Biopesticides for Disease Management in Specialty Crops

A. R. Chase - Chase Ag Consulting

Examples of Products

Product	Active agent	Manufacturer	Uses
Actinovate	*Streptomyces lydicus* WYEC 108	Natural Industries	soilborne diseases
Cease	*Bacillus subtilis* QRD 713	BioWorks Inc.	foliar diseases
Companion	*Bacillus subtilis* strain GB03	Growth Products	soilborne diseases
GallTrol	*Agrobacterium radiobacter* strain K-84	AgBioChem	crown gall
MilStop	potassium bicarbonate	BioWorks Inc.	foliar diseases
MycoStop	*Streptomyces griseoviridis* strain K61	AgBio Development	soilborne diseases
Regalia	extract from giant knotweed	Marrone Bio Innovations	suggested as additive for other products
RootShield Plus	*Trichoderma harzianum* T-22 and *Trichoderma virens* G-41	BioWorks Inc.	soil-borne diseases
Triathlon BA (Double Nickel)	*Bacillus amyloliquifaciens* strain D747	OHP (Certis)	foliar and soil-borne diseases

For resale -
   Greenhouse vegetable transplants
   Nursery production of strawberries, blueberries etc.
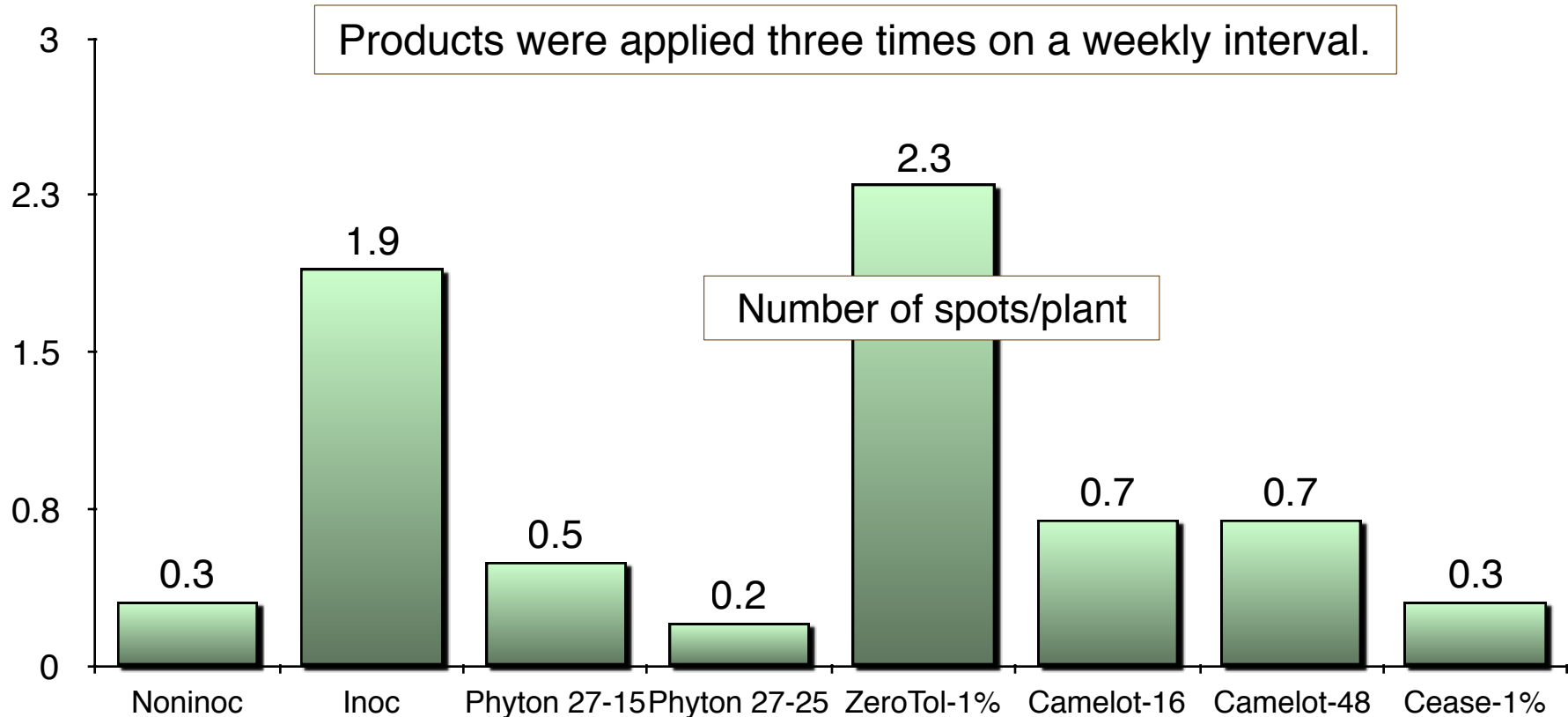   Greenhouse vegetable 6 packs and quarts
   Basil - organic and normal
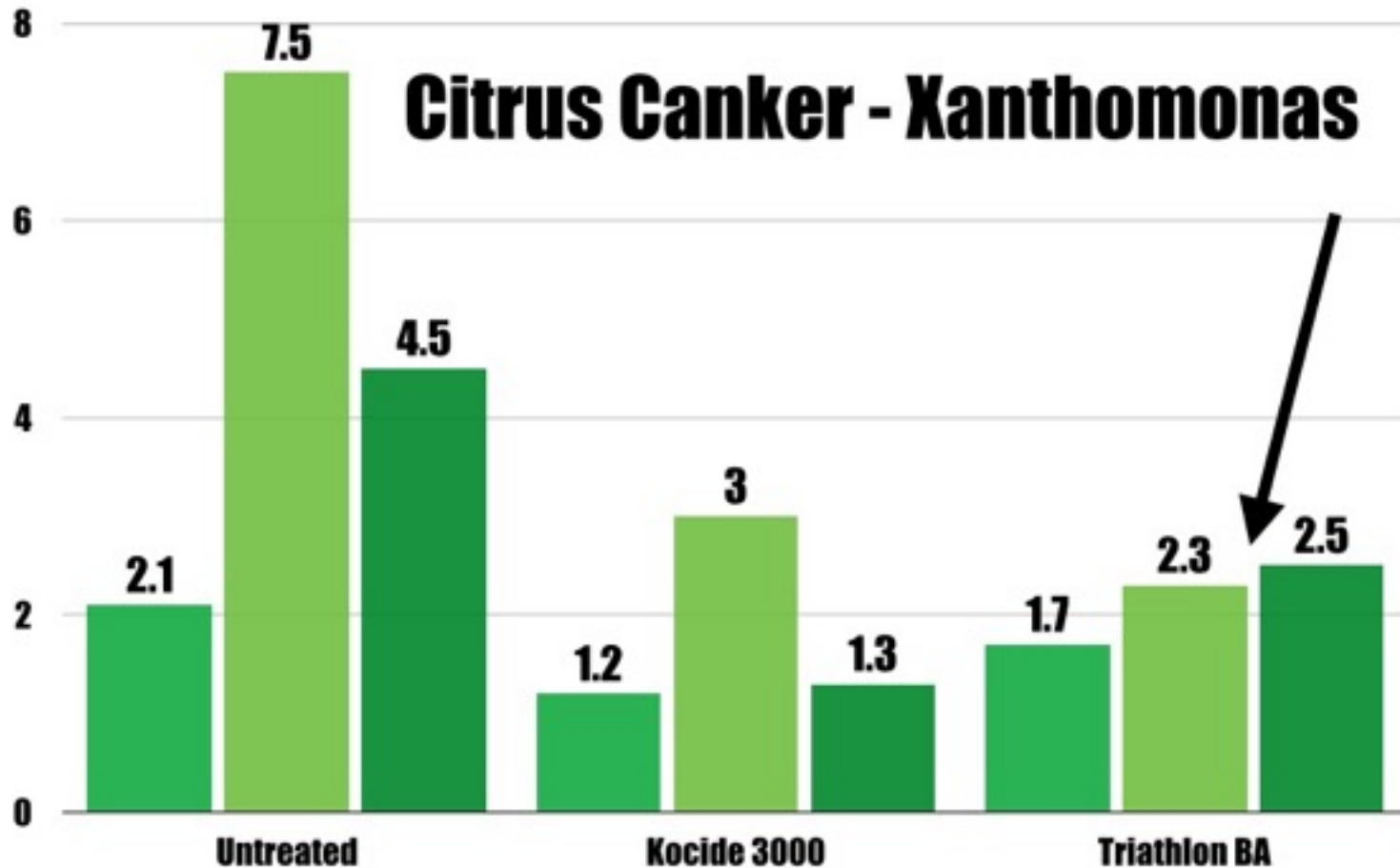Organic production - mainly edibles at the moment
   fruit, microgreens, basil and other herbs, vegetables
   (like lettuce - whole plant in recirc system), cannabis
Complex product mix small growers

Dr. Pam Roberts
University of Florida, IFAS

Citrus Canker - Xanthomonas

Post-harvest control of Botrytis on Liatris

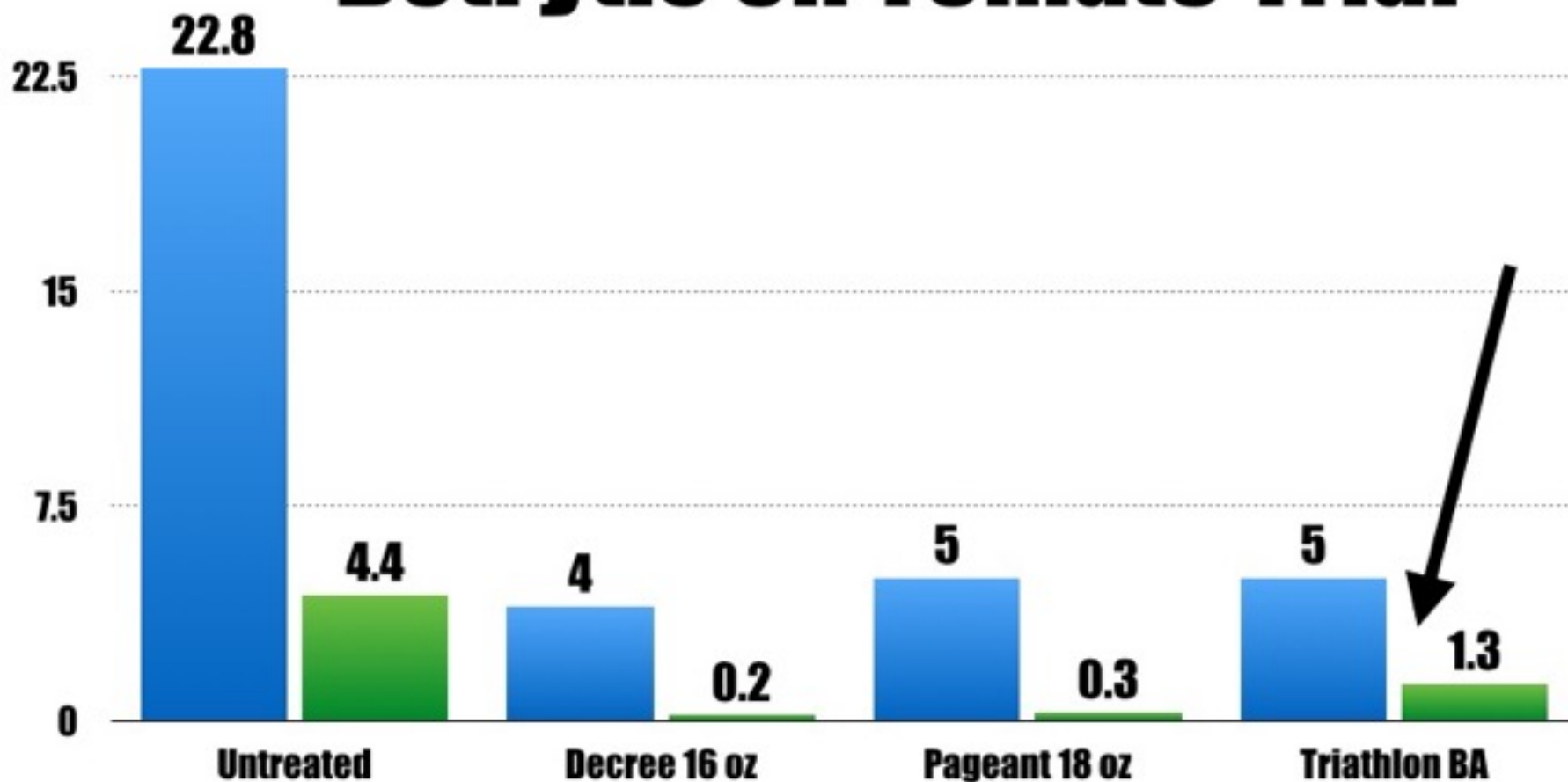| Botrytis Control on Liatris		
Treatment	**Rate/ 100 gal**	**Botrytis severity**
No dip	——	3.1 d
Water	——	2.9 cd
Decree	24 oz	1.5 a
Cease	1%	2.2 b
Cease	1.5%	2.5 bc
Cease	2%	2.1 b
Numbers in the same column followed by the same letter are not significantly different (Student-Newman-Keuls method)		

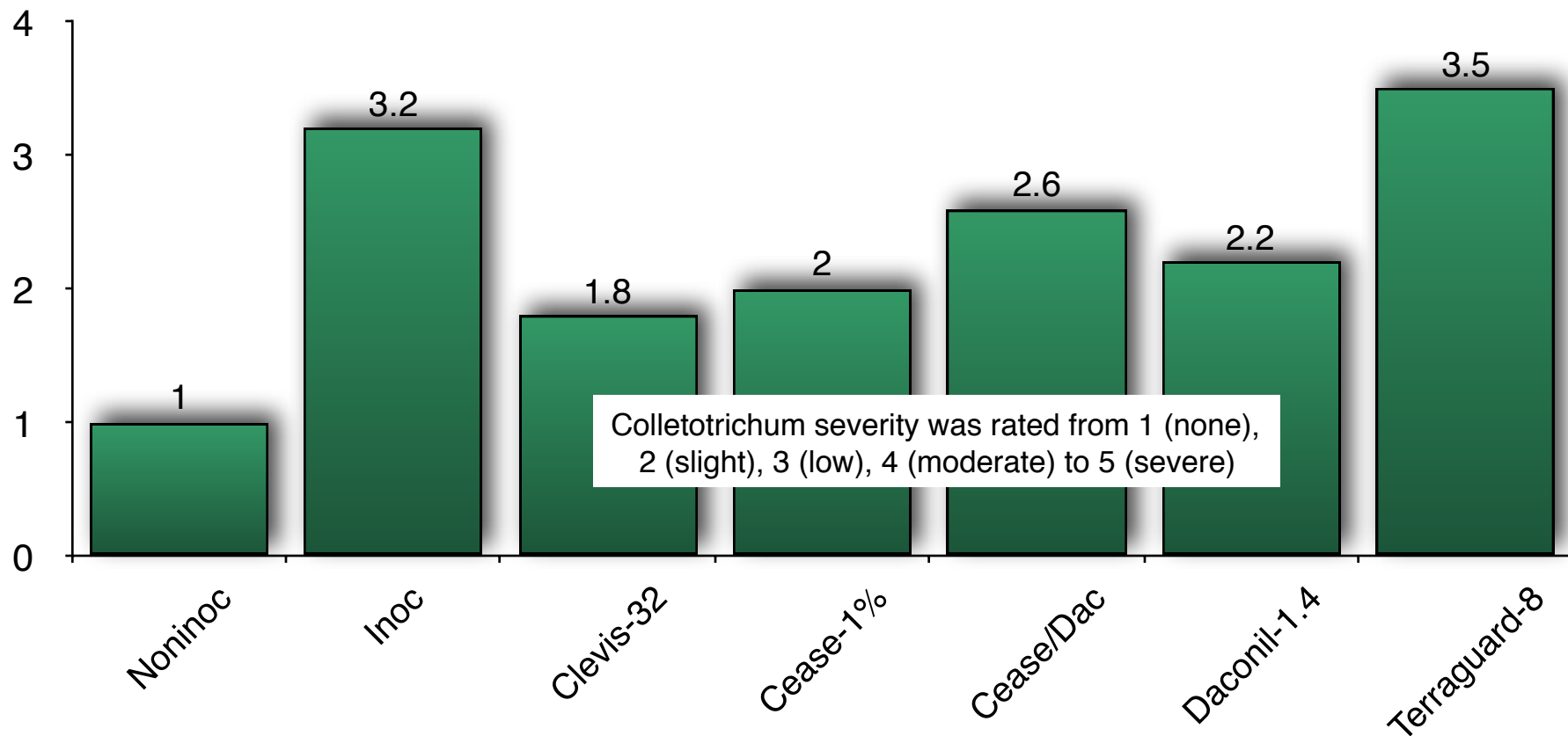No dip   Water   Decree   Cease 1%   Cease. 1.5%   Cease 2%

Botrytis was rated from 1 (none), 2 (slight), 3 (low), 4 (moderate) to 5 (severe)

Colletotrichum leaf spot on Cyclamen

Three sprays on a 7-day interval

Colletotrichum severity was rated from 1 (none),
2 (slight), 3 (low), 4 (moderate) to 5 (severe)

Noninoc	Inoc	Clevis-32	Cease-1%	Cease/Dac	Daconil-1.4	Terraguard-8
1	3.2	1.8	2	2.6	2.2	3.5

Chase Agricultural Consulting, LLC.
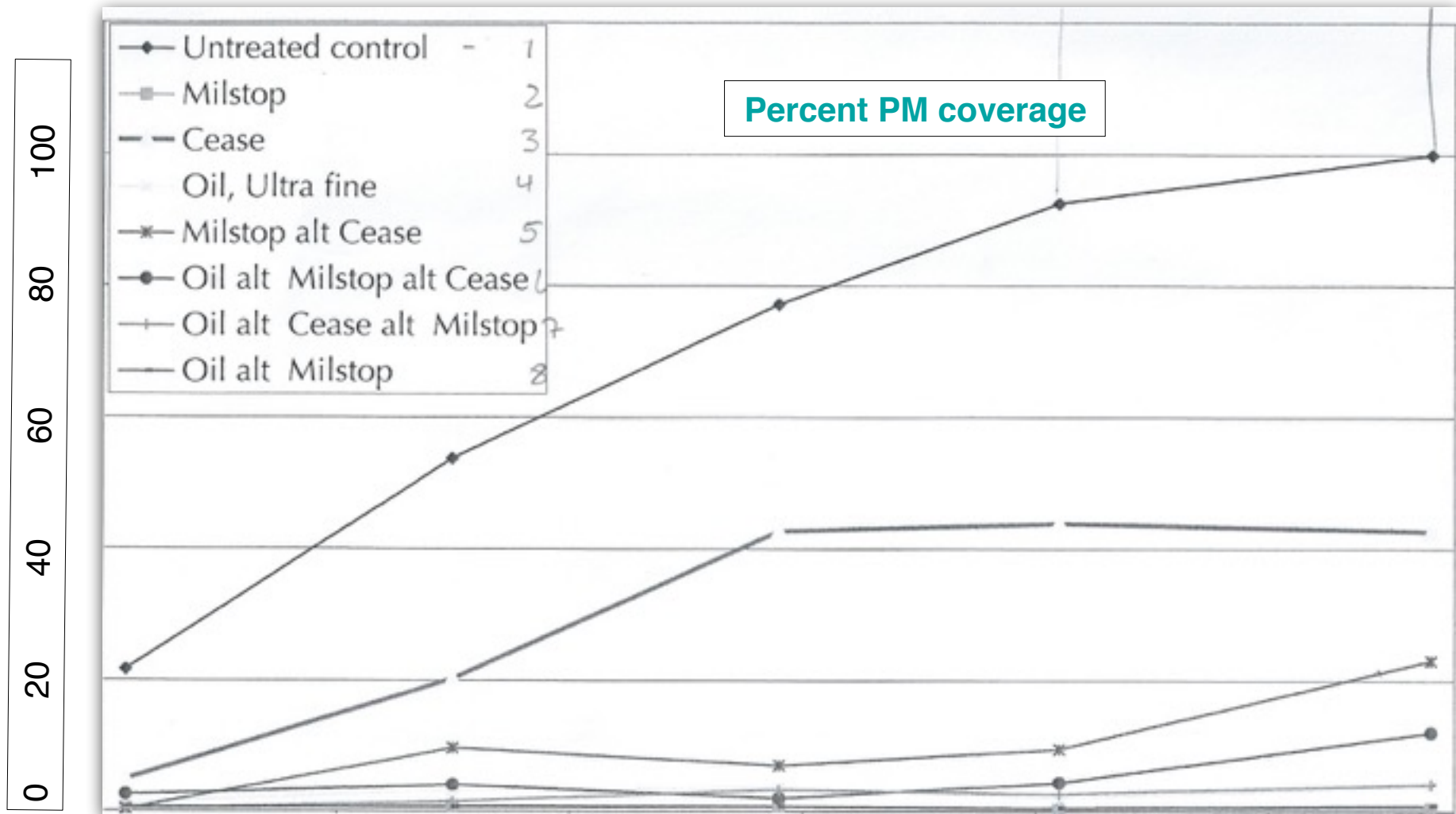Practical Solutions for Growers

Eradication of powdery mildew on Rosemary with biocontrols and wetting agents
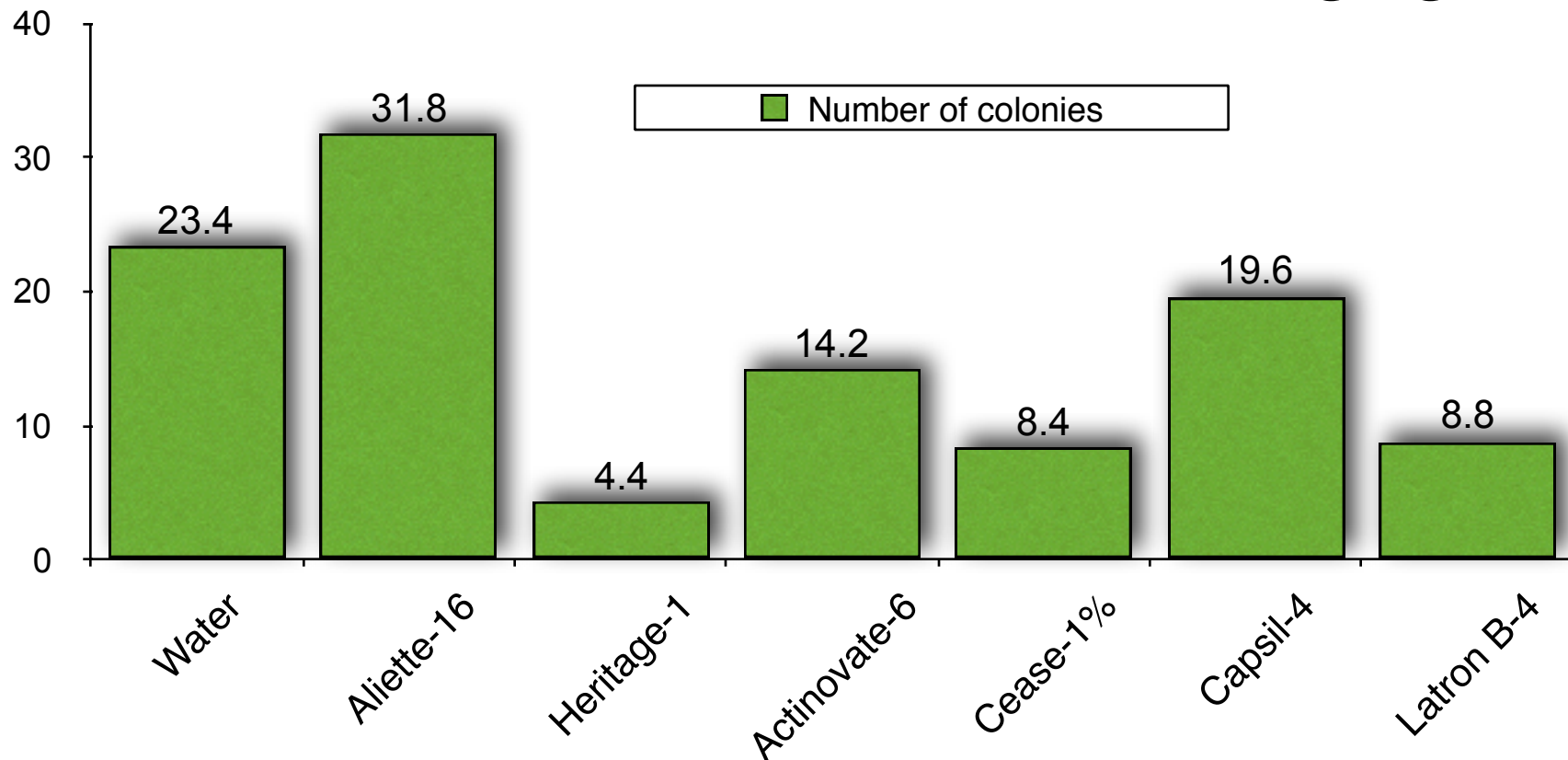
Powdery Mildew Control on Rosemary

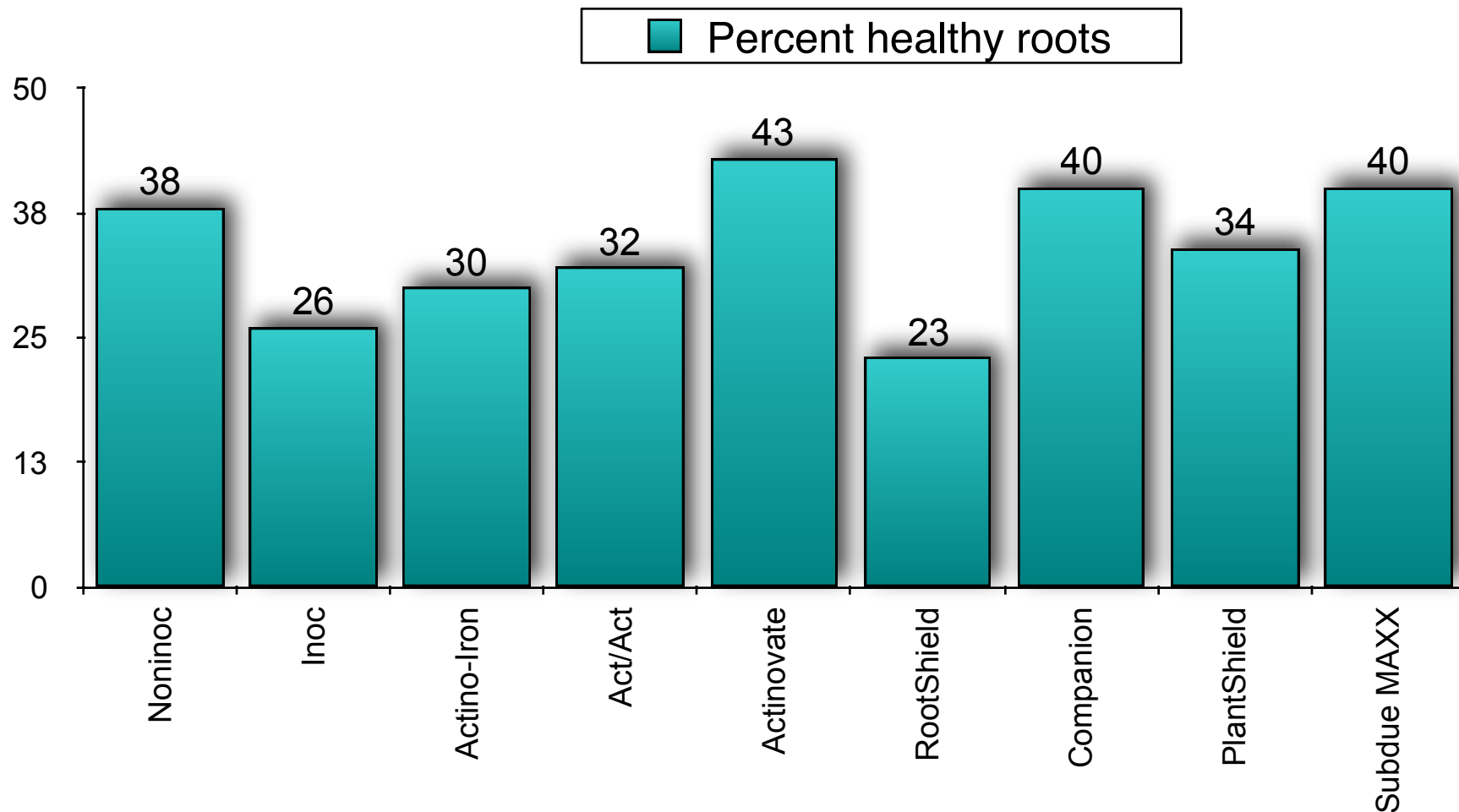Margery Daughtrey, LIHREC Cornell University

Percent PM coverage

Legend:
- Untreated control — 1
- Milstop — 2
- Cease — 3
- Oil, Ultra fine — 4
- Milstop alt Cease — 5
- Oil alt Milstop alt Cease — 6
- Oil alt Cease alt Milstop — 7
- Oil alt Milstop — 8

Prevention of Rhizoctonia stem rot on Impatiens

Treatment	Rate/100 gal	Disease severity
Noninoculated control	— —	1.0 a
Inoculated control	— —	4.2 d
Cease	2 quarts	3.4 c
Cleary 3336	16 oz	1.0 a
Cease and 3336	2 quarts and 8 oz	1.2 a

Rhizoctonia stem rot was rated from 1 (none), 2 (slight), 3 (low), 4 (moderate) to 5 (severe-dead)

Pythium root rot control on Geranium

Percent healthy roots

Noninoc	Inoc	Actino-Iron	Act/Act	Actinovate	RootShield	Companion	PlantShield	Subdue MAXX
38	26	30	32	43	23	40	34	40

Biologicals for Pythium Root Rot Control on Geranium

Margery Daughtrey, LIHREC Cornell University

Left to right:

white - Noninoculated control

white - Inoculated control

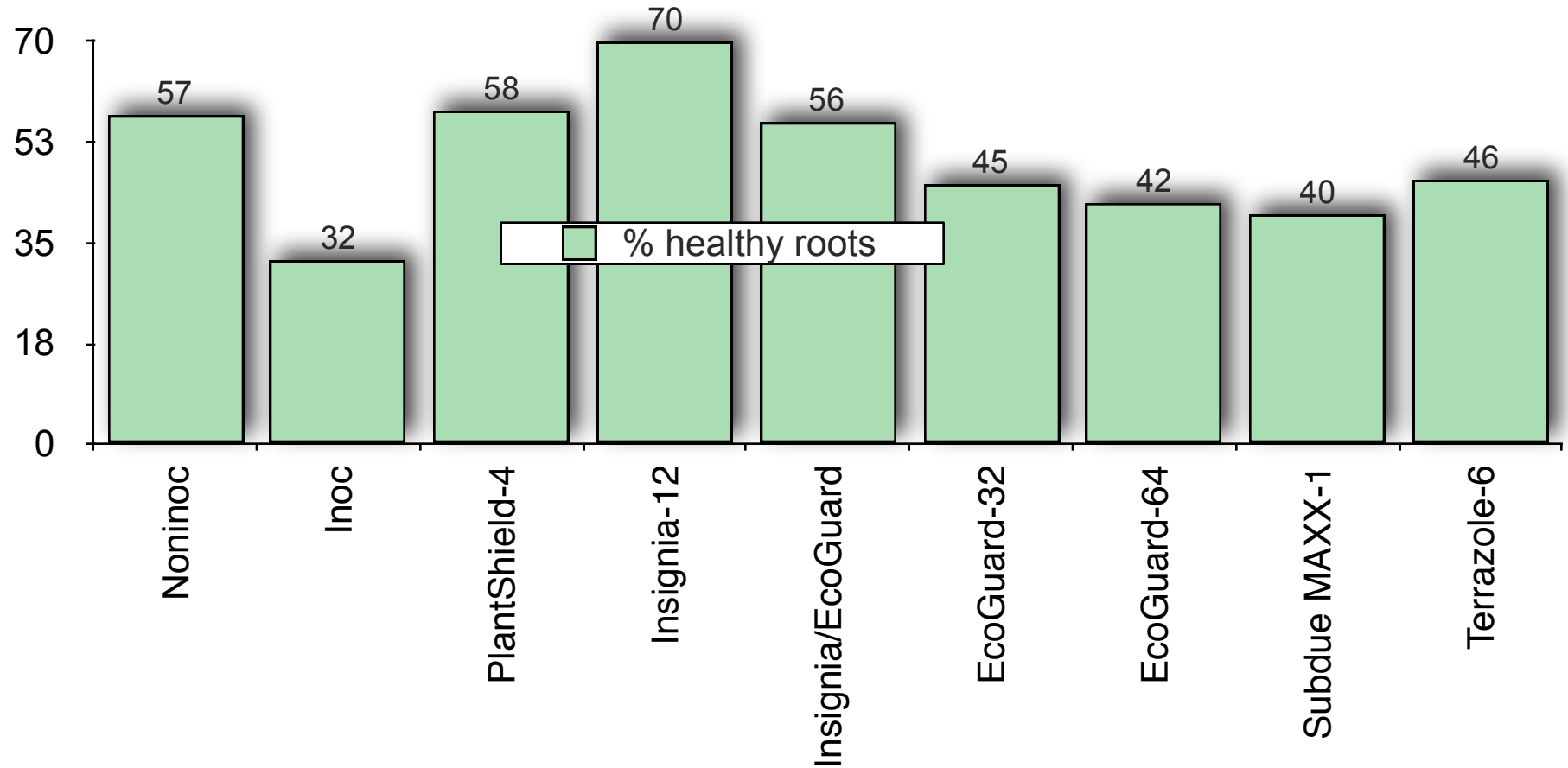**orange -** RootShield G

green - RootMate

green - RootShield drench
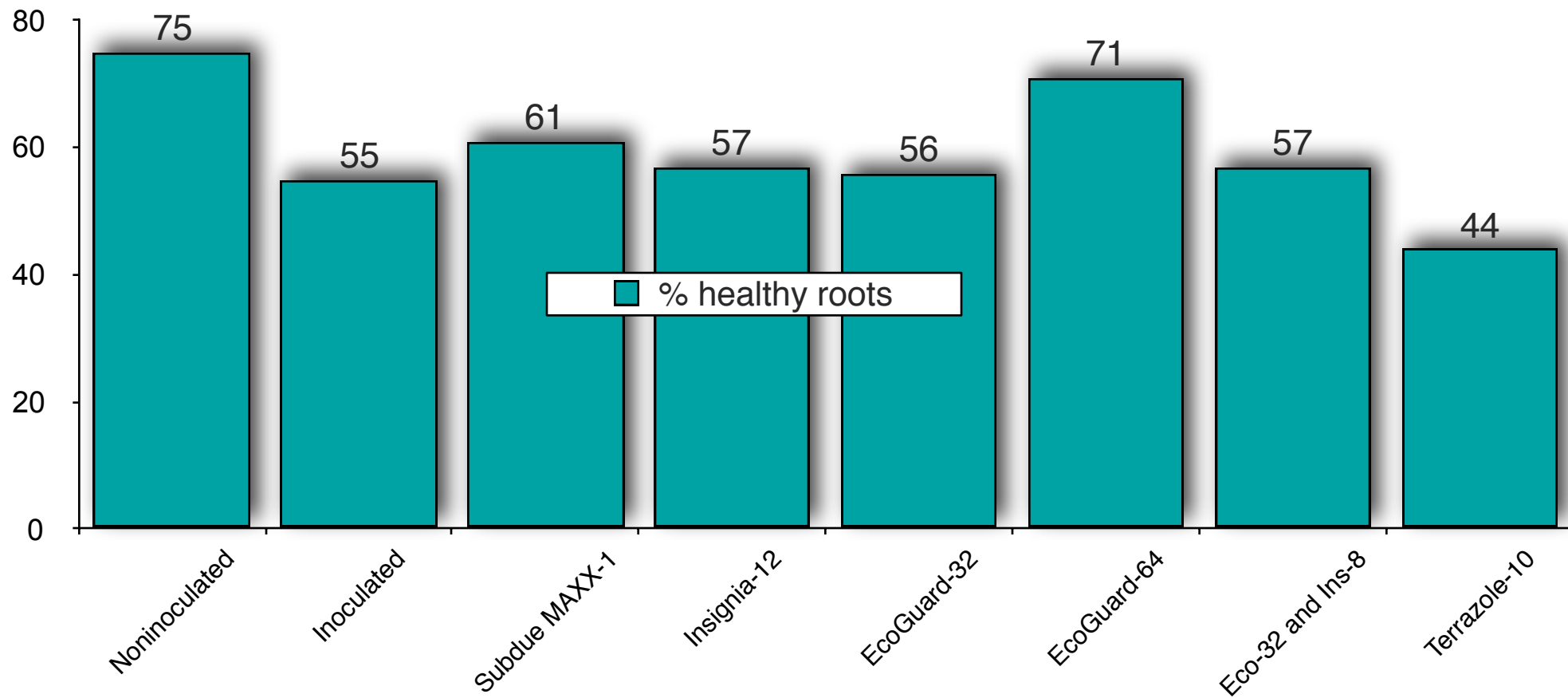
blue - RootShield Plus

red - Banrot low rate

red - Banrot high rate

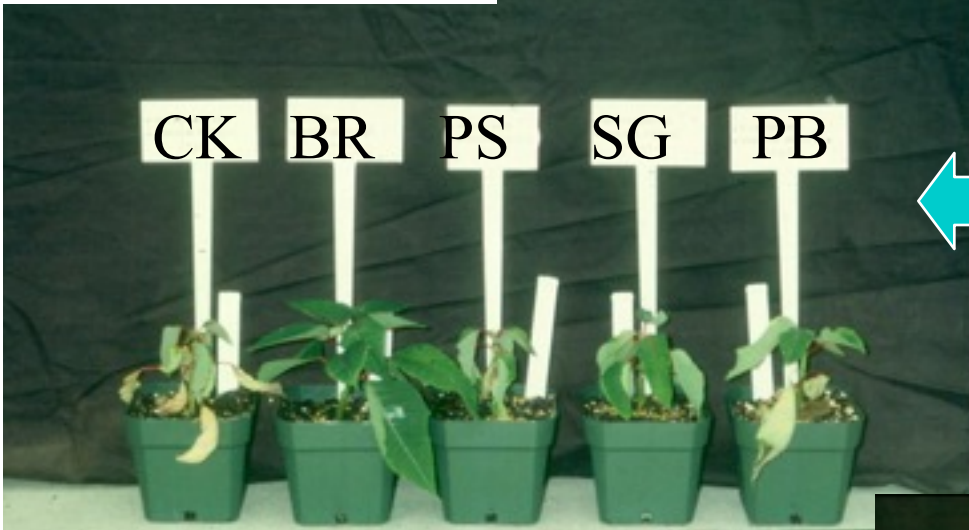Prevention of Pythium Root Rot on Geranium

Prevention of Pythium Root Rot on Vinca

Chase Agricultural Consulting, LLC.
Practical Solutions for Growers

Four drenches on a 14-day interval

Bar chart values:
- Noninoculated: 75
- Inoculated: 55
- Subdue MAXX-1: 61
- Insignia-12: 57
- EcoGuard-32: 56
- EcoGuard-64: 71
- Eco-32 and Ins-8: 57
- Terrazole-10: 44

Legend: ☐ % healthy roots

Ck - check
BR - Banrot
PS - PlantShield
SG - SoilGard

Biologicals do not work well
under high inoculum pressure

Biologicals do much better under
Low inoculum pressure

Dr. Wade Elmer,
Connecticut Ag Expt. Stn.

Effect of Pythium Species and Plant Host on Product Efficacy

Johanna Del Castillo Munera and Mary K. Hausbeck. 2015. HortScience 50(9):1319–1326.

Fungicide treatment	*Pythium aphanidermatum*	*Pythium irregulare*	*Pythium ultimum*
Non-inoculated control	40	40	40
Actinovate	50	54	63
Heritage	104	93	72
RootShield	68	102	89
Segway O	129	138	66
Subdue MAXX	67	92	45
Terrazole	108	94	64
Inoculated control	151	126	66

Fungicide treatment	*Pythium aphanidermatum*	*Pythium irregulare*	*Pythium ultimum*
Non-inoculated control	40	40	40
Actinovate	125	157	83
Heritage	145	139	87
RootShield	95	68	90
Segway O	122	136	90
Subdue MAXX	85	126	43
Terrazole	92	168	52
Inoculated control	98	148	90

(AUDPC = Area under the disease progress curve -
boxes in green show lowest disease levels

How do biological fungicides work on their own against Fusarium wilt of cyclamen?

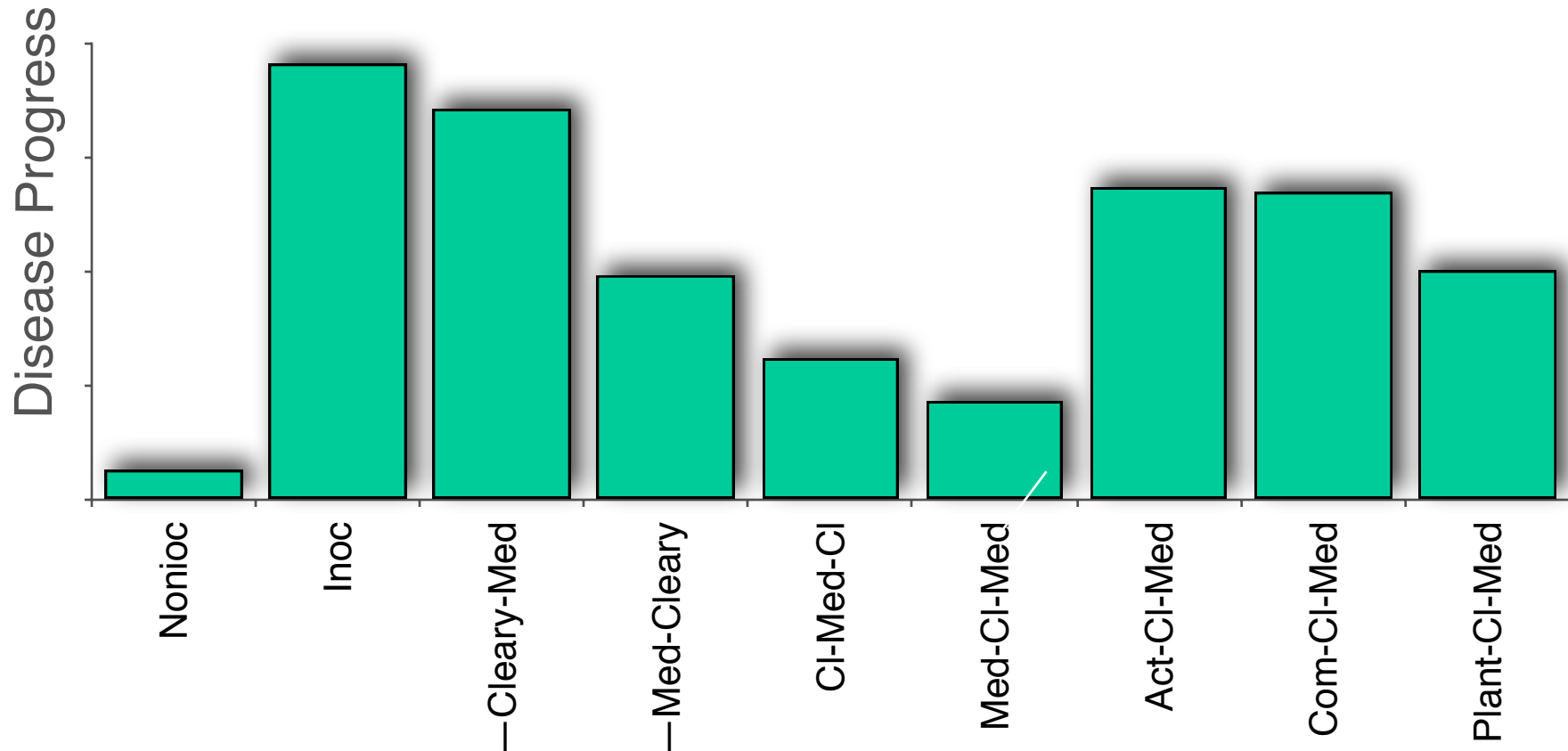Dr. Wade Elmer, Conn Ag Expt Stn

Control RootShield Companion SoilGard

Left row healthy (not inoculated)
Right row infected (inoculated)

BioFungicides used first did not protect even with post fungicide applications

Disease Progress

Nonioc | Inoc | —Cleary-Med | —Med-Cleary | Cl-Med-Cl | Med-Cl-Med | Act-Cl-Med | Com-Cl-Med | Plant-Cl-Med

Biologicals performed well when fungicides were used once before inoculation
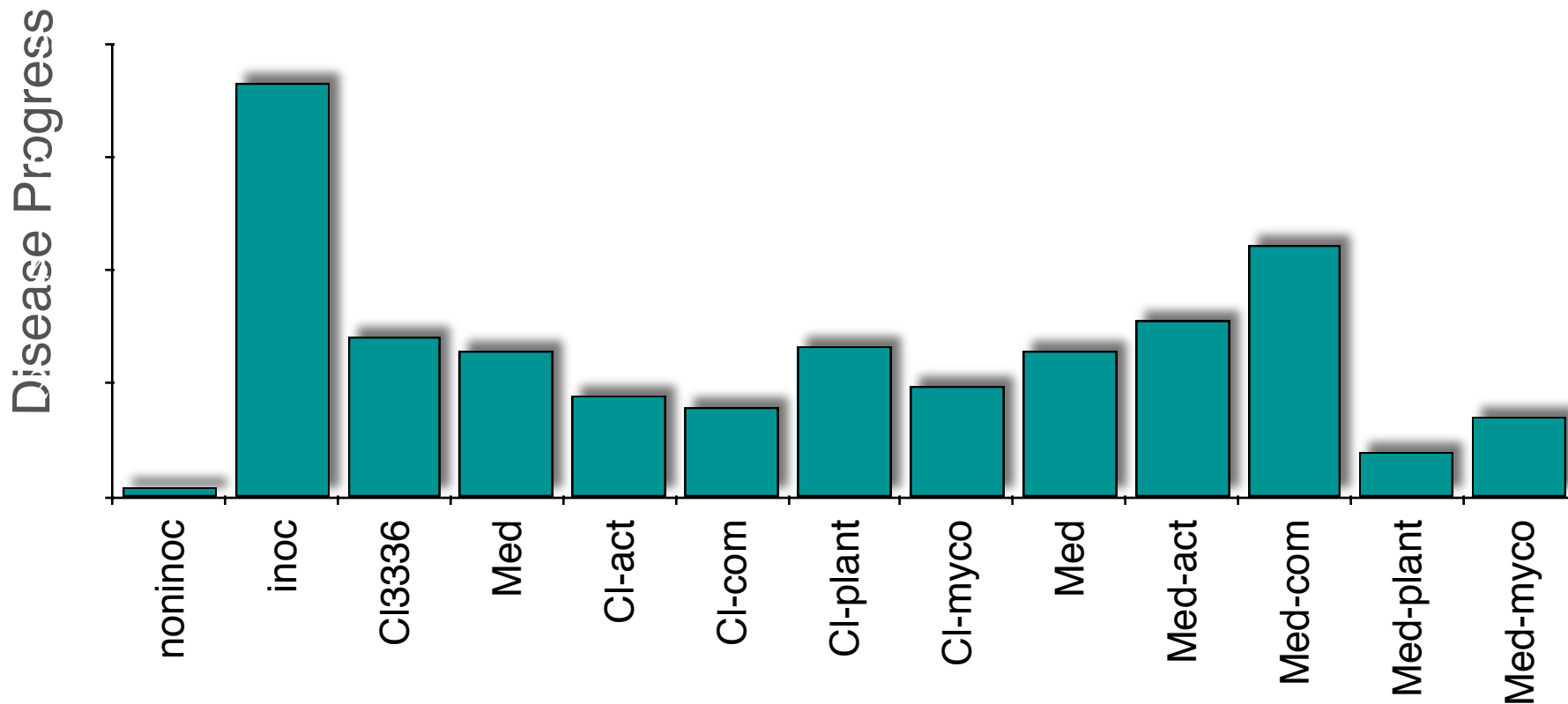
Some biologicals performed well in tank-mixes with fungicides when used before inoculation
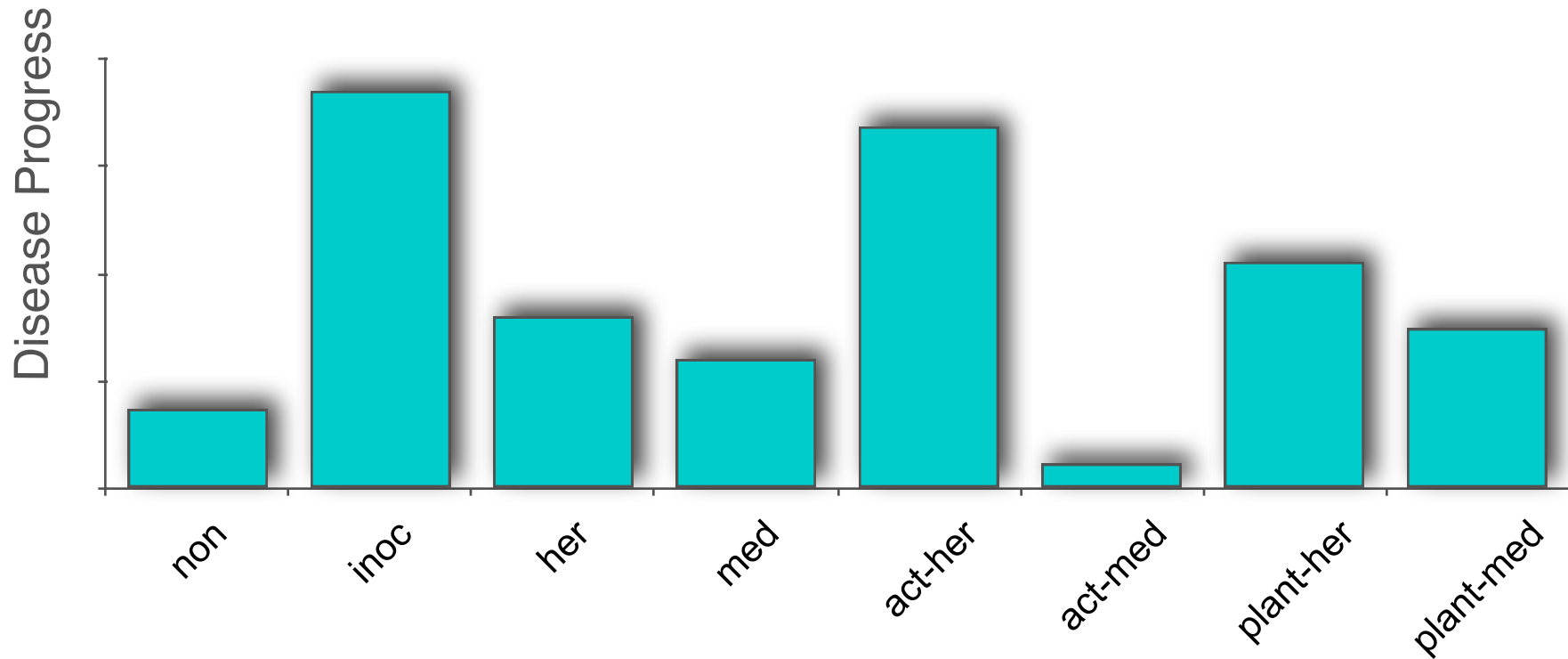
Actinovate Summary

n=none
s=some
g=good
e=excellent

Pathogen	Crops	Results
Alternaria	impatiens, collards	n, n, n
Botrytis	rose, strawberry, tomato	n, n, n
Cedar apple rust	apple	n
Charcoal rot	strawberry	s
Crown gall	solidago, aster	n, n
Cylindrocladium	spathiphyllum	s
Downy mildew	stock, rose, basil, cucumber	n, n, n, n, n
Fireblight	apple	s
Fusarium	xmas cactus, gladiolus, tomato	n, n, n, n, s, n
Phytophthora	vinca, snapdragon, squash (fruit), pepper	n, n, e, e
Powdery mildew	rose, gerbera daisy, grape, melon, cantaloupe	n, s, g, s, n, s, s, s
Pythium	geranium	n
Rhizoctonia	poinsettia, celosia	n, n
Rust	hypericum	n
Sclerotinia	lettuce	s, s
Septoria	tomato	n
Southern blight	tomato	n, s
Thielaviopsis	pansy	n, n
Xanthomonas	tomato, collards	s, n, n

Double Nickel/Triathlon BA Summary

Pathogen	Crops	results
alternaria	tomato, cabbage, collards, cole crops	some, none, good, none, none
blue mold	tobacco	some
botrytis	grape, tomato	excellent, good, very good
charcoal rot	strawberry	none
fireblight	apple	none, good
fusarium	New Guinea impatiens	some-good
powdery mildew	squash, grape	some, very good
rhizoctonia	bean, cotton	none, good, very good, very good
rust	quince, cedar apple	excellent, none, none
xanthomonas	cabbage, tomato, citrus, ficus	excellent, very good, very good, good

MilStop Summary

Pathogen	Crops	Results
Botrytis	pansy	none to very good
Cercospora	pansy	excellent
Colletotrichum	cyclamen	none to good (Cease)
Downy mildew	stock, snapdragon, rose	none to excellent
Powdery mildew	gerber daisy, rose	good to excellent
Pseudomonas	snapdragon	none
Rust	geranium	very good to excellent
Sphaceloma	poinsettia	good
Xanthomonas	geranium	none

MycoStop Summary

Pathogen	Plant	Result - control
Alternaria brassicicola	Cabbage	none
Botrytis cinerea	Geranium	none
Fusarium oxysporum	Cucumber	good
Fusarium oxysporum	Gladiolus	none, none, some
Phytophthora nicotianae	Snapdragon	none
Pythium myriotylum	Tomato	good
Pythium ultimum	Geranium	none
Pythium ultimum	Lettuce	good
Pythium ultimum	Mum	none
Rhizoctonia solani	Tobacco	moderate
Sclerotinia sclerotiorum	Tobacco	moderate to very good
Sclerotium rolfsii	Tomato	none, none
Thielaviopsis basicola	Pansy	good
Thielaviopsis basicola	Citrus	good at high rates

Taegro Summary

Bacterial

Xanthomonas leaf spot on geranium (none in four trials

at different rates over a period of four years)

Erwinia soft rot on poinsettia (good in two trials)

Pseudomonas leaf sot on mandevilla (some)

Fusarium wilt

F. oxysporum on cyclamen (some)

Phytophthora

P. parasitica on lavender (none)

P. parastica on vinca (none)

Pythium

P. irregulare root rot on geranium (none)

P. irregulare root rot on gerber daisy (none)

Rhizoctonia
Rhizoctonia damping-off on celosia (none in two trials)

Regalia Summary

Botrytis and related diseases
- Botrytis on potato (slight control)

Bacterial diseases
- Fireblight on apple (none)
- Xanthomonas on pepper (none)
- Shothole (bacterial) on almond (none)
- Pseudomonas on mandevilla (some to good, my trial)

Fungal leaf spots
- Alternaria on potato (slight to none)
- Septoria on tomato (slight)
- Cercospora and Cercosporidium on peanut (some)
- Cercospora on pansy (good, my trial)

Phytophthora
- Late blight on potato (none)
- Phytophthora on bean (none)

Downy mildew
- Downy mildew on cucumber (none, none)
- Downy mildew on squash (poor)
- Downy mildew on mustard greens (some)
- Downy mildew on lettuce (some to good)
- Downy mildew on basil (none to slight)
- Downy mildew on coleus (some to very good)
- Downy mildew on rose (very good, my trial)

Powdery mildew
- Powdery mildew on grape (none, some, good, good)
- Powdery mildew on lettuce (some)
- Powdery mildew on cantaloupe (none to some)
- Powdery mildew on squash (none, none)
- Powdery mildew on rose (very good to excellent - my trial)
- Powdery mildew on gerbera daisy (very good to excellent)

What Affects Efficacy of Biopesticides?

- Timing
- Rate
- Interval
- Inoculum pressure
- Host plant
- Tank-mixing or alternation with synthetic fungicides
- Potting medium
- Pathogen species
- Fertility regime

Preconceptions from users

Some Myths and Preconceptions

- They do not work as well as synthetic products.
- They do not have a good shelf-life.
- They are not compatible with synthetic products.
- Applying them once is enough.
- We don't know what they are doing - they are magic!
- They are never phytotoxic.
- You don't have to alternate for resistance management.

So what do we know about biologicals?

- Some must be used **before** the pest pressure arrives (at seedling, at planting in plugs trays)
- They should be used following (or sometimes with) chemical fungicides.
- Under high disease pressure, they may not perform well.
- Many things affect their efficacy:
  - fertilizer regime
  - host plant
  - pathogen and pathogen species
- Biopesticides act more like synthetic products making them simpler to use in many cases

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Important Resources

WELCOME TO OUR BLOG SITE

Chase Agricultural Consulting (that's Ann and I) really enjoy bringing you the latest information on plant diseases. We thought a blog site would fit our goal of more dynamic interactions to solve your problems faster and more effectively. Please check regularly as we will be changing and adding new content weekly. We want to hear form you!

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