

**Project Name:** Bacterial Disease Efficacy

<b>New</b>	<b>Ongoing</b>	<b>Completed</b>	X	<b>Duration if ongoing or completed:</b>	2006-2012, 2016-2017
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**Project Description:**

Studying bacterial diseases arose in the IR-4 Southern Regional as a regional project. Since 2006, this became a high priority national project with the increased number of potential actives available for screening. Seventy-four products have been screened including antibiotics, biopesticides, plant extracts, conventionals, and copper based materials.

**Research Project Abstract (if available):**

*Abstract from 2021 Bacterial Disease Efficacy Summary*

From 2008 to 2020, 70 products were tested through the IR-4 Environmental Horticulture 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 looked promising based on their efficacy relative to standards including, CG100, Citrex, HM-0736, Insimmo, 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.

**Target Species (Phytotoxicity, or common and Latin name of arthropod, pathogen, weed):**

<i>Agrobacterium sp. (Agrobacterium sp.)</i>	<i>Pseudomonas marginalis (Pseudomonas marginalis)</i>
<i>Erwinia (Erwinia sp.)</i>	<i>Pseudomonas sp. (Pseudomonas sp.)</i>
<i>Erwinia chrysanthemi (Dickeya (Erwinia) chrysanthemi)</i>	<i>Pseudomonas Syringae Blight (Pseudomonas syringae)</i>
<i>Pseudomonas chichorii (Pseudomonas chichorii)</i>	<i>Xanthomonas sp. (Xanthomonas sp.)</i>

**Target Crops (list tested crops if ongoing or completed project)**

<i>Acer palmatum</i>	<i>Hibiscus sp.</i>	<i>Oncidium sp.</i>
<i>Brassica oleracea</i>	<i>Hydrangea quercifolia</i>	<i>Pelargonium sp.</i>
<i>Chrysanthemum/Dendranthema sp.</i>	<i>Impatiens walleriana</i>	<i>Prunus sp.</i>
<i>Euphorbia pulcherrima</i>	<i>Lavandula sp.</i>	<i>Pyrus calleryana</i>
<i>Ficus microcarpa</i>	<i>Mandevilla boliviensis</i>	<i>Solidago sp.</i>
<i>Helianthus sp.</i>	<i>Myrica cerifera</i>	<i>Syringa sp.</i>
		<i>Zinnia sp.</i>

**Target Product(s)(list tested products or numbered compounds if ongoing or completed project)**

Actinovate Soluble (Streptomyces lydicus WYEC 108)	BMJ (Bacillus mycoides isolate J)
Agrimycin 17 (Streptomycin sulfate)	BotryStop WP (Ulocladium oudemansii (U3 Strain))
Agriphage (Bacteriophage (for Xanthomonas campestris pv. vesicatoria and Pseudomonas syringae pv. tomato))	BW165N (Ulocladium oudemansii (U3 Strain))
Alexin (Fruit and vegetable extract)	Camelot (Copper salts of fatty and rosin acids)
Aliette WDG (Fosetyl Al)	Canker Kill (Unknown)
ASAP (Silver)	Cease (Bacillus subtilis strain QST 713)
BlightBan A506 (Pseudomonas fluorescens A506)	CG100 (Caprylic acid)
Bloomtime FD (Pantoea agglomerans strain E325)	Champ Formula 2F (Copper hydroxide)
	Citrex (Citrus extraction)
	Companion (Bacillus subtilis GB03)

<b>Target Product(s)Continued</b>		
Copper Count N (copper diammonia diacetate complets)	MilStop (Potassium bicarbonate)	SP2478 (SP2478)
CuPro (Copper hydroxide)	NAI-4201 (Tiadinil)	SP2704 (SP2704)
CuPro 2005 (Copper hydroxide)	Nu-Cop 50DF (Copper Hydroxicide)	SP8000 (SP8000)
Cuprofix MZ Disperse (Mancozeb + Basic copper sulfate)	Omega Grow Plus (Fish oil)	Stargus (Bacillus nakamurai strain F727)
CuproFix Ultra 40 Disperse (Basic copper sulfate)	OxiPhos (Mono and di potassium salts of phosphorus acid + hydrogen peroxide)	Taegro (Bacillus subtilis var amyloliquefaciens strain FZB24)
Dithane 75DF Rainshield (Mancozeb)	Penncozeb DF (Mancozeb)	Tanos (Famoxadone + Cymoxanil)
EarthTec (Copper)	Phyton-27 (Copper sulfate pentahydrate)	TDA02 (TDA01)
Firewall 17WP (Streptomycin sulfate)	Phyton-27 New Dimension (Copper sulphate pentahydrate)	TDA-NC-1 (TDA)
Flameout (Oxytetracycline)	Postiva (pydiflumetofen + difenoconozole)	TDA-RTU (TDA-RTU)
Floreil (Ethephon)	Prophytex EC (Bacillus subtilis strain B1111)	Terracyte Pro (PerCarb, GC Pro, GreenClean Max) (Sodium carbonate peroxyhydrate)
HM-0736 (aka Physpe) (Laminarin)	Prophytex WP (Bacillus subtilis strain B1111)	Triathlon (Bacillus amyloliquefaciens Strain D747)
Inosco (Potassium phosphite)	Protect T/O (Mancozeb)	TriCon (BW 420) (Sodium tetraborahydrate decahydrate)
Insimmo (Acibenzolar-S-methyl)	Proud 3 (Thyme oil)	Tril-21 (Thyme oil)
Junction (SePro) (Mancozeb + copper hydroxide)	RD00AS-1 (BW159) (BW159)	TXC2020 (Thyme oil)
Kasumin (Kasugamycin)	Regalia O5 (MOI-10605) (Extract of Reynoutria sachalinensis)	USF 0914 (USF 0914)
Kleengrow (Didecyl dimethyl ammonium chloride)	Regalia SC (MOI 106) (Extract of Reynoutria sachalinensis)	USF 2018a (USF 2018a)
Kocide 2000 (Dupont) (Copper Hydroxide)	ReZist (Aluminium ammonium sulphate)	Vital 4L (Potassium phosphite)
Kocide 3000 (Copper hydroxide)	SP2015 (SP2015)	Vitalonil (Potassium phosphite + chlorothalonil)
K-Phite (Phophorus acid salts)		ZeroTol (Hydrogen dioxide)
MBI 121 (MBI 121)		ZeroTol 2.0 (Hydrogen dioxide + peroxyacetic acid)
Milsana (now Regalia) (Extract of Reynoutria sachalinensis)		

<b>Product Registration and Research Status</b>			
	<b>Fully Screened (also includes standards)</b>	<b>Partially Screened through IR-4 <sup>1</sup></b>	<b>Need Data Across Species ?</b>
Labeled Generally & Commercialized	Aliette WDG Cease Copper compounds <sup>2</sup> Dithane 75DF, Protect DF	KleenGrow Stargus* Triathlon BA ZeroTol	
Labeled Generally But NOT Commercialized		<b>Insimmo</b>	
Labeled for Specific Diseases& Commercialized		<b>Actinovate</b> <b>GC Pro</b> <b>Regalia 50 *</b>	Agri-Mycin Alude
Labeled for Specific Diseases but NOT Commercialized			
Not yet registered or Labeled		BlightBan A506 Bloomtime Kasumin NAI-4201 TDA 02	Agriphage DPZ, Optimum Milstop



# Environmental Horticulture Program Research Project Sheet

<https://www.ir4project.org/ehc/ehc-registration-support-research/env-hort-extension-resources/>

		Citrex Inosco Insimmo	Taegro Vacciplant	
No longer available for development			CG100 Florel Prophytex EC Prophytex WP SP2015	
<p>* IR-4 Data contributed to registration decision – either adding pest to label or not pursuing further research</p> <p>1 At least one species screened fully</p> <p>2 Including but not limited to Camelot O, CuPRO, Kocide, Junction, Nu-Cop, Phyton 27</p>				

PROS	CONS
Bacterial disease problems have few optimal control tools	Multiple years of data screening over 70 products and combinations with not many optimal options arose other than copper-based and mancozeb products were effective generally
Tank mix combinations	Tank mix combinations
Important to Growers	Acibenzolar efficacy was variable based on pathogen-host system
Yes, for the couple new tools identified	Phytotoxicity
Oregon, Southeast, NY commented on specific, continuing, issues	
Primarily a propagation problem	
<p><b>Comments:</b> Some treatments in current protocol have sufficient data on certain bacterial species. Some have variable activity and may warrant additional testing.</p>	

IR-4 Efficacy Trials to Date
<p>Average rating on a scale of 1 – 5 with 1 = 0 to about 50% efficacy (not effective) and 5 = 95 to 100 efficacy (very effective); minimum to maximum rating; number of trials (See table on next page). For product/insect combinations that are blank, IR-4 has not screened this combination.</p> <p>‘Labeled’ indicates that this disease species or genera is listed on the label. A rating of 2 or lower is considered unacceptable efficacy (<i>red text</i>). A rating of 3 or higher is considered commercially acceptable (black text). Non-labeled, completed product/disease combinations (3 or more trials) with an average rating of 3 or higher are highlighted with <i>green text</i>. For disease/product combinations that are blank, IR-4 has not screened this combination.</p>

Table 1 of 2.

MOA Class	Product (Active Ingredients)	Agrobacterium sp.	Erwinia sp.	Erwinia chrysanthemi (Dickeya chrysanthemi)	Xanthomonas sp.
/ FRAC M1	Rotation: Tricon / Phyton New Dimension (Sodium borate decahydrate / copper pentahydrate)				1.0 (1 - 1) n2
FRAC 11 + FRAC 27	SP2015 (SP2015)		1.0 (1 - 1) n2	1.0 (1 - 1) n3	2.2 (1 - 4) n5
FRAC 11 + FRAC 27	Tanos (Famoxadone + Cymoxanil)				1.0 (1 - 1) n1
FRAC 11 + FRAC 27 + FRAC M1	Tank Mix: SP2015 + CuPRO 2005 (Famoxadone + Cymoxanil + Copper)		1.5 (1 - 2) n2	1.0 (1 - 1) n3	2.4 (1 - 4) n10
FRAC 24	Kasumin (Kasugamycin)	1.0 (1 - 1) n1	1.3 (1 - 2) n4	1.0 (1 - 1) n3	1.6 (1 - 4) n10
FRAC 24 + FRAC M1	Tank Mix: Kasumin + Kocide (Kasugamycin + copper hydroxide)				1.7 (1 - 3) n3
FRAC 25	Agrimycin 17 (Streptomycin sulfate)	1.0 (1 - 1) n1 <i>Labeled</i>			
FRAC 25	Firewall 17WP (Streptomycin sulfate)				2.5 (2 - 3) n2
FRAC 41	Flameout (Oxytetracycline)				1.0 (1 - 1) n1
FRAC 7 + FRAC 3	Postiva (pydiflumetofen + difenoconazole)				
FRAC BM01	Proud 3 (Thyme oil)				
FRAC BM01	Tril-21 (Thyme oil)				
FRAC BM01	TXC2020 (Thyme oil)				
FRAC BM02	Actinovate Soluble (Streptomyces lydicus WYEC 108)				1.0 (1 - 1) n3 <i>Labeled</i>
FRAC BM02	BlightBan A506 (Pseudomonas fluorescens A506)				3.0 (3 - 3) n1
FRAC BM02	Bloomtime FD (Pantoea agglomerans strain E325)				2.0 (1 - 3) n2
FRAC BM02	BotryStop WP (Ulocladium oudemansii (U3 Strain))				
FRAC BM02	BW165N (Ulocladium oudemansii (U3 Strain))				
FRAC BM02	Cease (Bacillus subtilis strain QST 713)				2.0 (1 - 4) n5 <i>Labeled</i>

MOA Class	Product (Active Ingredients)	Agrobacterium sp.	Erwinia sp.	Erwinia chrysanthemi (Dickeya chrysanthemi)	Xanthomonas sp.
FRAC BM02	Companion (Bacillus subtilis GB03)				2.0 (1 - 3) n2
FRAC BM02	Prophytex EC (Bacillus subtilis strain B1111)				3.0 (3 - 3) n1
FRAC BM02	Prophytex WP (Bacillus subtilis strain B1111)				3.0 (3 - 3) n1
FRAC BM02	Taegro (Bacillus subtilis var amyloliquefaciens strain FZB24)		1.0 (1 - 1) n2	2.3 (1 - 5) n3	2.0 (1 - 4) n6
FRAC BM02 +	Tank Mix: Actinovate + Tricon (Streptomyces lydicus WYEC 108 + Sodium tetraborahydrate decahydrate)				1.0 (1 - 1) n2
FRAC BM02 + FRAC M1	Tank Mix: Rhapsody + Kocide (Bacillus subtilis + copper hydroxide)				3.0 (3 - 3) n1
FRAC BM02 + FRAC M1	Tank Mix: Rhapsody + Phyton (Bacillus subtilis + copper sulfate pentahydrate)				3.0 (3 - 3) n1
FRAC BM02 + FRAC M1 + FRAC P07	Tank Mix: Rhapsody + Kocide 2000 + Vital (Bacillus subtilis + copper hydroxide + potassium phosphite)				1.0 (1 - 1) n2
FRAC BM02 + FRAC M3	Tank Mix: Rhapsody + Penncozeb (Bacillus subtilis + mancozeb)				3.0 (3 - 3) n1
FRAC BM02 + FRAC NC	Tank Mix: Cease + Citrex (Bacillus subtilis + Citrus extraction)				2.0 (2 - 2) n1
FRAC BM02 + FRAC NC	Tank Mix: Cease + Milstop (Bacillus subtilis + potassium bicarbonate)		1.0 (1 - 1) n2	1.0 (1 - 1) n1	1.0 (1 - 1) n1
FRAC BM02 + FRAC NC	Tank Mix: Cease + TriCon (Bacillus subtilis + Sodium tetraborahydrate decahydrate)				3.0 (3 - 3) n1
FRAC BM02 + FRAC NC	Tank Mix: Rhapsody + Actinovate (Bacillus subtilis + Streptomyces lydicus WYEC 108)				1.0 (1 - 1) n1

MOA Class	Product (Active Ingredients)	Agrobacterium sp.	Erwinia sp.	Erwinia chrysanthemi (Dickeya chrysanthemi)	Xanthomonas sp.
FRAC BM02 + FRAC NC	Tank Mix: Taegro + Milstop (Bacillus subtilis var amyloliquefaciens strain FZB24 + potassium bicarbonate)				1.0 (1 - 1) n1
FRAC BM02 + FRAC P07	Tank Mix: Rhapsody + K-Phyte (Bacillus subtilis + phosphorus acid salts)				1.0 (1 - 1) n1
FRAC M1	Camelot (Copper salts of fatty and rosin acids)		2.0 (2 - 2) n1		2.5 (2 - 3) n2
FRAC M1	Champ Formula 2F (Copper hydroxide)				3.0 (2 - 4) n2
FRAC M1	Copper Count N (copper diammonia diacetate complets)			1.0 (1 - 1) n1	
FRAC M1	CuPro (Copper hydroxide)				3.0 (3 - 3) n1
FRAC M1	CuPro 2005 (Copper hydroxide)		1.5 (1 - 3) n4 Labeled	1.5 (1 - 2) n2 Labeled	2.3 (2 - 3) n3 Labeled
FRAC M1	CuproFix Ultra 40 Disperse (Basic copper sulfite)				3.5 (2 - 5) n2 Labeled
FRAC M1	EarthTec (Copper)				1.0 (1 - 1) n1
FRAC M1	Kocide 2000 (Dupont) (Copper Hydroxide)				1.8 (1 - 4) n4 Labeled
FRAC M1	Kocide 3000 (Copper hydroxide)				3.0 (1 - 4) n4
FRAC M1	Nu-Cop 50DF (Copper Hydroxide)				
FRAC M1	Phyton-27 (Copper sulfate pentahydrate)				3.0 (3 - 3) n3 Labeled
FRAC M1	Phyton-27 New Dimension (Copper sulphate pentahydrate)				1.0 (1 - 1) n2 Labeled
FRAC M1	ReZist (Aluminium ammonium sulphate)			1.0 (1 - 1) n1	
FRAC M1	Tank Mix: Resist + Sett (Chelated Copper/Manganese/Zinc + Calcium/Boron + surfactant)			3.0 (3 - 3) n1	
FRAC M1 +	Tank Mix: Kocide + Kleengrow (Copper Hydroxide + Didecyl dimethyl ammonium chloride)		2.0 (2 - 2) n1		
FRAC M3	Dithane 75DF Rainshield (Mancozeb)				3.0 (2 - 4) n2
FRAC M3	Penncozeb DF (Mancozeb)				3.5 (2 - 5) n2
FRAC M3	Protect T/O (Mancozeb)		3.0 (3 - 3) n1		3.0 (3 - 3) n1
FRAC M3 + FRAC M1	Cuprofix MZ Disperse (Mancozeb + Basic copper sulfite)				3.5 (3 - 4) n2 Labeled
FRAC M3 + FRAC M1	Junction (SePro) (Mancozeb + copper hydroxide)				3.5 (2 - 5) n2
FRAC NC	Alexin (Fruit and vegetable extract)				1.0 (1 - 1) n1
FRAC NC	CG100 (Caprylic acid)	1.0 (1 - 1) n1	1.0 (1 - 1) n3	1.0 (1 - 1) n1	1.7 (1 - 3) n3

MOA Class	Product (Active Ingredients)	Agrobacterium sp.	Erwinia sp.	Erwinia chrysanthemi (Dickeya chrysanthemi)	Xanthomonas sp.
FRAC NC	Citrex (Citrus extraction)	1.0 (1 - 1) n1	1.3 (1 - 2) n4	1.0 (1 - 1) n3	2.9 (2 - 4) n7
FRAC NC	MilStop (Potassium bicarbonate)				1.0 (1 - 1) n1
FRAC NC	Omega Grow Plus (Fish oil)				1.0 (1 - 1) n1
FRAC NC	ZeroTol (Hydrogen dioxide)	1.0 (1 - 1) n1 Labeled			1.0 (1 - 1) n1 Labeled
FRAC NC	ZeroTol 2.0 (Hydrogen dioxide + peroxyacetic acid)				3.0 (3 - 3) n1 Labeled
FRAC P01	Insimmo (Acibenzolar-S-methyl)	1.0 (1 - 1) n2	1.7 (1 - 4) n7	1.0 (1 - 1) n3	3.7 (3 - 5) n6
FRAC P03	NAI-4201 (Tiadinil)	1.0 (1 - 1) n1	1.3 (1 - 2) n3	1.0 (1 - 1) n1	1.0 (1 - 1) n2
FRAC P04	HM-0736 (aka Physpe) (Laminarin)	1.0 (1 - 1) n1	1.0 (1 - 1) n4	1.0 (1 - 1) n3	1.7 (1 - 3) n6
FRAC P04 + FRAC M1	Tank Mix: Physpe + Kocide 2000 (Laminarin + copper hydroxide)				3.0 (3 - 3) n1
FRAC P04 + FRAC M1	Tank Mix: Physpe + Phyton (Laminarin + copper sulfate pentahydrate)				3.0 (3 - 3) n1
FRAC P04 + FRAC M3	Tank Mix: Physpe + Penncozeb (Laminarin + mancozeb)				1.0 (1 - 1) n1
FRAC P05	Milsana (now Regalia) (Extract of Reynoutria sachalinensis)				1.0 (1 - 1) n1
FRAC P05	Regalia O5 (MOI-10605) (Extract of Reynoutria sachalinensis)	1.0 (1 - 1) n1 Labeled	1.0 (1 - 1) n3 Labeled	1.0 (1 - 1) n1 Labeled	2.5 (1 - 4) n2 Labeled
FRAC P05	Regalia SC (MOI 106) (Extract of Reynoutria sachalinensis)		1.0 (1 - 1) n1		2.0 (2 - 2) n1
FRAC P06	BMJ (Bacillus mycoides isolate J)				1.0 (1 - 1) n1
FRAC P07	Aliette WDG (Fosetyl Al)		1.0 (1 - 1) n3 Labeled		3.0 (2 - 4) n2 Labeled
FRAC P07	Inosco (Potassium phosphite)		1.0 (1 - 1) n1		
FRAC P07	K-Phite (Phosphorus acid salts)				1.0 (1 - 1) n3 Labeled
FRAC P07	OxiPhos (Mono and di potassium salts of phosphorus acid + hydrogen peroxide)				3.0 (3 - 3) n1
FRAC P07	Vital 4L (Potassium phosphite)				2.0 (1 - 3) n2 Labeled
FRAC P07 + FRAC BM02	Tank Mix: Vital + Rhapsody (Potassium phosphite + Bacillus subtilis)				1.0 (1 - 1) n1
FRAC P07 + FRAC M1	Tank Mix: BioPhos + Chelated Copper (Phosphorus acid + chelated copper)				1.0 (1 - 1) n4
FRAC P07 + FRAC M1	Tank Mix: K-Phyte + Kocide 2000 (Phosphorus acid salts + copper hydroxide)				3.0 (3 - 3) n1

MOA Class	Product (Active Ingredients)	Agrobacterium sp.	Erwinia sp.	Erwinia chrysanthemi (Dickeya chrysanthemi)	Xanthomonas sp.
FRAC P07 + FRAC M1	Tank Mix: K-Phyte + Phyton (Phosphorus acid salts + copper sulfate pentahydrate)				<b>3.0 (3 - 3) n1</b>
FRAC P07 + FRAC M3	Tank Mix: K-Phyte + Penncozeb (Phosphorus acid salts + mancozeb)				<b>3.0 (3 - 3) n1</b>
FRAC P07 + FRAC M5	Vitalonil (Potassium phosphite + chlorothalonil)				<b>3.0 (3 - 3) n1</b>
FRAC P07 + FRAC NC	Tank Mix: K-Phyte + Tricon (Phosphorus acid salts + Sodium tetraborate decahydrate)				<i>1.0 (1 - 1) n2</i>
IRAC 11 & FRAC BM02	Triathlon (Bacillus amyloliquefaciens Strain D747)				<b>3.0 (3 - 3) n1</b>
IRAC UNF & FRAC BM02	Stargus (Bacillus nakamurai strain F727)				3.0 (3 - 3) n1 Labeled
unknown	ASAP (Silver)				<i>2.0 (2 - 2) n1</i>
unknown	Canker Kill (Unknown)				<i>1.0 (1 - 1) n1</i>
unknown	Florel (Ethephon)			<i>1.0 (1 - 1) n2</i>	
unknown	Kleengrow (Didecyl dimethyl ammonium chloride)			<i>1.3 (1 - 2) n3 Labeled</i>	
unknown	MBI 121 (MBI 121)				
unknown	RD00AS-1 (BW159) (BW159)				
unknown	SP2704 (SP2704)				
unknown	TDA02 (TDA01)				
unknown	TDA-NC-1 (TDA)				
unknown	TDA-RTU (TDA-RTU)				<b>3.0 (3 - 3) n1</b>
unknown	Terracyte Pro (PerCarb, GC Pro, GreenClean Max) (Sodium carbonate peroxyhydrate)				3.0 (3 - 3) n1 Labeled
unknown	TriCon (BW 420) (Sodium tetraborate decahydrate)				<i>1.5 (1 - 3) n4</i>
unknown	USF 0914 (USF 0914)				<b>3.0 (3 - 3) n1</b>
unknown	USF 2018a (USF 2018a)				3.0 (3 - 3) n1



Table 2 of 2.

MOA Class	Product (Active Ingredients)	<i>Pseudomonas chitorii</i>	<i>Pseudomonas marginalis</i>	<i>Pseudomonas sp.</i>	<i>Pseudomonas Syringae</i> Blight ( <i>Pseudomonas syringae</i> )
/ FRAC M1	Rotation: Tricon / Phytan New Dimension (Sodium borate decahydrate / copper pentahydrate)	2.0 (2 - 2) n1	1.0 (1 - 1) n1		
FRAC 11 + FRAC 27	SP2015 (SP2015)	1.0 (1 - 1) n1		1.0 (1 - 1) n2	1.0 (1 - 1) n1
FRAC 11 + FRAC 27	Tanos (Famoxadone + Cymoxanil)				
FRAC 11 + FRAC 27 + FRAC M1	Tank Mix: SP2015 + CuPRO 2005 (Famoxadone + Cymoxanil + Copper)	1.7 (1 - 3) n3	1.0 (1 - 1) n2	3.0 (3 - 3) n2	1.0 (1 - 1) n1
FRAC 24	Kasumin (Kasugamycin)	2.3 (1 - 3) n3	1.0 (1 - 1) n1	3.0 (1 - 5) n2	2.5 (1 - 5) n4
FRAC 24 + FRAC M1	Tank Mix: Kasumin + Kocide (Kasugamycin + copper hydroxide)	1.0 (1 - 1) n1	1.0 (1 - 1) n1		
FRAC 25	Agrimycin 17 (Streptomycin sulfate)				
FRAC 25	Firewall 17WP (Streptomycin sulfate)				
FRAC 41	Flameout (Oxytetracycline)				
FRAC 7 + FRAC 3	Postiva (pydiflumetofen + difenoconazole)				3.0 (1 - 4) n3 Labeled
FRAC BM01	Proud 3 (Thyme oil)				2.7 (1 - 4) n3
FRAC BM01	Tril-21 (Thyme oil)				3.5 (3 - 4) n2
FRAC BM01	TXC2020 (Thyme oil)				1.0 (1 - 1) n1
FRAC BM02	Actinovate Soluble ( <i>Streptomyces lydicus</i> WYEC 108)				
FRAC BM02	BlightBan A506 ( <i>Pseudomonas fluorescens</i> A506)	3.0 (3 - 3) n1			
FRAC BM02	Bloomtime FD ( <i>Pantoea agglomerans</i> strain E325)	3.0 (3 - 3) n1			
FRAC BM02	BotryStop WP ( <i>Ulocladium oudemansii</i> (U3 Strain))				4.0 (4 - 4) n1
FRAC BM02	BW165N ( <i>Ulocladium oudemansii</i> (U3 Strain))	1.0 (1 - 1) n1			3.0 (3 - 3) n2
FRAC BM02	Cease ( <i>Bacillus subtilis</i> strain QST 713)				1.0 (1 - 1) n1 Labeled

MOA Class	Product (Active Ingredients)	<i>Pseudomonas chitorii</i>	<i>Pseudomonas marginalis</i>	<i>Pseudomonas sp.</i>	<i>Pseudomonas Syringae</i> Blight ( <i>Pseudomonas syringae</i> )
FRAC BM02	Companion (Bacillus subtilis GB03)				
FRAC BM02	Prophytex EC (Bacillus subtilis strain B1111)				
FRAC BM02	Prophytex WP (Bacillus subtilis strain B1111)				
FRAC BM02	Taegro (Bacillus subtilis var amyloliquefaciens strain FZB24)	1.0 (1 - 1) n1		1.0 (1 - 1) n2	1.0 (1 - 1) n1
FRAC BM02 +	Tank Mix: Actinovate + Tricon (Streptomyces lydicus WYEC 108 + Sodium tetraborahydrate deceahydrate)	2.0 (2 - 2) n2			
FRAC BM02 + FRAC M1	Tank Mix: Rhapsody + Kocide (Bacillus subtilis + copper hydroxide)				
FRAC BM02 + FRAC M1	Tank Mix: Rhapsody + Phyton (Bacillus subtilis + copper sulfate pentahydrate)				
FRAC BM02 + FRAC M1 + FRAC P07	Tank Mix: Rhapsody + Kocide 2000 + Vital (Bacillus subtilis + copper hydroxide + potassium phosphite)	1.0 (1 - 1) n1	1.0 (1 - 1) n1		
FRAC BM02 + FRAC M3	Tank Mix: Rhapsody + Penncozeb (Bacillus subtilis + mancozeb)				
FRAC BM02 + FRAC NC	Tank Mix: Cease + Citrex (Bacillus subtilis + Citrus extraction)				
FRAC BM02 + FRAC NC	Tank Mix: Cease + Milstop (Bacillus subtilis + potassium bicarbonate)				
FRAC BM02 + FRAC NC	Tank Mix: Cease + TriCon (Bacillus subtilis + Sodium tetraborahydrate deceahydrate)				
FRAC BM02 + FRAC NC	Tank Mix: Rhapsody + Actinovate (Bacillus subtilis + Streptomyces lydicus WYEC 108)				

MOA Class	Product (Active Ingredients)	<i>Pseudomonas chiorii</i>	<i>Pseudomonas marginalis</i>	<i>Pseudomonas sp.</i>	<i>Pseudomonas Syringae</i> Blight ( <i>Pseudomonas syringae</i> )
FRAC BM02 + FRAC NC	Tank Mix: Taegro + Milstop (Bacillus subtilis var amyloliquefaciens strain FZB24 + potassium bicarbonate)				
FRAC BM02 + FRAC P07	Tank Mix: Rhapsody + K-Phyte (Bacillus subtilis + phosphorus acid salts)				
FRAC M1	Camelot (Copper salts of fatty and rosin acids)				3.5 (2 - 5) n4
FRAC M1	Champ Formula 2F (Copper hydroxide)				
FRAC M1	Copper Count N (copper diammonia diacetate complets)				
FRAC M1	CuPro (Copper hydroxide)				2.0 (2 - 2) n1
FRAC M1	CuPro 2005 (Copper hydroxide)	4.0 (3 - 5) n3 Labeled			3.0 (3 - 3) n1 Labeled
FRAC M1	CuproFix Ultra 40 Disperse (Basic copper sulfate)				
FRAC M1	EarthTec (Copper)				4.0 (4 - 4) n1
FRAC M1	Kocide 2000 (Dupont) (Copper Hydroxide)	1.0 (1 - 1) n1 Labeled	1.0 (1 - 1) n1 Labeled		1.0 (1 - 1) n1 Labeled
FRAC M1	Kocide 3000 (Copper hydroxide)	1.0 (1 - 1) n1	2.5 (1 - 4) n2		
FRAC M1	Nu-Cop 50DF (Copper Hydroxicide)				2.0 (2 - 2) n1 Labeled
FRAC M1	Phyton-27 (Copper sulfate pentahydrate)			1.0 (1 - 1) n1 Labeled	
FRAC M1	Phyton-27 New Dimension (Copper sulphate pentahydrate)	1.0 (1 - 1) n1 Labeled	1.0 (1 - 1) n1 Labeled		
FRAC M1	ReZist (Aluminium ammonium sulphate)				
FRAC M1	Tank Mix: Resist + Sett (Chelated Copper/Manganese/Zinc + Calcium/Boron + surfactant)				
FRAC M1 +	Tank Mix: Kocide + Kleengrow (Copper Hydroxide + Didecyl dimethyl ammonium chloride)				
FRAC M3	Dithane 75DF Rainshield (Mancozeb)				
FRAC M3	Penncozeb DF (Mancozeb)				
FRAC M3	Protect T/O (Mancozeb)	3.0 (3 - 3) n1			3.0 (1 - 5) n2
FRAC M3 + FRAC M1	Cuprofix MZ Disperse (Mancozeb + Basic copper sulfate)				
FRAC M3 + FRAC M1	Junction (SePro) (Mancozeb + copper hydroxide)				
FRAC NC	Alexin (Fruit and vegetable extract)				
FRAC NC	CG100 (Caprylic acid)	1.0 (1 - 1) n2		3.0 (3 - 3) n1	1.3 (1 - 2) n4

MOA Class	Product (Active Ingredients)	<i>Pseudomonas chiorii</i>	<i>Pseudomonas marginalis</i>	<i>Pseudomonas sp.</i>	<i>Pseudomonas Syringae</i> Blight ( <i>Pseudomonas syringae</i> )
FRAC NC	Citrex (Citrus extraction)	2.0 (1 - 3) n2		1.5 (1 - 2) n2	1.3 (1 - 2) n4
FRAC NC	MilStop (Potassium bicarbonate)				
FRAC NC	Omega Grow Plus (Fish oil)				
FRAC NC	ZeroTol (Hydrogen dioxide)	2.5 (2 - 3) n2 <i>Labeled</i>			1.3 (1 - 2) n3 <i>Labeled</i>
FRAC NC	ZeroTol 2.0 (Hydrogen dioxide + peroxyacetic acid)				
FRAC P01	Insimmo (Acibenzolar-S-methyl)	1.0 (1 - 1) n3		1.7 (1 - 3) n3	2.0 (1 - 4) n4
FRAC P03	NAI-4201 (Tiadinil)	1.0 (1 - 1) n1		2.0 (2 - 2) n1	1.5 (1 - 2) n2
FRAC P04	HM-0736 (aka Physpe) (Laminarin)	1.0 (1 - 1) n2	1.0 (1 - 1) n1	3.0 (3 - 3) n1	1.0 (1 - 1) n3
FRAC P04 + FRAC M1	Tank Mix: Physpe + Kocide 2000 (Laminarin + copper hydroxide)				
FRAC P04 + FRAC M1	Tank Mix: Physpe + Phyton (Laminarin + copper sulfate pentahydrate)				
FRAC P04 + FRAC M3	Tank Mix: Physpe + Penncozeb (Laminarin + mancozeb)				
FRAC P05	Milsana (now Regalia) (Extract of Reynoutria sachalinensis)				
FRAC P05	Regalia O5 (MOI-10605) (Extract of Reynoutria sachalinensis)	2.0 (1 - 3) n2 <i>Labeled</i>			1.5 (1 - 2) n2 <i>Labeled</i>
FRAC P05	Regalia SC (MOI 106) (Extract of Reynoutria sachalinensis)			2.0 (1 - 3) n2	1.0 (1 - 1) n2
FRAC P06	BMJ (Bacillus mycoides isolate J)				
FRAC P07	Aliette WDG (Fosetyl Al)				1.5 (1 - 2) n2 <i>Labeled</i>
FRAC P07	Inosco (Potassium phosphite)	1.0 (1 - 1) n1			1.0 (1 - 1) n2
FRAC P07	K-Phite (Phosphorus acid salts)	1.0 (1 - 1) n1 <i>Labeled</i>	1.0 (1 - 1) n1 <i>Labeled</i>		
FRAC P07	OxiPhos (Mono and di potassium salts of phosphorus acid + hydrogen peroxide)	1.0 (1 - 1) n1			
FRAC P07	Vital 4L (Potassium phosphite)				
FRAC P07 + FRAC BM02	Tank Mix: Vital + Rhapsody (Potassium phosphite + Bacillus subtilis)				
FRAC P07 + FRAC M1	Tank Mix: BioPhos + Chelated Copper (Phosphorus acid + chelated copper)	1.0 (1 - 1) n2	1.0 (1 - 1) n2		
FRAC P07 + FRAC M1	Tank Mix: K-Phyte + Kocide 2000 (Phosphorus acid salts + copper hydroxide)				
FRAC P07 + FRAC M1	Tank Mix: K-Phyte + Phyton (Phosphorus acid salts + copper sulfate pentahydrate)				

MOA Class	Product (Active Ingredients)	<i>Pseudomonas chiorii</i>	<i>Pseudomonas marginalis</i>	<i>Pseudomonas sp.</i>	<i>Pseudomonas Syringae</i> Blight ( <i>Pseudomonas syringae</i> )
FRAC P07 + FRAC M3	Tank Mix: K-Phyte + Penncozeb (Phosphorus acid salts + mancozeb)				
FRAC P07 + FRAC M5	Vitalonil (Potassium phosphite + chlorothalonil)				
FRAC P07 + FRAC NC	Tank Mix: K-Phite + Tricon (Phosphorus acid salts + Sodium tetraborahydrate decahydrate)	<i>1.0 (1 - 1) n1</i>	<i>1.0 (1 - 1) n1</i>		
IRAC 11 & FRAC BM02	Triathlon (Bacillus amyloliquefaciens Strain D747)	<i>2.0 (2 - 2) n1</i>			
IRAC UNF & FRAC BM02	Stargus (Bacillus nakamurai strain F727)	<i>2.0 (2 - 2) n1 Labeled</i>			<i>2.7 (1 - 4) n3 Labeled</i>
unknown	ASAP (Silver)				
unknown	Canker Kill (Unknown)				
unknown	Florel (Ethephon)				
unknown	Kleengrow (Didecyl dimethyl ammonium chloride)	<i>1.0 (1 - 1) n1 Labeled</i>			<i>1.0 (1 - 1) n1 Labeled</i>
unknown	MBI 121 (MBI 121)				<i>2.7 (1 - 4) n3</i>
unknown	RD00AS-1 (BW159) (BW159)				<b>4.0 (4 - 4) n1</b>
unknown	SP2704 (SP2704)				<b>4.0 (4 - 4) n1</b>
unknown	TDA02 (TDA01)	<i>1.0 (1 - 1) n1</i>		<i>1.0 (1 - 1) n1</i>	
unknown	TDA-NC-1 (TDA)				<b>3.3 (3 - 4) n3</b>
unknown	TDA-RTU (TDA-RTU)				
unknown	Terracyte Pro (PerCarb, GC Pro, GreenClean Max) (Sodium carbonate peroxyhydrate)	<i>1.0 (1 - 1) n1 Labeled</i>			
unknown	TriCon (BW 420) (Sodium tetraborahydrate decahydrate)	<i>1.0 (1 - 1) n1</i>	<i>1.0 (1 - 1) n1</i>		
unknown	USF 0914 (USF 0914)				
unknown	USF 2018a (USF 2018a)				