied twice; much inferior to non-inoculated check.
30256	Regalia O5 (MOI-10605) (Extract of Reynoutria sachalinensis)	Xanthomonas sp. (Xanthomonas sp.)	Poinsettia (Euphorbia pulcherrima) 'Eckespoint Red Velvet'	Greenhouse	Norman	FL	2011	Foliar	Did not reduce number of leaf spots with 1 % v:v applied twice.
29204	Regalia O5 (MOI-10605) (Extract of Reynoutria sachalinensis)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Bright Red'	Greenhouse	Norman	FL	2009	Foliar	Good control at 1 % dilution; comparable to CuPro and non-inoculated Check.
28936	Regalia SC (MOI 106) (Extract of Reynoutria sachalinensis)	Erwinia (Erwinia sp.)	Callery Pear (Pyrus calleryana) 'Kieffer'	Field Container	Steddom	TX	2010	Foliar	No effect on a very low disease pressure at 1 % conc.; virtually no injury.
28393	Regalia SC (MOI 106) (Extract of Reynoutria sachalinensis)	Pseudomonas sp. (Pseudomonas sp.)	Lavender (Lavandula sp.) L. heterophylla ‘Patriot Bright Red’	Greenhouse	Chase	CA	2008	Foliar	No efficacy at 1 % + Nu-Film P
29610	Regalia SC (MOI 106) (Extract of Reynoutria sachalinensis)	Pseudomonas sp. (Pseudomonas sp.)	Bolivian Jasmine (Mandevilla boliviensis) 'Alice DuPont'	Greenhouse	Chase	CA	2010	Foliar	Significantly reduced disease severity and vine infection at 1 % solution.
29572	Regalia SC (MOI 106) (Extract of Reynoutria sachalinensis)	Pseudomonas syringae blight (Pseudomonas syringae)	Lilac (Syringa sp.) S. vulgaris 'Ellen Willmott'	Field In-Ground	Pscheidt	OR	2010	Foliar	No reduction of disease incidence and severity with 1 gal per 100 gal.

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
29572	Regalia SC (MOI 106) (Extract of Reynoutria sachalinensis)	Pseudomonas syringae blight (Pseudomonas syringae)	Lilac (Syringa sp.) S. vulgaris 'Ellen Willmott'	Field In-Ground	Pscheidt	OR	2012	Foliar	No significant reduction of disease incidence and severity with 1 gal per 100 gal.
28044	Regalia SC (MOI 106) (Extract of Reynoutria sachalinensis)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) P. x hortorum 'Patriot Bright Red'	Greenhouse	Chase	CA	2008	Foliar	45 % reduction at 1 % + Nu-Film P
27696	Rotation: Tricon / Phyton New Dimension (Sodium borate decahydrate / copper pentahydrate)	Pseudomonas cichorii (Pseudomonas cichorii)	Rosemallow (Hibiscus sp.) H. rosa-sinensis	Field Container	Strandberg	FL	2007	Foliar	Slight to moderate disease pressure; fair efficacy at 0.8 % / 25 oz per 100 gal
27695	Rotation: Tricon / Phyton New Dimension (Sodium borate decahydrate / copper pentahydrate)	Pseudomonas marginalis (Psuedomonas marginalis)	Hydrangea, Oakleaf (Hydrangea quercifolia)	Field Container	Strandberg	FL	2007	Foliar	Moderate to severe disease pressure; no significant differences among treatments
27694	Rotation: Tricon / Phyton New Dimension (Sodium borate decahydrate / copper pentahydrate)	Xanthomonas sp. (Xanthomonas sp.)	Wax Myrtle (Myrica cerifera)	Field Container	Strandberg	FL	2007	Foliar	Severe disease pressure; no significant differences among treatments
27693	Rotation: Tricon / Phyton New Dimension (Sodium borate decahydrate / copper pentahydrate)	Xanthomonas sp. (Xanthomonas sp.)	Plum (Prunus sp.) P. incisa x campanulata 'Okame'	Field Container	Strandberg	FL	2007	Foliar	Severe disease pressure; no significant efficacy at 0.8 % / 25 oz per 100
28040	SP2015 (SP2015)	Erwinia chrysanthemi (Erwinia chrysanthemi)	Poinsettia (Euphorbia pulcherrima) 'Prestige' and 'Autumn Red'	Greenhouse	Chase	CA	2009	Foliar	Reduced infection, though not statistically significant from inoculated Check, at 12 oz per 100 gal.
29216	SP2015 (SP2015)	Erwinia chrysanthemi (Erwinia chrysanthemi)	Orchid, Dancing Lady (Oncidium sp.)	Greenhouse	Palmateer	FL	2010	Foliar	Low disease incidence (both inoculated and non-inoculated Checks had 0 disease rating); no significant effect at 12 oz per 100 gal.
29216	SP2015 (SP2015)	Erwinia chrysanthemi (Erwinia chrysanthemi)	Orchid, Dancing Lady (Oncidium sp.) 'Wilson's Wicked Qua'	Greenhouse	Chase	CA	2009	Foliar	Reduced infection, though not statistically significant from inoculated Check, at 12 oz per 100 gal.

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
29198	SP2015 (SP2015)	Erwinia (Erwinia sp.)	Orchid, Moth (Phalaenopsis sp.)	Greenhouse	Norman	FL	2009	Foliar	Very low disease pressure in inoculated Check; not possible to evaluate efficacy of all treatments.
29198	SP2015 (SP2015)	Erwinia (Erwinia sp.)	Orchid, Moth (Phalaenopsis sp.)	Greenhouse	Norman	FL	2010	Foliar	Did not reduce leaf lesion size at 12 oz per 100 gal.
28802	SP2015 (SP2015)	Erwinia (Erwinia sp.)	Callery Pear (Pyrus calleryana) 'Kieffer'	Field Container	Steddom	TX	2010	Foliar	No effect on a very low disease pressure at 12 oz per 100 gal; virtually no injury.
29578	SP2015 (SP2015)	Pseudomonas cichorii (Pseudomonas cichorii)	Chrysanthemum, Garden (Chrysanthemum/Dendranthema sp.)	Field Container	Norman	FL	2010	Foliar	Did not reduce leaf lesion incidence at 12 oz per 100 gal.
28390	SP2015 (SP2015)	Pseudomonas sp. (Pseudomonas sp.)	Lavender (Lavandula sp.) L. heterophylla 'Patriot Bright Red'	Greenhouse	Chase	CA	2008	Foliar	No efficacy at 12 oz per 100 gal
29611	SP2015 (SP2015)	Pseudomonas sp. (Pseudomonas sp.)	Bolivian Jasmine (Mandevilla boliviensis) 'Alice DuPont'	Greenhouse	Chase	CA	2010	Foliar	No significant control at 12 oz per 100 gal.
27569	SP2015 (SP2015)	Pseudomonas syringae blight (Pseudomonas syringae)	Maple, Japanese (Acer palmatum)	Field Container	Regan	OR	2008	Foliar	No significant difference from untreated check with 12 oz per 100 gal.
28524	SP2015 (SP2015)	Xanthomonas sp. (Xanthomonas sp.)	Ornamental Cabbage/Kale (Brassica oleracea) Kale 'Nagoya Rose'	Greenhouse	Becker	NY	2009	Foliar	Significantly reduced disease severity at 12 oz per 100 gal.
28524	SP2015 (SP2015)	Xanthomonas sp. (Xanthomonas sp.)	Ornamental Cabbage/Kale (Brassica oleracea) Kale 'White Crane	Greenhouse	Becker	NY	2009	Foliar	Reduced disease severity, but not significantly, at 12 oz per 100 gal.
27750	SP2015 (SP2015)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Maverick Red'	Greenhouse	Reddy	AL	2009	Foliar	Significantly reduced severity of X. campestris at 12 fl oz per 100 gal; inferior to non-inoculated Check.
27750	SP2015 (SP2015)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) P. x hortorum 'Patriot Bright Red'	Greenhouse	Chase	CA	2008	Foliar	No efficacy at 12 oz per 100 gal
27750	SP2015 (SP2015)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Bright Red'	Greenhouse	Norman	FL	2009	Foliar	No control at 12 oz per 100 gal.

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
28041	Taegro (Bacillus subtilis var amyloliquefaciens strain FZB24)	Erwinia chrysanthemi (Erwinia chrysanthemi)	Poinsettia (Euphorbia pulcherrima) 'Prestige' and 'Autumn Red'	Greenhouse	Chase	CA	2009	Foliar	Significantly reduced infection at 12 oz per 100 gal; comparable to uninoculated Check.
29217	Taegro (Bacillus subtilis var amyloliquefaciens strain FZB24)	Erwinia chrysanthemi (Erwinia chrysanthemi)	Orchid, Dancing Lady (Oncidium sp.)	Greenhouse	Palmateer	FL	2010	Foliar	Low disease incidence (both inoculated and non-inoculated Checks had 0 disease rating); no significant effect at 3.5 oz per 100 gal.
29217	Taegro (Bacillus subtilis var amyloliquefaciens strain FZB24)	Erwinia chrysanthemi (Erwinia chrysanthemi)	Orchid, Dancing Lady (Oncidium sp.) 'Wilson's Wicked Qua'	Greenhouse	Chase	CA	2009	Drench	Higher infection than inoculated Check at 3.5 oz per 100 gal
29199	Taegro (Bacillus subtilis var amyloliquefaciens strain FZB24)	Erwinia (Erwinia sp.)	Orchid, Moth (Phalaenopsis sp.)	Greenhouse	Norman	FL	2009	Foliar	Very low disease pressure in inoculated Check; not possible to evaluate efficacy of all treatments.
29199	Taegro (Bacillus subtilis var amyloliquefaciens strain FZB24)	Erwinia (Erwinia sp.)	Orchid, Moth (Phalaenopsis sp.)	Greenhouse	Norman	FL	2010	Foliar	Did not significantly reduce leaf lesion size at 3.5 oz per 100 gal.
28803	Taegro (Bacillus subtilis var amyloliquefaciens strain FZB24)	Erwinia (Erwinia sp.)	Callery Pear (Pyrus calleryana) 'Kieffer'	Field Container	Steddom	TX	2010	Foliar / Drench	No effect on a very low disease pressure at 3.5 oz per 100 gal; very minor injury comparable to untreated.
29579	Taegro (Bacillus subtilis var amyloliquefaciens strain FZB24)	Pseudomonas cichorii (Pseudomonas cichorii)	Chrysanthemum, Garden (Chrysanthemum/Dendranthema sp.)	Field Container	Norman	FL	2010	Foliar	Significantly reduced leaf lesion incidence at 3.5 oz per 100 gal but much inferior to CuPro.
28391	Taegro (Bacillus subtilis var amyloliquefaciens strain FZB24)	Pseudomonas sp. (Pseudomonas sp.)	Lavender (Lavandula sp.) L. heterophylla 'Patriot Bright Red'	Greenhouse	Chase	CA	2008	Drench	No efficacy at 3.5 oz per 100 gal
29612	Taegro (Bacillus subtilis var amyloliquefaciens strain FZB24)	Pseudomonas sp. (Pseudomonas sp.)	Bolivian Jasmine (Mandevilla boliviensis) 'Alice DuPont'	Greenhouse	Chase	CA	2010	Foliar / Drench	No significant control at 3.5 oz per 100 gal.
27570	Taegro (Bacillus subtilis var amyloliquefaciens strain FZB24)	Pseudomonas syringae blight (Pseudomonas syringae)	Maple, Japanese (Acer palmatum)	Field Container	Regan	OR	2008	Foliar / Drench	No significant difference from untreated check with 3.5 oz per 100 gal.
28525	Taegro (Bacillus subtilis var amyloliquefaciens strain FZB24)	Xanthomonas sp. (Xanthomonas sp.)	Ornamental Cabbage/Kale (Brassica oleracea) Kale 'Nagoya Rose'	Greenhouse	Becker	NY	2009	Foliar	Significantly reduced disease severity at 3.5 oz per 100 gal.

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
28525	Taegro (Bacillus subtilis var amyloliquefaciens strain FZB24)	Xanthomonas sp. (Xanthomonas sp.)	Ornamental Cabbage/Kale (Brassica oleracea) Kale 'White Crane'	Greenhouse	Becker	NY	2009	Foliar	Reduced disease severity, but not significant, at 3.5 oz per 100 gal.
27749	Taegro (Bacillus subtilis var amyloliquefaciens strain FZB24)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Maverick Red'	Greenhouse	Reddy	AL	2009	Foliar	Significantly reduced severity of X. campestris at 3.5 oz per 100 gal; inferior to non-inoculated Check.
27749	Taegro (Bacillus subtilis var amyloliquefaciens strain FZB24)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) P. x hortorum 'Patriot Bright Red'	Greenhouse	Chase	CA	2008	Drench / Foliar	No efficacy at 3.5 oz per 100 gal
27749	Taegro (Bacillus subtilis var amyloliquefaciens strain FZB24)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Bright Red'	Greenhouse	Norman	FL	2009	Foliar	First Trial: No control at 3.5 oz per 100 gal.
28092	Tank Mix: Actinovate + Tricon (Streptomyces lydicus WYEC 108 + Sodium tetraborahydrate deceahydrate)	Pseudomonas cichorii (Pseudomonas cichorii)	Rosemallow (Hibiscus sp.) H. rosa-sinensis	Field Container	Strandberg	FL	2006	Foliar	Significantly suppressed disease at 3.4 g + 15 ml per gal; the only effective treatment at about 50% control.
28097	Tank Mix: Actinovate + Tricon (Streptomyces lydicus WYEC 108 + Sodium tetraborahydrate deceahydrate)	Pseudomonas cichorii (Pseudomonas cichorii)	Hydrangea, Oakleaf (Hydrangea quercifolia)	Field Container	Strandberg	FL	2006	Foliar	Significantly suppressed disease at 3.4 g + 15 ml per gal; the only effective treatment at about 50 % efficacy.
28087	Tank Mix: Actinovate + Tricon (Streptomyces lydicus WYEC 108 + Sodium tetraborahydrate deceahydrate)	Xanthomonas sp. (Xanthomonas sp.)	Wax Myrtle (Myrica cerifera)	Field Container	Strandberg	FL	2006	Foliar	Statistically significantly suppressed disease at 3.4 g + 15 ml per gal, but not biologically significant.
28082	Tank Mix: Actinovate + Tricon (Streptomyces lydicus WYEC 108 + Sodium tetraborahydrate deceahydrate)	Xanthomonas sp. (Xanthomonas sp.)	Plum (Prunus sp.) P. incisa x campanulata 'Okame'	Field Container	Strandberg	FL	2006	Foliar	Statistically significantly suppressed disease at 3.4 g + 15 ml per gal but not biologically significant.
27671	Tank Mix: BioPhos + Chelated Copper (Phosphorus acid + chelated copper)	Pseudomonas cichorii (Pseudomonas cichorii)	Rosemallow (Hibiscus sp.) H. rosa-sinensis	Field Container	Strandberg	FL	2006	Foliar	No efficacy at 2 % concentration + 0.1 lb ai per acre

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
27671	Tank Mix: BioPhos + Chelated Copper (Phosphorus acid + chelated copper)	Pseudomonas cichorii (Pseudomonas cichorii)	Rosemallow (Hibiscus sp.) H. rosa-sinensis	Field Container	Strandberg	FL	2007	Foliar	Slight to moderate disease pressure; no significant efficacy at 2 % + 0.1 lb ai per 100 gal
27664	Tank Mix: BioPhos + Chelated Copper (Phosphorus acid + chelated copper)	Pseudomonas marginalis (Psuedomonas marginalis)	Hydrangea, Oakleaf (Hydrangea quercifolia)	Field Container	Strandberg	FL	2006	Foliar	Poor efficacy at 2 % concentration + 0.1 lb ai per acre
27664	Tank Mix: BioPhos + Chelated Copper (Phosphorus acid + chelated copper)	Pseudomonas marginalis (Psuedomonas marginalis)	Hydrangea, Oakleaf (Hydrangea quercifolia)	Field Container	Strandberg	FL	2007	Foliar	Moderate to severe disease pressure; no significant differences among treatments
27657	Tank Mix: BioPhos + Chelated Copper (Phosphorus acid + chelated copper)	Xanthomonas sp. (Xanthomonas sp.)	Wax Myrtle (Myrica cerifera)	Field Container	Strandberg	FL	2006	Foliar	No significant efficacy at 2 % concentration + 0.1 lb ai per acre
27657	Tank Mix: BioPhos + Chelated Copper (Phosphorus acid + chelated copper)	Xanthomonas sp. (Xanthomonas sp.)	Wax Myrtle (Myrica cerifera)	Field Container	Strandberg	FL	2007	Foliar	Severe disease pressure; no significant differences among treatments
27650	Tank Mix: BioPhos + Chelated Copper (Phosphorus acid + chelated copper)	Xanthomonas sp. (Xanthomonas sp.)	Plum (Prunus sp.) P. incisa x campanulata 'Okame'	Field Container	Strandberg	FL	2006	Foliar	No significant efficacy at 2 % concentration + 0.1 lb ai per acre
27650	Tank Mix: BioPhos + Chelated Copper (Phosphorus acid + chelated copper)	Xanthomonas sp. (Xanthomonas sp.)	Plum (Prunus sp.) P. incisa x campanulata 'Okame'	Field Container	Strandberg	FL	2007	Foliar	Severe disease pressure; no significant efficacy at 2 % + 0.1 lb ai per 100 gal
29226	Tank Mix: Cease + Milstop (Bacillus subtilis + potassium bicarbonate)	Erwinia chrysanthemi (Erwinia chrysanthemi)	Orchid, Dancing Lady (Oncidium sp.)	Greenhouse	Palmateer	FL	2010	Foliar	Low disease incidence (both inoculated and non-inoculated Checks had 0 disease rating); no significant effect at 1 % (v/v) + 2.5 lb per 100 gal.
28937	Tank Mix: Cease + Milstop (Bacillus subtilis + potassium bicarbonate)	Erwinia (Erwinia sp.)	Callery Pear (Pyrus calleryana) 'Cleveland'	Field Container	Steddom	TX	2012	Foliar	Did not significantly reduce shoot blight with 4 qt + 3 lb per 100 gal applied 6 times (bloom to petal fall).
28937	Tank Mix: Cease + Milstop (Bacillus subtilis + potassium bicarbonate)	Erwinia (Erwinia sp.)	Callery Pear (Pyrus calleryana) 'Kieffer'	Field Container	Steddom	TX	2011	Foliar	No significant control with 4 qt + 3 lb per 100 gal applied 5 times.

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
27668	Tank Mix: Kasumin + Kocide (Kasugamycin + copper hydroxide)	Pseudomonas cichorii (Pseudomonas cichorii)	Rosemallow (Hibiscus sp.) H. rosa-sinensis	Field Container	Strandberg	FL	2007	Foliar	Slight to moderate disease pressure; poor efficacy at 1 gal + 2 lb per 100 gal
27661	Tank Mix: Kasumin + Kocide (Kasugamycin + copper hydroxide)	Pseudomonas marginalis (Psuedomonas marginalis)	Hydrangea, Oakleaf (Hydrangea quercifolia)	Field Container	Strandberg	FL	2007	Foliar	Moderate to severe disease pressure; no significant differences among treatments
27654	Tank Mix: Kasumin + Kocide (Kasugamycin + copper hydroxide)	Xanthomonas sp. (Xanthomonas sp.)	Wax Myrtle (Myrica cerifera)	Field Container	Strandberg	FL	2007	Foliar	Severe disease pressure; no significant differences among treatments
27581	Tank Mix: Kasumin + Kocide (Kasugamycin + copper hydroxide)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Red'	Greenhouse	Norman	FL	2006	Foliar	Significantly reduced leafspots at 2 qt + 2 lb per 100 gal; considered one of the best treatments
27647	Tank Mix: Kasumin + Kocide (Kasugamycin + copper hydroxide)	Xanthomonas sp. (Xanthomonas sp.)	Plum (Prunus sp.) P. incisa x campanulata 'Okame'	Field Container	Strandberg	FL	2007	Foliar	Severe disease pressure; no significant efficacy at 1 gal + 2 lb per 100 gal
31445	Tank Mix: Kocide + Kleengrow (Copper Hydroxide + Didecyl dimethyl ammonium chloride)	Erwinia (Erwinia sp.)	Callery Pear (Pyrus calleryana) 'Cleveland'	Field Container	Steddom	TX	2012	Foliar	Significantly reduced shoot blight with 50 fl oz + 2 lb per 100 gal applied 5 times (green tip to petal fall).
27670	Tank Mix: K-Phite + Tricon (Phophorus acid salts + Sodium tetraborahydrate deceahydrate)	Pseudomonas cichorii (Pseudomonas cichorii)	Rosemallow (Hibiscus sp.) H. rosa-sinensis	Field Container	Strandberg	FL	2007	Foliar	Slight to moderate disease pressure; no significant efficacy at 2 qt + 0.4 % per 100 gal
27663	Tank Mix: K-Phite + Tricon (Phophorus acid salts + Sodium tetraborahydrate deceahydrate)	Pseudomonas marginalis (Psuedomonas marginalis)	Hydrangea, Oakleaf (Hydrangea quercifolia)	Field Container	Strandberg	FL	2007	Foliar	Moderate to severe disease pressure; no significant differences among treatments
27656	Tank Mix: K-Phite + Tricon (Phophorus acid salts + Sodium tetraborahydrate deceahydrate)	Xanthomonas sp. (Xanthomonas sp.)	Wax Myrtle (Myrica cerifera)	Field Container	Strandberg	FL	2007	Foliar	Severe disease pressure; no significant differences among treatments
27649	Tank Mix: K-Phite + Tricon (Phophorus acid salts + Sodium tetraborahydrate deceahydrate)	Xanthomonas sp. (Xanthomonas sp.)	Plum (Prunus sp.) P. incisa x campanulata 'Okame'	Field Container	Strandberg	FL	2007	Foliar	Severe disease pressure; no significant efficacy at 2 qt + 0.4 % per 100 gal

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
27595	Tank Mix: K-Phyte + Kocide 2000 (Phophorus acid salts + copper hydroxide)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Red'	Greenhouse	Norman	FL	2006	Foliar	Significantly reduced leafspots at 2 qt + 2 lb per 100 gal; considered one of the best treatments
27596	Tank Mix: K-Phyte + Penncozeb (Phophorus acid salts + mancozeb)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Red'	Greenhouse	Norman	FL	2006	Foliar	Significantly reduced leafspots at 2 qt + 1.5 lb per 100 gal; considered one of the best treatments
27597	Tank Mix: K-Phyte + Phyton (Phophorus acid salts + copper sulfate pentahydrate)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Red'	Greenhouse	Norman	FL	2006	Foliar	Significantly reduced leafspots at 2 qt + 50 oz per 100 gal; equal to Kocide T-M
27592	Tank Mix: Physpe + Kocide 2000 (Laminarin + copper hydroxide)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Red'	Greenhouse	Norman	FL	2006	Foliar	Significantly reduced leafspots at 58 oz + 2 lb per 100 gal; considered one of the best treatments
27594	Tank Mix: Physpe + Penncozeb (Laminarin + mancozeb)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Red'	Greenhouse	Norman	FL	2006	Foliar	No efficacy at 58 oz + 1.5 lb per 100 gal
27593	Tank Mix: Physpe + Phyton (Laminarin + copper sulfate pentahydrate)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Red'	Greenhouse	Norman	FL	2006	Foliar	Significantly reduced leafspots at 58 + 50 oz per 100 gal; equal to Kocide T-M
30512	Tank Mix: Rezist + Sett (Chelated Copper/Manganese/Zinc + Calcium/Boron + surfactant)	Erwinia chrysanthemi (Erwinia chrysanthemi)	Poinsettia (Euphorbia pulcherrima) 'Prestige' and 'Autumn Red'	Greenhouse	Chase	CA	2009	Foliar	At 32 oz for both products, disease was significanly less than the inoculated control.
27586	Tank Mix: Rhapsody + Actinovate (Bacillus subtilis + Streptomyces lydicus WYEC 108)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Red'	Greenhouse	Norman	FL	2006	Foliar	No efficacy at 8 qt + 12 oz per 100 gal
27583	Tank Mix: Rhapsody + Kocide (Bacillus subtilis + copper hydroxide)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Red'	Greenhouse	Norman	FL	2006	Foliar	Significantly reduced leafspots at 8 qt + 2 lb per 100 gal; considered one of the best treatments
28090	Tank Mix: Rhapsody + Kocide 2000 + Vital (Bacillus subtilis + Copper hydroxide + phosphite)	Pseudomonas cichorii (Pseudomonas cichorii)	Rosemallow (Hibiscus sp.) H. rosa-sinensis	Field Container	Strandberg	FL	2006	Foliar	No significant efficacy at 1 % concentration + 1.5 lb + 4 pt per acre

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
28095	Tank Mix: Rhapsody + Kocide 2000 + Vital (Bacillus subtilis + Copper hydroxide + phosphite)	Pseudomonas marginalis (Psuedomonas marginalis)	Hydrangea, Oakleaf (Hydrangea quercifolia)	Field Container	Strandberg	FL	2006	Foliar	No significant efficacy at 1 % concentration + 1.5 lb + 4 pt per acre
28085	Tank Mix: Rhapsody + Kocide 2000 + Vital (Bacillus subtilis + Copper hydroxide + phosphite)	Xanthomonas sp. (Xanthomonas sp.)	Wax Myrtle (Myrica cerifera)	Field Container	Strandberg	FL	2006	Foliar	Statistically significantly suppressed disease at 1 % concentration + 1.5 lb + 4 pt per acre, but not biologically significant.
28080	Tank Mix: Rhapsody + Kocide 2000 + Vital (Bacillus subtilis + Copper hydroxide + phosphite)	Xanthomonas sp. (Xanthomonas sp.)	Plum (Prunus sp.) P. incisa x campanulata 'Okame'	Field Container	Strandberg	FL	2006	Foliar	No significant efficacy at 1 % concentration + 1.5 lb + 4 pt per acre
27585	Tank Mix: Rhapsody + K-Phyte (Bacillus subtilis + phosphorus acid salts)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Red'	Greenhouse	Norman	FL	2006	Foliar	Poor efficacy at 8 qt + 2 qt per 100 gal
27584	Tank Mix: Rhapsody + Penncozeb (Bacillus subtilis + mancozeb)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Red'	Greenhouse	Norman	FL	2006	Foliar	Significantly reduced leafspots at 8 qt + 1.5 lb per 100 gal; considered one of the best treatments
27587	Tank Mix: Rhapsody + Phyton (Bacillus subtilis + copper sulfate pentahydrate)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Red'	Greenhouse	Norman	FL	2006	Foliar	Significantly reduced leafspots at 8 qt + 50 oz per 100 gal; equal to Kocide T-M's
28042	Tank Mix: SP2015 + CuPRO 2005 (Famoxadone + Cymoxanil + Copper)	Erwinia chrysanthemi (Erwinia chrysanthemi)	Poinsettia (Euphorbia pulcherrima) 'Prestige' and 'Autumn Red'	Greenhouse	Chase	CA	2009	Foliar	Reduced infection, though not statistically significant from inoculated Check, at 8 oz + 2 lb per 100 gal.
29218	Tank Mix: SP2015 + CuPRO 2005 (Famoxadone + Cymoxanil + Copper)	Erwinia chrysanthemi (Erwinia chrysanthemi)	Orchid, Dancing Lady (Oncidium sp.)	Greenhouse	Palmateer	FL	2010	Foliar	Low disease incidence (both inoculated and non-inoculated Checks had 0 disease rating); no significant effect at 8 oz + 2 lb per 100 gal.
29218	Tank Mix: SP2015 + CuPRO 2005 (Famoxadone + Cymoxanil + Copper)	Erwinia chrysanthemi (Erwinia chrysanthemi)	Orchid, Dancing Lady (Oncidium sp.) 'Wilson's Wicked Qua'	Greenhouse	Chase	CA	2009	Foliar	Reduced infection, though not statistically significant from inoculated Check, at 8 oz + 2 lb per 100 gal.

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
29200	Tank Mix: SP2015 + CuPRO 2005 (Famoxadone + Cymoxanil + Copper)	Erwinia (Erwinia sp.)	Orchid, Moth (Phalaenopsis sp.)	Greenhouse	Norman	FL	2009	Foliar	Very low disease pressure in inoculated Check; not possible to evaluate efficacy of all treatments.
29200	Tank Mix: SP2015 + CuPRO 2005 (Famoxadone + Cymoxanil + Copper)	Erwinia (Erwinia sp.)	Orchid, Moth (Phalaenopsis sp.)	Greenhouse	Norman	FL	2010	Foliar	Significantly reduced leaf lesion size at 8 oz + 2 lb per 100 gal; almost comparable to CuPro and non-inoculated check.
28804	Tank Mix: SP2015 + CuPRO 2005 (Famoxadone + Cymoxanil + Copper)	Erwinia (Erwinia sp.)	Callery Pear (Pyrus calleryana) 'Kieffer'	Field Container	Steddom	TX	2010	Foliar	No effect on a very low disease pressure at 8 oz + 2 lb per 100 gal; very minor injury comparable to untreated.
29900	Tank Mix: SP2015 + CuPRO 2005 (Famoxadone + Cymoxanil + Copper)	Pseudomonas cichorii (Pseudomonas cichorii)	Chrysanthemum, Garden (Chrysanthemum/Dendranthema sp.)	Field Container	Norman	FL	2010	Foliar	Significantly reduced leaf lesion incidence at 8 oz + 2 lb per 100 gal; comparable to CuPro.
27672	Tank Mix: SP2015 + CuPRO 2005 (Famoxadone + Cymoxanil + Copper)	Pseudomonas cichorii (Pseudomonas cichorii)	Rosemallow (Hibiscus sp.) H. rosa-sinensis	Field Container	Strandberg	FL	2006	Foliar	No efficacy at 8 oz + 1.5 lb per acre
27672	Tank Mix: SP2015 + CuPRO 2005 (Famoxadone + Cymoxanil + Copper)	Pseudomonas cichorii (Pseudomonas cichorii)	Rosemallow (Hibiscus sp.) H. rosa-sinensis	Field Container	Strandberg	FL	2007	Foliar	Slight to moderate disease pressure; no significant efficacy at 8 oz + 2 lb per 100 gal
28392	Tank Mix: SP2015 + CuPRO 2005 (Famoxadone + Cymoxanil + Copper)	Pseudomonas sp. (Pseudomonas sp.)	Lavender (Lavandula sp.) L. heterophylla 'Patriot Bright Red'	Greenhouse	Chase	CA	2008	Foliar	Only treatment that significantly reduced disease incidence at 8 + 32 oz per 100 gal
29613	Tank Mix: SP2015 + CuPRO 2005 (Famoxadone + Cymoxanil + Copper)	Pseudomonas sp. (Pseudomonas sp.)	Bolivian Jasmine (Mandevilla boliviensis) 'Alice DuPont'	Greenhouse	Chase	CA	2010	Foliar	Good control at 8 oz + 2 lb per 100 gal.
27571	Tank Mix: SP2015 + CuPRO 2005 (Famoxadone + Cymoxanil + Copper)	Pseudomonas syringae blight (Pseudomonas syringae)	Maple, Japanese (Acer palmatum)	Field Container	Regan	OR	2008	Foliar	No significant difference from untreated check with 8 oz + 2 lb per 100 gal.
27665	Tank Mix: SP2015 + CuPRO 2005 (Famoxadone + Cymoxanil + Copper)	Pseudomonas marginalis (Psuedomonas marginalis)	Hydrangea, Oakleaf (Hydrangea quercifolia)	Field Container	Strandberg	FL	2006	Foliar	No significant efficacy at 8 oz + 1.5 lb per acre

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
27665	Tank Mix: SP2015 + CuPRO 2005 (Famoxadone + Cymoxanil + Copper)	Pseudomonas marginalis (Psuedomonas marginalis)	Hydrangea, Oakleaf (Hydrangea quercifolia)	Field Container	Strandberg	FL	2007	Foliar	Moderate to severe disease pressure; no significant differences among treatments
28526	Tank Mix: SP2015 + CuPRO 2005 (Famoxadone + Cymoxanil + Copper)	Xanthomonas sp. (Xanthomonas sp.)	Ornamental Cabbage/Kale (Brassica oleracea) Kale 'Nagoya Rose'	Greenhouse	Becker	NY	2009	Foliar	Significantly reduced disease severity at 8 oz + 2 lb per 100 gal.
28526	Tank Mix: SP2015 + CuPRO 2005 (Famoxadone + Cymoxanil + Copper)	Xanthomonas sp. (Xanthomonas sp.)	Ornamental Cabbage/Kale (Brassica oleracea) Kale 'White Crane	Greenhouse	Becker	NY	2009	Foliar	Reduced disease severity, but not significantly, at 8 oz + 2 lb per 100 gal.
27658	Tank Mix: SP2015 + CuPRO 2005 (Famoxadone + Cymoxanil + Copper)	Xanthomonas sp. (Xanthomonas sp.)	Wax Myrtle (Myrica cerifera)	Field Container	Strandberg	FL	2006	Foliar	No significant efficacy at 8 oz + 1.5 lb per acre
27658	Tank Mix: SP2015 + CuPRO 2005 (Famoxadone + Cymoxanil + Copper)	Xanthomonas sp. (Xanthomonas sp.)	Wax Myrtle (Myrica cerifera)	Field Container	Strandberg	FL	2007	Foliar	Severe disease pressure; no significant differences among treatments
26722	Tank Mix: SP2015 + CuPRO 2005 (Famoxadone + Cymoxanil + Copper)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Maverick Red'	Greenhouse	Reddy	AL	2009	Foliar	Significantly reduced severity of X. campestris at 8 oz + 2 lb per 100 gal; best treatment; comparable to non-inoculated Check.
26722	Tank Mix: SP2015 + CuPRO 2005 (Famoxadone + Cymoxanil + Copper)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) P. x hortorum 'Patriot Bright Red'	Greenhouse	Chase	CA	2008	Foliar	90 % reduction at 8 + 32 oz per 100 gal
26722	Tank Mix: SP2015 + CuPRO 2005 (Famoxadone + Cymoxanil + Copper)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Bright Red'	Greenhouse	Norman	FL	2009	Foliar	Good control at 8 oz + 2 lb per 100 gal; comparable to CuPro and non-inoculated Check.
26722	Tank Mix: SP2015 + CuPRO 2005 (Famoxadone + Cymoxanil + Copper)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Red'	Greenhouse	Norman	FL	2006	Foliar	Significantly reduced leafspots at 8 oz + 1 lb per 100 gal; considered one of the best treatments
27651	Tank Mix: SP2015 + CuPRO 2005 (Famoxadone + Cymoxanil + Copper)	Xanthomonas sp. (Xanthomonas sp.)	Plum (Prunus sp.) P. incisa x campanulata 'Okame'	Field Container	Strandberg	FL	2006	Foliar	No significant efficacy at 8 oz + 1.5 lb per acre

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
27651	Tank Mix: SP2015 + CuPRO 2005 (Famoxadone + Cymoxanil + Copper)	Xanthomonas sp. (Xanthomonas sp.)	Plum (Prunus sp.) P. incisa x campanulata 'Okame'	Field Container	Strandberg	FL	2007	Foliar	Severe disease pressure; no significant efficacy at 8 oz + 2 lb per 100 gal
27599	Tank Mix: Vital + Rhapsody (Phosphite + Bacillus subtilis)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Red'	Greenhouse	Norman	FL	2006	Foliar	Poor efficacy at 2 qt + 8 qt per 100 gal
27955	Tanos (Famoxadone + Cymoxanil)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Red'	Greenhouse	Norman	FL	2007	Foliar	No efficacy at 8 oz per 100 gal
33544	TDA02 (TDA01)	Pseudomonas cichorii (Pseudomonas cichorii)	Chrysanthemum, Garden (Chrysanthemum/Dendranthema sp.) 'Sparkling Cheryl Yellow'	Field Container	Norman	FL	2017	Foliar	No efficacy with 100 g + 300 ml and 200 g + 600 ml applied once; some foliar damage observed.
32994	TDA-RTU (TDA-RTU)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Calliope Crimson Flame'	Greenhouse	Norman	FL	2016	Foliar	Effective control with 0.4 g per 100 gal applied once; comparable to CuPro. Moderate marginal leaf burn.
33140	TDA-RTU (TDA-RTU)	Xanthomonas sp. (Xanthomonas sp.)	Zinnia (Zinnia sp.) 'Lilliput Yellow'	Greenhouse	Ong	TX	2016	Foliar	No disease infection developed. Severe injury with RTU solution applied 3 times.
33542	Triathlon (Bacillus amyloliquefaciens Strain D747)	Pseudomonas cichorii (Pseudomonas cichorii)	Chrysanthemum, Garden (Chrysanthemum/Dendranthema sp.) 'Sparkling Cheryl Yellow'	Field Container	Norman	FL	2017	Foliar	Mediocre efficacy with 6 qt per 100 gal applied 3 times weekly; inferior to noninoculated check.
32996	Triathlon (Bacillus amyloliquefaciens Strain D747)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Calliope Crimson Flame'	Greenhouse	Norman	FL	2016	Foliar	Effective control with 6 qt per 100 gal applied twice at weekly intervals; comparable to CuPro.
27669	TriCon (BW 420) (Sodium tetraborahydrate decahydrate)	Pseudomonas cichorii (Pseudomonas cichorii)	Rosemallow (Hibiscus sp.) H. rosa-sinensis	Field Container	Strandberg	FL	2007	Foliar	Slight to moderate disease pressure; no significant efficacy at 0.8 %
27662	TriCon (BW 420) (Sodium tetraborahydrate decahydrate)	Pseudomonas marginalis (Psuedomonas marginalis)	Hydrangea, Oakleaf (Hydrangea quercifolia)	Field Container	Strandberg	FL	2007	Foliar	Moderate to severe disease pressure; no significant differences among treatments
27655	TriCon (BW 420) (Sodium tetraborahydrate decahydrate)	Xanthomonas sp. (Xanthomonas sp.)	Wax Myrtle (Myrica cerifera)	Field Container	Strandberg	FL	2007	Foliar	Severe disease pressure; no significant differences among treatments

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
27954	TriCon (BW 420) (Sodium tetraborahydrate decahydrate)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Red'	Greenhouse	Norman	FL	2007	Foliar	No efficacy at 0.8 % concentration
27648	TriCon (BW 420) (Sodium tetraborahydrate decahydrate)	Xanthomonas sp. (Xanthomonas sp.)	Plum (Prunus sp.) P. incisa x campanulata 'Okame'	Field Container	Strandberg	FL	2007	Foliar	Severe disease pressure; no significant efficacy at 0.8 %
32973	USF 0914 (USF 0914)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Calliope Crimson Flame'	Greenhouse	Norman	FL	2016	Foliar	Effective control with 575 g per 100 gal applied twice at weekly intervals; inferior to CuPro. Minor marginal leaf burn.
32974	USF 2018a (USF 2018a)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Calliope Crimson Flame'	Greenhouse	Norman	FL	2016	Foliar	Effective control with 220 ml per 100 gal applied twice at weekly intervals; inferior to CuPro. Minor marginal leaf burn.
27598	Vital 4L (Potassium phosphite)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Red'	Greenhouse	Norman	FL	2006	Foliar	Good efficacy at 2 qt per 100 gal; equal to Kocide
27598	Vital 4L (Potassium phosphite)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Red'	Greenhouse	Norman	FL	2007	Foliar	Poor efficacy at 2 qt per 100 gal
29556	Vitalonil (Potassium phosphite + chlorothalonil)	Erwinia (Erwinia sp.)	Orchid, Moth (Phalaenopsis sp.)	Greenhouse	Norman	FL	2009	Foliar	Very low disease pressure in inoculated Check; not possible to evaluate efficacy of all treatments.
29547	Vitalonil (Potassium phosphite + chlorothalonil)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Patriot Bright Red'	Greenhouse	Norman	FL	2009	Foliar	Good control at 5 pt per 100 gal; almost comparable to CuPro and non-inoculated Check; caused significant injury.
30651	ZeroTol (Hydrogen dioxide)	Agrobacterium sp. (Agrobacterium sp.)	Goldenrod (Solidago sp.)	Greenhouse	Chase	CA	2011	Foliar	Did not significantly reduce number and size of galls with 1 % conc.
31488	ZeroTol (Hydrogen dioxide)	Pseudomonas cichorii (Pseudomonas cichorii)	Chrysanthemum, Garden (Chrysanthemum/Dendranthema sp.) 'Shasta Improved'	Field Container	Norman	FL	2012	Foliar	Significantly reduced leaf spots with 128 fl oz per 100 gal applied once post-inoculation; inferior to untreated non-inoculated check.

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
31488	ZeroTol (Hydrogen dioxide)	Pseudomonas cichorii (Pseudomonas cichorii)	Chrysanthemum, Garden (Chrysanthemum/Dendranthema sp.) 'Sparkling Cheryl Yellow'	Field Container	Norman	FL	2017	Foliar	Good efficacy with 2 gal per 100 gal applied 3 times weekly; inferior to noninoculated check.
30266	ZeroTol (Hydrogen dioxide)	Pseudomonas syringae blight (Pseudomonas syringae)	Rosemallow (Hibiscus sp.) 'Double Red'	Greenhouse	Norman	FL	2011	Foliar	More lesion development, though not statistically significant, with 128 fl oz per 100 gal applied twice.
32362	ZeroTol (Hydrogen dioxide)	Pseudomonas syringae blight (Pseudomonas syringae)	Impatiens, Common Garden/Buzzy Lizzy (Impatiens walleriana) 'Super Elfin XP Violet Improved'	Greenhouse	Norman	FL	2012	Foliar	Did not significantly reduce number of leaf spots with 128 fl oz per 100 gal applied once.
31306	ZeroTol (Hydrogen dioxide)	Pseudomonas syringae blight (Pseudomonas syringae)	Lilac (Syringa sp.) S. vulgaris 'Ellen Willmott'	Field In-Ground	Pscheidt	OR	2012	Foliar	Significantly reduced disease incidence but not severity with 128 fl oz per 100 gal.
30258	ZeroTol (Hydrogen dioxide)	Xanthomonas sp. (Xanthomonas sp.)	Poinsettia (Euphorbia pulcherrima) 'Eckespoint Prestige Red '	Greenhouse	Norman	FL	2011	Foliar	Did not reduce number of leaf spots with 128 fl oz per 100 gal applied twice.
33138	ZeroTol (Hydrogen dioxide)	Xanthomonas sp. (Xanthomonas sp.)	Zinnia (Zinnia sp.) 'Lilliput Yellow'	Greenhouse	Ong	TX	2016	Foliar	No disease infection developed. Severe injury with 2 gal per 100 gal applied 3 times.
32997	ZeroTol 2.0 (Hydrogen dioxide + peroxyacetic acid)	Xanthomonas sp. (Xanthomonas sp.)	Geranium (Pelargonium sp.) 'Calliope Crimson Flame'	Greenhouse	Norman	FL	2016	Foliar	Effective control with 2 gal per 100 gal applied twice at weekly intervals; inferior to CuPro. Minor marginal leaf burn.

Appendix 1: Contributing Researchers

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