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

New		**Ongoing**	X	**Completed**		**Duration if ongoing or completed:**	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 (if available):

Abstract from 2020 Rhizoctonia Efficacy Summary & Literature Review

From 1999 to 2019, numerous products representing 48 active ingredients were evaluated in several greenhouse experiments as soil drench, soil incorporation, foliar or soak application, and in 2 field trials as soil drench, against *Rhizoctonia solani*. Trials were conducted on begonia, chrysanthemum, garden impatiens, petunia, poinsettia, snapdragon, viburnum and zinnia. The relatively new registered products Affirm/Endorse/Veranda O (polyoxin D), Empress Intrinsic (pyraclostrobin), Heritage (azoxystrobin), Medallion (fludioxonil), Mural (azoxystrobin + benzovindiflupyr) and Pageant Intrinsic (pyraclostrobin + boscalid) showed excellent efficacy. Although there were insufficient data for definitive conclusions, BAS 703/Orkestra, BAS 750, Broadform, Compass, Disarm, Hurricane, Picatina, Promax, Prostar, Tourney and Trinity generally provided good to excellent efficacy, while Astun, SP2700, and ZeroTol generally provided poor to mediocre efficacy. The biological products Actinovate, Howler, IT-5103, MBI-110/Stargus, MBI-601, Pvent, RootShield PLUS and SoilGard also provided mediocre to excellent efficacy in limited number of tests. Of the established standards, Terraclor generally provided good efficacy, while 3336 generally provided inconsistent efficacy.

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

Rhizoctonia solani (*Rhizoctonia solani*)

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

Acer rubrum	*Euphorbia pulcherrima*	*Rhododendron sp.*
Antirrhinum majus	*Impatiens sp.*	*Rhododendron sp.*
Begonia semperflorens	*Impatiens walleriana*	*Syngonium podophyllum*
Buxus sp.	*Juniperus sp.*	*Tagetes sp.*
Catharanthus roseus	*Pachysandra terminalis*	*Vinca sp.*
Cynodon dactylon	*Petunia sp.*	*Zinnia sp.*
Dianthus sp.	*Petunia x hybrida*	

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

3336 F (Thiophanate-methyl)	BAS 673 05F (BAS 673 05F)
3336 WP (50%) (Thiophanate-methyl)	Benlate 50WP (Benomyl)
3336 WP 70% (Pennwalt) (Thiophanate-methyl)	Broadform SC500 (Fluopyram + Trifloxystrobin)
Actinovate Soluble (Streptomyces lydicus WYEC 108)	BW161N (BW161N)
Adorn 4F (Fluopicolide)	Captan (Captan)
Agrifos (Dipotassium phosphonate + Dipotassium phosphate)	Companion (Bacillus subtillis GB03)
	Daconil 54EC (Chlorothalonil)
Astun (isofetamid)	Demosan 65WP (Chloroneb)
Avelyo Fungicide (Mefentrifluconazole)	Disarm 480SC (Fluoxastrobin)
Banrot I 30WP (Ethazole + thiabendazole)	EcoGuard (Bacillus licheniformis SB3086 + Indole-3-butyric Acid)
Banrot II 40WP (Ethazole + thiophanate methyl)	
BAS 516 09F (pyraclostrobin + boscalid)	Empress Intrinsic Brand Fungicide (Pyraclostrobin)

Target Product(s)(Con't)	
Endorse (Polyoxin D)	Pvent (Gliocladium catenulatum Strain J1446)
Fenstop (Fenamidone)	RD00AS-1 (BW159) (BW159)
Fermate 76WP (Ferbam)	Segway (Cyazofamid)
Heritage (Azoxystrobin)	SP2478 (SP2478)
Hymexazol 30L (Hymexazol)	SP2480 (SP2480)
MBI 121 (MBI 121)	SP2700 AS (SP2700)
MBI 601 (Muscodor albus)	SP2700 WP (SP2700)
Medallion (Fludioxonil)	SP2770 10WP (SP2770)
Mertect 160 (60 WP) (Thiabendazole)	Stargus (Bacillus nakamurai strain F727)
Micora (Mandipropamid)	Terraclor 75WP (PCNB)
MultiGuard (Furfural)	Tril-21 (Thyme oil)
Orkestra Intrinsic (Fluxapyroxad + pyraclostrobin)	TXC2020 (Thyme oil)
Picatina (Pydiflumetofen)	Vital 4L (Potassium phosphite)
Postiva (pydiflumetofen + difenoconozole)	ZeroTol (Hydrogen dioxide)
Potassium azide (Potassium azide)	Zio (Pseudomonas chlororaphis strain AFS009)
Promax (Thyme oil)	Zyban 25WP (Thiophanate-methyl)
ProStar 70WP/WG (Flutalonil)	

Product Registration and Research Status			
	Fully Screened (also includes standards)	**Partially Screened through IR-4** [1]	**Need Data Across Species ?**
Labeled Generally & Commercialized	3336 Medallion	Orkestra Tourney **Trinity ***	Disarm Pageant Intrinsic Hurricane Palladium PlantShield, RootShield **RootShield Plus ***
Labeled Generally But NOT Commercialized			
Labeled for Specific Diseases& Commercialized	Terraguard	Heritage	26/36 Chipco 26019 **Empress Intrinsic *** MycoStop Trinity SC
Labeled for Specific Diseases but NOT Commercialized			Picatina
Not yet registered or Labeled			BAS 750 Compass O Insimmo MBI 601 Promax SP2550 SP2770 Torque
No longer available for development		CG100 SP2169	

* 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
New unregistered active ingredients	Rhizoctonia diseases impact different portions of plant tissues necessitating different application patterns and protocol refinements
Wide range of FRAC mode of actions to test, including biologicals	Biopesticides better as preventative
New unregistered active ingredients	Multiple applications considerations required
Alternative application methods	
Loss of methyl bromide – need alternatives	
Rhizoctonia root and crown diseases remain major issues	
Some treatments in current protocol need additional data for registration	Some treatments in current protocol have provided variable responses

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/insect 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)	*Rhizoctonia solani*
FRAC 1	3336 F (Thiophanate-methyl)	*2.0 (1 - 3) n2*
FRAC 1	3336 WP (50%) (Thiophanate-methyl)	*2.9 (1 - 4) n12 Labeled*
FRAC 1	3336 WP 70% (Pennwalt) (Thiophanate-methyl)	3.5 (3 - 4) n2 Labeled
FRAC 1	Benlate 50WP (Benomyl)	**4.0 (3 - 5) n2**
FRAC 11	Disarm 480SC (Fluoxastrobin)	*2.0 (2 - 2) n1 Labeled*
FRAC 11	Empress Intrinsic Brand Fungicide (Pyraclostrobin)	5.0 (5 - 5) n1 Labeled
FRAC 11	Fenstop (Fenamidone)	*1.0 (1 - 1) n1 Labeled*
FRAC 11	Heritage (Azoxystrobin)	*1.0 (1 - 1) n1 Labeled*
FRAC 12	Medallion (Fludioxonil)	5.0 (5 - 5) n1 Labeled
FRAC 19	Endorse (Polyoxin D)	3.0 (1 - 5) n2 Labeled
FRAC 21	Segway (Cyazofamid)	*1.5 (1 - 2) n2*
FRAC 3	Avelyo Fungicide (Mefentrifluconazole)	**4.0 (3 - 5) n3**
FRAC 32	Hymexazol 30L (Hymexazol)	*1.0 (1 - 1) n1*
FRAC 40	Micora (Mandipropamid)	*2.0 (2 - 2) n1*
FRAC 43	Adorn 4F (Fluopicolide)	*2.0 (2 - 2) n1*
FRAC 7	Astun (isofetamid)	*2.0 (1 - 4) n4*
FRAC 7	Picatina (Pydiflumetofen)	**3.0 (3 - 3) n1**
FRAC 7	ProStar 70WP/WG (Flutalonil)	**5.0 (5 - 5) n1**

MOA	Product (Active Ingredients)	*Rhizoctonia solani*
FRAC 7 + FRAC 11	Broadform SC500 (Fluopyram + Trifloxystrobin)	3.7 (1 - 5) n3 Labeled
FRAC 7 + FRAC 11	Orkestra Intrinsic (Fluxapyroxad + pyraclostrobin)	**5.0 (5 - 5) n1**
FRAC 7 + FRAC 3	Postiva (pydiflumetofen + difenoconozole)	3.0 (1 - 5) n2 Labeled
FRAC BM01	Promax (Thyme oil)	*1.0 (1 - 1) n1*
FRAC BM01	Tril-21 (Thyme oil)	**5.0 (5 - 5) n1**
FRAC BM01	TXC2020 (Thyme oil)	*1.0 (1 - 1) n1*
FRAC BM02	Actinovate Soluble (Streptomyces lydicus WYEC 108)	*1.0 (1 - 1) n1 Labeled*
FRAC BM02	MBI 601 (Muscodor albus)	*2.3 (1 - 3) n3*
FRAC BM02	Pvent (Gliocladium catenulatum Strain J1446)	**3.0 (3 - 3) n1**
FRAC BM02	Zio (Pseudomonas chlororaphis strain AFS009)	*1.0 (1 - 1) n1*
FRAC M4	Captan (Captan)	*1.0 (1 - 1) n1 Labeled*
FRAC NC	ZeroTol (Hydrogen dioxide)	*1.0 (1 - 1) n1*
FRAC P07	Agrifos (Dipotassium phosphonate + Dipotassium phosphate)	**3.0 (3 - 3) n1**
FRAC P07	Vital 4L (Potassium phosphite)	**3.0 (3 - 3) n1**
IRAC UNF & FRAC BM02	Stargus (Bacillus nakamurai strain F727)	*1.7 (1 - 3) n3 Labeled*
unknown	BW161N (BW161N)	**3.0 (1 - 5) n2**
unknown	MBI 121 (MBI 121)	*2.5 (1 - 4) n2*
unknown	MultiGuard (Furfural)	*2.0 (2 - 2) n1 Labeled*
unknown	SP2478 (SP2478)	**5.0 (5 - 5) n1**
unknown	SP2480 (SP2480)	*1.0 (1 - 1) n1*
unknown	SP2700 AS (SP2700)	*1.7 (1 - 3) n3*
unknown	SP2700 WP (SP2700)	**4.5 (4 - 5) n2**