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## **IR-4 Ornamental Horticulture Program Downy Mildew Efficacy**

**Coleus Downy Mildew (*Peronospora sp.*)**  
**Impatiens Downy Mildew (*Plasmopara obducens*)**  
**Lamium Downy Mildew (*Peronospora lamii*)**  
**Limonium Downy Mildew (*Peronospora statices*)**  
**Rose Downy Mildew (*Peronospora sparsa*)**  
**Snapdragon Downy Mildew (*Peronospora antirrhini*)**  
**Viburnum Downy Mildew (*Plasmopara viburni*)**  
**Basil Downy Mildew (*Peronospora belbahrii*)**

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## Abstract

In 2008, IR-4 initiated a high priority project to determine efficacy of several fungicides on downy mildew pathogens so data can be obtained to support current and future registrations. This research was conducted in 2008 and in 2009. Subsequently, Impatiens Downy Mildew (IDM) emerged, and studies on this disease sponsored in part by USDA-APHIS occurred from 2013 through to 2016. In addition to research collected from 12 studies through the IR-4 program from 2008 to 2016, this summary includes a review of 38 experiments conducted from 2000 to 2014 on ornamental horticulture crops. During this time period, numerous products representing 41 active ingredients were tested as foliar or drench applications against several species causing downy mildew on ornamentals. Most products are registered and commercially used. Most tests were conducted on *Plasmopara obducens* (impatiens downy mildew); other species tested included *Peronospora lamii* (lamium downy mildew), *Peronospora sp.* (coleus downy mildew), *Peronospora sparsa* (rose downy mildew), *Peronospora statice* (limonium downy mildew), *Peronospora antirrhini* (snapdragon downy mildew), and *Plasmopara viburni* (viburnum downy mildew). Although there were insufficient data for definitive conclusions, five relatively new products provided efficacy. Adorn (V-10161) was effective for impatiens initially, lamium and snapdragon downy mildews. Orvego (BAS 651F) provided good to excellent control of coleus, impatiens, lamium and snapdragon downy mildews. Micora (NOA 446510) provided good to excellent control of coleus, impatiens, lamium and snapdragon downy mildews. Regalia exhibited excellent control of impatiens downy mildew, and good control of lamium, snapdragon and viburnum downy mildews at the higher rate. Segovis applied as a drench provided excellent control of impatiens downy mildew.

Basil downy mildew, caused by *Peronospora belbahrii*, has become a major problem in the production of basil in the United States since it was first reported in south Florida in 2007. We reviewed 31 available trials published in Plant Disease Management Reports to check efficacy of experimental and registered fungicides on basil downy mildew. Generally, Revus (mandipropamid), Quadris/Amistar (azoxystrobin), and Reason (fenamidone) applied as sprays, and Ridomil Gold (mefenoxam) drench or spray provided good to excellent efficacy. Efficacy of Ranman (cyazofamid) spray was variable. Two new products Zorvec/QGU42 (oxathiopiprolin) and Zampro/BAS 651 (ametoctradin + dimethomorph also provided excellent efficacy. The phosphorus acid fungicides (including Agri-Fos, K-Phite, Nutri-Phyte, Phostrol, Prophyt) and the products for organic production, including biofungicides (Actinovate, Companion, Double Nickel, Regalia, Serenade, Sonata), and copper fungicides (Badge X2, Cueva, Kocide, Nordox, Nu-Cop) generally provided poor efficacy.



## Introduction

In 2008, IR-4 initiated a high priority project to determine efficacy of several fungicides on downy mildew pathogens so data can be obtained to support current and future registrations. This research was conducted in 2008 and in 2009. Subsequently, Impatiens Downy Mildew (IDM) emerged, and studies on this disease sponsored in part by USDA-APHIS occurred from 2013 through to 2016. This summary includes information from 12 tests garnered through the IR-4 Ornamental Horticulture Program and 38 studies conducted by researchers to present a fuller picture on downy mildew efficacy on ornamentals, and 31 non-IR4 sponsored experiments for basil downy mildew from 2007-2016. These additional reports were published in Fungicide & Nematicide Tests (F&N Tests) or Plant Disease Management Reports (PDMR). Tables containing these reports have an asterisk (\*) at the beginning of their titles and a citation in the footer.

## Materials and Methods

From 2008 to 2016, several products representing 41 active ingredients were tested as foliar or drench applications against seven downy mildew pathogens (Table 1). For basil downy mildew, 57 products representing 47 active ingredients were tested from 2007 to 2016. (Table 2). Species tested on ornamental horticulture crops included: *Peronospora lamii*, *Peronospora sp.*, *Peronospora staites*, *Peronospora sparsa*, *Peronospora antirrhini*, *Plasmopara obducens*, and *Plasmopara viburni*. Experiments relied on either natural infections or prepared inoculations. In most experiments, treatments were applied either a few days before disease inoculation or immediately after inoculation. Several experiments on *Plasmopara obducens* were conducted to determine residual efficacy with fungicides applied 6-28 days before disease inoculation. A minimum of four plants (replicate treatments) were required with most researchers exceeding this minimum. Disease severity and incidence were recorded at various intervals after initial application. Phytotoxicity or lack of it was generally noted in the reports. Ten researchers were involved in the testing. For more detailed materials and methods, including application rates for various products, please visit <http://ir4.rutgers.edu/ornamental/OrnamentalDrafts.cfm> to view and download these protocols. For basil downy mildew, all field trials relied on natural infections, while greenhouse experiments used inoculations. Treatments were applied as preventive applications. Five researchers were involved in the testing.

Products were supplied to researchers by manufacturers to researchers (Appendix 1).

For all research data tables, product names have been updated where manufacturers have established trade names, and tables have been rearranged by product alphanumeric order. Where both inoculated and non-inoculated checks were included in the experiment, the inoculated check appears last in the table with the non-inoculated check immediately preceding it.

**Table 1. List of Products and Rates Tested on Ornamental Horticulture Crops from 2000 to 2016.**

Product	Active Ingredient(s)	Rate(s) Tested		Manufacturer
Acibenzolar WDG *	Acibenzolar	Drench	0.125oz per 100 gal 0.25 oz per 100 gal	Syngenta
		Spray	0.125 oz per 100 gal 0.25 oz per 100 gal	
Adorn (V-10161) 4FL (Presidio)	Fluopicolide	Foliar	1 fl oz per 100 gal 2 fl oz per 100 gal 4 fl oz per 100 gal	Valent

Product	Active Ingredient(s)	Rate(s) Tested		Manufacturer
		Drench	1 fl oz per 100 gal 2 fl oz per 100 gal 4 fl oz per 100 gal	
AGRI-FOS 44.5SL *	Mono- and di-potassium salts of Phosphorous Acid	Drench	0.13 pt per 100 gal 1.57 pt per 100 gal	Lawn and Garden Products, Inc.
		Foliar	5 pt per 100 gal	
Aliette 80WDG	Fosetyl-AL	Foliar	2.5 lb per 100 gal 4 lb per 100 gal 5 lb per 100 gal	OHP
		Drench	12.8 oz per 100 gal	
Alude	Potassium phosphite	Foliar	64 fl oz per 100 gal 2.5 qt per 100 gal	Cleary
		Drench	0.75 pt per 100 gal 2.5 qt per 100 gal	
Banol 6EC *	Propamocarb	Foliar	202.8 fl oz per 100 gal	Bayer
Captan 80WDG *	Captan	Foliar	1.5 lb per 100 gal	Albaugh
Cease *	QST 713 strain of <i>Bacillus subtilis</i> *	Foliar	4 qt per 100 gal 8 qt per 100 gal	BioWorks
Compass O WDG *	Trifloxystrobin	Foliar	1 oz per 100 gal 2 oz per 100 gal 4 oz per 100 gal	OHP
Daconil WeatherStik, Daconil Ultrex *	Chlorothalonil	Foliar	1 pint per 100 gal 2 lb per 100 gal	Syngenta
Disarm 480SC (TM-473)	Fluoxastrobin	Foliar	2 fl oz per 100 gal 4 fl oz per 100 gal	Arysta
Dithane 75DF *	Mancozeb	Foliar	2 lb per 100 gal	DOW
F9110	<i>Lupinus</i> extract	Foliar	18 fl oz per 100 gal 30 fl oz per 100 gal 45 fl oz per 100 gal	FMC
FenStop	Fenamidone	Foliar	7 fl oz per 100 gal 9 fl oz per 100 gal 14 fl oz per 100 gal	OHP
Heritage 50WG	Azoxystrobin	Foliar	4 oz per 100 gal	Syngenta
		Drench	0.9 oz per 100 gal	
Inosco (A14658C)	Potassium phosphite	Spray	4 pt per 100 gal 8 pt per 100 gal	Syngenta
Insignia 20W	Pyraclostrobin	Foliar	4 oz per 100 gal 8 oz per 100 gal	BASF
Junction *	Mancozeb + copper hydroxide	Foliar	3.5 lb per 100 gal	SePro
KleenGrow *	Didecyl dimethyl ammonium chloride	Foliar	50 fl oz per 100 gal	Pace, Inc
Kocide *	Copper hydroxide	Foliar	2 lb per 100 gal	DuPont
Micora (NOA 446510)	Mandipropamid	Foliar	4 fl oz per 100 gal 8 fl oz per 100 gal	Syngenta
Orkestra (BAS 703)	Fluxapyroxad + Pyraclostrobin	Foliar	7 fl oz per 100 gal 10 fl oz per 100 gal 13 fl oz per 100 gal	BASF

Product	Active Ingredient(s)	Rate(s) Tested		Manufacturer
Orvego (BAS 651)	Ametoctradin + Dimethoate	Foliar	11 fl oz per 100 gal 14 fl oz per 100 gal 28 fl oz per 100 gal	BASF
OxiPhos *	Mono- and di-potassium salts of Phosphorous Acid	Drench	50 fl oz per 100 gal	BioSafe Systems
		Foliar	102 fl oz per 100 gal	
Pageant 38WG	Boscalid + pyraclostrobin	Foliar	6 oz per 100 gal 12 oz per 100 gal 12.5 oz per 100 gal 18.5 oz per 100 gal	BASF
Pentathlon *	Mancozeb	Foliar	0.8 qt per 100 gal	Griffin
Phyton 27 *	Copper sulfate pentahydrate	Foliar	0.25 fl oz per 100 gal	Source Technology Biologicals
Plentrix *	Azoxystrobin + Metalaxyl	Drench	1.3 fl oz	Syngenta
Protect T/O, 75DF *	Mancozeb	Foliar	4 oz per 100 gal 1.5 lb per 100 gal 2 lb per 100 gal	Cleary
Regalia 100SC	Extract of Reynoutria sachalinensis	Foliar	64 fl oz per 100 gal 128 fl oz per 100 gal	Marrone Organic Innovations
Segovis (SYN546539)	Oxathiopiprolin	Drench	3.2 fl oz per 10 gal	Syngenta
Segway *	Cyazofamid	Foliar	3.5 fl oz per 100 gal	FMC
SP2003 *	SP2003	Foliar	1.75 lb per 100 gal	SePro
SP2005 *	SP2005	Foliar	0.2 lb per 100 gal 0.4 lb per 100 gal	SePro
SP2015	SP2015	Foliar	8 oz per 100 gal 10 oz per 100 gal 12 oz per 100 gal	SePro
SP2770	SP2770	Foliar	2.66 lb per 100 gal	SePro
Stature DM	Dimethomorph	Foliar	9.6 oz per 100 gal 12.3 oz per 100 gal 12.8 oz per 100 gal	BASF
Stature SC	Dimethomorph	Foliar	6.12 fl oz per 100 gal 12 fl oz per 100 gal	BASF
Subdue MAXX 2E	Mefenoxam	Foliar	0.5 fl oz per 100 gal 1 fl oz per 100 gal 2 fl oz per 100 gal	Syngenta
		Drench	0.5 fl oz per 100 gal 1 fl oz per 100 gal	
V-10208 *	Ethaboxam	Drench	4 fl oz per 100 gal	Valent
		Foliar	4 fl oz per 100 gal	
Vital *	Potassium phosphite	Foliar	4 pt per 100 gal	Luxembourg Chemical
		Drench	1.25 pt per 100 gal 4 pt per 100 gal	
Zerotol *	Hydrogen peroxide + Peroxyacetic acid	Foliar	50 fl oz per 100 gal 128 fl oz per 100 gal	BioSafe Systems

\* Product not tested in an IR-4 sponsored experiment.

**Table 2. List of Products and Rates Tested on Basil from 2007 to 2016\*.**

Product	Active Ingredient(s)	Rate(s) Tested		Manufacturer
Actigard 50DF	Acibenzolar	Foliar	0.5 oz per acre	Syngenta
Acibenzolar	Acibenzolar	Foliar	25 mg/L 50 mg/L	Syngenta
Actinovate WP	<i>Streptomyces lydicus</i>	Foliar	12 oz per acre 0.06 % v/v	Natural Industries
Agri-Fos	Mono- and di-potassium salts of Phosphorous Acid	Foliar	6 pt per acre	Monterey
Aliette 80WDG	Fosetyl-AL	Foliar	5 lb per acre	OHP
Amistar 80WDG	Azoxystrobin	Foliar	3 oz per acre 4 oz per acre 5 oz per acre	Syngenta
Badge X2	Copper hydroxide + Copper oxychloride	Foliar	1.5 lb per acre	Gowan
BAS 651 F	Ametoctradin + Dimethoate	Foliar	11 fl oz per acre 13.7 fl oz per acre 14 fl oz per acre	BASF
Basic Copper 53, 2 lb	Copper sulfate	Foliar	2 lb per acre	Albaugh
BU EXP 1216 C	<i>Bacillus subtilis</i> MB1600	Foliar	3 lb per acre	Becker Underwood
BU EXP 1216 S	<i>Bacillus subtilis</i> MB1600	Foliar	3 lb per acre	Becker Underwood
Calci-Phite	Calcium plus phosphoric acid	Foliar	6 pt per acre	Biagro
Chitosan	Chitooligosaccharide	Foliar	1 % v/v	Kitto Life Co.
Companion	<i>Bacillus subtilis</i> BG03	Foliar	128 fl oz per acre	Growth Products
Cueva	Copper octanoate	Foliar	4 qt per acre 1 % v/v	Certis
Bravo Ultrex	Chlorothalonil	Foliar	2 lb per acre	Syngenta
Bravo Weatherstik F	Chlorothalonil	Foliar	1.5 ptper acre	Syngenta
Double Nickel WDG	<i>Bacillus amyloquefaciens</i> strain D747	Foliar	3 lb per acre	Certis
Forum F	Dimethomorph	Drench	6 fl oz per acre	Syngenta
		Foliar	4 fl oz per acre 6 fl oz per acre 8 fl oz per acre	
Forticept Agro	Thyme oil	Foliar	0.66 % v/v	Lidan
Gavel 75DF	Mancoze + zoxamide	Foliar	2 lb per acre	Gowan
Heritage 50WG	Azoxystrobin	Foliar	4 oz per 100 gal	Syngenta
		Drench	0.9 oz per 100 gal	
HMO 736	Laminarin	Foliar	14 oz per acre	Goemar
Howler, 5 g/L	<i>Pseudomonas chlororaphis</i>	Foliar	5 g/L 7.5 g/L	AgBiome
K-Phite	Mono- and di-potassium salts of Phosphorous Acid	Foliar	3 pt per acre 6 pt per acre	Plant Food Systems
Kocide DF	Copper hydroxide	Foliar	2 lb per 100 gal	DuPont
Milagram Plus	<i>Bacillus subtilis</i> strain IAB/BS03	Foliar	40 oz per acre	IAB, S. L.
Nordox 75WG	Cuprous oxide	Foliar	14 oz per acre	Brandt
NuCop HB	Cupric hydroxide	Foliar	1 lb per acre 2 lb per acre	Agri Star
Nutri-Phite	Phosphorous Acid	Drench	3 pt per acre	Biagro

Product	Active Ingredient(s)	Rate(s) Tested		Manufacturer
		Foliar	3 pt per acre 6 pt per acre	
Organocide	Sesame oil	Foliar	200 oz per 100gal	Organic Labs
Orondis Gold	Oxathiapiprolin	Drench	13.5 fl oz per acre	Syngenta
Oxidate	Hydrogen dioxide	Foliar	1 %	BioSafe Systems
Phostrol	Mono- and di-sodium, potassium, and ammonium salts of Phosphorous Acid	Foliar	6 pt per acre	Nufarm
Presidio 4F	Fluopicolide	Drench	4 fl oz per acre	Valent
		Foliar	4 fl oz per acre	
Previcur Flex	Propamocarb	Foliar	1 pt per acre 1.2 pt per acre 1.5 pt per acre 2 pt per acre	Bayer
Pristine WDG	Boscalid + pyraclostrobin	Foliar	16 oz per acre	BASF
Procidic	Citric acid	Foliar	20 oz per acre 40 oz per acre	Greenspire Global
ProPhyt SL	Potassium phosphite	Foliar	1 pt per acre 2 pt per acre 3 pt per acre 4 pt per acre 6 pt per acre	Helena
Quadris	Azoxystrobin	Foliar	15 fl oz per acre 9 oz/ 100 gal	Syngenta
Rampart	Mono- and di-potassium salts of Phosphorous Acid	Foliar	6 pt per acre	Loveland
Ranman 400SC	Cyazofamid	Drench	2.75 fl oz per acre	FMC
		Foliar	2.75 fl oz per acre 3 fl oz per acre 4 fl oz per acre	
Reason 500 SC	Fenamidone	Foliar	6 fl oz per acre 8 fl oz per acre	Bayer
Regalia 100SC	Extract of <i>Reynoutria sachalinensis</i>	Foliar	2 qt per 100 gal 4 qt per 100 gal	Marrone
Rescue 6 pt	Mono- and di-potassium salts of Phosphorous Acid	Foliar	2 pt per acre 3 pt per acre 4 pt per acre 6 pt per acre	Helena
Revus 250 SC	Mandipropamid	Foliar	4 fl oz per acre 6 fl oz per acre 8 fl oz per acre	Syngenta
Ridomil Gold EC	Mefenoxam	Drench	16 fl oz per acre	Syngenta
		Foliar	16 fl oz per acre	
Serenade ASO	<i>Bacillus subtilis</i> strain QST 713	Foliar	2 qt per acre	AgraQuest
Serenade Max WP	<i>Bacillus subtilis</i> strain QST 713	Foliar	3 lb per acre 4 lb per acre	AgraQuest
Sonata ASO	<i>Bacillus pumilus</i> strain QST 2808	Foliar	2 qt per acre 3 qt per acre 4 qt per acre	AgraQuest
Sporatec AG, 1 qt	Rosemary oil, clove oil, and thyme oil.	Foliar	1 qt per acre	Brandt

Product	Active Ingredient(s)	Rate(s) Tested		Manufacturer
Tanos 50DF	Cymoxanil + famoxadone	Foliar	8 oz per acre 10 oz per acre	DuPont
Timorex Gold	Tea tree oil	Foliar	0.75 % v/v 1 % v/v	Stockton
V-10208 SC	V-10208	Foliar	10 fl oz per acre	Valent
Zampro SC	Ametoctradin + dimethomorph	Foliar	14 fl oz per acre	BASF
Zorvec / QGU42	oxathiapiprolin	Foliar	0.0625 fl oz per acre 0.125 fl oz per acre 0.25 fl oz per acre 0.5 fl oz per acre 1.0 fl oz per acre 2.0 fl oz per acre 2.4 fl oz per acre	DuPont

\* Product not tested in an IR-4 sponsored experiment.

## Results

### Comparative Efficacy on Coleus Downy Mildew (*Peronospora sp.*)

Coleus downy mildew (*Peronospora sp.*) has become more prevalent over the last few years. It is also suspected to be seed borne and ramify throughout the foliage until suitable environmental conditions prevail to induce symptom development and sporulation. Orvego (BAS 651), Stature and Subdue MAXX provided excellent efficacy in the 3 experiments below where they were included; Micora (NOA 446510) also provided excellent efficacy in both experiments where it was included. Heritage provided excellent efficacy in 3 of 4 experiments, Adorn in 2 of 3 experiments, and Disarm and FenStop in 1 of 2 experiments. Vital provided excellent efficacy, and SP2015 also show promise and merit further testing.

In 2007, Warfield examined seven different products for a combination of preventative and curative efficacy: Aliette, Fenstop, Heritage, Protect, Stature, Subdue, and Vital. In addition, a rotation of Fenstop with Protect was evaluated. Plants were allowed to establish for 3 wk prior to the first fungicide treatment on 10 May. All treatments were applied as a foliar spray using a hand-pump sprayer, except for Subdue MAXX. Subdue MAXX was applied as a 1.5 fl oz drench. One day after treatment all plants were spray inoculated with a spore suspension derived from naturally infested coleus leaves. Heritage, Protect, and Vital were applied three times at 7-day intervals. Stature DM was applied three times at 10-day intervals. Only one application was made for the Fenstop and Subdue MAXX treatments. For the Fenstop and Protect rotation, Fenstop was applied once, followed by two applications of Protect at 7-day intervals.

The most effective fungicides were Aliette, Stature DM, Subdue MAXX, and Vital based on visual sporulation ratings and the percentage of leaves with sporulation (Table 3). There were no significant differences between cultivars at the first two evaluation dates based on the amount of visible sporulation. Sporulation on 'Mosaic', 'Golden', 'Pastel', and 'Red Velvet' was more abundant than on 'Coral Sunrise' and 'Sunset' on June 13 (Data not shown). No phytotoxicity was observed from any treatment.

**Table 3. \*Efficacy on Downy Mildew (*Peronospora sp.*) of Coleus (*Solenostemon scutellarioides*), ‘Wizard Mix’, Warfield, 2007.**

Product – Rate per 100 gal	Visual sporulation rating (1-4) <sup>z</sup>			Leaves with sporulation (%)
	27 May	4 June	13 June	13 June
Aliette 80 WDG - 2.5 lb	1.0 a <sup>y</sup>	1.5 bc	2.1 c	2.5 bc
FenStop - 7 fl oz	1.8 a	2.4 a	2.9 ab	12.3 a
Rotation: FenStop/Protect - 7 fl oz/4 oz	1.3 a	1.9 ab	2.3 bc	5.8 abc
Heritage - 4 oz	1.5 a	2.0 ab	2.6 bc	9.3 ab
Protect DF - 4 oz	1.4 a	2.5 a	2.8 abc	5.7 abc
Stature DM - 12.8 oz	1.1 a	1.0 c	1.1 d	0.1 c
Subdue MAXX - 1 fl oz	1.1 a	1.0 c	1.0 d	0.0 c
Vital - 4 pt	1.4 a	1.0 c	1.0 d	0.0 c
Untreated inoculated	1.4 a <sup>**</sup>	2.4 a	3.4 a	10.8 a

\* Not an IR-4 Experiment: Plant Disease Management Reports 2:OT004

<sup>z</sup> Rated on a scale of 1 to 4; where 1=no visible sporulation, 2=sparse sporulation, 3=moderate sporulation; 4=abundant sporulation based on a visual estimation of the density of conidiophores.

<sup>y</sup> Means within a column followed by the same letter are not significantly different according to the Waller-Duncan k ratio, t-test, k=100, P=0.05.

In 2009, Hausbeck and Harlan tested 10 products for coleus downy mildew efficacy: Adorn, BAS 651, Disarm, FenStop, Heritage, NOA 446510, Regalia, SP2015, Stature, and Subdue MAXX. Disease pressure was severe in this experiment with the untreated inoculated plants averaging 10.3 infected leaves. Although all treatments reduced infection compared to the untreated control, BAS 651F, FenStop SC, Stature SC, and Subdue MAXX EC were the only treatments that completely prevented infection in this experiment (Table 4). Heritage, NOA 44610 and SP2015 did limit the average number of infected leaves to below 1 per plant. Higher rates of Disarm could be explored to improve efficacy. No phytotoxicity was observed from any treatment.

**Table 4. Efficacy on Downy Mildew (*Peronospora sp.*) of Coleus (*Solenostemon scutellarioides*) 'Volcano', Hausbeck and Harlan, MI, 2009.**

Treatment and rate/100 gal applied once	Application method	Infected leaves (#)	Leaf area with sporulation (%) <sup>*</sup>
Adorn 4SC 1 fl oz	drench	4.5 bc	37.5
Adorn 4SC 2 fl oz	drench	2.8 ab	30.0
BAS 651F F 11 fl oz	spray	0.0 a	--
BAS 651F 13.4 fl oz	spray	0.0 a	--
Disarm 480SC 2 fl oz	spray	1.8 ab	29.0
Disarm 480SC 4 fl oz	spray	1.0 a	30.0
FenStop SC 14 fl oz	spray	0.0 a	--
Heritage 40WG 4 oz	spray	0.3 a	47.5
NOA 44610 250SC 4 fl oz	spray	0.2 a	10.0
NOA 44610 250SC 8 fl oz	spray	0.5 a	35.0
Regalia SC 0.5%	spray	6.3 c	68.3
Regalia SC 1%	spray	4.3 bc	55.0
SP2015 50DF 12 oz	spray	0.5 a	20.0
Stature SC 6.12 fl oz	spray	0.0 a	--
Subdue MAXX EC 1 fl oz	spray	0.0 a	--
Untreated inoculated	--	10.3 d <sup>**</sup>	81.7

<sup>\*</sup>Based on a visual estimation of percentage of diseased leaves with sporulation.

<sup>\*\*</sup>Column means with a letter in common or with no letter are not significantly different (Student-Newman-Keuls;  $P=0.05$ ).

In 2010, Hausbeck and Harlan tested seven products for coleus downy mildew efficacy. Disease pressure was severe in this experiment with the untreated control plants averaging 22.7 leaves sporulating with *Peronospora sp.* All treatments, except Alude and Aliette, prevented infection (Table 5). Aliette and Alude statistically limited infection compared to the untreated control; however, infection rates remained at levels unacceptable to growers. No phytotoxicity was observed from any treatment.

**Table 5. \*Efficacy on Downy Mildew (*Peronospora sp.*) of Coleus (*Solenostemon scutellarioides*) 'Black Dragon', Hausbeck and Harlan, MI2010.**

Treatment and rate/100 gal applied once	Application method	Leaf area with sporulation (%) <sup>y</sup>
Adorn 4SC 1 fl oz	spray	0.0 a
Aliette 80WDG 4 lb	spray	10.5 b
Alude 2.5 qt	spray	15.3 c
Heritage 50WDG 4 oz	spray	0.0 a
Orvego 525SC 11 fl oz	spray	0.0 a
Orvego 525SC 14 fl oz	spray	0.0 a
Orvego 525SC 28 fl oz	spray	0.0 a
Stature SC 12.25 fl oz	spray	0.0 a
Subdue MAXX EC 1 fl oz	drench	0.0 a
Untreated inoculated	-	22.7 d

<sup>\*</sup> Not an IR-4 Experiment: Plant Disease Management Reports 5:OT018.

<sup>x</sup> Column means with a letter in common or no letter are not significantly different (Fisher's LSD;  $P=0.05$ ).

<sup>y</sup> Based on a visual estimation of percentage of diseased leaves with sporulation.



In 2010, Ivors tested seven products for coleus downy mildew efficacy. All treatments were applied on Sep 28 as foliar sprays, except for Adorn which was applied as a drench. Plants were inoculated with *Peronospora belbaharii* one day post-treatment. All products significantly reduced spores, although both Regalia applications were less effective in reducing the number of spores produced per plant (Table 6). Both rates of Adorn, as well as the high rate of Disarm, completely inhibited downy mildew sporulation. Although plants treated with Regalia had significantly higher spore counts, these plants were better able to retain their foliage compared to all other treatments. This experiment indicates that many of these products are effective at managing downy mildew of coleus if applied before infection. No phytotoxicity was observed from any treatment.

**Table 6. Efficacy on Downy Mildew (*Peronospora sp.*) of Coleus (*Solenostemon scutellarioides*) 'Pineapple', Ivors, NC, 2010.**

Treatment and rate/100 gal applied once	Total no. spores per plant <sup>x</sup>	No. of abscised leaves	
Adorn 4SC 1.0 fl oz	0 c	0.00	0.6 bc
Adorn 4SC 2.0 fl oz	0 c	0.00	0.8 bc
BAS 651F 11.0 fl oz	294 c	0.08	1.0 bc
BAS 651F 14.0 fl oz	439 c	0.12	1.6 ab
Disarm 480SC 2.0 fl oz	1,000 c	0.28	0.7 bc
Disarm 480SC 4.0 fl oz	0 c	0.00	1.6 ab
Heritage 50WDG 4.0 fl oz	483 c	0.15	0.9 bc
NOA-446510 SC 4.0 fl oz	800 c	0.25	1.1 bc
NOA-446510 SC 8.0 fl oz	356 c	0.10	1.1 bc
Regalia SC 0.5%	47,934 b	13.42	0.3 c
Regalia SC 1.0%	32,019 bc	8.96	0.1 c
Untreated uninoculated	0 c	0.00	0.1 c
Untreated inoculated	354,281 a	100.00	2.4 a

<sup>x</sup> Column means with a letter in common or no letter are not significantly different (Waller-Duncan *k*-ratio (*k* = 100) test)*P*=0.05).

### **Comparative Efficacy on Impatiens Downy Mildew (*Plasmopara obducens*).**

Impatiens downy mildew, caused by *Plasmopara obducens*, is an old disease that has become problematic again recently. It was first reported in the US in 2004, and has become a widespread disease problem on impatiens by 2013, occurring in 38 states. It attacks mainly common garden impatiens (*Impatiens walleriana*) causing plants to stop flowering, leaves dropping and stems collapsing.

The tables below (Table 7, Table 8) contain a general summary of 30 efficacy experiments on impatiens downy mildew (*Plasmopara obducens*). Generally, Adorn and Subdue MAXX applied as drench or foliar spray, and Micora, Stature, Orvego and Pageant applied foliar, provided excellent control. Adorn, and Subdue MAXX also provided some residual activity. Vital applied foliar provided good control, and excellent control when applied drench; other potassium phosphite fungicides Alude and Inosco provided good to excellent control. A new product Segovis applied as drench provided excellent control. See the discussion and data of individual experiments for more details.

**Table 7. General summary of efficacy for downy mildew (*Plasmopara obducens*) on impatiens (*I. walleriana*) – Part 1.**

<b>Product</b>	Warfield 2011* <sub>1</sub>	Warfield 2011* <sub>1</sub>	Warfield 2011* <sub>2</sub>	Warfield 2012* <sub>1</sub>	Warfield 2012* <sub>1</sub>	Warfield 2012* <sub>2</sub>	Warfield 2012* <sub>3</sub>	Warfield 2012* <sub>3</sub>	Warfield 2012* <sub>3</sub>	Warfield 2012* <sub>3</sub>	Warfield 2012* <sub>3</sub>	Warfield 2012* <sub>3</sub>	Warfield 2012* <sub>3</sub>	Hausbeck 2012* <sub>1</sub>	Hausbeck 2012* <sub>1</sub>
Adorn drench	++							++	++				++		
Adorn spray		++				++		++							
Adorn + Pageant															
Adorn + Protect			++					++							
Adorn + Subdue MAXX drench															
AGRI-FOS drench															
AGRI-FOS spray															
Aliette drench	+/-														
Alude drench															++
Alude spray															
Alude + Subdue MAXX drench															
Banol	+/-														
Cease						-									
Disarm		++	+/-											+/-	
Dithane															
F9110															
Fenstop		++	+							++					
Heritage drench															-
Heritage spray	++								-					+/-	
Inosco (A14658C)															
Micora (NOA 446510)				++		++	++							++	
Orkestra (BAS 703)															
Orvego (BAS 651)	++				++	++		+/-							
Oxiphos															
Pageant	++									+					
Protect	++							++	++	++					
Regalia															
Segovis (SYN 546539) drench															
Segway		++	+/-								+/-				
SP2770															
Stature SC		++		++	++		++				+/-				
Stature SC + Pageant															

Product	Warfield 2011*.1	Warfield 2011*.1	Warfield 2011*.2	Warfield 2012*.1	Warfield 2012*.1	Warfield 2012*.2	Warfield 2012*.3	Warfield 2012*.3	Warfield 2012*.3	Warfield 2012*.3	Warfield 2012*.3	Warfield 2012*.3	Warfield 2012*.3	Hausbeck 2012*.1	Hausbeck 2012*.1
Subdue MAXX drench									++					++	++
Subdue MAXX spray		-		++		++	++					++	++		
Subdue MAXX + Protect			-												
SYN 546539 drench															
V-10208 drench															
V-10208 spray															
Vital drench	++										++		++		++
Vital spray		++	+								+				
ZeroTol											-				

\* Not an IR-4-sponsored experiment.

<sup>1</sup> Experiment to determine preventive efficacy; fungicides applied  $\leq 1$  day before disease inoculation.

<sup>2</sup> Experiment to determine curative efficacy; fungicides applied 1-2 days after disease inoculation

<sup>3</sup> Experiment to determine residual efficacy; fungicides applied 6-28 days before disease inoculation.

<sup>4</sup> Rating Scale: ++ = clearly statistically equivalent or better than untreated non-inoculated and/or clearly statistically different than untreated inoculated; + = statistically different from untreated inoculated and untreated non-inoculated; +/- statistically equivalent to both untreated inoculated and untreated non-inoculated; - = statistically equivalent to untreated inoculated. For experiments without non-inoculated check, efficacy determined on author's conclusions, % control or comparisons to standard product(s).

<sup>5</sup> Where more than one rate or application type for a product was included in the experiment and each performed statistically different, the better rating is provided in this table. Products applied as drench, and products applied as drench or spray identified in table; all other products with no application identification were applied as spray.

**Table 8. General summary of efficacy for downy mildew (*Plasmopara obducens*) on impatiens (*I. walleriana*) – Part 2.**

<b>Product</b>	<b>Palmaateer 2012**<sup>1</sup></b>	<b>Hausbeck 2013**<sup>1</sup></b>	<b>Hausbeck 2013**<sup>1</sup></b>	<b>Hausbeck 2013**<sup>1</sup></b>	<b>Hausbeck 2013**<sup>1</sup></b>	<b>Warfield 2013**<sup>3</sup></b>	<b>Warfield 2013**<sup>3</sup></b>	<b>Warfield 2013**<sup>3</sup></b>	<b>Freiberger 2013<sup>1</sup></b>	<b>Hausbeck 2014**<sup>1</sup></b>	<b>Palmaateer 2014**<sup>1</sup></b>	<b>Freiberger 2014<sup>1</sup></b>	<b>Freiberger 2015<sup>1</sup></b>	<b>Freiberger 2016a<sup>2</sup></b>	<b>Freiberger 2016b<sup>2</sup></b>
Adorn drench						++		-	++	++	++	-	-	-	-
Adorn spray						-									
Adorn + Pageant											++				
Adorn + Protect		-		++											
Adorn + Subdue MAXX drench		++		++				++							
AGRI-FOS drench							-								
AGRI-FOS spray							-								
Aliette drench															
Alude drench		-		-								++	+	++	
Alude spray									+						
Alude + Subdue MAXX drench		+	++	++								++			
Banol															
Cease															
Disarm															
Dithane							++	+							
F9110					++										
Fenstop							-								
Heritage drench															
Heritage spray	+														
Inosco (A14658C)									+			++	+	+	
Micora (NOA 446510)															
Orkestra (BAS 703)										++			-		
Orvego (BAS 651)	++	-													
Oxiphos				-											
Pageant	++									++					
Protect							++	+							
Regalia					++										
Segovis (SYN 546539) drench												++	++	++	
Segway			++							++					
SP2770												-			

Product	Palmateer 2012** <sup>1</sup>	Hausbeck 2013** <sup>1</sup>	Hausbeck 2013** <sup>1</sup>	Hausbeck 2013** <sup>1</sup>	Hausbeck 2013** <sup>1</sup>	Warfield 2013** <sup>3</sup>	Warfield 2013** <sup>3</sup>	Warfield 2013** <sup>3</sup>	Freiberger 2013 <sup>1</sup>	Hausbeck 2014** <sup>1</sup>	Palmateer 2014** <sup>1</sup>	Freiberger 2014 <sup>1</sup>	Freiberger 2015 <sup>1</sup>	Freiberger 2016a <sup>2</sup>	Freiberger 2016b <sup>2</sup>
Stature SC	++														
Stature SC + Pageant															+/-
Subdue MAXX drench			++		+	++		++	++	++		-	-	-	-
Subdue MAXX spray						-									
Subdue MAXX + Protect															
V-10208 drench			++												
V-10208 spray			++												
Vital drench							++								
Vital spray							-	-							
ZeroTol				-											

\* Not an IR-4-sponsored experiment.

<sup>1</sup> Experiment to determine preventive efficacy; fungicides applied  $\leq 1$  day before disease inoculation.

<sup>2</sup> Experiment to determine curative efficacy

<sup>3</sup> Experiment to determine residual efficacy; fungicides applied 6-28 days before disease inoculation.

<sup>4</sup> Rating Scale: ++ = clearly statistically equivalent or better than untreated non-inoculated and/or clearly statistically different than untreated inoculated; + = statistically different from untreated inoculated and untreated non-inoculated; +/- statistically equivalent to both untreated inoculated and untreated non-inoculated; - = statistically equivalent to untreated inoculated. For experiments without non-inoculated check, efficacy determined on author's conclusions, % control or comparisons to standard product(s).

<sup>5</sup> Where more than one rate or application type for a product was included in the experiment and each performed statistically different, the better rating is provided in this table. Products applied as drench, and products applied as drench or spray identified in table; all other products with no application identification were applied as spray.

In 2011, Warfield conducted 2 experiments to evaluate several products on downy mildew of impatiens caused by *Plasmopara obducens*. In the first experiment, treatments were applied as either foliar sprays or as a drench on Nov 13; three treatments (Pageant, Orvego and Heritage) were also applied as foliar sprays 3 days after inoculation on Nov 14. Disease pressure was high in this experiment with visible, heavy sporulation present on more than 98% of the leaves on the untreated plants although the amount of leaf abscission was minimal (Table 9). All treatments significantly reduced both the percentage of leaves with sporulation and the total number of abscised leaves. However, the levels of infection for the Aliette and Banol treatments would not be acceptable in a production setting. There was no significant difference in final plant height among treatments (data not shown). The percentage of sporulating leaves was less for treatments applied prior to inoculation compared to applications made 3 days after inoculation. No phytotoxicity was observed from any treatment, but chemical residue was noted on plants receiving treatments containing Protect

In the second experiment, fungicides were applied as foliar sprays on Oct 9. Adorn and the foliar application of Subdue MAXX were each tank-mixed with Protect, following label recommendations for resistance management. Subdue MAXX was also applied as a drench. Plants were unoculated 30 hr after treatment on Oct 10. All treatments, except the drench application of Subdue MAXX, provided excellent control of a severe disease pressure (Table 10). The efficacy of the foliar application of Subdue MAXX+Protect may be a result of the Protect component. The drench application of Subdue MAXX was ineffective in controlling downy mildew infection with the *P. obducens* isolate used in this experiment. There was no difference in the final height, or change in height (data not shown), among all treatments. Chemical residue was noted on plants receiving treatments containing Protect.

**Table 9. \*Efficacy on Downy Mildew (*Plasmoparaobducens*) of Impatiens (*I. walleriana*) 'Super Elfin White', Warfield, IL, 2011, Test 1.**

Treatment and rate/100 gal applied once	Application Method <sup>y</sup>	Leaves with sporulation (%) <sup>x</sup>	Total no. leaves abscised
Adorn 4SC 1 fl oz	drench	0.0d	0.0c
Aliette 80WDG 12.8 oz	drench	45.8b	1.8bc
Banol 6EC 202.8 fl oz	spray	38.3 b	1.3 bc
Heritage 50 WG (2 oz) + Capsil (6 fl oz)	spray	0.88 d	0.0 c
Heritage 50 WG (2 oz) + Capsil (6 fl oz)	spray 3 dpi	40.2 b	2.8 b
Orvego 525SC 11 fl oz	spray	0.0 d	0.0 c
Orvego 525SC 11 fl oz	spray 3 dpi	18.7 c	0.0 c
Pageant 38WP 12 oz	spray	0.0 d	0.0 c
Pageant 38WP 12 oz	spray 3 dpi	13.2 cd	0.0 c
Protect 75DF 2 lb	spray	0.0 d	0.0 c
Vital 55%SL 4 pt	drench	0.35 d	0.0c
Untreated inoculated	-	98.3 a	7.0 a

\* Not an IR-4 Experiment: Plant Disease Management Reports 6:OT014.

<sup>x</sup> Column means with a letter in common are not significantly different (Fisher's Protected LSD  $P=0.05$ ).

<sup>y</sup> Fungicides were applied as either foliar spray applications (spray) or as a soil drench (drench) one day prior to inoculation, or as a foliar spray three days post inoculation (spray 3 dpi).

**Table 10. \*Efficacy on Downy Mildew (*Plasmoparaobducens*) of Impatiens (*I. walleriana*) 'Super Elfin White', Warfield, IL, 2011, Test 2.**

Treatment and rate/100 gal applied once	Leaves with sporulation (%) <sup>x</sup>	Total no. leaves abscised	Final height (in.)
Adorn 4SC (1 fl oz) + Protect 75DF (2 lb) + Capsil (6 fl oz)	0.0 b	0.0 c	6.3
Disarm 480SC (4 fl oz) + Capsil (6 fl oz)	0.21 b	0.75 c	5.9
Fenstop 4.13SC 14 fl oz	0.0 b	0.25 c	5.9
Segway 3.33SC (3.5 fl oz) + Capsil (6 fl oz)	0.16 b	0.0 c	6.4
Stature 4.18SC 6.12 fl oz	0.25 b	0.0 c	5.5
Subdue MAXX 22%ME (1.0 fl oz) + Protect 75DF (2.0 lb) (spray)	0.23 b	0.0 c	5.4
Subdue MAXX 22%ME 1.0 fl oz (drench)	66.3a	31.0b	6.0
Vital 55%SL 4 pt	1.3 b	0.25 c	5.8
Untreated uninoculated	0.0 b	0.0 c	5.8
Untreated inoculated	69.4 a	39.8 a	6.1

\* Not an IR-4 Experiment: Plant Disease Management Reports 6:OT015.

<sup>x</sup> Column means with with no letter, or a letter in common are not significantly different (Fisher's Protected LSD  $P=0.05$ ).

In 2012, Warfield conducted 2 experiments to evaluate preventive applications of several products. In the first experiment, all treatments were applied as foliar sprays on Apr 12, and inoculated 30 hr after treatment on Apr 13. All treatments provided excellent control of a severe disease pressure (Table 11). Visible chemical residue was observed on plants treated with the high rate of Micora.

In the second experiment, all treatments were applied as foliar sprays on Mar 1. and inoculated 24 hr after treatment on Mar 2. Orvego and Stature provided complete control of a severe disease pressure, while Kleengrow and Cease provided poor and no control (Table 12). KleenGrow was highly phytotoxic to the impatiens plants (leaf necrosis and stunting).

**Table 11. \*Efficacy on Downy Mildew (*Plasmoparaobducens*) of Impatiens (*I. walleriana*) 'Super Elfin White', Warfield, IL, 2012a.**

Treatment and rate/100 gal applied once	Disease incidence (% plants) <sup>x</sup>	Leaves with sporulation (%) <sup>y</sup>
Micora 23.3SC 4 fl oz	18.8b	2.3 b
Micora 23.3SC 8 fl oz	0.0 c	0.0 b
Stature 4.18SC 6.12 fl oz	6.3 bc	0.7 b
Stature 4.18SC 12.25 fl oz	0.0c	0.0 b
Subdue MAXX 22%ME 1 fl oz	0.0 c	0.0 b
Untreated uninoculated	0.0 c	0.0 b
Untreated inoculated	100.0 a	97.1 a

\* Not an IR-4 Experiment: Plant Disease Management Reports 6:OT026.

<sup>x</sup>Percentage of plants with sporulating leaves on Apr 27. Column means with a letter in common are not significantly different (Fisher's Protected LSD  $P=0.05$ ).

<sup>y</sup> Percentage of leaves, per infected plant, with visible sporulation on Apr 27.

**Table 12. \*Efficacy on Downy Mildew (*Plasmoparaobducens*) of Impatiens (*I. walleriana*) 'Super Elfin White', Warfield, IL, 2012b.**

Treatment and rate/100 gal applied once	Disease incidence (% plants) <sup>x</sup>	Leaves with sporulation (%) <sup>y</sup>
Cease 4 qt	100.0 a	64.7 a
Cease 8 qt	100.0 a	45.0 a
KleenGrow 0.5 fl oz/gal	43.8 b	7.2 b
Orvego 11 fl oz	0.0 c	0.0c
Orvego 14 fl oz	0.0c	0.0c
Stature SC 6.12 fl oz	0.0c	0.0c
Untreated uninoculated	0.0 c	0.0 c
Untreated inoculated	100.0 a	71.1 a

\* Not an IR-4 Experiment: Plant Disease Management Reports 6:OT029.

<sup>x</sup> Percentage of plants with sporulating leaves on Mar 15. Column means with a letter in common are not significantly different (Fisher's Protected LSD  $P=0.05$ ).

<sup>y</sup> Percentage of leaves, per infected plant, with visible sporulation on Mar 15.

In 2012, Warfield conducted 7 experiments to evaluate the residual efficacy of various products when applied several days before inoculation on impatiens downy mildew. In the first experiment, all treatments were applied as foliar sprays on Apr 12, seven days before inoculation. Subdue MAXX provided 100 % residual efficacy on a severe disease pressure, while Micora and Stature were slightly less effective (Table 13). Chemical residue was observed on plants treated with the higher rate of Micora.

In a second experiment, all treatments were applied as foliar sprays except Adorn drench, on Mar 3, six days before inoculation. Protect alone, treatments containing Protect, and both rates of Adorn applied as a drench had the best residual efficacy on a severe disease pressure (Table 14). Adorn at the higher rate was also effective, however Orvego had marginal residual efficacy.

In a third experiment, all treatments were applied as drench or foliar sprays on Mar 11, eight days prior to inoculation with two different isolates (California and Holland) of the pathogen. Adorn applied as a drench provided complete control of severe disease pressures from the 2 isolates, while Subdue MAXX drench completely controlled the California isolate but provided no control of the Holland isolate (Table 15). Protect as foliar spray provided good residual efficacy, while Heritage was very poor. Chemical residue was noted on plants treated with Protect.

In a fourth experiment, treatments were applied as foliar sprays on Jan 9, then inoculated 7 days (Jan 16) or 14 days (Jan 23) after treatment. Fenstop provided the longest duration of efficacy of all treatments and was the only fungicide to reduce the incidence of infected plants when applied 14 days before inoculation (Table 16). All treatments significantly reduced the percentage of sporulating leaves when applied at either 7 or 14 days before inoculation; however, the amount of control would be insufficient in most growing operations. Protect and Fenstop had both the lowest incidence of infected plants and the fewest number of sporulating leaves of all treatments when fungicides were applied seven days before inoculation. Phytotoxicity was not observed on any treatment, but plants treated with Protect had visible chemical residue.

In a fifth experiment, treatments were applied as either foliar sprays (Vital and ZeroTol) or as a drench (Vital) 7 days before inoculation on Oct 12. In addition, a foliar treatment of ZeroTol was applied on Oct 18, 30 hours before inoculation. Vital applied as drench provided complete control of a severe disease pressure, while it was less effective when applied as a spray (Table 17). Neither the preventive nor the seven day residual ZeroTol treatments were effective in controlling this disease. No phytotoxicity was observed for any treatment.



In a sixth experiment, Adorn and Subdue MAXX were applied as drench on Sep 7, 21 days before disease inoculation on Sep 28. Both fungicides provided complete control of a severe disease pressure (Table 18).

In a seventh experiment, Adorn, Subdue MAXX and Vital were applied as drench on Oct 12, 28 days before disease inoculation on Nov 9. All fungicides provided excellent control of a severe disease pressure (Table 19). No phytotoxicity was observed for any treatment.

**Table 13. \*Efficacy on Downy Mildew (*Plasmoparaobducens*) of Impatiens (*I. walleriana*) 'Super Elfin White', Warfield, IL, 2012, Test 1.**

Treatment and rate/100 gal applied once	Disease incidence (% plants) <sup>x</sup>	Leaves with sporulation (%) <sup>y</sup>	Leaves with sporulation across treatment (%) <sup>z</sup>
Micora 23.3SC 4 fl	68.8 b	9.7 b	8.5 b
Micora 23.3SC 8 fl	75.0 b	8.2 bc	7.2 b
Stature 4.18SC 6.12 fl oz	87.5 ab	9.3b	8.4 b
Subdue MAXX 22.2%ME 1 fl oz	0.0 c	0.0 c	0.0 b
Untreated uninoculated	0.0 c	0.0 c	0.0 b
Untreated inoculated	100.0 a	78.5 a	78.5 a

\* Not an IR-4 Experiment: Plant Disease Management Reports 6:OT027. Not all treatments included in table.

<sup>x</sup> Percentage of plants with sporulating leaves on May 4. Column means with a letter in common are not significantly different (Fisher's Protected LSD  $P=0.05$ ).

<sup>y</sup> Percentage of leaves, per infected plant, with visible sporulation on May 4.

<sup>z</sup> Percentage of leaves with sporulation across all plants within a treatment on May 4.

**Table 14. \*Efficacy on Downy Mildew (*Plasmoparaobducens*) of Impatiens (*I. walleriana*) 'Super Elfin White', Warfield, IL, 2012, Test 2.**

Treatment and rate/100 gal applied once	Application Method	Disease incidence (% plants) <sup>x</sup>	Leaves with sporulation (%) <sup>y</sup>	Leaves with sporulation across treatment (%) <sup>z</sup>
Adorn 4SC 1 fl oz	drench	0.0 d	0.0 e	0.0 d
Adorn 4SC 4 fl oz	drench	0.0 d	0.0 e	0.0 d
Adorn 4SC (1 fl oz) + Capsil (6 fl oz)	spray	86.3 b	21.4 d	17.1 c
Adorn 4SC (4 fl oz) + Capsil (6 fl oz)	spray	12.5 c	9.6 e	2.4 d
Adorn 4SC (1 fl oz) + Protect (2 lb) + Capsil (6 fl oz)	spray	0.0 d	0.0 e	0.0 d
Adorn 4SC (4 fl oz) + Protect (2 lb) + Capsil (6 fl oz)	spray	0.0 d	0.0 e	0.0 d
Protect DF 75DF (2 lb) + Capsil (6 fl oz)	spray	0.0 d	0.0 e	0.0 d
Orvego 525SC 11 fl oz	spray	100.0a	50.0c	50.0b
Orvego 525SC 14 fl oz	spray	93.8 ab	61.0 b	57.7 b
Untreated uninoculated	-	0.0 d	0.0 e	0.0 d
Untreated inoculated	-	100.0 a	100.0 a	100.0 a

\* Not an IR-4 Experiment: Plant Disease Management Reports 6:OT028.

<sup>x</sup> Percentage of plants with sporulating leaves on Mar 23. Column means with a letter in common are not significantly different (Fisher's Protected LSD  $P=0.05$ ).

<sup>y</sup> Percentage of leaves, per infected plant, with visible sporulation on Mar 23.

<sup>z</sup> Percentage of leaves with sporulation across all plants within a treatment on Mar 23.

**Table 15. \*Efficacy on Downy Mildew (*Plasmoparaobducens*) of Impatiens (*I. walleriana*) 'Super Elfin White', Warfield, IL, 2012, Test 3.**

Treatment and rate/100 gal applied once	Isolate	Application Method	Leaves with sporulation (%) <sup>x</sup>
Adorn 4SC 2 fl oz	California	drench	0.0 d
Heritage 50WG 2 oz	California	spray	92.2 b
Protect DF 75DF 2lb	California	spray	7.4 c
Subdue MAXX 22.2%ME 1 fl oz	California	drench	0.0 d
Untreated uninoculated	-	-	0.0 d
Untreated inoculated	California	-	99.2 a
Adorn 4SC 2 fl oz	Holland	drench	0.0 d
Subdue MAXX 22.2%ME 1 fl oz	Holland	drench	98.3 a
Untreated uninoculated	-	-	0.0 d
Untreated inoculated	Holland	-	99.6 a

\* Not an IR-4 Experiment: Plant Disease Management Reports 6:OT031.

<sup>x</sup> Percentage of leaves, per infected plant, with visible sporulation on Apr 2. Column means with a letter in common are not significantly different (Fisher's Protected LSD  $P=0.05$ ).

**Table 16. \*Efficacy on Downy Mildew (*Plasmoparaobducens*) of Impatiens (*I. walleriana*) 'Super Elfin White', Warfield, IL, 2012. Test 4.**

Treatment and rate/100 gal applied once	Inoculation (days after trt)	Disease incidence (% plants) <sup>x</sup>	Leaves with sporulation (%) <sup>y</sup>
Adorn 4SC (1 fl oz) + Vital (4 pt) + Capsil (6 fl oz)	7	81.3 b	7.9 c
Fenstop 4.13SC (14 fl oz) + Capsil (6 fl oz)	7	18.8 c	1.4 d
Pageant 38WG 12 oz	7	100.0 a	22.6 b
Protect DF 75DF (2 lb) + Capsil (6 fl oz)	7	6.3 cd	0.4 d
Segway 3.33SC (3.5 fl oz) + Capsil (6 fl oz)	7	87.5 ab	11.6 c
Stature 4.18SC 6.12 fl oz	7	100.0a	21.9 b
Untreated uninoculated	-	0.0 d	0.0 d
Untreated inoculated	-	100.0 a	100.0 a
Adorn 4SC (1 fl oz) + Vital (4 pt) + Capsil (6 fl oz)	14	100.0 a	25.9 cd
Fenstop 4.13SC (14 fl oz) + Capsil (6 fl oz)	14	66.7 b	2.5 e
Pageant 38WG 12 oz	14	100.0 a	33.5 bc
Protect DF 75DF (2 lb) + Capsil (6 fl oz)	14	100.0 a	18.2 d
Segway 3.33SC (3.5 fl oz) + Capsil (6 fl oz)	14	100.0 a	39.3 b
Stature 4.18SC 6.12 fl oz	14	100.0 a	45.0 b
Untreated uninoculated	-	0.0 c	0.0 e
Untreated inoculated	-	100.0 a	100.0 a

\* Not an IR-4 Experiment: Plant Disease Management Reports 6:OT032.

<sup>x</sup> Percentage of plants with sporulating leaves at 16 days post inoculation. Column means with a letter in common are not significantly different (Fisher's Protected LSD  $P=0.05$ ).

<sup>y</sup> Percentage of leaves, per infected plant, with visible sporulation at 16 days post inoculation.

**Table 17. \*Efficacy on Downy Mildew (*Plasmoparaobducens*) of Impatiens (*I. walleriana*) 'Super Elfin White', Warfield, IL, 2012, Test 5.**

Treatment and rate/100 gal applied once	Application method	Disease incidence (% plants) <sup>x</sup>	Leaves with sporulation (%) <sup>y</sup>
Vital 55%SL 1.25 pt	drench 7 day prior	0.0 c	0.0 d
Vital 55%SL 4 pt	spray 7 day prior	56.3 b	10.0 c
ZeroTol 27% 50 fl oz	spray 30 hr prior	100.0 a	95.0 ab
ZeroTol 27% 50 fl oz	spray 7 day prior	100.0 a	92.8 b
Untreated uninoculated	-	0.0 c	0.0 d
Untreated inoculated	-	100.0 a	96.0 a

\* Not an IR-4 Experiment: Plant Disease Management Reports 7:OT008.

<sup>x</sup> Percentage of plants with sporulating leaves at 14 days post inoculation. Column means with a letter in common are not significantly different (Fisher's Protected LSD  $P=0.05$ ).

<sup>y</sup> Percentage of leaves, per infected plant, with visible sporulation at 14 days post inoculation.

**Table 18. \*Efficacy on Downy Mildew (*Plasmoparaobducens*) of Impatiens (*I. walleriana*) 'Super Elfin White', Warfield, IL, 2012, Test 6.**

Treatment and rate/100 gal applied once	Leaves with sporulation (%) <sup>x</sup>
Adorn 4SC 1 fl oz	0.0 b
Adorn 4SC4 fl oz	0.0 b
Subdue MAXX 22%ME 1 fl oz	0.0 b
Subdue MAXX 22%ME (1 fl oz) + Adorn 4SC (1 fl oz)	0.0 b
Untreated uninoculated	0.0 b
Untreated inoculated	92.5 a

\* Not an IR-4 Experiment: Plant Disease Management Reports 7:OT007.

<sup>x</sup> Percentage of plants with sporulating leaves at 14 days post inoculation. Column means with a letter in common are not significantly different (Fisher's Protected LSD  $P=0.05$ ).

**Table 19. \*Efficacy on Downy Mildew (*Plasmoparaobducens*) of Impatiens (*I. walleriana*) 'Super Elfin White', Warfield, IL, 2012, Test 7.**

Treatment and rate/100 gal applied once	Disease incidence (% plants) <sup>x</sup>	Leaves with sporulation (%) <sup>y</sup>
Adorn 4SC 1 fl oz	6.3 b	0.2 b
Subdue MAXX 22%ME 1 fl oz	0.0 b	0.0 b
Subdue MAXX 22%ME (1 fl oz) + Adorn 4SC (1 fl oz)	0.0 b	0.0 b
Vital 55%SL 1.25 pt	0.0 b	0.0 b
Untreated uninoculated	0.0 b	0.0 b
Untreated inoculated	100.0 a	98.0 a

\* Not an IR-4 Experiment: Plant Disease Management Reports 7:OT009.

<sup>x</sup> Percentage of plants with sporulating leaves at 19 days post inoculation. Column means with a letter in common are not significantly different (Fisher's Protected LSD  $P=0.05$ ).

<sup>y</sup> Percentage of leaves, per infected plant, with visible sporulation at 19 days post inoculation.

During 2011 to 2012, Warfield conducted two experiments to evaluate the curative efficacy of several fungicides to prevent sporulation when applied after disease inoculation. In 2011, six-week old impatiens were inoculated on Aug 26, then fungicides applied as foliar sprays at 3 (Aug 29) or 6 (Sep 1) days post inoculation. Disease severity and final plant height were recorded on Sep 13. When applied three days post inoculation (3 dpi), Adorn + Protect, Segway, Vital, Stature and Fenstop significantly reduced a severe disease pressure, while Subdue MAXX + Protect were ineffective (Table 20). With the exception of Adorn + Protect, the levels of infection in the other treatments would not be acceptable in a production setting. Treatments applied at 6 dpi had a significantly higher incidence of infection compared to the same treatments applied at 3 dpi with exception of Adorn + Protect. Adorn + Protect and Stature applied 3 dpi had significantly less sporulation compared to all other treatments. The Adorn + Protect treatment applied 6 dpi had significantly less leaf sporulation compared to all other treatments applied at 6 dpi. A small, but significant, reduction in plant height was recorded for all treatments except for the 3 dpi Vital and Stature treatments. Chemical residue was visible on plants receiving treatments containing Protect.

**Table 20. \*Efficacy on Downy Mildew (*Plasmopara obducens*) of Impatiens (*I. walleriana*) 'Super Elfin White', Warfield, IL, 2011.**

Treatment and rate/100 gal applied once	Dpi <sup>z</sup>	Leaves with sporulation (%) <sup>x</sup>	Visual rating of leaf <sup>y</sup>	Total no. abscised	Plant Height (in)
Adorn 4SC (1 fl oz) + Protect 75DF (2 lb) + Capsil (6 fl oz)	3	0.28 f	1.0e	1.0f	4.3 b-e
Adorn 4SC (1 fl oz) + Protect 75DF (2 lb) + Capsil (6 fl oz)	6	5.3f	1.3e	44.e	4.1c-f
Disarm 480SC (4 fl oz) + Capsil (6 fl oz)	3	39.1cd	3.3ab	64.0cde	4.4bcd
Fenstop 4.13SC 14 fl oz	3	11.7 ef	2.3 cd	16.5 f	4.3 b-f
Fenstop 4.13SC 14 fl oz	6	47.9 c	3.0 bc	72.5 bc	4.3 b-e
Segway 3.33SC (3.5 fl oz) + Capsil (6 fl oz)	3	24.8 de	3.2 ab	47.0 de	4.6 bc
Segway 3.33SC (3.5 fl oz) + Capsil (6 fl oz)	6	42.2 c	3.5 ab	87.3 ab	4.1 b-f
Stature 4.18SC 6.12 fl oz	3	13.3 ef	1.9 de	9.0 f	5.9 a
Stature 4.18SC 6.12 fl oz	6	72.9 b	3.3 ab	68.0 bcd	3.9 def
Subdue MAXX 22%ME (1 fl oz) + Protect 75DF (2 lb)	3	87.7 ab	4.0 a	107.8 a	3.6 f
Subdue MAXX 22%ME (1 fl oz) + Protect 75DF (2 lb)	6	93.8 a	4.0 a	102.3 a	3.7 ef
Vital 55%SL 4 pt	3	20.7e	2.3cd	9.8f	4.7ab
Vital 55%SL 4 pt	6	75.7b	3.7ab	18.3f	3.9c-f
Untreated uninoculated	-	0.0 f	0.0 f	0.5 f	5.4 a
Untreated inoculated	-	99.5 a	4.0 a	76.3 bc	3.9 def

\* Not an IR-4 Experiment: Plant Disease Management Reports 6:OT016.

<sup>x</sup> Column means with a letter in common are not significantly different (Fisher's Protected LSD  $P=0.05$ ).

<sup>y</sup> Visual rating of sporulation on leaf undersides: 1 = very sparse on one area of leaf, 2 = light sporulation in one or a few areas of leaf, 3 = abundant sporulation covering entire underside of leaf, 4 = heavy sporulation (clumping) covering entire underside of leaf.

<sup>z</sup> Fungicides were applied three or six days post inoculation.

In 2012, five-week old impatiens were inoculated on Oct 10, then fungicides applied 48 hours post inoculation. All treatments provided early curative control of a moderate disease pressure, with Adorn +

Capsil, Orvego and Stature applied as sprays, and Subdue MAXX applied as drench, providing complete control (Table 21). Adorn drench and Micora spray were slightly less effective. The difference in efficacy of Adorn spray vs. drench, and that of Subdue MAXX, suggests that the rate of plant uptake and/or distribution of Adorn drench occur more slowly. No phytotoxicity was observed for any treatment.

**Table 21. \*Efficacy on Downy Mildew (*Plasmoparaobducens*) of Impatiens (*I. walleriana*) 'Super Elfin White', Warfield, IL, 2012.**

Treatment and rate/100 gal applied once	Application method	Disease incidence (% plants) <sup>x</sup>	Leaves with sporulation (%) <sup>y</sup>
Adorn 4SC 1 fl oz	drench	75.0 b	4.6 b
Subdue MAXX 22%ME 1 fl oz	drench	0.0 d	0.0 b
Subdue MAXX 22%ME (1 fl oz) + Adorn 4SC (1 fl oz)	drench	0.0 d	0.0 b
Adorn 4SC (1 fl oz)+ Capsil (6 fl oz)	spray	0.0 d	0.0 b
Adorn 4SC (4 fl oz)+ Capsil (6 fl oz)	spray	0.0 d	0.0 b
Micora 23.3SC 8 fl oz	spray	12.5c	1.7 b
Orvego 525SC 14 fl oz	spray	0.0 d	0.0 b
Stature 4.18SC 12.25 fl oz	spray	0.0 d	0.0 b
Untreated uninoculated	-	0.0 d	0.0 b
Untreated inoculated	-	100.0 a	76.7 a

\* Not an IR-4 Experiment: Plant Disease Management Reports 7:OT020.

<sup>x</sup> Percentage of plants with sporulating leaves at 15 days post treatment. Column means with a letter in common are not significantly different (Fisher's Protected LSD  $P=0.05$ ).

<sup>y</sup> Percentage of leaves, per infected plant, with visible sporulation at 15 days post treatment.

In 2013, Warfield conducted three experiments to evaluate the efficacy of several fungicides applied as drench or foliar sprays on impatiens downy mildew. In the first experiment, Adorn and Subdue MAXX were compared when applied to plugs prior to transplant or after transplant into cell-packs. On Jan 4, fungicides were applied to the plants in each plug strip, except for a Subdue MAXX drench treatment applied directly after transplant. One day after treatment, plugs were transplanted into 4-cell pack, and plants inoculated 20 days after treatment. The drench applications of both Adorn and Subdue MAXX provided complete control of a severe disease pressure, while foliar sprays were ineffective (Table 22). Plants drenched with Subdue MAXX while in the plug tray were protected as equally long as drenching the larger cell-packs after transplant within the timeframe of the experiment. No phytotoxicity was observed for any treatment.

In a second experiment, phosphite fungicides (Vital and AGRI-FOS), were compared for residual efficacy when applied as foliar or drench applications on Jan 21, ten days prior to inoculation on Jan 31. Foliar applications of Dithane and Protect, and drench applications of Vital and AGRI-FOS (experimental rate only) provided complete control of a severe disease pressure, while AGRI-FOS drench at labeled rate was ineffective, and the efficacy of foliar sprays with both phosphites and Fenstop would be unacceptable for commercial production (Table 23). Phytotoxicity was not observed for any treatment, but plants treated with Dithane and Protect had some visible chemical residue.

In a third experiment, the residual efficacy of fungicides to impatiens growing in plug trays was evaluated. Treatments were applied as foliar spray or drench on Feb 5. One day after treatment, plugs were transplanted into 4-cell packs, and plants inoculated 21, 29, 35 or 42 days after treatment. Drench applications of Adorn, Subdue MAXX, or Adorn tank mixed with Subdue MAXX gave the longest residual efficacy against a severe disease pressure (Table 24). The Adorn and Subdue MAXX tank mix provided 35 days of complete protection in this experiment, exceeding that of either product applied

alone. Foliar applications of AGRI-FOS and Vital had the shortest residual efficacy (less than 21 days). Dithane and Protect significantly reduced the percentage of plants with visible sporulation and the number of sporulating leaves up to 21 days after treatment, but the level of control would not be sufficient in a commercial operation. No phytotoxicity was observed for any treatment, but both Dithane and Protect left a visible residue on the foliage.

**Table 22. \*Efficacy on Downy Mildew (*Plasmoparaobducens*) of Impatiens (*I. walleriana*) 'Super Elfin White', Warfield, IL, 2013, Test 1.**

Treatment and rate/100 gal applied once	Application method <sup>z</sup>	Disease incidence (% plants) <sup>x</sup>	Leaves with sporulation (%) <sup>y</sup>
Adorn SC 1 fl oz	plug tray drench	0.0 b	0.0 d
Adorn SC (2 fl oz) + Capsil (6 fl oz)	plug tray foliar spray	100.0 a	73.4 ab
Adorn SC )4 fl oz) + Capsil (6 fl oz)	plug tray foliar spray	93.8 a	60.3 b
Subdue MAXX 0.5 fl oz	plug tray drench	0.0 b	0.0 d
Subdue MAXX 0.5 fl oz	drench after transplant	0.0 b	0.0 d
Subdue MAXX 0.5 fl oz	plug tray foliar spray	93.8 a	27.1 c
Untreated uninoculated	-	0.0 b	0.0 d
Untreated inoculated	-	100.0 a	87.1 a

\* Not an IR-4 Experiment: Plant Disease Management Reports 7:OT022.

<sup>x</sup> Percentage of plants with sporulating leaves on Feb 4. Column means with a letter in common are not significantly different (Fisher's Protected LSD  $P=0.05$ ).

<sup>y</sup> Percentage of leaves, per infected plant, with visible sporulation on Feb 4.

<sup>z</sup> Fungicides were applied to seedlings growing in plug trays as either a soil drench (plug tray drench), foliar spray (plug tray foliar spray) or as a soil drench immediately after transplanting into cell-packs (drench after transplant) 20 days prior to inoculation.

**Table 23. \*Efficacy on Downy Mildew (*Plasmoparaobducens*) of Impatiens (*I. walleriana*) 'Super Elfin White', Warfield, IL, 2013, Test 2.**

Treatment and rate/100 gal applied once	Application method	Disease incidence (% plants) <sup>x</sup>	Leaves with sporulation (%) <sup>y</sup>
AGRI-FOS 44.5%SL 5 pt	spray	87.5 ab	9.0 c
AGRI-FOS 44.5%SL 0.13 pt = label rate	drench	100.0 a	58.6 a
AGRI-FOS 44.5%SL 1.57 pt = experimental rate	drench	0.0 c	0.0 d
FenStop 4.13SC (9 fl oz) + Capsil (6 fl oz)	spray	75.0 b	10.1 c
Dithane Rainshield 75DF 2 lb) + Capsil (6 fl oz)	spray	0.0 c	0.0 d
Protect 75DF (2 lb) + Capsil 6 fl oz)	spray	0.0 c	0.0 d
Vital 55%SL 4 pt	spray	100.0 a	20.5 b
Vital 55%SL 1.25 pt	drench	0.0 c	0.0 d
Untreated uninoculated	-	0.0 c	0.0 d
Untreated inoculated	-	100.0 a	84.5 a

\* Not an IR-4 Experiment: Plant Disease Management Reports 7:OT023.

<sup>x</sup> Percentage of plants with sporulating leaves on Feb 14. Column means with a letter in common are not significantly different (Fisher's Protected LSD  $P=0.05$ ).

<sup>y</sup> Percentage of leaves, per infected plant, with visible sporulation on Feb 14.

**Table 24. \*Efficacy on Downy Mildew (*Plasmoparaobducens*) of Impatiens (*I. walleriana*) 'Super Elfin White', Warfield, IL, 2013, Test 3.**

Treatment and rate/100 gal applied once	Application method <sup>z</sup>	Disease incidence (% plants) <sup>x</sup>	Leaves with sporulation (%) <sup>y</sup>
<b>Inoculated 21 days post treatment</b>			
Dithane 75 DF 2 lb +Capsil 6.0 fl oz	foliar spray	25.0 b	11.1 d
Protect DF 2 lb + Capsil 6.0 fl oz	foliar spray	37.5 b	4.5 d
AGRI-FOS 44.5%SL 5 pt	foliar spray	100.0 a	80.5 b
Vital 55%SL 5 pt	foliar spray	100.0 a	83.5 b
Adorn 4SC 1 fl oz	plug tray drench	25.0 b	30.7 c
Subdue MAXX 22%ME 0.5 fl oz	plug tray drench	0.0 c	0.0 d
Adorn 4SC (1 fl oz) + Subdue MAXX 22%ME (0.5 fl oz)	plug tray drench	0.0 c	0.0 d
Untreated uninoculated	-	0.0 c	0.0 d
Untreated inoculated	-	100.0 a	96.1 a
<b>Inoculated 29 days post treatment</b>			
Dithane 75 DF 2 lb +Capsil 6.0 fl oz	foliar spray	100.0 a	43.4 bc
Protect DF 2 lb + Capsil 6.0 fl oz	foliar spray	100.0 a	48.1 b
Adorn 4SC 1 fl oz	plug tray drench	68.8 b	31.3 c
Subdue MAXX 22%ME 0.5 fl oz	plug tray drench	18.8 c	1.5 d
Adorn 4SC (1 fl oz) + Subdue MAXX 22%ME (0.5 fl oz)	plug tray drench	0.0 c	0.0 d
Untreated uninoculated	-	0.0 c	0.0 d
Untreated inoculated	-	100.0 a	100.0 a
<b>Inoculated 35 days post treatment</b>			
Adorn 4SC 1 fl oz	plug tray drench	81.3 b	49.8 b
Subdue MAXX 22%ME 0.5 fl oz	plug tray drench	6.3 c	0.38 c
Adorn 4SC (1 fl oz) + Subdue MAXX 22%ME (0.5 fl oz)	plug tray drench	0.0 c	0.0 c
Untreated uninoculated	-	0.0 c	0.0 c
Untreated inoculated	-	100.0 a	100.0 a
<b>Inoculated 42 days post treatment</b>			
Subdue MAXX 22%ME 0.5 fl oz	plug tray drench	81.3 a	13.0 b
Adorn 4SC (1 fl oz) + Subdue MAXX 22%ME (0.5 fl oz)	plug tray drench	50.0 b	4.5 bc
Untreated uninoculated	-	0.0 c	0.0 c
Untreated inoculated	-	100.0 a	100.0 a

\* Not an IR-4 Experiment: Plant Disease Management Reports 7:OT024.

<sup>x</sup> Percentage of plants with sporulating leaves on Mar 11, Mar 19, Mar 28 and Apr 4. Column means with a letter in common are not significantly different (Fisher's Protected LSD  $P=0.05$ ).

<sup>y</sup> Percentage of leaves, per infected plant, with visible sporulation on Mar 11, Mar 19, Mar 28 and Apr 4.

<sup>z</sup> Fungicides were applied to seedlings grown in plug trays as either a soil drench (plug tray drench) or foliar spray application (foliar spray) 21, 29, 35 or 42 days prior to inoculation.

In 2012, Hausbeck and Harlan conducted 2 experiments to evaluate fungicides on impatiens downy mildew. In the first experiment in 2012, treatments were applied as a drench or foliar spray on May 14 and allowed to dry, then plants inoculated. Adorn, Subdue MAXX, and Plenitrix, all applied as drenches, provided complete control of a severe disease pressure (Table 25). Micora SL (4 fl oz rate) was the only spray treatment to prevent infection during the experiment. Disarm and Heritage + Capsil, both applied as

foliar sprays, resulted in disease levels unacceptable to growers. No phytotoxicity was observed for any treatment.

In the second experiment in 2012, all treatments were applied as a drench on Apr 23, and plants inoculated on Apr 24. Alude, Vital and Subdue MAXX provided complete control of a severe disease pressure, while Heritage, which is not labeled as a drench application, was ineffective (Table 26). No phytotoxicity was observed for any treatment.

**Table 25. \*Efficacy on Downy Mildew (*Plasmoparaobducens*) of Impatiens (*I. walleriana*) 'Dazzler Pink', Hausbeck and Harlan, MI, 2012, Test 1.**

Treatment and rate/100 gal applied once	Application Method	Leaves with sporulation <sup>x</sup>		Leaf area with sporulation (%) <sup>x</sup>
		Number	Percentage	
Adorn SC 2 fl oz	drench	0.0 a	0.0 a	0.0 a
Disarm O SC 4 fl oz	foliar spray	2.5 a	4.3 a	24.2 a
Heritage 50WG 4 oz + Capsil 4 fl oz	foliar spray	2.3 a	3.7 a	25.8 a
Micora SL 4 fl oz	foliar spray	0.0 a	0.0 a	0.0 a
Micora SL 8 fl oz	foliar spray	0.3 a	0.7 a	2.5 a
Plentrix SC 1.3 fl oz	drench	0.0 a	0.0 a	0.0 a
Subdue MAXX EC 1 fl oz	drench	0.0 a	0.0 a	0.0 a
Untreated inoculated	-	20.3 b	44.3 b	86.7 b

\* Not an IR-4 Experiment: Plant Disease Management Reports 7:OT031.

<sup>x</sup> Based on a visual estimation of the percentage of total leaf area with sporulation per plant on Jun 18. Column means with a letter in common are not significantly different (Student-Newman-Keuls;  $P=0.05$ ).

**Table 26. \*Efficacy on Downy Mildew (*Plasmoparaobducens*) of Impatiens (*I. walleriana*) 'Dazzler Pink', Hausbeck and Harlan, MI, 2012, Test 2.**

Treatment and rate/100 gal applied once	Leaves with sporulation			
	Number Per Plant		Percentage of leaf tissue	
	5/7	5/15	5/7	5/15
Alude L 2.5 qt	0.0 a	0.0 a	0.0 a	0.0 a
Heritage 50WG 0.9 oz	5.2 a	29.7 b	6.2 a	32.7 b
Subdue MAXX EC 1 fl oz	0.0 a	0.0 a	0.0 a	0.0 a
Vital 1.25 pt	0.0 a	0.0 a	0.0 a	0.0 a
Vital 1.25 pt + Subdue MAXX EC 1 fl oz	0.0 a	0.0 a	0.0 a	0.0 a
Vital 1.25 pt + Heritage 50WG 0.9 oz	0.2 a	0.0 a	0.2 a	0.0 a
Untreated inoculated	17.0 b	23.7 b	23.5 b	37.9 b

\* Not an IR-4 Experiment: Plant Disease Management Reports 7:OT032.

<sup>x</sup> Column means with a letter in common are not significantly different (t Test (LSD);  $P=0.05$ ).

In 2013, Hausbeck and Harlan conducted 4 experiments to evaluate fungicides on impatiens downy mildew. In the first experiment on 2013, treatments were applied as a drench or foliar spray on Jul 1. Subsequent applications were applied only to the Orvego SC treatments on the day of transplanting into a landscape bed on Jul 11. The drench applications of Alude + Subdue MAXX and the standard Adorn + Subdue MAXX were the only treatments that provided good control of a severe disease pressure (Table 27). The biopesticide Alude applied drench, and spray applications of Orvego and Adorn + Protect provided poor control. Minor phytotoxicity (leaf chlorosis and distortion) was observed on plants drenched with Adorn + Subdue MAXX.



In the second experiment, treatments were applied as a drench or foliar spray on Nov 11, plants allowed to dry, then inoculated. All treatments provided complete control of a severe disease pressure (Table 28). No phytotoxicity was observed for any treatment.

In the third experiment, treatments were applied as a drench or foliar spray on Jun 23 or 24, and reapplied as shown in Table 29. Plants were inoculated on Jun 25. Drench applications of Adorn + Subdue MAXX, Subdue MAXX + Alude, and the foliar application of Adorn + Protect DF were the only treatments that provided complete control of a severe disease pressure. Alude, OxiPhos and ZeroTol were ineffective. Minor leaf distortion and stunting were observed on the plants drenched with Adorn + Subdue MAXX.

In the fourth experiment, treatments were applied as a drench or foliar spray on Sep 18, and plants inoculated on Sep 19. Spray applications of Acibenzolar + Heritage were the only treatments that provided complete control of a severe disease pressure (Table 30). The biopesticide Regalia and F9110 at the highest rate also provided effective control. No phytotoxicity was observed for any treatment.

**Table 27. \*Efficacy on Downy Mildew (*Plasmopara obducens*) of Impatiens (*I. walleriana*) 'Accent Premium Red', Hausbeck and Harlan, MI, 2013, Test 1.**

Treatment, rate/100 gal and application method	No. of Applic <sup>z</sup>	Leaves with sporulation <sup>x</sup>			Disease Severity <sup>y</sup>
		8/12	8/21	8/27	
Adorn SC 1 fl oz + Subdue MAXX EC 1 fl oz <i>Drench</i>	1	0.0 a	0.0 a	0.0 a	2.2 a
Adorn SC 2 fl oz + Protect DF 2 lb + Capsil 6 fl oz <i>Spray</i>	1	0.0 a	2.9 a	27.6 b	7.0 b
Alude 12.75 fl oz <i>Drench</i>	1	0.0 a	4.6 a	27.3 b	7.8 b
Alude 12.75 fl oz + Subdue MAXX EC 1 fl oz <i>Drench</i>	1	0.0 a	0.0 a	1.7 a	3.3 a
Orvego SC 14 fl oz <i>Spray</i>	2	1.1 a	24.0 b	60.2 c	9.8 c
Orvego SC 14 fl oz + Droplex 0.25 % v/v <i>Spray</i>	2	0.0 a	27.5 b	76.5 cd	9.5 c
Untreated control	-	1.0 a	57.9 c	99.4 d	10.0 c

\* Not an IR-4 Experiment: Plant Disease Management Reports 8:OT017.

<sup>x</sup> Column means with a letter in common are not significantly different (LSD;  $P=0.05$ ).

<sup>y</sup> Disease severity on 10/1 using rating scale of 1 to 10 where 1=healthy, 2=minor chlorosis, 3=moderate chlorosis, 4=severe chlorosis, 5=moderate stunting, 6=severe stunting, 7=minor defoliation, 8=moderate defoliation, 9=severe defoliation, 10=complete defoliation/plant death.;

<sup>z</sup>The first fungicide application was made 1 Jul in the greenhouse. The second fungicide application was made 11 Jul just prior to transplant into the landscape.

**Table 28. \*Efficacy on Downy Mildew (*Plasmoparaobducens*) of Impatiens (*I. walleriana*) 'Accent Premium White', Hausbeck and Harlan, MI, 2013, Test 2.**

Treatment and rate/100 gal applied once	Applic method	Leaves sporulating (%) <sup>x</sup>	Sporulation severity (%) <sup>y</sup>
Acibenzolar 50WDG 0.25 oz + Heritage 50WG 0.9 oz	spray	0.0 a	1.0 a
Segway SC 3.5 fl oz	spray	0.0 a	1.0 a
Subdue MAXX 1 fl oz + Alude 12.75 fl oz	drench	0.0 a	1.0 a
Syngenta Experimental 9.6 fl oz	spray	0.0 a	1.0 a
Syngenta Experimental 9.6 fl oz	drench	0.0 a	1.0 a
V-10208 SC 4 fl oz	spray	0.0 a	1.0 a
V-10208 SC 4 fl oz	drench	0.0 a	1.0 a
Untreated control	-	53.1 b	8.5 b

\* Not an IR-4 Experiment: Plant Disease Management Reports 8:OT018.

<sup>x</sup> Observed on 11/25. Column means with a letter in common are not significantly different (LSD;  $P=0.05$ ).

<sup>y</sup> Sporulation severity on 11/25 using rating scale of 1 to 10 where 1=no sporulation, 2=1-5% leaf area sporulating with pathogen, 3=6-10% sporulating, 4=11-20% sporulating, 5=21-30% sporulating, 6=31-40% sporulating, 7=41-50% sporulating, 8=51-60% sporulating, 9=61-70%, 10=>71% leaf area sporulating.

**Table 29. \*Efficacy on Downy Mildew (*Plasmoparaobducens*) of Impatiens (*I. walleriana*) 'Accent Premium White', Hausbeck and Harlan, MI, 2013, Test 3.**

Treatment, rate/100 gal and application method	Applic schedule <sup>z</sup>	Leaves w/ sporulation (%) <sup>x</sup>	Leaf area w/ sporulation (%) <sup>y</sup>	Plants w/ sporulation (%)
Alude 12.75 fl oz Drench	1 dpi, 14 dai	5.4 ab	41.7 b	66.7 bc
Adorn SC 1 fl oz + Subdue MAXX EC 1 fl oz Drench	1 dpi	0.0 a	0.0 a	0.0 a
Adorn SC 1 fl oz + Protect DF 2 lb + Capsil 6 fl oz Spray	1 dpi, 14 dai	0.0 a	0.0 a	0.0 a
OxiPhos 50 fl oz Drench OxiPhos 102 fl oz Spray	2 dpi 0.5 dpi, 7 dai	3.1 b	36.7 b	66.7 bc
OxiPhos 50 fl oz Drench ZeroTol 2.0 42.6 fl oz + Capsil 6 fl oz Spray	2 dpi 0.5, 3, 7, 14 dai	5.8 ab	14.2 ab	50.0 b
Subdue MAXX EC 1 fl oz + Alude 12.75 fl oz Drench	1 dpi	0.0 a	0.0 a	0.0 a
ZeroTol 2.0 128 fl oz + Capsil 8 fl oz Spray	1 dpi; 0.5, 3, 7, 14 dai	11.2 b	33.3 b	50.0 b
Untreated control	-	10.3 b	73.3 c	100.0

\* Not an IR-4 Experiment: Plant Disease Management Reports 8:OT019.

<sup>x</sup> Observed on 7/15. Column means with a letter in common are not significantly different (Student-Newman-Keuls;  $P=0.05$ ).

<sup>y</sup> Based on a visual estimate of leaf area with sporulation on 7/15.

<sup>z</sup> dpi=days prior to inoculation; dai=days after inoculation.

**Table 30. \*Efficacy on Downy Mildew (*Plasmoparaobducens*) of Impatiens (*I. walleriana*) 'Accent Premium Red', Hausbeck and Harlan, MI, 2013, Test 4.**

Treatment and rate/100 gal applied once	Applic method	Leaves w/ sporulation (%) <sup>x</sup>	Leaf area w/ sporulation (%) <sup>y</sup>	Plants w/ sporulation (%)
Acibenzolar WDG 0.25 oz + Heritage WDG 0.9 oz	Drench	12.2 a	60.0 bc	100.0 c
Acibenzolar WDG 0.125 oz + Heritage WDG 0.5 oz	Drench	18.7 ab	70.0 c	100.0 c
Acibenzolar WDG 0.25 oz + Heritage WDG 0.9 oz	Spray	0.0 a	0.0 a	0.0 a
Acibenzolar WDG 0.125 oz + Heritage WDG 0.5 oz	Spray	0.0 a	0.0 a	0.0 a
F9110 18 fl oz + Capsil 1 fl oz	Spray	7.0 a	40.0 abc	60.0 abc
F9110 30 fl oz + Capsil 1 fl oz	Spray	6.4 a	62.0 bc	100.0 c
F9110 45 fl oz + Capsil 1 fl oz	Spray	1.5 a	8.0 a	20.0 ab
Regalia 4 qt	Spray	0.4 a	34.0 abc	40.0 abc
Subdue MAXX EC 1 fl oz	Drench	4.1 a	16.0 ab	40.0 abc
Untreated control	-	37.0 b	61.0 bc	80.0 bc

\* Not an IR-4 Experiment: Plant Disease Management Reports 8:OT020.

<sup>x</sup> Observed on 10/11. Column means with a letter in common are not significantly different (Student-Newman-Keuls;  $P=0.05$ ).

<sup>y</sup> Based on a visual estimate of leaf area with sporulation on 10/11.

In 2014, Hausbeck and Harlan conducted 4 experiments to evaluate fungicides on downy mildew of impatiens caused by *Plasmopara obducens*. Fungicides were applied as a drench or foliar spray on Aug 14, and plants inoculated on the same day. All treatments provided complete control of a moderate disease pressure (Table 31). No phytotoxicity was observed for any treatment.

**Table 31. \*Efficacy on Downy Mildew (*Plasmoparaobducens*) of Impatiens (*I. walleriana*) 'Accent Premium White', Hausbeck and Harlan, MI, 2014.**

Treatment and rate/100 gal applied once	Application method	Leaves sporulating (%) <sup>x</sup>	Sporulation severity (%) <sup>y</sup>	Plants with sporulation (%)
Adorn SC 1 fl oz	Drench	0.0 a	1.0 a	0.0 a
BAS 70301F 7 fl oz	Spray	0.0 a	1.0 a	0.0 a
BAS 70301F 10 fl oz	Spray	0.0 a	1.0 a	0.0 a
BAS 70301F 13 fl oz	Spray	0.0 a	1.0 a	0.0 a
Pageant WG 18 oz	Spray	0.0 a	1.0 a	0.0 a
Segway SC 3.5 fl oz	Spray	0.0 a	1.0 a	0.0 a
Subdue MAXX 1 fl oz	Drench	0.0 a	1.0 a	0.0 a
Untreated inoculated	-	11.5 b	3.0 b	66.7 a

\* Not an IR-4 Experiment: Plant Disease Management Reports 9:OT015.

<sup>x</sup> Observed on Aug 22. Column means with a letter in common are not significantly different (LSD;  $P=0.05$ ).

<sup>y</sup> Sporulation severity on a scale of 1 to 5 on Aug 22; 1= no sporulation, 2=minor sporulation, 3=moderate sporulation, 4=severe sporulation, 5=defoliation.

In 2012 and 2014, Palmateer studied the efficacy of several new products on impatiens downy mildew. In 2012, fungicides were applied to visibly disease-free plants on a 14-day schedule beginning Feb 10 for a total of three applications. Plants were inoculated 24 hr post treatment on Feb 11. All products significantly reduced a severe disease pressure compared to both uninoculated and inoculated checks (Table 32).

Generally, Stature, Orvego and Pageant provided better control than Heritage. No phytotoxicity was observed from any treatment.

In 2014, all products were applied to visibly disease-free plants as foliar sprays on Nov 12 and 19 before transplanting on Nov 22, and then received two additional 28-day sprays on Dec 17 and Jan 14. Plants were inoculated 48 hr post treatment. All products significantly reduced a severe disease pressure compared to both uninoculated and inoculated checks, with Adorn at the higher rate + Daconil or Pageant providing the best control (Table 33). No phytotoxicity was observed for any treatment.

**Table 32. \*Efficacy on Downy Mildew (*Plasmoparaobducens*) of Impatiens (*I. walleriana*) 'Super Elfin White', Palmateer, FL, 2012.**

Treatment and rate/100 gal	Application method	Disease incidence <sup>x</sup>	Disease severity (%) <sup>y</sup>	AUDPC <sup>w</sup>
Heritage 50WG 4 oz	Spray	20.0 c	54 c	626 c
Heritage 50WG 4 oz	Air blast	11.0 de	36 c	426 d
Orvego 525SC (BASF 651) 11 fl oz	Spray	16.0 cd	35 c	123 fg
Orvego 525SC (BASF 651) 14 fl oz	Spray	3.3 fg	9 gh	35 g
Orvego 525 SC (BASF 651) 11 fl oz	Air blast	20.0 c	39 c	141 efg
Orvego 525 SC (BASF 651) 14 fl oz	Air blast	8.2 ef	21 ef	84 fg
Pageant 38WG 12 oz	Spray	6.2 efg	19 efg	132 fg
Pageant 38WG 12 oz	Air blast	8.7 ef	24 de	270 e
Stature 4.18SC 6.12 fl oz	Spray	8.3 ef	8 gh	206 ef
Stature 4.18SC 12.25 fl oz	Spray	3.7 fg	13 fgh	91 fg
Stature 4.18SC 6.12 fl oz	Air blast	5.6 efg	13 fgh	62 g
Stature 4.18SC 12.25 fl oz	Air blast	1.3 g	4 h	26 g
Untreated uninoculated	-	55.0 b	100 a	1067 b
Untreated inoculated	-	65.0 a	100 a	1617 a

\* Not an IR-4 Experiment: Plant Disease Management Reports 6:OT035.

<sup>x</sup> Average number of leaves with sporulation. Column means with a letter in common are not significantly different (Student Newman-Keuls test  $P=0.05$ ).

<sup>y</sup> Percent canopy area affected.

<sup>w</sup> Area Under the Disease Progress Curve was calculated from weekly disease severity ratings from Feb 10 to Mar 9.

**Table 33. \*Efficacy on Downy Mildew (*Plasmoparaobducens*) of Impatiens (*I. walleriana*) 'Super Elfin White', Palmateer, FL, 2014.**

Treatment and rate/100 gal	Disease severity (%) <sup>x</sup>	AUDPC <sup>y</sup>
Adorn 4SC 2 fl oz	46 d	2752 c
Adorn 4SC 1 fl oz + Daconil Ultrex 82.5WG 2.0 lb	57 c	3293 b
Adorn 4SC 2 fl oz + Daconil Ultrex 82.5WG 2.0 lb	38 f	2240 d
Adorn 4SC 1 fl oz + Pageant Intrinsic 38WG 12 oz	44 de	2676 cd
Adorn 4SC 2 fl oz + Pageant Intrinsic 38WG 12 oz	41 ef	2485 cd
Untreated uninoculated	94 b	5275 a
Untreated inoculated	94 b	5271 a

\* Not an IR-4 Experiment: Plant Disease Management Reports 9:OT011.

<sup>x</sup> Percent canopy area affected as an average across all rating dates. Column means with a letter in common are not significantly different (Tukey's HSD  $P=0.05$ ).

<sup>y</sup> Area Under the Disease Progress Curve was calculated from weekly disease severity ratings until the conclusion of the experiment on Feb 24.

From 2013 to 2016, Freiburger conducted five experiments testing the efficacy of several new products on impatiens downy mildew. In 2013, fungicides were applied as drench or foliar spray to three impatiens cultivars from Jul 17 to Aug 21 and reapplied as shown in Table 34. Drench applications of Adorn and Subdue MAXX provided virtually complete control of a severe disease pressure, while the weekly spray applications of A14658C and Alude provided good control.

In 2014, fungicides were applied as drench or foliar spray to three impatiens cultivars from Aug 4 to Sep 2 and reapplied as shown in Table 35 and Table 36. A14658C, reduced disease development fairly well across all three cultivars, while SYN546539 completely prevented any development of disease, and plants from both treatments had high quality. Alude and all the Alude combination treatments reduced disease and resulted in very high quality ratings. Subdue MAXX drenches initially performed well, but low disease levels started to occur 8/26/2014 and continued to build throughout the experiment. Adorn, the best treatment in a 2013 experiment, and the SP2770 WP treatments were not statistically different from the Untreated (water sprays).

In 2015, fungicides were applied as drench or foliar spray to two impatiens cultivars from Jul 28 to Aug 18 and reapplied as shown in Table 37 and Table 38. SYN546539 was the only treatment that provided almost complete control of a severe disease pressure in both cultivars, with plants of high quality until 9/22/15. Alude drench, and foliar applications of A14658C and BAS 703 initially performed well but could not significantly reduce disease levels towards the end of the experiment.

In 2016, fungicides were evaluated applied as drench or foliar spray to three impatiens cultivars from Jul 19 to Aug 17 in two experiments, and reapplied as shown in Table 39 through Table 42. In the first experiment, Segovis drench was the best treatment, providing virtually complete control of a severe disease pressure, resulting in high quality plants. Alude drench also provided excellent control, while Inosco spray was less effective. Segovis rotated with Inosco and Alude rotated with Orkestra also provided excellent control. In the second experiment, Alude rotated with Stature + Pageant was the only treatment providing control of a severe disease pressure. In both experiments, Adorn and Subdue MAXX applied as drench were ineffective.

**Table 34. \*Efficacy on Downy Mildew (*Plasmoparaobducens*) of Impatiens(*I. walleriana*), Freiberger, NJ, 2013.**

Cultivar	Treatment and rate/100 gal	Application method and interval	Sporulation <sup>x</sup>	
			7/30/2013	8/8/2013
Dazzler Punch	A14658C 4pt	Spray weekly	1.0 ab	1.3 abc
	A14658C 8pt	Spray biweekly	1.0 ab	1.8 abc
	Adorn 4floz	Drench monthly	0.0 a	0.2 a
	Alude 1.25qt	Spray weekly	0.8 ab	2.1 abc
	Alude 2.5qt	Spray biweekly	1.9 abc	3.0 bcd
	Subdue MAXX 2floz	Drench monthly	0.0 a	0.0 a
	Untreated	-	2.5 bcd	5.0 d
Accent Rose	A14658C 4 pt	Spray weekly	0.1 a	0.6 a
	A14658C 8 pt	Spray biweekly	0.5 ab	0.8 ab
	Adorn 4 fl oz	Drench monthly	0.0 a	0.3 a
	Alude 1.25 qt	Spray weekly	0.4 a	1.4 abc
	Alude 2.5 qt	Spray biweekly	0.6 ab	1.4 abc
	Subdue MAXX 2 fl oz	Drench monthly	0.0 a	0.0 a
	Untreated	-	3.2 cd	5.0 d
Accent White	A14658C 4 pt	Spray weekly	0.8 ab	1.7 abc
	A14658C 8 pt	Spray biweekly	1.1 ab	1.2 ab
	Adorn 4 fl oz	Drench monthly	0.1 a	0.0 a
	Alude 1.25 qt	Spray weekly	0.9 ab	2.0 abc
	Alude 2.5 qt	Spray biweekly	1.9 abc	3.6 cd
	Subdue MAXX 2 fl oz	Drench monthly	0.0 a	0.0 abc
	Untreated	-	4.0 d	5.0 d

<sup>x</sup> Sporulation severity on a scale of 0 to 5 where 0 = 0 observed sporulation, 1 = 1 to 20%, 2 = 21 to 40%, 3 = 41 to 60 %, 4 = 61 to 80%, 5 = greater than 80% sporulation. Column means with a letter in common are not significantly different (LSD;  $P=0.05$ ).

**Table 35. Disease Severity of Downy Mildew (*Plasmoparaobducens*) of Impatiens (*I. walleriana*), Freiberger, NJ, 2014.**

Cultivar	Treatment and rate/100 gal	Application method and interval	Sporulation (0 to 5 with 5 = 100% sporulation on under leaf surface) <sup>x</sup>					
			8/20/2014	8/26/2014	9/3/2014	9/17/2014	9/24/2014	10/5/2014
Ruby	A14658C 8 pt	Spray 14 d	0.0 a	0.2 a	0.0 a	0.2 a	0.7 a	2.2 bcd
	Adorn 3 fl oz	Drench 28 d	1.5 abc	3.9 cd	4.5 d	5.0 f	5.0 c	5.0 ef
	Alude + Adorn	Drench 28 d	0.0 a	0.0 a	0.1 a	0.0 a	0.2 a	0.5 ab
	Alude + SYN 546539	Drench 28 d	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
	Alude + Subdue	Drench 28 d	0.0 a	0.0 a	0.0 a	0.0 a	0.1 a	0.1 a
	Alude 2.5 qt	Drench 28 d	0.0 a	0.1 a	0.0 a	0.1 a	0.2 a	0.3 ab
	Alude 2.5 qt	Spray 14 d	0.1 a	0.6 a	0.2 a	2.0 bc	3.5 c	3.8 def
	SP2770 2.66 lb	Spray 14 d	2.3 ab	3.8 cd	4.8 d	5.0 f	5.0 c	na
	SP2770 2.66 lb	Spray 7 d	1.0 ab	2.8 bd	3.8 cd	5.0 f	5.0 c	na
	Subdue MAXX 2 fl oz	Drench 28 d	0.0 a	0.9 ab	1.4 ab	3.2 cde	5.0 c	4.5 f
	SYN 546539 3.2 fl oz	Drench 28 d	0.0 ab	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
Untreated	-	3.4 bc	4.9 d	5.0 d	5.0 f	5.0 c	na	
Impreza White	A14658C 8 pt	Spray 14 d	0.0 a	0.0 a	0.0 a	0.4 a	1.2 ab	3.3 def
	Adorn 3 fl oz	Drench 28 d	2.7 abc	4.9 d	5.0 d	5.0 f	5.0 c	na
	Alude + Adorn	Drench 28 d	0.0 a	0.0 a	0.0 a	0.2 a	0.3 a	0.6 ab
	Alude + SYN 546539	Drench 28 d	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
	Alude + Subdue	Drench 28 d	0.0 a	0.0 a	0.0 a	0.0 a	0.1 a	0.1 a
	Alude 2.5 qt	Drench 28 d	0.0 a	0.1 a	0.1 a	0.0 a	0.1 a	0.6 ab
	Alude 2.5 qt	Spray 14 d	0.1 a	0.4 a	1.3 ab	2.5 cd	3.8 c	4.5 f
	SP2770 2.66 lb	Spray 14 d	1.4 abc	4.0 cd	4.8 d	5.0 f	5.0 c	5.0 b-f
	SP2770 2.66 lb	Spray 7 d	2.1 abc	4.7 cd	5.0 d	5.0 f	5.0 c	5.0 b-f
	Subdue MAXX 2 fl oz	Drench 28 d	0.0 a	1.5 ab	2.4 bc	4.1 def	5.0 c	4.1 def
	SYN 546539 3.2 fl oz	Drench 28 d	0.3 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
Untreated	-	4.3 c	5.0 d	4.9 d	5.0 ef	5.0 c	na	
White XP	A14658C 8 pt	Spray 14 d	0.0 a	0.1 a	0.0 a	0.4 ab	0.9 ab	2.5 cde
	Adorn 3 fl oz	Drench 28 d	2.5 abc	4.8 cd	4.8 d	5.0 c-f	na	na
	Alude + Adorn	Drench 28 d	0.0 a	0.0 a	0.0 a	0.3 a	0.5 a	0.8 abc
	Alude + SYN 546539	Drench 28 d	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
	Alude + Subdue	Drench 28 d	0.0 a	0.0 a	0.0 a	0.1 a	0.2 a	0.4 ab
	Alude 2.5 qt	Drench 28 d	0.0 a	0.0 a	0.0 a	0.2 a	0.2 a	0.7 abc
	Alude 2.5 qt	Spray 14 d	0.1 a	0.2 a	0.6 a	2.7 cd	4.4 c	4.8 f
	SP2770 2.66 lb	Spray 14 d	2.5 abc	4.4 cd	5.0 d	5.0 ef	na	na

	SP2770 2.66 lb	Spray 7 d	2.1 abc	4.7 cd	5.0 d	5.0 ef	5.0 bc	na
	Subdue MAXX 2 fl oz	Drench 28 d	0.3 a	1.4 ab	2.8 bc	4.8 f	5.0 c	5.0 b-f
	SYN 546539 3.2 fl oz	Drench 28 d	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
	Untreated	-	4.1 c	5.0 d	5.0 d	5.0 cdef	na	na

<sup>x</sup> Sporulation severity on a scale of 0 to 5 where 0 = 0 observed sporulation, 1 = 1 to 20%, 2 = 21 to 40%, 3 = 41 to 60 %, 4 = 61 to 80%, 5 = greater than 80% sporulation. Column means with a letter in common are not significantly different (LSD;  $P=0.05$ ).

na = no plants available for rating sporulation because plants had completely succumbed to disease.



**Table 36. Quality of Plants with Downy Mildew (*Plasmoparaobducens*) of Impatiens (*I. walleriana*), Freiberger, NJ, 2014.**

Cultivar	Treatment and rate/100 gal	Application method and interval	Quality (0 to 5 with 5 = full lush plant with no visible decline) <sup>x</sup>					
			8/20/2014	8/26/2014	9/3/2014	9/17/2014	9/24/2014	10/5/2014
Ruby	A14658C 8 pt	Spray 14 d	5.0 b	5.0 d	5.0 f	5.0 h	4.9 f	4.2 abc
	Adorn 3 fl oz	Drench 28 d	4.9 ab	4.3 bcd	3.4 bcd	1.6 bcd	1.0 bc	0.3 a
	Alude + Adorn	Drench 28 d	5.0 b	5.0 d	5.0 f	5.0 h	5.0 f	5.0 c
	Alude + SYN 546539	Drench 28 d	5.0 b	5.0 d	5.0 f	5.0 h	5.0 f	5.0 c
	Alude + Subdue	Drench 28 d	5.0 b	5.0 d	5.0 f	5.0 h	5.0 f	5.0 c
	Alude 2.5 qt	Drench 28 d	5.0 b	5.0 d	5.0 f	5.0 h	5.0 f	5.0 c
	Alude 2.5 qt	Spray 14 d	5.0 b	5.0 d	5.0 f	5.0 h	4.0 e	2.0 a
	SP2770 2.66 lb	Spray 14 d	4.9 ab	4.1 a-d	3.5 b-e	1.4 bcd	1.0 bc	0.9 a
	SP2770 2.66 lb	Spray 7 d	4.9 b	4.5 cd	3.9 c-f	2.2 cde	1.3 bc	0.0 a
	Subdue MAXX 2 fl oz	Drench 28 d	5.0 b	5.0 d	4.9 ef	3.8 fg	2.8 d	1.1 a
	SYN 546539 3.2 fl oz	Drench 28 d	5.0 b	5.0 d	5.0 f	5.0 h	5.0 f	5.0 c
	Untreated	-	4.3 ab	3.3 ab	2.2 ab	0.8 ab	0.6 ab	0.0 a
Impreza White	A14658C 8 pt	Spray 14 d	5.0 b	5.0 d	5.0 f	5.0 h	5.0 f	3.2 ab
	Adorn 3 fl oz	Drench 28 d	4.9 ab	4.1 a-d	2.7 ab	1.2 abc	0.8 ab	0.0 a
	Alude + Adorn	Drench 28 d	5.0 b	5.0 d	5.0 f	5.0 h	5.0 f	4.9 bc
	Alude + SYN 546539	Drench 28 d	5.0 b	5.0 d	5.0 f	5.0 h	5.0 f	5.0 c
	Alude + Subdue	Drench 28 d	5.0 b	5.0 d	5.0 f	5.0 h	5.0 f	4.9 bc
	Alude 2.5 qt	Drench 28 d	5.0 b	5.0 d	5.0 f	5.0 h	5.0 f	4.9 bc
	Alude 2.5 qt	Spray 14 d	5.0 b	5.0 d	5.0 f	4.6 gh	3.9 e	1.5 a
	SP2770 2.66 lb	Spray 14 d	4.8 ab	4.3 bcd	3.7 c-f	1.1 ab	1.0 bc	0.1 a
	SP2770 2.66 lb	Spray 7 d	5.0 b	4.6 cd	3.5 b-f	1.2 abc	0.6 ab	0.3 a
	Subdue Maxx 2 fl oz	Drench 28 d	5.0 b	5.0 d	4.9 ef	3.3 ef	2.6 d	1.1 a
	SYN 546539 3.2 fl oz	Drench 28 d	5.0 b	5.0 d	5.0 f	5.0 h	5.0 f	5.0 c
	Untreated	-	4.3 a	3.0 a	1.6 a	0.8 ab	0.6 ab	na
White XP	A14658C 8 pt	Spray 14 d	5.0 b	5.0 d	5.0 f	5.0 h	5.0 f	4.1 abc
	Adorn 3 fl oz	Drench 28 d	4.8 ab	4.3 bcd	3.4 bcd	0.2 a	0.0 a	na
	Alude + Adorn	Drench 28 d	5.0 b	5.0 d	5.0 f	5.0 h	5.0 f	5.0 c
	Alude + SYN 546539	Drench 28 d	5.0 b	5.0 d	5.0 f	5.0 h	5.0 f	5.0 c
	Alude + Subdue	Drench 28 d	5.0 b	5.0 d	5.0 f	5.0 h	5.0 f	5.0 c
	Alude 2.5 qt	Drench 28 d	5.0 b	5.0 d	5.0 f	5.0 h	5.0 f	4.9 bc
	Alude 2.5 qt	Spray 14 d	5.0 b	5.0 d	5.0 f	4.6 gh	4.1 e	1.2 a
	SP2770 2.66 lb	Spray 14 d	4.9 ab	4.4 bcd	3.8 c-f	0.7 ab	0.0 a	0.0 a

	SP2770 2.66 lb	Spray 7 d	5.0 b	4.4 bcd	3.7 c-f	0.6 ab	0.1 a	0.0 a
	Subdue MAXX 2 fl oz	Drench 28 d	5.0 b	5.0 d	4.8 def	2.5 de	1.6 c	0.1 a
	SYN 546539 3.2 fl oz	Drench 28 d	5.0 b	5.0 d	5.0 f	5.0 h	5.0 f	5.0 c
	Untreated	-	4.7 ab	3.6 abc	2.1 ab	0.1 a	0.0 ab	na

<sup>x</sup> Plant quality rated on a scale of 0 to 5 where 0 = completely defoliated, 5 = full lush plant with no visible decline. Column means with a letter in common are not significantly different (LSD;  $P=0.05$ ).

**Table 37. Disease Severity of Downy Mildew (*Plasmoparaobducens*) of Impatiens (*I. walleriana*), Freiberger, NJ, 2015.**

Cultivar	Treatment and rate/100 gal	Application method and interval	Sporulation <sup>x</sup>										
			7/28	8/6	8/12	8/18	8/25	9/1	9/8	9/15	9/22	10/6	10/13
<b>Accent Star Red</b>	A14658C 8 pt	Spray 14 d	0.7 a	0.6 a	3.2 bcd	1.8 bc	1.6 c-f	1.6 abc	2.1 ab	2.8 c	4.6 c	na	na
	Adorn 3 fl oz	Drench	1.3 a	1.8 ae	4.8 a	4.8 a	4.7 a	5.0 fg	3.9 cd	4.8 d	4.8 c	na	na
	Alude 2.5 qt	Drench	1.1 a	1.0 abc	2.4 b-e	2.2 b	1.5 def	2.1 bcd	2.0 ab	2.4 bc	3.2 b	na	na
	BAS 703 10 fl oz	Spray 7 d	0.7 a	0.6 a	2.7 b-e	2.5 b	1.8 cde	3.2 c-g	3.2 bcd	3.8 cd	4.4 bc	na	na
	Stature / Pageant 12.25 fl oz / 18 oz	Spray 7 d	1.1 a	1.3 a-d	4.1 a-d	3.8 a-d	3.0 bc	4.3 fg	4.7 d	4.9 d	4.9 c	na	na
	Subdue MAXX 2 fl oz	Drench	0.9 a	1.3 a-d	4.0 a-d	4.3 a	4.6 a	4.7 g	3.9 cd	4.7 d	4.6 c	na	na
	SYN 546539 3.2 fl oz	Drench	0.9 a	0.7 abc	1.7 ef	0.8 cd	0.7 ef	0.2 a	0.8 a	0.9 ab	0.3 a	na	na
	Untreated	-	1.8 a	2.0 a-e	4.9 a	4.9 a	4.4 a	5.0 efg	4.1 cd	4.6 d	4.6 c	na	na
<b>Xtreme Violet</b>	A14658C 8 pt	Spray 14 d	1.1 a	0.9 abc	2.7 b-e	1.9 bcd	1.6 c-f	1.1 ab	1.7 ab	2.4 bc	4.6 c	na	na
	Adorn 3 fl oz	Drench	1.4 a	3.1 e	4.8 a	4.6 a	4.7 a	0.0 ?	3.2 bcd	4.4 cd	4.5 bc	na	na
	Alude 2.5 qt	Drench	1.2 a	1.7 a-e	2.8 b-e	2.6 bcd	2.4 cd	2.4 b-e	2.8 bc	3.6 cd	4.1 bc	na	na
	BAS 703 10 fl oz	Spray 7 d	1.6 a	2.2 b-e	3.1 bcd	2.9 bcd	1.8 cde	2.8 b-f	3.2 bcd	4.0 cd	4.1 bc	na	na
	Stature / Pageant 12.25 fl oz / 18 oz	Spray 7 d	1.2 a	2.4 b-e	4.2 a-d	4.1 a-d	2.8 cd	3.6 d-g	4.4 d	5.0 d	5.0 c	na	na
	Subdue MAXX 2 fl oz	Drench	1.2 a	2.3 b-e	4.1 a-d	4.6 a	4.3 ab	4.6 efg	4.2 cd	4.2 cd	4.6 bc	na	na
	SYN 546539 3.2 fl oz	Drench	1.7 a	1.3 a-d	1.1 f	0.6 d	0.3 f	0.1 a	0.6 a	0.7 a	0.3 a	na	na
	Untreated	-	1.4 a	2.8 de	5.0 a	4.8 a	4.9 a	0.0 ?	3.2 bcd	5.0 cd	5.0 bc	na	na

<sup>x</sup> Plants were rated 0-5 based on sporulation on the underside of the leaves where 0 = no leaves and 5 = all leaves showing spores. Column means with a letter in common are not significantly different (LSD;  $P=0.05$ ).

na = no plants available for rating sporulation because plants had completely succumbed to disease.

**Table 38. Quality of Plants with Downy Mildew (*Plasmoparaobducens*) of Impatiens (*I. walleriana*), Freiberger, NJ, 2015.**

Cultivar	Treatment and rate/100 gal	Application method and interval	Quality <sup>x</sup>										
			7/28	8/6	8/12	8/18	8/25	9/1	9/8	9/15	9/22	10/6	10/13
<b>Accent Star Red</b>	A14658C 8 pt	Spray 14 d	5.0 a	5.0 a	4.4 ab	4.9 a	4.2 a-d	4.7 a	3.9 efg	3.3 ef	3.0 gh	1.7 b	1.0 c
	Adorn 3 fl oz	Drench	4.9 a	4.9 a	3.4 cde	2.9 c	1.8 efi	0.9 bc	2.0 bc	1.7 bc	1.6 b-e	0.6 b	0.9 dc
	Alude 2.5 qt	Drench	5.0 a	5.0 a	4.4 ab	4.6 ab	4.1 a-d	4.6 a	4.1 efg	3.8 fg	3.7 hi	3.7 a	4.2 a
	BAS 703 10 fl oz	Spray 7 d	5.0 a	5.0 a	3.6 a-e	4.9 a	4.3 ab	4.7 a	3.7 ef	3.2 ef	2.8 fgh	0.6 b	0.6 dc
	Stature / Pageant 12.25 fl oz / 18 oz	Spray 7 d	5.0 a	4.8 a	4.0 a-e	4.2 ab	3.2 c-h	3.8 ade	3.1 de	3.0 ef	2.5 efg	2.5 ab	2.1 c
	Subdue MAXX 2 fl oz	Drench	5.0 a	5.0 a	4.0 a-e	4.3 ab	2.8 ghi	2.6 bde	2.7 cd	2.0 cd	1.8 c-f	1.0 b	0.9 dc
	SYN 546539 3.2 fl oz	Drench	5.0 a	4.9 a	3.1 d	4.8 ab	4.6 ab	4.9 a	4.4 fg	4.6 gh	4.4 ij	0.9 b	0.8 dc
	Untreated	-	4.8 a	4.8 a	4.4 ab	2.7 c	1.4 ef	2.2 be	1.5 ab	1.0 ab	1.3 a-d	0.8 b	0.8 dc
<b>Xtreme Violet</b>	A14658C 8 pt	Spray 14 d	5.0 a	5.0 a	4.4 ab	4.8 ab	4.0 a-d	4.8 a	3.7 ef	2.8 de	2.2 d-g	1.5 b	0.5 dc
	Adorn 3 fl oz	Drench	5.0 a	5.0 a	3.2 cd	2.8 c	1.4 ef	0.0 c	0.8 a	0.3 a	0.9 abc	1.0 b	0.5 dc
	Alude 2.5 qt	Drench	5.0 a	4.9 a	4.5 a	4.6 ab	3.6 a-h	4.0 ad	3.4 def	2.7 de	1.9 c-f	4.3 a	4.6 a
	BAS 703 10 fl oz	Spray 7 d	5.0 a	4.7 a	4.1 a-e	4.4 ab	4.2 ab	4.7 a	4.0 efg	3.3 ef	2.8 fgh	1.3 b	0 d
	Stature / Pageant 12.25 fl oz / 18 oz	Spray 7 d	5.0 a	4.6 a	3.4 a-e	4.2 ab	3.1 cgh	3.9 a-d	3.1 de	2.9 ef	2.1 c-g	1.6 b	0.4 dc
	Subdue MAXX 2 fl oz	Drench	5.0 a	4.9 a	3.8 a-e	4.0 ab	2.3 fgi	1.3 bc	1.4 ab	0.6 a	0.7 ab	1.2 b	0.3 dc
	SYN 546539 3.2 fl oz	Drench	5.0 a	4.7 a	4.3 a-e	4.8 ab	4.7 b	5.0 a	4.9 g	5.0 h	4.9 j	1.2 b	0 d
	Untreated	-	5.0 a	5.0 a	3.2 cd	2.9 c	1.0 e	1.7 bc	0.5 a	0.2 a	0.3 a	0.8 b	0 d

<sup>x</sup> Plant quality rated on a scale of 0 to 5 where 0 = completely defoliated, 5 = perfectly healthy with no leaves affected. Column means with a letter in common are not significantly different (LSD;  $P=0.05$ ).

**Table 39. Disease Severity of Downy Mildew (*Plasmoparaobducens*) of Impatiens (*I. walleriana*), Freiberger, NJ, 2016a.**

Cultivar	Treatment and rate/100 gal	Application method <sup>z</sup> and interval	Sporulation <sup>x</sup>									AUDPC	AUDPC <sub>y</sub>
			7/19	7/26	8/1	8/8	8/16	8/23	8/30	9/6	9/13	9/13	9/13
Coral	Adorn 3 fl oz	Drench	0.3 b	3.1 a-d	4.8 a	4.9 a	3.4 a	5.0 a	5.0 a	na	na	22.3 b	36.4 ab
	Alude 2.5 qt	Drench	0.6 ab	0.4 e	0.7 ef	0.1 d	0.0 b	0.2 c	0.2 de	0.6 d	1.0 cd	3.7 ef	3.7 fg
	Alude/ Orkestra 2.5 qt / 10 fl oz	Drench Spray 8/2, 8/9	0.5 ab	0.3 e	0.7 ef	0.0 d	0.0 b	0.1 c	0.0 e	0.1 d	1.2 c	2.8 ef	2.8 fg
	Inosco 8 pt	Spray 7 d	0.5 ab	0.2 e	1.6 def	1.8 b	0.8 b	1.5 b	1.8 c	3.2 b	4.1 a	15.4 c	15.4 d
	Segovis 3.2 fl oz	Drench	0.2 b	0.0 e	0.2 f	0.0 d	0.0 b	0.0 c	0.0 e	0.0 d	0.0 d	0.4 f	0.4 g
	Segovis / Inosco 3.2 fl oz / 8 pt	Drench Spray 7/19, 8/2, 8/17	1.1 ab	0.0 e	0.2 f	0.0 d	0.0 b	0.1 c	0.0 e	0.1 d	0.0 d	1.4 ef	1.4 g
	Subdue MAXX 2 fl oz	Drench	1.1 ab	1.6 b-e	3.2 bc	4.8 a	3.8 a	4.9 a	3.8 b	4.6 a	5.0 a	30.2 a	33.0 bc
	Untreated	-	0.8 ab	4.1 a	5.0 a	5.0 a	3.5 a	5.0 a	na	na	na	24.0 b	39.0 a
Rose	Adorn 3 fl oz	Drench	0.6 ab	3.5 abc	4.6 ab	4.9 a	4.4 a	4.8 a	5.0 a	4.7 a	5.0 a	31.2 a	37.6 ab
	Alude 2.5 qt	Drench	0.6 ab	1.7 b-e	1.7 de	0.8 cd	0.0 b	0.3 c	0.3 de	0.6 d	1.2 c	7.2 cd	7.2 ef
	Alude / Orkestra 2.5 qt / 10 fl oz	Drench Spray 8/2, 8/9	0.5 ab	1.0 de	1.1 ef	0.3 cd	0.0 b	0.1 c	0.0 e	0.1 d	0.7 cd	3.7 ef	3.7 fg
	Inosco 8 pt	Spray 7 d	1.1 ab	1.4 cde	1.4 ef	1.2 bc	0.6 b	0.7 c	0.9 de	1.5 c	2.7 b	11.4 cd	11.4 de
	Segovis 3.2 fl oz	Drench	2.1 a	1.8 b-e	1.2 ef	0.1 d	0.0 b	0.4 c	0.3 de	0.1 d	0.0 d	5.9 def	5.9 efg
	Segovis/ Inosco 3.2 fl oz / 8 pt	Drench Spray 7/19, 8/2, 8/17	1.7 ab	1.7 b-e	1.3 ef	0.0 d	0.1 b	0.0 c	0.1 de	0.1 d	0.0 d	5.0 ef	5.0 fg
	Subdue MAXX 2 fl oz	Drench	0.6 ab	1.6 b-e	2.9 cd	4.9 a	4.2 a	4.4a	3.9 b	4.4 a	4.7 a	31.6 a	31.6 c
	Untreated	-	1.4 ab	3.7 ab	4.8 a	5.0 a	4.4 a	5.0 a	5.0 a	5.0 a	na	27.8 ab	39.5 a

<sup>x</sup> Plants were rated 0-5 based on sporulation on the underside of the leaves where 0 = no leaves and 5 = all leaves showing spores. Column means with a letter in common are not significantly different (Scheffe's post hoc at p = 0.05).

na = no plants available for rating sporulation because plants had completely succumbed to disease.

<sup>z</sup> Drench treatments applied on 7/19 and 8/16.

<sup>y</sup> Missing data (na) assigned 5 ratings.

**Table 40. Quality of Plants with Downy Mildew (*Plasmoparaobducens*) of Impatiens (*I. walleriana*), Freiberger, NJ, 2016a.**

Cultivar	Treatment and rate/100 gal	Application method <sup>z</sup> and interval	Quality <sup>x</sup>									AUDPC
			7/19	7/26	8/1	8/8	8/16	8/23	8/30	9/6	9/13	9/13
Coral	Adorn 3 fl oz	Drench	5.0 a	5.0 a	3.5 cd	2.3 de	0.9 cd	0.4 de	0.2 de	0.0 e	0.0 f	17.3 de
	Alude 2.5 qt	Drench	5.0 a	4.9 a	5.0 a	5.0 a	5.0 a	4.9 a	5.0 a	4.8 ab	4.7 ab	44.3 a
	Alude/ Orkestra 2.5 qt / 10 fl oz	Drench Spray 8/2, 8/9	4.9 a	4.9 a	5.0 a	5.0 a	5.0 a	5.0 a	5.0 a	5.0 a	4.9 a	44.8 a
	Inosco 8 pt	Spray 7 d	4.9 a	4.9 a	5.0 a	4.7 a	5.0 a	4.9 a	4.7 a	4.1 b	3.7 c	42.1 a
	Segovis 3.2 fl oz	Drench	4.7 a	5.0 a	5.0 a	4.9 a	5.0 a	4.9 a	4.8 a	4.7 ab	4.4 abc	43.4 s
	Segovis / Inosco 3.2 fl oz / 8 pt	Drench Spray 7/19, 8/2, 8/17	4.9 a	5.0 a	5.0 a	5.0 a	4.9 a	4.9 a	5.0 a	4.8 ab	4.8 a	44.4 a
	Subdue MAXX 2 fl oz	Drench	4.8 a	4.9 a	4.4 ab	3.4 bc	1.6 c	1.7 c	1.7 c	1.5 d	1.0 e	24.9 c
	Untreated	-	4.9 a	4.8 a	3.1 d	1.5 e	0.6 d	0.1 e	0.0 e	0.0 e	0.0 f	14.9 e
Rose	Adorn 3 fl oz	Drench	4.9 a	4.9 a	3.9 bc	2.5 cd	1.0 cd	1.3 c	0.8 d	0.7 e	0.2 ef	20.2 d
	Alude 2.5 qt	Drench	5.0 a	5.0 a	5.0 a	5.0 a	4.8 a	4.7 a	4.8 a	4.8 ab	4.6 ab	43.7 a
	Alude / Orkestra 2.5 qt / 10 fl oz	Drench Spray 8/2, 8/9	4.8 a	4.8 a	5.0 a	4.8 a	5.0 a	5.0 a	4.9 a	5.0 a	4.9 a	44.3 a
	Inosco 8 pt	Spray 7 d	4.8 a	4.4 a	4.9 a	4.9 a	5.0 a	4.9 a	5.0 a	4.4 ab	3.9 bc	42.3 a
	Segovis 3.2 fl oz	Drench	4.8 a	4.7 a	4.7 a	4.9 a	5.0 a	5.0 a	4.8 a	4.4 ab	4.3 abc	42.8 a
	Segovis/ Inosco 3.2 fl oz / 8 pt	Drench Spray 7/19, 8/2, 8/17	4.9 a	4.4 a	4.8 a	4.8 a	4.7 a	4.8 a	5.0 a	4.8 ab	4.8 a	43.1 a
	Subdue MAXX 2 fl oz	Drench	4.7 a	4.9 a	4.8 a	4.1 ab	2.6 b	2.7 b	2.8 b	2.3 c	2.1 d	30.9 b
	Untreated	-	4.8 a	4.5 a	3.3 cd	2.3 de	0.8 d	1.0 cd	0.5 de	0.1 e	0.0 f	17.3 de

<sup>x</sup> Plant quality rated on a scale of 0 to 5 where 0 = no plant, 5 = best quality with full canopy and high flower density. Column means with a letter in common are not significantly different (Scheffe's post hoc at p = 0.05).

<sup>z</sup> Drench treatments applied on 7/19 and 8/16.

**Table 41. Disease Severity of Downy Mildew (*Plasmoparaobducens*) of Impatiens (*I. walleriana*), Freiberger, NJ, 2016b.**

Cultivar	Treatment and rate/100 gal	Application method <sup>z</sup> and interval	Sporulation <sup>x</sup>									AUDPC
			7/19	7/26	8/1	8/8	8/16	8/23	8/30	9/6	9/13	9/13
Orange	Adorn 3 fl oz	Drench	0.3 a	1.8 a	3.5 ab	5.0 a	3.7 ab	4.0 a	4.0 a	4.7 a	4.7 a	31.9 a
	Stature 12.25 fl oz + Pageant 18 oz	Spray 7/19, 8/2, 8/17 + Spray 7/26, 8/9	0.6 a	2.1 a	2.9 bc	4.0 b	2.3 c	1.2 c	1.8 c	3.9 b	4.6 a	23.4 b
	Stature+Pageant / Alude	Spray / Drench	0.6 a	1.0 a	1.5 c	2.8 c	1.3 d	0.3 d	0.1 d	0.2 c	0.5 b	8.4 c
	Subdue MAXX 2 fl oz	Drench	1.0 a	2.3 a	2.4 bc	4.4 ab	3.3 b	3.2 b	2.5 b	3.2 b	4.1 a	26.6 b
	Untreated	-	0.3 a	2.3 a	3.7 a	5.0 a	4.2 ab	4.5 a	4.7 a	4.9 a	5.0 a	34.6 a

<sup>x</sup> Plants were rated 0-5 based on sporulation on the underside of the leaves where 0 = no leaves and 5 = all leaves showing spores. Column means with a letter in common are not significantly different (Scheffe's post hoc at p = 0.05).

<sup>z</sup> Drench treatments applied on 7/19 and 8/16.

**Table 42. Quality of Plants with Downy Mildew (*Plasmoparaobducens*) of Impatiens (*I. walleriana*), Freiberger, NJ, 2016a.**

Cultivar	Treatment and rate/100 gal	Application method <sup>z</sup> and interval	Quality <sup>x</sup>									AUDPC
			7/19	7/26	8/1	8/8	8/16	8/23	8/30	9/6	9/13	9/13
Orange	Adorn 3 fl oz	Drench	5.0 a	4.9 a	4.4 a	3.3 bc	1.8 c	1.2 b	1.6 b	1.5 c	1.3 c	25.1 c
	Stature 12.25 fl oz + Pageant 18 oz	Spray 7/19, 8/2, 8/17 + Spray 7/26, 8/9	5.0 a	4.7 a	4.5 a	4 ab	3.0 a	3.0 a	3.3 a	3.0 b	2.1 b	32.6 b
	Stature+Pageant / Alude	Spray / Drench	5.0 a	4.5 a	4.8 a	4.5 a	3.3 a	3.1 a	3.4 a	3.9 a	3.8 a	26.2 a
	Subdue MAXX 2 fl oz	Drench	5.0 a	4.7 a	4.5 a	4.2 a	2.8 ab	2.6 a	2.8 a	2.8 b	2.6 b	32.1 b
	Untreated	-	5.0 a	4.7 a	4.2 a	3.3 c	2.3 bc	1.2 b	1.3 b	1.1 c	1.0 c	24 c

<sup>x</sup> Plant quality rated on a scale of 0 to 5 where 0 = no plant, 5 = best quality with full canopy and high flower density. Column means with a letter in common are not significantly different (Scheffe's post hoc at p = 0.05).

<sup>z</sup> Drench treatments applied on 7/19 and 8/16.

## **Comparative Efficacy on Lamium Downy Mildew (*Peronospora lamii*).**

During 2008 and 2009, Kirk studied the impact of several new products on downy mildew of lamium caused by *Peronospora lamii*. Products tested included Adorn, Heritage, Insignia, NOA 4461023, Pageant, Stature, and Subdue.

In the experiment conducted in 2008, downy mildew developed slowly partially due to a long dry period during the experiment despite irrigation. The first applications were made to field grown lamium on June 27, 2008. All treatments significantly reduced downy mildew in comparison to the untreated control at both evaluation dates (Table 43). The most effective treatment was Adorn 2SC (2 fl oz/100 gal) although it was not significantly different from the other products except Alude. All treatments exhibited increased vigor over the untreated control.

In the experiment conducted in 2009, downy mildew also developed slowly with first applications made to field grown lamium on August 6, 2009. All treatments significantly reduced downy mildew in comparison to the untreated control at all evaluation dates (Table 44). The most effective treatments at the first evaluation date included, NOA 44610 (4-application program) and BAS 651 13.4 fl oz although they were not significantly different from programs less than 0.5% downy mildew. The most effective treatments at the second evaluation date included, NOA 44610 (4-application program) and BAS 651 13.4 fl oz although they were not significantly different from programs less than 5.5% downy mildew. The most effective treatments at the final evaluation date included, NOA 44610 (4-application program) and BAS 651 11 and 13.4 fl oz although they were not significantly different from programs less than 7.3% downy mildew. All treatments had significantly higher vigor than the untreated control 21 days after the final fungicide application (DAFA). Treatments with greater than 70.0% vigor scores had significantly higher vigor than the untreated control 49 DAFA.

No phytotoxicity was observed in either experiment.



**Table 43. Efficacy on Downy Mildew (*Peronospora lamii*) of Lamium (*Lamium maculatum*), Kirk, MI, 2008.**

Treatment and Rate of application	Downy Mildew (%) <sup>z</sup>		Plant vigor <sup>y</sup>	
	92 DAP <sup>x</sup> (54 DAFA <sup>w</sup> )	126 DAP (88 DAFA)	92 DAP (54 DAFA)	126 DAP (88 DAFA)
Adorn 2SC 1 fl oz/100 gal (A,D)	0.3 b	0.5 cd	77.5 de	78.8 bc
Adorn 2SC 2 fl oz/100 gal (A,D)	0 b	0 d	73.8 def	77.5 bc
Alude 45.8SC 64 fl oz/100 gal (A,C)	0.8 b	2.8 b	72.5 ef	75 c
Heritage 50WDG 4 oz/100 gal + Induce SL 0.125% v/v (A,B,C,D <sup>v</sup> )	0.3 b <sup>u</sup>	0.5 cd	77.5 de	77.5 bc
Heritage 50WDG 4 oz/100 gal + Induce SL 0.125% v/v (A,C)	0.3 b	1.5 bcd	77.5 de	80 bc
Insignia 20WG 4 oz/100 gal (A,C)	0.3 b	2 bcd	90 ab	93.8 a
Insignia 20WG 8 oz/100 gal(A,C)	0.3 b	0.8 bcd	87.5 abc	95 a
NOA 44610 23.3 SC 4 oz/100 gal + Induce SL 0.125% v/v (A,C)	0.8 b	2.3 bc	82.5 bcd	82.5 b
NOA 44610 23.3 SC 8 oz/100 gal + Induce SL 0.125% v/v (A,C)	0.5 b	1.5 bcd	78.8 cde	81.3 bc
Pageant 38WG 6 oz/100 gal (A,B,C,D)	0.5 b	1 bcd	95 a	95 a
Pageant 38WG 12 oz/100 gal (A,B,C,D)	0.8 b	2 bcd	95 a	97.5 a
Stature 50WG 12.3 oz/100 gal (A,C)	0.5 b	2 bcd	77.5 de	77.5 bc
Subdue Maxx 21.3SC 1 fl oz/100 gal (A,C)	0.5 b	1.5 bcd	75 def	77.5 bc
Untreated control	5.8 a	11.3 a	67.5 f	61.3 d

<sup>z</sup>Percentage of foliage affected by downy mildew (*Peronospora lamii*).

<sup>y</sup>Plant vigor where 100% represents the most vigorous plants in the experiment.

<sup>x</sup>Days after planting.

<sup>w</sup> Days after final application of fungicide.

<sup>v</sup> Application dates: A= 27 Jun; B= 5 Jul; C= 12Jul; D= 19 Jul.

<sup>u</sup> Values followed by the same letter are not significantly different at  $p = 0.05$  (Tukey Multiple Comparison).

**Table 44. Efficacy on Downy Mildew (*Peronospora lamii*) of Lamium (*Lamium maculatum*), Kirk, MI, 2009.**

Treatment and rate of application per 100 gal	Downy Mildew (%) <sup>z</sup>			Plant vigor <sup>y</sup>	
	79 DAP <sup>x</sup> (0 DAFA <sup>w</sup> )	100 DAP (21 DAFA)	128 DAP (49 DAFA)	92 DAP (21 DAFA)	126 DAP (49 DAFA)
Adorn 4SC 1 fl oz (A,D <sup>v</sup> )	0.8bc	4d-h	87.5 abc	7 cde	68.8 def
Adorn 4SC 2 fl oz (A,D)	0.8bc	3.8d-h	77.5 bcd	5.3 def	78.8 b-e
BAS 651F 20SC 11 fl oz (A,C)	0.5bcd	2.5fgh	90 abc	2.8 ef	96.3 a
BAS 651F 20SC 13.4 fl oz (A,C)	0.3cd	1.8h	88.8 abc	2.8 ef	85 a-d
Disarm 480SC 2 fl oz (A,C)	1.0b	9.5bc	72.5 d	11 bc	68.8 def
Disarm 480SC 4 fl oz (A,C)	1.0b	6.5bcd	85 a-d	9 bcd	71.3 cde
Heritage 50WDG 4 oz + Induce SL 0.125% v/v (A,B,C,D)	1.0b	6.3cde	78.8 a-d	8.3 bcd	76.3 b-e
Heritage 50WDG 4 oz + Induce SL 0.125% v/v (A,C)	0.5bcd	6c-f	87.5 abc	6.8 cde	75 b-e
NOA 44610 23.3 SC 4 oz + Induce SL 0.125% v/v (A,B,C,D)	0.0d	2gh	92.5 a	2 f	88.8 ab
NOA 44610 23.3 SC 8 oz + Induce SL 0.125% v/v (A,C)	0.3cd	3.5d-h	91.3 ab	5 def	88.8 ab
NOA 44610 23.3 SC 8 oz + Induce SL 0.125% v/v (A,B,C,D)	0.3cd	2.8e-h	82.5 a-d	2.8 ef	87.5 abc
Regalia 100SC 64 fl oz (A,B,C,D)	0.8bc	5.5d-g	81.3 a-d	8.8 bcd	73.8 b-e
Regalia 100SC 128 fl oz (A,B,C,D)	0.8bc	4.8d-h	82.5 a-d	7.3 cde	67.5 ef
Subdue Maxx 21.3SC 1 fl oz (A,C)	1.0b	10b	76.3 cd	12.5 b	65 ef
Stature 50SC 6.12 fl oz (A,C)	0.3cd	4.3d-h	82.5 a-d	5.3 def	70 de
Untreated control	1.8a	22.5a	52.5 e	36.3 a	52.5 f

<sup>z</sup>Percentage of foliage affected by downy mildew (*Peronospora lamii*).

<sup>y</sup>Plant vigor where 100% represents the most vigorous plants in the experiment.

<sup>x</sup>Days after planting.

<sup>w</sup> Days after final application of fungicide.

<sup>v</sup> Application dates: A= 6 Aug; B= 13 Aug; C= 20 Aug; D= 28 Aug.

<sup>u</sup> Values followed by the same letter are not significantly different at  $p = 0.05$  (Tukey Multiple Comparison).

### Comparative Efficacy on Limonium Downy Mildew (*Peronospora stativae*)

Downy mildew of Limonium was examined by Wegulo in 2004 and 2005 in hoop houses located in San Diego County, CA. Limonium is a multi year crop and the experiments were conducted in the third and fourth years, respectively, of the cropping cycle. Two weeks before each experiment started, plants were trimmed to a height of approximately 2 inches so that new vegetative growth could be evaluated.

In the 2004 experiment, foliar sprays were made on June 10, June 21, July 1, and July 9 with the products listed in Table 45. Disease severity was rated on July 9 and 19, or 29 and 39 days after first application (DAT). Downy mildew growth was rated on July 9. Residue was rated on July 22. All ratings were on whole plots on a 0 to 5 scale. Under low disease pressure, disease severity and downy mildew growth in all fungicide treatments were significantly lower than in the non-treated control 29 DAT. Disease severity increased substantially in the untreated by 39 DAT. All treatments statistically reduced disease severity with the exception of Heritage. The best disease control was provided by Fenstop and Aliette + Fore tank mix. Amount of residue was greatest in the Aliette + Fore treatment, but did not adversely affect marketability.

The experiment in 2005 was conducted earlier in the year with foliar sprays applied on April 5, 12, 22, and 29. Products applied included a tank mix of Aliette + Fore, Phyton 27, STBX-304, and ZeroTol. Disease severity was rated on April 29 and May 6, or 24 DAT and 31 DAT. Phytotoxicity was rated on 6 May. All products significantly lowered disease severity by 31 DAT, but the best control was provided by the Aliette + Fore tank mix treatment (Table 46).

Phytotoxicity was not observed in any treatment in the 2004 experiment, but in 2005 STBX-304 treatments did cause minor plant injury.

**Table 45. \*Efficacy on Downy Mildew (*Peronospora spatices*) of Limonium (*Limonium sp.*) ‘Misty White’, Wegulo, CA, 2004.**

Treatment	Rate/100 gal	Downy Mildew Growth <sup>z</sup>	Necrosis <sup>y</sup>		Residue <sup>x</sup>
		29 DAT	29 DAT	39 DAT	42 DAT
Aliette + Fore (fosetyl-AL + mancozeb)	2.5 lb + 1.5 lb	0.3 cd <sup>w</sup>	0.3 de	2.0 de	0.8 a
EXP <sup>v</sup>	6.0 oz	0.5 cd	0.8 cd	3.3 bc	0.3 b
EXP	12.5 oz	0.8 bc	1.1 bc	2.8 b-d	0.2 b-d
FenStop (fenamidone)	7.0 fl oz	0.2 d	0.4 de	2.0 de	0.0 cd
FenStop (fenamidone)	14 fl oz	0.3 cd	0.3 e	1.7 e	0.2 b-d
Heritage (azoxystrobin)	1.0 oz	0.8 b-d	1.4 b	3.6 ab	0.1 b-d
Insignia (pyraclostrobin) <sup>u</sup>	8.0 oz	0.9 bc	1.1 bc	3.3 bc	0.2 b-d
Stature DM	9.6 oz	1.1 b	1.1 bc	2.6 cd	0.3 bc
Untreated	---	2.7 a	2.0 a	4.2 a	0.0 d

\* Not an IR-4 Experiment: F&N Tests Vol 61:OT028

<sup>z</sup> 0, no visible signs of downy mildew; 1, 2, 3, 4, and 5 represent 0.1-20, 21-40, 41-60, 61-80, and 81-100% of leaf surface covered with downy mildew, respectively (whole-plot rating).

<sup>y</sup> 0, no visible symptoms of downy mildew; 1, 2, 3, 4, and 5 represent 0.1-20, 21-40, 41-60, 61-80, and 81-100% of leaf surface symptomatic, respectively.

<sup>x</sup> 0, no visible residue; 1, 2, 3, 4, and 5 represent 0.1-20, 21-40, 41-60, 61-80, and 81-100% of leaf surface covered with residue, respectively.

<sup>w</sup> Means within a column followed by the same letter are not significantly different at  $P = 0.05$  according to the least significant difference test.

<sup>v</sup> Experimental product, confidential.

<sup>u</sup> Listed as BAS 500 in original publication.

**Table 46. \*Efficacy on Downy Mildew (*Peronospora sparsa*) of Limonium (*Limonium sp.*) ‘Misty White’, Wegulo, CA, 2005.**

Treatment	Rate/gallon	Disease severity <sup>z</sup> 29 April	Disease severity <sup>z</sup> 6 May	Phytotoxicity <sup>z</sup> 6 May
Aliette + Fore	0.4 oz + 0.24 oz	0.1 c <sup>y</sup>	0.1 c	0.0 c
Phyton 27	0.25 fl oz	1.4 b	2.0 b	0.0 c
STBX-304	0.15 fl oz	1.5 b	2.1 b	0.4 b
STBX-304	0.25 fl oz	1.4 b	1.4 b	0.7 a
ZeroTol	0.5 fl oz	1.6 ab	2.1 b	0.0c
Non-treated control		2.4 a	3.3 a	0.0 c

\* Not an IR-4 Experiment: F&N Tests Vol 61:OT029

<sup>z</sup> 0 to 5 scale with 0 = no visible symptoms of downy mildew; 1, 2, 3, 4, and 5 representing 0.1-20, 21-40, 41-60, 61-80, and 81-100% of leaf surface symptomatic or showing phytotoxicity damage, respectively.

<sup>y</sup> Means followed by the same letter within columns are not significantly different according to the least significant difference (LSD) test at  $P = 0.05$ .

### **Comparative Efficacy on Rose Downy Mildew (*Peronospora sparsa*)**

Rose downy mildew is often a cryptic disease which only surfaces when environmental conditions are suitable for symptom expression and those symptoms can be mistaken for phytotoxicity or other diseases. Four experiments were conducted from 2000 to 2009 to examine which products can sufficiently manage this disease.

In 2000, Hagan conducted a field study on the effectiveness of fungicides applied as foliar sprays at 7-day intervals from Mar 1 to May 1. Unseasonably low rainfall levels slowed pathogen spread and disease development. The incidence of downy mildew was significantly reduced by all treatments except the 0.2-lb per 100-gal rate of SP2005 (Table 47). SP2003 and the high rate of SP2005 controlled downy mildew as effectively as Protect and both rates of Aliette did.

**Table 47. \*Efficacy on Downy Mildew (*Peronospora sparsa*) on Rose (*Rosa sp.*) ‘Ice Meidiland’, Hagan, AL, 2000.**

Treatment	Rate/100 gal	Disease Rating <sup>x</sup>
Aliette T/O	2.5 lb	2.0 b
Aliette T/O	5.0 lb	2.5 b
Protect T/O	1.5 lb	2.1 b
SP2003 56W	1.75 lb	2.3 b
SP2005 50W	0.2 lb	3.4 a
SP2005 50W	0.4 lb	2.3 b
Untreated Control	-	4.0 a

\* Not an IR-4 Experiment: F & N Tests 56: OT30.

<sup>x</sup> Observed on May 11 using the Barratt and Horsfall rating scale where 1 = no disease, 2 = 0 to 3%, 3 = 3 to 6%, 4 = 6 to 12%, 5 = 12 to 25%, 6 = 25 to 50%, 7 = 50 to 75%, 8 = 75 to 87%, 9 = 87 to 94%, 10 = 94 to 97%, 11 = 97 to 100%, and 12 = 100% of the leaves diseased or prematurely shed. Mean separation within the column was according to Duncan's Multiple Range Test ( $P=0.05$ ).

In 2006, Hausbeck and Gevens examined 17 products in two experiments. Both experiments were conducted at a commercial grower in Quincy, FL on 3 gal potted rose plants. The first experiment ran from March through April, whereas the second experiment was implemented in April. The initial sprays were applied when disease was already established on the canes and leaves. Foliar applications were applied at 7 day intervals while the Subdue MAXX EC drench was applied at 1 month intervals. Rose plants were rated for downy mildew by counting the total number of infected leaves per plant on Apr 24 for the first experiment and on Apr 11 for the second experiment (additional ratings were taken, but the infection rates dropped significantly and were not included in the PDMR publication - *personal communication*).

In the first experiment (Table 48), all fungicides tested significant reduced rose downy mildew in comparison to the untreated plants. The best performing product was Daconil WeatherStik, however it also caused plant injury. Other products exhibiting less than 6 infected leaves on average included Heritage WDG, Junction DF, and Stature DM.

In the second experiment (Table 49), all products once again significantly reduced the number of infected leaves in comparison to the untreated plants. However, only the tank mix of Heritage + A12946 reduced the average infected leaves to below 6.

Captan Pro at 1.5 lb/100 gal and Daconil WeatherStik at 1.0 pt/100 gal caused foliar injury.

**Table 48. \*Efficacy on Downy Mildew (*Peronospora sparsa*) on Rose (*Rosa sp.*) ‘Double Knockout’, Hausbeck and Gevens, FL2006a.**

Treatment	Rate/100 gal	Average no. of infected leaves (
Aliette WDG	2.5 lb	11.5 c
Alude	2.5 qt	12.3 cd
Captan Pro 80 WDG	1.5 lb	13.5 cd
Compass O WDG	4 oz	12.6 cd
Daconil WeatherStik	1pt	3.3 a
Heritage WDG	4 oz	4.9 ab
Junction DF	3.5 lb	5.5 ab
Kocide 2000 DF	2 lb	7.7 b
Pentathlon LF	0.8 qt	6.7 b
Stature DM	12.8 oz	5.2 ab
Subdue MAXX EC	1 fl oz (drench, 1 month application interval)	15.2 d
Subdue MAXX EC	2 fl oz (foliar)	11.4 c
Untreated control	---	19.4 e

\* Not an IR-4 Experiment: Plant Disease Management Reports 1:OT005

<sup>z</sup> Mean separation within the column was according to Fisher’s Protected LSD Test ( $P=0.05$ ).

**Table 49. \*Efficacy on Downy Mildew (*Peronospora sparsa*) on Rose (*Rosa sp.*) ‘Double Knockout’, Hausbeck and Gevens,FL 2006b.**

Treatment	Rate/100 gal	Average no. of infected leaves <sup>z</sup>
A12946	2.05	10.4 bcdef
A12946	4.1 fl oz	11.1 cdef
A12946	8.2 fl oz	7.7 abcd
A12946 +Subdue MAXX	2.05 fl oz + 1 fl oz	10.7 bcdef
A12946 +Subdue MAXX	4.1 fl oz + 1 fl oz	6.1 abc
A12946 +Subdue MAXX	8.2 fl oz + 1 fl oz	6.4 abc
BAS 516 WG	12.5 oz	9.7 bcdef
BAS 516 WG	18.5 oz	8.6 abcd
Heritage 50 WG	1 oz	13.3 defg
Heritage 50 WG +A12946	1 oz +2.05 fl oz	5.4 ab
Heritage 50 WG +A12946	1 oz +4.1 fl oz	7.2 abc
Heritage 50 WG +A12946	1 oz +8.2 fl oz	3.4 a
Insignia WG	4 oz	13.2 defg
Insignia WG	8 oz	13.3 defg
SP2015 WDG	8 oz	17.2 g
SP2015 WDG	10 oz	9.6 bcde
SP2015 WDG	12 oz	10.7 bcdef
Stature DM WP	12.8 oz	15.3 fg
Subdue MAXX EC	2 fl oz	7.9 abcd
V-10116 50 WD	1 oz	16.8 g
V-10116 50 WD	2 oz	17.2 g
V-10116 50 WD	4 oz	14.7 efg
V-10116 50 WD	8 oz	14.3 efg
V-10190 2.5 FL	6.4 fl oz	15.3 fg
Untreated control	---	25.4 h*

\* Not an IR-4 Experiment:Plant Disease Management Reports 1:OT004

<sup>z</sup> Mean separation within the column was according to Fisher’s Protected LSD Test ( $P=0.05$ ).

In 2009, Chase studied the impact of eight products used as preventative applications. Disease severity was low to moderate during the experiment due to unfavorable weather until near the end. The rating on March 24 (5 weeks after initiation) did show the best prevention with Regalia at 1% although this treatment caused phytotoxicity. NOA 44610 at 4 oz/100 gal and Disarm O were also significantly better than the water sprayed control. At the end of the experiment (10 weeks after initiation) there were significant differences between treatments based on the analysis of variance but differences could not be separated using Student-Newman-Keuls test for mean separation. Nevertheless, the lowest levels of downy mildew were found on plants treated with Disarm O (4 oz/100 gal) and both rates of Heritage as well as Stature SC (Table 50).

Phytotoxicity was observed with Regalia SC at 1%.

**Table 50. Efficacy on Downy Mildew (*Peronospora sparsa*) on Rose (*Rosa sp.*), Chase, CA, 2009.**

Treatment	Trt. Interval	Rate/100 gal.	Disease severity	
			3/24	4/26
Adorn	28 days drench	1 oz	3.4 d	3.0 a
Adorn	28 days drench	2 oz	2.7 abcd	2.6 a
BAS651	14 days spray	11 oz	3.3 cd	3.0 a
BAS651	14 days spray	13.4 oz	3.0 abcd	3.2 a
Disarm 480SC	14 days spray	2 oz	2.6 abc	2.7 a
Disarm 480SC	14 days spray	4 oz	3.1 bcd	2.3 a
Heritage/Bond Max	7 days spray	4 oz/4 oz	2.7 abcd	2.5 a
Heritage/Bond Max	14 days spray	4 oz/4 oz	2.8 abcd	2.3 a
Mandipropamid/Bond Max	7 days spray	4 oz/4 oz	2.5 ab	2.9 a
Mandipropamid/Bond Max	7 days spray	8 oz/4 oz	2.8 abcd	3.0 a
Regalia SC	7 days spray	0.5 %	2.8 abcd	2.9 a
Regalia SC	7 days spray	1 %	2.3 a	2.8 a
Subdue MAXX	14 days spray	1 oz	2.9 abcd	3.1 a
Stature SC	14 days spray	6.12 oz	2.7 abcd	2.5 a
Water	7 days spray	-	3.3 d	3.2 a

### **Comparative Efficacy on Snapdragon Downy Mildew (*Peronospora antirrhini*)**

Downy mildew of snapdragon was examined in two experiments.

In the first experiment, Wegulo tested seven products solo, in tank mixes and in rotational programs to manage downy mildew on snapdragon cv. Potomac Ivory. Fungicide sprays were applied to runoff on May 15, May 23, June 2, June 11, and June 24, and disease severity was rated on a 0 to 5 scale on Jul 8, or 54 days after first application (DAT).

Symptoms of downy mildew were first observed in early June. Disease development was slow at first, but progressed faster as foliage density and size increased. All treatments significantly reduced disease severity except for Compass O 50WDG and Heritage (Table 51). The best treatments were Alliette + Fore, FenStop, FenStop + Fore, Fore, and Insignia + Stature DM.

Phytotoxicity was not observed in any treatment.

In the second experiment conducted by Villaviciencio, nine products were tested as curative applications on snapdragon ‘Snapshot White’ (Table 52). Initial sporulation was quite variable at the time of the first applications. By 7 DAT, none of the products provided statistically significant control or, but by 14 DAT most of the treatments exhibited less disease severity than the untreated plants. The best products included Adorn, Fenstop, Heritage at 14 day intervals, Regalia at 1%, and Stature SC. Aliette, BAS 651, and MICORA also reduced infection levels.

**Table 51. \*Efficacy on Downy Mildew (*Peronospora antirrhini*) of Snapdragon (*Antirrhinum majus*) ‘Potomac Ivory’, Wegulo, CA, 2003.**

<b>Treatment</b>	<b>Rate/100 gal</b>	<b>Disease severity <sup>z</sup>54 DAT</b>
Aliette WDG (fosetyl AL)	2.5 lb	1.4 e-g <sup>y</sup>
Aliette WDG + Fore	2.5 lb +1.5 lb	0.5 gh
Compass O 50WDG (trifloxystrobin)	1 oz	3.8 a
Compass O 50WDG (trifloxystrobin)	2 oz	3.4 ab
FenStop (fenamindone)	7 fl oz	0.8 f-h
FenStop (fenamindone)+ Fore (mancozeb)	7 fl oz + 1.5 lb	0.3 h
Fore (mancozeb)	1.5 lb	0.3 h
Heritage (azoxystrobin)	1oz	3.1 a-c
Insignia (pyraclostrobin)	4 oz	2.1 c-e
Insignia (pyraclostrobin)	8 oz	1.4 e-g
Insignia (pyraclostrobin)+ Stature DM (dimethomorph)	4 oz + 9.6 oz	0.4 gh
Rotation: Fore / Heritage / Stature DM	1.5 lb / 1 oz / 9.6 oz	1.1 e-h
Rotation: Heritage / Aliette WDG / Insignia	1 oz / 2.5 lb / 4 oz	2.5 b-d
Rotation: Heritage / Stature DM / Aliette WDG	1 oz / 9.6 oz / 2.5 lb	2.0 de
Stature DM (dimethomorph)	9.6 oz	1.6 ef
Non-treated control		3.6 a

\* Not an IR-4 Experiment: F&N Tests Vol 61:OT027

<sup>z</sup> Disease severity was rated on a 0 to 5 scale where 0 = no downy mildew and 5 = 80 to 100% of the foliage chlorotic.

<sup>y</sup> Means within a column followed by the same letter are not significantly different at  $P = 0.05$  according to the least significant difference test.



**Table 52. Efficacy on Downy Mildew (*Peronospora antirrhini*) of Snapdragon (*Antirrhinum majus*), Villavicencio, CA, 2009.**

Product (active ingredient)	Rate per 100 gal	Mean Disease Severity <sup>z</sup> (Henderson's Percent Control)			
		0 DAT	7 DAT	14 DAT	28 DAT
Adorn (fluopicolide)	1 fl oz	27.5	15.5 ef (45)	7.0 e (79)	12.5 def (26)
Adorn (fluopicolide)	2 fl oz	17.3	22.1 abc (0)	14.3 bc (31)	4.6 abcd (57)
Aliette	12.8 fl oz	22.0	34.8 a (0)	13.5 bcd (49)	14.1 abcd (0)
BAS 651 F	11 fl oz	36.0	25.6 def (31)	28.8 bcd (33)	11.4 ef (49)
BAS 651 F	13.4 fl oz	21.9	20.0 bcdef (11)	14.9 bcd (43)	14.1 abcd (0)
Disarm 480SC (fluoxystrobin)	2 fl oz	13.9	22.3 abc (0)	23.5 a (0)	11.4 ab (0)
Disarm 480SC (fluoxystrobin)	4 fl oz	17.9	18.5 abcdef (0)	28.8 a (0)	16.0 a (0)
Fenstop (fenamidone)	14 fl oz	22.6	31.0 ab (0)	9.1 bcde (66)	7.1 abcde (49)
Heritage (azoxystrobin)	4 oz 7 days	4.9	2.3 bcdef (54)	5.1 ab (13)	0.8 abc (74)
Heritage (azoxystrobin)	4 oz 14 days	27.6	14.4 f (49)	12.1 de (63)	11.0 bcdef (36)
NOA 44610 (mandipropamid)	4 fl oz	27.0	21.3 cdef (23)	12.7 bcd (61)	2.0 cdef (88)
NOA 44610 (mandipropamid)	8 fl oz	20.6	17.8 bcdef (16)	15.8 bcd (36)	6.6 abcd (48)
Regalia* SC	0.5%	24.4	27.8 abcd (0)	10.0 bcd (66)	6.7 abcde (56)
Regalia SC	1%	39.4	28.8 def (29)	25.1 cde (47)	13.8 f (43)
Stature SC	6.12 fl oz	38.4	41.1 abc (0)	12.0 bcde (74)	16.6 abcde (30)
Untreated	---	51.3	52.5 abcde (0)	61.3 a (0)	31.7 abcdef (0)

<sup>z</sup> Letters following numbers are significantly different based on difference of mean percent severity at the rating date minus the initial mean percent severity. Henderson's percent control was calculated on the mean percent severity at each rating date.

**Comparative Efficacy on Viburnum Downy Mildew (*Plasmopara viburni*).**

In 2009, Palmateer examined seven products as preventative/curative treatments to control Viburnum downy mildew, caused by *Plasmopara viburni*. Foliar sprays or drenches were applied to container grown Viburnum (*Viburnum odoratissimum* var. *awabuki*) starting 3/24/09 and continuing through 5/12/09. Inoculum was collected from severely affected plants, and sprayed onto treated plants on 4/1/09. Disease severity (percentage of plant exhibiting disease) and incidence (number of diseased leaves/total number of leaves) were rated at 0, 13, 28, 42, and 63 days after the first fungicide application, with the initial rating taking place before inoculation. Area under the disease progress curve (AUDPC) was calculated using severity values.

Disease incidence was reduced by Adorn, BAS 651, Disarm at 2 fl oz, Heritage, Regalia at 1%, and Stature SC (Table 53). The severity of disease was lowered by Adorn at 1 fl oz, BAS 651 at 13.4 fl oz, Disarm, Heritage, NOA 44610, Regalia at 1%, and Stature.

No phytotoxicity was observed with any treatment.

**Table 53. Efficacy on Downy Mildew (*Plasmopara viburni*) of Viburnum (*Viburnum sp.*), Palmateer, FL, 2009.**

Product	Rate	Interval	Incidence (# diseased leaves)	Severity ( $y_{max}$ )	AUDPC
Adorn (fluopicolide)	1 fl oz/100 gal	28 d	20.0±1.1 f	0.21±0.02 bc	9.5±0.6 bcd
Adorn (fluopicolide)	2 fl oz/100 gal	28 d	30.0±2.5 cd	0.33±0.08 a	15.3±1.9 a
BAS 651 F	11 fl oz/100 gal	14 d	29.0±3.0 cd	0.36±0.03 a	16.4±1.3 a
BAS 651 F	13.4 fl oz/100 gal	14 d	27.8±2.8 cd	0.23±0.05 bc	10.6±2.4 bc
Disarm F	2 fl oz/100 gal	14 d	27.3±1.9 cd	0.11±0.01 d	5.8±1.0 de
Disarm F	4 fl oz/100 gal	14 d	33.5±2.3 ab	0.19±0.01 bcd	8.3±0.6 cde
Heritage (azoxystrobin)	4 oz/100 gal	7 d	20.8±1.9 ef	0.11±0.01 d	6.1±0.5 de
Heritage (azoxystrobin)	4 oz/100 gal	14d	24.5±1.2 def	0.16±0.02 cd	9.4±1.6 bcd
NOA 44610 (mandipropamid)	4 oz /100 gal	7 d	33.5±0.6 ab	0.19±0.03 bcd	8.0±1.2 cde
NOA 44610 (mandipropamid)	8 oz/100 gal	7 d	33.5±2.9 ab	0.18±0.03 cd	8.7±1.0 bcde
Regalia SC	0.5%	7 d	33.3±1.9 ab	0.28±0.05 ab	12.5±2.1 ab
Regalia SC	1%	7 d	19.3±0.6 f	0.11±0.01 d	5.0±0.7 e
Stature SC (dimethomorph)	6.12 fl oz/100 gal	14 d	26.3±0.8 cd	0.15±0.00 cd	6.5±0.3 de
Untreated Inoculated	---	---	37.0±1.9 a	0.34±0.04 a	15.9±2.3 a
		<b>LSD</b>	5.60	0.09	3.95

Values within each column with the same letter do not differ significantly based on means separation using Fisher's LSD.

**Comparative Efficacy on Basil Downy Mildew (*Peronospora belbahrii*).**

Basil downy mildew, caused by *Peronospora belbahrii*, has been a major problem in the production of basil not only in the United States but also elsewhere in the world in the last 16 years. It was first reported in the US in south Florida in 2007 and has now spread to at least 42 states since its first detection. It attacks mainly basil (*Ocimum spp.*), including culinary and ornamental varieties, causing leaf chlorosis, necrosis and premature leaf fall. Crops with any leaf injury would be unmarketable.

The tables below (Table 54, Table 55) contain a general summary of 24 field and 7 greenhouse efficacy experiments on basil downy mildew (*Peronospora belbahrii*). Generally, Revus (mandipropamid), Quadris/Amistar (azoxystrobin), and Reason (fenamidone) applied as sprays, and Ridomil Gold (mefenoxam) drench or spray provided good to excellent efficacy. Efficacy of Ranman (cyazofamid) spray was variable. Two new products Zorvec/QGU42 (oxathiopiprolin) and Zampro (ametotradin + dimethomorph) also provided excellent efficacy. The phosphorus acid fungicides (including Prophyt, K-Phite, Nutri-Phyte, Agri-Fos, Phostrol) and the organic fungicides, including biofungicides (Actinovate, Companion, Double Nickel, Regalia, Serenade, Sonata), and copper fungicides (Badge X2, Cueva, Kocide, Nordox, Nu-Cop) generally provided poor efficacy. See the discussion and data of individual experiments for more details.

**Table 54. General summary of efficacy for downy mildew (*Peronospora belbahrii*) on basil (*Ocimum basilicum*) – Part 1\*.**

Product	Raid 2007 Test 1	Raid 2007 Test 2	Raid 2007 Test 3	Raid 2007 Test 4	Raid 2007 Test 5	Raid 2007 Test 6	Raid 2007 Test 7	Raid 2007 Test 8	Raid 2010 Test 1	Raid 2010 Test 2	Raid 2010 Test 3	Raid 2010 Test 4	Raid 2010 Test 5	Zhang 2010 Expt. 1**	Zhang 2010 Expt. 2**	Zhang 2010 Expt. 3**
Actigard			.					.								
Actinovate			.											.	.	+/-
Agri-Fos spray					+											
Aliette									+/-							
Amistar			++	+		+	+									
Badge X2																
BAS 651									++	++						
Basic Copper																
Bravo	-												-			
BU EXP 1216 C														.	.	+/-
BU EXP 1216 S														.	.	.
Calci-Phite					+											
Chitosan																
Companion														.	.	.
Cueva																
Double Nickel																
Forum drench																
Forum spray	++			+		+		+/-								
HMO 736														.	.	.
Howler																
Kocide			.													
K-Phite	+				+											
Nutri-Phyte					+					+	.	.	.			
Milagrum Plus																
Nordox																
NuCop HB					.											
Nutri-Phyte																
Organocide																
Orondis Gold drench																
Orvego (BAS 651)									++	++						
Oxidate																
Phostrol					.											

Product	Raid 2007 Test 1	Raid 2007 Test 2	Raid 2007 Test 3	Raid 2007 Test 4	Raid 2007 Test 5	Raid 2007 Test 6	Raid 2007 Test 7	Raid 2007 Test 8	Raid 2010 Test 1	Raid 2010 Test 2	Raid 2010 Test 3	Raid 2010 Test 4	Raid 2010 Test 5	Zhang 2010 Exmt 1**	Zhang 2010 Exmt 2**	Zhang 2010 Exmt 3**
Presidio drench																
Presidio spray				+/-			-				+		-			
Previcur Flex	+	-		-				-								
Pristine			++	+/-												
Procidic																
Prophyt	+	+/-	+	+/-	-									+/-	+	
Phostrol					+											
Quadris											+/-	-	++			
Rampart					+/-		+/-	-								
Ranman drench																
Ranman spray	++			+			+/-	-			+		+/-			
Reason	++							+	+							
Regalia														-	-	+/-
Rescue					+/-	-										
Revus	++	++		+			+/-		++		++	++	++			
Ridomil Gold drench																
Ridomil Gold spray	++												++			
Serenade			-											-	-	-
Sonata			-											-	-	+/-
Sporatec																
Tanos			+	-												
Timorex Gold																
V 10208																
Zampro													+			
Zorvec (QGU42)																

\* Not IR-4-sponsored experiments.

\*\* Greenhouse experiment.

<sup>1</sup> Rating Scale: ++ = clearly statistically equivalent or better than untreated non-inoculated and/or clearly statistically different than untreated inoculated; + = statistically different from untreated inoculated and untreated non-inoculated; +/- statistically equivalent to both untreated inoculated and untreated non-inoculated; - = statistically equivalent to untreated inoculated. For experiments without non-inoculated check, efficacy determined on author's conclusions, % control or comparisons to standard product(s).

<sup>2</sup> Where more than one rate or application type for a product was included in the experiment and each performed statistically different, the better rating is provided in this table. Products applied as drench, and products applied as drench or spray identified in table; all other products with no application identification were applied as spray.

**Table 55. General summary of efficacy for downy mildew (*Peronospora belbahrii*) on basil (*Ocimum basilicum*) – Part 2\*.**

Product	Babadooost 2011	Zhang 2011	McGrath 2011	Raid 2012	McGrath 2012	Zhang 2013 Expt 1**	Zhang 2013 Expt 2**	Zhang 2013	Zhang 2014 Expt 1**	Zhang 2014 Expt 2**	Wick 2014	Raid 2016	McGrath 2016
Actigard		-											
Actinovate			-		-	+/-	+/-						
Agri-Fos spray													
Double Nickel													-
Aliette													
Amistar													
Badge X2											-		
BAS 651													
Basic Copper											-		
Bravo													
BU EXP 1216 C													
BU EXP 1216 S													
Calci-Phite													
Chitosan						+/-	+						
Companion			-										
Cueva											-		-
Double Nickel													-
Forum drench												-	
Forum spray	++			++									
Forticept Agro													-
Gavel	+/-												
HMO 736													
Howler													-
Kocide													
K-Phite					-								
Milagrum Plus													-
Nordox	-												
NuCop HB					-						-		
Nutri-Phyte drench											-		
Organocide			-		-	+/-	++						
Orondis Gold drench												++	

Product	Babadoost 2011	Zhang 2011	McGrath 2011	Raid 2012	McGrath 2012	Zhang 2013 Expt 1**	Zhang 2013 Expt 2**	Zhang 2013	Zhang 2014 Expt 1**	Zhang 2014 Expt 2**	Wick 2014	Raid 2016	McGrath 2016
Oxidate			-										
Phostrol													
Presidio drench												-	
Presidio spray	+/-			++	-								
Previcur Flex				+/-	-								
Pristine													
Procidic													-
Prophyt	++		-	-	-				++	++			
Phostrol													
Quadris				++		++	++						
Rampart													
Ranman drench												-	
Ranman spray	++			++	-						+/-		
Reason				++									
Regalia	-		-		-							-	
Rescue													
Revus	++		-	++	-								
Ridomil Gold drench												++	
Serenade	-												
Sonata	-		-										
Sporatec			-										
Tanos	-												
Timorex Gold			-			+/-	+/-						
V110208				+/-									
Zampro	++			++	-								
Zorvec (QGU42)				++	+/-			++	++	++			

\* Not IR-4-sponsored experiments.

\*\* Greenhouse experiment.

1 Rating Scale: ++ = clearly statistically equivalent or better than untreated non-inoculated and/or clearly statistically different than untreated inoculated; + = statistically different from untreated inoculated and untreated non-inoculated; +/- statistically equivalent to both untreated inoculated and untreated non-inoculated; - = statistically equivalent to untreated inoculated. For experiments without non-inoculated check, efficacy determined on author's conclusions, % control or comparisons to standard product(s).

<sup>2</sup>Where more than one rate or application type for a product was included in the experiment and each performed statistically different, the better rating is provided in this table. Products applied as drench, and products applied as drench or spray identified in table; all other products with no application identification were applied as spray.

In 2007, Raid conducted eight field experiments to determine the efficacy of several products to control basil downy mildew, caused by *Peronospora belbahrii*. Fungicide treatments, mixed with Induce NIS, were sprayed to basil (*Ocimum basilicum*) at the 4-6 lf stage starting Oct 25, with subsequent applications on Nov 1 and 7. Disease pressure arose from natural inoculum and downy mildew lesions were first observed in the trial area on Oct 29. The translaminar and/or systemic fungicides Ridomil, Revus, Forum, Ranman and Reason provided excellent control, the phosphonic compounds K-Phite and ProPhyt were less effective, and Bravo provided poor control of a severe disease pressure (Table 56). No phytotoxicity was observed for any treatment.

In a second experiment, fungicide treatments, mixed with Induce NIS, were sprayed at the 4-6 lf stage starting Oct 25, with subsequent applications on Nov 1 and 7. Of the three fungicides evaluated in this experiment, Revus provided the highest level of downy mildew control, followed by ProPhyt and Previcur (Table 57). A spray interval or pre-harvest interval of 7 days would be much more appropriate for this high disease pressure. No phytotoxicity was observed for any treatment.

In a third experiment, fungicide treatments were sprayed at the 4-6 lf stage starting Oct 25, with subsequent applications on Nov 1 and 7. Biotune, an adjuvant specifically formulated for use with Serenade and Sonata, was added to those respective treatments; for all other treatments, Induce NIS was added. The strobilurin-containing compounds Amistar and Pristine provided the best control, Tanos and the phosphonic compound ProPhyt were intermediate, and the biofungicides were ineffective against a severe disease pressure (Table 58). In order to obtain economic control, it may be necessary to apply biofungicides more frequently than one time per week. No phytotoxicity was observed for any treatment.

In a fourth experiment, fungicide treatments, mixed with Induce NIS, were applied at the cotyledon stage starting Dec 12, with subsequent applications on Dec 24, Jan 1 and 12. All treatments reduced infection from a severe disease pressure, with Forum, Amistar, Revus, and Ranman resulting in the greatest disease reduction (Table 59). No phytotoxicity was observed for any treatment.

In a fifth experiment, fungicide treatments, mixed with Induce NIS, were applied at the cotyledon stage starting Dec 12, with subsequent applications on Dec 24, Jan 1 and 12. Disease pressure arose from natural inoculum and it is significant to note that downy mildew was observed in the trial area on the date of initial application, but visual incidence was low. All treatments reduced infection from a severe disease pressure, with the potassium phosphites, ProPhyt, NutriPhite, Phostrol, K-Phite, and Agri-Fos resulting in the greatest disease reduction (Table 60). All treatments provided for significant increases in fresh biomass, with the most efficacious treatments providing for correspondingly higher increases. No phytotoxicity was observed for any treatment.

In a sixth experiment, fungicide treatments, mixed with Induce NIS, were sprayed at the 4-6 lf stage starting Oct 25, with subsequent applications on Nov 1 and 7. Of the three fungicides evaluated in this experiment, Forum provided the highest level of downy mildew control, followed by Amistar and Rescue (Table 61). A spray interval or pre-harvest interval of 7 days would be much more appropriate for this high disease pressure. No phytotoxicity was observed for any treatment.

In a seventh experiment, fungicide treatments, mixed with Induce NIS, were applied at the cotyledon stage starting Dec 17, with subsequent applications on Dec 26, Jan 3 and 12. Disease pressure arose from natural inoculum and it is significant to note that downy mildew was observed in the trial area on the date of initial application, but visual incidence was low. All treatments reduced infection from a severe disease pressure (Table 62). With each of the four fungicides of dissimilar mode of actions (Amistar, Revus, Ranman, and Presidio), the addition of the phosphonic fungicide Rampart resulted in significant improvements in efficacy over each used individually. No phytotoxicity was observed for any treatment.



In the eighth 2007 experiment, fungicide treatments, mixed with Induce NIS, were applied at the cotyledon stage starting Dec 17, with subsequent applications on Dec 26, Jan 3 and 12. Disease pressure arose from natural inoculum and it is significant to note that downy mildew was observed in the trial area on the date of initial application, but visual incidence was low. All treatments reduced infection from a severe disease pressure (Table 63). In treatments where a single compound was used, Reason provided the best control, followed by Forum, Rampart, Previcur, and finally Actigard. The addition of the phosphonic fungicide Rampart to each of these provided significant improvements in efficacy. Reason or Forum, whether alone or tank-mixed with Rampart, resulted in significantly higher fresh biomass than all other treatments. No phytotoxicity was observed for any treatment.

**Table 56. \*Efficacy on Downy Mildew (*Peronospora belbahrii*) of Basil (*Ocimum basilicum*) 'Martina', Raid, FL, 2007, Test 1.**

Treatment and rate/acre	% Severity <sup>x</sup>		Whole plant disease rating <sup>z</sup>
	Nov 6	Nov 18 <sup>y</sup>	
Bravo Ultrex 82.5WDG 2 lb	14 b	64 b	5.7 a
Forum F 6 fl oz	2 bc	19 c	0.0 d
K-Phite SL 3 pt	3 bc	25 c	2.7 b
Previcur Flex EC 2 pt	2 c	38 bc	2.0 cd
ProPhyt SL 3 pt	1 c	16 c	3.0 b
Ranman 400SC 2.75 fl oz	3 bc	23 c	0.3 cd
Reason 500 SC 6 fl oz	1 c	11 c	0.7 cd
Revus 250 SC 6 fl oz	0 c	11 c	0.0 d
Ridomil Gold EC 1 pt	1 c	16 c	0.7 cd
Untreated	33 a	100 a	7.3 a

\* Not an IR-4 Experiment: Plant Disease Management Reports 2:V066.

<sup>x</sup> Column means with a letter in common are not significantly different (Fisher's LSD  $P=0.05$ ).

<sup>y</sup> Mean disease severity on the leaves collected on 6 Nov following 12 days in refrigerated storage. This rating provides an indication of residual control.

<sup>z</sup> Disease ratings on Nov 18 using a 0-10 scale with 0=no visible disease, 2 = disease visible in lower third of canopy only, 4 = disease visible in lower to mid canopy, no necrosis, 6 = disease visible in lower to mid canopy, some necrosis in lower canopy, 8 = disease visible throughout entire canopy, no necrosis in mid to upper, and 10 = disease visible throughout entire canopy, necrosis prevalent throughout.

**Table 57. \*Efficacy on Downy Mildew (*Peronospora belbahrii*) of Basil (*Ocimum basilicum*) 'Martina', Raid, FL, 2007, Test 2.**

Treatment and rate/acre	% Severity <sup>x</sup>		Whole plant disease rating <sup>z</sup>
	Nov 6	Nov 19 <sup>y</sup>	
ProPhyt SL 1 pt	6 c	32 cd	5.8 bc
ProPhyt SL 2 pt	5 c	33 cd	5.3 c
ProPhyt SL 3 pt	5 c	21 cd	4.3 cd
Previcur Flex EC 1 pt	24 b	76 ab	7.0 b
Previcur Flex EC 1.5 pt	8 c	55 bc	7.0 b
Previcur Flex EC 2 pt	8 c	46 cd	5.7 bc
Revus SC 4 fl oz	3 c	17 cd	3.3 d
Revus SC 6 fl oz	2 c	11 d	0.8 e
Revus SC 8 fl oz	2 c	7 d	0.5 e
Untreated	49 a	98 a	9.3 a

\* Not an IR-4 Experiment: Plant Disease Management Reports 2:V067.

<sup>x</sup> Column means with a letter in common are not significantly different (Fisher's LSD  $P=0.05$ ).

<sup>y</sup> Mean disease severity on the leaves collected on 6 Nov following 13 days in refrigerated storage. This rating provides an indication of residual control.

<sup>z</sup> Disease ratings on Nov 19 using a 0-10 scale with 0=no visible disease, 2 = disease visible in lower third of canopy only, 4 = disease visible in lower to mid canopy, no necrosis, 6 = disease visible in lower to mid canopy, some necrosis in lower canopy, 8 = disease visible throughout entire canopy, no necrosis in mid to upper, and 10 = disease visible throughout entire canopy, necrosis prevalent throughout.

**Table 58. \*Efficacy on Downy Mildew (*Peronospora belbahrii*) of Basil (*Ocimum basilicum*) 'Martina', Raid, FL, 2007, Test 3.**

Treatment and rate/acre	% Severity <sup>x</sup>		Whole plant disease rating <sup>z</sup>
	Nov 6	Nov 18 <sup>y</sup>	
Actigard 50DF 0.5 oz	26 bc	99 ab	7.7 b
Actinovate WP 12 oz	26 bc	91 c	8.0 b
Amistar 80WDG 4 oz	5 d	39 e	1.7 d
Kocide DF 2 lb	23 bc	94 bc	7.7 b
Pristine WDG 16 oz	3 d	3 f	1.0 d
ProPhyt SL 3 pt	6 d	55 de	5.2 c
Serenade Max WP 4 lb	36 b	96 abc	8.0 b
Sonata ASO 4 pt	38 b	92 bc	7.5 b
Tanos 50DF 8 oz	10 cd	73 d	5.8 c
Untreated	66 a	100 a	9.5 a

\* Not an IR-4 Experiment: Plant Disease Management Reports 2:V068.

<sup>x</sup> Column means with a letter in common are not significantly different (Fisher's LSD  $P=0.05$ ).

<sup>y</sup> Mean disease severity on the leaves collected on 6 Nov following 12 days in refrigerated storage. This rating provides an indication of residual control.

<sup>z</sup> Disease ratings on Nov 18 using a 0-10 scale with 0=no visible disease, 2 = disease visible in lower third of canopy only, 4 = disease visible in lower to mid canopy, no necrosis, 6 = disease visible in lower to mid canopy, some necrosis in lower canopy, 8 = disease visible throughout entire canopy, no necrosis in mid to upper, and 10 = disease visible throughout entire canopy, necrosis prevalent throughout.

**Table 59. \*Efficacy on Downy Mildew (*Peronospora belbahrii*) of Basil (*Ocimum basilicum*), Raid, FL, 2007, Test 4.**

Treatment and rate/acre	Fresh biomass <sup>x</sup> (grams/10 plants)	% Downy mildew control <sup>y</sup>
Amistar 82.5WDG 4 oz	137 ab	73 ab
Forum 6F 6 fl oz	122 bc	82 a
Presidio 4F 4 fl oz	90 de	58 c
Previcur 6F 2 pt	76 ef	33 e
Pristine WDG 16 oz	155 a	58 c
ProPhyt 4L 4 pt	106 cd	57 c
Ranman 250SC 4 fl oz	125 bc	70 b
Revus 250SC 6 fl oz	124 bc	73 ab
Tanos 50DF 8 oz	73 ef	45 d
Untreated	59 f	0 f

\* Not an IR-4 Experiment: Plant Disease Management Reports 3:V160.

<sup>x</sup> Aggregate fresh biomass of 10 basil plants (including roots) harvested at random from the two central rows within each experimental unit on Jan 19. Column means with a letter in common are not significantly different (Fisher's LSD  $P=0.05$ ).

<sup>y</sup> Level of downy mildew control on Jan 19 expressed as a percentage relative to the untreated check (0 %).

**Table 60. \*Efficacy on Downy Mildew (*Peronospora belbahrii*) of Basil (*Ocimum basilicum*), Raid, FL, 2007, Test 5.**

Treatment and rate/acre	Fresh biomass <sup>x</sup> (grams/10 plants)	% Downy mildew control <sup>y</sup>
Agri-Fos 6 pt	99 bc	75 a
Calci-Phite 6 pt	71 e	40 c
K-Phite 6 pt	113 ab	75 a
NutriPhite 6 pt	113 ab	78 a
Phostrol 6 pt	112 ab	77 a
ProPhyt 6 pt	121 a	78 a
Rampart 6 pt	73 de	55 b
Rescue 6 pt	89 cd	52 b
Untreated	51 f	0 d

\* Not an IR-4 Experiment: Plant Disease Management Reports 3:V161. Not all treatments included in table.

<sup>x</sup> Aggregate fresh biomass of 10 basil plants (including roots) harvested at random from the two central rows within each experimental unit on Jan 19. Column means with a letter in common are not significantly different (Fisher's LSD  $P=0.05$ ).

<sup>y</sup> Level of downy mildew control on Jan 19 expressed as a percentage relative to the untreated check (0 %).

**Table 61. \*Efficacy on Downy Mildew (*Peronospora belbahrii*) of Basil (*Ocimum basilicum*) 'Martina', Raid, FL, 2007, Test 6.**

Treatment and rate/acre	% Severity <sup>x</sup>		Whole plant disease rating <sup>z</sup>
	Nov 6	Nov 19 <sup>y</sup>	
Amistar 80WDG 3 oz	5 d	40 c	3.5 e
Amistar 80WDG 4 oz	5 d	43 c	2.8 ef
Amistar 80WDG 5 oz	3 d	42 c	2.3 f
Forum F 4 fl oz	5 d	44 c	2.3 f
Forum F 6 fl oz	2 d	31 c	0.8 g
Forum F 8 fl oz	2 d	25 c	0.5 g
Rescue SL 2 pt	42 b	99 a	8.7 b
Rescue SL 3 pt	39 b	100 a	7.7 c
Rescue SL 4 pt	26 c	92 b	6.7 d
Untreated	64 a	100 a	10.0 a

\* Not an IR-4 Experiment: Plant Disease Management Reports 2:V069.

<sup>x</sup> Column means with a letter in common are not significantly different (Fisher's LSD  $P=0.05$ ).

<sup>y</sup> Mean disease severity on the leaves collected on 6 Nov following 13 days in refrigerated storage. This rating provides an indication of residual control.

<sup>z</sup> Disease ratings on Nov 19 using a 0-10 scale with 0=no visible disease, 2 = disease visible in lower third of canopy only, 4 = disease visible in lower to mid canopy, no necrosis, 6 = disease visible in lower to mid canopy, some necrosis in lower canopy, 8 = disease visible throughout entire canopy, no necrosis in mid to upper, and 10 = disease visible throughout entire canopy, necrosis prevalent throughout.

**Table 62. \*Efficacy on Downy Mildew (*Peronospora belbahrii*) of Basil (*Ocimum basilicum*), Raid, FL, 2007, Test 7.**

Treatment and rate/acre	Fresh biomass <sup>x</sup> (grams/10 plants) <sup>x</sup>	% Downy mildew control <sup>y</sup>
Amistar WDG 4 oz	190 a	75 b
Amistar 4 oz + Rampart 4pt	198 a	81 a
Presidio 4F 4fl oz	125 b	45 d
Presidio 4 fl oz + Rampart 4 pt	133 b	63 c
Rampart 4 pt	112 b	48 d
Ranman 250SC 3 fl oz	139 b	60 c
Ranman 3 fl oz + Rampart 4 pt	186 a	75 b
Revus 250SC 6 fl oz	140 b	62 c
Revus 6 fl oz + Rampart 4 pt	175 a	73 b
Untreated	78 c	0 e

\* Not an IR-4 Experiment: Plant Disease Management Reports 3:V162.

<sup>x</sup> Aggregate fresh biomass of 10 basil plants (including roots) harvested at random from the two central rows within each experimental unit on Jan 19. Column means with a letter in common are not significantly different (Fisher's LSD  $P=0.05$ ).

<sup>y</sup> Level of downy mildew control on Jan 19 expressed as a percentage relative to the untreated check (0 %).

**Table 63. \*Efficacy on Downy Mildew (*Peronospora belbahrii*) of Basil (*Ocimum basilicum*), Raid, FL, 2007, Test 8.**

Treatment and rate/acre	Fresh biomass <sup>x</sup> (grams/10 plants) <sup>x</sup>	% Downy mildew control <sup>y</sup>
Actigard WDG 0.5 oz	55 e	23 g
Actigard 0.5 oz + Rampart 4pt	99 bcd	48 e
Forum 6F 6 fl oz	106 abc	68 cd
Forum 6 fl oz + Rampart 4 pt	131 a	83 ab
Previcur 6F 2 pt	70 de	37 f
Previcur 2 pt + Rampart 4 pt	91 bcd	60 d
Rampart 4 pt	89 cd	48 e
Reason 500SC 6 fl oz	130 a	75 bc
Reason 6 fl oz + Rampart 4 pt	120 ab	87 a
Untreated	58 e	0 h

\* Not an IR-4 Experiment: Plant Disease Management Reports 3:V163.

<sup>x</sup> Aggregate fresh biomass of 10 basil plants (including roots) harvested at random from the two central rows within each experimental unit on Jan 19. Column means with a letter in common are not significantly different (Fisher's LSD  $P=0.05$ ).

<sup>y</sup> Level of downy mildew control on Jan 19 expressed as a percentage relative to the untreated check (0 %).

In 2010, Raid conducted five field experiments to determine the efficacy of several products to control basil downy mildew, caused by *Peronospora belbahrii*. In the first test, fungicide treatments were sprayed to basil (*Ocimum basilicum*) on Feb 20 and 27, Mar 6, 13, 20, and 27. All fungicide treatments provided control of a moderate disease pressure (Table 64). BAS 651F at the higher rate was comparable to the industry standard Revus when an adjuvant was used with each. No phytotoxicity was observed for any treatment.

In a second test, fungicide treatments, mixed with various adjuvants, were sprayed at the cotyledon stage starting Apr 19, with subsequent applications on Apr 25 and May 3. All fungicide treatments provided control of a severe disease pressure (Table 65). BAS 651 performed well, whether alone or in alternation, although slightly less control was obtained with alternations. No phytotoxicity was observed for any treatment.

In a third test, fungicide treatments, mixed with Induce NIS, were sprayed at the 4-5 If stage starting Apr 18, with subsequent applications on Apr 24, 30 and May 3. All fungicide treatments provided control of a severe disease pressure, with Revus providing the best control, followed by Ranman, Presidio and Quadris (Table 66). No phytotoxicity was observed for any treatment.

In a fourth test, fungicide treatments, mixed with Induce NIS, were sprayed at the 4-5 If stage starting Apr 18, with subsequent applications on Apr 24, 30 and May 3. All fungicide treatments provided control of a severe disease pressure, with Revus providing superior control, compared to Quadris and Nutri-Phite (Table 67). No phytotoxicity was observed for any treatment.

In the fifth 2010 field test, fungicide treatments, mixed with Induce NIS, were sprayed at the 4-5 If stage starting Oct 14, with subsequent applications on Oct 21, 28, and Nov 4. All fungicide treatments provided control of a severe disease pressure, with Revus, Ridomil Gold and Quadris providing the most effective control, followed by Zampro and Ranman, which provided intermediate levels of control (Table 68). No phytotoxicity was observed for any treatment.

**Table 64. \*Efficacy on Downy Mildew (*Peronospora belbahrii*) of Basil (*Ocimum basilicum*) 'Large Leaf Italian', Raid, FL, 2010, Test 1.**

Treatment and rate/acre	Downy mildew rating <sup>x</sup>
Aliette 80WDG 5 lb	2.4 bc
BAS 651 F 11.0 fl oz	2.9 b
BAS 651 F 13.7 fl oz	2.1 c
BAS 651 F 11.0 fl oz + Silwet 0.06% v/v	1.4 d
BAS 651 F 13.7 fl oz + Silwet 0.06% v/v	0.6 e
Reason 500SC + Bond 0.06% v/v	1.5 d
Revus 250SC + Silwet 0.06% v/v	0.6 e
Untreated	4.0 a

\* Not an IR-4 Experiment: Plant Disease Management Reports 5:V045.

<sup>x</sup> Mildew rated on a 0 to 4 scale with 0 representing no disease and 4 representing the level of disease in the untreated check on Apr 11. Column means with a letter in common are not significantly different (Fisher's LSD  $P=0.05$ ).

**Table 65. \*Efficacy on Downy Mildew (*Peronospora belbahrii*) of Basil (*Ocimum basilicum*) 'Large Leaf', Raid, FL, 2010, Test 2.**

Treatment and rate/acre	Downy mildew rating <sup>x</sup>	% Disease Severity <sup>y</sup>
BAS 651 F 14.0 fl oz (Induce 0.125% v/v)	0.8 ef	3 d
BAS 651 F 14.0 fl oz (Silwet 0.125% v/v)	1.4 de	9 cd
BAS 651 F 14.0 fl oz (Agridex 0.125% v/v)	0.5 f	3 d
BAS 651 F 13.7 fl oz alt. w/ Maneb 4F 2.0 qt (Induce 0.125% v/v)	2.0 cd	10 bc
BAS 651 F 13.7 fl oz alt. w/ Nutri-Phite SL 3.0 pt (Induce 0.125% v/v)	1.5 cd	8 cd
Nutri-Phite SL 3.0 pt alt. w/ Maneb 4F 2.0 qt (Induce 0.125% v/v)	3.1 b	16 b
Nutri-Phite SL 3.0 pt (Induce 0.125% v/v)	2.1 c	11 bc
Untreated	5.0 a	49 a

\* Not an IR-4 Experiment: Plant Disease Management Reports 5:V046.

<sup>x</sup> Mildew rated on a 0 to 5 scale with 0 representing no disease and 5 representing the level of disease in the untreated check on May 10. Column means with a letter in common are not significantly different (Fisher's LSD  $P=0.05$ ).

<sup>y</sup> Percentage of the canopy exhibiting downy mildew symptoms on May 10.

**Table 66. \*Efficacy on Downy Mildew (*Peronospora belbahrii*) of Basil (*Ocimum basilicum*) 'Italian Large Leaf', Raid, FL, 2010, Test 3.**

Treatment and rate/acre	Downy mildew rating <sup>x</sup>	% Disease Severity <sup>y</sup>
Nutri-Phite SL 3.0 pt	4.0 b	27 b
Presidio 4F 4.0 fl oz	2.8 c	14 d
Quadris SC 15.2 fl oz	3.1 c	19 c
Ranman 400SC 4.0 fl oz	1.6 d	11 d
Revus 250SC 8.0 fl oz	0.4 e	1 e
Untreated	10.0 a	82 a

\* Not an IR-4 Experiment: Plant Disease Management Reports 5:V047.

<sup>x</sup> Mildew rated on a 0 to 10 scale with 0 representing no disease and 10 representing the level of disease in the untreated check on May 10. Column means with a letter in common are not significantly different (Fisher's LSD  $P=0.05$ ).

<sup>y</sup> Percentage of the canopy exhibiting downy mildew symptoms on May 10.

**Table 67. \*Efficacy on Downy Mildew (*Peronospora belbahrii*) of Basil (*Ocimum basilicum*) 'Italian Large Leaf', Raid, FL, 2010, Test 4.**

Treatment and rate/acre	Downy mildew rating <sup>x</sup>	% Disease Severity <sup>y</sup>
Nutri-Phite SL 3.0 pt	5.1 b	36 b
Quadris SC 15.2 fl oz	4.5 b	29 bc
Quadris SC 15.2 fl oz alt w/ Nutri-Phite SL 3.0 pt	2.8 c	20 cd
Quadris SC 15.2 fl oz + Nutri-Phite SL 3.0 pt	2.0 c	6 de
Revus 250SC 8.0 fl oz	0.8 d	2 e
Untreated	10.0 a	80 a

\* Not an IR-4 Experiment: Plant Disease Management Reports 5:V048.

<sup>x</sup>. Mildew rated on a 0 to 10 scale with 0 representing no disease and 10 representing the level of disease in the untreated check on May 10. Column means with a letter in common are not significantly different (Fisher's LSD  $P=0.05$ ).

<sup>y</sup> Percentage of the canopy exhibiting downy mildew symptoms on May 10.

**Table 68. \*Efficacy on Downy Mildew (*Peronospora belbahrii*) of Basil (*Ocimum basilicum*) 'Italian Large Leaf', Raid, FL, 2010, Test 5.**

Treatment and rate/acre	% Severity <sup>x</sup>		% Marketable stems <sup>y</sup>
	Nov 5	Nov 11	
Bravo Weatherstik F, 1.5 pt	25 b	31 bc	25 d
Nutri-Phite SL, 6.0 pt	25 b	39 b	24 c
Presidio 4F, 4.0 fl oz	14 c	29 cd	37 c
Quadris SC, 15.0 fl oz	1 e	6 fg	89 a
Ranman 400SC, 4.0 fl oz	10 cd	20 de	56 b
Revus 250SC, 8.0 fl oz	3 de	0 g	85 a
Ridomil Gold EC, 16.0 fl oz	6 cde	4 fg	86 a
Zampro SC, 14.0 fl oz	3 de	12 ef	68 b
Untreated	64 a	88 a	0 d

\* Not an IR-4 Experiment: Plant Disease Management Reports 5:V157.

<sup>x</sup> Downy mildew severity was the percentage of total plant canopy exhibiting downy mildew symptoms at two randomly selected location. Column means with a letter in common are not significantly different (Fisher's LSD  $P=0.05$ ).

<sup>y</sup> Percentage of stem tips at least 6 inches in length not exhibiting visible downy mildew symptoms at time of harvest on Nov 14.

In 2010, Zhang conducted three greenhouse experiments to determine the efficacy of biological and biorational products to control basil downy mildew, caused by *Peronospora belbahrii*. In the first experiment, fungicide treatments were sprayed to basil (*Ocimum basilicum*) on Aug 19, 26, and Sep 2, and plants were inoculated on Sep 4. Actinovate, HMO 736, Regalia and Sonata significantly reduced a high disease severity, but were much inferior to Prophyt and the standard Prophyt + Quadris (Table 69). In the second experiment, fungicide treatments were sprayed to basil on Sep 22, 29 and Oct 6, and plants were inoculated on Oct 9. Actinovate, BU EXP 1216 C and Companion significantly reduced a high disease severity, but were much inferior to Prophyt and the standard Prophyt + Quadris (Table 70). Disease severity or incidence from all biologicals was non-significant when compared to the untreated check during the last assessment of experiments 1 (Oct 2) and 2 (Nov 10) except for Sonata in experiment 1 and Actinovate and Sonata in experiment 2.

The third 2010 greenhouse experiment evaluated application timing of fungicide treatments, which were sprayed to basil pre-pathogen inoculation (Nov 1, 8 and 15) and post-pathogen inoculation ( Nov 23, 30, and Dec 7); plants were inoculated on Nov 16. Overall, Actinovate, BU EXP 1216 C, Regalia and Sonata effectively reduced downy mildew severity in greenhouse grown basil particularly when applied pre- + post-inoculation (Table 71). Furthermore, Actinovate, regardless of the application timing and BU EXP 1216 C applied as pre-inoculation treatment significantly reduced number of defoliated leaves compared to the untreated check.

**Table 69. \*Efficacy on Downy Mildew (*Peronospora belbahrii*) of Basil (*Ocimum basilicum*) 'Genovese', Zhang, FL, 2010, Experiment 1.**

Treatment and rate/acre	% Disease Severity <sup>x</sup>			Total infected leaves (%)
	Sep 17	Oct 2	AUDPC <sup>y</sup> (%-days)	
Actinovate 12 oz	0.30 cd	82.0 ab	664.4 b	84.5 a
BU EXP 1216 C 3 lb	0.04 c	86.2 ab	733.7 ab	85.1 a
BU EXP 1216 S 3 lb	3.00 abc	82.0 ab	820.6 ab	86.5 a
Companion 32 fl oz	3.70 ab	81.0 ab	771.1 ab	87.8 a
HMO 736 14 oz	1.02 abc	83.6 ab	672.0 b	83.7 a
Prophyt 4 pt	0.20 bc	21.6 c	70.3 c	41.3 b
Prophyt 2 pt + Quadris, 9 fl oz	0.00 c	15.0 c	33.7 c	45.6 b
Regalia SC 1% v/v	0.22 bc	83.2 ab	659.1 b	86.1 a
Serenade 3 lb	4.20 a	80.0 ab	758.6 ab	85.8 a
Sonata 4 qt	0.56 bc	74.0 b	631.6 b	83.3 a
Untreated	2.50 abc	92.7 a	890.7 a	85.4 a

\* Not an IR-4 Experiment: Plant Disease Management Reports 6:V059.

<sup>x</sup> Downy mildew severity was the percentage of symptomatic leaf area (signs and symptoms) of all plants in a pot. Column means with a letter in common are not significantly different (Tukey's HSD  $P = 0.05$ ).

<sup>y</sup> Area under the disease progress curve (AUDPC) was based on four disease ratings that were made on Sep 17, 23, 28 and Oct 2.

**Table 70. \*Efficacy on Downy Mildew (*Peronospora belbahrii*) of Basil (*Ocimum basilicum*) 'Genovese', Zhang, FL, 2010, Experiment 2.**

Treatment and rate/acre	% Disease Severity <sup>x</sup>			Total infected leaves (%)
	Oct 18	Nov 10	AUDPC <sup>y</sup> (%-days)	
Actinovate 12 oz	3.0 cd	70.7 b	1091.5 d	89.3 a
BU EXP 1216 C 3 lb	4.0 bc	88.3 a	1381.8 c	90.5 a
BU EXP 1216 S 3 lb	7.3 ab	93.0 a	1549.5 ab	92.1 a
Companion 32 fl oz	4.3 bc	91.7 a	1488.2 bc	90.3 a
HMO 736 14 oz	6.0 abc	91.7 a	1544.0 abc	88.8 a
Prophyt 4 pt	0.00 d	10.3 c	175.8 e	40.4 b
Prophyt 2 pt + Quadris, 9 fl oz	0.00 d	0.3 d	1.3 f	5.2 c
Regalia SC 1% v/v	7.0 ab	95.0 a	1595.2 ab	80.4 a
Serenade 3 lb	7.7 ab	93.0 a	1606.5 ab	84.3 a
Sonata 4 qt	5.7 abc	92.3 b	1615.2 ab	80.4 a
Untreated	8.0 a	94.0 a	1698.5 a	89.6 a

\* Not an IR-4 Experiment: Plant Disease Management Reports 6:V059.

<sup>x</sup> Downy mildew severity was the percentage of symptomatic leaf area (signs and symptoms) of all plants in a pot. Column means with a letter in common are not significantly different (Tukey's HSD  $P = 0.05$ ).

<sup>y</sup> Area under the disease progress curve (AUDPC) was based on six disease ratings that were made on Oct 18, 22, 29, Nov 2, 6 and 10.



**Table 71. \*Efficacy on Downy Mildew (*Peronospora belbahrii*) of Basil (*Ocimum basilicum*) 'Genovese', Zhang, FL, 2010, Experiment 3.**

Treatment and rate/acre	% Disease Severity <sup>x</sup>			Total infected leaves (%)	Total defoliated leaves (%)
	Oct 18	Nov 10	AUDPC <sup>y</sup> (%-days)		
Actinovate 12 oz					
Pre-pathogen	5.0 a	85.2 abc	531 g	90.5 a	3.1 cd
Pre- + Post-pathogen	6.7 a	78.6 cd	520 g	76.7 ab	3.1 cd
BU EXP 1216 C <sup>z</sup> 3 lb					
Pre-pathogen	5.3 a	85.9 abc	736 def	92.9 a	3.1 cd
Pre- + Post-pathogen	7.0 a	88.6 ab	738 def	92.9 a	3.6 bcd
BU EXP 1216 S <sup>z</sup> 3 lb					
Pre-pathogen	9.3 a	91.9 a	996 ab	100.0 a	4.1 abc
Pre- + Post-pathogen	10.0 a	92.6 a	1006 a	93.8 a	4.9 a
Companion 32 fl oz					
Pre-pathogen	10.0 a	89.9 ab	814 bcde	95.9 a	3.9 abcd
Pre- + Post-pathogen	8.0 a	85.2 abc	638 efg	92.9 a	3.8 abcd
HMO 736 14 oz					
Pre-pathogen	4.3 a	91.9 a	810 cde	97.7 a	3.4 bcd
Pre- + Post-pathogen	6.0 a	86.6 abc	728 def	100.0 a	3.6 bcd
Regalia SC 1% v/v					
Pre-pathogen	6.3 a	91.9 a	847 abcd	93.1 a	3.2 bcd
Pre- + Post-pathogen	6.7 a	87.6 ab	636 efg	87.8 a	3.3 bcd
Serenade 3 lb					
Pre-pathogen	8.3 a	88.2 ab	744 def	96.4 a	3.6 bcd
Pre- + Post-pathogen	6.7 a	88.6 ab	827 abcd	90.5 a	3.2 bcd
Sonata 4 qt					
Pre-pathogen	6.0 a	82.6 bcd	636 efg	100.0 a	3.0 cd
Pre- + Post-pathogen	7.7 a	76.2 d	577 fg	53.6 b	2.9 d
Untreated	11.0 a	88.7 ab	972 abc	97.6 a	4.2 ab

\* Not an IR-4 Experiment: Plant Disease Management Reports 6:V060.

<sup>x</sup> Downy mildew severity was the percentage of symptomatic leaf area (signs and symptoms) of all plants in a pot. Column means with a letter in common are not significantly different (Tukey's HSD  $P = 0.05$ ).

<sup>y</sup> Area under the disease progress curve (AUDPC) was based on four disease ratings that were made on Nov 23, 30, Dec 6, and 13.

<sup>z</sup> BU EXP 1216 S has a water soluble diluent and BU EXP 1216 C has a water insoluble diluent.

In 2011, Babadoost conducted a field trial to determine the efficacy of several products to control basil downy mildew, caused by *Peronospora belbahrii*. Fungicide treatments, were sprayed to basil (*Ocimum basilicum*) at weekly interval on Jul 16, 23, 30, Aug 6, 13, 20, 27, and Sep 3. Disease pressure arose from natural inoculum and downy mildew lesions were first observed in the trial area on Aug 18. ProPhyt, Forum, Ranman, Revus, and Zampro provided effective control, while the organic products (Nordox 75WG, Nordox 75WG + Safe-T-Side, Serenade + Induce, Sonata + Induce, and Serenade + Regalia) provided poor control of a severe disease pressure (Table 72).

**Table 72. \*Efficacy on Downy Mildew (*Peronospora belbahrii*) of Basil (*Ocimum basilicum*) 'Esmeralda', Babadoost, IL, 2011.**

Treatment and rate/acre	% Disease Severity <sup>x</sup>	
	Aug 27	Sep 3
Forum 4.16SC 6 fl oz	0.0 d	2.5 e
Gavel 75DF 2 lb	0.0 d	25.0 cd
Nordox 75WG 14oz	37.5 c	72.5 a
Nordox 75WG 8 oz. + Safe-T-Side, 2% v/v	47.5 bc	87.5 a
Presidio 4SC 4 fl oz	2.5 d	27.5 c
ProPhyt 4L 3 pt	2.5 d	2.5 e
Ranman 400SC 2.75 fl oz	0.0 d	5.0 e
Revus 2.09SC 4 fl oz	0.0 d	2.5 e
Serenade 2 qt + Induce 90	60.0 b	80.0 a
Serenade 2 qt + Regalia, 1% v/v	85.0 a	87.5 a
Sonata 2 qt	45.0 bc	77.5 a
Tanos 50DWG 10 oz	12.5 d	52.5 b
Zampro 525SC 14 fl oz	0.0 d	5.0 e
Untreated	55.0 b	85.0 a

\* Not an IR-4 Experiment: Plant Disease Management Reports 6:V131. Not all products tested included in table.

<sup>x</sup> Severity = percent area of leaves affected. Column means with a letter in common are not significantly different (Fisher's Protected LSD  $P=0.05$ ).

<sup>y</sup> Induce 90 adjuvant at 0.125% v:v was mixed with all treatments, except Nordox 75WG.

In 2011, Zhang conducted a field trial to determine the efficacy of acibenzolar-S-methyl (ASM) with and without fungicide combination to control basil downy mildew. Treatments were sprayed to basil on Feb 14, 22, and 28 for those plots with a 3 x application and continued on Mar 15, 22 and 29 for those with 6 x sprays. All treatments, except for the 3 x application of ASM at 25 mg/L, significantly reduced a high disease severity (Table 73). Increased frequency of ASM application from 3 x to 6 x resulted in better control of downy mildew. Six weekly sprays of the standard ProPhyt + Quadris mix starting from the early season resulted in better disease control than when ASM was followed by two sprays of the fungicide mix at the end of season.

In 2011, McGrath conducted a field trial to determine the efficacy of biopesticides to control basil downy mildew. Treatments were sprayed weekly on a preventive schedule from Aug 11 to Sep 16. Disease pressure arose from natural inoculum and downy mildew lesions were first observed in the plots on Aug 25. Unusually frequent rains provided favorable conditions for downy mildew. Suppression of downy mildew was not detected with any treatment, including the conventional fungicide Revus (Table 74). These results document the challenges of effectively managing downy mildew in basil when conditions are very favorable. Among the biopesticide treatments, the numerically fewest affected leaves were observed in plots treated with ProPhyt, similar to plots treated with Revus.

**Table 73. \*Efficacy on Downy Mildew (*Peronospora belbahrii*) of Basil (*Ocimum basilicum*) 'Genovese', Zhang, FL, 2011.**

Treatment, (rate) and frequency <sup>z</sup>	% Disease Severity <sup>x</sup>			Plant height infected (%)
	Mar 8	Apr 5	AUDPC <sup>y</sup> (%-days)	
Acibenzolar (25 mg/L) 3 x	0.09 b	73.4 ab	427.5 a	90.5 ab
Acibenzolar (50 mg/L) 3 x	0.08 b	58.8 b	299.2 b	86.9 ab
Acibenzolar (25 mg/L) 6 x	0.11 b	37.6 c	181.2 cd	62.5 cd
Acibenzolar (50 mg/L) 6 x	0.05 b	36.9 c	207.1 bc	70.8 bc
Acibenzolar (25 mg/L) 3 x + Prophyt-Quadris mix	0.16 b	14.9 d	99.1 cde	46.3 de
Acibenzolar (50 mg/L) 3 x + Prophyt-Quadris mix	0.21 b	12.0 d	80.8 de	18.5 f
Acibenzolar (25 mg/L) 6 x + Prophyt-Quadris mix	0.20 b	7.1 d	78.3 de	31.8 ef
Acibenzolar (50 mg/L) 6 x + Prophyt-Quadris mix	0.41 b	10.1 d	96.1 de	28.3 ef
Prophyt (2.5 ml/L) + Quadris (0.7 ml/L) 6 x <sup>w</sup>	0.08 b	3.4 d	18.7 e	18.1 f
Untreated	1.38 a	83.5 a	511.3 a	94.2 a

\* Not an IR-4 Experiment: Plant Disease Management Reports 6:V088.

<sup>z</sup> Acibenzolar sprays were made on Feb 14, 21, and 28 for the 3 x treatments and continued on Mar 15, 22, and 29 for the 6 x treatments. All acibenzolar treatments mixed with Silwet L-77 surfactant. When combined with acibenzolar, the Prophyt + Quadris mix was applied during the last two assessments Mar 22 and 29.

<sup>y</sup> Area under the disease progress curve (AUDPC) was based on four disease ratings that were made on Mar 8, 15, 23, 30, and Apr 5.

<sup>x</sup> Disease severity was the percentage of symptomatic leaf area (signs and symptoms). Column means with a letter in common are not significantly different (Tukey's HSD  $P = 0.05$ ).

<sup>w</sup> The standard fungicide was a mixture of Prophyt + Quadris applied 6 x during the same dates as acibenzolar.

**Table 74. \*Efficacy on Downy Mildew (*Peronospora belbahrii*) of Basil (*Ocimum basilicum*) 'Italian Large Leaf', McGrath, NY, 2011.**

Treatment and rate/acre <sup>z</sup>	Incidence of leaves affected by downy mildew (%) <sup>x</sup>			
	Aug 25	Sep 1	Sep 9	AUDPC <sup>y</sup>
Actinovate 12 oz	5.8 a	4.5 a	44.0 a	248.9 ab
Companion 1 gal	5.8 a	20.4 a	54.0 a	390.6 a
Organocide 2 oz/gal	3.7 a	10.4 a	47.5 a	291.7 ab
Oxidate, 1% + Yucca ag-aide 0.25%	4.9 a	16.4 a	56.0 a	388.7 a
ProPhyt 2 qt	2.2 a	4.3 a	25.5 a	148.7 b
Regalia 1%	2.3 a	7.8 a	38.0 a	220.2 ab
Revus 8 fl oz	3.7 a	3.4 a	25.3 a	142.3 b
Sonata ASO 3 qt + Nu-Film P, 0.03%	3.2 a	18.4 a	37.8 a	317.9 ab
Sporatec AG 1 qt + Saf-T-Side, 1.5%	3.0 a	17.3 a	53.5 a	359.0 ab
Timorex Gold 0.75%	5.6 a	9.0 a	42.5 a	259.7 ab
Untreated	6.2 a	14.7 a	41.0 a	307.4 ab

\* Not an IR-4 Experiment: Plant Disease Management Reports 6:V099. Not all products tested included in table.

<sup>x</sup> Column means with a letter in common are not significantly different (Tukey's HSD,  $P=0.05$ ).

<sup>y</sup> AUDPC values were calculated from Aug 25, Sep 1 and 9, and were square root transformed before analysis. Table contains de-transformed values.

<sup>z</sup> All treatments were applied on Aug 11, 17, 24, 31, Sep 7 and 14. Oxidate was also applied on Aug 22, 26, Sep 2, 9, and 16.

In 2012, Raid conducted a field trial to determine the efficacy of several products to control basil downy mildew. Fungicide treatments, mixed with Induce NIS, were sprayed at the 3-4 lf stage on Nov 10, with subsequent applications on Nov 17 and 24. All treatments significantly reduced a severe disease pressure, with Revus, Zampro, QGU42, and Reason, Ranman, Presidio, Forum, and Quadris providing excellent control (Table 75). No phytotoxicity was observed for any treatment.

**Table 75. \*Efficacy on Downy Mildew (*Peronospora belbahrii*) of Basil (*Ocimum basilicum*) 'Large Leaf Italian', Raid, FL, 2012.**

Treatment and rate/acre	% Disease Severity <sup>x</sup>
Forum SC 6.0 fl oz	1 d
Presidio SC 4.0 fl oz	3 d
Previcur Flex EC 2.0 pt	17 c
ProPhyt SL 3.0 pt	58 b
QGU42 OD 2.4 fl oz	0 d
Quadris SC 15.2 fl oz	1 d
Ranman SC 2.75 fl oz	3 d
Reason SC 8.0 fl oz	0 d
Revus SC 8.0 fl oz	0 d
V-10208 SC 10.0 fl oz	20 c
Zampro SC 14.0 fl oz	0 d
Untreated	93 a

\* Not an IR-4 Experiment: Plant Disease Management Reports 7:V146.

<sup>x</sup> Percent leaf area exhibiting downy mildew symptoms on Dec 4. Column means with a letter in common are not significantly different (Fisher's LSD  $P=0.05$ ).

In 2012, McGrath conducted a field trial to determine the efficacy of several products to control basil downy mildew. Treatments were sprayed weekly on a preventive schedule from Aug 7, 14, 20, 27, Sep 7, 13, 20, and 27. Disease pressure arose from natural inoculum and downy mildew lesions were first observed in the trial area on Aug 16. Incidence of leaves with downy mildew was assessed rather than severity because affected leaves are unmarketable. Only QGU42 effectively suppressed downy mildew based on incidence of affected leaves on Sep 7 and AUDPC value (Table 76). Zampro also was effective based on the assessment on Sep 7. While not significant, incidence often was lower than the non-treated control plants for plants treated with the other fungicides. AUDPC values were lower for treated plants except those treated with Previcur Flex. Among the products approved for organic production, AUDPC value was lowest for Organocide applied at the highest label rate (2 oz/gal). The two phosphorous acid fungicides, K-Phite and Pro-Phyt, were similar in efficacy.

In 2013, Zhang conducted a greenhouse trial to determine the efficacy of biopesticides to control basil downy mildew. One pre-inoculation application was made on Jan 3 (Expt 1) and Mar 28 (Expt 2); post-inoculation treatments were applied at weekly intervals in both experiments for 3 times. Plants were inoculated after 24 h (Expt 1) and 48 h (Expt 2) of the first foliar application of products. In both experiments, Timorex Gold, Chitosan, Actinovate, Organocide and the chemical standard Quadris reduced disease severity and AUDPC (Table 77). Among these biopesticides tested, Organocide showed the highest efficacy in suppressing downy mildew disease. Timorex Gold, Chitosan and Actinovate were able to control disease at intermediate levels.

**Table 76. \*Efficacy on Downy Mildew (*Peronospora belbahrii*) of Basil (*Ocimum basilicum*) 'Italian Large Leaf', McGrath, NY, 2012.**

Treatment and rate/acre	Downy mildew incidence (% leaves w/ symptoms) <sup>x</sup>					
	Aug 24	Aug 31	Sep 7	Sep 14	AUDPC <sup>y</sup>	Oct 11
Actinovate 12 oz/A	1.9 b	21.7 a	46.0 a-d	22.0 a	568.8 ab	48.8 a
K-Phite 3 qt/A	0.9 b	19.2 a	34.9 a-d	14.5 a	442.4 ab	46.5 a
NuCop HB 1 lb/A	2.6 ab	20.8 a	42.5 a-d	25.3 a	552.0 ab	33.5 a
Organocide 2 oz/gal	1.2 b	8.7 a	51.6 abc	18.5 a	495.9 ab	42.8 a
Organocide 1 oz/gal + NuCop HB 1 lb/A	3.6 ab	15.4 a	61.1 a	18.2 a	621.3 a	26.8 a
Presidio 4 fl oz/A	2.5 b	17.8 a	31.6 a-d	10.7 a	402.0 ab	48.0 a
Previcur Flex 1.2 pt/A	11.1 a	17.4 a	60.1 a	17.9 a	658.2 a	30.3 a
Pro-Phyt 3 qt/A	2.1 b	11.0 a	41.0 a-d	9.3 a	410.6 ab	33.8 a
QGU42 <sup>z</sup> 2.4 fl oz/A	0.1 b	8.7 a	11.9 d	2.6 a	157.8 b	22.4 a
Ranman <sup>z</sup> 2.75 fl oz/A	6.4 ab	23.5 a	37.3 a-d	15.3 a	516.5 ab	32.5 a
Regalia 0.5 %	3.0 ab	13.7 a	52.1 abc	19.9 a	548.9 ab	48.0 a
Revus <sup>z</sup> 8 fl oz/A	0.2 b	10.6 a	22.0 bcd	4.2 a	248.5 ab	30.5 a
Zampro <sup>z</sup> 14 fl oz/A	1.2 b	14.0 a	16.0 cd	6.3 a	243.9 ab	25.5 a
Untreated	6.2 ab	20.3 a	54.7 ab	26.2 a	650.7 a	54.0 a

\* Not an IR-4 Experiment: Plant Disease Management Reports 7:V015.

<sup>x</sup> Column means with a letter in common are not significantly different (Tukey's HSD, P=0.05).

<sup>y</sup> AUDPC values were calculated from Aug 24 through Sep 14, and were square root transformed before analysis. Table contains de-transformed values.

<sup>z</sup> Ranman and Revus were applied with Silwet L-77 at 0.125% v/v, Zampro and QGU42 were applied with Induce at 0.25% v/v.

**Table 77. \*Efficacy on Downy Mildew (*Peronospora belbahrii*) of Basil (*Ocimum basilicum*) 'Genovese', Zhang, FL, 2013.**

Treatment and rate	Experiment 1		Experiment 2	
	% Disease Severity <sup>x</sup>	AUDPC <sup>y</sup>	% Disease Severity <sup>x</sup>	AUDPC <sup>y</sup>
Actinovate 0.06% v/v	46.3 c	688.8 de	45.8 b	718.1 b
Chitosan 1% v/v	53.8 b	786.8 bc	15.3 cd	268.3 d
Chitosan 1% v/v + Actinovate 0.06% v/v	55.0 b	825.1 ab	14.8 cd	111.4 e
Organocide 200 oz/100 gal	36.3 d	662.4 ef	3.5 e	86.5 e
Quadris 9 oz/ 100 gal	0.0 e	15.6 g	5.8 de	160.5 e
Timorex Gold 1% v/v	37.5 d	608.5 f	20.8 c	372.4 c
Untreated	60.8 a	869.9 a	69.8 a	952.3 a

\* Not an IR-4 Experiment: Plant Disease Management Reports 7:V147. Not all products tested included in table.

<sup>x</sup> Disease severity was the percentage of the leaves affected by downy mildew observed 14 and 12 days after inoculation for Expt 1 and Expt 2, respectively. Column means with a letter in common are not significantly different (Fisher's Protected LSD P = 0.05).

<sup>y</sup> Area under the disease progress curve (AUDPC) was based on four disease severity ratings that were made at 10, 14, 21 and 24 days after inoculation (DAI) in Expt 1, and at 9, 12, 16 and 22 DAI in Expt 2.

In 2013, Zhang conducted a field trial to determine the efficacy of Zorvec (oxathiopiprolin) foliar spray to control basil downy mildew. The first application was made 29 days after planting (DAP) on Jun 14 and

re-applied four times at 7-day intervals through Jul 12. Disease pressure arose from natural inoculum and downy mildew lesions were first observed in the trial area on July 2 (48 DAP). Zorvec at all rates reduced a severe disease incidence comparable to the standard Quadris + ProPhyt (Table 78). No phytotoxicity was observed for any treatment.

**Table 78. \*Efficacy on Downy Mildew (*Peronospora belbahrii*) of Basil (*Ocimum basilicum*) 'Genovese', Zhang, FL, 2013.**

Treatment and rate/acre	% Disease Incidence <sup>x</sup>	
	55 DAP	62 DAP
Quadris (22.9 F) 9 fl oz + ProPhyt (54.5 L) 4 pt	0.0 c	0.0 c
Zorvec 0.0625 fl oz	0.0 c	7.1 c
Zorvec 0.125 fl oz	0.0 c	10.9 c
Zorvec 0.25 fl oz	0.0 c	0.0 c
Zorvec 0.5 fl oz	0.0 c	0.0 c
Zorvec 1 fl oz	0.0 c	0.0 c
Zorvec 2 fl oz	0.0 c	0.0 c
Untreated	14.3 bc	100.0 a

\* Not an IR-4 Experiment: Plant Disease Management Reports 9:OT009.

<sup>x</sup> Disease incidence was measured as the presence or absence of disease symptoms or signs on plants. Column means with a letter in common are not significantly different (Fisher's protected LSD  $P = 0.05$ ). Foliar applications were made 29 days after planting (DAP) and were reapplied four times at 7-day intervals.

In 2014, Zhang conducted a greenhouse trial to determine the efficacy of QGU42 (oxathiapiprolin) to control basil downy mildew. The pre-inoculation application was made on May 10 (Expt 1) and July 5 (Expt 2). One post-inoculation treatment of QGU42 was applied at 14-day interval and the standard ProPhyt was applied weekly for 2 post-application treatments. Plants were inoculated after 24 h of the first treatment application. In both greenhouse experiments, all fungicide treatments reduced disease severity and AUDPC values from a severe disease pressure (Table 79). In Expt 1, QGU42 at 2 fl oz per acre had significantly lower disease compared to all other rates of QGU42, whereas 2 fl oz of QGU42 was not significant compared to other rates except 0.5 fl oz of QGU42 in Expt 2. In both experiments, AUDPC value of 2.0 fl oz QGU42 was comparable to the standard ProPhyt. No phytotoxicity was observed for any treatment.

In 2014, Wick conducted a field trial to determine the efficacy of several products for organic production to control basil downy mildew, caused by *Peronospora belbahrii*. Fungicide treatments, mixed with NuFilm P, were sprayed to basil at 5-day intervals on Aug 20, 25, 30 and Sep 4. Disease pressure arose from natural inoculum and downy mildew lesions were first observed in the trial area on Aug 22. None of the treatments performed as well as the standard Ranman against a severe disease pressure (Table 80). Of the copper products tested, only the NuCop HB treatment significantly reduced disease incidence or severity at any time-point. No phytotoxicity was observed for any treatment.

**Table 79. \*Efficacy on Downy Mildew (*Peronospora belbahrii*) of Basil (*Ocimum basilicum*) 'Genovese', Zhang, FL, 2014.**

Treatment and rate/acre	Experiment 1		Experiment 2	
	% Disease Severity <sup>x</sup>	AUDPC <sup>y</sup>	% Disease Severity <sup>x</sup>	AUDPC <sup>y</sup>
Prophyt 4 pt	0.0 e	0.0 c	0.0 d	0.0 d
QGU42 0.0625 fl oz	10.6 b	47.1 b	7.8 bc	42.3 bc
QGU42 0.125 fl oz	7.4 c	34.5 b	7.0 bc	40.5 bc
QGU42 0.25 fl oz	3.6 d	7.8 c	8.0 bc	46.8 bc
QGU42 0.5 fl oz	3.6 d	5.4 c	11.0 b	62.7 b
QGU42 1.0 fl oz	2.6 d	4.8 c	7.2 bc	40.5 bc
QGU42 2.0 fl oz	0.0 e	0.0 c	5.0 c	13.5 cd
Untreated	80.0 a	588.6 a	71.0 a	421.2 a

\* Not an IR-4 Experiment: Plant Disease Management Reports 8:V208.

<sup>x</sup> Disease severity was the percentage of the leaves affected by downy mildew observed 21 days after inoculation. Column means with a letter in common are not significantly different (Fisher's Protected LSD  $P = 0.05$ ).

<sup>y</sup> Area under the disease progress curve (AUDPC) was based on five disease severity ratings that were made at 9, 12, 15, 18, 21 days after inoculation (DAI) in both experiments.

**Table 80. \*Efficacy on Downy Mildew (*Peronospora belbahrii*) of Basil (*Ocimum basilicum*) 'Genovese', Wick, MA, 2014.**

Treatment and rate/acre	% Disease Incidence <sup>x</sup>			% Disease Severity <sup>y</sup>		AUDPC <sup>z</sup>
	Aug 29	Sep 3	Sep 9	Sep 3	Sep 9	
Badge X2 1.5 lb	16.8 ab	84.4 abc	98.9 a	35.0 bc	84.6 ab	866.0 a
Basic Copper 53 2 lb	11.6 b	84.0 abc	98.5 a	36.3 bc	83.7 ab	829.9 a
Cueva 1% v/v	15.4 ab	89.8 ab	99.5 a	50.5 a	89.0 a	889.6 a
NuCop HB 2 lb	8.3 b	76.6 c	97.6 a	40.6 abc	81.1 b	765.1 a
Ranman 3 fl oz	17.8 ab	36.4 d	74.3 b	29.5 c	56.5 c	535.4 b
Regalia 4 qt	15.9 ab	91.5 a	96.1 a	36.3 bc	84.9 ab	888.8 a
Untreated	16.3 ab	90.5 ab	99.5 a	42.0 ab	89.1 a	895.7 a

\* Not an IR-4 Experiment: Plant Disease Management Reports 9:V001. Not all products tested included in table.

<sup>x</sup> Disease incidence was the percentage of foliage with sporulation on leaf undersides. Column means with a letter in common are not significantly different (Tukey's HSD,  $P=0.05$ ).

<sup>y</sup> Disease severity was the percentage of chlorotic and necrotic symptoms on upper leaf surfaces.

<sup>z</sup> Area under the disease progress curve (AUDPC) was based on four disease incidence ratings that were made on Aug 22, 26, Sep 3 and 9.

In 2016, Raid conducted a field trial to determine the efficacy of drench treatments to control basil downy mildew. Drenches were applied at the cotyledon stage, with downy mildew inoculum present in the vicinity from an earlier planting. A foliar treatment Revus, mixed with Induce adjuvant, was applied twice on Nov 19 (1-2 lf) and 26 to the drench treatments. All fungicide treatments applied as a drench provided significant reductions in downy mildew severity (Table 81). Ridomil Gold and Orondis Gold provided the highest level of downy mildew control, followed by Ranman, Forum, Presidio, and Nutri- Phite. In the absence of foliar sprays following the initial drench, only Ridomil Gold and Orondis Gold provided a level of control that would be considered commercially acceptable (<5% severity) No phytotoxicity was observed for any treatment.

**Table 81. \*Efficacy on Downy Mildew (*Peronospora belbahrii*) of Basil (*Ocimum basilicum*) 'Italian Large Leaf', Raid, FL, 2016.**

Treatment and rate/acre	% Disease Severity <sup>x</sup>			
	Nov 29		Dec 5	
	No foliar	With foliar <sup>y</sup>	No foliar	With foliar <sup>y</sup>
Forum SC 6.0 fl oz	21.7 d	8.3 bc	70.0 bc	13.3 cd
Nutri-Phite SL 3.0 pt	46.7 b	13.3 b	78.3 b	21.7 bc
Orondis Gold SC 13.5 fl oz	0.0 e	0.0 d	1.7 e	0.0 e
Presidio SC 4.0 fl oz	35.0 c	11.7 b	73.3 b	23.3 b
Ranman SC 2.75 fl oz	20.0 d	5.0 cd	63.3 c	8.3 de
Ridomil Gold EC 16.0 fl oz	1.7 e	0.0 d	3.3 e	0.0 e
Untreated check	78.3 a	28.3 a	93.3 a	35.0 a

\* Not an IR-4 Experiment: Plant Disease Management Reports 11:V031. Not all products tested included in table.

<sup>x</sup>. Disease severity was rated as the percentage of the entire canopy expressing disease symptoms. Column means with a letter in common are not significantly different (Fisher's Protected LSD,  $P=0.05$ ).

<sup>y</sup> Two applications of Revus SC at 8.0 fl oz per acre, one and two weeks subsequent to the fungicide drench.

In 2016, McGrath conducted a field trial to determine the efficacy of several products for organic production to control basil downy mildew. Treatments were sprayed starting when basil plants were small on Jul 22, 28, Aug 4 11, 18, 25, and 31. Downy mildew developed naturally and became severe as is typical for the area. None of the treatments tested in this experiment were distinguishable from the untreated control until the last assessment on 2 Sep (Table 82). Among the fungicides tested for organic production, only one, the copper fungicide Cueva, was able to provide detectable control of downy mildew compared to the untreated control, and only moderately so, providing 44% control compared to the 96% control provided by the conventional grower standard treatment of Ranman alternated with Revus. This treatment was included partly to provide an assessment of control potential with the application timing. Interestingly, adding the biological fungicide Howler to the grower standard rotation of Ranman and Revus provided statistically similar control compared to the standard rotation of Ranman and Revus despite applying these on a 14-day interval, although the rotation with Howler was numerically less effective, providing 58% control compared to 96% control with the standard rotation. Results from this experiment add to previous results documenting that it is difficult to manage downy mildew organically in basil.



**Table 82. \*Efficacy on Downy Mildew (*Peronospora belbahrii*) of Basil (*Ocimum basilicum*) 'Genovese', McGrath, NY, 2016.**

Treatment and rate/A (application dates) <sup>y</sup>	Incidence (% symptomatic plants) <sup>x</sup>		Incidence (% symptomatic leaves on affected plants)		Incidence (% symptomatic leaves in plot)		Defoliation (%)
	Aug 15	Aug 22	Aug 15	Aug 22	Aug 15	Aug 22	
Cueva 0.16F 4 qt (1-7)	13.3 a	52.5 a	0.35 a	2.45 a	0.19 a	1.95 a	38.8 bc
Double Nickel WDG 3 lb (1-7)	10.0 a	45.0 a	0.56 a	2.63 a	0.10 a	1.20 a	52.5 abc
Forticept Agro 0.66 % v/v (1-7)	0.0 a	75.0 a	0.00 a	3.06 a	0.00 a	2.55 a	65.0 ab
Howler 5 g/L (1-7) <sup>z</sup>	7.5 a	70.0 a	0.31 a	3.56 a	0.10 a	2.55 a	63.8 ab
Howler 7.5 g/L (1-7) <sup>z</sup>	5.0 a	80.0 a	0.06 a	4.18 a	0.05 a	3.60 a	63.8 ab
Howler 5 g/L (1,3,5,7) <sup>z</sup> Ranman 400SC 3 oz (2,6) <sup>z</sup> Revus 250SC 8 oz (4) <sup>z</sup>	0.0 a	62.5 a	0.00 a	2.96 a	0.00 a	2.00 a	28.8 cd
Milagrum Plus 40 oz (1-7)	5.0 a	65.0 a	0.25 a	4.80 a	0.20 a	4.13 a	51.2 abc
Procidic 20 oz (1-7)	12.5 a	87.5 a	0.29 a	5.06 a	0.15 a	4.80 a	72.5 a
Procidic 40 oz (1-7)	2.5 a	74.4 a	0.38 a	3.04 a	0.15 a	2.34 a	66.2 ab
Ranman 400SC 3 oz (1,3,5,7) <sup>z</sup> Revus 250SC 8 oz (2,4,6) <sup>z</sup>	0.0 a	62.5 a	0.00 a	1.88 a	0.00 a	1.23 a	3.0 d
Untreated	15.0 a	77.5 a	0.44 a	3.55 a	0.28 a	2.54 a	68.8 a

\* Not an IR-4 Experiment: Plant Disease Management Reports 11:V030.

<sup>x</sup> Column means with a letter in common are not significantly different (Tukey's HSD, P=0.05).

<sup>y</sup> Application dates were 1=21 Jul, 2=28 Jul, 3=4 Aug, 4=11 Aug, 5=18 Aug, 6=25 Aug, and 7=31 Aug.

<sup>z</sup> Ranman and Revus were applied with Induce at 0.125% v/v, Howler applied with Capsil at 0.125% v/v.

## ***Efficacy Summary by Product/Active Ingredient – Ornamental Horticulture***

A brief efficacy summary for select products tested on ornamentals is given below.

**Adorn (V-10161).** Adorn (V-10161) generally provided excellent control of impatiens downy mildew, good to excellent control of lamium downy mildew, and good control of snapdragon downy mildew. It provided excellent control of coleus downy mildew under heavy disease pressure in 2 of 3 experiments. For rose downy mildew poor control was obtained.

**Aliette.** Aliette provided fair control of coleus, impatiens and rose downy mildews.

**Disarm.** Disarm provided good to excellent control of downy mildews on coleus, snapdragon and viburnum, fair to excellent control of impatiens downy mildew, and fair to good efficacy on lamium downy mildew. For rose downy mildew fair control was obtained.

**FenStop.** Downy mildews on coleus and impatiens were well managed with this product.

**Heritage.** Heritage provided good to excellent control of coleus, lamium and snapdragon downy mildews, fair to excellent control of impatiens downy mildew, and poor to fair control of rose downy mildew.

**Insignia.** Insignia provided good control of lamium and rose downy mildews.

**Micora (NOA 446510).** NOA 446510, provided excellent control of impatiens downy mildew, and good to excellent control of lamium, snapdragon and coleus downy mildews. For viburnum downy mildew fair control was obtained.

**Orkestra (BAS 703).** This active ingredient provided poor to excellent control of impatiens downy mildew.

**Orvego (BAS 651).** This active ingredient provided excellent control of coleus and impatiens downy mildew, good to excellent control of lamium downy mildew, and good control of snapdragon downy mildew. However, it provided poor control of rose downy mildew.

**Pageant.** This product provided excellent control of impatiens downy mildew, and good control of lamium downy mildew.

### ***Phosphorus Acids/Phosphorus Acid Generators.***

**Alude.** Alude provided good to excellent control of impatiens downy mildew, and poor control of coleus and rose downy mildews.

**Agri-Fos.** Agri-Fos provided no control of impatiens downy mildew.

**Inosco (A14658C).** Inosco (A14658C) provided good to excellent control of impatiens downy mildew.

**Vital.** Vital provided excellent control of coleus and impatiens downy mildews.

**Regalia.** This extract of Reynoutria demonstrated good management of lamium and snapdragon downy mildew at both rates tested. For viburnum downy mildew only the 1% rate was effective and for coleus downy mildew poor and good control were observed. Also it provided excellent control of impatiens downy mildew, and fair control of rose downy mildew.

**Segovis (SYN 546539).** Segovis (SYN 546539) drench provided excellent control of impatiens downy mildew.

**Stature.** Stature provided excellent control of impatiens downy mildew, good to excellent control of coleus, lamium, and viburnum downy mildews, and fair control of rose downy mildew.

**Subdue MAXX.** Subdue MAXX generally provided excellent control of impatiens downy mildew, and good to excellent control of coleus, and lamium downy mildews. For rose downy mildew poor control was obtained.

## **Phytotoxicity**

KleenGrow was highly phytotoxic to impatiens (leaf necrosis and stunting). Minor phytotoxicity (leaf chlorosis and distortion) was observed on impatiens drenched with Adorn + Subdue MAXX in 2 experiments. STBX 304 caused injury on limonium.

Captan Pro, Daconil WeatherStik and Regalia at 1% caused phytotoxicity on rose.

Chemical residue was noted on plants treated with Dithane 75DF and Protect DF in some impatiens experiments.

*Please see Table 83- for individual summaries of IR-4 experiments conducted during 2008 – 2016.*

## **Efficacy Summary by Product/Active Ingredient - Basil**

A brief efficacy summary for select products tested on basil downy mildew is given below.

**Actinovate.** Actinovate generally provided poor control of basil downy mildew in 3 field and 5 greenhouse trials.

**Companion.** Companion generally provided poor control of basil downy mildew in 1 field and 3 greenhouse trials.

**Copper Products.** The copper products Badge X2, Cueva, Nordox, Nu-Cop, etc. provided poor control of basil downy mildew in 9 field trials.

**Double Nickel.** Double Nickel provided poor control of basil downy mildew in 1 field trial.

### **Phosphorus Acids/Phosphorus Acid Generators.**

**Agri-Fos.** Agri-Fos provided good control of basil downy mildew in 1 field trial.

**K-Phite.** K-Phite provided poor and good control of basil downy mildew in 3 field trials.

**Nutri-Phyte.** Nutri-Phyte spray provided poor and good control of basil downy mildew in 5 field trials; when applied as a drench, it provided poor control in 1 field trial.

**Phostrol.** Phostrol provided poor control of basil downy mildew in 1 field trial.

**Prophyt.** Prophyt provided variable control (poor to excellent) of basil downy mildew in 11 field and 2 greenhouse trials.

**Rampart.** Rampart provided poor and fair control of basil downy mildew in 3 field trials.

**Rescue.** Rescue provided poor and fair control of basil downy mildew in 2 field trials.

**Presidio.** Presidio generally provided variable control (poor to excellent) of basil downy mildew in 7 field trials; when applied as a drench, it provided poor control in 1 field trial.

**Quadris/Amistar.** This active ingredient generally provided good to excellent control of basil downy mildew in 10 field trials.

**Ranman.** Ranman spray generally provided fair to excellent control of basil downy mildew in 10 field trials; when applied as a drench, it provided poor control in 1 field trial.

**Reason.** Reason provided good and excellent control of basil downy mildew in 4 field trials.

**Regalia.** Regalia generally provided poor control of basil downy mildew in 4 field and 3 greenhouse trials.

**Revus.** Revus generally provided excellent control of basil downy mildew in 12 field trials.

**Ridomil Gold.** Ridomil Gold applied as drench or spray provided excellent control of basil downy mildew in 3 trials.

**Serenade.** Serenade provided poor control of basil downy mildew in 2 field and 3 greenhouse trials.

**Sonata.** Sonata generally provided poor control of basil downy mildew in 3 field and 3 greenhouse trials.

**Zampro (BAS 651).** This active ingredient generally provided excellent control of basil downy mildew in 5 field trials.

**Zorvec (QGU42).** This active ingredient generally provided excellent control of basil downy mildew in 3 field and 2 greenhouse trials.

### ***Phytotoxicity***

No phytotoxicity to basil was observed with the products listed above in 24 field and 7 greenhouse experiments.

**Table 83. Summary of product efficacy by pathogen and crop.**

Note: Table entries are sorted by product, pathogen Latin name, and then by crop Latin name. Only those IR-4 experiments received by 9/8/2017 are included in the table below.

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
28339	Adorn 4F (Fluopicolide)	Downy Mildew of Mint, Coleus (Peronospora lamii)	Dead Nettle (Lamium sp.) L. maculatum 'Silver Beacon'	Field In-Ground	Kirk	MI	2008	Foliar	Both 1 and 2 fl oz per 100 gal provided excellent control.
28339	Adorn 4F (Fluopicolide)	Downy Mildew of Mint, Coleus (Peronospora lamii)	Dead Nettle (Lamium sp.) L. maculatum 'Silver Beacon'	Field In-Ground	Kirk	MI	2009	Foliar	Good control at 1 and 2 fl oz per 100 gal applied twice; comparable to Stature.
32052	Adorn 4F (Fluopicolide)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) 'Accent Rose'	Shadehouse/Lathehouse	Freiberger	NJ	2013	Drench	Great efficacy (very little sporulation) with 4 fl oz per 100 gal drenched monthly.
32052	Adorn 4F (Fluopicolide)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) 'Accent Rose'	Shadehouse/Lathehouse	Freiberger	NJ	2014	Drench	No control of a severe downy mildew pressure with 4 fl oz per 100 gal.
32052	Adorn 4F (Fluopicolide)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) Accent Star Red	Shadehouse/Lathehouse	Freiberger	NJ	2015	Drench	Poor efficacy on a severe disease pressure with 3 fl oz per 100 gal.
32052	Adorn 4F (Fluopicolide)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) 'Accent White'	Shadehouse/Lathehouse	Freiberger	NJ	2013	Drench	Excellent efficacy (no sporulation) with 4 fl oz per 100 gal drenched monthly.
32052	Adorn 4F (Fluopicolide)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) 'Accent White'	Shadehouse/Lathehouse	Freiberger	NJ	2014	Drench	No control of a severe downy mildew pressure with 4 fl oz per 100 gal.
32052	Adorn 4F (Fluopicolide)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) 'Dazzler Pink'	Shadehouse/Lathehouse	Freiberger	NJ	2014	Drench	No control of a severe downy mildew pressure with 4 fl oz per 100 gal.
32052	Adorn 4F (Fluopicolide)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) 'Dazzler Punch'	Shadehouse/Lathehouse	Freiberger	NJ	2013	Drench	Great efficacy (very little sporulation) with 4 fl oz per 100 gal drenched monthly.

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
32052	Adorn 4F (Fluopicolide)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) 'Impreza White'	Shadehouse/Lathehouse	Freiberger	NJ	2014	Drench	No control of a severe downy mildew pressure with 3 fl oz per 100 gal applied twice.
32052	Adorn 4F (Fluopicolide)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) 'Ruby'	Shadehouse/Lathehouse	Freiberger	NJ	2014	Drench	No control of a severe downy mildew pressure with 3 fl oz per 100 gal applied twice.
32052	Adorn 4F (Fluopicolide)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) Super Elfin XP Bright Orange	Shadehouse/Lathehouse	Freiberger	NJ	2016	Drench	No efficacy on a severe disease pressure with 3 fl oz per 100 gal applied twice at 4-wk interval.
32052	Adorn 4F (Fluopicolide)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) Super Elfin XP Coral	Shadehouse/Lathehouse	Freiberger	NJ	2016	Drench	No efficacy on a severe disease pressure with 3 fl oz per 100 gal applied twice at 4-wk interval.
32052	Adorn 4F (Fluopicolide)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) Super Elfin XP Rose	Shadehouse/Lathehouse	Freiberger	NJ	2016	Drench	No efficacy on a severe disease pressure with 3 fl oz per 100 gal applied twice at 4-wk interval.
32052	Adorn 4F (Fluopicolide)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) 'White XP'	Shadehouse/Lathehouse	Freiberger	NJ	2014	Drench	No control of a severe downy mildew pressure with 3 fl oz per 100 gal applied twice.
32052	Adorn 4F (Fluopicolide)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) Xtreme Violet	Shadehouse/Lathehouse	Freiberger	NJ	2015	Drench	Poor efficacy on a severe disease pressure with 3 fl oz per 100 gal.
28515	Adorn 4F (Fluopicolide)	Downy Mildew (Peronospora sp.)	Coleus, Flamenettle (Coleus sp.) Solenostemon scutellaroides 'Pineapple'	Greenhouse	Ivors	NC	2010	Sprenc	Completely inhibited sporulation of P. belbaharii with 1 and 2 fl oz per 100 gal; comparable to non-inoculated check.
28515	Adorn 4F (Fluopicolide)	Downy Mildew (Peronospora sp.)	Coleus, Flamenettle (Coleus sp.) 'Volcano'	Greenhouse	Hausbeck	MI	2009	Drench	Severe disease pressure. Poor control at 1 and 2 fl oz per 100 gal.
28507	Adorn 4F (Fluopicolide)	Downy mildew of rose (Peronospora sparsa)	Rose (Rosa sp.) 'Pink Double Knock Out'	Field In-Ground	Chase	CA	2009	Drench	Did not significantly reduced disease severity at 1 and 2 fl oz per 100 gal.

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
29267	Adorn 4F (Fluopicolide)	Viburnum Downy Mildew (Plasmopara viburni)	Arrowwood (Viburnum sp.) Viburnum odoratissimum var. awabuki	Greenhouse	Palmateer	FL	2009	Drench	Poor to no control of Plasmopora viburni at 1 and 2 fl oz per 100 gal.
31675	Aliette WDG (Fosetyl Al)	Downy Mildew (Peronospora sp.)	Garden Snapdragon (Antirrhinum majus) 'Snapshot White'	Field Container	Villavicencio	CA	2009	Drench	Significantly reduced disease severity at 12.8 fl oz per 100 gal.
28340	Alude (Potassium phosphite)	Downy Mildew of Mint, Coleus (Peronospora lamii)	Dead Nettle (Lamium sp.) L. maculatum 'Silver Beacon'	Field In-Ground	Kirk	MI	2008	Foliar	A rate of 64 fl oz per 100 gal provided good control.
32053	Alude (Potassium phosphite)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) 'Accent Rose'	Shadehouse/ Lathehouse	Freiberger	NJ	2013	Foliar	Some reduction in sporulation with 1.25 qt per 100 gal applied weekly or 2.5 qt per 100 gal applied biweekly. Plants, however, appeared healthy through most of the experiment.
32053	Alude (Potassium phosphite)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) Accent Star Red	Shadehouse/ Lathehouse	Freiberger	NJ	2015	Drench	Poor efficacy on a severe disease pressure with 2.5 qt per 100 gal.
32053	Alude (Potassium phosphite)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) 'Accent White'	Shadehouse/ Lathehouse	Freiberger	NJ	2013	Foliar	Some reduction in sporulation with 1.25 qt per 100 gal applied weekly or 2.5 qt per 100 gal applied biweekly. Plants, however, appeared healthy through most of the experiment.
32053	Alude (Potassium phosphite)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) 'Dazzler Punch'	Shadehouse/ Lathehouse	Freiberger	NJ	2013	Foliar	Some reduction in sporulation with 1.25 qt per 100 gal applied weekly or 2.5 qt per 100 gal applied biweekly. Plants, however, appeared healthy through most of the experiment.
32053	Alude (Potassium phosphite)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) 'Impreza White'	Shadehouse/ Lathehouse	Freiberger	NJ	2014	Drench	Excellent control of a severe downy mildew pressure with 2.5 qt per 100 gal applied twice; very high plant quality rating.

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
32053	Alude (Potassium phosphite)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) 'Impreza White'	Shadehouse/Lathehouse	Freiberger	NJ	2014	Foliar	Very poor control of a severe downy mildew pressure with 2.5 qt per 100 gal applied 3 times; very low plant quality rating.
32053	Alude (Potassium phosphite)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) 'Ruby'	Shadehouse/Lathehouse	Freiberger	NJ	2014	Drench	Excellent control of a severe downy mildew pressure with 2.5 qt per 100 gal applied twice; very high plant quality rating.
32053	Alude (Potassium phosphite)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) 'Ruby'	Shadehouse/Lathehouse	Freiberger	NJ	2014	Foliar	Very poor control of a severe downy mildew pressure with 2.5 qt per 100 gal applied 3 times; very low plant quality rating.
32053	Alude (Potassium phosphite)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) Super Elfin XP Coral	Shadehouse/Lathehouse	Freiberger	NJ	2016	Drench	Excellent control of a severe disease pressure with 2.5 qt per 100 gal applied twice at 4-wk interval; high plant quality.
32053	Alude (Potassium phosphite)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) Super Elfin XP Rose	Shadehouse/Lathehouse	Freiberger	NJ	2016	Drench	Excellent control of a severe disease pressure with 2.5 qt per 100 gal applied twice at 4-wk interval; high plant quality.
32053	Alude (Potassium phosphite)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) 'White XP'	Shadehouse/Lathehouse	Freiberger	NJ	2014	Drench	Excellent control of a severe downy mildew pressure with 2.5 qt per 100 gal applied twice; very high plant quality rating.
32053	Alude (Potassium phosphite)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) 'White XP'	Shadehouse/Lathehouse	Freiberger	NJ	2014	Foliar	Very poor control of a severe downy mildew pressure with 2.5 qt per 100 gal applied 3 times; very low plant quality rating.
32053	Alude (Potassium phosphite)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) Xtreme Violet	Shadehouse/Lathehouse	Freiberger	NJ	2015	Drench	Poor efficacy on a severe disease pressure with 2.5 qt per 100 gal.



PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
29877	Disarm 480SC (Fluoxastrobin)	Downy Mildew of Mint, Coleus (Peronospora lamii)	Dead Nettle (Lamium sp.) L. maculatum 'Silver Beacon'	Field In-Ground	Kirk	MI	2009	Foliar	Fair to good control at 2 and 4 fl oz per 100 gal applied twice; almost comparable to Stature.
28915	Disarm 480SC (Fluoxastrobin)	Downy Mildew (Peronospora sp.)	Coleus, Flamenettle (Coleus sp.) Solenostemon scutellarioides 'Pineapple'	Greenhouse	Ivors	NC	2010	Foliar	Significantly reduced sporulation of P. belbaharii with 2 and 4 fl oz per 100 gal; comparable to non-inoculated check.
28915	Disarm 480SC (Fluoxastrobin)	Downy Mildew (Peronospora sp.)	Coleus, Flamenettle (Coleus sp.) 'Volcano'	Greenhouse	Hausbeck	MI	2009	Foliar	Severe disease pressure. Good control at 2 and 4 fl oz per 100 gal.
28770	Disarm 480SC (Fluoxastrobin)	Downy mildew of rose (Peronospora sparsa)	Rose (Rosa sp.) 'Pink Double Knock Out'	Field In-Ground	Chase	CA	2009	Foliar	Significantly reduced disease severity at 2, but not at 4 fl oz per 100 gal.
29269	Disarm 480SC (Fluoxastrobin)	Viburnum Downy Mildew (Plasmopara viburni)	Arrowwood (Viburnum sp.) Viburnum odoratissimum var. awabuki	Greenhouse	Palmateer	FL	2009	Foliar	Effective control of Plasmopora viburni at 2 and 4 fl oz per 100 gal; comparable to standard Stature.
31676	Fenstop (Fenamidone)	Downy Mildew (Peronospora sp.)	Garden Snapdragon (Antirrhinum majus) 'Snapshot White'	Field Container	Villavicencio	CA	2009	Foliar	Significantly reduced disease severity at 14 fl oz per 100 gal.
29543	Fenstop (Fenamidone)	Downy Mildew (Peronospora sp.)	Coleus, Flamenettle (Coleus sp.) 'Volcano'	Greenhouse	Hausbeck	MI	2009	Foliar	Severe disease pressure. 100 % control at 14 fl oz per 100 gal.
28335	Heritage (Azoxystrobin)	Downy Mildew of Mint, Coleus (Peronospora lamii)	Dead Nettle (Lamium sp.) L. maculatum 'Silver Beacon'	Field In-Ground	Kirk	MI	2008	Foliar	Foliar applications of 4 oz at 7 and 14 d intervals provided great control.
28335	Heritage (Azoxystrobin)	Downy Mildew of Mint, Coleus (Peronospora lamii)	Dead Nettle (Lamium sp.) L. maculatum 'Silver Beacon'	Field In-Ground	Kirk	MI	2009	Foliar	Good control at 4 oz per 100 gal + Induce applied 2 or 4 times; almost comparable to Stature.
28517	Heritage (Azoxystrobin)	Downy Mildew (Peronospora sp.)	Coleus, Flamenettle (Coleus sp.) Solenostemon scutellarioides 'Pineapple'	Greenhouse	Ivors	NC	2010	Foliar	Significantly reduced sporulation of P. belbaharii with 4 oz per 100 gal; comparable to non-inoculated check.

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
28517	Heritage (Azoxystrobin)	Downy Mildew (Peronospora sp.)	Coleus, Flamenettle (Coleus sp.) 'Volcano'	Greenhouse	Hausbeck	MI	2009	Foliar	Severe disease pressure. Good control at 2 and 4 fl oz per 100 gal.
28503	Heritage (Azoxystrobin)	Downy mildew of rose (Peronospora sparsa)	Rose (Rosa sp.) 'Pink Double Knock Out'	Field In-Ground	Chase	CA	2009	Foliar	Did not significantly reduced disease severity at 4 oz per 100 gal.
29266	Heritage (Azoxystrobin)	Viburnum Downy Mildew (Plasmopara viburni)	Arrowwood (Viburnum sp.) Viburnum odoratissimum var. awabuki	Greenhouse	Palmateer	FL	2009	Foliar	Effective control of Plasmopora viburni at 4 oz per 100 gal; comparable to standard Stature.
32051	Inosco (A14658C) (Potassium phosphite)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) 'Accent Rose'	Shadehouse/ Lathehouse	Freiberger	NJ	2013	Foliar	Partial reduction in sporulation with 4 pt per 100 gal applied weekly or 8 pt per 100 gal applied biweekly.
32051	Inosco (A14658C) (Potassium phosphite)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) Accent Star Red	Shadehouse/ Lathehouse	Freiberger	NJ	2015	Foliar	Poor efficacy on a severe disease pressure with 8 pt per 100 gal applied twice biweekly.
32051	Inosco (A14658C) (Potassium phosphite)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) 'Accent White'	Shadehouse/ Lathehouse	Freiberger	NJ	2013	Foliar	Partial reduction in sporulation with 4 pt per 100 gal applied weekly or 8 pt per 100 gal applied biweekly.
32051	Inosco (A14658C) (Potassium phosphite)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) 'Dazzler Punch'	Shadehouse/ Lathehouse	Freiberger	NJ	2013	Foliar	Partial reduction in sporulation with 4 pt per 100 gal applied weekly or 8 pt per 100 gal applied biweekly.
32051	Inosco (A14658C) (Potassium phosphite)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) 'Impreza White'	Shadehouse/ Lathehouse	Freiberger	NJ	2014	Foliar	Very good control of a severe downy mildew pressure with 8 pt per 100 gal applied 3 times; high plant quality rating.
32051	Inosco (A14658C) (Potassium phosphite)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) 'Ruby'	Shadehouse/ Lathehouse	Freiberger	NJ	2014	Foliar	Very good control of a severe downy mildew pressure with 8 pt per 100 gal applied 3 times; high plant quality rating.

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
32051	Inosco (A14658C) (Potassium phosphite)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) Super Elfin XP Coral	Shadehouse/Lathehouse	Freiberger	NJ	2016	Foliar	Mediocre control of a severe downy mildew pressure with 8 pt per 100 gal applied 3 times; good plant quality rating.
32051	Inosco (A14658C) (Potassium phosphite)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) Super Elfin XP Rose	Shadehouse/Lathehouse	Freiberger	NJ	2016	Foliar	Mediocre control of a severe downy mildew pressure with 8 pt per 100 gal applied 3 times; good plant quality rating.
32051	Inosco (A14658C) (Potassium phosphite)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) 'White XP'	Shadehouse/Lathehouse	Freiberger	NJ	2014	Foliar	Very good control of a severe downy mildew pressure with 8 pt per 100 gal applied 3 times; high plant quality rating.
32051	Inosco (A14658C) (Potassium phosphite)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) Xtreme Violet	Shadehouse/Lathehouse	Freiberger	NJ	2015	Foliar	Poor efficacy on a severe disease pressure with 8 pt per 100 gal applied twice biweekly.
28336	Insignia 20WDG Intrinsic Brand Fungicide (Pyraclostrobin)	Downy Mildew of Mint, Coleus (Peronospora lamii)	Dead Nettle (Lamium sp.) L. maculatum 'Silver Beacon'	Field In-Ground	Kirk	MI	2008	Foliar	Both 4 and 8 oz per 100 gal applied at 14 d intervals provided great control and enhanced plant vigor.
28337	Micora (NOA 446510) (Mandipropamid)	Downy Mildew of Mint, Coleus (Peronospora lamii)	Dead Nettle (Lamium sp.) L. maculatum 'Silver Beacon'	Field In-Ground	Kirk	MI	2008	Foliar	Both 4 and 8 oz per 100 gal plus surfactant applied at 14 d intervals provided good control.
28337	Micora (NOA 446510) (Mandipropamid)	Downy Mildew of Mint, Coleus (Peronospora lamii)	Dead Nettle (Lamium sp.) L. maculatum 'Silver Beacon'	Field In-Ground	Kirk	MI	2009	Foliar	Good to excellent control at 4 and 8 oz per 100 gal + Induce applied 2 or 4 times; comparable to Stature.
28519	Micora (NOA 446510) (Mandipropamid)	Downy Mildew (Peronospora sp.)	Coleus, Flamenettle (Coleus sp.) Solenostemon scutellarioides 'Pineapple'	Greenhouse	Ivors	NC	2010	Foliar	Significantly reduced sporulation of P. belbaharii with 4 and 8 oz per 100 gal; comparable to non-inoculated check.
28519	Micora (NOA 446510) (Mandipropamid)	Downy Mildew (Peronospora sp.)	Coleus, Flamenettle (Coleus sp.) 'Volcano'	Greenhouse	Hausbeck	MI	2009	Foliar	Severe disease pressure. Good control at 4 and 8 fl oz per 100 gal.

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
28505	Micora (NOA 446510) (Mandipropamid)	Downy mildew of rose (Peronospora sparsa)	Rose (Rosa sp.) 'Pink Double Knock Out'	Field In-Ground	Chase	CA	2009	Foliar	Significantly reduced disease severity at 4/4, but not at 8/4 oz per 100 gal.
29271	Micora (NOA 446510) (Mandipropamid)	Viburnum Downy Mildew (Plasmopara viburni)	Arrowwood (Viburnum sp.) Viburnum odoratissimum var. awabuki	Greenhouse	Palmateer	FL	2009	Foliar	Fair control of Plasmopora viburni at 4 oz per 100 gal; inferior to standard Stature.
32502	Orkestra Intrinsic (BAS703 06F/BAS703 01F) (Fluxapyroxad + pyraclostrobin)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) Accent Star Red	Shadehouse/ Lathehouse	Freiberger	NJ	2015	Foliar	Poor efficacy on a severe disease pressure with 10 fl oz per 100 gal applied 4 times weekly.
32502	Orkestra Intrinsic (BAS703 06F/BAS703 01F) (Fluxapyroxad + pyraclostrobin)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) Xtreme Violet	Shadehouse/ Lathehouse	Freiberger	NJ	2015	Foliar	Poor efficacy on a severe disease pressure with 10 fl oz per 100 gal applied 4 times weekly.
29876	Orvego (BAS 651F) (Ametoctradin + dimethomorph (BAS 651))	Downy Mildew of Mint, Coleus (Peronospora lamii)	Dead Nettle (Lamium sp.) L. maculatum 'Silver Beacon'	Field In-Ground	Kirk	MI	2009	Foliar	Excellent control at 11 and 13.4 fl oz per 100 gal applied twice; at least comparable to Stature.
29730	Orvego (BAS 651F) (Ametoctradin + dimethomorph (BAS 651))	Downy Mildew (Peronospora sp.)	Garden Snapdragon (Antirrhinum majus) 'Snapshot Yellow'	Field Container	Villavicencio	CA	2009	Foliar	Significantly reduced disease severity at 11 and 13.4 fl oz per 100 gal.
28516	Orvego (BAS 651F) (Ametoctradin + dimethomorph (BAS 651))	Downy Mildew (Peronospora sp.)	Coleus, Flamenettle (Coleus sp.) Solenostemon scutellaroides 'Pineapple'	Greenhouse	Ivors	NC	2010	Foliar	Significantly reduced sporulation of P. belbaharii with 11 and 14 fl oz per 100 gal; comparable to non-inoculated check.
28516	Orvego (BAS 651F) (Ametoctradin + dimethomorph (BAS 651))	Downy Mildew (Peronospora sp.)	Coleus, Flamenettle (Coleus sp.) 'Volcano'	Greenhouse	Hausbeck	MI	2009	Foliar	Severe disease pressure. 100 % control at 11 and 13.4 fl oz per 100 gal.
28502	Orvego (BAS 651F) (Ametoctradin + dimethomorph (BAS 651))	Downy mildew of rose (Peronospora sparsa)	Rose (Rosa sp.) 'Pink Double Knock Out'	Field In-Ground	Chase	CA	2009	Foliar	Did not significantly reduced disease severity at 11 and 13.4 fl oz per 100 gal.

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
29268	Orvego (BAS 651F) (Ametoctradin + dimethomorph (BAS 651))	Viburnum Downy Mildew (Plasmopara viburni)	Arrowwood (Viburnum sp.) Viburnum odoratissimum var. awabuki	Greenhouse	Palmateer	FL	2009	Foliar	Significant control of Plasmopora viburni at 13.4 but not at 11 fl oz per 100 gal; inferior to standard Stature.
28338	Pageant Intrinsic (Boscalid + Pyraclostrobin)	Downy Mildew of Mint, Coleus (Peronospora lamii)	Dead Nettle (Lamium sp.) L. maculatum 'Silver Beacon'	Field In-Ground	Kirk	MI	2008	Foliar	Both 6 and 12 oz per 100 gal provided good control and greatly enhanced vigor.
29878	Regalia O5 (MOI-10605) (Extract of Reynoutria sachalinensis)	Downy Mildew of Mint, Coleus (Peronospora lamii)	Dead Nettle (Lamium sp.) L. maculatum 'Silver Beacon'	Field In-Ground	Kirk	MI	2009	Foliar	Good control at 64 and 128 fl oz per 100 gal applied 4 times; comparable to Stature.
28531	Regalia SC (MOI 106) (Extract of Reynoutria sachalinensis)	Downy Mildew (Peronospora sp.)	Coleus, Flamenettle (Coleus sp.) Solenostemon scutellaroides 'Pineapple'	Greenhouse	Ivors	NC	2010	Foliar	Significantly reduced sporulation of P. belbaharii with 0.5 and 1 % conc.; inferior to non-inoculated check.
28531	Regalia SC (MOI 106) (Extract of Reynoutria sachalinensis)	Downy Mildew (Peronospora sp.)	Coleus, Flamenettle (Coleus sp.) 'Volcano'	Greenhouse	Hausbeck	MI	2009	Foliar	Severe disease pressure. Poor control at 0.5 and 1 % concentration.
28529	Regalia SC (MOI 106) (Extract of Reynoutria sachalinensis)	Downy mildew of rose (Peronospora sparsa)	Rose (Rosa sp.) 'Pink Double Knock Out'	Field In-Ground	Chase	CA	2009	Foliar	Significantly reduced disease severity at 1 %, but not at 0.5 % solution; significant phytotoxicity at 1 %.
29272	Regalia SC (MOI 106) (Extract of Reynoutria sachalinensis)	Viburnum Downy Mildew (Plasmopara viburni)	Arrowwood (Viburnum sp.) Viburnum odoratissimum var. awabuki	Greenhouse	Palmateer	FL	2009	Foliar	No control of Plasmopora viburni at 0.5 %, effective at 1 %; comparable to standard Stature.
32892	Rotation: Alude/Orkestra (Potassium phosphite / fluxapyroxad + pyraclostrobin)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) Super Elfin XP Coral	Shadehouse/ Lathhouse	Freiberger	NJ	2016	Drench, Foliar	Excellent control of a severe disease pressure with 2.5 qt / 10 fl oz per 100 gal; high plant quality.
32892	Rotation: Alude/Orkestra (Potassium phosphite / fluxapyroxad + pyraclostrobin)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) Super Elfin XP Rose	Shadehouse/ Lathhouse	Freiberger	NJ	2016	Drench, Foliar	Excellent control of a severe disease pressure with 2.5 qt / 10 fl oz per 100 gal; high plant quality.
32893	Rotation: Segovis / Inosco (Oxathiapiprolin / Potassium phosphite)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) Super Elfin XP Coral	Shadehouse/ Lathhouse	Freiberger	NJ	2016	Drench, Foliar	Complete control of a severe downy mildew pressure with 3.2 fl oz / 8 pt per 100 gal; high plant quality rating.

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
32893	Rotation: Segovis / Inosco (Oxathiapiprolin / Potassium phosphite)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) Super Elfin XP Rose	Shadehouse/ Lathehouse	Freiberger	NJ	2016	Drench, Foliar	Complete control of a severe downy mildew pressure with 3.2 fl oz / 8 pt per 100 gal; high plant quality rating.
32894	Rotation: Stature + Pageant / Alude (Dimethomorph + Boscalid + Pyraclostrobin / Potassium phosphite)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) Super Elfin XP Bright Orange	Shadehouse/ Lathehouse	Freiberger	NJ	2016	Foliar, Drench	Good control of a severe downy mildew pressure with 12.25 fl oz + 18 oz / 2.5 qt per 100 gal; high plant quality rating.
32127	Segovis (A21008A SC, SYN546539) (Oxathiapiprolin)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) Accent Star Red	Shadehouse/ Lathehouse	Freiberger	NJ	2015	Drench	Great efficacy on a severe disease pressure with 3.2 fl oz per 100 gal; the only effective product in trial.
32127	Segovis (A21008A SC, SYN546539) (Oxathiapiprolin)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) 'Impreza White'	Shadehouse/ Lathehouse	Freiberger	NJ	2014	Drench	Complete control of a severe downy mildew pressure with 3.2 fl oz per 100 gal applied twice; very high plant quality rating.
32127	Segovis (A21008A SC, SYN546539) (Oxathiapiprolin)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) 'Ruby'	Shadehouse/ Lathehouse	Freiberger	NJ	2014	Drench	Complete control of a severe downy mildew pressure with 3.2 fl oz per 100 gal applied twice; very high plant quality rating.
32127	Segovis (A21008A SC, SYN546539) (Oxathiapiprolin)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) Super Elfin XP Coral	Shadehouse/ Lathehouse	Freiberger	NJ	2016	Drench	Complete control of a severe disease pressure with 3.2 fl oz per 100 gal applied twice at 4-wk interval; high plant quality.
32127	Segovis (A21008A SC, SYN546539) (Oxathiapiprolin)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) Super Elfin XP Rose	Shadehouse/ Lathehouse	Freiberger	NJ	2016	Drench	Complete control of a severe disease pressure with 3.2 fl oz per 100 gal applied twice at 4-wk interval; high plant quality.
32127	Segovis (A21008A SC, SYN546539) (Oxathiapiprolin)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) 'White XP'	Shadehouse/ Lathehouse	Freiberger	NJ	2014	Drench	Complete control of a severe downy mildew pressure with 3.2 fl oz per 100 gal applied twice; very high plant quality rating.
32127	Segovis (A21008A SC, SYN546539) (Oxathiapiprolin)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) Xtreme Violet	Shadehouse/ Lathehouse	Freiberger	NJ	2015	Drench	Great efficacy on a severe disease pressure with 3.2 fl oz per 100 gal; the only effective product in trial.

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
29542	SP2015 (SP2015)	Downy Mildew (Peronospora sp.)	Coleus, Flamenettle (Coleus sp.) 'Volcano'	Greenhouse	Hausbeck	MI	2009	Foliar	Severe disease pressure. Good control at 12 oz per 100 gal.
32129	SP2770 10WP (SP2770)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) 'Impreza White'	Shadehouse/Lathehouse	Freiberger	NJ	2014	Foliar	No control of a severe downy mildew pressure with 2.66 lb per 100 gal applied 5 times.
32129	SP2770 10WP (SP2770)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) 'Ruby'	Shadehouse/Lathehouse	Freiberger	NJ	2014	Foliar	No control of a severe downy mildew pressure with 2.66 lb per 100 gal applied 5 times.
32129	SP2770 10WP (SP2770)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) 'White XP'	Shadehouse/Lathehouse	Freiberger	NJ	2014	Foliar	No control of a severe downy mildew pressure with 2.66 lb per 100 gal applied 5 times.
28341	Stature SC (Dimethomorph)	Downy Mildew of Mint, Coleus (Peronospora lamii)	Dead Nettle (Lamium sp.) L. maculatum 'Silver Beacon'	Field In-Ground	Kirk	MI	2008	Foliar	A rate of 12.3 oz per 100 gal provided good control.
31677	Stature SC (Dimethomorph)	Downy Mildew (Peronospora sp.)	Garden Snapdragon (Antirrhinum majus) 'Snapshot White'	Field Container	Villavicencio	CA	2009	Foliar	Significantly reduced disease severity at 6.12 fl oz per 100 gal.
29544	Stature SC (Dimethomorph)	Downy Mildew (Peronospora sp.)	Coleus, Flamenettle (Coleus sp.) 'Volcano'	Greenhouse	Hausbeck	MI	2009	Foliar	Severe disease pressure. 100 % control at 12 fl oz per 100 gal.
29273	Stature SC (Dimethomorph)	Viburnum Downy Mildew (Plasmopara viburni)	Arrowwood (Viburnum sp.) Viburnum odoratissimum var. awabuki	Greenhouse	Palmateer	FL	2009	Foliar	Good efficacy at 6.12 fl oz per 100 gal.
28342	Subdue MAXX (Mefenoxam)	Downy Mildew of Mint, Coleus (Peronospora lamii)	Dead Nettle (Lamium sp.) L. maculatum 'Silver Beacon'	Field In-Ground	Kirk	MI	2008	Foliar	A rate of 1 fl oz per 100 gal provided good control.
32054	Subdue MAXX (Mefenoxam)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) 'Accent Rose'	Shadehouse/Lathehouse	Freiberger	NJ	2013	Drench	Excellent efficacy (no sporulation) with 2 fl oz per 100 gal drenched monthly.

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
32054	Subdue MAXX (Mefenoxam)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) 'Accent Rose'	Shadehouse/Lathehouse	Freiberger	NJ	2014	Drench	Mediocre control of a severe downy mildew pressure with 2 fl oz per 100 gal applied twice; high plant quality rating.
32054	Subdue MAXX (Mefenoxam)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) Accent Star Red	Shadehouse/Lathehouse	Freiberger	NJ	2015	Drench	Poor efficacy on a severe disease pressure with 2 fl oz per 100 gal.
32054	Subdue MAXX (Mefenoxam)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) 'Accent White'	Shadehouse/Lathehouse	Freiberger	NJ	2013	Drench	Excellent efficacy (no sporulation) with 2 fl oz per 100 gal drenched monthly.
32054	Subdue MAXX (Mefenoxam)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) 'Accent White'	Shadehouse/Lathehouse	Freiberger	NJ	2014	Drench	Mediocre control of a severe downy mildew pressure with 2 fl oz per 100 gal applied twice; high plant quality rating.
32054	Subdue MAXX (Mefenoxam)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) 'Dazzler Pink'	Shadehouse/Lathehouse	Freiberger	NJ	2014	Drench	Mediocre control of a severe downy mildew pressure with 2 fl oz per 100 gal applied twice; high plant quality rating.
32054	Subdue MAXX (Mefenoxam)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) 'Dazzler Punch'	Shadehouse/Lathehouse	Freiberger	NJ	2013	Drench	Excellent efficacy (no sporulation) with 2 fl oz per 100 gal drenched monthly.
32054	Subdue MAXX (Mefenoxam)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) 'Impreza White'	Shadehouse/Lathehouse	Freiberger	NJ	2014	Drench	Poor control of a severe downy mildew pressure with 2 fl oz per 100 gal applied twice; very low plant quality rating.
32054	Subdue MAXX (Mefenoxam)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) 'Ruby'	Shadehouse/Lathehouse	Freiberger	NJ	2014	Drench	Poor control of a severe downy mildew pressure with 2 fl oz per 100 gal applied twice; very low plant quality rating.
32054	Subdue MAXX (Mefenoxam)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) Super Elfin XP Bright Orange	Shadehouse/Lathehouse	Freiberger	NJ	2016	Drench	Poor efficacy on a severe disease pressure with 2 fl oz per 100 gal applied twice at 4-wk interval.



PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
32054	Subdue MAXX (Mefenoxam)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) Super Elfin XP Coral	Shadehouse/Lathehouse	Freiberger	NJ	2016	Foliar	Poor efficacy on a severe disease pressure with 2 fl oz per 100 gal applied twice at 4-wk interval.
32054	Subdue MAXX (Mefenoxam)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) Super Elfin XP Rose	Shadehouse/Lathehouse	Freiberger	NJ	2016	Drench	Poor efficacy on a severe disease pressure with 2 fl oz per 100 gal applied twice at 4-wk interval.
32054	Subdue MAXX (Mefenoxam)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) 'White XP'	Shadehouse/Lathehouse	Freiberger	NJ	2014	Drench	Poor control of a severe downy mildew pressure with 2 fl oz per 100 gal applied twice; very low plant quality rating.
32054	Subdue MAXX (Mefenoxam)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) Xtreme Violet	Shadehouse/Lathehouse	Freiberger	NJ	2015	Drench	Poor efficacy on a severe disease pressure with 2 fl oz per 100 gal.
29545	Subdue MAXX (Mefenoxam)	Downy Mildew (Peronospora sp.)	Coleus, Flamenettle (Coleus sp.) 'Volcano'	Greenhouse	Hausbeck	MI	2009	Foliar	Severe disease pressure. 100 % control at 1 fl oz per 100 gal.
32252	Tank Mix: Adorn + Alude (Flupicolide + phosphorus acid)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) 'Impreza White'	Shadehouse/Lathehouse	Freiberger	NJ	2014	Drench	Excellent control of a severe downy mildew pressure with 3 fl oz + 2.5 qt per 100 gal applied twice; very high plant quality rating.
32252	Tank Mix: Adorn + Alude (Flupicolide + phosphorus acid)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) 'Ruby'	Shadehouse/Lathehouse	Freiberger	NJ	2014	Drench	Excellent control of a severe downy mildew pressure with 3 fl oz + 2.5 qt per 100 gal applied twice; very high plant quality rating.
32252	Tank Mix: Adorn + Alude (Flupicolide + phosphorus acid)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) 'White XP'	Shadehouse/Lathehouse	Freiberger	NJ	2014	Drench	Excellent control of a severe downy mildew pressure with 3 fl oz + 2.5 qt per 100 gal applied twice; very high plant quality rating.
32128	Tank Mix: Alude + Segovis (Potassium phosphite + oxathiapiprolin)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) 'Impreza White'	Shadehouse/Lathehouse	Freiberger	NJ	2014	Drench	Complete control of a severe downy mildew pressure with 2.5 qt + 3.2 fl oz per 100 gal applied twice; very high plant quality rating.

PR#	Product (Active Ingredients)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
32128	Tank Mix: Alude + Segovis (Potassium phosphite + oxathiapiprolin)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) 'Ruby'	Shadehouse/Lathehouse	Freiberger	NJ	2014	Drench	Complete control of a severe downy mildew pressure with 2.5 qt + 3.2 fl oz per 100 gal applied twice; very high plant quality rating.
32128	Tank Mix: Alude + Segovis (Potassium phosphite + oxathiapiprolin)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) 'White XP'	Shadehouse/Lathehouse	Freiberger	NJ	2014	Drench	Complete control of a severe downy mildew pressure with 2.5 qt + 3.2 fl oz per 100 gal applied twice; very high plant quality rating.
32130	Tank Mix: Alude + Subdue (Potassium phosphite + mefonaxom)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) 'Impreza White'	Shadehouse/Lathehouse	Freiberger	NJ	2014	Drench	Excellent control of a severe downy mildew pressure with 2.5 qt + 2 fl oz per 100 gal applied twice; very high plant quality rating.
32130	Tank Mix: Alude + Subdue (Potassium phosphite + mefonaxom)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) 'Ruby'	Shadehouse/Lathehouse	Freiberger	NJ	2014	Drench	Excellent control of a severe downy mildew pressure with 2.5 qt + 2 fl oz per 100 gal applied twice; very high plant quality rating.
32130	Tank Mix: Alude + Subdue (Potassium phosphite + mefonaxom)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) 'White XP'	Shadehouse/Lathehouse	Freiberger	NJ	2014	Drench	Excellent control of a severe downy mildew pressure with 2.5 qt + 2 fl oz per 100 gal applied twice; very high plant quality rating.
32891	Tank Mix: Stature + Pageant (Dimethomorph + Boscalid + Pyraclostrobin)	Impatiens Downy Mildew (Peronospora obducens)	Buzzy Lizzy (Impatiens walleriana) Super Elfin XP Bright Orange	Shadehouse/Lathehouse	Freiberger	NJ	2016	Foliar	Poor efficacy on a severe disease pressure with 12.25 fl oz + 18 oz per 100 gal.

## Label Suggestions

Based upon data contained within this summary, we suggest that manufacturers consider adding the following downy mildew diseases to their future product labels:

- Adorn (V-10161): lamium downy mildew (*Peronospora lamii*), impatiens downy mildew (*Plasmopara obducens*), and snapdragon downy mildew (*Peronospora antirrhini*).
- Orvego (BAS 651): coleus downy mildew (*Peronospora sp.*), impatiens downy mildew (*Plasmopara obducens*), lamium downy mildew (*Peronospora lamii*) and snapdragon downy mildew (*Peronospora antirrhini*).
- Disarm: specifically list *Peronospora lamii*, *Peronospora sparsa*, *Plasmopara obducens*, and *Plasmopara viburni*.
- FenStop: specifically list coleus downy mildew and impatiens downy mildew.
- Heritage: specifically list coleus downy mildew, impatiens downy mildew, lamium downy mildew, rose downy mildew, and snapdragon downy mildew.
- Insignia 20WG: specifically list lamium downy mildew and rose downy mildew.
- Micora (NOA 446510): place *Peronospora spp* on the label along with listing lamium downy mildew, snapdragon downy mildew, and coleus downy mildew; add impatiens downy mildew (*Plasmopara obducens*).
- Orkestra (BAS 703): specifically list impatiens downy mildew (*Plasmopara obducens*).
- Pageant: specifically list impatiens downy mildew (*Plasmopara obducens*) and lamium downy mildew (*Peronospora lamii*).
- Regalia: add impatiens downy mildew (*Plasmopara obducens*), lamium downy mildew (*Peronospora lamii*), snapdragon downy mildew (*Peronospora antirrhini*), and viburnum downy mildew (*Plasmopara viburni*) at 1% use rate.
- Segovis (SYN 546539): specifically list impatiens downy mildew (*Plasmopara obducens*).
- Stature: specifically list impatiens downy mildew (*Plasmopara obducens*), lamium downy mildew (*Peronospora lamii*), coleus downy mildew (*Peronospora sp*), and viburnum downy mildew (*Plasmopara viburni*).
- Subdue Maxx: specifically list coleus downy mildew and lamium downy mildew (*Peronospora lamii*).

## Appendix 1: Contributing Researchers

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