

**Project Name:** Pythium Efficacy

<b>New</b>		<b>Ongoing</b>	X	<b>Completed</b>		<b>Duration if ongoing or completed:</b>	2006, 2007, 2010 – 2013, 2020 – 2023
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**Project Description:**

Development of Pythium efficacy to screen active ingredients and expand current labels arose jointly with Phytophthora Efficacy at the 2005 IR-4 Ornamental Horticulture Program Workshop. Pythium root rots often occur on young seedlings as damping off and on other plants under stress. Pythium is part of a group of organisms known as water molds or close cousins of fungi. Banol, Subdue and Truban have been the standard management tools, however pockets of resistant populations to each have developed. Aliette has also been an effective tool. Additional products of different mode of actions are needed. Pythium diseases typically have been put on labels along with Phytophthora diseases, but the activity spectra are different. And as Pythium species are described and growers get more details diagnoses, it is becoming apparent that not all Pythium species respond to management tools similarly. Understanding which tool is the best to use for each is important for a better implementation of IPM and judicious use of products, especially when growers face economic difficulties where every dollar spent must positively impact the bottom line.

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

*Abstract from 2012 Pythium Efficacy Summary*

At the IR-4 Environmental Horticulture Program Workshops in 2009 and 2019, Pythium 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 1999 to 2013 on environmental horticulture crops. During this time period, numerous products representing 47 active ingredients were tested as drench, foliar or soil applications against several *Pythium* species causing root rot and damping-off. *Pythium* species tested included: *P. aphanidermatum*, *P. irregulare*, *P. mamillatum*, *P. dissotocum*, *P. ultimum* and *P. vipa*. Most trials were conducted on *P. aphanidermatum* and *P. ultimum*. Although there were insufficient data for definitive conclusions, several relatively new products that are included in the Pythium efficacy project looked promising for managing *P. aphanidermatum*. These were BW159, BW161N, Daconil ZN, MBI-121, Picarbutrazox 20WG and Picarbutrazox SC. The established standards and recently registered materials (Adorn, Fenstop, Subdue Maxx and Terrazole/Truban) generally performed well. The data from these trials suggest that the effectiveness of some fungicides in controlling Pythium root rot may vary, depending on the species of *Pythium* or crop.

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

Pythium aphanidermatum ( <i>Pythium aphanidermatum</i> )	Pythium splendens ( <i>Pythium splendens</i> )
Pythium dissotocum ( <i>Pythium dissotocum</i> )	Pythium ultimum ( <i>Pythium ultimum</i> )
Pythium irregulare ( <i>Pythium irregulare</i> )	Pythium vipa ( <i>Pythium vipa</i> )
Pythium sp. ( <i>Pythium sp.</i> )	TBD (TBD)

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

<i>Antirrhinum majus</i>	<i>Euphorbia pulcherrima</i>	<i>Pelargonium sp.</i>
<i>Catharanthus roseus</i>	<i>Geranium sp.</i>	<i>Petunia sp.</i>
<i>Celosia sp.</i>	<i>Impatiens hawkeri</i>	<i>Petunia x hybrida</i>
<i>Chrysanthemum/Dendranthema sp.</i>	<i>Lavandula angustifolia</i>	<i>Pseudotsuga menziesii</i>
<i>Delphinium sp.</i>	<i>Osteospermum sp.</i>	

Target Product(s)(list tested products or numbered compounds if ongoing or completed project)
Actinovate Soluble (Streptomyces lydicus WYEC 108)
Adorn 4F (Fluopicolide)
Agrifos (Dipotassium phosphonate + Dipotassium phosphate)
Aliette WDG (Fosetyl Al)
Alude (Potassium phosphite)
Bountify (MBI 306) (Burkholderia rinojensis strain A396)
BSEF-11 (BSEF-11)
BW161N (BW161N)
Calirus 150 (Mono- and di- potassium salts of phosphorus acid + copper sulfate pentahydrate)
Captan (Captan)
CG100 (Caprylic acid)
Daconil ZN (Chlorothalonil)
Disarm 480SC (Fluoxastrobin)
Empress Intrinsic Brand Fungicide (Pyraclostrobin)
Fenstop (Fenamidone)
Heritage (Azoxystrobin)
Hymexazol 30L (Hymexazol)
Inosco (Potassium phosphite)
Insignia 20WDG Intrinsic Brand Fungicide (Pyraclostrobin)
Insimmo (Acibenzolar-S-methyl)
K-Phite (Phosphorus acid salts)
Magellan (Mono- and Dibasic Sodium, Potassium and Ammonium Phosphites)
MBI 121 (MBI 121)
Micora (Mandipropamid)
MultiGuard (Furfural)
Muscodor albus (Muscodor albus)
Pageant Intrinsic (Boscalid + pyraclostrobin)
Phosphorus acid/phosphorus acid generator (Phosphorus acid/phosphorus acid generator)
Picarbutrazox 20WG (Picarbutrazox)
Picarbutrazox SC (NF-171) (Picarbutrazox)
Plentrix (A13836B) (azoxystrobin + mefenoxam)
RD00AS-1 (BW159) (BW159)
Remedier (Trichoderma asperellum + Trichoderma gamsii)
RootShield Plus WP (aka BW240) (Trichoderma harzianum T-22 + Trichoderma virens G-41)
Segway (Cyazofamid)
SP2478 (SP2478)
SP2700 WP (SP2700)
SP2770 10WP (SP2770)
SP2771 (SP2771)
Subdue MAXX (Mefenoxam)
Taegro (Bacillus subtilis var amyloliquefaciens strain FZB24)
Terrazole 35%WP (Etridiazole)
Terrazole EC (Etridiazole)
Tril-21 (Thyme oil)
TXC2020 (Thyme oil)
V-10208 SC (V-10208)
Vital 4L (Potassium phosphite)



# Environmental Horticulture Program Research Project Sheet

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

Products/Crops Registered through IR-4Research:					
	Fully Screened (also includes standards)		Partially Screened through IR-4 <sup>1</sup>		Need Data Across Species ?
Labeled Generally & Commercialized	<b>Adorn *</b> Aliette DisArm FenStop <b>Pageant *</b>	<b>RootShield Plus *</b> <b>Segway *</b> <b>Subdue</b> <b>Maxx *</b> Terrazole	Banol Banrot Cease Companion <b>Empress *</b> Heritage	Hurricane PlantShield RootShield Phosphorus Acid Salts <sup>1</sup> SoilGard	Actinovate Captan Mycostop Taegro
Labeled Generally But NOT Commercialized					
Labeled for Specific Pythium& Commercialized					
Labeled for Specific Pythium but NOT Commercialized					
Not yet registered or labeled for Pythium			Bas 703 06F Bio-Tam CG100 SP 2770 10WP SP 2771		
No longer available for development for Pythium			A13839B <b>Micora (NOA 446510) *</b> Remedier SP20155		

\* IR-4 Data contributed to registration decision – either adding pest to label or not pursuing further research

<sup>1</sup> Agri-Fos, Alude Magellan, Vital etc.

**Other:**

This project also tested tank mix and rotations to foster IPM strategies for managing resistance.

PROS	CONS
Individual Pythium & Phytophythium species vary in response	Individual Pythium & Phytophythium species vary in response
Not enough effective tools	Multiple years of data with successful registrations of products of different classes
Pythium efficacy does not mirror Phytophthora efficacy (new Phytophthora products not necessarily good on Pythium)	Many labels already list “Pythium diseases” on the label so further refinement of labels is not needed
General labels could be refined by listing species – however, growers may not know which species they might have without detailed diagnostics	General labels could be refined by listing species – however, growers may not know which species they might have without detailed diagnostics
Issue in Northeast & North Central with greenhouse & herbaceous materials	
Some products should be screened on identified Pythium species	
<b>Comments:</b> some treatments well screened on <i>P. aphanadermatum</i> and data for other species needed.	



## 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).

'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>Pythium aphanidermatum</i>	<i>Pythium dissotocum</i>	<i>Pythium irregulare</i>	<i>Pythium sp.</i>	<i>Pythium ultimum</i>	<i>Pythium vipa</i>
FRAC 11	Disarm 480SC (Fluoxastrobin)	2.3 (1 - 5) n6	1.0 (1 - 1) n1	1.0 (1 - 1) n4	3.0 (3 - 3) n2	1.6 (1 - 3) n5	1.0 (1 - 1) n1
FRAC 11	Empress Intrinsic Brand Fungicide (Pyraclostrobin)			2.0 (2 - 2) n1 Labeled			
FRAC 11	Fenstop (Fenamidone)	3.7 (3 - 5) n6 Labeled	1.0 (1 - 1) n1 Labeled	1.0 (1 - 1) n2 Labeled	3.5 (2 - 5) n2 Labeled	3.0 (1 - 5) n5 Labeled	1.0 (1 - 1) n1 Labeled
FRAC 11	Heritage (Azoxystrobin)	2.4 (1 - 5) n10	1.0 (1 - 1) n2	2.2 (1 - 5) n5	1.0 (1 - 1) n1	1.4 (1 - 3) n7	1.5 (1 - 2) n2
FRAC 11	Insignia 20WDG Intrinsic Brand Fungicide (Pyraclostrobin)			2.0 (2 - 2) n2 Labeled		1.0 (1 - 1) n1 Labeled	
FRAC 11 + FRAC 4	Plentrix (A13836B) (azoxystrobin + mefenoxam)	3.5 (3 - 4) n2 Labeled		3.0 (3 - 3) n1 Labeled		1.0 (1 - 1) n1 Labeled	
FRAC 11 + FRAC 4	Tank Mix: Heritage + Subdue MAXX (Azoxystrobin + mefonaxam)	3.0 (3 - 3) n1		5.0 (5 - 5) n1			
FRAC 14	Terrazole 35%WP (Etridiazole)	5.0 (5 - 5) n1 Labeled		2.3 (1 - 5) n3 Labeled		3.7 (1 - 5) n3 Labeled	
FRAC 14	Terrazole EC (Etridiazole)	3.5 (1 - 5) n4 Labeled		1.0 (1 - 1) n1 Labeled	5.0 (5 - 5) n1 Labeled	2.0 (1 - 3) n2 Labeled	
FRAC 21	Segway (Cyazofamid)	2.0 (2 - 2) n2 Labeled		3.0 (3 - 3) n2 Labeled	4.0 (3 - 5) n2 Labeled	3.0 (1 - 5) n2 Labeled	
FRAC 32	Hymexazol 30L (Hymexazol)	2.5 (1 - 4) n2		1.7 (1 - 3) n3	3.0 (3 - 3) n1	1.0 (1 - 1) n1	
FRAC 4	Subdue MAXX (Mefenoxam)	3.9 (1 - 5) n12 Labeled	2.5 (2 - 3) n2 Labeled	3.3 (2 - 5) n4 Labeled	5.0 (5 - 5) n1 Labeled	2.2 (1 - 5) n5 Labeled	2.5 (2 - 3) n2 Labeled
FRAC 40	Micora (Mandipropamid)	2.0 (1 - 3) n2		1.0 (1 - 1) n1	3.0 (3 - 3) n1		
FRAC 43	Adorn 4F (Fluopicolide)	3.1 (1 - 5) n8 Labeled	1.0 (1 - 1) n2 Labeled	1.0 (1 - 1) n6 Labeled	3.0 (3 - 3) n1 Labeled	2.6 (1 - 5) n5 Labeled	2.5 (2 - 3) n2 Labeled
FRAC 43 + FRAC 4	Tank Mix: Adorn + Subdue MAXX (Fluopicolide + mefonaxam)	4.0 (3 - 5) n3		1.0 (1 - 1) n1		3.0 (3 - 3) n1	
FRAC 7 + FRAC 11	Pageant Intrinsic (Boscalid + pyraclostrobin)	3.0 (1 - 5) n8 Labeled	1.0 (1 - 1) n2 Labeled	1.5 (1 - 3) n4 Labeled	2.0 (2 - 2) n1 Labeled	1.4 (1 - 3) n5 Labeled	1.0 (1 - 1) n2 Labeled
FRAC BM01	Tril-21 (Thyme oil)	1.0 (1 - 1) n5		1.0 (1 - 1) n1	5.0 (5 - 5) n1		
FRAC BM02	Actinovate Soluble (Streptomyces lydicus WYEC 108)				2.0 (2 - 2) n1 Labeled	1.0 (1 - 1) n1 Labeled	
FRAC BM02	Remedier (Trichoderma asperellum + Trichoderma gamsii)				1.0 (1 - 1) n1 Labeled		
FRAC BM02	RootShield Plus WP (aka BW240) (Trichoderma harzianum T-22 + Trichoderma virens G-41)	1.6 (1 - 5) n8 Labeled	1.0 (1 - 1) n2 Labeled	1.8 (1 - 3) n4 Labeled	1.0 (1 - 1) n1 Labeled	1.5 (1 - 3) n4 Labeled	1.5 (1 - 2) n2 Labeled

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FRAC M4	Captan (Captan)			2.0 (2 - 2) n2 Labeled		1.0 (1 - 1) n1 Labeled	
FRAC M5	Daconil ZN (Chlorothalonil)	3.0 (1 - 5) n5		2.0 (2 - 2) n1	1.0 (1 - 1) n1		
FRAC NC	CG100 (Caprylic acid)	1.8 (1 - 5) n5	1.0 (1 - 1) n1	1.0 (1 - 1) n3	1.0 (1 - 1) n1	1.0 (1 - 1) n3	1.0 (1 - 1) n1
FRAC NC & IRAC UNB	Bountify (MBI 306) (Burkholderia rinojensis strain A396)	1.0 (1 - 1) n1					
FRAC NC / FRAC P07	Rotation: BW240 / Agrifos (BW240 / potassium phosphite)	1.0 (1 - 1) n1					
FRAC NC / FRAC P07	Rotation: BW240 / Aliette (BW240 / Aluminum tris-phosphate)			1.0 (1 - 1) n1		1.0 (1 - 1) n1	
FRAC NC / FRAC P07	Rotation: BW240 / Alude (BW240 / potassium phosphite)	2.0 (1 - 3) n2					
FRAC NC / FRAC P07	Rotation: BW240 / Phosphorus Acid (BW240 / Phosphorus Acid)	2.0 (2 - 2) n1			1.0 (1 - 1) n1		
FRAC NC / FRAC P07	Rotation: BW240/Vital (BW240 / potassium phosphite)	1.0 (1 - 1) n1					
FRAC NC + FRAC P07	Tank Mix: BW420 + Alude (BW420 + potassium phosphite)		1.0 (1 - 1) n1	1.0 (1 - 1) n1			2.0 (2 - 2) n1
FRAC P01	Insimmo (Acibenzolar-S-methyl)	1.0 (1 - 1) n2		3.0 (3 - 3) n1	1.0 (1 - 1) n1	1.5 (1 - 2) n2	
FRAC P01 + FRAC 11	Tank Mix: Acibenzolar + Heritage (Acibenzolar + Azoxystrobin)	1.0 (1 - 1) n2		3.0 (3 - 3) n1		1.0 (1 - 1) n2	
FRAC P07	Agrifos (Dipotassium phosphonate + Dipotassium phosphate)	1.0 (1 - 1) n1 Labeled			3.0 (3 - 3) n1 Labeled	1.0 (1 - 1) n2 Labeled	
FRAC P07	Aliette WDG (Fosetyl Al)	2.0 (1 - 3) n2 Labeled	3.0 (3 - 3) n1 Labeled	2.8 (1 - 4) n4 Labeled	1.0 (1 - 1) n1 Labeled	1.0 (1 - 1) n2 Labeled	3.0 (3 - 3) n1 Labeled
FRAC P07	Alude (Potassium phosphite)	1.0 (1 - 1) n1 Labeled	3.0 (3 - 3) n1 Labeled	1.7 (1 - 3) n3 Labeled		1.8 (1 - 3) n4 Labeled	4.0 (4 - 4) n1 Labeled
FRAC P07	Inosco (Potassium phosphite)			3.0 (3 - 3) n1 Labeled			
FRAC P07	Magellan (Mono- and Dibasic Sodium, Potassium and Ammonium Phosphites)			1.0 (1 - 1) n2 Labeled	1.0 (1 - 1) n1 Labeled	1.0 (1 - 1) n1 Labeled	
FRAC P07	Vital 4L (Potassium phosphite)	1.3 (1 - 2) n3 Labeled			4.0 (4 - 4) n1 Labeled	1.0 (1 - 1) n2 Labeled	
FRAC P07 / FRAC NC	Rotation: AgriFos / BW240 (Potassium phosphite / BW240)					1.0 (1 - 1) n1	
FRAC P07 + FRAC 11	Tank Mix: Inosco + Heritage (Potassium phosphite + azoxystrobin)			3.0 (3 - 3) n1			

MOA	Product (Active Ingredients)	<i>Pythium aphanidermatum</i>	<i>Pythium dissotocum</i>	<i>Pythium irregulare</i>	<i>Pythium sp.</i>	<i>Pythium ultimum</i>	<i>Pythium vicia</i>
FRAC U17	Picarbutrazox 20WG (Picarbutrazox)	4.2 (3 - 5) n5		5.0 (5 - 5) n1	4.0 (4 - 4) n1		
FRAC U17	Picarbutrazox SC (NF-171) (Picarbutrazox)	4.3 (3 - 5) n4		1.0 (1 - 1) n1	3.0 (3 - 3) n1		
unknown	BSEF-11 (BSEF-11)	1.0 (1 - 1) n2					
unknown	BW161N (BW161N)	3.0 (1 - 5) n4		2.0 (2 - 2) n1	4.0 (4 - 4) n1		
unknown	MBI 121 (MBI 121)	5.0 (5 - 5) n3		1.0 (1 - 1) n1	1.0 (1 - 1) n1		
unknown	MultiGuard (Furfural)			1.0 (1 - 1) n2 Labeled	2.0 (2 - 2) n1 Labeled	1.0 (1 - 1) n1 Labeled	
unknown	RD00AS-1 (BW159) (BW159)	3.7 (1 - 5) n3			2.0 (2 - 2) n1		
unknown	SP2770 10WP (SP2770)		1.0 (1 - 1) n1	1.0 (1 - 1) n1		1.0 (1 - 1) n1	1.0 (1 - 1) n1
unknown	SP2771 (SP2771)		1.0 (1 - 1) n2	1.0 (1 - 1) n1		1.0 (1 - 1) n1	
unknown	V-10208 SC (V-10208)					4.0 (4 - 4) n1	

\*\* Disarm 480SC is now known as Fame SC