

Project Name: Botrytis Efficacy

Dates Active: 2004-2005; 2011-2015; 2017-2023

Project Description:

This project originated as a regional project and then at the 2011 IR-4 Ornamental Horticulture Workshop became a high priority project due to reports of tolerance developing among *Botrytis cinerea* populations to several key fungicides and because there are other Botrytis species not typically screened for efficacy.

Research Project Abstract:

Abstract from 2023 Botrytis Efficacy Summary

At the IR-4 Environmental Horticulture Program Workshop in 2011, Botrytis Efficacy was selected as a high priority project to expand the knowledge and list of fungicides available to growers for these diseases. In addition to research collected through the IR-4 Program, this summary includes a review of experiments conducted from 1998 to 2022 on environmental horticulture crops. During this time period, numerous products representing 56 active ingredients were tested as foliar applications against several *Botrytis* species causing blight and gray mold on multiple environmental horticulture crops. Most products are now registered and commercially used. Almost all trials were conducted on *Botrytis cinerea*; however, other species tested were *B. elliptica*, and *B. tulipae*. For *B. cinerea*, across all crops and rates screened, Affirm, Picatina Flora, Astun, Spirato/Medallion, Mural, Tournay, Pageant Intrinsic, Decree, and Postiva provided good to excellent efficacy routinely as did two not-yet-registered tools for Botrytis management: XDE-659 and Trinity. Orkestra Intrinsic, PreStop, S2200, Broadform, and Regalia generally provided good reduction in disease; however, some variability was seen among experiments. S2200 also was variable in performance but could be registered and be part of an overall management program. For *Botrytis elliptica*, fewer experiments have been conducted. The best performing tools with at least 3 trials are Orchestra Intrinsic, Mural, and S2200. ZeroTol, and the copper products (Badge X2, Camelot, Phytan 27, STBX-304) generally performed poorly under the conditions of these experiments.

Target Species (Phytotoxicity, or common and Latin name of arthropod, pathogen, weed):	
<i>Botrytis elliptica</i> Botrytis Gray Mold (<i>Botrytis cinerea</i>)	<i>Botrytis sp.</i> <i>Botrytis tulipae</i>

Target Crops (list tested crops if ongoing or completed project)	
Begonia (<i>Begonia sp.</i>) Periwinkle, Madagascar (<i>Catharanthus roseus</i>) Poinsettia (<i>Euphorbia pulcherrima</i>) Hardy Geranium (<i>Geranium magniflorum</i>) Geranium (<i>Geranium sp.</i>) Hydrangea (<i>Hydrangea sp.</i>) Impatiens, Common Garden (<i>Impatiens walleriana</i>) Lily (<i>Lilium sp.</i>)	Peony (<i>Paeonia sp.</i>) Geranium (<i>Pelargonium sp.</i>) Fir, Douglas (<i>Pseudotsuga menziesii</i>) Rose (<i>Rosa sp.</i>) Hemlock, Western (<i>Tsuga heterophylla</i>) Tulip (<i>Tulipa sp.</i>) Violet (<i>Viola sp.</i>) V. x wittrockiana Pansy, Large Flowering; Wittrock's Violet

Target Product(s)(list tested products or numbered compounds if ongoing or completed project)	
3336 F (Thiophanate-methyl)	Orchestra Intrinsic (Fluxapyroxad + pyraclostrobin)
Affirm (Polyoxin D zinc salt)	OxiPhos (Mono and di potassium salts of phosphorus acid + hydrogen peroxide)
Alibi Flora SC (Azoxystrobin + difenoconazole)	Pageant Intrinsic (Boscalid + pyraclostrobin)
Astun (isofetamid)	Palladium (Cyprodinil + fludioxonil)
Badge X2 (Copper Oxychloride + Copper Hydroxide)	Phyton-27 (Copper sulfate pentahydrate)
BAS 516 UFF (Boscalid + pyraclostrobin)	Picatina (Pydiflumetofen)
BAS 640 00F (BAS 640 00F)	Picatina Flora (Pydiflumetofen + fludioxonil)
BAS 673 05F (BAS 673 05F)	Postiva (pydiflumetofen + difenoconazole)
Bayleton 25WP (Triadimefon)	Prestop (Clonostachys rosea/Gliocladium catenulatum Strain J1446)
Botector (Aureobasidium pullans strain DSM 14940 + strain DSM 14941)	Prophytex EC (Bacillus subtilis strain B1111)
BotryStop WP (Ulocladium oudemansii (U3 Strain))	Prophytex WP (Bacillus subtilis strain B1111)
Broadform SC500 (Fluopyram + Trifloxystrobin)	Proud 3 (Thyme oil)
BW165N (Ulocladium oudemansii (U3 Strain))	RD00AS-1 (BW159) (BW159)
Chipco 26019 FLO (Iprodione)	Regalia MAXX (Extract of Reynoutria sachalinensis)
Chipco 26019 N/G 50WP (Iprodione)	Regalia O5 (MOI-10605) (Extract of Reynoutria sachalinensis)
Chipco 26GT Flo (Iprodione)	Regalia SC (MOI 106) (Extract of Reynoutria sachalinensis)
Daconil 54EC (Chlorothalonil)	Regime (Banda de Lupinus albus doce (BLAD))
Daconil Weather Stik (2787 Flowable Fungicide) (Chlorothalonil)	RES 505 (RES 505)
Decree (Fenhexamid)	S2200 4SC (Mandestrobin)
Disarm 480SC (Fluoxastrobin)	S-2399 (S-2399)
Dithane 75DF Rainshield (Mancozeb)	SP2478 (SP2478)
EcoGuard (Bacillus licheniformis SB3086 + Indole-3-butyric Acid)	SP2480 (SP2480)
EcoSwing (Swinglea glutinosa)	SP2770 10WP (SP2770)
Empress Intrinsic Brand Fungicide (Pyraclostrobin)	SP2773 (SP2773)
Endorse (Polyoxin D)	Spectro 90WDG (Thiophanate-methyl + Chlorothalonil)
EpiShield (Peppermint oil, clove oil, and sodium lauryl sulfate)	Spirato (Fludioxonil)
Fame SC (Fluoxastrobin)	Stargus (Bacillus nakamurai strain F727)
Fore 80WP (Manganese + Zinc + Ethylene bis-dithiocarbamate Ion)	Switch 62.5WG (Cyprodinil + Fludioxonil)
Heritage (Azoxystrobin)	Torque 3.6SC (Tebuconazole)
IKF-5411 (isofetamid)	Tourney 50WDG (Metconazole)
Insignia 20WDG Intrinsic Brand Fungicide (Pyraclostrobin)	Triathlon (Bacillus amyloliquefaciens Strain D747)
Kocide 3000 (Copper hydroxide)	Tril-21 (Thyme oil)
MBI 121 (MBI 121)	Trinity 2SC (Triticonazole)

Target Product(s)(list tested products or numbered compounds if ongoing or completed project)	
Medallion (Fludioxonil)	TXC2020 (Thyme oil)
Milban 39EC (Dodemorph)	V-10135 (Fenpyrazamine)
MilStop (Potassium bicarbonate)	XDE-659 (florylpicoxamid)
Mural WDG (Azoxystrobin + benzovindiflupyr)	ZeroTol (Hydrogen dioxide)
ND05AS-1 (ND05AS-1)	ZeroTol 2.0 (Hydrogen dioxide + peroxyacetic acid)
	Zonix (Rhamnolipid Biosurfactant)

Product Registration and Research Status				
	Fully Screened (also includes standards)			Need Data Across Species?
Labeled Generally & Commercialized	Affirm/ Endorse * Alibi Flora Badge 2X Botector* Chipco 26019	Daconil Decree Disarm Emerald Milstop Mural Palladium	Phyton-27 Prestop Regalia 50 Switch Tourney ZeroTol	Astun/ IKF-5411* Insignia * Medallion * Orkestra * Pageant * Picatina * Picatina Flora * Regime * Spirato Stargus *
Labeled Generally But NOT Commercialized				
Labeled for Specific Diseases& Commercialized				
Labeled for Specific Diseases but NOT Commercialized				
Not yet registered or Labeled				IKF-309 IKF-5411 Midori S2200 Torque Trinity V-10135
No longer available for development		Prophytex * SP2770 * SP2773 *		
* IR-4 Data contributed to registration decision – either adding pest to label or not pursuing further research 1 At least one species screened fully				

IR-4 Efficacy Trials to Date

Average rating on a scale of 1 – 5 where 1 = <60% Control (not effective), 2 = 60-79% control, 3 = 80-89% control, 4 = 90-94% control and 5 = 95-100% control; minimum to maximum rating; number of trials (See table on next page). For product/pest combinations that are blank, IR-4 has not screened this combination. A rating of 3 or higher is considered commercially acceptable. 'Labeled' indicates that this pest species or genera is listed on the label.

MOA	Product (Actives)	<i>Botrytis elliptica</i>	Botrytis Gray Mold (<i>Botrytis cinerea</i>)	<i>Botrytis sp.</i>	<i>Botrytis tulipae</i>
FRAC 1	3336 F (Thiophanate-methyl)		5.0 (5 - 5) n1 Labeled		
FRAC 1 + FRAC M5	Spectro 90WDG (Thiophanate-methyl + Chlorothalonil)		5.0 (5 - 5) n1		
FRAC 11	Disarm 480SC (Fluoxastrobin)	2.0 (1 - 3) n2 Labeled	1.0 (1 - 1) n1 Labeled		
FRAC 11	Empress Intrinsic Brand Fungicide (Pyraclostrobin)		3.0 (3 - 3) n1		
FRAC 11	Fame SC (Fluoxastrobin)		1.0 (1 - 1) n1		
FRAC 11	Heritage (Azoxystrobin)		5.0 (5 - 5) n1 Labeled		
FRAC 11	Insignia 20WDG Intrinsic Brand Fungicide (Pyraclostrobin)		2.5 (1 - 4) n2 Labeled		
FRAC 11	S2200 4SC (Mandestrobin)	4.5 (4 - 5) n4	2.6 (1 - 5) n14	2.5 (1 - 4) n2	2.5 (2 - 3) n2
FRAC 11 + FRAC 3	Alibi Flora SC (Azoxystrobin + difenoconazole)		5.0 (5 - 5) n1 Labeled	1.0 (1 - 1) n1 Labeled	
FRAC 11 + FRAC 7	Mural WDG (Azoxystrobin + benzovindiflupyr)	4.3 (3 - 5) n3 Labeled	3.3 (2 - 5) n3 Labeled	1.0 (1 - 1) n1 Labeled	
FRAC 12	Medallion (Fludioxonil)	3.0 (3 - 3) n1 Labeled	2.6 (1 - 5) n12 Labeled	4.0 (4 - 4) n1 Labeled	
FRAC 12	Spirato (Fludioxonil)	5.0 (5 - 5) n2 Labeled	3.5 (2 - 5) n6 Labeled	4.0 (4 - 4) n1 Labeled	3.0 (3 - 3) n1 Labeled
FRAC 17	Decree (Fenhexamid)	1.3 (1 - 2) n3 Labeled	3.1 (1 - 5) n7 Labeled	1.0 (1 - 1) n1 Labeled	
FRAC 17	V-10135 (Fenpyrazamine)	1.0 (1 - 1) n1 Labeled	1.0 (1 - 1) n1 Labeled		
FRAC 19	Affirm (Polyoxin D zinc salt)	1.0 (1 - 1) n1 Labeled	4.3 (3 - 5) n4 Labeled		
FRAC 19	Endorse (Polyoxin D)		2.0 (1 - 3) n3 Labeled		
FRAC 2	Chipco 26019 FLO (Iprodione)		2.2 (1 - 5) n5		
FRAC 2	Chipco 26019 N/G 50WP (Iprodione)	1.0 (1 - 1) n2 Labeled	5.0 (5 - 5) n1 Labeled	2.5 (1 - 4) n2 Labeled	2.0 (2 - 2) n2 Labeled
FRAC 2	Chipco 26GT Flo (Iprodione)		1.0 (1 - 1) n1		
FRAC 3	Bayleton 25WP (Triadimefon)		5.0 (5 - 5) n1		
FRAC 3	Torque 3.6SC (Tebuconazole)	1.0 (1 - 1) n2	5.0 (5 - 5) n1	1.0 (1 - 1) n1	2.0 (2 - 2) n1
FRAC 3	Tourney 50WDG (Metconazole)	1.0 (1 - 1) n1 Labeled	3.3 (1 - 5) n3 Labeled		
FRAC 3	Trinity 2SC (Triticonazole)	1.0 (1 - 1) n2	3.0 (1 - 5) n4		
FRAC 5	Milban 39EC (Dodemorph)		4.0 (4 - 4) n1		
FRAC 7	Astun (isofetamid)		4.1 (2 - 5) n8 Labeled		

MOA	Product (Actives)	<i>Botrytis elliptica</i>	Botrytis Gray Mold (<i>Botrytis cinerea</i>)	<i>Botrytis sp.</i>	<i>Botrytis tulipae</i>
FRAC 7	IKF-5411 (isofetamid)	5.0 (5 - 5) n1 Labeled	3.2 (1 - 5) n6 Labeled	4.0 (4 - 4) n1 Labeled	
FRAC 7	Picatina (Pydiflumetofen)		4.0 (3 - 5) n2 Labeled		
FRAC 7 + FRAC 11	BAS 516 UFF (Boscalid + pyraclostrobin)		2.0 (1 - 3) n2		
FRAC 7 + FRAC 11	Broadform SC500 (Fluopyram + Trifloxystrobin)		2.9 (1 - 5) n7 Labeled		
FRAC 7 + FRAC 11	Orkestra Intrinsic (Fluxapyroxad + pyraclostrobin)	4.8 (4 - 5) n4 Labeled	2.9 (1 - 5) n17 Labeled		4.0 (3 - 5) n2 Labeled
FRAC 7 + FRAC 11	Pageant Intrinsic (Boscalid + pyraclostrobin)	2.0 (1 - 3) n2 Labeled	3.2 (1 - 5) n6 Labeled	2.5 (1 - 4) n2 Labeled	3.5 (3 - 4) n2 Labeled
FRAC 7 + FRAC 12	Picatina Flora (Pydiflumetofen + fludioxonil)		4.3 (3 - 5) n3 Labeled		
FRAC 7 + FRAC 3	Postiva (pydiflumetofen + difenoconazole)		3.8 (2 - 5) n5 Labeled		
FRAC 9 + FRAC 12	Palladium (Cyprodinil + fludioxonil)	1.5 (1 - 2) n2 Labeled	2.3 (1 - 5) n3 Labeled	4.0 (4 - 4) n1 Labeled	
FRAC 9 + FRAC 12	Switch 62.5WG (Cyprodinil + Fludioxonil)		3.0 (2 - 4) n2		
FRAC BM01	EcoSwing (Swinglea glutinosa)		1.4 (1 - 3) n7 Labeled		
FRAC BM01	Proud 3 (Thyme oil)	1.0 (1 - 1) n5	1.3 (1 - 3) n11	1.0 (1 - 1) n2	1.0 (1 - 1) n2
FRAC BM01	Regime (Banda de Lupinus albus doce (BLAD))	1.0 (1 - 1) n4 Labeled	1.7 (1 - 5) n9 Labeled	1.0 (1 - 1) n2 Labeled	1.5 (1 - 2) n2 Labeled
FRAC BM01	Tril-21 (Thyme oil)		1.7 (1 - 3) n3		
FRAC BM01	TXC2020 (Thyme oil)		1.0 (1 - 1) n1		
FRAC BM02	Botector (Aureobasidium pullans strain DSM 14940 + strain DSM 14941)	1.0 (1 - 1) n2 Labeled	1.8 (1 - 4) n16 Labeled	1.0 (1 - 1) n1 Labeled	
FRAC BM02	BotryStop WP (Ulocladium oudemansii (U3 Strain))		1.0 (1 - 1) n1 Labeled		
FRAC BM02	BW165N (Ulocladium oudemansii (U3 Strain))	1.0 (1 - 1) n1	2.2 (1 - 5) n12	1.0 (1 - 1) n1	
FRAC BM02	Prestop (Clonostachys rosea/Gliocladium catenulatum Strain J1446)		2.8 (2 - 5) n4 Labeled	1.0 (1 - 1) n1 Labeled	
FRAC BM02	Prophytex EC (Bacillus subtilis strain B1111)	1.0 (1 - 1) n2	1.8 (1 - 3) n4	1.0 (1 - 1) n1	
FRAC BM02	Prophytex WP (Bacillus subtilis strain B1111)	1.0 (1 - 1) n2	1.8 (1 - 2) n4	1.0 (1 - 1) n1	
FRAC M1	Badge X2 (Copper Oxychloride + Copper Hydroxide)			2.5 (1 - 4) n2 Labeled	

MOA	Product (Actives)	<i>Botrytis elliptica</i>	Botrytis Gray Mold (<i>Botrytis cinerea</i>)	<i>Botrytis sp.</i>	<i>Botrytis tulipae</i>
FRAC M1	Phyton-27 (Copper sulfate pentahydrate)		1.0 (1 - 1) n2 Labeled		
FRAC M3	Fore 80WP (Manganese + Zinc + Ethylene bis-dithiocarbamate Ion)		5.0 (5 - 5) n1 Labeled	1.0 (1 - 1) n1 Labeled	
FRAC M5	Daconil 54EC (Chlorothalonil)		2.0 (2 - 2) n1 Labeled		
FRAC M5	Daconil Weather Stik (2787 Flowable Fungicide) (Chlorothalonil)		5.0 (5 - 5) n1 Labeled	4.0 (4 - 4) n1 Labeled	
FRAC NC	MilStop (Potassium bicarbonate)		1.0 (1 - 1) n2 Labeled		
FRAC NC	ZeroTol (Hydrogen dioxide)	1.0 (1 - 1) n1 Labeled	1.0 (1 - 1) n1 Labeled	1.0 (1 - 1) n2 Labeled	
FRAC NC	ZeroTol 2.0 (Hydrogen dioxide + peroxyacetic acid)		5.0 (5 - 5) n1 Labeled		
FRAC P05	Regalia MAXX (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) n2 Labeled		
FRAC P05	Regalia SC (MOI 106) (Extract of Reynoutria sachalinensis)		2.4 (1 - 5) n5		
FRAC P07	OxiPhos (Mono and di potassium salts of phosphorus acid + hydrogen peroxide)		1.8 (1 - 3) n5		
IRAC 11 & FRAC BM02	Triathlon (Bacillus amyloliquefaciens Strain D747)		1.0 (1 - 1) n1		
IRAC UNF & FRAC BM02	Stargus (Bacillus nakamurai strain F727)	1.0 (1 - 1) n3 Labeled	1.3 (1 - 3) n9 Labeled	4.0 (4 - 4) n1 Labeled	1.0 (1 - 1) n1 Labeled
unknown	BAS 673 05F (BAS 673 05F)		1.0 (1 - 1) n1		
unknown	EpiShield (Peppermint oil, clove oil, and sodium lauryl sulfate)		1.0 (1 - 1) n1		
unknown	ND05AS-1 (ND05AS-1)		1.0 (1 - 1) n1		
unknown	RD00AS-1 (BW159) (BW159)		1.0 (1 - 1) n2		
unknown	S-2399 (S-2399)		2.5 (1 - 4) n2		
unknown	SP2478 (SP2478)		2.0 (1 - 3) n3		
unknown	SP2480 (SP2480)		2.0 (1 - 5) n10		
unknown	SP2770 10WP (SP2770)	2.0 (2 - 2) n1	1.0 (1 - 1) n1	1.0 (1 - 1) n1	1.0 (1 - 1) n1
unknown	SP2773 (SP2773)	2.0 (2 - 2) n1	1.0 (1 - 1) n1	1.0 (1 - 1) n1	1.0 (1 - 1) n1
unknown	XDE-659 (florylpicoxamid)		3.3 (1 - 5) n4		
unknown	Zonix (Rhamnolipid Biosurfactant)		1.0 (1 - 1) n1		