Environmental Horticulture Program Research Summaries

IR-4 Environmental Horticulture Program
Fenamidone Efficacy and Crop Safety Summary

Downy Mildews
Phytophthora spp.
Pythium spp.

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Table of Contents

Table of Tables

Abstract

From 2004 to 2012, fenamidone (FenStop, FenStar) was screened through the IR-4 Program as drench or foliar applications for effacay against nine *Phytophthora* species causing root rots and stem/leaf blights (*P. cactorum, P. cinnamomi*, *P. citricola*, *P. cryptogea*, *P. drechsleri*, *P. nicotianae*/*parasitica, P. ramorum*, *P. syringae*, and *P. tropicalis*), five Pythium species (*P. aphanadermatum*, *P. dissotocum*, *P. irregulare*, *P. ultimum*, and *P. vipa*), and two downy mildews (coleus, snapdragon). Efficacy ranged from highly effect to similar to nontreated inoculated controls depending on pathogen, host, and level of disease pressure. Based on findings it is recommended the following specific diseases be added to fenamidone labels: Coleus downy mildew, *Phytophthora cryptogea, Phytophthora nicotianae, Phytophthora ramorum, Phytophthora cinnamomi, Pythium aphanadermatum, Pythium mamillatum, Pythium ultimum*, and Snapdragon downy mildew. Currently, the FenStop/FenStar label is limited to greenhouse use. It is recommended this be expanded to include outdoor use patterns.

Introduction

In 2003, IR-4 initiated a high priority project to determine efficacy of several fungicides on *Phytophthora* species so data can be obtained to support current and future registrations. This research was conducted during 2004 and continued in 2005. Generating additional efficacy information on Phytophthora species remained a high priority project through 2015. 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 2010, IR-4 initiated a high priority project to determine efficacy of several fungicides on *Pythium* species to obtain data supporting current and future registrations on ornamentals. This report includes the results of 18 experiments from 2010 to 2013 received from the IR-4 Ornamental Horticulture Program. To present a fuller picture on efficacy, additional reports from researchers published in Fungicide & Nematicide Tests (F&N) and Plant Disease Management Reports (PDMR) are included, with permission from the authors. Tables containing these reports have an asterisk (*) at the beginning of their titles and the source of report is included under each data table.

Materials and Methods

From 2003 to 2012, 61 experiments were conducted through the IR-4 Program as drench or foliar applications against nine *Phytophthora* species causing root rots and stem/leaf blights (*P. cactorum*, *P. cinnamomi*, *P. citricola*, *P. cryptogea*, *P. drechsleri*, *P. nicotianae*/*parasitica*, *P. ramorum*, *P. syringae*, and *P. tropicalis*), five *Pythium* species (*P. aphanadermatum*, *P. dissotocum*, *P. irregulare*, *P. ultimum*, and *P. vipa*), and two downy mildews (coleus, snapdragon). Treatments were applied either a few days before disease inoculation or immediately after 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 was recorded on a scale of 0 to 10 (0 = no phytotoxicity; 10 = complete kill) at each rating date for any treatment exhibiting damage unrelated to disease.

For IR-4 testing, the following protocols were used: 06-001 (Phytophthora Efficacy Soilborne), 06-002 (Phytophthora Efficacy Foliar), 06-003 (Pythium Efficacy), 07-001 (Phytophthora Efficacy - Soilborne), 07-002 (Phytophthora Efficacy - Foliar), 08-001 (Phytophthora Efficacy - Soilborne), 08-002 (Phytophthora Efficacy - Foliar), 09-007 (Soilborne Phytophthora Efficacy), 10-017 (Pythium Efficacy), and 11-011 (Pythium Efficacy - 2011), 08-003 (Downy Mildew Efficacy), and 09-001 (Downy Mildew Efficacy). Please visit https://www.ir4project.org/ehc/ehc-registration-support-research/env-hort-researcher-resources/#Protocols to view and download these protocols.

FenStop and FenStar were supplied to researchers by OHP and Bayer. FenStop and FenStar are alternate names for the same products and are used interchangibly below. Fenamindone treatments are highlighted in each results table. Fifteen researchers were involved in the testing. For contact information and research locations, please see the list of researchers in Appendix 1.

For all research data tables, product names have been updated where manufacturers have established trade names, and tables may 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.

Results

Comparative Efficacy on Downy Mildews

Coleus Downy Mildew (Peronospora sp.)

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 1). 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 1. *Efficacy on Downy Mildew (*Peronospora sp.*) of Coleus (*Solenostemon scutellarioides*), 'Wizard Mix', Warfield, 2007.

	Visual sporulation rating (1-4) [z]			Leaves with sporulation (%)
Product – Rate per 100 gal	**27 May**	**4 June**	**13 June**	**13 June**
Aliette 80 WDG - 2.5 lb	1.0 a[y]	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
Nontreated inoculated	1.4 a**	2.4 a	3.4 a	10.8 a

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

z 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.

y 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, Orvego, Disarm, FenStop, Heritage, Micora, Regalia, SP2015, Stature, and Subdue MAXX. Disease pressure was severe in this experiment with the nontreated inoculated plants averaging 10.3 infected leaves. Although all treatments reduced infection compared to the nontreated control, Orvego, FenStop SC, Stature SC, and Subdue MAXX EC were the only treatments that completely prevented infection in this experiment (Table 2). Heritage, Micora 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 2. 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 (%)*
Adorn 4SC 1 fl oz	drench	4.5	bc	37.5
Adorn 4SC 2 fl oz	drench	2.8	ab	30.0
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
Micora 250SC 4 fl oz	spray	0.2	a	10.0
Micora 250SC 8 fl oz	spray	0.5	a	35.0
Orvego 11 fl oz	spray	0.0	a	--
Orvego 13.4 fl oz	spray	0.0	a	--
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	--
Nontreated inoculated	--	10.3	d**	81.7

*Based on a visual estimation of percentage of diseased leaves with sporulation.

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

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 3). 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 4). 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 nontreated plants.The best products included Adorn, Fenstop, Heritage at 14 day intervals, Regalia at 1%, and Stature SC. Aliette, Orvego, and MICORA also reduced infection levels.

Table 3. *Efficacy on Downy Mildew (*Peronospora antirrhini*) of Snapdragon (*Antirrhinum majus*) 'Potomac Ivory', Wegulo, CA, 2003.

Treatment	Rate/100 gal	Disease severity [z]54 DAT
Aliette WDG (fosetyl AL)	2.5 lb	1.4 e-g[y]
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

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

[y] 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 4. Efficacy on Downy Mildew (*Peronospora antirrhini*) of Snapdragon (*Antirrhinum majus*), Villavicencio, CA, 2009.

Product (active ingredient)	Rate per 100 gal	Mean Disease Severity [z](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)
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)
Micora (mandipropamid)	4 fl oz	27.0	21.3 cdef (23)	12.7 bcd (61)	2.0 cdef (88)
Micora (mandipropamid)	8 fl oz	20.6	17.8 bcdef (16)	15.8 bcd (36)	6.6 abcd (48)
Orvego (ametoctradin + dimethomorph)	11 fl oz	36.0	25.6 def (31)	28.8 bcd (33)	11.4 ef (49)
Orvego (ametoctradin + dimethomorph)	13.4 fl oz	21.9	20.0 bcdef (11)	14.9 bcd (43)	14.1 abcd (0)
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)
Nontreated	---	51.3	52.5 abcde (0)	61.3 a (0)	31.7 abcdef (0)

[z] 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 Phytophthora Root Rots

Phytophthora cactorum. In Chastagner's 2007 study on rhododendron 'Nova Zembla', no disease developed during the course of the experiment. Limited injury symptoms and discoloration developed but there were no significant differences between treatments (Table 5). Similarly, treatments had no effect on plant height and width.

Table 5. Efficacy of drench treatments on *Phytophthora cactorum* on rhododendron 'Nova Zembla', phytotoxicity and plant growth, Chastagner, WA, 2007.

Treatment	Rate per 100 gal	AUDPC[1]	Red coloration rating (0-4)	Height (cm)	Width (cm)
Actinovate SP (actinovate)	10 oz	0 a	1.2 a	6.7 a	7.0 a
Adorn 4FL (fluopicolide)	60 ml	12.9 a	1.8 a	4.3 a	7.6 a
	120 ml	9.9 a	1.6 a	4.2 a	9.0 a
Aliette 80 WG (fosetyl-AL)	12.8 oz	0 a	1.4 a	6.1 a	8.3 a
Alude (potassium phosphate)	12.7 fl oz	23.2 a	1.6 a	5.2 a	8.3 a
BioPhos (dipotassium phosphonate + dipotassium phosphate)	64 fl oz	0 a	1.4 a	6.3 a	10.8 a
Disarm 480SC (fluoxastrobin)	2 fl oz	11.6 a	1.2 a	3.7	7.1 a
	4 fl oz	2.6 a	1.4 a	3.4 a	7.4 a
	8 fl oz	0 a	1.0 a	6.2 a	8.5 a
Fenstar (fenamidone)	14 fl oz	0 a	1.2 a	4.2 a	9.3 a
Heritage WG 50 (azoxystrobin)	0.9 oz	0 a	1.8 a	4.1 a	9.2 a
	1.8 oz	5.6 a	2.2 a	4.0 a	6.3 a
Heritage WG 50 + Subdue MAXX FV	0.9 oz + 1 oz	0 a	1.0 a	6.5 a	9.7 a
Insignia 20.4 % (pyraclostrobin)	8oz	5.2 a	1.2 a	3.7 a	6.2 a
	12 oz	0 a	1.4 a	5.2 a	8.8 a
Magellan (mono- and dibasic sodium, potassium and ammonium phosphites)	12 fl oz	0 a	1.4 a	4.9 a	8.6 a
Micora (mandipropamid)	4 fl oz	0 a	1.2 a	5.0 a	8.4 a
	8 fl oz	0 a	1.6 a	5.0 a	7.2 a
Segway/Ranman 400 SC (cyazofamid)	3 fl oz	0 a	1.4 a	4.2 a	8.5 a
	6 fl oz	0 a	1.2 a	5.6 a	9.1 a
Stature DM 50 WP (dimethomorph)	12.8 oz	0 a	1.2 a	5.9 a	8.4 a
Subdue MAXX FV (mefonoxam)	1 fl oz	0 a	2.0 a	5.5 a	7.4 a
	2 fl oz	13.0 a	1.6 a	3.7 a	6.3 a
Terrazole 35 WP (etridiazole)	8 oz	0 a	1.4 a	5.4 a	8.8 a
Vital (potassium phosphate)	4 pt	0 a	1.2 a	5.9 a	8.9 a
Nontreated non-inoculated		0 a	1.6 a	6.1 a	9.8 a
Nontreated inoculated		0 a	2.4 a	3.5 a	7.0 a

[1] Area under phytotoxicity curve

Means followed by the same letter do not differ significantly (P=0.05, Tukey's Studentized Range Test).

Phytophthora cinnamomi.

From 2004 through 2006, six experiments were conducted to determine efficacy on *Phytophthora cinnamomi* on azalea and rhododendron. In general, *P. cinnamomi* seemed to be better managed on azalea cultivars than on the various rhododendron cultivars (Table 6); fenamidone performance was consistent with this observation. In the series of azalea experiments (Table 7 - Table 9), fenamidone consistently performed well. In the series of rhododendron experiments, the results are less clear because of less statistical separation between the inoculated and non-inoculated treatments (Table 10- Table 13). Fenamidone ranged from little impact to excellent efficacy.

Table 6. General summary of efficacy for *Phytophthora cinnamomi* on azalea and rhododendron species.

Product	Azalea			Rhododendron		
	Benson 2004	Benson 2005	Benson 2006	Benson 2004	Chastagner 2005	Chastagner 2006
Actinovate						-
Adorn			++		-	+/-
Aliette	++		++		+/-	+/-
Alude		++	++		-	++
Biophos	++	++	++		+/-	+/-
Calirus		++	++			
Captan		+			+/-	-
Disarm			++		+/-	-
FenStop	++	++	++	++	+/-	-
Heritage						+/-
Insignia		++	++		+/-	-
K-Phyte			++			
Magellan			++		-	++
Medallion				-		
Micora		++	++			++
MultiGuard			-			-
Muscodor			-			-
Segway	++	++	++	+	+/-	++
Stature	++	++		-	+/-	+/-
Subdue	-	++	++	-	+/-	++
Terrazole					+/-	+/-
Truban	++	++				
Vital	++	++	++		+/-	++

* Not an IR-4-sponsored experiment.

[1] Rating Scale: ++ =clearly statistically equivalent or better than nontreated non-inoculated and/or clearly statistically different than nontreated inoculated; + = statistically different from nontreated inoculated and nontreated non-inoculated; +/- statistically equivalent to both nontreated inoculated and nontreated non-inoculated; - = statistically equivalent to nontreated inoculated.

[2] 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.

Benson conducted a series of tests on azalea (Table 7 - Table 9). Good control was achieved with drench applications of Aliette (12.8 oz per 100 gal), FenStop (14 fl oz per 100 gal), Insignia (16 and 40 oz per 100 gal), Segway (1.5 and 3 fl oz per 100 gal), Stature DM (6.4 and 12.8 oz per 100 gal) and Alude (6.25

and 12.5 fl oz per 100 gal), and spray applications of Aliette (5 lb per 100 gal), Biophos (2 gal per 100 gal) and Vital (4 pt per 100 gal). Calirus 150 (4 pt per 100 gal) and Micora (8 fl oz per 100 gal) applied via drench also provided good control in one test.

In 2004, Benson examined several products typically used as drenches for their possibility as foliar fungicides to control *P. cinnamomi* root rot (Table 10). FenStop at 28 and 56 fl oz per 100 gal did give good control similar to the nontreated non-inoculated treatment. Segway at 6 fl oz per 100 gal also did well. Medallion, Stature DM and Subdue MAXX did not provide control.

In Chastagner's 2005 experiment on rhododendron 'Nova Zembla', the inoculated and non-inoculated controls performed statistically equivalent (Table 11). Most treatments had little evidence of impact from inoculation, but certain treatments did exhibit elevated root ratings (indicating some root damage) – Adorn at 10 g ai per 100 gal, Alude, Magellan, and Stature DM at 6.4 oz per 100 gal. However, there were no differences in root or shoot dry weights.

In 2006, Chastagner screened a number of fungicides with two separate application timings. The phosphorus acid generators were applied 5 days before inoculation while the remaining products were applied immediately after inoculation. By 105 days after treatment, the best performers giving significantly better disease ratings than the inoculated controls were Alude (12.7 fl oz per 100 gal), Magellan (12 oz per 100 gal drench, 5 pints per 100 gal foliar), Micora (2 and 8 fl oz per 100 gal drench), Segway (6 oz per 100 gal drench), Subdue MAXX (2 fl oz per 100 gal drench) and Vital (4 pints per 100 gal drench) The rest of the treatments were not significantly different than the nontreated inoculated controls (Table 12 - Table 13).

Table 7. Efficacy on *Phytophthora cinnamomi* root rot on azalea (*Rhododendron obtusum*) 'Hinodegiri', Benson, NC, 2004.

Treatment	Rate Per 100 Gal	Application Method	Disease Severity (1-4)		Top Wt (oz)	Root Rot (1-5)
			7/22	9/09		
Aliette 80 W	5 lb	Foliar	1.0 b	1.2 c	2.2 abc	1.2 c
	12.8 oz	Drench	1.0 b	1.0 c	2.6 ab	1.0 c
Biophos 43L	2 gal	Foliar	1.2 b	1.0 c	2.5 ab	1.0 c
Fenstar 500SC	14 fl oz	Drench	1.0 b	1.0 c	2.8 a	1.0 c
Segway 400SC	1.5 fl oz	Drench	1.0 b	1.2 c	2.0 bcd	1.8 b
Stature DM 50W	6.4 oz	Drench	1.0 b	1.0 c	2.2 abc	1.2 c
Subdue MAXX 2E	1.0 fl oz	Drench	1.0 b	2.7 ab	1.6 d	2.8 a
Truban 25EC	8.0 fl oz	Drench	1.0 b	2.5 b	1.7 cd	2.6 a
Vital 4L	4 pt	Foliar	1.0 b	1.0 c	2.1 bcd	1.0 c
Nontreated non-inoculated			1.2 b	1.0 c	2.3 abc	1.0 c
Nontreated inoculated			2.4 a	3.0 a	0.7 e	3.0 a

* Treatments applied foliar starting 9 Jun or drench starting 14 Jun and reapplied 2 times on a 30-day schedule. Disease severity rated on a 1 to 4 scale, where 1= healthy and 4=dead. Root rot rating scale was 1=healthy and 5 = dead, all roots necrotic.

Column means with a letter in common are not significantly different (Waller-Duncan k ratio, t-test, k=100, P=0.05).

Table 8. Efficacy on *Phytophthora cinnamomi* root rot on azalea (*Rhododendron obtusum*) 'Hinodegiri', Benson, NC, 2005.

Treatment	Rate Per 100 Gal	Applic Method	Foliar Disease Rating (1-4)			Top Wt (oz)	Root Rot (1-5)
			7/27	8/09	9/01		
Alude 46L	6.25 fl oz	Drench	1.4 def	1.4 d-g	1.6 efg	90 cde	1.0 g
	12.5 fl oz	Drench	1.1 f	1.1 fg	1.3 g-j	104 abc	1.0 g
Biophos 43L	2 gal	Foliar	1.0 f	1.0 g	1.1 ij	111 a	1.0 g
Calirus 150 (PMA 300)	4 pt	Drench	1.3 df	1.3 efg	1.3 g-j	87 def	1.0 g
Captan 80W	10 oz	Drench	1.9 c	1.8 cd	2.1 cd	66 hi	2.3 cd
Fenstar 500SC	14 fl oz	Drench	1.1 f	1.2 efg	1.4 f-i	96 a-e	1.0 g
	28 fl oz	Drench	1.3 def	1.3 efg	1.4 f-i	103 abc	1.1 fg
Insignia 20W	16 oz	Drench	1.7 cde	1.7 cde	1.6 efg	83 d-g	1.4 efg
	40 oz	Drench	1.3 def	1.4 d-g	1.6 efg	81 e-h	1.9 de
Micora 250SC	8 fl oz	Drench	1.1 f	1.1 fg	1.2 hij	95 b-e	1.0 g
Segway 400SC	1.5 fl oz	Drench	1.1 f	1.1 fg	1.1 ij	89 cde	1.3 fg
	3.0 fl oz	Drench	1.3 def	1.3 efg	1.4 f-i	91 cde	1.3 fg
Stature DM 50W	6.4 oz	Drench	1.4 def	1.3 efg	1.4 f-i	82 d-g	1.0 g
	12.8 oz	Drench	1.4 def	1.3 efg	1.4 f-i	93 b-e	1.0 g
Subdue MAXX 2E	1.0 fl oz	Drench	1.7 cd	1.6 c-f	1.8 def	72 fgh	1.6 ef
Vital 4L	4 pt	Foliar	1.1 f	1.0 g	1.0 j	107 ab	1.0 g
Nontreated non-inoculated			1.2 ef	1.1 fg	1.3 g-j	97 a-d	1.0 g
Nontreated inoculated			2.6 ab	2.6 ab	2.7 ab	43 jk	2.6 bc

Foliar treatments applied 13 Jun, drench treatments applied 17 Jun and reapplied 3 times on a 28-day schedule.
Foliar disease rated on a 1 to 4 scale, where 1= healthy and 4=dead. Root rot rating scale was 1=healthy and 5 = dead, all roots necrotic.
Column means with a letter in common are not significantly different (Waller-Duncan k ratio, t-test, k=100, P=0.05).

Table 9. Efficacy on *Phytophthora cinnamomi* root rot on azalea (*Rhododendron obtusum* cv. 'Hinodegiri'), Benson, NC 2006.

Treatment	Rate per100 gal	Application Method	Foliar Rating (1-4)								Top Wt. (g)		Root rating (1-5) [z]	
			7/20		8/4		8/18		9/7					
Adorn	30 ml	Drench	1.1	c	1.4	cd	1.6	def	1.5	cde	47	bc	1.0	c
	60 ml	Drench	1.2	c	1.4	cd	1.4	ef	1.4	e	57	ab	1.0	c
Aliette	5 lbs	Spray [y]	1.1	c [x]	1.3	cd	1.3	f	1.4	de	59	ab	1.0	c
Alude	12.7 fl oz	Spray	1.1	c	1.3	cd	1.6	def	1.8	c	51	abc	1.1	c
Biophos	64 fl oz	Spray	1.0	c	1.2	cd	1.3	f	1.4	de	60	a	1.0	c
Calirus150	64 fl oz	Spray	1.1	c	1.6	c	1.7	d	1.8	c	47	bc	1.1	c
Disarm	3 oz	Drench	1.1	c	1.4	cd	1.6	def	1.6	cde	47	bc	1.3	c
Fenstar	7 fl oz	Drench	1.2	c	1.3	cd	1.4	ef	1.6	cde	56	abc	1.0	c
	14 fl oz	Drench	1.1	c	1.4	cd	1.6	def	1.6	cde	57	ab	1.0	c
Insignia 20W	16 oz	Drench	1.2	c	1.4	cd	1.6	def	1.7	cd	50	abc	1.0	c
	40 oz	Drench	1.0	c	1.5	cd	1.5	def	1.5	cde	50	abc	1.1	c
K-Phyte	48 fl oz	Spray	1.0	c	1.3	cd	1.4	def	1.5	cde	53	abc	1.0	c
Magellan	12 fl oz	Spray	1.0	c	1.4	cd	1.4	def	1.5	cde	54	abc	1.0	c
MultiGard	500 ppm	Drench	2.3	b	2.8	b	3.1	ab	3.1	ab	16	d	3.3	a
	1,000 ppm	Drench	3.2	a	3.3	a	3.3	a	3.3	a	9	d	3.6	a
Muscodor albus	3.75 g/L	Incorp.	2.1	b	2.5	b	2.6	c	2.8	b	22	d	2.6	b
Micora	4 fl oz	Drench	1.1	c	1.3	cd	1.6	de	1.6	cde	55	abc	1.0	c
	8 fl oz	Drench	1.4	c	1.6	c	1.5	def	1.6	cde	50	abc	1.0	c
Segway	3.0 fl oz	Drench	1.1	c	1.2	cd	1.4	ef	1.5	cde	54	abc	1.0	c
	6.0 fl oz	Drench	1.1	c	1.1	d	1.4	def	1.5	cde	59	ab	1.0	c
Subdue MAXX	1.0 fl oz	Drench	1.1	c	1.4	cd	1.5	def	1.8	c	44	c	1.0	c
Vital 4L	64 fl oz	Spray	1.2	c	1.4	cd	1.3	f	1.5	cde	58	ab	1.0	c
Nontreated non-inoculated			1.0	c	1.5	cd	1.6	de	1.6	cde	49	abc	1.0	c
Nontreated inoculated			2.4	b	2.8	b	2.9	bc	2.9	b	17	d	2.9	b

[z]Foliar rating: 1= healthy, 2 = chlorosis, slight stunting, 3 = severe stunting, 4= dead.

[y]Root rot rating: 1= healthy, 2= fine roots necrotic, 3= coarse roots necrotic, 4= crown rot, and 5= dead plant.

[x]Means within a column followed by the same letter are not different according to the Waller-Duncan k ratio, t-test, k=100, *P*=0.05.

Table 10. Efficacy of foliar treatments on *Phytophthora cinnamomi* root rot on *Rhododendron catawbiense* 'Roseum', Benson, NC 2004.

Treatment	Rate Per 100 Gal	Disease Severity (1-4)			Top Wt (oz)	Root Rot (1-5)
		7/16	8/11	9/09		
Fenstar 500SC	14 fl oz	2.1 a	2.5 ab	3.0 abc	0.7 de	4.4 abc
	28 fl oz	1.1 b	1.4 cd	1.7 efg	1.2 bc	3.6 d
	56 fl oz	1.0 b	1.0 d	1.0 g	1.3 b	2.4 e
Medallion 50W	2 oz	2.7 a	3.3 a	3.6 ab	0.4 de	4.7 ab
	4 oz	2.9 a	3.3 a	3.5 abc	0.3 e	4.7 ab
	8 oz	2.6 a	3.3 a	3.7 a	0.6 de	4.9 ab
Segway 400SC	1.5 fl oz	2.4 a	2.9 ab	3.1 abc	0.4 de	4.6 abc
	3.0 fl oz	2.3 a	2.4 abc	2.6 cde	0.6 de	4.1 abc
	6.0 fl oz	1.2 b	1.1 d	1.5 fg	1.0 bcd	3.7 cd
Stature DM 50W	12.8 oz	2.5 a	3.0 ab	3.4 abc	0.5 de	4.3 abc
	25.6 oz	2.1 a	2.5 ab	2.7 abc	0.7 cde	4.0 bcd
	51.2 oz	2.1 a	2.2 bc	2.4 edf	0.7 cde	3.6 d
Subdue MAXX 2E	1.0 fl oz	2.2 a	2.6 ab	2.8 abc	0.6 de	4.4 abc
Nontreated non-inoculated		1.0 b	1.0 d	1.0 g	1.9 a	1.4 f
Nontreated inoculated		2.7 a	3.3 a	3.6 ab	0.4 de	5.0 a

Treatments applied foliar starting 9 Jun and reapplied 6 times on a 14-day schedule. Disease severity rated on a 1 to 4 scale, where 1= healthy and 4=dead. Root rot rating scale was 1=healthy and 5 = dead, all roots necrotic.

Column means with a letter in common are not significantly different (Waller-Duncan k ratio, t-test, k=100, P=0.05).

Table 11. Effect of drench treatments on rhododendron 'Nova Zembla' *Phytophthora cinnamomi* root rot rating and dry weights, Chastagner, WA, 2005.

Treatment	Rate per 100 gal	Root Rating [2]	Dry weights (g) [1]	
			Roots	Tops
Adorn (fluopicolide)	10 grams ai	2.2 ab	132.3 a	70.5 a
Aliette (fosetyl Al)	5 lbs	1.4 bc[3]	128.3 a	54.9 a
Alude (phosphorus acid)	12.7 fl oz	2.4 a	103.1 a	56.5 a
Biophos (phosphorus acid)	2 gal	1.4 bc	115.7 a	55.2 a
Captan 80 WP (captan)	20 oz	1.4 bc	144.6 a	63.7 a
Disarm	5 oz	1.4 bc	132.9 a	62.5 a
Fenstar (fenamidone)	14 oz	1.8 abc	130.4 a	64.2 a
	28 oz	1.6 abc	141.9 a	63.2 a
Insignia 20W (pyraclostrobin)	16 oz	1.8 abc	122.1 a	61.7 a
	40 oz	1.8 abc	138.8 a	57.4 a
Magellan (phosphorus acid generator)	12 fl oz	2.4 a	110.2 a	63.3 a
Segway (cyazofamid)	1.5 oz	1.6 abc	123.1 a	70.4 a
	3 oz	1.4 bc	138.6 a	64.7 a
Stature DM (dimethomorph)	6.4 oz	2.2 ab	121.5 a	57.1 a
	12.8 oz	1.8 abc	115.9 a	49.8 a
Subdue MAXX (mefenoxam)	2 fl oz	1.4 bc	131.5 a	58.5 a
Terrazole (etridiazole)	10 oz	1.4 bc	139.6 a	62.3 a
Vital (phosphorus acid generator)	4 pt	1.8 abc	127.7 a	62.2 a
Nontreated non-inoculated		1.0 c	135.7 a	58.9 a
Nontreated inoculated		1.0 c	138.5 a	59.2 a

[1]Average of five plants per treatment

[2]Washed root balls rated on a scale of 1 to 5, where 1= solid root mass in the shape of the pot, 2= up to 25% of root mass deteriorated, 3= 26 to 50% of root mass deteriorated, 4= 51 to 75% of root mass deteriorated, 5= >76% of root mass deteriorated

[3]Numbers followed by the same letter are not significantly different, P = 0.05, Duncan's Multiple Range Test

Table 12. Effect of treatments on rhododendron 'Purple Splendour'*Phytophthora cinnamomi*, day 35 to 70, Chastagner, WA, 2006.

Treatment	Rate/100 gal	Application method	Application interval (days)	Disease Rating (1-4, 1=no disease) on Day					
				35	42	49	56	63	70
Actinovate SP	10 oz	drench	14	1.0 b	1.2 a	1.6 ab	1.6 a-c	1.8 ab	1.6 ab
Adorn 4FL	30 ml	drench	28	1.0 b	1.0 a	1.0 b	1.0 c	1.0 b	1.0 b
	60 ml	drench	28	1.0 b	1.0 a	1.0 b	1.0 c	1.6 ab	1.6 ab
Alude	2 qts	foliar	28	1.6 a	1.6 a	1.6 ab	1.6 a-c	1.8 ab	1.8 ab
	12.7 fl oz	drench	28	1.0 b	1.0 a	1.0 b	1.0 c	1.2 ab	1.2 ab
BioPhos	64 fl oz	foliar	14	1.0 b	1.0 a	1.0 b	1.0 c	1.6 ab	1.6 ab
	64 fl oz	drench	14	1.0 b	1.0 a	1.0 b	1.0 c	1.2 ab	1.2 ab
Captan 80 WP	4 oz	drench	14	1.0 b	1.0 a	1.0 b	1.0 c	1.2 ab	1.2 ab
Chipco Aliette 80 WP	12.8 oz	drench	28	1.0 b	1.0 a	1.0 b	1.0 c	1.4 ab	1.4 ab
Disarm 480SC	3.0 fl oz	drench	28	1.0 b	1.0 a	1.0 b	1.2 bc	1.6 ab	1.6 ab
Fenstar	7.0 fl oz/	drench	28	1.0 b	1.0 a	1.2 ab	1.2 bc	1.4 ab	1.4 ab
	14.0 fl oz	drench	28	1.0 b	1.0 a	1.0 b	1.0 c	1.6 ab	1.6 ab
Heritage WG 50	4 oz	drench	28	1.0 b	1.0 a	1.2 ab	1.2 bc	1.6 ab	1.6 ab
Insignia 20.4%	8 oz	drench	28	1.0 b	1.0 a	1.0 b	1.0 c	1.4 ab	1.4 ab
Magellan	12 fl oz	drench	28	1.0 b	1.0 a	1.0 b	1.0 c	1.0 b	1.0 b
	5 pints	foliar	28	1.0 b	1.0 a	1.0 b	1.0 c	1.4 ab	1.4 ab
MultiGuard	500 ppm	drench	7	1.2 ab[1]	1.6 a	1.8 a	2.0 a	2.2 a	2.2 a
	1000 ppm	drench	7	1.4 ab	1.6 a	1.6 ab	1.8 ab	2.2 a	2.2 a
Muscodor albus	7.5 g/L soil vol.	soil incorp.	1 x	1.0 b	1.0 a	1.4 ab	1.4 a-c	1.8 ab	1.8 ab
Micora	2 fl oz	drench	14	1.0 b	1.0 a	1.0 b	1.0 c	1.0 b	1.0 b
	8 fl oz	drench	14	1.0 b	1.0 a	1.0 b	1.0 c	1.4 ab	1.4 ab
Segway 400SC	3.0 fl oz	drench	14	1.0 b	1.0 a	1.0 b	1.0 c	1.8 ab	1.8 ab
	6.0 fl oz/	drench	14	1.0 b	1.0 a	1.0 b	1.0 c	1.2 ab	1.2 ab
Stature DM 50 WP	12.8oz	drench	14	1.0 b	1.0 a	1.0 b	1.0 c	1.4 ab	1.4 ab
Subdue MAXX FV	2 fl oz	drench	28	1.0 b	1.0 a	1.0 b	1.0 c	1.2 ab	1.2 ab
Terrazole 35 WP	8 oz	drench	28	1.0 b	1.0 a	1.0 b	1.0 c	1.2 ab	1.2 ab
Vital	4 pts	foliar	28	1.0 b	1.0 a	1.0 b	1.0 c	1.8 ab	1.8 ab
	4 pts	drench	28	1.0 b	1.0 a	1.0 b	1.0 c	1.0 b	1.0 b
Non-inoculated check				1.0 b	1.0 a	1.0 b	1.0 c	1.0 b	1.0 b
Inoculated check				1.2 ab	1.2 a	1.2 ab	1.2 bc	1.2 ab	1.2 ab

[1]Numbers in columns followed by the same letter are not significantly different, P = 0.05, Duncan's Multiple Range Test

Table 13. Effect of treatments on rhododendron 'Purple Splendour'*Phytophthora cinnamomi*, day 77 to 105, Chastagner, WA, 2006.

Treatment	Rate/100 gal	Application method	Application interval (days)	Disease Rating (1-4, 1=no disease) on Day				
				77	84	93	98	105
Actinovate SP	10 oz	drench	14	1.6 b-d	1.6 cd	2.4 a-d	2.6 a-c	2.6 a-e
Adorn 4FL	30 ml	drench	28	1.2 cd	1.4 cd	1.8 b-f	2.0 b-f	2.0 c-g
	60 ml	drench	28	1.6 b-d	1.6 cd	1.8 b-f	2.0 b-f	2.0 c-g
Alude	2 qts	foliar	28	2.0 a-d	2.0 a-d	2.2 b-e	2.2 b-e	2.2 b-f
	12.7 fl oz	drench	28	1.2 cd	1.2 cd	1.4 d-f	1.4 d-f	1.8 d-g
BioPhos	64 fl oz	foliar	14	1.6 b-d	1.6 cd	2.0 b-f	2.0 b-f	2.0 c-g
	64 fl oz	drench	14	1.6 b-d	1.8 b-d	1.8 b-f	1.8 c-f	2.0 c-g
Captan 80 WP	4 oz	drench	14	2.0 a-d	2.0 a-d	2.2 b-e	2.4 b-d	2.6 a-e
Chipco Aliette 80 WP	12.8 oz	drench	28	1.4 b-d	1.6 cd	1.8 b-f	2.0 b-f	2.0 c-g
Disarm 480SC	3.0 fl oz	drench	28	1.8 a-d	1.8 b-d	2.2 b-e	2.4 b-d	2.6 a-e
Fenstar	7.0 fl oz/	drench	28	1.4 b-d	1.8 b-d	2.0 b-f	2.2 b-e	2.6 a-e
	14.0 fl oz	drench	28	1.6 b-d	1.8 b-d	1.8 b-f	2.0 b-f	2.4 a-f
Heritage WG 50	4 oz	drench	28	1.8 a-d	1.6 cd	1.6 c-f	1.8 c-f	2.0 c-g
Insignia 20.4%	8 oz	drench	28	1.4 b-d	1.6 cd	2.0 b-f	2.2 b-e	2.8 a-d
Magellan	5 pints	foliar	28	1.4 b-d	1.4 cd	1.8 b-f	1.8 c-f	1.8 d-g
	12 fl oz	drench	28	1.0 d	1.0 d	1.0 f	1.0 f	1.6 e-g
MultiGuard	500 ppm	drench	7	2.8 a	3.0 a	3.2 a	3.4 a	3.4 a
	1000 ppm	drench	7	2.4 ab	2.8 ab	2.8 ab	3.0 ab	3.2 ab
Muscodor albus	7.5 g/L soil vol.	soil incorp.	1 x	2.2 a-c	2.2 a-c	2.6 a-c	2.6 a-c	2.6 a-e
Micora	2 fl oz	drench	14	1.0 d	1.0 d	1.0 f	1.0 f	1.0 g
	8 fl oz	drench	14	1.4 b-d	1.6 cd	1.6 c-f	1.6 c-f	1.8 d-g
Segway 400SC	3.0 fl oz	drench	14	1.8 a-d	1.8 b-d	1.8 b-f	2.0 b-f	2.0 c-g
	6.0 fl oz/	drench	14	1.2 cd	1.2 cd	1.4 d-f	1.8 c-f	1.8 d-g
Stature DM 50 WP	12.8oz	drench	14	1.6 b-d	1.8 b-d	1.8 b-f	1.8 c-f	2.0 c-g
Subdue MAXX FV	2 fl oz	drench	28	1.2 cd	1.4 cd	1.6 c-f	1.6 c-f	1.8 d-g
Terrazole 35 WP	8 oz	drench	28	1.2 cd	1.2 cd	1.8 b-f	1.8 c-f	2.0 c-g
Vital	4pts	foliar	28	1.8 a-d	2.0 a-d	2.0 b-f	2.2 b-e	2.0 c-g
	4pts	drench	28	1.0 d	1.2 cd	1.6 c-f	1.6 c-f	1.8 d-g
Non-inoculated check				1.2 cd	1.2 cd	1.2 ef	1.2 ef	1.4 fg
Inoculated check				1.8 a-d	2.0 a-d	2.6 a-c	2.6 a-c	3.0 a-c

[1]Numbers in columns followed by the same letter are not significantly different, P = 0.05, Duncan's Multiple Range Test.

Phytophthora cryptogea.

During 2007 through 2009, five experiments were conducted on *P. cryptogea* on either gerbera, Frasier fir or noble fir.

In 2007 and 2008, Benson tested several products against *P. cryptogea* on *Gerbera jamesonia* 'Yellow Revolution'. All foliar and soil treatments were applied twice with the exception of *Muscodor albus* which was incorporated into the soil prior to planting. In 2007, four products provided foliar ratings equivalent to the non-inoculated nontreated control: Adorn at 30 and 60 ml, Fenstop at14 fl oz, Segway at 6 fl oz, and Subdue Maxx at 1 fl oz (Table 14). On May 21, the plants were destructively harvested and root rot ratings were assessed. The treatments exhibiting ratings similar to the non-inoculated nontreated controls included Fenstop, Micora, and Adorn. In 2008, Fenstar at 7 and 14 fl oz, Segway at 3 and 6 fl oz, Subdue MAXX at 1 fl oz and Presidio at 2 fl oz provided foliar and root rot ratings equivalent to the non-inoculated nontreated control. (Table 15).

In the experiment conducted during 2009, disease pressure was extremely high because the plants were grown in the greenhouse during June-July when the environment was optimal for *Phytophthora cryptogea*. The Gerbera daisy cultivar used *Gerbera jamesonii* 'Yellow Revolution' is extremely susceptible to this pathogen and the drip irrigation system provided enough water to create highly favorable conditions along with maximum temperatures above 30 C for severe disease development. Foliar rating for the nontreated, inoculated control was 3.8 on a 4 point scale by day 24, while the noninoculated control was 1, healthy. At harvest on day 34 after inoculation the nontreated, inoculated control had a root rot rating of 4.8 on a 5 point scale, while the noninoculated control roots had an average rating of 1 (healthy) The standard fungicide, Subdue MAXX at 1 fl oz/100 gal (drench) provided acceptable control as foliar ratings, top weight and root rot rating was similar to the noninoculated control (Table 16). A second standard, Stature SC provided some control of crown rot but average top weight and root rot rating were different (P=0.05) from the noninoculated control. The most effective products for control of Phytophthora root rot of gerbera caused by *P. cryptogea* were Adorn at 120 ml/100 gal; Orvego at either rate; Fenstop, and Segway in terms of low foliar ratings, greatest top weights and lowest root rot ratings, in most cases not different (P=0.05) from the noninoculated control. Aliette at 80 oz/100 gal (spray) and the other phosphorus acid generators evaluated (Alude, Agri-Fos, Magellan and Vital) were not effective in control of *P. cryptogea* on gerbera daisy. Foliar ratings paralleled the nontreated inoculated control and most plants treated with phosphorus acid generators were dead at harvest.

A marginal chlorosis starting with the emerging leaf tip was observed on some gerbera daisy treated at the 34 fl oz rate of Orvego. No other products appeared phytotoxic.

Table 14. Efficacy of Foliar and Soil Treatments on *Phytophthora cryptogea* Root Rot on Gerbera 'Yellow Revolution', Benson, NC, 2007.

Treatment[w]	Rate per 100 gal	Applic method	Foliar rating (1-4)[x]			At harvest (May 21)		
			5/03	5/09	5/14	Height (cm)	Top wt (g)	Root rot (1-5)[y]
Adorn	30 ml	Drench	1.1 ab	1.3 gh	1.4 gh	10.1 ab	77.4 ab	1.6 e
	60 ml	Drench	1.0 b	1.0 h	1.0 h	9.6 ab	92.5 a	1.5 e
Aliette	5 lbs	Spray	1.0 b	2.0 ef	3.4 abcd	3.0 e	5.0 e	5.0 a
Alude	12.7 fl oz	Spray	1.5 ab	2.1 def	2.6 def	3.9 de	14.8 de	4.8 ab
Biophos	64 fl oz	Spray	1.8 a	3.1 ab	3.6 abc	3.0 e	5.0 e	5.0 a
Disarm	3 oz	Drench	1.0 b	1.9 fg	3.3 abcd	3.5 de	6.3 e	4.9 a
Fenstop	14 fl oz	Drench	1.0 b	1.0 h	1.0 h	11.0 a	86.8 a	1.1 e
Heritage	0.9 oz.	Drench	1.0 b	2.1 def	2.8 cdef	4.8 cde	28.7 cd	4.0 bc
	1.8 oz	Drench	1.0 b	2.8 abcd	3.8 ab	3.0 e	5.0 e	5.0 a
Insignia	8 oz	Drench	1.4 ab	3.0 abc	3.3 abcd	3.9 de	10.5 de	4.6 ab
Magellan	12 fl oz	Spray	1.4 ab	2.6 abcde	3.3 abcd	3.0 e	5.0 e	5.0 a
Medallion	2.0 oz	Drench	1.5 ab	3.3 a	3.6 abc	3.0 e	7.9 e	4.9 a
MultiGard	1,000 ppm	Drench	1.5 ab	3.0 abc	4.0 a	3.0 e	5.0 e	5.0 a
Muscodor albus	7.5 g/L	Incorp.	1.8 a	3.1 ab	3.8 ab	3.0 e	5.0 e	5.0 a
Micora	8 fl oz	Drench	1.0 b	1.0 h	2.3 efg	10.8 a	89.8 a	1.4 e
Remedier	2.0 oz	Drench	1.6 ab	3.3 a	3.8 ab	3.0 e	5.0 e	5.0 a
Segway	3.0 fl oz	Drench	1.3 ab	2.4 cdef	2.9 bcde	5.0 cd	19.9 de	4.3 ab
	6.0 fl oz	Drench	1.0 b	1.0 h	1.3 h	8.4 b	64.8 b	2.5 d
Subdue MAXX	1.0 fl oz	Drench	1.0 b	1.0 h	1.9 fgh	6.4 c	43.6 c	3.4 c
Vital	64 fl oz	Spray	1.0 b	2.5 bcdef	3.1 abcde	3.6 de	12.3 de	4.9 a
Non-inoculated Nontreated	--		1.0 b	1.0 h	1.0 h	10.9 a	88.8 a	1.0 e
Inoculated Nontreated	--		1.5 ab	3.1 ab	3.6 abcd	3.0 e	5.0 e	5.0 a
Non-inoculated Adorn	60 ml	Drench	1.0 b	1.0 h	1.0 h	11.3 a	88.9 a	1.3 e
Non-inoculated Heritage	1.8 oz	Drench	1.0 b	1.0 h	1.0 h	11.3 a	90.7 a	1.3 e
Non-inoculated Segway	6.0 fl oz	Drench	1.0 b	1.0 h	1.0 h	10.9 a	87.7 a	1.3 e

[w] Treatments 22 through 25 were not inoculated

[x] Foliar rating: 1= healthy, 2 = some leaves wilted, some chlorosis, 3 = most leaves wilted, chlorosis,4= crown rot, plant dead,.

[y]Root rot rating: 1= healthy, 2= 25% or less roots necrotic, 3= 26 - 50% roots necrotic, 4= more than 50% necrotic, and 5= crown rot,plant dead.

[z]Means within a column followed by the same letter are not different according to the Waller-Duncan k ratio, t-test, k=100, *P*=0.05.

Table 15. Efficacy of Foliar and Soil Treatments on *Phytophthora cryptogea* Root Rot on Gerbera 'Yellow Revolution', Benson, NC, 2008.

Treatment	Rate per 100 gal	Applic method	Foliar Rating (1-4)[x]				At Harvest (July 1)	
			6/12	6/17	6/24	7/01	Top wt (g)	Root rot (1-5)[y]
Aliette	5 lb	Spray	1.0 a[z]	2.4 abc	2.9 ab	3.6 ab	12.0 f-i	4.5 abc
Agri-Fos	64 fl oz	Spray	1.3 a	2.0 cd	2.8 abc	3.3 abc	11.5 ghi	4.5 abc
Alude	12.7 fl oz	Spray	1.1 a	2.5 abc	3.0 ab	4.0 a	5.9 i	5.0 a
Disarm	4 oz	Drench	1.1 a	2.1 bcd	3.0 ab	3.6 ab	10.1 hi	4.9a
	8 oz	Drench	1.0 a	1.3 ef	2.1 c-f	3.1 bc	20.3 efg	3.9 bcd
Fenstar	7 fl oz	Drench	1.0 a	1.3 ef	1.3 ghi	1.4 ef	39.3 bc	1.5 fg
	14 fl oz	Drench	1.0 a	1.0 f	1.0 i	1.0 f	48.9 a	1.0 g
Heritage	0.9 oz	Drench	1.1 a	2.0 cd	2.9 ab	3.5 ab	12.3 f-i	4.5 abc
	1.8 oz	Drench	1.3 a	1.9 cde	2.5 bcd	3.5 ab	14.1 f-i	4.5 abc
Insignia	8 oz	Drench	1.5 a	2.3 bc	2.5 bcd	3.9 ab	11.3 ghi	4.8 ab
Magellan	12 fl oz	Spray	1.4 a	2.4 abc	3.0 ab	4.0 a	8.6 hi	5.0 a
Muscodor albus	7.5 g/L	Incorp.	1.0 a	1.0 f	2.4 b-e	3.3 abc	15.8 fgh	4.6 ab
Micora	4 fl oz	Drench	1.3 a	2.8 ab	3.3 a	3.6 ab	12.1 f-i	4.6 ab
	8 fl oz	Drench	1.0 a	2.0 cd	2.5 bcd	3.9 ab	10.1 hi	4.9 a
Presidio	1 fl oz	Drench	1.0 a	1.0 f	1.9 d-g	2.5 cd	25.3 de	3.3 de
	2 fl oz	Drench	1.0 a	1.0 f	1.0 i	1.0 f	38.7 bc	1.5 fg
Remedier	2.0 oz	Drench	1.3a	3.0 a	3.3 a	4.0 a	6.0 i	5.0 a
Segway	3.0 fl oz	Drench	1.0 a	1.0 f	1.0 i	1.0 f	45.4 ab	1.0 g
	6.0 fl oz	Drench	1.0 a	1.0 f	1.0 i	1.0 f	45.3 ab	1.0 g
Stature SC	6.12 fl oz	Drench	1.0 a	1.3 f	1.5 g-f	2.0 de	32.3 cd	2.4 ef
Subdue MAXX	1.0 fl oz	Drench	1.0 a	1.0 f	1.1 hi	1.6 ef	35.3 c	1.8 fg
Taegro	3.5 oz	Drench	1.6 a	2.5 abc	3.3 a	4.0 a	6.7 hi	5.0 a
Tanos	12.0 oz	Drench	1.0 a	2.1 bcd	2.5 bcd	3.6 ab	13.1 f-i	4.9 a
Vital	64 fl oz	Spray	1.4 a	1.5 def	1.8 e-h	2.5 cd	21.2 ef	3.6 cd
Nontreated Non-inoculated			1.0 a	1.0 f	1.0 i	1.0 f	38.6 bc	1.1 g
Nontreated Inoculated			1.8 a	2.8 ab	3.3 a	4.0 a	6.3 hi	5.0 a

[x] Foliar rating: 1= healthy, 2 = some leaves wilted, some chlorosis, 3 = most leaves wilted, chlorosis,4= crown rot, plant dead,.

[y] Root rot rating: 1= healthy, 2= 25% or less roots necrotic, 3= 26 - 50% roots necrotic, 4= more than 50% necrotic, and 5= crown rot,plant dead.

[z] Means within a column followed by the same letter are not different according to the Waller-Duncan k ratio, t-test, k=100, *P*=0.05.

Table 16. Efficacy of Foliar and Soil Treatments on *Phytophthora cryptogea* Root Rot on Gerbera 'Yellow Revolution', Benson, NC, 2009.

Treatment	Rate per 100 gal	Application Method	Foliar Rating (1-4)				Top Weight 34 DAT	Root Rot (1 – 5) 34 DAT
			10 DAT	17 DAT	24 DAT	33 DAT		
Adorn	60 ml	Drench	1.5 abcd	2.9 bc	3.8 abc	3.8 ab	2.2 hij	4.8 ab
	120 ml	Drench	1.1 de	1.7 efg	1.9 g	2.2 e	10.2 de	2.4 d
Agri-fos	64 fl oz	Spray*	1.3 bcde	2.6 bcd	3.3 bcde	3.3 bcd	3.8 fghij	4.4 abc
Aliette	80 oz	Spray*	1.2 cde	2.7 bcd	3.6 abcd	3.8 ab	2.7 ghij	4.7 ab
Alude	12.7 fl oz	Spray*	1.5 abcd	3.2 ab	3.9 a	4.0 a	1.5 ij	5.0 a
Orvego	22.5 fl oz	Drench	1.0 e	1.0 h	1.0 i	1.0 h	15.0 ab	1.0 f
	34 fl oz	Drench	1.1 de	1.2 gh	1.2 hi	1.3 gh	14.3 abc	1.3 ef
RootShield Plus WP	6.0 oz	Drench*	1.8 a	3.7 a	4.0 a	4.0 a	1.5 ij	5.0 a
Disarm	4 fl oz	Drench	1.3 bcde	2.4 cd	3.1 def	3.4 abc	4.7 fghij	4.3 abc
	8 fl oz	Drench	1.2 cde	2.3 cde	2.8 ef	3.0 cd	7.3 ef	3.7 c
Fenstop	14.0 oz	Drench	1.0 e	1.0 h	1.1 hi	1.2 gh	14.1 abc	1.3 ef
Insignia	8.0 oz	Drench	1.1 de	2.7 bcd	3.4 abcd	3.5 abc	3.7 ghij	4.5 ab
Magellan	64 fl oz	Spray*	1.1 de	2.9 bc	3.3 bcde	3.5 abc	4.4 fghij	4.2 abc
Pageant	12.0 oz	Drench	1.2 cde	2.1 de	3.1 def	3.4 abc	5.0 fghi	4.2 abc
Remedier (Tenet) (Trichoderma)	7.5 oz	Drench*	1.6 abc	3.2 ab	3.9 a	4.0 a	1.5 ij	5.0 a
Segway	6.0 oz	Drench	1.1 de	1.4 fgh	1.7 gh	1.8 ef	11.4 cd	2.0 de
Stature SC	6.12 fl oz	Drench	1.0 e	1.2 gh	1.6 gh	1.9 ef	10.1 de	2.1 d
Subdue MAXX	1.0 fl oz	Drench	1.0 e	1.2 gh	1.3 hi	1.3 gh	13.1 abcd	1.7 def
Taegro (Bacillus subtilis)	3.5 oz	Drench*	1.2 cde	2.6 bcd	3.4 abcd	3.6 ab	2.9 ghij	4.7 ab
Tanos	12.0 oz	Drench	1.1 de	2.1 de	2.6 f	2.8 d	5.8 fg	3.7 c
Vital	64 fl oz	Spray*	1.2 cde	2.1 de	3.3 bcde	3.4 abc	5.2 fgh	4.1 bc
Nontreated Inoculated			1.6 abc	3.2 ab	3.8 abc	3.8 ab	2.7 ghij	4.8 ab
Nontreated Noninoculated			1.0 e	1.0 h	1.0 i	1.0 h	16.0 a	1.0 g

x Foliar rating: 1= healthy, 2 = some leaves wilted, some chlorosis, 3 = most leaves wilted, chlorosis, 4= crown rot, plant dead,

y Root rot rating: 1= healthy, 2= 25% or less roots necrotic, 3= 26 - 50% roots necrotic, 4= more than 50% necrotic, and 5= crownrot, plant dead.

z Means within a column followed by the same letter are not different according to the Waller-Duncan k ratio, t-test, k=100, *P*=0.05.

In 2008, Chastagner tested drench applications of several products on Fraser and noble firs (Table 17 - Table 18). Treatments which significantly reduced disease severity ratings on Fraser fir included Insignia, Stature, Adorn, Subdue, Fenstop, and Disarm at 4 fl oz. Root rot rating was reduced most effectively by Insignia, Stature, Adorn, Fenstop, and Subdue on Fraser fir. Disease severity and root rot ratings were higher on the noble fir and at the end of the experiment on day 84, the inoculated noble fir check seedlings were all dead. All of the treatments except Aliette, Heritage and Magellan had significantly lower disease ratings than the inoculated checks. The most effective treatments in reducing root rot on noble fir included Disarm, Segway, Stature, Adorn, Fenstop, and Subdue. Seedling growth occurred before significant levels of disease had developed, particularly on the noble fir, hence, most of the fungicides had no or only a limited effect on growth.

Table 17. Efficacy of drench treatments on *Phytophthora cryptogea* on Fraser Fir, Chastagner, WA 2008.

Treatment	Rate Per 100 Gal	Disease Severity Rating (0-4)[1]		Root Rating (1-4)[2]	Leader Length (cm)	Shoot Length (cm)
		Day 70	Day 84			
Adorn 4FL	1 fl oz	0 b	0 b	1.0 b	6.7 a	7.4 abc
	2 fl oz	0 b	0 b	1.0 b	6.4 a	7.4 abc
Aliette 80 WDG	12.8 oz	0.8 ab	0.8 ab	1.6 ab	6.6 a	7.1 abc
Disarm 480SC	4 fl oz	0 b	0 b	1.6 ab	6.1 ab	7.7 abc
	8 fl oz	0.8 ab	0.8 ab	1.4 ab	7.1 a	8.0 ab
Fenstop	14 fl oz	0 b	0 b	1.0 b	6.7a	7.6 abc
	28 fl oz	0 b	0 b	1.0 b	6.8 a	7.9 ab
Heritage WG 50	0.9 oz	0.8 ab	0.8 ab	2.6 ab	4.9 ab	5.8 bc
	1.8 oz	1.6 ab	1.6 ab	1.8 ab	5.5 ab	7.7 abc
Insignia 20.4 %	8 oz	0 b	0 b	1.0 b	6.1 ab	7.0 abc
Magellan	12 fl oz	0.8 ab	0.8 ab	1.6 ab	6.5 a	7.2 abc
Segway	3 fl oz	0.8 ab	0.8 ab	1.6 ab	6.5 a	8.2 ab
	6 fl oz	0 b	0.8 ab	1.6 ab	7.0 a	7.4 abc
Stature SC	6.1 fl oz	0 b	0 b	1.0 b	6.5 a	7.4 abc
Subdue MAXX FV	2 fl oz	0 b	0 b	1.0 b	7.1 a	9.2 a
Nontreated non-inoculated		0 b	0.2 ab	1.0 b	6.7 a	7.8 abc
Nontreated inoculated		3.0 a	3.0 a	3.4 a	3.2 b	4.6 c

[1] Disease severity rating: 0= no disease, 1= slight wilt/chlorosis, 2= moderate wilt/chlorosis, 3 = severe wilt/chlorosis, 4= dead seedling.

[2] Root rating: 1 = 0-10% (limited to root tips), 2 = 11-33%, 3 = 34-66%, and 4 = $\geq$ 67% of roots dead

Numbers in columns followed by the same letter are not significantly different, P=0.05, Tukey's Studentized Range Test

Table 18. Efficacy of drench treatments on Phytophthora cryptogea on Noble Fir, Chastagner, WA 2008.

Treatment	Rate Per 100 Gal	Disease Severity Rating (0-4)[1]		Root Rating (1-4)[2]	Leader Length (cm)	Shoot Length (cm)
		Day 70	Day 84			
Adorn 4FL	1 fl oz	0.2 bc	0.2 c	1.2 d	6.7 a	8.1 abc
	2 fl oz	0 c	0 c	1.0 d	8.3 a	9.5 abc
Aliette 80 WDG	12.8 oz	2.6 ab	3.0 ab	3.6 ab	8.0 a	8.2 abc
Disarm 480SC	4 fl oz	0 c	0 c	1.4 cd	8.5 a	9.6 abc
	8 fl oz	0 c	0.3 c	2.0 b-d	7.9 a	8.8 abc
Fenstop	14 fl oz	0 c	0 c	1.0 d	9.4 a	9.9 ab
	28 fl oz	0 c	0 c	1.0 d	9.3 a	11.0 a
Heritage WG 50	0.9 oz	2.4 abc	2.4 abc	3.2 abc	8.1 a	7.6 bc
	1.8 oz	1.4 bc	2.0 abc	2.8 a-d	5.8 a	6.4 c
Insignia 20.4 %	8 oz	0.8 bc	1.0 bc	2.2 a-d	7.4 a	8.3 abc
Magellan	12 fl oz	1.2 bc	1.8 abc	2.4 a-d	7.2 a	9.0 abc
Segway	3 fl oz	0.2 bc	0.2 c	1.4 cd	7.6 a	9.0 abc
	6 fl oz	0 c	0 c	1.0 d	8.5 a	9.4 abc
Stature SC	6.1 fl oz	0 c	0.4 c	1.2d	8.6 a	8.7 abc
Subdue MAXX FV	2 fl oz	0 c	0.2 c	1.0 d	8.2 a	9.6 abc
Nontreated non-inoculated		0 c	0 c	1.0 d	8.6 a	9.1 abc
Nontreated inoculated		4.0 a	4.0 a	4.0 a	6.8 a	7.5 bc

[1] Disease severity rating: 0= no disease, 1= slight wilt/chlorosis, 2= moderate wilt/chlorosis, 3 = severe wilt/chlorosis, 4= dead seedling.

[2] Root rating: 1 = 0-10% (limited to root tips), 2 = 11-33%, 3 = 34-66%, and 4 = $\geq$ 67% of roots dead

Numbers in columns followed by the same letter are not significantly different, P=0.05, Tukey's Studentized Range Test

Phytophthora drechsleri.

In 2003, Hausbeck conducted an experiment examining efficacy of several products for *Phytophthora drechsleri* on poinsettia (*Euphorbia pulcherrima*). Disease pressure was severe. Three treatments had significantly less plant death (16.7%) and were healthier (rating=1.7) when compared to the nontreated inoculated control plants at the end of this study: Stature DM 50WP, Subdue MAXX, and Truban 30WP (Table 19).

In 2007, Hausbeck examined several additional products for *P. drechsleri* on poinsettia. In this experiment, disease pressure was severe with 66.7% of the nontreated inoculated plants dead with the remaining alive plants severely stunted (Table 20). Adorn and Subdue MAXX were the only treatments that resulted in plants showing no symptoms. Two biopesticides were included: Alude and ZeroTol. Alude significantly reduced infection compared to the nontreated inoculated while ZeroTol had 100% plant death by the second rating date. A high and low rate of Cyazofamid, Heritage, and Adorn were included in this experiment with no significant differences between the rates for each treatment on the last rating date. Strobilurin products Heritage and Insignia were not effective in controlling infection and resulted in plant health and death (%) similar to that of the nontreated inoculated. No phytotoxicity was observed on any of the treated plants.

In 2003, Hausbeck conducted an experiment using *P. drechsleri* on calibrachoa. The disease pressure in this case was less severe with only 50% mortality at the last reading date. All treatments except Subdue Maxx and Truban completely prevented plant death (Table 21).

In 2009, Benson examined *P. drechsleri* on Gerbera (Table 22). Adorn, Fenstop, Orvego and Segway exhibited little foliar symptoms equivalent to non-treated, non-inoculated controls; root rot ratings 59 DAT for these products were also statistically equivalent to the non-treated, non-inoculated controls.

Table 19. * Evaluation of a biopesticide and fungicides in managing *Phytophthora drechsleri* root rot of poinsettia (*Euphorbia pulcherrima*) 'Freedom Red', Hausbeck, MI, 2003.

Treatment, rate per 100 gal, and application interval (days)	Health				Death (%)		
	5/01	5/08	5/15	5/22	5/08	5/15	5/22
Camelot 58EC 3 pt (14)	3.3 efg	5.0 e	5.0 d	5.0 c	100.0 c	100.0 d	100.0 c
Camelot 58EC 6 pt (14)	3.5 efg	4.8 de	5.0 d	5.0 c	83.3 bc	100.0 d	100.0 c
Camelot 58EC 12 pt (14)	2.8 bcdefg	4.2 de	5.0 d	5.0 c	33.3 abc	100.0 d	100.0 c
Fenamidone 500SC 4 fl oz (14)	1.8 abcde	3.7 cde	5.0 d	5.0 c	50.0 abc	100.0 d	100.0 c
Fenamidone 500SC 8 fl oz (14)	1.8 abcde	4.2 de	5.0 d	5.0 c	66.7 abc	100.0 d	100.0 c
Fenamidone 500SC 16 fl oz (14)	2.7 abcdefg	4.5 de	4.5 cd	5.0 c	83.3 bc	83.3 cd	100.0 c
Pristine 38WG 4 oz (14)	2.5 abcdefg	5.0 e	5.0 d	5.0 c	100.0 c	100.0 d	100.0 c
Pristine 38WG 8 oz (14)	2.5 abcdefg	4.7 de	5.0 d	5.0 c	100.0 c	100.0 d	100.0 c
Pristine 38WG 16 oz (14)	3.0 cdefg	4.7 de	5.0 d	5.0 c	83.3 bc	100.0 d	100.0 c
Segway 400SC 1.5 fl oz (14)	2.0 abcdef	4.8 de	5.0 d	5.0 c	83.3 bc	100.0 d	100.0 c
Segway 400SC 3 fl oz (14)	2.3 abcdefg	4.8 de	5.0 d	5.0 c	83.3 bc	100.0 d	100.0 c
Segway 400SC 6 fl oz (14)	1.5 abcd	3.0 bcd	3.0 bc	4.8 c	50.0 abc	50.0 bc	83.3 c
Stature DM 50WP 12.8 oz (14)	1.2 ab	2.0 abc	1.0 a	1.0 a	0.0 a	0.0 a	0.0 a
Subdue MAXX 21.3EC 1 fl oz (14)	1.0 a	2.0 abc	3.7 cd	5.0 c	16.7 ab	66.7 cd	100.0 c
Truban 30WP 6 oz (14)	1.0 a	1.2 ab	1.0 a	1.5 a	0.0 a	0.0 a	0.0 a
Nontreated non-inoculated	1.0 a[**]	1.0 a	1.0 a	1.0 a	0.0 a	0.0 a	0.0 a
Nontreated inoculated	3.8 g	5.0 e	5.0 d	5.0 c	100.0 c	100.0 d	100.0 c

* Not an IR-4-sponsored experiment. F&N Tests vol 59:OT009.

[z]Rated on a scale of 1 to 5, where 1=healthy to 5=dead.

[y] Column means with a letter in common or with no letter are not significantly different (Tukey's Studentized Range; *P*=0.05).

Table 20. Efficacy of drench treatments on *Phytophthora drechsleri* Root Rot on Poinsettia (*Euphorbia pulcherrima*) 'Freedom Red', Hausbeck, MI, 2007.

Treatment (active ingredient)	Rate per 100 gal	Plant health*			Plant death	
		6/29	7/18	8/01	7/18	8/01
Adorn 4FL (fluopicolide)	1 fl oz	1.0 a	1.0 a	1.0 a	0.0 a	0.0 a
	2 fl oz	1.0 a	1.0 a	1.0 a	0.0 a	0.0 a
Alude (potassium phosphate)	12.7 fl oz	1.0 a	2.3 ab	2.3 ab	33.3 abc	33.3 ab
FenStop SC (fenamidone)	7 fl oz	1.0 a	2.2 ab	2.3 ab	16.7 ab	33.3 ab
Heritage 50WG (azoxystrobin)	0.9 oz	3.2 cd	5.0 d	5.0 c	100.0 d	100.0 c
	1.8 oz	1.5 ab	3.3 bc	3.7 bc	50.0 bc	66.7 bc
Insignia 20WG (pyraclostrobin)	8 oz	1.8 ab	3.7 bcd	4.7 c	66.7 cd	66.7 bc
Segway 400SC (cyazofamid)	3 fl oz	1.0 a	1.2 a	1.2 a	0.0 a	0.0 a
	6 fl oz	2.2 bc	2.3 ab	2.3 ab	33.3 abc	33.3 ab
Stature DM 50WP (dimethomorph)	6.4 oz	1.5 ab	1.7 a	1.7 a	16.7 ab	16.7 a
Subdue MAXX EC (mefonaxam)	1 fl oz	1.0 a	1.0 a	1.0 a	0.0 a	0.0 a
Terrazole 35WP	8 oz	1.0 a	1.5 a	1.7 a	0.0 a	16.7 a
ZeroTol 27%	250 fl oz	3.5 d	5.0 d	5.0 c	100.0 d	100.0 c
Nontreated noninoculated		1.0 a**	1.0 a	1.0 a	0.0 a	0.0 a
Nontreated inoculated		1.8 ab	4.0 cd	4.3 c	66.7 cd	66.7 bc

*Plant health rating is 1 to 5; 1=healthy, 2=chlorosis/stunting, 3=minor wilting, 4=severe wilting, 5=plant death.
**Column means with a letter in common are not significantly different (Fisher's protected LSD; *P*=0.05).

Table 21. * Evaluation of a biopesticide and fungicides in managing *Phytophthora drechsleri* crown rot of calibrachoa (*Calibrachoa hybrida*) 'Spring Fling Yellow', Hausbeck, MI, 2003.

Treatment and rate/100 gal, applied at 14-day intervals unless otherwise noted	Plant Health z			Death (%)	
	5/16	5/23	5/30	5/23	5/30
Camelot 58EC 3.0 pt	1.0 a y	1.0 a	1.0 a	0.0 a	0.0 a
Camelot 58EC 6.0 pt	1.0 a	1.0 a	1.0 a	0.0 a	0.0 a
Camelot 58EC 12.0 pt	1.0 a	1.0 a	1.0 a	0.0 a	0.0 a
Fenamidone 500SC 4.0 fl oz	1.0 a	1.0 a	1.0 a	0.0 a	0.0 a
Fenamidone 500SC 8.0 fl oz	1.0 a	1.0 a	1.0 a	0.0 a	0.0 a
Fenamidone 500SC 16.0 fl oz	1.0 a	1.0 a	1.0 a	0.0 a	0.0 a
Pristine 38WG 4.0 oz	1.0 a	1.0 a	1.0 a	0.0 a	0.0 a
Pristine 38WG 8.0 oz	1.0 a	1.0 a	1.0 a	0.0 a	0.0 a
Pristine 38WG 16.0 oz	1.0 a	1.0 a	1.0 a	0.0 a	0.0 a
Segway 400SC 1.5 fl oz	1.0 a	1.0 a	1.0 a	0.0 a	0.0 a
Segway 400SC 3.0 fl oz	1.0 a	1.0 a	1.0 a	0.0 a	0.0 a
Segway 400SC 6.0 fl oz	1.0 a	1.0 a	1.0 a	0.0 a	0.0 a
Stature DM 50WP 12.8 oz	1.0 a	1.0 a	1.0 a	0.0 a	0.0 a
Subdue MAXX 21.3EC 1.0 fl oz	3.0 a	5.0 c	5.0 b	100.0 c	100.0 b
Truban 30WP 6.0 oz	2.7 a	3.0 abc	3.0 ab	50.0 abc	50.0 ab
Nontreated non-inoculated	1.0 a	1.0 a	1.0 a	0.0 a	0.0 a
Nontreated inoculated	2.3 a	2.3 ab	3.5 b	33.3 ab	50.0 ab

* Not an IR-4-sponsored experiment. F&N Tests vol 59:OT017.
zRated on a scale of 1 to 5, where 1=healthy to 5=dead.
y Column means with a letter in common are not significantly different (Tukey's Studentized Range; *P*=0.05).

Table 22. Efficacy of Foliar and Soil Treatments on *Phytophthora drechsleri* Root Rot on Gerbera 'Yellow Revolution', Benson, NC, 2009.

Treatment	Rate per 100 gal	Application Method	Foliar Rating (1-4)				Top Weight 59 DAT	Root Rot (1-5) 59 DAT
			28 DAT	38 DAT	47 DAT	59 DAT		
Adorn	60 ml	Drench	1.6 de	1.8 ef	1.8 de	1.8 de	14 a	2.0 e
	120 ml	Drench	1.0 e	1.0 f	1.0 e	1.0 e	14 a	1.0 e
Agri-fos	64 fl oz	Spray*	1.9 cde	2.5 de	3.0 abc	3.3 abc	4 bcd	4.1 ab
Aliette	80 oz	Spray*	1.4 e	1.9 ef	2.1 cd	2.9 bc	5 bcd	3.8 abc
Alude	12.7 fl oz	Spray*	1.6 de	2.4 de	3.0 abc	3.6 ab	3 bcd	4.6 ab
Orvego	22.5 fl oz	Drench	1.0 e	1.0 f	1.0 e	1.0 e	14 a	1.0 e
	34 fl oz	Drench	1.0 e	1.0 f	1.0 e	1.0 e	12 a	1.1 e
RootShield Plus WP	6.0 oz	Drench*	3.1 ab	3.1 abcd	3.3 ab	3.8 ab	3 bcd	4.5 ab
Disarm	4 fl oz	Drench	2.4 bcd	2.6 cde	3.3 ab	3.6 ab	3 bcd	4.0 ab
	8 fl oz	Drench	2.6 bc	3.3 abcd	3.9 a	4.0 a	2 d	5.0 a
Fenstop	14.0 oz	Drench	1.0 e	1.0 f	1.0 e	1.4 e	13 a	1.3 de
Insignia	8.0 oz	Drench	3.0 ab	3.8 abc	3.9 a	4.0 a	2 d	5.0 a
Magellan	64 fl oz	Spray*	1.9 cde	2.8 bcde	3.0 abc	3.5 abc	3 bcd	4.3 ab
Pageant	12.0 oz	Drench	1.9 cde	2.1 def	2.5 bcd	2.6 cd	8 b	2.5 cd
Remedier (Tenet) (*Trichoderma*)	7.5 oz	Drench*	3.6 a	3.9 ab	4.0 a	4.0 a	2 d	5.0 a
Segway	6.0 oz	Drench	1.0 e	1.0 f	1.0 e	1.0 e	16 a	1.0 e
Stature SC	6.12 fl oz	Drench	1.8 cde	2.8 bcde	3.0 abc	3.3 abc	6 bc	3.8 abc
Subdue MAXX	1.0 fl oz	Drench	3.8 a	4.0 a	4.0 a	4.0 a	2 d	5.0 a
Taegro (*Bacillus subtilis*)	3.5 oz	Drench*	3.9 a	4.0 a	4.0 a	4.0 a	2 d	5.0 a
Tanos	12.0 oz	Drench	1.6 de	2.5 de	3.0 abc	3.0 bc	5 bcd	3.5 bc
Vital	64 fl oz	Spray*	1.6 ed	2.4 de	3.0 abc	3.3 abc	4 bcd	4.1 ab
Nontreated Noninoculated			1.0 e	1.0 f	1.0 e	1.0 e	16 a	1.0 e
Nontreated Inoculated			3.0 ab	3.8 abc	4.0 a	4.0 a	2 d	5.0 a

x Foliar rating: 1= healthy, 2 = some leaves wilted, some chlorosis, 3 = most leaves wilted, chlorosis, 4= crown rot, plant dead.

y Root rot rating: 1= healthy, 2= 25% or less roots necrotic, 3= 26 - 50% roots necrotic, 4= more than 50% necrotic, and 5= crownrot, plant dead.

z Means within a column followed by the same letter are not different according to the Waller-Duncan k ratio, t-test, k=100, *P*=0.05.

Phytophthora nicotianae/parasitica. From 2003 through 2012, 13 experiments were conducted on *Phytophthora nicotianae/parasitica* root rot. Of these, seven were sponsored by IR-4. Five different host systems were utilized: pansy (*Viola x wittrockiana*), Mexican cliff rose (*Purshia mexicana*), rhododendron (*Rhododendron sp.*), snapdragon (*Antirrhinum sp*.), and spathiphyllum (*Spathiphyllum sp*.).

The Adorn, Aliette, Alude, Biophos, Fenamidone, Insignia, Micora, and Subdue MAXX treatments provided the most consistent levels of control across the experiments (Table 23 - **Error! Reference source not found.**). Stature DM usually provided excellent control; however, it did not do well in two of Hausbeck's snapdragon experiments in 2003 which had considerable disease pressure. Segway consistently provided excellent control in the more recent experiments. In single experiments, Segway + Alude effectively managed *P. nicotianae/parasitica*. The only two products which consistently performed

poorly against this pathogen were Terrazole and Truban. See the following paragraphs for summaries of each experiment.

For the control of *P. nicotianae* on Spathiphyllum, all treatments gave excellent efficacy with the exception of MultiGuard Protect (Table 36). Norman noted that in other experiments with a slow feed instead of a concentrated drench this treatment did provide acceptable efficacy.

Evans & Kratsch examined *P. parasitica* on a native species: Mexican cliff rose (*Purshia mexicana*). This species had not yet been domesticated for the ornamental trade and presented challenges in germination and even growth habit of the resulting seedlings. Most treatments provided some measure of control through 28 days after inoculation, although the level may not have been statistically different from the nontreated inoculated controls (Table 25). By 56 days after inoculation, only Fenamidone at 14 fl oz per 100 gal, Stature DM at 28 fl oz per 100 gal, and Terrazole provided no efficacy.

Kratsch, in 2007, tested 16 products for *P. parasitica* control on Mexican cliff rose. Aliette, Seqay at 3 oz, Disarm, and Vital gave econtrols tatistically better than the noninoculated nontreated control. Phytotoxicity was only observed with MultiGard (Table 26).

In 2007, both Becker and Benson examined *P. nicotianae* on several Rhododendron sp. In Becker's experiment, with three cultivars, there were differences in response based on cultivar for both number of dead plants and percent new roots (Table 27, Table 28). However, for all three cultivars there was no statistical difference in the number of dead plants between the inoculated and non-inoculated nontreated plants. MultiGard elevated the number of dead plants for all three cultivars, although in *R. catawbiense* 'Boursault' only the 1000 ppm rate was statistically significant. For the percent of new roots, only R. 'Nova Zembla' provided statistical separation between the inoculated and non-inoculated nontreated controls. In this cultivar, all but Actinovate, Adorn at 1 fl oz, and Insignia exhibited more new roots than the inoculated nontreated control.

In Benson's experiment, most products provided good control according to a foliar rating scale of 1 to 4 (Table 29). The exceptions were Medallion, *Muscodor albus* and Remedier. However, when root rot was rated, Fenomen exhibited significant root damage even though the foliage had not yet started to show symptoms. Adorn, Aliette, Alude, Biophos, Disarm, Heritage, Insignia, Magellan, Micora (NOA 445610), Segway, and Vital provided good control with both foliar and root ratings equivalent to the noninoculated nontreated controls. No phytotoxicity was observed with Adorn, Heritage, or Segway, the three products to be applied to un-inoculated plants.

See page ## for the beginning of the snapdragon results.

Table 23. General summary of drench efficacy for *Phytophthora nicotianae/parasitica* root rot – Part 1

Product	Pansy	Purshia		Rhododendron		Snapdragon							Spathiphyllum
	*Hong 2012	Evans/ Kratsch 2005	Kratsch 2007	Becker 2007	Benson 2007	Norman 2006	*Hausbeck 2004	*Hausbeck 2005	Hausbeck 2005	Hausbeck 2006	*Hausbeck 2008	*Hausbeck 2008	Norman 2006
Actinovate				-									
Adorn			+/-	+/-	++	++				++	++	++	++
Aliette		+/-	++	+/-	++	++	++		-				++
Alude			+/-		++		++		-		++	++	
Biophos			+		++		++	++	++		++		
Disarm			++	+/-	++								
Fenamidone	+	++	+	+/-	++	++				++	++	++	++
Heritage			+		++						+	+	
Insignia		+/-		-	++		++		++				
Magellan		+/-	+/-		++								
Medallion					-								
Micora			+/-	+/-	++					++	++	++	
MultiGuard			-	-		+/-				-			+/-
Muscodor albus			-		-								
Remedier					-								
Segway		+/-	++	+/-	++	++	++	-	++	++			++
Segway + Alude								++					
Stature		++	+/-	+/-			++	++	++	++	+	+/-	
Subdue MAXX						++					++	++	++
Terrazole		+/-		+/-			-		-		-	-	
Truban			+/-							-			
Vital		+/-	++		++								
ZeroTol													

[1] Rating Scale: ++ =clearly statistically equivalent or better than nontreated non-inoculated and/or clearly statistically different than nontreated inoculated; + = statistically different from nontreated inoculated and nontreated non-inoculated; +/- statistically equivalent to both nontreated inoculated and nontreated non-inoculated; - = statistically equivalent to nontreated inoculated.

[2] 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.

nicotianae/parasitica. The only two products which consistently performed poorly against this pathogen were Terrazole and Truban. See the following paragraphs for summaries of each experiment.

In 2012, Hong conducted an experiment with *P. nicotianae* on petunia (*Petunia* x *hybrida*) evaluating treatments applied as drench on Jun 28, and plants inoculated 6 days later. Disease severity was assessed weekly for 3 weeks after initial symptoms were observed on July 16 until Jul 30. All treatments significantly reduced a very high disease pressure, with Fenstop and Heritage + Subdue MAXX close to the non-inoculated check (Table 24). No phytotoxicity was observed for any treatment.

Table 24. * Evaluation of fungicide drenches for control of *Phytophtora nicotianae* root rot on petunia (*Petunia x hybrida*), 'Wave Red', Hong, VA, 2012.

Treatment and rate/100 gal	AUDPC [z]	Root quality [y]
FenStop 20SC fl oz	10.69 bc [x]	2.56 b
Heritage 50WG 0.9 oz + Subdue MAXX SL 1 fl oz	19.25 bc	0.83 c
Plentrix 3.66SE (A13836B) 1.3 fl oz	25.08 b	1.39 bc
Nontreated, non-inoculated	2.52 c	4.17 a
Nontreated, inoculated	44.72 a	0.11 c

* Not an IR-4 Experiment: PDMR 7:OT002.

[z] Each number is the mean AUDPC calculated from the disease severity ratings for each plant. Rated on a scale of 0 to 5 where 0 = healthy plant, 1 = slight wilt/infection, 2 = light infection, 3 = moderate infection: plant may not survive, 4 = severe infection: plant will not survive, and 5 = dead plant.

[y] Rated Jul 30 on a scale of 0 to 5 where 0 = poor root quality, 3 = acceptable quality for the plant size, and 5 = excellent root quality

[x] The mean values listed in a column followed by the same letter are not significantly different according to Waller=Duncan *k*-ratio, *t*-test, k=100, P<0.05.

Evans & Kratsch examined *P. parasitica* on a native species: Mexican cliff rose (*Purshia mexicana*). This species had not yet been domesticated for the ornamental trade and presented challenges in germination and even growth habit of the resulting seedlings. Most treatments provided some measure of control through 28 days after inoculation, although the level may not have been statistically different from the nontreated inoculated controls (Table 25). By 56 days after inoculation, only Fenamidone at 14 fl oz per 100 gal, Stature DM at 28 fl oz per 100 gal, and Terrazole provided no efficacy.

Kratsch, in 2007, tested 16 products for *P. parasitica* control on Mexican cliff rose. Aliette, Seqay at 3 oz, Disarm, and Vital gave econtrols tatistically better than the noninoculated nontreated control. Phytotoxicity was only observed with MultiGard (Table 26).

Table 25. Efficacy of drench treatments on *Phytophthora parasitica* Root Rot on Mexican Cliff Rose (*Purshia mexicana*), Evans & Kratsch, UT, 2005.

Treatment[1]	Rate per 100 gal	Disease Severity[2,3] (1-4) Days following inoculation				
		0	14	28	42	56
Aliette WDG	10 oz	1.75	2.12 ab	2.37 ab	2.50	2.75 ab
Fenamidone	14 fl oz	1.25	1.37 ab	2.00 ab	2.37	3.50 b
	28 fl oz	1.50	1.50 ab	1.37a	2.37	2.12 ab
Insignia	16 oz	1.00	2.00 ab	1.75 ab	2.00	3.12 ab
	40 oz	1.00	2.12 ab	3.50b	2.50	2.75 ab
Magellan*	8 fl oz	1.00	2.37 ab	2.25 ab	2.62	2.75 ab
Segway	1.5 oz	1.25	1.50 ab	2.75 ab	3.25	2.12 ab
	3.0 oz	1.00	2.25 ab	3.12 ab	2.62	3.00 ab
Stature DM 50WP	6.4 oz	1.00	1.75 ab	2.87 ab	3.62	2.62 ab
	12.8 oz	1.00	2.37 ab	1.25 a	3.62	3.75b
Terrazole 35 WP*	10 oz	1.00	2.75 ab	3.00 ab	3.37	3.87b
Vital 4L*	4 pt	1.25	1.25a	1.75 ab	2.37	2.75 ab
Nontreated-non-inoculated		1.37	1.25a	2.12 ab	2.00	1.37a
Nontreated-inoculated		1.25	3.12b	3.50b	3.75	4.00b

[1]Treatments applied as soil drench (woody ornamental protocol) at 28 day intervals (*), all other treatments at 30 day intervals.

[2]Disease severity rated on a 1-4 scale (1=no disease visible, 2=slight disease, 3=moderate to severe disease, 4=dead plant).

[3]Means in columns without letters are not significantly different whereas means in columns followed by common letters are not significantly different (Tukey's HSD comparison test).

Table 26. Efficacy of drench treatments on *Phytophthora parasitica* Root Rot on Mexican Cliff Rose (*Purshia mexicana*), Kratsch, UT, 2006.

Treatment (active ingredient) – Rate per 100 gal	Mean change in plant length (cm) over 56 days	Mean change in plant width (cm) over 56 days	Phytotoxicity Rating (56 DAI)[z] 0=none; 10=dead	Disease Rating (56 DAI) 1=no disease; 4=dead
Adorn 4FL (fluopicolide) – 30 ml	-1.05	0.38	0	3.0
Adorn 4FL (fluopicolide) – 60 ml	-0.35	0.20	0	2.5
Aliette (fosetyl AL) – 6.4 oz	1.95	0.35	0	2.0*[y]
Alude (phosphite) – 12.7 oz	3.98**[x]	0.38	0	2.5
Biophos (phosphite) – 64 fl oz	1.9	1.10	0	2.25
Disarm 480SC (fluoxystrobin) – 3 oz	2.75	0.45	0	2.13**
FenStar (fenamidone) – 7 oz	-1.2	-0.63**	0	2.38
FenStar (fenamidone) – 14 oz	-0.7	-0.18	0	2.5
Heritage (azoxystrobin) – 4 oz	1.08	0.40	0	2.5
Insignia (pyraclostrobin) – 8 oz	1.38	0.63	0	2.38
Magellan (phosphite) – 6 fl oz	3.65	0.75	0	2.38
MultiGuard (furfural) – 500 ppm	-0.93	-2.10*	8.2	3.25
MultiGuard (furfural) – 1000 ppm	1.1	-0.08	8.2	3.38
Muscodor albus – 7.5 g/L soil volume	1.15	0.13	0	2.75
Micora (mandipropamid) – 2 oz	0.78	0.20	0	2.63
Micora (mandipropamid) – 8 oz	-1.3	-0.53**	0	2.88
Segway (cyazofamid) – 3.0 oz	-0.9	0.10	0	1.88*
Segway (cyazofamid) – 6.0 oz	-0.2	-0.73**	0	2.75
Stature DM (dimethomorph) – 12.8 oz	2.75	-0.55**	0	2.5
Truban (terrazole) – 8 oz	0.18	0.35	0	2.38
Vital (phosphite) – 4 pints	5.68**	0	0	2.0*
Nontreated noninoculated	1.35	0.25	0	2.25
Nontreated inoculated	0.73	1.08	0	2.88

[x] ** indicates pairwise difference between chemical treatment and nontreated inoculated control at $P < 0.10$.

[y] * indicates pairwise difference between chemical treatment and nontreated inoculated control at $P < 0.05$.

[z] DAI = Days after inoculation.

In 2007, both Becker and Benson examined *P. nicotianae* on several Rhododendron sp. In Becker's experiment, with three cultivars, there were differences in response based on cultivar for both number of dead plants and percent new roots (Table 27, Table 28). However, for all three cultivars there was no statistical difference in the number of dead plants between the inoculated and non-inoculated nontreated plants. MultiGard elevated the number of dead plants for all three cultivars, although in *R. catawbiense* 'Boursault' only the 1000 ppm rate was statistically significant. For the percent of new roots, only R. 'Nova Zembla' provided statistical separation between the inoculated and non-inoculated nontreated controls. In this cultivar, all but Actinovate, Adorn at 1 fl oz, and Insignia exhibited more new roots than the inoculated nontreated control.

In Benson's experiment, most products provided good control according to a foliar rating scale of 1 to 4 (Table 29). The exceptions were Medallion, *Muscodor albus* and Remedier. However, when root rot was rated, Fenomen exhibited significant root damage even though the foliage had not yet started to show symptoms. Adorn, Aliette, Alude, Biophos, Disarm, Heritage, Insignia, Magellan, Micora (NOA 445610), Segway, and Vital provided good control with both foliar and root ratings equivalent to the noninoculated nontreated controls. No phytotoxicity was observed with Adorn, Heritage, or Segway, the three products to be applied to un-inoculated plants.

Table 27. Efficacy of foliar treatments on *Phytophthora nicotianae* infesting several rhododendron species – Number of Dead Plants, Becker, NY, 2007c.

Treatment (active ingredient)	Rate per 100 gal	Number of Dead Plants					
		'Nova zembla'		'Catawbiense alba'		'Catawbiense boursault'	
Actinovate 100SP (*Streptomyces lydicus*)	10 oz	1.00	bcd	0.40	bc	0.20	b
Adorn 4SC (fluopicolide)	1 fl oz	1.80	bc	0.60	bc	0.40	b
Adorn 4SC (fluopicolide)	2 fl oz	0.60	cd	1.00	bc	0.40	b
Aliette 75WP (fosetyl AL)	12.8 oz	1.20	bcd	0.80	bc	0.80	b
Disarm 480SC (fluoxastrobin)	3 fl oz	1.20	bcd	0.80	bc	0.40	b
FenStop 500SC (fenamidone)	7 fl oz	0.80	bcd	0.60	bc	0.00	b
FenStop 500SC (fenamidone)	14 fl oz	0.60	cd	0.60	bc	0.40	b
Insignia 20WP (pyraclostrobin)	8 oz	0.40	d	0.40	bc	0.40	b
MultiGuard 8.68EC (furfural)	500 ppm	3.00	a	1.60	b	1.40	b
MultiGuard 8.68EC (furfural)	1000 ppm	3.00	a	2.40	a	2.20	a
Muscodor albus 100GR	3.5 g/plant	0.40	d	0.20	c	0.60	b
Muscodor albus 100GR	7.5 g/plant	0.20	d	0.00	c	0.40	b
Micora 250SC (mandipropamid)	2 fl oz	0.20	d	0.20	c	1.00	b
Micora 250SC (mandipropamid)	8 fl oz	0.60	cd	0.80	bc	0.60	b
Segway 300SC (cyazofamid)	3 fl oz	2.00	b	0.20	c	0.40	b
Segway 300SC(cyazofamid)	6 fl oz	0.80	bcd	0.80	bc	0.20	b
Stature DM 50WP	12.8 oz	1.00	bcd	0.40	bc	0.80	b
Terrazole 35WP (etridiazole)	8 oz	0.60	cd	1.00	bc	0.60	b
Non-inoculated		0.60	cd	0.60	bc	0.20	b
Inoculated		0.80	bcd	0.80	bc	0.40	b
LSD (*P*=0.10)		0.701		0.641		0.771	
Standard Deviation		0.664		0.607		0.730	

Means followed by the same letter do not differ significantly (*P*=0.10, Student-Newman-Keuls)
Mean comparisons performed only when AOV Treatment *P*(F) is significant at mean comparison OSL

Table 28. Efficacy of foliar treatments on *Phytophthora nicotianae* infesting several rhododendron species – Percent New Roots, Becker, NY, 2007c.

Treatment (active ingredient)	Rate per 100 gal	Percent New Roots					
		'Nova zembla'		'Catawbiense alba'		'Catawbiense boursault'	
Actinovate 100SP (*Streptomyces lydicus*)	10 oz	21.63	b	21.40	b	21.73	a
Adorn 4SC (fluopicolide)	1 fl oz	18.62	b	19.00	b	22.50	a
Adorn 4SC (fluopicolide)	2 fl oz	42.67	ab	19.26	b	27.40	a
Aliette 75WP (fosetyl AL)	12.8 oz	45.08	ab	23.37	b	29.30	a
Disarm 480SC (fluoxastrobin)	3 fl oz	43.83	ab	29.50	ab	32.00	a
FenStop 500SC (fenamidone)	7 fl oz	31.63	ab	17.70	b	36.83	a
FenStop 500SC (fenamidone)	14 fl oz	35.17	ab	15.07	b	21.53	a
Insignia 20WP (pyraclostrobin)	8 oz	24.40	b	27.83	ab	34.67	a
MultiGuard 8.68EC (furfural)	500 ppm			14.03	b	13.75	a
MultiGuard 8.68EC (furfural)	1000 ppm			15.27	b	22.50	a
Muscodor albus 100GR	3.5 g/plant	26.50	ab	18.73	b	15.43	a
Muscodor albus 100GR	7.5 g/plant	40.67	ab	17.67	b	30.47	a
Micora 250SC (mandipropamid)	2 fl oz	40.50	ab	25.17	ab	26.43	a
Micora 250SC (mandipropamid)	8 fl oz	37.17	ab	19.43	b	22.90	a
Segway 300SC (cyazofamid)	3 fl oz	42.67	ab	26.33	ab	35.40	a
Segway 300SC(cyazofamid)	6 fl oz	51.53	ab	30.40	ab	38.00	a
Stature DM 50WP	12.8 oz	56.33	ab	28.90	ab	33.40	a
Terrazole 35WP (etridiazole)	8 oz	45.67	ab	28.23	ab	39.67	a
Non-inoculated		65.50	a	44.83	a	24.33	a
Inoculated		25.73	b	27.73	ab	37.17	a
LSD (*P*=0.10)		20.331		11.541		16.622	
Standard Deviation		19.238		10.920		15.728	

Means followed by the same letter do not differ significantly (*P*=0.10, Student-Newman-Keuls)
Mean comparisons performed only when AOV Treatment *P*(F) is significant at mean comparison OSL

Table 29. Efficacy of foliar and drench treatments on *Phytophthora nicotianae* infesting several rhododendron species, Benson, NC, 2007.

Product	Rate(s) per 100 gal	Application Method	Foliar disease rating (1-4) [x]				Dec 3, 2007	
			11/01	11/08	11/20	12/03	Top wt (g)	Root Rot [y]
Adorn (fluopicolide)	30 ml	Drench	1.3 b	1.0 d	1.0 d	1.3 c	47.8 cd	2.4 de
Adorn (fluopicolide)	60 ml	Drench	1.0 b	1.0 d	1.0 d	1.0 c	61.7 abc	1.8 efgh
Aliette (fosetyl-AL)	80 oz	Spray	1.0 b [z]	1.0 d	1.0 d	1.1 c	58.4 bc	1.4 fgh
Alude	12.7 fl oz	Spray	1.0 b	1.0 d	1.0d	1.0 c	68.0 ab	1.0 h
Biophos	64 fl oz	Spray	1.0 b	1.0 d	1.1d	1.3 c	60.8 abc	1.6 efgh
Disarm (fluoxastrobin)	3 oz	Drench	1.1 b	1.1 cd	1.1 d	1.0 c	59.3 bc	1.1 gh
Fenomen (fenamidone)	14 fl oz	Drench	1.3 b	1.1 cd	1.5 cd	1.4 c	48.2 cd	3.0 cd
Heritage (azoxystrobin)	0.9 oz	Drench	1.0 b	1.o d	1.3 d	1.0 c	61.6 abc	1.4 fgh
Heritage (azoxystrobin)	1.8 oz	Drench	1.0 b	1.0 d	1.0 d	1.0 c	66.1 ab	1.5 fgh
Heritage + Subdue	1.8 oz + 1 fl oz	Drench	1.0 b	1.0 d	1.1 d	1.0 c	60.5 abc	1.5 fgh
Insignia (pyraclostrobin)	8 oz	Drench	1.0 b	1.0 d	1.1 d	1.0 c	60.9 abc	1.6 efgh
Magellan	12 fl oz	Spray	1.0 b	1.0 d	1.3 d	1.4 c	58.3 bc	1.8 efgh
Medallion (fludioxanil)	2.0 oz	Drench	1.0 b	1.3 cd	1.9 bc	2.5 ab	38.0 de	3.3 bc
*Muscador albu*s	7.5 g/L	Mix-in	1.9 a	2.4 a	2.9 a	2.8 ab	16.7 f	4.1 a
Micora (mandipropamid)	8 fl oz	Drench	1.0 b	1.0 d	1.0 d	1.1 c	74.3 a	1.1 gh
Remedier	2 oz	Drench	1.4 b	1.8 b	2.4 ab	2.4 b	23.6 ef	3.5 abc
Segway (cyazofamid)	3.0 fl oz	Drench	1.0 b	1.0 d	1.0 d	1.4 c	58.9 bc	1.9 efg
Segway (cyazofamid)	6.0 fl oz	Drench	1.0 b	1.0 d	1.0 d	1.0 c	61.1 abc	2.0 ef
Subdue MAXX (mefonaxam)	1.0 fl oz	Drench	1.0 b	1.0 d	1.0 d	1.0 c	61.1 abc	1.3 fgh
Vital	64 fl oz	Spray	1.1 b	1.0 d	1.3 d	1.0 c	61.8 abc	1.4 fgh
Inoculated Nontreated	--		1.1 b	1.5 bc	2.3 b	3.1 a	24.4 ef	3.9 ab
Non-inoculated Nontreated	--		1.0 b	1.0 d	1.0 d	1.1 c	65.3 ab	1.4 fgh
Non-inoculated Cyazofamid	6.0 oz	Drench	1.0 b	1.0 d	1.0 d	1.0 c	61.8 abc	1.4 fgh
Non-inoculated Heritage	1.8 oz	Drench	1.1 b	1.0 d	1.1 d	1.0 c	66.3 ab	1.4 fgh
Non-inoculated Adorn	60 ml	Drench	1.0 b	1.0 d	1.0 d	1.0 c	61.4 abc	1.5 fgh

In 2003, Hausbeck ran an experiment comparing several products to manage *P. nicotianae* on snapdragon (*Antirrhinum majus*). Disease pressure from *P. nicotianae* was severe. Subdue MAXX was the only treatment significantly better than the nontreated inoculated plants for both plant health (rating=1.0; 1=healthy to 5=dead) and plant death (0%) assessments (Table 30). Fenamidone at the highest rate (16 fl oz) limited plant death to 66.7%. Four treatments limited plant death to 83.3%: Segway SC 1.5 fl oz, Fenamidone 4 fl oz, Stature DM, and Truban.

In 2004 Hausbeck conducted a single experiment examining *P. nicotianae* on snapdragon (*Antirrhinum majus*). While the nontreated inoculated control did reach 100% death by the final reading, this was achieved several weeks later after inoculation than the 2003 experiment (Table 31). Fenamidone (7 and 14 fl oz) and the low rate of Segway (3 fl oz) completely prevented plant death. Phostrol also suppressed plant death, however, some wilting was observed (plant health 1.5). The high rate of Captan, Segway (12

fl oz), and Stature DM performed well and limited plant death to <25%. Subdue MAXX prevented plant death at the Jul 30 rating, however, 62.5% of the plants died by the Aug 16 rating indicating that a shorter application interval than 42 days may be warranted. Aliette, Banol, Curzate, Kocide 2000, and Terrazole did not provide effective disease control in this experiment.

In 2006, Hausbeck conducted another experiments with *P. nicotianae* on snapdragon (*Antirrhinum majus*). Disease pressure was moderate with 50% of the nontreated plants dead by the second rating date, Jun 1 (Table 32, Table 33). Fenamidone at 7 fl oz per 100 gal, Micora at 8.2 fl oz per 100 gal, Adorn, and V-10162 completely prevented plant death at the final rating date. The other treatments, with the exception of MultiGuard and Truban, significantly limited plant death at the final rating date. No injury from any of the treatments was observed.

In 2008, Hausbeck conducted two experiments with *P. nicotianae* on snapdragon (*Antirrhinum majus*). Fungicide drenches were applied on Jul 18, and plants inoculated on Jul 20. In the first test, plants treated with Mandipropamid, Adorn, Biophos, FenStop, Alude and Subdue MAXX completely prevented plant death from a severe disease pressure (Table 34). Treatments that received plant health ratings statistically similar to the nontreated noninoculated control included Heritage (1.8 oz), Mandipropamid, Adorn (both rates), Biophos, FenStop, Alude, and Subdue MAXX. Terrazole-treated plants had a 50% mortality rate and the health rating was not significantly different from the inoculated control on Aug 4. In the second test, Mandipropamid, Adorn (alone or as a tank mix), FenStop, Alude and Subdue MAXX completely prevented plant death from a severe disease pressure and were not statistically different from the nontreated noninoculated control (Table 35). Terrazole- treated plants had a 50% plant death rate and the health rating was not statistically different from the nontreated inoculated plants. No phytotoxicity was observed for any treatment.

Table 30. * Evaluations of fungicides in managing *Phytophthora nicotianae* root rot of snapdragon (*Antirrhinum majus*) 'Liberty Mix', Hausbeck, MI, 2003.

Treatment and rate/100 gal, applied at 14-day intervals	Plant health [z]		Plant death (%)	
	6/19	6/25	6/19	6/25
Camelot 58EC 3.0 pt	3.5 c [y]	5.0 b	0.0	100.0 b
Camelot 58EC 6.0 pt	3.7 c	5.0 b	0.0	100.0 b
Camelot 58EC 12.0 pt	3.8 c	5.0 b	0.0	100.0 b
Fenamidone 500SC 4.0 fl oz	3.2 c	4.3 b	0.0	83.3 b
Fenamidone 500SC 8.0 fl oz	4.0 c	5.0 b	0.0	100.0 b
Fenamidone 500SC 16.0 fl oz	2.5 abc	3.7 b	0.0	66.7 b
Pristine 38WG 4.0 oz	3.5 c	5.0 b	0.0	100.0 b
Pristine 38WG 8.0 oz	3.7 c	5.0 b	0.0	100.0 b
Pristine 38WG 16.0 oz	3.5 c	5.0 b	0.0	100.0 b
Segway 400SC 1.5 fl oz	3.2 c	4.3 b	16.7	83.3 b
Segway 400SC 6.0 fl oz	4.0 c	5.0 b	0.0	100.0 b
Stature DM 50WP 12.8 oz	2.8 bc	4.8 b	0.0	83.8 b
Subdue MAXX 21.3EC 1.0 fl oz	1.2 ab	1.0 a	0.0	0.0 a
Truban 30WP 6.0 oz	2.8 bc	4.3 b	0.0	83.3 b
Nontreated non-inoculated	1.0 a	1.0 a	0.0	0.0 a
Nontreated inoculated	3.8 c	5.0 b	0.0	100.0 b

* Not an IR-4-sponsored experiment. F&N Test vol 59: OT011.

[z] Rated on a scale of 1-5, where 1=healthy to 5=dead.

[y] Column means with a letter in common or no letter are not significantly different (Tukey's Studentized Range; P=0.05).

Table 31. * Evaluations of registered and unregistered fungicides for the control of Phytophthora *nicotianae* root rot of snapdragon (*Antirrhinum majus*) 'Floral Showers White', Hausbeck, MI, 2004.

Treatment	Rate per 100 gal	Application Interval (days)	Plant health [z]	Plant death %)		
			8/16	7/19	7/30	8/16
Aliette 80WDG	12 oz	28	4.9 c [y]	0.0 a	50.0 abc	87.5 c
Banol 6EC	30 fl oz	28	4.5 c	0.0 a	87.5 c	87.5 c
Captan 80WDG	2.5 lb	14	2.0 ab	0.0 a	12.5 a	25.0 ab
Curzate 60DF	3 oz	14	5.0 c	37.5 bc	87.5 c	100.0 c
Curzate 60DF	10 oz	14	4.9 c	50.0 c	75.0 c	87.5 c
Fenamidone 500SC	7 fl oz	28	1.0 a	0.0 a	0.0 a	0.0 a
Fenamidone 500SC	14 fl oz	28	1.0 a	0.0 a	0.0 a	0.0 a
Kocide 2000 T/N/O 54DF	3 lb	14	3.5 bc	0.0 a	25.0 ab	62.5 bc
Phostrol 6.69SC	72 fl oz	28	1.5 ab	0.0 a	0.0 a	0.0 a
Segway 400SC	3 fl oz	14	1.0 a	0.0 a	0.0 a	0.0 a
Segway 400SC	12 fl oz	14	1.5 ab	0.0 a	0.0 a	12.5 ab
Stature DM 50WP	12.8 oz	14	1.5 ab	0.0 a	12.5 a	12.5 ab
Subdue MAXX 21.3EC	1 fl oz	42	3.5 bc	0.0 a	0.0 a	62.5 bc
Terrazole 35WP	10 oz	28	4.5 c	0.0 a	50.0 abc	87.5 c
Nontreated inoculated			5.0 c	12.5 ab	87.5 c	100.0 c

* Not an IR-4-sponsored experiment. F&N Test vol 60: OT006.

[z] Health was rated on a scale of 1 to 5; where 1=health, 2 to 4=various stages of wilting, and 5=dead.

[y]Column means with a letter in common are not significantly different (Tukey's Studentized Range Test, *P*=0.05).

Table 32. Plant health ratings and percent death of snapdragon (*Antirrhinum majus*) 'Montego Fire Mix' after drench treatments for *Phytophthora nicotianae* Root Rot – Plant Health, Hausbeck, MI, Test 1, 2006.

Treatment	Rate per 100 gal	Interval	Health (1 – 5)[1]			
			5/25	6/01	6/08	6/15
Adorn 4FL	1.02 fl oz	14 day	1.1 a	1.1 a	1.0 a	1.0 a
	2.04 fl oz	14 day	1.1 a	1.1 a	1.2 a	1.2 a
	4 fl oz	14 day	1.0 a	1.0 a	1.0 a	1.0 a
Fenstop 500SC	7 fl oz	14 day	1.0 a[2]	1.0 a	1.0 a	1.0 a
	14 fl oz	14 day	1.5 a	1.5 a	1.7 a	1.6 a
MultiGard	500 ppm	7 day	4.3 b	4.3 b	4.8 b	5.0 c
	1000 ppm	7 day	4.4 b	4.4 b	4.8 b	5.0 c
Micora	4.1 fl oz	14 day	1.5 a	1.5 a	1.8 a	1.6 a
	8.2 fl oz	14 day	1.0 a	1.0 a	1.0 a	1.0 a
Segway 400SC	3 fl oz	14 day	1.8 a	1.8 a	2.1 a	2.9 b
	6 fl oz	14 day	1.9 a	1.9 a	2.2 a	2.2 b
Stature DM 50WP	6.4 oz	14 day	1.3 a	1.3 a	1.7 a	1.8 a
Truban 30WP	6.0 oz	14 day	3.6 b	3.6 b	4.8 b	5.0 c
V-10162 5.73FL	16 fl oz	14 day	1.0 a	1.0 a	1.0 a	1.0 a
Nontreated non-inoculated			1.0 a	1.0 a	1.0 a	1.0 a
Nontreated inoculated			4.3 b	4.3 b	4.7 b	5.0 c

[1]Plant health rating is 1 to 5; 1=healthy, 2=slight wilting, 3=moderate wilting, 4=completely wilted, 5=plant death.

[2]Column means followed by the same letter are not significantly different (Student-Newman-Keuls; *P*=0.05).

Table 33. Plant health ratings and percent death of snapdragon (*Antirrhinum majus*) 'Montego Fire Mix' after drench treatments for *Phytophthora nicotianae* Root Rot - % Death, Hausbeck, MI, Test 1, 2006.

Treatment	Rate per 100 gal	Interval	Percent Death			
			5/25	6/01	6/08	6/15
Adorn 4FL	1.02 fl oz	14 day	0.0 a	0.0 a	0.0 a	0.0 a
	2.04 fl oz	14 day	0.0 a	0.0 a	0.0 a	0.0 a
	4 fl oz	14 day	0.0 a	0.0 a	0.0 a	0.0 a
Fenstop 500SC	7 fl oz	14 day	0.0 a[1]	0.0 a	0.0 a	0.0 a
	14 fl oz	14 day	0.0 a	0.0 a	0.0 a	10.0 a
MultiGard	500 ppm	7 day	10.0 a	30.0 ab	30.0 ab	100.0 c
	1000 ppm	7 day	10.0 a	40.0 ab	40.0 ab	100.0 c
Micora	4.1 fl oz	14 day	0.0 a	0.0 a	0.0 a	10.0 a
	8.2 fl oz	14 day	0.0 a	0.0 a	0.0 a	0.0 a
Segway 400SC	3 fl oz	14 day	10.0 a	10.0 a	10.0 a	40.0 b
	6 fl oz	14 day	0.0 a	10.0 a	10.0 a	30.0 ab
Stature DM 50WP	6.4 oz	14 day	0.0 a	0.0 a	0.0 a	20.0 ab
Truban 30WP	6.0 oz	14 day	0.0 a	10.0 a	10.0 a	100.0 c
V-10162 5.73FL	16 fl oz	14 day	0.0 a	0.0 a	0.0 a	0.0 a
Nontreated non-inoculated			0.0 a	0.0 a	0.0 a	0.0 a
Nontreated inoculated			0.0 a	50.0 b	50.0 b	100.0 c

[1]Column means followed by the same letter are not significantly different (Student-Newman-Keuls; *P*=0.05).

Table 34. * Plant health ratings and percent death of snapdragon (*Antirrhinum majus*) 'Montego Yellow' after drench treatments for *Phytophthora nicotianae* Root Rot, Hausbeck, MI, Test 1, 2008.

Treatment and rate per 100 gal	Plant health rating [x]		Plant death (%)
	7/28	8/4	8/4
Adorn 4SC 1 fl oz	1.0 a [y]	1.0 a	0.0 a
Adorn 4SC 2 fl oz	1.0 a	1.0 a	0.0 a
Alude 12.75 fl oz	1.3 a	2.0 ab	0.0 a
Biophos 255.6 fl oz	1.0 a	1.0 a	0.0 a
FenStop 14 fl oz	1.0 a	1.0 a	0.0 a
Heritage 50WDG 0.9 oz	2.0 b	4.6 c	12.5 a
Heritage 50WDG 1.8 oz	2.0 b	2.3 abc	12.5 a
Mandipropamid 250SC 8.2 fl oz	1.0 a	1.0 a	0.0 a
Stature DM 50WP 6.4 oz	3.1 b	3.4 bc	25.0 ab
Subdue MAXX EC 1 fl oz	1.0 a	1.0 a	0.0 a
Terrazole 35WP 10 oz	3.0 b	8.4 d	50.0 bc
Nontreated noninoculated	1.0 a	1.0 a	0.0 a
Nontreated inoculated	7.9 c	9.6 d	75.0 c

* Not an IR-4-sponsored experiment. PDMR vol 3: OT015.

[x] Plant health rated on a scale of 1 to 10, where 1=healthy, 2=minor chlorosis/minor stunting, 3=severe chlorosis/moderate stunting, 4=severe stunting, 5=minor wilting, 6=moderate wilting, 7=severe wilting, 8=severe wilting/minor necrosis, 9= severe wilting/moderate necrosis, 10=plant death.

[y] Column means followed by the same letter are not significantly different (Fisher's Protected LSD; *P*=0.05).

Table 35. * Plant health ratings and percent death of snapdragon (*Antirrhinum majus*) 'Rocket Red' after drench treatments for *Phytophthora nicotianae* Root Rot, Hausbeck, MI, Test 2, 2008.

Treatment and rate per 100 gal	Plant health rating [x]		Plant death (%)
	7/28	8/4	8/4
Adorn 4SC 2 fl oz	1.0 a	1.0 a	0.0 a
Adorn 4SC 2 fl oz + Alude 12.75 fl oz	1.0 a	1.0 a	0.0 a
Adorn 4SC 2 fl oz + Heritage 50WDG 0.9 oz	1.0 a	1.0 a	0.0 a
Adorn 4SC 2 fl oz + Terrazole 35WP 10 oz	1.0 a	1.0 a	0.0 a
Alude 12.75 fl oz	1.3 a	1.5 a	0.0 a
FenStop 14 fl oz	1.0 a	1.0 a	0.0 a
Heritage 50WDG 1.8 oz	2.3 a	4.0 b	12.5 a
Mandipropamid 250SC 8.2 fl oz	1.0 a	1.0 a	0.0 a
Stature DM 50WP 6.4 oz	3.4 b	6.6 c	25.0 ab
Subdue MAXX EC 1 fl oz	1.0 a	1.0 a	0.0 a
Terrazole 35WP 10 oz	4.6 c	9.3 d	50.0 b
Nontreated noninoculated	1.0 a	1.0 a	0.0 a
Nontreated inoculated	5.3 c	9.0 d	25.0 ab

* Not an IR-4-sponsored experiment. PDMR vol 3: OT016.

[x] Plant health rated on a scale of 1 to 10, where 1=healthy, 2=minor chlorosis/minor stunting, 3=severe chlorosis/moderate stunting, 4=severe stunting, 5=minor wilting, 6=moderate wilting, 7=severe wilting, 8=severe wilting/minor necrosis, 9= severe wilting/moderate necrosis, 10=plant death.

[y] Column means followed by the same letter are not significantly different (Fisher's Protected LSD; *P*=0.05).

For the control of *P. nicotianae* on Spathiphyllum, all treatments gave excellent efficacy with the exception of MultiGuard Protect (Table 36). Norman noted that in other experiments with a slow feed instead of a concentrated drench this treatment did provide acceptable efficacy.

Table 36. Percent Rotten Roots and Damaged Foliage of Spathiphyllum 'Patrice' after treatments for *Phytophthora parasitica* Root Rot, Norman, FL, 2006.

Treatment	Rate per 100 gal	Drench interval	Avg % rotten roots	LSD (0.05)	Avg % damaged foliage	LSD (0.05)
Adorn	3.0 fl oz	14 day	0	a	0	a
	6.0 fl oz	14 day	0	a	0	a
Aliette	12.8 fl oz	30 day	0	a	0	a
Fenamidone	7.0 fl oz	28 day	0.5	a	0.5	a
	14 fl oz	28 day	0	a	0	a
MultiGuard Protect (furfural)	500 ppm	7 day	54.5	b	33	b
	1000 ppm	7 day	71	c	62	c
Segway	3.0 fl oz	14 day	0	a	0	a
	6.0 fl oz	14 day	0	a	0	a
Subdue Maxx 2E	0.6 fl oz	60 day	0	a	0	a
Nontreated non-inoculated			0	a	0	a
Nontreated inoculated			60	b	58	c

Phytophthora palmivora.

In 2010, Becker examined the impact of fungicides applied as drench treatments on *Phytophthora palmivora* on English ivy (*Hedera helix L. ssp. Helix*). Bare rooted plants were inoculated at transplanting on Apr 10, then followed with drench applications of fungicides on Apr 11 & 25, May, 10 & 20, Jun 7 & 21, and Jul 10. Adorn, Captan, Disarm, Heritage, Segway and Stature significantly increased shoot and vigor, comparable to the non-inoculated check; Fenstop, Insignia, Magellan, Subdue MAXX, and Terrazole were slightly inferior to the non-inoculated check (Table 37, Table 38). No phytotoxicity was observed for any treatment, except severe decrease in shoot and root vigor with the phosphorus acids Agri-fos and Vital; Aliette and Alude also caused slight phytotoxicity.

Table 37. Shoot data from English ivy (*Hedera helix L. ssp. Helix*) after drench treatments for *Phytophthora palmivora* root rot, Becker, NY, 2010.

Treatment	Rate per 100 gal	Shoot			Shoot Weight (gm)	Shoot Vigor (0-10) [z]
		Length (cm)	No. Live leaves	No. Dead leaves		
Agri-Fos	12.7 fl oz	31.64 a [x]	7.29 a	7.00 a	5.66 bc	3.00 i
Aliette	12.8 oz	26.43 a	19.57 a	2.57 a	7.83 abc	6.29 gh
Alude	12.7 fl oz	26.64 a	13.00 a	2.00 a	8.44 abc	5.64 h
Captan	16 oz	29.93 a	16.29 a	2.14 a	11.79 ab	8.36 a-e
Disarm 480	4 fl oz	30.07 a	12.86a	1.00 a	9.36 ab	6.96 fg
Disarm 480	8 fl oz	33.07 a	14.57 a	1.00 a	10.13 ab	8.64 abc
Fenstop	14 fl oz	31.57 a	15.71 a	2.43 a	9.22 ab	7.57 c-f
Heritage	0.9 fl oz	34.21 a	12.86 a	1.57 a	8.37 abc	8.57 abc
Heritage	1.8 fl oz	34.86 a	15.57 a	1.71 a	12.71 a	8.93 ab
Insignia	8 oz	34.00 a	14.86 a	3.00 a	9.21 ab	7.64 b-f
Magellan	12 fl oz	26.14 a	14.86 a	2.86 a	8.52 abc	7.21 d-g
Segway	3 fl oz	33.50 a	15.71 a	2.57 a	11.18 ab	8.50 a-d
Segway	6 fl oz	28.21 a	12.14 a	2.14 a	9.40 ab	7.14 efg
Stature SC	6.12 fl oz	32.07 a	15.14 a	2.00 a	10.43 ab	8.21 a-f
Subdue MAXX	1 fl oz	31.07 a	14.29 a	2.29 a	8.00 abc	7.14 efg
Taegro	3.5 oz	30.43 a	14.57 a	2.29 a	8.81 abc	7.00 fg
Tanos	6.1oz	29.14	13.29 a	2.86 a	8.45 abc	6.93 fg
Terrazole	8 oz	31.57 a	14.29 a	2.29 a	10.25 ab	8.00 b-f
Adorn	1 fl oz	31.64 a	14.71 a	3.29 a	10.77 ab	8.50 a-d
Adorn	2 fl oz	30.57 a	12.29 a	1.43 a	9.94 ab	8.00 b-f
Vital	64 fl oz	15.14 a	8.57 a	1.86 a	3.45 c	1.79 j
Noninoculated Check		37.50 a	17.00 a	1.86 a	13.06 a	9.47 a
Inoculated Check		29.50 a	12.14 a	2.71 a	7.31 abc	5.57 h

All data collected Aug 1.

[z] A 0 to 10 rating was given to the plants based on the visual health of the plant, based on foliar chlorosis or necrosis, as well, as relative shoot length.

[x] Column means followed by the same letter are not significantly different (Student-Newman-Keuls; *P*=0.10).

Table 38. Root data from English ivy (*Hedera helix L. ssp. Helix*) after drench treatments for *Phytophthora palmivora* root rot, Becker, NY, 2010.

Treatment	Rate per 100 Gal	Fresh Root Wt (gm) 8/1	Dry Root Wt (gm) 8/25	Root Vigor (0-10) [z] 8/1
Agri-Fos	12.7 fl oz	1.98 f [x]	0.50 de	3.57 de
Aliette	12.8 oz	5.06 a-f	1.12 a-e	6.21 abc
Alude	12.7 fl oz	5.55 a-f	1.25 a-e	6.79 abc
Captan	16 oz	8.96 abc	1.62 abc	7.86 ab
Captan	16 oz	8.96 abc	1.62 abc	7.86 ab
Disarm 480	4 fl oz	5.31 a-f	1.01 a-e	6.29 abc
Disarm 480	8 fl oz	4.57 b-f	1.15 a-e	6.29 abc
Fenstop	14 fl oz	6.29 a-f	1.06 a-e	6.29 abc
Heritage	0.9 fl oz	5.68 a-f	1.10 a-e	6.86 abc
Heritage	1.8 fl oz	9.44 ab	1.61 abc	7.57 ab
Insignia	8 oz	3.28 def	0.74 b-e	5.57 bcd
Magellan	12 fl oz	6.24 a-f	1.21 a-e	6.43 abc
Segway	3 fl oz	9.54 a	1.84 ab	8.86 a
Segway	6 fl oz	7.27 a-e	1.45 a-d	8.00 ab
Stature SC	6.12 fl oz	5.75 a-f	1.38 a-d	7.36 ab
Subdue MAXX	1 fl oz	7.48 a-e	1.21 a-e	7.71 ab
Taegro	3.5 oz	4.31 c-f	1.06 a-e	4.57 cd
Tanos	6.1oz	5.00 a-f	0.90 a-e	4.71 cd
Terrazole	8 oz	7.98 a-d	1.83 ab	7.43 ab
Adorn	1 fl oz	8.14 abc	1.91 a	7.86 ab
Adorn	2 fl oz	8.87 abc	1.87 a	8.43 ab
Vital	64 fl oz	1.64 f	0.28 e	1.86 e
Noninoculated Check		7.83 a-e	1.72 ab	8.43 ab
Inoculated Check		3.06 ef	0.54 cde	3.50 de

[z] A 0 to 10 root vigor rating was made from visual assessment of root size and bushiness.
[x] Column means followed by the same letter are not significantly different (Student-Newman-Keuls; *P*=0.10).

***Phytophthora tropicalis*.** In 2007, Norman screened several products with drench applications to control *Phytophthora tropicalis* on Pothos 'Golden' (Table 39). The inoculated control had 5% rotten roots and the nontreated noninoculated control had 0% rotten roots. All treatments had either 0 or 2.5% rotten roots with the exception of MultiGard. This treatment appeared to accentuate disease development with approximately 20% rotten roots. In 2008, he tested drench applications of several products on English ivy (Table 40). The inoculated control had 97% rotten roots and the nontreated noninoculated control had 0% rotten roots. Stature, Disarm at 8 fl oz, Adorn and Segway at 6 fl oz provided the best control followed by Disarm at 4 fl oz, Fenstar and Heritage at 0.9 oz, all statistically equivalent to the nontreated noninoculated control. Other products that reduced disease but not statistically equivalent to the nontreated noninoculated control included: Segway at 3 fl oz, Heritage at 1.8 oz, Insignia and Aliette. Taegro provided no significant control.

In 2008-09, Benson tested 17 products against *P. tropicalis* on vinca (*Catharanthus roseus*)'PeppermintCooler' (Table 41). All foliar and soil treatments were applied 5 times at 2-3 week intervals. Symptoms of Phytophthora root rot including mortality did show up on plants beginning 54 days after inoculation with *P. tropicalis*, but symptomatic plants were not consistent across a given treatment. At the end of the experiment, there was no difference between the inoculated, nontreated

control and the non-inoculated nontreated control so no treatment effects could be separated. Tanos caused vinca to be uniformly chlorotic and stunted.

In 2010, Benson tested several products against *P. tropicalis* on gloxinia (*Gloxinia* sp.). Fungicides were applied following inoculation on May 18, and applications were repeated 3 times on a 2-week schedule until Jun 29. The phosphite generators Alude, Agri-fos and Vital applied as foliar sprays provided effective control of a severe disease pressure, equal to the standard Aliette and non-inoculated check (Table 42). Drench treatments Adorn, Fenstop, Orvego, Pageant, Segway, Disarm and the standard Subdue also provided effective control; Tanos provided poor control, while Stature and Taegro were ineffective. No phytotoxicity was observed for any treatment.

Table 39. Summary of the effects of fungicide treatments on root rot ratings for Pothos (*Pothos* sp.) 'Golden' inoculated with *Phytophthora tropicalis*, Norman, 2007.

Treatment	Rate per 100 gal	Drench Interval	Average % Rotten Roots
Adorn (fluopicolide)	3 fl oz	14 d	0 a
	6 fl oz	14 d	0 a
Aliette (fosetyl-AL)	12.8 fl oz	30 d	2.5 a
Fenstar (fenamidone)	7.0 oz	28 d	0 a
	14.0 oz	28 d	0 a
Heritage (azoxystrobin)	0.9 oz	14 d	2.5 a
	1.8 oz	14 d	0 a
MultiGard (furfural)	500 ppm	7 d	19 b
	1000 ppm	7 d	20 b
Micora (mandipropamid)	2 fl oz	14 d	0 a
	8 fl oz	14 d	0 a
Segway (cyazofamid)	3 fl oz	14 d	0 a
	6 fl oz	14 d	0 a
Subdue (mefonaxam)	0.6 fl oz	60 d	0 a
Control (inoculated)			5 a
Control (not inoculated)			0 a

Table 40. Efficacy of of drench treatments on *Phytophthora tropicalis* root rot on English ivy (*Hedera helix*), Norman, 2008

Treatment	Rate per 100 gal	Drench Interval	Average % Rotten roots
Adorn (fluopicolide)	1 fl oz	28 day	0.5 a
	2 fl oz	28 day	0 a
Aliette (fosetyl-AL)	12.8 oz	30 day	81 e
Disarm (fluoxastrobin)	4 fl oz	21 day	7 ab
	8 fl oz	21 day	0 a
Fenstar (fenamidone)	7.0 fl oz	28 day	9 ab
	14 fl oz	28 day	3 ab
Heritage (azoxystrobin)	0.9 oz	28 day	7 ab
	1.8 oz	28 day	20 c
Insignia (pyraclostrobin)	8 oz	28 day	32 d
Segway (cyazofamid)	3.0 fl oz	28 day	13 bc
	6.0 fl oz	28 day	2 a
Stature SC (dimethomorph)	6.12 fl oz	14 day	0 a
	12.25 fl oz	14 day	0 a
Taegro (*Bacillus subtilis* var. *amyloliquefasciens*)	3.5 oz	21 day	93 f
Control (inoculated)			97 f
Control (not inoculated)			0 a

Table 41. Efficacy of drench treatments on *Phytophthora tropicalis* root rot on Vinca (*Catharanthus roseus*)'Peppermint Cooler', Benson, NC, 2008-09.

Treatment	Rate per 100 gal	Applic method	Disease Rating (1-4)[x]			At Harvest (2/11)	
			1/05	1/16	2/02	Top wt (g)	Root rot (1-5)[y]
Adorn	1 fl oz	Drench	1.0 b	1.0 c	1.0 c	25.3 ab	1.0 d
	2 fl oz	Drench	1.0 b	1.0 c	1.0 c	26.3 a	1.0 d
Aliette	5 lb	Spray	1.0 b[z]	1.0 c	1.0 c	21.8 abc	1.4 cd
Agri-Fos	64 fl oz	Spray	1.0 b	1.0 c	1.0 c	23.6 abc	1.3 cd
Alude	64 fl oz	Spray	1.0 b	1.0 c	1.0 c	24.2 abc	1.1 cd
Disarm	4 oz	Drench	1.4 ab	1.3 bc	1.3 bc	24.1 abc	1.1 cd
	8 oz	Drench	1.0 b	1.0 c	1.0 c	21.9 abc	1.4 cd
Fenstar	7 fl oz	Drench	1.0 b	1.0 c	1.0 c	22.8 abc	1.1 cd
	14 fl oz	Drench	1.0 b	1.0 c	1.4 bc	21.4 abc	1.0 d
Heritage	0.9 oz	Drench	1.0 b	1.0 c	1.0 c	27.0 a	1.0 d
	1.8 oz	Drench	1.0 b	1.0 c	1.0 c	25.2 ab	1.0 d
Insignia	8 oz	Drench	1.0 b	1.0 c	1.0 c	24.1 abc	1.1 cd
Magellan	12 fl oz	Spray	1.3 ab	1.0 c	1.0 c	24.4 ab	1.1 cd
Micora	4 fl oz	Drench	1.3 ab	1.4 bc	1.3 bc	22.2 abc	1.3 cd
	8 fl oz	Drench	1.4 ab	1.6 b	1.5 b	19.0 bc	1.6 bc
Remedier	2.0 oz	Drench	1.4 ab	1.5 b	1.5 b	17.3 cd	2.0 b
Segway	3.0 fl oz	Drench	1.0 b	1.0 c	1.0 c	23.6 abc	1.0 d
	6.0 fl oz	Drench	1.1 b	1.5 b	1.0 c	20.7 abc	1.3 cd
Stature SC	6.12 fl oz	Drench	1.0 b	1.0 c	1.1 bc	22.9 bc	1.0 d
Subdue Maxx	1.0 fl oz	Drench	1.0 b	1.0 c	1.0 c	25.3 ab	1.0d
Taegro	3.5 oz	Drench	1.0 b	1.0 c	1.0 c	22.0 abc	1.5 bcd
Tanos	12.0 oz	Drench	1.9 a	2.6 a	3.0 a	11.9 d	3.8a
Vital	64 fl oz	Spray	1.0 b	1.0 c	1.0 c	22.9 abc	1.3 cd
Nontreated Non-inoculated			1.0 b	1.4 bc	1.4 bc	23.4 abc	1.5 bcd
Nontreated Inoculated			1.4 ab	1.4 bc	1.5 b	21.8 abc	1.5 bcd

[x] Foliar rating: 1= healthy, 2 = some leaves wilted, some chlorosis, 3 = most leaves wilted, chlorosis,4= crown rot, plant dead,.

[y] Root rot rating: 1= healthy, 2= 25% or less roots necrotic, 3= 26 - 50% roots necrotic, 4= more than 50% necrotic, and 5= crown rot,plant dead.

[z] Means within a column followed by the same letter are not different according to the Waller-Duncan k ratio, t-test, k=100, *P*=0.05.

Table 42. Efficacy of drench treatments on *Phytophthora tropicalis* root rot on Gloxinia (*Gloxinia* sp.), 'Avanti Peach Rose' Benson, NC, 2010.

Treatment	Rate per 100 gal	Applic method	Disease Rating (1-4)[x]			At Harvest: Day 52	
			Day 30	Day 39	Day 52	Top wt (g)	Root rot (1-5)[y]
Adorn	60 ml	Drench	1.0 c	1.0 b	1.0 d	354 a	1.0 c
	120 ml		1.0 c	1.0 b	1.0 d	337 a	1.0 c
Agri-fos	64 fl oz	Spray	1.0 c	1.0 b	1.3 cd	288 ab	1.5 c
Aliette	80 oz	Spray	1.0 c	1.0 b	1.0 d	289 ab	1.0 c
Alude	12.7 fl oz	Spray	1.0 c	1.0 b	1.6 cd	298 ab	1.9 c
Disarm	4 fl oz	Drench	1.0 c	1.0 b	1.4 cd	270 ab	1.5 c
	8 fl oz		1.3 bc	1.4 b	1.4 cd	284 ab	1.6 c
Fenstop	14.0 oz	Drench	1.0 c	1.0 b	1.0 d	293 ab	1.0 c
Orvego (Orvego)	22.5 fl oz	Drench	1.0 c	1.0 b	1.0 d	331 a	1.1 c
	34 fl oz		1.0 c	1.0 b	1.0 d	345 a	1.1 c
Pageant	12.0 oz	Drench	1.0 c	1.0 b	1.0 d	310 ab	1.0 c
Segway	6.0 fl oz	Drench	1.0 c	1.0 b	1.0 d	307 ab	1.0 c
Stature SC	6.12 fl oz	Drench	1.1 bc	2.8 a	2.9 ab	159 cde	3.5 a
Subdue Maxx	1.0 fl oz	Drench	1.1 bc	1.4 b	2.0 bc	260 abc	2.1 bc
Taegro (*Bacillus subtilis)*	3.5 oz	Drench	1.4 b	2.1 a	2.8 ab	148 de	3.3 ab
Tanos	12.0 oz	Drench	1.0 c	1.0 b	1.0 d	220 bcd	2.1 bc
Vital	64 fl oz	Spray	1.0 c	1.0 b	1.8 cd	264 ab	2.0 bc
Nontreated Noninoculated			1.0 c	1.0 b	1.0 d	328 a	1.0 c
Nontreated Inoculated			1.8 a	2.8 a	3.6 a	78 e	4.5 a

[x] Foliar rating: 1= healthy, 2 = some leaves wilted, some chlorosis, 3 = most leaves wilted, chlorosis, 4 = crown rot, plant dead.

[y] Root rot rating: 1= healthy, 2= 25% or less roots necrotic, 3= 26 - 50% roots necrotic, 4= more than 50% necrotic, and 5= crown rot, plant dead.

[z] Means within a column followed by the same letter are not different according to the Waller-Duncan k ratio, t-test, k=100, *P*=0.05.

Phytophthora sp. In 2006, Reddy screened several products to manage a *Phytophthora* species on marigold (*Tagetes sp.*) seedlings (Table 43). Several treatments provided control statistically equivalent to the nontreated non-inoculated control across all ratings: Fenamidone at 14 fl oz, Hymexazole at 12 oz, MultiGuard Protect at 500 ppm, NOA446510 at 8 oz, Segway at 3 oz, Adorn at 60 ml, and Vital at 4 pints. The other treatments providing low levels of pre-emergence or post-emergence damping off included BioPhos at 2 gal and Adorn at 30 ml.

Table 43. Efficacy of various products to control *Phytophthora sp.* in marigold *(Tagetes sp.*) seedlings, Reddy, 2006.

Treatments[1]	Rate per 100 gal	Vigor[2]	% Healthy stand[3]	% Pre-emergence damping-off[4]	% Post-emergence damping-off[5]	Root rot severity[6]	Phytotoxicity[7]
Actinovate	10 oz	5.0 a [8]	76.7 ab	5.4 ab	11.8 bc	2.8 ab	No
Adorn	30 ml	4.5 b	68.9 abc	6.4 ab	6.9 ab	4.3 bc	No
	60 ml	5.0 a	79.8 ab	3.1 a	3.4 ab	2.1 ab	No
BioPhos	1 gal	4.8 ab	76.9 ab	5.1 ab	11.9 bc	1.9 ab	No
	2 gal	5.0 a	89.9 a	1.1 a	3.2 ab	3.8 bc	No
Disarm	3 oz	5.0 a	83.6 ab	4.7 ab	3.8 ab	3.6 bc	No
Fenstop	7 oz	4.5 b	73.8 ab	6.5 ab	11.3 bc	3.6 bc	No
	14 oz	5.0 a	87.9 a	3.5 a	3.9 ab	1.1 a	No
Hymexazole	6 oz	4.5 b	78.4 ab	7.8 ab	8.9 b	2.2 ab	No
	12 oz	5.0 a	85.4 ab	2.1 a	2.1 a	1.1 a	No
Multiguard	250 ppm	4.0 c	65.9 bc	11.9 b	9.4 b	2.9 ab	No
	500 ppm	5.0 a	75.5 ab	4.6 ab	6.9 ab	2.9 ab	No
Micora (mandipropamid)	2 oz	4.5 b	75.6 ab	7.8 ab	8.9 b	4.9 bc	No
	8 oz	5.0 a	86.9 ab	2.1 a	5.1 ab	2.3 ab	No
Promax	2 gal	4.5 b	75.1 ab	3.5 a	12.9 c	1.1 a	No
Segway	1.5 oz	4.4 bc	75.6 ab	7.8 ab	12.9 c	4.7 bc	No
	3 oz	5.0 a	85.5 ab	4.8 ab	3.9 ab	1.4 ab	No
Vital	2 pts	4.5 b	73.8 ab	6.3 ab	7.9 b	4.3 bc	No
	4 pts	5.0 a	87.2 ab	1.7 a	2.9 a	1.9 ab	No
Nontreated non-inoculated		4.5 b	89.5 a	2.5 a	3.7 ab	1.8 ab	--
Nontreated inoculated		3.5 d	48.9 c	21.9 c	15.9 c	5.6 c	--
LSD *P* = 0.05		0.4	21.6	7.8	4.9	2.3	

[1]All the treatments were applied as a soil drench at 1 and 2 weeks after transplanting at recommended doses.
[2]Mean of 8 replications per treatment, one seedling per replication. Vigor is rated as 1 = Very poor, 2 = Poor, 3 = Better, 4 = Good, and 5 = Very good.
[3]Mean 8 replications per treatment, one seedling per replication.
[4]Pre-emergence damping-off was rated 21 days after transplanting.
[5]Post-emergence was rated 45 days after transplanting.
[6] Root rot severity ratedon a scale of 1-10. 1 = no symptoms, very healthy. 2 = 10-20% discoloration, 3 = 20-30% discoloration, 4 = 30-40% discoloration, 5 = 40-50% discoloration, 6 = 50-60% discoloration, 7 = 60-70% discoloration, 8 = 70-80% discoloration, 9 = 80-90% discoloration, and 10 = dead.
[7] Phyto, - - = not applicable, No = no phytotoxicity.
[8]Numbers followed by different letteras are significantly different from pathogen control according to Fisher's protected LSD at *P* = 0.05.

Comparative Efficacy on Phytophthora Foliar Blights

Phytophthora citricola. In an experiment for control of foliar *Phytophthora citricola* on rhododendron (*Rhododendron* sp.) with foliar applications, Aliette (5 lb per 100 gal), Biophos (2 gal per 100 gal) and Magellan (4 pt per 100 gal) provided the best overall control of Phytophthora blight (Table 44).

Table 44. Efficacy of foliar treatments on *Phytophthora citricola* blight on rhododendron, Regan, OR, 2005.

Treatment	Rate Per 100 Gal	Stem Canker Length (cm) (% Control)	Leaf Spot Diameter (cm)	Disease Severity (0-10)
Aliette 80W	5 lb	2.3 c (82)	0.7 a	0.3 a
Biophos 43L	2 gal	4.7 c (64)	0.8 a	0.6 a
Fenstop500SC	14 fl oz	11.7 ab (9)	1.0 a	1.0 a
	28 fl oz	11.8 ab (9)	1.1 a	1.9 a
Fore 80W	1.5 lb	10.8 ab (16)	1.4 a	2.1 a
Insignia 20W	16 oz	11.8 ab (9)	0.6 a	2.0 a
	40 oz	11.2 ab (13)	0.9 a	1.1 a
Magellan	4 pt	3.0 c (77)	0.8 a	0.5 a
Segway 400SC	3.0 fl oz	11.3 ab (12)	0.7 a	1.7 a
	6.0 fl oz	12.0 ab (7)	0.7 a	1.0 a
Stature DM 50W	6.4 oz	11.4 ab (12)	0.8 a	2.1 a
	12.8 oz	9.4 b (27)	0.4 a	2.3 a
TM-459	6 fl oz	12.3 ab (5)	1.2 a	1.3 a
Nontreated non-inoculated		-	-	-
Nontreated inoculated		12.9 a (0)	1.5 a	3.1 a

Treatments applied foliar starting 3 Jun and reapplied 2 times 11 and 26 days later except for Aliette which was applied 26 days later.
Disease severity rated on a 0 to 10 scale, where 0= no disease and 10=complete necrosis.
Column means with a letter in common are not significantly different (Tukey-Kramer multiple comparison test).

Phytophthora nicotianae/parasitica. From 2003 through 2012, five experiments were conducted on *Phytophthora nicotianae/parasitica* foliar blight. Of these, two were sponsored by IR-4. Two different host systems were utilized: vinca (*Catharanthus roseus*), and spathiphyllum (*Spathiphyllum sp*.). The Adorn, Aliette, Fenamidone, Stature, and Subdue MAXX treatments provided the most consistent levels of control across the experiments. In single experiments, Micora and Vital effectively managed *P. nicotianae.* See the following paragraphs for summaries of each experiment.

Table 45. General summary of efficacy for *Phytophthora nicotianae/parasitica* aerial blight.

Product	Annual Vinca				Spathiphyllum
	*Hausbeck 2003	Hausbeck 2006	*Steddom 2009	*Hong 2012	Norman 2006
Inosco				++	
Adorn		++			++
Aliette	+				++
Alude					
Biophos					
Camelot	+				
Captan		++			
Daconil					
Fenamidone	+	++	++	+	++
Heritage	+			-	
Hurricane					
Insignia					
Micora		++			
MultiGuard		+			
Orvego					
Pageant					
PlantShield					
Polyram					
Pristine	+				
Segway	+/-	++			++
Spectro					
Stature	+	++	++		
Subdue MAXX	++		++	-	
Truban	+/-				
Vital					

[1] Rating Scale: ++ =clearly statistically equivalent or better than nontreated non-inoculated and/or clearly statistically different than nontreated inoculated; + = statistically different from nontreated inoculated and nontreated non-inoculated; +/- statistically equivalent to both nontreated inoculated and nontreated non-inoculated; - = statistically equivalent to nontreated inoculated.

[2] 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.

In 2003, Hausbeck conducted two experiments to control *P. nicotianae* foliar blight on vinca. In the first test, plants were sprayed, with the exceptions of Subdue MAXX and Heritage which were applied as a drench, on Jun 19. Plants were inoculated on the same day. Pristine (4.0 and 8.0 oz), Camelot (12.0 pt), Reason (4.0 and 8.0 fl oz), Stature DM, Aliette, Subdue MAXX, Heritage, and Truban completely prevented plant death from a severe disease pressure (Table 46). By the last observation date (Jul 8), Subdue MAXX was the only treatment having a health rating significantly better than the nontreated inoculated plants.

In 2006 Hausbeck conducted an experiment to control *P. nicotianae* foliar blight on vinca.In the first test, disease pressure was moderate with the nontreated inoculated having 8.1 infected leaves per plant 20 days after inoculation (Table 47). All treatments significantly reduced infection from in this test. Segway, Fenamidone at 14 fl oz, Micora at 4.1 fl oz, Stature DM at 6.4 oz, and Adorn at 120 ml, were the only treatments that completely prevented infection in this test. In the second test, disease pressure was moderate. No phytotoxicity was observed for any treatment in these experiments.

In 2006, Norman conducted a foliar *P. parasitica* experiment on *Spathiphyllum sp*. All four products (Aliette 80WDG, Fenamidone, Segway, and Adorn) provided excellent control (Table 48).

In 2009 Steddom studied the efficacy of Stature and other fungicides applied as drench to control *P. nicotianae* foliar blight on two cultivars of vinca: 'First Kiss Pure White' and 'First Kiss Raspberry'. Stature DM and Stature SC were applied at 14-day intervals on Mar 2, 15 and 29, while Subdue MAXX and Fenstop were applied on Mar 2 and 29. Plants were inoculated two days after the first treatment. Cultivar differences were not significant; with both cultivars highly susceptible. Subdue MAXX, Fenstop, and all three rates of Stature DM and Stature SC significantly reduced disease severity from a severe disease pressure (Table 49). The lowest rate (3.1 fl oz) of Stature SC was not as effective as the higher rates of Stature SC. Ranking the quality of whole plants within blocks provided more sensitive mean separation than whole plant disease severity ratings aiding differentiating similar rates of the same fungicide. No phytotoxicity was observed for any treatment.

Table 46. * Evaluation of fungicides for control of *Phytophtora nicotianae* aerial blight on annual vinca (*Catharanthus roseus*) 'Rose Cooler', Hausbeck, MI, Test 1, 2003.

	Plant Health[y]			Plant Death (%)	
Treatment and rate/100 gal	**6/23**	**6/30**	**7/8**	**6/30**	**7/8**
Aliette 80WDG 80.0 oz	2.0 a-e[z]	3.5 ab	4.0 abc	0.0 a	0.0 a
Camelot 58EC 3.0 pt	1.8 a-d	7.5 b	8.2 c	16.7 a	50.0 a
Camelot 58EC 6.0 pt	2.2 a-e	4.5 ab	4.8 abc	16.7 a	16.7 a
Camelot 58EC 12.0 pt	1.5 abc	3.3 ab	3.2 abc	0.0 a	0.0 a
Heritage 50WG 3.0 oz[x]	4.2 fgh	5.2 ab	4.0 abc	0.0 a	0.0 a
Pristine 38WG 4.0 oz	3.2 b-h	6.2 b	6.5 bc	0.0 a	0.0 a
Pristine 38WG 8.0 oz	3.5 c-h	5.2 ab	4.5 abc	0.0 a	0.0 a
Pristine 38WG 16.0 oz	4.0 e-h	6.2 b	5.8 abc	16.7 a	16.7 a
Ranman 400SC 1.5 fl oz	4.2 fgh	5.8 ab	5.5 abc	33.3 a	33.3 a
Ranman 400SC 3.0 fl oz	4.3 gh	6.2 b	6.2 abc	16.7 a	33.3 a
Ranman 400SC 6.0 fl oz	3.8 d-h	5.0 ab	4.7 abc	16.7 a	16.7 a
Reason 500SC 4.0 fl oz	3.3 b-h	5.2 ab	4.8 abc	0.0 a	0.0 a
Reason 500SC 8.0 fl oz	3.0 a-g	4.8 ab	4.2 abc	0.0 a	0.0 a
Reason 500SC 16.0 fl oz	2.7 a-g	5.8 ab	5.7 abc	16.7 a	16.7 a
Stature DM 50WP 12.8 fl oz	2.3 a-g	3.5 ab	4.0 abc	0.0 a	0.0 a
Subdue MAXX 21.3EC 1.0 oz[x]	1.3 ab	1.2 a	1.3 ab	16.7 a	0.0 a
Truban 30WP 2.0 oz	5.2 h	6.8 b	6.7 c	0.0 a	0.0 a
Nontreated inoculated	4.3 gh	7.3 b	7.2 c	16.7 a	33.3 a

* Not an IR-4 Experiment: F&N Tests vol 59:OT020. Not all treatments included in table.

[x] Applied as a drench.

[y] Rated on a scale of 1 to 10, where 1=healthy to 10=plant death.

[z] Column means with a letter in common or with no letter are not significantly different (Tukey's Studentized Range; P=0.05).

Table 47. Disease severity of vinca (*Catharanthus roseus*)'Pink Cooler' after foliar treatments for *Phytophthora nicotianae* foliar blight resistant to mefenoxam, Hausbeck, MI, Test 1, 2006.

Treatment	Rate per 100 gal	Average Number of Infected Leaves	Disease Severity[1]
Adorn 4FL	60 ml	0.6 a[2]	1.5 a
	120 ml	0.0 a	1.0 a
Captan 80WDG	1.5 lb	0.1 a [2]	1.1 a
Fenstop 500SC	7 fl oz	0.1 a	1.1 a
	14 fl oz	0.0 a	1.0 a
MultiGard	500 ppm	1.0 a	1.6 a
	1000 ppm	1.4 a	1.8 a
Micora	4.1 fl oz	0.0 a	1.0 a
	8.2 fl oz	0.4 a	1.4 a
Segway 400SC	3 fl oz	0.0 a	1.0 a
	6 fl oz	0.0 a	1.0 a
Stature DM 50WP	6.4 oz	0.0 a	1.0 a
Nontreated inoculated		8.1 b	4.5 b

[1] Disease severity rating is 1 to 10; 1=no disease symptoms, 10=plant death.
[2] Column means with a letter in common are not significantly different (Student-Newman-Keuls; *P*=0.05).

Table 48. Average number of leaf lesions on spathiphyllum after foliar treatments for *Phytophthora parasitica* foliar blight, Norman, FL, 2006.

Treatment	Rate per 100 gal	Spray interval	Avg # leaf lesions	LSD (0.05)
Adorn	3.0 fl oz	1 application	0.2	a
	6.0 fl oz	1 application	0	a
Aliette	12.8 fl oz	1 application	0.3	a
Fenstop	7.0 fl oz	1 application	0	a
	14 fl oz	1 application	0	a
Segway	3.0 fl oz	1 application	0	a
	6.0 fl oz	1 application	0	a
Nontreated non-inoculated			0	a
Nontreated inoculated			9	b

Table 49. *Disease severity of vinca(*Catharanthus roseus*) 'First Kiss Pure White' and 'First Kiss Raspberry' after drench treatments for *Phytophthora nicotianae* foliar blight, Steddom, TX, 2009.

Treatment and rate/100 gal	Foliar disease severity rating [y]		Whole plant disease severity rating	Visual plant ranking [x]
	3/20	4/12	4/12	4/12
Fenstop 14 fl oz	0.3 bc	0.2 c	1.3 c	5.1 bc
Stature DM 3.2 oz	0.3 bc	0.5 bc	1.3 c	4.9 bc
Stature DM 6.4 oz	0.5 bc	1.0 bc	1.5 c	5.6 abc
Stature DM 12.8 oz	0.2 bc	0.0 c	1.2 c	5.1 bc
Stature SC 3.1 fl oz	0.9 b	1.5 b	2.6 b	7.6 ab
Stature SC 6.1 fl oz	0.0 c	0.0 c	0.6 c	3.7 c
Stature SC 12.3 fl oz	0.2 bc	0.0 c	1.0 c	4.9 bc
Subdue MAXX 1 fl oz	0.3 bc	0.2 c	0.9 c	4.5 c
Nontreated noninoculated	0.1 bc	0.1 c	1.2 c	5.5 abc
Nontreated inoculated	2.2 a	3.0 a	3.7 a	8.1 a

* Not an IR-4 Experiment: PDMR vol 3:OT030.

[z] Column means with a letter in common are not significantly different Waller- Duncan k-ratio t-test, P=0.05).

[y] Visual disease severity rating from 0-5, where 0= no symptoms; 3=unmarketable, 5=dead plant. Whole plant ratings were performed on plants where the media had been rinsed from the root system prior to evaluation.

[x] Plant ranking per block from 1-10, where 1=the best quality plant in the block and 10=the worst plant in the block.

In 2012, Hong evaluated an experimental product Inosco (potassium phosphite) and other fungicides were applied as foliar sprays for Phytophthora aerial blight on annual vinca (*Catharanthus roseus*) 'Titan Lilac' on Jun 5, and plants inoculated one day later; a second and third inoculation was made on Jun 13 and 20. Treatments were reapplied at various intervals for a total of two or three applications as shown in Table 50. Inosco provided excellent control of Phytophthora aerial blight, comparable to the standard FenStop, throughout the duration of the test. No phytotoxicity was observed for any treatment.

Table 50. * Evaluation of fungicides for control of Phytophthora aerial blight (*Phytophtora nicotianae*), on annual vinca (*Catharanthus roseus*) 'Titan Lilac', Hong, VA, 2012.

Treatment and rate/100 gal	No. of Applications	Application Interval (days)	AUDPC [z]
Inosco SL 64 fl oz	3	14	17.50 cd [y]
Inosco SL 64 fl oz + Heritage 50WG 2 oz	3	14	12.64 cd
Inosco SL 64 fl oz + Subdue MAXX SL 1 fl oz	3	14	20.81 cd
FenStop 4.13SC 10 fl oz	2	28	75.64 bc
Heritage 50WG 2 oz	3	14	94.69 ab
Subdue MAXX SL 1 fl oz	3	14	110.60 ab
Nontreated noninoculated			0.00 d
Nontreated inoculated			163.50 a

* Not an IR-4 Experiment: Plant Disease Management Reports 7:OT005.

[z] Each number is the mean calculated from the disease incidence counts of 18 plants observed weekly.

[y] The mean values listed in a column followed by the same letter are not significantly different according to Waller=Duncan k-ratio, t-test, k=100, P<0.05.

***Phytophthora ramorum*.** In a series of experiments between 2005 and 2009, Drs. Chastagner, Grunwald and Linderman examined the efficacy of several products to manage foliar ramorum blight on rhododendron and firs. Only Subdue Maxx consistently provided excellent control in all but one of the experiments. The other products that tended to provide good control in most of the experiments were Adorn, Fenstar, Insignia, Segway, and Stature DM.

In 2005, Chastagner conducted two Ramorum blight experiments on rhododendron (*Rhododendron* x 'Nova Zembla'), grand fir (*Abies grandis*) and Noble fir (*Abies procera*). He added a number of treatments above and beyond the 2005 IR-4 in both experiments. On rhododendron, the best overall control was achieved with foliar applications of Maneb (2 lb per 100 gal) and Gavel (2 lb per 100 gal), and drench application of Subdue MAXX (2 fl oz per 100 gal) (Table 51). On grand and noble firs, best overall control was achieved with foliar applications of Daconil Ultrex (1.4 lb per 100 gal), Dithane (2 lb per 100 gal), Fenamidone(14 and 28 fl oz per 100 gal), Gavel (2 lb per 100 gal), Insignia (40 oz per 100 gal), Maneb (2 lb per 100 gal), Polyram (2 lb per 100 gal), Segway (3 and 6 fl oz per 100 gal), Stature (6.4 and 12.8 oz per 100 gal),andAdorn (40 g ai per 100 gal) (Table 52).

In 2005, Linderman conducted four experiments to determine efficacy of foliar applications of registered and experimental chemical agents on *P. ramorum* on rhododendron (*Rhododendron* x 'Nova Zembla') (Table 53). Subdue MAXX (4 fl oz per 100 gal) was the only product that consistently provided excellent control in all 3 experiments where it was included. In one experiment, good to excellent control was achieved with Aliette (5 oz per 100 gal), Biophos (2 gal/100 gal), Fenamidone (14 and 28 fl oz per 100 gal), Segway (3 and 6 fl oz per 100 gal), Stature (6.4 and 12.8 oz per 100 gal) and Adorn (3 oz per 100 gal). Insignia and Magellan provided no to poor control.

In 2006, Chastagner tested various products where inoculations occurred with or without wounding (Table 54). When leaves were wounded, only Micora at 2 and 8 oz per 100 gal and Segway at 6 fl oz per 100 gal provided excellent control similar to that of non-inoculated plants. When leaves were not wounded, several products provided statistically significant efficacy: Captan at 4 oz, Fenamidone at 7 and 14 oz, Micora at 2 and 8 oz, Segway at 6 fl oz, and Stature DM at 12.8 oz per 100 gal.

In 2006, Linderman inoculated *P. ramorum* onto wounded tissues. The only product in this assay to provide levels of lesion area similar to that of the nontreated non-inoculated treatment was Subdue MAXX (Table 55).

In 2008, Chastagner again looked at treatments applied to wounded or non-wounded inoculation sites (Table 56). Wounded inoculation sites did tend to have higher number of lesions and larger lesions. The best treatments included Dithane DF at 2 lbs, Fenstop at 14 and 28 fl oz, Gavel DF at 2 lbs, Maneb 75DF at 2 lbs, Micora at 8 fl oz, Polyram 80 DF at 2 lbs and Stature DM at 12.8 oz.

In 2008, Grunwald continued screening products for *P. ramorum* efficacy on detached camellia leaves. Camellia plants in containers were maintained outdoors under shade. A single application of fungicide was applied to run-off using a hand-pump sprayer. Seven days after each fungicide application, three leaves from each plant were removed for detached leaf inoculations under quarantine containment conditions. Separate containers were used for different chemical treatments. Each leaf was needle-wounded once on the abaxial side to the right of the midvein, just prior to inoculation with *P. ramorum* strain Pr-05-046 (A2 mating type isolated in OR). After inoculation, leaves were misted and containers were placed in an incubator at 20ºC with a 14-hour light cycle for ten days. Disease severity was determined by evaluating lesion area on day seven. The non-inoculated control showed no lesions. Aliette, Captan, Adorn, Micora, Fenstar (low rate only), Disarm (low rate only) and Stature DM were not significantly different from the nontreated controls (Table 57). For Disarm and Fenstar, significant differences were observed among high and low rates. Disarm (high rate), Segway and Subdue MAXX were most effective in reducing disease severity. All chemicals were effectively fungistatic, not fungicidal, after confirmation of the pathogen's viability by isolation and subsequent culture of the pathogen from wound-sites on symptomless leaves. No phytotoxicity was observed for any treatment.

Table 51. Efficacy of foliar and drench treatments on ramorum blight on Rhododendron, Chastagner, WA, 2005.

Treatment	Rate Per 100 Gal	Application Method	Number of Infected Sites[1] (% Control)		Lesion Area in mm^2 (% Control)	
			Non-wounded Leaves	Wounded Leaves	Non-wounded Leaves	Wounded Leaves
Adorn	40 g ai	Foliar	1.3 defgh 52)	1.7 cdefg (41)	27.5 hi (78)	34.4 fghij (74)
Aliette 80W	5 lb	Foliar	2.7 abc (0)	2.6 abc (10)	87.2 cd (29)	70.2 cdefg (47)
Alude	2 pt	Drench	2.4 abc (11)	2.8 ab (3)	94.9 abcd (23)	105.8 abc (19)
Biophos 43L	2 gal	Drench	2.5 abc (7)	2.7 abc (7)	67.5 defg (45)	75.9 cdef (42)
Champ Formula 2F	1.33 pt	Foliar	1.9 cde (30)	2.1 abcde (28)	72.3 def (41)	91.4 bcde (30)
Daconil Ultrex	1.4 lb	Foliar	0.9 fghij (67)	2.3 abcd (21)	20.6 hi (83)	52.5 efg (60)
Dismiss	5 oz	Foliar	2.1 bcd (22)	2.7 abc (7)	48.1 efgh (61)	50.0 efgh (62)
Dithane 75 DF	2 lb	Foliar	0.4 ij (85)	1.4 defgh (52)	14.9 hi (88)	56.5 efg (57)
Fenstop 500SC	14 fl oz	Foliar	0.0 j (100)	2.4 abc (17)	0.0 i (100)	26.9 ghij (80)
	28 fl oz	Foliar	0.6 ghij 78)	1.7 cdefg (41)	17.7 hi (86)	42.3 fghij (68)
Gavel 75 DF	2 lb	Foliar	0.1 j (96)	0.5 hij (83)	0.0 I (100)	6.0 hij (95)
Insignia 20W	16 oz	Foliar	1.4 defg (48)	2.5 abc (14)	33.7 ghi (73)	52.1 efg (60)
	40 oz	Foliar	1.1 efghi (59)	2.2 abcde (24)	20.6 hi (83)	41.7 fghij (68)
Magellan	80 fl oz	Drench	3.0 a (0)	2.8 ab (3)	127.5 a (0)	119.2 ab (9)
Maneb 75 DF	2 lb	Foliar	0.0 j (100)	0.3 ij (90)	0.0 i (100)	4.3 ij (97)
Polyram 80 DF	2 lb	Foliar	0.5 hij (81)	1.7 cdefg (41)	11.9 hi (90)	34.0 fghij (74)
Rhapsody	1 gal	Foliar	2.8 ab (0)	3.0 a (0)	98.8 abcd (20)	102.5 abcd (22)
	1.5 gal	Foliar	2.8 ab (0)	3.0 a (0)	118.0 abc (4)	141.9 a (0)
	2 gal	Foliar	1.5 def (44)	2.6 abc (10)	89.1 bcd (28)	103.8 abcd (21)
Segway 400SC	3.0 fl oz	Foliar	0.9 fghij (67)	1.1 fghi (62)	18.9 hi (85)	27.1 ghij (79)
	6.0 fl oz	Foliar	0.7 fghij (74)	1.9 bcdef (34)	18.0 hi (85)	35.4 fghij (73)
Stature DM 50W	6.4 oz	Foliar	1.3 defgh (52)	1.3 efgh (55)	43.0 fgh (65)	45.7 fghi (65)
	12.8 oz	Foliar	0.9 fghij (67)	1.1 fghi (62)	27.2 hi (78)	38.7 fghij (71)
Subdue MAXX	2 fl oz	Drench	0.6 ghij (78)	0.8 ghij (72)	3.0 i (98)	3.2 ij (98)
Vital	4 pt	Drench	2.5 abc (7)	2.2 abcde (24)	79.9 de (35)	62.0 defg (53)
Nontreated non-inoculated			0.0 j	0.0 j	0.0 i	0.0 j
Nontreated inoculated			2.7 abc (0)	2.9 ab (0)	123.0 ab (0)	131.3 ab (0)

* Drench treatments applied 7 days, and foliar treatments applied 1 day before inoculation of detached leaves of treated seedlings placed on moistened filter paper in a petri dish. Disease assessment done 7 days after inoculation.

[1] Average number out of 3 inoculated sites per leaf

Column means with a letter in common are not significantly different (Duncan's Multiple Range Test, P=0.05).

Table 52. Efficacy of foliar and drench treatments on Ramorum Shoot Blight on Grand and Noble Firs, Chastagner, WA 2005.

Treatment	Rate Per 100 Gal	Application Method	No. of Infected Shoots (% Control)	
			***P. ramorum* Mating Type A1**	***P. ramorum* Mating Type A2**
Adorn	40 g ai	Foliar	1.0 fgh (79)	1.6 efghi (71)
Aliette 80W	5 lb	Foliar	3.0 abcd (38)	2.9 def (48)
Alude	1 qt	Drench	2.6 cdef (46)	5.3 a (5)
Biophos 43L	2 gal	Drench	4.4 ab (8)	5.1 ab (9)
Champ Formula 2F	1.33 pt	Foliar	2.1 cdefg (56)	3.0 cdef (46)
Daconil Ultrex	1.4 lb	Foliar	1.1 efgh (77)	1.4 efghi (75)
Dismiss	5 oz	Foliar	3.3 abc (31)	2.7 defg (52)
Dithane 75 DF	2 lb	Foliar	0.0 h (100)	0.0 i (100)
Fenstop 500SC	14 fl oz	Foliar	0.3 h (94)	1.4 efghi (75)
	28 fl oz	Foliar	0.0 h (100)	1.1 efghi (80)
Gavel 75 DF	2 lb	Foliar	0.6 gh (88)	0.1 i (98)
Insignia 20W	16 oz	Foliar	1.3 defgh (73)	3.3 bcde 41)
	40 oz	Foliar	1.4 defgh (71)	1.7 efghi (70)
Magellan	80 fl oz	Drench	3.0 abcd (38)	5.6 a (0)
Maneb 75 DF	2 lb	Foliar	0.0 h (100)	0.6 ghi (89)
Polyram 80 DF	2 lb	Foliar	0.3 h (94)	1.0 fghi (82)
Rhapsody	1 gal	Foliar	4.7 a (2)	5.0 abc (11)
	1.5 gal	Foliar	4.6 ab (4)	4.4 abcd (21)
	2 gal	Foliar	2.9 bcde (40)	5.6 a (0)
Segway 400SC	3.0 fl oz	Foliar	0.3 h (94)	1.1 efghi (80)
	6.0 fl oz	Foliar	0.0 h (100)	0.4 hi (93)
Stature DM 50W	6.4 oz	Foliar	1.1 efgh (77)	1.0 fghi (82)
	12.8 oz	Foliar	0.0 h (100)	0.4 hi (93)
Subdue MAXX	2 fl oz	Drench	0.1 h (98)	2.6 defgh (54)
Vital	2 qt	Drench	3.3 abc (31)	5.7 a (0)
Nontreated non-inoculated			0.0 h	0.0 i
Nontreated inoculated			4.8 a (0)	5.6 a (0)

* Drench treatments applied 7 days, and foliar treatments applied 1 day before inoculation of detached tops of treated seedlings placed on moistened filter paper in a petri dish. Number of infected shoots counted 7 days after inoculation.

Column means with a letter in common are not significantly different (Duncan's Multiple Range Test, P=0.05).

Table 53. Efficacy on Ramorum Blight (*Phytophthora ramorum*) on Rhododendron, Linderman, OR, 2005.

Treatment	Rate Per 100 Gal	Experiment 1 % Lesion Area (% Control)		Experiment 2 % Lesion Area (% Control)	Experiment 3 % Lesion Area (% Control)		Experiment 4 % Lesion Area (% Control)	
		D12A Mycelial Plug	N10A Mycelial Plug	N10A Sporangia	N10A Mycelial Plugs	N10A Sporangia	No Surfactant	With Surfactant
Adorn	3 oz	57.6 ± 3.0 (0)	51.7 ± 2.1 (0)	12.2 ± 2.2 (54)	51.7 ± 2.1 (0)	12.2 ± 2.2 (54)	0.4 ± 0.2 (98)	2.2 ± 3.0 (82)
Aliette 80W	5 oz	43.9 ± 1.0 (0)	41.9 ± 3.7 (0)	37.2 ± 3.4 (0)	41.9 ± 3.7 (0)	37.2 ± 3.4 (0)	0.1 ± 0.1 (99)	0.1 ± 0.1 (99)
Biophos 43L	2 gal	41.9 ± 3.9 (4)	43.2 ± 0.9 (0)	28.1 ± 3.9 (0)	43.2 ± 0.9 (0)	28.1 ± 3.9 (0)	1.3 ± 1.2 (93)	2.2 ± 0.7 (82)
Fenstop 500SC	14 fl oz	53.7 ± 5.2 (0)	48.9 ± 5.4 (0)	31.4 ± 3.2 (0)	48.9 ± 5.4 (0)	31.4 ± 3.2 (0)	2.0 ± 3.0 (90)	1.3 ± 0.5 (89)
	28 fl oz	48.3 ± 2.2 (0)	51.7 ± 5.0 (0)	9.1 ± 0.7 (66)	51.7 ± 5.0 (0)	9.1 ± 0.7 (66)	5.5 ± 3.3 (72)	0.1 ± 0.0 (99)
Insignia 20W	16 oz	52.4 ± 1.3 (0)	43.8 ± 4.7 (0)	32.9 ± 5.5 (0)	43.8 ± 4.7 (0)	32.9 ± 5.5 (0)	12.4 ± 7.4 (36)	11.8 ± 6.7 (2)
	40 oz	52.2 ± 2.4 (0)	53.1 ± 1.8 (0)	34.2 ± 8.8 (0)	53.1 ± 1.8 (0)	34.2 ± 8.8 (0)	14.3 ± 6.8 (26)	8.0 ± 4.8 (33)
Magellan	64 fl oz	55.0 ± 5.8 (0)	53.9 ± 0.9 (0)	36.0 ± 2.5 (0)	53.9 ± 0.9 (0)	36.0 ± 2.5 (0)	29.5 ± 1.0 (0)	19.4 ± 14.5 (0)
Mancozeb	46 oz	46.4 ± 2.9 (0)	43.3 ± 2.7 (0)	23.9 ± 8.5 (10)	43.3 ± 2.7 (0)	23.9 ± 8.5 (10)	7.1 ± 3.0 (63)	5.4 ± 4.1 (55)
SA110201	4 oz	23.4 ± 6.0 (46)	22.2 ± 9.8 (46)	19.3 ± 11.4 (28)	22.2 ± 9.8 (46)	19.3 ± 11.4 (28)	6.2 ± 4.9 (68)	7.8 ± 10.9 (35)
Segway 400SC	3.0 fl oz	51.7 ± 2.8 (0)	47.0 ± 0.4 (0)	9.1 ± 3.4 (66)	47.0 ± 0.4 (0)	9.1 ± 3.4 (66)	0.8 ± 1.5 (96)	7.2 ± 3.4 (40)
	6.0 fl oz	55.6 ± 2.0 (0)	55.1 ± 5.7 (0)	13.5 ± 6.9 (49)	55.1 ± 5.7 (0)	13.5 ± 6.9 (49)	1.1 ± 0.9 (94)	9.3 ± 7.3 (23)
Stature DM 50W	6.4 oz	50.3 ± 0.7 (0)	45.0 ± 2.3 (0)	23.9 ± 4.1 (10)	45.0 ± 2.3 (0)	23.9 ± 4.1 (10)	1.7 ± 0.7 (91)	1.7 ± 1.8 (86)
	12.8 oz	62.3 ± 6.7 (0)	55.4 ± 5.7 (0)	22.4 ± 18.8 (16)	55.4 ± 5.7 (0)	22.4 ± 18.8 (16)	0.2 ± 0.0 (99)	1.2 ± 1.5 (90)
Subdue MAXX	4 fl oz	-	-	1.1 ± 1.4 (96)	0 ± 0.0 (100)	1.1 ± 1.4 (96)	0.1 ± 0.0 (99)	0 ± 0.0 (100)
Nontreated non-inoculated		0	0	0	0	0	0	0
Nontreated inoculated		43.6 ± 4.2 (0)	41.1 ± 1.8 (0)	26.7 ± 2.4 (0)	41.1 ± 1.8 (0)	26.7 ± 2.4 (0)	19.3 ± 4.8 (0)	12.0 ± 0.9 (0)

* Foliar treatments applied 1 or 2 weeks before inoculation of detached leaves of treated seedlings placed on moistened containers. Disease assessment done 8 days after inoculation.

Table 54. Efficacy on Ramorum Blight (*Phytophthora ramorum*) on Rhododendron, Chastagner, WA, 2006.

Treatment	Rate per 100 gal	Application method	Number	
			Wounded	Non-wounded
Actinovate SP	12 oz	sprench	2.87 a	2.47 ab
Adorn 4FL	60 ml	foliar	1.53 c-f	1.53 b-f
	120 ml	foliar	2.13 a-d	1.67 a-e
Alude	2 qts	foliar	2.67 a	2.07 a-d
BioPhos	256 fl oz	drench	2.60 a	2.33 a-c
	256 fl oz	foliar	2.13 a-d	1.40 b-g
Captan 80 WP	4 oz	foliar	1.67 b-f	0.67 e-i
Chipco Aliette 80 WG	12.8 oz	foliar	2.27 a-d	1.40 b-g
Disarm 480SC	3.0 fl oz	foliar	2.93 a[1]	1.53 b-f
Fenstop	7.0 fl oz	foliar	1.40 d-f	0.47 f-i
	14.0 fl oz	foliar	1.13 e-h	0.40 g-i
Heritage WG 50	4 oz	foliar	2.27 a-d	1.87 a-d
Insignia 20.4%	8 oz	foliar	2.40 a-c	1.40 b-g
Magellan	12 fl oz	drench	2.93 a	2.67 a[1]
	5 pints	foliar	2.60 a	2.36 a-c
MultiGuard	500 ppm	foliar	1.67 b-e	1.27 c-h
	1000 ppm	foliar	2.00 a-e	1.27 c-h
Micora	2 fl oz	foliar	0.33 hi	0.47 f-i
	8 fl oz	foliar	0.40 hi	0.60 e-i
Segway 400SC	3.0 fl oz	foliar	1.60 b-f	1.07 d-h
	6.0 fl oz	foliar	0.67 g-i	0.27 hi
Stature DM 50 WP	12.8oz	foliar	1.07 f-h	0.47 f-i
Subdue MAXX FV	2 fl oz	foliar	1.53 c-f	2.13 a-d
Terrazole 35 WP	8 oz	foliar	2.60 a	2.00 a-d
Vital	4 pints	drench	2.67 a	2.40 ab
	4 pints	foliar	2.64 a	1.50 b-f
Non-inoculated check			0.00 i	0.00 i
Inoculated check			2.47 ab	1.80 a-d

[1]Numbers in columns followed by the same letter are not significantly different, P = 0.05, Duncan's Multiple Range Test

Table 55. Efficacy on Ramorum Blight (*Phytophthora ramorum*) on Rhododendron, Linderman, OR, 2006.

Treatment	Rate per 100 gal	Inoculated with N10A	Wounded	% Lesion Area
Actinovate	10 oz	Yes	Yes	79.4 ± 3.7
Adorn 4Fl	60 ml	Yes	Yes	15.5 ± 0.6
	120 ml	Yes	Yes	11.0 ± 7.1
Aliette 80W	5 oz	Yes	Yes	52.6 ± 9.8
Alude	12.7	Yes	Yes	66.0 ± 9.3
Biophos	2 gal	Yes	Yes	76.1 ± 8.6
Captan 50WP	32 oz	Yes	Yes	56.2 ± 16.8
Dismiss	3 oz	Yes	Yes	80.8 ± 1.3
Fenstop 500SC	14 fl oz	Yes	Yes	74.6 ± 6.0
	28 fl oz	Yes	Yes	51.9 ± 9.8
Heritage	4 oz	Yes	Yes	81.5 ± 1.2
Insignia 20W	16 oz	Yes	Yes	78.8 ± 0.5
Magellan	64 fl oz	Yes	Yes	76.7 ± 10.0
Multiguard	1000 ppm	Yes	Yes	72.3 ± 12.3
	1000 ppm	No	No	0.1 ± 0.0
Segway 400SC	3.0 fl oz	Yes	Yes	74.4 ± 6.4
	6.0 fl oz	Yes	Yes	67.8 ± 2.6
Stature DM 50W	12.8 oz	Yes	Yes	54.2 ± 13.7
Subdue MAXX	4 fl oz	Yes	Yes	0.2 ± 0.0
Terrazole	8 oz	Yes	Yes	83.4 ± 3.1
Vital	4 pints	Yes	Yes	63.2 ± 5.6
Nontreated non-inoculated		No	No	0.2 ± 0.0
Nontreated inoculated		Yes	Yes	76.5 ± 1.0
Nontreated inoculated		Yes	No	0.9 ± 1.2

Table 56. Efficacy of foliar treatments on Ramorum Blight (*Phytophthora ramorum*) on Rhododendron, Chastagner, WA, 2008.

Treatment	Rate per 100 gal	Wounded		Non-Wounded	
		Number of lesions	Area of lesions (mm^2)	Number of lesions	Area of lesions (mm^2)
Adorn 4FL	1 fl oz	0.3 cd	14.2 c	0.4 bc	14.1 bc
	2 fl oz	0.5 cd	9.8 c	0.2 c	5.0 bc
Captan 80 WP	4 oz	0.5 cd	2.8 c	0.1 c	0.1 c
Disarm 480 SC	4 fl oz	2.1 ab	87.3 ab	1.0 ab	41.6 ab
	8 fl oz	0.9 cd	17.1 c	0.3 bc	4.5 c
Dithane DF	2 lbs	0.9 cd	21.0 c	0 c	2.0 c
Fenstop	14 fl oz	0.3 cd	5.8 c	0 c	0 c
	28 fl oz	0.3 cd	1.2 c	0 c	0 c
Gavel 75 DF	2 lbs	0.9 cd	9.6 c	0.1 c	0.1 c
Insignia 20.4%	8 oz	0.5 cd	12.0 c	0.1 c	0.1 c
Maneb 75 DF	2 lbs	0.9 cd	15.5 c	0 c	0 c
Micora	4 fl oz	0.4 cd	0.4 c	0 c	0 c
	8 fl oz	0.3 cd	0.5 c	0.1 c	0.1 c
Polyram 80 DF	2 lbs	1.1 bc	37.6 bc	0.1 c	2.7 c
Segway	3 fl oz	0.3 cd	3.5 c	0 c	0 c
	6 fl oz	0.3 cd	0.3 c	0 c	0 c
Stature SC	12.8 fl oz	0.1 cd	0.4 c	0 c	0 c
Subdue MAXX FV	1 fl oz	0.3 cd	0.4 c	0.2 c	4.6 c
	2 fl oz	0.3 cd	0.4 c	0.1 c	0.6 c
Tanos	12 oz	0.5 cd	7.4 c	0.1 c	0.8 c
Non-inoculated check		0 d	0.1 c	0 c	0 c
Inoculated check		2.5 a	121.0 a	1.5 a	74.1 a

[1]Numbers in columns followed by the same letter are not significantly different, P = 0.05, Tukey's Studentized Range Test

Table 57. Efficacy of foliar fungicides for control of Ramorum blight on camellia, Grunwald & Rolfe, 2008.

Treatment (active ingredient)	Rate/L (rate per 100 gal)	Lesion area (cm^2)*
Adorn (fluopicolide)	0.08 ml (1 fl oz)	5.4bc
	0.16 ml (2 fl oz)	5.6bc
Aliette (fosetyl Al)	0.71 g (9.5 oz)	9.1a
Captan	2.4 g (32 oz)	7.1abc
Disarm 480SC (fluoxastrobin)	0.31 ml (4 fl oz)	6.6abc
	0.62 ml (8 fl oz)	1.1ed
Fenstar (fenamidone)	1.09 ml (14 fl oz)	6.4abc
	2.18 ml (28 fl oz)	4.5cd
Micora (mandipropamid)	0.31 ml (4 fl oz)	5.8abc
	0.62 ml (8 fl oz)	6.2abc
Segway (cyazofamid)	0.23 g (3 oz)	0.8e
	0.47 g (6.3 oz)	0.7e
Stature DM (dimethomorph)	0.48 ml (6 fl oz)	6.6abc
Subdue MAXX (mefenoxam)	0.16 ml (2 fl oz)	0.5e
Nontreated, inoculated control		8.0ab

*Means followed by the same letter are not significantly different at P=0.05, according to a Fisher's protected least significance difference test.

Phytophthora syringae.

In 2008, Grunwald and Rolfe also examined the efficacy of various products to control *Phytophthora syringae* causing a stem canker disease on crabapple (*Malus sp.*) 'Spring Snow'. Chemical treatments had a significant effect on % lesion length observed. However, only Aliette was significantly different from the nontreated control and significantly reduced disease severity (Table 58). All chemicals were effectively fungistatic, not fungicidal, after confirmation of the pathogen's viability by isolation and subsequent culture of the pathogen from wound-sites on symptomless leaves. The non-inoculated control showed no lesions

Table 58. Efficacy on *Phytophthora syringae* canker on crabapple 'Spring Snow', Grunwald, OR, 2008.

Treatment	Rate per 100 gal	Application method	Lesion Length (mm)
Adorn 4FL	1 fl oz	Drench	27.2 a
	2 fl oz	Drench	26.5 a
Aliette	9.5 oz	Drench	8.0 b
Captan	2 lb	Spray	29.3 a
Disarm 480 SC	4 fl oz	Drench	30.5 a
	8 fl oz	Drench	23.2 a
Fenstar	14 fl oz	Drench	27.8 a
	28 fl oz	Drench	30.2 a
Micora	4 fl oz	Drench	32.7 a
	8 fl oz	Drench	27.2 a
Segway	3.1 oz	Drench	32.8 a
	6.3 oz	Drench	30.5 a
Stature	5.1 fl oz	Drench	24.8 a
Subdue MAXX	2 fl oz	Spray	29.3 a
Nontreated Inoculated			29.5 a

Means followed by the same letter are not significantly different (Alpha = 0.05), according to a non-parametric multiple comparison of means using PROC MULTTEST in SAS allowing for non-normality using permutation resampling methods.

Comparative Efficacy Pythium Root Rot
Pythium aphanidermatum.

In 2010, Reddy conducted a greenhouse trial to determine efficacy of various products for control of Pythium root rot and damping-off caused by *Pythium aphanidermatum* on petunia (*Petunia x violacea).* Products were applied as drench around the plant base at 7 days after transplanting and 4 days before disease inoculation. Root rot and damping-off severity, and plant growth parameters were recorded one month after transplanting. All the tested products (Adorn, Adorn + Subdue Maxx, RootShield Plus WP, CG100, Disarm, Fenstop, Heritage, Pageant and Subdue Maxx) were effective in reducing root rot and damping-off incidence and severity in petunias caused by *Pythium apanidermatum;* all were at least equal to the noninoculatedcontrol (Table 59). Due to significant disease control, plant height, stem girth, root and shoot weights in these treatments were enhanced. No phytotoxicity was observed from any treatment.

Table 59. Efficacy on Pythium Root Rot and Damping-off Caused by *Pythium aphanidermatum* on Petunia (*Petunia x violacea*), 'Laura Bush', Reddy, AL, 2010.

Treatment	Rate Per 100 Gal	Plant Growth Parameters[x]				Disease Severity	
		Height (cm)	Stem Girth (mm)	Root Wt. (g)	Shoot Wt. (g)	Root Rot[y]	Damping-off[z]
Adorn 4SC (fluopicolide)	2 fl oz	45.20a	4.24a	3.18ab	13.60cd	0 c	0 b
Adorn 4SC + Subdue Maxx 2EC	2 + 1 fl oz	45.28a	4.08a	3.22ab	14.53cd	0 c	0 b
RootShield Plus WP WP	6 oz	41.44abc	4.24a	3.42a	16.75b	0 c	0 b
CG100 (caprylic acid)	1.2 pt	30.96cd	3.20bc	2.61d	13.08d	0.4 c	0.2 b
Disarm 480SC (fluoxastrobin)	0.18 fl oz per 1000 sq ft	35.32abcd	3.58b	2.89bcd	13.67cd	0.2 c	0 b
Fenstop (fenamidone)	10 fl oz	35.30abcd	4.22a	3.44a	22.72a	0.2 c	0 b
Heritage (azoxystrobin)	0.9 oz	38.30abc	3.51bc	2.83cd	13.26cd	0.4 c	0 b
Pageant 38WG (boscalid+pyraclostrobin)	12 oz	42.84ab	4.13a	3.06bc	22.79a	0 c	0 b
Subdue Maxx 2EC (mefenoxam)	1 fl oz	35.32abcd	3.44bc	2.82cd	14.76c	0.4 c	0 b
Nontreated noninoculated	-	32.18bcd	3.15c	2.59d	13.54cd	1.4 b	0.2 b
Nontreated inoculated	-	24.62d	2.20d	1.04e	9.60e	3.0 a	3.4 a

[x] Means followed by the same letter do not differ significantly based on SAS 9.2 (PROC-ANOVA), P=0.05.

[y] Root rot severity is on a "0 to 4 scale" where 0= normal/healthy, 1= <25% ; 2= 26 to 50% ; 3=51 to75% ;and 4=>75% of root rotting.

[z] Damping-off severity is on a "0 to 5 scale" where 0= no visible symptoms; 1= plants slightly drooped;2=prominent drooping of plants with browning of stem tissues at base; 3=50% of the plant wilted due to root rot; 4= >50 of the plant wilted due root rot and 5= death of the plant.

In 2010, Chase conducted a greenhouse trial to determine efficacy of various products for control of Pythium root rot caused by *P. aphanidermatum* on poinsettia (*Euphorbia pulcherrima).* Products were applied as drench around the plant base on 3 August 2010 five days after transplanting and three days before disease inoculation. Applications for several treatments were repeated on 17 and 31 August, 13 and 27 September. Plant height and top grade, phytotoxicity, root growth and root rot incidence were recorded at various times during the experiment (Table 60). No treatment, including noninoculated control, significantly reduced a low root rot incidence although plants treated with Heritage showed no root rotting; similarly, root growth was not significantly affected. No significant differences were observed for plant height and top grade except for plants treated with Adorn and Adorn + Subdue that

were taller and had lower top grade because of leaf curling and tip damage due to Adorn phytotoxicity. No other treatment caused phytotoxicity.

In 2010-2011, Benson conducted three trials to determine efficacy of various products for control of Pythium root rot (*Pythium aphanidermatum*) on poinsettia (*Euphorbia pulcherrima)*. In 2010, all products were applied as drench except Vital applied as spray (Table 61). Products were applied on the day of disease inoculation except RootShield Plus WP and Vital which were applied 3 days before, and repeated on a 2-week schedule. In 2011, all products were applied as drench 2 days before disease inoculation and repeated on a 2-week schedule (Table 62). Plant height was recorded at various times, and top weight and root rot severity, at harvest (41-55 days after inoculation). The standards Terrazole and Subdue Maxx provided very good control of a severe Pythium root rot pressure in all trials. In 2010, Adorn, Fenstop and Pageant provided good control, with average plant heights, top weights and root rot ratings statistically the same as the noninoculated control. Disarm and Heritage provided significant but unsatisfactory control, with plants treated with Disarm judged not salable. RootShield Plus WP, CG100, Vital and the RootShield Plus WP/Vital rotation all failed to control Pythium root rot. In 2011, Fenstop, A13839B, Adorn, Subdue MAXX and the Adorn/Subdue MAXX tank mix provided good control of Pythium root rot with average root rot ratings statistically the same as the noninoculated controls. Demonstrating slight, but unsatisfactory control of Pythium root rot were Disarm and Pageant; plants treated with these fungicides were not salable. CG100, BSEF-11, RootShield Plus WP, Heritage, Vital, and the RootShield Plus WP/Vital rotation all failed to control Pythium root. No phytotoxicity was observed from any treatment in these trials.

Table 60. Efficacy on Pythium Root Rot (*Pythium aphanidermatum*) on Poinsettia (*Euphorbia pulcherrima*), Chase, CA, 2010.

Treatment	Rate Per 100 Gal	Height (cm)[x] 20 Aug	Top Grade[y] 20 Aug	Height (cm) 3 Sep	Top Grade 3 Sep	Height (cm) 20 Sep	Top Grade 20 Sep	Phyto-toxicity 1 Oct	Height (cm) 11 Oct	Top Grade 11 Oct	% Roots 12 Oct	% Rotted Roots 12 Oct
Adorn 4SC (fluopicolide)	2 fl oz	9.2 a	3.5 a	10.3 a	3.4 a	13.2 a	3.4	2.6 b	18.0 ab	2.7 a	51.0 a	3.0 a
Adorn 4SC + Subdue Maxx 2EC	2 + 1 fl oz	10.0 a	3.8 a	10.5 a	3.7 a	14.3 a	3.7 a	3.1 c	19.8 b	2.6 a	57.0 a	5.0 a
Aliette 80WDG (fosetyl Al)	12.8 oz	9.4 a	3.7 a	10.7 a	3.6 a	13.6 a	3.8 a	1.0 a	18.2 ab	4.1 b	63.0 a	2.0 a
RootShield Plus WP WP	6 oz (once only)	9.1 a	3.7 a	10.4 a	3.6 a	12.9 a	3.6 a	1.0 a	17.4 a	4.0 b	61.0 a	12.0 a
RootShield Plus WP then Aliette	6 oz (once only) then 12.8 oz	9.2 a	-	10.7 a	3.6 a	13.4 a	3.7 a	1.0 a	17.8 ab	4.2 b	61.0 a	2.0 a
CG100 (caprylic acid)	0.6 pt (once only)	9.6 a	3.7 a	10.3 a	3.5 a	12.9 a	3.4 a	1.0 a	17.0 a	3.9 b	62.0 a	1.0 a
Disarm 480SC (fluoxastrobin)	0.6 fl oz	9.2 a	3.6 a	10.3 a	3.6 a	13.0 a	3.6 a	1.0 a	17.2 a	3.9 b	57.0 a	2.0 a
Fenstop (fenamidone)	14 fl oz (once only)	9.5 a	3.6 a	10.2 a	3.6 a	13.0 a	3.5 a	1.0 a	17.8 ab	3.8 b	56.0 a	6.0 a
Heritage (azoxystrobin)	0.9 oz (once only)	10.2 a	3.6 a	10.2 a	3.7 a	14.1 a	3.6 a	1.0 a	18.1 ab	3.9 b	61.0 a	0.0 a
Pageant 38WG (boscalid + pyraclostrobin)	12 oz	9.8 a	3.6 a	10.9 a	3.6 a	13.4 a	3.6 a	1.0 a	18.2 ab	4.0 b	58.0 a	7.0 a
Segway (cyazofamid)	1.5 fl oz	9.9 a	3.7 a	10.9 a	3.7 a	13.6 a	3.6 a	1.0 a	18.1 ab	4.0 b	56.0 a	7.0 a
Nontreated noninoculated	-	9.7 a	3.7 a	10.5 a	3.6 a	13.1 a	3.7 a	1.0 a	16.9 a	4.0 b	57.0 a	3.0 a
Nontreated inoculated	-	9.1 a	3.5 a	10.0 a	3.4 a	12.7 a	3.5 a	1.0 a	16.5 a	3.8 b	49.0 a	6.0 a

[x] Means followed by the same letter do not differ significantly at P=0.05.

[y] Top grade was recorded using the following scale: 1 - plant dead, unsalable, 2 - poor, unsalable, 3 - moderate, salable, 4 - good, salable to 5 - excellent, salable.

[z] Phytotoxicity severity (leaf curl) was recorded using the following scale: 1 – no phytotoxicity, 2 – slight, 3 – moderate, 4 – severe to 5 – plant dead.

Table 61. Efficacy on Pythium Root Rot (*Pythium aphanidermatum*) on Poinsettia (*Euphorbia pulcherrima*),'Angelica White', Benson, NC, 2010.

Treatment	Rate Per 100 Gal	Plant Height (cm)[x]			Top Wt (g)	Root Rot (1-5)[y]
		Day 12	Day 32	Day 46	Day 55	Day 55
Adorn 4SC (fluopicolide)	2 fl oz	13.6 b	15.8 bc	19.3 cd	54.6 c	1.3 de
RootShield Plus WP*	6 oz	8.9 d	9.4 de	10.1 f	9.4 e	3.9 a
RootShield Plus WP* drench then Vital spray	6 oz drench then 64 fl oz spray	8.9 d	9.6 de	10.1 f	8.4 e	3.8 a
CG100 (caprylic acid)	0.8 pt	8.1 d	8.5 e	8.9 f	7.4 e	3.8 a
Disarm 480SC (fluoxastrobin)	0.6 fl oz	10.3 cd	12.4 cd	15.9 de	33.4 d	2.5 b
Fenstop (fenamidone)	14 fl oz	17.5 a	23.9 a	30.5 a	76.4 ab	1.4 de
Heritage (azoxystrobin)	0.9 oz	12.2 bc	17.8 b	20.5 cd	46.5 cd	2.0 bc
Heritage	1.8 oz	13.1 b	17.6 b	21.1 bc	45.1 cd	1.6 cd
Pageant 38WG (boscalid + pyraclostrobin)	12 oz	13.3 b	15.1 bc	18.1 cd	59.1 bc	1.3 de
Terrazole L (etridiazole)	7 fl oz	14.3 b	17.8 b	25.8 ab	85.8 a	1.0 e
Vital* then Vital (potassium phosphite)	64 fl oz	10.2 cd	11.3 de	12.0 ef	8.8 e	4.1 a
Nontreated noninoculated	-	14.1 b	16.6 b	21.3 bc	62.0 bc	1.0 e
Nontreated inoculated	-	8.3 d	9.3 de	10.1 f	8.4 e	3.8 a

[x] Means followed by the same letter do not differ significantly based on the Waller-Duncan k ratio, t-test, k=100, *P*=0.05.

[y] Root rot rating: 1= healthy, 2= 25% or less roots necrotic, 3= 26 - 50% roots necrotic, 4= more than 50% necrotic, and 5= crown rot, plant dead.

*Pre-treated three days prior to start of test and then repeated or rotated on subsequent treatment days.

Table 62. Efficacy on Pythium Root Rot (*Pythium aphanidermatum*) on Poinsettia (*Euphorbia pulcherrima*),'Angelica White', Benson, NC, 2011.

Treatment	Rate Per100 Gal	Plant Height (cm)[x]				Top Wt (g)	Root Rot (1-5)[y]
		Day 0	Day 21	Day 28	Day 40	Day 41	Day 41
A13839B	1.3 fl oz	7.7 a	17.4 ab	19.8 abc	22.8 ab	27.4 ab	1.3 d
Adorn 4SC (fluopicolide)	2 fl oz	7.1 a	13.8 bcd	15.1 cde	17.9 bc	14.4 cde	1.9 cd
Adorn 4SC + Subdue Maxx	2 fl oz + 1 fl oz	7.2 a	15.8 abc	18.0 abc	21.6 ab	22.6 bcd	1.5 d
BSEF-11	25.6 fl oz	7.5 a	10.1 de	10.3 ef	10.4 d	3.6 ef	4.1 ab
RootShield Plus WP	6 oz	7.9 a	8.8 e	8.9 f	8.0 d	1.4 f	4.9 a
RootShield Plus WP then rotated w/ Vital	6 oz drench then 20 fl oz spray	6.9 a	9.4 e	9.0 f	9.3 d	1.8 ef	4.9 a
CG100 (caprylic acid)	0.8 pt	6.4 a	9.5 e	9.9 f	10.3 d	4.5 ef	4.5 ab
Disarm 480SC (fluoxastrobin)	0.6 fl oz	7.4 a	12.3 cde	12.3 def	13.8 cd	10.3 def	3.1 bc
Fenstop (fenamidone)	14 fl oz	7.1 a	18.3 a	21.3 ab	28.3 a	29.1 ab	1.1 d
Heritage (azoxystrobin)	1.8 oz	7.3 a	16.1 abc	18.3 abc	21.0 abc	23.8 bc	3.6 ab
Pageant 38WG (boscalid + pyraclostrobin)	12 oz	7.8 a	15.1 abc	16.3 bcd	19.4 bc	21.6 bcd	3.1 bc
Subdue Maxx 2EC (mefenoxam)	1 fl oz	7.6 a	16.4 ab	18.3 abc	23.0 ab	28.6 ab	1.4 d
Terrazole L (etridiazole)	7 fl oz	7.0 a	15.4 abc	18.5 abc	23.9 ab	32.1 ab	1.1 d
Vital (potassium phosphite)	20 fl oz	7.4 a	10.4 de	9.9 f	10.0 d	2.8 ef	4.5 ab
Nontreated noninoculated	-	6.9 a	19.0 a	23.0 a	28.3 a	38.1 a	1.0 d
Nontreated inoculated	-	6.8 a	9.8 e	9.9 f	9.9 d	2.8 ef	4.9 a

[x] Means followed by the same letter do not differ significantly based on the Waller-Duncan k ratio, t-test, k=100, *P*=0.05.

[y] Root rot rating: 1= healthy, 2= 25% or less roots necrotic, 3= 26 - 50% roots necrotic, 4= more than 50% necrotic, and 5= crown rot, plant dead.

In 2011, Benson conducted two trials to determine efficacy of various products for control of Pythium root rot (*Pythium aphanidermatum*) on snapdragon (*Antirrhinium majus)*. In 2011, all productswere applied as drench on 4 May 2 days before disease inoculation on 6 May, except A13839B and BSEF-11, which were applied on 10 May and before inoculation on 12 May. Plant height, top weight and root rot severity were observed at harvest (27and 57 days after inoculation). In 2011, Terrazole as a standard provided good control of severe Pythium root rot pressure, slightly better than the other standard Subdue MAXX (Table 63). Overall, A13839B, Adorn + Subdue MAXX, Pageant, and Fenstop gave good control while Disarm and Heritage were intermediate. RootShield Plus WP, CG100, Vital, and the RootShield Plus WP/Vital rotation looked ineffective. No phytotoxicity was observed from any treatment in this experiment.

Table 63. Efficacy on Pythium Root Rot (*Pythium aphanidermatum*) on Snapdragon (*Antirrhinium majus*),'Snapshot Red', Benson, NC, 2011.

Treatment	Rate Per 100 Gal	Harvest (Day 27)			
		Plant Ht. (cm)[x]	Plant Rating	Top Wt (g)	Root Rot (1-5)[y]
A13839B[w]	1 fl oz	32.0 ab	1.0 a	25.4 a-d	1.5 c-f
Adorn 4SC (fluopicolide)	2 fl oz	25.5 cde	1.6 a	20.4 def	2.0 b-e
Adorn 4SC + Subdue Maxx	2 fl oz + 1 fl oz	30.0 abc	1.0 a	21.7 c-f	1.8 c-f
BSEF-11[w]	25.6 fl oz	28.6 bcd	1.3 a	20.1 def	2.4 abc
RootShield Plus WP	6 oz	24.5 de	2.1 a	13.6 g	3.3 a
RootShield Plus WP then rotated w/ Vital	6 oz drench then 20 fl oz spray	26.9 cde	1.7 a	18.7 efg	2.4 abc
CG100 (caprylic acid)	0.8 pt	25.4 cde	2.1 a	13.8 g	2.9 ab
Disarm 480SC (fluoxastrobin)	0.6 fl oz	29.5 a-d	1.0 a	23.4 b-e	1.6 c-f
Fenstop (fenamidone)	14 fl oz	32.5 ab	2.3 a	26.6 abc	1.4 def
Heritage (azoxystrobin)	1.8 oz	32.4 ab	1.0 a	22.6 c-f	1.4 def
Pageant 38WG (boscalid + pyraclostrobin)	12 oz	32.0 ab	1.0 a	29.0 ab	1.4 def
Subdue Maxx 2EC (mefenoxam)	1 fl oz	29.3 a-d	1.3 a	19.1 efg	2.0 b-e
Terrazole L (etridiazole)	7 fl oz	30.3 abc	1.0 a	24.1 b-e	1.3 ef
Vital (potassium phosphite)	20 fl oz	29.5 a-d	1.4 a	19.7 d-g	2.3 bcd
Nontreated noninoculated	-	33.9 a	1.0 a	31.1 a	1.0 f
Nontreated inoculated	-	23.4 e	2.0 a	16.9 fg	3.3 a

[x] Means followed by the same letter do not differ significantly based on the Waller-Duncan k ratio, t-test, k=100, *P*=0.05.

[y] Root rot rating: 1= healthy, 2= 25% or less roots necrotic, 3= 26 - 50% roots necrotic, 4= more than 50% necrotic, and 5= crown rot, plant dead.

[w] First treated on 10 May and inoculated on 12 May.

Pythium dissotocum.

In 2010, Grunwald conducted a greenhouse experiment to test the efficacy of several fungicides applied as drench for control of root rot caused by *P. dissotocum* (isolate 41-08) on Douglas fir (*Pseudotsuga menziesii*). Products were applied on the day of disease inoculation (6 July) except RootShield Plus WP and RootShield Plus WP + Aliette which were applied 3 days before (3 July). Plants were seeded on 8 July. Treatments were applied once or twice on 2- or 3-week schedule for various products. Seedling germination and stand counts were taken at 2, 3, 4 and 5 weeks after planting. Alude, Heritage and the standards Aliette and Subdue Maxx provided some control of *P. dissotocum* resulting in significant stand improvement over the nontreated control although not as good as the noninoculated control (Table 64). Adorn, RootShield Plus WP, RootShield Plus WP + Aliette, Cg100, Disarm, Fenstop and Pageant were ineffective. No phytotoxicity was observed from any treatment.

Table 64. Efficacy on Pythium Root Rot (*Pythium dissotocum*) on Douglas Fir (*Pseudotsuga menziesii*), Grunwald, OR, 2010a.

Treatment	Rate Per 100 Gal	No. / Interval of Applications	Plant Emergence at Weeks After Planting[x]			
			2	3	4	5
Adorn 4FL (fluopicolide)	2 fl oz	2/14 days	0.88 d-g	0.88 fg	0.88 ef	0.88 ef
Aliette 80WP (fosetyl Al)	9.6 oz	1	2.5 b	2.63 bcd	2.25 cd	2.25 cd
Alude (phosphorus acid salts)	12.7 fl oz	1	4.38 a	3.75 b	3.75 b	3.75 b
RootShield Plus WP	6 oz	1	1.88 b-e	1.25 f	1.13 def	1.13 def
RootShield Plus WP + Aliette	6 oz + 9.6 oz	1	2 bcd	1.38 ef	1.38 de	1.38 de
CG100 (caprylic acid)	0.6 pt	1	1.5 b-f	1.5 def	1.5 cde	1.5 cde
Disarm 480SC (fluoxastrobin)	0.4 fl oz	2/14 days	1 c-g	1.13 fg	1.25 de	1.25 de
Fenstop (fenamidone)	10 fl oz	1	0 g	0 g	0 f	0 f
Heritage (azoxystrobin)	0.9 oz	2/21 days	2.75b	2.5 cde	2.63 bc	2.63 bc
Pageant 38WG (boscalid + pyraclostrobin)	12 oz	2/14 days	0.5 efg	0.5 fg	0.5 ef	0.5 ef
Subdue Maxx (mefenoxam)	1 fl oz	2/21 days	2.38 bc	2.75 bc	2.63 bc	2.63 bc
Nontreated noninoculated	-	-	4.88 a	5.25 a	5.38 a	5.38 a
Nontreated inoculated	-	-	0.25 g	0.38 fg	0.38 ef	0.38 ef

[x] Means followed by the same letter do not differ significantly based on Tukey's HSD Test, (P=0.05).

Pythium irregulare

In 2010, Chase conducted a greenhouse trial to determine efficacy of various products for control of damping-off caused by *Pythium irregulare* on cockscomb (*Celosia* sp.). Products were applied as sprench at 10 ml per 3.5 inch pot on 8 October one day after seeding (7 October) and four days before disease inoculation (12 October). Several treatments were applied a second time on 22 October. Seedling emergence was recorded on 20 and 27 October. RootShield Plus WP, RootShield Plus WP + Aliette and Heritage were the only treatments that provided some control of severe damping-off on 20 October, with plant emergence comparable to the noninoculated control (Table 65). All other treatments did not increase emergence over the inoculated control. However, no treatment was effective by 27 October.

Table 65. Efficacy on Damping-off (*Pythium irregulare*) on Cockscomb (*Celosia* sp.), Chase, CA, 2010.

Treatment	Rate Per 100 Gal	No. Seedlings Per Pot[x]	
		20 Oct	27 Oct
Adorn 4SC (fluopicolide)	2 fl oz	6.6 a-d	0.8 a
Adorn 4SC + Subdue Maxx 2EC	2 + 1 fl oz	5.0 ab	3.6 a
Aliette 80WDG (fosetyl Al)	12.8 oz	9.0 a-d	5.8 a
RootShield Plus WP WP	6 oz (once only)	12.5 b-e	2.4 a
RootShield Plus WP then Aliette	6 oz (once only) then 12.8 oz	13.3 cde	5.9 a
CG100 (caprylic acid)	0.6 pt (once only)	9.2 a-d	1.6 a
Disarm 480SC (fluoxastrobin)	0.6 fl oz	6.1 abc	5.8 a
Fenstop (fenamidone)	14 fl oz (once only)	1.6 a	7.9 a
Heritage (azoxystrobin)	0.9 oz (once only)	14.1 de	8.8 a
Pageant 38WG (boscalid+pyraclostrobin)	12 oz	7.9 a-d	5.7 a
Segway (cyazofamid)	1.5 fl oz	8.0 a-d	8.4 a
Nontreated noninoculated	-	16.8 e	26.9 b
Nontreated inoculated	-	9.2 a-d	0.4 a

[x] Means followed by the same letter do not differ significantly at P=0.05.

In 2010, Grunwald conducted a greenhouse experiment to test the efficacy of several fungicides applied as drench for control of root rot caused by *P. irregulare* (isolate 45-08) on Douglas fir (*Pseudotsuga menziesii*). Products were applied on the day of disease inoculation (6 July) except RootShield Plus WP and RootShield Plus WP + Aliette which were applied 3 days before (3 July). Plants were seeded on 8 July. Treatments were applied once or twice on 2- or 3-week schedule for various products. Seedling germination and stand counts were taken at 2, 3, 4 and 5 weeks after planting. Alude, RootShield Plus WP, and the standards Aliette and Subdue Maxx provided some control of *P. irregulare* resulting in significant stand improvement over the nontreated control although not as good as the noninoculated control (Table 66). Adorn, RootShield Plus WP + Aliette, Cg100, Disarm, Fenstop, Heritage and Pageant were ineffective. No phytotoxicity was observed from any treatment.

Table 66. Efficacy on Pythium Root Rot (*Pythium irregulare*) on Douglas Fir (*Pseudotsuga menziesii*), Grunwald, OR, 2010b.

Treatment	Rate Per 100 Gal	No. / Interval of Applications	Plant Emergence at Weeks After Planting[x]			
			2	3	4	5
Adorn 4FL (fluopicolide)	2 fl oz	2/14 days	0.75 e	1 cd	1.13 cd	1.13 cd
Aliette 80WP (fosetyl Al)	9.6 oz	1	3.25 bc	3.25 b	3.38 b	3.38 b
Alude (phosphorus acid salts)	12.7 fl oz	1	3.75 ab	2.63 b	3.00 b	3.00 b
RootShield Plus WP WP	6 oz	1	3.63 ab	3.13 b	3.25 b	3.25 b
RootShield Plus WP + Aliette	6 oz + 9.6 oz	1	0.63 e	0.63 d	0.63 d	0.63 d
CG100 (caprylic acid)	0.6 pt	1	0.63 e	0.5 d	0.5 d	0.5 d
Disarm 480SC (fluoxastrobin)	0.4 fl oz	2/14 days	0.25 e	0.5 d	0.5 d	0.5 d
Fenstop (fenamidone)	10 fl oz	1	0.13 e	0 d	0.13 d	0.13 d
Heritage (azoxystrobin)	0.9 oz	2/21 days	1 de	1.13 cd	1.13 cd	1.13 cd
Pageant 38WG (boscalid + pyraclostrobin)	12 oz	2/14 days	0 e	0.13 d	0.13 d	0.13 d
Subdue Maxx (mefenoxam)	1 fl oz	2/21 days	2.25 cd	2.25 bc	2.38 bc	2.38 bc
Nontreated noninoculated	-	-	4.88 a	5.25 a	5.38 a	5.38 a
Nontreated inoculated	-	-	0 e	0 d	0 d	0 d

[x] Means followed by the same letter do not differ significantly based on Tukey's HSD Test, (P=0.05).

In 2013, Becker conducted a greenhouse trial to test the efficacy of several fungicides applied as drench for control of root rot caused by *P. irregulare* on geranium (*Pelargonium x domesticum*). Cultures of *P. irregulare* were inoculated into each pot at planting on Jan 17. Products were applied as drenches starting on Feb 17, then reapplied 2 times every 2 weeks, except Adorn and RootShield Plus WP. Evaluations were made on foliar symptoms during the trial, and subsequent root weight, shoot weight, and visual estimate of internal necrosis within the stem tissue observed at harvest. Low disease infection resulted in virtually no statistical differences between treatments including inoculated and non-inoculated checks (Table 67). Leaf necrosis symptoms on Feb 27 were not significantly different from the inoculated or non inoculated plants and were not likely to be due to the treatments. Similarly, yield components on Mar 14 indicated that the inoculation of Pythium reduced the root and shoot weights numerically, but not significantly. No phytotoxicity was observed from any treatment.

Table 67. Efficacy on Pythium Root Rot (*Pythium irregulare*) on Geranium (*Pelargonium* x *domesticum*), 'Bright Red' Becker, 2013.

Treatment	Rate Per 100 Gal	% Leaf Chlorosis 2/22	No. of Leaves 2/27	% Leaf Necrosis 2/27	Leaf Chlorosis 2/27	No. of Flowers 2/27	Root Wt. (g) 3/14	Shoot Wt. (g) 3/14	Visual Discoloration [y] 3/14
Adorn4SC (fluopicolide)	2 fl oz once only	3.78 a	10.89 ab	8.67 a	2.44 def	0.56 ab	9.22 bc	33.30 ab	2.44 ab
Adorn, then Alude	2 fl oz once, 12 fl oz twice	2.11 a	10.22 ab	4.56 a	4.33 a-d	0.89 ab	10.00 bc	38.75 ab	3.33 ab
Alliete (fosetyl-Al)	12.8 oz	8.56 a	9.33 ab	4.67 a	5.22 ab	0.11 b	8.95 bc	35.21 ab	2.56 ab
Alude (mono- and di-potassium salts of phosphorus acid)	12 fl oz	11.67 a	10.22 ab	12.89 a	4.67 abc	0.78 ab	11.30 bc	37.88 ab	4.22 ab
RootShield Plus WP (*Trichoderma harzianum* and *T. virens*)	6 oz once only	11.00 a	11.33 ab	10.78 a	1.89 f	0.78 ab	9.23 bc	37.88 ab	2.44 ab
RootShield Plus WP + Alude	6 oz + 12 fl oz once	12.00 a	10.22 ab	5.67 a	4.11 a-e	0.78 ab	8.69 bc	34.18 ab	4.00 ab
CG100 (caprylic acid)	0.6 pt	9.89 a	9.44	12.89 a	2.11 ef	1.00 ab	9.31 bc	35.53 ab	2.89 ab
Disarm (fluoxastrobin)	0.15 fl oz	6.11 a	12.11 ab	13.11 a	2.11 ef	1.33 a	9.12 bc	38.40 ab	2.11 b
	0.6 fl oz	4.11 a	9.78 ab	4.33 a	3.44 b-f	0.78 ab	9.80 bc	40.58 a	3.78 ab
FenStop (fenamidone)	14 fl oz	13.00 a	9.22 ab	2.78 a	2.22 def	0.78 ab	8.82 bc	39.06 ab	5.11 a
Heritage (azoxystrobin)	0.9 oz	10.00 a	9.00 b	4.00 a	3.22 b-f	0.67 ab	9.57 bc	32.99 ab	4.00 ab
Insignia (pyraclostrobin)	6 oz	10.78 a	10.44 ab	8.33 a	4.33 a-d	0.56 ab	11.93 b	35.05 ab	4.33 ab
Magellan (mono- and dibasic sodium,potassium and ammonium phosphite)	12 fl oz	8.11 a	10.11 ab	8.22 a	5.56 a	0.78 ab	11.25 bc	40.37 a	4.89 a
Pageant (boscalid + pyraclostrobin)	12 oz	8.11 a	12.00 ab	6.56 a	3.33 b-f	0.44 ab	9.95 bc	36.69 ab	4.44 ab
	16 oz	9.33 a	9.11 ab	8.67 a	2.78 c-f	0.67 ab	7.47 c	29.04 b	3.44 ab
Segway (cyazofamid)	2.8 fl oz	4.44	11.44 ab	3.11 a	3.56 b-f	0.78 ab	15.62 a	41.22 a	4.11 ab
SubdueMaxx (mefenoxam)	1 fl oz	6.44 a	10.33 ab	3.11 a	2.56 def	0.22 b	8.88 bc	37.50 ab	3.56 ab
TerrazoleL (etridiazole)	7 fl oz	5.89 a	10.89 ab	7.00 a	3.11 c-f	0.67 ab	12.37 b	38.08 ab	3.56 ab
Nontreated noninoculated	-	2.44 a	13.22 a	4.44 a	1.89 f	0.44 ab	12.15 b	40.64 a	3.11 ab
Nontreated inoculated	-	5.44 a	10.11 ab	9.00 a	1.89 f	0.67 ab	9.85 bc	35.64 ab	4.78 ab

[x] Means followed by the same letter do not differ significantly based on Student-Newman-Keuls, (P=0.05).

[y] Visual estimate of any necrosis within the stem was rated using a 0-10 scale, where 10 was most severe.

Pythium mamillatum.

In 2010, Chastagner conducted a greenhouse trial to test the efficacy of several fungicides applied as drench for control of damping off and root rot caused by *P.mamillatum* (isolates PD 266A & PP 158A) on Douglas fir (*Pseudotsuga menziesii*). Products were applied Dec 20, 5 days after disease inoculation of potting mix (Dec 15), except Remedier and RootShield Plus WP which were applied on Dec 7 and Dec 12, respectively. Plants were seeded on Dec 22. Treatments were applied one to three times on 1 to 4-week intervals for various products. Data on symptom development was collected once per week for 4 weeks beginning 14 days after seeding. Notes on symptoms were taken and the number of "healthy" seedlings was recorded. Symptoms included damping off, which occurred shortly after emergence of the cotyledon, to root rot which killed the seedlings during the experiment. Terrazole L, Subdue MAXX, Segway, and Disarm provided good control of *P. mamillatum*, resulting in higher numbers of healthy seedlings per pot compared to the inoculated control (Table 68). No phytotoxicity was observed from any treatment.

Table 68. Efficacy on Pythium Root Rot (*Pythium mamillatum*) on Douglas Fir (*Pseudotsuga menziesii*), Chastagner WA, 2010a.

Treatment	Rate Per 100 Gal	Application Dates[z]	Application Interval	No. of Healthy Seedlings[x,y]
Adorn 4FL (fluopicolide)	2 fl oz	3, 7	21 Days	2 cde
Aliette 80WP (fosetyl Al)	9.6 oz	3, 8	28 Days	1.8 cde
RootShield Plus WP (*Trichoderma harziamum & T. virens)*	6 oz	2	1 application	0.8 de
RootShield Plus WP / Magellan rotation	6 oz + 12 fl oz	2, 4	Magellan @ 14 days	1.2 de
CG100 (caprylic acid)	9.6 fl oz	3, 8	28 Days	1.8 cde
Disarm 480SC (fluoxastrobin)	0.4 fl oz	3, 6, 8	14 Days	5.4 abc
Fenstop (fenamidone)	10 fl oz	3, 8	28 Days	3.8 bcd
Heritage (azoxystrobin)	0.9 oz	3, 7	21 Days	2.8 cde
Magellan (Mono- and Dibasic Sodium, Potassium and Ammonium Phosphites)	12 fl oz	3, 8	28 Days	0.6 de
Pageant 38WG (boscalid + pyraclostrobin)	12 oz	3, 6, 8	14 Days	3.6 b-e
Remedier (*Trichoderma asperellum* and *T. gamsii)*	2.5 oz	1, 5, 8	14-21 Days	0 e
Remedier	7.5 oz	1, 5, 8	14-21 Days	0 e
Segway (cyazofamid)	3 fl oz	3, 8	28 Days	7.2 ab
Subdue Maxx (mefenoxam)	2 fl oz	3, 7	21 Days	8.0 a
Terrazole L (etridiazole)	7 fl oz	3, 8	28 Days	8.6 a
Nontreated noninoculated	-	-	-	3.0 bcd
Nontreated inoculated	-	-	-	0.6 de

[x] Means followed by the same letter do not differ significantly based on Tukey's HSD Test, (P=0.001).
[y] Data collected 35 days after seeding (January 26, 2011).
[z] Dates: 1 = 12/7/10, 2 = 12/12/10, 3 = 12/20/10, 4 = 12/26/10, 5 = 12/29/11, 6 = 1/3/11, 7 = 1/10/11, and 8 = 1/18/11.

Pythium ultimum.

In 2008, Hausbeck studied 10 product and product combinations for *P. ultimum* on *Pelargonium x hortorum*. The initial fungicide application was applied the day of transplanting into mefenoxam-resistant infested medium on 23 May. An additional drench was made 6 Jun to all treatments, with the exception of Terrazole, Adorn + Terrazole, FenStop and Subdue MAXX in which a second fungicide application was

not applied due to label recommendations. Terrazole or Adorn (applied alone or as a tank mix with Heritage, Alude or Terrazole), completely prevented plant death from a severe disease pressure causing 100 % mortality of nontreated inoculated plants (Table 69). Plants that were similar in health to the nontreated noninoculated plants included Terrazole and Adorn + Terrazole. Treatments of Heritage (both rates), Subdue, Mandipropamid, FenStop, and Alude resulted in ≥50% plant death. In 2010, the initial fungicide application was applied the day of transplanting into mefenoxam-resistant infested medium on 5 Aug and reapplied on 18 Aug for all treatments. Disease pressure in this trial was severe with all nontreated inoculated plants dead by the first rating (Table 70). By the fourth rating, the Cg100, Disarm, Pageant, and Subdue MAXX treatments all had 100% plant death. Applications of Adorn SC and Terrazole 35WP completely prevented plant death and were similar in plant vigor and height in comparison to the nontreated noninoculated. Alude, Fenstop and V-10208 were also effective in preventing plant death in comparison to the nontreated inoculated. No phytotoxicity was observed from any treatment.

Table 69. * Efficacy on Pythium Root Rot (*Pythium ultimum*) on Geranium (*Pelargonium x hortorum*) 'Orbit White', Hausbeck, MI, 2008.

Treatment	Rate Per 100 Gal	Plant Health (1-5)[x, y]			Plant Death (%)		
		30 May	6 Jun	13 Jun	30 May	6 Jun	13 Jun
Adorn 4SC (fluopicolide)	2 fl oz	1.9 b	2.0 bc	2.3 bc	0 a	0 a	0 a
Adorn + Alude (fluopicolide + phosphorus acid salts)	2 + 12.75 fl oz	1.8 b	2.3 bc	2.4 c	0 a	0 a	0 a
Adorn + Heritage (fluopicolide + acibenzolar)	2 fl oz + 0.9 oz	2.0 b	2.5 bc	2.9 c	0 a	0 a	0 a
Adorn + Terrazole (fluopicolide + etridiazole)	2 fl oz + 10 oz	1.9 b	1.6 ab	1.6 ab	0 a	0 a	0 a
Alude L (phosphorus acid salts)	12.75 fl oz	3.1 c	3.9 d	4.1 de	12.5 ab	50 b	50 b
Fenstop 500SC (fenamidone)	14 fl oz	3.0 c	3.2 d	3.9 d	0 a	37.5 b	50 b
Heritage 50WDG (azoxystrobin)	0.9 oz	4.1 d	4.9 e	5.0 f	12.5 ab	87.5 c	100 c
	1.8 oz	4.1 d	4.8 e	4.8 ef	37.5 bc	87.5 c	87.5 c
Micora 250SC (mandipropamid)	8.2 fl oz	4.3 d	4.8 e	4.9 f	37.5 bc	87.5 c	87.5 c
Subdue Maxx 2EC (mefenoxam)	1 fl oz	4.4 d	4.9 e	5.0 f	37.5 bc	87.5 c	100 c
Terrazole 35WP (etridiazole)	10 oz	1.4 ab	1.3 a	1.4 a	0 a	0 a	0 a
Nontreated noninoculated	-	1.0 a	1.0 a	1.1 a	0 a	0 a	0 a
Nontreated inoculated	-	4.5 d	4.9 e	5.0 f	62.5 c	87.5 c	100 c

* Not an IR-4 Experiment: PDM Reports Vol 3: OT003.

[x] Means followed by the same letter do not differ significantly based on Fisher's Protected LSD (P=0.05).

[y] Plant health rating based on 1 to 5 scale where 1=healthy, 2=minor wilting or chlorosis, 3=moderate wilting or chlorosis, 4=severe wilting or chlorosis, and 5=plant death.

Table 70. Efficacy on Pythium Root Rot (*Pythium ultimum*.) on Geranium (*Pelargonium x hortorum*)'Orbit White', Hausbeck, MI, 2010.

Treatment	Rate Per 100 Gal	VigorRating [x, y]					Height (cm)			Plant Death (%)				
		9 Aug	12 Aug	16 Aug	19 Aug	23 Aug	16 Aug	19 Aug	23 Aug	9 Aug	12 Aug	16 Aug	19 Aug	23 Aug
Adorn 4SC (fluopicolide)	4 fl oz	1.1 c	1.4 d	1.4 e	1.4 d	1.5 d	3.38 a	3.8 a	5.1 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
Alude L (phosphorus acid salts)	64 fl oz	1.5 c	2.4 c	3.5 c	3.9 b	4.1 b	1.84 b	1.6 b	1.3 b	12.5 ab	12.5 a	12.5 a	37.5 b	50.0 c
CG100 (caprylic acid)	0.6 pt	4.8 a	4.9 a	4.9 a	5.0 a	5.0 a	0.04 d	0.0 c	0.0 c	75.0 c	87.5 c	87.5 b	100.0 c	100.0 d
Disarm 480SC (fluoxastrobin)	2.4 fl oz	3.5 b	4.5 ab	4.8 a	5.0 a	5.0 a	0.11 d	0.0 c	0.0 c	37.5 b	50.0 b	75.0 b	100.0 c	100.0 d
Fenstop 500SC (fenamidone)	14 fl oz	1.6 c	2.5 c	3.1 c	3.5 b	3.8 b	2.19 b	1.8 b	1.7 b	0.0 a	0.0 a	0.0 a	25.0 b	37.5 bc
Heritage 50WDG (azoxystrobin)	0.9 oz	3.1 b	4.0 b	4.1 b	4.8 a	4.9 a	0.80 c	0.4 c	0.2 c	12.5 ab	25.0 ab	25.0 a	87.5 c	87.5 d
Pageant 38WG (boscalid + pyraclostrobin)	12 oz	4.6 a	4.9 a	4.9 a	5.0 a	5.0	0.06 d	0.0 c	0.0 c	87.5 c	87.5 c	87.5 b	100.0 c	100.0 d
Subdue Maxx 2EC (mefenoxam)	1 fl oz	4.8 a	4.9 a	4.9 a	5.0 a	5.0 a	0.00 d	0.0 c	0.0 c	75.0 c	87.5 c	87.5 b	100.0 c	100.0 d
Terrazole 35WP (etridiazole)	10 oz	1.0 c	1.0 d	1.1 e	1.3 d	1.3 d	3.74 a	4.5 a	5.4 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
V-10208 SC	8 fl oz	1.0 c	1.3 d	2.0 d	2.5 c	3.1 c	2.26 b	2.2 b	1.7 b	0.0 a	0.0 a	0.0 a	0.0 a	12.5 ab
Nontreated noninoculated	-	1.0 c	1.0 d	1.0 e	1.0 d	1.0 d	3.76 a	4.7 a	5.7 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
Nontreated inoculated	-	5.0 a	5.0 a	5.0 a	5.0 a	5.0 a	0.00 d	0.0 c	0.0 c	100.0 c	100.0 c	100.0 b	100.0 c	100.0 d

[x] Means followed by the same letter do not differ significantly based on Fisher's LSD (P=0.05).

[y] Rated on a scale of 1 to 5, where 1=healthy; 2=chlorosis/stunting; 3=minor to moderate wilting; 4=severe wilting; 5=plant death.

In 2011, Hausbeck conducted another study to determine efficacy of various products for control of Pythium root rot on poinsettia. All fungicides were applied as a drench immediately after transplanting except RootShield Plus WP which was applied 3 days before inoculation and transplanting. Fungicides were applied at various intervals starting on 26 Jul (Table 71). Disease pressure was moderate in this trial with 25% of the nontreated inoculated plants dead by the final rating date (Table 73). Stunting was severe in the nontreated control. Adorn SC (both rates), Disarm SC, FenStop SC, Heritage (both rates), Pageant WG (16 oz), and Terrazole WP were the only treatments that resulted in plants statistically taller than the nontreated control (Table 72). Adorn SC (1 fl oz), FenStop SC, and Terrazole WP were the only treatments that resulted in plant heights statistically similar to the nontreated noninoculated plants. No phytotoxicity was observed except on plants treated with Adorn SC in the form of severe leaf curl. This symptom was especially noticeable on the newer growth and was severe enough that the plants would be classified as unsalable.

Table 71. Efficacy on Pythium Root Rot (*Pythium ultimum*) on Poinsettia (*Euphorbia pulcherrima*), 'Freedom Red' – Plant Health, Hausbeck, MI, 2011.

Treatment	Rate Per 100 Gal	Applic. Intervals	Plant Health [x,y]				
			8/9	8/17	8/23	9/1	9/23
Adorn SC (fluopicolide)	1 floz	14-day	1.1 ab	1.1 ab	1.4 a-c	1.5 a-c	1.9 ab
Adorn SC	2 fl oz	14-day	1.1 ab	1.1 ab	1.5 a-d	1.5 a-c	1.6 ab
Aliette (fosetyl Al)	12.8 oz	28-day	1.9 bc	2.0 bc	2.4 d	2.8 e	3.1 d
Alude (Mono- and Di-potassium salts of Phosphorus Acid)	12.75 fl oz	21-day	1.8 a-c	1.9 a-c	2.1 b-d	2.5 de	3.1 d
RootShield Plus WP (*Trichoderma harzianum* & *T. virens*)	6 oz	3 dbi	1.3 ab	1.3 a-c	1.4 a-c	2.0 b-e	2.4 b-d
RootShield Plus WP / Alude	6 oz / 12.75 fl oz	14-day	1.0 a	1.0 a	1.4 a-c	1.8 a-d	1.6 ab
Cg100 (caprylic acid)	0.8 pt	doi	1.5 a-c	1.5 a-c	1.6 a-d	1.9 a-e	2.4 b-d
Disarm SC (fluoxastrobin)	6 fl oz	14-day	1.6 a-c	1.6 a-c	1.6 a-d	1.8 a-d	2.1 bc
FenStop SC (fenamidone)	14 floz	28-day	1.0 a	1.0 a	1.5 a-d	1.6 a-d	1.9 ab
Heritage WDG (azoxystrobin)	0.9 fl oz	21-day	1.0 a	1.0 a	1.0 a	1.1 ab	1.8 ab
Heritage WDG	1.8 fl oz	21-day	1.3 ab	1.3 a-c	1.4 a-c	1.5 a-c	1.9 ab
Pageant WG (boscalid+pyraclostrobin)	12 oz	14-day	1.6 a-c	1.8 a-c	1.9 a-d	1.9 a-e	2.3 b-d
Pageant WG	16 oz	14-day	1.0 a	1.0 a	1.4 a-c	1.6 a-d	1.9 ab
Terrazole WP (etridiazole	10 oz	28-day	1.1 ab	1.1 ab	1.3 ab	1.4 a-c	1.6 ab
Nontreated noninoculated	-	-	1.0a	1.0 a	1.0 a	1.0 a	1.0 a
Nontreated inoculated	-	-	2.1 c	2.1 c	2.3 cd	2.3 c-e	2.9 cd

* dbi=days before inoculation; doi=day of inoculation

[x] Means followed by the same letter do not differ significantly based on Fisher's LSD (P=0.05).

[y] Plant health rating based on 1 to 5 scale where 1=healthy, 2=minor wilting or chlorosis, 3=moderate wilting or chlorosis, 4=severe wilting or chlorosis, and 5=plant death.

Table 72. Efficacy on Pythium Root Rot (*Pythium ultimum*) on Poinsettia (*Euphorbia pulcherrima*), 'Freedom Red' – Plant Height, Hausbeck, MI, 2011.

Treatment	Rate Per 100 Gal	Applic. Intervals	Plant Height (cm) [x,y]			
			8/17	8/23	9/1	9/23
Adorn SC (fluopicolide)	1 floz	14-day	12.2 a	13.1 a	14.5 a	16.9 ab
	2 fl oz	14-day	11.1 a-d	12.2 a-c	13.5 ab	14.7 b-d
Aliette (fosetyl Al)	12.8 oz	28-day	8.5 e	9.0 e	9.1 f	9.9 f
Alude (Mono- and Di-potassium salts of Phosphorus Acid)	12.75 fl oz	21-day	9.9 b-e	9.9 de	10.2 ef	11.1 ef
RootShield Plus WP (*Trichoderma harzianum* & *T. virens*)	6 oz	3 dbi	9.8 c-e	10.7 b-e	11.5 b-f	12.7 d-f
RootShield Plus WP / Alude	6 oz / 12.75 fl oz	14-day	9.3 de	10.0 de	9.9 f	11.4 ef
Cg100 (caprylic acid)	0.8 pt	doi	9.4 de	9.9 de	10.3 d-f	11.7 ef
Disarm SC (fluoxastrobin)	6 fl oz	14-day	10.2 b-e	10.9 b-e	12.3 a-e	15.0 b-d
FenStop SC (fenamidone)	14 floz	28-day	10.7 a-d	11.4 a-d	13.3 a-c	17.4 ab
Heritage WDG (azoxystrobin)	0.9 fl oz	21-day	9.5 c-e	10.4 c-e	11.5 b-f	14.8 b-d
	1.8 fl oz	21-day	10.8 a-d	11.5 a-d	12.7 a-d	15.4 b-d
Pageant WG (boscalid+pyraclostrobin)	12 oz	14-day	9.6 c-e	9.9 de	10.9 c-f	13.4 c-e
	16 oz	14-day	11.1 a-d	11.8 a-d	13.2 a-c	16.2 bc
Terrazole WP (etridiazole	6 oz alt. 12.75 fl oz	14-day	11.8 ab	12.6 ab	14.7 a	17.4 ab
Nontreated noninoculated	10 oz	28-day	11.3 a-c[z]	12.7 ab	14.7 a	19.7 a
Nontreated inoculated	-	-	9.5 c-e	10.4 c-e	10.5 d-f	11.7 ef

* dbi=days before inoculation; doi=day of inoculation

[x] Means followed by the same letter do not differ significantly based on Fisher's LSD (P=0.05).

[y] Plant health rating based on 1 to 5 scale where 1=healthy, 2=minor wilting or chlorosis, 3=moderate wilting or chlorosis, 4=severe wilting or chlorosis, and 5=plant death.

Table 73. Efficacy on Pythium Root Rot (*Pythium ultimum*) on Poinsettia (*Euphorbia pulcherrima*), 'Freedom Red' – Plant Death, Hausbeck, MI, 2011.

Treatment	Rate Per 100 Gal	Applic. Intervals	Plant Death (%) [x,y]				
			8/9	8/17	8/23	9/1	9/23
Adorn SC (fluopicolide)	1 floz	14-day	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
	2 fl oz	14-day	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
Aliette (fosetyl Al)	12.8 oz	28-day	0.0 a	0.0 a	0.0 a	0.0 a	12.5 a
Alude (Mono- and Di-potassium salts of Phosphorus Acid)	12.75 fl oz	21-day	12.5 ab	12.5 ab	12.5 ab	25.0 b	25.0 a
RootShield Plus WP (*Trichoderma harzianum* & *T. virens*)	6 oz	3 dbi	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
RootShield Plus WP / Alude	6 oz / 12.75 fl oz	14-day	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
Cg100 (caprylic acid)	0.8 pt	doi	12.5 ab	12.5 ab	12.5 ab	12.5 ab	12.5 a
Disarm SC (fluoxastrobin)	6 fl oz	14-day	12.5 ab	12.5 ab	12.5 ab	12.5 ab	12.5 a
FenStop SC (fenamidone)	14 floz	28-day	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
Heritage WDG (azoxystrobin)	0.9 fl oz	21-day	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
	1.8 fl oz	21-day	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
Pageant WG (boscalid+pyraclostrobin)	12 oz	14-day	0.0 a	12.5 ab	12.5 ab	12.5 ab	12.5 a
	16 oz	14-day	0.0 a	0.0 a	0.0 a	0.0 a	12.5 a
Terrazole WP (etridiazole	10 oz	28-day	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
Nontreated noninoculated	-	-	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
Nontreated inoculated	-	-	25.0 b	25.0 b	25.0 b	25.0 b	25.0 a

* dbi=days before inoculation; doi=day of inoculation

[x] Means followed by the same letter do not differ significantly based on Fisher's LSD (P=0.05).

[y] Plant health rating based on 1 to 5 scale where 1=healthy, 2=minor wilting or chlorosis, 3=moderate wilting or chlorosis, 4=severe wilting or chlorosis, and 5=plant death.

In 2010, Chase conducted a greenhouse trial to determine efficacy of various products for control of damping-off caused by *Pythium ultimum* on cockscomb (*Celosia* sp.*).* Products were applied as sprench at 20 ml per 3.5 inch pot on 11 October three days after seeding (8 October) and one day before disease inoculation (12 October). Several treatments were applied a second time on 25 October. Seedling emergence was recorded on 20 October and 2 November. Adorn + Subdue Maxx was the only treatment that provided significant control of severe damping-off on 20 October, with plant emergence comparable to the noninoculated control (Table 74); Adorn by itself was ineffective. All other treatments did not significantly increase emergence over the inoculated control. By 2 November, Adorn + Subdue Maxx and Fenstop had higher emergence than the inoculated control, though not as high as the noninoculated control.

Table 74. Efficacy on Damping-off (*Pythium ultimum*) on Cockscomb (*Celosia* sp.), Chase, CA, 2010.

Treatment	Rate Per 100 Gal	No. Seedlings Per Pot[x]	
		20 Oct	2 Nov
Adorn 4SC (fluopicolide)	2 fl oz	1.7 a	0.1 a
Adorn 4SC + Subdue Maxx 2EC	2 + 1 fl oz	15.3 b	14.5 c
Aliette 80WDG (fosetyl Al)	12.8 oz	1.8 a	0.3 a
RootShield Plus WP (*Trichoderma harziamum & T. virens*)	6 oz (once only)	2.9 a	0.3 a
RootShield Plus WP / Aliette	6 oz (once only) / 12.8 oz	2.8 a	0.4 a
CG100 (organic acid)	0.6 pt (once only)	4.0 a	0.0 a
Disarm 480SC (fluoxastrobin)	0.6 fl oz	4.6 a	1.4 a
Fenstop (fenamidone)	14 fl oz (once only)	8.6 a	10.9 b
Heritage (azoxystrobin)	0.9 oz (once only)	3.8 a	1.9 a
Pageant 38WG (boscalid + pyraclostrobin)	12 oz	5.2 a	1.4 a
Segway (cyazofamid)	1.5 fl oz	7.5 a	2.4 a
Nontreated noninoculated	-	18.3 b	18.8 d
Nontreated inoculated	-	1.8 a	0.2 a

[x] Means followed by the same letter do not differ significantly at P=0.05.

In 2010, Chastagner conducted a greenhouse trial to test the efficacy of several fungicides applied as drench for control of damping off and root rot caused by *P.ultimum* (isolates 193 and PP249B) on Douglas fir (*Pseudotsuga menziesii*). Products were applied 20 Dec, 5 days after disease inoculation of potting mix (15 Dec), except Remedier and RootShield Plus WP which were applied on 7 Dec and 12 Dec, respectively. Plants were seeded on 22 Dec. Treatments were applied one to three times on 1 to 4-week intervals for various products. Data on symptom development was collected once per week for 4 weeks beginning 14 days after seeding. Notes on symptoms were taken and the number of "healthy" seedlings was recorded. Symptoms included damping off, which occurred shortly after emergence of the cotyledon, to root rot which killed the seedlings during the experiment. Subdue MAXX, Fenstop, Adorn and Segway provided good control of *P. ultimum* resulting in higher numbers of healthy seedlings per pot compared to the inoculated control (Table 75). No phytotoxicity was observed from any treatment.

Table 75. Efficacy on Pythium Root Rot (*Pythium ultimum*) on Douglas Fir (*Pseudotsuga menziesii*), Chastagner WA, 2010b.

Treatment	Rate Per 100 Gal	Application Dates[z]	Application Interval	No. of Healthy Seedlings[x,y]
Adorn 4FL (fluopicolide)	2 fl oz	3, 7	21 Days	7.4 ab
Aliette 80WP (fosetyl Al)	9.6 oz	3, 8	28 Days	5.2 a-e
RootShield Plus WP (*Trichoderma harziamum & T. virens*)	6 oz	2	1 application	2.6 b-e
RootShield Plus WP / Magellan rotation	6 oz + 12 fl oz	2, 4	Magellan @ 14 days	0.8 de
CG100 (organic acid)	9.6 fl oz	3, 8	28 Days	4.0 a-e
Disarm 480SC (fluoxastrobin)	0.4 fl oz	3, 6, 8	14 Days	6.6 abc
Fenstop (fenamidone)	10 fl oz	3, 8	28 Days	8.2 a
Heritage (azoxystrobin)	0.9 oz	3, 7	21 Days	4.2 a-e
Magellan (Mono- and Dibasic Sodium, Potassium and Ammonium Phosphites)	12 fl oz	3, 8	28 Days	4.6 a-e
Pageant 38WG (boscalid + pyraclostrobin)	12 oz	3, 6, 8	14 Days	6.0 a-d
Remedier (*Trichoderma asperellum* and *T. gamsii)*	2.5 oz	1, 5, 8	14-21 Days	0.2 e
Remedier	7.5 oz	1, 5, 8	14-21 Days	0.2 e
Segway (cyazofamid)	3 fl oz	3, 8	28 Days	7.0 ab
Subdue Maxx (mefenoxam)	2 fl oz	3, 7	21 Days	8.8 a
Terrazole L (etridiazole)	7 fl oz	3, 8	28 Days	6.2 a-d
Nontreated noninoculated	-	-	-	7.6 ab
Nontreated inoculated	-	-	-	1.3 cde

[x] Means followed by the same letter do not differ significantly based on Tukey's HSD Test, (P=0.001).
[y] Data collected 35 days after seeding (January 26, 2011).
[z] Dates: 1 = 12/7/10, 2 = 12/12/10, 3 = 12/20/10, 4 = 12/26/10, 5 = 12/29/11, 6 = 1/3/11, 7 = 1/10/11, and 8 = 1/18/11.

In 2010, Kirk conducted a greenhouse trial to test the efficacy of several fungicides for control of root rot caused by *P.ultimum* on larkspur (*Delphinium sp.*). Initial treatments were applied as drench 4 days after transplanting, except RootShield Plus WP which was applied to plant roots as an immersion in solution for 30 seconds prior to transplanting. Plants were inoculated with a liquid suspension of *Pythium ultimum* that had been grown in liquid PDA culture for 14 days. Pythium root rot developed in the trial and about 140 days after transplanting, the inoculated control plants developed some leaf chlorosis and root necrosis. No treatments significantly reduced Pythium leaf chlorosis or root necrosis in comparison to the nontreated control (Table 76). No treatment affected the number of leaves per plant. Pageant and Terrazole significantly increased the height of the plants in comparison to the nontreated control plants. Several treatments caused transient leaf phytotoxicity; these included the treatments of Adorn, RootShield Plus WP, Disarm, Fenstop and Terrazole.

Table 76. Efficacy on Pythium Root Rot (*Pythium ultimum*) on Larkspur (*Delphinium sp.*), Kirk, MI, 2010.

Treatment	Rate Per 100 Gal	Application Dates[u]	Phytotoxicity[x, w] 79 DAP[v]	No. Leaves Per Plant 137 DAP	Plant Height (cm) 137 DAP	Leaf Necrosis[y] 137 DAP	Root Necrosis[z] 137 DAP
Adorn 4SC (fluopicolide)	4 fl oz	B, C	0.9 b	8.9 a	45.9 abc	5.4 ab	4.5 bcd
AgriFos 45.8SC (mono- and di-potassium salts of phosphorus acid) then RootShield Plus	67 fl oz, 6 oz	B, C	0.2 c	10.0 a	38.2 bcd	4.6 ab	4.6 bcd
RootShield Plus WP (*Trichoderma harziamum & T. virens*)	3 oz	A, E	0.9 b	9.4 a	33.6 cd	6.1 a	4.9 bcd
CG100 20SC (organic acid)	0.8 pt	B	0.5 bc	9.8 a	41.6 a-d	4.8 ab	4.7 bcd
Disarm 480SC (fluoxastrobin)	0.6 fl oz	B, D	1.0 ab	9.6 a	37.0 bcd	5.7 ab	6.1 ab
Fenstop 480SC (fenamidone)	14 fl oz	B, D	1.6 a	11.2 a	31.3 d	5.4 ab	6.7 a
Heritage 50WDG (azoxystrobin)	1.8 oz	B, D	0.5 bc	8.2 a	36.9 bcd	5.8 ab	5.9 abc
Magellan 23SC (mono- and dibasic sodium, potassium and ammonium phosphites)	8 fl oz	B	0.5 bc	9.2 a	30.7 b	4.7 ab	4.4 bcd
Pageant 38WG (boscalid + pyraclostrobin)	12 oz	B, C	0.0 c	9.2 a	48.0 ab	4.9ab	4.6 bcd
Subdue Maxx 2EC (mefenoxam)	1 fl oz	B	0.4 bc	10.0 a	34.9 bcd	4.4 bc	4.2 cde
Terrazole 35WP (etridiazole)	10 oz	B	1.0 b	9.5 a	54.8 a	4.5 abc	3.4 de
Nontreated noninoculated	-	-	0.0 c	7.7 a	34.2 cd	2.9 c	2.7 e
Nontreated inoculated	-	-	0.0 c	7.2 a	34.1 cd	5.8 ab	5.1 a-d

[x] Means followed by the same letter do not differ significantly based on Fisher's LSD (P=0.05).

w Phytotoxicity scale from 0 – 5; 0= no phytotoxicity; 1= ≈1mm of entire leaf margin yellow of at least one leaf; 2= 1-5% of entire leaf margin yellow of at least one leaf; 3= 1-5% of entire leaf margin yellow of all leaves; 4= 5-10% of entire leaf margin yellow of all leaves; 5= >10% of entire leaf margin yellow of all leaves.

[y] Leaf necrosis scale from 0 – 10; 0= no yellowing; 1= bottom two leaves pale green; 2= bottom two leaves pale yellow; 3= bottom two leaves yellow; 4= 5-10% all leaves yellow; 5= 10-20% of all leaves yellow; 6= 20-50% of all leaves yellow; 7= 50-75% of all leaves yellow; 8= 75-100% of all leaves yellow; 9= 0 - 50% of leaves necrotic; 10= 100% of leaves necrotic.

[z] Root necrosis scale from 0 – 10; 0= no necrosis; 1= 0-5%; 2= 6-10%; 3= 11-15%; 4= 16-20%; 5= 20-30%; 6= 30-40%; 7= 40-50%; 8= 50-60%; 9= 60-75%; 10= 75-100% of root mass necrotic.

[u] Application dates: A= 12 Sep; B= 16 Sep; C= 5 Oct; D= 19 Oct; E= 8 Dec.

[v] Days after transplanting (on 9/12/10).

Pythium vipa.

In 2010, Grunwald conducted a greenhouse experiment to test the efficacy of several fungicides applied as drench for control of root rot caused by *P. vipa* (isolate 09) on Douglas fir (*Pseudotsuga menziesii*). In the first trial, products were applied on the day of disease inoculation (6 July) except RootShield Plus WP and RootShield Plus WP + Aliette which were applied 3 days before (3 July). Plants were seeded on 8 July. Treatments were applied once or twice on 2- or 3-week schedule for various products. Seedling germination and stand counts were taken at 2, 3, 4 and 5 weeks after planting. Alude provided the best control of *P. vipa* resulting in significant stand improvement comparable to the noninoculated control (Table 77). Adorn, Heritage and the standards Aliette and Subdue Maxx provided some control resulting in significant stand improvement over the nontreated control although not as good as the noninoculated control. RootShield Plus WP, RootShield Plus WP + Aliette, Cg100, Disarm, Fenstop and Pageant were ineffective. No phytotoxicity was observed from any treatment.

Table 77. Efficacy on Pythium Root Rot Caused by *Pythium vipa* on Douglas Fir (*Pseudotsuga menziesii*), Grunwald, OR, 2010c.

Treatment	Rate Per 100 Gal	No. / Interval of Applications	Plant Emergence at Weeks After Planting[x]			
			2	3	4	5
Adorn 4FL (fluopicolide)	2 fl oz	2/14 days	3.38 bcd	2.38 bc	2.38 cd	2.38 cd
Aliette 80WP (fosetyl Al)	9.6 oz	1	3.13 cde	2.75 b	2.5 cd	2.5 cd
Alude (phosphorus acid salts)	12.7 fl oz	1	4.75 ab	4.38 a	4.38 ab	4.38 ab
RootShield Plus WP (*Trichoderma harziamum & T. virens*)	6 oz	1	1.75 edf	1.63 bcd	1.63 cde	1.63 cde
RootShield Plus WP + Aliette	6 oz + 9.6 oz	1	0.375 gh	0.5 ed	0.5 ef	0.5 ef
CG100 (caprylic acid)	0.6 pt	1	1.25 fgh	1.13 cde	1.13 def	1.13 def
Disarm 480SC (fluoxastrobin)	0.4 fl oz	2/14 days	0.75 fgh	0.63 de	0.63 ef	0.63 ef
Fenstop (fenamidone)	10 fl oz	1	0 h	0.25 de	0.25 ef	0.25 ef
Heritage (azoxystrobin)	0.9 oz	2/21 days	2.13 def	1.63 bcd	1.63 cde	1.63 cde
Pageant 38WG (boscalid + pyraclostrobin)	12 oz	2/14 days	0.13 h	0.38 de	0.38 ef	0.38 ef
Subdue Maxx (mefenoxam)	1 fl oz	2/21 days	3.75 abc	2.63 b	3 bc	3 bc
Nontreated noninoculated	-	-	4.88 a	5.25 a	5.38 a	5.38 a
Nontreated inoculated	-	-	0 h	0 e	0 f	0 f

[x] Means followed by the same letter do not differ significantly based on Tukey's HSD Test, (P=0.05).

Efficacy Summary by Product/Active Ingredient

A brief efficacy summary for select products is given below, with a reminder that there are very limited data available to draw definitive conclusions for many products. Products were selected based on interest in these products for testing in Phytophthora efficacy projects from 2005 t0 2015. While this summary does include some non-IR-4 data, it is not exhaustive and other data for *Phytophthora*-managing products may be available.

Fenamidone.

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

Fenamidone sufficiently managed *P. cinnamomi* on azalea but not on rhododendron, a similar story with other products. Fenamidone applied to the foliage did not provide sufficient efficacy on *P. citricola*, but it tended to provide excellent control of *P. nicotianae* regardless of host crop. Also it provided excellent control of *P. nicotianae* when applied as drench on snapdragon and vinca. On *P. cryptogea, P. palmivora, P. ramorum* and *P. tropicalis*, Fenamidone also tended to have good to excellent efficacy.

Fenstop provided excellent control of Pythium root rot and damping-off caused by *Pythium aphanidermatum* in a petunia trial. Good control of *P. aphanidermatum* was obtained in poinsettia and snapdragon trials. It provided excellent control of *P. ultimum* in a poinsettia trial but poor control in two geranium trials, and no control in cockscomb and larkspur trials. No control of *P. dissotocum, P. irregulare* and *P. ultimum* was obtained in one Douglas fir trial; in another trial, no control of *P. mamillatum* and *P. ultimum* was obtained. Similarly, it provided no control of *P. irregulare* in one cockscomb trial; results of a trial on geranium were inconclusive.

Please see Table 78 for individual summaries of IR-4 trials conducted during 2004 to 2012.

Phytotoxicity

No phytotoxicity was observed in any crop with the exception of larkspur where FenStop caused very minor and transient leaf phytotoxicity.

Table 78. 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 trials received by 11/28/2016 are included in the table below.

PR#	Product (Active)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
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.
28025	Fenstop (Fenamidone)	Phytophthora cactorum (Phytophthora cactorum)	Rhododendron (Rhododendron sp.) 'Nova Zembla'	Greenhouse	Chastagner	WA	2007	Drench	No significant difference among treatments.
25851	Fenstop (Fenamidone)	Phytophthora cinnamomi (Phytophthora cinnamomi)	Alder (Alnus sp.) Alnus maritima	Greenhouse	Kratsch	UT	2006	Drench	Disease did not develop
25844	Fenstop (Fenamidone)	Phytophthora cinnamomi (Phytophthora cinnamomi)	Mexican Cliffrose (Purshia mexicana)	Greenhouse	Kratsch	UT	2006	Drench	Low disease pressure; did not reduce disease rating at 7 and 14 fl oz per 100 gal
25834	Fenstop (Fenamidone)	Phytophthora cinnamomi (Phytophthora cinnamomi)	Azalea & Rhododendron (Rhododendron sp.) 'Nova Zembla'	Greenhouse	Chastagner	WA	2005	Drench	Good efficacy at 14 and 28 oz per 100 gal, but inoculated and non-inoculated checks had no disease.
25834	Fenstop (Fenamidone)	Phytophthora cinnamomi (Phytophthora cinnamomi)	Azalea & Rhododendron (Rhododendron sp.) 'Purple Splendour'	Greenhouse	Chastagner	WA	2006	Drench	No significant reduction in disease with 7 and 14 fl oz per 100 gal.
24910	Fenstop (Fenamidone)	Phytophthora cinnamomi (Phytophthora cinnamomi)	Azalea & Rhododendron (Rhododendron sp.) R. catawbiense 'Roseum Elegans'	Field Container	Benson	NC	2004	Foliar	Good efficacy with 28 and 56 fl oz/100 gal; poor efficacy with 14 fl oz per 100 gal.
24910	Fenstop (Fenamidone)	Phytophthora cinnamomi (Phytophthora cinnamomi)	Azalea & Rhododendron (Rhododendron sp.) R. obtusum 'Hinodegiri'	Field Container	Benson	NC	2004	Drench	Excellent efficacy with drench application of 14 fl oz per 100 gal.
24910	Fenstop (Fenamidone)	Phytophthora cinnamomi (Phytophthora cinnamomi)	Azalea & Rhododendron (Rhododendron sp.) R. obtusum 'Hinodegiri'	Field Container	Benson	NC	2005	Drench	Excellent efficacy with drench application of 14 and 28 fl oz per 100 gal
24910	Fenstop (Fenamidone)	Phytophthora cinnamomi (Phytophthora cinnamomi)	Azalea & Rhododendron (Rhododendron sp.) R. obtusum 'Hinodegiri'	Field Container	Benson	NC	2006	Drench	Excellent efficacy with 7.0 and 14.0 fl oz per 100 gal drench application.
24920	Fenstop (Fenamidone)	Phytophthora citricola (Phytophthora citricola)	Azalea & Rhododendron (Rhododendron sp.) 'Nova Zembla'	Field Container	Regan	OR	2005	Foliar	Poor efficacy with foliar application

PR#	Product (Active)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
24920	Fenstop (Fenamidone)	Phytophthora citricola (Phytophthora citricola)	Azalea & Rhododendron (Rhododendron sp.) 'Nova Zembla'	Field Container	Regan	OR	2006	Foliar	Mediocre efficacy with both 7 and 14 oz per 100 gal as foliar spray 2 weeks after inoculation.
27553	Fenstop (Fenamidone)	Phytophthora cryptogea (Phytophthora cryptogea)	Fir (Abies sp.) A. fraseri	Greenhouse	Chastagner	WA	2008	Drench	Excellent efficacy at 14 and 28 fl oz per 100 gal; one of the most effective products
27553	Fenstop (Fenamidone)	Phytophthora cryptogea (Phytophthora cryptogea)	Fir (Abies sp.) A. procera	Greenhouse	Chastagner	WA	2008	Drench	Excellent efficacy at 14 and 28 fl oz per 100 gal; one of the most effective products
26997	Fenstop (Fenamidone)	Phytophthora cryptogea (Phytophthora cryptogea)	Transvaal Daisy (Gerbera sp.) G. jamesonii 'Yellow Revolution'	Greenhouse	Benson	NC	2007	Drench	Extremely high disease pressure; excellent control at 14 fl oz per 100 gal; comparable to uninfested control
26997	Fenstop (Fenamidone)	Phytophthora cryptogea (Phytophthora cryptogea)	Transvaal Daisy (Gerbera sp.) G. jamesonii 'Yellow Revolution'	Greenhouse	Benson	NC	2008	Drench	Extremely high disease pressure; excellent control at 7 and 14 fl oz per 100 gal; comparable to uninfested control
26997	Fenstop (Fenamidone)	Phytophthora cryptogea (Phytophthora cryptogea)	Transvaal Daisy (Gerbera sp.) G. jamesonii 'Yellow Revolution'	Greenhouse	Benson	NC	2009	Drench	Extremely high disease pressure; excellent control at 14 oz per 100 gal; almost comparable to uninfested control
27772	Fenstop (Fenamidone)	Phytophthora drechsleri (Phytophthora drechsleri)	Poinsettia (Euphorbia pulcherrima) 'Freedom Red'	Greenhouse	Hausbeck	MI	2007	Drench	Severe disease pressure; good efficacy at 7 fl oz per 100 gal
29467	Fenstop (Fenamidone)	Phytophthora drechsleri (Phytophthora drechsleri)	Transvaal Daisy (Gerbera sp.) G. jamesonii 'Yellow Revolution'	Greenhouse	Benson	NC	2009	Drench	Extremely high disease pressure; excellent control at 14 oz per 100 gal; comparable to uninfested control
26715	Fenstop (Fenamidone)	Phytophthora nicotianae (Phytophthora nicotianae)	Garden Snapdragon (Antirrhinum majus) 'Montego Mix'	Greenhouse	Hausbeck	MI	2006	Drench	Excellent efficacy at 7 and 14 fl oz per 100 gal.
24972	Fenstop (Fenamidone)	Phytophthora nicotianae (Phytophthora nicotianae)	Mexican Cliffrose (Purshia mexicana)	Greenhouse	Evans	UT	2005	Drench	No efficacy at 14 fl oz per 100 gal, and some efficacy at 28 fl oz per 100 gal, but this was not significantly different from both nontreated non-inoculated and nontreated inoculated controls.
25810	Fenstop (Fenamidone)	Phytophthora nicotianae (Phytophthora nicotianae)	Azalea & Rhododendron (Rhododendron sp.) 'Nova Zembla'	Field Container	Becker	NY	2007	Drench	No statistical difference between treatments and inoculated Check

PR#	Product (Active)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
25810	Fenstop (Fenamidone)	Phytophthora nicotianae (Phytophthora nicotianae)	Azalea & Rhododendron (Rhododendron sp.) R. catawbiense 'Alba'	Field Container	Becker	NY	2007	Drench	No statistical difference between treatments and inoculated Check
25810	Fenstop (Fenamidone)	Phytophthora nicotianae (Phytophthora nicotianae)	Azalea & Rhododendron (Rhododendron sp.) R. catawbiense 'Boursault'	Field Container	Becker	NY	2007	Drench	No statistical difference between treatments and inoculated Check
25169	Fenstop (Fenamidone)	Phytophthora nicotianae (Phytophthora nicotianae)	Spathe Flower; Spathiphyllum (Spathiphyllum sp.) 'Patrice'	Greenhouse	Norman	FL	2006	Drench	Excellent efficacy with 7 and 14 fl oz per 100 gal.
25169	Fenstop (Fenamidone)	Phytophthora nicotianae (Phytophthora nicotianae)	Spathe Flower; Spathiphyllum (Spathiphyllum sp.) 'Petite'	Greenhouse	Norman	FL	2005	Drench	Excellent control at 14 and 28 oz per 100 gal.
25804	Fenstop (Fenamidone)	Phytophthora nicotianae (Phytophthora nicotianae)	Periwinkle (Vinca sp.)	Greenhouse	Hausbeck	MI	2006	Drench	Excellent efficacy at 7 and 14 fl oz per 100 gal.
27630	Fenstop (Fenamidone)	Phytophthora nicotianae (Phytophthora nicotianae)	Violet (Viola sp.) V. x wittrockiana 'Matrix Purple'	Greenhouse	Benson	NC	2007	Drench	Moderately high disease pressure; significant but not commercially acceptable control at 14 fl oz per 100 gal
30541	Fenstop (Fenamidone)	Phytophthora palmivora (Phytophthora palmivora)	Ivy, English (Hedera helix)	Greenhouse	Becker	NY	2008	Drench	Significantly increased root and shoot vigor at 14 fl oz per 100 gal; slightly inferior to non-inoculated check.
25177	Fenstop (Fenamidone)	Phytophthora palmivora (Phytophthora palmivora)	Lilyturf, Big Blue (Liriope muscari) 'Evergreen Giant'	Greenhouse	Strandberg	FL	2005	Drench	Good efficacy at 14 and 28 fl oz per 100 gal
26794	Fenstop (Fenamidone)	Phytophthora ramorum (Phytophthora ramorum)	Camellia (Camellia sp.) C. japonica 'Magnoliaflora'	Field Container	Grunwald	OR	2008	Foliar	Significant reduction of lesion development at 28, but not at 14 fl oz per 100 gal.
24900	Fenstop (Fenamidone)	Phytophthora ramorum (Phytophthora ramorum)	Azalea & Rhododendron (Rhododendron sp.) 'Catawbiense Boursault'	Field Container	Linderman	OR	2006	Foliar	Significantly suppressed lesion development at high rate
24900	Fenstop (Fenamidone)	Phytophthora ramorum (Phytophthora ramorum)	Azalea & Rhododendron (Rhododendron sp.) 'Nova Zembla'	Field Container	Chastagner	WA	2005	Foliar	Good efficacy with foliar application
24900	Fenstop (Fenamidone)	Phytophthora ramorum (Phytophthora ramorum)	Azalea & Rhododendron (Rhododendron sp.) 'Nova Zembla'	Field Container	Chastagner	WA	2006	Foliar	Significantly reduced lesion size at 14 fl oz per 100 gal and both rates reduced number of lesions for both wounded and non-woudned leaves.
24900	Fenstop (Fenamidone)	Phytophthora ramorum (Phytophthora ramorum)	Azalea & Rhododendron (Rhododendron sp.) 'Nova Zembla'	Field Container	Chastagner	WA	2008	Foliar	Excellent efficacy at 14 and 28 fl oz per 100 gal; one of the most effective products

PR#	Product (Active)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
24900	Fenstop (Fenamidone)	Phytophthora ramorum (Phytophthora ramorum)	Azalea & Rhododendron (Rhododendron sp.) 'Nova Zembla'	Field Container	Linderman	OR	2005	Foliar	Mixed results: only good efficacy in 1 out of 4 trials.
26774	Fenstop (Fenamidone)	Phytophthora root rot (Phytophthora sp.)	Marigold (Tagetes sp.)	Greenhouse	Reddy	AL	2006	Drench	Good and excellent efficacy at 7 and 14 oz per 100 gal
25621	Fenstop (Fenamidone)	Phytophthora syringae (Phytophthora syringae)	Apple (Malus sp.) 'Spring Snow'	Field Container	Grunwald	OR	2008	Drench	No effect on lesion development at 14 and 28 fl oz per 100 gal
28893	Fenstop (Fenamidone)	Phytophthora tropicalis (Phytophthora tropicalis)	Periwinkle, Madagascar (Catharanthus roseus) 'Peppermint Cooler'	Greenhouse	Benson	NC	2008	Drench	Low pressure; no difference between non-inoculated and inoculated control and treatments
28844	Fenstop (Fenamidone)	Phytophthora tropicalis (Phytophthora tropicalis)	Ivy, English (Hedera helix)	Greenhouse	Norman	FL	2008	Drench	Excellent control of a severe disease pressure drenched at 7 and 14 fl oz per 100 gal
25818	Fenstop (Fenamidone)	Phytophthora tropicalis (Phytophthora tropicalis)	Centipede Tongavine (Pothos sp.)	Greenhouse	Norman	FL	2007	Drench	Excellent control drenched at 7 and 14 fl oz per 100 gal.
23618	Fenstop (Fenamidone)	Phytotoxicity (Phytotoxicity)	Garden Snapdragon (Antirrhinum majus)	Greenhouse	Linderman	OR	2004	Foliar	No injury at 7, 14, and 28 fl oz per 100 gal
23620	Fenstop (Fenamidone)	Phytotoxicity (Phytotoxicity)	Calibrachoa (Calibrachoa sp.)	Greenhouse	Linderman	OR	2004	Foliar	No injury at 7, 14, and 28 fl oz per 100 gal
29825	Fenstop (Fenamidone)	Pythium aphanidermatum (Pythium aphanidermatum)	Garden Snapdragon (Antirrhinum majus) 'Snapshot Red'	Greenhouse	Benson	NC	2011	Drench	High disease pressure. Good control with 14 fl oz per 100 gal; comparable to nontreated non-inoculated control.
25493	Fenstop (Fenamidone)	Pythium aphanidermatum (Pythium aphanidermatum)	Poinsettia (Euphorbia pulcherrima)	Greenhouse	Chase	CA	2010	Drench	No significant differences in disease incidence, plant height and top grade between inoculated and non-inoculated Checks, and Fenstop at 14 fl oz per 100 gal; no phytotoxicity.
25493	Fenstop (Fenamidone)	Pythium aphanidermatum (Pythium aphanidermatum)	Poinsettia (Euphorbia pulcherrima) 'Angelica White'	Greenhouse	Benson	NC	2006	Drench	Low disease pressure; root rating and plant size equal to noninoculated and inoculated Checks at 7 and 14 fl oz per 100 gal
25493	Fenstop (Fenamidone)	Pythium aphanidermatum (Pythium aphanidermatum)	Poinsettia (Euphorbia pulcherrima) 'Angelica White'	Greenhouse	Benson	NC	2010	Drench	High disease pressure; good control at 14 fl oz per 100 gal; comparable to noninoculated control.
25493	Fenstop (Fenamidone)	Pythium aphanidermatum (Pythium aphanidermatum)	Poinsettia (Euphorbia pulcherrima) 'Angelica White'	Greenhouse	Benson	NC	2011	Drench	High disease pressure. Excellent control with 14 fl oz per 100 gal; comparable to noninoculated control.

PR#	Product (Active)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
25493	Fenstop (Fenamidone)	Pythium aphanidermatum (Pythium aphanidermatum)	Poinsettia (Euphorbia pulcherrima) 'Freedom Red'	Greenhouse	Hausbeck	MI	2011	Drench	Good control of a moderate disease pressure with 14 fl oz per 100 gal; almost comparable to noninoculated check.
29949	Fenstop (Fenamidone)	Pythium aphanidermatum (Pythium aphanidermatum)	Geranium (Pelargonium sp.) 'Scarlet Orbit'	Greenhouse	Wick	MA	2010	Drench	Significantly increased plant volume and top dry weight with 14 fl oz per 100 gal; only treatment comparable to non-inoculated check.
29958	Fenstop (Fenamidone)	Pythium aphanidermatum (Pythium aphanidermatum)	Petunia (Petunia sp.) P. x violacea 'Laura Bush'	Greenhouse	Reddy	AL	2010	Drench	Excellent control of root rot and damping-off at 10 fl oz per 100 gal.
30165	Fenstop (Fenamidone)	Pythium dissotocum (Pythium dissotocum)	Fir, Douglas (Pseudotsuga menziesii)	Greenhouse	Grunwald	OR	2010	Drench	No significant stand improvement at 10 fl oz per 100 gal.
29709	Fenstop (Fenamidone)	Pythium irregulare (Pythium irregulare)	Cockscomb, Wool Flower (Celosia sp.)	Greenhouse	Chase	CA	2010	Sprench	No significant control at 14 oz per 100 gal
32118	Fenstop (Fenamidone)	Pythium irregulare (Pythium irregulare)	Geranium (Pelargonium sp.) P. x domesticum 'Bright Red'	Greenhouse	Becker	NY	2011	Drench	Inconclusive results due to low disease infection. Virtually no statistical differences between treatments including inoculated and non-inoculated checks.
26509	Fenstop (Fenamidone)	Pythium irregulare (Pythium irregulare)	Fir, Douglas (Pseudotsuga menziesii)	Greenhouse	Grunwald	OR	2010	Drench	No significant stand improvement at 10 fl oz per 100 gal.
26509	Fenstop (Fenamidone)	Pythium irregulare (Pythium irregulare)	Fir, Douglas (Pseudotsuga menziesii)	Greenhouse	Linderman	OR	2006	Drench	High variability precluded determination of statistical significance between treatments
26763	Fenstop (Fenamidone)	Pythium sp. (Pythium sp.)	Geranium (Geranium sp.)	Greenhouse	Reddy	AL	2006	Drench	Poor and good efficacy at 7 and 14 oz per 100 gal
29884	Fenstop (Fenamidone)	Pythium sp. (Pythium sp.)	Fir, Douglas (Pseudotsuga menziesii)	Greenhouse	Chastagner	WA	2010	Drench	High disease pressure. Excellent control of P. ultimum, may be less effective on P. mamillatum, with 10 fl oz per 100 gal.
29699	Fenstop (Fenamidone)	Pythium ultimum (Pythium ultimum)	Cockscomb, Wool Flower (Celosia sp.)	Greenhouse	Chase	CA	2010	Sprench	Significant control, though inferior to non-inoculated check, at 14 oz per 100 gal.
30431	Fenstop (Fenamidone)	Pythium ultimum (Pythium ultimum)	Larkspur (Delphinium sp.)	Greenhouse	Kirk	MI	2010	Drench	No significant control at 14 fl oz per 100 gal applied twice; slight, transient leaf injury.
26004	Fenstop (Fenamidone)	Pythium ultimum (Pythium ultimum)	Geranium (Pelargonium sp.) P x hortorum 'Orbit White'	Greenhouse	Hausbeck	MI	2010	Drench	Significantly reduced plant death from severe disease pressure at 14 fl oz per 100 gal.

PR#	Product (Active)	Target	Crop	Production Site	Researcher	State	Year	Application Type	Results
26004	Fenstop (Fenamidone)	Pythium ultimum (Pythium ultimum)	Geranium (Pelargonium sp.) P. x hortorum 'Elita White'	Greenhouse	Chastagner	WA	2006	Drench	Significant reduction of disease severity
26004	Fenstop (Fenamidone)	Pythium ultimum (Pythium ultimum)	Geranium (Pelargonium sp.) P. x hortorum 'Orbit White'	Greenhouse	Hausbeck	MI	2012	Drench	Completely prevented plant death from severe disease pressure with 14 fl oz per 100 gal; comparable to non-inoculated Check.
30176	Fenstop (Fenamidone)	Pythium vipa (Pythium vipa)	Fir, Douglas (Pseudotsuga menziesii)	Greenhouse	Grunwald	OR	2010	Drench	No significant stand improvement at 10 fl oz per 100 gal.
26784	Fenstop (Fenamidone)	Rhizoctonia solani (Rhizoctonia solani)	Petunia (Petunia sp.)	Greenhouse	Reddy	AL	2006	Drench	Poor and fair efficacy at 7 and 14 oz per 100 gal

Label Suggestions

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

Specifically list the downy mildew, Phytophthora and Pythium diseases on the label:

- Coleus downy mildew
- *Phytophthora cryptogea*
- *Phytophthora nicotianae*
- *Phytophthora ramorum*
- *Phytophthora. cinnamomic*
- *Pythium aphanadermatum*
- *Pythium mamillatum*
- *Pythium ultimum*
- Snapdragon downy mildew

It is also recommended to add outdoor production nurseries for root diseases of woody crops.

Appendix 1: Contributing Researchers

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