

**Project Name:** Rust Efficacy

<b>New</b>	<b>Ongoing</b>	<b>Completed</b>	X	<b>Duration if ongoing or completed:</b>	2010-2011
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**Project Description:**

Rusts diseases are caused by complex fungi that can produce up to 5 types of spores. One spore type has orangish pigments giving infected plants a “rusty” look, hence the name of these diseases. Rusts impact both monocot and dicot plants. In some cases, these diseases are relatively innocuous causing quality issues, but in other cases rust diseases can be quite severe causing significant economic losses. At the 2009 Ornamental Horticulture Workshop, rust diseases were discussed as regional priority projects and funded accordingly.

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

*Abstract from 2012 Rust Efficacy Summary: A Literature Review*  
 From 2000 to 2011, numerous products representing 30 active ingredients were tested as foliar applications against several genera and species of pathogens causing rust on ornamentals and food crops (Tables 1 and 2). These genera/species tested included: *Cronartium ribicola*, *Gymnosporangium libocedri*, *G. clavipes*, *G. juniperi-virginianae*, *Phragmidium* sp., *Puccinia hemerocallidis*, *P. pelargonii-zonalis*, *P. malvacearum*, *P. emaculata*, *P. veronica-longifoliae*, *P. arachidis* and *Uromyces apendiculatus*. Although there were insufficient data for definitive conclusions, new products like SP2169, Tourney (metconazole), LEM-17 (penthiopyrad) and Topguard (flutriafol) - looked promising. The products registered on ornamentals - Banner (propiconazole), Compass O (trifloxystrobin), Eagle (myclobutanil), Heritage (azoxystrobin), Insignia (pyraclostrobin), Pageant (boscalid+pyraclostrobin), Prostar (flutolanil) and Trinity (triticonazole) - generally performed well. Tank-mix combinations with mancozeb generally improved rust control.

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

- Cedar-Apple Rust (*Gymnosporangium juniperi-virginianae*)
- Geranium Rust (*Puccinia pelargonii-zonalis*)
- Hollyhock Rust (*Puccinia malvacearum*)
- Serviceberry Rust (*Gymnosporangium libocedri*)
- Veronica Rust (*Puccinia veronicae-longifoliae*)

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

- Apple & Crabapple (Non-Bearing) (*Malus* sp.)
- Geranium, Zonal (*Pelargonium x hortorum*)
- Hollyhock (*Alcea rosea*)
- Shadbush Serviceberry (*Amelanchier canadensis*)
- Veronica longifolia*

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

- |   |   |
|---|---|
| 3336 WP (50%) (Thiophanate-methyl)          | Hurricane (Fludioxonil + mefonomaxam)         |
| Acibenzolar-S-methyl                        | Insignia Intrinsic (Pyraclostrobin)           |
| Armada 50WP (Trifloxystrobin + triademefon) | Pageant Intrinsic (Boscalid + Pyraclostrobin) |
| Banner MAXX (Propiconazole)                 | ProStar 70WP (Flutolanil)                     |
| Bayleton 50WDG (Triademefon)                | Protect T/O (Mancozeb)                        |
| Captan (Captan)                             | Rubigan AS (Fenarimol)                        |
| Compass O 50WDG (Trifloxystrobin)           | SP2169 (SP2169)                               |
| Eagle 20 EW (Myclobutanil)                  | Tourney 50WDG (Metconazole)                   |
| Heritage (Azoxystrobin)                     | Trinity 2SC (Triticonazole)                   |

**Product Registration and Research Status**



# Ornamental Horticulture Program Research Project Sheet

<http://ir4.rutgers.edu/Ornamental/ornamentalProjectInformationSheets.cfm>

	Fully Screened (also includes standards)	Partially Screened through IR-4 <sup>1</sup>	Need Data Across Species ?
Labeled Generally & Commercialized	3336 WP Armada 50WP Banner MAXX Bayleton 50WDG Captan Eagle 20 EW	Heritage Insignia Pageant Protect Rubigan Tourney	
Labeled Generally But NOT Commercialized			
Labeled for Specific Diseases & Commercialized	Compass 0 50WDG ProStar		
Labeled for Specific Diseases but NOT Commercialized			
Not yet registered or Labeled		BAS 703 06F	Acibenzolar-S-methyl Hurricane Trinity
No longer available for development			

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

1 At least one species screened fully

Project Pros	Project Cons
<ol style="list-style-type: none"> <li>1 Rust diseases can be challenging to manage</li> <li>2 A couple new active ingredients are available in current and new MOA classes</li> <li>3 Several different genera cause rust diseases and performance may not be similar</li> <li>4 Starting to see resistance</li> </ol>	<ol style="list-style-type: none"> <li>1 Many classes are currently available for growers</li> <li>2 Several different genera cause rust diseases and performance may not be similar</li> </ol>

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/disease 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 <b>green text</b>. For disease/product combinations that are blank, IR-4 has not screened this combination.</p>

Product (Active Ingredients)	Geranium Rust ( <i>Puccinia pelargonii-zonalis</i> )	Serviceberry Rust ( <i>Gymnosporangium libocedri</i> )	Hollyhock Rust ( <i>Puccinia malvacearum</i> )	Veronica Rust ( <i>Puccinia veronicae-longifoliae</i> )
3336 WP (50%) (Thiophanate-methyl)			1.0 (1 - 1) n1 <i>Labeled</i>	
Acibenzolar-S-methyl (Acibenzolar-S-methyl)			1.0 (1 - 1) n1	1.0 (1 - 1) n1
Armada 50WP (Trifloxystrobin + triademefon)				3.0 (3 - 3) n1 Labeled
Banner MAXX (Propiconazole)	1.0 (1 - 1) n1 <i>Labeled</i>	3.0 (3 - 3) n1 Labeled	1.0 (1 - 1) n1 <i>Labeled</i>	5.0 (5 - 5) n1 Labeled
Bayleton 50WDG (Triademefon)			5.0 (5 - 5) n1 Labeled	
Captan (Captan)			1.0 (1 - 1) n1 <i>Labeled</i>	
Compass O 50WDG (Trifloxystrobin)	1.0 (1 - 1) n1	3.0 (3 - 3) n1 Labeled	<b>5.0 (5 - 5) n1</b>	<b>5.0 (5 - 5) n1</b>
Eagle 20 EW (Myclobutanil)	1.0 (1 - 1) n1 <i>Labeled</i>	4.0 (4 - 4) n1 Labeled	5.0 (5 - 5) n1 Labeled	5.0 (5 - 5) n1 Labeled
Heritage (Azoxystrobin)			5.0 (5 - 5) n1 Labeled	5.0 (5 - 5) n1 Labeled
Hurricane (Fludioxonil + mefonaxam)			<b>5.0 (5 - 5) n1</b>	
Insignia Intrinsic (Pyraclostrobin)		2.0 (2 - 2) n1 <i>Labeled</i>	3.0 (3 - 3) n1 Labeled	
Pageant Intrinsic (Boscalid + Pyraclostrobin)		2.0 (2 - 2) n1 <i>Labeled</i>	5.0 (5 - 5) n1 Labeled	
ProStar 70WP (Flutalonil)	1.0 (1 - 1) n1 <i>Labeled</i>	1.0 (1 - 1) n1 <i>Labeled</i>	3.0 (3 - 3) n1 Labeled	5.0 (5 - 5) n1 Labeled
Protect T/O (Mancozeb)			1.0 (1 - 1) n1 <i>Labeled</i>	
Rotation: Banner Maxx / Compass O (Propiconazole / Trifloxystrobin)		2.0 (2 - 2) n1		
Rubigan AS (Fenarimol)			1.0 (1 - 1) n1 <i>Labeled</i>	
SP2169 (SP2169)	1.0 (1 - 1) n1			<b>5.0 (5 - 5) n1</b>
Tourney 50WDG (Metconazole)	1.0 (1 - 1) n1 <i>Labeled</i>	3.0 (3 - 3) n1 Labeled	3.0 (3 - 3) n1 Labeled	5.0 (5 - 5) n1 Labeled
Trinity 2SC (Triticonazole)	1.0 (1 - 1) n1		<b>3.0 (3 - 3) n1</b>	<b>3.0 (3 - 3) n1</b>

Fungicides (active ingredients)	FRAC Class	Registered Use Site(s)	REI	Efficacy on Rusts				
				<i>Cronartium</i> spp.	<i>Gymnosporangium</i> spp.	<i>Phragmidium</i> spp.	<i>Puccinia</i> spp.	<i>Uromyces</i> spp.
3336, OHP 6672, etc. (thiophanate methyl)	1	G, I, L, N, S	12 h	?	?	?	P-E	?
Alibi Flora (azoxystrobin + difenoconazole)	11 + 3	G, L, N, S	12 h	?	?	?	?	?
Armicarb, Milstop, etc. (potassium bicarbonate)	NC	G, I, L, N, S	4 h	?	?	?	?	?
Banner Maxx, ProPensity (propiconazole)	3	N	12 h	?	G-E	?	F-G	G-E
Bayleton, Strike (triadimefon)	3	G, N	12 h	?	G	?	F-G	?
Camelot, etc. (copper octanoate)	M1	G, I, N, S	4 h	?	?	?	?	?
Cease, Rhapsody, Serenade Optimum, etc. ( <i>Bacillus subtilis</i> )	44	G, I, N, S	4 h	P	P-E	?	G-E	?
Clevis (mancozeb + myclobutanil)	M3+3	G, N	24 h	?	E	?	?	?
Compass (trifloxystrobin)	11	G, I, L, N, S	12 h	?	E	?	G-E	E
Concorde, Daconil, etc. (chlorothalonil)	M5	G, N	12 h	?	?	?	G	P
Concert (chlorothalonil+propiconazole)	M5+3	N	12 h	?	?	?	P	?
Contrast, ProStar (flutolanil)	7	G, N, S	12 h	?	P	?	P-E	?
Consyst, Spectro (chlorothalonil+thiophanate methyl)	M5+1	G, I, N	12 h	?	?	?	?	?
Cygnus (kresoxym-methyl)	11	G, L, N, S	12 h	?	?	?	?	?
Daconil Zn (chlorothalonil + zinc)	M5	N	12 h	?	?	P	P-F	G
Disarm, Fame (fluoxastrobin) <sup>b</sup>	11	G, I, N, S	12 h	?	?	?	?	?
Dithane, Fore, etc. (mancozeb)	M3	G, N	24 h	E	P-G	?	E	F-E
Eagle, Hoist, etc. (myclobutanil)	3	G, N	24 h	E	E	E	G-E	G
Heritage (azoxystrobin)	11	G, N, S	4 h	?	E	?	G-E	E
Insignia, Empress Intrinsic (pyraclostrobin) <sup>a</sup>	11	G, I, L, N, S	12 h	G	G	?	E	G
Junction (copper hydroxide+mancozeb)	M1	G, N	24 h	?	?	?	?	?
Microthiol Disperss, etc. (sulfur)	M2	G, N	24 h	?	P	?	P	P
Pageant (pyraclostrobin+boscalid)	11+7	TBD	12 h	?	E	?	E	?
Phyton (copper sulfate pentahydrate)	M1	G, I, N	24 h	?	?	?	?	?
Strike Plus (trifloxystrobin + triadimefon)	11 + 3	G, N	12 h	?	?	?	?	?
SuffOil-X, etc. (mineral oil)	NC	G, N	4 h	?	?	?	P-E	?
Terraguard (triflumizole)	3	G, I, N, S	12 h	?	E	P	?	?
Torque (tebuconazole)	3	N	12 h	?	?	?	E	G
Tourney (metconazole)	3	N	12 h	?	G	?	P-E	?
Triact 70, Trilogy, etc. (neem oil extract)	18B	G, I, L, N, S	4 h	?	?	?	?	?
Zyban (Mancozeb+thiophanate methyl)	M3+1	G, N	24 h	?	?	?	?	?
Experimentals								
Hurricane (fludioxonil+mefenoxam)	12 + 4	G	48 h	?	?	?	?	?
Insimmo (Acibenzolar)	P1	TBD	12 h	?	?	?	P-G	?
MBI-110 ( <i>Bacillus amyloliquefaciens</i> strain F727)	44	TBD	?	?	?	?	?	?
Regalia (extract of <i>Reynoutria sachalinensis</i> )	P5	TBD	4 h	?	P-G	?	?	?
SP2169 (SP2169)	-	TBD	-	?	?	?	P-E	?
Trinity (triticonazole)	3	TBD	12 h	?	?	?	P-G	?

Registered Use Sites: G = Greenhouse; L = Lath House; I = Indoors; N = Nursery; S = Shade House; TBD = To Be Determined

Application Method: D = Drench; S = Spray



## Registered and Experimental Products for Rust Disease Control

Efficacy: E = clearly statistically different than untreated, best treatment; G = statistically different from untreated, inferior to best treatment; F = statistically different than untreated, much inferior to best treatment; P = statistically equivalent to untreated; OR

Efficacy: E = clearly statistically better than untreated and greater than 95% control; G = statistically better than untreated and between 85 and 95% control; F- statistically better than untreated with control between 70 and 85%; P = statistically equivalent to untreated and/or efficacy less than 70%, OR

Efficacy: E = clearly statistically equivalent or better than untreated non-inoculated and/or clearly statistically different than untreated inoculated; G = statistically different from untreated inoculated and untreated non-inoculated; F = statistically equivalent to both untreated inoculated and untreated non-inoculated; P = statistically equivalent to untreated inoculated. For trials without non-inoculated check, efficacy determined on author's conclusions, % control or comparisons to standard product(s).

Rust Efficacy taken from the 2012 IR-4 Rust efficacy summary report that included 3 IR-4 and 31 PDMR efficacy reports, 2012-15 PDMR reports – 7 *Cronartium*, 33 *Gymnosporangium*, 1 *Phragmidium*, 15 *Puccinia* and 5 *Uromyces*, and 1 additional IR-4 efficacy report.

<sup>a</sup> Empress Intrinsic has replaced Insignia for use in production ornamentals

<sup>b</sup> Fame will be replacing DisArm