



# Environmental Horticulture Program Research Project Sheet

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

**Project Name:** Botrytis Efficacy

<b>New</b>		<b>Ongoing</b>	X	<b>Completed</b>		<b>Duration if ongoing or completed:</b>	2004, 2005 2011-2015, 2017 - 2023
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**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 (if available):**

*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, Tourney, 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, Phyton 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 (Botrytis elliptica)</i>	<i>Botrytis sp. (Botrytis sp.)</i>
<i>Botrytis Gray Mold (Botrytis cinerea)</i>	<i>Botrytis tulipae (Botrytis tulipae)</i>

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

<i>Begonia sp.</i>	<i>Pelargonium sp.</i>
<i>Catharanthus roseus</i>	<i>Pelargonium x hortorum</i>
<i>Euphorbia pulcherrima</i>	<i>Pseudotsuga menziesii</i>
<i>Geranium magniflorum</i>	<i>Rosa sp.</i>
<i>Geranium sp.</i>	<i>Tsuga heterophylla</i>
<i>Hydrangea sp.</i>	<i>Tulipa sp.</i>
<i>Impatiens walleriana</i>	<i>Viola sp.</i>
<i>Lilium sp.</i>	<i>Viola X wittrockiana</i>
<i>Paeonia sp.</i>	

Target Product(s)(list tested products or numbered compounds if ongoing or completed project)	
3336 F (Thiophanate-methyl)	Orkestra 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 (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)	S2200 4SC (Mandestrobin)
Decree (Fenhexamid)	S-2399 (S-2399)
Disarm 480SC (Fluoxastrobin)	SP2478 (SP2478)
Dithane 75DF Rainshield (Mancozeb)	SP2480 (SP2480)
EcoGuard (Bacillus licheniformis SB3086 + Indole-3-butyric Acid)	SP2770 10WP (SP2770)
EcoSwing (Swinglea glutinosa)	SP2773 (SP2773)
Empress Intrinsic Brand Fungicide (Pyraclostrobin)	Spectro 90WDG (Thiophanate-methyl + Chlorothalonil)
Endorse (Polyoxin D)	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)
Medallion (Fludioxonil)	TXC2020 (Thyme oil)
Milban 39EC (Dodemorph)	V-10135 (Fenpyrazamine)
MilStop (Potassium bicarbonate)	XDE-659 (florylpicoxamid)
Mural WDG (Azoxystrobin + benzovindiflupyr)	ZeroTol (Hydrogen dioxide)
NI02ES-1 (NI02ES-1)	ZeroTol 2.0 (Hydrogen dioxide + peroxyacetic acid)
	Zonix (Rhamnolipid Biosurfactant)

Product Registration and Research Status			
	Fully Screened (also includes standards)	Partially Screened through IR-4 <sup>1</sup>	Need Data Across Species?
Labeled Generally & Commercialized	<b>Affirm/ Endorse *</b> Alibi Flora Badge 2X <b>Botector*</b> Chipco 26019 Daconil Decree Disarm Emerald Milstop Mural Palladium Phyton-27 Prestop Regalia 50 Switch Tourney ZeroTol	<b>Astun/ IKF-5411*</b> <b>Insignia *</b> <b>Medallion *</b> <b>Orkestra *</b> <b>Pageant *</b> <b>Picatina *</b> <b>Picatina Flora *</b> <b>Regime *</b> Spirato <b>Stargus *</b>	BotryStop Proud 3
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			

PROS	CONS
Botrytis is prone to resistance development and new classes of chemistry are a critical component	Very few new products to screen
New potential products	Biologicals
Biologicals (ie. Midori)	Biological – few working on resistance mgmt / field efficacy (ornamental bulbs)
Postharvest use	Perennial – more data & communication needed
Resistance management	
Comments: Some tools in current protocol have sufficient information to support registration of certain species. Others still need additional efficacy on <i>B. cinerea</i> , the most common Botrytis species.	



## IR-4 Efficacy Trials to Date

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/disease combinations that are blank, IR-4 has not screened this combination.

'Labeled' indicates that this disease species or genera is listed on the label. A rating of 2 or lower is considered unacceptable efficacy (*red text*). 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 *green text*. For disease/product combinations that are blank, IR-4 has not screened this combination.

MOA	Product (Active Ingredients)	<i>Botrytis elliptica</i>	<i>Botrytis Gray Mold (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)		<b>5.0 (5 - 5) n1</b>		
FRAC 11	Disarm 480SC (Fluoxastrobin)	<i>2.0 (1 - 3) n2 Labeled</i>	<i>1.0 (1 - 1) n1 Labeled</i>		
	Empress Intrinsic Brand Fungicide (Pyraclostrobin)		<b>3.0 (3 - 3) n1</b>		
	Fame SC (Fluoxastrobin)		<i>1.0 (1 - 1) n1</i>		
	Heritage (Azoxystrobin)		5.0 (5 - 5) n1 Labeled		
	Insignia 20WDG Intrinsic Brand Fungicide (Pyraclostrobin)		<i>2.5 (1 - 4) n2 Labeled</i>		
	S2200 4SC (Mandestrobin)	<b>4.5 (4 - 5) n4</b>	<i>2.6 (1 - 5) n14</i>	<i>2.5 (1 - 4) n2</i>	<i>2.5 (2 - 3) n2</i>
FRAC 11 + FRAC 3	Alibi Flora SC (Azoxystrobin + difenoconazole)		5.0 (5 - 5) n1 Labeled	<i>1.0 (1 - 1) n1 Labeled</i>	
FRAC 11 + FRAC 7	Mural WDG (Azoxystrobin + benzovindiflupyr)	4.3 (3 - 5) n3 Labeled	3.3 (2 - 5) n3 Labeled	<i>1.0 (1 - 1) n1 Labeled</i>	
FRAC 12	Medallion (Fludioxonil)	3.0 (3 - 3) n1 Labeled	<i>2.6 (1 - 5) n12 Labeled</i>	4.0 (4 - 4) n1 Labeled	
	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)	<i>1.3 (1 - 2) n3 Labeled</i>	3.1 (1 - 5) n7 Labeled	<i>1.0 (1 - 1) n1 Labeled</i>	
	V-10135 (Fenpyrazamine)	<i>1.0 (1 - 1) n1</i>	<i>1.0 (1 - 1) n1</i>		
FRAC 19	Affirm (Polyoxin D zinc salt)	<i>1.0 (1 - 1) n1 Labeled</i>	4.3 (3 - 5) n4 Labeled		
	Endorse (Polyoxin D)		<i>2.0 (1 - 3) n3 Labeled</i>		
FRAC 2	Chipco 26019 FLO (Iprodione)		<i>2.2 (1 - 5) n5</i>		
	Chipco 26019 N/G 50WP (Iprodione)	<i>1.0 (1 - 1) n2 Labeled</i>	5.0 (5 - 5) n1 Labeled	<i>2.5 (1 - 4) n2 Labeled</i>	<i>2.0 (2 - 2) n2 Labeled</i>
	Chipco 26GT Flo (Iprodione)		<i>1.0 (1 - 1) n1</i>		
FRAC 3	Bayleton 25WP (Triadimefon)		<b>5.0 (5 - 5) n1</b>		
	Torque 3.6SC (Tebuconazole)	<i>1.0 (1 - 1) n2</i>	<b>5.0 (5 - 5) n1</b>	<i>1.0 (1 - 1) n1</i>	<i>2.0 (2 - 2) n1</i>
	Tourney 50WDG (Metconazole)	<i>1.0 (1 - 1) n1 Labeled</i>	3.3 (1 - 5) n3 Labeled		
	Trinity 2SC (Triticonazole)	<i>1.0 (1 - 1) n2</i>	<b>3.0 (1 - 5) n4</b>		
FRAC 5	Milban 39EC (Dodemorph)		<b>4.0 (4 - 4) n1</b>		
FRAC 7	Astun (isofetamid)		4.1 (2 - 5) n8 Labeled		
	IKF-5411 (isofetamid)	5.0 (5 - 5) n1 Labeled	3.2 (1 - 5) n6 Labeled	4.0 (4 - 4) n1 Labeled	
	Picatina (Pydiflumetofen)		4.0 (3 - 5) n2 Labeled		
FRAC 7 + FRAC 11	BAS 516 UFF (Boscalid + pyraclostrobin)		<i>2.0 (1 - 3) n2</i>		
	Broadform SC500 (Fluopyram + Trifloxystrobin)		<i>2.9 (1 - 5) n7 Labeled</i>		

MOA	Product (Active Ingredients)	<i>Botrytis elliptica</i>	<i>Botrytis Gray Mold (Botrytis cinerea)</i>	<i>Botrytis sp.</i>	<i>Botrytis tulipae</i>
	Orkestra Intrinsic (Fluxapyroxad + pyraclostrobin)	4.8 (4 - 5) n4 Labeled	2.9 (1 - 5) n17 Labeled		4.0 (3 - 5) n2 Labeled
	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	
	Switch 62.5WG (Cyprodinil + Fludioxonil)		3.0 (2 - 4) n2		
FRAC BM01	EcoSwing (Swinglea glutinosa)		1.4 (1 - 3) n7 Labeled		
	Proud 3 (Thyme oil)	1.0 (1 - 1) n5	1.3 (1 - 3) n11	1.0 (1 - 1) n2	1.0 (1 - 1) n2
	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
	Tril-21 (Thyme oil)		2.0 (1 - 3) n2		
	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	
	BotryStop WP (Ulocladium oudemansii (U3 Strain))		1.0 (1 - 1) n1 Labeled		
	BW165N (Ulocladium oudemansii (U3 Strain))	1.0 (1 - 1) n1	2.2 (1 - 5) n12	1.0 (1 - 1) n1	
	Prestop (Gliocladium catenulatum Strain J1446)		2.8 (2 - 5) n4 Labeled	1.0 (1 - 1) n1 Labeled	
	Prophytex EC (Bacillus subtilis strain B1111)	1.0 (1 - 1) n2	1.8 (1 - 3) n4	1.0 (1 - 1) n1	
	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	
	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		
	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		
	ZeroTol (Hydrogen dioxide)	1.0 (1 - 1) n1 Labeled	1.0 (1 - 1) n1 Labeled	1.0 (1 - 1) n2 Labeled	
	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		

MOA	Product (Active Ingredients)	<i>Botrytis elliptica</i>	Botrytis Gray Mold ( <i>Botrytis cinerea</i> )	<i>Botrytis sp.</i>	<i>Botrytis tulipae</i>
	Regalia O5 (MOI-10605) (Extract of <i>Reynoutria sachalinensis</i> )	1.0 (1 - 1) n1 <i>Labeled</i>	1.0 (1 - 1) n2 <i>Labeled</i>		
	Regalia SC (MOI 106) (Extract of <i>Reynoutria sachalinensis</i> )		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 ( <i>Bacillus amyloliquefaciens</i> Strain D747)		1.0 (1 - 1) n1		
IRAC UNF & FRAC BM02	Stargus ( <i>Bacillus nakamurai</i> strain F727)	1.0 (1 - 1) n3 <i>Labeled</i>	1.3 (1 - 3) n9 <i>Labeled</i>	4.0 (4 - 4) n1 Labeled	1.0 (1 - 1) n1 <i>Labeled</i>
unknown	RD00AS-1 (BW159) (BW159)		1.0 (1 - 1) n1		
	S-2399 (S-2399)		4.0 (4 - 4) n1		
	SP2478 (SP2478)		2.5 (2 - 3) n2		
	SP2480 (SP2480)		2.0 (1 - 5) n10		
	SP2770 10WP (SP2770)	2.0 (2 - 2) n1	1.0 (1 - 1) n1	1.0 (1 - 1) n1	1.0 (1 - 1) n1
	SP2773 (SP2773)	2.0 (2 - 2) n1	1.0 (1 - 1) n1	1.0 (1 - 1) n1	1.0 (1 - 1) n1
	XDE-659 (florylpicoxamid)		4.0 (3 - 5) n3		

\*Regalia rate used was lower than the lowest labeled rate of 2 quarts per 100 gal.