

Project Name: Non-Oomycete Root and Crown Rot Efficacy – Fusarium

Dates Active: 2012-2013; 2018-2023

Project Description:

This project arose out of the 2011 IR-4 Environmental Horticulture Workshop as one of several projects focusing on root diseases. *Fusarium* and *Pythium* were the two pathogen genera chosen for study. *Fusarium* species can infect roots, crown and stems causing root and crown rots and canker diseases. Subsequently, nonoomycete root and crown rot diseases became a high priority project starting in 2018.

Research Project Abstract:

Abstract from 2021 Fusarium Efficacy Summary & Literature Review

From 2001 to 2020, numerous products representing 40 active ingredients were evaluated in greenhouse and field trials as soil drench, soil incorporation, foliar, in-furrow, drip irrigation or tuber soak applications against several *Fusarium* species causing rots (crown, stem and tuber rots) and wilt on environmental horticulture crops, and wilt and root rot on vegetables. *Fusarium* species tested included: *F. avenaceum*, *F. commune*, *F. oxysporum*, *F. solani* and *F. sp.* Most trials were conducted on *F. oxysporum* on larkspur, liriopse, lisianthus and watermelon. Although there were insufficient data for definitive conclusions, several relatively new products showed promising, though inconsistent, efficacy comparable to the standards. These include Astun (isofetamid), BAS 750 (mefentriconazole), Picatina (pydiflumetofen), Heritage (azoxystrobin), Compass (trifloxystrobin), Hurricane (fludioxonil+mefenoxam), Insignia (pyraclostrobin), Insimmo (acibenzolar), MBI-121, Orkestra (fluxapyroxad + pyraclostrobin), SP2169, Tournay (metconazole) and Trinity (triticonazole)., Broadform (fluopyram + trifloxystrobin), BW240/RootShield Plus (*Trichoderma harzianum* & *T. virens*), (BW1161N), CG100 (caprylic acid), Mural, Pageant (boscalid+pyraclostrobin), Palladium (cyprodinil+fludioxonil), SP2550, SP2770 and TCX2020 provided no to mediocre efficacy. Postiva (pydiflumetofen + difenoconazole) provided excellent efficacy on *F. oxysporum* on various environmental horticultural crops in greenhouse experiments. Proline (prothioconazole) provided consistently good control of *F. oxysporum* in watermelon trials. The established standards 3336, Medallion and Terraguard generally provided inconsistent efficacy.

Target Species (Phytotoxicity, or common and Latin name of arthropod, pathogen, weed):
<i>Fusarium commune</i> <i>Fusarium oxysporum</i> <i>Fusarium solani</i> <i>Fusarium sp.</i> Fusarium Wilt of Basil (<i>Fusarium oxysporum f sp basilici</i>) Fusarium Wilt of Chrysanthemum (<i>Fusarium oxysporum f sp chrysanthemi</i>) Fusarium Wilt of Cyclamen (<i>Fusarium oxysporum f sp cyclaminis</i>)

Target Crops (list tested crops if ongoing or completed project)
Chrysanthemum, Garden (<i>Chrysanthemum/Dendranthema</i> sp.)
Florist's Cyclamen (<i>Cyclamen persicum</i>) 'Halios HD Scarlet'
Larkspur (<i>Delphinium</i> sp.)
Dracaena, Striped; Janet Craig Dracaena (<i>Dracaena deremensis</i>)
Gladiolus (<i>Gladiolus</i> sp.)
Hydrangea, Oakleaf (<i>Hydrangea quercifolia</i>) 'Queen of Hearts'
Iris, Dutch (<i>Iris x hollandica</i>) 'Blue Diamond'
Lisianthus (<i>Lisianthus</i> sp.) Eustoma grandiflora
Sweet Basil (<i>Ocimum basilicum</i>) 'Genovese'
Fir, Douglas (<i>Pseudotsuga menziesii</i>)
Upright Prairie Coneflower (<i>Ratibida columnifera</i>)

Target Product(s)(list tested products or numbered compounds if ongoing or completed project)	
3336 F (Thiophanate-methyl)	Mural WDG (Azoxystrobin + benzovindiflupyr)
Astun (isofetamid)	Pageant Intrinsic (Boscalid + pyraclostrobin)
Avelyo Fungicide (Mefentrifluconazole)	Palladium (Cyprodinil + fludioxonil)
BAS 673 05F (BAS 673 05F)	Postiva (pydiflumetofen + difenoconazole)
Broadform SC500 (Fluopyram + Trifloxystrobin)	Pradia (Cyclaniliprole + Flonicamid)
BW161N (BW161N)	Promax (Thyme oil)
CG100 (Caprylic acid)	RD00AS-1 (BW159) (BW159)
Compass 0 50WDG (Trifloxystrobin)	RootShield Plus WP (aka BW240) (Trichoderma harzianum T-22 + Trichoderma virens G-41)
Disarm 480SC (Fluoxastrobin)	SP2169 (SP2169)
Empress Intrinsic Brand Fungicide (Pyraclostrobin)	SP2478 (SP2478)
Flagship 0.22G (Thiamethoxam)	SP2480 (SP2480)
Flagship 25WG (Thiamethoxam)	SP2550 (SP2550)
Floramite (Bifenazate)	SP2700 WP (SP2700)
Heritage (Azoxystrobin)	SP2770 10WP (SP2770)
Hurricane (Fludioxonil + mefonaxam)	Stargus (Bacillus nakamurai strain F727)
Insignia SC Intrinsic Brand Fungicide (Pyraclostrobin)	Terraguard 50W (Triflumizole)
Insimmo (Acibenzolar-S-methyl)	Torque 3.6SC (Tebuconazole)
Kleengrow (Didecyl dimethyl ammonium chloride)	Tourney 50WDG (Metconazole)
LEM17 (Penthiopyrad)	Tril-21 (Thyme oil)
MBI 121 (MBI 121)	Trinity 2SC (Triticonazole)
MBI 601 (Muscodor albus)	TXC2020 (Thyme oil)
Medallion (Fludioxonil)	Zio (Pseudomonas chlororaphis strain AFS009)

Product Registration and Research Status			
	Fully Screened (also includes standards)	Partially Screened through IR-4 ¹	Need Data Across Species ?
Labeled Generally & Commercialized	3336 WP Double Nickel LC Affirm Eagle 20EW Armada 50WP Heritage Banner MAXX Insignia Bayleton 50WDG Mural Cease Pageant Copper Regalia compounds ² Tourney Daconil Ultrex ZeroTol	Regime	
Labeled Generally But NOT Commercialized			
Labeled for Specific Diseases& Commercialized	Actinovate Compass 0 50WDG Cygnus Disarm 480SC Orkestra Pipron Terraguard		Torque Triact 70 Trinity
Labeled for Specific Diseases but NOT Commercialized			
Not yet registered or Labeled	NF-149 Picatina Picatina Flora Picatina Gold	Gatten IKF-309 SP2478 XDE-659	Midori
No longer available for development	SP 2770		
* IR-4 Data contributed to registration decision – either adding pest to label or not pursuing further research 1 At least one species screened fully. 2 Including but not limited to Camelot O, CuPRO, Kocide, Junction, Nu-Cop, Phyton 27			

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.

Environmental Horticulture Program Research Project Sheet

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

MOA Class	Product (Actives)	<i>Fusarium commune</i>	<i>Fusarium oxysporum</i>	<i>Fusarium solani</i>	<i>Fusarium sp.</i>	<i>Fusarium oxysporum f sp basilici</i>	<i>Fusarium oxysporum f sp chrysanthi</i>	<i>Fusarium oxysporum f sp cyclaminis</i>
FRAC 1	3336 F (Thiophanate-methyl)	3.5 (3 - 4) n2 Labeled	4.0 (3 - 5) n2 Labeled	5.0 (5 - 5) n1 Labeled	1.0 (1 - 1) n2 Labeled	5.0 (5 - 5) n1 Labeled		
FRAC 1 + FRAC P1	Tank Mix: 3336 50WP + Insimmo (Thiophanate-methyl + acibenzolar-S-methyl)				1.0 (1 - 1) n2			
FRAC 11	Compass 0 50WDG (Trifloxystrobin)	2.5 (2 - 3) n2		3.0 (3 - 3) n1				
FRAC 11	Disarm 480SC (Fluoxastrobin)				1.3 (1 - 2) n4 Labeled			
FRAC 11	Empress Intrinsic Brand Fungicide (Pyraclostrobin)		3.0 (3 - 3) n1 Labeled					
FRAC 11	Heritage (Azoxystrobin)	1.3 (1 - 2) n4 Labeled		5.0 (5 - 5) n1 Labeled	2.0 (1 - 4) n3 Labeled			
FRAC 11	Insignia SC Intrinsic Brand Fungicide (Pyraclostrobin)	3.0 (3 - 3) n1						
FRAC 11 + FRAC 12	Tank Mix: Heritage + Medallion WDG (Azoxystrobin + fludioxonil)	3.0 (3 - 3) n1						
FRAC 12	Medallion (Fludioxonil)	1.3 (1 - 2) n3 Labeled	5.0 (5 - 5) n1 Labeled	3.0 (3 - 3) n1 Labeled	1.0 (1 - 1) n4 Labeled			
FRAC 12 + FRAC 4	Hurricane (Fludioxonil + mefonaxam)	1.0 (1 - 1) n2 Labeled	5.0 (5 - 5) n1 Labeled					
FRAC 3	Avelyo Fungicide (Mefentrifluconazole)		4.0 (4 - 4) n1				2.0 (2 - 2) n1	4.0 (4 - 4) n1
FRAC 3	Terraguard 50W (Triflumizole)		1.0 (1 - 1) n1					
FRAC 3	Torque 3.6SC (Tebuconazole)	3.0 (1 - 5) n2			1.0 (1 - 1) n3	1.0 (1 - 1) n1		
FRAC 3	Tourney 50WDG (Metconazole)	3.3 (1 - 5) n4 Labeled	2.0 (1 - 3) n2 Labeled	4.0 (4 - 4) n1 Labeled	1.4 (1 - 3) n5 Labeled	3.0 (3 - 3) n1 Labeled		

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FRAC 3	Trinity 2SC (Triticonazole)	2.3 (1 - 4) n4 Labeled	2.5 (2 - 3) n2 Labeled	4.0 (4 - 4) n1 Labeled	1.7 (1 - 3) n3 Labeled	3.0 (3 - 3) n1 Labeled		
FRAC 7	Astun (isofetamid)		3.0 (3 - 3) n1					
FRAC 7 + FRAC 11	Pageant Intrinsic (Boscalid + pyraclostrobin)	3.7 (3 - 4) n3 Labeled	3.0 (3 - 3) n1 Labeled					
FRAC 7 + FRAC 3	Postiva (pydiflumetofen + difenoconazole)		3.0 (3 - 3) n1 Labeled				5.0 (5 - 5) n1 Labeled	5.0 (5 - 5) n1 Labeled
FRAC 9 + FRAC 12	Palladium (Cyprodinil + fludioxanil)	1.0 (1 - 1) n3 Labeled	3.0 (3 - 3) n1 Labeled	5.0 (5 - 5) n1 Labeled	1.2 (1 - 2) n5 Labeled	3.0 (3 - 3) n1 Labeled		
FRAC BM01	TXC2020 (Thyme oil)		3.0 (3 - 3) n1				1.0 (1 - 1) n1	1.0 (1 - 1) n1
FRAC BM02	RootShield Plus WP (aka BW240) (Trichoderma harzianum T-22 + Trichoderma virens G-41)	1.5 (1 - 3) n4 Labeled	2.0 (1 - 3) n2 Labeled	5.0 (5 - 5) n1 Labeled	1.0 (1 - 1) n5 Labeled	1.0 (1 - 1) n1 Labeled		
FRAC NC	CG100 (Caprylic acid)	1.7 (1 - 3) n3	2.0 (2 - 2) n2	3.0 (3 - 3) n1	1.0 (1 - 1) n3			
FRAC P01	Insimmo (Acibenzolar-S-methyl)	1.3 (1 - 2) n3	4.5 (4 - 5) n2	3.0 (3 - 3) n1	1.8 (1 - 4) n4			
FRAC P01 + FRAC 11	Tank Mix: Acibenzolar + Heritage (Acibenzolar + Azoxystrobin)	1.0 (1 - 1) n1			1.8 (1 - 3) n5			
IRAC 4A	Flagship 0.22G (Thiamethoxam)	1.0 (1 - 1) n1			2.0 (2 - 2) n1			
IRAC 4A	Flagship 25WG (Thiamethoxam)	1.0 (1 - 1) n1			1.0 (1 - 1) n1			
IRAC 4A + FRAC 11	Tank Mix: Flagship 0.22G + Heritage (Thiamethoxam + azoxystrobin)	1.0 (1 - 1) n1			3.0 (3 - 3) n1			

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IRAC 4A + FRAC 11	Tank Mix: Flagship 25WG + Heritage (Thiamethoxam + azoxystrobin)	2.5 (2 - 3) n2			2.0 (2 - 2) n1			
unknown	BW161N (BW161N)		2.0 (2 - 2) n1				2.0 (2 - 2) n1	1.0 (1 - 1) n1
unknown	Kleengrow (Didecyl dimethyl ammonium chloride)		3.0 (3 - 3) n1					
unknown	MBI 121 (MBI 121)		3.0 (3 - 3) n1				2.0 (2 - 2) n1	1.0 (1 - 1) n1
unknown	SP2169 (SP2169)	1.5 (1 - 2) n2	5.0 (5 - 5) n1		1.0 (1 - 1) n3			
unknown	SP2480 (SP2480)		1.0 (1 - 1) n1					1.0 (1 - 1) n1
unknown	SP2550 (SP2550)				1.0 (1 - 1) n2	1.0 (1 - 1) n1		
unknown	SP2700 WP (SP2700)		3.0 (3 - 3) n1				1.0 (1 - 1) n1	1.0 (1 - 1) n1