

Project Name: Powdery Mildew Efficacy

New		Ongoing		Completed	X	Duration if ongoing or completed:	1981-1985, 2012-2017, 2020-2021
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Project Description:

Powdery mildew has routinely surfaced in the biennial survey of grower needs. While 15 classes and subclasses for fungal mode of action are currently available, growers continue to have difficulty managing powdery mildew diseases. At the 2019 Workshop, powdery mildew was selected to study biopesticide options, but since new human designed chemistries were available both were included in the 2020 and 2021 protocols.

Research Project Abstract (if available):

Abstract from 2023 Powdery Mildew Efficacy Summary

Powdery mildew is a highly recognizable disease with pronounced colonies of white on foliage and, for some species, on petals. Due to the high number of spores produced, powdery mildews often develop resistance quickly to fungicides. Starting in 2012, IR-4 initiated a series of regional projects to examine new fungicides and biofungicides for powdery mildew management. In addition, we performed a literature review. Contained in the project summary are outcomes from 96 experiments conducted in greenhouses and or outdoors. Specific powdery mildew pathogens included: *Erysiphe azaleae*, *Erysiphe knautiae*, *Erysiphe lagerstroemia*, *Erysiphe lonicerae* var. *lonicerae*, *Erysiphe monardae*, *Erysiphe polygoni*, *Erysiphe pulchra*, *Golovinomyces cichoracearum*, *Golovinomyces orontii*, *Oidium* spp., *Podosphaera pannosa*, and *Podosphaera xanthii*. Across species, the best performing products and actives included Aveylo, Bayleton, Broadform, Gatten, Heritage. Magus. Mural, NF-149 (cyflufenamid), SP2478, and XDE-659.

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

- Powdery Mildew, Azalea (*Erysiphe azaleae*)
- Powdery Mildew, Cucurbit (*Golovinomyces/Erysiphe cichoracearum*)
- Powdery Mildew, Golovinomyces orontii (*Golovinomyces orontii*)
- Powdery Mildew, Lilac (*Microsphaera lonicerae*)
- Powdery Mildew, Rose (*Podosphaera pannosa*)

Please note: powdery mildew taxonomy has shifted so some may have both current and former genera listed

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

- | | |
|-----------------------|---------------------|
| Begonia sp. | Rosa sp. |
| Hydrangea macrophylla | Syringa vulgaris |
| Lathyrus odoratus | Zinnia angustifolia |
| Leucothoe axillaris | Zinnia elegans |
| Rhododendron sp. | |

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

- | | |
|---|---------------------------------------|
| Aveylo Fungicide (Mefentrifluconazole) | EcoSwing (Swinglea glutinosa) |
| Banner MAXX (Propiconazole) | F9944 (F9944) |
| Bayleton 25WP (Triadimefon) | Funginex (Triforine 18.2) (Triforine) |
| Bayleton 50WP (Triadimefon) | Gatten (Flutianil) |
| Baytan 25DF (Triadimenol) | Heritage (Azoxystrobin) |
| Benlate 50WP (Benomyl) | IKF-309 (Pyriofenone) |
| Broadform SC500 (Fluopyram + Trifloxystrobin) | Magus (Fenazaquin) |
| CGA 71818 10W (Penconazole) | MBI 121 (MBI 121) |
| Eagle 20 EW (Myclobutanil) | Mettle (Tetraconazole) |



Environmental Horticulture Program Research Project Sheet

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

Target Product(s)(con't)	
Milban 39EC (Dodemorph) MilStop (Potassium bicarbonate) Mural WDG (Azoxystrobin + benzovindiflupyr) NF-149 (Cyflufenamid) NSTKI-014 (NSTKI-014) Orkestra Intrinsic (Fluxapyroxad + pyraclostrobin) Problad Verde (Banda de Lupinus albus doce (BLAD)) Regalia O5 (MOI-10605) (Extract of Reynoutria sachalinensis) Regime (Banda de Lupinus albus doce (BLAD)) SP2478 (SP2478)	SP2480 (SP2480) SP2700 WP (SP2700) SP2770 10WP (SP2770) Stargus (Bacillus nakamurai strain F727) TDA-NC-1 (TDA) Tilt 3.6E (Propiconazole) Tril-21 (Thyme oil) TXC2020 (Thyme oil) XDE-659 (florylpicoxamid) XE-779 25 WP (Diniconazole) ZeroTol (Hydrogen dioxide)

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 Affirm Armada 50WP Banner MAXX Bayleton 50WDG Cease Copper compounds ² Daconil Ultrex	Double Nickel LC Eagle 20EW Heritage Insignia Mural Pageant Regalia Tourney 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, Phytan 27			

PROS	CONS
Powdery mildew diseases can be prone to resistance development and new classes of chemistry are a critical component	Several different genera cause powdery mildew diseases and performance may not be similar
A couple new active ingredients are available in current and new MOA classes (Gatten, Midori, XDE-659)	Many classes are currently available for growers
Several different genera cause powdery mildew diseases and performance may not be similar	Better things to do for IR-4
Major pest for growers	
Future need - maybe	
New product, Seido (frac 50) just registered – very selective & compatible with microbiological fungicides	
Scope of Project: quite a few products available/in the pipeline	

IR-4 Efficacy Trials to Date
<p>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.</p> <p>‘Labeled’ indicates that this disease species or genera is listed on the label. A rating of 2 or lower is considered unacceptable efficacy (<i>red text</i>). 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.</p>

MOA Class	Product (Active Ingredients)	Powdery mildew, Azalea (<i>Erysiphe azaleae</i>)	Powdery Mildew, Cucurbit, Zinnia (<i>Golovinomyces/ Erysiphe cichoracearum</i>)	Powdery Mildew (<i>Golovinomyces orontii</i>)	Powdery Mildew, Lilac (<i>Microsphaera loniceriae</i>)	Powdery Mildew, Rose (<i>Podosphaera pannosa</i>)
FRAC 1	Benlate 50WP (Benomyl)				5.0 (5 - 5) n1	
FRAC 11	Heritage (Azoxystrobin)		3.0 (3 - 3) n1 Labeled		3.0 (3 - 3) n1 Labeled	
FRAC 11 + FRAC 7	Mural WDG (Azoxystrobin + benzovindiflupyr)		4.0 (3 - 5) n2 Labeled	5.0 (5 - 5) n1 Labeled	4.0 (3 - 5) n2 Labeled	
FRAC 3	Avelyo Fungicide (Mefentrifluconazole)		4.5 (4 - 5) n2 Labeled			
FRAC 3	Banner MAXX (Propiconazole)				3.0 (3 - 3) n1 Labeled	
FRAC 3	Bayleton 25WP (Triadimefon)	3.5 (3 - 4) n2 Labeled	5.0 (5 - 5) n1 Labeled		5.0 (5 - 5) n1 Labeled	4.0 (4 - 4) n1 Labeled
FRAC 3	Bayleton 50WP (Triadimefon)	4.0 (4 - 4) n1	5.0 (5 - 5) n1			
FRAC 3	Baytan 25DF (Triadimenol)	4.0 (4 - 4) n1				
FRAC 3	CGA 71818 10W (Penconazole)	5.0 (5 - 5) n1				
FRAC 3	Eagle 20 EW (Myclobutanil)		5.0 (5 - 5) n2			
FRAC 3	Funginex (Triforine 18.2) (Triforine)		5.0 (5 - 5) n1			
FRAC 3	Mettle (Tetraconazole)				2.0 (1 - 3) n2	
FRAC 3	Tilt 3.6E (Propiconazole)		5.0 (5 - 5) n1			
FRAC 3	XE-779 25 WP (Diniconazole)	1.0 (1 - 1) n1				
FRAC 5	Milban 39EC (Dodemorph)	3.0 (3 - 3) n1 Labeled	5.0 (5 - 5) n1 Labeled			
FRAC 50	IKF-309 (Pyriofenone)		3.5 (2 - 5) n2			
FRAC 7 + FRAC 11	Broadform SC500 (Fluopyram + Trifloxystrobin)		5.0 (5 - 5) n1			
FRAC 7 + FRAC 11	Orkestra Intrinsic (Fluxapyroxad + pyraclostrobin)		3.0 (3 - 3) n1 Labeled		5.0 (5 - 5) n1 Labeled	
FRAC BM01	EcoSwing (Swinglea glutinosa)		1.0 (1 - 1) n4 Labeled			
FRAC BM01	Problad Verde (Banda de Lupinus albus doce (BLAD))		2.0 (2 - 2) n1			
FRAC BM01	Regime (Banda de Lupinus albus doce (BLAD))		1.0 (1 - 1) n2 Labeled		1.0 (1 - 1) n2 Labeled	
FRAC BM01	Tril-21 (Thyme oil)		3.0 (1 - 5) n2			
FRAC BM01	TXC2020 (Thyme oil)		1.0 (1 - 1) n1			

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FRAC NC	MilStop (Potassium bicarbonate)				3.0 (3 - 3) n1 Labeled	
FRAC NC	ZeroTol (Hydrogen dioxide)				1.0 (1 - 1) n1 Labeled	
FRAC NC + IRAC UNF	Tank Mix: MilStop + Cease (potassium bicarbonate + <i>Bacillus subtilis</i>)				1.0 (1 - 1) n1	
FRAC P05	Regalia O5 (MOI-10605) (Extract of <i>Reynoutria sachalinensis</i>)				1.0 (1 - 1) n1 Labeled	
FRAC U13	Gatten (Flutianil)		4.3 (2 - 5) n4	4.0 (4 - 4) n1		
FRAC U6	NF-149 (Cyflufenamid)		3.0 (3 - 3) n2		3.5 (2 - 5) n2	
IRAC 21A	Magus (Fenazaquin)				5.0 (5 - 5) n1	
IRAC UNF & FRAC BM02	Stargus (<i>Bacillus nakamurai</i> strain F727)		1.0 (1 - 1) n1 Labeled			
unknown	MBI 121 (MBI 121)		2.0 (1 - 3) n4			
unknown	NSTKI-014 (NSTKI-014)		2.5 (2 - 3) n2			
unknown	SP2478 (SP2478)		4.3 (3 - 5) n3			
unknown	SP2700 WP (SP2700)		2.8 (2 - 4) n4			
unknown	TDA-NC-1 (TDA)		1.5 (1 - 3) n4			
unknown	XDE-659 (florylpicoxamid)		3.3 (1 - 5) n4			